Team Alberta

Project Manual

U.S. Department of Energy Solar Decathlon 2013

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1. Revised Rules Compliance Checklist
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5. Revised Quantity Takeoff
6. Added specifications to Construction Specifications

Revision 2 Date: February 14, 2013

1. Revised Rules Compliance Checklist
2. Revised Summary of Reconfigurable Features
3. Added Lighting Design
4. Revised Quantity Takeoff
5. Added specifications to Construction Specifications

Revision 3 Date: April 5, 2013

1. Revised Rules Compliance Checklist
2. Revised Structural Calculations
3. Revised Summary of Reconfigurable Features
4. Revised Quantity Takeoff
5. Added specifications to Construction Specifications

Revision 4 Date: August 22, 2013

1. Revised Rules Compliance Checklist
2. Added Stamped Structural Calculations
3. Revised Summary of Reconfigurable Features
4. Revised Quantity Takeoff
5. Revised Construction Specifications

Rules Compliance Checklist

RULE	RULE DESCRIPTION	LOCATION DESCRIPTION	LOCATION
Rule 4-2	Construction Equipment	Drawing(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the competition site	O-101, O-901
Rule 4-2	Construction Equipment	Specifications for heavy machinery	Not included
Rule 4-3	Ground Penetration	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	S-101, S-502
Rule 4-4	Impact within the Solar Envelope	Drawing(s) showing the location, contact area, and bearing pressure of every component resting directly within the solar envelope	S-101, L-101
Rule 4-5	Generators	Specifications for generators (including sound rating)	Not included
Rule 4-6	Spill Containment	Drawing(s) showing the locations of all equipment, containers, and pipes that will contain liquids at any point during the event	P-101
Rule 4-6	Spill Containment	Specifications for all equipment, containers, and pipes that will contain fluids at any point during the event	22 13 53 22 14 29.19
Rule 4-7	Lot Conditions	Calculations showing that the structural design remains compliant even if 18 in. of vertical elevation change exists	Appendix 1
Rule 4-7	Lot Conditions	Drawing(s) showing shimming methods and materials to be used if 18 in. of vertical elevation change exists on the lot	S-501
Rule 5-2	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	G-201, G-202, P-101
Rule 5-2	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	N/A
Rule 6-1	Structural Design Approval	List of, or marking on, all drawing and project manual sheets that will be stamped by the qualified, licensed design professional in the stamped structural submission; the stamped submission shall consist entirely of sheets that also appear in the drawings and project manual	S-SERIES PM P.6
Rule 6-2	Finished Square Footage	Drawing(s) showing all information needed by the rules officials to measure the finished square footage electronically	G-101
Rule 6-2	Finished Square Footage	Drawing(s) showing all movable components that may increase the finished square footage if operated during contest week	N/A
Rule 6-3	Entrance and Exit Routes	Drawing(s) showing the accessible public tour route	G-103
Rule 7-1	Placement	Drawing(s) showing the location of all vegetation and, if applicable, the movement of vegetation designed as part of an integrated mobile system	L-111

RULE	RULE DESCRIPTION	LOCATION DESCRIPTION	LOCATION
Rule 7-2	Watering Restrictions	Drawing(s) showing the layout and operation of greywater irrigation systems	N/A
Rule 8-1	PV Technology Limitations	Specifications for photovoltaic components	26 31 00
Rule 8-3	Batteries	Drawing(s) showing the location(s) and quantity of all primary and secondary batteries and stand-alone, PV-powered devices	N/A
Rule 8-3	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	N/A
Rule 8-4	Desiccant Systems	Drawing(s) describing the operation of the desiccant system	M-601, M-602
Rule 8-4	Desiccant Systems	Specifications for desiccant system components	M-601
Rule 8-5	Village Grid	Completed interconnection application form	PM P.9
Rule 8-5	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	E-SERIES
Rule 8-5	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	E-SERIES
Rule 8-5	Village Grid	One-line electrical diagram	E-001
Rule 8-5	Village Grid	Calculation of service/feeder net computed load per NEC 220	E-601
Rule 8-5	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	E-301
Rule 8-5	Village Grid	Elevation(s) showing the meter housing, main utility disconnect, and other service equipment	E-201
Rule 9-1	Container Locations	Drawing(s) showing the location of all liquid containers relative to the finished square footage	P-101
Rule 9-1	Container Locations	Drawing(s) demonstrating that the primary supply water tank(s) is fully shaded from direct solar radiation between 9 a.m. and 5 p.m. PDT or between 8 a.m. and 4 p.m. solar time on Oct. 1	C-801
Rule 9-2	Team-Provided Liquids	Quantity, specifications , and delivery date(s) of all team-provided liquids for irrigation, thermal mass, hydronic system pressure testing, and thermodynamic system operation	Project Manual P.6
Rule 9-3	Greywater Reuse	Drawing(s) showing the layout and operation of greywater reuse systems	N/A
Rule 9-4	Rainwater Collection	Drawing(s) showing the layout and operation of rainwater collection systems	P-101
Rule 9-6	Thermal Mass	Drawing(s) showing the locations of liquid-based thermal mass systems	N/A
Rule 9-6	Thermal Mass	Specifications for components of liquid-based thermal mass systems	N/A
Rule 9-7	Greywater Heat Recovery	Drawing(s) showing the layout and operation of greywater heat recovery systems	M-602
Rule 9-8	Water Delivery	Drawing(s) showing the complete sequence of water delivery and distribution events	P-101, L-501

RULE	RULE DESCRIPTION	LOCATION DESCRIPTION	LOCATION
Rule 9-8	Water Delivery	Specifications for the containers to which water will be delivered	P-101
Rule 9-9	Water Removal	Drawing(s) showing the complete sequence of water consolidation and removal events	P-101
Rule 9-9	Water Removal	Specifications for the containers from which water will be removed	P-101, L-501
Rule 11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	G-103

Structural Calculations

See Appendix 1

Detailed Water Budget

FUNCTION	WATER USE (GALLONS)	CALCULATIONS		NOTES
		GAL	EVENTS	
Hot Water Draws	240	15	16	Hot water draws per contest criteria
Water Vaporization	2.4	0.6	4	Water evap. events per contest criteria
Dishwasher	20	4	5	Dishwasher events per contest criteria
Clothes Washer	120	15	8	Clothes washer estimate per contest criteria
Vegetation	30	-	-	1/4" irrigation per ft2 vegetation/week using low water plant species. Can be reduced by rainwater collection
Fire Protection	300	-	-	Fire protection fill + 250 gal. in event of fire
Thermal Storage Tanks	60	-	-	
Testing	50	-	-	Testing of plumbing systems
Initial Systems Fill	10	-	-	
Solar Thermal Collectors	10	-	-	
Aesthetic Purpose	200	-	-	Exterior wetland (10'x8'x3")
Safety Factor	104.74	-	-	10% of above
WATER REQUIRED	1147.14	gallons		Provide (3) 385 gallon tanks for 1155 gal. capacity

Summary of Unlisted Electrical Components

All electrical components carry an approved testing agency's listing per Section 6-7 of the SD2013 Building Code

Summary of Reconfigurable Features

Flexible Interior Spaces

The interior of Borealis follows no standards as to what a home should be. Instead, functional and spatial requirements were reconsidered from the perspective of the target market, or end user. Designed for two working professionals, the layout may at first appear unconventional. The interior space has been split into two distinct apartments that share a set of common amenities. In each of the living modules, there is a flexible space, delineated by architectural thresholds and may be physically separated by a set of three sliding doors on either side of the center service module. Opening these doors creates a large, open social space out of the kitchen and dining, and the living and working areas from each side module.

Each side module living and working space has the same “kit of parts”: one apartment sized sofa, two task chairs, two small stools, and an adjustable table. All of these pieces can be arranged as a typical living room used for relaxation and socialization, or as an office used for conference calls, work assignments or presentations. The key element in either of these scenarios is the adjustable height table. Using the lever on one side of the table, Borealis’ inhabitants can effortlessly lower the table to coffee table height, or raise it to desk height. It will lock back in at any desired height, for use from the task chairs or sofa, or at standing height. Being that Borealis has been designed with working professionals in mind, the inclusion of office capabilities are an important element. Power and data are also provided in both of these rooms to support said activities.

Other furniture provides alternative seating, like the wood stools that can alternatively be used as accent tables throughout the home. The dining table in the adjacent kitchen space has also been integrated into the volume, so that the television screens can be viewed from the dining room, making conferencing, presenting and entertaining easy to accommodate through all shared spaces.

Flexible Glazing

Both the south and north modules use a glazing system provided by Innotech, in which tilt-and-turn window units are used strategically to permit passive cooling. These pieces can be tilted towards the interior of the space for fresh air and ventilation, or hinge open like a door (all are also equipped with screens) to allow a breeze. Because the function of these windows prohibits any type of wall mounted window covering, each unit has also been fitted within the frame with a blind system that can be entirely adjusted – they can be pulled all the way across the window to block all light and views or anything in between, where the bottom of the window is covered to block high sun while maintaining a view above.

Interconnection Application Form

Team Alberta

Lot 116

PV Systems

Module Manufacturer	Short Description of Array	DC Rating of Array (sum of the DC ratings)
Canadian Solar	CanadianSolar CS6P–250P PV Panels	10 000W

Total DC power of all arrays is **10.0** kW

INVERTERS

Inverter Manufacturer	Model Number	Voltage	Rating (kVA or KW)	Quantity
Enphase	M215	240V	260W(DC)/215W(AC)	40

Total AC power of all inverters is 8.6 kW

REQUIRED INFORMATION

The following information must be included in the project manual or construction documents. If located in the construction documents, list the drawing locations in this section of the project manual. (Example: B3/E-201)

	Location
One-Line Electrical Schematic	E-001
Calculations of service/feeder net computed load and neutral load (NEC 220)	E-601
Plan view of the lot showing the house, decks, ramps, tour paths, the service point, and the distribution panel or load center	E-105

Provide the Team's "Electrical Engineer" contact in the "Team Officer Contact Info" database on the Yahoo Group as required per Rule 3-2.

Energy Analysis Results and Discussion

With two previous competition entries as experience, Team Alberta seeks to build on our research and lessons learned from 2009 and 2011. For example, the team believes strongly in keeping a lot of glazing for the purpose of making the house aesthetically pleasing and provides a more attractive interior for its inhabitants. In the response to this desire, the team worked hard on the mechanical system and ended up with a more complex system, but more energy efficient than a simple system. The key to this increased efficiency is utilizing waste heat from the heat pump during cooling operations.

Energy Simulation Tool

Currently the team has used Hot2000 to model the house. Other software such as E-Quest and TRNSYS will be used to do final sizing evaluations of the systems, as well as additional checks.

Hot2000

This is free software available from Natural Resources Canada and has weather information for a vast amount of locations, allowing for energy modeling in different locations. This program is primarily made to model existing houses and see how much different energy upgrades (improvements) will add to the overall performance of the house. It is also used to model newly built houses, but has limited constructions options. For example, SIPs (structural insulated panels) are not an option. This software is also used to give a Canadian energy efficiency rating for a house just like appliances have. The main benefit of this software is that it is easy to use, easy to do modifications, and can calculate a vast amount of data even PV (photovoltaic) output.

When using Hot2000, it quickly came evident that this software should only be used as guidance for several reasons. One of the main problems that was found, again like last competition, was that the user does not know exactly how the program calculates the energy use of the house, leading to an unclear understanding of how the energy numbers come to be. In addition, it was later found that the program does not properly calculate or has great assumptions in certain areas such as natural Air Ventilation and more advance software will need to be used later.

Key Assumptions

1. That the house structure is “fairly” airtight. This assumption is on the basis that the spray foam, which is used for insulation, will be installed correctly and if so provides the house with a very air tight envelope. In addition, high quality windows will be installed with great care again allowing for an air tight envelope.
2. That the heat pump will be working close to its intended COP. Simply because the mechanical system is specifically designed to maintain a constant optimal cooling water temperature as it enters the condenser.
3. Windows and glass door reflective coatings perform according to its performance specifications in terms of reducing solar thermal gain by the windows.
4. That the solar thermal evacuated tubes do not loose significant efficiency due to the far transportation of liquid to the mechanical room at the back of the house due to good insulation around the pipes.
5. That the hot water systems including pre-dryer air heating and thermal storage tanks to not leak a significant amount of heat into the house leading to an increased cooling demand.

Simulation Analysis and Findings

This time the team wanted to make sure that the house is both aesthetically pleasing to the market, as well have sufficient natural light entering the house. This leads to a design of the entire south facing side of the house being glazing, as well as it leads to the possibility of overheating. A critical point of the house was quickly found that the type of shading system used for this large glazing has a tremendous effect on the amount of cooling necessary for the house. Therefore great care was taken in selecting the shading system and glazing coating for the house to prevent high solar gain in the summer (for the California climate).

In running the simulations, it was found that the heat pump has a significant amount of waste heat. The engineering team decided to take on the challenge of utilizing this waste heat in some way. This concept of utilizing waste heat to fulfill other mechanical tasks such as domestic hot water hopes to compensate for its large glazing and still make it energy efficient.

Type of Heat and Cooling Distribution System

In total three different types of heat and cooling distribution systems were looked at. The first was floor heating. It was found that this is a very desirable way to heat the house for many reasons, such as greater efficiency and higher comfort to the occupants. However, many disadvantages where found when exploring this option. Firstly, it is much more costly and requires some thermal mass in the floor making the house heavier for transportation. Secondly, this system has somewhat of a lag between when the heat is added to the system, to when that change is felt in the house, mostly due to the needed thermal mass acting as a buffer. With so many visitors coming inside to see the house, and possibly in waves, the team wanted a system that can quickly adjust to the changing cooling loads due to these visitors. Thirdly, as found in last competition's analysis, this system adds unwanted complexity to the house, especially during reconstruction which the team would like to keep as simple as possible.

The second system that was looked at was a traditional air handler, and the third system was a high velocity air handler. Both of these two options looked promising over the in floor heating in comparison of cost; however in the end the high velocity furnace was picked for several reasons:

- Making sure the house is very modular and easy to transport, the height of the modules was a strong concern for the entire team. Since the high velocity furnace uses smaller ducts, it allowed the celling inside the house to be higher than would be possible with a typical air handler.
- The high velocity air handler claims it can maintain a better temperature throughout the house than a standard air handler. This was particularly important because it is expected that there will be a warm section near the south glazing part of the house, as well as cool areas along the east and west walls. Therefore, a system that can maintain small temperature fluctuations within the house was considered much more beneficial. The manufacture claims a temperature distribution in the house of just 2 degrees compared to 6 degrees with a conventional air handler.
- Since the mechanical system is complex and requires lots of room for the many different components, the much smaller size than a conventional system was greatly attractive.

Solar Thermal Tubes

Annual solar radiation is not constant year round, which adds to the problem of producing too much heat during the summer, as well as problems of increased maintenance and complexity of the system. Originally, an additional air source heat pump was looked at for domestic hot water demand and not incorporating the solar tubes. However in the end evacuated tubes where chosen for many reasons:

The mechanical team wanted to have a flexible system that could work in many different parts of Canada, and evacuated solar thermal tubes allowed for additional flexibility. When fall comes around, the efficiency of the heat pump used to heat the house decreases, and by winter in some parts of Canada the temperature is so low it would be more energy efficient to heat the house with a simple electric heater. Therefore, this is when solar evacuated tubes add to the flexibility of the mechanical system, since now the evacuated tubes can be used to heat water or even help heat the house. The solar thermal system can also be simply expanded to meet heating needs of a certain climates. The thermal storage is ready for storing heat from the evacuated tubes and reusing it at night.

Since the mechanical team focused on utilizing waste heat from the heat pump as best it could, so many house systems, like the dryer-air preheater and dehumidifier, run on hot water. Therefore, there are more things to utilize the produced hot water from the evacuated tubes such as a heat storage tank and dehumidifier. Since the solar thermal energy has more uses then just domestic hot water, the energy from this high efficiency solar system can be utilized more effectively year round.

The cost estimate was not much more than incorporating an additional heat pump and the benefits seems to have outweighed the cost.

Heat pump

The water-to-water (ground source) heat pump might seem as an odd choice, however it was selected because it was the easiest way, that the team found, to be able to fully utilize the waste heat of the heat pump. Since the waste heat is in the form of hot water, it can easily be utilized to do many things such as heating the domestic hot water tank. When the waste heat is utilized as much as possible, the waste heat liquid goes through a variable speed fan radiator, therefore cooling down the water to the proper temperature before it goes back into the condenser on the heat pump to remove heat. This allows the heat pumps efficiency to not be compromised when using its waste heat.

By using a water-to-water (ground source) heat pump, flexibility is added again to the mechanical system. If the house would be located in a region with reasonable ground temperature then the mechanical system is ready to be connected to make a ground source heat pump system. It is as simple as removing the liquid external radiator and connecting those same pipes with the in-ground pipes, filling with liquid and the system is complete. This not only allows for flexibility, but also allows for the consumer to have the ability to move to a more efficient heat pump system in the future if desired.

Glazing

The generous glazing that flanks the ends of each module provides a connection to the outdoors and allows for the interior of Borealis to be illuminated with natural light. It also allows for unobstructed sight lines and view, an asset for our target occupant, who is responsible for overseeing work camps in Northern Alberta.

Such a large amount of glazing needs to be considered strategically in order to regulate the interior climate of Borealis. The glazing system that is supplied by Innotech utilizes triple pane glass and a dual low-e coating to ensure that there is minimal solar gain through the windows. The coating that is used allows for 56% visible light transmittance, while rejecting 76% of the solar heat that hits the windows. Large over-hangs shade a significant portion of the Southern windows at the competition site in California, but allow for more sunshine into the building in Northern Alberta where the sun is lower and the temperatures are colder. Additional exterior roller shades or louvers may be added later if further shading is deemed necessary.

Building Envelope Thermal Analysis

In each case, a logical cross-section was chosen that would best represent the entire system to be simulated. Details were set up as a worst case scenario and material thermal properties are assumed linear. Thermal analysis does not take into consideration non-perfect installation (void spaces / non-conforming material thickness & properties).

LBNL's THERM v6.3.46 program reports analysis results in graphical form (see below) and numerical form. Values for thermal performance are calculated by the program as an overall average heat transfer coefficient for the system (U-factors), the inverse of which is thermal resistance (R & RSI value).

The results are as follows (Imperial R-values truncated in each case to nearest whole value):

- Roof: R38
- Wall: R39.5 (glazing not considered)
- Floor: R26

Lighting Design

IESNA Lighting Handbook

The Illuminating Engineering Society of North America, IESNA, was founded in 1906 for the purpose of advancing the field of lighting and to explore the new and budding technologies in this field. The mission of the IESNA is to improve the lighting environment by bringing together those with lighting knowledge and by translating that knowledge into actions that benefit the public [1]. The IESNA also envisions building upon a century of excellence to create a leading lighting community dedicated to promoting the art and science of quality lighting to the public. The knowledge gathered through the society is presented in the form of the IESNA Handbook. The handbook in its 10th Edition is a collaborative work that addresses a broad range of technologies, procedures and design issues to ensure that the appropriate lighting knowledge is available to the professionals in the field of illumination as well as to those interested in exploring the field. The 10th edition incorporates new technologies and scientific developments, such as solid state lighting sources, humans' perception of light as they age, sustainability and the integration of day lighting with electrical lighting. The handbook also looks into the more extensive and specific qualitative lighting design criteria such as subjective impressions and architectural special factors [1]. The 10th edition is made of three sections [2]:

- **Framework:** this section describes the science and technology related to lighting;
- **Design:** this section includes the fundamental considerations and special issues of day lighting and electrical lighting as well as energy management, controls and economics.
- **Applications:** this section covers the design context for many lighting applications and provides luminance recommendations for certain tasks and areas and identifies certain analytical goals of lighting design using science and technology.

The Borealis Electrical Engineering team's main focus was on using the standards outlined by the IESNA to optimize the lighting design. This process involved looking into the fundamentals of lighting and considering the guidelines set by the IESNA during the design process. The team created the following list of targeted lighting values based on IESNA's applications table of lighting for residential dwellings. The table is as follows

Table 1: IESNA Lighting Targeted Values

IESNA MINIMUM LIGHTING TARGETS					
INDOOR LIGHTING TARGETS					
AREA	**Eh**	**Ev**	**LUX(Eh)**	**LUX (Ev)**	**AVE:MIN**
BATHROOM SHOWER	FLOOR		50		2:1
BATHROOM TOILET	SEAT		100		2:1
BEDROOM DRESSING ROOM	FLOOR		100		3:1
BEDROOM READING	3'		200		3:1
DINING ROOM INFORMAL	TABLE TOP		100		4:1
DINING ROOM STUDY USE	TABLE TOP		200		2:1
FAMILY ROOM	FLOOR		100		3:1
KITCHEN CABINETS		FACE		50	3:1
KITCHEN COOKTOPS	SURFACE		300		2:1
KITCHEN PREP COUNTER	SURFACE		500		2:1
KITCHEN SINK	TOP OF SINK		300		2:1
KITCHEN GENERAL AREA	FLOOR		50		2:1
OFFICE DESK SPACE	2'6"		300		1.5:1
ART		FACE		200	2:1

The numbers outlined in the table above address the fundamentals to achieve optimal lighting in the different areas in the house. The table outlines the power measurements on horizontal plane (E_h) as well as on a vertical plane (E_v), it then measures the energy measurements for both the horizontal and vertical planes (LUX E_h) and (LUX E_v) respectively. The last column presents the average to minimum ratio which is the ratio between the average light in a room to the darkest corner of the room.

A reliable simulation tool was needed to conduct appropriate simulations to meet the targeted values. The tool used is called ElumTools, and is provided by Lighting Analyst Inc. which has as mission to assist the architectural lighting industry with the preparation and presentation of predicted lighting performance through the use of powerful micro-computer software. ElumTools is the first fully integrated add-in for Autodesk Revit designed to calculate point-by-point illuminance on any work plane or surface. This tool is also approved by IESNA which is a sustaining member and therefore aligns with the guidelines the team has chosen to abide by.

The performance of the different light fixtures being considered would be tested to determine the energy consumption and the power output of each one. Another feature of the house that would be tested during the simulations is the daylight dimmable sensors and controls which take into account the amount of natural daylight available and adjust the indoor lighting automatically to the required amount. This feature will allow the Borealis house to be more sustainable and to consume less energy.

Taking into consideration the guidelines outlines by IESNA, two different simulations were needed to achieve accurate values. The first one was to calculate the amount of light reaching the furniture and the second simulations was to account for the shadowing affect created by the furniture which affects the average to minimum ratio by removing the furniture even though not all of it was removed (it was necessary to maintain the kitchen table for instance). The house was also broken into different lighting zones to calculate the light levels and task lighting per room. Two calculations were performed on the bedrooms to account for both the general area as well as a task light area suited for reading.

The common theme throughout the house was the use of recessed linear LED fixtures so the bedroom had two of these fixtures, in addition to two switched half receptacles by the bed devoted to task lighting via lamps. The next area to be simulated was the living rooms. Two recessed linear LED fixtures were again used to accomplish all of the general and ambient lighting required for the room with task lighting installed such as lamps for desk work and adjustable accent lights for artwork. The bathroom also had two calculations to simulate the general area as well as the lighting levels at the toilet seat. These lighting levels were achieved by using three recessed pot lights, in addition to a water-tight recessed pot light for the shower stall. The lights were spaced to reach the levels required by the IESNA for both the general area and for the toilet seat. The kitchen was the area with the most lighting surface calculations, due to the IESNA levels of 500 lux for the kitchen prep counter and 300 lux for the island and sink. Team Borealis achieved these lighting levels by using architectural recessed spotlights to illuminate specific counters and cooktops in addition to under-cabinet lighting for the prep counter. It will be interesting to see how closely the simulated values match the recorded values during the competition. When doing the lighting calculations for the kitchen there were some shading issues caused by the table which suggests a higher average to minimum value for that room. The last room to be simulated was the Mechanical room. A single suspended wire guard dual fluorescent style luminaire with retrofit LED bulbs was used and achieved a high light output. The mechanical room presents some challenges since the numerous devices in there may cause interesting shading to occur, the simulation indicate that is possible to achieve an average of 105 lux with a minimum of 27 lux. The table below summarizes the results of the simulations.

Table 2: Testing Results

	Calculations with furniture					
Lighting Surfaces	Calculation Point	Ave (lx)	Max (lx)	Min (lx)	Avg/Min	Max/Min
	BEDROOM READING	269	301	215	1.25	1.4
	BEDROOM READING	279	324	186	1.5	1.75
	COUNTERTOP	599	729	385	1.56	1.9
	ISLAND	564	734	439	1.29	1.67
	TABLE	397	625	207	1.91	3.01
	TOILET SEAT	492	528	448	1.1	1.18
	Calculations without furniture (no shadows)					
Lighting Rooms	Calculation Points	Ave (lx)	Max (lx)	Min (lx)	Avg/Min	Max/Min
	BEDROOM 1	216	259	140	1.54	1.84
	BEDROOM 2	214	253	136	1.57	1.86
	LIVING ROOM 2	250	313	140	1.78	2.23
	LIVING ROOM 1	233	386	124	1.88	3.12
	BATHROOM	345	454	155	2.22	2.93
	KITCHEN	268	447	52	5.12	8.56
	MECHANICAL	105	168	27	3.86	6.17

The aim of the team members going to the competition grounds in October will be looking to measure the values the Borealis provides in order to validate the simulation results.

Control and Monitoring

The Borealis house design incorporates an extensive customizable control and monitoring system. The primary purpose is to ensure all the equipment used in the house is performing at optimal levels and will allow for an interactive user interface. Monitoring the performance of the house will allow for historical data to be collected establishing a solid foundation that “Team Alberta” could use to build upon in the future.

The Photovoltaic array placed on the roofs of the house is the main source of electricity; therefore, it is important to monitor the performance by keeping track of the power produced by the PV array. The PV modules considered by the team have a nominal maximum power of 250W, each of the arrays on the side house modules has 16 modules and 16 inverters so one inverter per module. The center array on the other hand has 8 modules and 8 inverters. The Enphase M215 inverter system will allow for panel by panel monitoring giving the end user the capability to optimize the array for maximum power output.

The DeltaSol BX solar thermal controller will not only operate the solar thermal system it will also perform advanced data logging. The BX controller has the ability to monitor up to seven thermal

points and a flow sensor for the solar loop. It is also capable of connecting to a computer via a Vbus/Ethernet converter and will provide real time energy information to the data logging equipment. The current flowing through each circuit in the house will also be monitored by the Branch Circuit Power Monitor (BCPM) to determine the power usage of the house. The temperature and flow rate in the lines feeding in and out of the tanks will also be monitored to determine how the energy is used and what percentage of it is lost compared to that which is efficiently used for the house. A customizable monitoring system is considered for the Heat Pump in order to offer the user wide range of flexibility when it comes to adjusting the system for the house. The Programmable Logic Controller (PLC) is used to control the heat recovery path and temperature as well as monitor the flow sensors. The BCPM monitoring system and the PLC are connected through an Ethernet gateway and using a Modbus RTU protocol the information collected can be logged on to a server on the web and viewed through an Android application or on a personal computer.

Bibliography

[1] [Online]. Available: http://www.ies.org/handbook/. [Accessed 3 February 2013].

[2] K. W. H. R. G. M. G. R. David L. Dilaura, The Lighting Handbook, Illuminating Engineering Society of North America, 2012.

Quantity Takeoff

SPECIFICATION NUMBER	BRIEF DESCRIPTION	DETAILED DESCRIPTION	QTY	UNIT
DIVISION 01	**GENERAL REQUIREMENTS**			
01 XX XX	TYPICAL JACK-AND-ROLL SYSTEM	1 SYSTEM FOR 1 DAY	1	DAY
DIVISION 05	**METAL**			
05 12 73.M13	W8X18	BEAMS	6,786	LBS
05 12 73	W6X20	COLUMNS	1,980	LBS
05 50 00	DECK HANDRAIL POSTS	CUSTOM FABRICATED POWDER COATED STEEL POSTS 0.375X2.5 BAR	75	EACH.
05 XX XX	CABLE RAILING ASSEMBLIES	1/8” 316 SS CABLE PREFAB ASSEMBLIES	1	PROJ.
DIVISION 06	**WOOD, PLASTIC AND COMPOSITES**			
06 15 33.13	CEDAR - INTERIOR CEILING	7/16X4 CEDAR CHANNEL SIDING	2,530	LF
06 15 33.13	CEDAR - EXTERIOR CLADDING	1X4 CEDAR T&G SIDING	400	LF
06 16 00.D10	1/2" PLYWOOD	EXTERIOR WALL SHEATHING	2015	SF
06 16 53	1/2" PLYWOOD	EXTERIOR ROOF	982	SF
06 20 XX	INTERIOR BASE MOULDING	1” X 4” MDF BASE MOULDING	152	LF
06 61 19	QUARTZ SOLID SURFACE	WHITE QUARTZ, 1/2” THICK, STRAIGHT WITH EASED EDGE PROFILE	33	SF
06 XX XX	DIMENSIONAL LUMBER 4X4	POSTS, TREATED WOOD	236	LF
06 XX XX	CEDAR 5/4X6	DECKING SURFACE	1050	SF
06 XX XX	DIMENSIONAL LUMBER 2X4	WALL FRAMING 16"O.C	1651	LF
06 XX XX	DIMENSIONAL LUMBER 2X6	INTERIOR ROOF AND FLOOR FRAMING	444	LF
06 XX XX	DIMENSIONAL LUMBER 2X8	INTERIOR ROOF AND FLOOR FRAMING	4237	LF
06 XX XX	1/2" INTERIOR GYPSUM	INTERIOR WALLS	2150	SF
06 XX XX	1/2" PLYWOOD	FLOOR JOIST SHEATHING	900	SF
06 XX XX	3/4" PLYWOOD	SUBFLOOR	900	SF
06 XX XX	3.5" X 9.5" LAMINATED VENEER LUMBER BEAM	INTERIOR FRAMING	56	LF
06 XX XX	POND LINER	POLYETHELENE LINER 10’ WIDE	16	LF
06 XX XX	POND CLADDING	2X8 LUMBER	32	LF
06 XX XX	POND STRUCTURE	2X4 LUMBER	40	LF
06 XX XX	SOUTH EAST SEATING AND PLANTERS	2X6 Lumber	636	LF

06 XX XX	SOUTH WEST PLANTERS	2X6 Lumber	265	LF
06 XX XX	NORTH MECH COVER, PLANTERS, SEATING	2X6 Lumber	768	LF
DIVISION 07	**THERMAL AND MOISTURE PROTECTION**			
07 62 00	SHEET METAL FLASHING AND TRIM	SHEET METAL FLASHING, ALUMINUM, FLEXIBLE, MILL FINISH, .013" THICK, INCLUDING UP TO 4 BENDS	300	LF
07 71 23	MANUFACTURED GUTTERS AND DOWNSPOUTS	3” PVC PIPING AND FITTINGS	60	LF
07 21 19	EXTERIOR WALLS INSULATION	TYPICAL SPRAY POLYURETHANE FOAM INSULATION, FLOORS. WALLS AND CEILINGS, 2#/CF DENSITY, ±7" THICK, R42, SPRAYED	2015	SF
07 21 29	FLOOR INSULATION	TYPICAL SPRAY POLYURETHANE FOAM INSULATION, FLOORS. WALLS AND CEILINGS, 2#/CF DENSITY, ±7" THICK, R42, SPRAYED	900	SF
07 21 29	CEILING INSULATION	TYPICAL SPRAY POLYURETHANE FOAM INSULATION, FLOORS. WALLS AND CEILINGS, 2#/CF DENSITY, ±7" THICK, R42, SPRAYED	982	SF
07 53 29	TPO SINGLE PLY ROOF	FIRESTONE TPO	900	SF
DIVISION 08	**OPENINGS**			
08 53 00	WINDOW - SOUTH ELEVATIONS OF SIDE MODULES	3’-2” W X 7’-6” H UPVC, TRIPLE GLAZED, LOW-E, FIXED, INNOTECH WINDOW	2	EACH
08 53 00	WINDOW - SOUTH ELEVATION OF CENTRE MODULE	3’-3 1/2” W X 7’-6” H UPVC, TRIPLE GLAZED, LOW-E, FIXED, INNOTECH WINDOW	3	EACH
08 53 00	WINDOW - SOUTH ELEVATION OF CENTRE MODULE	1’-8” W X 9’-10 1/2” H UPVC, TRIPLE GLAZED, LOW-E, FIXED, INNOTECH WINDOW	1	EACH
08 53 00	CLERESTORY WINDOW - NORTH ELEVATION OF SIDE MODULES	6’-5” W X 1’-2” H UPVC, TRIPLE GLAZED, LOW-E, FIXED, INNOTECH WINDOW	2	EACH
08 53 00	TRANSOM WINDOW - ABOVE NORTH ELEVATION DOORS	3’-0” W X 1’-2” H UPVC, TRIPLE GLAZED, LOW-E, FIXED, INNOTECH WINDOW	2	EACH
08 53 00	DOOR - SOUTH AND NORTH ELEVATIONS OF SIDE MODULES	3’-0” W X 7’-6” H UPVC, PRE-HUNG, EXTERIOR, INNOTECH DOOR WITH OPERABLE SASH AND TRIPLE GLAZED LOW-E LITE	4	EACH
08 53 00	DOOR - NORTH ELEVATION OF CENTRE MODULE	3’-0” W X 7’-6” H UPVC, PRE-HUNG, EXTERIOR VINYL INNOTECH DOOR	1	EACH
08 14 00	DOOR - INTERIOR POCKET	34” W X 6’-9” H X 1-3/8” WITH TRACK HARDWARE	4	EACH
08 14 00	DOOR - INTERIOR POCKET	32” W X 6’-9” H X 1-3/8” WITH TRACK HARDWARE	4	EACH
08 14 00	DOOR – INTERIOR SLIDING	34” W X 6’-8” H X 1-3/8” WITH TRACK HARDWARE	6	EACH
DIVISION 09	**FINISHES**			
09 21 16	GYPSUM BOARD	1/2” GYPSUM WALLBOARD, STANDARD, W/COMPOUND SKIM COAT (LEVEL 5 FINISH)	1400	SF

09 30 00	PORCELAIN TILING - BATHROOM FLOOR	PORCELAIN TILES, 6"X12" TILE, MATTE FINISH	57	SF
	PORCELAIN TILING - BATHROOM WALLS	PORCELAIN TILES, 6"X12" TILE, GLOSSY FINISH	86	SF
09 30 00	RECYCLED GLASS TILING - KITCHEN BACKSPLASH	RECYCLED GLASS TILES, 2”X6”	15.6	SF
09 91 05	INTERIOR PAINT	ZERO VOC LATEX PAINT, EGGSHELL FINISH, 2 COATS, ROLL APPLIED	1200	SF
09 91 05	INTERIOR PAINT - BASE MOULDING	ZERO VOC LATEX PAINT, SATIN FINISH, 2 COATS, ROLL/BRUSH APPLIED	158	LF
09 64 29	LAMINATE FLOORING	3 1/2” W X 9/16" T LAMINATE PLANK FLOORING	650	SF
09 XX XX	VINYL COMPOSITE FLOORING	12”W X 12”D VINYL COMPOSITE FLOOR TILES	42	SF
09 XX XX	FLOOR EXPANSION JOINT	WABO WWF-200	86	LF
DIVISION 10	**SPECIALITIES**			
10 22 26	FOLDING PARTITIONS	2’-10” W X 7’-6” H X 0’-1 1/2” W HOLLOW CORE PANEL, PAINTED FINISH, SLIDING DOOR HARDWARE	6	EACH
10 22 26	FOLDING PARTITION HARDWARE	11’-2” OVERHEAD ALUM. SLIDING DOOR TRACK HARDWARE	2	EACH
10 28 13	RESIDENTIAL BATH ACCESSORIES	5’-0” W X 2’-4” H MIRROR	1	EACH
10 28 13	RESIDENTIAL BATH ACCESSORIES	STAINLESS STEEL STANDING TOILET PAPER ROLL HOLDER	1	EACH
10 28 13	RESIDENTIAL BATH ACCESSORIES	STAINLESS STEEL TOWEL/ROBE HOOK	2	EACH
10 XX XX	BATHROOM GREEN WALL	INTERIOR DIRTT BREATHE LIVING WALL SYSTEM MOUNTED ON BATHROOM SOUTH WALL 5'-6" H x 4’-0” '	1	EACH
10 XX XX	BATHROOM LIGHT TUBES (SKYLIGHTS)	VELUX LOW PROFILE FLEXIBLE (TGF) SUN TUNNEL SKYLIGHTS	2	EACH
DIVISION 11	**EQUIPMENT**			
11 31 00	COOKTOP	30" WHIRLPOOL GCI3061XB	1	EACH
11 31 00	WALL OVEN	30" WHIRLPOOL WOS551EC0AS	1	EACH
11 31 00	RANGEHOOD	30" MAYTAG UXT5230AYS	1	EACH
11 31 00	REFRIGERATOR/FREEZER	24" BLOMBERG BRFB1450	1	EACH
11 31 00	DISHWASHER	18" BOSCH SPX5ES55UC	1	EACH
11 31 00	CLOTHES WASHER	24" BLOMBERG WM77110	1	EACH
11 31 00	CLOTHES DRYER	24" BLOMBERG DV7542	1	EACH
DIVISION 12	**FURNISHINGS**			
12 XX XX	BASE CABINET – 3 DRAWER	30”W X 30”H X 24”D PREFABRICATED IKEA BASE CABINET WITH DRAWERS	2	EACH
12 XX XX	BASE CABINET – FACE PANEL WITH WALL OVEN CUTOUT	30”W X 30”H X 24”D PREFABRICATED IKEA BASE CABINET WITH APPLIANCE CAVITY	1	EACH

12 XX XX	ISLAND BASE CABINET – DISHWASHER	18”W X 30”H X 24”D PREFABRICATED IKEA BASE CABINET WITH APPLIANCE CAVITY	1	EACH
12 XX XX	ISLAND BASE CABINET – 3 DRAWER WITH SINK CUTOUT	36”W X 30”H X 24”D PREFABRICATED IKEA BASE CABINET WITH DRAWERS	1	EACH
12 XX XX	ISLAND BASE CABINET – 3 DRAWER	24”W X 30”H X 24”D PREFABRICATED IKEA BASE CABINET WITH DRAWERS	1	EACH
12 XX XX	WALL-MOUNTED CABINET – LIFT DOOR	30”W X 15”H X 12”D PREFABRICATED IKEA UPPER CABINET WITH LIFT HARDWARE	6	EACH
12 XX XX	WALL-MOUNTED CABINET – LIFT DOOR (GLASS INSERT)	30”W X 15”H X 12”D PREFABRICATED IKEA UPPER CABINET WITH LIFT HARDWARE	6	EACH
12 XX XX	FULL-HEIGHT CABINET - FINISH CARPENTRY	27"W X 7'6"H X 9"D SINGLE DOOR CABINET STORAGE, PARTICLEBOARD CONSTRUCTION, PAINTED FINISH FRONT PANEL	2	EACH
DIVISION 21	**FIRE SUPPRESSION**			
21 XX XX	PIPING	CPVC 1" BLAZEMASTER PIPE	90	FOOT
21 XX XX	PIPING	1" SCHEDULE 40 BLACK STEEL PIPE	21	FOOT
21 XX XX	SPRINKLER	RELIABLE CONCEALED SPRINKLER HEADS	8	EACH
21 XX XX	TEE FITTING	CPVC TEE FITTING	5	EACH
21 XX XX	ELBOW FITTING	CPVC ELBOW FITTING	4	EACH
21 XX XX	ELBOW FITTING	CAST IRON ELBOW FITTING	5	EACH
21 XX XX	TEE FITTING	CAST IRON TEE FITTING	2	EACH
21 XX XX	HEAD ADAPTER	1" x 1/2" HEAD ADAPTER	8	EACH
21 XX XX	FIP ADAPTER	1" FIP ADAPTER	1	EACH
21 XX XX	FIRE SUPPRESSION PUMP	GUARDIAN G3100	1	EACH
DIVISION 22	**PLUMBING**			
22 XX XX	PIPING	TYPICAL PEX ROUGH PLUMBING SUPPLY SYSTEM, PIPING, FITTINGS, W/O FIXTURES & TRIMS, 1 KITCHEN & 1 BATH	900	SF/LIVING
22 XX XX	TOILET	TOTO CST454CEFG	1	EACH
22 XX XX	BATHROOM VANITY FAUCET	BSP-L-65014LF-PC	1	EACH
22 XX XX	SHOWER HEAD	DELTA 52655	1	EACH
22 XX XX	SHOWER CONTROLS	DELTA T17059	1	EACH
22 XX XX	SHOWER PAN	INFINITY DRAIN DG38SS	1	EACH
22 XX XX	KITCHEN SINK	BLANCO QUATRUS U2 401247	1	EACH
22 XX XX	KITCHEN FAUCET	BRIZO BSP-K-64020LF-PC	1	EACH
22 XX XX	HOT WATER TANK	BRADFORD WHITE S-DC-DW2-55R6SW	2	EACH
22 XX XX	TANKLESS HOT WATER HEATER	Stiebel Eltron DHC-E	1	EACH
22 XX XX	SEWAGE PUMP	FLOTEC E75STVT	1	EACH
22 XX XX	DOMESTIC WATER PUMP	RED LION RJS-50E	1	EACH

22 XX XX	SOLAR CIRCULATION PUMP	APRICUS AP-KIT-DOM-CL	1	EACH
22 XX XX	THERMAL STORAGE CIRCULATION PUMP	GRUNDFOS UP 15-42F/VS	2	EACH
22 XX XX	2-WAY SOLENOID VALVE	ASCO REDHAT	1	EACH
22 XX XX	3-WAY SOLENOID VALVE	ASCO REDHAT	3	EACH
22 XX XX	SOLAR THERMAL TUBES	APRICUS APSE-20	1	EACH
22 XX XX	HEAT PUMP WATER PUMP	GRUNDFOS UP 15-42F/VS	1	EACH
22 XX XX	DRAIN WATER HEAT RECOVER	ECOINNOVATION TD342B	1	EACH
22 XX XX	COPPER PIPING 3/4"	STANDARD ASSEMBILY	75	LF
DIVISION 23	**HEATING, VENTILATION AND AIR CONDITIONING**			
23 XX XX	HEAT PUMP	LENNOX XP21	1	EACH
23 XX XX	DEHUMIDIFIER	MUNTERS DRYCOOL HD	1	EACH
23 XX XX	BATHROOM EXHAUST FAN	BROAN XB110C	1	EACH
23 XX XX	HEAT RECOVERY VENTILATOR	LIFEBREATH 155ECM	1	EACH
23 XX XX	HEAT PUMP HEAT RECOVERY	TURBOTEC ENVIRO-PAK	1	EACH
23 XX XX	AIR HANDLER BLOWER MODULE	UNICO MB2430-EC2	1	EACH
23 XX XX	A/C R410 COIL	UNICO MC2430CX	1	EACH
23 XX XX	VERTICAL PLENUM	UNICO MV2430	1	EACH
23 XX XX	TAKE-OFF KITS	UNICO UPC-89M-6	4	EACH
23 XX XX	SOUND ATTENUATOR	UNICO UPC-26	18	EACH
23 XX XX	SUPPLY TUBE	UNICO UPC-25-1	4	EACH
23 XX XX	SUPPLY ADAPTER	UNICO UPC-61-2430	1	EACH
23 XX XX	SLOTTED OUTLET 90 DEGREES	UNICO UPC-67A	22	EACH
23 XX XX	GALVANIZED PIPE 26 GA	7" X 60	35	LF
23 XX XX	GALVANIZED PIPE 30 GA	14" X 60	5	LF
23 XX XX	RECTANGULAR DUCT	12 X 4 8 FOOT LONG	6	EACH
23 XX XX	RECTANGULAR ELBOW	12 X 4	2	EACH
23 XX XX	ROUND TO RECTANGULAR	7" TO 12 x 4 RECTANGULAR	1	EACH
23 XX XX	26 GA ELBOW	7"	3	EACH
23 XX XX	DUCT END CAP	12 X 4	4	EACH
23 XX XX	SPUN PLUGS	7"	1	EACH
23 XX XX	TEES	7" X 7" X 7"	3	EACH
23 XX XX	FRESH AIR INTAKE	4"	1	EACH
23 XX XX	PIPE DAMPERS	4"	1	EACH
23 XX XX	BOEFLEX	4"	25	LF
23 XX XX	INSULATION	REFLECTIX 500 SQFT	1	ROLL

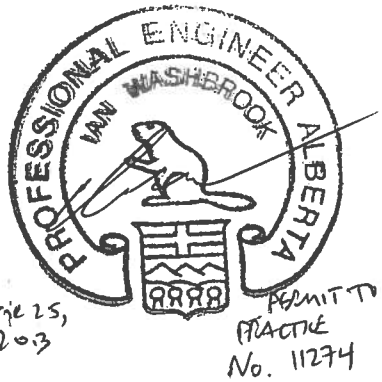
23 XX XX	THERMOSTAT	RADIO THERMOSAT CT300	3	EACH
	THERMOSAT	RADIO THERMOTAT		
23 XX XX	ZONE CONTROL	NCM-300-2-3 ZONE PANEL	1	EACH
DIVISION 25	**INTEGRATED AUTOMATION**			
25 09 00	GENERIC SENSORS, ROUTER, SOFTWARE FOR MONITORING HEAT AND HUMIDITY		1	PROJECT
25 50 00	PROGRAMMABLE MINI PLC	TWIDO PROGRAMMABLE CONTROLER SQD TWDLCAA40DRF	1	EACH
25 06 91	RESOL SOLAR CONTROLER	RESOL DELTASOL BX	1	EACH
25 06 91	BRANCH CIRCUIT POWER MONITORING	BCPM POWER LOGIC SQD BCPMC042S	1	EACH
25 50 00	ANALOG EXPANSION INPUT FOR TWIDO PLC	8 PORT ANALOG EXPANSION SQD TM2ARI8HT	2	EACH
25 50 00	MODBUS TO ETHERNET GATWAY	TELEMECANIQUE TSXETG100	1	EACH
DIVISION 26				
26 XX XX	RULE OF THUMB, INSTALLATION, DISTRIBUTION, INCLUDES ALL ROUGH ELECTRICAL WORK, OUTLETS AND SWITCHES, NO FIXTURES		900	PROJECT
26 24 16	TYPICAL LOAD PANEL	SQUAR D LOAD CENTERS, 1 PHASE, 3 WIRE, MAIN LUGS, INDOOR, 120/240 V, 200 AMP BUS (150A MAIN), 42 CIRCUITS	1	EACH
26 XX XX	RULE OF THUMB, TYPICAL PV ROUGH IN ELECTRICAL SYSTEM		10,000KW	EACH
26 31 00	GENERIC PV MOUNTING RACK, PER SOLAR PANEL		40	EACH
26 31 00	PV PANELS	250W POLYCRYSTALLINE SOLAR PANELS	40	EACH
26 31 00	INVERTERS	ENPHASE M215	40	EACH
26 50 00	ENPHASE INSTALLATION KIT; AC BRANCH CIRCUIT	ENPHASE ENGAGE CABLE	3	EACH
26 50 00	OUTDOOR LED POT LIGHT	4"SQUARE LED POT LIGHT RATED FOR WET LOCATION, 600-1200 lm, 2700K-4000K, >20W	6	EACH
26 50 00	EXTERIOR DOOR LIGHT	LED WALL LANTERN, 600-1000 lm, 3000K-4000K, >20W	4	EACH
26 50 00	EXTERIOR RECESSED LED PLANE LIGHT	RECESSED LED STEP LIGHT, 50-200 lm, 3000K-4000K, >13W	11	EACH
26 50 00	RECESSED LED 2' FIXTURE	3" LED STRIP FIXTURE, 800-1200 lm, 2700K-3500K, >35W	12	EACH
26 50 00	SHOWER/BATHROOM LED POT LIGHTS	3" ROUND LED POT LIGHT RATED FOR WET LOCATION, 600-1200 lm, 2700K-4000K, >20W	4	EACH
26 50 00	ACCENT TASK LIGHT	4"SQUARE LED ADJUSTABLE POT LIGHT, 400-800 lm, 2700K-4000K, >20W	7	EACH
26 50 00	MECH ROOM STRIP LIGHT WITH LED REPLACEMENT	4' STRIP FIXTURE, 1600-2500 lm, 3000K-4000K, >35W	1	EACH
26 50 00	KITCHEN TABLE PENDANT LIGHT	LED CYLINDRICAL GLASS PENDANT LIGHT, 200-400 lm, 3700K-3500K, >10W	5	EACH

26 50 00	UNDERCABINET LED LIGHT FIXTURE	15"-20", 450-600 lm, 2700K-3500K, >15W	2	EACH
26 09 23	DIMMABLE DAYLIGHT SENSOR	DIMMABLE DAYLIGHT SENSOR WITH 0-10V CONTROL	3	EACH
DIVISION 28	**ELECTRONIC SAFETY AND SECURITY**			
28 XX XX	FIRE ALARM SYSTEM	FIRE DETECTION SYSTEMS, REMOTE ANNUNCIATOR, 8 ZONE LAMP, EXCLUDING WIRES & CONDUITS	1	EACH
DIVISION 31	**EARTHWORK**			
31 XX XX	SMALL STEEL ADJUSTABLE PIERS FOR HOUSE	CENTRAL PIERS SEISMIC PIER, SMALL, 7"-12" ADJUSTMENT	26	EACH
31 XX XX	MEDIUM STEEL ADJUSTABLE PIERS FOR HOUSE	CENTRAL PIERS SEISMIC PIER, MEDIUM, 11"-19" ADJUSTMENT	16	EACH
31 XX XX	FOUNDATION PADS	TYPICAL 3/4" CDX PLYWOOD	26	EACH
DIVISION 32	**EXTERIOR IMPROVEMENTS**			
32 XX XX	DECK HANDRAIL	CUSTOM FABRICATED POWDER COATED STEEL POSTS SPACED 5' APART FROM CENTRE, WITH 10 9/16" PERFORATIONS ACCOMMODATING APPROPRIATE CABLE AND FITTINGS	200	LF
32 XX XX	MAIDEN GRASS	DWARF MAIDEN GRASS FROM ARMSTRONG GARDEN CENTERS	120	SF
32 XX XX	PURPLE FOUNTAIN GRASS	PURPLE FOUNTAIN GRASS FROM ARMSTRONG GARDEN CENTERS	120	SF

Appendix 1: Structural Calculations

BOREALIS

Structural Calculations



June 25, 2013

BOREALIS

Structural Calculations

1 Load Analysis

1.1 General

All calculations will be conducted in SI units. Where appropriate, conversions will be provided into Imperial/US units.

1.2 Compliance with Building Codes

The building in question is to be designed to the following locations:

1. Calgary, Alberta, Canada
2. Irvine, California, United States of America

The design references the following codes, standards and design manuals.

1. National Building Code of Canada 2010 (NBCC)
2. International Building Code 2012 (IBC)
3. International Residential Code 2012 (IRC)
4. Solar Decathlon 2013 Building Code (SDBC).
5. American Society of Civil Engineers Standard 7 2010 (ASCE 7-10)
6. Canadian Wood Council Wood Design Manual 2010 (CWC-WDM)
7. Canadian Institute of Steel Construction Handbook of Steel Construction 2010 (CISC-HSC)

1.3 Dead Loads

Unless noted otherwise, values were obtained from P.7-57 of the Canadian Institute of Steel Construction (CISC) Handbook of Steel Construction 2010.

Compliance with IRC R301.2.2.2.1 Weights of materials:

Roof and ceiling: $D = 1.13$ kPa < 1.19 kPa
Therefore, provide a 1.175 factor on wall bracing (IRC, Chapter 6)

Floor: $D = 1.4 - 1 = 0.4 < 0.48$ kPa

Exterior light wood frame walls: $D = 0.66$ kPa < 0.72 kPa

Interior light wood frame walls: $D = 0.25$ kPa < 0.48 kPa

TABLE 1: DEAD LOAD ANALYSIS

Typical Roof	**0.49 kPa**
Typical Roof with PV Panels	**0.74 kPa**
Roofing (3-ply asphalt, no gravel)	0.15 kPa
Plywood (16mm)	0.09 kPa
Joists (38x184 @ 400)	0.09 kPa
Gypsum board (12.7mm)	0.10 kPa
Polyurethane spray foam (200mm)	0.06 kPa
PV Panels	0.25 kPa
Typical Ceiling	**0.39 kPa**
Joists (38x89 @ 400mm)	0.05 kPa
Glass fibre insulation (100 mm)	0.05 kPa
Cedar ceiling planks (12.5mm)	0.04 kPa
Ducts, pipes, wiring allowance	0.25 kPa
Exterior Walls without Cladding	**0.41 kPa**
Exterior Walls with Wood	**0.48 kPa**
Exterior Walls with Aluminum	**0.66 kPa**
Double stud wall (38x89 @ 400 x 2)	0.10 kPa
Polyurethane spray foam (200mm)	0.06 kPa
Plywood (16mm + 9.5 mm)	0.15 kPa
Gypsum board (12.7mm)	0.10 kPa
Cedar channel siding (20mm)	0.07 kPa
Fibre cement panel cladding	0.25 kPa

Interior Walls	**0.25 kPa**
Stud wall (38x89 @ 400)	0.05 kPa
Gypsum board (12.7mm x 2)	0.20 kPa
Windows	**0.40 kPa**
Windows, wood frame	0.40 kPa
Floor	**1.31 kPa**
Floor (mechanical)	**1.56 kPa**
Interior partitions	1.00 kPa
Wood Flooring (10mm)	0.08 kPa
Plywood (19mm)	0.08 kPa
Joists (38x184 @ 400)	0.09 kPa
Polyurethane spray foam (200mm)	0.06 kPa
Structural Steel	
Wide flange beams (W200x27)	0.222 kN/m
Wide flange columns (W150x30)	0.292 kN/m
Typical Roof	**0.49 kPa**
Typical Roof with PV Panels	**0.74 kPa**
Roofing (3-ply asphalt, no gravel)	0.15 kPa
Plywood (16mm)	0.09 kPa
Joists (38x184 @ 400)	0.09 kPa
Gypsum board (12.7mm)	0.10 kPa

TABLE 2: HOUSE WEIGHT ESTIMATE

Summary		Side Module		Centre Module	
	Load	Area	Weight	Area	Weight
Roof	0.49 kPa	-	-	15.0 m²	7.4 kN
Roof (with PV)	0.74 kPa	29.2 m²	21.6 kN	17.7 m²	13.1 kN
Ceiling	0.39 kPa	21.8 m²	8.6 kN	22.3 m²	8.8 kN
Exterior walls (Wood)	0.48 kPa	-	-	32.2 m²	15.5 kN
Exterior walls (Single aluminum)	0.66 kPa	34.8 m²	23.0 kN	-	-
Extior walls (No cladding)	0.41 kPa	18.8 m²	7.7 kN	28.4 m²	11.6 kN
Interior walls	0.25 kPa	5.9 m²	1.5 kN	16.7 m²	4.2 kN
Windows	0.40 kPa	11.0 m²	4.4 kN	10.0 m²	4.0 kN
Floor	1.31 kPa	29.1 m²	38.1 kN	34.6 m²	45.3 kN
Steel (W200x27)	0.222 kN/m	35.9 m	8.0 kN	35.4 m	7.9 kN
Steel (W150x30)	0.292 kN/m	11.7 m	3.4 kN	10.3 m	3.0 kN

Side Module = 117 kN = 26,603 lbs
Centre Module = 121 kN = 27,202 lbs
Total Weight = 2 × Side + Centre
= 355 kN = 79,807 lbs

1.4 Live Loads

Governing loads:

- Roof: NBCC specified 1.0 kPa roof live load
- Floor: SDBC specified 2.4 kPa floor live load
- Decks and ramps: SDBC specified 4.8 kPa live load

1.5 Snow Loads

1.5.1 NBCC Snow Load

See Appendix 1 for Calculations.

Note: Case I only; Case II does not apply for low slope non-gable roofs.

1.5.2 ASCE Snow Load

Minimum 1.0 kPa Snow/Rain load

1.6 Wind Loads

See Appendix 1.

1.7 Earthquake Loads

1.7.1 NBCC Earthquake Load

See Appendix 1.

1.7.2 ASCE Earthquake Load

Per SDBC: Seismic design category D_2

Seismic Force Resisting System (SFRS):
North-South axis: (SFRS A15) Bearing Wall System: Light wood frame walls sheathed with wood structural panels rated for shear resistance.

$R = 6.5$
$\Omega_0 = 3$
$C_d = 4$
$h_n = 65$ ft

East-West axis: (SFRS C4) Moment Frame: Steel ordinary moment frames.

$R = 3.5$
$\Omega_0 = 2.5$
$C_d = 2$

Clause 12.3.5: Centre module has two SFRS in east-west axis. The weaker SFRS is used for sake of calculation; in this case the steel moment frame, R=3.5

Clause 12.3.1.16: Wood structural panel diaphragm shall be considered flexible due to use as a one or two-family dwelling.

Footnote g, Table 12.2-1. Where the tabulated value of the overstrength factor, Ω0, is greater than or equal to 2½, Ωo is permitted to be reduced by subtracting the value of ½ for structures with flexible diaphragms.

$$\therefore \Omega_0(NS) = 3 - 0.5 = 2.5$$
$$\therefore \Omega_0(EW) = 2.5 - 0.5 = 2.0$$

Use the equivalent lateral force procedure

Seismic base shear, $V = C_s W$
C_s = seismic response coefficient
W = effective seismic weight

$T_a = 0.0488(4.572)^{0.75} = 0.15$ s
$T_L = 8$ s

$S_S = 1.496$ g
$S_1 = 0.555$ g
$S_{MS} = 1.496$ g
$S_{M1} = 0.833$ g
$S_{DS} = 0.997$ g
$S_{D1} = 0.555$ g

For R=6.5

$$C_s = \frac{S_{DS}}{R/I_e} = \frac{0.997}{6.5/1} = 0.153 \text{ g}$$

Check conditions:

Case 1 ($T \leq T_L$) $\quad C_s \leq \dfrac{S_{D1}}{T(R/I_e)} = \dfrac{0.555}{0.15(6.5/1)} = 0.569$

Case 2 $\quad C_s \geq 0.044 S_{DS} I_e = 0.044(0.997)(1) = 0.0438 \geq 0.01$

$\therefore C_s = 0.153$ g

For R=3.5

$$C_s = \frac{S_{DS}}{R/I_e} = \frac{0.997}{3.5/1} = 0.285 \text{ g}$$

Check conditions:

Case 1 ($T \leq T_L$) $\quad C_s \leq \dfrac{S_{D1}}{T(R/I_e)} = \dfrac{0.555}{0.15(3.5/1)} = 1.057$

Case 2 $\quad C_s \geq 0.044 S_{DS} I_e = 0.044(0.997)(1) = 0.0438 \geq 0.01$

$\therefore C_s = 0.285$ g

Therefore,

$V_{EW} = 0.285W$ (steel moment frame)
$V_{NS} = 0.153W$ (light frame bearing walls with wood structural panels)

1.8 Load Summary

See Appendix 1: Load Summary

2 Roof Loading

2.1 Joists

See Appendix 2: Roof Joist Calculations

2.2 Diaphragm

Diaphragm Design	Core
Joist spacing	400 mm
specified load	2.55 kPa
Edges unsupported	
CSA O151 CSP	
Minimum thickness	9.5 mm

Dimensions		
W	3.66	m
L	9.7	m
L_e	1	m
H_min	3.45	m
H_avg	3.86	m
H_max	4.27	m

Loads		West/East	South	North	
Wind Pressure	q	1.06	1.09	1.09	kPa
Wind Pressure, End Zone	q_e	1.22	1.22	1.22	kPa
Dist. Wind Load	w	4.30	5.00	4.10	kN/m
Factored Wind Load	w_f	6.02	7.00	5.74	kN/m

Shear Force in Walls				
Along E/W walls	v_f	v = wL /2L	7.9773224	kN/m
Along N/S walls	v_f	v = wL /2L	1.3206186	kN/m
Strut reaction	R_f		29.197	kN
	R_f		12.81	kN

Sheathing Design					
12.5 mm plywood					
3.25 mm nails					
38 mm framing member					
Design Case 1					
Apply for E/W wind loads	v_r		9.27	kN/m	Acceptable
	s_n	*Nail spacing at diaphragm boundary*	64	mm	
	S_ni	*Nail spacing at other panel edges*	100	mm	
Design Case 3					
Apply for N/S wind loads	v_r		6.31	kN/m	Acceptable
	s_n	*Nail spacing at diaphragm boundary*	100	mm	
	S_ni	*Nail spacing at other panel edges*	100	mm	

Chord Design

The top plate of the stud wall will be used as chord members.

By inspection, the BM in E/W direction will govern.

M_f	*Nail spacing at other panel edges*	70.80	kN/m	
h	*3.66 m - 0.184 m (member depth)*	3.48	m	
T_f		20.37	kN	
T_r	*From P.162 WDM2010; Kd=1.15*	47.73	kN	Acceptable

Design of Splice

Assuming 8' minimum member lengths:

Location (mm)	Specified Moment (kN/m)	Specified Force (kN)	Number of nails per splice		Force per Nail (kN)	Δc	Δc*x
1219	22.22742885	6.3871922	8	16	0.399	0.18	219.42
2438	38.0652254	10.938283	14	28	0.391	0.18	438.84
3657	47.51338965	13.653273	17	34	0.402	0.18	658.26
4876	50.5719216	14.532161	18	36	0.404	0.18	877.68
							2194.2

Diaphragm-Shearwall Connection

Joist spacing	s	400	mm		
West wind	w_f	7.29	kN/m		
	P_f	2.917264	kN		
Strongtie A23	P_r1	3.23	kN	> P_f = 2.92	Acceptable
	V_r2	2.27	kN		

Deflection

EW direction

v	4.30	N/mm	
L	9700	mm	
E	9500	MPa	
A	13984	mm2	(38x184x2 mm2)
L_d	3660	mm	
B_v	5700	N/mm	12.5 mm
e_n	0.2		0.424 kN/nail

5vL3 / 96 E*A*L_d	0.434	
vL/4Bv	1.829	
0.000614*L*en	1.191	
sum(Δcx)/2Ld	0.300	
Δ	3.754	mm

2.3 Ceiling Framing

2x4 framed dropped ceiling. Depth <8". Dead Load only.

$DL = 0.39$ kPa

Permanent load: $\therefore K_D = 0.65$

16" spacing.

Determine max length

Bending

$M_r = 0.65(0.906) = 0.589$ kN-m

$w = 1.4(0.39)(0.4) = 0.22$ kN/m

$$l_{\max} = \sqrt{\frac{8M_r}{w}} = \sqrt{\frac{8(0.589)}{0.22}} = 4.62 \text{ m}$$

Shear

$V_r = 0.65(5.17) = 3.36$ kN

$w = 1.4(0.39)(0.4) = 0.22$ kN/m

$$l_{\max} = \frac{2V_r}{w} = \frac{2(3.36)}{0.22} = 30.5 \text{ m}$$

Deflection

$E_S I = 0.65(21.2) = 12.8$ kN-m^2

$w = 0.39(0.4) = 0.16$ kN/m

$$\Delta_{\max} = \frac{l}{360} = \frac{5wl^4}{384E_s I}$$

$$l_{\max} = \sqrt[3]{\frac{384E_s I}{(360 \times 5)(w)}} = \sqrt[3]{\frac{384(12.8 \text{ kN-m}^2)}{(360)(5)(0.16 \text{ kN/m})}} = 2.57 \text{ m}$$

Therefore, maximum span is 2.57 m or 8'-5"

At 2.57 m:

$V_f = (0.22)(2.57)/2 = 0.283$ kN

$M_f = (0.22)(2.57)^2/8 = 0.182$ kN-m

Tension

$T_r = 25.1 \text{ kN} > V_f$

Connection

$K' = 0.65$

$J = 1.0$

2.5" Nail C

$N'_r n_s = 0.553$ kN

$$n_F = \frac{V_f}{N'_r n_s \times 0.65} = \frac{0.283}{0.553(0.65)} = 0.79$$

Provide minimum 2 2-1/2" nails

3 Walls

3.1 Stud Walls

Notes	SPF No.1/No.2

Critical conditions are Side Module, North End and Core Module, South End. Dimensions are identical for these conditions.

Stud Spacing	400	mm	
Stud Length (maximum)	3.3	m	
Vertical Dead Load	4.62	kN/m	
Vertical Snow Load	2.23	kN/m	
Horizontal Wind Load *External Pressure*	0.67	kPa	
External Pressure, End Zone	0.83	kPa	
Internal Pressure	0.39	kPa	

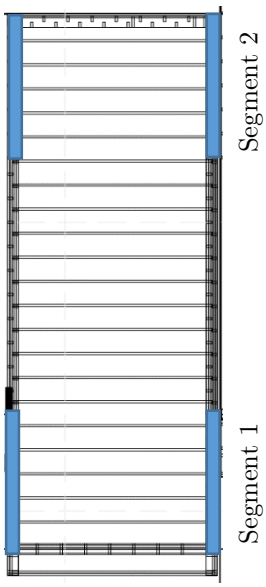
Method 1: Consider external pressure on outside studs; internal pressure on interior studs

Load Case 1	*1.25D+1.5S+0.4W*	*P_f*	3.64731	kN	
		w_f	0.1328	kN/m	
Load Case 2	*1.25D+1.4W+0.5S*	*P_f*	2.75427	kN	
		w_f	0.4648	kN/m	
Satisfy these two cases	L = 3.3 m	*P_r*	4.1		PASS
		w_r	0.66		
Check Shear		*V_f*	0.76692	kN	
		V_r	8.33		PASS
Check Deflection	Exterior stud; L/180	*EI_req*	21.0		
			21.2		PASS
	Interior stud; L/180	*EI_req*	9.85		
			21.2		PASS

3.2 Shear Walls

3.2.1 Core Module East and West Shear Walls

- single story residential building framed with SPF lumber studs @ 400 mm
- plywood wall sheathing applied directly to studs on exterior
- dry service conditions
- factoured roof diaphragm reaction (20.4 kN)
- factored shear force (Vfs = 20.4 kN)



Notes:
Provide plywood on both sides.
Do not consider gypsum (only sheathing that is in contact with stud)
All shear walls will be blocked

		Segment 1	Segment 2
	L_s (m)	2.47	2.3
	H (m)	3.16	2.68
	V_{hd} (kN)	20.8	19.4
Wind from the North	P_t (kN)	2.30	2.14
	P_j (kN)	4.05	3.53
	Hold-down*	Yes	Yes
	J_{hd}	1	1
	V_{rs} (kN)	20.8	19.4
Wind from the South	P_t (kN)	2.30	2.14
	P_j (kN)	4.054641	3.527177
	Hold-down*	Yes	Yes
	J_{hd}	1	1
	V_{rs} (kN)	20.8	19.4
Wind from the North	V_{fs1} (kN)	10.6	9.8
	R_1 (kN)	10.7	9.2
Wind from the South	V_{rs} (kN)	10.7	10.0
	R_1 (kN)	11.0	9.4

**Plywood: 12.5 mm Exterior @ 150mm + 9.5 mm Interior @ 200mm

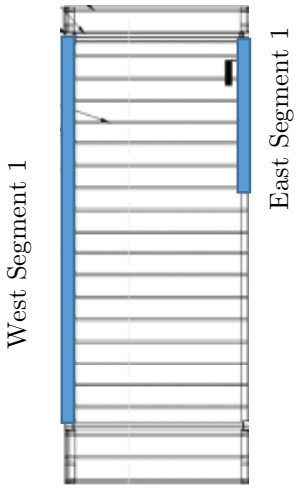
q_wall = .5 kPa

Design hold-down connections for 11.0 kN

Specify StrongTie HDU2-SDS2.5
5/8" anchor bolt
6-SDS 1/4"x2 1/2"
Tr = 12.9 kN

3.2.2 Side Module

- single story residential building framed with SPF lumber studs @ 400 mm
- plywood wall sheathing applied directly to studs on exterior
- dry service conditions
- factoured roof diaphragm reaction (20.3 kN)
- factored shear force (Vfs = 20.3 kN)



Notes:
Provide plywood on both sides.
Do not consider gypsum (only sheathing that is in contact with stud)
All shear walls will be
blocked

	West Segment 1	East Segment 1	
L_s (m)	8.21	3.23	
H (m)	3	3.2	
			**Plywood: 12.5 mm Exterior @ 150mm + 9.5 mm
V_{hd} (kN)	69.2	27.2	Interior @ 200mm
P_t (kN)	7.64	3.01	
P_j (kN)	13.18	5.33	q_wall = .5 kPa
Hold-down*	Yes	Yes	
J_{hd}	1	1	
V_{rs} (kN)	69.2	27.2	> Vfs = 20.3 -- ACCEPTABLE
V_{fs1} (kN)	21.3	21.3	
R_1 (kN)	-4.6	17.7	

Design hold-down connections for	17.7	kN

Specify: HDU4-SDS25.4
1-5/8" A307 threaded rod (to steel frame)
10-SDS 1/4"x2 1/2"
3" member depth (2-2x8)
Tr = 20.09 kN

4 Steel frame

See Appendix 3: Steel Calculations

5 Floor

5.1 Joists

See Appendix 4: Floor Joist Calculations

5.2 NBCC Vibration Criterion

Floor system:

- 3.10 m span
- 38×184 SPF No.1/No.2
- 19 mm subfloor sheathing thickness
- 400 mm joist spacing
- Subfloor sheathing field–glued to joists

Vibration-controlled span = KS_i

$$\ln K = A - B \ln \left[\frac{S_i}{S_{184}} \right] + G$$
$A = 0.30$ (WDM Table 11.22)
$B = 0.33$ (WDM Table 11.22)
$G = 0.10$ (WDM Table 11.23)

$$S_i = \sqrt[3]{\frac{48 \Delta E_s I}{P}} = \sqrt[3]{\frac{48 \times 2 \times 187 \times 10^9}{1000}} = 2618 \text{ mm}$$
$S_{184} = S_i = 2618$
$\frac{S_i}{S_{184}} = 1$

$$\ln K = 0.3 - 0.33 \ln(1) + 0.1 = 0.4$$
$$K = e^{0.4} = 1.49$$

$KS_i = 1.49 \times 2.618 = 3.90 \text{ m} > 3.10 \text{ m}$

Acceptable.

6 Foundation

6.1 Substructure Connection

See Appendix 5: Foundation Jack Data Sheet

Capacity		lbs	kN
	Pr	16000	71.1
	Vr EW	3203	14.2
	Vr NS	2273	10.1

6.2 Bearing loads

2'×2' 3-ply ¾" plywood foundation pads.
Load at 1.25D+1.5L+0.5S

	LOAD (KN)		LOAD (LBS)		BEARING PRESSURE (PSF)	
GRID	1	2	1	2	1	2
A	17.14	16.72	3853	3759	963	940
C	29.79	30.41	6697	6836	1674	1709
E	34.75	30.49	7812	6854	1953	1714
G	23.27	15.78	5231	3547	1308	887
H	23.54	25.76	5292	5791	1323	1448

	LOAD (KN)		LOAD (LBS)		BEARING PRESSURE (PSF)	
GRID	3	4	3	4	3	4
B	20.46	20.46	4600	4600	1150	1150
C	48.71	48.71	10950	10950	2738	2738
F	32.56	32.56	7320	7320	1830	1830
J	40.79	40.79	9170	9170	2292	2292
K	23.63	23.63	5312	5312	1328	1328

6.3 Uplift

ASCE 07 Wind load:

$$D_f = 355 \text{ kN}$$
$$FS = \frac{D_f}{W_f} > 2$$
$$W_f \leq \frac{355}{2} = 177.5 \text{ kN}$$

North-south direction: Maximum uplift will occur under a North wind and negative internal pressure.

$$A_C = 7.32 \text{ m}^2$$
$$A_{C'} = 7.32 \text{ m}^2$$
$$A_{S'} = 20.86 \text{ m}^2$$

Pressure on side modules roofs ($\alpha = 4.6°$)

$$p_C = -2.55 \text{ kPa}$$
$$p_{C'} = -2.98 \text{ kPa}$$
$$p_{S'} = -2.81 \text{ kPa}$$

Pressure on north-facing roof

$$p_{int} = -0.39 \text{ kPa}$$
$$p_{C_N} = p_{C'_N} = 0.6 - 0.39 = 0.21 \text{ kPa}$$
$$p_{S'_N} = 0.48 - 0.39 = 0.09 \text{ kpa}$$

$$\begin{aligned} W_f &= A_C(2p_{C_S} + p_{C_N}) + A_{C'}(2p_{C'_S} + p_{C'_N}) + A_{S'}(2p_{S'_S} + p_{S'_N}) \\ &= 7.32(2(-2.55) + 0.21) + 7.32(2(-2.98) + 0.09) + 20.86(2(-2.81) + 0.21) \\ &= 191.6 \text{ kN} < 177.5 \text{ kN} \end{aligned}$$

Therefore, provide anchorage with minimum pullout capacity of:

$$P = 191.6 - 177.5 = 14.1 \text{ kN}$$

6.4 Overturning

6.4.1 East-West Axis

$$W_T = 355 \text{ kN}$$
$$x = 3.66 + \frac{3.66}{2} = 5.49 \text{ m}$$
$$M_r = 0.9W_T x = 0.9(355 \text{ kN})(5.49 \text{ m}) = 1754 \text{ kN-m}$$

Wind shear for entire house:

$$\begin{aligned} V_w &= (8.96 \text{ m})(3.96 \text{ m})(0.87 + 1.06 \text{ kPa}) + (2.0 \text{ m})(3.96 \text{ m})(0.98 + 1.22 \text{ kPa}) \\ &= 86.0 \text{ kN} \end{aligned}$$
$$M_{fw} = 1.4V_w(H + H_{foundation})$$

$$\begin{aligned} H_{foundation} &= \text{base foundation height} + \text{max elevation change} \\ &= 14\text{"}+18\text{"} = 32\text{"} = 0.813 \text{ m} \end{aligned}$$

$$\therefore M_{fw} = 1.4(86.0 \text{ kN})(3.96 + 0.813 \text{ m}) = 575 \text{ kN-m}$$

$$\frac{M_r}{M_{fw}} = \frac{1754}{575} = 3.05 > 2 \quad \therefore \text{SDBC requirement met}$$

6.4.2 North-South Axis

$W_{side} = 117$ kN
$W_{core} = 121$ kN
$x_{side} = 3.69$ m
$x_{core} = 5.07$ m

$$M_r = 0.9(2W_{side}x_{side} + W_{core}x_{core}) = 0.9[2(117)(3.69) + 121(5.07)] = 1329 \text{ kN-m}$$

Wind shear for entire house:
$V_w = 30.31 \times 2 + 29.54 = 90.2$ kN
$M_{fw} = 1.4V_w(H + H_{foundation})$

$H_{foundation}$ = base foundation height + max elevation change
= 14+18 = 32 = 0.813 m

$\therefore M_{fw} = 1.4(90.2 \text{ kN})(3.96 + 0.813 \text{ m}) = 602.7$ kN-m

$$\frac{M_r}{M_{fw}} = \frac{1329}{602.7} = 2.20 > 2 \quad \therefore \text{SDBC requirement met}$$

6.5 Sliding

According to SDBC 2013, sliding must be resisted by a factor of 2.

- Load combination is 0.9D+1.0E (ASCE 7-10).
- Surface condition is wood on asphalt/concrete.

6.5.1 East-West Direction

Maximum shear, $V_{E(EW)} = 0.285W = 110.9\ kN$ due to seismic action in Irvine, CA.

Sliding resistance, $V_r = F_s = \mu N$

$\mu = 0.62$[1]
$N = 0.9W$
$V_r = \mu N = 0.62(0.9)W = 0.558W$

$$FS = \frac{V_r}{V_f} = \frac{0.558W}{0.285W} = 1.96 < 2$$

$\therefore$ Sliding action is not prevented with FS = 2

Therefore, provide anchorage with shear capacity of:

$$V_r' = 0.285W - \frac{0.558W}{2} = 0.006W = 2.334 \text{ kN}$$

6.5.2 North-South Direction

Maximum shear, $V_{E(EW)} = 0.153W = 54.4\ kN$ due to seismic action in Irvine, CA.

Sliding resistance, $V_r = F_s = \mu N$

$\mu = 0.62$
$N = 0.9W$
$V_r = \mu N = 0.62(0.9)W = 0.558W$

$$FS = \frac{V_r}{V_f} = \frac{0.558W}{0.153W} = 3.64 > 2$$

$\therefore$ Sliding action is prevented with FS = 2

[1] http://www.roymech.co.uk/Useful_Tables/Tribology/co_of_frict.htm

6.6 Ground Anchor Design

Solar Decathlon 2013 Anchoring System Design Parameters:

- Ground anchorage shall be 1" diameter steel stakes driven a minimum of 36" into the existing pavement section consisting of asphalt, macadam and underlying soil.
- Teams are responsible for providing their own anchors.
- Minimum strength steel should be A36 mild steel
- Assumed pullout design capacity will be 1,250 pounds
- Assumed shear design capacity will be 1,500 pounds
- The quantity and placement of anchors shall be such that the combination of Actual Pullout Load/1,250 + Actual Shear Load/1,500 shall be less than or equal to 1
- Either threaded or unthreaded rods are permissible.
- Anchors shall be solid - composition pipe is not permissible.
- Anchors shall be installed vertically - angled installation is not permissible.
- Rods will need to be greater than 36" in length to allow a minimum of 36" embedment. The length and connection method is to be determined by each team.
- Teams may choose a rod-end design (i.e. threaded, cotter-pin, etc.) to meet their design requirements.
- Anchors shall be spaced with a minimum distance of 2' between anchors.
- At the conclusion of the event, the stakes will need to be driven into the asphalt to a depth wherein the top of the anchor is at least 4" below the surface of the runway OR will need to be pulled out of the runway surface completely. Prior to being driven into the asphalt, teams may need to saw-cut the top of the anchor to minimize the amount of material to be embedded and remove end features to allow for driving the anchor beneath the surface of the asphalt

Anchor capacity

$P_r = 1250 \text{ lbs} = 5.56 \text{ kN}$
$V_r = 1500 \text{ lbs} = 6.67 \text{ kN}$

Check: $\frac{P_f}{P_r} + \frac{V_f}{V_r} \leq 1$

Uplift only:

$P_f = 14.1 \text{ kN}$
$n_{\text{min,P}} = \frac{P_f}{P_r} = \frac{14.1}{5.56} = 2.53$

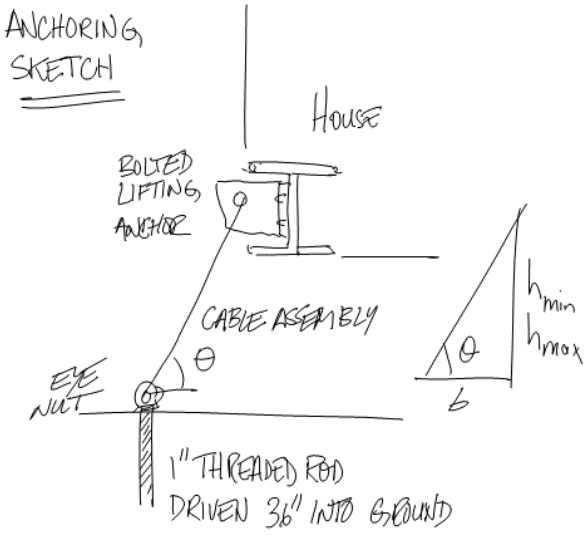
Therefore, minimum 3 anchors are needed to provide pure uplift resistance.

Sliding only in E-W direction

$V_f = 2.33 \text{ kN}$
$n_{\text{min,V}} = \frac{V_f}{V_r} = \frac{2.33}{6.67} = 0.35$

Therefore, at least 1 anchor is required to provide shear resistance.

6.6.1 Design Specifications



Location

- Anchors will be placed near the following grid intersections: C1, G1, C6 and G6
- Anchors will be placed approx. 16" from the marked grids C and G, outboard of the house structure on both sides.

Components

- Comply with SDBC requirements in addition to the below:
- Have maximum 1" threaded length above surface with cotter pin hole available. Provide sufficient matching washers to have base of eye nut contact ground surface.
- 1" galvanized eye nuts with 10'000 lb in-line working limit and 3000 lb limit at 45 degrees
- 3/16" galvanized aircraft cable (7x19) with min. 5/16" jaw-jaw turnbuckles and 3 3/16"wire rope clips per connection. Rope protection thimbles at all connections. All accessories to be hot-dipped galvanized.
- Rope clip spacing to be 6 times rope diameter or 1-1/8" for 3/16" rope.

Due to configuration, sliding in EW direction will only be taken by 2 anchors. Therefore, each anchor shall be designed for ½ the shear load and ¼ the pullout load.

$$P_f = \frac{14.1}{4} = 3.53 \text{ kN} = 800 \text{ lbs}$$
$$V_f = \frac{2.33}{2} = 1.17 \text{ kN} = 265 \text{ lbs}$$

Check

$$\frac{800}{1250} + \frac{265}{1500} = 0.817 < 1$$

Based on geometry

$b = 12$ in
$h_{\min} = 16$ in
$h_{\max} = 34$ in
$\theta_{\min} = 53°$
$\theta_{\max} = 71°$

At θ_{min},

$$V = T\cos 53^\circ = 0.6\ T$$
$$P = T\sin 53^\circ = 0.8\ T$$

To develop necessary V, T = 441 lbs
To develop necessary P, T = 1000 lbs

At θ_{max},

$$V = T\cos 71^\circ = 0.326\ T$$
$$P = T\sin 71^\circ = 0.945\ T$$

To develop necessary V, T = 814 lbs
To develop necessary P, T = 846 lbs

Therefore, design the cable to a minimum Tr = 1000 lbs.

3/16" 7x19 strand galvanized aircraft cable (GAC) has T_{ult} = 4200 lbs. The working limit is 1400 lbs using a standard FS of 3.

Use a 5/16" turnbuckle (double jaw type) for a 2200 lbs working limit.

Check: Lifting anchors have minimum 30.25 kN (6800 lbs) capacity.

7 Decking, Ramps and Handrail

7.1 Concept

Code	Dimension	Quantity	Location
D1	7'6"x6'	2	South Deck
D2	12'x6'	4	South Deck
D3	12'x8'	3	North Deck
R1	5'x10'	8	Ramp
R2	5'x6'	2	Ramp Transition
D4	5'x5'	2	Ramp Landing

7.2 Joists

Determine maximum span for 2x8 treated SPF joists at 16" O.C.

Dead Load:		**0.19 kPa**
	Cedar decking (1" / 25.4 mm)	0.10 kPa
	2x8 joists @ 16" O.C.	0.09 kpa
Live Load:		**4.80 kPa**
ULS:	**1.25D+1.5L**	**7.44 kPa**
SLS:	**1.0D+1.0L**	**4.99 kPa**

Wood Design Factors

K_D	STANDARD	1.0
K_H	CASE 1	1.0
K_S	WET, Mr	0.84
	WET, Vr	0.96
	WET, EsI	0.94
K_T	DRY, Mr & Vr	0.75
	DRY, EsI	0.9
	WET, Mr & Vr	0.85
	WET, EsI	0.95
K_{DRY}	Mr	0.75
	Vr	**0.75**
	EsI	0.9
K_{WET}	**Mr**	**0.714**
	Vr	0.816
	EsI	**0.893**

Bending

$M_r = K \times 2.73$ kN-m $= 0.714 \times 2.73 = 1.95$ kN-m
$w = 0.4 \times 7.44 = 2.98$ kN/m

$$l_{\max} = \sqrt{\frac{8M_r}{w}} = \sqrt{\frac{8(1.95)}{2.98}} = 2.29 \text{ m}$$

Shear

$V_r = K \times 7.55 \text{ kN} = 0.75 \times 7.55 = 5.66 \text{ kN}$
$w = 0.4 \times 7.44 = 2.98 \text{ kN/m}$
$l_{\max} = \frac{2V_r}{w} = \frac{2(5.66)}{2.98} = 3.81 \text{ m}$

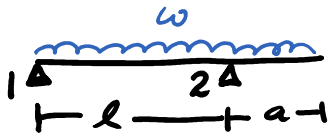
Deflection

$E_sI = K \times 187 = 0.893 \times 187 = 167 \text{ kN-m}^2$
$w = 0.4 \times 4.80 = 1.92 \text{ kN/m}$
$\Delta_{\max} = \frac{l}{360} = \frac{5wl^4}{384E_sI}$

$$l_{\max} = \sqrt[3]{\frac{384E_sI}{(360 \times 5)(w)}} = \sqrt[3]{\frac{384(167 \text{ kN-m}^2)}{(360)(5)(1.92 \text{ kN/m})}} = 2.64 \text{ m}$$

Therefore, deck joists can be designed for a maximum span of 2.29 m or 7'-4" at 16" O.C. spacing.

7.2.1 Joists With Cantilever



Dimensions l, a, and x determined by solving equation to minimize deflection of beam.

$L = l + a = 1.83 \text{ m}$
$l = 1.28 \text{ m}$
$a = 0.55 \text{ m}$

$w_f = 7.44 \times 0.4 = 2.98 \text{ kN/m}$
$w_s = 4.8 \times 0.4 = 1.92 \text{ kN/m}$

Under full distributed load:

$$V_{f1} = R_1 = \frac{w}{2l}(l^2 - a^2) = \frac{2.98}{2(1.28)}(1.28^2 - 0.55^2) = 1.56 \text{ kN}$$
$$V_{f2} = R_2 = \frac{w}{2l}(l + a)^2 = \frac{2.98}{2(1.28)}(1.28 + 0.55)^2 = 3.90 \text{ kN}$$

$V_r = 5.66$ kN

Acceptable.

$$M_{f1} = \frac{w}{8l^2}(l + a)^2(l - a)^2 = \frac{2.98}{8(1.28)^2}(1.82)^2(1.28 - 0.55)^2 = 0.406 \text{ kN-m}$$
$$M_{f2} = \frac{wa^2}{2} = \frac{2.98(0.55)^2}{2} = 0.451 \text{ kN-m}$$

$M_r = 1.95$ kN-m

Accceptable.

$x = 0.575$ m

$$\Delta_{span} = \frac{wx}{24EIl}(l^4 - 2l^2x^2 + lx^3 - 2a^2l^2 + 2a^2x^2)$$
$$= \frac{(1.92 \text{ kN/m})(0.575 \text{ m})}{24(167 \text{ kN-m}^2)(1.28 \text{ m})}[(1.28)^4 - 2(1.28^2)(0.575^2) + (1.28)(0.575^3) - 2(0.55^2)(1.28^2) + 2(0.55^2)(0.575^2)]$$
$$= 0.227 \text{ mm}$$

$$\Delta_{max} = \frac{1230}{360} = 3.42 \text{ mm}$$

Acceptable.

$$\Delta_{overhang} = \frac{wa}{24EI}(4a^2l - l^3 + 3a^3)$$
$$= \frac{(1.92)(0.55)}{24(167)}[(4(0.55^2)(1.28) - (1.28^3) + 3(0.55^3)]$$
$$= 0.013 \text{ mm}$$

$$\Delta_{max} = \frac{550}{180} = 3.06 \text{ mm}$$

Acceptable.

Load on cantilever only:

$$\Delta_{overhang} = \frac{wa^3}{24EI}(4l + 3a) = \frac{(1.92)(0.55)}{24(167)}(4 \times 1.28 + 3 \times 0.55) = 1.78 \text{ mm}$$
$$\Delta_{main} = 0.03208 \times \frac{wa^2l^2}{EI} = 0.03208\left(\frac{(1.92)(0.55)^2(1.28)^2}{167}\right) = 0.18 \text{ mm}$$
$$V_{f2} = \frac{wa}{2l}(2l + a) = \frac{(2.98)(0.55)}{2(1.28)}(2(1.28) + 0.55) = 2.0 \text{ kN}$$

Load on main span only:

$$\Delta_{overhang} = \frac{5wl^4}{384EI} = \frac{5(1.92)(1.28)^4}{384EI} = 0.40 \text{ mm}$$
$$M_f = \frac{wl^2}{8} = \frac{(2.98)(1.28)^2}{8} = 0.61 \text{ kN-m}$$
$$V_{f1} = \frac{wl}{2} = \frac{(2.98)(1.28)}{2} = 1.91 \text{ kN}$$

Load Summary:

Joist	**Full Load**	**Cantilever Only**	**Main Spain Only**
Vf1	1.56 kN	-	1.91 kN
Vf2	3.90 kN	2.0 kN	1.91 kN
Mf, main	0.406 kN-m	-	0.61 kN-m
Mf, cantilever	0.451 kN-m	0.451 kN-m	-
Δ, main	0.227 mm	0.18 mm	0.40 mm
Δ, cantilever	0.013 mm	1.78 mm	-

Connection of joist at R1. Shear only

$V_r > V_{f2} = 1.91$ kN

Strongtie A35

$V_r = 3.0$ kN

Uses 12-SDS#9x1½”

Support at R2: Bearing only. Joist bears onto 2-ply 2x beam.

Check bearing for 38 mm member with 76 mm bearing length (built up 2x beam):

$Q_r > V_{f2} = 3.90$ kN

$Q_r = q_r L_b$

$L_b = 76$ mm

$q_r = 0.75[0.161] = 0.121$ kN/mm

$Q_r = 0.121(76) = 9.17$ kN

$Q_r > V_{f2}$

Acceptable.

At 1.83 m span,

$$V_f = \frac{(7.44 \text{ kPa})(0.4 \text{ m})(1.83 \text{ m})}{2} = 2.72 \text{ kN}$$

Strongtie A35 acceptable in this position as well.

7.3 Beams

Check capacity of supporting beams. Determine maximum column spacing.

Beam 1A:

Consider Beam 1 as single 38x184 for half TW (half of 1.24 m)

$M_r = 1.95$ kN-m

$V_r = 5.66$ kN

$E_s I = 167$ kN-m^2

$Q_r = q_r l_b = (0.75 \times 1.61 \text{ kN/mm})(89 \text{ mm}) = 10.75 \text{ kN} < V_r$

For continuous beam with 3 spans:

Moment:

$$w = 7.44\left(\frac{1.24}{2}\right) = 4.61 \text{ kN/m}$$

$$M_{max} = 0.08wl$$

$$l = \frac{M_r}{0.08w} = \frac{1.95}{0.08(4.61)} = 5.28 \text{ m}$$

Shear:

$R_{max} = V_f$ or $Q_f = 1.1w$

$$l = \frac{5.66 \text{ kN}}{1.1} = 5.15 \text{ m}$$

Deflection:

$$\Delta_{max} = \frac{l}{360} = \frac{0.0069 w_s l^4}{EI}$$

$$w_s = 4.8\left(\frac{1.24}{2}\right) = 2.98$$

$$l = \sqrt[3]{\frac{167}{0.0069(360)(2.98)}} = 2.82 \text{ m}$$

Space supports at 2.82 m maximum.

Beam 2A:

Consider Beam 2 as 2-ply 38x184 for TW of 1.21 m

$M_r = 0.714 \times 6.01 = 4.29$ kN-m
$V_r = 0.75 \times 16.6 = 12.45$ kN
$E_s I = 0.893 \times 375 = 334$ kN-m^2
$Q_r = q_r l_b = (0.75 \times 2 \times 1.61 \text{ kN/mm})(89 \text{ mm}) = 21.5 \text{ kN} < V_r$

For continuous beam with 3 spans:

Moment:

$w = 7.44(1.21) = 9.00$ kN/m
$M_{max} = 0.08wl$
$$l = \frac{M_r}{0.08w} = \frac{4.29}{0.08(9.00)} = 5.95 \text{ m}$$

Shear:

$R_{max} = V_f$ or $Q_f = 1.1w$
$$l = \frac{12.45 \text{ kN}}{1.1} = 11.3 \text{ m}$$

Deflection:

$$\Delta_{max} = \frac{l}{360} = \frac{0.0069 w_s l^4}{EI}$$
$w_s = 4.8(1.21) = 5.81$
$$l = \sqrt[3]{\frac{334}{0.0069(360)(5.81)}} = 2.85 \text{ m}$$

Space supports at 2.85 m maximum. Check capacity of columns to support this spacing.

7.4 Post/Column

89x89 Post connected to 2-38x184 SPF joists.

$L_{min} = 425.5$ mm$_{max} = 882.65$ mm

7.4.1 Post Capacity

Note that post is symmetrical, therefore analysis is identical in both directions. Assumptions are wet service, preservative treated and incised. Standard term loads.

$P_r = \phi F_c A \; K_{Zc} K_C$
$\phi F_c = 5.94$ [WDM P.103]
$A = 89^2 = 7921$ mm^2
$\frac{F_c}{E'} = 36.5 * 10^{-6}$ [WDM P.103]
$K_{Zc} = 6.3(89 \times 882.65)^{-0.13} = 1.46 > 1.3 \rightarrow K_{Zc} = 1.3$
$$K_C = \left[1.0 + \frac{F_c}{E'} K_{Zc} C_c^3\right]^{-1} = [1.0 + (36.5 * 10^{-6})(1.3)(19.84)^3]^{-1} = 0.730$$
$$C_c = \frac{K_e L}{b} = \frac{(2.0)(882.65)}{89} = 19.84$$

$P_r = (5.94)(7921)(1.3)(0.73) = 44.65$ kN

7.4.2 Bearing

$Q_r = q_r L_b$
$L_b = 89$ mm

Bearing given for 38 mm member. Multiply by 2 for built up member.

$q_r = 0.75[2 \times 0.161] = 0.2415$ kN/mm
$Q_r = 0.2415(89) = 21.5$ kN

Thus bearing governs over compression of post.

7.4.3 Maximum tributary area

Based on the critical bearing capacity, the maximum tributary area is:

$$TA = \frac{Q_r}{q_{ULS}} = \frac{21.5 \text{ kN}}{8.05 \text{ kPa}} = 2.67 \text{ m}^2 = 28.7 \text{ ft}^2$$

Fixed TW

For Beam 1

$TW_{B1} = 4$'-0 7/8" $= 1.24$ m

For Beam 2

$TW_{B2} = 3$'-11 5/8" $= 1.21$ m

7.4.4 Foundation bearing pressure

Pad size for 3000 psf bearing pressure at the critical load:

$P = 21.5$ kN $= 4835$ lbs
$A = \frac{4835}{3000} = 1.61$ SF
$d = \sqrt{A} = 15.25$ in.

Minimum pad size of 16x16, 2-ply 3/4" plywood.

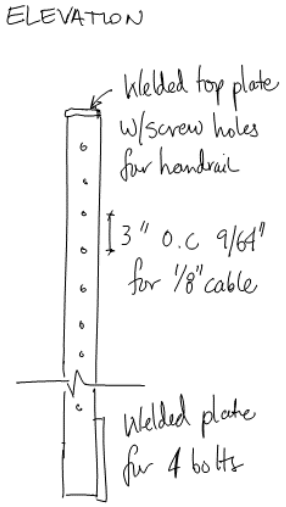
7.5 Deck Module Design Guidelines

	Maximum	
Joist Spacing	0.400 m	1'-4"
Joist Span, simple	2.64 m	7'-4"
Beam Span	2.82 m	9'-4"
Posts Spacing	2.82 m	9'-4"

7.6 Railing

Per IBC 1607.8.1.1, railing needs to support an applied force of 890 N at the top rail.

Steel bar with 9/64" holes @ 3" O.C. for 1/8" stainless 1x9 aircraft cable



$V_s = 0.89$ kN
$V_f = 1.5(0.89) = 1.34$ kN
$e = 36 + 1 + 7.25/2 = 40.625$ in $= 1031$ mm
$M_f = 1.031(1.34) = 1.38$ kN-m
$M_s = 1.031(0.89) = 0.92$ kN

$\phi = 0.9$
$F_y = 300$ MPa
$E = 200 * 10^3$ MPa

$M_f < M_r = \phi S F_y$
$V_f < V_r = \phi A F_y$
$\Delta_{\max} = \dfrac{L}{120} = \dfrac{PL^3}{3EI}$

$$S_{\text{req}} = \frac{M_f}{\phi F_y} = \frac{1.38 * 10^3}{0.9(300)} = 5.117 * 10^3 \text{ mm}^3$$
$$A_{\text{req}} = \frac{V_f}{\phi F_y} = \frac{1.34 * 10^3}{0.9(300)} = 15.039 \text{ mm}^2$$
$$I_{\text{req}} = \frac{120PL^2}{3E} = \frac{120(0.89 * 10^3)(1031)}{3(200 * 10^3)} = 189.2 * 10^3 \text{ mm}^4$$

For various d (bar depth) determine the required bar thickness:

$$t_A = \frac{A_{\text{req}}}{d} \qquad t_S = \frac{6S_{\text{req}}}{d^2} \qquad t_I = \frac{3I_{\text{req}}}{d^3}$$

d	51 mm (2")	64 mm (2.5")	76 mm (3")
t_S	11.9 mm	7.61 mm	5.29 mm
t_A	0.30 mm	0.24 mm	0.20 mm
t_I	17.4 mm	8.87 mm	5.13 mm

Choose 64x9mm bar size (or 2.5"x3/8")

7.6.1 Handrail Connection

Handrail 2x4 Cedar mounted on wide face to top of post. Vr from steel sideplate (minimum 4.76 mm) and 18 mm penetration into lumber (Northern species)

$V_f = 1.34$ kN
$V_r = 0.827$ kN

Provide 4 screws for $V_r = 3.31$ kN to prevent twisting of the handrail

7.6.2 Base Connection

Connection compliance with Strongtie Technical Bulletin T-GRDRLPST10 3/10 “Code-Compliant Guardrail Post Connections” to meet IRC 2009. Expires June 30, 2013.

Use DTT2Z hold-down on bolt through rim joist.

7.7 Ramp

7.7.1 2x8 Joist with Notch

From 7.1, 2x8 joists can be designed for a maximum span of 2.29 m or 7’-4” at 16” O.C. spacing.

Check:

Shear with Notch

$V_r = K \times 7.55 \text{ kN} = 0.75 \times 7.55 = 5.66 \text{ kN}$

$\frac{A_n}{A} = \frac{(38)(184 - 7.25)}{(38)(184)} = 0.96$

$V_{r,notch} = V_r \times \frac{A_n}{A} = 5.66 \times 0.96 = 5.43 \text{ kN}$

Notch

$e = 89 \text{ mm}$

$d_n = 7.25 \text{ mm}$

$d = 184 \text{ mm}$

$\alpha = 1 - \frac{d_n}{d} = 1 - \frac{7.25}{184} = 0.96$

$\eta = \frac{e}{d} = \frac{89}{184} = 0.48$

$$K_N = \left(0.006d\left(1.6\left(\frac{1}{\alpha} - 1\right) + \eta^2\left(\frac{1}{\alpha^3} - 1\right)\right)\right)^{-0.5}$$

$$= \left(0.006(184)\left(1.6\left(\frac{1}{0.96} - 1\right) + (0.48)^2\left(\frac{1}{(0.96)^3} - 1\right)\right)\right)^{-0.5}$$

$= 3.06$

$F_f = f_f(K_D K_H K_{Sf} K_T)$

Where:

$f_f = 0.5$ (specified notch shear resistance for sawn lumber)

$K_D = 1.0$ (standard duration)

$K_H = 1.0$ (case I system)

$K_{Sf} = 0.7$ (wet service)

$K_T = 0.85$ (wet, treated, incised)

$F_f = 0.5(0.70)(0.85) = 0.2975 \text{ MPa}$

$F_r = \phi F_f A K_N$

Where:

$\phi = 0.9$

$A = 38 \times 184 = 6992 \text{ mm}^2$

$K_N = 3.06$

$F_r = 0.9(0.2975 \text{ MPa})(6992 \text{ mm}^2)(3.06) = 6.09 \text{ kN}$

Shear strength is more critical than notch resistance.

Updated maximum span due to shear resistance: Bending and deflection maximum spans remain same as Section 7.2.

$$l_{\text{max, M}} = \sqrt{\frac{8M_r}{w}} = \sqrt{\frac{8(1.95)}{2.98}} = 2.29 \text{ m}$$

$$l_{\text{max, V}} = \frac{2V_r}{w} = \frac{2(5.43)}{2.98} = 3.64 \text{ m}$$

$$l_{\text{max, }\Delta} = \sqrt[3]{\frac{384E_sI}{(360 \times 5)(w)}} = \sqrt[3]{\frac{384(167 \text{ kN-m}^2)}{(360)(5)(1.92 \text{ kN/m})}} = 2.64 \text{ m}$$

Therefore, span limitation is the same as for non-notched 2x8 joists at 16" O.C.

Appendix 1: Load Summary

Calculation Cover Sheet

Customer: Alberta Solar Decathlon
Project Title: Borealis Solar House
Calculation Title: Structural Loads
Elec File Location:
Project File Location:

Proj. No.:
Calc No.:
Phase/CTR:

Calculation Objective

This spreadsheet is intended for calculating load on steel frame of Solar Decathlon house for 2013.
Design for placement in Irvine, California and Calgary, Alberta
Engineering Check is included but not limited to Wind Load, Snow Load, Seismic effects,

Calculation Method

Ultimate Limit State Design Method

Assumptions

Software Used

Title	Version	Validation (Y / N / N/A)
Microsoft Excel	*2010*	*Y*
S-Frame	*10*	*y*

References

1. National Building Code of Canada **(NBCC)** 2010
2. International Building Code **(IBC)** 2012
3. America Society of Civil Engineers **(ASCE)**
4. Canadian Institute of Steel Construction **(CISC 10th)**

Conclusions

Rev	Date	Description	By	Checked	Approved
0	4/5/2013	Issued for Information	Omid	Adam	

Calculation Sheet

Customer:	Alberta Solar Decathlon	**Proj. No.:**	
Project Title:	Borealis Solar House	**Calc No.:**	
Calculation Title:	Minimum Load Requirement Based on (IBC and ASCE)	**Phase/CTR:**	
Elec File Location:			

Rev	Date	By		Checked		Rev	Date	By	Checked	Rev	Date	By	Checked
0	4/5/2013	Omid	Moghadam	Adam	Cripps	8	3/3/2013	APC					

Dead Load (DL)

Roof (incl. PV panels, ceiling)		1.3 kPa
Walls		
Exterior, wood		0.5 kPa
Exterior, aluminum		0.7 kPa
Interior		0.3 kPa
Windows		0.7 kPa
Floor (incl. wood or vinyl flooring)		0.6 kPa
Self weight of Structure Steel member		

Live Load (LL)

Live load applied to floor	Specified in Solar Decathlon 2013 building code	2.4 kPa
Live Load (applied to roof)		1.0 kPa

Snow Loads (S)

$p_f = 0.7\, I_s\, [C_e C_t\, p_g\,]$ ASCE 7.3.4

Importance Factor (I_s)	1.0
Ground Snow Load (p_g)	1 kPa
Wind exposure factor (C_e)	1.0
Thermal factor (C_t)	1.0

Rain Load	ASCE 7.10	0.24 kPa
Calculated Snow Loads (S)		0.94 kPa
Minimum Snow Load (p_m)	ASCE 7.3.4	1 kPa

Calculation Sheet

Customer:	Alberta Solar Decathlon	**Proj. No.:**	
Project Title:	Borealis Solar House	**Calc No.:**	
Calculation Title:	Minimum Load Requirement Based on (IBC and ASCE)	**Phase/CTR:**	
Elec File Location:			

Rev	Date	By	Checked	Rev	Date	By	Checked	Rev	Date	By	Checked
0	4/5/2013	Omid Moghadam	Adam Cripps	8	3/3/2013	APC					

Wind Load (W)

$q_z = 0.613\, k_z k_{zt} k_d v^2$

Importance Factor (I_w)			1.0
Wind directionality factor (K_d)	ASCE 26.6		0.85
Topographic Factor (K_{zt})	ASCE 26.8.2		1.0
Gust effect Factor (G)	ASCE 26.9.1		0.85
Internal pressure (GC_{pi})	ASCE Table26.11-1	±	0.55
Velocity pressure exposure (k_z)	Table 27.3-1and Table 26.9-1 (alpha=9.5 ,Zg=274.32)		1.10
Velocity pressure exposure (k_h)			0.85
Basic wind speed	ASCE Fig 26.6-1A		49 m/s
Velocity pressure (q_z)			1.4 kPa
Velocity pressure (q_h)			1.1 kPa

Low-rise Walls & Roofs

$p = q_h[GC_{pf} - GC_{pi}]$

Wind pressure for low rise building (ASCE 28.4.1)

Load Case A

1	ASCE Fig 28.4-1	0.4	-0.22 kPa	0.9 kPa
2		-0.69	-1.21 kPa	0.0 kPa
3		-0.37	-0.92 kPa	0.3 kPa
4		-0.29	-0.85 kPa	0.3 kPa
1E		0.61	-0.03 kPa	1.1 kPa
2E		-1.07	-1.55 kPa	-0.4 kPa
3E		-0.53	-1.06 kPa	0.1 kPa
4E		-0.43	-0.97 kPa	0.2 kPa

Load Case B

1	-0.45	-0.99 kPa	0.2 kPa
2	-0.69	-1.21 kPa	0.0 kPa
3	-0.37	-0.92 kPa	0.3 kPa
4	-0.45	-0.99 kPa	0.2 kPa
5	0.4	-0.22 kPa	0.9 kPa
6	-0.29	-0.85 kPa	0.3 kPa
1E	-0.48	-1.02 kPa	0.2 kPa
2E	-1.07	-1.55 kPa	-0.4 kPa
3E	-0.53	-1.06 kPa	0.1 kPa
4E	-0.48	-1.02 kPa	0.2 kPa
5E	0.61	-0.03 kPa	1.1 kPa
6E	-0.43	-0.97 kPa	0.2 kPa

Directional procedure

ASCE 27.2-1 $p = qGC_p - q_i GC_{pi}$ ASCE 27.4.1

Walls External pressure coefficient C_p

Windward wall pressrue	0.8	0.94 kPa
Side walls	-0.7	-0.74 kPa
Leeward wall pressrue	-0.3	-0.32 kPa

Roof External pressure coefficient C_p

0 to h/2	0.9	0.96 kPa
h/2 to h	0.9	0.96 kPa
h to 2h	0.5	0.53 kPa
> 2h	0.3	0.32 kPa

Calculation Sheet

Customer:	Alberta Solar Decathlon	**Proj. No.:**	
Project Title:	Borealis Solar House	**Calc No.:**	
Calculation Title:	Minimum Load Requirement Based on (IBC and ASCE)	**Phase/CTR:**	
Elec File Location:			

Rev	Date	By		Checked		Rev	Date	By	Checked	Rev	Date	By	Checked
0	4/5/2013	Omid	Moghadam	Adam	Cripps	8	3/3/2013	APC					

Earthquake Load (E) Site class D and category II

Importance Factor (I_E)	*ASCE 7 (p.48)*	1.0
Spectral accelerations for short period (S_s)		1.5
Spectral accelerations at 1-second (S_1)		0.6
Site coefficient (F_a)		1.0
Site coefficient (F_V)		1.5
Maximum spectral acceleration for short term (S_{MS})		1.5
Maximum spectral acceleration for 1-second (S_{M1})		0.8
Design spectral acceleration for short period (S_{DS})	*ASCE (Eqs. 11.4-1 and 11.4-3)*	1.00
Design spectral acceleration for short period (S_{D1})	*ASCE (Eqs. 11.4-2 and 11.4-4)*	0.6
Long-Period Transition (T_L)	*ASCE Figure (22-12)*	8s
(Ts)		0.6
(T_0)		0.1

Seismic Base Shear

Effective seismic weight (w) (core)	*As of3/3/2013*	121 kN
Effective seismic weight (w) (side)	*As of 3/3/2013*	117 kN
Structural height (hn)	*Includes max. jack height of 26"/0.66m*	4.6
Approximate Fundamental Period (T_a)	*ASCE 12.8.2.1 (p.90)*	0.15
Fundamental period of the Structure (T)	*Cu = 1.4 for SD1 > 0.4 (Table 12.8-1),*	0.21

Light frame walls with shear panels of all other materials

Response modification coefficient (R)	*ASCE Table 12.2-1*	6.5
Overstrength factor (Ω_0)		2.0
Deflection amplification factor (C_d)		2.0
Seismic Response Coefficient (C_s)		0.15
Minimum (C_s)		0.04
Maximum (C_s)	*ASCE 12.8-3*	0.40
Seismic Base shear V (Core)		18.57 kN
Seismic Base shear V (Side)		17.95 kN

Steel ordinary moment frames

Response modification coefficient (R)	*ASCE Table 12.2-1*	3.5		
Overstrength factor (Ω_0)		2.5		
Deflection amplification factor (C_d)		3.0		
Seismic Response Coefficient (C_s)		0.28		
Minimum (C_s)		0.04		
Maximum (C_s)	*ASCE 12.8-3*	0.74		
Seismic Base shear V (Core)		34.48 kN		
Seismic Base shear V (Side)		33.34 kN	16.669714	8.334857143

Horizontal Seismic Load Effect

Redundancy Factor (ρ)	*ACSE 07-10 12.3.4.2*	1.3
Effects of Horizontal seismic forces (E_h)	*Maximum for EW Axis Side Module*	23.34 kN

Vertical Seismic Load Effect

Effects of Vertical seismic forces (E_v)	*Ev = 0.25S_{DS} D*	23.34 kN

Calculation Sheet

Customer:	Alberta Solar Decathlon	**Proj. No.:**	
Project Title:	Borealis Solar House	**Calc No.:**	
Calculation Title:	Minimum Load Requirement Based on (IBC and ASCE)	**Phase/CTR:**	
Elec File Location:			

Rev	Date	By		Checked		Rev	Date	By	Checked	Rev	Date	By	Checked
0	4/5/2013	Omid	Moghadam	Adam	Cripps	8	3/3/2013	APC					

Factored Load Combination

Dead load	1.25	Live Load	2.4	Snow load	1	Earthquake		Wind load	1.55	Rain Load	0.24
		Roof live	1								

1)	1.4 D			1.8 kPa
2)	1.2 D +1.6 L+ 0.5 Lr			5.8 kPa
3)	1.2 D +1.6 L+ 0.5 S			5.8 kPa
4)	1.2 D +1.6 L+ 0.5 R			5.5 kPa
5)	1.2 D +1.6 Lr+ f_1 L	where f1 is (1 or 0.5)	IBC 1605.2	4.3 kPa
6)	1.2 D +1.6 Lr+ 0.5 W			3.9 kPa
7)	1.2 D +1.6 S+ f_1 L			4.3 kPa
8)	1.2 D +1.6 S+ 0.5 W			3.9 kPa
9)	1.2 D +1.6 R+ f_1 L			3.1 kPa
10)	1.2 D +1.6 R+ 0.5 W			2.7 kPa
11)	1.2 D+1.0W+ f_1L+0.5 Lr			4.8 kPa
12)	1.2 D+1.0W+ f_1L+0.5 S			4.8 kPa
13)	1.2 D+1.0W+ f_1L+0.5 R			4.4 kPa
14)	1.2 D +1.0 E+f_1 L + f_2 S			
15)	1.2 D+1.0E+ 1.0L+ 0.2S			
16)	1.0 D + (0.6W or 0.7E)			
17)	1.0 D + 0.75L + 0.75(0.6W) + 0.75(Lr or S or R)			
18)	1.0 D + 0.75L + 0.75(0.7E) + 0.75S			

Serviceability Load:

1)

2)

Defelection Limits

Roof Members (L/360)		IBC Table (1604.3)
Floor Members (L/360)	L/240 (D+L)	
Frame Buildings (L/120)		

Sliding and over turning moment

Calculation Sheet

Customer: Alberta Solar Decathlon
Project Title:
Calculation Title: Minimum Load requirement base on (NBCC)
Elec File Location:

Proj. No.: 0
Calc No.: 0
Phase/CTR:

Rev	Date	By		Checked		Rev	Date	By	Checked	Rev	Date	By	Checked
0	4/5/2013	Omid	Moghadam										

Dead Load (DL)

Roofing and Insulation

Self weight of the roof including insulation	1.2 kPa
Self weight of Structure Steel member	Calculated by S-Frame

Live Load (LL)

Live load applied to floor	2.4 kPa

Live Load (applied to roof) 1.0 kPa

Snow Loads (S)

$$S = I_s\,[S_s(C_b C_w C_s C_a) + S_r\,]$$

Importance Factor (I_s)	1.0
Ground Snow Load 1-in-50 years (S_s)	1.4 kPa
Raind Load (S_r)	0.1 kPa
Wind exposure factor (C_w)	1.0
Slope factor (C_s)	1.0
Basic roof snow load factor (C_b)	0.8
Shape factor (C_a)	1.0

Calculated Snow Loads (S) 1.22 kPa

NBCC2010 9.4.2.2 S=C_b*S_S+S_r

C_b = 0.45 (width < 4.3)
S 0.73 kPa

#REF!
#REF!
#REF!
#REF!

Calculation Sheet

Customer:	Alberta Solar Decathlon	**Proj. No.:**	0
Project Title:		**Calc No.:**	0
Calculation Title:	Minimum Load requirement base on (NBCC)	**Phase/CTR:**	
Elec File Location:			

Rev	Date	By	Checked	Rev	Date	By	Checked	Rev	Date	By	Checked
0	4/5/2013	Omid Moghadam									

Wind Load (W)

$$F_n = I_w C_p C_g C_e q$$

Importance Factor (I_w)		1.0
Exposure Factor (Ce)	Open terrain. Ce >= 0.9. Ce = (h/10)^0.2 = 0.86	0.9
Gust Effect Factor (Cg)		2.0
Wind Pressure (q)		0.48 kPa

Walls Pressure-gust coefficients ($C_p C_g$)

	Pressure	Suction
EW	1.4	-1.55
EW, End Zone	1.65	-1.9
N	1.6	-1.6
N, End Zone	1.65	-1.9
S	1.55	-1.6
S, End Zone	1.65	-1.9

Net Wind load on the exterior Walls

	External pressure		Net pressure	
EW	0.61 kPa	-0.67 kPa	0.87 kPa	-1.06 kPa
EW, End Zone	0.72 kPa	-0.83 kPa	0.98 kPa	-1.22 kPa
N	0.70 kPa	-0.70 kPa	0.96 kPa	-1.09 kPa
N, End Zone	0.72 kPa	-0.83 kPa	0.98 kPa	-1.22 kPa
S	0.67 kPa	-0.70 kPa	0.93 kPa	-1.09 kPa
S, End Zone	0.72 kPa	-0.83 kPa	0.98 kPa	-1.22 kPa

Wind Shear (Core Module)

					Pressure	Suction
East or West Faces	A_w	25.6 m²	A_e	7.6 m²	**29.64 kN**	**-36.31 kN**
North Face	A_w	5.7 m²	A_e	6.9 m²	**12.22 kN**	**-14.62 kN**
South Face	A_w	7.1 m²	A_e	8.5 m²	**14.92 kN**	**-18.09 kN**

Net Wind Shear

East or West Wind	**65.95 kN**
North Wind	**30.31 kN**
South Wind	**29.54 kN**

Roof Pressure-gust coefficients ($C_p C_g$)

C	NBCC (Fig I-13)	-2.5	0.4
S'		-2.8	0.25
C'		-3	0.4

Wind load on the Roof

C	includes internal pressure	-2.55 kPa	0.60 kPa
S'	includes internal pressure	-2.81 kPa	0.48 kPa
C'	includes internal pressure	-2.98 kPa	0.60 kPa

Internal Wind Pressure

Importance Factor (I_w)		1.0	
Exposure Factor (Ce)		0.9	
Gust Effect Factor (Cgi)		2.0	
Internal pressure (C_{pi})	category 2 (Commentary I, I-22)	-0.45	0.30
Wind Pressure (q)		0.48 kPa	

Internal pressure (P_i)

	-0.39 kPa	0.26 kPa

Calculation Sheet

Customer: Alberta Solar Decathlon
Project Title:
Calculation Title: Minimum Load requirement base on (NBCC)
Elec File Location:

Proj. No.: 0
Calc No.: 0
Phase/CTR:

Rev	Date	By		Checked		Rev	Date	By	Checked	Rev	Date	By	Checked
0	4/5/2013	Omid	Moghadam										

Calculation Sheet

Customer:	Alberta Solar Decathlon	**Proj. No.:**	0
Project Title:		**Calc No.:**	0
Calculation Title:	Minimum Load requirement base on (NBCC)	**Phase/CTR:**	
Elec File Location:			

Rev	Date	By	Checked	Rev	Date	By	Checked	Rev	Date	By	Checked
0	4/5/2013	Omid Moghadam									

Earthquake Load (E)

Importance Factor (I_E)			1.0
Soil Undrained Shear Strength (S_u)			
Spectral accelerations Sa(0.2)			0.15
Spectral accelerations Sa(0.5)			0.08
Spectral accelerations Sa(1.0)			0.04
Spectral accelerations Sa(2.0)			0.02
Peak ground acceleration (PGA)			0.09
Acceleration-based site coefficient (fa)			1.3
Velocity-based site coefficient (fv)			1.4
Fundamental lateral period	$T_a = 0.05h_n$^0.75		0.14
	$T_a = 0.085h_n$^0.75		0.24

Steel Moment Frames

Ductility-Related Force factors (Rd)			1.5
Overstrength-Related Force factors (R_0)			1.3
Effective seismic weight (w)			102 kN
Higher Mode Factor (Mv)		Table 4.18.11 (NBCC)	1.0
5% spectral response acceleration S_a(T)			0.195 g
Shear Base (V)	$v = \frac{S(T_a) \times m_v \times I_e \times w}{R_d \times R_0}$		10.20 kN
Minimum shear base (V_{min})	$v_{min} = \frac{S(2) \times m_v \times I_e \times w}{2}$		1.20 kN
Maximum shear base (V_{max})	$v_{max} = \frac{2}{3}\frac{S(0.2) \times I_e \times w}{R_d \times R_0}$	NBCC 4.1.8.11 (2c)	5.23 kN Govern

Shear walls: wood-based and gypsum panels in combination

Ductility-Related Force factors (Rd)			2.0
Overstrength-Related Force factors (R_0)			1.7
Effective seismic weight (w)			121 kN
Higher Mode Factor (Mv)		Table 4.18.11 (NBCC)	1.0
5% spectral response acceleration S_a(T)			0.195 g
Shear Base (V)			6.94 kN
Minimum shear base (V_{min})			0.82 kN
Maximum shear base (V_{max})		NBCC 4.1.8.11 (2c)	3.56 kN Govern

Appendix 2: Roof Joist Calculations

Loads:

DL = 1.25 kPa
LL = 1.0 kPa
SL = 1.22 kPa
WL = -3.7 kPa & 0.672 kPa

Critical load combinations

ULS: $1.25D + 1.5S + 0.4W = 1.25(1.25) + 1.5(1.22) + 0.4(0.672) = 3.66$ kPa
$0.9D + 1.4W = 0.9(1.25) + 1.4(-3.7) = -4.06$ kPa

SLS: $D + I_S S + I_W(0.4)W = 1.25 + 0.9(1.22) + 0.75(0.4)(0.672) = 2.55$ kPa
$D + I_W W = 1.25 + (0.75)(-3.7) = -1.525$ kPa

Dimensions:

Centre module: Span = 3.36 m

Side module: Span = 3.325 m

Joists:

Check 2×8 SPF No.1/2 joists @ 400 mm (Case 2)

$M_r = 3.83$ kN·m
$V_r = 10.6$ kN
$E_S I = 187$ N·mm²×10⁹

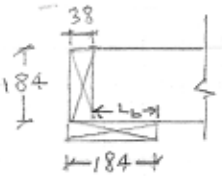
Load case 1: 1.25D + 1.5S + 0.4W
Standard term ($K_D = 1$)
Laterally supported

$W_f = 0.4(3.66) = 1.464$ kN/m
$W = 0.4(2.55) = 1.02$ kN/m

$M_f = w_f \ell^2/8 = (1.464)(3.36)^2/8 = 2.07$ kN·m $< M_r = 3.83$ ✓
$V_f = w_f \ell/2 = (1.464)(3.36)/2 = 2.46$ kN $< V_r = 10.6$ ✓

$E_S I = \frac{5 w \ell^4}{384 \Delta} = \frac{5(1.02)(3.36)^4}{384(3.36/0.360)} = 181.4$ N·mm² ×10⁹ $< E_S I = 187$ ✓

Bearing:



$L_b = 184 - 38 = 146$ mm
$q_r = 0.161$ kN/mm (38mm width; SPF)

$Q_r = q_r L_b = (0.161)(146) = 23.5$ kN $> V_f = 2.46$ ✓

Load Case 2: $0.9D + 1.4W$ (uplift)
Short term ($K_D = 1.15$)
Laterally supported

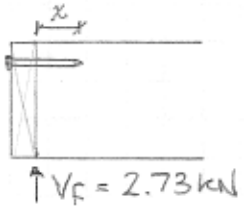
$w_f = 0.4(-4.06) = -1.624$ kN/m
$w_f = 0.4(-1.525) = -0.61$ kN/m

$M_f = w_f \ell^2/8 = (-1.624)(3.36)^2/8 = -2.29$ kN·m $< M_r = 3.83$ ✓
$V_f = w_f \ell/2 = (-1.624)(3.36)/2 = -2.73$ kN $< V_r = 10.6$ ✓

$E_s I = \frac{5w\ell^4}{384\Delta} = \frac{5(-0.61)(3.36)^4}{384(3360/360)} = 108.5$ N·mm$^2 \times 10^9 < E_s I = 187.$ ✓

Connection.

Short-term load ($K_D = 1.15$)



Common wire nail

3½" nails: 51 mm penetration

$N'_r n_s = 0.854$ kN $N'_r \geq 2.73$ kN

$\therefore n_s = 2.73/0.854 = 3.2 \rightarrow$ use 4 3½" nails

4" nails: 64 mm penetration

$N'_r n_s = 1.19$ kN

$n_s = 2.73/1.19 = 2.3 \rightarrow$ use 3 4" nails

3" nails.

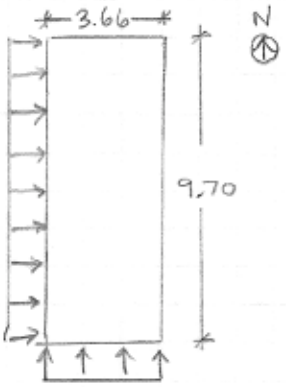
$N'_r n_s = 0.707 \rightarrow n_s = 2.73/0.707 = 3.86 \rightarrow$ use 4 3" nails

Minimum roof sheathing

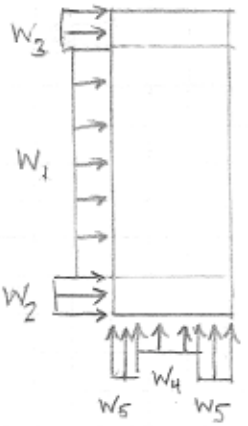
Joist spacing = 400 mm
Specified load = 2.55 kPa
Edges unsupported
CSA O151 CSP

Minimum thickness = 9.5 mm (p. 22 WDM 2010)

Core module diaphragm



$h_{max} = 4.27$ m
$h_{min} = 3.45$ m
$h_{avg} = 3.86$ m



Load Cases

West Wind: (or East).

$w_1 = (0.972\ kPa)(3.86m) = 3.75\ kN/m$
$w_2 = (1.092\ kPa)(4.27\ m) = 4.66\ kN/m$
$w_3 = (1.092\ kPa)(3.45\ m) = 3.77\ kN/m$

$w_1' = (-1.194\ kPa)(3.86\ m) = -4.61\ kN/m$
$w_2' = (-1.362\ kPa)(4.27m) = -5.82\ kN/m$
$w_3' = (-1.362\ kPa)(3.45m) = -4.70\ kN/m$

$w_{avg} = (7.7 w_1 + w_2 + w_3)/9.7 = 3.85\ kN/m$
$w'_{avg} = (7.7 w_1' + w_2' + w_3')/9.7 = -4.75\ kN/m$

South Wind

$w_4 = (1.044\ kPa)(4.27m) = 4.46\ kN/m$
$w_5 = (1.092\ kPa)(4.27m) = 4.66\ kN/m$
} $w_{avg} = 4.57\ kN/m$

$w_4' = (-1.218\ kPa)(4.27m) = -5.20\ kN/m$
$w_5' = (-1.362\ kPa)(4.27m) = -5.82\ kN/m$
} $w'_{avg} = -5.54\ kN/m$

Calculations -

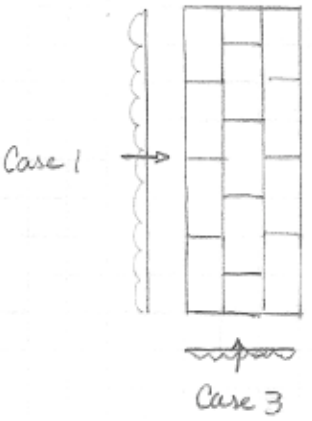
Shear force in walls - L_D = length of diaphragm.

$$V_{f\,E/W} = \frac{W_{south}\, L}{2L_D} = \frac{1.4(5.54)(3.66)}{2(9.70)} = 1.46 \text{ kN/m}$$

$$V_{f\,N/S} = \frac{W_{west}\, L}{2L_D} = \frac{1.4(4.75)(9.7)}{2(3.66)} = 8.81 \text{ kN/m}$$

1. Design of sheathing

12.5 mm plywood
3.25 mm nails
38 mm wide framing member

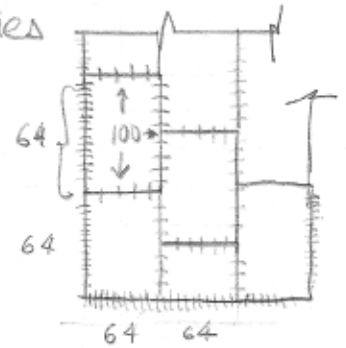


Case 1 $V_f = 8.81$ kN/m

By inspection of P.441 (WDM 2010), provide blocking in this direction.

$V_r = 9.27$ kN/m > $V_f = 8.81$ kN/m

→ 64 mm nail spacing at diaphragm boundaries
→ 100 mm " " at other panel edges



Case 3 $V_f = 1.46$ kN/m

Using 100 mm spacing (per Case 1)

$V_r = 6.31 > V_f = 1.46$.

2. Design of Chords.

The top plate of the staggered stud wall will be used as chord members. Check if one or two are needed.

Bending moment in E-W direction will govern.

$M_f = w_f l^2/8 = (4.75 \text{ kN/m})(9.7)^2/8 = 55.9 \text{ kN·m}$
$h = 3.66 - 0.184 = 3.476$ m

$T_F = P_f = M_F/h = 55.9/3.476 = 16.08$ kN

From tension member tables ($K_D = 1.15$, short term loading)

$T_r = 41.5 \times 1.15 = 47.7$ kN > T_F Use 1 38×184 chord

(As chord is fully laterally supported by wall sheathing tension governs loading)

Shear wall and Diaphragm connection

West wind V_f = 64.5 kN

South wind V_f = 28.4 kN

Connection angle capacities.

Strongtie HGA10KT

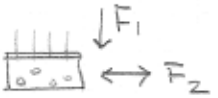
Uplift	500 lbs	= 2.22 kN
F_1	840 lbs	= 3.73 kN
F_2	675 lbs	= 3.00 kN
F_3	495 lbs	= 2.20 kN

For South wind: $n = 28.4/3.73 = 7.6 \rightarrow 8$

West wind: $n = 64.5/3.73 = 17.3 \rightarrow 18.$

West wind (F_3): $n = 64.5/2.2 = 29.3 \rightarrow 30$

Strongtie A21 / 23 (10d - 1½)



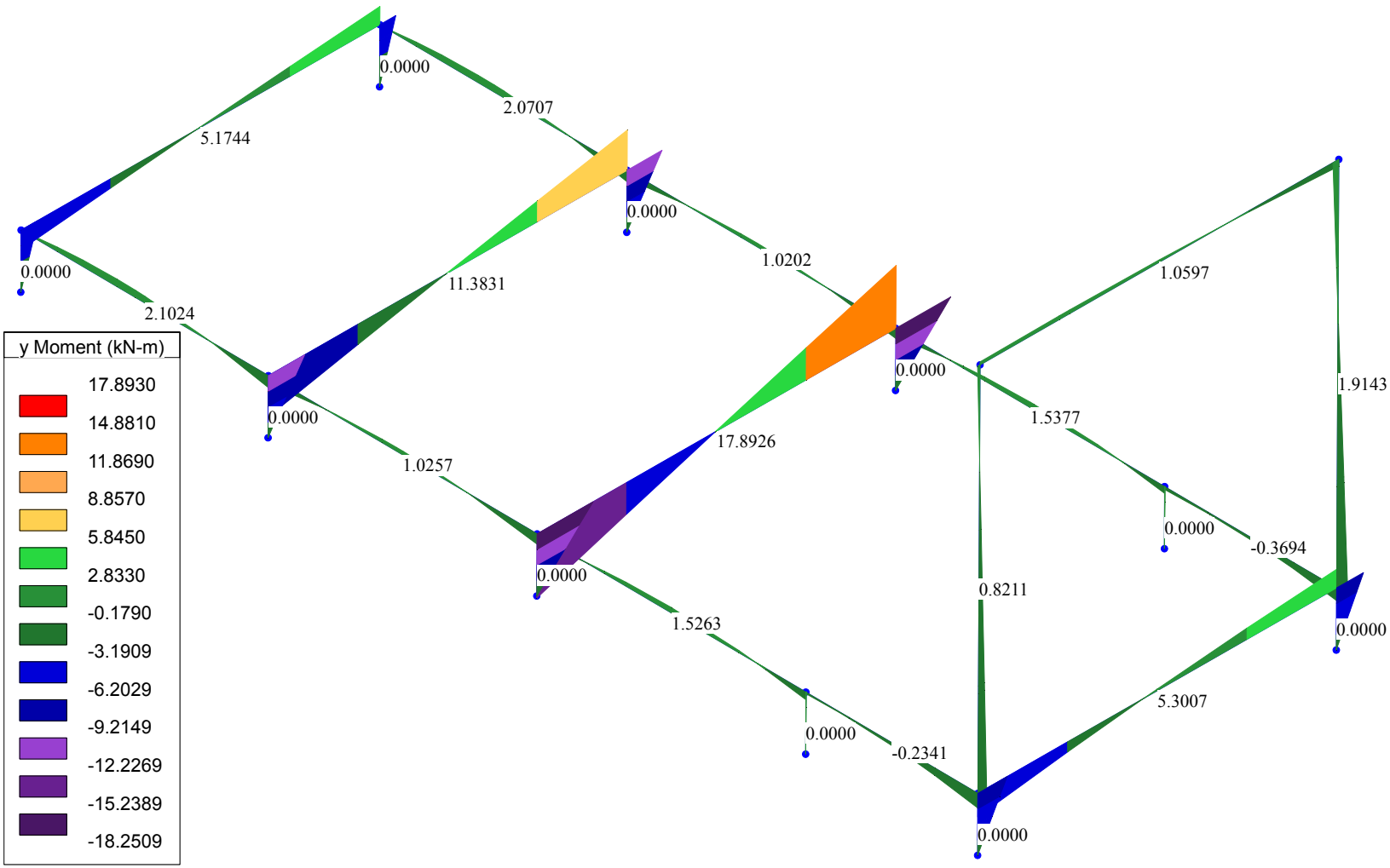
	A21	A23
F_1	210.7 (0.93 kN)	503 (2.23 kN)
F_2	150.5 (0.67 kN)	486 (2.16 kN)

Appendix 3: Steel Calculations

Calgary, AB

Kearl

Filename: C:\Users\omogha2\Desktop\Solar House\S-frame\Entiuitive\CORE MODULE (NBC-Entuitive 1).TEL
GRAPHICAL RESULTS - Ld Comb 10 0.9 D - 1.4 Wy + 0.5 S->y Moment (kN-m)
Engineer: Omid Moghadam



S-FRAME
Enterprise Version 10.0

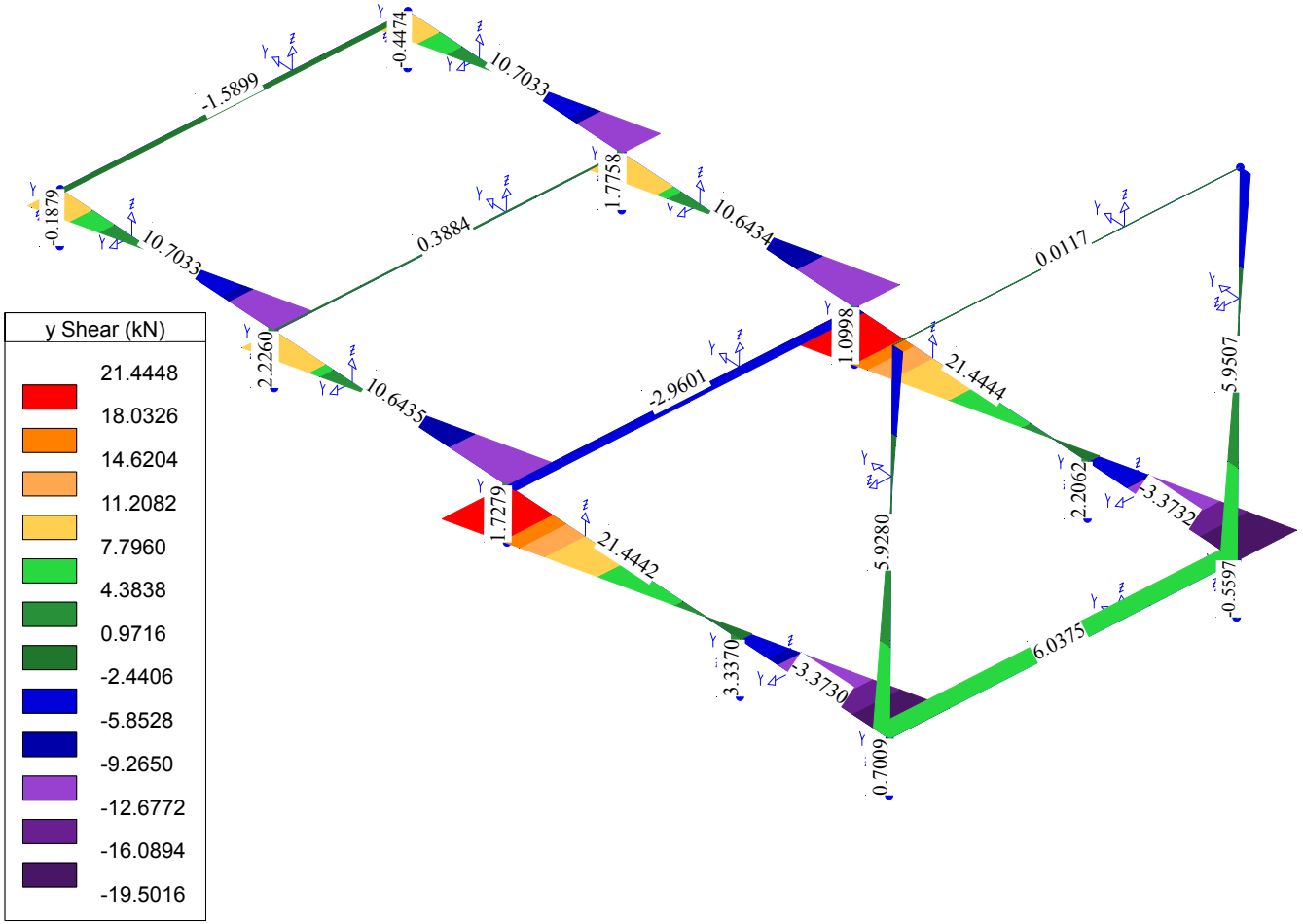
Calgary, AB

Kearl

Filename: C:\Users\omogha2\Desktop\Solar House\S-frame\Entiuitive\CORE MODULE (NBC-Entuitive 1).TEL

GRAPHICAL RESULTS - Ld Comb 10 0.9 D - 1.4 Wy + 0.5 S->y Shear (kN)

Engineer: Omid Moghadam



S-FRAME

Enterprise Version 10.0

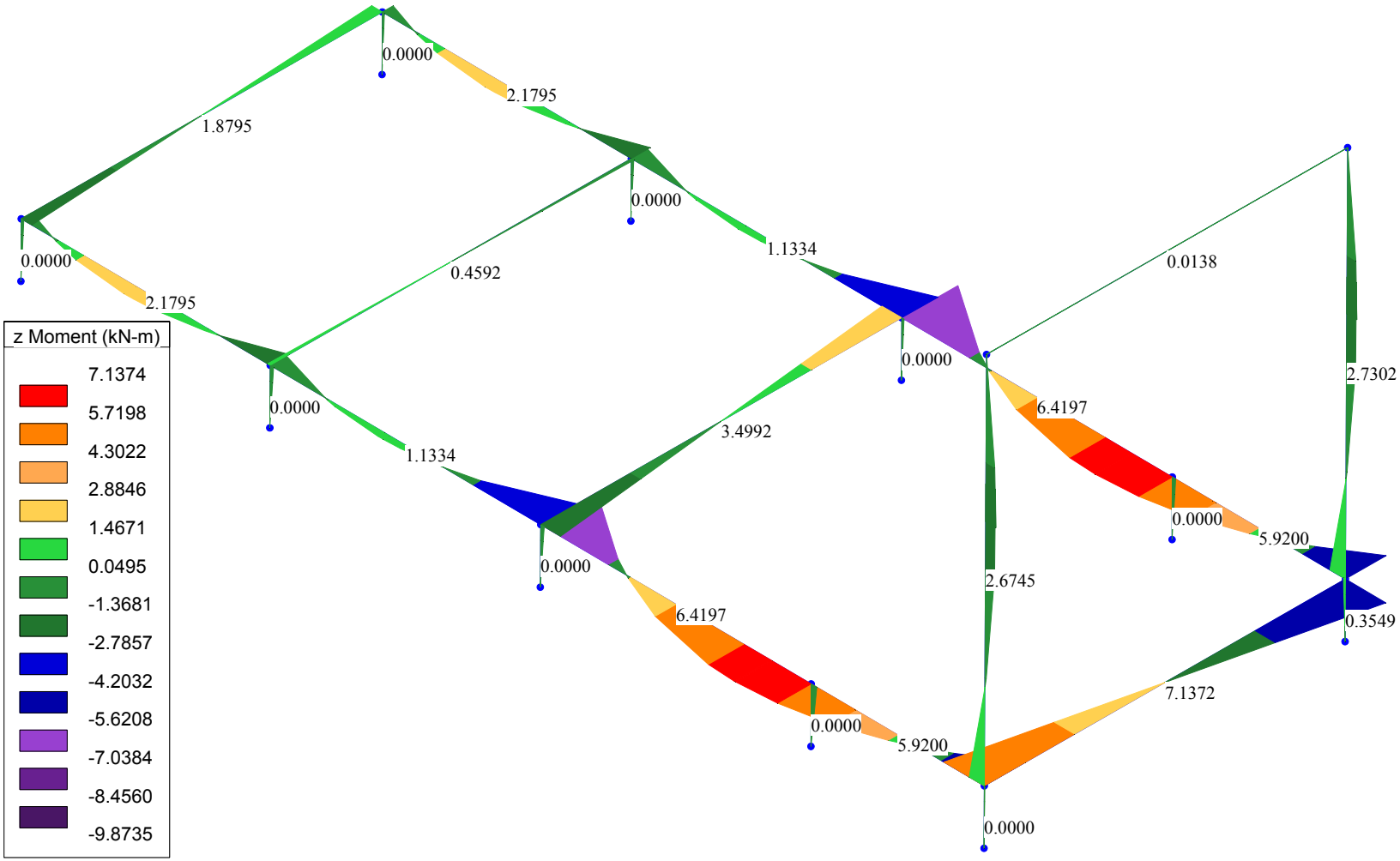
Calgary, AB

Kearl

Filename: C:\Users\omogha2\Desktop\Solar House\S-frame\Entiuitive\CORE MODULE (NBC-Entuitive 1).TEL

GRAPHICAL RESULTS - Ld Case 5 Wind Load->z Moment (kN-m)

Engineer: Omid Moghadam



S-FRAME

Enterprise Version 10.0

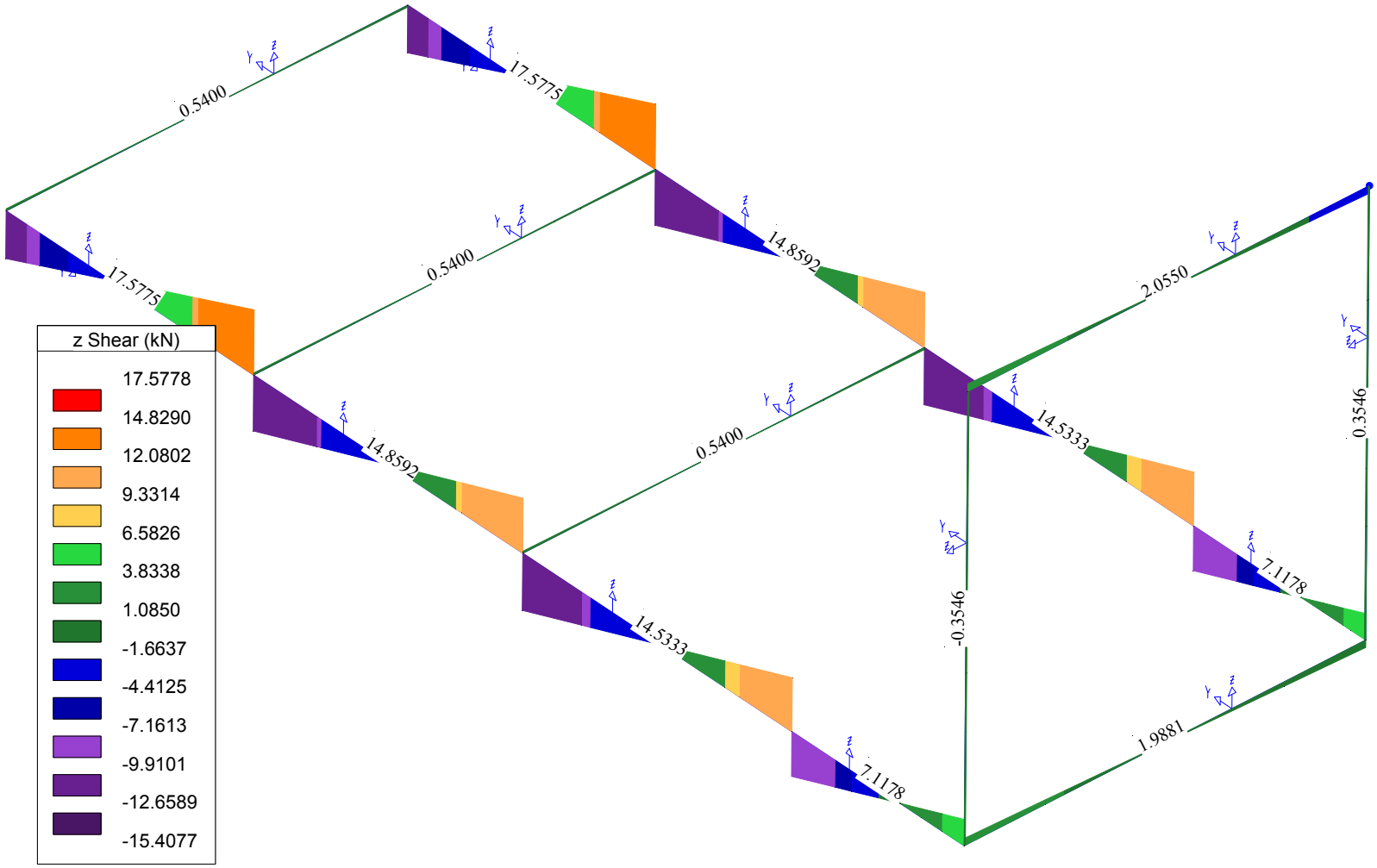
Calgary, AB

Kearl

Filename: C:\Users\omogha2\Desktop\Solar House\S-frame\Entiuitive\CORE MODULE (NBC-Entuitive 1).TEL

GRAPHICAL RESULTS - Ld Comb 2 1.25 D +1.5 L+ 0.5 S->z Shear (kN)

Engineer: Omid Moghadam



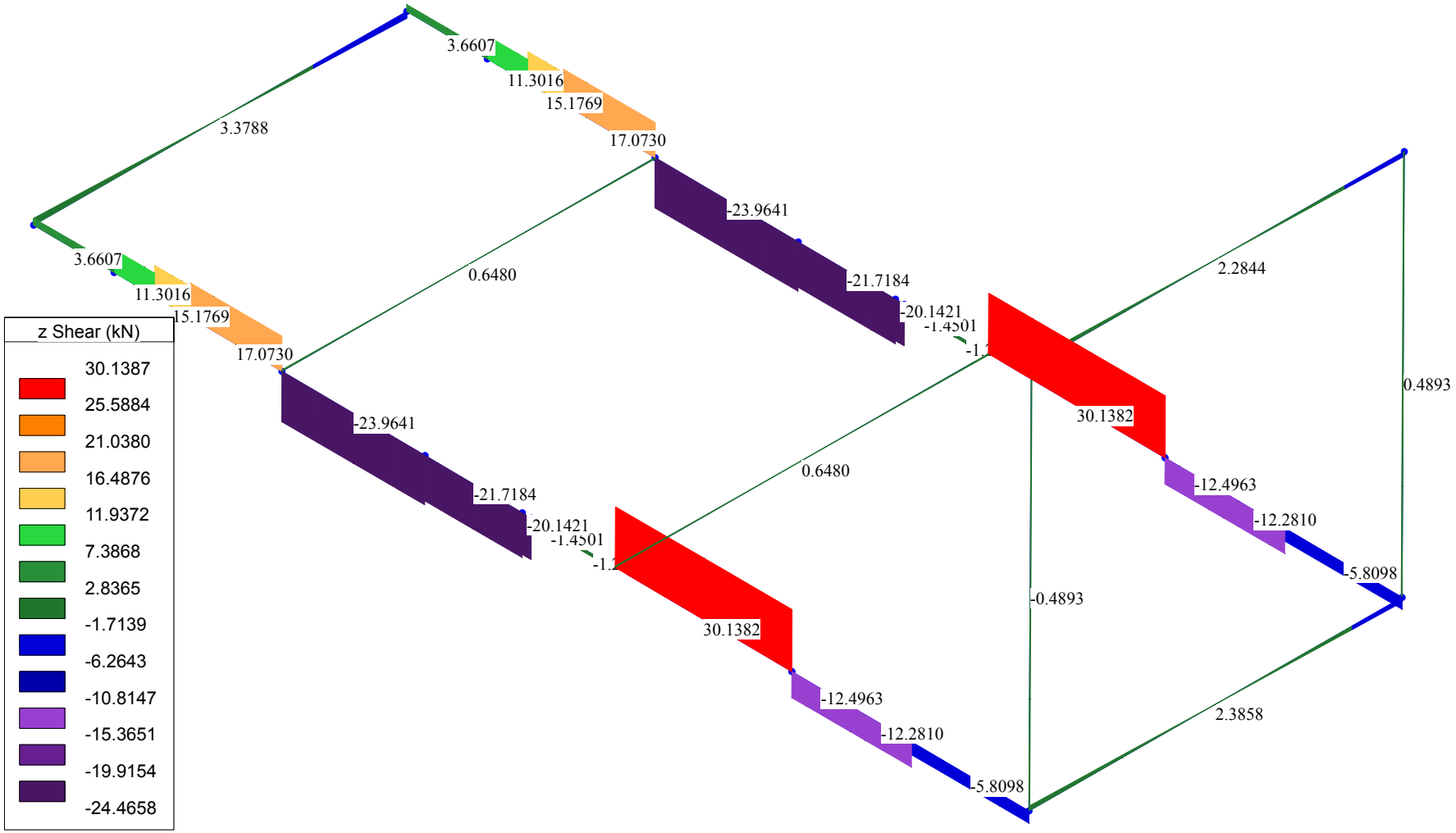
S-FRAME

Enterprise Version 10.0

Calgary, AB

SD House (Core Module)

Filename: C:\Users\omogha2\Desktop\SOLAR HOUSE\S-frame\ENTIUITIVE\CORE (NEW -LIFTING 1).TEL
GRAPHICAL RESULTS - Ld Comb 1 1.5 D->z Shear (kN) - File has changed! Results may be invalid.
Engineer:



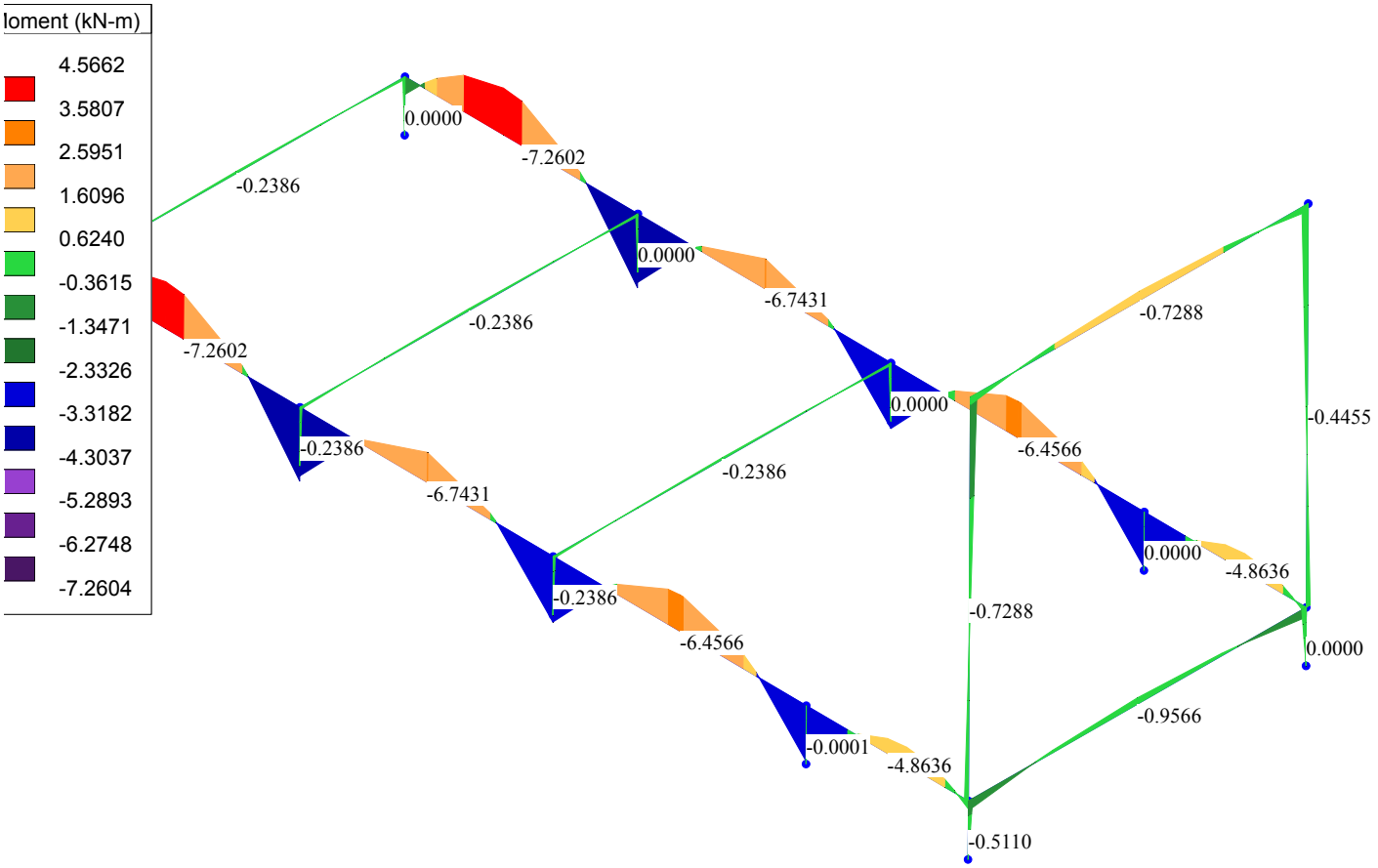
S-FRAME

Enterprise Version 10.0

Calgary, AB

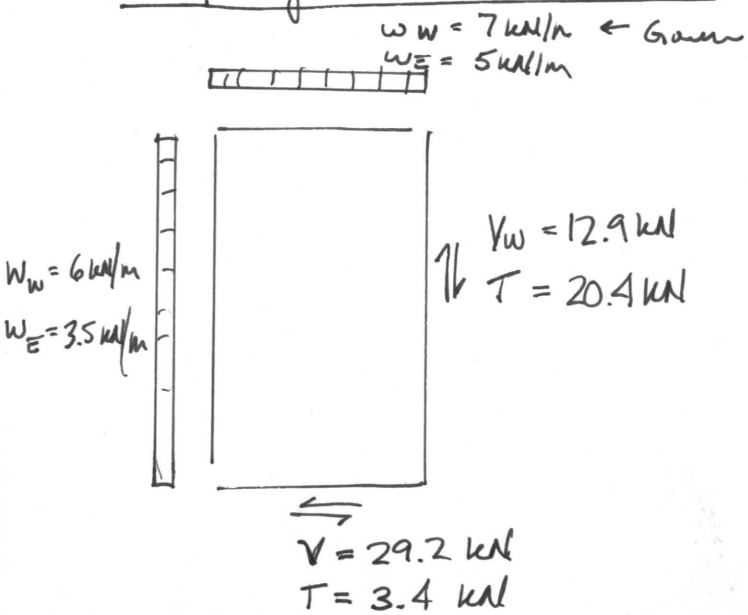
SD House (Core Module)

Filename: C:\Users\omogha2\Desktop\SOLAR HOUSE\S-frame\ENTIUITIVE\CORE MODULE (IBC-ENTUITIVE- 1).TEL
GRAPHICAL RESULTS - Ld Comb 3 1.2 D +1.6 L+ 0.5 S->y Moment (kN-m)
Engineer: Omid Moghadam



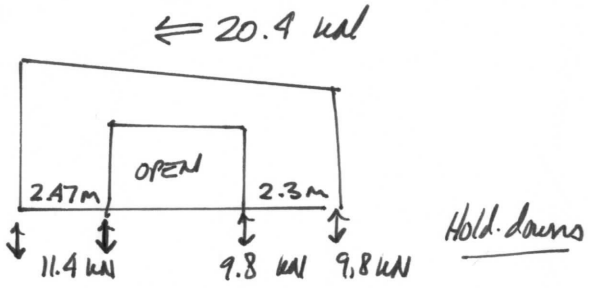
S-FRAME
Enterprise Version 10.0

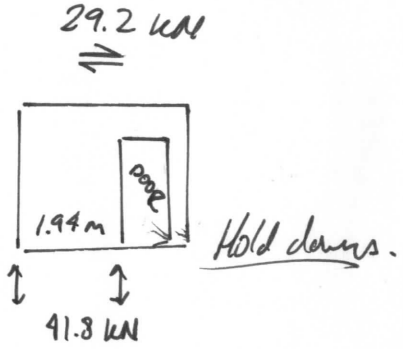
Diaphragm reactions / loads



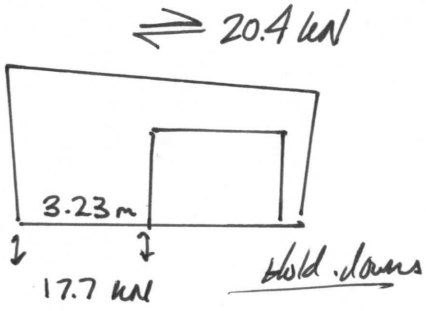
Shear Walls

Core Module

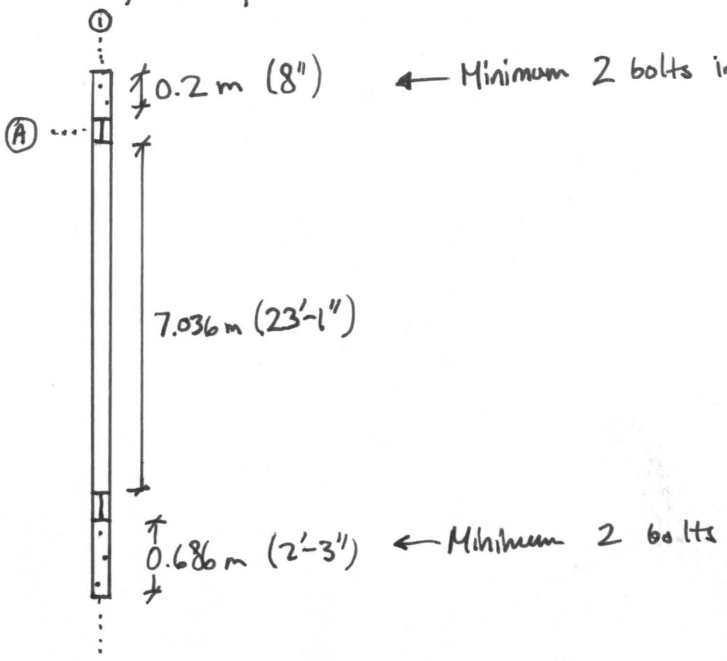


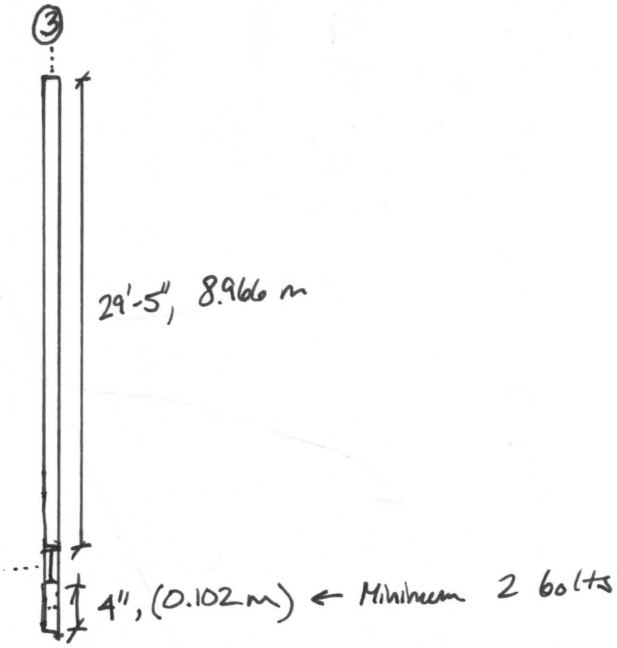


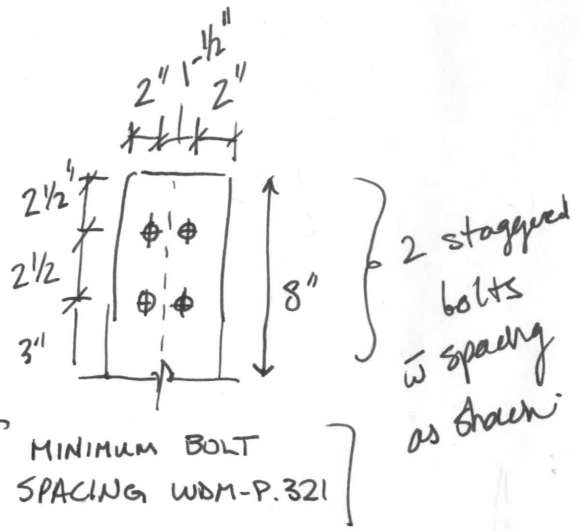
Side Module



Specify 24" o.c.







[MINIMUM BOLT SPACING WDM-P.321]

A307 - ½" V_{f_1} = 20.4 kN
V_r = 17.6 kN V_{f_2} = 29.2 kN.

@32" spacing on 7.036 m & 8.966 m sections:

$n_b = \frac{7.036\ m}{0.8\ m} = 8.7$ bolts. → 8.

$V_r = V_{rb} n_b = 8(17.6) = 140.8$ kN

$V_r > V_f = 29.2$ kN.

@24" spacing:

$n_b = \frac{7.036}{0.6} = 11.7$ → 11 bolts

$V_r = 11(17.6) = 193$ kN.

Similar spacings apply to E-W nailers

($V_{f_1} = 29.2$ kN
$V_{f_2} = 20.4$ kN)

$L = 3.118$ m

@32": $n_b = 3.118/0.8 = 3.9$ → 3

@24": $n_b = 3.118/0.6 = 5.2$ → 5

$V_r = 5(17.6) = 88$ kN.

Steel moment frame acts to resist E/W axis loads

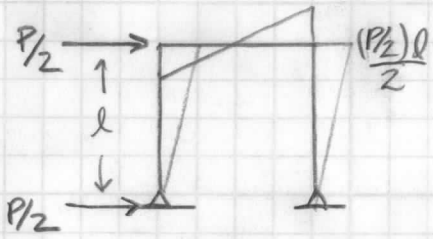
Wood shear walls resist N/S axis loads.

E/W loads:

- Base Shear, Seismic ($\varphi = 1.0$) $V = 101.2$ kN (entire building)
  Wind ($\varphi = 1.4$) $V = 86.0$ kN (entire building).

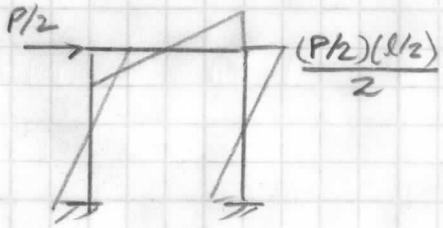
Load on one frame $P_{mod} = \frac{101.2\ kN}{5} = 20.3\ kN$ (5 moment frames in building)

As Pinned-Fixed.



$M = \frac{(20.3/2)(3.26)}{2} = 16.5\ kN{\cdot}m$

As Fixed-Fixed



$M = \frac{(20.3/2)(3.26/2)}{2} = 8.3\ kN{\cdot}m$

$\ell = 10' - 8\frac{1}{4}'' = 3.26\ m$

Actual connection will resist some M at base.

Specify frames for: $V_f = 20$ kN

$M_f = 25\ kN{\cdot}m$

Appendix 4: Floor Joist Calculations

Centre module span = 10'8" - 6" = 10'2" = 3.10 m

Loads: DL = 0.6 kPa + 1.0 kPa = 1.6 kPa
LL = 2.4 kPa

ULS 1.25(1.6) + 1.5(2.4) = 5.6 kPa
SLS 1.6 + 2.4 = 4.0 kPa

Propose: SPF No.1/No.2 M_r = 3.83 kN·m
38 x 184 joists V_r = 10.6 kN
400mm spacing $EI = 187 \times 10^9$ N·mm²
Case 2

$w_f = 0.4(5.6) = 2.24$ kN/m
$w = 0.4(4) = 1.60$ kN/m
$w_L = 0.4(2.4) = 0.96$ kN/m

$M_f = w_f l^2/8 = (2.24)(3.1)^2/8 = 2.69$ kN·m < M_r Acceptable
$V_f = w_f l/2 = (2.24)(3.1)/2 = 3.47$ kN < V_r Acceptable

$$E_s I = 360\left(\frac{5 w_L l^3}{384}\right) = \frac{360(5)(0.96)(3100)^3}{384} = 134 \times 10^9 \text{ N·mm}^2 < E_s I_{req}$$

Acceptable

Bearing Simpson strongtie JB28, LB28, W28

Min. bearing length, L_b = 1½" = 38 mm

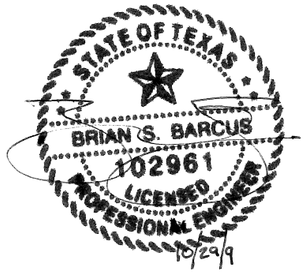
q_r = 0.161 kN/mm (38mm, SPF)

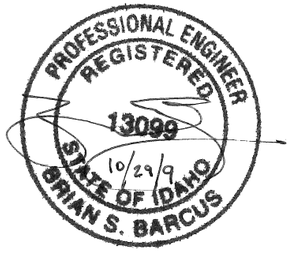
∴ $Q_r = q_r L_b = (0.161 \text{ kN/mm})(38 \text{ mm}) = 6.11 \text{ kN} > V_f = 3.47$ kN ✓

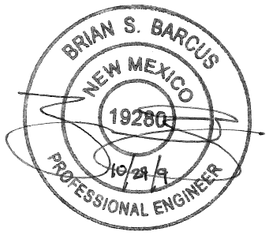
Connection

		Fasteners Headers	Joist
JB28	V_r (gravity) = 6.16 kN V_r (uplift) = 0	4-10d	2-PRONG
LB28	V_r (gravity) = 6.26 kN V_r (uplift) = 2.02 kN	4-16d	2-10d x 1½

Appendix 5: Foundation Jack Data Sheet



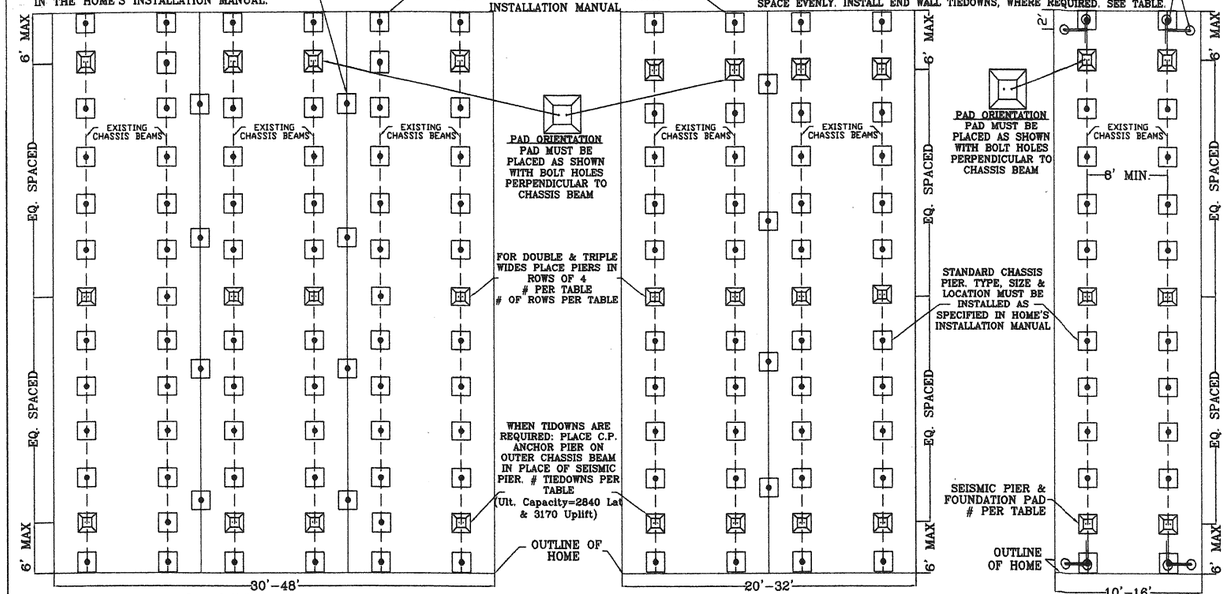




SIZE TYPE & LOCATION OF MARRIAGE LINE SUPPORTS MUST BE INSTALLED AS SPECIFIED IN THE HOME'S INSTALLATION MANUAL.

STANDARD CHASSIS PIER SUPPORT. TYPE, SIZE & LOCATION MUST BE INSTALLED AS SPECIFIED IN HOME'S INSTALLATION MANUAL

INSTALL HOME PRIDE EARTH ANCHORS PER MANUFACTURER'S INSTRUCTIONS & PER IRC AE604. MIN. 2900 lbs ALLOW. CAPACITY. NUMBER OF ANCHORS PER TABLE THIS SHEET. SPACE 1ST ROW 2 FT FROM END THEN SPACE EVENLY. INSTALL END WALL TIEDOWNS, WHERE REQUIRED. SEE TABLE.



PLAN Not to Scale
TRIPLE WIDE HOME

PLAN Not to Scale
DOUBLE WIDE HOME

PLAN Not to Scale
SINGLE WIDE HOME

MAX. ROOF LIVE/SNOW LOAD (PSF)			30 PSF			30 PSF			40 PSF			100 PSF		
MAX. WIND LOAD (MPH,EXP)			85B			85C			100B			100C		
HOME SIZE			# OF SEISMIC PIERS	# OF ROWS	# OF TIE DOWNS	# OF SEISMIC PIERS	# OF ROWS	# OF TIE DOWNS	# OF SEISMIC PIERS	# OF ROWS	# OF TIE DOWNS	# OF SEISMIC PIERS	# OF ROWS	# OF TIE DOWNS
ROOF PITCH	WIDTH	LENGTH												
SINGLES 4:12	10'-16'	UP TO 48'	4	2 ROWS	4 4*	4	2 ROWS	4 4*	4	2 ROWS	4 4*	4	2 ROWS	4 4*
		48.5'-60'	6	3 ROWS	4	6	3 ROWS	4	6	3 ROWS	4	6	3 ROWS	6 4*
		60.5'-78'	8	4 ROWS	4	8	4 ROWS	4	8	4 ROWS	4	8	4 ROWS	8 4*
DOUBLE WIDES 3:12	20'-23.5'	UP TO 56'	8	2 ROWS	0	4	2 ROWS	4	4	2 ROWS	4	8	3 ROWS	4
		56.5'-66'	12	3 ROWS	0	8	3 ROWS	4	8	3 ROWS	4	12	4 ROWS	4
		66.5'-78'	12	3 ROWS	0	8	3 ROWS	4	8	3 ROWS	4	12	4 ROWS	4
	24'-32'	UP TO 56'	8	2 ROWS	0	8	2 ROWS	0	8	3 ROWS	4	12	4 ROWS	4
		56.5'-66'	12	3 ROWS	0	12	3 ROWS	0	8	3 ROWS	4	12	4 ROWS	4
		66.5'-78'	12	3 ROWS	0	12	3 ROWS	0	12	4 ROWS	4	16	5 ROWS	4
4:12	20'-26'	UP TO 56'	8	2 ROWS	0	4	2 ROWS	4	8	3 ROWS	4	8	3 ROWS	4
		56.5'-66'	8	2 ROWS	0	8	3 ROWS	4	8	3 ROWS	4	10	4 ROWS	6
		66.5'-78'	12	3 ROWS	0	8	3 ROWS	4	12	4 ROWS	4	10	4 ROWS	6
	26.5'-32'	UP TO 56'	8	2 ROWS	0	8	3 ROWS	4	8	3 ROWS	4	12	4 ROWS	4
		56.5'-66'	12	3 ROWS	0	8	3 ROWS	4	8	3 ROWS	4	10	4 ROWS	6
		66.5'-78'	12	3 ROWS	0	12	3 ROWS	0	12	4 ROWS	4	14	5 ROWS	6
TRIPLES WIDES 4:12	30'-40'	UP TO 48'	8	2 ROWS	0	8	2 ROWS	0	8	3 ROWS	4	12	4 ROWS	4
		48.5'-56'	12	3 ROWS	0	12	3 ROWS	0	8	3 ROWS	4	12	4 ROWS	4
		56.5'-66'	12	3 ROWS	0	12	3 ROWS	0	12	4 ROWS	4	16	5 ROWS	4
		66.5'-78'	16	4 ROWS	0	16	4 ROWS	0	12	4 ROWS	4	20	6 ROWS	4
	40.5'-48'	UP TO 48'	12	3 ROWS	0	12	3 ROWS	0	8	3 ROWS	4	12	4 ROWS	4
		48.5'-56'	12	3 ROWS	0	12	3 ROWS	0	12	4 ROWS	4	16	5 ROWS	4
		56.5'-66'	12	3 ROWS	0	12	3 ROWS	0	12	4 ROWS	4	20	6 ROWS	4
		66.5'-78'	16	4 ROWS	0	16	4 ROWS	0	16	5 ROWS	4	22	7 ROWS	6

TABLE NOTES:
TO USE TABLE, FIND HOME SIZE (SINGLE, DOUBLE OR TRIPLE), THEN FIND ROOF PITCH, WIDTH AND LENGTH. FOLLOW ROW ACROSS TO DESIGN SNOW LOAD THEN DESIGN WIND LOAD. READ TOTAL NUMBER OF C.P. SEISMIC PIERS, # OF ROWS & TIDOWNS REQUIRED. SEE PLAN ABOVE FOR PLACEMENT OF C.P. SEISMIC PIERS AND TIEDOWN SPECIFICATIONS.

FOR EXAMPLE, FOR A 24'x60' HOME WITH A 3:12 ROOF PITCH, DESIGN SNOW LOAD OF 30 PSF & 85 MPH, EXPOSURE C WIND LOAD, READ 12 C.P. SEISMIC PIERS, PLACED IN 3 ROWS, WITH 0 C.P. ANCHOR PIER TIEDOWNS. LAYOUT SHOWN IN DOUBLE WIDE PLAN VIEW ABOVE.

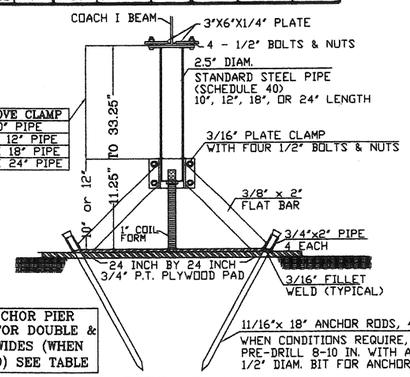
*FOR SINGLE WIDES, WHERE TIEDOWN COLUMN IS SPLIT AS SHOWN, INSTALL 2 EARTH ANCHOR TIEDOWNS AT EACH ENDWALL . TOTAL # OF ENDWALL TIEDOWNS PER HOME IS INDICATED IN TABLE BY *.

4 — TOTAL # OF SIDEWALL TIEDOWNS
4* — TOTAL # OF ENDWALL TIEDOWNS

HOME SIZES REFER TO NOMINAL SIZES THAT ARE COMMONLY MANUFACTURED. IF THE EXACT SIZE OF THE HOME IS NOT LISTED, CHECK THE NEXT HIGHER OR LOWER SIZE AND USE THE ONE THAT REQUIRED MORE PIERS.

THE TIEDOWNS SHALL BE LISTED & INSTALLATION INSTRUCTIONS SHALL BE ON SITE AT TIME OF INSPECTION.

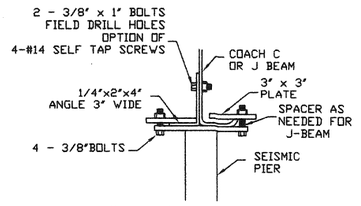
NO MORE THAN 1/3 OF THE TOTAL NUMBER OF C.P. SEISMIC MAY BE EXTENDED ABOVE 22.75 INCHES MEASURED FROM THE BASE OF THE PIER TO THE TOP PLATE OF THE PIER. NO MORE THAN ⅙ OF THE C.P. ANCHOR PIER MAY BE EXTENDED ABOVE 28 INCHES MEASURED AS STATED ABOVE.



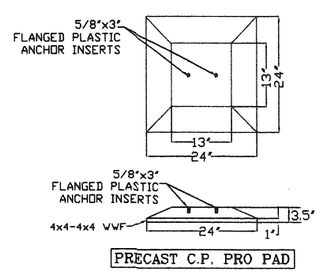
MAX HT ABOVE CLAMP
7" FOR 10" PIPE
9" FOR THE 12" PIPE
15" FOR THE 18" PIPE
22" FOR THE 24" PIPE

C.P. ANCHOR PIER TIEDOWN FOR DOUBLE & TRIPLE WIDES (WHEN REQUIRED) SEE TABLE

C.P. ANCHOR PIER TIEDOWN NOT TO SCALE
LISTING #186.6 BY CTC PATENT #5873679

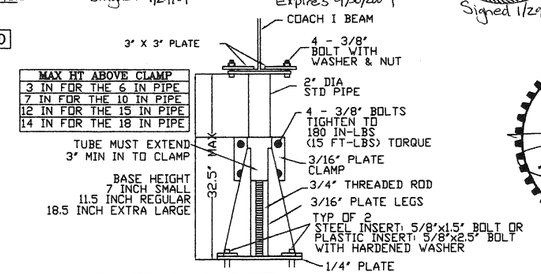


TYP BEAM CONNECTION
Not to Scale



PRECAST C.P. PRO PAD

FOUNDATION PADS
Not to scale



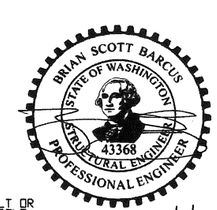
MAX HT ABOVE CLAMP
3 IN FOR THE 6 IN PIPE
7 IN FOR THE 10 IN PIPE
12 IN FOR THE 15 IN PIPE
14 IN FOR THE 18 IN PIPE

C.P. SEISMIC PIER Not to Scale
C.P. SEISMIC PIER#1-PATENT #5595366
LISTING #C03-044-60F BY BSK

Registered Professional Engineer — John M. Wilson — No. 60245 — Exp. 6/30/10 — CIVIL — State of California
Signed 1/29/09

Registered Professional Engineer — Certificate No. 39725 — Yvette M. Wilson — Date Signed 1/29/09 — Arizona, U.S.A.
Expires 9/30/2009

Professional Engineer-State of Nevada — Yvette M. Wilson — Exp. 10/30/10 — CIVIL — No. 016173
Signed 1/29/09



GENERAL NOTES:

REFERENCE: 2006 IBC & 2006 IRC, APPENDIX E:MANUFACTURED HOUSING USED AS DWELLINGS

1. DESIGN LOADS SHALL BE CONSISTENT WITH LOCAL REQUIREMENTS WHERE INSTALLED. THE FOLLOWING DESIGN LOADS ARE INCORPORATED HEREIN:
   FLOOR LIVE LOAD: 40 PSF ROOF LIVE SNOW LOAD: 30PSF – 100 PSF AS LISTED IN TABLE
   SEISMIC DESIGN CATEGORY: D BASIC WIND SPEED & EXPOSURE: 85–100MPH AS LISTED IN TABLE
   SITE CLASS D Ss=1.5 Sds=1.4 Fa=1.4
2. FOOTINGS ARE TO BE SUPPORTED BY EITHER FIRM, UNSATURATED, UNDISTURBED SOIL OR COMPACTED FILL, ASPHALT OR CONCRETE. FOOTINGS ARE DESIGNED FOR 1000 PSF BEARING CAPACITY AND SHALL BE COMPATIBLE WITH LOCAL SOIL CONDITIONS. ALL FOOTINGS SHALL BE FOUNDED IN ACCORDANCE WITH IRC AE502 GUIDLINES. PREPARE SUBGRADE PER SOIL REPORT, WHEN AVAILABLE.
3. STRUCTURAL STEEL:
   a. SHALL CONFORM TO ASTM A36 Fy = 36 KSI MINIMUM.
   b. SHALL BE FABRICATED ACCORDING TO AISC SPECIFICATIONS.
   c. SHALL BE WELDED ACCORDING TO AWS SPECIFICATIONS:
      i. ELECTRODES: E70
      ii. PLATES: ASTM A36
      iii. BOLTS: STANDARD ASTM A307
      iv. THREADED ROD: COLD DRAWN LOW CARBON WELDABLE
   d. ALL METAL COMPONENTS INCLUDING NAILS & SCREWS ETC. ARE TO BE PROTECTIVE COATED.
4. THE C.P. SEISMIC PIER SHALL BE LISTED & LABELED BY BSK ASSOCIATES FOR THESE ULTIMATE LOADS:
   A. 7" THRU 18 INCH PIERS: 3203 LBS. (STRONG DIR), 2273 (WEAK DIR), 16,000 VERTICAL
   B. 19 INCH X-LARGE PIER: 1553 LBS. (STRONG DIR.) 1462 (WEAK DIR), 16,000 VERTICAL
5. THIS FOUNDATION SYSTEM IS FOR PLACING MANUFACTURED HOMES CONSTRUCTED WITH LONGITUDINAL OR CROSS JOISTS.
6. THIS FOUNDATION SYSTEM IS DESIGNED TO BE CONSTRUCTED ON A FAIRLY LEVEL SITE WITH NO EXISTING SOIL PROBLEMS. SEE NOTE 2.
7. THE SIZE, TYPE & LOCATION OF STANDARD VERTICAL SUPPORT PIERS & FOOTINGS MUST BE INSTALLED PER THE HOME MANUFACTURER'S INSTALLATION MANUAL.

FOUNDATION PAD NOTES:

1. TWO FOUNDATION PAD TYPES ARE AVAILABLE FOR USE WITH THIS SYSTEM. THE CUSTOMER MAY CHOOSE EITHER OF THE PAD TYPES FOR THEIR HOME.
2. FDTN PADS SHALL BE PLACED ON FIRM, LEVEL UNDISTURBED SOIL (SEE GEN. NOTE 2)
3. THE FOUNDATION PADS SHALL BE ORIENTED AS SHOWN ON THE PLAN VIEW DRAWING WITH THE BOLT HOLES PERPENDICULAR TO THE CHASSIS BEAM. SEE PLAN VIEW.
4. PRECAST CONCRETE FOUNDATION PADS
   A. 2500 PSI AT 28 DAYS AS TESTED AND MANUF. BY STARLITE WEIGHT CONCRETE.
5. PRESSURE TREATED FOUNDATION PAD
   A. 3/4 INCH A.P.A. 48/24 EXTERIOR P.S.I.–83 CC. PLUGGED, NER–QA397,PRP–108.
6. ATTACHMENT TO EXISTING CONCRETE SLAB
   THE C.P. SEISMIC PIER MAY BE ATTACHED TO AN EXISTING COMPETENT CONCRETE SLAB OR CONCRETE FOOTING ACCORDING TO THE FOLLOWING CRITERIA:
   1. ATTACH WITH TWO ½" DIAM. ITW RAMSET/ REDHEAD TRUBULT WEDGE ANCHORS
   2. MINIMUM EMBEDMENT = 2.5"
   3. MINIMUM CONCRETE THICKNESS = 3¾"
   4. MINIMUM EDGE DISTANCE = 2"
7. FROST ZONES
   WHEN THE HOME IS TO BE LOCATED IN AN AREA SUBJECT TO FREEZED, ALL FOOTINGS MUST EXTEND BELOW THE FROST DEPTH PER IBC SECTION 1805.2.1 AND/OR PER LOCAL BUILDING OFFICIAL. THIS WILL REQUIRE REPLACING THE FOUNDATION PAD (PLYWOOD OR PRECAST) WITH A POURED CONCRETE FOOTING. ATTACH C.P. SEISMIC PIER TO CONCRETE FOOTING PER NOTE 6 (ABOVE). FOOTING DIMENSION SHALL BE 24"x24"x DEPTH SUFFICIENT TO PENETRATE FROST ZONE OF PER BUILDING OFFICIAL.

COACH SIZE NOTES:

1. UNLESS APPROVED BY ROCK SOLID ENGINEERING, INC., THE ROOF PITCH SHOULD NOT EXCEED:
   A. SINGLE WIDES: 4:12
   B. DOUBLE AND TRIPLE WIDES: 3:12 or 4:12 AS LISTED IN TABLE
2. FOR ANY HOME SIZE OTHER THAN AS SHOWN ON THIS PLAN OR REFERENCED IN THE TABLE, THE LAYOUT SHALL BE REVIEWED & APPROVED BY ROCK SOLID ENGINEERING, INC.

INSPECTION REQUIREMENTS:

1. THE DESIGN OF THIS SYSTEM IS BASED ON STANDARD MANUFACTURED HOMES AS BUILT BY THE MANUFACTURER. SITE BUILT ADDITIONS SUCH AS GARAGES AND SECONDARY ROOFS HAVE NOT BEEN INCLUDED IN THIS DESIGN.
2. ALL DIMENSIONS INCLUDED ON THIS PLAN, INCLUDING COACH SIZE, ROOF HEIGHT AND PIER HEIGHT, SHOULD BE FIELD VERIFIED BY THE LOCAL BUILDING OFFICIAL. ANY DISCREPENCIES SHOULD BE IMMEDIATELY BROUGHT TO THE ENGINEER'S ATTENTION.
3. THE BUILDING PAD SHOULD BE INSPECTED TO ENSURE THAT PROPER SOIL CONDITIONS AND DRAINAGE PATTERNS HAVE BEEN ESTABLISHED IN ACCORDANCE WITH THE HOME INSTALLATION MANUAL AND IRC APPENDIX E.

REVISIONS	BY

ROCK SOLID ENGINEERING, INC.
CIVIL & GEOTECHNICAL CONSULTANTS
Foundation Engineering ● Site Assessments ● Manufactured Home Foundations ● Expert Witness
1100 MAIN STREET, SUITE A, WATSONVILLE, CA. 95076 (831) 724-5868

FOR: CENTRAL PIERS, INC.
284 N. THORNE
FRESNO, CA. 93706
(559) 268-0828

ENGINEERED FOUNDATION SYSTEM: C.P. SEISMIC PIER (IBC/IRC)

DATE: 01-29-09
SCALE: AS SHOWN
DRAWN: YMW
JOB #: W03002
SHEET: 1
OF 1 SHEETS

BOREALIS

TEAM ALBERTA

Primary Student Contact

Adam Cripps

Schulich School of Engineering
University of Calgary
2500 University Drive NW
Calgary, Alberta, Canada
T2N 1N4

U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON 2013

Project Manual

August / 22 / 2013

UNIVERSITY OF CALGARY

MOUNT ROYAL UNIVERSITY 1910

SECTION 01 00 06

GENERAL REQUIREMENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Solar Decathlon 2013 Rules.

.2 Solar Decathlon Building Code

1.2 WORK OF THIS PROJECT

.1 Work of this Contract comprises the following:

Pre-Fabrication, assembly, operation and disassembly of a + / - 1000 ft² (92.9 m²), solar powered modular residence in accordance with the U.S. Department of Energy Solar Decathlon 20 13 Rules.

.2 Municipal Address:

U.S. Department of Energy Solar Decathlon 2013 Competition site located in:
Orange County Great Park, Irvine, California
United Stated of America.
92623-9575

.3 Physical Limits: Work of Contract is not necessarily restricted to Work within Solar Envelope, but may include Work required by the Competition Documents, both within and outside the Solar Envelope.

.4 Property Line(s): shall mean the Solar Envelope as defined by rule 5. of the U.S. Department of Energy Solar Decathlon Rules.

1.3 PROJECT COORDINATION

.1 Responsibility for Project Coordination: Each Team Crew Member is encouraged to participate in project coordination.

.2 Coordination: Coordination that generally applies to all components of the Project Manual as follows:

.1 Coordination with the Team's construction activities and schedule to ensure efficient and orderly installation of each part of Work.

.2 Either before or after its own installation, notify The Team project Manager and responsible team Crew Members where installation of one part of Work is dependent on installation of other components.

.3 It is strongly encouraged that Team and Team Crew Members jointly schedule and coordinate construction activities of other Team Crew Members in sequence required to obtain best results. Where availability of space is limited, Team Project Manager and Team Crew members shall coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.

.4 It's advisable that Team and Team Crew Members make adequate provisions to accommodate items scheduled for later installation by other Team and Team Crew Members.

.3 Responsible Team Crew member will supervise Work; it is recommended that other Team Crew Members:

.1 Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to Team Project Manager or responsible Team Member for final decision.

.2 Install each component during weather conditions and Project status that will ensure best possible results. Isolate each part of completed construction from incompatible material as necessary to prevent deterioration.

.3 Coordinate temporary enclosures with required reviews, inspections and tests, to minimize necessity of uncovering completed construction for that purpose.

.4 Install individual components at standard mounting heights recognized within the industry for particular applications indicated where mounting heights are not indicated. Refer questionable mounting height decisions to Team Project Manager or responsible Team Member] for final decision.

.5 Coordinate construction activities to ensure that no part of Work; completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

1.4 PROJECT MEETINGS

.1 Administrative: Team Project Manager collaboratively with the responsible Team Crew Members overseeing Construction activities; schedule and administer project progress meetings throughout the progress of the work.

1.5 SUBMITTAL ADMINISTRATION

.1 It is strongly recommended that "standard" construction practices for Submittals and Submittal Procedures be followed to ensure suitable and adequate coordination of the materials, product, components, systems and other all items used during the performance of the work are acceptable for use on the project.

.2 This section specifies general requirements and procedures for submissions of shop drawings, Product data, and samples to the Team for review; additional specific requirements for submissions are specified in individual sections of Project Manual and as follows:

.1 Action Submittals: Submittals confirming constructability and conformity with design intent, and are generally reviewed by the Team Project Manager or responsible Team Member before starting any work.

.2 Informational Submittals: Submittals necessary for coordination of the Work.

.3 Submittal Transmittal Contents: It is recommended that a transmittal letter accompany submissions be provided and should contain the following information:

.1 Submissions from Team Crew Members Responsible for Construction Coordination:

.1 Date

.2 Project Title: BOREALIS

.3 Team Crew Member's name and address.

.4 Identification and quantity of each shop drawing, product data and sample

.5 Other pertinent data

.6 Submittals may be rejected for not complying with these requirements

.4 Electronic Drawing Files Available from Team: Electronic drawing files will be made available to Team Crew Members by the Team for preparation of Shop Drawings specific to this Project subject to the following conditions:

.1 The following electronic drawing files will be made available:

.2 Site Plans, Landscape Plans, Pile or Foundation Plans, Floor Plans, Reflected Ceiling Plans, Roof Plans, Sections, Details, Elevations and similar drawing types;

.3 Drawings indicating specific wall or floor patterns may also be included with the package where it is essential to have a pattern match in actual construction;

.4 Electronic drawing files will be provided by e-mail, CDROM or via FTP Site, depending on size and quantities of requested electronic drawing files.

.5 Electronic drawing files will be provided in the file format used for production of drawings.

1.6 ELECTRONIC SUBMITTAL PROCEDURES

.1 Electronic Submittals: Submit shop drawings, product data, design criteria, delegated design documentation, and other documents indicated in the specifications electronically using open source Portable Document Format (PDF) software that is compatible with ISO 32000-1:2008 Document Management:

.1 Software Writers: Any software that can save to or write a PDF including that allows for encryption and signature.

.2 Scanned Copies: Legible scanned PDF files of paper originals are acceptable; scanned submittals that are not legible will be rejected.

.3 File Size: Maximum file sizes for delivery of PDF submittals are as follows:

.1 E-Mail Delivery: 5 Megabytes (MB)

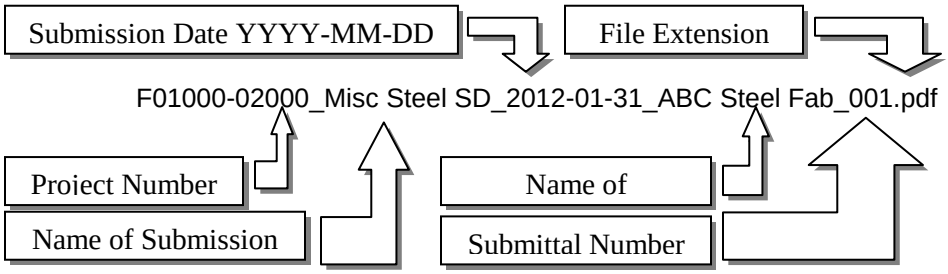
.2 FTP Site Delivery: 100 MB

.3 Split Delivery: Break larger PDF files into small packages where necessary to meet delivery restrictions; identify split packages as “1 of 2” and “2 of 2” in the Subject Line of submission after other required information listed below.

.4 Sheet Orientation: Assemble PDF sheets in a single file; unless resulting file is larger than 10 MB, rotated to a “Ready-to-Read” orientation with majority of text horizontal to the sheet with no additional adjustments or formatting required by the viewer.

.5 File Security: Do not set any permissions on the file; protected documents will not be accepted.

.6 File Identification: File name must contain Project Number, Name of Submission, Date of Submission, Name of Fabricator and Submittal Number with underscore between each item; do not use periods except immediately prior to document type; example file name follows:



.4 Transmission Requirements: Send non-zipped files as an attachment to e-mail or upload to FTP site; zipped files will be rejected:

.1 E-Mail Transmission: Include same name as the attachment file name without the file type extension in the Subject Line; e-mail that does not contain appropriate subject will be rejected.

.2 FTP Transmission: Notify Consultant using e-mail that documents have been uploaded; use same subject line protocol as noted above.

.3 Transmittal Layout: Include only one attachment or one topic per e-mail transmission, with the following text appearing in the body of the transmission; <> indicates text edited by sender:

.1 Attention: [Team Project Manager]

.2 Project Name: BOREALIS

.3 Name of Team Crew Member: <Insert Name>

.4 Name of Fabricator: <Insert Name>

.5 Name of Product or Assembly: <Insert Name>

.6 Submission Method: <e-mail> <FTP site>

.7 Attached is one set of <Shop Drawings> <Product Data> <Insert Name of Other Document> relating to the above mentioned project, product or assembly.

1.7 HARD COPY SUBMITTAL PROCEDURES

.1 Hard Copy Submittals: Submit shop drawings, Product data, design criteria, delegated design documentation, and other documents required by the specifications as follows:

.1 Size: Submit paper documents ranging in size as follows:

.1 Minimum Sheet Size: 215 mm x 280 mm

.2 Maximum Sheet Size: 750 mm x 1000 mm

.2 Quantity: Prepare drawings containing full size templates or patterns on sheets of sufficient size to convey required information and as follows:

.1 Drawings up to 280 mm x 430 mm: Submit one (1) photo reproducible copy.

.2 Drawings larger than 280 mm x 430 mm: Submit one (1) reproducible transparency

1.8 SHOP DRAWINGS

.1 Shop Drawings: Original of drawings drawn accurately to scale, modified standard drawings provided by manufacturers, or modified standard drawings provided by Team Crew Members to illustrate details of portions of Work, that are specific to project requirements:

.1 Do not base Shop Drawings on reproductions of the Competition Documents except as allowed by use of electronic drawing files noted above.

.2 Include the following information on Shop Drawings, as applicable:

.1 Information cross referenced to applicable portions of Competition Documents

.2 Include dimensions consistent with units shown on drawings; converted values are acceptable when items or information are not produced in indicated units

.3 Identification of Products

.4 Fabrication and installation drawings

.5 Roughing-in and setting diagrams

.6 Wiring diagrams showing site installed wiring, including power, signal, and control wiring

.7 Shop work manufacturing instructions

.8 Templates and patterns

.9 Design calculations

.10 Compliance with specified standards

.11 Notation of coordination requirements by specific related Team Crew Members.

.12 Notation of critical dimensions established by site measurement, or that have to be maintained to fit components

.2 Product Data: Submit Product data sheets such as manufacturers' catalogue sheets, brochures, performance charts and diagrams, and similar literature used to illustrate standard manufactured Products, modified as follows:

.1 Delete information not applicable to project

.2 Supplement standard information to provide details applicable to project

.3 Cross reference Product data information to applicable portions of Contract Documents

1.9 REGULATORY REQUIREMENTS

.1 Refer to Section 01 41 00 – Regulatory Requirements.

1.10 PERMITS

.1 The Team Project Manager, Team Member or Team Crew Member that has been assigned such tasks will require that specific Team Crew Members obtain permits required by authorities having jurisdiction, where their Work is affected by Work requiring permits.

.2 The Team will pay all fees associated with, but not necessarily limited to the following:

.1 Permits, Licenses, Certificates and Approvals: The responsible Team Crew member shall apply for and obtain all permits, licenses, certificates, and approvals required by regulatory requirements and Competition Documents and the following:

.1 Regulatory requirements and fees in force on date of submission to the authorities having jurisdiction.

1.11 CONSTRUCTION SITE SAFETY REQUIREMENTS

.1 Responsibility for Work Site Safety:

.1 The Team and Responsible Team Crew Member, for the purposes of the Occupational Health and Safety Act (Alberta), and for the duration of the Work of this Project:

.1 Act as the “Prime Contractor” and;

.2 Meet all requirements of the Occupational Health and Safety Act and Regulations, Workers Compensation Board legislation, the Fire Code legislation and all other applicable laws that govern work place safety.

1.12 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

.1 Include for payment of, and supply and installation of temporary facilities and controls required for the project and as follows:

.1 Temporary utilities include the following:

.1 Sewers and drainage

.2 Water service and distribution

.3 Sanitary facilities, including toilets, wash facilities, and drinking water facilities

.4 Heating and cooling facilities

.5 Ventilation

.6 Electric power service

.7 Lighting

.8 Telephone service

.2 Support facilities include the following:

.1 Temporary signs

.2 Waste disposal facilities

.3 Storage and fabrication sheds

.4 Lifts and hoists

.5 Temporary stairs

.6 Construction aids and miscellaneous services and facilities.

.3 Security and protection facilities include the following:

.1 Environmental protection

.2 Temporary enclosures

.3 Storm water, erosion and sedimentation controls

.4 Tree and plant protection

.5 Site enclosure fence

.6 Security enclosure and lockup

.7 Barricades, warning signs, and lights

.8 Fire protection

.4 Design of Temporary Facilities: Team Crew Member that is assigned such tasks is responsible for design and safety of temporary facilities:

.1 Temporary facilities of such nature that engineering proficiency is required for their design to ensure safety during construction shall be designed by a professional engineer in the employ of the Team.

.2 Before the temporary structure is used, the engineer responsible for the design or their representative shall inspect the structure and issue a certificate stating that it has been constructed according to the engineer's design.

.5 Overloading of Structures: Take precautions to prevent any part the structure from being loaded with a load greater than its calculated bearing capacity until completion of construction:

.1 Make every temporary support as strong as permanent support.

.6 Temporary Facility Requirements: Provide hoists, cranes and moving equipment, and shoring and bracing required for hoisting, lifting and moving equipment and materials required for the project into final position within the structure and as follows:

.1 Notify affected team Crew Members and coordinate placement of hoisting, lifting and moving equipment, and shoring and bracings.

.2 Provide qualified personnel to operate and erect hoists, cranes and moving equipment, and shoring and bracing.

.3 Provide qualified engineer where site engineering is required to inspect and supervise erection procedures.

.2 Site Storage and Overloading: Confine apparatus, storage of Products, and operations of employees to limits indicated by laws, ordinances, permits or the Competition Documents and that do not unreasonably encumber the premises with Products.

1.13 COMMON PRODUCT REQUIREMENTS

.1 Product and Material Quality: Provide and pay for labour, Products, tools, construction machinery and equipment, water, heat, light, power, transportation and other facilities and services necessary for the performance of the Work in accordance with the Competition Documents and as follows:

.1 Provide only new Products.

.2 Products that are not specified shall be of a quality best suited to the purpose required and their use.

.3 Maintain good order and discipline among their employees engaged on the Work and will not engage anyone who is not skilled in the task assigned to them.

.2 Storage, Handling and Protection: Handle and store Products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable and as follows:

.1 Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact.

.2 Protect and store Products subject to damage from weather in weatherproof enclosures

.3 Manufacturer's Instructions: Install or erect Products in accordance with manufacturer's instructions and as modified by Technical Specifications Sections; do not rely solely on labels or enclosures provided with Products; obtain written instructions directly from manufacturers and as follows:

.1 Notify the Team Project Manager in writing of conflicts between the specifications and manufacturer's instructions so the Consultant can establish the course of action.

.4 Workmanship: Provide workmanship of Workmanship best quality executed by workers experienced and skilled in their respective duties for which they are employed and as follows:

.1 Immediately notify the Team Project Manager if required Work is such as to make it impractical to produce required results.

.1 Do not engage any unfit person or anyone unskilled in their required duties.

.2 Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Consultant, whose decision is final.

.2 Concealment: Conceal pipes, ducts and wiring in finished areas within floors, walls and ceilings, except indicated as being exposed as an architectural element; inform the Team Project Manager if there is a contradictory situation before installation and install as directed by the Team Project Manager or responsible Team Member

1.14 SOLAR ENVELOPE REGULATIONS

.1 Comply with regulations of the U.S. Department of Energy's Solar Decathlon Rules and Regulations and Building Codes..

.2 Be aware of and comply with all Competition "Standing Orders" in case of fire or other emergency.

.3 Protect all personnel and the public from all airborne dust, debris and contaminates which may be generated during Construction activities at both the prefabrication site; located in Calgary, Alberta and the Competition Site.

.4 Do not block or encumber fire exits or routes. Maintain and keep free of debris, materials and equipment, all emergency and fire exits and routes.

1.15 EXECUTION REQUIREMENTS

.1 Construction of project in Calgary: Confine hours of work to those as defined by the Team Project Manager and as governed by Federal, Provincial, State, Municipal and local Codes, Laws, By-Laws, regulations and guidelines.

.1 Hours of Work: Confine hours of Work at the Competition site as indicated in Appendix A-3 of the U.S. Department of Energy Solar Decathlon Rules.

.2 Smoking Policy: Facility is a smoke free environment; no one will be allowed to smoke anywhere at either; the Calgary Construction Site or the Competition site; both inside and outside of buildings except in areas as directed by the team Project Manager and the Competition authorities having Jurisdiction ; keep designated smoking areas clean and sanitary, do not permit butts to accumulate.

.3 Consumables Policy: Food or drink consumption by construction forces will only be permitted within areas designated; keep designated eating areas clean and sanitary; use closed waste receptacles and remove trash on a daily basis.

.4 Installation: Locate the Products and other components of the Work accurately, in correct alignment and elevation as indicated and as follows:

.1 Make vertical work plumb and make horizontal work level.

.2 Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.

.3 Conceal pipes, ducts, and wiring in finished areas, unless indicated specifically as being exposed as architectural features:

.1 In rooms or areas having no finished ceiling; pipes, conduits and ducts will generally be left exposed, except where indicated on the Mechanical drawings as built into walls or behind furring. Electrical conduit and fittings shall be built into walls.

.2 In the event of conflicts occurring between equipment shown in concealed areas, observe the following order of priority:

.1 Structural elements

.2 Plumbing drains

.3 Sprinkler piping

.4 Ductwork

.5 Heating piping

.6 Plumbing piping

.7 Electrical conduit

.5 Inform the Team Project Manager or responsible Team Member of impending installation of fixtures, switches and attachments and confirm actual locations prior to final installation:

.1 Location of fixtures, apparatus or outlets shown or specified shall be considered as approximate only. The actual location shall be as directed and required to suit conditions at the time of installation as defined by the team Project manager or responsible Team Member.

.2 Locations noted on drawings are diagrammatic only.

.3 Note furring requirements and limitations shown on the drawings.

.4 Make allowance for the possibility that indications and locations shown on mechanical and electrical drawings are diagrammatic.

.6 Inform the Team Project Manager before proceeding with the work where the location of holes in the structure could affect the nature or strength of the structure.

1.16 CUTTING AND PATCHING

.1 Approvals: Submit written requests to the Team Project Manager and Team Crew Member assigned the task of overseeing construction of the Project in Calgary in advance of cutting or alteration which affects the following:

.1 Structural integrity of any element of the Project

.2 Integrity of weather exposed or moisture resistant elements

.3 Efficiency, maintenance, or safety of any operational element

.4 Visual qualities of sight exposed elements

.5 Work of other Team Members or Team Crew Members

.2 Perform cutting, fitting and patching as required, to complete the Work and as follows:

.1 Remove and replace defective and non-conforming Work.

.2 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical work.

.3 Perform Work to avoid damage to other Work.

.4 Prepare surfaces to receive patching and finishing.

.5 Cut rigid materials using power saw or core drill.

.6 Restore Work with new products in accordance with Competition Documents.

.7 Fit work tight to pipes, sleeves, ducts, conduit and other penetrations through surfaces; allow for expansion and contraction of materials; install sealants and firestop per requirements of the technical specifications, and drawings.

.8 At penetration of fire rated wall, ceiling or floor construction, completely seal voids with fire rated material, full thickness of the construction element.

.9 Refinish surfaces to match adjacent finishes; for continuous surfaces refinish to nearest intersection. For an assembly, refinish entire unit.

1.17 ANCHORS AND FASTENERS

.1 Fastenings: Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, and as follows:

.1 Prevent electrolytic action between dissimilar metals and materials.

.2 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.3 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable; coordinate design of fastenings and anchors with requirements listed below.

.4 Keep exposed fastenings to a minimum, space evenly and install neatly.

.5 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

.2 Equipment Fastenings: Use fastenings of standard commercial sizes and patterns with material and finish suitable for service, and as follows:

.1 Use heavy hexagon heads, semi-finished unless otherwise specified.

.2 Use No. 304 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur.

.5 Use resilient washers with stainless steel.

.3 Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work:

.1 Mount components at heights directed by Team Project Manager, team member, or Team Crew Member assigned to such task where mounting heights are not indicated.

.2 Allow for building movement, including thermal expansion and contraction.

.4 Powder Actuated Tools; Comply with requirements of the local Occupational Health and Safety Act, General Safety Regulations when powder actuated tools are used.

1.18 HOUSEKEEPING

.1 Individual Team member and Team Crew members will be responsible for daily housekeeping and site clean-up at both the site in Calgary and at the Competition Site.

.2 Clean Project site and work areas daily, at the Calgary Construction site and the Competition Site including, but not necessarily limited to; adjacent solar envelopes where the work of Competition Site fabrication affects adjacent solar envelopes.

.1 Dispose of materials lawfully:

.1 Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

.2 Do not hold materials more than seven (7) days during normal weather or three (3) days if the temperature is expected to rise above 25°C.

.3 Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

.2 Maintain both the Calgary construction site and the Solar Envelope assigned to the Team at the Competition Site free of waste materials and debris.

.3 Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work and safety of personnel in the area:

.1 Remove liquid spills promptly.

.2 Broom clean or vacuum the entire work area, as appropriate, where dust impairs proper execution of the Work.

.4 Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property, and that will not damage exposed surfaces.

.5 Remove debris from concealed spaces before enclosing the space.

.6 Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Performance.

.7 Clean areas and spaces where cutting and patching are performed; completely remove paint, mortar, oils, putty, and similar materials:

.1 Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

.8 Burying or burning waste materials on site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

.9 Clean and protect construction in progress and adjoining materials already in place during handling and installation. Apply protective covering where required to ensure protection from damage or deterioration until Substantial Performance.

.10 Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction and Competition period. Adjust and lubricate operable components to ensure operability without damaging effects.

.11 Team Project Manager or Team Member assigned to the task will supervise construction operations at both the Calgary Construction Site and the Competition Site to assure that no part of the construction; completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

1.19 PROJECT CLOSEOUT

.1 Starting, Testing, Adjusting and Balancing (STAB): Coordinate requirements for STAB requirements for installed equipment with requirements of Mechanical and Electrical Divisions:

- .1 Start equipment and operating components to confirm proper operation
- .2 Remove malfunctioning units, replace with new units, and retest
- .3 Adjust operating components for proper operation without binding
- .4 Adjust equipment for proper operation
- .5 Test each piece of equipment to verify proper operation
- .6 Test and adjust controls and safeties

.2 Replace damaged and malfunctioning controls and equipment

.3 Comply with qualification requirements for Quality Control listed earlier in this Section where a factory authorized service representative is required to inspect site assembled components and equipment installation.

.4 Systems Demonstration: Demonstrate operation of each system to Team Members:

- .1 Provide Instruction to Team Members for the operation, adjustment and maintenance of equipment and systems, using provided operation and maintenance data as the basis for instruction.
- .2 Also refer to Mechanical and Electrical requirements for specific requirements for the following:
  - .1 Equipment start-up
  - .2 Fire alarm verification
  - .3 Additional items identified in Technical Specification Sections

1.20 CLOSEOUT SUBMISSIONS

.1 Closeout Procedures: It is strongly recommended and encouraged that the Team Collect all submittals and assemble documents issued by Team Crew Members, suppliers and manufacturers and combine them into a set of Operation and Maintenance Manuals.

.2 Operation and Maintenance Data: Provide an organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual Products or systems as specified in the technical sections and as follows:

- .1 Binders: “D” ring type, heavy duty vinyl binders having clear plastic pockets on the spine and front cover for project information inserts; limited to a maximum of 75 mm spine width and no more than 2/3 full.
- .2 Binder Colours:
  - .1 Architectural: Black
  - .2 Mechanical: Green
  - .3 Electrical: Royal Blue

.4 Shop Drawings: Red

.3 Or where all documents are able to fit into one 75 mm binder; provide one (1) Royal Blue Binder.

.4 Index of Operation and Maintenance Manuals: Include an index based on Systems that cross reference the MasterFormat Division, Number and Title, and Volume including; but not limited to, the following:

.1 Include equipment as specified in mechanical and electrical specification sections.

.2 Additional Data: Prepare and insert additional information that becomes apparent during demonstration and instructions to Team Project Manager, Team member or other Team Crew member assigned to such duties, when it is evident that operations and maintenance information is insufficient or requires clarification.

.5 Content: Coordinate requirements with specific requirements contained in the Technical Specifications; include cover sheets identifying:

.1 Date submitted

.2 Project title, location and project number

.3 Names and addresses

.4 Table of Contents of all binder volumes and disciplines

.5 List of warranties and guaranties for the project

.6 List of approvals and certificates for the project

.6 Material, Product or System Data: Include the following listing of information for each individual tab within the Operation and Maintenance Manuals:

.1 Tab Contents: Include vendor name, and equipment make, model and serial number

.2 Spare parts lists: Source of spare parts for materials that are not kept at site; list of spare parts that are required to be kept at site

.3 Warranty or Guaranty information and claim procedure specific to material, Product or system

.7 Operation Data: Description of each system and its controls and as follows:

.1 Control schematics for each system including environmental controls

.2 Description of operation of each system at various loads together with reset schedules and seasonal variances

.3 Operation instruction for each system and each component

.4 Description of actions to be taken in event of equipment failure

.8 Maintenance Data: Servicing, maintenance, operation and troubleshooting instructions for each item of equipment and as follows:

.1 Maintenance schedules with tasks and frequencies including listing of tools required to complete maintenance and estimated task time

.9 Performance Data: Equipment manufacturer's performance data sheets with point of operation as left after facility systematic testing and balancing was completed including the following:

.1 Equipment performance verification test results

.2 Special performance data as specified in individual Technical Specification Sections

1 Products

1.1 NOT USED

2 Execution

2.1 NOT USED

END OF SECTION

SECTION 01 11 00

SUMMARY OF WORK

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Solar Decathlon 2013 Rules.

.2 Section 01 50 00 – Temporary Facilities and Controls

1.2 WORK OF THIS PROJECT

.1 Work of this Contract comprises the following:

.1 Pre-Fabrication, assembly, operation and disassembly of a + / - 1000 ft² (92.9 m²), solar powered modular residence in accordance with the U.S. Department of Energy Solar Decathlon 20 13 Rules.

.2 Municipal Address:

U.S. Department of Energy Solar Decathlon 2013 Competition site located in:

Orange County Great Park, Irvine, California
United Stated of America.
92623-9575

.3 Physical Limits: Work of Contract is not necessarily restricted to Work within Solar Envelope, but may include Work required by the Competition Documents, both within and outside the Solar Envelope.

.4 Property Line(s): shall mean the Solar Envelope as defined by rule 5. of the U.S. Department of Energy Solar Decathlon Rules.

1.3 COMPETITION TIME

.1 Competition shall be as determined by the U.S. Department of Energy, as noted in the U.S. Department of Energy Solar Decathlon 2013 Rules and as follows:

Assembly Start Date	September 29, 2013
Assembly Completion Date	October 02, 2013
Contest Start Date	October 03, 2013
Contest Completion Date	October 13, 2013
Disassembly Start Date	October 14, 2013
Disassembly Completion Date	October 17, 2013

.2 Attain assembly, operation and disassembly of the Work within time period stated in the U.S. Department of Energy Solar Decathlon 2013 Rules.

1.4 WORK SEQUENCE

.1 Decathletes shall prepare a proposed assembly and disassembly plan based on U.S. Department of Energy Solar Decathlon 2013 Rules – Appendix A – Event Schedule and A-3. Detailed Event Schedule.

Part 2 Products

2.1 RELATED WORK BY U.S. SOLAR DECATHLON 2013 ORGANIZERS

.1 Village Grid: D.O.E. organizers will provide the village with a power grid that will provide and accept AC power from the houses in accordance with Rule 8-5 of the U.S. Department of Energy Solar Decathlon 2013 Rules and includes, but may not necessarily be limited to the following:

- .1 Provision of the necessary service conductors.
- .2 Intertie connections.
- .3 Connection of the necessary service conductors to the intertie points.

.2 Water Delivery and Removal: D.O.E. organizers will provide up to 1500 gallons of water. Teams may request water in accordance with Rule 9. Liquids of the Energy of the U.S. Department of Energy Solar Decathlon 2013 Rules.

.3 Coordinate with and afford D.O.E. organizers every opportunity for integration of their work.

Part 3 Execution

3.1 COMPETITION SITE

.1 Teams shall be financially responsible for the following in connection with the Competition Site occurring both inside and outside of the Solar Envelope:

- .1 Making good of damage to existing roads, curbs, gutters, and sidewalks, grass, landscaping and other existing site conditions caused by Work of this Project.
- .2 Teams shall make arrangements with, pay costs and charges levied by, and comply with requirements the D.O.E organizers.

3.2 TEAM'S USE OF PREMISES

.1 Teams shall have partial use of premises for performance of the Work in accordance the U.S. Department of Energy Solar Decathlon 2013 Rules.

.2 Teams shall limit their use of premises to the following:

- .1 Areas of Work established by the D.O.E must be kept separate from on-going activities of the Competition Site.
- .2 Decathletes will not be allowed access to occupied areas during normal working hours without prior approval from D.O.E. organizers.
- .3 Overhead work shall be completed in accordance the U.S. Department of Energy Solar Decathlon 2013 Rules. Precautions must be made for overhead work to prevent debris from falling onto occupied or adjacent spaces.
- .4 Maintain fire exit routes through areas of Work until completion of Work.
- .5 Teams shall limit their use of premises to allow for:
  - .1 D.O.E. Organizer use
  - .2 Public use.
  - .3 Work of Other Teams.

3.3 RESPONCIBILIY FOR EXISTING PROPERTY

.1 Teams shall assume full responsibility for care, custody and control of area that is assigned to them for performance of Work of their Project.

.2 Teams shall repair all damage to existing property attributable to performance of Work of their Project.

3.4 ADMINISTRATIVE PROCEDURES

.1 Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of Work; such administrative activities shall include, but not be limited to, the following:

.1 Preparation of schedules and coordination with D.O.E organizers and Team Crew's activities.

.2 Installation and removal of temporary facilities under direction of the D.O.E organizers and Team Project Manager for facilities installed by Team crew members.

.3 Progress meetings where required by D.O.E organizers and Team project managers

.4 Supervise activities to ensure that no part of the Work the is either; in progress, or completed, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during assembly, operation or disassembly periods.

END OF SECTION

SECTION 01 33 50

DELEGATED DESIGN SUBMITTALS

Part 1 General

1.1 INTENT

.1 The intent of Delegated Design Submittals required by this section is to account for professional engineering responsibility for design, review and acceptance of components of Work forming a part of permanent Work in accordance with Building Code, and that has been assigned to a design entity other than the Team including, but not limited to, the following:

.1 Design requiring structural analysis of load bearing components and connections.

.2 Design requiring compliance with fire safety regulations.

.3 Design requiring compliance with life or health safety regulations.

.2 This section provides standard forms for submittal of Letters of Assurance and Due Diligence required complying with requirements of Building Code and design delegated to a professional Engineer within technical specification sections.

.3 Delegated Design Submittals are not required for components of Work requiring engineering for temporary Work (for example: crane hoisting and engineered lifts,) that would normally form a part of the Team and Team Crew members scope of Work.

.4 The requirements of this section do not diminish responsibilities of Teams requirements to obtain a Registered Professional of Record; Delegated Design submittals will be used by the Team and Team Crew members to establish that Work is substantially performed in accordance with Building Code.

1.2 RELATED REQUIREMENTS

.1 Section 01 00 06 – General Requirements; Submittals: Submission of Letters of Assurance and Due Diligence

.2 Section 01 42 19 – Reference Standards: Requirements for governing Building Codes and Standards.

.3 Section 05 12 00 – Structural Steel Framing: Steel connection requirements.

.4 Section 05 50 00 – Metal Fabrications: Design of handrails, guardrails, and other load supporting elements.

.5 Section 07 84 00 – Firestopping: Engineered judgements for firestop and smokeseal assemblies.

.6 Section 21 13 00 – Fire Suppression Sprinkler Systems

.7 Other Technical specification sections making specific reference to delegated design requirements described in this Section.

1.3 DEFINITIONS

.1 Delegated Design Professional Engineer: The professional engineer hired or contracted to the fabricator or manufacturer to design specialty elements, produce delegated design submittals and shop drawings to meet the requirements of the Project; who is registered in the province of the Work; and who is not the Team Project Manager or, Team Member

.2 Letters of Commitment and Compliance: Documents prepared by the delegated design professional engineer as recommended by APEGA's Responsibilities for Engineering Services for Building Projects.

1.4 REFERENCE STANDARDS

.1 Association of Professionals in Engineering and Geoscience in Alberta (APEGA):

.1 APEGA Responsibilities for Engineering Services for Building Projects

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements; Submittals.

.2 Informational Submittals: Provide the following submittals during the course of the Work:

.1 Letter of Assurance: Submit a signed and sealed Letter of Assurance on company letterhead addressed to Consultant in accordance with format in Appendix A attached to the end of this Section prior to starting Work requiring design and seal of a professional engineer.

1.6 PROJECT CLOSEOUT SUBMISSIONS

.1 Record Documentation: Submit the following required information in accordance with Section 01 00 06 – General Requirements; Project Record Documents before application for Substantial Performance:

.1 Letter of Compliance: Submit a signed and sealed Letter of Compliance on company letterhead addressed to Consultant in accordance with format in Appendix B attached to the end of this Section on completion of Work requiring design and seal of a professional engineer.

Part 2 Products

2.1 DELEGATED DESIGN

.1 Performance and Design Criteria: Provide products and systems complying with specific performance and design criteria indicated where professional design services or certifications by a design professional are specifically required of the Team Project Manager or Team Member by Contract Documents.

.1 Requirements listed for Team Crew Member apply to volunteering Team Crew Member Engineers where Delegated Design requirements are required for self performed components of the Work.

.2 Delegated design will be required for elements designed by a specialty professional, which may include:

.1 Elements normally fabricated off-site

.2 Elements that require specialized fabrication equipment or a proprietary fabrication process not usually available at job site (for example: open web steel joists, wood trusses, combination wood and metal or plywood joists, prefabricated wood or metal buildings, noise and vibration isolation devices, elevators).

.3 Elements requiring civil engineering, not normally a part of scope of services performed by architectural; structural; mechanical; electrical; or geotechnical disciplines of The Team Crew Members (for example: structural steel connection design, steel deck design).

Part 3 Execution

3.1 IMPLEMENTATION

.1 Include Summary of Work described in technical specification section as a part of the required Letter of Commitment.

.2 Prepare required submittals and present to Consultant within sufficient time to allow for Consultant's detailed review and acceptance.

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APPENDIX A

LETTER OF COMMITMENT

Submit a signed and sealed Letter of Commitment on company letterhead in the form as follows:

[Date]

TEAM CANADA
EVDS, Professional Facilities Building,
University of Calgary
2500 University Drive N.W.,
Calgary, Alberta, Canada
T2N – 1N4Attention:

Re: Letter of Commitment for Delegated Design of System of Component of Work

BOREALIS
Calgary, Alberta

As the retained registered professional engineer for design and field review of the above named component of Work and project, I hereby give assurance I am qualified to perform the following Work as required by Contract Documents:

1. [List appropriate design services for System or Component of Work];
2. Preparation of shop and erection documents;
3. Review fabrication of [structural] [fire rated] [life and health safety] components;
4. Review erection of [structural] [fire rated] [life and health safety] components.
5. [Modify list to suit System of Component of Work.]

I hereby give assurance that I will be responsible for above noted Work as described in Section [?? ?? ?? – [Name of Section] of Project Manual, including requirements of addenda, change orders and change directives.

I also undertake to be responsible for field review of fabrication and erection of [structural] [fire rated] [life and health safety] components as required to ascertain substantial compliance with the Building Code and Contract Documents.

I will notify you in writing if my responsibility is terminated at any time during the course of Work covered by this Letter of Assurance.

Retained Professional Engineer

Signature

Date

(Apply seal)

APPENDIX B

LETTER OF COMPLIANCE

[Date]

Team Canada

EVDS, Professional Facilities Building,
University of Calgary
2500 University Drive N.W.,
Calgary, Alberta, Canada
T2N – 1N4

Re: Letter of Compliance for Delegated Design of System of Component of Work

BOREALIS
Calgary, Alberta

I hereby give assurance that I have fulfilled my obligations for field review as outlined by previously submitted Letter of Assurance.

I hereby give assurance that aspects of [structural] [life and health safety] Work as defined by previously submitted [Letter of Due Diligence] [Letter of Compliance] substantially comply with Contract Documents and Building Code.

Retained Professional Engineer

Signature

Date

(Apply seal)

END OF SECTION

SECTION 01 35 00

SITE SAFETY REQUIREMENTS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 U.S. Department of Energy 2013 Solar Decathlon Rules

.2 U.S. Department of Energy 2013 Solar Decathlon Building Code

.3 Section 01 00 06 – General Requirements; Submittals: Safety Plan, MSDS's and other information required by this section.

.4 Requirements of this section apply with equal weight to all sections of the Project Manual.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Responsibility for Work Site Safety:

.1 The Team, for the purposes of the U.S. Department of Energy Solar Decathlon Competition, and for the entire duration of the Work of this Competition, including pre-fabrication, assembly, operation and disassembly shall:

.2 Meet all requirements of the U.S. Department of Energy Solar Decathlon Health and Safety Rules and Regulations, 2012 International Building Code, Fire Code legislation and all other applicable laws that govern work place safety both in the pre-fabrication location and at the Competition Site.

.3 The Team Project Manager direct all Team Crew members, workers and any other persons involved in the pre-fabrication, assembly operation and disassembly on safety related matters, to the extent required to fulfill the requirements and responsibilities pursuant to applicable Laws, Codes By-laws, rules and regulation that govern the U.S. Department of Energy 2013 Solar Decathlon.

.2 Team Life-Safety captain will coordinate safety requirements with Team and Team Crew members.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 00 06 – General Requirements; Submittals and as required by the U.S. Department of Energy 2013 Solar Decathlon Building Code and Competition Rules.

.2 Informational Submittals: Provide the following submittals during the course of the work:

.1 Provide Material Safety and Data Sheets (MSDS's) for all controlled products as listed in the provincial Chemical Hazards Regulation.

.2 Team's Safety Plan: Submit Team's Safety Plan in accordance with the U.S. Department of Energy 2013 Solar Decathlon Building Code and Rules and shall include, but may not necessarily limited to the following:

.1 Emergency plans and contact name and telephone list,

.2 Safety procedures for electrical systems, including but not limited to, de-energization and re-energization, locking out and tagging of systems, identification of energized lines, and requirements of local utilities,

.3 Safety procedures for mechanical systems, including but not limited to, isolation and depressurization of pressure systems, locking out and tagging of systems, purging of systems, and restart and refill of systems,

.4 Ventilation procedures for confined spaces and MSDS work requirements,

.5 List of Personal Protection Equipment (PPE) required on site,

.6 Noise control procedures,

.7 Safety plans including procedures to meet requirements of the Solar Decathlon rules, Regulations and Building Codes

.8 Copies of all Material Safety Data Sheets for the use of the Team Project Manager, Team member or other Team Crew member assigned to such duties Health Centre.

.3 The D.O.E Organizers and D.O.E Site Safety Officer(s) will review the Team's Safety Plan for compliance to the Competition Documents and may request modifications or additions as necessary.

.4 The Teams' Safety Plan shall be kept on site and updated after each Safety Meeting.

1.4 SITE CONDITIONS

.1 Environmental Requirements: Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada and the State of California U.S.A.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 SAFETY REQUIREMENTS

.1 Teams will verify that emergency procedures including appropriate First Aid facilities and First Aid personnel are in place at the Places of Work.

.2 Teams will also have access to the First Aid Facilities provided by the U.S. Department of Energy Solar Decathlon Organizers. Conditions for use will be reviewed at the All-Team Meeting, refer to Appendix A, A-1 and A-3 of the U.S. Department of Energy 2013 Solar Decathlon Rules.

.3 Teams shall designate and maintain, on-site a Life-Safety Captain who is responsible for the following:

.1 Providing Team Crew orientation

.2 Overseeing assembly, operation and disassembly activities and operations

.3 Providing appropriate training on personal protective equipment and Workplace Hazardous Materials Information System (WHMIS)

.4 Conducting and documenting accident investigations as required

.5 Conducting daily work site inspections and reviews

.4 Maintain on site sufficient quantities of PPE, including but not limited to: hard hats, safety glasses, hearing protection and other items of clothing or special equipment as necessary to verify that visitors to the site, Team Project Manager, Team Member or other Team Crew Members are adequately protected.

.5 Verify that all team members and Team Crew members and others working on the project, meet clothing requirements of shirts with sleeves no shorter than midway between shoulder and elbow and full length pants; muscle shirts or sleeveless shirts, cut-offs or shorts will not be allowed on the work site.

END OF SECTION

SECTION 01 41 00

REGULATORY REQUIREMENTS

Part 1 General

1.1 DEFINITIONS

.1 Authority Having Jurisdiction: Means all U.S. Department of Energy 2013 Solar Decathlon organizers, Safety Officers, Contest Officials, Director and Site Operations Manager

.2 Regulatory Requirements: Regulatory requirements means laws, by-laws, ordinances, rules, regulations, codes, orders of Authority Having Jurisdiction, and other legally enforceable requirements applicable to Work and that are or become in force during performance of Work.

.3 Governing Building Code: Work of this Project is based minimum requirements of the U.S. Department of Energy 2013 Solar Decathlon Building Code which has adopted the 2012 International Residential Code and, when read in conjunction is considered as the Governing Building Code requirements for the Competition:

.1 Specific design and performance requirements listed in the specifications or indicated on the Drawings may exceed the minimum requirements established by the referenced Building Code; these requirements will govern over the minimum requirements listed in the Building Code.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

SECTION 01 42 16

DEFINITIONS

Part 1 General

1.1 DEFINITIONS

.1 **Assembly**

The period of time between the arrival of trucks and the beginning of the contests on the competition site.

.2 **Communications Manager**

The organizer responsible for the project's public outreach and communications activities.

.3 **Communications Materials**

All printed or electronic publications designed to convey information to the public.

.4 **Competition**

All aspects of the Solar Decathlon related to the contests and the scoring of those contests.

.5 **Competition Documents**

All documents provided by the Team and Solar Decathlon building officials including, but not limited to the followings: drawings, project manual, Solar Decathlon Rules, Regulations, Building Code and other documents used that govern over the Competition.

.6 **Competition Manager**

The organizer responsible for writing and enforcing the rules and conducting a fair and compelling competition.

.7 **Competition Prototype**

The complete assembly of physical components installed within the solar envelope.

.8 **Competition Site**

The area provided by the organizers containing all solar envelopes, pedestrian walkways, and associated organizer equipment, structures, and infrastructure.

.9 **Contest**

The Solar Decathlon competition consists of 10 separately scored contests, each containing one or more subcontests.

.10 **Contest Official**

An individual selected by the competition manager to officiate one or more of the contests; a contest official is only authorized to interpret the rules of the contest(s) to which he or she is assigned.

.11 **Contest Week**

The 9-day period on the competition site when some or all contests are in progress.

.12 **Decathlete**

A team member who meets the decathlete eligibility rules outlined in the file posted in the "/Files/Rules" folder on the Yahoo Group.

.13 **Decision**

The rules officials' interpretation or clarification of a rule.

.14 **Decisions on the Solar Decathlon Rules**

The compilation of all decisions made by the rules officials during the project.

.15 **Director**

The organizer representing the U.S. Department of Energy with final decision-making authority regarding all aspects of the project.

.16 **Disassembly**

The period of time between the closing of the public exhibit and the completion of competition site cleanup; Rule 8-2 does not apply during disassembly.

.17 **Event**

The activities that take place on the competition site including, but not limited to, registration, assembly, inspections, contests, special events, public exhibits, and disassembly.

.18 **Event Production Manager**

The organizer responsible for the project's special events and volunteer activities.

.19 **Event Sponsor**

An entity selected by the director to support the Solar Decathlon—a project of the U.S. Department of Energy (DOE), which partners with other institutions, such as its National Renewable Energy Laboratory (NREL), to help ensure the success of the project.

.20 **Faculty Advisor**

A team member who is the lead faculty member and primary representative of a participating school in the project; also provides guidance to the team on an as-needed basis throughout the project.

.21 **Grid-Tie Assembly**

The period of time during assembly after the house has been connected to the village grid (interconnected); Rule 8-2 applies during grid-tie assembly.

.22 **Interconnection Application**

Submitted in the project manual by the team's electrical engineer, this form provides the technical details needed to determine the suitability of the team's electrical system for interconnection to the village grid.

.23 **Juried subcontest**

A subcontest based on a jury evaluation.

.24 **Juror**

An individual selected by the organizers to make subjective evaluations of the projects.

.25 **Jury**

A group of jurors evaluating a specific aspect of each team's competition prototype.

.26 **Measured Subcontest**

A subcontest based on task completion or monitored performance.

.27 **Observer**

Assigned by the competition manager to observe team activities during contest week, an observer reports observed rules infractions to the rules officials and records the results of specific contest tasks, but does not provide interpretations of the Solar Decathlon Rules.

.28 **Organizer**

A DOE or NREL employee, subcontractor, or observer working on the project and having the authority described in Rule 1-4.

.29 **Project**

All activities related to the U.S. Department of Energy Solar Decathlon 2013—from the issuance of the request for proposals through the closing of subcontracts.

.30 **Protest Resolution Committee**

A group of individuals selected by the organizers to resolve team protests during the competition.

.31 **Public Exhibit**

Areas of the competition site open to the public during designated hours.

.32 **Rule**

A principle or regulation governing conduct, action, procedure, arrangement, etc., for the duration of the project.

.33 **Rules Official**

An organizer authorized to interpret the rules; the competition manager is the lead rules official.

.34 **Safety Officer**

An organizer whose primary responsibilities are to evaluate the teams' construction documents and the teams' competition site activities for compliance with Rule 3-3.

.35 **Scored Period**

Any 15-minute period beginning at 0, 15, 30, or 45 minutes after the hour, during which a particular monitored contest is in progress.

.36 **Scorekeeper**

The individual selected by the organizers to operate the scoring server during the competition .

.37 **Scoring Server**

A server that collects data from the central datalogger server; includes forms for manually entering juried and task-based measured contest results, and calculates composite scores.

.38 **Site Operations Manager**

The organizer responsible for all event site operations except those listed as responsibilities of the competition manager and event production manager.

.39 **Solar Decathlon Building Code**

A set of design and construction standards set forth and enforced by the Solar Decathlon building official for the protection of public health and safety during the event.

.40 **Solar Decathlon Building Official**

The rules official responsible for writing, interpreting, and enforcing the Solar Decathlon Building Code.

.41 **Solar Envelope**

The area, as defined by Rule 5, containing the competition prototype.

.42 **Stand-Alone Assembly**

The period of time during assembly before the house has been interconnected to the village grid; Rule 8-2 does not apply during stand-alone assembly.

.43 **Staff**

Individuals working for the organizers on the project, including volunteers.

.44 **Subcontest**

An individually scored element within a contest.

.45 **Team**

The combination of team members, including team crew and decathletes, representing a single entry to the competition.

.46 **Team Crew**

A person who is integrally involved with a team's project but is unaffiliated with a participating school; contractors, subcontractors, suppliers, volunteers, team media, and sponsors represent team crew examples.

.47 **Team Crew Member**

See Team crew for definition.

.48 **Team Member**

An enrolled student, recent graduate, faculty member, or other person who is affiliated with one of the participating schools and is integrally involved with a team's project activities; decathletes, faculty advisors, and involved staff from a participating school are all considered team members.

.49 **Village Grid**

The bi-directional, AC electrical network on the competition site to which each house has an individually metered connection.

END OF SECTION

SECTION 01 42 19

REFERENCE STANDARDS

Part 1 General

1.1 SUMMARY

.1 All references to codes, standards and standard specifications referred to in these Specifications or used on drawings shall mean and intend to be the currently adopted edition, amendment and revision of such reference standards in effect at the time of Bid closing.

.2 In the event that the most current version of a code, standard or standard specification differs from the version indicated in these Specifications:

.1 Report the discrepancy to the Team immediately.

.2 The most current standard will be used to establish the quality of the work or material being referenced.

.3 Referenced standards and code requirements shall be considered minimum requirements only. The Specifications may indicate additional requirements in excess of those established by referenced codes and standards.

.4 Applicable portions of Standards used that are not in conflict with the Competition Documents are hereby made a part of the Specifications.

.5 Modifications or exceptions to Standards shall be considered as amendments, and unmodified portions shall remain in full effect.

.6 In cases of discrepancies between the Specifications and Standards, the requirements of the Specification shall govern.

.7 In cases of discrepancies between Codes and the Specifications, the Code requirements shall govern.

1.2 RELATED REQUIREMENTS

.1 Section 01 41 00 – Regulatory Requirements: Governing Building Code relating to standards applicable to project.

1.3 STANDARDS ORGANIZATIONS

.1 The following list of standards organizations indicate the most common standards that may be referenced within the technical specifications:

.1 ANSI - American National Standards Institute

.2 ASTM - American Society for Testing and Materials

.3 CGA - Canadian Gas Association

.4 CGSB - Canadian General Standards Board

.5 CSA - Canadian Standards Association

.6 CAN1 - National Standard of Canada (published by CGA)

.7 CAN2 - National Standard of Canada (published by CGSB)

.8 CAN3 - National Standard of Canada (published by CSA)
.9 CAN4 - National Standard of Canada (published by ULC)
.10 ULC - Underwriters Laboratories of Canada
.11 UL or ULI - Underwriters Laboratories Inc.

Name of Association	Abbreviation
Acoustical Materials Association	AMA
Air Movement & Control Association	AMCA
Alberta Building Code	ABC
Alberta Floor Covering Association	AFCA
Alberta Roofing Contractors Association	ARCA
American Concrete Institute	ACI
American Iron & Steel Institute	AISI
American Society of Heating, Refrigerating and Airconditioning Engineers	ASHRAE
American Society of Mechanical Engineers	ASME
American Standards Association	ASA
American Wood Preservers' Association	AWPA
Architectural Woodwork Manufacturers Association of Canada	AWMAC
Canadian Institute of Steel Construction	CISC
Ceilings & Interior Systems Construction Association	CISCA
Canadian Sheet Steel Building Institute	CSSBI
Canadian Welding Bureau	CWB
Construction Specifications Canada	CSC
Factory Mutual	FM
Heating, Refrigerating and Airconditioning Institute of Canada	HRAI
Hydronics Institute	HI
Industrial Fabric Association International	IFAI
Insulated Glass Manufacturers Association of Canada	IGMAC
Master Painters Institute	MPI
National Association of Architectural Metal Manufacturers	NAAMM
International Residential Code	IRC
National Fire Protection Association	NFPA
National Lumber Grades Authority	NLGA
Northwest Wall and Ceiling Bureau	NWCB
Terrazzo, Tile & Marble Association of Canada	TTMAC
Tile Council of North America	TCNA
The Society for Protective Coatings	SSPC

.12 WHI - Warnock Hersey | Intertek Testing Services

.2 The following limitations on marks issued by standards organizations will apply to the standards issued by the organizations listed in **Error! Reference source not found.**:

.1 Underwriters Laboratories Inc.: Only systems designated by "UL" , "UL_{US}", "$_{C}UL$"and "$_{C}UL_{US}$ will be acceptable for use on this project. Systems indicating design standards other than "UL" , "UL_{US}", "$_{C}UL$"and "$_{C}UL_{US}$" will only be considered where U.S. Department of Energy 2013 Solar Decathlon authorities having jurisdiction have reviewed and accepted the systems.

.2 Warnock Hersey Intertek: Only materials designated by "WH", "WHI" "$_{C}WHI_{US}$" or "$_{C}WHI$" mark will be acceptable for use. Materials bearing stamps other than a "WH", "WHI" "$_{C}WHI_{US}$" or "$_{C}WHI$" will only be considered where U.S. Department of Energy 2013 Solar Decathlon authorities having jurisdiction have reviewed and accepted the systems.

.3 Teams and Team Crew members will be responsible for obtaining written acceptance of materials and submitting them to the U.S. Department of Energy 2013 Solar Decathlon authorities having jurisdiction prior to installation.

1.4 ABBREVIATIONS

.1 Additional Technical Societies, Associations, or Standards may be referenced in these Specifications in addition to the following abbreviations:

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.

.2 Support facilities include, but are not limited to, the following:

.1 Lifts and hoists.

.2 Temporary elevator usage.

.3 Temporary stairs.

.4 Construction aids and miscellaneous services and facilities.

.3 Security and protection facilities include, but are not limited to, the following:

.1 Barricades, warning signs, and lights.

.2 Fire protection.

1.2 DESIGN OF TEMPORARY FACILITIES

.1 Design Requirements: Project Team is responsible for design and safety of temporary facilities:

.1 Temporary facilities of such nature that engineering proficiency is required for their design to ensure safety during construction shall be designed by a professional engineer in the employ of the Contractor.

.2 Before the temporary structure is used, the engineer responsible for the design or their representative shall inspect the structure and issue a certificate stating that it has been constructed according to the engineer's design.

.3 Submit certificate to Consultant as an Informational Submittal in accordance with Section 01 00 06 – General Requirements; Submittals.

.2 Temporary Facility Requirements: Provide hoists, cranes and moving equipment, and shoring and bracing required for hoisting, lifting and moving equipment and materials required for the project into final position within the structure and as follows:

.1 Notify affected Team Crew Members, Event Organizers, Contest Officials and other governing Authorities and coordinate placement of hoisting, lifting and moving equipment, and shoring and bracings.

.2 Provide qualified personnel to operate and erect hoists, cranes and moving equipment, and shoring and bracing.

.3 Provide qualified engineer where site engineering is required to inspect and supervise erection procedures.

.3 Notification Requirements: Prepare risk control plan and engineered lift study for any equipment or material movements that have the potential to overload the structure, adjacent buildings and structures, or affect occupant safety and as follows:

.1 Notify the Team Crew Members, Event Organizers, Contest Officials and other governing Authorities of engineered erection procedures for hoisting, lifting and moving equipment, and shoring and bracings.

.2 Prepare risk control plan and engineered lift study before equipment and materials requiring detailed erection procedures sufficiently in advance of when they are scheduled to arrive on site to allow for Team Crew Members, Event Organizers, Contest Officials and other governing Authorities review.

.3 Submit risk control plan and engineered lift study to the Team Crew Members, Event Organizers, Contest Officials and other governing Authorities as an Informational Submittal in accordance with Section 01 00 06 – General Requirements; Submittals.

1.3 UTILITIES AND USAGE CHARGES

.1 Cost or use charges for temporary facilities are not chargeable to Team Crew Members, Event Organizers, Contest Officials and other governing Authorities or Solar Decathlon Officials. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:

.1 Team Crew Members,

.2 Event Organizers,

.3 Contest Officials and other governing Authorities

.4 Testing agencies.

.5 Personnel of authorities having jurisdiction.

.2 Water: Use water from as stipulated in the 2013 Solar Decathlon Rules:

.3 Electricity: Use electric power as stipulated in the 2013 Solar Decathlon Rules:

.4 Sanitary Facilities: Team and team Crew Members will be permitted use of assigned sanitary facilities, Decathletes shall be responsible for maintaining assigned facilities in a clean and tidy manner.

.5 It is the intention of the Solar Decathlon Authorities having Jurisdiction to supply temporary services where specified, however, in the event of any unforeseen occurrence, the Solar Decathlon Authorities having Jurisdiction may discontinue such temporary services.

.6 Supply of temporary services by the Solar Decathlon Authorities having Jurisdiction is subject to the requirements of the 2013 Solar Decathlon Rules and Regulations.

.7 Teams shall bear costs of all temporary services required for the project in excess of those, available from existing services, supplied by the Solar Decathlon Authorities having Jurisdiction.

1.4 SUBMITTALS

.1 Temporary Utility Reports: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

.2 Implementation and Termination Schedule: Submit a schedule indicating implementation and termination of each temporary utility forming a part of the Construction Schedule

1.5 QUALITY ASSURANCE

.1 Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

.1 Keep temporary services and facilities clean and neat.

.2 Relocate temporary services and facilities as required by progress of the Work.

Part 2 Products

2.1 MATERIALS

.1 Provide new materials; undamaged and suitable for use intended.

.2 Lumber and Plywood: In accordance with requirements in Section 06 10 00 – Rough Carpentry.

.3 Gypsum Board: Minimum 13 mm (½") thickness x 1220 mm (48") wide by maximum available lengths; regular type panels with tapered edges, as specified in Section 09 21 16 – Gypsum Board Assemblies.

.4 Insulation: Unfaced mineral fibre blanket, manufactured from glass, slag wool, or rock wool; with maximum flame spread and smoke developed classification of 25/50, as specified in Section 07 21 16 – Blanket Insulation.

.5 Paint: Comply with requirements in Section 09 90 05 - Painting.

.6 Tarpaulins: Fire resistive labelled with flame spread rating of 15 or less.

.7 Water: Potable.

2.2 FIRE PROTECTION

.1 Provide hand carried, portable, ULC rated fire extinguishers in class and extinguishing agent as indicated or a combination of extinguishers of NFPA recommended classes for exposures encountered on the work site.

.2 Fire extinguishers will in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

.3 During full time of construction, while existing buildings remain occupied, maintain free unobstructed access to all sides of existing buildings for fire department vehicles. Confirm access with fire department.

2.3 EQUIPMENT

.1 Diesel Fuelled Equipment: Equip diesel fuelled equipment with diesel oxidation catalytic converter and particulate filter; certified in accordance with US Environmental Agency (EPA) Clean Air Act and meeting ambient air quality standards established by US Occupational Health and Safety Administration (OSHA).

.2 Provide equipment suitable for use intended.

.3 Provide containerized, tap dispenser, bottled water drinking water units, including paper cup supply.

.4 Provide properly configured, NEMA polarized outlets to prevent insertion of 110 V plugs into higher voltage outlets; equipped with ground fault circuit interrupters, reset button, and pilot light.

.5 Provide power distribution system circuits, and overhead and exposed for surveillance, wiring circuits, not exceeding 125 VAC, 20 A rating, and lighting circuits may be non-metallic sheathed cable in accordance with the requirements of the authorities having jurisdiction.

2.4 SHEDS AND STORAGE

.1 There is limited space available on site for the placement of sheds and enclosed storage facilities. Contractor shall schedule deliveries for immediate needs only, no storage will be allowed on site, except in the immediate area of the work.

2.5 SCAFFOLDING

.1 Provide and maintain scaffolding, ramps, ladders, swing staging, and platforms required for Scope of Work requiring access.

.2 Coordinate placement and notification of affected Team Crew Members.

.3 Install scaffolding only when backfill work has been completed and risk of damage to structure is minimized.

.4 Design and engineer scaffolding in accordance with authorities having jurisdiction, and provide certifications as necessary to prove compliance. Submit certificates when requested by the Competition Organizers

2.6 STAIRS

.1 Provide temporary stairs where ladders are not adequate until permanent stairs are available.

Part 3 Execution

3.1 INSTALLATION, GENERAL

.1 Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

3.2 TEMPORARY ENCLOSURE INSTALLATION

.1 Requirements specified below are additional to and are intended to supplement requirements pertaining to temporary enclosures specified elsewhere in the Competition Documents.

.2 Provide temporary barriers and enclosures as required to ensure that construction work and activities continue uninterrupted and unhampered by adverse weather conditions for duration of construction period.

3.3 SUPPORT FACILITIES INSTALLATION

.1 Locate site offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.

.2 Maintain support facilities until near Substantial Performance:

.1 Remove before Declaration for Substantial Performance.

.2 Personnel remaining after Substantial Performance will be permitted to use permanent facilities, under conditions acceptable to Owner.

3.4 DEWATERING FACILITIES AND DRAINS

.1 Provide temporary drainage and dewatering facilities to maintain Project site, excavations, and construction free of water.

.2 Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining property, and that will endanger permanent Work or temporary facilities.

.3 Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

.4 Provide temporary drainage where roofing or similar waterproof deck construction is completed and where connection and operation of permanent drainage piping system has not been completed.

.5 Remove snow and ice as required to minimize accumulations.

3.5 WASTE DISPOSAL FACILITIES

.1 Provide waste collection containers in sizes adequate to handle waste from construction operations.

.2 Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste.

.3 Provide separate containers, clearly labelled, for each type of waste material to be deposited, if required by authorities having jurisdiction.

3.6 SECURITY AND PROTECTION FACILITIES INSTALLATION

.1 Secure building against illegal entry at end of each work day. Equip exterior temporary doors with hardware and locks.

.2 Provide protection, operate temporary facilities, and conduct construction in ways and by methods that in accordance with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

.3 Avoid using tools and equipment that produce harmful noise:

.1 Restrict use of noisemaking tools and equipment to hours that will minimize complaints from neighbouring persons or businesses near Project site.

.2 Restrict use of noisemaking tools and equipment to in accordance with local bylaws and the authorities having jurisdiction.

.4 Provide protection for trees, shrubs and planting beds:

.1 Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage.

.2 Protect tree root systems from damage, flooding, and erosion.

.5 Provide barricades, warning signs, and lights in accordance with standards and code of authorities having jurisdiction.

3.7 TEMPORARY FIRE PROTECTION

.1 Install and maintain temporary fire protection facilities of types needed to protect against reasonably predictable and controllable fire losses until permanent facilities are complete and operational. In accordance with requirements of authorities having jurisdiction and NFPA 241 96, Standard for Safeguarding Construction, Alteration, and Demolition Operations.

.2 Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above including, but not limited to the following:

.1 Site Offices: Class A stored pressure water type extinguishers.

.2 Other Locations: Class ABC dry chemical extinguishers or a combination of extinguishers of NFPA recommended classes for exposures.

.3 Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.

.3 Store combustible materials in containers in fire safe locations.

.4 Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire exposure areas.

.5 Supervise welding operations, combustion type temporary heating units, and similar sources of fire ignition.

.6 Provide hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.8 OPERATION, TERMINATION, AND REMOVAL

.1 Enforce strict discipline in use of temporary facilities to minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

.2 Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Declaration of Substantial Performance.

3.9 TERMINATION AND REMOVAL

.1 Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Performance.

.2 Clean and renovate permanent facilities used during construction period in accordance with final cleaning requirements specified in Section 01 00 06 – General Requirements; Housekeeping

END OF SECTION

SECTION 05 05 00

COMMON WORK RESULTS FOR METALS

Part 1 General

1.1 SUMMARY

.1 This Section includes general provisions and common work results applicable to work relating to the fabrication and erection of structural steel, steel joists, light-weight steel framing and metal fabrications.

1.2 RELATED REQUIREMENTS

.1 Section 01 33 50 – Delegated Design Submittals: Submission requirements for systems requiring professional design services or certifications by a design professional employed by the fabricator, and who is not the Consultant.

.2 Section 05 05 19 – Common Work Results for Metalwork Finishing: Priming applied to structural steel components.

.3 Section 05 12 00 – Structural Steel Framing

.4 Section 05 21 00 – Steel Joist Framing

.5 Section 05 41 00 – Lightweight Structural Steel Framing

.6 Section 05 50 00 – Metal Fabrications: Design of steel stairs, landings and handrails, and other load supporting elements.

1.3 REFERENCE STANDARDS

.1 American Welding Society (AWS):

.1 AWS A05.1 – Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.

.2 AWSA05.18 – Specification for Carbon Steel Electrodes and Rots for Gas Shielded Arc Welding.

.3 AWS B02.1 – Guide for Non-Destructive Examination of Welds.

.4 AWS D1.1/D1.1M:2002, Structural Welding Code - Steel

.2 Canadian Standards Association (CSA):

.1 CAN/CSA-G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.

.2 CAN/CSA S16-01, Limit States Design of Steel Structures

.3 CAN/CSA S136-07, North American Specification for the Design of Cold-Formed Steel Structural Members

.4 CSA W47.1-03 (R2008), Certification of Companies for Fusion Welding of Steel

.5 CSA W55.3-08, Certification of Companies for Resistance Welding of Steel and Aluminum, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings

.6 CSA W59-03, Welded Steel Construction (Metal Arc Welding)

.7 CSA W117.2-01, Safety in Welding, Cutting and Allied Processes

.8 CSA W178.1-2008, Certification of Welding Inspection Organizations

.9 CSA W178.2-2008, Certification of Welding Inspectors

.3 Canadian Welding Bureau (CWB Group Industry Services):

.1 CWB 112E, 2003-1, Welding Symbols Study Guide

.2 CWB 113E, 99-1, Weld Quality and Examination Methods Study Guide

.4 Canadian Institute of Steel Construction (CISC):

.1 7th Edition, Code of Standard Practice, 2009

.2 10th Edition, Handbook of Steel Construction, 2010

1.4 DEFINITIONS

.1 Quality Control: Tests, inspections, procedures, and related actions during and after execution of the Work by a third party testing agency to evaluate that completed construction complies with requirements whose services do not include contract enforcement activities performed by Consultant.

.2 Quality Assurance: Activities, actions, and procedures performed before and during execution of the Work by the Team Crew Members to guard against defects and deficiencies and ensure proposed construction complies with requirements.

.1 Delegated Design Professional Engineer: The professional engineer hired or contracted to the fabricator or manufacturer to design specialty elements, produce delegated design submittals and shop drawings to meet the requirements of the Project; who is registered in the province of the Work; and who is not the Consultant.

.2 Letters of Commitment and Compliance: Documents prepared by the delegated design professional engineer as recommended by APEGA's Responsibilities for Engineering Services for Building Projects.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate shop priming and finishing requirements with Section 05 05 19.

.2 Testing and Inspections: The Team will appoint and pay for services of testing agency to perform testing and inspection of work of this Section:

.1 Coordinate with the all Team Members and Team Crew Members prior to commencement of fabrication work so testing and inspection may be properly scheduled and reviewed.

.2 Correct, or remove and replace structural steel with defects revealed by testing and inspection to the recommendations of the testing authority and to the approval of authorities having jurisdiction.

.3 Sequencing: Sequence steel work to account for the following:

.1 Supply anchorage items embedded in or attached to other construction without delaying the Work

.2 Deliver steel bearing plates and other devices as not to cause delay to the project

.3 Schedule delivery of structural steel to Project site in quantities and at times to maintain continuity of installation

.4 Schedule delivery of steel joists to Project site in quantities and at times to maintain continuity of installation

.4 Delegated Design Requirements: Design structural steel connections required by the Contract Documents to withstand design loadings indicated and in accordance with requirements of the Building Code and CAN/CSA S16 to resist forces, moments, shears and allow for movements indicated:

.1 Engage fabricator who utilizes registered professional engineer to prepare calculations, shop drawings, and other structural data for steel joists and connections not shown on drawings that comply with requirements of this Section.

.2 Retain registered professional engineer to ascertain and report fabrication and erection of work meets specific design criteria for materials referenced by Related Requirements.

.5 Building Information Model (BIM): The Team has prepared drawings that include 3D BIM using Revit software that may be helpful to steel fabricators using compatible 3D Manufacturing Model (3DMM) software; arrange a meeting that will be attended by the all Team Members, Team Crew Members and other affected personnel to coordinate compatible information sharing requirements.

1.6 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit following product test reports for steel deck materials, from qualified testing agency indicating each of following complies with requirements, based on comprehensive testing of current products:

.1 Provide product certificates signed by steel deck manufacturers certifying products provided comply with requirements of specifications and Building Code.

.2 Provide product data for mechanical and adhesive fasteners indicating load ratings and methods of installation.

.2 Informational Submittals: Provide the following submittals during the course of the work:

.1 Reports: Submit written reports prepared by the testing and inspection agency that includes the following:

.1 Date of issue

.2 Project title and number

.3 Name, address, and telephone number of testing agency

.4 Dates and locations of samples and tests or inspections

.5 Names of individuals making tests and inspections

.6 Description of the Work and test and inspection method

.7 Identification of product and specification section

.8 Complete test or inspection data

.9 Test and inspection results and an interpretation of test results

.10 Ambient conditions at time of sample taking and testing and inspecting

.11 Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements

.12 Name and signature of laboratory inspector

.13 Recommendations on re-testing and re-inspecting

.3 Delegated Design Submittals: Submit Letters of Commitment and Compliance in accordance with Section 01 33 50 – Delegated Design Submittals, and as follows:

.1 At the onset of work of this section and prior to shop drawing submission, prepare and submit a Letters of Commitment, including a summary of the work covered by this section.

.2 On completion of work of this section, prepare and submit a Letters of Compliance, including a summary of the work covered by this section.

.3 Letters referred to in Section 01 33 50 must cover all aspects of structural steel, steel joist work and structural steel including; but not limited to, design of connections and erection.

.4 Source Quality Control Submittals: Submit following mill test reports signed by manufacturers certifying their products comply with following requirements:

.1 Structural steel, including chemical and physical properties

.2 Bolts, nuts, and washers, including mechanical properties and chemical analysis

.3 Direct tension indicators

.4 Headed stud shear connectors

.5 Twist-off tension control bolts or other alternative design bolts

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements: Provide design, materials and fabrication in accordance with AWS Welding requirements, CAN/CSA S16, CAN/CSA S136, and CWB certification requirements including, but not limited to, the following:

.1 Fabricator certified by CWB to CSA W47.1, Division 1 or 2.1.

.2 Fabricator only subcontract or sublet work of fabrication or installation to another CWB certified company.

.3 Installer CWB certified where they are directly engaged by the Team to same requirements as fabricator.

.2 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Fabricator: Use fabricator experienced in fabricating structural steel similar to that indicated for this Project and with record of successful in service performance, and sufficient production capacity to fabricate structural steel without delaying the Work.

.2 Installers: Use installers; if different than fabricator, experienced with structural steel work similar in material, design, and extent to that indicated for this Project; with record of successful in service performance; using welders certified by CWB for classification of work being performed; and having same certifications as required by CSA and CWB for fabricator.

.3 Delegated Design: Delegated design performed by professional engineer, registered in the province of the Work and experienced in providing engineering services for the work specified, and as required by Authority Having Jurisdiction.

.3 Certifications: Provide proof of the following during the course of the Work:

.1 Welding Certificates: Comply with applicable CWB standards for classification of work being performed including, but not limited to, following:

.1 Welding inspection: to CSA W178.

.2 Resistance welding: to CSA W55.3.

.3 Fusion welding: to CSA W59.

.2 Failure of fabricator and installer to maintain CSA and CWB requirements for certification will result in having their certification withdrawn in accordance with the contract that they sign with CSA and CWB, and considered as being in breach of Contract for the Work of the Project leading to decertification.

.4 Quality Management: Team Crew Members assigned to such task shall provide inspections, testing and reports during the course of the work confirming that the work of steel fabrication and erection is conducted in accordance with the Competition Documents and Engineered Shop Drawings (Delegated Design); the frequency of testing and inspection by the inspection and testing agency may be adjusted in consultation with the Team, Team members and Team Crew Members where the steel Team Crew Members own Quality Management Plan demonstrates its effectiveness during the course of the project

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Storage and Handling Requirements: Store materials to permit easy access for inspection and identification; keep steel members off ground by using pallets, platforms, or other supports; protect steel members and packaged materials from erosion and deterioration, and as follows:

.1 Store fasteners in a protected place

.2 Clean and re-lubricate bolts and nuts that become dry or rusty before using

.3 Do not store materials on structure in manner that might cause distortion or damage to members or supporting structures

.4 Repair or replace damaged materials or structures as directed

Part 2 Products

2.1 NOT USED.

Part 3 Execution

3.1 EXAMINATION

.1 Report any discrepancy and potential problem areas to Team Project Manager or other Team Member assigned to such duties for direction before commencing fabrication or erection.

.2 Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads.

.2 Verify that site safety measures are in place and personal protection equipment is worn in accordance with the following:

.1 Occupational Health and Safety Act – Alberta for the Construction Site located in Calgary and,

.2 Occupation Safety and Health Administration – Regulations governing workplace safety and wellness for the State of California for assembly and disassembly of the project at the Competition Site before starting any work of this Section at the respective Project locations.

3.3 CONNECTION TO EXISTING WORK

.1 Verify dimensions and condition of existing work; report any discrepancies and potential problem areas to the Team Project Manager or, other Team Member assigned to such duties before commencing with fabrication.

3.4 ERECTION

.1 Erect structural steel in accordance with CAN/CSA S16 and CSA S136.

.2 Obtain Consultant's review before site cutting or altering any members.

.3 Set structural steel accurately in locations and to elevations indicated on Drawings and reviewed shop drawings.

END OF SECTION

SECTION 05 05 19

COMMON WORK RESULTS FOR METALWORK FINISHING

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements regarding the appearance and surface preparation for non-exposed and exposed structural Steel priming, and finishing of the following metal items and assemblies:

- .1 Structural steel framing
- .2 Metal fabrications
- .3 Ornamental metal fabrications

1.2 RELATED REQUIREMENTS

.1 Section 05 05 00 – Common Work Results for Metals

.2 Section 05 05 13 – Shop Applied Coatings: Shop applied coatings for metal fabrications.

.3 Section 05 12 00 – Structural Steel Framing: Priming and finishing steel framing.

.4 Section 05 50 00 – Miscellaneous Metal Fabrications: Loose steel bearing plates and miscellaneous steel framing and assemblies.

.5 Section 09 91 05 – Painting: Surface preparation and priming requirements, relating to exposed elements requiring finish painting.

1.3 DEFINITIONS

.1 Non-Exposed Standard Structural Steel: Structural steel that is concealed in final construction; that is not subject to weathering or aggressive conditions; and that does not require special coatings to prevent corrosion.

.2 Exposed Standard Structural Steel: Structural steel that is exposed to view or concealed in final construction and is subject to weathering or aggressive conditions that require additional protection to prevent corrosion and loss of sectional area.

1.4 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

- .1 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- .2 ASTM A153/A153M-05, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- .3 ASTM A780-01 (2006), Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- .4 ASTM D4417-03, Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 1.40-97, Anticorrosive Structural Steel Alkyd Primer

.2 CAN/CGSB-1.181, Single Component Organic Zinc Rich Primer

.3 CAN/CGSB 85.10-99, Protective Coatings for Metals

.3 Canadian Standards Association (CSA):

.1 CSA W47.1-92 (R1998), Certification of Companies for Welding of Steel Structures

.2 CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding

.3 CSA W55.3-1965 (R1998), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings

.4 CSA W59-M1989 (R1998), Welded Steel Construction (Metal Arc Welding)

.5 CSA W178.2-1996, Certification of Welding Inspectors

.4 Canadian Welding Bureau (CWB Group Industry Services):

.1 CWB 113E, 94-1, Weld Quality and Examination Methods Study Guide

.5 Canadian Institute of Steel Construction (CISC):

.1 CISC/CPMA Standard 2-75, A Quick-drying Primer For Use On Structural Steel

.2 CISC Code of Standard Practice 7th Edition, 2009

.6 The Society for Protective Coatings (SSPC)/National Association of Corrosion Engineers (NACE International):

.1 Coating Materials Guidelines

.2 Surface Preparation Guidelines:

.1 SSPC-SP 1, Solvent Cleaning

.2 SSPC-SP2, Hand Tool Cleaning

.3 SSPC-SP3, Power Tool Cleaning

.4 SSPC-SP5/NACE No.1, White Metal Blast Cleaning

.5 SSPC-SP6/NACE No. 3, Commercial Blast Cleaning

.6 SSPC-SP10/NACE No.2, Near White Metal Blast Cleaning

.3 Application, Inspection and Quality Control Guidelines

.1 SSPC-QP 2, Standard Procedure for the Qualification of Painting Contractors (Field Removal of Hazardous Coatings from Complex Structures)

.2 SSPC-QP 3, Standard Procedure for Evaluating Qualifications of Shop Painting Applicators

.3 SSPC-QP 5, Standard Procedure for Evaluating the Qualifications of Coating and Lining Inspection Companies

.7 Master Painter's Institute (MPI):

.1 Architectural Painting Specification Manual

.8 The National Association of Architectural Metal Manufacturers (NAAMM):

.1 AMP 505-88, Applied Coatings

.2 AMP 550-89, Metal Product Outline

.3 AMP 555-92, Code of Standard Practice for Architectural Metal Industry, including Miscellaneous Iron

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate coating requirements with affected Division 05 Sections with requirements specified for Section 09 91 05; establish responsibilities, pre-coating requirements and site finishing requirements.

.1 The use of bulk shop primers and temporary coatings for all exterior and interior exposed structural steel work will not be permitted unless it forms a part of a painting system specified in Section 09 91 05.

.2 Where non-complying primers are used, this section of work shall completely remove deficient primer from surfaces, and prepare and prime surfaces in accordance with the requirements of Section 09 91 05 for painted steel work at no additional cost to the Project.

.3 Coordinate compatible shop primer for exposed structural steel with Section 09 91 05 as follows:

.1 This section will be responsible for surface preparation and application of compatible primer systems.

.2 Metal fabricators will be responsible for applying primer to match shop applied materials at site welds, immediately after completion of welds.

.3 Section 09 91 05 will perform minor site touch-up and repair to priming system, and apply finish coats of paint.

.4 This method of finishing has been specified to minimize primer and finish coating incompatibility, and to satisfy primer “open-time” limits for proper application of finish coats.

.5 The primers specified are intended to form a part of a total system and shall be compatible with and be produced by the same manufacturer as the finish coats.

1.6 SUBMITTALS

.1 Provide requested information in accordance with Section 01 00 06 – General Requirements.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit product data for each type of coating products and primers indicating:

.1 Submit components and application procedures of the paint system as a single coordinated submittal and indicate compatibility and maximum recoat times for each product.

.2 Identify required surface preparation, primer, intermediate coat (if applicable) and finish coat.

.3 Coordinate submittal information with finish coat specified in Section 09 91 05.

.2 Shop Drawings: Submit shop drawings detailing fabrication of exposed and non exposed structural steel components, as follows:

.1 Include details that clearly identify requirements listed in for Fabrication and Erection; provide connections for exposed Structural Steel consistent with concepts shown on the architectural and structural drawings.

.2 Indicate welds by standard CWB symbols, distinguishing between shop and site welds, and show size, length and type of each weld; identify grinding, finish and profile of welds as defined in this Section.

.3 Indicate type, size, finish and length of bolts, distinguishing between shop and site bolts; identify high strength bolted slip critical, direct tensioned shear/bearing connections.

.4 Clearly indicate which surfaces or edges are exposed and class of surface preparation.

.5 Indicate special tolerances and erection requirements as noted on the drawings or defined herein.

1.7 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Fabricator: In addition to qualifications specified in Section 05 05 00, engage a firm experienced in fabricating exposed structural steel similar to that indicated for this Project with a record of successful in-service performance, as well as sufficient production capacity to fabricate exposed structural steel without delaying the Work.

.2 Erector: In addition to qualifications listed in Section 05 05 00, engage an experienced erector who has completed exposed structural steel work similar in material, design, and extent to that indicted for this Project and with a record of successful in-service performance.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements: Use special care in handling to prevent twisting or warping of exposed structural steel members:

.1 Erect pre-painted finish pieces using padded slings or other methods to protect them from damage arising from handling including, but not limited to, the following:

.2 Provide padding as required to protect while rigging and aligning member's frames.

.3 Weld tabs for temporary bracing and safety cabling only at points concealed from view in the completed structure or where approved by the Consultant during the pre-installation meeting.

.4 Submit methods of removing temporary erection devices and finishing, and refinishing pre-painted pieces for review and acceptance by the Consultant prior to erection.

.2 Storage and Handling Requirements: Store materials to permit easy access for review and identification; store steel members off ground by using pallets, platforms, or other supports; protect steel members and packaged materials from erosion and deterioration.

Part 2 Products

2.1 METAL MATERIALS

.1 Coordinate requirements of this Section with related requirements of referenced Division 5 – Metals technical specification sections.

2.2 NON-EXPOSED STANDARD STRUCTURAL STEEL

.1 Clean and prepare structural steel surfaces in accordance environmental exposure class as follows:

.1 Zone 0: Leave uncoated

.2 Clean and prepare exposed structural steel surfaces in accordance with coating manufacturer's recommended profile and surface specification requirements; where they are more stringent than the minimums listed in this Section, and for the following environmental exposure classes:

.1 Zone 0: Leave uncoated

.2 Zone 1B: Shop prime using CISC/CPMA 2-75 over minimum SSPC-SP7 ready for site applied double finish coat of alkyd based enamel specified in Section 09 91 05

.3 Do not prime exposed structural steel surfaces in the following conditions:

.1 Surfaces that are embedded in concrete or mortar; prime partially embedded members to a depth of 50 mm only

.2 Surfaces that will be site welded

.3 Surfaces that will be high strength bolted with slip critical connections

.4 Surfaces that will receive sprayed applied fire resistant material

.5 Galvanized surfaces

.4 Apply primer under cover, on dry surfaces only and when surface and air temperatures are at and rising, or above manufacturer's recommended minimum application temperature; and maintain temperature until primer is thoroughly cured.

.5 Apply primer immediately after surface cleaning and priming in accordance with manufacturer's instructions and dry film thickness recommendations using methods as required to achieve full coverage of the following:

.1 Joints, corners, edges, and exposed surfaces

.2 Corners, crevices, bolts, welds, and sharp edges

.3 Apply second coat of shop primer to surfaces that will be inaccessible after assembly or erection; change colour of second coat.

.6 Refer to Section 09 91 05 for coating and application requirements for application of site applied finishing systems.

2.3 SHOP FINISHING; EXPOSED STRUCTURAL STEEL

.1 Clean and prepare exposed structural steel surfaces in accordance with coating manufacturer's recommended profile and surface specification requirements; where they are more stringent than the minimums listed in this Section.

.2 Primer for Bare Steel: As required by MPI Coating System that will be specified in Section 09 91 05, and as follows:

.1 Surface preparation: Minimum SSPC-SP6 as required by Paint Finish System specified in Section 09 91 05.

.2 MPI 107 Water Based Rust Inhibitive Primer for use in MPI EXT 5.1M and INT 5.1B Water Based Light Industrial Coatings.

.1 Composition: Acrylic

.2 Colour: Grey.

.3 MPI E Range: E3 to E2 qualifying for GPS

.3 Acceptable Materials:

.1 Cloverdale EcoLogic Rustex Primer 703 Series

.2 PPG WB Industrial Primer 215 Series

.3 Sherwin Williams DTM Acrylic Primer B66W1 Series

.3 Primer for Galvanized Steel: As required by MPI Coating System specified in Section 09 91 05 and as follows:

.1 Surface preparation: Minimum SSPC-SP3 as required by Paint Finish System specified in Section 09 91 05.

2.4 GALVANIZING

.1 Hot Dip Galvanized Finish: Hot dip galvanize in accordance with ASTM A123/A123M to locations indicated; 600 g/m^2 minimum zinc coating; galvanize components after assembly where size permits.

2.5 SHOP COATINGS

.1 Zinc Rich Paint: Single component organic zinc anticorrosive primer in accordance with CAN/CGSB-1.181 and as follows:

.1 Clean metal to SSPC SP3- Power Tool Cleaning at a minimum and where required, provide SP6-Commercial Blast Cleaning in accordance with surface preparation requirements and environmental exposure limitations listed in CAN/CGSB-1.181

.2 Apply two (2) coats zinc rich paint to all surfaces exposed after assembly to manufacturer's minimum dry film thickness.

.3 Apply coating immediately after cleaning

.2 Isolation Coating: Acid and alkali resistant asphaltic paint to CAN/CGSB-1.108.

.1 Apply an isolation coating to contact surfaces of following components in contact with cementitious materials and dissimilar metals except stainless steel:

.1 Exterior components

.2 Interior components exposed to high humidity conditions

.3 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale, grease, do not paint when temperature is below 7°C.

.4 Do not paint surfaces to be site welded. Prime and apply first finish coat after site welding has been completed, immediately prior to applying final finish coat to completed assembly.

2.6 FABRICATION OF EXPOSED STRUCTURAL STEEL

.1 Fabricate and assemble exposed structural steel in the shop to the greatest extent possible in accordance with CISC requirements for Categories listed for the project and as follows:

.1 Detail exposed structural steel assemblies to minimize site handling and expedite erection.

.2 Fabricate exposed structural steel with exposed surfaces smooth, square and of surface quality consistent with the accepted sample.

.3 Use special care in handling and shipping of exposed structural both before and after shop painting.

2.7 SHOP CONNECTIONS

.1 Bolted Connections: Make in accordance with Section 05 05 00 and 05 12 00

.1 Provide bolt type and finish as specified in this section; align bolt heads as indicated on shop and erection drawings.

.2 Welded Connections:

.1 Comply with requirements specified in Section 05 05 00 and 05 12 00.

.2 Make appearance and quality of welds consistent with mock-up.

.3 Assemble and weld built-up sections by methods that maintain alignment of members without warp exceeding tolerances of this section.

Part 3 Execution

3.1 EXAMINATION

.1 Verify exposure of steel components, architectural or non-exposed, and finish assemblies as specified.

.2 Report any discrepancy and potential problem areas to Consultant for direction before commencing finishing operations.

3.2 APPLICATION OF PRIMERS AND COATINGS

.1 Primer: Spray applied at fabrication shop by this Section, touch-up and recoating by Section 09 91 05, and as follows:

.1 Work primer into all corners

.2 Touch-up bare or worn areas on site after installation

.3 Leave surfaces unpainted as follows:

.1 Surfaces that are embedded in concrete or mortar; prime partially embedded members to a depth of 50 mm only.

.2 Surfaces that will be site welded.

.3 Surfaces that will be high strength bolted with slip critical connections.

.4 Surfaces that will receive sprayed applied fire resistant material.

3.3 INSTALLATION OF EXPOSED STRUCTURAL STEEL

.1 Set exposed structural steel accurately in locations and to elevations indicated in accordance with CISC requirements for Categories listed for the project and as follows:

.2 Bolted Connections: Install bolts of specified type and finish in accordance with Section 05 12 00 and as follows:

.1 Bolt Head Alignment is indicated on Drawings: Orient bolt heads for each connection as indicated on erection drawings and verify orientation on site.

.2 Bolt Head Alignment is not indicated on Drawings; Orient bolt heads for each connection to one side acceptable to the Consultant.

.3 Welded Connections: Comply with CWB procedures for appearance; refer to Section 05 05 00 and 05 12 00 for other requirements, and as follows:

.1 Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

.2 Verify that weld sizes, fabrication sequence, and equipment used for exposed structural steel will limit distortions to allowable tolerances.

.3 Obtain Consultant's acceptance for appearance of welds in repaired or site modified work.

.4 Make site welded profiles, quality, and finish consistent with mock-ups accepted prior to fabrication.

.5 Splice members only where indicated, or where found acceptable by the Consultant.

.6 Obtain permission for any torch cutting or site fabrication from the Team Crew Member assigned to oversee steel erection; finish sections thermally cut during erection to a surface appearance consistent with the mock up.

.7 Do not enlarge unfair holes in members by burning or by using drift pins; ream holes that must be enlarged to admit bolts; replace connection plates that are misaligned where holes cannot be aligned with acceptable final appearance.

.4 Site Quality Control: Perform testing and inspections in accordance with Section 05 05 00 to verify structural requirements for detailed bolt and weld connections.

3.4 ADJUSTING AND CLEANING

.1 Site Touch-Up and Repair Shop Primer and Galvanized Finishes:

.1 Touch-Up Painting: Cleaning and touch-up painting of site welds, bolted connections, and abraded areas of shop paint shall completed to blend with the adjacent surfaces in accordance with manufacturer's instructions as specified in Section 09 91 05.

.2 Galvanized Surfaces: Clean site welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

Part 1 General

1.1 SUMMARY

.1 This Section includes structural steel

1.2 RELATED REQUIREMENTS

.1 Section 05 05 00 – Common Work Results for Metals: Qualifications, testing and inspection requirements for this Section [and LEED® submittal requirements].

.2 Section 05 05 19 – Common Work Results for Metalwork Finishing: Quality of welds; surface preparation and priming , and galvanizing of structural steel framing.

.3 Section 05 21 00 – Steel Joist Framing

.4 Section 05 50 00 – Miscellaneous Metal Fabrications: Loose steel bearing plates and miscellaneous steel framing.

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A36/A36M-08 Standard Specification for Carbon Structural Steel

.2 ASTM A108-07, Steel Bars, Carbon, Cold-Finished, Standard Quality

.3 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.4 ASTM A153/A153M-09 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

.5 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

.6 ASTM A325-10, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

.7 ASTM A490-12 Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength

.8 ASTM A500/A500M-10a, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

.9 ASTM A563-07, Standard Specification for Carbon and Alloy Steel Nuts

.10 ASTM A780-09, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

.11 ASTM A992/992M-06a, Standard Specification for Structural Steel Shapes

.12 ASTM F593-02(2008)e1, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

.13 ASTM F1136-04, Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners

.14 ASTM F1852-08, Standard Specification for “Twist Off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

.15 ASTM F2280-08e1, Standard Specification for “Twist Off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 150 ksi Minimum Tensile Strength

.2 Canadian Institute of Steel Construction (CISC):

.1 1995, Fundamentals of Structural Shop Drafting

.2 1999, CISC Code of Standard Practice

.3 10th Edition, 2010, Handbook Of Steel Construction

.3 Canadian Standards Association (CSA):

.1 CAN/CSA G40.20-04, General Requirements for Rolled or Welded Structural Quality Steel

.2 CAN/CSA G40.21-04, Structural Quality Steels

.3 CAN/CSA S16-01, Limit States Design of Steel Structures

.4 CAN/CSA S136-94 (R2001), Cold Formed Steel Structural Members.

.5 CSA W47.1-92 (R1998), Certification of Companies for Welding of Steel Structures

.6 CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding

.7 CSA W55.3-1965 (R1998), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings

.8 CSA W59-M1989 (R1998), Welded Steel Construction (Metal Arc Welding)

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate shop priming and finishing requirements with Section 05 05 19.

1.5 SUBMITTALS

.1 In addition to submittal items listed in Section 05 05 00, submit in accordance with Section 01 00 06 – General Requirements.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Provide product data for each type of product specified.

.2 Shop Drawings: Provide shop drawings using CISC standard drafting practices; detailing fabrication of structural steel components including, but not limited to, the following:

.1 Details of cuts, connections, splices, camber, holes, and other pertinent data

.2 Indicate welds using CWB symbols, distinguishing between shop and site welds, and show size, length, and type of each weld

.3 Type, size, and length of bolts, distinguishing between shop and site bolts; high strength bolted slip critical, direct tension, or tensioned shear/bearing connections

.4 Shop drawings shall be signed and sealed by a professional engineer qualified in the province of the Work, and who was responsible for their preparation.

.3 Informational Submittals: Provide the following submittals during the course of the work:

.1 Setting Diagrams: Provide setting diagrams, templates, instructions and directions for installation of components supplied by this section and as necessary for the completion of work of this Section.

.2 Delegated Design Submissions: Provide delegated design in accordance with Section 05 05 00 and as follows:

.1 If connection for shear only (standard connection) is required:

.1 Select framed beam shear connections from an industry accepted publication such as the CISC Handbook of Steel Construction.

.2 If shear values are not indicated, select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam.

.2 Submit sketches and design calculations in accordance with requirements of this Section for non-standard connections.

.3 Connections not detailed on the drawings shall be designed and detailed by the fabricator for the loads indicated on the drawing or ½ of uniformly distributed factored loads for laterally supported beams in the Handbook of Steel Construction.

.4 Loads indicated on Drawings are not factored, unless specifically indicated otherwise.

1.6 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Delegated Design Engineer: Retain a professional engineer, registered in the Province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Documents requirements including, but not limited to, the following:

.1 Seal and signature to shop drawings and design submittals

.2 Site review of installed components.

.3 Completion of Letters or Commitment and Supervision specified in Section 01 33 50

.2 Design and Testing Requirements:

.1 Design, materials and fabrication in accordance with Section 05 05 00

.2 Testing and inspections will be conducted in accordance with Section 05 05 00

Part 2 Products

2.1 DESIGN REQUIREMENTS

.1 Delegated Design Engineering Responsibility: Use a qualified professional engineer registered in the province of the Work to prepare structural analyses data for structural steel connections.

.2 Connections: Provide details of connections required for the project, designed by or selected by delegated design professional engineer to withstand Load and Resistance Factors for Limit States Design and loads indicated on Drawings and in accordance with CSA S16.

2.2 STEEL MATERIALS

.1 Rolled W-Sections: In accordance with CAN/CSA G40.20/G40.21, Grade 350W or ASTM A992, Grade 50

.2 WWF Shapes: In accordance with CAN/CSA G40.20/G40.21, Grade 350W for W shapes and W300 for plates and other rolled shapes

.3 Other Rolled Sections and Plates: In accordance with CAN/CSA G40.20/G40.21, Grade 300W

.4 Hollow Structural Sections: In accordance with CAN/CSA G40.20/G40.21, Grade 350W, Class C

.5 Cold formed structural sections: In accordance with CAN/CSA S136

.6 Welding Materials: Meeting requirements of CSA W48 and certified by CWB.

.7 Post-Installed Anchors and Fastenings: Refer to Section 05 05 23

.8 Embedded Anchor Rods, Setting and Bearing Assemblies: Refer to Section 05 05 31

.9 Mechanical Fasteners: Bolts, nuts and washers as follows:

.1 Regular Duty Headed Bolts: Structural bolts meeting requirements of ASTM A307 with matching nuts and washers meeting requirements of ASTM A563, and as follows:

.1 Grade: A

.2 Minimum Tensile Strength: 413.7 MPa

.3 Style: Hex or Heavy Hex as required

.4 Nominal Size: As indicated

.5 Zinc Coating: Hot Dip Galvanize

.6 Tapping: Tap after hot dip zinc coating

.2 Heavy Duty Headed Bolts: Structural bolts meeting requirements of ASTM A325; and with matching nuts and washers meeting requirements of ASTM A563 or ASTM F1852, and as follows:

.1 Type: 3

.2 Minimum Tensile Strength: 724.0 MPa and 827.4 MPa

.3 Style: Heavy hex

.4 Nominal Size: As indicated

.5 Threading: Thread for full length

.6 Zinc Coating: Hot Dip Galvanize

.7 Tapping: Tap after hot dip zinc coating

2.3 FABRICATION

.1 Fabricate and assemble structural steel in shop to greatest extent possible, and as follows:

.1 Fabricate beams, columns and other members of continuous sections in accordance with CAN/CSA S16-1; do not splice pieces unless specifically shown on the Drawings or with authorization of consultant.

.2 Provide 10 mm web stiffeners to both sides of beams over all supports unless specifically noted as being thicker on drawings.

.3 Provide additional support as required for concentrated roof loads and suspended loads such as mechanical equipment.

.4 Provide support for steel deck to openings exceeding 17.71 in. (450 mm) in any direction.

.2 Fabricate structural steel in accordance with CAN/CSA S16 and CAN/CSA S136, reviewed shop drawings, and as follows:

.1 Camber structural steel members where indicated.

.2 Identify high strength structural steel and maintain markings until steel has been erected.

.3 Mark and match mark materials for site assembly.

.4 Accurately mill ends of columns and other members transmitting loads in bearing.

.5 Complete structural steel assemblies, including welding of units, before starting shop priming operations.

.3 Thermal Cutting:

.1 Perform thermal cutting by machine to greatest extent possible.

.2 Plane thermally cut edges to be welded.

.4 Shop Installed Headed Stud Shear Connectors:

.1 Prepare steel surfaces as recommended by manufacturer of headed stud shear connectors.

.2 Shop Weld headed stud shear connectors to members with automatic stud welding equipment.

.3 Steel surface receiving studs must be thoroughly clean of substances that could reduce the weld strength.

.4 Weld stud stem perpendicular to the receiving surface.

.5 Holes:

.1 Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members.

.2 Cut, drill, or punch holes perpendicular to steel surfaces; do not flame-cut holes or enlarge holes by burning.

.3 Drill holes in bearing plates.

.4 Provide 10 mm Ø weep holes in tops and bottoms of all HSS columns.

.5 Weld threaded nuts to framing and other specialty items as indicated to receive other work.

2.4 FINISHING

.1 Provide shop-applied primer in accordance with Section 05 05 19.

.2 Provide hot dip galvanized finish in accordance Section 05 05 19.

Part 3 Execution

3.1 EXAMINATION

.1 Verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.

.2 Report any discrepancy and potential problem areas to Consultant for direction before commencing fabrication or erection.

.3 Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads.

.2 Remove temporary supports when permanent structural steel, connections, and bracing are in place.

3.3 ERECTION

.1 Erect structural steel in accordance with CAN/CSA S16 and CSA S136.

.2 Obtain Consultant’s acceptance before site cutting or altering any members.

.3 Repair of Coatings: Site touch-up and repair shop primer and galvanized finishes at bolts, welds and burned or scratched surfaces using same primer as applied in shop and zinc paint in accordance with ASTM 780.

.4 Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors; use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

.5 Setting Structural Steel: Set structural steel accurately in locations and to elevations indicated on Drawings and reviewed shop drawings; survey measure critical areas and components that align with other construction.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of non-ornamental metal fabrications and miscellaneous metals required for installation of structural steel, decking and joist framing, and other structural components.

1.2 RELATED REQUIREMENTS

.1 Section 05 05 00 – Common Work Results for Metals.

.2 Section 05 05 19 – Common Work Results for Metalwork Finishing

.3 Section 05 12 00 – Structural Steel Framing

.4 Section 06 10 00 – Rough Carpentry: Materials and finishing requirements for data and voice back boards.

.5 Section 06 20 00 – Finished Carpentry: Concealed supports for shop finished carpentry.

.6 Section 06 40 00 – Shop Fabricated Architectural Woodwork: Concealed supports for shop finished carpentry.

.7 Section 09 21 16 – Gypsum Board Systems: Wall supports for stub walls; placement of reinforcements for support of metal fabrications.

.8 Section 09 91 05 – Painting

1.3 REFERENCE STANDARDS

.1 American Society for Testing of Materials (ASTM):

.1 ASTM A27/A27M-05, Standard Specification for Steel Castings, Carbon, for General Application

.2 ASTM A36/A36M-05, Standard Specification for Carbon Structural Steel

.3 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless

.4 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.5 ASTM A153/A153M-05, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

.6 ASTM A307-07b, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

.7 ASTM A325M-07 Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength [Metric]

.8 ASTM A666-03, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

.9 ASTM A780-01(2006) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

.10 ASTM A792M-06a, Specification for Steel Sheet, 55% Aluminum-Zinc Alloy Coated by the Hot Dip Process

.11 ASTM B221-12 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

.12 ASTM D1187-97 (2002)e1, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal

.13 ASTM E488-96 (2003), Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

.14 ASTM F568M-07, Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

.15 ASTM F1554-07a, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

.2 Canadian Standards Association (CSA):

.1 CAN/CSA S16-09 Limit States Design of Steel Structures

.2 CSA G30.18-09, Billet Steel Deformed Bars for Concrete Reinforcement

.3 CAN/CSA-G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels

.4 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel

.5 CSA W55.3-08, Certification of Companies for Resistance Welding of Steel and Aluminum

.6 CSA W59-03 (R2008), Welded Steel Construction (Metal Arc Welding)

.7 CSA W178.1-08, Certification of Welding Inspection Organizations

.3 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.40M-97, Primer, Structural Steel, Oil Alkyd Type

.2 CAN/CGSB 1.181M-99, Coating, Zinc Rich, Organic, Ready Mixed

.4 The National Association of Architectural Metal Manufacturers (NAAMM):

.1 AMP 555-92, Code of Standard Practice for Architectural Metal Industry, including Miscellaneous Iron

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate with for requirements affecting this Section and as follows:

.1 Exposed Structural Components: Coordinate finishing requirements for miscellaneous metals with the category of finish indicated for architecturally exposed structural steel listed in Section 05 05 19.

.2 Priming and Galvanizing: Coordinate priming and galvanizing requirements with Section 05 05 19 for non-architecturally finished components.

.3 Architectural Finishing: Coordinate finishing requirements with paint systems specified in Section 09 91 05; failure to apply referenced primer will result in this section removing applied primer and recoating with specified material at no additional cost to the Project.

1.5 SUBMITTALS

.1 In addition to submittal items listed in Section 05 05 00, provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit product data for the following:

.1 Grout

.2 Fasteners

.3 Prefabricated components

.4 Paint and coating products

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: Perform structural welding, use personnel and qualify procedures in accordance with requirements listed in Section 05 05 00.

.2 Qualifications: Provide proof of qualifications when requested by the Team Project manager, Team Member or Team Crew member assigned to such duties:

.1 Fabricators: Use fabricator experienced in producing metal fabrications similar to those required for this project and with a record of successful in-service performance with sufficient production capacity to produce required units.

.2 Personnel: Use welders qualified by Canadian Welding Bureau for classification of work being performed that are experienced in type and extent of work required for the project.

1.7 PROJECT CONDITIONS

.1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where metal fabrications are indicated to fit walls and other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.

.2 Established Dimensions: Establish dimensions and proceed with fabricating metal fabrications without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual dimensions correspond to established dimensions; allow for trimming and fitting.

Part 2 Products

2.1 SOURCE OF SUPPLY

.1 Steel Shapes and Sections: Sizes and configurations indicated on Drawings are conceptual and may represent materials that are not commonly available under the referenced standards; Team members will consider substitute materials having similar profiles or meeting different standards provided they meet or exceed the structural requirements of the detailed materials.

2.2 MATERIALS

.1 Metal Surfaces: Provide materials with smooth, flat surfaces without blemishes for metal fabrications exposed to view in the completed Work; do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

.2 Ferrous Metals:

.1 Steel Plates, Shapes, and Bars: In accordance with CAN/CSA G40.20/G40.21, Grade 300W or ASTM A36/A36M.

.2 Hollow Structural Sections: In accordance with CAN/CSA G40.20/G40.21, Grade 350W, Class C or ASTM A500 Grade C

.3 Stainless Steel Sheet, Strip, Plate, and Flat Bars: In accordance with ASTM A666, Type 304.

.4 Stainless Steel Bars and Shapes: In accordance with ASTM A276, Type 304.

.1 Width of Channels: 1.16 in. (41 mm)

.2 Depth of Channels: minimum 1.16 in. (41 mm) and as indicated on drawings

.3 Metal and Thickness:

.1 Galvanized steel in accordance with ASTM A653/A653M, structural quality, Grade 230, with Z275 coating; 0.078 in. (2.0 mm) nominal core metal thickness

.2 Uncoated steel in accordance with ASTM A570, Grade 33; 0.067 in. (1.7 mm) nominal core metal thickness

.4 Finish:

.1 Uncoated Steel: Rust inhibitive, baked on, acrylic enamel

.2 Galvanized Steel: Hot-dip galvanized after fabrication

.5 Acceptable Materials:

.1 Powerstrut Engineering Co., Inc.

.2 Unistrut Corporation

.3 Non-Ferrous Metals:

.1 Aluminum Extrusions: In accordance with ASTM B221, alloy 6063-T6

.2 Aluminum Alloy Rolled Tread Plate: In accordance with ASTM B632/B632M, alloy 6061-T6

.4 General Fasteners: Provide Type 304 or 316 stainless steel fasteners for exterior use and zinc plated fasteners with coating in accordance with ASTM B633, Class Fe/Zn 5, where built into exterior walls; select fasteners for type, grade and class required and selected from the following:

.1 Bolts and Nuts:

.1 Bolts: Regular hexagon head bolts, ASTM A307, Grade A or ASTM F568M, Property Class 4

.2 Nuts and Washers ASTM A563/A563M hex nuts and flat washers,

.2 Anchor Bolts: ASTM F1554, Grade 36.

.3 Machine Screws: ASME B18.6.3/B18.6.7M.

.4 Lag Bolts: ASME B18.2.1/B18.2.3.8M.

.5 Wood Screws: Flat head, carbon steel, ASME B18.6.1.

.6 Plain Washers: Round, carbon steel, ASME B18.22.1/B18.22M.

.7 Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1/B18.21.2M.

.5 Finishes: Finish metal fabrications in accordance with NAAMM Metal Finishes Manual for Architectural and Metal Products following recommendations for applying and designating finish after assembly and as follows:

.1 Steel and Iron Finishes:

.1 Galvanizing: Hot dip galvanize items as indicated in accordance with applicable standard following:

.1 Products: ASTM A123/A123M

.2 Hardware ASTM A153/A153M

.2 Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces in accordance with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

.1 Exteriors SSPC Zone 1B: SSPC-SP6, Commercial Blast Cleaning

.2 Interiors SSPC Zone 1A: SSPC-SP3, Power Tool Cleaning

.2 Stainless Steel Finishes: Remove tool and die marks and stretch lines or blend into finish; grind and polish surfaces to match original finish; passivate and rinse surfaces after polishing, remove embedded foreign matter and leave surfaces chemically clean.

.3 Aluminum Finishes:

.1 Clear Anodized Finish:

.1 Interior: Class I, Clear Anodic Finish, AA-M12C22A41, clear coating 0.018 mm or thicker in accordance with AAMA 607.1

.2 Exterior: Class II Finish: Architectural Class II, clear coating 0.010 mm or thicker in accordance with AAMA 611.

.2 Coloured Anodized Finish:

.1 Colour to be selected by the Team Members from the manufacturer's complete range of anodized colours.

.2 Interior: Class I Finish: Architectural Class I, integrally coloured or electrolytically deposited colour coating 0.018 mm or thicker in accordance with AAMA 611.

.3 Exterior: Class II Finish: Architectural Class II, integrally coloured or electrolytically deposited colour coating 0.010 mm or thicker in accordance with AAMA 611.

.4 Applied Finishes: Apply finishes to uncoated surfaces of metal fabrications, except items with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry in accordance with SSPC-PA1, Paint Application Specification No. 1 ; stripe coat corners, crevices, bolts, welds, and sharp edges and as follows:

.1 Shop Primer for Ferrous Metal: Organic zinc rich primer, in accordance with SSPC-Paint 20 compatible with topcoat and as follows:

.1 Acceptable Materials:

.1 Carboline 621; Carboline Company

.2 Aquapon Zinc-Rich Primer 97-670; PPG Industries

.3 Tneme-Zinc 90-97; Tnemec Company

.2 Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, in accordance with SSPC-Paint 20, coordinate requirements with Section 05 05 19.

.3 Bituminous Paint: Cold applied asphalt mastic in accordance with SSPC-Paint 12; except containing no asbestos fibres, or cold applied asphalt emulsion in accordance with ASTM D1187.

2.3 FABRICATION

.1 Shop Fabrication: Shear and punch metals cleanly and accurately, remove burrs; ease exposed edges to a radius of approximately 0.039 inch (1 mm); form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work and as follows:

- .1 Fabricate joints exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate
- .2 Fabricate assemblies exposed to exterior conditions that allow for thermal movement resulting from ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects.
- .3 Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- .4 Remove sharp or rough areas on exposed traffic surfaces.

.2 Shop Welding: Weld corners and seams continuously and as follows:

- .1 Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals
- .2 Obtain fusion without undercut or overlap
- .3 Remove welding flux immediately
- .4 At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface

.3 Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize site splicing and assembly and as follows:

- .1 Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
- .2 Use exposed fasteners of type indicated; or if not indicated, Phillips flat-head countersunk screws or bolts.
- .3 Locate joints where least conspicuous.
- .4 Disassemble units only as necessary for shipping and handling limitations
- .5 Use connections that maintain structural value of joined pieces
- .6 Clearly mark units for reassembly and coordinated installation

.4 Anchorage Fabrication: Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support required loads; provide for anchorage of type indicated and suitable for supporting structure, and as follows:

- .1 Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

Part 3 Execution

3.1 INSTALLATION

.1 Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

.2 Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels and as follows:

.1 Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

.2 Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

.3 Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with bituminous paint applied to a high build thickness of 1.5 to 2 mm.

3.2 ADJUSTING AND CLEANING

.1 Galvanized Surfaces: Clean site welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780.

3.3 SCHEDULE OF COMPONENTS

.1 The following listing of metal fabrications is provided by the Team Members for the convenience of Team Crew Members every attempt has been made to provide a complete list metal fabrications; however, it and is not intended to be comprehensive listing; list of metal fabrications includes; but is not limited to, the following:

.1 Miscellaneous Framing and Supports: Structural steel shapes, plates, and bars of welded construction; galvanize where located in exterior construction; fabricated to sizes, shapes, and profiles necessary to receive adjacent construction retained by framing and supports; cut, drill, and tap units to receive hardware, hangers, and similar items including but not limited to the following:

.1 Steel framing and supports for operable partitions

.2 Steel girders for supporting wood frame construction

.3 Steel pipe columns for supporting wood frame construction

.4 Steel framing and supports for countertops

.5 Steel framing and supports for mechanical and electrical equipment

.6 Steel framing and supports for applications where framing and supports are not specified in other Sections

.7 Miscellaneous steel trim

.8 Steel floor plate, handrails and supports

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

Part 1 General

1.1 SUMMARY

.1 This section includes requirements for supply and installation of structural dimensional lumber framing and blocking, sheathing, plywood backing panels, floor sheathing, subflooring and roof curb and parapet framing, cants and blocking.

1.2 RELATED REQUIREMENTS

.1 Section 06 17 00 – Shop Fabricated Structural Lumber

.2 Section 06 20 00 – Finish Carpentry

.3 Section 06 40 00 – Shop Fabricated Architectural Woodwork

.4 Section 07 21 16 – Blanket Insulation: Requirements for installation of blanket insulation at locations that will be inaccessible to insulation work after sheathing is installed.

.5 Section 07 62 00 – Sheet Metal Flashing and Trim: Requirements blocking and support of sheet metal flashings and trims.

.6 Section 07 92 00 – Joint Sealants: Requirements for placement of solid blocking at joint sealants located at sole plates, head plates and at intersections between interior and exterior walls for sound rated construction.

.7 Section 09 21 16 – Gypsum Board Assemblies: Requirements for wall framing and blocking reinforcements; acoustically rated wall construction; and fire blocking for fire rated wall construction relating to gypsum board construction.

.8 Section 09 30 00 – Tiling

.9 Section 09 91 05 – Painting

.10 Division 26 – Basic Electrical Materials and Methods

.11 Division 27 – Communications Horizontal Cabling: Requirements for telecommunications and data panel boards.

1.3 DEFINITIONS

.1 Stud Framing: Vertical framing members within non-load bearing wall systems are considered as No.3 or Stud Grade; No.3 and Stud grade framing material is not allowed for any horizontal applications; No. 3 or Stud Grade framing materials will not be permitted for any load bearing wall assemblies.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Preconstruction Meeting: Conduct a preconstruction before starting work of this Section meeting shall be attended by Team Members and team Crew members responsible for work of this Section to discuss the following:

.1 Discuss any installation methods relating to starting structural framing to review installation techniques required to achieve specified performance values.

.1 Review blocking and structural wood supporting components required for facility fall protection requirements.

.2 Do not proceed with work until meeting is complete.

1.5 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.2 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

.3 ASTM D5516-09, Standard Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures

.4 ASTM D5664-10, Standard Test Method for Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire-Retardant Treated Lumber

.5 ASTM F1482-04 (2009)e1, Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring

.2 American Wood Protection Association (AWPA):

.1 AWPA Book of Standards, 2012

.2 AWPA U1-12, Use Category System: User Specification for Treated Wood

.3 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 71.26-M88, Standard for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems

.4 Canadian Standards Association (CSA):

.1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples

.2 CAN/CSA O80 Series-08, Wood Preservation

.3 CSA O86-09, Engineering Design in Wood

.4 CSA O112 Series-M1977 (R2006), Wood Adhesives

.5 CAN/CSA O121-08, Douglas Fir Plywood

.6 CAN/CSA O141-05 (R2009), Softwood Lumber

.7 CAN/CSA O151-09, Canadian Softwood Plywood

.8 CSA O325-07, Construction Sheathing

.9 CSA O437 Series 93 (R2006) OSB and Waferboard

.10 CSA O452 Series 94 (R2001), Design Rated OSB

.5 National Lumber Grading Authority (NLGA):

.1 NLGA Standard Grading Rules for Canadian Lumber, 2010

.6 Underwriters Laboratories Canada (ULC):

.1 CAN/ULC S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.6 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product data: Submit manufacturer's product data for factory fabricated products indicating component materials and dimensions, and include construction and application specific details where required.

.3 Informational Submittals: Provide the following submittals during the course of the work:

.1 Pressure Treated Materials Certificates: Submit information for wood preservative treatment materials indicating the following:

.1 Composition of chemical treatment

.2 Moisture content of materials treated with water based chemical treatments

.3 Treating plant's certification of compliance with specified requirements

.4 Net amount of preservative retained

.2 Material Certificates: Submit certificates for machine graded [and finger joined] dimensional lumber indicating species and grade selected for each use and design values approved by the National Lumber Grading Association.

.3 Sheathing Material Certificates: Provide certificates from manufacturer indicating tested performance requirements required by Alberta Fire Code and the local Authorities Having Jurisdiction for required sheathing fire resistance rating.

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements: Wood products used for sheathing and framing must be legibly identified on the face or edge indicating manufacturer of material, standard to which it was produced, grade of material including whether grade is visually graded or machine stress rated, and exterior use where applicable in accordance with Authority Having Jurisdiction, the Building Code and as follows:

.1 Preservative Treated Materials: Use only pressure preservative treated wood materials that are acceptable by Authority Having Jurisdiction.

.2 Fire Resistant Sheathing Materials: Sheathing products installed under adjacent building requirements of the Alberta Fire Code are required to be manufactured under testing requirements acceptable to the Authority Having Jurisdiction and labeled indicating compliance with ULC S101 for 15 minute stay-in-place requirement, ULC S102 and ASTM E84 for flame spread.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Protect materials from weather in transit and on the jobsite

.2 Storage and Handling Requirements: Store materials using pallets or blocking 152 mm minimum from ground covered with protective waterproof sheets allowing for air circulation and ventilation under the covering, and as follows:

.1 Protect edges and corners of sheet materials from damage during handling and storage.

.2 Store preservative treated materials under cover, off the ground and protected from moisture; prevent water runoff from materials from entering surface water and planted areas.

.3 Do not store seasoned materials under conditions that will cause moisture content to increase.

.4 Do not store NAUF products in contact with or in close proximity to other materials that may contain urea-formaldehyde and that have potential to contaminate NAUF products.

1.9 SITE CONDITIONS

.1 Indoor Air Quality: Provide temporary ventilation during and immediately after installation of treated wood and engineered wood products within interior spaces.

.2 Site Waste Reduction and Management: Select lumber sizes to minimize waste, reuse scrap lumber to the greatest extent possible and as follows:

.1 Use scrap lumber for non-critical locations such as shims, bracing and blocking.

.2 Do not leave any wood, shavings, sawdust, and similar components, on the ground or buried in fill; prevent sawdust and wood shavings from entering the storm drainage system.

.3 Do not burn scraps that have been pressure treated; do not send pressure treated lumber to recycling centres, cogeneration facilities or waste-to-energy facilities.

.4 Do not burn waste lumber on site.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

.1 Lumber Grades: Provide lumber products that are all sides finished (S4S) in nominal dimensions required for the project; grade-marked by accredited agencies of the Canadian Lumber Standards Accreditation Board and conform to Standard Grading Rules published by the National Lumber Grades Authority.

.2 Finger Jointed Lumber: Provide machine graded lumber products acceptable to Authority Having Jurisdiction and meeting stress design requirements indicated in Building Code and that are grade-marked by accredited agencies of the Canadian Lumber Standards Accreditation Board and conform to Standard Grading Rules published by the National Lumber Grades Authority.

.3 Panel Grades: Provide panel products that are grade-marked by agencies recognized by CSA O325 and National Institute of Standards and Technology, Voluntary Product Standard PS 2-04 Performance Standard for Wood-Based Structural-Use Panels as modified by other listed CSA panel standards.

.4 Moisture Content: Provide lumber and panel products installed in contact with gypsum board and similar moisture sensitive materials must have a maximum moisture content of 8% or less, tested immediately prior to installation of those products.

.5 Volatile Organic Compound Emissions: Use adhesives in composite lumber and panel products that have no added urea-formaldehyde and that are not volatile at normal occupied building temperature conditions.

2.2 LUMBER MATERIALS

.1 Structural Light Framing, Structural Joists and Planks: Provide materials meeting CAN/CSA O141 and NLGA Rules having maximum moisture content at time of dressing of 19%, consisting of species group D (SPF) No. 2 Grade or Better, and having the following minimum properties:

.1	Sizes: 38 mm or 89 mm wide by depth indicated on drawings.	
.2	Bending at extreme fibre (Fb):	11.8 MPa
.3	Longitudinal shear (Fv):	1.0 MPa
.4	Compression parallel to grain (Fc):	11.5 MPa
.5	Compression perpendicular to grain (Fcp):	4.6 MPa
.6	Tension parallel to grain (Ft):	5.5 MPa
.7	Modulus of elasticity (E/ EO5):	9500/6500

.2 Light Framing: Provide materials meeting CAN/CSA O141 and NLGA Rules having maximum moisture content at time of dressing of 19%, consisting of species group D (SPF) Construction Grade or better, and having the following minimum properties:

.1	Sizes: 38 mm maximum width by 89 mm maximum depth.	
.2	Bending at extreme fibre (Fb):	15.3MPa
.3	Longitudinal shear (Fv):	1.7 MPa
.4	Compression parallel to grain (Fc):	13.1 MPa
.5	Compression perpendicular to grain (Fcp):	5.3 MPa
.6	Tension parallel to grain (Ft):	6.2 MPa
.7	Modulus of elasticity (E/ EO5):	9000/5500 MPa

.3 Stud Framing: Provide materials meeting CAN/CSA O141 and NLGA Rules having maximum moisture content at time of dressing of 19%, consisting of species group D (SPF) Stud (No. 1) Grade or better and having the following minimum properties:

.1	Sizes: 38 mm or 89 mm wide by maximum 140 mm depth as noted on drawings.	
.2	Bending at extreme fibre (Fb):	11.8 MPa
.3	Longitudinal shear (Fv):	1.0 MPa
.4	Compression parallel to grain (Fc):	11.5 MPa
.5	Compression perpendicular to grain (Fcp):	4.6 MPa
.6	Tension parallel to grain (Ft):	5.5 MPa
.7	Modulus of elasticity (E/ EO5):	9500/6500

.4 Strapping: Provide 19 mm deep x 38 mm wide pressure preservative treated materials as described above for Stud Framing.

.5 Miscellaneous Framing: Provide furring, blocking, nailing strips, grounds, tough bucks, cants, curbs, fascia backing and sleepers, and other materials matching lumber used within framed construction except that Construction Grade materials must be used as a minimum where a lumber grade has not been indicated for framed construction and assemblies.

2.3 PANEL MATERIALS

.1 Structural Shear Walls and Floor Diaphragm Panels: Provide design rated plywood panels or oriented strand board (OSB) panels; at choice of Team Crew Member, meeting requirements of CSA O86, thickness as indicated on drawings and as follows:

.1 Design Rated Plywood: Exterior Rated, Sheathing Grade square edged Douglas Fir or Canadian Softwood plywood meeting requirements of CSA O121 or O151.

.2 Wall Sheathing: Provide plywood wall sheathing or oriented strand board having End Use Mark W (Walls); at choice of Team Crew Member, thickness as required by span rating and meeting requirements of CSA O325 and as follows:

.1 Plywood: Exterior Rated, Sheathing Grade square edged Douglas Fir or Canadian Softwood plywood meeting requirements of CSA O121 or CSA O151.

.3 Roof Sheathing: Provide plywood roof sheathing or oriented strand board having End Use Mark 2R Roof Sheathing with Edge Support; at choice of Team Crew Member, thickness as required by span rating and meeting requirements of CSA O325 and as follows:

.1 Plywood: Exterior Rated, Sheathing Grade square edged, Douglas Fir or Canadian Softwood plywood meeting requirements of CSA O121 or CSA O151.

.4 Floor Sheathing: Provide plywood subfloor or oriented strand board having End Use Mark 2F subfloor; at choice of Team Crew Member, thickness as required by span rating and meeting requirements of CSA O325 and as follows:

.1 Plywood: Exterior Rated, Sheathing Grade tongue and groove edged Douglas Fir or Canadian Softwood plywood meeting requirements of CSA O121 or CSA O151.

2.4 PRESSURE TREATED MATERIALS

.1 Exposed or Finished Materials: Use chemical formulations that do not require incising and do not contain colourants, and that will not bleed through or otherwise adversely affect finishes on exposed materials.

.2 Grading Marks: Mark each treated item with treatment quality mark and type of treatment as follows:

.1 Use marks made by certification inspection agency acceptable to NLGA and Authority Having Jurisdiction.

.2 Mark ends or back of items indicated to receive a stained or natural finish; or omit marking and provide certificates of treatment compliance issued by certification inspection agency.

.3 Pressure Preservative Treated Lumber: Lumber graded and stamped for preservative retention in accordance standards listed in this Section in accordance with CAN/CSA O80.20M and AWPA U1, and as follows:

.1 Species: Pine or Spruce-Pine

.2 Grade: No.2 or better structural posts and lumber, pieces may be grade stamped or shipment certified by letter of compliance.

.3 Do not use material having twisted grain or structural defects affecting integrity of lumber.

.4 Use only material having radius edges; minimum 6 mm.

.5 Kiln dry lumber materials to 19% moisture content or less.

.4 Pressure Preservative Treated Plywood: Treated in accordance with CAN/CSA O80.9M using waterborne preservative to obtain minimum net retention of 4 kg/m³ of wood; use only plywood or laminated materials manufactured with exterior grade adhesives meeting requirements of CSA O121 or CSA O151; kiln dry plywood to moisture content of 15% or less after treatment.

.5 Pressure Preservative Treatments: Use the following preservative treatments based on usage location meeting preservative retention requirements of AWPA Usage Classifications and Preservative Treatment Standards:

.1 Waterborne Inorganic Boron (SBX): Exterior materials installed above 450 mm from ground and continuously protected from liquid water in accordance with AWPA C31; colour-less.

.2 Waterborne Copper Azoles (CBA-A and CA-B): Unfinished exposed exterior materials installed above 450 mm from ground, in locations having poor water runoff, sill plates and other wood in contact with concrete, and for wood materials in contact with roofing membranes; colour range green to brown depending on actual treatment materials.

.3 Oil Borne 3-Iodo-2-Propynyl Butyl Carbamate (IPBC): Finished vertical exposed exterior materials installed above 450 mm from ground in locations having good water runoff; colour-less; do not use for horizontal applications or critical structural components.

.4 Oil Borne Pentachlorophenol: Unfinished exterior materials installed below 450 mm from ground (light oil treatment) and in contact with ground (heavy oil treatment); colour range light brown to brown depending on oil treatment; finish with manufacturer recommended polyurethane coating for contact surfaces such as handrails.

.5 Other Treatments: Treatments such as alkaline copper quaternary or copper naphthenate, oxine copper or ammoniac copper zinc arsenate may be acceptable to meet specific installation requirements when submitted information is submitted to Consultant for review, before purchasing treated materials.

.6 Site Applied Wood Preservative: Treatment manufacturer's required preservative wood treatment for touching up and repairing wood products, meeting requirements of CSA O80 series of standards, compatible with pressure preservative treated materials.

.7 Acceptable Materials: Provide plywood and lumber materials treated by licensed applicators meeting project requirements using treatments from any of the following:

.1 Arch Lonza Wolmanized or SillBor Treatments

.2 Hoover Treated Wood Preservers Inc. Micro-Guard Treatment

.3 Viance Treated Wood Solutions Treatment

2.5 ACCESSORIES

.1 Nails, Brads and Staples: Steel nails meeting requirements of CSA B111, length to penetrate connecting solid wood materials and as follows:

.1 Exterior Work: Hot dipped galvanized

.2 Interior High Humidity Work: Hot dipped galvanized

.3 Interior Work: Electroplated zinc plated or cadmium plated

.4 Pressure Treated Materials: Stainless steel

.2 Rough Hardware (Bolts, Nuts and Washers): Provide fasteners of size and type required for installation and as follows:

.1 Ground Contact Materials: Stainless steel

.2 Exterior Work: Hot dipped galvanized

.3 Interior High Humidity Work: Hot dipped galvanized

.4 Interior Work: Electroplated zinc plated or cadmium plated

.5 Pressure Treated Materials: Stainless steel

.3 Wood Screws: Steel screws meeting requirements of ASME B18.6.1 and as follows:

.1 Exterior Work: Galvanized, ceramic coated or stainless steel

.2 Interior Work: Galvanized

.4 Screws for Fastening to Cold Formed Metal Framing: Steel screws meeting requirements of ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

.5 Metal Anchoring Systems, Framing Connectors and Hangers: Prefabricated hot dipped zinc coated steel or stainless steel products tested or designed in accordance with CSA O86.1; types and configurations as indicated on drawings and as follows:

.1 Basis-of-Design Materials: Simpson Strong-Tie Company Inc.

.6 Surface Applied Wood Preservative: Non-pressure treated, general purpose liquid applied copper based wood preservative meeting requirements of CSA O80 P8 and P9 and as follows:

.1 Basis-of-Design Materials: Osmose-Pentox Inc.

.7 Adhesives: Gun grade, cartridge loaded adhesives meeting requirements of GS-36 for Commercial Adhesive, South Coast Air Quality Management District Rule 1168 and as follows:

.1 Subfloor Adhesive: Meeting requirements of CAN/CGSB 71.26 having maximum having a maximum VOC content of 30 g/L

.2 General Purpose Adhesive: Meeting requirements of CSA O112 having maximum VOC content of 70 g/L

.8 Sealant: Non-hardening butyl sealant as specified in Section 07 92 00.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: Verify conditions of substrates installed by other parts of the Work are acceptable for materials specified in this Section and are in accordance with manufacturer's written instructions.

.2 Installation of products specified in this Section will denote acceptance of site conditions.

3.2 INSTALLATION

.1 Accurately frame and properly assemble rough carpentry work; securely attaching rough carpentry work to substrate by anchoring and fastening and include required nails, fastenings and other connectors.

.2 Set rough carpentry to required levels and lines with members plumb, true to line, cut, and fitted; fit rough carpentry to other construction; scribe and cope as needed for accurate fit; locate furring, nailers, blocking, grounds, and similar supports as required attaching to other construction.

.3 Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

.4 Wood Frame Construction: Space framing members at 16 in. (406 mm) or 12 in. (305 mm) O/C maximum and as indicated on the drawings, using continuous pieces of longest possible length and as follows:

.1 Fabricate wood frame construction to the requirements of the Building Code, Part 9, except where more stringent requirements are indicated on the drawings, Solar Decathlon building Codes and Regulations and the State of California.

.2 Make allowance for erection stresses.

.3 Securely brace members in place to maintain plumb and true until permanently fixed and held to structure.

.4 Minimize cutting of framing members for pipes and other penetrations by coordinating with other parts of the Work before starting work of this Section; limit cutting and hole drilling to limitations listed in Building Code, Part 9.

.5 Sheathing Installation: Install sheathing in accordance with Building Code, and as follows:

.1 Wall Sheathing: Install wall sheathing horizontally to wood framing using minimum 2 in. (50 mm) long coated nails at 6 in. (152 mm) along edges and 12 in. (305 mm) along vertical members in the middle of the sheets; leave 0.078 in. (2 mm) to 0.118 in. (3 mm) between sheets to allow for shrinkage of wood framing.

.2 Shear Wall Sheathing: Refer to drawings for nailing patterns and installation details; install blocking behind all shear wall sheathing joints; adhere and nail sheathing to wall framing.

.3 Roof Sheathing: Install roof sheathing with length perpendicular to roof framing using 2 in. (50 mm) coated nails at 6 in. (152 mm) along edges and 12 in. (305 mm) along roof framing in the middle of the sheets and as follows:

.1 Nail size and pattern as required by the Building Code and the manufacturer's instructions and recommendations is a requirement.

.2 Butt joints tightly together, support all edges of non tongue and grooved sheathing with 1.50 x 3.50 in. (38 x 89 mm) framing, or other acceptable method for square edge sheathing.

.4 Floor Sheathing: Install subfloor sheathing with length direction of face orientation at right angles to floor framing, offset joints parallel to the floor joists and as follows:

.1 Make panels continuous over two or more supports.

.2 Use continuous bead of adhesive along each floor framing member and screw fasten at 6 in. (152 mm) along edges and 12 in. (305 mm) along floor framing in middle of sheathing.

.3 Nail size and pattern as required by the Building Code and the manufacturer's instructions and recommendations is a requirement.

.4 Butt joints tightly together, use only tongue and grooved floor sheathing materials to maintain edge support.

.5 Support all edges of tongue and grooved plywood with 1.50 x 3.50 in. (38 mm x 89 mm) framing where indicated for diaphragm construction.

.6 Leave a minimum 0.118 in. (3 mm) gap between subfloor sheathing panels where panels are indicated covered with underlayment. Butt panels into light contact for combined subfloor and underlayment sheathing.

.7 Drill holes in subfloor sheathing in ponded areas where flooding has occurred to allow standing water to drain from floor; repair holes in combined subfloor and underlayment sheathing prior to installation of floor finish materials.

.6 Roof Framing, Parapets, Cant Strips and Plates: Construct wooden roof curbs around openings in the roof for vents, ducts, and other penetrations, for parapets and edge blocking using pressure preservative treated wood and as follows:

.1 Make curbs a minimum height of 6 in. (152 mm) above roof membrane; make base of curbs same thickness as insulation.

.2 Form sloped tops to wood parapet plates and wood up-stands more than 1.50 in. (38 mm) wide to roofs that receive metal flashings; sloped not less than 2:12.

.3 Provide continuous wood backing for flashings.

.4 Provide solid wood or plywood sheathing and backing to receive membrane and metal flashings, conforming to ARCA Manual; fasten plywood sheathing securely to walls of parapets using mechanical fasteners; nails are not acceptable.

.5 Construct framing and blocking for membrane control joints in compliance with building codes and to ARCA Manual.

.7 Pressure Preservative Treated Wood: Install pressure preservative treated wood in accordance with AWPA M4 and as follows:

.1 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation; allow first coating to soak into grain before applying second coating in accordance with manufacturer's instructions.

.2 Use waterborne preservative treated wood for the following:

.1 Wood in contact with masonry or concrete

.2 Wood within 17.71 in. (450 mm) of grade

.3 Wood in contact with flashings

.4 Wood in contact with waterproofing membranes; confirm compatibility with membrane manufacturer prior to application.

.3 Use oil borne preservative treated wood for the following

.1 Wood in contact with the ground

.2 Wood in contact with freshwater

.3 Landscaping

.8 Telecommunications and Data Panel Boards: Install .75 in. (19 mm) DFP G1S plywood on all walls in telephone rooms receiving wiring and equipment; minimum 48 x 96 in. (1220 mm x 2440 mm) panels on periphery walls over 12 in. (305 mm) wide, mounted 152 mm off of finished floor; coordinate installation and locations with division 27 and as follows:

.1 Paint panels with two (2) coats of light coloured fire retardant paint finish; coat all sides of panels (back, front and sides) to meet the intent of fire rated panel requirements listed in CSA T530 and ANSI/TIA/EIA 569-B requirements.

END OF SECTION

SECTION 06 15 33

CEDAR WOOD CARPENTRY

Part 1 GENERAL

1.1 SUMARY

.1 This Section includes requirements for supply and installation of cedar wood Decking, interior ceilings and decorative accessories including but, not necessarily limited to the following:

.2 Cedar Decking.

.3 Cedar Steps.

.4 Interior Wood Plank Ceilings

1.2 RELATED REQUIREMENTS

.1 Section 01 00 06 – General Requirements: Submittals

.2 Section 06 10 00 – Rough Carpentry: Blocking, Strapping, furring, panel material and other miscellaneous rough carpentry required to install cedar Decking materials

.3 Section 07 62 00 – Sheet Metal Flashing and Trim: Flashing, gutters, and other sheet metal work.

.4 Section 07 92 00 – Joint Sealants

1.3 REFERENCE STANDARDS

.1 American Wood Protection Association (AWPA):

.1 AWPA Book of Standards, 2012

.2 AWPA U1-12, Use Category System: User Specification for Treated Wood

.2 Canadian Standards Association (CSA):

.1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples

.2 CAN/CSA O80 Series-08, Wood Preservation

.3 CSA O86-09, Engineering Design in Wood

.4 CSA O112 Series-M1977 (R2006), Wood Adhesives

.5 CAN/CSA O121-08, Douglas Fir Plywood

.6 CAN/CSA O141-05 (R2009), Softwood Lumber

.3 Forest Stewardship Council (FSC):

.1 FSC Principals and Criteria

.2 Chain-of-Custody and Percentage Based Claims

.4 National Lumber Grading Authority (NLGA):

.1 NLGA Standard Grading Rules for Canadian Lumber, 2010

.5 WCLIB - West Coast Lumber Inspection Bureau

.1 Standard 17 Grading Rules for West Coast Lumber, 2004

.6 Western Red Cedar Lumber Association

.1 Designer's Handbook
.2 Specifying Western Red Cedar Decking
.3 How to Install Western Red Cedar Decking
.4 Guide to Finishing Western Red Cedar

.7 WWPA - Western Wood Products Association

.1 "Grading Rules"

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Sequencing: Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's product data for each type of product specified.
.2 Samples for Initial Selection: Submit colour fans for Decking and decorative accessories.

1.6 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Source Limitations for Decking: Obtain each type, color, texture, and pattern of Decking, including related accessories, through one source from a single manufacturer.
.2 Manufacturer Qualifications: Manufacturer shall be a member of the Western Red Cedar Lumber Association capable of providing all Western Red Cedar Decking materials specified in this section.
.3 Installer Qualifications: Installer shall have five (5) years experience installing cedar trim on the type and size of project specified by this section.
.4 Installer shall be licensed, registered or otherwise approved by the local jurisdiction to install Cedar Decking.

.2 Installation: Install products in accordance with the Western Red Cedar Lumber Association installation guidelines; adhere to applicable building codes, as amended by this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Protect materials from weather in transit and on the jobsite.

.2 Deliver materials for interior use only when building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

.3 Inspect the materials upon delivery to assure that specified products have been received, report all shortages, damaged materials and other deficiencies in materials occurring from manufacturing, shipping and handling to the Team members.

.4 Storage and Handling Requirements: Deliver, store, and handle Decking as follows:

.1 Store materials on site in a location protected from weather and contact with damp or wet surfaces, and activities that could damage surfaces.

.2 Store in a location where environmental conditions meet requirements required for installation areas.

.3 Stack lumber, plywood, and other panels; allow for air circulation within and around stacks and under temporary coverings.

.4 Do not store products in contact with or in close proximity to other materials that may contain formaldehyde or urea-formaldehyde.

1.8 SITE CONDITIONS

.1 Ambient Conditions: Proceed with exterior Decking installation only when substrate is completely dry and when existing and forecasted weather conditions permit Decking to be installed in accordance with the Western Red Cedar Lumber Association's recommendations.

.2 Proceed with Decking for interior use only when building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

.3 Site Waste Reduction and Management: Select lumber sizes to minimize waste, reuse scrap lumber to the greatest extent possible and as follows:

.1 Use scrap lumber for non-critical locations such as shims, bracing and blocking.

.2 Do not leave any wood, shavings, sawdust, and similar components, on the ground or buried in fill; prevent sawdust and wood shavings from entering the storm drainage system.

.3 Do not burn scraps that have been pressure treated; do not send pressure treated lumber to recycling centers, cogeneration facilities or waste-to-energy facilities.

.4 Do not burn waste lumber on site.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Western Red Cedar Lumber Association, which is located at: 1501 - 700 W. Pender St. Pender Place 1, Business Bldg. ; Vancouver, BC, Canada V6C 1G8; Toll Free Tel: 866-778-9096; Tel: 604-684-0266; Fax: 604-687-4930; Email: request info; Web: www.wrcla.org

.2 Substitutions: Consultant will accept additional manufacturers having similar products to Acceptable Materials listed in this Section provided they meet the performance requirements established by the named products in this Section.

2.2 DECKING MATERIAL

.1 Western Red Cedar Decking: Western Red Cedar Lumber Association decking grades.

.1 Grade: Architectural Clear.

.2 Grade: Custom Clear.

.3 Grade: Architectural Knotty.

.4 Grade: Custom Knotty.

2.3 ACCESSORIES

.1 Fasteners: Steel fasteners meeting requirements of CSA B111, length to penetrate connecting solid wood materials and as follows:

.1 Stainless Steel Splitless Decking Nails

.2 Pressure Treated Materials: Stainless steel Splitless Decking Nails

.3 Hardware: Provide bolts, nuts, washers and other fasteners of size and type required for installation and as follows:

.1 Stainless steel

.4 Wood Screws: Steel screws meeting requirements of ASME B18.6.1 and as follows:

.1 Exterior Work: Stainless steel

.2 Interior Work: Stainless steel

.5 Screws for Fastening to Cold Formed Metal Framing: Steel screws meeting requirements of ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

2.4 FINISH

.1 Provide Semi-transparent Stain, colour as selected by the Consultant from the manufacturers complete range of colours and in accordance with Section 09 91 05.

Part 3 EXECUTION

3.1 PREPARATION

.1 Coordinate work with related trades; scribe and cope decking for accurate fit. Allow installation of related work to avoid cutting and patching.

.2 Select decking boards of longest possible lengths. Discard boards that are warped, twisted, bowed, crooked or otherwise defective.

.1 Clean substrates of projections and substances detrimental to application.

.2 Protect adjacent finished surfaces and materials from damage by work of this Section.

3.2 INSTALLATION

.1 Install decking square, plumb, and level, evenly fitted and securely fastened.

.2 Space decking planks 1/8 inch (3mm) apart to allow for adequate drainage and expansion.

.3 Fasten decking using appropriate length nails for the application.

.4 Provide 3 inch (10d) nails to fasten decking with nominal thickness of 2 in. and 2-1/2 inch (8d) nails to fasten decking with nominal thickness of 1-1/4 in. (31.7 mm).

.5 Provide thin shanked nails with blunt points to prevent splitting.

.6 Provide one nail per joist for deck boards 2 in. (50 mm) wide, two nails per joist for deck boards 4 in. (100 mm) and wider.

.7 Fasten deck with screws long enough to penetrate 1 inch (25 mm) into support members. Provide 1-1/2 in. (38 mm) penetration for structural components.

.8 Secure decking with blind fastening system following blind fastener manufacturer's instructions.

.9 Site Finishing: Apply finish on all sides and ends, touch up coating on new cuts, refer to Section 09 91 05 for materials and application.

3.3 ADJUSTING AND CLEANING

.1 As work proceeds, maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris related to this work.

3.4 CLOSEOUT ACTIVITIES

.1 Explain proper maintenance procedures to Team Project Manager, Team member or other Team Crew member assigned to such duties at project closeout.

.2 Visually inspect Decking, sealants, flashing for overall condition. Re-apply sealants and coating as necessary. Adjust flashing as required.

.3 The use of pressure washers is not recommended.

.4 Fill and retouch nicks, chips and scratches; replace damaged items that cannot be repaired.

.5 Remove pencil and ink marks, remove waste and packing materials, and clean area in accordance with Section 01 00 06 – General Requirements: Final Cleaning.

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY

Part 1 General

1.1 SUMMARY

.1 This section includes requirements for supply, site fabrication and site and factory finishing, and installation of millwork items and site manufactured finish carpentry indicated on Drawings and as specified including; but not limited to, the following:

- .1 Interior millwork used for standing and running trim
- .2 Millwork used for site fabricated and installed wood door and window frames
- .3 Site fabricated and installed shelving and clothes rods
- .4 Wood stairs and handrails

1.2 RELATED REQUIREMENTS

.1 Section 06 10 00 - Rough Carpentry: Materials and finishing requirements for data and voice back boards.

.2 Section 06 40 00 – Shop Fabricated Architectural Woodwork: Shop fabricated interior woodwork and casework.

.3 Section 08 14 00 – Wood Veneer Faced Wood Doors: Door preparation and installation of wood doors in millwork frames provided by this Section and in hollow metal frames.

.4 Section 08 81 00 – Glass and Glazing: Glass forming a part of site installed finish carpentry.

.5 Section 09 21 16 – Gypsum Board Assemblies: Blocking and bracing required for installing woodwork and concealed within other construction before woodwork installation.

.6 Section 09 91 05 – Painting: Painting: Back priming of concealed surfaces before installation of work of this Section and finishing requirements for site fabricated carpentry items.

1.3 REFERENCE STANDARDS

.1 Architectural Woodwork Standards referenced in this Section form the basis of the quality standards for materials and installation; materials standards and grading authorities referenced in this Section and listed in the Architectural Woodwork Standard are applicable where specifically referenced and are considered to form a part of and be applicable to this Section.

.2 Architectural Woodwork Manufacturing Association of Canada (AWMAC):

- .1 AWMAC Architectural Woodwork Standards, 1st Edition, 2009

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate sizes and locations of framing, blocking, furring, and reinforcements provided by work that is specified in other Sections is complete before starting work of this Section.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's descriptive literature or brochures of specialty items not fabricated on site.

.2 Samples for Initial Selection: Submit samples of wood veneer, wood solids and finishes for each material specified for the project to determine acceptable grain character, colour, and lay-up required for the project.

.3 Lumber and Panel Products with Applied Opaque Finish: 6 in. x 12 in. (152 mm wide x 305 mm) long lumber and 12 x 12 in. (305 mm x 305 mm) panels for each finish system and colour.

.4 Exposed Fasteners, Hardware and Accessories: One unit for each type and finish.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: Provide materials that have fire test response characteristics acceptable to the Authority Having Jurisdiction and as follows:

.1 Provide materials and products with specified fire test response characteristics where fire retardant materials or products are indicated.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver woodwork materials only when building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period,

.2 Storage and Handling Requirements: Deliver, store, and handle millwork in accordance with AWS Section 2 Care and Storage, and as follows:

.1 Store materials on site in a location protected from weather and contact with damp or wet surfaces, and activities that could damage finished surfaces

.2 Store in a location where environmental conditions meet requirements required for installation areas

.3 Stack lumber, plywood, and other panels; allow for air circulation within and around stacks and under temporary coverings.

1.8 SITE CONDITIONS

.1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where finish carpentry items are indicated to fit between or around other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.

.2 Established Dimensions: Establish dimensions and proceed with fabricating finish carpentry items without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions; allow for trimming and fitting.

.3 Ambient Conditions: Maintain area or room in which millwork is being installed at a uniform temperature and humidity for 24 hours prior to, during and after installation in accordance with AWS for relative humidity and moisture content; provide additional lighting to maintain a minimum of 430 lx on surfaces and areas where millwork is being installed.

Part 2 Products

2.1 MATERIALS

.1 Use clean stock for each type of woodwork and quality grade specified in accordance with AWS.

.2 Furring, Blocking, Shims, and Hanging Strips: Fire retardant treated softwood and Softwood or hardwood lumber.

.3 Anchors: Select material, type, size, and finish required for each substrate for secure anchorage:

.1 Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance.

.2 Provide toothed steel or lead expansion sleeves for drilled-in-place anchors.

.4 Wood Mouldings: Provide interior millwork in accordance with AWS Section 6 for profiles and configurations required for the project and as follows:

.1 Medium Density Fibreboard (MDF): Meeting ASTM D1037 and ANSI A208.2, Premium Grade for interior use, minimum 700 kg/m³ density; formaldehyde emissions shall be 0.30 ppm or less per $0.424 m^2/m^3$ of room volume ; fire retardant treated for Class A having a flame spread rating of 0 to 25, opaque finish in profiles indicated on Drawings for the following:

.1 Window and Door Casings

.2 Base Boards

.3 Other trim as detailed on the drawings.

.5 Panel Materials: Provide panel materials meeting requirements for moisture content and Premium Grade in accordance with AWS Section 4, and as follows:

.1 Industrial Particleboard: Meeting ANSI 208.1 Grade M-2 for interior use, minimum 720 kg/m³ density and Grade M-3, minimum 750 kg/m^3 particleboard for shelves; clearly mark panels with grade mark in visible location; extruded particleboard having loose cores with voids will not be permitted; having no added urea formaldehyde ; and having fire resistant core treatment for ULC Class A panels and as follows:

.1 Recycled content

.2 Regional materials content (possible depending on source)

.3 FSC materials

.4 No added urea formaldehyde contributing to IAQc4.4

.5 Acceptable Materials:

.1 DuraFlake, Flakeboard

.2 Vesta Particleboard, Flakeboard

.3 Purekor Platinum Particleboard, Panel Source International

.4 Encore SDF Sustainable Particleboard, SierraPine Ltd.

.6 Acceptable Fire Rated Materials

.1 Vesta Particleboard FR, Flakeboard

.2 DuraFlake FR, Flakeboard

.2 Medium Density Fibreboard (MDF): Meeting ASTM D1037 and ANSI A208.2, Premium Grade for interior use, minimum 700 kg/m³ density; formaldehyde emissions shall be 0.30 ppm or less per 0.424m^2/m^3 of room volume ; fire retardant treated for Class A having a flame spread rating of 0 to 25:

.1 Acceptable Materials:

.1 AllGreen MDF, CanFibre Group Ltd.

.2 Medex and Medite II MDF, SierraPine Ltd.

.3 Flakeboard Premier MDF, Flakeboard.

.2 Acceptable Fire Rated Materials:

.1 Medford Medite MDF FR, SierraPine Ltd.

.2 Vesta FR, Flakeboard

.3 DuraFlake FR, Flakeboard.

.4 Premier MDF FR, Flakeboard.

.6 Decorative Laminate Finishes: Grades and applications in accordance with AWS Section 4, and as follows:

.1 High Pressure Decorative Laminate (HPDL): Meeting CAN3 A172 or ANSI/NEMA LD3 composed of phenolic resin impregnated Kraft paper filler stock for Class 1 Decorative Laminate of Grade required by woodwork quality standard; colour through, fire rated, laminate as selected by Team Project Manager or Team member assigned to such duties from manufacturer's full range and as follows:

.1 Self Edging Work: General Purpose Grade, HGS standard duty.

.2 Liner Sheet Work: Same as for self edging work.

.3 Backing Sheet Work: BKL backing material, thickness as recommended by manufacturer to prevent warpage of surfaces, sanded on one side; furniture finish, solid white colour

.4 Acceptable Materials: Subject to compliance with requirements, manufacturers offering high pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:

.1 Arborite

.2 Formica

.3 Lamin-Art

.4 Nevamar

.5 Pionite

.6 Wilsonart

.2 Low Pressure Decorative Laminate (LPDL): minimum 1/64 inch (0.5 mm) low pressure decorative laminate (melamine) overlay, decorative paper, and phenolic resin impregnated kraft paper with fibre reinforcing inner layers; fire rated as selected by Team Project Manager or Team member Assigned to such duties from complete range of materials.

.7 Sealant: 1 part silicone to CAN/CGSB-19.13, non-staining, mould and mildew resistant, refer to Section 07 92 00; colour white.

.8 Glass: Refer to Section 08 81 00.

2.2 FABRICATION

.1 Fabricate millwork, standing and running trim , shelves and rods, and handrails rigid, plumb and square, as detailed, with tight, beveled, hairline joints; sand work smooth; set nails and screws, and fill with matching patching compounds and as follows:

.1 Build-in millwork as required to receive reinforcing, bracing, anchors

.2 Countersink bolts and washers; fill holes with matching wood plugs

.3 Fabricate straight run millwork accurately; provide over length to allow for site trimming to proper fit

.4 Plane sides and back, sand exposed faces, surfaces; hollow out backs 3 mm round-off edges

.5 Finish: Factory finished and Jobsite finished Coatings in accordance with requirements of Section 5 of AWS and as indicated in Section 09 06 05

2.3 FINISHING

.1 Shop Applied Finishes: Clear and Opaque finish, refer to Section 09 91 05 for materials and application; apply to locations as indicated on Drawings.

Part 3 Execution

3.1 EXAMINATION

.1 Visit site and note state of completion within various areas in which millwork is being installed; verify that surfaces are ready to receive work of this Section and that other work is finished and painted before being built-over or covered in any way by installed millwork:

.1 Verify that areas in which millwork is scheduled are finished and ready to accept work of this Section; with walls painted, ceilings finished, overhead services completed, tested and accepted.

3.2 PREPARATION

.1 Confirm access is sufficient for large pieces of millwork, and that they can be transported easily and safely to final installation location.

.2 Protect adjacent finished surfaces and materials from damage by work of this Section.

3.3 INSTALLATION

.1 Scribe and cut as required to fit abutting walls, and surfaces, to fit properly into recesses and to accommodate intersecting or penetrating objects; secure materials and components in place, rigid, plumb and square, with tight, hairline joints to locations indicated on Drawings and in accordance with AWS, and as follows:

- .1 Form joints to conceal shrinkage
- .2 Set finishing nails to receive filler
- .3 Countersink screws in round cleanly cut hole and plug with wood plug matching material being secured
- .4 Match wood pieces end to end for consistent colour and grain appearance; space and centre joints evenly in runs.

.2 Install door and window trim in single lengths without splicing.

.3 Site Finishing: Apply clear or opaque finish, refer to Section 09 91 05 for materials and application; apply to locations as indicated on Drawings.

3.4 CLOSEOUT ACTIVITIES

.1 Sand smooth, fill and retouch nicks, chips and scratches; replace damaged items that cannot be repaired.

.2 Remove pencil and ink marks, remove waste and packing materials, and clean area in accordance with Section 01 00 06 – General Requirements: Housekeeping.

END OF SECTION

SECTION 06 40 00

SHOP FABRICATED ARCHITECTURAL WOODWORK

Part 1 General

1.1 SUMMARY

.1 This section includes requirements for supply, fabrication, factory finishing and delivery to the job site, and installation of shop fabricated casework indicated on the drawings including, but not limited to, the following:

- .1 Decorative laminate finished casework and cabinets
- .2 Hardware forming a part of casework and cabinets fabricated by this Section
- .3 Quartz Surfacing countertops
- .4 Shop finishing of casework, cabinets and countertops

1.2 RELATED REQUIREMENTS

.1 Section 06 10 00 – Rough Carpentry: Materials and finishing requirements for data and voice back boards.

.2 Section 06 20 00 – Finish Carpentry: Interior standing and running trims, flush wood paneling, site applied interior ornamental millwork, stairs and rails, and frames and jambs, and installation of wood doors and other interior carpentry exposed to view that is not specified in this Section.

.3 Section 06 61 19 – Quartz Surfacing Fabrications: Quartz surface countertops, trims and panels forming a part of casework.

.4 Section 08 81 00 – Glass and Glazing: Glass forming a part of casework.

.5 Section 09 21 16 – Gypsum Board Assemblies: Blocking and bracing required for installing woodwork and concealed within other construction before woodwork installation.

.6 Section 09 91 05 – Painting: Back priming of concealed surfaces before installation of work of this Section.

.7 Division 22 – Plumbing Fixtures and Trim: Preparation and finishing of cut outs for sinks and lavatories installed in decorative laminate countertops.

.8 Division 26 – Common Work Results for Electrical: Preparation and coordination ready for electrical cabling built into casework.

1.3 REFERENCE STANDARDS

.1 Architectural Woodwork Standards referenced in this Section form the basis of the quality standards for materials and installation; materials standards and grading authorities referenced in this Section and listed in the Architectural Woodwork Standard are applicable where specifically referenced and are considered to form a part of and be applicable to this Section.

.2 Architectural Woodwork Manufacturing Association of Canada (AWMAC) and Architectural Woodwork Institute (AWI):

.1 AWMAC / AWI Architectural Woodwork Standards, 1st Edition, 2009

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Architectural woodwork Team Members are jointly responsible for the following items:

.1 Coordinate delivery of casework components at a time when building and storage areas are sufficiently dry so that the casework will not be damaged by excessive changes in moisture content.

.2 Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that interior casework can be supported and installed including; but not limited to, the following:

.1 Metal support brackets and fittings that are part of building structure

.2 Plumbing, electrical fixtures and telephone equipment

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements; Submittals prior to fabrication; do not fabricate any work until required submittals are reviewed and accepted by the Team Project Manager.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit product data for each type of product indicated including, but not limited to, the following:

.2 Cabinet hardware and accessories

.3 Finishing materials and processes

.4 Manufactured medium density fibreboard, particleboard and plywood

.5 Solid surfacing material

.3 Shop Drawings: Submit shop drawings indicating location of each item referenced to actual site dimensions, dimensioned plans and elevations, large scale details and thickness of materials, attachment devices, scribe strip locations, locations of exposed fastenings and other components as applicable to the work of this Section and as follows:

.1 Show details full size

.2 Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections

.3 Show locations and sizes of cut outs and holes for plumbing fixtures, faucets and other items installed in casework.

.4 Samples for Verification: Submit two (2) samples prior to fabrication of casework as follows; accepted samples will form the standard of acceptance for the remainder of the work:

.5 Solid Surfacing Materials: 6 in. (152 mm) square for each type, colour, pattern, and surface finish.

.6 Exposed Cabinet Fasteners, Hardware and Accessories: One unit for each type and finish.

1.6 PROJECT CLOSEOUT SUBMISSIONS

.1 Submit maintenance data for applied finishes in accordance with Section 01 00 06 – General Requirements; Operations and Maintenance Data.

.2 Submit one electronic copy of Project Record Sheet in accordance with Section 01 00 06 – General Requirements; Project Record Documents identifying the following:

.1 Project title and address

.2 Team Project Manager and Millworker

.3 Materials and finishes used for casework and whether shop finished or site finished and by whom

.4 Type and source of cabinet hardware and any specialty items used under casework

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements: Provide materials that have fire test response characteristics acceptable to the Authority Having Jurisdiction and as follows:

.1 Provide materials and products with specified fire test response characteristics where fire retardant materials or products are indicated.

.2 Confirm fire test response characteristics as determined by testing for identical products and test methods indicated by CSA, UL, ITS, or another testing and inspecting agency acceptable to Authority Having Jurisdiction.

1.8 DELIVERY STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver woodwork materials only when building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period, as follows:

.1 Deliver, store, and handle casework in accordance with AWS Section 2 Care and Storage.

.2 Delivered materials that are damaged in any way or do not comply with these specifications will be rejected by the Consultant; remove rejected materials from job site and replace with acceptable materials.

1.9 SITE CONDITIONS

.1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on Shop Drawings where casework is indicated to fit walls and other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work; locate concealed framing, blocking, and reinforcements that support woodwork by site measurements before being enclosed and indicate measurements on Shop Drawings.

.2 Established Dimensions: Establish dimensions and proceed with fabricating casework without confirmed site measurements where site measurements cannot be made without delaying the Work; coordinate with the construction to ensure that actual dimensions correspond to established dimensions; allow for trimming and fitting.

.3 Ambient Conditions: Maintain area or room in which casework is being installed at a uniform temperature and humidity for 24 hours prior to, during and after installation in accordance with AWS for relative humidity and moisture content; provide additional lighting to maintain a minimum of 430 lx on surfaces and areas where casework is being installed.

Part 2 Products

2.1 MATERIALS

Item Tag	Location	Product No.	Item Description	Dims.	Finish	Qty
MWK01	Kitchen	S49826863	AK B4D AKURUM Base Cabinet	29 7/8" W x 30 3/8" H x 24 7/8" D	Abstrakt White	2
MWK02	Kitchen	S09814193	AK BO AKURUM Base Cabinet (Oven)	29 7/8" W x 30 3/8" H x 24 3/4" D	Abstrakt White	1
MWK03	Kitchen	S09827157	AK WH AKURUM Horizontal Cabinets	30 3/8" W x 15" H x 12 7/8" D	Abstrakt White	6
MWK04	Kitchen	S99826865	AK B4D AKURUM Base Cabinet	35 7/8" W x 30 3/8" H x 24 7/8" D	Abstrakt White	1
MWK05	Kitchen	S09844543	AK B3D AKURUM Base Cabinet	24 7/8" W x 30 3/8" H x 24 7/8" D	Abstrakt White	1
--	Kitchen	10226211	BLANKETT Hardware Pulls	15" L	Aluminum	11
--	Kitchen	70038504	PERFEKT Plinth Toe-Kick Trim	88" L x 4" H	Foil White	4
--	Kitchen	60069987	PERFEKT ABSTRAKT Base Cover Panel	30" W	Hi Gloss White	4
MWB01	Bathroom	798.843.71	Godmorgon/Odensvik Vanity & Sink	24 3/4" W x 25 1/4" H x 19 1/4" D	Hi Gloss White	1
MWL01	Living	S39906737	AK WGH AKURUM Horizontal Cabinets	30" W x 15" H x 12 7/8" D	White/Clear	6
MWD01	Bedroom	244.960.10	AKURUM HI Cabinet	30" W x 80" H x 24" D	White	2
MWD02	Bedroom	000.699.52	ABSTRAKT Door	15" W x 64" H x 3/4" T	Hi Gloss White	4
MWD03	Bedroom	000.699.47	ABSTRAKT Door	15" W x 15" H x 3/4" T	Hi Gloss White	4
MWD04	Bedroom	342.692.10	AKURUM Wall Top Cabinet	36" W x 15" H x 24" D	White	4
MWD05	Bedroom	800.699.53	ABSTRAKT Door	18" W x 15" H x 3/4" T	Hi Gloss White	8
--	Bedroom	700.385.04	PERFEKT Plinth Toe-Kick Trim	88" L x 4" H	Foil White	2
--	Bedroom	200.699.89	PERFEKT ABSTRAKT Cover Panel	88" W	Hi Gloss White	4
--	Bedroom	400.699.88	PERFEKT ABSTRAKT Cover Panel	80" W	Hi Gloss White	2
--	Bedroom	600.699.87	PERFEKT ABSTRAKT Base Cover Panel	30" W	Hi Gloss White	2
--	Bedroom		Hardware Pulls		Aluminum	16

.1 Quartz Surfacing Countertops: Refer to Section 06 61 19.

.1 Adhesives:

.1 Decorative laminate: polyvinyl acetate or aliphatic resin in accordance with manufacturer's recommendation for curing under pressure for bonding to wood cores, water resistant type.

.2 Edge banding: Thermoplastic hot melt, synthetic resin suitable for applying thin veneer wood edge banding and film overlays.

2.2 ACCESSORIES

.1 Casework Hardware: Provide cabinet hardware described in this Section in quantity required, with necessary screws, bolts, washers for complete installation.

.1 Fasteners:

.1 Draw Bolt Fasteners: Mitre butt joint fastener, adjustable and requiring no special tools for installation, galvanized.

.2 Non-exposed Fasteners: Fabricators choice consistent with quality level specified.

.2 Pulls:

.1 Edge Pulls: Extruded aluminum profile, 0.39 inch (10 mm) finger pull:

.1 Acceptable Materials:

.1 IKEA Canada 10229211

.2 Richelieu 989880170

.3 Drawer Slides: Following list of drawer slides is provided to indicate general conformance requirements only; notify the Consultant where drawer width, height or intended use differs from that indicated in the general descriptions and the requirements of the manufacturer; coordinate sample submittals before ordering materials:

.1 Low Height Drawers ≤ 6 inch (≤152 mm): ¾ (19 mm) extension, rail mount, length to suit drawer box, 8 inch (406 mm) maximum drawer width, 48.5 lbs (22 kg) capacity, side mounting with positive stop and hold-in detent features, zinc finish:

.1 Acceptable Materials:

.1 IKEA Canada

.2 Accuride 2037

.3 Hettich Canada

.4 Häfele America Co.

.2 High Height Drawers ≥ 6 inch, ≤ 12 inch (≥152 mm, ≤305 mm): Full extension, length to suit drawer box; 406 mm maximum drawer width, 99.2 lbs (45 kg) capacity, side mounting with positive stop, self closing, hold-in detent and silencer features, zinc finish:

.1 Acceptable Materials:

.1 IKEA Canada

.2 Accuride 3834

.3 Hettich Canada LP KA5632

.4 Häfele America Co.

.4 Hinges:

.1 Typical Cabinet Doors: Concealed, euro-style hinge with cover caps; fully adjustable for overlay, depth, height and closing force; opening angle of 110°; self-closing feature; nickel plated steel construction; overlay and half overlay mounting, size and profile to suit cabinet construction:

.1 Acceptable Materials:

.1 IKEA Canada

.2 Julius Blum Canada Ltd., Modul and Expando Series

.3 Hettich Canada LP, Intermat Soft 9943 Series

.4 Häfele America Co., H-Series

.5 Miscellaneous Items:

.1 Coat Rod: Closets, 1.1 inch (28 mm) outside diameter x 0.11 inch (2.8 mm) thick chrome tube complete with closed end chrome flanges

.1 Basis-of-Design Materials: Knape & Vogt 734/770.

.2 Sealant: 1 part silicone to CAN/CGSB-19.13, non-staining, mould and mildew resistant, colour: white and clear, refer to Section 07 92 00.

.3 Hardware: Bolts, nuts, washers, screws, etc., hot dip heavy zinc-coated.

2.3 CASEWORK FABRICATION

.1 Fabricate casework in accordance with requirements of Section 10 of AWS as applicable and as modified by this Section and Drawings.

.2 Casework for Paint Finish:

.1 AWMAC Quality Grade Premium Locations: As indicated on Drawings.

.2 Exposed Exterior Parts:

.1 Core: Particleboard, MDF or plywood

.2 Finish:

.1 Paint type as indicated on Drawings

.2 ABS 0.039 inch (1 mm) thick with ultra high gloss acrylic overlay

.3 Exposed Interior Parts:

.1 Core: Particleboard, MDF or plywood

.2 Finish:

.1 Paint type as indicated on Drawings

.2 ABS 1 mm thick with ultra high gloss acrylic overlay

.4 Semi-Exposed Parts:

.1 Core: Particleboard, MDF or plywood

.2 Finish: Paint type as indicated on Drawings

.5 Concealed Parts:

.1 Core: Same as Semi-Exposed Parts

.2 Finish: Paint type as indicated on Drawings

.6 Edge Banding for Shelves: Finished on all four (4) edges and as follows:

.1 PVC Banding for HPDL and LPDL Finished Surfaces: 0.118 inch (3 mm) PVC banding with exposed edges and corners machine profiled to 0.118 inch (3 mm) radius; colour to match with surface finish

.7 Edge Banding for Doors, Drawers and False Fronts: Finished on all four (4) edges and as follows:

.1 ABS Banding for HPDL and LPDL Finished Surfaces: 0.118 inch (3 mm) ABS banding with exposed edges and corners machine profiled to 0.118 inch (3 mm) radius; colour to match with surface finish

.8 Edge Banding Adhesive: Thermoplastic hot melt, synthetic resin suitable for applying edge banding and film overlays.

.9 Fabricate doors and drawer fronts using flush overlay; fabricate drawers in accordance with AWS requirements for Grade indicated.

.3 Quartz Solid Surface Countertops: Install Quartz solid surface countertops using skilled personnel specializing in the type of work indicated; cut quartz accurately to conform to shape and dimensions required with exposed surfaces true:

.1 Perform cutting and drilling not provided by supplier.

.2 Do not use impact or hammer drills; use only diamond drill bits.

.3 Carefully cut and fit edges and grind to a perfect fit in a manner that does not impair strength or appearance.

.4 Machine polish exposed edges; do not use waxes, sealers or coatings.

.5 Patching or other forms of concealment to cover defects in material or workmanship will not be permitted.

.4 Construct casework using minimum core thickness for materials listed in this section; adjust thickness of shelves to allow for uniformly distributed loading of 90 kg with a concentrated load of 50.7 lbs (23 kg) and length for maximum of L/140 deflection in full use:

.1 Assemble casework with flush butt hairline corners and joints; make cut outs for services on site during installation

.2 Carefully fit, cope or mitre joints and glue with no end wood visible on finished surfaces.

.3 Make blocking, framing, web frames from solid lumber

.4 Cut 1 inch (25 mm) Ø finger pulls in sliding doors and insert pre-manufactured recessed pulls

.5 Cut and adapt casework to receive hardware; install finishing hardware and fittings in shop, except that fittings that may be susceptible to damage during shipping and installation may be installed after casework is installed on site

.5 Glue, dowel, mortise, lock joint or dado casework; do not use staples; nailing and screws are acceptable; do not surface nail or screw through countertops:

.1 Set nail heads in finished surfaces; countersink screws and bolts; fill holes with edge grain wood plugs to match colour and grain.

.6 Remove dust from routed or cut edges before gluing hardwood edges to particleboard and plywood cores; clamp liquid glued adhered edges until set is achieved; apply pressure to hot melt glued adhered edges until component has cooled to set point; lap joints.

Part 3 Execution

3.1 EXAMINATION

.1 Visit site and note state of completion within various areas in which casework is being installed; verify that surfaces are ready to receive work of this Section and that other work is finished and painted before being built-over or covered in any way by installed casework:

.1 Verify that areas in which casework is scheduled are finished and ready to accept work of this Section; with walls painted, ceilings finished, overhead services completed, tested and accepted.

.2 Starting work will be considered as acceptance of conditions.

3.2 PREPARATION

.1 Confirm access is sufficient for large pieces of casework, and that they can be transported easily and safely to final installation location.

.2 Protect adjacent finished surfaces and materials from damage by work of this Section.

.3 Back prime casework immediately after delivery to site.

3.3 INSTALLATION

.1 Install casework plumb, level and true to locations indicated on Drawings and in accordance with AWS.

.2 Anchor to floor, walls or ceiling using fastening devices and hardware consistent with materials being fastened into and quality of finish, and as follows:

.1 Do not use wood plugs

.2 Do not use plastic plugs for ceilings or walls

.3 Provide wall cleats fastened to wall blocking as required

.4 Shim level and square in relation to adjoining surfaces

.5 Scribe accurately to adjacent work

.6 Provide allowance for finish flooring installation to base by related sections of work

.3 Scribe neatly and accurately to smooth snug fit with adjoining surfaces and materials to align work properly; mitre corners accurately.

.4 Perform cutting, fitting, repairing in woodwork as required by other trades where their Work is connected to or part of this Work.

.5 Cut out openings for mechanical and electrical fittings and fixtures; coordinate and cooperate with mechanical and electrical work and obtain required templates, cutting locations and dimensions.

.6 Apply neat bead of sealant between plumbing fixtures countertops and adjoining walls and casework; seal edges of cut out core material before fixtures installed with moisture resistant compound.

.7 Install stone surface countertops to casework units; coordinate schedule and delivery requirements to meet the construction schedule.

.1 Mitre corners and changes of direction

.2 Make fixing devices inconspicuous and of same colour as angles

.3 Apply screws flush without dimpling supports

.4 Fill space between wall and supports with preformed PVC tape of adequate thickness to prevent light leakage where walls are not plumb

.5 Provide tee supports at locations where coves change direction

.6 Cut to size so that they do not fall out of supports and align so that they read in one continuous pattern along their length.

3.4 CLOSEOUT ACTIVITIES

.1 Deficient Work: Replace, rework or refinish work that does not meet AWS requirements as directed by Team Project Manager.

.2 Adjusting: Adjust hardware and operating parts during and after installation to provide smooth and proper operation of casework components.

.3 Cleaning: Clean casework, cabinets, countertops, shelves and fixtures, and remove marks, scratches or marring on exposed and semi-exposed surfaces after work of this Section is complete and prior to Completion of the project.

END OF SECTION

SECTION 06 61 19

QUARTZ SURFACING FABRICATIONS

Part 1 General

1.1 SUMMARY

.1 Work of this Section includes fabrication of, but not limited to, the following:

.1 Countertops

1.2 RELATED REQUIREMENTS

.1 Section 05 50 00 – Metal Fabrications: Countertop supports.

.2 Section 06 10 00 – Rough Carpentry: Plywood underlayment.

.3 Section 06 20 00 – Finish Carpentry

.4 Section 06 40 00 – Architectural Woodwork

.5 Section 07 92 00 – Joint Sealants

.6 Section 09 30 00 – Tiling

.7 Section 10 28 13 - Toilet Accessories.

.8 Division 22 – Plumbing: Coordination with plumbing fixtures, supply lines and waste pipes.

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI):

.1 ANSI A137.1 2008, American National Standards Specifications for Ceramic Tile

.2 ANSI Z124.6-1997, Stain Resistance

.2 NSF International/American National Standards Institute (ANSI):

.1 NSF/ANSI 51-2005, Food Equipment Materials

.3 American Society for Testing and Materials (ASTM):

.1 ASTM C97-96e1, Absorption and Bulk Specific Gravity of Dimension Stone.

.2 ASTM C99-08, Modulus of Rupture of Dimension Stone.

.3 ASTM C170-06, Compressive Strength of Dimension Stone.

.4 ASTM C501-84 (2002), Relative Resistance to Wear of Unglazed Ceramic Tile by Taber Abrasion.

.5 ASTM C482-02, Bond Strength of Ceramic Tile to Portland Cement.

.6 ASTM C484-99, Thermal Shock Resistance of Grazed Ceramic Tile.

.7 ASTM C531-95, Linear Shrinkage and Coefficient of Thermal Expansion of Chemical -Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concrete.

.8 ASTM C648-98, Breaking Strength of Ceramic Tile.

.9 ASTM C1026-87 (2002), Resistance of Ceramic Tile to Freeze Thaw Cycling.

.10 ASTM E84-09, Surface Burning Characteristics of Building Materials.

.11 ASTM E662-09, Specific Optical Density of Smoke Generated by Solid Materials.

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit shop drawings indicating dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.

.3 Submit manufacturer's standard product data indicating product description, fabrication information and compliance with specified performance requirements.

.4 Submit coordination drawings indicating layout of plumbing and electrical work, steel reinforcing, recessed and built-in items and wall blocking information; indicate the following:

.1 Project specific information, drawn accurately to scale.

.2 Do not base coordination drawings on reproductions of the contract documents or standard printed data.

.3 Indicate dimensions shown on the contract drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements.

.4 Interference locations and sketches indicating proposed resolution; minor dimension changes and difficult installations will not be considered changes to the contract.

1.5 PROJECT CLOSEOUT SUBMISSIONS

.1 Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Operations and Maintenance Data.

.2 Submit manufacturer's care and maintenance data, including repair and cleaning instructions.

1.6 QUALITY ASSURANCE

.1 Fabricator and installer shall have a minimum of three years experience in fabrication and installation of quartz surfacing materials and have training and certification from the manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver components to project when areas are ready for installation.

.2 Store components indoors in heated conditions similar to the area of installation until ready for installation.

.3 Handle materials to prevent damage to finished surfaces; provide protective coverings to prevent physical damage or staining following installation until just prior to Substantial Performance for the Project.

1.8 WARRANTY

.1 Provide manufacturer's standard 1 year warranty against defects in materials and workmanship; including material and labour to repair or replace defective materials.

Part 2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design products are named in this Section; additional manufacturers offering similar setting systems may be incorporated into the work provided they meet the performance and aesthetic requirements established by the named products.

2.2 MATERIALS

.1 Homogeneous mixture containing 93% pure quartz with additions of high performance polyester resin, pigments and special effects. Manufacturer is licensed to utilize Bretonstone™ technology and equipment used to compact and polish mixture, and having the following nominal properties:

- .1 Thickness: 1-9/16 inch (30 mm)
- .2 Identification: Material shall be labeled with manufacturer’s identifying mark.
- .3 Color: Pure White
- .4 Finish: Polished
- .5 Exposed Edges and Corners:
  - .1 Countertops profile: Eased
- .6 Performance Requirements:
  - .1 Moisture Absorption: typical results 0.02%; ASTM C97
  - .2 Modulus of Rupture: typical results 6,800 psi; ASTM C99
  - .3 Compressive Strength: typical results 24,750 psi; ASTM C170
  - .4 Abrasion Resistance: typical results 223; ASTM C501
  - .5 Bond Strength: typical results 205 psi; ASTM C482
  - .6 Thermal Shock: passes 5 cycles: ASTM 484
  - .7 Coefficient of Thermal Expansion: typical results $1.2x10^{-5}$ inch/°F; ASTM C531
  - .8 Breaking Strength of Tile: typical results 3,661 lbf; ASTM C648
  - .9 Resistance to Freeze Thaw Cycling: unaffected 15 cycles; ASTM C1026
  - .10 Coefficient of Friction Pull Method: .75 avg. dry / .55 avg. wet; ANSI A137.1
  - .11 Surface Burning Characteristics: typical results 17; ASTM E84
  - .12 Smoke Density: flaming 196, non-flaming 69; ASTM E662
  - .13 Stain Resistance: Unaffected; ANSI Z124.6
- .7 Food Zone Use: Pass Rating in accordance with NSF 51 Sanitation requirements.
- .8 Pattern and Colour: As indicated on Drawings
- .9 Basis-of-Design Material: Caesarstone Quartz Surfaces

2.3 ACCESSORIES

.1 Mounting Adhesive: Provide structural grade '50 year' silicone or epoxy adhesive.

.1 Acceptable silicone manufactures:

.1 Dow Corning.

.2 Acceptable epoxy manufactures:

.1 Akemi North America.

.2 Tenax USA.

.2 Quartz Surface Adhesive:

.1 Provide epoxy or polyester adhesive of a type recommended by manufacturer for application and conditions of use.

.2 Acceptable manufacturers:

.1 Akemi North America.

.2 Tenax USA.

.3 Adhesive which will be visible in finished work shall be tinted to match quartz Surface.

.3 Joint Sealant:

.1 Clear sealant of type recommended by manufacturer for application and use.

.2 Provide anti-bacterial type in toilet, bath and food preparation areas.

.3 Acceptable manufacturers:

.1 Dow Corning.

.4 Solvent: Denatured alcohol for cleaning quartz surfacing to assure adhesion of adhesives and sealants.

.5 Cleaning Agents: Mild soap and water.

.6 Sink Mounting Hardware: Manufacturer's recommended clips, inserts and fasteners for attachment of under mount sinks.

2.4 FABRICATION

.1 Fabricate units to maximum size capable of being safely transported and handled to place of final installation in accordance with shop drawing and manufacturer's written instructions using a fabricator certified by the manufacturer.

.2 Fabricate and machine shapes to profiles indicated on Drawings; obtain all dimensions affecting fabrication and installation from job site before starting fabrication.

.3 Layout surface to minimize joints and avoid L-shaped pieces of quartz surfacing. Layout and fabricate with 'hairline' joints.

.4 Cut and polish with water cooled powered tools.

.5 Cut, drill and shape fabrications as required to receive plumbing fittings and services, and built-in accessories.

.6 Where edges of cut-outs will be exposed in finished work; polish edges.

.7 Finish edges and surfaces true, level and even with inconspicuous joints between having no voids formed using manufacture's standard joint adhesive and reinforcing strips.

.8 Make cut outs with 10 mm radius corners to prevent stress cracking.

.9 Fabrication assemblies with tolerances as follows:

.1 Variation in component size: ±0.118 inch 9 (± 3 mm).

.2 Location of openings: ±0.118 inch (± 3 mm) from indicated location.

.10 Provide anchorage to receive Work of other Sections scheduled and detailed to be installed.

Part 3 Execution

3.1 INSTALLATION

.1 Install components plumb and level, in accordance with shop drawings and manufacturers written installation requirements.

.2 Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work.

.3 Adhere under mount sinks to countertops using manufacturer's recommended adhesive and mounting hardware.

.4 Install backsplashes and end splashes as indicated on Drawings; adhere to countertops using manufacturer's standard colour matched silicone sealant.

.5 Coordinate plumbing connections with Division 22.

3.2 PROTECTION AND CLEANING

.1 Keep components and hands clean during installation; remove adhesives, sealants and other stains as work progresses; keep components clean until Substantial Performance for the Project.

.2 Clean exposed surfaces with denatured alcohol.

.3 Protect installed fabrications with non-staining sheet coverings.

.4 Repair or replace damaged work that cannot be repaired to match installed work at no additional cost to the Project.

END OF SECTION

SECTION 07 05 10

COMMON WORK RESULTS FOR AIR BARRIER AND VAPOR RETARDER SYSTEMS

Part 1 General

1.1 SUMMARY

.1 This section includes administrative and procedural requirements for constructing an airtight Building Envelope that controls infiltration and exfiltration of air using a combined air and vapor retarder membrane system and separate air barrier and vapor retarder systems in accordance with the Building Code.

.2 Airtight components of the building include non-moisture permeable membranes , and moisture permeable sheets as specified in Related Sections, and as indicated on the Drawings.

.3 Successful installation of the Building Envelope is dependent on, but is not limited, to the following:

.1 Coordination between the various contributors to the Building Envelope installing, joining to, modifying, or otherwise affecting the installed Building Envelope.

.2 Scheduling and sequencing of the Work.

.4 Verify that the intent of constructing the Building Envelope with regards to controlling air leakage into or out of conditioned spaces is achieved using training and follow-up procedures of Team Members and Team Crew Members involved with installation of Building Envelope materials including, but not limited to, the following characteristics:

.1 The importance of continuity of air barrier and vapor retarder system components with all joints and penetrations sealed.

.2 The concept that air barrier and vapor retarder system components must be structurally supported to withstand positive and negative air pressures applied to the Building Envelope.

.3 Installation of air barrier and vapor retarder system components must have physical connection between:

.1 Walls to windows and doors.

.2 Different wall systems.

.3 Wall and roof transitions

.4 Wall and roof over conditioned space.

.5 Walls, floor and roof across construction, control and expansion joints.

.6 Walls, floors and roof to utility, pipe and duct penetrations.

.4 Make penetrations to air barrier and vapor retarder systems airtight.

1.2 RELATED REQUIREMENTS

.1 Section 01 00 06 – General Requirements

.2 Section 07 25 19 – Foamed-In-Place Air and Vapor Barrier

.3 Section 07 53 00 – Elastomeric Membrane Roofing

.4 Section 07 92 00 – Joint Sealants

.5 Section 09 21 16 – Gypsum Board Assemblies

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM E96/E96M-05, Standard Test Methods for Water Vapor Transmission of Materials

.2 ASTM E779-03, Standard Test Method for Determining Air Leakage Rate by Fan Pressurization

.3 ASTM E1677-05, Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls

.4 ASTM E2178-11, Standard Test Method for Air Permeance of Building Materials

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-149.10-M86, Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method

.2 CAN/CGSB 149.15-96, Determination of the Overall Envelope Airtightness of Buildings by the Fan Pressurization Method using the Building's Air Handling Systems, and amendments.

1.4 DEFINITIONS

.1 **Building Envelope:** Building Envelope includes the airtight and moisture resistant components including joints, junctures and transitions between materials, Products, and assemblies forming the building enclosure.

.2 **Vapor Retarder:** Vapor retarders form an integral part of the building enclosure and must be maintained intact and continuous on the interior (warm) side of all insulated assemblies; comprised of moisture vapor impermeable membranes that are maintained in tight physical contact to the building enclosure insulation; sealed tight to all openings and penetrations and to all other elements of the Building Envelope.

.3 **Air Barrier:** Air barriers are comprised of physically strong and reliable materials designed to resist air movement into or out of the Building Envelope and resist a minimum air pressure difference of 0.29 lbs/in² (2.0 kPa) without tearing, rupturing or breaking away from its fastening; may form a part of a combined air and vapor retarder material, or may form as separate air barrier system as specified.

.4 Manufacturers' use different methods of describing the rate at which water vapor will pass through their vapor retarder materials. The three most common terms are as follows:

.5 **Water Vapor Permeability:** Time rate of water vapor transmission through unit area of flat material of unit thickness induced by unit vapor pressure difference between two specific surfaces, under specified temperature and humidity condition; arithmetic product of permeance and thickness that provides the property of a material.

.6 **Water Vapor Permeance:** Time rate of water vapor transmission through unit area of flat material or construction induced by unit vapor pressure difference between two specific surfaces, under specified temperature and humidity conditions; permeance indicates the performance of the material and is not a property of a material.

.7 **Water Vapor Transmission Rate:** Steady water vapor flow in unit time through unit area of a body, normal to specific parallel surfaces, under specific conditions of temperature and humidity at each surface.

.8 Metric units will be used to assess the performance of any given vapor retarder material, the following conversions will be used to asses manufacturers' product information.

1.5 PERFORMANCE REQUIREMENTS

.1 This Section describes coordination required between the various contributors to the successful installation of the Building Envelope including any customized fabrication and installation procedures that may be required; this section does not cover specification requirements for Products listed in Related Sections.

.2 Common performance requirements required to maintain continuity of the Building Envelope include, but are not limited to, the following:

.1 Correct installation of Products at joints and transitions to provide airtight assemblies.

.2 Specific quality control requirements for individual construction activities are specified in the sections of the specifications; verify that each contributor to the Building Envelope is adequately and satisfactorily performing the quality assurance documentation, tests and procedures required by each Related Section.

.3 Specified inspections, tests, and related actions performed by the Competition Document Requirements or Team Members Requirements do not replace the Team Crew Member's quality assurance procedures required to facilitate compliance with specified requirements.

.4 Products used for air barrier and vapor retarder systems forming the Building Envelope shall be in accordance with the Building Code.

1.6 QUALITY ASSURANCE

.1 Coordinate work contributing to or affecting construction of the Building Envelope, and sequence of construction required to attain continuity of air barrier and vapor retarder system joints, junctures and transitions between materials and assemblies of materials and Products.

.2 Use labour trained and experienced in the installation of Building Envelope Products; use materials that are compatible with each other in the final construction and that will form a continuous air barrier and vapor retarder system.

.3 Provide quality assurance procedures, testing and verification required to install Building Envelope as follows:

.1 Team Crew Member's quality assurance program as a part of the Contract Price.

.2 Organize pre-construction meetings between the contributors to the Building Envelope to determine extent, responsibility and sequence of installation of airtight joints, junctures, and transitions between materials, Products and assemblies installed by the contributors to the Building Envelope.

.3 Perform spot checks to verify that materials, Products and assemblies installed by the contributors to the Building Envelope.

1.7 QUALITY CONTROL

.1 The Team may, at their sole discretion, pay for inspection and testing services performed by an independent agency to verify compliance with specified requirements specified in accordance with Section 07 08 15.

.2 Inspection agency will provide qualified personnel to perform required inspections and tests as required by Section 07 08 15.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 INSTALLATION

.1 Conform to the requirements of this Section to maintain and protect continuity and integrity of the Building Envelope.

.2 Install air barriers and vapor retarders in full contact with substrate in accordance with manufacturer's instructions using recommended fasteners, primers or adhesives required for a complete system.

.3 Maintain continuity of Building Envelope across expansion and control joints whether indicated and designed or not.

.4 Leave sufficient transition flaps of air barrier and vapor retarder materials to allow subsequent contributors to the Building Envelope to complete junctions; temporarily fasten and protect transition flaps from weather, wind and damage from construction so that junctions can be completed without having to repair transition flaps and so that transition can form an airtight and vapor retardant seal.

.5 Refer to referenced related sections for specific requirements and any site testing.

3.2 TEAM'S SITE TESTING AND INSPECTION ACTIVITIES

.1 The Team may, at their sole discretion, hire a testing and inspection agency to provide Occasional observation and inspection during installation of the air barrier and vapor retarder systems in accordance with Section 07 08 15.

.2 Team Members and Team Crew Members will cooperate with agencies performing the required inspections, tests, and similar services; notify inspection agency in advance of required testing in accordance with Section 07 08 15; auxiliary services as required by testing agency will include, but are not necessarily limited to, the following:

.1 Access to the Work.

.2 Incidental labour and facilities necessary to facilitate inspections and tests.

.3 Adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.

.4 Deliver samples to testing laboratories, when requested.

.5 Security and protection of samples and test equipment at the Project Site.

.6 Coordinate the sequence of activities to accommodate required inspection services with a minimum of delay.

.7 Coordinate activities to avoid removing and replacing construction to accommodate inspections and tests.

.8 Team Project Manager is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

3.3 REPAIR AND PROTECTION

.1 Repair damaged construction and restore substrates and finishes when inspection, testing, sample taking and similar services have been completed in accordance with Section 01 00 06 – General Requirements; Cutting and patching; repair immediately after testing and sampling is completed to prevent damage to assemblies resulting from moisture diffusion or air leakage.

.2 Protect construction exposed during quality control activities and repaired construction from weather and sources of moisture that are deleterious to the tested assemblies.

.3 Take all necessary precautions to prevent puncturing, tearing, weakening or damaging the Building Envelope membranes during construction; repair any damage to the building envelope products, materials, components, systems and assemblies.

.4 Protect vapor retarder membranes from cold in final building construction.

END OF SECTION

SECTION 07 05 80.01

COMMON WORK RESULTS FOR FIRE RATED SEPARATIONS AND ASSEMBLIES

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 00 06 – General Requirements; Submittal Procedures

.2 Section 06 10 00 – Rough Carpentry: Fire retardant treated lumber and panels.

.3 Section 07 84 00 – Firestopping and Smokeseals: Openings through fire resistive assemblies, top-of-wall and building perimeter joints, and mechanical and electrical penetrations.

.4 Section 09 21 16 – Gypsum Board Assemblies: Materials used in fire rated assemblies.

.5 Division 21 – Fire Suppression: Fire suppression systems.

.6 Division 23 – Heating, Ventilating and Air Conditioning: Fire rated dampers and detection systems.

.7 Other sections making reference to fire resistance or separation ratings.

1.2 DESIGN REQUIREMENTS

.1 Conform to listed requirements to maintain the continuity of fire separations whether or not shown on the drawings.

.2 Do not support non-combustible construction on or from combustible construction.

.3 Firestop all openings and joints in fire rated construction with non-combustible material specified in Section 07 84 00 where a fire separation or assembly is required to be of non-combustible construction and terminates at the exterior wall, the underside of floor, ceiling, or roof structure and at floors.

.4 Do not use combustible members, fastenings, and similar items to anchor fixtures to fire separations.

.5 Firestop openings for non-combustible pipes and ducts to prevent the passage of smoke and flame; Team Crew member responsible for firestopping will install firestopping where their work passes through a fire separation, plug the opening with ULC labelled and approved firestopping sealant, insulation or other material approved by local Authorities Having Jurisdiction to maintain the integrity of the fire separations.

.6 Do not pierce fire separations with electrical or similar service outlets except in accordance with the Building Code.

.7 Existing fire separations must be maintained as such, and any cutting must be sealed to retain the separation's assembly rating.

.8 Refer to technical sections for specific requirements for sealing penetrations and joints of smoke and fire separations.

1.3 FIRE TEST RESPONSE CHARACTERISTICS

.1 Provide materials and construction identical to those tested in assembly indicated according to CAN/ULC S101 for assemblies or materials having fire resistance ratings, as verified by an independent testing and inspecting agency acceptable to Authorities Having Jurisdiction for fire resistance ratings of specific assemblies indicated on drawings:

.2 Provide label and proof of acceptance for fire resistance rated assemblies and materials as indicated by design designations from ULC List of Equipment and Materials or Warnock Hersey-Intertek Directory of Listed Products. Where no design designation is provided, use only time assigned to materials listed in the Building Code.

.3 Fire resistance rated assemblies and materials will only be accepted from an organization recognized by the Authority Having Jurisdiction as being capable of conducting testing and providing labelling for materials, assemblies and systems that include, but are not limited to, the following organizations:

.1 Underwriters Laboratories of Canada (ULC).

.2 Underwriters Laboratories Inc. (UL).

.3 Intertek-Warnock Hersey (I/WH) ETL Semko.

.4 Acceptance of UL or WHI labels are subject to the following conditions:

.1 Fire resistance rated assemblies and materials bearing an Underwriter's Laboratories Inc. (UL) or Intertek-Warnock Hersey (I/WH) label will be acceptable for use on this project provided that the label indicates acceptance under Underwriters Laboratories of Canada (ULC) and having either a $_{c}$UL, $_{c}$UL$_{us}$, $_{c}$I/WH or $_{c}$I/WH$_{us}$ marking.

.2 Materials that only have a UL, UL$_{us}$, I/WH or I/WH$_{us}$ marking will not be acceptable.

.5 Examples of acceptable marks from Recognized Testing Authorities:

END OF SECTION

SECTION 07 21 16

BLANKET INSULATION

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of fibrous blanket insulation for installation in wall stud spaces, ceiling spaces and concealed spaces as a part of a thermal component of the building envelope.

1.2 RELATED REQUIREMENTS

.1 Section 01 00 06 – General Requirements

.2 Section 06 10 00 – Rough Carpentry: Coordinate requirements for installation between wood wall studs and concealed spaces.

.3 Section 07 25 13 – Air and Vapor Barriers

.4 Section 07 25 19 – Foamed-in-Place Air and Vapor Barriers

.5 Section 09 21 16 – Gypsum Board Assemblies: Coordinate installation of thermal insulation in framed assemblies.

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM C1320-05 (2009)e1, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction

.2 Underwriters Laboratories Canada (ULC):

.1 CAN/ULC S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.2 CAN/ULC S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials

.3 CAN/ULC S129-06, Standard Method of Test for Smoulder Resistance of Insulation (Basket Method)

.4 CAN/ULC S702-97, Standard for Thermal Insulation Mineral Fibre for Buildings

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: Provide materials that meet requirements for CAN/ULC S102 for flame spread rating of 25 or less; CAN/ULC S114 for non-combustibility; and CAN/ULC S129 for smoulder resistance when using materials in fire resistant rated construction.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Storage and Handling Requirements: Protect insulation materials from physical damage and from deterioration by moisture and soiling; store undercover and protect from wetting or moisture.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Material Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 Roxul Inc.

.2 Additional material manufacturers offering similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products on this Section.

2.2 MATERIALS

.1 Mineral Fibre Insulation: Unfaced, preformed mineral slag batt insulation in accordance with CAN/ULC S702, Type 1; having a nominal RSI of 0.67/25 mm; rated non-combustible in accordance with CAN/ULC S114 and having a flame spread rating of 5 or less in accordance with CAN/ULC S102; density 32 kg/m^3; square edges, thickness as required to meet design insulation values indicated on drawings or as required to fill insulated spaces where not indicated, and as follows:

.1 Acceptable Materials:

.1 Roxul Inc., Roxul Plus

2.3 ACCESSORIES

.1 Air and Vapour Retarder: As specified in Section 07 25 13 and Section 07 25 19

Part 3 Execution

3.1 INSTALLATION

.1 Batt Insulation: Install batt insulation where indicated with continuous vapor retarder on the warm side of the insulation in accordance with ASTM C1320, and as follows:

.1 Where required to maintain continuity of thermal insulation of the building envelope.

.2 Cut and trim insulation neatly to fit spaces; butt ends and edges tight; fit insulation tightly to framing members and around pipes, conduits, and projecting structural members within insulated spaces.

.3 Fill stud space of exterior framed walls with insulation full depth of stud only where no insulation/vapor retardant indicated on exterior face of stud walls.

.4 Do not compress insulation to fit into spaces.

.5 Hold insulation in position with clips, wires or as recommended by manufacturer when insulation is installed in horizontal locations.

3.2 PROTECTION

.1 Protect installed insulation from damage arising from harmful weather exposures, physical abuse, and other causes.

.2 Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 23 13

AIR AND VAPOR MEMBRANES

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of air and vapor membranes that prevent exfiltration and infiltration between interior and exterior of building through wall and roof transition construction under all conditions of air pressure differentials forming an integral part of the building enclosure installed intact and continuous on warm side of exterior insulated walls.

1.2 RELATED REQUIREMENTS

.1 Section 01 00 06 – General Requirements; Submittals

.2 Section 07 05 10 – Common Work Results for Air and Vapor Membrane and Vapor Retarder Systems: Measurement criteria for confirming air tightness and vapor pressure required to maintain building envelope.

.3 Section 07 25 19 – Foamed-In-Place Air and Vapor Barrier: Coordinate installation of materials providing continuation of air and vapor seals around penetrations and openings, and other locations required to form a complete building envelope.

.4 Section 07 53 00 – Elastomeric Membrane Roofing: Coordinate compatibility of roofing transition membranes with membranes specified in this Section.

.5 Section 07 62 00 – Sheet Metal Flashing and Trim: Coordination with flexible flashings and compatibility with specified air and vapor membranes.

.6 Section 07 92 00 – Joint Sealants: Coordinate compatibility of joint sealants used for building envelope continuity.

.7 Section 09 21 16 – Gypsum Board Assemblies: Coordinate surface preparation of air and vapor membrane for application to gypsum sheathing substrates.

1.3 REFERENCE STANDARDS

.1 American Society for Testing of Materials (ASTM):

.1 ASTM D146-04, Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing

.2 ASTM D412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

.3 ASTM D1970-09, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

.4 ASTM E96/E96M-05, Standard Test Methods for Water Vapor Transmission of Materials

.5 ASTM E283-04, Standard Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen

.6 ASTM E2178-11, Standard Test Method for Air Permeance of Building Materials

.7 ASTM E2357-05, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate interface of membranes specified in this Section with adjacent systems to ensure continuity of system and that junctions between various components are effectively sealed; verify with manufacturers and installers for installation procedures of materials incorporated into air and vapor membrane elements including membranes, transitions, coatings and sealants and continuity with roofing membrane.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver materials to job site in original unopened packages, clearly marked with manufacturer's name, material brand name and description of contents.

.2 Storage and Handling Requirements: Protect membrane materials before, during and after installation in accordance with manufacturer’s requirements for weight, temperature, heat and flame, and humidity; store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by membrane manufacturer.

1.6 SITE CONDITIONS

.1 Ambient Conditions: Apply air and vapor membrane to substrate surfaces that are within manufacturer’s installation temperature threshold range accounting for wind cooling and apparent temperature when actual temperature is approaching manufacturer’s minimum temperature threshold.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 Bakor Inc. (Henry Canada)

.2 Grace Construction Materials

.3 Soprema Canada

.4 Tremco Commercial Sealants and Waterproofing

.5 W. R. Meadows Inc.

2.2 PERFORMANCE REQUIREMENTS

.1 Provide materials and installations that meet the following material and assembly performance ratings as required by Section 07 05 10, and as follows:

.1 Material Performance: Provide materials having an air permeance rating not exceeding 0.02 l/sec-m^2 measured at 75 Pa pressure differentials in accordance with ASTM E2178; and having a vapor permeance rating not exceeding 3.5 g/sec-m^2 in accordance with ASTM E96.

.2 Assembly Performance: Install materials and accessories to provide a continuous air and vapor membrane assembly having an air leakage rate not exceeding 0.20 l/sec-m^2 measured at 75 Pa pressure differential in accordance with ASTM E2357; that will perform as the primary drainage plane flashed to direct condensation or water penetration to the exterior; that will accommodate movement of building materials and building expansion and contraction; and that has appropriate accessory materials to account for changes in substrate, transitions and other perimeter conditions.

2.3 AIR AND VAPOR MEMBRANE ASSEMBLY

.1 Self Adhering Membrane: Self adhering SBS modified bitumen reinforced membrane; having low temperature formulation appropriate for installation requirements; tested in accordance with ASTM E96 and ASTM E2178, and having the following nominal properties:

.1 Low Temperature Flexibility: Less than -20°C

.2 Thickness: 0.039 in. (1.0 mm).

.3 Acceptable Materials:

.1 Bakor Blueskin SA

.2 Grace Perm-A-Barrier Wall Membrane

.3 Soprema Soprastick 1100T

.4 Tremco ExoAir 110

.5 W. R. Meadows Air-Shield

2.4 ACCESSORIES

.1 Roof-to-Wall Transition Membranes: Manufacturer's recommended reinforced self adhesive, compatible with roofing air and vapor membranes and wall materials specified in this Section.

.2 Opening Transition Membranes: Manufacturer's recommended reinforced, self adhesive membrane compatible with adjacent materials and air and vapor membranes specified in this Section.

.3 Through Wall Membranes: Manufacturer's recommended reinforced self adhesive, compatible with air and vapor membrane and that will not become plastic and extrude onto finished surfaces when exposed to high wall temperatures..

Part 3 Execution

3.1 EXAMINATION

.1 Examine conditions of substrates and other conditions affecting this Section before starting work; notify other related trades and verify that substrates are complete and ready for installation of products specified in this Section.

3.2 PREPARATION

.1 Prepare surfaces in accordance with manufacturer's written requirements for type of substrate; free from voids, spalled areas, loose aggregates or sharp points; clean surfaces to remove contaminants that could affect bond such as grease or wax, dust, dirt and debris and as follows:

.1 Exterior OSB Sheathing Panels: Verify that panels are installed correctly with non-protruding fasteners; pre-treat panel joints with self adhesive membrane tape compatible with primary membrane materials.

.2 Adjacent Materials: Treat construction joints and install flashings as recommended by manufacturer.

3.3 INSTALLATION

.1 Install air and vapor membranes in accordance with manufacturer's written requirements, using appropriate equipment and skilled workers and as follows:

.1 Holes and Tears: Repair holes and tears with compatible membrane materials; overlap affected surface area by a minimum of 4 in. (100 mm) and seal edges of repair with manufacturer's recommended mastic material.

.2 Transition Membranes: Connect air and vapor membranes to adjacent assemblies having pre-installed transition membranes at openings and other assemblies; install transition membranes where required to maintain continuity of building envelope.

.3 Corner Details and Protrusions: Cover inside corners and protrusions, centred and installed in direct contact with the substrate with no voids under the membrane strip; reinforce outside corners by double lapping or stripping as required by membrane manufacturer.

.4 Through Wall and Flexible Flashings: Install flexible membranes where required to maintain flow direction to divert water away from face of building envelope.

.2 Separate air and vapor membranes from incompatible materials, and provide manufacturer's recommended transition materials required to maintain continuity of building envelope.

.3 Inspect membrane installation at end of each day of work and before installation of insulation; seal upper edge of membrane with mastic at end of day's work when precipitation is anticipated or when work is expected to be delayed or interrupted by more than one day.

3.4 SITE QUALITY CONTROL

.1 Allow access for review of installed air and vapor membranes, and repair of deficiencies before placement of insulation materials.

.2 Non-Conforming Work: Repair or replace non-conforming work.

3.5 CLOSEOUT ACTIVITIES

.1 Protection: Protect membrane as recommended by manufacturer from effects of long term exposure where membrane is open to the environment for prolonged time periods using opaque plastic sheets or tarpaulins; protect membrane from penetrations and damage by successive components of the Work; assign payment for repairs to responsible parties; make repairs in accordance with manufacturer's written instructions using original installers.

.2 Cleaning: Remove masking materials, debris, excess materials and equipment from site at completion of the work; conduct ongoing daily cleaning as directed by the Project Team Members; clean stains, drips or spills of coatings, sealants, mastic or primers visible on finished surfaces.

END OF SECTION

SECTION 07 23 13

AIR AND VAPOR MEMBRANES

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of air and vapor membranes that prevent exfiltration and infiltration between interior and exterior of building through wall and roof transition construction under all conditions of air pressure differentials forming an integral part of the building enclosure installed intact and continuous on warm side of exterior insulated walls.

1.2 RELATED REQUIREMENTS

.1 Section 01 00 06 – General Requirements; Submittals

.2 Section 07 05 10 – Common Work Results for Air and Vapor Membrane and Vapor Retarder Systems: Measurement criteria for confirming air tightness and vapor pressure required to maintain building envelope.

.3 Section 07 25 19 – Foamed-In-Place Air and Vapor Barrier: Coordinate installation of materials providing continuation of air and vapor seals around penetrations and openings, and other locations required to form a complete building envelope.

.4 Section 07 53 00 – Elastomeric Membrane Roofing: Coordinate compatibility of roofing transition membranes with membranes specified in this Section.

.5 Section 07 62 00 – Sheet Metal Flashing and Trim: Coordination with flexible flashings and compatibility with specified air and vapor membranes.

.6 Section 07 92 00 – Joint Sealants: Coordinate compatibility of joint sealants used for building envelope continuity.

.7 Section 09 21 16 – Gypsum Board Assemblies: Coordinate surface preparation of air and vapor membrane for application to gypsum sheathing substrates.

1.3 REFERENCE STANDARDS

.1 American Society for Testing of Materials (ASTM):

.1 ASTM D146-04, Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing

.2 ASTM D412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

.3 ASTM D1970-09, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

.4 ASTM E96/E96M-05, Standard Test Methods for Water Vapor Transmission of Materials

.5 ASTM E283-04, Standard Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen

.6 ASTM E2178-11, Standard Test Method for Air Permeance of Building Materials

.7 ASTM E2357-05, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 37-GP-56M, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate interface of membranes specified in this Section with adjacent systems to ensure continuity of system and that junctions between various components are effectively sealed; verify with manufacturers and installers for installation procedures of materials incorporated into air and vapor membrane elements including membranes, transitions, coatings and sealants and continuity with roofing membrane.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements; Submittals

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's product literature, and installation instructions required for complete and proper installation of air and vapor retarder elements including membranes, primers, fasteners, proprietary application equipment, and detailing requirements to suit specific project installation.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver materials to job site in original unopened packages, clearly marked with manufacturer's name, material brand name and description of contents.

.2 Storage and Handling Requirements: Protect membrane materials before, during and after installation in accordance with manufacturer’s requirements for weight, temperature, heat and flame, and humidity; store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by membrane manufacturer.

1.7 SITE CONDITIONS

.1 Ambient Conditions: Apply air and vapor membrane to substrate surfaces that are within manufacturer’s installation temperature threshold range accounting for wind cooling and apparent temperature when actual temperature is approaching manufacturer’s minimum temperature threshold.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 Bakor Inc. (Henry Canada)

.2 Grace Construction Materials
.3 Soprema Canada
.4 Tremco Commercial Sealants and Waterproofing
.5 W. R. Meadows Inc.

2.2 PERFORMANCE REQUIREMENTS

.1 Provide materials and installations that meet the following material and assembly performance ratings as required by Section 07 05 10, and as follows:

.1 Material Performance: Provide materials having an air permeance rating not exceeding 0.02 l/sec-m^2 measured at 75 Pa pressure differentials in accordance with ASTM E2178; and having a vapor permeance rating not exceeding 3.5 g/sec-m^2 in accordance with ASTM E96.

.2 Assembly Performance: Install materials and accessories to provide a continuous air and vapor membrane assembly having an air leakage rate not exceeding 0.20 l/sec-m^2 measured at 75 Pa pressure differential in accordance with ASTM E2357; that will perform as the primary drainage plane flashed to direct condensation or water penetration to the exterior; that will accommodate movement of building materials and building expansion and contraction; and that has appropriate accessory materials to account for changes in substrate, transitions and other perimeter conditions.

2.3 AIR AND VAPOR MEMBRANE ASSEMBLY

.1 Primers and Undercoats: Manufacturer's recommended primer or surface conditioner to improve bond between membranes to substrates having VOC content meeting or less than required for project sustainability requirements.

.2 Self Adhering Membrane: Self adhering SBS modified bitumen reinforced membrane; having low temperature formulation appropriate for installation requirements; tested in accordance with ASTM E96 and ASTM E2178, and having the following nominal properties:

.1 Low Temperature Flexibility: Less than -20°C
.2 Thickness: 0.039 in. (1.0 mm).
.3 Acceptable Materials:
.1 Bakor Blueskin SA
.2 Grace Perm-A-Barrier Wall Membrane
.3 Soprema Soprastick 1100T
.4 Tremco ExoAir 110
.5 W. R. Meadows Air-Shield

2.4 ACCESSORIES

.1 Roof-to-Wall Transition Membranes: Manufacturer's recommended reinforced self adhesive, compatible with roofing air and vapor membranes and wall materials specified in this Section.

.2 Opening Transition Membranes: Manufacturer's recommended reinforced, self adhesive membrane compatible with adjacent materials and air and vapor membranes specified in this Section.

.3 Through Wall Membranes: Manufacturer's recommended reinforced self adhesive, compatible with air and vapor membrane and that will not become plastic and extrude onto finished surfaces when exposed to high wall temperatures..

Part 3 Execution

3.1 EXAMINATION

.1 Examine conditions of substrates and other conditions affecting this Section before starting work; notify other related trades and verify that substrates are complete and ready for installation of products specified in this Section.

3.2 PREPARATION

.1 Prepare surfaces in accordance with manufacturer's written requirements for type of substrate; free from voids, spalled areas, loose aggregates or sharp points; clean surfaces to remove contaminants that could affect bond such as grease or wax, dust, dirt and debris and as follows:

.1 Exterior OSB Sheathing Panels: Verify that panels are installed correctly with non-protruding fasteners; pre-treat panel joints with self adhesive membrane tape compatible with primary membrane materials.

.2 Adjacent Materials: Treat construction joints and install flashings as recommended by manufacturer.

.2 Apply primer to substrates when required by manufacturer at rate recommended by manufacturer; cover primed substrates on same day, reapply primer when work cannot be completed on the same day.

3.3 INSTALLATION

.1 Install air and vapor membranes in accordance with manufacturer's written requirements, using appropriate equipment and skilled workers and as follows:

.1 Holes and Tears: Repair holes and tears with compatible membrane materials; overlap affected surface area by a minimum of 4 in. (100 mm) and seal edges of repair with manufacturer's recommended mastic material.

.2 Transition Membranes: Connect air and vapor membranes to adjacent assemblies having pre-installed transition membranes at openings and other assemblies; install transition membranes where required to maintain continuity of building envelope.

.3 Corner Details and Protrusions: Cover inside corners and protrusions, centred and installed in direct contact with the substrate with no voids under the membrane strip; reinforce outside corners by double lapping or stripping as required by membrane manufacturer.

.4 Through Wall and Flexible Flashings: Install flexible membranes where required to maintain flow direction to divert water away from face of building envelope.

.2 Separate air and vapor membranes from incompatible materials, and provide manufacturer's recommended transition materials required to maintain continuity of building envelope.

.3 Inspect membrane installation at end of each day of work and before installation of insulation; seal upper edge of membrane with mastic at end of day's work when precipitation is anticipated or when work is expected to be delayed or interrupted by more than one day.

3.4 SITE QUALITY CONTROL

.1 Allow access for review of installed air and vapor membranes, and repair of deficiencies before placement of insulation materials.

.2 Non-Conforming Work: Repair or replace non-conforming work.

3.5 CLOSEOUT ACTIVITIES

.1 Protection: Protect membrane as recommended by manufacturer from effects of long term exposure where membrane is open to the environment for prolonged time periods using opaque plastic sheets or tarpaulins; protect membrane from penetrations and damage by successive components of the Work; assign payment for repairs to responsible parties; make repairs in accordance with manufacturer’s written instructions using original installers.

.2 Cleaning: Remove masking materials, debris, excess materials and equipment from site at completion of the work; conduct ongoing daily cleaning as directed by the Project Team Members; clean stains, drips or spills of coatings, sealants, mastic or primers visible on finished surfaces.

END OF SECTION

SECTION 07 25 19

FOAMED-IN-PLACE AIR AND VAPOR MEMBRANES

Part 1 General

1.1 SUMMARY

.1 This section includes requirements for supply and installation of a spray polyurethane foam air and vapor seal system, and other components to bridge and seal the following air leakage pathways and gaps between; but not limited to, the following

- .1 Connections of the walls to the roof air seal
- .2 Connections of the walls to the foundations
- .3 Expansion joints
- .4 Openings and penetrations
- .5 Piping, conduit, duct and similar penetrations
- .6 All other air leakage pathways in the building envelope

1.2 RELATED REQUIREMENTS

.1 Section 05 12 00 – Structural Steel Framing

.2 Section 07 05 10 – Common Work Results for Air Barrier and Vapor Retarder Systems

.3 Section 07 25 13 – Air and Vapor Membranes: Transition membranes and flashing components to adjacent wall construction.

.4 Section 07 92 00 – Joint Sealers: Joint sealant materials and installation.

.5 Section 08 11 13 – Steel Doors and Frames

1.3 DEFINITIONS

.1 HCFC Free: Zero Global Warming, Zero Ozone Depletion (ODP) in compliance with Montreal Protocol requirement to eliminate production of HCFC 141b; products using HFC-245fa will be given preference over all other products.

.2 LTTR (Long Term Thermal Resistance): Defined as using techniques from CAN/ULC S770 predicting foam's insulating value that has been shown to be equivalent to the average performance of a permeably faced foam insulation product over 15 years.

1.4 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

- .1 ASTM E84-12 Standard test method for Surface burning Characteristics of Building Materials
- .2 ASTM E783-02 Standard Test Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors

.3 ASTM E1677-05, Standard Specification for an Air Seal (AR) Material or System for Low-Rise Framed Building Walls

.2 Underwriters Laboratories Canada (ULC):

.1 CAN/ULC S102-07, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.2 CAN/ULC S124-06, Standard Method of Test for the Evaluation of Protective Coverings for Foamed Plastic

.3 CAN/ULC S127-07, Standard Corner Wall Method of Test for Flammability Characteristics of Non-Melting Foam Plastic Building Materials

.4 CAN/ULC S705.1-01, Standard for Thermal Insulation-Spray Applied Rigid Polyurethane Foam, Medium Density-Material-Specification

.5 CAN/ULC S705.2-01, Standard for Thermal Insulation-Spray Applied Rigid Polyurethane Foam, Medium Density-Material-Application

.6 CAN/ULC S770-2000, Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Sequencing: Sequence work of this Section so that work for closures and substrates are installed before start of work for this Section.

1.6 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements; Submittals

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's product data sheets for each type of material, including manufacturer's printed instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.

.3 Informational Submittals: Provide the following submittals during the course of the work:

.1 Installation Instructions: Submit manufacturer's installation instructions.

.2 Certificates: Submit certificate of compatibility by air and vapor seal manufacturer, listing all materials on the project that it connects to or that come in contact with it, and documentation confirming that materials meet requirements for an air and vapor barrier.

.3 Source Quality Control Submittals: Submit testing results performed by an accredited laboratory confirming material has been tested and conforms to the requirements of ASTM E1677.

.4 Site Quality Control Submittals: Submit SPF Quality Assurance Program (QAP) documentation and reports in accordance with requirements listed in this Section at completion of work.

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements: Provide insulations that meet requirements for non-ozone depleting materials as regulated in the Montreal Protocol adopted by the United Nations Environmental Program and that have been tested in accordance with CAN/ULC S102 and S127, with protective covering installed in accordance with CAN/ULC S124.

.2 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Manufacturer: Obtain air and vapor seal materials from a single manufacturer regularly engaged in manufacturing the products specified in this Section.

.2 Installers: Use companies having trained and certified installers in accordance with CAN/ULC S705.2 and by the manufacturer.

.3 Certifications: Provide proof of the following during the course of the Work:

.1 Quality Assurance Program: Arrange for site inspections, documentation and reporting in accordance with a recognized SPF Quality Assurance Program (QAP) requirements such as CUFCA, ITS or Morrison Hershfield.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacture, expiration date, and directions for storage.

.2 Storage and Handling Requirements: Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air and vapor seal manufacturer, and as follows:

.1 Protect stored materials from direct sunlight.

.2 Avoid spillage; immediately notify Consultant if spillage occurs and start clean up procedures; clean spills and leave area as it was prior to spill.

1.9 SITE CONDITIONS

.1 Ambient Conditions: Apply air and vapor seal within range of ambient and substrate temperatures recommended by air and vapor seal manufacturer; do not apply air and vapor seal to frozen, damp or wet substrates.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 BASF The Chemical Company

.2 Demilec Canada

.3 Icynene Inc.

.4 Lapolla Industries

2.2 MATERIALS

.1 Spray Applied Polyurethane Foam: Two component, polyurethane resin and polyol, closed cell foamed-in-place insulation containing recycled materials in accordance with CAN/ULC S705.1, Type 2 and having the following minimum properties:

- .1 Permeance: Qualifies as a vapor seal in applied thicknesses.
- .2 Air Leakage Rate: Maximum 0.02 L/s-m^2 at 75 Pa
- .3 Long Term Thermal Resistance: Nominal RSI 1.0/25 mm in accordance with ASTM C177 and ULC S770
- .4 Density: Nominal 30 kg/m^3 ±10% by weight.
- .5 Closed Cell Content: Minimum 90% in accordance with ASTM D2856
- .6 Ozone Depletion Potential: Zero
- .7 Global Warming Potential: Low
- .8 Volatile Organic Compounds: Zero
- .9 Acceptable Materials:
  - .1 BASF Walltite Eco
  - .2 Demilec Heatlok Soya
  - .3 Icynene MD-C-200
  - .4 Lapolla FoamLOK

.2 Equipment: Use equipment recommended by manufacturer for specific type of installation and in accordance with CAN/ULC S705.2.

.3 Accessories: Manufacturer's recommended materials required for a complete and functioning installation including primers and other surface preparation materials.

Part 3 Execution

3.1 EXAMINATION

.1 Examine substrates, areas, and conditions, and verify that surfaces and conditions are in accordance with manufacturer's requirements before starting work of this Section; start of work indicates acceptance of substrates.

3.2 PREPARATION

.1 Protection of Existing Conditions:

- .1 Mask and cover adjacent areas to protect from over spray.
- .2 Verify that any required foam stop or back up materials are in place to prevent over spray and achieve complete seal.
- .3 Seal off existing ventilation equipment; install temporary ducting and fans to remove exhaust fumes; provide for make-up air.
- .4 Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.

.2 Surface Preparation:

- .1 Clean, prepare, and treat substrate in accordance with manufacturer's written instructions; provide clean, dust free, and dry substrate ready for installation of air and vapor seal.

.2 Prime substrates to suit the materials being bonded to; apply adequate number of coats to achieve required bond to transition membranes; allow for drying time between coats.

.3 Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air and vapor seal and at protrusions according to air and vapor seal manufacturer's written instructions.

3.3 INSTALLATION

.1 Air and Vapor Seals: Apply foamed-in-place air and vapor barrier materials so that foam completely fills spaces without voids with foam continuous at corners and junctions, and as follows:

.1 Install transition membranes to adjacent surfaces and ensure proper adhesion of the transition membranes to the substrate, compatible with spray polyurethane foam insulation in accordance with manufacturer's written instructions.

.2 Install flashings, counter flashings and metal transitions in accordance with manufacturer's written instructions.

.3 Spray polyurethane foam air seals when surfaces and environmental conditions are within limits indicated by CAN/ULC S705.2 and manufacturer's written instructions.

.4 Finish foam surface free from voids and embedded foreign objects.

.5 Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened; clean adjacent surfaces using cleaning methods that do not damage work performed by other Sections.

.6 Trim any excess thickness that interferes with the application of cladding or covering materials installed by other Sections.

.7 Tolerances: -6 mm, +10 mm maximum variation from required thickness.

.8 Installation – Building Perimeter Air Seal: Fill juncture of external walls and roofs with continuous gusset shaped seal extending minimum 152 mm horizontally and vertically from line of juncture and protect with thermal barrier, and at the following additional locations:

.1 All joints in perimeter wide flange beam along perimeter

.2 Underside of parapet diagonal bracing intersection to metal decking

.3 Other locations indicated on drawings

.9 Installation – Hollow Metal Door Frame Air Seals: Fill hollow metal door frames 75% full with foamed-in-place air and vapor barrier prior to installation of frames, and as follows:

.1 Fill the remainder of the frame after installation, through the gap between the frame and the wall construction.

.2 Fill frame members as masonry walls are being built at lifts no greater than 48 in. (1220 mm).

.10 Installation – Exterior Aluminum Frame Air Seals: Install foamed-in-place air and vapor barrier around perimeter of exterior window and door frames to maintain continuity of the thermal barrier, after air and vapor barrier has been installed and sealed to windows.

.11 Installation – Protrusions through Building Air and Vapor Seals: Install foamed-in-place air and vapor barrier around protrusions through exterior building envelope to achieve and maintain continuity of air/vapor seal and as follows:

.1 Install around hollow structural steel sections (HSS) that protrude through building envelope for a minimum distance of 48 in. (1220 mm).

.2 Apply to interior (warm side) of structural elements to provide an insulation barrier where structural elements are continuous from interior to exterior of building envelope.

.2 Firestopping System: Cover spray polyurethane foam with type X gypsum wall thermal barrier, Spray Foam applied in thickness and density required to achieve fire resistance rating over spray applied polyurethane foam in accordance with requirements of the Authorities Having Jurisdiction, and as follows:

.1 Provide temporary forming or damming as required, and as follows:

.1 Use combustible type damming boards for temporary dams only; remove after air seal/firestopping materials are cured.

.2 Use non-combustible damming boards for temporary or permanent dams wherever damming cannot be removed after applying air seal/firestopping materials.

.2 Remove temporary forming and damming when materials have gained sufficient strength and after initial cure of firestop materials.

.3 Install mortar by pumping, trowelling or hand packing into openings to thicknesses required by UL and ULC firestop system; tool or trowel exposed surfaces to smooth even finish.

.4 Completely fill and seal voids with air seal/firestop and smoke seal materials; remove excess air seal/firestop material promptly as work progresses and when installation is completed.

.5 Allow materials to cure; do not cover up materials until full curing has taken place and the Team Members have reviewed and accepted the installation.

3.4 SITE QUALITY CONTROL

.1 Non-Conforming Work: Repair or replace non-conforming work and re-test to verify that installation meets specified requirements.

3.5 CLOSEOUT ACTIVITIES

.1 Cleaning: Perform final cleaning in accordance with Section 01 00 06 – General Requirements; Housekeeping and as follows:

.1 Cut back excess foamed-in-place air and vapor barrier once cured flush with surrounding surfaces.

.2 Recess foam where application of sealants is required.

.3 Clean adjacent surfaces of overspray and dusting.

END OF SECTION

SECTION 07 27 16

AIR BARRIER SHEETS

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for the supply and installation of weather resistant, breather type air barrier sheets, accessories and installation applied over exterior wall sheathing to provide an effective and continuous air barrier forming a part of the complete building envelope system.

1.2 RELATED REQUIREMENTS

.1 Section 01 00 06 – General Requirements; Submittals

.2 Section 06 10 00 – Rough Carpentry: Wood sheathing materials.

.3 Section 07 05 10 – Common Work Results for Air Retarder and Vapor Retarder Systems

.4 Section 07 25 13 – Air and Vapor Membranes

.5 Section 07 25 19 – Foamed-in-Place Air and Vapor Barriers

.6 Section 09 21 16 – Gypsum Board Assemblies: Gypsum sheathing materials.

1.3 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 51.32-M77, Sheathing, Membrane, Breather Type

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit manufacturer's printed installation instructions including special handling criteria, installation sequence, and joint treatment and repair recommendations.

.3 Submit product data sheets for sheet Vapor retarders indicating the following:

.1 Product characteristics.

.2 Performance criteria.

.3 Limitations.

1.5 QUALITY ASSURANCE

.1 Use breather type sheathing membranes intended for use on the outside of heated buildings, under the exterior finish, as a secondary protective covering against the entry of wind and moisture and that provides an effective moisture resistant and draught resistant barrier that does not impede the passage of water Vapor from the wall construction to the exterior and having a minimum Vapor permeance of 250 ng/Pa/s/m^2.

Part 2 Products

2.1 MATERIALS

.1 Building Paper: Asphalt impregnated kraft paper manufactured from virgin cellulose and having a 30 minute moisture resistance rating meeting the requirements of CGSB 51.32, including 35 mm long screw or nail fasteners having 2 inch (50 mm) diameter plastic caps.

Part 3 Execution

3.1 INSTALLATION

.1 Install two (2) layers of building paper air barrier sheets in direct contact with exterior side of exterior wall sheathing before windows and doors are installed; eliminate any voids behind air barrier by wrapping sheet materials over projections or recesses in wall construction.

.2 Install air barrier materials plumb and level to top edge of floor joist; unroll and extend air barrier sheets over window and door openings.

.3 Install starting from lowest portion of wall area working towards upper areas so that layers are shingled over preceding layers to divert water away from exterior wall sheathing materials as follows:

- .1 Wrap corners of building with a minimum overlap of 12 in. (305 mm).
- .2 Overlap horizontal seams a minimum of 4 in. (100 mm).
- .3 Overlap vertical seams a minimum of 6 in. (152 mm).
- .4 Install second layer of building paper air barrier sheets having an offset of 50% of roll width and same corner and seam overlap widths as the first layer.

.4 Attach air barrier to sheathing using plastic capped screws or nails placed at a maximum vertical spacing of 17.71 in. (450 mm) O/C along each stud line.

.5 Cut window and door rough openings as follows:

- .1 Windows:
  - .1 Cut modified "I" pattern in the air barrier sheet.
  - .2 Cut horizontally along bottom of header.
  - .3 Cut vertically down centre of opening from top down to 2/3 of the way to the bottom.
  - .4 Cut diagonally from bottom vertical cut to left and right corners of opening.
  - .5 Fold side and bottom flaps into window opening and fasten at 6 in. (152 mm) O/C and trim off excess material.
- .2 Doors:
  - .1 Cut standard "I" pattern air barrier sheet.
  - .2 Cut horizontally along bottom of door frame header and along top of sill.
  - .3 Cut vertically cut down the centre of door openings from header to sill.
  - .4 Fold side flaps inside around door openings and fasten at 6 in. (152 mm) O/C and trim off excess material.

.6 Tape horizontal and vertical seam using manufacturer's recommended seaming tape; seal tears and cuts using manufacturer's recommended repair materials and methods.

END OF SECTION

SECTION 07461

SIDING

Part 1 GENERAL

1.1 SECTION INCLUDES

.1 A. Fiber cement, panels, James Hardie HZ5 Engineered for Climate Siding.

.2 B. Factory-finished fiber panels, James Hardie HZ5 Engineered for Climate Siding.

1.2 RELATED SECTIONS

.1 Section 06100 - Rough Carpentry: Wood framing and bracing.

.2 Section 06100 - Rough Carpentry: Sheathing.

.3 Section 07210 - Insulation: Exterior wall insulation.

1.3 REFERENCES

.1 ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets

.2 ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test, Tool and Tape.

1.4 SUBMITTALS

.1 Submit under provisions of Section 01300.

.2 Product Data: Manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Storage and handling requirements and recommendations.

.3 Installation methods.

.3 Shop Drawings: Provide detailed drawings of atypical non-standard applications of cementitious siding materials which are outside the scope of the standard details and specifications provided by the manufacturer.

1.5 QUALITY ASSURANCE

.1 Installer Qualifications: Minimum of 2 years experience with installation of similar products.

B. Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

.1 Finish areas designated by Architect team leads.

.2 Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect team leads.

.3 Refinish mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Store products in manufacturer's unopened packaging until ready for installation.

.2 Store siding on edge or lay flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.

.3 Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

.1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

.1 Product Warranty: Limited, non-pro-rated product warranty.

.1 HardiePlank HZ5 lap siding for 30 years.
.2 HardiPanel HZ5 vertical siding for 30 years.
.3 HardieSoffit HZ5 panels for 30 years.
.4 HardieShingle HZ5 siding for 30 years.
.5 Artisan HZ5 lap siding for 30 years.
.6 Product Warranty: Limited, product warranty.
.7 HardieTrim HZ and HZ5 boards for 15 years.

Part 2 PRODUCTS

2.1 2.1 MANUFACTURERS

.1 Acceptable Manufacturer: James Hardie Building Products, Inc., which is located at: 26300 La Alameda Suite 400 ; Mission Viejo, CA 92691; Toll Free Tel: 866-274-3464; Tel: 949-367-4980; Fax: 949-367-4981; Email: request info (info@jameshardie.com); Web: www.jameshardiecommercial.com

.3 Substitutions: Not permitted.

.4 Requests for approval of equal substitutions will be considered in accordance with provisions of Section 01600.

2.2 2.2 SIDING

.1 Vertical Siding: HardiePanel HZ5 siding as manufactured by James Hardie Building Products, Inc.

.1 Type: Smooth Vertical siding panel 4 feet by 8 feet (1219 mm by 2438 mm).
.2 Type: Smooth Vertical siding panel 4 feet by 9 feet (1219 mm by 2743 mm).
.3 Type: Smooth Vertical siding panel 4 feet by 10 feet (1219 mm by 3048 mm).

2.3 2.3 FASTENERS

.1 Wood Framing Fasteners:
.2 Wood Framing: 4d common corrosion resistant nails.

.3 Wood Framing: 6d common corrosion resistant nails.

.4 Wood Framing: 8d box ring common corrosion resistant nails.

.5 Wood Framing: 0.089 inch (2.2 mm) shank by 0.221 inch (5.6 mm) head by 2 inches (51 mm) corrosion resistant siding nails.

.6 Wood Framing: 0.093 inch (2.4 mm) shank by 0.222 inch (5.6 mm) head by 2 inches (51 mm) corrosion resistant siding nails.

.7 Wood Framing: 0.093 inch (2.4 mm) shank by 0.222 inch (5.6 mm) head by 2-1/2 inches (64 mm) corrosion resistant siding nails.

.8 Wood Framing: 0.091 inch (2.3 mm) shank by 0.221 inch (5.6 mm) head by 1-1/2 inches (38 mm) corrosion resistant siding nails.

.9 Wood Framing: 0.091 inch (2.3 mm) shank by 0.225 inch (5.7 mm) head by 1-1/2 inches (38 mm) corrosion resistant siding nails.

.10 Wood Framing: 0.121 inch (3 mm) shank by 0.371 inch (9.4 mm) head by 1-1/4 inches (32 mm) corrosion resistant roofing nails.

.11 Wood Framing: No. 11 gauge 1-1/4 inches (32 mm) corrosion resistant roofing nails.

.12 Wood Framing: No. 11 gauge 1-1/2 inches (38 mm) corrosion resistant roofing nails.

.13 Wood Framing: No. 11 gauge 1-3/4 inches (44 mm) corrosion resistant roofing nails.

2.4 FINISHES.

.1 Factory Primer: Provide factory applied universal primer.

.1 Primer: Factory primed by James Hardie.

.3 Topcoat: Refer to Section 09900 and Exterior Finish Schedule.

.2 Factory Finish: Refer to Exterior Finish Schedule.

.1 Product: ColorPlus Technology by James Hardie.

.2 Definition: Factory applied finish; defined as a finish applied in the same facility and company that manufactures the siding substrate.

.3 Factory Finish Color for Trim, Soffit and Siding Colors:

.1 Alpine Frost JH50-10.

.2 Arctic White JH10-20.

.3 Autumn Tan JH20-20.

.4 Boothbay Blue JH70-20.

.5 Chestnut Brown JH80-30.

.6 Cobble Stone JH40-10.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Do not begin installation until substrates have been properly prepared.

.2 If framing preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

.3 Nominal 2 inch by 4 inch (51 m by 102 mm) wood framing selected for minimal shrinkage and complying with local building codes, including the use of water-resistive barriers or vapor barriers where required. Minimum 1-1/2 inches (38 mm) face and straight, true, of uniform dimensions and properly aligned.

.1 Install water-resistive barriers and claddings to dry surfaces.

.2 Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.

.3 Protect siding from other trades.

3.2 PREPARATION

.1 Clean surfaces thoroughly prior to installation.

.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

.3 Install a water-resistive barrier is required in accordance with local building code requirements.

.4 The water-resistive barrier must be appropriately installed with penetration and junction flashing in accordance with local building code requirements.

.5 Install Engineered for ClimateTM HardieWrapTM weather barrier in accordance with local building code requirements.

3.3 INSTALLATION - HARDIEPANEL HZ5 VERTICAL SIDING

.1 Install materials in strict accordance with manufacturer's installation instructions.

.2 Block framing between studs where HardiePanel siding horizontal joints occur.

.3 Install metal Z flashing and provide a 1/4 inch (6 mm) gap at horizontal panel joints.

.4 Place fasteners no closer than 3/8 inch (9.5 mm) from panel edges and 2 inches (51 mm) from panel corners.

.5 Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.

.6 Maintain clearance between siding and adjacent finished grade.

.7 Factory Finish Touch Up: Apply touch up paint to cut edges in accordance with manufacturer's printed instructions.

.1 Touch-up nicks, scrapes, and nail heads in pre-finished siding using the manufacturer's touch-up kit pen.

.2 Touch-up of nails shall be performed after application, but before plastic protection wrap is removed to prevent spotting of touch-up finish.

.3 Use touch-up paint sparingly. If large areas require touch-up, replace the damaged area with new pre-finished siding. Match touch up color to siding color through use of manufacturer's branded touch-up kits.

3.4 INSTALLATION - HARDIETRIM HZ5 BOARDS

.1 Install materials in strict accordance with manufacturer's installation instructions. Install flashing around all wall openings.

.2 Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 3/4 inch (19 mm) or full thickness of sheathing. Additional fasteners may be required to ensure adequate security.

.3 Place fasteners no closer than 3/4 inch (19 mm) and no further than 2 inches (51 mm) from side edge of trim board and no closer than 1 inch (25 mm) from end. Fasten maximum 16 inches (406 mm) on center.

.4 Maintain clearance between trim and adjacent finished grade.

.6 .

.7 G. Allow 1/8 inch gap between trim and siding.

.8 I. 3.7 FINISHING

3.5 PROTECTION

.1 Protect installed products until completion of project.

.2 Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 07 46 23.13

WOOD CEDAR SIDING

Part 1 GENERAL

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of cedar wood siding and decorative accessories including but, not necessarily limited to the following"

1.2 RELATED REQUIREMENTS

.1 Section 01 00 06 – General Requirements; Submittals

.2 Section 06 10 00 – Rough Carpentry: Blocking, Strapping, furring, panel material and other miscellaneous rough carpentry required to install cedar siding materials

.3 Section 07 05 10 – Common Work results for Air Barrier and Vapor retarder Systems.

.4 Section 07 25 19 - Foamed-In-Place Air and Vapor Barriers.

.5 Section 07 27 16 – Air Barrier Sheets: Building paper.

.6 Section 07 62 00 – Sheet Metal Flashing and Trim: Flashing, gutters, and other sheet metal work.

.7 Section 07 92 00 – Joint Sealants

1.3 REFERENCE STANDARDS

.1 American Wood Protection Association (AWPA):

.1 AWPA Book of Standards, 2012

.2 AWPA U1-12, Use Category System: User Specification for Treated Wood

.2 Canadian Standards Association (CSA):

.1 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples

.2 CSA O112 Series-M1977 (R2006), Wood Adhesives

.3 CAN/CSA O141-05 (R2009), Softwood Lumber

.3 Forest Stewardship Council (FSC):

.1 FSC Principals and Criteria

.2 Chain-of-Custody and Percentage Based Claims

.4 National Lumber Grading Authority (NLGA):

.1 NLGA Standard Grading Rules for Canadian Lumber, 2010

.5 West Coast Lumber Inspection Bureau (WCLIB):

.1 Standard 17 Grading Rules for West Coast Lumber, 2004

.6 Western Red Cedar Lumber Association (WRLCA):

.1 Designer's Handbook.

.2 Specifying Western Red Cedar Siding.

.3 Installing Cedar Siding.

.4 Guide to Finishing Western Red Cedar.

.7 Western Wood Products Association (WWPA):

.1 "Grading Rules".

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's product data for each type of product specified.

1.5 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Source Limitations for Siding: Obtain each type, color, texture, and pattern of siding, including related accessories, through one source from a single manufacturer.

.2 Manufacturer Qualifications: Manufacturer shall be a member of the Western Red Cedar Lumber Association capable of providing all Western Red Cedar siding materials specified in this section.

.2 Installation: Products shall be installed according to Western Red Cedar Lumber Association installation guidelines and adhere to local building codes.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Protect materials from weather in transit and on the jobsite.

.2 Deliver materials for interior use only when building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

.3 Inspect the materials upon delivery to assure that specified products have been received, report all shortages, damaged materials and other deficiencies in materials occurring from manufacturing, shipping and handling to the Team and Team Crew Members

.4 Storage and Handling Requirements: Deliver, store, and handle siding as follows:

.1 Store materials on site in a location protected from weather and contact with damp or wet surfaces, and activities that could damage finished surfaces

.2 Store in a location where environmental conditions meet requirements required for installation areas

.3 Stack lumber, plywood, and other panels; allow for air circulation within and around stacks and under temporary coverings.

.4 Do not store products in contact with or in close proximity to other materials that may contain urea-formaldehyde.

1.7 SITE CONDITIONS

.1 Ambient Conditions: Proceed with exterior siding installation only if substrate is completely dry and if existing and forecasted weather conditions permit siding to be installed in accordance with manufacturer's written instructions. Proceed with siding for interior use only when building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the assembly period.

.2 Site Waste Reduction and Management: Select lumber sizes to minimize waste, reuse scrap lumber to the greatest extent possible and as follows:

.1 Use scrap lumber for non-critical locations such as shims, bracing and blocking.

.2 Do not leave any wood, shavings, sawdust, and similar components, on the ground or buried in fill; prevent sawdust and wood shavings from entering the storm drainage system.

.3 Do not burn scraps that have been pressure treated; do not send pressure treated lumber to recycling centres, cogeneration facilities or waste-to-energy facilities.

.4 Do not burn waste lumber on site.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Western Red Cedar Lumber Association, which is located at: 1501 - 700 W. Pender St. Pender Place 1, Business Bldg. ; Vancouver, BC, Canada V6C 1G8; Toll Free Tel: 866-778-9096; Tel: 604-684-0266; Fax: 604-687-4930; Email: request info; Web: www.wrcla.org

.2 Substitutions: Consultant will accept additional manufacturers having similar products to Acceptable Materials listed in this Section provided they meet the performance requirements established by the named products in this Section.

2.2 MATERIALS

.1 LAP SIDING

.1 Clear Cedar Lap Siding: Western Red Cedar graded to meet NLGA "Grading Standards," paragraph 200, and WCLIB "Grading Standards," paragraph 102, Kiln dried to 19% moisture content or less and as follows:

.1 Grade: A Clear and Better with 5% of B Clear allowed.

.2 Pattern: 105

.3 Texture: Smooth faced

.4 Finish: Finish: Factory Finished, Semi-transparent Stain, colour as selected by the Consultant from the manufacturers complete range of colours.

2.3 ACCESSORIES

.1 Fasteners: Steel fasteners meeting requirements of CSA B111, length to penetrate connecting solid wood materials and as follows:

.1 Exterior Work:

.1 Stainless Steel, Splitless Siding Nails.

.2 Hardware (Bolts, Nuts and Washers): Provide fasteners of size and type required for installation and as follows:

.1 Ground Contact Materials: Stainless steel

.2 Exterior Work: Stainless steel

.3 Pressure Treated Materials: Stainless steel

.3 Wood Screws: Steel screws meeting requirements of ASME B18.6.1 and as follows:

.1 Exterior Work: Stainless steel

.4 Screws for Fastening to Cold Formed Metal Framing: Steel screws meeting requirements of ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

.5 Adhesives: Gun grade, cartridge loaded adhesives meeting requirements of GS-36 for Commercial Adhesive, South Coast Air Quality Management District Rule 1168 and as follows:

.1 General Purpose Adhesive: Meeting requirements of CSA O112 having maximum VOC content of 70079.96 ppm (70 g/L)

.2 Sealant: As specified in Section 07 92 00.

Part 3 EXECUTION

3.1 PREPARATION

.1 Select siding boards of longest possible lengths. Discard boards that are warped, twisted, bowed, crooked or otherwise defective.

.1 Clean substrates of projections and substances detrimental to application.

.2 Protect adjacent finished surfaces and materials from damage by work of this Section.

3.2 INSTALLATION

.1 Install siding in accordance with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

.2 Overlap joints to shed water away from direction of prevailing wind.

.1 Scribe and cut as required to fit abutting walls, and surfaces, to fit properly into recesses and to accommodate intersecting or penetrating objects; secure materials and components in place, rigid, plumb and square, with tight, hairline joints to locations indicated on Drawings and as follows:

.1 Form joints to conceal shrinkage

.2 Set finishing nails to receive filler

.3 Countersink screws in round cleanly cut hole and plug with wood plug matching material being secured

.4 Match wood pieces end to end for consistent colour and grain appearance; space and centre joints evenly in runs.

.5 Install door and window trim in single lengths without splicing.

.6 Install caulking in accordance with caulking manufacturers written instructions.

.7 Site Finishing: Apply finish on all sides and ends, touch up coating on new cuts; refer to Section 09 91 05 for materials and application.

3.3 CLOSEOUT ACTIVITIES

.1 Explain proper maintenance procedures to Team project Manager, Team Members and required Team Crew Members at project closeout.

.2 Visually inspect siding, caulking, flashing annually for overall condition. Re-apply caulking and coating as necessary. Adjust flashing as required.

.3 The use of pressure washers is not recommended.

.1 Fill and retouch nicks, chips and scratches; replace damaged items that cannot be repaired.

.2 Remove pencil and ink marks, remove waste and packing materials, and clean area in accordance with Section 01 00 06 – General Requirements: Housekeeping.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

Part 1 General

1.1 SUMMARY

.1 This Section includes sheet metal flashing and trim in the following categories:

- .1 Roof drainage systems
- .2 Metal flashing
- .3 Roof joint covers
- .4 Shower pans

.2 Sheet metal flashings specified in this section are intended to protect membranes from accelerated deterioration arising from exposure to the elements, and to protect the building from migration of moisture into vulnerable assemblies by diverting water to the exterior or other drainage plane.

.3 Membrane through wall and roof flashings are identified in affected related sections and specified in Section 07 25 13.

1.2 RELATED REQUIREMENTS

.1 Section 06 10 00 – Rough Carpentry: Blocking for support of flashings and copings.

.2 Section 06 15 33 – Cedar Wood Carpentry: Metal Flashing used in conjunction with Cedar wood decking materials

.3 Section 07 42 43.13 – Composite Wall Panels: Flashing and accessories installed integral with wall system work.

.4 Section 07 46 23.13 – Cedar Wood Siding: Flashing and accessories installed integral with siding work.

.5 Section 07 53 00 – Elastomeric Membrane Roofing: Flashing and roofing accessories installed integral with roofing membrane as part of roofing system work.

.6 Section 07 92 00 – Joint Sealants: Elastomeric sealants.

1.3 REFERENCE STANDARDS

.1 Aluminum Association (AA):

- .1 Designation System for Aluminum Finishes, 1997
- .2 Guidelines for Aluminum Sheet Metal Work in Building Construction, 2000

.2 American Society for Testing and Materials (ASTM):

- .1 ASTM B209-04, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

.2 ASTM A653/A653M-06, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process, Physical (Structural) Quality

.3 ASTM A755/A755M-03, Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products

.4 ASTM A792/A792M-06, Standard Specification for Steel Sheet, 55% Aluminum Zinc Alloy Coated by the Hot-Dip Process

.5 ASTM B32-03, Specification for Solder Metal

.3 Canadian Standards Association (CSA):

.1 CSA A123.3-98 (R2004), Asphalt or Tar Saturated Roofing Felt

.4 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 37.5-M89, Cutback Asphalt Plastic Cement

.2 CAN/CGSB 37.29-M89, Rubber/Asphalt Sealing Compound

.3 CAN/CGSB 51.32-M77, Sheathing, Membrane, Breather Type

.5 Other References:

.1 The Alberta Roofing Contractors Association (ARCA): Manual on Good Roofing Practice and Accepted Roofing Systems

.2 Canadian Roofing Contractors Association (CRCA): Roofing Specifications

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): Architectural Sheet Metal Manual, 5th Edition, 1993

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

.1 Coordinate work of this Section with interfacing and adjoining Work for proper sequencing of each installation and to provide positive weather resistance, durability of the work, and protection of materials and finishes.

.2 Coordinate work of this section with the requirements of Section 07 42 43.13, for specific requirements for supply of prefinished sheet metal flashing materials to other sections of the work as follows:

.1 Supply prefinished sheet metal flashings required for the project, regardless of sheet metal thickness and colour.

.2 Provide prefinished sheet metal flashings to installing trades, tension leveled and guillotine sheared to length ready for brake forming, fabrication and installation by installing trades.

.3 Requirements of this portion of the scope of work do not apply to extruded aluminum or other pre-manufactured flashing materials normally supplied by installing Team Crew Members (i.e.: extruded aluminum curtain wall flashing and sills, preformed roof penetrations, non-prefinished sheet metal products).

.4 Team Crew Members responsible for supply of metal wall and soffit cladding will only be responsible for fabrication and installation of flashings relating to their scope of work.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.3 Product Data: Submit product data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.

.4 Shop Drawings: Submit shop drawings of each Item specified showing layout, profiles, methods of joining, and anchorage details.

Part 2 Products

2.1 METAL FLASHING MATERIALS

.1 Zinc Galvanized Sheet Steel Flashing: Tension levelled, Commercial Steel (CS) designation, Type A, Grade 230 in accordance with ASTM A653 and as follows:

- .1 Thickness: Minimum 0.017 inch (0.45 mm) base metal thickness
- .2 Galvanizing Designation: Z275 applied evenly to both sides.
- .3 Metal Flashing:
  - .1 Surface Texture: Smooth
  - .2 Finish: Prefinished colour selected from manufacturer’s extended range using Silicone Modified Polyester or Valspar WeatherX

.2 Aluminum/Zinc Galvanized Sheet Steel Cladding: Tension levelled, Commercial Steel (CS) designation, Type A, Grade 275 in accordance with ASTM A792 and as follows:

- .1 Thickness: Minimum 0.017 inch (0.45 mm) base metal thickness
- .2 Galvanizing Designation: AZM180, applied evenly to both sides.
- .3 Acceptable Materials:
  - .1 Dofasco Inc., Galvalume Plus

.3 Formed Aluminum Flashings: Tension leveled, aluminum sheet in accordance with ASTM B209 and ANSI H35.1 alloy designation 3003-H14 and as follows:

- .1 Thickness: Minimum 0.039 inch (0.039 inch (1.00 mm).
- .2 AF): Prefinished colour selected from manufacturer’s standard range using Duranar XL or Valspar Fluropon Classic II coatings.

2.2 MISCELLANEOUS MATERIALS AND ACCESSORIES

.1 Fasteners: Same metal as sheet metal flashing or other non-corrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

.2 , compounded for 0.015 inch (0.015 inch (0.040 mm)) dry film thickness per coat.

.3 Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07 92 00.

.4 Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather resistant seaming and adhesive application of flashing sheet metal.

.5 Flexible Flashing: Polyethylene faced bituminous membrane materials compatible with membrane air and vapor retarder specified in Section 07 25 13, not less than 0.019 inch (0.5 mm) thick and be compatible with all other materials being used and mastic compatible and approved for use with the flashing material.

.6 Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; non-corrosive; size and thickness required for performance.

2.3 FABRICATION, GENERAL

.1 Fabricate sheet metal building flashings and trim in accordance with the recommendations of SMACNA's Architectural Sheet Metal Manual that apply to the design, dimensions, metal, and other characteristics as required.

.2 Fabricate sheet metal roofing flashings in accordance with the recommendations of the ARCA, and as follows:

.1 Make flashing of prefinished metal for cap flashings, for all flashings adjacent to roofing at roof edges and area dividers and where exposed to view from ground.

.2 Make flashing for other roof locations, of plain galvanized metal.

.3 Fabricate flashings using the following metal core thicknesses for indicated assemblies:

.1 Flat Surfaces Less than 12 in. (305 mm) in Width or Height: Use 0.017 inch (0.45 mm) material except where specifically noted otherwise.

.2 Flat Surfaces 12 in. (305 mm) and Greater in Width or Height: Use 0.024 (0.62 mm) material except where specifically noted otherwise.

.3 Concealed Fastening Strips: Use 0.031 inch (0.031 inch (0.80 mm)) material.

.4 Fabricate sheet metal flashing and trim to fit substrates and result in waterproof and weather resistant performance once installed.

.5 Verify shapes and dimensions of surfaces being covered before fabricating sheet metal.

.6 Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.

.7 Seams:

.1 Fabricate non-moving seams in sheet metal with flat lock seams.

.2 Tin edges being seamed, form seams, and solder.

.8 Seams: Fabricate non-moving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

.9 Expansion Provisions:

.1 Space movement joints at 120 in. (3050 mm) O/C with no joints allowed within 24 in. (610 mm) of corners or intersections

.2 Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant concealed within joints where lapped or bayonet type expansion provisions cannot be used or are not sufficiently weatherproof and waterproof.

.10 Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant in accordance with SMACNA standards.

.11 Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

.12 Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

2.4 SHEET METAL FABRICATIONS

.1 Fabricate sheet metal items in thickness or weight needed in accordance with performance requirements but not less than that listed below for each application and metal.

.2 Roof Drain Flashing: Fabricate from the following material:

.1 Stainless Steel: 0.015 inch (0.040 mm) thick.

.3 Base Flashing: Fabricate from the following material:

.1 Galvanized Steel: 0.027 inch (0.70 mm)thick.

.2 Coil Coated Galvanized Steel: 0.027 inch (0.70 mm) thick.

.4 Counter Flashing: Fabricate from the following material:

.1 Coil Coated Galvanized Steel: 0.021 inch (0.55 mm) thick.

.5 Flashing Receivers: Fabricate from the following material:

.1 Coil Coated Galvanized Steel: 0.021 inch (0.55 mm) thick.

.6 Valley Flashing: Fabricate from the following material:

.1 Coil Coated Galvanized Steel: 0.027 inch (0.70 mm)thick.

.7 Drip Edges: Fabricate from the following material:

.1 Coil Coated Galvanized Steel: 0.021 inch (0.55 mm) thick.

.8 Eave Flashing: Fabricate from the following material:

.1 Coil Coated Galvanized Steel: 0.021 inch (0.55 mm) thick.

.9 Equipment Support Flashing: Fabricate from the following material:

.1 Galvanized Steel: 0.027 inch (0.70 mm)thick.

.10 Roof Penetration Flashing: Fabricate from the following material:

.1 Stainless Steel: 0.019 inch (0.50 mm) thick.

.11 Shower Pans: Fabricate from the following material:

.1 Stainless Steel: 0.015 inch (0.040 mm) thick.

.12 Roof Joint Cover: Fabricate from the following material:

.1 Galvanized Steel: 0.027 inch (0.70 mm) thick.

.2 Coil Coated Galvanized Steel: 0.027 inch (0.70 mm)thick.

Part 3 Execution

3.1 EXAMINATION

.1 Examine substrates and conditions under which sheet metal flashing and trim are being installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

.1 Install sheet metal flashing and trim in accordance with performance requirements, manufacturer's installation instructions, and SMACNA's Architectural Sheet Metal Manual.

.2 Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated.

.3 Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.

.4 Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather resistant performance.

.5 Verify shapes and dimensions of surfaces being covered before fabricating sheet metal.

.6 Roof Edge Flashings: Secure metal flashings at roof edges at a maximum of 24 in. (610 mm) O/C and in accordance with FM Loss Prevention Data Sheet 1-49 for specified wind zone.

.7 Expansion Provisions:

.1 Provide for thermal expansion of exposed sheet metal Work.

.2 Space movement joints at maximum of 120 inch (3050 mm) with no joints allowed within 24 in. (610 mm) of corner or intersection.

.3 Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints) where lapped or bayonet type expansion provisions in work cannot be used or are not sufficiently weatherproof and waterproof.

.8 Sealed Joints:

.1 Form non-expansion, but movable, joints in metal to accommodate elastomeric sealant in accordance with SMACNA standards.

.2 Fill joint with sealant and form metal to completely conceal sealant.

.3 Use joint adhesive for non-moving joints specified not being soldered.

.9 Seams:

.1 Fabricate non-moving seams in sheet metal with flat lock seams.

.2 Tin edges being seamed, form seams, and solder.

.10 Seams: Fabricate non-moving seams in aluminum with flat lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

.11 Counter Flashings:

.1 Coordinate installation of counter flashings with installation of assemblies being protected by counter flashing. Install counter flashings in reglets or receivers.

.2 Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant.

.3 Lap counter flashing joints a minimum of 2 inch (50 mm) and bed with sealant.

.12 Roof Drainage System:

.1 Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA's Manual or the Item manufacturer, to drain roof in the most efficient manner.

.2 Coordinate roof drain flashing installation with roof drainage system installation.

.3 Coordinate flashing and sheet metal items for steep sloped roofs with roofing installation.

.13 Equipment Support Flashing:

.1 Coordinate equipment support flashing installation with roofing and equipment installation.

.2 Weld or seal flashing to equipment support member.

.14 Roof Penetration Flashing:

.1 Coordinate roof penetration flashing installation with roofing and installation of items penetrating roof.

.2 Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.

.3 Seal and clamp flashing to pipes penetrating roof, other than lead flashing on vent piping.

3.3 CLEANING AND PROTECTION

.1 Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

.2 Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Performance.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

Part 1 General

1.1 SUMMARY

.1 This Section includes through penetration firestopping for penetrations through the following fire resistance rated assemblies, including both empty openings and openings containing penetrating items:

.1 Walls and partitions

.2 Construction enclosing compartmentalized areas

.3 assembly.

1.2 RELATED REQUIREMENTS

.1 Section 05 05 00 – Common Work Results for Metals

.2 Section 05 05 19 – Common Work Results for Metalwork Finishing: Coordination of surface preparation and priming requirements for structural steel surfaces.

.3 Section 05 12 00 – Structural Steel Framing

.4 Section 07 05 80.01 – Common Work Results for Fire Rated Separations and Assemblies: General provisions relating to this section.

.5 Section 09 21 16 – Gypsum Board Assemblies

.6 Division 21 – Fire Suppression: Coordination of pipes and pipe fittings and other materials penetrating fire resistance rated assemblies.

.7 Division 22 – Plumbing: Coordination of pipes and pipe fittings and other materials penetrating fire resistance rated assemblies.

.8 Division 23 – Heating, Ventilation and Air Conditioning: Coordination of ductwork and other materials penetrating fire resistance rated assemblies.

.9 Division 26 – Electrical: Coordination conduit, wiring, communications cabling, cable trays and other materials penetrating fire resistance rated assemblies.

.10 Division 27 – Communications: Coordination conduit, wiring, communications cabling, cable trays and other materials penetrating fire resistance rated assemblies.

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A653/A653M-08, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.2 ASTM A1008/A1008M-12, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

.3 ASTM E119-08, Standard Test Methods for Fire Tests of Building Construction and Materials

.4 ASTM E814-08B, Standard Test Method for Fire Tests of Penetration Firestop Systems

.5 ASTM E1966-07, Standard Test Method for Fire-Resistive Joint Systems

.6 ASTM E2174-04, Standard Practice for On-Site Inspection of Installed Fire Stops

.7 ASTM E2307-04E1, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus

.8 ASTM E2393-04, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers

.2 Underwriters Laboratories of Canada (ULC):

.1 ULC Guide No. 40 U19-2004, Firestop Systems

.2 CAN/ULC S101-07, Fire Endurance Tests of Building Construction and Materials

.3 CAN4 S114-05, Test for Determination of Non-Combustibility in Building Materials

.4 ULC S115-05, Fire Tests of Firestop Systems

.5 CAN/ULC S702-09, Mineral Fibre Thermal Building Insulation

.6 List of Equipment and Materials

.3 Underwriters Laboratories Inc. (ULI):

.1 ANSI/UL 1479 May-2003, Standard for Fire Tests of Through-Penetration Firestops

.4 National Fire Protection Agency (NFPA):

.1 NFPA 251-2006, Standard Methods of Tests of Fire Endurance Building Construction and Materials

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate construction of openings and penetrating items and verify that firestopping systems are installed according to specified requirements and as follows:

.1 Coordinate sizing of sleeves, openings, core drilled holes, or cut openings to accommodate firestopping systems.

.2 Leave firestopping and joint system installations that will become concealed behind other construction open until Consultant and building inspector, if required by authorities having jurisdiction, have examined each installation.

.2 Pre-Construction Meeting: Arrange a pre-construction meeting in accordance with Section 01 00 06 – General Requirements: Project Meetings, and as follows:

.1 Meeting shall be attended by the Team and Team Crew Members responsible for firestopping, and other Team Crew Member affected by work of this Section.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Provide submittals required by Section 07 05 80, and as follows:

.1 Submit a schedule listing surfaces or components to which firestopping is applied, and indicating the manufacturer's firestopping, required materials, and detailed installation procedures for review by the Team Project Manager, Team Members and Team Crew Members assigned to such duties.

.2 Determine thickness of applied materials from tests of assemblies identical to the assembly to be protected where possible, conducted in accordance with reference standards listed above.

.3 Use the same system and material as would be required for a tested assembly with similar conditions where the assembly includes conditions which do not correspond to those included in any previously tested assembly and for which no relevant engineering information is available.

.3 Informational Submittals: Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site; include manufacturer's printed instructions for installation.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: Use materials and methods of determining required thickness of application that have the full acceptance of Authority Having Jurisdiction and that are materials tested to ULC S115.

.2 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Ratings: Assemblies containing the materials shall be in accordance with assemblies tested and approved by agencies acceptable to authority having jurisdiction.

.2 Materials: Provide materials having fire test response characteristics in accordance with requirements specified in Section 07 05 80.

.3 Installer: Apply firestopping materials or systems specified in this Section using fully experienced applicators trained by manufacturer, using proper equipment in strict accordance with manufacturer's instructions.

.4 Source Responsibility: Obtain through penetration firestop and joint systems, for each kind of penetration and construction condition indicated, from a single source of installation responsibility.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver and store materials in a dry protected area, in original undamaged sealed containers with the manufacturer's labels, application instructions, and labelling agency's labels intact.

.2 Keep materials dry until ready for use.

.3 Keep the packages of material off the ground, under cover, and away from sweating walls and other damp surfaces. Discard material that has been exposed to water before actual use.

.4 Use stock before its expiration date.

1.8 SITE CONDITIONS

.1 Install firestopping materials only when the areas in which they are scheduled are closed-in and protected from dampness.

.2 Ventilate firestopping systems in accordance with manufacturer's written instructions by natural means or forced air circulation where natural means are not adequate.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; and as established by the Basis-of-Design Materials, use any of the listed manufacturers' products in accordance with Section.

.1 A/D Fire Protection Systems Inc.
.2 Passive Fire Protection Partners Firestop Systems Inc.
.3 Hilti Canada Ltd.
.4 Johns Manville Fire protection Systems
.5 Nuco Self Seal Firestopping Products
.6 Specified Technologies Inc.
.7 3M Canada Inc.
.8 Tremco Ltd.

2.2 DESIGN REQUIREMENTS

.1 Delegated Design Requirements: Design firestopping required by the Contract Documents to withstand fire ratings indicated and in accordance with requirements of the Building Code, and as described in Section 07 05 80.

.2 Performance Requirements: Manufacturer shall design proprietary assemblies to withstand the listed ratings in accordance with the Building Code, Underwriters Laboratories Canada, and authorities having jurisdiction, and as follows:

.1 Provide through penetration firestop and joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire resistance rating of assembly penetrated:

.1 Fire resistance rated load bearing walls, including partitions, with fire protection rated openings.
.2 Fire resistance rated non-load bearing walls, including partitions, with fire protection rated openings.
.3 Fire resistance rated floor assemblies.

2.3 FIRESTOPPING

.1 Compatibility: Provide firestopping systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating firestopping systems, under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and site experience, and as follows:

.1 Fire resistance rating of installed firestopping assembly not less than the fire resistance rating of surrounding floor and wall assembly.
.2 Firestopping at openings intended for ease of re-entry such as cables: elastomeric seal; do not use cementitious or rigid seal at such locations.

.3 Firestopping at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal; do not use a cementitious or rigid seal at such locations. Exemption to fire dampers.

.2 Accessories: Provide components for each firestopping system that are needed to install fill materials. Use only components specified by firestopping system manufacturer and approved by the qualified testing and inspecting agency for firestopping systems indicated. Accessories include, but are not limited to, the following items:

.1 Permanent forming, damming and backing materials, including the following:

.1 Slag or rock wool fibre insulation.

.2 Sealants used in combination with other forming, damming or backing materials to prevent leakage of fill materials in liquid state.

.3 Fire rated form board.

.4 Fillers for sealants.

.2 Temporary forming materials.

.3 Substrate primers.

.4 Collars.

.5 Steel sleeves.

.6 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.7 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.8 Metal fire stop: Commercial galvanized steel, to ASTM A1008/A1008M, zinc coating 260 g/m^2, minimum metal core thickness 0.035 in. (0.912 mm).

2.4 FILL MATERIALS

.1 General:

.1 Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

.2 Firestopping products shall have the ability to provide a minimum of STC 55 and have Volatile Organic Compound (VOC) of less than 250 g/L.

.2 Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

.3 Firestopping and Smokeseals Devices: Factory assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrating item.

.4 Intumescent Spray Foam: Expanding spray-in-place intumescent foam sealant.

.5 Silicone Foams: Multi-component, silicone based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

.6 Silicone Sealants: Moisture curing, single component, silicone based, neutral curing elastomeric sealants of grade indicated below:

.1 Grade for Horizontal Surfaces: Pourable (self levelling) formulation for openings in floors and other horizontal surfaces.

.2 Grade for Vertical Surfaces: non-sag formulation for openings in vertical and other surfaces.

2.5 MIXING

.1 For those products requiring mixing before application, comply with firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

Part 3 Execution

3.1 EXAMINATION

.1 Examine surfaces, components, materials to receive firestopping material; report any conditions that would detrimentally affect the application of the material or the proper firestopping of the system.

.2 Commence Work when conditions of surfaces and the working conditions are suitable.

.3 Verify service lines are in place, tested and approved where penetration sealants or caulking are required.

.4 Verify that proper blocking, framing (using non-combustible materials) are properly installed and prepared to receive firestopping. Notify Consultant in writing of any deficiencies affecting the proper performance of the firestopping do not proceed until deficiencies are corrected.

.5 Prepare surfaces in contact with firestopping materials and smoke seals to manufacturer's instructions.

.6 Maintain insulation around pipes and ducts penetrating fire separation without interruption to Vapor barrier where applicable.

.7 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.2 PREPARATION

.1 Provide and maintain masking, drop cloths and polyethylene coverings for such surfaces to protect them during installation operations where adjacent finished floors, walls and similar surfaces are exposed.

.2 Provide complete enclosures and human protective devices when installing or mixing hazardous materials.

.3 Surfaces shall be free of oil, grease, dirt, loose paint, mill scale or any other matter that could impair bond, including paint.

.4 Prime surfaces as required.

.5 Make provisions for natural ventilation during and subsequent to application of firestopping and smokeseals, sealant or caulking; circulate interior air by use of temporary circulators or exhaust fans in enclosed areas or area lacking openings for natural ventilation.

3.3 APPLICATION

.1 Apply firestopping materials in strict accordance with manufacturer's printed instructions, accepted and approved tested assemblies, and approved details.

.2 Apply firestopping materials/systems to maintain the fire separations in the project as indicated on drawings.

.3 Seal holes or voids made by through penetrations, poke through termination devices, and unpenetrated openings or joints and verify continuity and integrity of fire separation are maintained.

.4 Remove excess compound promptly as work progresses and upon completion.

3.4 CLEANING

.1 After completion of firestopping work, remove equipment and clean exposed wall and floor areas to remove excess materials, spatter.

3.5 SYSTEM SCHEDULE

.1 Design and provide through penetration firestopping and smokeseals as follows for:

.1 Systems with No Penetrating Items: Select one or more of the following fill materials:

.1 Latex sealant.
.2 Silicone sealant.
.3 Intumescent putty.
.4 Intumescent foam blocks or boards.
.5 Intumescent spray foam.

.2 Systems for Metallic Pipes, Conduit, or Tubing: Select one or more of the following fill materials:

.1 Latex sealant.
.2 Silicone sealant.
.3 Intumescent putty.
.4 Intumescent foam blocks or boards.
.5 Intumescent spray foam.

.3 Systems for Non-metallic Pipe, Conduit, or Tubing: Select one or more of the following fill materials:

.1 Latex sealant.
.2 Silicone sealant.
.3 Intumescent putty.
.4 Intumescent wrap strips.
.5 Firestopping and Smokeseals device.
.6 Intumescent spray foam.

.4 Systems for Electrical, and Data and Communications Cables: Select one or more of the following fill materials:

.1 Latex sealant
.2 Silicone sealant
.3 ntumescent putty
.4 Silicone foam
.5 Prefabricated Firestop Sleeve (Hilti)
.6 Preformed Intumescent Blocks (Roxtec)
.7 Prefabricated Cable Pathways (EZ-Path)
.8 Intumescent foam blocks or boards
.9 Intumescent spray foam

.5 Systems for Insulated Pipes: Select one or more of the following fill materials:

.1 Latex sealant
.2 Intumescent putty
.3 Silicone foam
.4 Intumescent wrap strips
.5 Intumescent foam blocks or boards
.6 Intumescent spray foam

.6 Systems for Miscellaneous Electrical Penetrations: Select one or more of the following fill materials:

.1 Latex sealant
.2 Intumescent putty
.3 Intumescent foam blocks or boards
.4 Intumescent spray foam

.7 Systems for Miscellaneous Mechanical Penetrations: Select one or more of the following fill materials:

.1 Latex sealant
.2 Intumescent foam blocks or boards
.3 Intumescent spray foam

.8 Floor-to-Wall, Fire Resistive Joint System: Provide materials to meet the following criteria:

.1 Assembly Rating: 2 hours
.2 Nominal Joint Width: As indicated
.3 Movement Capabilities: Confirm, compression, extension, or horizontal shear

.9 Head-of-Wall, Fire Resistive Joint System: Provide materials to meet the following criteria:

.1 Assembly Rating: 2 hours
.2 Nominal Joint Width: As indicated
.3 Movement Capabilities: Compression and extension

.10 Wall-to-Wall, Fire Resistive Joint System: Provide materials to meet the following criteria:

.1 Assembly Rating: 2 hours

.2 Nominal Joint Width: As indicated

.3 Movement Capabilities: Compression and extension

3.6 STANDARD DETAILS

.1 Submit manufacturer's listed assembly drawings and standard details, and also include additional site detail for site conditions which may not be covered by the manufacturer's standard details.

.2 Verify site conditions and dimensions for compliance with manufacturer's details including, but not limited to:

.1 Minimum and maximum joint widths.

.2 Type and thickness of fire rated construction.

.3 Use manufacturer's approved alternate details where site conditions do not comply with standard details submitted for review.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

Part 1 General

1.1 SUMMARY

.1 This Section includes joint sealants for the following applications, including those specified by reference to this Section:

.1 Exterior joints for vertical surfaces and horizontal non-traffic surfaces:

.1 Joints between cement fibre board panels.

.2 Joints between cedar tongue and groove.

.3 Perimeter joints between materials listed above and frames of doors, windows, vents and louvers.

.4 Control and expansion joints in ceilings and other overhead surfaces.

.5 Other joints as indicated.

.2 Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:

.1 Control and expansion joints on exposed interior surfaces of exterior walls.

.2 Perimeter joints of exterior openings where indicated.

.3 Tile control and expansion joints.

.4 Perimeter joints between interior wall surfaces and frames of interior doors and windows.

.5 Joints between plumbing fixtures and adjoining walls, floors, and counters.

.6 Other joints as indicated.

.3 Interior joints in the following horizontal traffic surfaces:

.1 Isolation joints in cast-in-place concrete slabs.

.2 Control and expansion joints in tile flooring.

.3 Other joints as indicated.

1.2 RELATED REQUIREMENTS

.1 Other sections of the specification requiring sealants refer to this section; coordinate requirements of referencing sections.

.1 Section 06 20 00 – Finish Carpentry

.2 Section 06 40 00 – Shop Fabricated Architectural Woodwork

.3 Section 06 61 19 – Quartz Surfacing Fabrications

.4 Section 07 25 19 – Foamed-In-Place Insulation

.5 Section 07 42 43-13 - Aluminum Composite Wall Panels

.6 Section 07 62 00 – Sheet Metal Flashing and Trim

.7 Section 07 84 00 – Firestopping: Fire resistive joint systems; sealing joints in fire resistance rated construction.

.8 Section 08 11 13 – Steel Doors and Frames

.9 Section 08 43 13.13 – Aluminium-Framed Entrances and Storefronts

.10 Section 08 63 00 – Metal-Framed Skylights

.11 Section 08 81 00 – Glass Glazing: Glazing sealants.

.12 Section 09 21 16 – Gypsum Board Assemblies: Sealing perimeter joints of gypsum board partitions to reduce sound transmission.

.13 Section 09 30 00 – Tiling: Sealing tile joints.

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM C834-10, Standard Specification for Latex Sealants

.2 ASTM C919-08, Standard Practice for Use of Sealants in Acoustical Applications

.3 ASTM C920-11, Standard Specification for Elastomeric Joint Sealants

.4 ASTM C1184-05, Standard Specification for Structural Silicone Sealants

.5 ASTM C1193-11, Standard Guide for Use of Joint Sealants

.6 ASTM C1248-08, Standard Test Method for Staining of Porous Substrate by Joint Sealants

.7 ASTM C1311-10, Standard Specification for Solvent Release Sealants

.8 ASTM C1330-02, Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants

.9 ASTM C1481-12, Standard Guide for Use of Joint Sealants with Exterior Insulation and Finish Systems (EIFS)

.10 ASTM D2240-05, Standard Test Method for Rubber Property - Durometer Hardness

.2 Canadian Food Inspection Agency (CFIA):

.1 Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products Listings

.3 Canadian General Standards Board (CGSB):

.1 CGSB 19-GP-5M, Sealing Compound, One Component, Acrylic Base, Solvent Curing

.2 CGSB 19-GP-14M, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing

.3 CAN/CGSB 19.17-M90, One Component, Acrylic Emulsion Base Sealing Compound

.4 CAN/CGSB 19.13-M87, Sealing Compound, One Component, Elastomeric, Chemical Curing

.5 CAN/CGSB 19.24-M90, Multicomponent, Chemical Curing, Sealing Compound

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit product data for each joint sealant product indicated.

.3 Informational Submittals: Provide the following submittals when requested by the Team Project Manager, Team Members or Team Crew Members assigned to such duties:

.1 Certificates: Submit product certificates for each type of joint sealant and accessory, signed by product manufacturer certifying that materials used are appropriate for applications that they were used.

1.5 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Manufacturer: Obtain each type of joint sealant through one source from a single manufacturer.

1.6 PROJECT CONDITIONS

.1 Proceed with installation of joint sealants only when the following conditions are met:

.1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer.

.2 Joint substrates are dry.

.3 Joint widths are within tolerances of those permitted by joint sealant manufacturer for applications indicated.

.4 Substrates are free from contaminants capable of interfering with adhesion.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturer's products that may be incorporated into the Work include, but are not limited to, the following:

.1 GE Silicones Limited

.2 ChemRex Inc., Sonneborn

.3 Chemtron Manufacturing Ltd.

.4 Dow Corning Canada Inc.

.5 Sika Chemical of Canada Ltd.

.6 Tremco Ltd.

.7 BASF

2.2 MATERIALS

.1 Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and site experience.

.2 Colours of exposed joint sealants will be selected by the Consultant from manufacturer's complete range to match adjacent finish materials.

.3 Elastomeric Joint Sealants: Provide sealants in accordance with ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates and as follows:.

.1 Provide products that have been tested in accordance with ASTM C1248 where elastomeric sealants are required for non-staining to porous substrate applications.

.2 Provide products that have been tested and approved by the CFIA, and are labelled as Safe for Contact with Food where elastomeric sealants are required to come in repeated contact with food.

.4 Latex Joint Sealants: Provide sealants in accordance with ASTM C834, temperature Grade to suit related exposure and joint substrates, paintable, non-sag and non-staining for general application , and acoustic seals in exposed locations.

.5 Performance Requirements:

.1 Provide elastomeric joint sealants for exterior applications that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

.2 Provide joint sealants for interior applications that establish and maintain airtight and water resistant continuous joint seals without staining or deteriorating joint substrates.

2.3 LIQUID SEALANTS

.1 Type S-1; Not Used

.2 Type S-2; Silicone Sealant: Mould and mildew resistant, Shore A Hardness 15-25, conforming to ASTM C920, Type S, Grade NS, Class25, use NT, G, and A:

.1 Acceptable materials:

.1 GE SCS 1700

.2 Dow Corning 786

.3 Tremco Tremsil 200

.4 Sonneborn Omni Plus

.3 Type S-3; Silicone Sealant: Exterior Weatherproofing Sealant, One-part, low modulus, neutral cure, Shore A Hardness 15-25, conforming to CAN/CGSB-19.13-M, Classification C-1-40-B-N and C-1-25-B-N, and ASTM C 920, Type S, Grade NS, Class 25, use NT, M, G, A and O, colour as selected by Consultant from Custom Colour as selected by the Team Members:

.1 Acceptable materials:

.1 GE Silpruf LM SCS 2700

.2 Dow Corning 791

.3 Tremco Spectrum 1/Spectrum 3

.4 Sonneborn Omni Seal

.4 Type S-4, Silicone Sealant: Butt glazing, one part, moisture curing, shore A hardness 15-25, conforming to CAN/CGSB-19.13-M, Classification C-1-40-B-N and C-1-25-B-N and ASTM C920, Type S, Grade NS, Class 25, use NT, G, A, O; Colour: clear (translucent):

.1 Acceptable materials:

.1 GE SCS2000

.2 Dow Corning 795

.3 Chemtron Multiseal

.4 Tremco Spectrum 2

.5 Type S-5; interior acoustical sealant: Non-skinning, non-hardening, single component synthetic rubber sealant, conforming to CAN/CGSB-19.21-M:

.1 Acceptable materials:

.1 Chemtron Metaseal

.2 Tremco Acoustic Sealant

.6 Type S-6; air-seal sealant: One part, silicone, shore A hardness 15 – 25, conforming to CGSB 19-GP-13M, classification C-1-40-B-N and C-1-25-B-N and ASTM C920, Type S, Grade NS, Class 25. Use NT, M, G, A and O:

.1 Acceptable materials:

.1 Dow Corning 790

.2 GE Silpruf LM or SCS2700.

.3 Tremco Spectrum 1

.7 Type S-7; two part multi-component sealant: Chemical curing, non-sag, exterior wall sealant, Shore A Hardness 20-35, conforming to CAN/CGSB-19.24-M, Type 2, Class B, and ASTM C920, Type S, Grade NS, Class 25, use NT, M, and A:

.1 Acceptable materials:

.1 Sikaflex 2c NS

.2 Tremco Dymeric

.3 Sonneborn NP 2

.8 Type S-8 - Not Used

.9 Type S-9 – Not Used

.10 Type S-10; polyurethane sealant: One component, non-sag, for general construction, Shore A Hardness 15+, conforming to CAN/CGSB-19.13-M, Type 2, Classification MCG-2-25-A-N and ASTM C920, Type S, Grade NS, Class 25, Use NT, M, and A:

.1 Acceptable materials:

.1 Chemtron Multiflex

.2 Sikaflex 1-a Plus

.3 Tremco Dymonic

.4 Sonneborn NP 1

.5 Mameco/Vulkem 116

.11 Type S-11 – Not Used

2.4 SEALANT BACKING

.1 Provide sealant backings of material and type that are non-staining, compatible with joint substrates, sealants, primers, and other joint fillers, and are approved for applications indicated by sealant manufacturer based on site experience and laboratory testing.

.2 Rod Type Sealant Backings:

.1 ASTM C1330, Type C (closed cell material with a surface skin), Type O (open cell material) or Type B (bi-cellular material with a surface skin).

.2 Use any of the preceding types, as approved in writing by joint sealant manufacturer for joint application indicated.

.3 Size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

.4 Non-adhering to sealant, to maintain two sided adhesion across joint.

.3 Bond Breaker Tape: Self adhesive polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where three sided adhesion will result in sealant failure.

2.5 ACCESSORIES

.1 Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from pre-construction joint sealant substrate tests and site tests.

.2 Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

.3 Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

Part 3 Execution

3.1 EXAMINATION

.1 Examine joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance.

.2 Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

.1 Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

.2 Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.

.3 Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil free compressed air.

.4 Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

.5 Porous joint substrates include the following:

.1 Unglazed surfaces of ceramic tile.

.2 Solid Surface and Quartz Countertops and Vanities

.6 Nonporous joint substrates include the following:

.1 Metal.

.2 Glass.

.3 Porcelain enamel.

.4 Glazed surfaces of ceramic tile.

.2 Prime joint substrates as recommended in writing by joint sealant manufacturer, based on pre-construction joint sealant substrate tests or prior experience:

.1 Apply primer to comply with joint sealant manufacturer's written instructions.

.2 Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

.3 Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears; remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

.1 Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

.2 Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

.3 Acoustical Sealant Application Standard: Comply with recommendations in ASTM C919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

.4 Install sealant backings of type indicated to support sealants during application and at position required to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

.1 Do not leave gaps between ends of sealant backings.

.2 Do not stretch, twist, puncture, or tear sealant backings.

.3 Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

.5 Install bond breaker tape behind sealants where sealant backings are not used between sealants and backs of moving joints.

.6 Install sealants at the same time backings are installed, and as follows:

.1 Place sealants so they directly contact and fully wet joint substrates.

.2 Completely fill recesses in each joint configuration.

.3 Produce uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

.7 Sealants: Immediately after sealant application and before skinning or curing begins, tool non-sag sealants to form smooth, uniform beads, to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint, and as follows:

.1 Remove excess sealant from surfaces adjacent to joints.

.2 Use tooling agents and profiles that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces in accordance with the figures listed in ASTM C1193 as follows:

.1 Provide concave joints

.2 Provide flush joints

.3 Provide recessed joint configuration

.4 Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

.1 Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

.1 Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Performance.

.2 Cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work if, despite protection measures, damage or deterioration occurs.

3.6 JOINT SEALANT SCHEDULE

.1 Where no specified type of sealant is shown or specified choose one of the sealants specified in this Section applicable to that intended application, and consistent with manufacturer's recommendations.

.2 Use mould and mildew resistant silicone sealant Type S-2 for non-moving joints in washrooms and kitchens; do not use on floors.

.3 Use silicone general construction sealant Type S-3 or polyurethane sealant Type S-7 and S-10 for all joints, interior and exterior, where no other specific sealant type specified; do not use on horizontal traffic joints or where immersed in water.

.4 Use silicone glazing type S-4 for sealing butt glazing joints

.5 Use acoustical sealant Type S-5 for interior applications only where they will be fully concealed and only where no constant or consistent air pressure difference will exist across the joint.

.6 Use air seal sealant Type S-6 for exterior walls only where constant or consistent air pressure difference will exist across the joint.

.7 Use multi-component sealant Type S-7 for exterior vertical joints where large movement is anticipated; not for continuous water immersion.

.8 Use multi-component sealant type S-7 for edge joint sealant at slab edges at walls, columns, interior shaft walls and grade beams.

.9 In addition, seal the following joints:

.1 Seal perimeters of door frames on both sides, and at junction between door frame and resilient or solid flooring materials.

.2 Seal control joints in gypsum board, and junctures between interior partitions with exterior walls.

.3 Seal window and door frames around the inside perimeter, so that an airtight seal is obtained, as indicated on drawings.

END OF SECTION

SECTION 08 06 10

DOOR SCHEDULE

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 06 10 00 – Rough Carpentry

.2 Section 06 20 00 – Finish Carpentry: Preparation and installation of wood doors.

.3 Section 08 11 13 – Steel Doors and Frames

.4 Section 08 71 00 – Door Hardware

.5 Section 08 81 00 – Glass Glazing

1.2 COORDINATION

.1 The Team recognizes that hardware may be supplied and installed by different Sections of the work.

.2 Hardware groups listed in this Section and specified in Section 08 71 00 are not intended to imply trade responsibility or Scope-of-Work to a sole source of supply and installation.

.3 Coordinate supply of hardware groups listed in this Section and specified in Section 08 71 00 with supply or installation by Related Sections compatible to established building system.

Part 2 Products

2.1 MATERIALS ABBREVIATIONS

.1 The following Abbreviations are used to describe materials contained in the Door, Frame and Hardware Schedule:

Abbreviation	Material Description
AL	Aluminum
AN	Anodized
EX	Existing
FG	Fire Rated Glass
HCW	Hollow Core Wood
HM	Hollow Metal
HMI	Hollow Metal Insulated
P	Paint
PS	Pressed Steel Frame
SCW	Solid Core Wood
SG	Sealed Glass Unit
SN	Stain
SS	Stainless Steel
ST	Steel
STG	Sealed Tempered Glass Unit
TG	Tempered Glass Unit
TRR	Temperature Rise Rated
WD	Wood

Part 3 Execution

3.1 DOOR, FRAME AND HARDWARE SCHEDULE

.1 Confirm contents of Door, Frame and Hardware Schedule with Drawings; identify any inconsistencies to the Team Project Manager, Team member or Team Crew member assigned to such duties prior to ordering materials.

.2 Frame size is indicated in nominal millimeter dimensions; clearances and undercuts must be taken into account when doors are ordered.

.3 Sizes prefixed with a 2 or other number indicate multiple doors in one opening.

.4 Door, schedule and frame types in schedule shall be as indicated on Drawings

END OF SECTION

SECTION 08 53 00

PLASTIC WINDOWS AND DOORS

Part 1 General

1.1 INTENT

.1 This Section includes pre-assembled window and Door systems having factory installed glass and glazing of the following types:

.1 Single awing style windows

.2 tilt-turn door units.

.2 This Section specifies window frames and sashes consisting unplasticized polyvinyl chloride (uPVC) extrusions

.3 Frames or sashes utilizing wood are not permitted.

1.2 RELATED REQUIREMENTS

.1 Section 07 25 13 – Modified Bituminous Air and Vapor Membranes

.2 Section 07 92 00 – Joint Sealants

.3 Section 08 81 00 – Glass Glazing

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.2 ASTM A653/A653M-04a, Standard Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvanannealed) by the Hot-Dip Process

.3 ASTM D3917-96(2002)e1 Standard Specification for Dimensional Tolerance of Thermosetting Glass-Reinforced Plastic Pultruded Shapes

.4 ASTM D3918-96 (2003), Standard Terminology Relating to Reinforced Plastic Pultruded Products

.5 ASTM D4216-03, Standard Specification for Rigid Polyvinyl Chloride (PVC) and Related PVC and Chlorinated Polyvinyl Chloride (CPVC) Building Products Compounds

.6 ASTM D4726-02, Standard Specification for Rigid Polyvinyl Chloride (PVC) Exterior Profile Extrusions Used for Assembled Windows and Doors

.7 ASTM D4385-02, Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products

.2 Canadian Standards Association (CSA):

.1 CSA A440-00, Windows

.2 CSA A440.2-04, Energy Performance Evaluation of Windows and Other Fenestration Systems

.3 CSA A440.4-98, Window and Door Installation

.3 Insulating Glass Manufacturer's Alliance (IGMA):

.1 TM-3000(97), Glazing Guidelines for Sealed Insulating Glass Units

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit manufacturer's product data including construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of window indicated.

.3 Submit shop drawings including plans, elevations, large scale sections and details, hardware, attachments to other work, operational clearances, and the following:

.1 Sections details showing all window and door perimeter conditions.

.2 Mullion details and frame corner connections, including reinforcement and stiffeners.

.3 Joinery and frame anchorage to wall structure details.

.4 Expansion provisions.

.5 Flashing and drainage details, sill flashing terminations, in isometric view, including coordination with wall cladding materials.

.6 Connection to air and Vapor retarder membrane

.7 Weather stripping details showing air sealing within and around perimeter of framing and operable sash

.8 Glazing details.

.9 Required sizes and tolerances of openings.

.4 Submit maintenance data for operable window, operating hardware, weather stripping and finishes in accordance with Section 01 00 06 – General Requirements: Operations and Maintenance Data.

1.5 DESIGN CRITERIA

.1 Materials, fabrication, attachments, accessories, assembly and performance, other than thermal performance, shall meet or exceed applicable requirements of CSA A440, Windows, the following appendices, and as specified:

.1 Appendix D - Span(s) for Vinyl Members.

.2 Appendix E - Wall Thickness of Vinyl Windows.

.2 Determine thermal performance in conformance with CSA A440.2, Thermal Performance Evaluation of Windows and Sliding Glass Doors, and Appendix A – Overview of the Procedure for Determining the U-Value by Computer Simulation.

.3 Design windows and doors to equalize both positive and negative pressure between outside air and:

.1 Cavities surrounding insulating glass units, and

.2 Cavities surrounding operable sash.

.4 Design windows and doors to provide drainage from spaces around operable sash and around insulating glass units to exterior.

.5 Design windows and doors to protect drainage openings from direct entrance of wind-driven rain by use of baffles or other protection.

.6 Design frames and sashes for interior glazing methods; exterior glazing methods are not acceptable.

.7 Design windows and doors for strap anchorage or through jamb anchorage to withstand the wind loads, as determined by the Building Code, and to distribute wind load along frames to window manufacturer's recommendations.

.8 Design components to accommodate thermally induced movement.

1.6 PROJECT CONDITIONS

.1 Verify window and door openings by field measurements before fabrication and indicate measurements on shop drawings, coordinate fabrication schedule with construction progress to avoid delaying the work.

.2 Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating windows and doors without field measurements, coordinate wall construction to ensure actual locations of opening dimensions correspond to established dimensions.

Part 2 Products

2.1 SINGLE DOOR UNITS

.1 Meet or exceed requirements of CSA A440, and the following performance requirements:

.1 Air Tightness Rating: A3
.2 Water Tightness Rating: B7.
.3 Wind Load Resistance Rating: C5.
.4 Forced Entry: F2, pass test for resistance to forced entry.
.5 Insect Screens: S2
.6 Glazing: As specified in Article 2.8 of this section
.7 Overall Door U-Value: Minimum 0.920 Btu/ft-hr-°F (1.59 W/m^2°C.)

2.2 FIXED SINGLE UNIT WINDOWS

.1 Meet or exceed requirements of CSA A440, and the following performance requirements:

.1 Air Tightness Rating, Fixed Windows: Fixed.
.2 Water Tightness Rating: B7.
.3 Wind Load Resistance Rating: C5.
.4 Forced Entry: F2, pass test for resistance to forced entry.
.5 Insect Screens: S2
.6 Glazing: As specified in Article 2.8 of this section
.7 Overall Fixed Window U-Value: Mimimum 0.885 Btu/ft-hr-°F (1.53 W/m^2°C).

2.3 OPERABLE SINGLE UNIT WINDOWS

.1 Meet or exceed requirements of CSA A440, and the following performance requirements:

.1 Air Tightness Rating, Operable Windows: A3.

.2 Water Tightness Rating: B7.

.3 Wind Load Resistance Rating: C5.

.4 Forced Entry: F2, pass test for resistance to forced entry.

.5 Insect Screens: S2

.6 Glazing: As specified in Article 2.8 of this section

.7 Overall Fixed Window U-Value: Mimimum 0.885 Btu/ft-hr-°F (1.53 W/m^2°C).

2.4 COMBINATION WINDOWS AND DOORS

.1 Meet or exceed requirements of CSA A440 for combination windows, and the performance requirements for single unit windows

.2 Where combination windows and doors are specified and have not been tested as an entire assembly, individual lights shall meet the performance requirements for the applicable single unit window and door types specified.

.3 Air and water tightness of joints along frames mulled together, and at mullions where lites within one main frame join, shall meet or exceed performance ratings specified for adjacent single unit windows.

.4 Lateral deflection of mulled frames shall not exceed 1/175 of span when subjected to loading equivalent to wind load resistance of the adjacent single unit windows.

2.5 FRAME AND SASH REQUIREMENTS

.1 Frame and sash profiles and glazing detailed on drawings are not intended to restrict product types conforming with these specifications.

.2 Provide uPVC frame and sash meeting the following requirements:

.1 Unplasticized Polyvinyl chloride (uPVC): to ASTM D4216, Class 1-10154-33-0101, 1-20131-33-0101 or 1-40121-33-0101.

.3 Minimum external wall thickness of extrusions 0.078 inch (2 mm) nominal, exceeding requirements of CSA A440 for unplasticized Polyvinyl Chloride (uPVC) window wall types and as follows:

.1 Seal sash perimeter continuously at two locations minimum, with primary seal located between operator and exterior seal.

.2 Secure hardware and attachments using screws into H-ports or penetrating minimum of two walls of framing.

.3 Join single units to form combination units with joints at combination unit frame perimeter finished with sealant and steel plate, 3 inch (75 mm) x 75% of depth of framing; fasten plate using a minimum of four (4) screws through plastic into steel reinforcing.

.4 Anchor using metal strap anchors or concealed fasteners through frames; nailing fins or splines are not acceptable.

.5 Fit corners to provide hairline joint.

.6 Sill and head sections shall be continuous for combination units.

2.6 OPERATING HARDWARE

.1 Awning Hinges: Sash balancing friction hinge for use on commercial windows, concealed between sash and frame, complete with friction screw adjustment and enhanced corrosion protection coating:

.2 Casement Hinges: Low friction slide and pivot design casement hinge for use on windows, to provide 135 kg negative air pressure resistance, concealed between sash and frame, with Teflon filled slide shoe on roll formed stainless steel track and flat bottom design specifically for uPVC material, adjustment system for sash drag and corrosion protection coating:

.3 Multi-Point Locking System: Window locking system providing security and weather seal tightness having locking points to provide 135 kg of force for negative air pressure and forced entry resistance; sequential locking with .0629 (16 mm) of pull-in utilizing tie bar driven by a single locking handle to meet handicap accessibility hardware height standards, and lock drive O-ring weather seal between lock and window frame; manufactured from high pressure zinc alloy die castings with corrosion protection coating:

.4 Awning Operator: Operators shall provide easy adjustment of window position, crank operated and provide wide range of open positions. Connection to movable sash shall detach for window cleaning and maintenance. Scissors arm design driven by hand crank, hardened steel worm and gearing and high pressure zinc alloy die castings. High-strength plastic trim cover matching casement operator , and with corrosion protection coating:

.5 Casement Operator: Operators shall provide easy adjustment of window position. Connection to movable sash shall detach for window cleaning and maintenance. Operators shall be a combined push arm and drag arm/link design driven by a hand crank, constructed of hardened steel worm and gearing and high pressure zinc alloy die castings and with corrosion protection coating. High-strength plastic trim cover matching awning operator:

.6 Tilt-Turn Operator: Concealed hardware parts having only the handle visible. Horizontal and vertical perimeter locking points to provide weathertight performance and security.

2.7 INSECT SCREENS

.1 Insect Screens

- .1 Main frame members of operable windows shall be designed to accept insect screens intended for use with the window.
- .2 Insect screens shall be secured and removable without the use of special tools.
- .3 Insect screen frames shall conform to the material requirements of Clause 5. Frame corners shall be firmly joined together.
- .4 The insect screening and its retention in the insect screen sash shall conform to the applicable dimensional and physical requirements specified in CGSB Standard CAN/CGSB-79.1.

.2 Insect Screen Strength — Operable Windows Only When tested in accordance with Clause 11.10

.1 the screening material shall not be torn and shall remain firmly anchored to the insect screen sash;

.2 the insect screen sash members and their corner connections shall show no evidence of failure or permanent deformation that would impair the operation of the window; and

.3 the insect screen unit shall remain firmly anchored to the window, and the mounting fittings shall show no signs of failure or permanent deformation.

.3 Insect Screen Strength:

.1 The window shall be mounted in a suitable test frame with an insect screen unit of appropriate type and size in place. The operable sash shall be opened or, if necessary for access to the insect screen, the glazing shall be removed.

.2 The test force shown in Table 4 shall be applied to the insect screen through a 12 inch (305 mm) diameter, rigid, circular platen centred on the centroid of the insect screen unit (ie, that point where diagonal lines drawn through the insect screen corners cross). The force shall be perpendicular to the plane of the insect screen and shall be applied in the outward direction for 60 ± 5s.

.4 Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches, and as follows:

.1 Fabricate screens and frames in accordance with CAN/CSA A440 and CAN/CGSB 79.1.

.2 Fabricate insect screens to fully integrate with window frame.

.3 Locate screens on inside or outside as indicated on Drawings; provide one for each operable exterior sash or ventilator.

.5 Screen Frames:

.1 Extruded Aluminum or Aluminum Tubular Framing Sections and Cross Braces: Aluminum sections having 0.039 inch (1.0 mm) minimum nominal wall thickness, with finish to match aluminum window members.

.6 Screen Fabric:

.1 Screen Class: Class A in accordance with CAN/CGSB 79.1.

.2 Screen Strength: S1 in accordance with CAN/CSA A440 and CAN/CGSB 79.1.

.3 Screen Style: Style 1 in accordance with CAN/CGSB 79.1.

.4 Fabric Mesh Material:

.1 Aluminum Wire: 18X16/25 mm (12.7 mm x 1.3 mm) mesh, using nominal 0.011 inch (0.28 mm) diameter wire; having minimum 66.08% apparent opening size, using coated aluminum wire; charcoal grey finish; in accordance with CAN/CGSB 79.1.

2.8 GLASS AND GLAZING MATERIALS

.1 Insulating Glass Units: meet or exceed requirements of CAN/CGSB-12.8, units certified by IGMA.

.2 Overall unit thickness: 1 inch (25 mm) using 0.23 inch (6 mm) glass thickness for individual panes using two stage seal method of manufacture, as follows:

.1 Primary Seal: polyisobutylene sealing compound between glass and metal spacer/separator, super spacer bar or TDSE Intercept.

.2 Secondary Seal: polyurethane, silicone or polysulphide base sealant, filling gap between the two lites of glass at the edge up to the spacer/separator and primary seal.

.3 Spacer/separator to provide continuous Vapor retarder between interior of sealed unit and secondary seal.

.4 Clear Safety Glass: to CAN/CGSB-12.1-M90, tempered for inner lite.

.5 Tinted/Heat Absorbing Satety Glass: to CAN/CGSB-12.4, for outer lite, as follows:

.1 Glass Quality: Tempered Float glass, glazing quality.

.2 Class: as recommended by glass manufacturer, based on stress analysis.

.3 Style: 1 – High, above 55%, light transmittance.

.4 Grade: AA - Very low, below 0.45, shading coefficient.

.6 Provide low-E coating on No.2 and 5 surface of double glazed insulating glass units.

.7 Glazing Gaskets for FRP Sections: Manufacturer's standard.

.8 Other Glazing Accessories: setting blocks to CAN/CSA A440.

2.9 ACCESSORIES

.1 Weatherstripping at Operable Sash: neoprene, thermoplastic rubber or EPDM, flexible at minimum design temperature, and as follows:

.1 Profiled to mechanically key into window frame and operable sash.

.2 Removable without special tools and without dismantling of sash or frame.

.3 Designed to maintain pressure contact against sash through design temperature range.

.2 Insulating Foam Sealant: one-part polyurethane, closed cell foam, skin-forming type, expanding maximum 25%.

.3 Foam Backer Rod: extruded closed cell backer rod, oversize 30 to 50%.

.4 Screens: Standard duty, aluminum wire mesh with extruded aluminum sash and four (4) screw retainers per side; screen sash finish shall match colour of window sash, and as follows:

.1 Mesh Gauge: 16 per 1 inch (25 mm)

.2 Wire Diameter: 0.017 inmch (0.45 mm)

.3 Open Area: 50% minimum

.5 Flashing: prefinished sheet aluminum, brake formed as indicated on drawings, 0.024 inch (0.62 mm) thick, or extruded vinyl matching window framing, concealed fastened.

2.10 FABRICATION

.1 Fabricate window units square and true with maximum tolerance of plus or minus 0.059 inch (1.5 mm) for units with a diagonal measurement of 72.04m inch (1830 mm) or less and 0.118 inch (3 mm) for units with a diagonal measurement over 72.04 inch (1830 mm).

.2 Steel reinforce vertical and horizontal components of uPVC window and door units, with height or width greater than 35.43 inch (900 mm).

.3 Fasten steel reinforcement to extruded vinyl mullions with concealed stainless steel fasteners at maximum 12 inch (305 mm) O/C.

.4 Continuously and uniformly compress length of gaskets during installation, to compensate for linear shrinkage.

2.11 GLAZING

.1 Clean sealing surfaces at perimeter of glass and sealing surfaces of rabbets and stop beads before applying splines or gaskets. Use solvents and cleaning agents recommended by manufacturer of sealing materials.

.2 Install glazing gaskets uniformly with accurately formed corners and bevels. Ensure that proper contact is made with glass and rabbet interfaces.

.3 Support both lites of glass thermal units on leveled setting blocks, 0.157 inch (4 mm) or 0.236 inch (6 mm) minimum, spaced as recommended by glass manufacturer.

.4 Centre glass thermal units in glazing rabbet to maintain 6 mm minimum clearance between edges of glazing and plastic framing at sill or 4 mm minimum clearance between edges of glazing and plastic framing at sill if glazing bite incorporates a drainage channel with a depth of 0.118 inch (3 mm) minimum.

.5 Size glass thermal units to ensure exposed face of spacer is in line with glazing stops.

.6 Use spacers and shims in accordance with glass manufacturer's recommendations.

2.12 FRAME AND SASH FINISHES

.1 Vinyl: white or off-white integral colour, as selected by The Team or Team Member assigned to such duties, from the manufacturer's colour range.

Part 3 Execution

3.1 INSTALLATION

.1 Erect and secure window units in prepared openings, plumb and square, free from warp, twist or superimposed loads.

.2 Mount window with exterior surface of main frame flush with exterior sheathing.

.3 Secure work accurately to structure and in a manner not restricting thermal movement of materials.

.4 Transfer window dead load to wall construction by anchors alone or in combination with plastic shims; wood shims are not acceptable.

.5 Place shims under sill frame at setting block locations, and as recommended by window frame manufacturer.

.6 Conceal anchors and fitments; exposed heads of fasteners are not permitted.

.7 Maintain dimensional tolerances after installation and alignment with adjacent work.

.8 Provide seal around interior perimeter of window frame using foam joint sealant or foam backer rod, size as required to lightly compress between frame and rough opening, and sealant.

.9 Provide seal at head and jamb of exterior perimeter of window frame using foam joint sealant or foam backer rod, size as required to lightly compress between frame and rough opening, and sealant. Do not seal sill at exterior.

.10 Install jamb extensions, casings, brick moulds and trim as indicated on drawings.

.11 Install sealant, in accordance with Section 07 92 00, and related materials as indicated on drawings.

.12 Adjust operable sash and hardware to operate smoothly.

.13 Clean interior and exterior surfaces as soon as adjacent contaminating activities are completed, to recommendations of window manufacturer.

END OF SECTION

SECTION 08 63 00

METAL FRAMED SKYLIGHTS

Part 1 General

1.1 SUMMARY

.1 This Section includes the following:

.1 Aluminum-framed skylights with retaining caps.

.2 Two-sided, structural-sealant-glazed, aluminum-framed skylights with retaining caps at rafters.

.3 Circular structural-sealant-glazed, aluminum-framed skylights.

1.2 RELATED REQUIREMENTS

.1 Section 01 33 50 – Delegated Design Submittals

.2 Section 07 53 00 – Elastomeric Membrane Roofing

.3 Section 07 21 16 – Blanket Insulation

.4 Section 07 25 19 – Foamed-in-Place Air Vapor Barrier

.5 Section 07 92 00 – Joint Sealants: Sealants installed with metal framed skylights.

.6 Section 08 81 00 – Glass Glazing: glazed units installed in metal-framed skylights.

1.3 DEFINITIONS

.1 Delegated Design Professional Engineer: The professional engineer hired or contracted to the fabricator or manufacturer to produce delegated design submittals and shop drawings to meet the requirements of the Project, and registered in the province of the Work, and who is not the Consultant.

1.4 REFERENCE STANDARDS

.1 Aluminum Association (AA):

.1 Aluminum Design Manual, 2005

.2 American Architectural Manufacturer's Association (AAMA):

.1 AAMA 611-98, Voluntary Specification for Architectural Anodized Aluminum

.2 AAMA 1503-98, Voluntary Test Methof for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.

.3 AAMA AFPA-91, Anodic Finishes/Painted Aluminum

.4 AAMA RPC-00, Rain Penetration Control: Applying Current Knowledge

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A123/A123M-12, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.2 ASTM A653/A653M-06, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.

.3 ASTM A167-99 (R2004), Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

.4 ASTM B209/209M-04, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

.5 ASTM B221-12 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

.6 ASTM B429-02, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube

.7 ASTM C920-02 Standard Specification for Elastomeric Joint Sealants.

.8 ASTM E283-04, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

.9 ASTM E330-02, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

.10 ASTM E331-00, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

.11 ASTM E997-11, Standard Test Method for Structural Performance of Glass in Exterior Windows, Curtain Walls, and Doors Under the Influence of Uniform Static Loads by Destructive Methods

.12 ASTM E998-84(1999), Standard Test Method for Structural Performance of Glass in Windows, Curtain Walls, and Doors Under the Influence of Uniform Static Loads by Nondestructive Method

.4 Canadian Standards Association (CSA):

.1 CAN/CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels

.2 CSA W47.1-03, Certification of Companies for fusion Welding of Steel Structures

.3 CSA W47.2-M1987 (R2003), Aluminum Welding Qualification Code.

.4 CSA W59-03, Welded Steel Construction (Metal Arc Welding), Metric

.5 CSA W59.2-1991 (R2003), Welded Aluminum Construction

.5 Canadian Welding Bureau (CWB Group Industry Services):

.1 CWB 112E, 93-1, Welding Symbols Study Guide

.2 CWB 113E, 94-1, Weld Quality and Examination Methods Study Guide

.6 The Society for Protective Coatings (SSPC)/National Association of Corrosion Engineers (NACE International):

.1 Surface Preparation Guidelines:

.1 SSPC-SP COM Surface Preparation Commentary for Steel and Concrete Substrates

.2 SSPC-PS Guide 12.00, Guide to Zinc-Rich Coating Systems

.7 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S702-97, Standard for Mineral Fibre Thermal Insulation for Buildings.

1.5 SITE CONDITIONS

.1 Site Measurements: Where metal-framed skylights are indicated to fit to other construction, verify dimensions of other construction by site measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

.1 Established Dimensions: Where site measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating skylights without site measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.6 WARRANTY

.1 General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

.2 Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of metal-framed skylights that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

.1 Structural failures.

.2 Sealant failures.

.3 Failure of systems to meet performance requirements.

.4 Deterioration of metals, metal finishes, and other materials beyond normal weathering.

.5 Water leakage; defined as uncontrolled water appearing on normally exposed interior surfaces of skylights from sources other than condensation. Water controlled by flashing and gutters and drained back to the exterior and that cannot damage adjacent materials or finishes is not water leakage.

.6 Warranty Period: Five (5) years from date of Substantial Completion.

Part 2 Products

2.1 MANUFACTURERS

.1 Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 Velux

2.2 PERFORMANCE REQUIREMENTS

.1 General: Provide metal-framed skylights capable of withstanding loads and thermal and structural movements indicated without failure. Failure includes the following:

.1 Deflection exceeding specified limits.

.2 Thermal stresses transferred to the building structure.

.3 Framing members transferring stresses, including those caused by thermal and structural movement, to glazing.

.4 Noise or vibration created by thermal and structural movement and wind.

.5 Loosening or weakening of fasteners, attachments, and other components.

.6 Sealant failure.

2.3 FRAMING MATERIALS

.1 Aluminum: Alloy and temper recommended by manufacturer for use and finish indicated, and as follows:

.1 Extrusions: ASTM B 221/B 221M

.2 Sheet and Plate: ASTM B209/B209M

.3 Bars, Rods, and Wire: ASTM B211/B211M

.2 Brackets and Reinforcements: Provide manufacturer's standard high-strength aluminum brackets and reinforcements. Provide non-staining, nonferrous shims to install and align skylights.

.3 Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining non-bleeding flashing; compatible with adjacent materials.

.4 Exposed Flashing and Closures: Aluminum sheet minimum Thickness: 0.059 inch (1.5 mm).

.5 Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories; compatible with adjacent materials.

.1 Movement Joints: Provide slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.

.2 Aluminum-Retaining-Cap Fasteners: ASTM A193/A193M, Series 300 stainless steel screws; type as recommended by manufacturer.

.3 Connections to Supporting Structure: ASTM A307, zinc coated steel fasteners.

.4 Anchor Bolts: ASTM A307, Grade A, zinc coated steel anchor bolts.

.6 Framing-System Gaskets and Joint Fillers: Manufacturer's standard permanent gaskets and joint fillers for sliding, compression, and non-moving joints.

.7 Framing-System Sealants: Compatible with components with which sealants come in contact and recommended by skylight and sealant manufacturers for this use.

.8 Thermal Insulation: Refer to Section 07 25 19.

2.4 GLAZING MATERIALS

.1 Insulating Glass: Refer to Section 08 81 00.

.2 Glazing Gaskets: Manufacturer's standard pressure-glazing gaskets of elastomer type and hardness selected by skylight and gasket manufacturers to comply with requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.

.3 Spacers, Edge Blocks, and Setting Blocks: Manufacturer's standard permanent nonmigrating type of elastomer type and hardness selected to comply with requirements.

.4 For structural silicone glazing, provide bond-breaking spacer gaskets and bonding setting blocks compatible with silicone sealants.

.5 Weatherseal Sealant: Neutral-curing silicone sealant recommended by skylight and sealant manufacturers for this use.

.1 Sealant is capable of withstanding 50 percent movement in both extension and compression (total of 100 percent movement) when tested for adhesion and cohesion under maximum cyclic movement according to ASTM C 719.

.2 Sealant complies with ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and, as applicable to substrates including other sealants with which it comes in contact with.

.3 Colour: Black.

2.5 FABRICATION

.1 Framing Components: As follows:

.1 Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.

.2 Fabricate components to drain water passing joints and to drain condensation and moisture occurring or migrating within skylight system to the exterior.

.3 Fabricate components to accommodate expansion, contraction, and site adjustment, and to provide for minimum clearance and shimming at skylight perimeter.

.4 Fabricate components to ensure that glazing is thermally and physically isolated from framing members.

.5 Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.

.6 Fit and assemble components to greatest extent practicable before finishing.

.7 Fit and secure joints with screw and spline, internal reinforcement, or welding.

.8 Reinforce members as required to retain fastener threads.

.9 Where fasteners are exposed to view from interior, countersink bolt or screw heads and finish to match framing.

.10 Weld components before finishing and in concealed locations to greatest extent practicable to minimize distortion.

.11 Before shipping, shop assemble, mark, and disassemble components that cannot be permanently shop assembled.

.2 Provide continuous aluminum curb with weatherproof expansion joints and locked and sealed or fully welded corners. Locate weep holes in the curb at each rafter connection to drain condensation.

.3 Prepare framing to receive anchor and connection devices and fasteners.

.4 Metal Protection: As follows:

.1 Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

.2 Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

.3 Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by manufacturer.

.5 Factory Glazing: As follows:

.1 Insulating Glass: Comply with requirements in Section 08 81 00.

.2 Plastic Glazing: Comply with requirements in Section 08 81 00.

2.6 ALUMINUM FINISHES

.1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

.2 General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

.3 Clear Anodized Finish:

.1 Class II Finish: Architectural Class II, clear coating 0.00039 inch (0.010 mm) or thicker in accordance with AAMA 611.

Part 3 Execution

3.1 EXAMINATION

.1 Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting skylight performance.

.1 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Furnish anchor bolts and inserts for setting in wood framing or masonry indicated to support skylights.

.2 Metal Protection:

.1 Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

.2 Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by manufacturer.

3.3 INSTALLATION

.1 General: Comply with manufacturer's written instructions for protecting, handling, and installing skylight components.

.1 Fit frame joints to produce hairline joints free of burrs and distortion.

.2 Rigidly secure non-movement joints.

.3 Accommodate thermal and mechanical movements.

.4 Install framing components to drain water passing joints and to drain condensation and moisture occurring or migrating within skylight system to the exterior.

.5 Coordinate installation of insulation and flashings at skylight perimeters to maintain continuity of thermal and water barriers.

.6 Set continuous curbs and flashings in a full sealant bed, unless otherwise indicated. Comply with requirements in Section 07 92 00.

.2 Erection Tolerances: Install skylight components true in plane, accurately aligned, and without warp or rack. Adjust framing to comply with the following tolerances:

.1 Variation from Plane: Limit variation from plane or location shown to 0.118 inch (3 mm) in 118 in. (3.0 m); 0.236 inch (6 mm) over total length.

.2 Alignment: Where surfaces abut in line and at corners and where surfaces are separated by less than 3 in. (76 mm), limit offset from true alignment to less than 0.031 inch (0.80 mm); otherwise, limit offset from true alignment to 0.125 inch (3.2 mm).

3.4 CLEANING

.1 Clean skylights inside and outside, immediately after installation and after sealants have cured, according to manufacturer's written recommendations.

.2 Remove temporary protective coverings and strippable coatings from prefinished metal surfaces. Remove labels and markings from all components.

.3 Remove excess sealant according to sealant manufacturer's written recommendations.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of commercial door hardware for the following:

.1 Swinging doors

.2 Other doors to the extent indicated

.3 Cylinders for doors specified in other Sections

.2 Coordinating, purchasing, delivering, and scheduling of items specified in this Section is the responsibility of this Section.

1.2 RELATED REQUIREMENTS

.1 Section 08 06 10 – Door, Frame and Hardware Schedule: Door and frame characteristics.

.2 Section 08 11 13 – Steel Doors and Frames

.3 Section 08 14 00 – Wood Doors

.4 Section 26 05 28 – Conduits, Outlet Boxes and Fittings for Electrical Systems: Supply and installation of conduit, pull boxes, outlets and wiring for electrical hardware.

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)/Builders Hardware Manufacturers Association (BHMA):

.1 ANSI/ICC A117.1-2009, Standard for Accessible and Usable Buildings and Facilities

.2 ANSI/BHMA A156 Standards Set

.3 ANSI/BHMA A156.10-2005, Power Operated Pedestrian Doors

.4 ANSI/BHMA A156.18-2006, Materials and Finishes

.5 ANSI/BHMA A156.19-2007, Power Assist and Low Energy Power Operated Doors

.2 Builders Hardware Manufacturers Association (BHMA):

.1 Directory of Certified Products

.3 Door and Hardware Institute (DHI):

.1 Sequence and Format for the Hardware Schedule

.2 ANSI/DHI A115.IG Installation Guide for Doors and Hardware

.4 Underwriters Laboratories of Canada (ULC):

.1 UL 437-2000, Key Locks

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Obtain and distribute templates for doors, frames, and other work specified to be factory prepared for installing door hardware and coordinate with shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware in accordance with indicated requirements

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit product data indicating installation details, material descriptions, dimensions of individual components and profiles, and finishes.

.3 Informational Submittals: Provide the following submittals when requested by the Consultant:

.1 Source Quality Control Submittals: Submit proof of participation in DHI Continuing Education Program, and apply AHC stamp to completed door hardware schedule.

1.6 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Operations and Maintenance Data.

.1 Spare Parts and Tools: Submit unique parts and tools for maintaining hardware system in accordance with Section 01 00 06 – General Requirements: Spare Parts.

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements:

.1 Building Code Compliance: Conform to ULC and Building Code requirements, as applicable to hardware, for labelled or rated doors and frames, and for exiting, operation and function.

.2 Manufacturing Compliance: Use only products listed in the BHMA Directory of Certified Products for hardware of this Project.

.2 Performance Requirements: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated, and generally comply with the following provisions:

.1 Accessibility requirements in accordance with ANSI 117.1.

.2 Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.

.3 Latches, Locks, and Exit Devices: Nominal 65 N to release the latch, and shall not require the use of a key, tool, or special knowledge for operation.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver hardware items in original factory containers, clearly labeling contents and scheduled use for this project and as follows:

.1 Inventory door hardware on receipt and provide secure lock up for door hardware delivered to Project site.

.2 Store hardware in a clean, well illuminated (500 lux minimum) securely locked storage room accessible only to authorized personnel.

.2 Storage and Handling Requirements: Store hardware items on shelves; not on floors, separated and packaged as a group for each individual door with the door number, and list of items for that door on each package related to the door hardware schedule, and include basic installation instructions with each item or package and as follows:

.1 Maintain an itemized inventory list of each item, updated on a daily basis, to show items in storage and items installed.

1.9 WARRANTY

.1 Provide written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

.2 Failures include, but are not limited to, the following:

.1 Structural failures including excessive deflection, cracking, or breakage.

.2 Faulty operation of operators and door hardware.

.3 Deterioration of metals, metal finishes, and other materials beyond normal weathering.

Part 2 Products

2.1 SCHEDULED DOOR HARDWARE

.1 Provide door hardware for each door in accordance with requirements in this Section, door hardware sets indicated in door, frame and hardware schedule on Drawings and the Hardware Schedule appended to the end of this Section.

.2 Alternates to the hardware listed in the Door Hardware Schedule will not be accepted for this project.

2.2 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 Hinges:

.1 Innotech Windows + Doors

.2 Hager Companies (HAG)

.3 McKinney Products Company (MCK)

.4 Mont-Hard Corporation (MH)

.2 Top Tracks:
- .1 Kristrack KT25KIT

.3 Mechanical Locks and Latches:
- .1 Innotech Windows + Doors
- .2 Best Lock Corporation (BLC)
- .3 Sargent Manufacturing Company (SGT)
- .4 Schlage Lock Company (SCH)

.4 Cylinders:
- .1 Innotech Windows + Doors
- .2 Best Lock Corporation (BLC)
- .3 Sargent Manufacturing Company (SGT)
- .4 Schlage Lock Company (SCH)

2.3 KEYING

.1 Permanent Cores: Manufacturer's standard; finish face to match lockset; in accordance with the following:

- .1 Removable Cores: Core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.

.2 Construction Keying:

- .1 Construction Master Keys: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.
- .2 Replace construction cores with permanent cores, as directed by The Team Project Manager, team member assigned to such duties.

.3 Keying System:

- .1 Keyed Alike: Key all cylinders to the same change key; cylinders

Part 3 Execution

3.1 EXAMINATION

.1 Examine doors and frames, with installer present, for compliance with requirements for installation tolerances, labelled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

.2 Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Steel Doors and Frames: Comply with DHI A115 series.

.2 Wood Doors: Comply with DHI A115-W series.

3.3 INSTALLATION

.1 Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required in accordance with governing regulations:

- .1 Standard Steel Doors and Frames: DHI's Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames.
- .2 Custom Steel Doors and Frames: DHI's Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames.
- .3 Wood Doors: DHI WDHS.3, Recommended Locations for Architectural Hardware for Wood Flush Doors.

.2 Install each door hardware item in accordance with manufacturer's written instructions.

.3 Coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way.

.4 Do not install surface mounted items until finishes have been completed on substrates involved, and as follows:

- .1 Set units level, plumb, and true to line and location.
- .2 Adjust and reinforce attachment substrates as necessary for proper installation and operation.
- .3 Drill and countersink units that are not factory prepared for anchorage fasteners.
- .4 Space fasteners and anchors according to industry standards.

3.4 ADJUSTING

.1 Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended.

3.5 CLEANING AND PROTECTION

.1 Clean adjacent surfaces soiled by door hardware installation.

.2 Clean operating items as necessary to restore proper function and finish.

.3 Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DOOR HARDWARE SCHEDULE

.1 Hardware groups as indicated on Drawings, coordinate with Section 08 06 10, and other sections affected by hardware groupings.

END OF SECTION

SECTION 08 81 00

GLASS GLAZING

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 06 40 00 – Shop Fabricated Architectural Woodwork

.2 Section 07 92 00 – Joint Sealants

.3 Section 08 53 00 – Plastic Windows and Doors

.4 Section 08 63 00 – Metal-Framed Skylights

.5 Section 08 87 00 – Glazing Surface Film

1.2 REFERENCE STANDARDS

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

.1 ASHRAE 90.1-2001, Energy Standard for Buildings Except Low-Rise Residential Buildings

.2 American Society for Testing and Materials (ASTM):

.1 ASTM C1036-01, Standard Specification for Flat Glass

.2 ASTM C1048-04, Standard Specification for Heat-Treated Flat Glass, Kind HS, Kind FT Coated and Uncoated Glass

.3 ASTM C1172-09, Standard Specification for Laminated Architectural Flat Glass

.4 ASTM C1349-04, Standard Specification for Architectural Flat Glass Clad Polycarbonate

.5 ASTM C1503-01, Standard Specification for Silvered Flat Glass Mirror

.6 ASTM D1003-00, Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics

.7 ASTM E330-02, Structural Performance for Exterior Windows, Curtain Wall and Doors by Uniform Static Air Pressure Difference

.8 ASTM E1300-07e1, Standard Practice for Determining Load Resistance of Glass in Buildings

.9 ASTM F1233-08, Standard Test Method for Security Glazing Materials and Systems

.3 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 12.1 M90, Tempered or Laminated Safety Glass

.2 CAN/CGSB-12.3-M91, Flat, Clear Float Glass

.3 CAN/CGSB 12.8-97, Insulating Glass Units

.4 CAN/CGSB-12.10-M76, Glass, Light and Heat Reflecting

.5 CAN/CGSB-12.11-M90, Wired Safety Glass

.6 CAN/CGSB 19.2 M87, Glazing Compound, Non hardening, Modified Oil Type

.7 CAN/CGSB 12.20-M89, Structural Design of Glass for Buildings

.4 Consumer Products Safety Commission (CPSC):

.1 16 CFR 1201, Safety Standard for Architectural Glazing Materials

.5 Glass Association of North America (GANA):

.1 GANA Glazing Manual

.6 International Standards Organization (ISO):

.1 EN14179-1:2005, Glass in Building. Heat Soaked Thermally Toughened Soda Lime Silicate Safety Glass, Definition and Description.

1.3 ADMINISTRATION REQUIREMENTS

.1 Coordination: Coordinate work of this Section with the installation of frames to ensure a continuous, uninterrupted sequence, and to prevent the undue exposure of unprotected frames to weather, and as follows:

.1 Do not install any glazing until all nearby welding is completed.

.2 Mark each light of glass as it is installed in a manner to make it visible and obvious to all persons.

.3 Do not use materials that may permanently mar, discolour or disfigure the glass.

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's technical data for each glazing material required, including installation and maintenance, and listing following properties for single and multiple glazings with comparison to specified materials:

.1 Summer and Winter U-Factors (U-Value)

.2 Visible Light Transmittance (Tvis)

.3 Specific Heat Gain Coefficient (SHGC)

.4 Shading Coefficient (SC)

.3 Informational Submittals: Provide the following submittals during the course of the work of this Section:

.1 Certificates: Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to Authority Having Jurisdiction

.2 Source Quality Control Submittals: Submit product test listings from a qualified testing agency indicating fire rated glass complies with requirements, based on comprehensive testing of current product.

1.5 PROJECT CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: Submit maintenance brochures on the care and cleaning of Glass Glazing materials in accordance with Section 01 00 06 – General Requirements: Operations and Maintenance Data.

1.6 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Installer: Use installers having experience with projects of similar scope and complexity, and approved for installing products by glass manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver packaged materials in their original containers with manufacturer's labels and seals intact.

.2 Storage and Handling Requirements: Store vertically, blocked off the floor in a weatherproof enclosure in original containers with manufacturers labels and seals intact until read for installation, and as follows:

.1 Install glass as soon as possible after delivery to site.

.2 Handle glass carefully to its place of installation.

.3 Prevent damage to glass, adjacent materials and surfaces.

1.8 WARRANTY

.1 Provide manufacturer’s warranty for the following types of glass listed, against defects in materials and workmanship for the period indicated, commencing from the date of Substantial Performance of Work:

.1 Seal Failure: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions.

.2 Evidence of Failure: Obstruction of vision by dust, moisture, or film on interior surfaces of glass.

.3 Allowable Specific Exclusions: Breakage resulting from thermal stress will be accepted as a limitation to the warranty in accordance with CAN/CGSB 12.20

Part 2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design products are named in this Section; additional manufacturers offering similar setting systems may be incorporated into the work provided they meet the performance requirements established by the named products.

.2 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 Vision Glass:

.1 INNOTECH Windows + Doors

.2 AGC Flat Glass North America (formerly AFG or AFGD)

.3 AHC Glass (formerly Visteon)

.4 Pilkington Glass of Canada

.5 Prelco Inc.

.6 PPG Industries

.7 Schott Glass AG

.8 Viracon Inc.

2.2 PERFORMANCE REQUIREMENTS

.1 Building Envelope Performance: Provide continuity of building enclosure Vapor and air barrier using Glass Glazing materials utilizing inner light of multiple lite insulated units for continuity of air and Vapor seal.

2.3 GLASS MATERIALS

.1 Float Glass: In accordance with CAN/CGSB-12.3, glazing quality and as follows:

.1 Clear Glass: no tint

.2 Clear Safety Glass: Manufactured in accordance with CAN/CGSB-12.1 and ASTM C1048 and as follows:

.1 Type: 2 – Tempered

.2 Class: B - Float Glass

.3 Low Emissivity (Low E) Glass: In accordance with CAN/CGSB-12.10 and as having the following nominal properties:

.1 Glass Quality: Float glass, glazing quality, heat strengthened or tempered as required to prevent glass breakage arising from thermal shock.

.2 Clear glass, having the following similar nominal monolithic properties:

.1	USI Factor	1.65
.2	Shading Coefficient (SC):	0.34
.3	Solar Heat Gain Coefficient (SHGC):	0.30
.4	Visible Light Transmission (Tvis):	71.0%
.5	Light to Solar Heat Gain (LSG):	2.38

.3 Basis-of-Design Materials: E366 and E180 Low E Solar Control Coating on Clear Glass as provided by Innotech Windows and doors.

2.4 INSULATING GLASS

.1 Insulating Glass Units: Provide sealed insulating glass units in accordance with CAN/CGSB-12.8 in configurations indicated, and as specified herein.

.1 Manufacture sealed insulating glass units without edge channels or tape, that is, with bare glass edges.

.2 Use two stage seal method of manufacture, as follows:

.1 Primary Seal: polyisobutylene sealing compound between glass and metal spacer/separator.

.2 Secondary Seal: polyurethane, silicone or polysulphide base sealant, filling gap between the two lites of glass at the edge up to the spacer/separator and primary seal.

.3 Install stainless steel capillary breather tubes to equalize pressure differentials between insulating glass fabricating location and insulating glass installation location when required by manufacturer; seal tube immediately prior to installation in accordance with glass fabricator's written instructions.

.4 Spacer/Separator: Glass Fabricator's standard stainless steel; coloured natural, spacer containing desiccant, sealed to provide continuous Vapor barrier between interior of sealed unit and secondary seal.

.3 Sealants for Insulating Glass Units:

.1 Primary Seal: Polyisobutylene; colour as selected by the Team Project Manager or, Team Member assigned to such duties.

.2 Secondary Seal: Structural silicone based Type S-4 as specified in Section 07 92 00

.3 Weathering Seal: Silicone based Type S-3 as specified in Section 07 92 00; custom colour selected by Team Project Manager or, Team Member assigned to such duties

.2 Insulating Glass Units:

.1 Unit Composition:

.1 Exterior Lite: Clear heat strengthened or tempered glass, having high performance Low E coating on #2 surface.

.2 Air Space: 0.50 inch (12.7 mm) Air, Argon or Krypton Filled

.3 Mid Lite: Clear heat Strengthened float glass

.4 Air Space: 0.50 inch (12.7 mm) Air, Argon or Krypton Filled

.5 Interior Lite: Clear heat strengthened or tempered glass having high performance Low E coating on #2 and #5 surface.

.2 Unit Properties:

.1	U Value SI:	0.71
.2	U Value IP:	0.13
.3	R Value	8.0
.4	Solar Heat Gain Coefficient (SHGC):	0.24
.5	Visible Light Transmission (Tvis):	56%

.3 Basis-of-Design: solar control coating on position # 2 and #5 on clear glass, argon filled air space and clear glass interior lite.

.4 Substitute materials shall verify performance with the Team Project Manager or Team member assigned to such duties prior to submitting product data and other required submittals.

2.5 FABRICATION

.1 Cut all glass to field measurement with proper clearances. Cut to produce clean, straight edges with no chips, cracks or flaws.

.2 Make any cut outs, openings to approved drawings. Grind exposed edges smooth round off corners.

2.6 FABRICATION - INSULATING GLASS

.1 Shop fabricate insulating glass units in accordance with CAN/CGSB.12.8 and IGMAC certification as a minimum.

.2 Sealed units shall have a minimum of 0.50 inch (12.7 mm) air space giving a total overall thickness of not less than 1 inch (25 mm). Edge spacer shall not bow in or out more than 0.196 inch (5 mm) over full length of a side.

.3 Sealed units shall be assembled and air space sealed in a clean, dry environment, in a location with the same barometric air pressure as the job site.

.4 Sealed units shall be assembled and air space sealed in a clean, dry environment, to suit local barometric air pressure conditions to prevent distortion of sealed units.

.5 Unit types, make-up and colour shade as listed at end of this Section.

Part 3 Execution

3.1 EXAMINATION

.1 Verify that openings for glazing are correctly sized and within tolerance.

.2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2 PREPARATION

.1 Ensure all glazing rebates smooth and true, free of projections nails, screws, fastenings properly set to prevent contact with glass.

.2 Ensure all stops, splines, glazing accessories provided by others accurately cut to length and proper size and type for specific glazing.

.3 Clean contact surfaces with solvent and wipe dry.

.4 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.5 Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION - GENERAL

.1 Install in accordance with the manufacturer's written instructions and the contract documents, plumb, true, level and rigid.

.2 Do not glaze when ambient or surface temperatures are less than 4°C. Glazing rebates, stops and glass shall be dry, free from ice, frost slick, grease, oil, dust, rust, or other matter detrimental to adhesion of tape, glazing compounds and sealant.

.3 Installation of glass shall be by workmen skilled in this trade in strict accordance with manufacturer's directions, to produce a first class installation.

.4 Glass shall be free from contact with the frames and stops.

.5 Use sealant at exterior doors, sealing water and weather tight.

3.4 INSTALLATION - MIRRORS

.1 Align mirrors (in multiple application) to a parallel and true plane surface to produce a true reflection across all sections.

.2 Place plumb and level.

3.5 SEALED UNITS

.1 Install sealed units in accordance with fabricator’s written instructions, taking care not to warp or twist glass to prevent stress or breaking of glass seals.

.2 Crimp capillary breather tube in accordance with fabricator's written instructions, and as follows:

.1 Do not trim sealant from around base of tube.

.2 Do not pull or attempt to remove the tube.

.3 Crimp tube immediately prior to installing sealed unit by placing pliers perpendicular to tube 1 inch (25 mm) from end of tube.

.4 Do not permit tube to be exposed to or sit in water.

.5 Cover tube with stainless steel strip and set in sealant bead compatible with insulated glass sealants.

3.6 GLASS SCHEDULE

.1 Skylights:

.1 Aluminum skylight: – Insulating glass units, 0.236 inch (6 mm) tinted tempered safety exterior light; 0.236 inch (6 mm) clear laminated float interior light.

.2 Wood Doors:

.1 Insulating glass unit, tempered safety glazing: – 0.236 inch (6 mm) tinted exterior light; 6 mm clear interior light.

.3 Exterior Windows:

.1 Insulating glass units, 0.236 inch (6 mm)

.4 Washroom Mirrors:

.1 Single 0.196 inch (5 mm) non-tinted float glass mirror.

.5 Other glass types as indicated on drawings.

END OF SECTION

SECTION 08 87 00

GLAZING SURFACE FILMS

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of glazing films for Solar Control.

1.2 RELATED REQUIREMENTS

.1 Section 08 81 00 – Glass Glazing

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM D1004-09, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting

.2 ASTM D3330/D3330M-04 (2010), Standard Test Method for Peel Adhesion of Pressure-Sensitive Tape

.2 American National Standards Institute (ANSI):

.1 ANSI Z97.1-20094 Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate the Work of this Section with the installation of glazing; sequence work so that installation of glazing films coincides with installation of glass materials without causing delay to the Work.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

1.6 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit manufacturer's written instructions for cleaning solutions, materials and procedures, include name of original installer and contact information in accordance with Section 01 00 06 – General Requirements: Operation and Maintenance Manuals.

1.7 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Installer: Use installers having experience with projects of similar extent and complexity and that have experience laminating film to glass on site for a minimum of five (5) years.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver and store packaged materials in their original containers with manufacturer's labels and seals intact; store as recommended by manufacturer in a weatherproof enclosure.

1.9 SITE CONDITIONS

.1 Ambient Conditions: Proceed with film installation when ambient and substrate temperature conditions are within limits permitted by manufacturer and when glass substrates are free from wetness arising from frost, condensation, or other causes detrimental to adhesion.

Part 2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section [provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements: Substitutions.

.2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include the following:

.1 Avery Dennison Graphics
.2 Baekart Films
.3 Llumar Window Film
.4 3M Window Film Solutions
.5 Cardinal Glass Industries

2.2 GLAZING FILMS

.1 Solar Control Films: Polyester film 1 mil (0.025 mm) thickness, using pressure sensitive acrylic adhesive specifically designed for window film, resistant to distortion due to changing temperatures and able to withstand weathering, sunlight and UV ns as follows:

.1 Colors: As selected by the Project Team Manager or Team Member assigned to such duties
.2 Emissivity: 0.25 to 0.87
.3 U value: 0.236 inch (6 mm) clear glass thickness: 0.74 to 1.09
.4 UV Blocked: 98 to 99%
.5 Total Solar Energy Rejected: 34 to 77%
.6 Acceptable materials:

.1 3M Scotchtint Sun Control Window Films

Part 3 Execution

3.1 EXAMINATION

.1 Examine glass and surrounding adjacent surfaces for conditions affecting installation; proceed with installation after verification and correction of surface conditions acceptable to manufacturer.

3.2 PREPARATION

.1 Prepare glazing films using computer generated CNC cutting methods to eliminate any cutting of films directly on glass at project site.

.2 Clean glass surfaces of substances that could impair glazing film bond including mould, mildew, oil, grease, dirt and other foreign materials immediately before beginning installation of films.

.3 Protect window frames and surrounding conditions from damage during installation.

3.3 INSTALLATION

.1 Install in accordance with the manufacturer's written instructions and the contract documents, plumb, true, and level over clean glazing.

.2 Install film continuously, but not necessarily in one continuous length, with no gaps or overlaps and as follows:

.1 Install seams vertical and plumb where necessary; horizontal seams will not be allowed.

.2 Do not remove release liner from film until just before each piece of film is cut and ready for installation.

.3 Install film with mounting solution and custom cut to the glass with neat, square comers and edges to within 0.118 inch (3 mm) of window frame.

.4 Remove air bubbles, wrinkles, blisters, and other defects.

.3 Installation Tolerances: Consultant will view film installation from a distance of 3 metres against a bright uniform sky or background and will accept installation where it appears uniform in appearance with no visible streaks, banding, thin spots or pinholes; remove and replace with new film when directed by the Consultant for materials not meeting requirements.

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of the following:

.1 Interior gypsum board for walls, ceilings and bulkheads

.2 Exterior gypsum sheathing

.3 Tile backing panels.

1.2 RELATED REQUIREMENTS

.1 Section 06 10 00 – Rough Carpentry: Wood blocking and furring

.2 Section 06 20 00 – Finish Carpentry: Finishing seams of profiled panelling using gypsum based joint compounds; panels installed by Section 06 20 00, finishing of joints performed by this Section.

.3 Section 07 25 13 – Air and Vapor Membranes

.4 Section 07 53 00 – Elastomeric Membrane Roofing: Treated core gypsum board sheathing for steel deck leveling surface for roofing.

.5 Section 07 84 00 – Firestopping: Meeting requirements for top of wall preformed foam steel deck inserts and fire rating materials.

.6 Section 07 92 00 – Joint Sealants

.7 Section 08 11 13 – Steel Doors and Frames: Installation of steel door frames in gypsum board systems.

.8 Section 09 30 00 – Tiling: Substrates for tile.

.9 Section 09 91 05 – Painting

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A153/A153M-05, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

.2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

.3 ASTM A510-07, Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

.4 ASTM A641/A641M-03, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

.5 ASTM A653/A653M-07, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.6 ASTM B221-12 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

.7 ASTM C11-08, Standard Terminology Relating to Gypsum and Related Building Materials and Systems

.8 ASTM C423-07a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

.9 ASTM C475/C475M-02 (2007), Joint Compound and Joint Tape for Finishing Gypsum Board

.10 ASTM C645-08, Standard Specification for Nonstructural Steel Framing Members

.11 ASTM C754-07, Standard Specification for Installation of Steel Framing Members to Receive Screw Attached Gypsum Panel Products

.12 ASTM C834-05, Standard Specification for Latex Sealants

.13 ASTM C840-11, Standard Specification for Application and Finishing of Gypsum Board

.14 ASTM C919-02, Standard Practice for Use of Sealants in Acoustical Applications

.15 ASTM C954-07, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.75 mm) to 0.112 in. (2.84 mm) in Thickness

.16 ASTM C1002-07, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

.17 ASTM C1047-05, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base

.18 ASTM C1177/C1177M-06, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing

.19 ASTM C1178/C1178M-06, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel

.20 ASTM C1280-07, Standard Specification for Application of Gypsum Sheathing

.21 ASTM C1325-04, Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Interior Substrate Sheets

.22 ASTM C1396M-06a, Standard Specification for Gypsum Board

.23 ASTM C1658/C1658M-12, Standard Specification for Glass Mat Gypsum Panels

.24 ASTM D3273-12 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

.25 ASTM D5420-04 Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)

.26 ASTM E84-07b, Standard Test Method for Surface Burning Characteristics of Building Materials

.27 ASTM E90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

.28 ASTM E136-04, Standard Test Method for Behaviour of Materials in a Vertical Tube Furnace at 750°C

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.181-99, Ready-Mixed organic Zinc-Rich Coating

.2 CAN/CGSB-19.21-M87, Sealing and Bedding Compound for Acoustic Purposes (withdrawn)

.3 Canadian Sheet Steel Building Institute (CSSBI):

.1 CSSBI 57-02, Lightweight Steel Framing Architectural Design Guide

.4 Northwest Wall and Ceiling Bureau (NWCB):

.1 Specification Standards Manual

.5 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S101-07, Fire Endurance Tests of Building Construction and Materials

.2 CAN/ULC S102-07, Surface Burning Characteristics of Building Materials and Assemblies

.3 CAN/ULC S114-05, Test for Determination of Non-Combustibility in Building Materials

.4 CAN/ULC S702-97, Mineral Fibre Thermal Building Insulation

.5 Underwriters' Laboratories of Canada (ULC), List of Equipment and Materials

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate seam finishing of profiled panelling materials specified in Section 06 20 00; panels are installed by Section 06 20 00, finishing of joints performed by this Section.

.2 Coordination: Coordinate sealing of joints between base and perimeter of walls penetrating access flooring specified in Section 09 69 00 – Access Flooring; plenum space created by the installation of the access flooring system will be used for delivery of conditioned air to occupied spaces within the building; install work of this section to maintain cleanliness and to prevent air leaks that have the potential to affect performance of the access floor system

1.5 DEFINITIONS

.1 Levels of Finish: Standard levels of finish defined by NWCB Manual apply to products of this Section as follows:

.1 Level 0: No tape or joint compound in joints.

.2 Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, unless a higher level of finish is required for fire resistance rated assemblies and sound rated assemblies.

.3 Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile.

.4 Level 3: Embed tape and apply separate first and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will receive heavy gauge wall coverings Wall Coverings as final decoration.

.5 Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view.

.6 Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat over entire surface for corridors, long hallways, walls and ceilings longer than 295.27 inch (7500 mm) or walls higher than 141.73 inch (3600 mm) , and for all curved or angled wall surfaces.

.2 Refer to ASTM C11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.6 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide following submittals before starting any work of this Section:

.1 Product Data: Submit product data for each type of product indicated.

.2 Samples: Submit samples for trim accessories, full-size sample 12 inch (305 mm) long for each trim accessory indicated.

.3 Informational Submittals: Provide following submittals during the course of the Work:

.1 Fire Ratings: Submit ULC Assembly Listings and Materials cut sheets for fire rated assemblies as follows:

.1 Not later than 30 working days following Award of Contract, submit copies of ULC Assembly and Materials Listing for indicating ULC Number and how assembly meets the rating criteria for assemblies listed on drawings or meets requirements of Appendix D of Alberta Building Code for review by the Consultant.

.2 Use the same system and material as would be required for a tested assembly for the project; ULC Listings are tested with the specific materials indicated; substitutions will not be permitted unless evidence of equivalency is confirmed.

.3 Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site; include manufacturer's printed instructions for installation.

.2 Acoustic Ratings: Submit STC listings for assemblies based on manufacturer's testing and actual materials used for project; sound ratings of proposed assemblies are required to meet or exceed the acoustical performance listed on Drawings.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

.2 Storage and Handling Requirements: Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes; Stack gypsum panels flat and on sufficient spacers to prevent sagging, not in direct contact with floor surfaces.

1.8 SITE CONDITIONS

.1 Ambient Conditions: Store and install materials specified in this Section in accordance with requirements of NWCB Manual.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 CertainTeed

.2 CGC Inc.

.3 Georgia-Pacific Canada, Inc.

.2 Additional Manufacturers: Additional manufacturers are listed for accessory items and are incorporated into the Work subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials.

.3 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products and provided they submit requests for substitution.

.4 Acceptable Alternative Manufacturer: Subject to compliance with requirements specified in this Section, Serious Energy QuietRock is an acceptable alternative for acoustically rated wall systems and can be used to reduce multiple layers of standard gypsum board required to achieve required partition type STC ratings.

2.2 PERFORMANCE REQUIREMENTS

.1 Fire Test Response Characteristics: Refer to Section 07 05 80; use materials identical to those listed for ULC assemblies submitted to Consultant.

.2 Sound Transmission Characteristics: Provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by a qualified independent testing agency for STC ratings of specific assemblies indicated on Drawings.

2.3 MATERIALS

.1 Wood Framing materials as Specified in Section 06 10 00 – Rough Carpentry and Section 06 15 33.13 – Cedar Wood Carpentry.

.2 Insulation and air Vapor barriers as specified in the following Sections:

.1 Section 07 21 16 - Blanket Insulation

.2 Section 07 25 13 - Air and Vapor Membranes

.3 Section 07 25 19 - Foamed-In-Place Air and Vapor Barriers

.4 Section 07 27 16 - Air Barrier Sheets

.3 Interior Gypsum Panels: Provide in maximum lengths and widths available that minimize joints in each area and correspond with support system as indicated on drawings, in thicknesses as indicated and as follows:

.1 Regular Type Gypsum Board: Meeting requirements of ASTM C1396M with long edges tapered, and as follows:

.1 Location: Vertical surfaces, unless otherwise indicated.

.2 Acceptable Materials:

.1 CertainTeed, ProRoc Wallboard

.2 CGC Inc., Fiberock Aqua-Tough

.3 Georgia-Pacific Canada, Inc., Toughrock Gypsum Wallboard

.2 Fire Resistant Type (Type X) Gypsum Board: Meeting requirements of ASTM C1396M with long edges tapered, and as follows:

.1 Location: Where required for fire resistance rated assembly.

.2 Acceptable Materials:

.1 CGC Inc., Fiberock Aqua-Tough Firecode.

.2 Georgia Pacific Canada, Inc., Toughrock Fireguard

.3 CertainTeed Inc., ProRoc Type X

.3 Acoustically Rated Gypsum Board: Meeting requirements of ASTM C1396M with long edges tapered, and as follows:

.1 Thickness: As required to meet STC and fire resistance ratings

.2 Location: Acoustic wall assemblies having double layer gypsum board indicated as a requirement for STC rating.

.3 Assembly: Use materials that provide acoustic performance equal to or better than wall assemblies listed on Drawings.

.4 Basis-of-Design Materials: Serious Energy, QuietRock ES

.4 Water Resistant Gypsum Board: Meeting requirements of ASTM C1396M; [ype X ULC fire rating; water repellent face paper; with long edges tapered, and as follows:

.1 Location: Walls in washroom and housekeeping areas

.2 Acceptable Materials:

.1 CertainTeed ProRoc Moisture Resistant M2 Type X

.2 CGC Sheetrock Humitek Firecode C Core

.3 Georgia Pacific Tough Rock Fireguard Moisture-Guard

.5 Cementitious Backer Board: As specified in Section 09 30 00 and as follows:

.1 Reinforced portland cement board, reinforcing mesh embedded near both faces in accordance with ASTM C1325 or ANSI A118.9, and as follows:

.1 Location: Substrate for tile

.2 Acceptable Materials:

.1 CertainTeed, PanaRoc

.2 CGC Inc., Durock

.3 Custom Building Products Ltd., Wonderboard

.6 Glass Mat Water Resistant Gypsum Backer Board: Manufactured in accordance with ASTM C1178 and C1658/C1658M to produce greater resistance to water penetration and to provide improved surface bonding characteristics for ceramic tile than standard gypsum board:

.1 Location: Substrate for tile.

.2 Basis-of-Design Materials: Georgia Pacific Canada, Inc., GlasRoc Tile Backer

.4 Exterior Sheathing: Provide gypsum sheathing panels in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated, and as follows:

.1 Gypsum Roof Sheathing Board: As specified in Section 07 53 00

.1 Acceptable Materials:

.1 CertainTeed GlasRoc Sheathing Type X

.2 CGC Securock Glass-Mat Sheathing Firecode Core

.3 Georgia Pacific DensDeck DuraGuard Type X

.5 Joint Treatment Materials: Provide joint compound and accessory materials in accordance with ASTM C475 and as follows:

.1 Joint Tape:

.1 Interior Gypsum Board: Paper.

.2 Interior Mould Resistant Gypsum Board: Fibreglass mesh tape.

.3 Tile Backing Panels: As recommended by panel manufacturer.

.2 Joint Compound for Interior Gypsum Board: Vinyl based, non-asbestos, low dusting type compatible with other compounds applied on previous or for successive coats, and as follows:

.1 Pre-Filling: Setting type taping compound.

.2 Embedding and First Coat: Drying type compound.

.3 Fill Coat: Drying type compound.

.4 Finish Coat: Drying type, sandable topping compound.

.5 Skim Coat: Drying type, sandable topping compound.

.6 Acceptable Materials:

.1 CertainTeed Dust Away

.2 CGC Dust Control

.6 Joint Compound for Tile Backing Panels:

.1 Gypsum Based Tile Backing Board: Use setting type taping and setting type, sandable topping compounds.

.7 Joint Compound for Interior Mould Resistant Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

.1 Pre-Filling: Setting type joint compound.

.2 Embedding and First Coat: Setting type joint compound.

.3 Fill Coat: Setting type, sandable topping compound.

.4 kim Coat: Setting type joint compound, sandable topping compound.

2.4 ACCESSORIES

.1 Trim Accessories:

.1 Interior Trim: Galvanized coated steel sheet or rolled zinc meeting the requirements of ASTM C1047, in the following shapes:

.1 CB Corner Bead: Standard 0.015 inch (0.040 mm) thickness, corrosion resistant outside corner reinforcements, angle to suit installation.

.2 Reinforced Corner Bead: Heavy duty 0.0181 inch (0.46 mm) thickness, corrosion resistant outside corner reinforcements for use at high exposure corners, angle to suit installation.

.3 LC Edge Bead: U-shaped trim 0.40 thickness to provide a clean finished edge; exposed long flange receives joint compound; use at exposed panel edges, and returns to adjacent materials.

.4 Expansion Joints: Back-to-back edge beads at joints spanning building expansion and movement joints.

.5 Control Joints: V-shaped trim having strippable joint protection specifically manufactured to provide thermal stress relief to large ceiling and wall areas; confirm locations with Consultant before installation.

.6 Strippable Edge Trim: Extruded PVC with pre-masked L-shaped tape on trim with tear away protective serrated strip for removal after compound and paint is applied, for use at areas where gypsum butts aluminum frames and where gypsum butts concrete or concrete block.

.7 Acceptable Materials:

.1 Dietrich Industries, Metal Trims and Finishing Products

.2 Other materials may be acceptable provided information is sent to and accepted by the Consultant before installing products required by this Section.

.2 Acoustic Materials: Coordinate placement of acoustic materials with wall assembly types; use only fire rated materials in fire and smoke rated assemblies; apply acoustic sealants prior application of fire and smoke seals specified in Section 07 84 00 and as follows:

.1 Acoustic Sealant for Exposed Joints: Non-sag, paintable, non-staining, latex sealant in accordance with ASTM C834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction:

.1 Basis-of-Design Materials: Pecora Corp., AC-20 FTR Acoustic and Insulation Sealant.

.2 Acoustic Sealant for Concealed Joints: Non-drying, non-hardening, non-skinning, non-staining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission:

.1 Acceptable Materials:

.1 Pecora Corp., BA-98.

.2 Tremco, Acoustical Sealant

.3 Acoustic Insulation for Fire Rated Assemblies: Meeting the requirements of ULC S702 mineral fibre acoustic sound batts, Type 1 for all properties except thermal performance, width to friction fit steel studs; un-faced, thickness minimum 3.5 inch (89 mm) to fill a minimum of 90% of the cavity thickness, nominal density 40 kg/m^3 minimum; STC ratings as indicated on drawings; having maximum flame spread and smoke developed of 20/20 in accordance with CAN/ULC S102 and being non-combustible in accordance with CAN/ULC S114:

.1 Acceptable Materials:

.1 Roxul Inc., Roxul AFB Acoustical Fire Batt

.4 Acoustic Insulation for Non-Rated Assemblies: Meeting the requirements of ASTM C423, ASTM E90 and ASTM E413, and ULC S702 mineral fibre acoustic sound batts, Type 1 for all properties other than thermal, width to friction fit steel studs; un-faced, thickness as required to fill a minimum of 90% of the cavity thickness, nominal density 12.2 kg/m^3 minimum; STC ratings as indicated on drawings:

.1 Acceptable Materials:

.1 Owens-Corning Canada Inc., Quietzone Acoustical Batts

.2 Johns-Manville Sound Shield Glass Fibre Batts

.5 Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

.6 Steel Drill Screws: ASTM C1002, unless otherwise indicated, except use screws in accordance with ASTM C954 for fastening panels to steel members from 0.033 inch (0.84 mm) to 0.105 inch (2.67 mm) thickness, and as follows:

.1 Type S: Shallow pitch screw; used for single layer gypsum board application

.2 Type G: Steep pitch screw; used for double layer gypsum board application

.7 Isolation Strip at Exterior Walls: Adhesive backed, closed cell vinyl foam strips that allow fastener penetration without foam displacement, 0.118 inch (3 mm) thick, in width to suit steel stud size.

.8 Access Panels: Refer to Section 08 31 00, rated to suit wall or ceiling fire rating.

.9 Building Paper: Wall sheathing paper conforming to CAN/CGSB-51.32.

Part 3 Execution

3.1 EXAMINATION

.1 Examine areas and substrates, with Installer present, and including welded hollow metal frames, cast in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Fire Rated Construction:

.1 Install materials forming a part of fire rated construction in accordance with manufacturer's instructions and as required to meet specific ULC listed construction requirements submitted by Subcontractor.

.2 Install fire rated gypsum wall panels vertically; horizontal installation does not meet testing standard unless horizontal blocking is installed behind horizontal joints.

.2 Membrane Air and Vapor Retarders:

.1 Coordinate with self adhered air and Vapor retarder manufacturer and verify compatibility with membrane and primers with selected exterior gypsum based sheathing.

.2 Install specified materials in accordance with material manufacturer's written instructions.

.3 Cold Weather Application of Gypsum Board:

.1 Install gypsum board and joint compound in accordance with NWCB requirements and manufacturer's instructions.

.2 Provide temporary heat and moisture control for a period sufficiently in advance of gypsum board and joint compound application to allow building and substrates to acclimate to installation temperature and moisture range required by manufacturer.

.3 Maintain temporary heat until permanent building heating system is started and continuously running.

.4 Provide suitable ventilation to allow materials to dry properly; prevent excessive air movement that could dry materials too quickly and that could cause shrinkage cracking.

3.3 INSTALLING WOOD FRAMING

.1 Installation Standards: Install Wood Frame Construction in accordance with the requirements of Section 06 10 00 – Rough Carpentry.

3.4 ACCESS PANELS

.1 Install access panels in wall assemblies to maintain fire rating of assembly.

.2 Confirm location of access panels with the Team project Manager, Team member or Team Crew member assigned to such duties, prior to installation.

.3 Minor adjustments to location within wall system may be required where panel interferes with architectural appearance.

3.5 APPLYING AND FINISHING PANELS

.1 Gypsum Board Application and Finishing Standards: ASTM C840.

.2 Panel Application Methods:

.1 Single Layer Application:

.1 On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing.

.2 On partitions, apply gypsum panels vertically (parallel to framing), unless horizontal application is indicated or otherwise required by fire resistance rated assembly, and to minimize end joints.

.3 Stagger abutting end joints not less than one framing member in alternate courses of board.

.4 At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire resistance rated assembly.

.5 Apply gypsum panels to supports using Type S screws fastened 0.50 inch (12.7 mm) mm from edges of board.

.6 .

.2 Double Layer Application:

.1 Apply first layer with enough screws to hold panel in place.

.2 Stagger and offset joints of second layer from first layer.

.3 Apply second layer over first layer and secure as specified for single layer application using screws long enough to penetrate both layers and penetrate, 16 mm into wood framing.

.4 Apply gypsum board to assemblies having resilient channels as follows:

.1 Base Layer: Using Type S screws fastened 38 mm from long edges of board and 0.50 (12.7 mm) from short edges of board.

.2 Face Layer: Using Type G screws fastened 38 mm from long and short edges of board; offset face layer so that joints do not line up with base layer.

.3 Coordinate with installation of resilient channels.

.3 Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

.4 Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling; stagger abutting end joints of adjacent panels not less than one framing member spacing.

.5 Install gypsum panels with face side out; butt panels together for a light contact at edges and ends with not more than 0.059 inch (1.5 mm) of open space between panels; do not force into place.

.6 Locate edge and end joints over supports:

.1 Do not place tapered edges against cut edges or ends.

.2 Stagger vertical joints on opposite sides of partitions.

.3 Do not make joints other than control joints at corners of framed openings.

.4 Stop gypsum board away from underside of roof to allow for deflection of structure.

.5 Attach gypsum board to vertical studs, not to ceiling track, to allow for deflection.

.7 Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

.8 Attach gypsum panels to framing provided at openings and cut outs.

.9 Form control joints to account for thermal movements, to account for movement where direction of framing changes direction, and movements arising differing substrate materials using V-Shaped trims by framing back-to-back framing members and a break in gypsum panel at a maximum of 7.5 metres O/C, as follows:

.1 Install control joints in wall and ceiling construction in accordance with ASTM C840 so that gross area enclosed by joints does not exceed 80 m^2 between joints using limiting distances as follows:

Partition Type	Maximum Single Dimension
Interior Partitions	29 ft. / 9 metres
Interior Ceilings with Perimeter Relief	49.21 ft. / 15 metres
Interior Ceilings without Perimeter Relief	29 ft. / 9 metres
Exterior Ceilings	29 ft. / 9 metres
Exterior Walls	29 ft. / 9 metres

.2 Lay out control joints to coincide as far as possible with door, window or screen frames, but not necessarily to occur at every individual frame; install control joints vertically and horizontally from corners of openings.

.3 Install additional control joints at locations required for architectural or design accents as indicated on Drawings.

.4 Provide continuous dust barrier behind joints.

.5 Install joints straight and true.

.6 Form control joints to meet sound rated construction and fire ratings required for remainder of wall or ceiling construction.

.7 Obtain Consultant's acceptance of control joint layout before starting installation of materials specified in this Section.

.10 Form expansion joints to account for building movements using back-to-back framing members and edge trims, and a break in gypsum panel over structural movement joints and floor slab control joints as follows:

.1 Install expansion joints incorporating continuous air and Vapor membranes and with sufficient gap to allow for projected building movements.

.2 Seal back-to-back edge bead control joints with clear silicone sealant as specified in Section 07 92 00.

.3 Provide continuous dust barrier behind joints.

.4 Install joints straight and true.

.5 Form expansion joints to meet sound rated construction and fire ratings required for remainder of wall or ceiling construction.

.11 Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally:

.1 Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 0.7 m^2 in area.

.2 Fit gypsum panels around ducts, pipes, and conduits.

.3 Cut gypsum panels to fit profile formed by coffers, joists, and other structural members where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks; allow 0.236 inch (6 mm) to 0.05 inch (12.7 mm) wide joints to install sealant.

.12 Isolate perimeter of non-load bearing gypsum board partitions at structural abutments, except floors. Provide 0.236 inch (6 mm) to 0.50 inch (12.7 mm) wide spaces at these locations, and trim edges with J-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustic sealant.

.13 Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations, and as follows:

.1 Space screws a maximum of 12 inch (305 mm) O/C for vertical applications.

.2 Space fasteners in panels that are tile substrates a maximum of 8 inch (203 mm) O/C.

.14 Install fire rated and labeled gypsum board at all locations indicated on Drawings; continue fire and smoke rated wall construction behind and around fire hose cabinet recesses and other recessed items larger than a double gang switch box to maintain wall fire rating.

.15 Install s wall backing continuously where reinforcement is required for wall hung accessories and assemblies and as follows:

.1 Butt joints between adjoining metal sheets

.2 Form sheet metal extending 6 inch (152 mm) on each side of wall and ceiling corners without joints where metal backing is continuous around corners

.3 Spot glue first gypsum board layer at 6 inch (152 mm) O/C to metal backing to hold in place before mechanically fastening surface layer of gypsum board in a two layer installation.

.16 Install gypsum board laminated OSB or Plywood substrates using adhesive system recommended by gypsum board manufacturer and mechanical fasteners

.17 Tile Backing Panels:

.1 Install standard gypsum board panels in areas not subject to wetting to produce a flat surface.

.2 Install water resistant / mould resistant gypsum board in all washrooms and housekeeping rooms.

.3 Construct shower and bath surround] partitions of cementitious backer board or glass mat reinforced water resistant gypsum backing board only, in strict accordance with manufacturer's current recommended installation procedures.

.4 Shim surfaces to produce a uniform plane across panel surfaces where tile backing panels abut other types of panels in the same plane.

.18 Finishing Gypsum Board Assemblies:

.1 Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

.2 Pre-fill open joints, rounded or beveled edges, and damaged surface areas.

.3 Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

.4 Gypsum Board Finish Levels: Finish panels to levels indicated in Section 09 00 06 – Room Finish Schedule, according to defined criteria.

.5 Water Resistant and Mould Resistant Gypsum Board: Do not tape or fill joints in water resistant and mould resistant gypsum board used as a substrate for ceramic tile.

.6 Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed vertically applied wall sheathing.

3.6 ACOUSTIC INSTALLATION

.1 STC Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustic sealant. Install acoustic sealant at both faces of partitions at perimeters and through penetrations. In accordance with ASTM C919 and manufacturer's written recommendations for locating edge trim and closing off sound flanking paths around or through gypsum board assemblies, including sealing partitions above acoustic ceilings.

.2 Acoustic Sealants:

.1 Seal sound rated partitions in strict in accordance with gypsum board manufacturer's instructions for the specific sound rating requirements. Provide two (2) beads of sealant where no sealants are indicated; one under each inner and outer layer of gypsum board.

.2 Locate sealant so that it is covered at completion of partition when finishes applied; use appropriate sealant for exposed locations.

.3 Seal around mechanical and electrical work and other work in walls to achieve proper sound ratings.

.4 Provide gaskets where partitions abut a finished surface or material and where partitions meet exterior wall furring.

.5 Build in all door and borrowed light frames and equipment to provide a neat, cleanly finished system.

.6 Construct fire rated partitions using firestopping sealant instead of acoustic sealant to maintain required sound ratings; construct zero rated smoke separations the same as for fire rated partitions.

.3 Acoustic Sound Batts:

.1 Install acoustic sound batts within metal stud space and above suspended gypsum board ceilings as indicated for sound or fire rating.

.2 Acoustic sound batts to extend full height of partitions.

.3 Fill behind electrical outlet boxes, fire hose cabinets, washroom accessories and other openings with at least 6 inch (152 mm) lap around perimeter of opening; do not compress acoustic sound batts as this could cause the gypsum board finish to bulge or push outward.

.4 Coordinate with Electrical and Mechanical Subcontractors and verify that no back-to-back openings are formed, whether or not so indicated on drawings.

.5 Installation to in accordance with manufacturer's current written instructions and recommendations.

3.7 FIRE RATING SEALANT INSTALLATION

.1 Seal fire rated partitions strictly in accordance with fire sealant manufacturer’s instructions for specific fire rating requirements listed; coordinate with Section 07 84 00.

.2 Locate sealant so that it is covered at completion of partition when finishes applied.

.3 Seal around mechanical and electrical work and other work in wall to maintain proper fire rating.

3.8 INSTALLING TRIM ACCESSORIES

.1 For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

.2 Control Joints: Install control joints at locations indicated on Drawings, confirm locations of joints with Consultant before construction, and in accordance with ASTM C840 and in specific locations approved by the Team Project Manager, Team member or Team Crew member Assigned to such duties, for visual effect where joints are not otherwise indicated.

.3 Reveals: Cut vertical trims and casing beads at horizontal reveal locations, and install horizontal reveals continuous around corners and edges ; coordinate priming requirements with Section 09 91 05 where applied coatings are required for final appearance.

END OF SECTION

SECTION 09 30 00

TILING

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of the following:

- .1 Porcelain tile
- .2 Glazed wall tile
- .3 Special purpose tile
- .4 Waterproof membrane for thin set tile installations
- .5 Cementitious backer boards
- .6 Tile setting accessories including edge strips, transition strips, control strips, movement joints and other accessories required for a complete and finished installation

1.2 RELATED REQUIREMENTS

.1 Section 06 10 00 – Rough Carpentry: Plywood backer boards required for tile installation system and installed as a part of wood sheathing installation.

.2 Section 06 20 00 – Finish Carpentry

.3 Section 06 40 00 – Shop Fabricated Architectural Woodwork

.4 Section 07 92 00 – Joint Sealants: Sealing expansion, contraction, control, and isolation joints in tile surfaces.

.5 Section 09 21 16 – Gypsum Board Assemblies: Cementitious and Glass mat gypsum backer boards required for tile installation and installed as a part of gypsum board installation.

.6 Section 10 28 13 – Toilet Accessories

1.3 REFERENCE STANDARDS

.1 American National Standards Institute/Ceramic Tile Institute (ANSI/CTI):

- .1 ANSI/CTI A108.1-2012, Specification for the Installation of Ceramic Tile: Collection of 21 ANSI/CTI A108, A118 and A136 Series of Standards on Tile Installation
- .2 ANSI A137.1-2012, Specification for Ceramic Tile

.2 American Society for Testing and Materials (ASTM):

- .1 ASTM C1178/C1178M-11, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel
- .2 ASTM C1278/C1278M-07a, Standard Specification for Fiber-Reinforced Gypsum Panel
- .3 ASTM E84-12, Standard Test Method for Surface Burning Characteristics of Building Materials

.3 International Conrete Repair Institute (ICRI):

.1 Technical Guidelines 03732, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays.

.4 Terrazzo, Tile and Marble Association of Canada (TTMAC):

.1 2009/2010 Specification Guide 09 30 00, Tile Installation Manual

.2 Hard Surface Maintenance Guide

.5 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S102.2-10 Method of Test for Surface Burning Characteristics fo Flooring, Floor Coverings and Miscellaneous Materials and Assemblies

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Construction Meeting: Arrange a preconstruction meeting in accordance with Section 01 00 06 – General Requirements: Project Meetings, to discuss installation techniques, confirm compatibility of materials, identify any concerns arising from site conditions and identify any concerns of the installer or supplier, attended by Team Members, Team Crew members and , tile installer and tile supplier, mortar and grout representative Team Crew members and waterproof membrane representative Team Crew Member.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals:

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's product data for each type of product specified. Data shall indicate compliance with specification and installation recommendations of manufacturer of products being used.

.2 Shop Drawings: Submit shop drawings for the following:

.1 Tile patterns and locations

.2 Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces

.3 Samples for Verification: Submit samples for verification including sample sets showing the full range of variations expected where products involve normal colour and texture variations:

.1 Submit 12 inch x 12 inch (305 mm x 305 mm) sized panel using specified material including coloured grout mounted on 0.75 inch (19 mm) thick plywood backer.

.2 Submit tile sample showing installation of perimeter accessories, control or movement joints, and trims where applicable.

.3 Informational Submittals: Provide the following submittals during the course of the work:

.1 Certificates: Submit written statements from manufacturers indicating compatibility with respect to other manufacturer’s materials where more than one manufacturer’s products form a part of a single tile assembly.

1.6 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit copies of TTMAC Maintenance Guide in accordance with Section 01 00 06 – General Requirements: Operations and Maintenance Data, and additional materials as follows:

.1 Provide written literature and instructions to Team Project Manager, Team member or other Team Crew member assigned to such duties, addressing maintenance and replacement of slip resistant treatments specified in this Section.

.2 Provide specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.

.3 Provide manufacturer's maintenance data sheets for floor sealers and other non-tile accessories.

.2 Maintenance Materials: Deliver maintenance materials to Team Project Manager, Team member or other Team Crew member assigned to such duties, in accordance with Section 01 00 06 – General Requirements: Spare Parts as follows:

.1 Deliver minimum 1 – 4 litre container of cleaning products specified for maintenance cleaning and store as directed by Team Project Manager, Team member or other Team Crew member assigned to such duties.

.2 Deliver tile maintenance materials in the following quantities:

.1 Porcelain Tile: 2% of total installation with a minimum of 1 box of each colour and type.

.2 Trim Units: 3% of total installation consisting of full size units of each type, composition, colour, and pattern

.3 Provide extra materials that match products installed, packaged with protective covering for storage, and identified with labels describing contents and location within building

1.7 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Standard of work for this Section: Provide materials and workmanship in accordance with recommendations of Terrazzo, Tile and Marble Association of Canada (TTMAC) and the material and installation standard contained in the referenced standards.

.2 Supplier: Obtain materials from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties.

.3 Materials: Tile that does not meet a Grade 1 Standard, or is marked as a factory second or discount will be rejected, immediately removed from the site and replaced with specified materials.

.4 Installers: Execute Work of this Section using qualified personnel skilled in ceramic tile installation, having a minimum of five (5) years proven experience and have completed tile installations similar in material, design, and extent to that indicated for this Project.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use in accordance with ANSI A108.1 for labeling sealed tile packages.

.2 Storage and Handling Requirements: Store materials to prevent damage or contamination to materials by water, freezing, foreign matter, and other causes; store cementitious materials in a dry area, and blocked off floor and ground surfaces.

1.9 SITE CONDITIONS

.1 Ambient Conditions: Apply tile after completion of work by other Sections is complete; to surfaces sufficiently dry, clean, firm, level, plumb and free from oil or wax or any other material deleterious to tile adhesion and as follows:

.1 Temperature: Maintain tile materials and substrate temperature between TTMAC recommended minimum and maximum temperature range; unless indicated otherwise by manufacturer, for 48 hours before and during installation until materials are fully set and cured; provide additional heat during winter months or at any other time when there is a risk that surface temperatures may drop below minimum recommended temperatures.

.2 Ventilation: Maintain adequate ventilation where Work of this Section generates toxic gases or where there is a risk of raising relative humidity to levels that could damage building finishes and assemblies.

Part 2 Products

2.1 MATERIALS

.1 Performance Requirements: Provide tile products manufactured in accordance with ANSI A108.1 or ANSI A137.1 as appropriate to the Basis-of-Design Materials and as follows:

.1 Colour Variations: Factory blend tile that exhibits colour variations within the ranges selected; package so tile units taken from one package showing same range in colours as those taken from other packages.

.2 Slip Resistance: Provide materials having a minimum Dynamic Coefficient of Friction (DCOF) of 0.42 dry in accordance with ANSI A137.1 when tested using the BOT-3000 Digital Tribometer.

.3 Load Bearing Performance: Provide installations rated for the following load bearing performance in accordance with ASTM C627 for ceramic tile installed on walkway surfaces:

.1 Extra Heavy: Passes cycles 1 through 14.

.2 Heavy: Passes cycles 1 through 12.

.3 Moderate: Passes cycles 1 through 10.

.4 Light: Passes cycles 1 through 6.

.5 Residential: Passes cycles 1 through 3.

.4 Floor Level Tolerances: Make slabs flat measured to a minimum of F_F50; equivalent to 0.236 inch (6 mm) with 1 gap under 118 inch (3000 mm) straightedge.

.5 Provide Products used in exits having a flame spread rating of 25 or less when tested in accordance with ASTM E84 or ULC S102.2.

2.2 WALL TILE

.1 Type PT1: Porcelain wall tile, square edge, conforming to referenced standards and the following:

- .1 Composition: Porcelain.
- .2 Type: Wall Tile
- .3 Class: MR 4.
- .4 Chemical Resistance: CR 1.
- .5 Scratch Resistance: 7 MOH
- .6 Dimensions: Nominal 4 inch (100 mm) x 12 in. (305 mm) x 3/8 in. (9.5 mm) mm thickness.
- .7 Appearance: Plain.
- .8 Pattern: Non-Textured
- .9 Colour: Obsidian Black
- .10 Glaze: Glazed

.2 Type PT2: Porcelain wall tile, square edge, conforming to referenced standards and the following:

- .1 Composition: Porcelain.
- .2 Type: Wall Tile
- .3 Class: MR 4.
- .4 Chemical Resistance: CR 1.
- .5 Scratch Resistance: 7 MOH
- .6 Dimensions: Nominal 12 inch (305 mm) x 24 in. (610 mm) x 3/8 in. (9.5 mm) mm thickness.
- .7 Appearance: Plain.
- .8 Pattern: Non-Textured
- .9 Colour: Obsidian Black
- .10 Glaze: Glazed

.3 Glass Backsplash Tile:

- .1 Composition: Crushed Recycled Glass
- .2 Type: Wall Tile (backsplash)
- .3 Class: MR 4.
- .4 Chemical Resistance: CR 1.
- .5 Scratch Resistance: 6 MOH
- .6 Dimensions: Nominal 4 inch (100 mm) x 12 in. (305 mm) x 3/8 in. (9.5 mm) mm thickness.
- .7 Appearance: Plain.
- .8 Pattern: Non-Textured
- .9 Colour: As selected by the Consultant

2.3 FLOOR TILE

.1 Type PT2: Porcelain wall tile, square edge, conforming to referenced standards and the following:

.1 Composition: Porcelain.
.2 Type: Wall Tile
.3 Class: MR 4.
.4 Chemical Resistance: CR 1.
.5 Scratch Resistance: 7 MOH
.6 Dimensions: Nominal 12 inch (305 mm) x 24 in. (610 mm) x 3/8 in. (9.5 mm) mm thickness.
.7 Appearance: Plain.
.8 Pattern: Non-Textured
.9 Colour: Obsidian Black
.10 Glaze: Glazed

2.4 TRIMS

.1 90° Edge Strips: Brushed stainless steel edge strips; height as required to suit tile installation; with integral perforated anchoring leg for setting the strip into the setting material:

.1 Basis-of-Design Materials: Schlüter Eck-E EB

.2 Transition Edge Strips: Satin anodized aluminum edge strips; height as required to suit tile installation; with integral perforated anchoring leg for setting the strip into the setting material and sloped, narrow profile transition:

.1 Basis-of-Design Materials: Schlüter Schiene AE

2.5 ACCESSORY MATERIALS

.1 Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers and as follows:

.1 Job Site Cleaner: Phosphoric acid/nitric acid based cleaning solution mixed in accordance with cleaner manufacturers recommendations and as recommended by tile manufacturer.
.2 Maintenance Cleaner: Non-toxic, electrolytic, biodegradable, non-ammonia containing, pH controlled cleaning solution mixed in accordance with manufacturer's recommendations.

.2 Cementitious Backer Board: Reinforced portland cement board, interior rated, 0.05 inch b12.7 mm nominal thickness x manufacturer's maximum lengths and widths; reinforcing mesh embedded near both faces in accordance with ANSI A108.1, and as follows:

.1 Acceptable Materials:

.1 CGC Inc., Durock Next Gen
.2 Custom Building Products Ltd., EasyBoard
.3 Bed-Roc Industries Ltd., Super-Panel

.3 Glass Faced Backer Board: Water resistant, mould resistant and fire resistance rated fibreglass reinforced gypsum core panel having inorganic glass fibre facing sheets manufactured in accordance with ASTMC1178 or ASTM C1278, and as follows:

.1 Acceptable Materials:

.1 CertainTeed, GlasRoc Tile Backer Type X

.2 CGC Inc., Fiberock Aqua-Tough Tile Backerboard

.3 Georgia Pacific, DensShield Tile Backer

2.6 MORTAR SETTING MATERIALS

.1 Manufacturers: Mortar and grout materials listed in this Section shall be of a uniform quality for each mortar,and grout component from a single manufacturer and each aggregate from one source or producer as follows:

.1 Custom Building Products Ltd.

.2 Flextile Ltd.

.3 Kiesel Bauchemie GmbH

.4 MAPEI Inc.

.5 Parex USA Inc.

.2 Primer: Low VOC, low viscosity primer as recommended by manufacturer to suit substrate and site conditions; provide proof of bonding ability of setting system where manufacturer recommends that a primer is not necessary to installation.

.3 Surface Preparation Materials: Provide manufacturer's recommended primer or bond enhancing surface preparation material and provide the following underlayment materials:

.1 Leveling Bed/Mortar Additive: Cementitious Performance standard meeting requirements of ANSI A108.1, Type 2; Acceptable Materials:

.1 Custom Building Products Level Quik Underlayment

.2 Flextile Ltd., Mortar Bed with #43 Additive

.3 Kiesel Sercocret RS

.4 MAPEI Inc. Mapecem Premix PL50.

.5 Merkrete Underlay M System

.2 Self Leveling and Smoothing Underlayment: Performance standard meeting requirements of ANSI A108.1, Type 2; Acceptable Materials:

.1 Custom Building Products Level Quick with Acrylic Mortar Admix

.2 Flextile Ltd., Flex Flo Self Level

.3 Kiesel Servoplan P200 Plus

.4 MAPEI Inc. Ultra/Plan

.5 Merkrete Underlay SLU

.4 Interior Thin Set Wall System: Dry set mortar meeting or exceeding the requirements of ANSI A108.1 formulated for thin set applications of ceramic biscuit tile, factory sanded mortar consisting of portland cement, sand and additives requiring only potable water to be added for installation and waterproof crack and isolation membrane:

.1 Acceptable mortar materials:

.1 Custom Building Products Premium Blend Thinset

.2 Flextile Ltd., #51 Floor and Wall Mix

.3 MAPEI Inc. Kerabond
.4 Kiesel Servolight S2 SuperTec
.5 Merekrete 700 Premium Set

.2 Acceptable additive materials:
.1 Custom Building Products Acrylic Mortar Admix
.2 Flextile Ltd., #43 Acrylic Additive
.3 Kiesel, no additive required
.4 MAPEI Inc. Kera/Ply
.5 Merkrete 705, no addititve required

.5 Interior Thin Set Floor System: Dry set mortar meeting or exceeding the requirements of ASTM C627 for Extra Heavy installation using latex modified, portland cement mortar meeting requirements of ANSI A108.1 with bond enhancing latex additive:

.1 Acceptable mortar materials:
.1 Custom Building Products Master Blend Thinset
.2 Flextile Ltd., #53 Floor Mix
.3 Kiesel Servoflex Trio SuperTec
.4 MAPEI Inc. Kerabond
.5 Merkrete 200/211 System

.2 Acceptable additive materials:
.1 Custom Building Products Custom Flex
.2 Flextile Ltd., #44 High Solids Acrylic Additive
.3 Kiesel, no additive required
.4 MAPEI Inc. Keralastic
.5 Merkrete 200 Krete Latex and 211 Krete Filler

.6 Rapid Setting Mortar: Dry set mortar meeting or exceeding the requirements of ASTM C627 for Extra Heavy installation using rapid curing, latex modified, portland cement mortar meeting requirements of ANSI A108.1:

.1 Acceptable mortar materials:
.1 Custom Building Products, Prolite®
.2 Flextile Ltd., 58XT Fast Setting Two-Component High Solids Latex Mortar System
.3 Kiesel Servoflex Trio SuperTec Schnell
.4 MAPEI Inc., Grani/Rapid
.5 Merekrete

.2 Acceptable additive materials:
.1 Custom Building Products, Custom Flex
.2 Flextile Ltd., 58XT Fast Setting Two-Component High Solids Latex Mortar System
.3 Kiesel, no additive required
.4 MAPEI Inc., Grani/Rapid
.5 Merekrete

.7 High Humidity Shower Room System: Load bearing, bonded waterproof membrane and Vapor retarder system in accordance with ANSI A118.10 consisting of fleece faced polypropylene membrane having a Vapor permeance of 0.75 perm or less, including manufacturer's preformed corner and penetration sections; manufacturer's recommended thin set mortar and waterproofing system for tiling required for project and as follows:

.1 Basis-of-Design Materials: Schlüter KERDI System, substitutions will not be considered for this product.

2.7 GROUT

.1 Match colours as selected by the Team Member responsible for selecting colours

.2 Portland Cement Grout for Wall and Floor Joints ≤0.118 inch (3 mm) Interior Only (GU): factory blended polymer modified mixture meeting requirements of ANSI A108.1:

.1 Acceptable Materials:

.1 Custom Building Products Polyblend Unsanded Grout

.2 Flextile Ltd., 500 Series Unsanded Grout

.3 MAPEI Inc. Keracolor™ Unsanded Grout

.4 Merekrete ProGrout

.3 Latex-Portland Cement Grout for Floors with Joints ≥0.118 inch (3 mm) Interior or Exterior (GS): factory blended stain resistant latex modifiers, portland cement and graded silica sand and dry-set grout and meeting requirements of A108.1 for grout additive; colour selected from full range of colours by Consultant:

.1 Acceptable Materials:

.1 Custom Building Products Polyblend Sanded Grout

.2 Flextile Ltd., 600/100 Series Sanded Grout

.3 MAPEI Inc. Keracolour S Sanded Grout

.4 Merekrete ProGrout

.4 Rapid Setting Grout: Rapid setting, polymer modified sanded tile grout for tiles having joints ≥0.118 inch (3mm) meeting requirements of ANSI A108.1. Colour selected from full range of colours by Consultant:

.1 Acceptable Materials:

.1 Custom Building Products Polyblend Sanded Grout

.2 Flextile Ltd., 100 Flex-Epoxy

.3 MAPEI Inc. Ultra/Colour Sanded

.4 Merekrete Pro Epoxy

.5 Flexible Grout: Silicone Rubber to ASTM C920, non-solvent curing type; colour selected by Consultant from full range of colours to match other grout materials.

2.8 MEMBRANES

.1 Crack Suppression Membranes: Load bearing, premanufactured self adhering lightweight fabric reinforced crack isolation membrane; nominal 0.039 inch (1 mm) thick manufactured to accommodate in-plane substrate movement in thin set applications meeting requirements of ANSI A108.1 and as follows:

.1 Acceptable Materials:

.1 Flextile Ltd., 1000 Flexilastic Crack Isolation Membrane

.2 Kiesel Crack Suppression System

.3 MAPEI Inc., Mapeguard 2

.2 Preformed Waterproofing Membrane System: Meeting requirements of ANSI A108.1, soft polyethylene membrane with fleece webbing laminated on both sides complete with special cut width rolls and special shapes for corners and pipe sleeves, and manufacturers standard floor drain assembly:

.1 Basis-of-Design Materials: Schlüter Kerdi and Kerdi Drain

2.9 MIXING MORTARS AND GROUT

.1 Mix mortars and grouts in accordance with referenced standards, and mortar and grout manufacturers' written instructions.

.2 Add materials, water, and additives in accurate proportions.

.3 Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

Part 3 Execution

3.1 EXAMINATION

.1 Examine materials ordered for the project before delivering to the site; open boxes and confirm that materials match accepted samples, are free from defects and breakage detrimental to final appearance and installation, and as follows:

.1 Consultant will only accept Grade 1 Standard, materials appearing on site factory marked as seconds or discounted or that are not consistent with materials submitted for review will be rejected.

.2 Replace unacceptable materials at no additional cost to the Project; order replacement materials using most expedient delivery method to minimize effect on construction schedule.

.2 Examine substrates, areas, and conditions where tile will be installed for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile and confirm the following:

.1 Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and are within starting flatness tolerances as specified in Section 03 35 00, and are ready for application of levelling materials specified in this Section.

.2 Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of Work, and similar items located in or behind tile have been completed before installing tile.

.3 Verify that joints and cracks in tile substrates are coordinated with tile joint locations; adjust joints in consultation with Consultant where joints are not coordinated.

.4 Verify that concrete substrates have been allowed to cure sufficiently in accordance with TTMAC requirements.

.5 Verify that tile subject to colour variations has been blended in the factory and packaged so tile units taken from one package show the same range of colours as those taken from other packages. If not factory blended, blend tiles at site before installing.

.6 Verify that back of tile is free from contamination before installation.

.3 Subcontract Team Crew Member shall notify Team Project manager, Team member or Team Crew Member assigned to such duties in writing of any conditions that are not acceptable; do not proceed with installation until

3.2 PREPARATION

.1 Make backing surfaces level and true to a tolerance in plane of ± 0.118 inch (3 mm) in 96 inch (2440 mm) for walls and ± 0.118 inch (3 mm) in 120 inch (3050 mm) for floors using Leveling Bed Mortar or Self Leveling Mortar.

.2 Use trowellable leveling and patching compounds in accordance with tile setting material manufacturer's written instructions to fill cracks, holes, and depressions.

.3 Remove protrusions, bumps, and ridges by sanding or grinding.

3.3 WATERPROOFING AND CRACK SUPPRESSION MEMBRANE INSTALLATION

.1 Install waterproofing and crack suppression membranes in accordance with manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.

2.1.1 Install tiling after liquid applied membranes are cured and tested to confirm that it is watertight.

3.4 INSTALLATION

.1 Install tiling in accordance with requirements of TTMAC Tile Installation Manual and parts of ANSI A108 Series of tile installation standards that apply to types of setting and grouting materials, and to methods required for complete ceramic tile installation.

.2 Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions:

.1 Terminate Work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

.2 Cut edges smooth, even and free from chipping.

.3 Do not split tile.

.3 Accurately form intersections and returns; perform cutting and drilling of tile without marring visible surfaces:

.1 Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints.

.2 Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.

.4 Lay tile in pattern as follows:

.1 Align joints when adjoining tiles on floor, base, walls, and trim are the same size.

.2 Lay out tile Work and centre tile sites in both directions in each space or on each wall area.

.3 Centre tile patterns between control and movement joints. Notify the Consultant for further instructions where tile patterns do not align with control or movement joints.

.4 Cut tile accurately and without damage.

.5 Smooth exposed cut edges with abrasive stone, where exposed.

.6 Chipped or split edges are not acceptable.

.7 Minimum tile width: 1/2 unit unless specifically indicated otherwise on Drawings.

.8 Adjust tile layout to minimize tile cutting.

.9 Provide uniform joint widths.

.10 Make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished Work.

.11 Cut, drill, and fit tile as required accommodating Work of other trades.

.12 Slope floor tile towards floor drains in thick-bed mortar installations.

.13 Lay out tile wainscots to next full tile beyond dimensions indicated.

.5 Press setting material into the back of tile having raised or textured backs to provide a minimum of 95% coverage:

.1 Set tile in place while bond coat is wet and tacky before it has skinned over.

.2 Notch bond coat in horizontal straight lines and set on freshly set setting material while moving tile back and forth at 90° to the notches.

.3 Fully support corners and edges of tile with setting material.

.4 Set tile with, maximum lippage of 0.039 inch (1 mm) over a 0.118 inch (3 mm) wide joint.

.6 Prevent rapid drying of setting material:

.1 Do not set tile on dry bed.

.2 Sound tile after setting and replace any hollow sounding units to obtain full bond.

.7 Provide additional ventilation as required.

.8 Clean excess setting materials from surface of tiles before final set.

.9 Sound tiles after setting material have cured and replace hollow sounding tile before grouting.

.10 Joint Widths: Install tile with the following joint widths:

.1 Wall Tile: 0.059 inch (1.5 mm)

.2 Make joints consistent width and alignment within tile area.

.3 Maintain 2/3 of grout joint depth free of setting material.

.11 Back Buttering: Obtain minimum 100% mortar coverage in accordance with applicable requirements for back buttering of tile in referenced TTMAC and ANSI A108 series of tile installation standards for the following applications:

.12 Install prefabricated edge strips and control joints at locations indicated or where exposed edge of floor tile meets different flooring materials and exposed substrates.

.13 Protect exposed edges of floor tile with properly sized transition strips, use sloped reducer strips where uneven transitions between 0.236 inch (6 mm) and 0.050 inch (12.7 mm) occur.

3.5 FLOOR SEALER AND PROTECTIVE COATING

.1 Apply manufacturer's recommended floor sealer in strict accordance with manufacturer's written instructions for the specific tile type being sealed.

.2 Apply sealer to tiles before grouting in cases of absorbent biscuit tiles and again after completion and cleaning of grouting process.

3.6 CONTROL AND MOVEMENT JOINTS

.1 Install control and movement joints in tile Work in accordance with detail 301EJ from TTMAC Installation Manual to suit installation indicated.

.2 Locate expansion, control, contraction, and isolation joints, as indicated in following table, unless specifically indicated otherwise on the Drawings:

Environment	Minimum	Maximum	Joint Width
Interior	192 inch (4880 mm)	240 inch (6100 mm)	0.236 inch (6 mm)
Interior/Sunlight	144 inch (3660 mm)	192 inch (4880 mm)	0.236 inch (6 mm)
Exterior/Normal	96 inch (2440 mm)	144 inch (3660 mm)	0.393 inch (10 mm)
Exterior/Excessive	96 inch (2440 mm)	120 inch (3050 mm)	0.50 inch (12.7 mm)

.3 Do not saw-cut joints after installing tiles:

.1 Locate joints in tile surfaces directly above joints in concrete substrates.

.2 Provide floor control joints over structural control joints.

.3 Install prefabricated joint profiles in accordance with manufacturer's written instructions, set with top surface of joint profile slightly below top surface of tile.

.4 Prepare joints and apply sealants in accordance with requirements of Section 07 92 00.

.5 Keep control and movement joints free from setting materials.

.4 Form an open joint for sealant in tile Work wherever a change in the backing wall material occurs, at all vertical interior corners, around penetrating pipes and fixtures, and where tile abuts other materials or fixtures.

3.7 GROUT

.1 Install grout in accordance with manufacturer's written instructions, the requirements of the Terrazzo, Tile and Marble Association of Canada (TTMAC), and as follows:

.1 Allow proper setting time before application of grout.

.2 Force grout into joints to a smooth, dense finish.

.3 Remove excess grout in accordance with manufacturer's written instructions and polish tile with clean cloths.

.2 Install grout for ceramic tile (sand-portland cement, dry-set, commercial portland cement, and latex-portland cement grouts) in accordance with ANSI A108.10.

3.8 WATERPROOFING

.1 Install cementitious backer boards and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated for the following applications:

.1 Shower and bath surrounds

.2 Install waterproofing in accordance with waterproofing manufacturer's written instructions to produce a waterproof membrane of uniform thickness bonded securely to substrate.

.3 Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.9 CLEANING AND PROTECTION

.1 On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter using Job Site Cleaner listed in **Error! Reference source not found.**:

.1 Remove latex-portland cement grout residue from tile as soon as possible.

.2 Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation.

.3 Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning.

.4 Flush surface with clean water before and after cleaning.

.2 Leave finished installation clean and free of cracked, chipped, broken, unbonded, or other tile deficiencies:

.1 Protect finished areas from traffic until setting materials have sufficiently cured in accordance with TTMAC requirements.

.2 Protect floor areas from traffic after grouting is completed in accordance with manufacturer’s written instructions.

.1 Keep traffic off floors for a minimum of 24 hours after completion of grouting.

.2 Use stepping boards where access is required for light foot traffic only after 4 hours from completion of grouting.

.3 Do not immerse in water and protect from freezing for a minimum of 7 days after completion of tile work.

.3 Provide protective covering until Substantial Performance of the Work.

.4 Protect wall tiles and bases from impact, vibration, heavy hammering on adjacent and opposite walls for a minimum of 7 days after installation.

END OF SECTION

SECTION 09 64 29

WOOD STRIP AND PLANK FLOORING

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of engineered hardwood floor assembly.

1.2 RELATED REQUIREMENTS

.1 Section 06 10 00 – Rough Carpentry: Flooring substrate

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM E84-04, Surface Burning Characteristics of Building Materials

.2 ASTM F710-03, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

.3 ASTM F1869-04, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-51.34-M86, Vapor Retarder, Polyethylene Sheet, for Use in Building Construction

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit product data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for wood athletic flooring assemblies.

.2 Shop Drawings: Submit shop drawings indicating installation details including; but not limited to, the following:

.1 Location and layout of each type of floor assembly and accessory

.2 Expansion provisions and trim details

.3 Layout, colours, widths, and dimensions of game lines and markers

.3 Samples for Verification: Submit samples for verification for each type of athletic flooring assembly and accessory required; approximately 12 in. (305 mm) long of same thickness and material specified including sample sets indicating full range of normal colour and texture variations expected in wood flooring.

1.5 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit manufacturer's written maintenance data for wood athletic flooring assemblies and finish systems including a list of materials and equipment required to maintain the floor finish in accordance with Section 01 00 06 – General Requirements: Operation and Maintenance Manuals.

1.6 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Installer: Use only experienced installer who has completed installations similar in material, design, and extent to that indicated for this project and whose work has resulted in installations with a record of successful in service performance for a minimum of five (5) years.

.2 Compatibility: Use only sealers, paint for game lines, and clear coatings from a single manufacturer; using only components that are compatible with each other and with surface that coatings are being applied.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver assembly materials in unopened cartons or bundles after concrete, masonry, plaster, ceramic tile, and similar wet work is complete and dry.

.2 Storage and Handling Requirements: Protect wood from exposure to moisture; store wood components in a horizontal position, in a dry, warm, well ventilated, weather tight location.

1.8 SITE CONDITIONS

.1 Ambient Conditions: Start ambient conditioning period a minimum of seven (7) days before athletic flooring assembly installation, is continuous through installation, and continues a minimum of seven (7) days after athletic flooring installation, as follows:

.1 Environmental Conditioning: Maintain ambient temperature between 18°C and 24°C, and relative humidity planned for building occupants; but a minimum of 35% or more than 50%, in spaces to receive athletic flooring assemblies during conditioning period.

.2 Wood Conditioning: Move wood components into spaces where they are being installed, no later than beginning of conditioning period, as follows:

.1 Do not install wood flooring assemblies until wood components adjust to relative humidity of, and are at same temperature as spaces where they are being installed.

.2 Open sealed packages to allow wood components to acclimatize immediately upon moving wood components into spaces that they are being installed.

.2 Maintain relative humidity and ambient temperature planned for building occupants after conditioning period.

.3 Install flooring assemblies after other finishing operations have been completed including; but not limited to painting and overhead work.

1.9 WARRANTY

.1 Provide manufacturers engineered flooring 3 year Limited finish warranty and Limited Lifetime Structural Defect Warranty.

Part 2 Products

2.1 MATERIALS

.1 Western Red Cedar Hardwood Flooring: Western Red Cedar Lumber Association decking grades.

- .1 Grade: Architectural Clear.
- .2 Length: variable 8.85 inch (225 mm) to 48 inch (1220 mm).
- .3 Thickness: 0.393 in. (10 mm).
- .4 Face Width: 3 inch (75 mm).
- .5 Edges and Ends: Bevelled
- .6 Milling: Tongue and groove sides, end matched.

2.2 ACCESSORIES

.1 Wood Wall Base: Refer to Section 06 40 00.

.2 Trowellable Levelling and Patching Compound: Latex modified, hydraulic cement based formulation meeting manufacturer's standard requirements.

.3 Transition Strips: As supplied by manufacturer in appropriate blended colors.

.4 Underlayment: Asphalt impregnated, weather resistant, water-vapor permeable building felt paper.

- .1 Dry tensile strength: 20 psi minimum in both directions.
- .2 Maximum water vapor transmission: 35 grams per square meter per 24 hours.

.5 Sound isolation underlayment: 0.236 inch (6 mm) thick cork underlayment.

2.3 FLOOR FINISH

.1 Factory machine sand hardwood strip flooring to smooth even finish with no evidence of sander marks. Use 3 sequential sanding operations.

.2 Apply one seal coat followed by 7 finish coats of photoreactive urethane. Cure by ultra-violet light. 5 finish coats shall be aluminum oxide based.

.3 Total finish thickness; 3.2 mils.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: Examine substrates, areas and conditions for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of flooring assemblies.

3.2 PREPARATION

.1 Acclimatise the new flooring in accordance with manufacturer's instructions specific to wood species selected. Consistent indoor temperatures of 60^{o}-80^{o} F and constant indoor humidity levels of 35% - 55% are required during period of acclimatization. Very dry or humid regions may require extended conditioning. Excessive squeaks and gapping can result from poor or no acclimation.

.2 Coordinate installation of wood flooring with construction of wood subfloor specified in Section 06 10 00 - Rough Carpentry. Ensure that framing members are rigid and subfloor is level, smooth, and securely attached with ends over firm bearing.

.3 Fill low spots with trowellable levelling and patching compounds in accordance with manufacturer's written instructions to fill cracks, holes, and depressions in substrates.

.4 Broom and vacuum clean substrates being covered immediately before product installation.

.5 Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

.1 Install flooring in accordance with manufacturer's instructions and approved shop drawings.

.2 When installation to occur in high humidity area, allow wood flooring to acclimatize for an extended period, as recommended by manufacturer according to species specified.

.3 Intermingle board lengths.

.4 Stagger board ends 3 times board width or 6 in. (152 mm) minimum.

.5 Select wood boards from several cartons to ensure good color and shade mixture.

.6 Allow 3/4 inch (19 mm) voids, or voids equal to the thickness of the flooring, for expansion and movement of wood flooring at walls and permanent obstructions.

.7 Do not install flooring directly over joists without subflooring.

.8 Use joist spacing to determine minimum subfloor thickness.

.9 All structural panels/underlayment to be installed sealed-side down. Provide 3/4 inch (19 mm) perimeter spacing.

.10 Square-edged or non tongue and grooved panels used as a subfloor require a minimum 1/8 inch (3 mm) expansion space between all plywood seams.

.11 Panels must meet minimum CDX grade Exposure 1 and US Voluntary Product Standard PS1-95, PS2-04 or Canadian performance standard CAN/CSA 0325-0-92 for construction sheathing. Code must be stamped on underside of all panels used. Minimum of 3/8 inch (9.5 mm) panel thickness when used as an underlayment.

.12 For large wood floor areas, 30 ft. by 30 ft. (10 m by 10 m) or high humidity conditions provide center expansion gaps by inserting washers as temporary spacers in accordance with manufacturer's instructions.

.13 Lay hardwood strip flooring on underlayment over wood subfloor or wood nailing base and parallel with length of room and perpendicular to wood joists.

.14 Blind staple or nail flooring to subfloor with appropriate flooring nailer or stapler:

.1 Space fasteners at 6 to 8 in. (152 to 203 mm). Fasteners shall not be installed within 2 in. (50 mm) of board ends to avoid splitting.

.2 Fasteners shall be driven at an angle from the top of the tongue of the flooring board.

.3 Ensure that the flooring nailer or stapler is adjusted to insert fastener at proper angle and is set to the proper depth for flooring being installed to prevent splitting and damage to finished wood surface.

.4 Where clearance does not permit blind nailing with flooring nailer, pre-drill holes and top nail on the tongue side of the board.

.5 Solid Wood Flooring:

.1 For 2 1/4 inch (57 mm), 3/4 inch (19 mm) thick, flooring nail placement is every 8"-10 apart and a nail placed within 1 inch to 3 in. (25 mm to 76 mm) of each end, with at least two nails in every board.

.2 For flooring 3 in. (76 mm) wide: 3/4 inch (19 mm) thick the nail placement should be 6 in. to 8 in. (152 mm to 203 mm) apart and there should be a nail placed within 1 inch to 3 in. (25 mm to 76 mm) from each end, with at least two nails in every board

.3 Flooring 4 in. to 8 in. (102 mm to 203 mm) wide, 3/4 inch (19 mm) thick the nail placement should be 6 in. to 8 in. (152 mm to 203 mm) apart and there should be a nail placed within 1 inch to 3 in. (25 mm to 76 mm) from each end, with at least two nails in every board

.4 Flooring 5/16 inch to 3/8 inch (8 mm to 9.5 mm) thick the nail placement should be 4 in. to 8 in. (102 mm to 203 mm) apart and there should be a nail placed within 1 inch to 3 in. (25 mm to 76 mm) from each end, with at least two nails in every board

.5 Flooring 1/2 inch (12 mm) thick the nail placement should be 10 in. (254 mm) apart and there should be a nail placed within 1 inch to 3 in. (25 mm to 76 mm) from each end, with at least two nails in every board.

3.4 CLOSEOUT ACTIVITIES

.1 Protect finished floor from abuse by other trades using heavy Kraft paper or polyethylene sheet until project completion; keep traffic out of spaces and areas where flooring is being installed until adhesive has set.

.2 Thoroughly clean by sweeping, vacuuming or dust mopping to remove debris followed by cleaning using manufacturers recommended cleaner.

END OF SECTION

SECTION 09 91 05

PAINTING

Part 1 General

1.1 SUMMARY

.1 Provide labour, materials, tools and other equipment, services and supervision required to complete interior and exterior, including above roof, painting and decorating work.

.2 Surface preparation for this section will be limited to priming and back-priming, and specific pre-treatments noted in this section or as specified in the Master Painters Institute (MPI) Painting Specification Manual.

1.2 RELATED REQUIREMENTS

.1 Other sections of the specification requiring painting refer to this section. Coordinate requirements of referencing sections.

1.3 REFERENCE STANDARDS

.1 Environmental Choice Program (ECP):

.1 Paints and Surface Coatings, Low VOC Product Listings

.2 The Master Painters Institute (MPI):

.1 New Surfaces: Architectural Painting Specification Manual.

.3 The Society for Protective Coatings (SSPC):

.1 Coating Materials Guidelines

.2 Surface Preparation Guidelines

.3 Application, Inspection and Quality Control Guidelines

1.4 DEFINITIONS

.1 Gloss Levels: Standard coating terms defined by MPI Manual apply to products of this Section as follows, and are used in Section 09 06 00.13 – Room Finish Schedule to designate required gloss levels for indicated areas:

.1 G1 – Matte of Flat: Lustreless or matte finish with a gloss range below 10 when measured at 85° to meter and 0 to 5 when measured at 60°.

.2 G2 – Velvet: Matte to low sheen finish with a gloss range of 10 to 35 when measured at 85° to meter and 0 to 10 when measured at 60°.

.3 G3 – Eggshell: Low sheen finish with a gloss range of 10 to 35 when measured at 85° to meter and 10 to 25 when measured at 60°.

.4 G4 – Satin: Low to medium sheen with a gloss range of minimum 35 when measured at 85° to meter and 20 to 35 when measured at 60°.

.5 G5 – Semi-Gloss: Medium sheen finish with a gloss range of 35 to 70 when measured at 60° to meter.

.6 G6 – Gloss: High sheen finish with a gloss range of 70 to 85 when measured at 60° to meter.

.7 G7 – High Gloss: Reflective sheen having a gloss range in excess of 85 when measured at 60° to meter.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit list of all painting materials used for the Work to the Consultant for review prior to ordering materials for each paint system indicated, including block fillers and primers:

.1 Material List: An inclusive list of required coating materials indicating each material and cross reference specific coating, finish system, and application; identify each material by manufacturer's catalogue number and general classification.

.2 Base Information: Confirmation of manufacturer's ability to supply paint in a variety of base tints, specific to the range of colours being used on this project; indicate colour of base tint used and amount of colourant added to establish Scheduled colours.

.3 Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

.2 Samples: Provide stepped samples, defining each separate coat, including block fillers and primers using representative colours required for the project; label each sample for location and application, and as follows:

.1 Drawdown Samples: Provide three (3) drawdown sample charts (cards) for each type, texture and colour of finish specified for verification purposes before ordering paint materials:

.1 Apply paint sample in layers to Opacity Charts, by The Leneta Company until paint colour appearance over black and white areas is identical, or the specified level of opacity for translucent products has been achieved.

.2 Apply paint to Opacity-Display Charts in an even coat as soon as possible after mixing; apply enough layers to make painted area completely opaque, or to the required level of opacity for translucent products.

.3 Order paint only for drawdown cards accepted by Consultant.

.4 Final colour selection is by Consultant.

.5 Resubmit until accepted by Consultant.

.6 Consultant will provide colour chips if alternate colours are selected for rejected cards.

.3 Informational Submittals: Provide the following submittals when requested by the Consultant:

.1 Certification: Submit certification reports for paint products indicating that they meet or exceed low VOC and coloured base requirements listed in this Section.

.2 Purchase Orders: Retain purchase orders, invoices and other documents for verification of compliance with specification and design requirements.

1.6 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit copies of paint manufacturer's written maintenance information for inclusion in the operations manual in accordance with Section 01 00 06 – General Requirements: Project Closeout including specific warning of any maintenance practice or materials that may damage or disfigure the finished Work.

.2 Maintenance Materials: Deliver maintenance materials to Owner in quantities indicated and in accordance with Section 01 00 06 – General Requirements that match products installed; packaged with protective covering for storage, and identified with labels describing contents and building location and as follows:

.1 Paints and Coatings: Minimum of 2 - 4L containers of field colours and 4-1 L containers of each accent colour, and all remnants.

1.7 QUALITY ASSURANCE

.1 Conform to the standards contained in the MPI Manual.

.2 Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in service performance, and as follows:

.1 Have a minimum of five (5) years proven satisfactory experience and shall show proof before commencement of work that he will maintain a qualified crew of painters throughout the duration of the work.

.2 When requested provide a list of the last three comparable jobs including, name and location, specifying authority, start and completion dates and cost amount of the painting work.

.3 Only qualified journeymen who have a Tradesman Qualification Certificate of Proficiency shall be engaged in painting and decorating work.

.4 Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.

.3 Source Limitations: Obtain primers for each coating system from the same manufacturer as the finish coats and as follows:

.1 Use only paint manufacturers and products as listed under the Approved Products section of the MPI Manual Architectural Painting Specification Manual.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Conform to MPI Manual and manufacturer's requirements.

.2 Perform no painting or decorating work when the ambient air and substrate temperatures, relative humidity and dew point and substrate moisture content is below or above requirements for both interior and exterior work.

.3 Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.

.4 Ensure adequate continuous ventilation and sufficient heating and lighting is in place.

.5 Paint, stain and wood preservative finishes and related materials (thinners, solvents, caulking, empty paint cans, cleaning rags, etc.) shall be regarded as hazardous products. Recycle and dispose of same subject to regulations of applicable authorities having jurisdiction.

.6 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into the ground retain cleaning water and filter out and properly dispose of sediments.

.7 Set aside and protect surplus and uncontaminated finish materials not required by the Owner and deliver or arrange collection for verifiable re-use or re-manufacturing.

1.9 GENERAL COLOUR REQUIREMENTS

.1 Ceilings generally will be Finished a different colour than walls.

.2 Doors generally will be same colour, but different colour than trim and walls.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers that have attained the prerequisites for ecologically sustainable labelling mark on their products and may be incorporated into the Work include; but are not limited to, the following:

.1 Pratt & Lambert
.2 Benjamin Moore and Co. Limited
.3 Dulux Paints.
.4 Para Paints
.5 PPG Canada Inc.- Architectural Finishes
.6 SICO Inc.

2.2 MATERIALS

.1 Primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, and other painting materials shall be in accordance with the MPI Manual “Approved Product” listing and shall be from a single manufacturer for each system used.

.2 Materials such as linseed oil, shellac, and other accessory materials shall be the highest quality product of an approved manufacturer listed in the MPI Manual and shall be compatible with other coating materials.

.3 All materials and paints shall be lead and mercury free and shall have low VOC content where possible.

Part 3 Execution

3.1 PREPARATION OF SURFACES:

.1 Prepare surfaces in accordance with MPI Manual requirements. Refer to the Manual for specific surface preparation requirements for each substrate material.

3.2 APPLICATION

.1 Paint when substrates and environmental conditions (heating, ventilation, lighting and completion of other work) are acceptable for applications of products specified in this Section.

.2 Paint and stain surfaces requiring paint or stain finish to Premium MPI Manual finish requirements with application methods in accordance with best trade practices for type and application of materials used.

.3 Continue paint finishes through behind wall mounted items.

.4 Painting coats specified are intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with manufacturer's recommendations.

.5 Apply a minimum of four coats of paint where deep or bright colours are used to achieve satisfactory results.

3.3 EXTERIOR SURFACES

.1 Paint exterior surfaces in accordance with the MPI Manual painting systems listed in this section.

.2 Structural Steel and Metal Fabrications:

.1 EXT 5.1C – Alkyd metal primer/water based light industrial coating.

.3 Galvanized Metal (doors, frames, railings, misc. steel, pipes, overhead decking, ducts, gutters, flashing, etcetera):

.1 EXT 5.3B – Alkyd G5 finish.

.4 Dimension Lumber (columns, beams, exposed joists, underside of decking, siding, fencing, etcetera)

.1 EXT 6.2E – Varnish (over stain) finish.

.5 Dressed Lumber (including doors, door and window frames, casings, battens, smooth facias, etcetera):

.1 EXT 6.3E – Varnish (over stain) Semi Gloss finish.

.6 Wood Decks and Stairs/Steps: (using spaced lumber)

.1 EXT 6.5F – Deck Stain.

3.4 INTERIOR SURFACES

.1 Paint interior surfaces in accordance with the MPI Manual painting systems listed in this section.

.2 Structural Steel and Metal Fabrications:

.1 INT 5.1E – Alkyd G3 finish.

.3 Dimension Lumber: (columns, beams, exposed joists, underside of decking, etcetera)

.1 INT 6.2J – Polyurethane varnish (over stain) G3 finish.

.2 INT 6.2K – Alkyd varnish finish (over stain and sealer).

.4 Dressed Lumber (including doors, door and window frames, casings, mouldings, etcetera):

.1 INT 6.3A – High Performance Architectural Latex semi-gloss finish.

.2 INT 6.3E – Semi-transparent stain / polyurethane varnish [insert gloss] finish.

.5 Plaster and Gypsum Board (gypsum board, drywall, and other sheet gypsum materials):

.1 INT 9.2B – High performance architectural latex eggshell finish.

.2 INT 9.2M – Institutional low odour / VOC eggshell finish.

3.5 MECHANICAL AND ELECTRICAL EQUIPMENT

.1 Paint “unfinished” conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and texture to match adjacent surfaces, in the following areas:

.1 In exposed-to-view exterior and interior areas.

.2 In interior high humidity interior areas.

.3 In boiler room, mechanical and electrical rooms.

.2 Leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks in unfinished areas.

.3 Paint inside of ductwork where visible behind louvers, grilles and diffusers beyond sight line with primer and one coat of matt black (non-reflecting) paint.

.4 Paint the inside of light valances gloss white.

.5 Refer to Mechanical and Electrical specifications for painting, banding, stencilling of other surfaces/equipment, and generally as follows:

.1 Paint gas piping gas standard yellow where visible in service spaces.

.2 Paint both sides and all edges of plywood backboards for equipment before installation.

.3 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

.4 Do not paint over nameplates.

3.6 SITE QUALITY CONTROL

.1 Painted surfaces will be considered to lack uniformity and soundness if any of the following defects are apparent at time of field review when viewed from a distance of 48 inch (1220 mm) from the painted surface:

.1 Runs, sags, hiding or shadowing by inefficient application methods

.2 Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles

.2 Painted surfaces will be considered as deficient if any of the following defects are apparent at time of field review, regardless of viewing distance.

.1 Damage due to touching before paint is sufficiently dry or any other contributory cause.

.2 Damage due to application on moist surfaces or caused by inadequate protection from the weather.

.3 Damage or contamination of paint due to windblown contaminants (dust, sand blast materials, salt spray, etcetera)

.3 Painted surfaces found as unacceptable shall be replaced or repaired at no cost to the Owner or Consultant:

.1 Small affected areas may be touched up

.2 Large affected areas or areas without sufficient dry film thickness of paint shall be repainted.

.3 Runs, sags or damaged paint shall be removed by scraper or by sanding before application of new paint coats.

3.7 PROTECTION

.1 Protect newly painted exterior surfaces from rain and snow, condensation, contamination, dust, salt spray and freezing temperatures until paint coatings are completely dry.

.2 Curing periods shall exceed the manufacturer's recommended minimum time requirements.

.3 Erect barriers or screens and post signs to warn of or limit or direct traffic away or around work area as required.

3.8 RESTORATION

.1 Clean and re-install all hardware items that were removed before painting operations were undertaken, ensuring that tagged or labelled items are returned to the exact position from which they were removed.

.2 Clean, prime and re-paint all bolts, nuts and fasteners after torqueing or re-tightening following specified paint finish.

.3 Remove protective coverings and warning signs as soon as possible after operations cease.

.4 Protect freshly painted surfaces from paint droppings and dust to approval of Consultant. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Consultant.

3.9 CLEANUP

.1 Remove all paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

.2 Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.

.3 Remove combustible rubbish materials and empty paint cans each day and safely dispose of it in accordance with requirements of authorities having jurisdiction.

.4 Clean equipment and dispose of wash water or solvents, and other cleaning and protective materials (rags, drop cloths, masking papers, etcetera), paints, thinners, paint removers and strippers in accordance with the safety requirements of authorities having jurisdiction.

END OF SECTION

SECTION 10 22 26

FOLDING PARTITIONS

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of manually operated accordion folding partition system with all components required for fully functioning and operable system described for the project.

1.2 RELATED REQUIREMENTS

.1 Section 06 10 00 – Rough Carpentry

.2 Section 06 15 33 – Cedar Wood Carpentry: Cedar Exterior Soffits and Interior Ceilings.

.3 Section 05 50 00 – Metal Fabrications: Primary structural supports and coordination of support member attachment of track suspension systems.

.4 Section 09 21 16 – Gypsum Board Assemblies, ceiling storage pockets and bulkheads

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

.2 ASTM E336-09, Standard Method for Measurement of Airborne Sound Insulation in Buildings

.3 ASTM E557-00 (2006), Standard Guide for Installation of Operable Partitions

.2 Underwriters Laboratories Canada (ULC):

.1 CAN/ULC S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate stacking depths with manufacturer's requirements and confirm depth of pocket provided for project installation, revise dimensions in advance of installation with affected work to ensure a proper fit, and as follows:

.1 Floor Flatness: Coordinate manufacturer's requirements for floor flatness and level required to obtain airtight contact between acoustic seal and floor immediately under the folding panel partition with other sections relating to concrete floor preparation and installation.

.1 Support Structure: Coordinate manufacturer's requirements for size and configuration of miscellaneous steel support beam required for attachment of track suspension system.

.2 Above Track Construction: Coordinate manufacturer's requirements for sound rated ceilings and plenums with other sections relating to ceiling construction; install sound barrier construction above partition track to maintain sound rating performance specified in this Section.

.2 Pre-Construction Meetings: Conduct pre-installation meeting in sufficient time before starting work of this Section to verify project requirements and clearances.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's printed product literature for folding partitions or components, and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Shop Drawings: Submit drawings indicating location and extent of partitions including; but not limited to, the following:

.1 Plans, elevations, sections, details, and attachments to other construction

.2 Head and jamb details, opening sizes, anchorage clearances, stack depths, hardware and track including floor tolerances required and direction of travel, finish pattern and colour, and accessories required for complete installation

.3 Dimensions, weights, conditions at openings and storage areas

.4 Installation requirements for storage areas and operating clearances

.5 Indicate blocking specifically provided and coordinated by other sections of work

.3 Samples for Verification: Submit duplicate 12 inch x 8 inch (305 mm x 203 mm) samples of specified covering in same thickness and material indicated for the work for each folding partition cover to Consultant for confirmation of selection.

.3 Informational Submittals: Provide the following submittals during the course of the work:

.1 Setting Drawings: Submit setting drawings in advance of work of other sections affected by this Section indicating:

.1 Items embedded or cast into adjacent construction

.2 Cut outs and punching template in support structures and beams

.3 Other work required by other sections to complete their work

.2 Source Quality Control: Submit certified test reports for fire hazard classification and sound transmission from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.3 Site Quality Control Submissions: Submit written report prepared by manufacturer verifying compliance with specified performance requirements of installed materials and products.

.4 Manufacturer's Installation Instructions: Submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.6 PROJECT CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: Submit manufacturer's written instructions for operations and maintenance procedures, include name of original installer and contact information in accordance with Section 01 00 06 – General Requirements: Operation and Maintenance Manuals, and as follows:

.1 Panel finish facings and finishes for exposed trim and accessories; include precautions for cleaning materials and methods that could be detrimental to finishes and performance

.2 Seals, hardware, track, carriers, and other operating components

.2 Parts: Submit extra materials described below that match installed products in accordance with Section 01 00 06 – General Requirements: Spare Parts:

.1 Panel Finish Facing Material: Furnish full width in quantity to cover both sides of six (6) panels when installed

.2 Carriers: Two (2)]pairs of trolley assemblies

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements: Provide materials and assemblies tested and labelled indicating flame spread and smoke developed ratings acceptable to the Authority Having Jurisdiction.

.2 Qualifications: Provide proof of qualifications when requested by The Team Project Manager, Team Member, Team Crew Member assigned to such duties:

.1 Supplier: Obtain materials from a supplier capable of maintaining a stock of parts and components necessary to repair and maintain installed materials and products, and able to respond within a two (2) hour time period.

.2 Installer: Use installers that are trained and approved by manufacturer of installed materials having a minimum of five (5) years of experience in work of a similar scope and complexity as work required for Project.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Package and sequence accordion partition materials matching order of installation.

.2 Clearly mark packages with numbering system used on shop drawings; do not use permanent markings on accordion partitions.

1.9 SITE CONDITIONS

.1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on shop drawings where accordion folding partitions are indicated to fit between or around other construction; coordinate fabrication schedule with construction progress to avoid delaying the Work.

.2 Established Dimensions: Establish dimensions and proceed with fabricating accordion folding partitions without site measurements where site measurements cannot be made without delaying the Work; coordinate construction to ensure that actual site dimensions correspond to established dimensions; allow for trimming and fitting.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 Dorma, Modernfold Inc.

.2 Kwik-Wall, Curition Movable Wall Systems.

.3 Moderco Inc.

.4 Panelfold Inc.

2.2 FOLDING PARTITION

.1 Description: Manually operated, top supported accordion partitions as follows:

.1 Performance Requirements:

.1 Acoustic: 40 minimum nominal STC in accordance with ASTM E90

.2 Flame Spread/Smoke Developed: 25/50 when tested in accordance with CAN/ULC S102

.2 Partition Construction: Manufacturer's standard twin wall wood veneer panels laminated to engineered core connected with hinge and steel rods with vinyl seals between panels to provide sight [and acoustic] privacy and as follows:

.1 Finish: As selected from manufacturer's standard range of finishes for designated materials

.3 Suspension System: Manufacturer's standard suspension track, yokes and carriers including curves, switches and multiple meeting posts as required to meet project requirements, and as follows:

.1 Track: Flush ceiling mounted architectural grade aluminum track designed to support weight of partition.

.2 Trolley Yokes and Frame: Bearing mounted steel alloy trolley yoke functioning as a hinge pin at intervals supporting frame assembly.

.3 Carriers: Four wheel units positioned at lead post and two wheel units at each support point with 1 inch (25 mm) steel wheels and self lubricating nylon tires with carrier spacing at a nominal maximum of 11 inch (280 mm).

.4 Operating Hardware: Manufacturer's standard pull bar, draw latches, screws and installation hardware selected from manufacturer's standard finishes and as follows:

.1 Hand Pulls: Manufacturer's standard satin chrome finished grip with integral latching hardware; extruded aluminum rods or plastic hand pulls are not acceptable.

.2 Locking Hardware: Privacy lock one side

.5 Basis-of-Design Materials: Modernfold 911 – Single Panel Folding Partition System.

2.3 ACCESSORIES

.1 Sweeps: Vinyl strips at head to conceal track.

.2 Sound Seals: Vinyl or rubber gaskets at jambs with double sweep strips at top and bottom.

.3 Air Release: Provide series of 0.393 inch (10 mm) holes in lead post molding to assist with release of air trapped with partition during operation.

.4 Jamb Panels: Provide sliding jamb panels, finished to match partition as required by installation.

Part 3 Execution

3.1 EXAMINATION

.1 Verify that substrate conditions and work installed by other sections match manufacturer's requirements as discussed during coordination and pre-installation meetings; starting work is denoted as acceptance of conditions.

3.2 INSTALLATION

.1 Install accordion folding partitions in accordance with requirements of ASTM E577 to achieve sound ratings required and in accordance with manufacturer's written instructions and as follows:

.1 Level tracks and fasten securely to header.

.2 Install partition in accordance with manufacturer's printed instructions.

.3 Touch up damaged finishes, repair damage to partitions to match original finish.

.4 Clean folding partition system and protect from damage.

.5 Adjust and leave partitions in smooth operating conditions.

3.3 SITE QUALITY CONTROL

.1 Manufacturer's Site Services: Schedule site visits to comment on and provide direction to installer at following stages of construction, to ensure that work of this Section is installed in accordance with manufacturer's instructions:

.1 After delivery and storage of products, and when preparatory Work is complete but before installation begins

.2 Twice during progress of Work at 25% and 60% complete

.3 Upon completion of Work, after cleaning is carried out

.2 Reporting: Prepare a report describing observations and any corrective measures undertaken to install accordion folding partitions required to meet specified performance requirements; submit results of acoustical testing confirming specified performance requirements.

3.4 CLOSEOUT ACTIVITIES

.1 Cleaning: On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment and perform cleaning as required by Section 01 00 06 – General Requirements; Final Cleaning.

.2 Demonstration: Provide training to Owner's representative performed by manufacturer's authorized site representative of moveable components and setting out and maintenance of folding panel partition components.

END OF SECTION

SECTION 10 28 13

TOILET ACCESSORIES

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of toilet accessories.

1.2 RELATED REQUIREMENTS

.1 Section 08 81 00 – Glass Glazing: Mirrored Glass for frameless mirrors.

.2 Section 09 21 16 – Gypsum Board Assemblies

.3 Section 09 30 00 – Tiling: Ceramic toilet and bath accessories.

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI):

.1 ANSI/ICC A117.1-2003, Standard for Accessible and Usable Buildings and Facilities

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-12.5-M86, Mirrors, Silvered

.3 Canadian Standards Association (CSA):

.1 CSA B651-012, Accessible Design for the Built Environment

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate accessory locations with other affected work to prevent interference with clearances required for access by disabled persons, proper installation within substrate, blocking requirements, adjustment, operation, cleaning, and servicing of accessories including the following:

.1 Installation of grab bars to metal toilet partitions, provide templates and detail to partition manufacturer for shop fabrication of steel reinforcing plates. Instruct whether shop or field, drill and tap technique will be used.

.2 Reinforcement locations indicated in Section 09 21 16.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting work of this section:

.1 Submit product data including construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

.3 Information Submittals: Provide the following submittals during the course of the work of this Section:

.1 Submit samples for each accessory item to verify design, operation, and finish requirements; accepted full size samples will be returned and maybe used in the Work.

.2 Submit setting drawings for cut outs required in other work; include templates, substrate preparation instructions, and directions for preparing cut outs and installing anchoring devices.

1.6 PROJECT CLOSEOUT SUBMITTALS

.1 Operations and Maintenance Data: Submit maintenance data for accessories in accordance with Section 01 00 06 – General Requirements, Operations and Maintenance Data; include lists of sources for disposable supplies, replacement parts and service recommendations.

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements: Install toilet accessories in accordance with CSA B651 at accessible washroom locations.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Handling Requirements: Deliver washroom accessories in manufacturer's original, undamaged packaging, clearly marked for contents and location within building.

1.9 WARRANTY

.1 Manufacturer's Mirror Warranty: Submit manufacturer’s standard written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects and as follows:

.1 Minimum Warranty Period: 15 years from date of Substantial Performance for the Project.

Part 2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section.

.2 Additional Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section ; and as established by the Basis-of-Design Materials, use any of the listed manufacturers products in accordance with Section including the following:

.1 Taymor Canada

.2 ASI Specialties Inc.

.3 Bobrick Washroom Equipment of Canada Ltd.

.4 Bradley Corporation

2.2 DESIGN REQUIREMENTS

.1 Fastener and Mounting Requirements: Install grab bars to withstand a minimum 1.3 kN downward shear force when tested in accordance with ASTM F446; provide fasteners and mountings of types suitable for substrates, and as required for permanent and durable installation.

.2 Labels: Provide unobtrusive stamped manufacturer logo on exposed surfaces; with printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number mounted to non-exposed faces.

.3 Surface Mounted Units: Provide units having tight seams and joints, and with exposed edges rolled; doors and access panels having continuous stainless steel hinges; and concealed anchorage where possible.

.4 Recessed Mounted Units: Provide units having welded construction, without mitred corners; doors and access panels having full length, stainless steel hinges and anchorage fully concealed when unit is closed.

2.3 MATERIALS

.1 Stainless Steel: Type 304, stretcher levelled stainless steel sheet in accordance with ASTM A666; minimum nominal thickness as established by product type and manufacturers standard.

.2 Sheet Steel: Steel: Cold rolled, commercial quality , stretcher levelled steel sheet in accordance with ASTM A366; minimum nominal thickness as established by product type and manufacturers standard; surface preparation and metal pretreatment as required for applied finish.

.3 Galvanized Steel Sheet: Minimum Z180 coating designation, cold rolled commercial quality , stretcher levelled galvanized steel sheet in accordance with ASTM A653/A653M; minimum nominal thickness as established by product type and manufacturers standard.

.4 Mirror Glass: In accordance with CGSB 12.5; type 1B for high humidity use, 0.236 inch (6 mm) nominal thickness, with silvering, electroplated copper coating, and protective organic coating.

.5 Fasteners: Manufacturer’s standard for installation; through bolts for mounting to toilet partitions; expansion anchors of type designed to accept anticipated loads and as follows:

.1 Galvanized Steel Mounting Devices: In accordance with ASTM A153/A153M, hot dip galvanized after fabrication.

.2 Screws, Bolts, and other Devices: Same material as accessory unit, tamper and theft resistant when exposed, and galvanized steel when concealed.

Part 3 Execution

3.1 EXAMINATION

.1 Examine site conditions and verify that the following are complete:

.1 Wall thickness and construction will accept recessed accessories.

.2 Solid blocking for support and anchoring of washroom accessories is installed where required.

.3 Frames and anchors provided are correctly and securely installed ready to accept the accessory scheduled for the specific location.

.4 Painting is complete and dry in area of installation before accessories are installed.

.2 Beginning of installation will denote acceptance of site conditions

3.2 INSTALLATION

.1 Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer; install toilet accessory units level, plumb, and firmly anchored in locations and at heights indicated.

.2 Conform to mounting heights indicated on Fixture Mounting Schedule attached to this Section and meeting accessibility requirements listed in CSA B651; confirm locations prior to site installation.

.3 Install recessed fixtures in fire rated partitions to maintain required fire rating of assembly by installing 0.629 inch (16 mm) Type fire rated gypsum board completely around unit, coordinate with Section 09 21 16.

.4 Install and secure fixtures rigidly in place using tamper proof headed screws and bolts for fasteners and as follows:

.1 Stud Walls: Install steel back plate to stud prior to gypsum board finish; provide threaded studs or plugs in back plates

3.3 ADJUSTING AND CLEANING

.1 Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

.2 Remove temporary labels and protective coatings.

.3 Clean and polish exposed surfaces in accordance with manufacturer's written recommendations.

.4 Provide a list of paper towel, toilet paper and other disposable supplies required to make accessories usable.

.5 Instruct Owner in proper adjustment, operation and refilling procedures.

3.4 WASHROOM AND CUSTODIAL ACCESSORY SCHEDULE

No.	Description / Model
H1	Robe Hooks: Polished chrome, square profiled robe hook with concealed mounting, provide 2 for each washroom, located in compliance with ADA guidelines and as directed by the Team Project Manager ot Team Member assigned to such duties and as follows: Acceptable Materials: Taymor 02-D20502 ASI 7340-S Bobrick B-76717 Bradley 9114

M1	Mirror: Mirror as specified in Section 08 81 00, length of vanity x top of vanity to 86.73 in. (2203 mm) above finished floor, frameless.
TB	Towel Bar: 9 in. (228 mm) long, rectangular polished chrome towel bar complete with concealed mounting plates and as follows: Acceptable Materials: Taymor 02-D20509 ASI 7355-24 Bobrick B-530-24 Bradley 9065-24
TD1	Toilet Paper Holder: Single roll, surface mounted, paper holder with concealed mounting, polished chrome finish and as follows: Acceptable Materials: Taymor 02-D20548 ASI 7305 Series Bobrick B-685-60 Bradley 5084-52

END OF SECTION

SECTION 11 31 00

RESIDENTIAL APPLIANCES

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of the following:

- .1 Cooking equipment including:
  - .1 Electric cook tops.
  - .2 Electric wall ovens.
- .2 Ventilation Range hoods
- .3 Refrigerator/freezers.
- .4 Cleaning appliances:
  - .1 Dishwashers.
  - .2 Clothes washers.
  - .3 Clothes dryers..

1.2 RELATED REQUIREMENTS

.1 Section 06 40 00 – Shop Fabricated Architectural Woodwork: Coordination with custom made cabinets and plastic laminate countertops receiving residential appliances.

.2 Section 09 21 16 – Gypsum Board Assemblies: Coordination with built-in appliances and adjacent wall construction.

.3 Division 22 – Plumbing: Coordination of pipes and pipe fittings and other materials.

.4 Division 26 – Electrical: Coordination conduit, wiring and other materials.

1.3 SUBSTITUTIONS

.1 Materials other than the named products for the Project may be acceptable to the Consultant. Submit information in accordance with Section.

.2 The Team Project Manager, Team member or Team Crew Members assigned to such duties will review all proposed alternates prior to close of bids when submitted no later than seven (7) days prior to bid closing date as follows:

- .1 Proposed alternates shall match colour range and performance characteristics of named products.
- .2 Proposed alternates found acceptable by the Consultant will be listed in the form of an Addendum.
- .3 The Consultant is not obliged to accept any materials presented for their review and does not need to provide reasons for rejection of proposed alternates.

1.4 SUBMITTALS

.1 Provide the following required information in accordance with 01 00 06 – General Requirements: Submittals.

.2 Submit product data for each appliance indicated including operating characteristics, dimensions of individual appliances, and finishes for each appliance.

1.5 QUALITY ASSURANCE

.1 Use installers having workers trained and approved by manufacturer for installation and maintenance of appliances required for this Project.

.2 Obtain products from a qualified manufacturer having a service centre capable of providing training, parts, and emergency maintenance repairs.

.3 Obtain residential appliances through one source from same manufacturer for entire Project to the greatest extent possible.

.4 Appliances shall be labelled in accordance with requirements of CSA, ULC, CGA and other standards acceptable to the Authorities Having Jurisdiction.

.5 Provide residential appliances that carry labels indicating energy cost analysis (estimated annual operating costs) and efficiency information qualifying for labelling under the Energy Star Program.

1.6 WARRANTY

.1 Provide manufacturer's standard form of warranty stating that each appliance specified will repaired or replaced that fail in materials or workmanship within specified warranty periods as follows:

.1 Electric Range: Five (5) year limited warranty for of surface burner elements.

.2 Microwave Oven: Five (5) year limited warranty for of defects in the magnetron tube.

.3 Refrigerator/Freezer: Five (5) year limited warranty for of sealed refrigeration system.

.4 Dishwasher: Ten (10) year limited warranty for against deterioration of tub and door liner.

.5 Clothes Washer: Ten (10) year limited warranty for the inner wash basket and outer tub, and a five (5) year limited warranty for the balance suspension system and drive transmission.

Part 2 Products

2.1 COOKING APPLIANCES

.1 Cook Top CT-1:

.1 Basis-of-Design Product: Whirlpool GCI3061XB 30" electric inductionor a comparable product by one of the listed acceptable manufacturers.

.2 Wall Oven WO-1:

.1 Basis-of-Design Product: Whirlpool WOS51EC0AS 30" 5.0 CU FT single wall oven or a comparable product by one of the listed acceptable manufacturers.

.3 Exhaust Hood EX-1:

.1 Basis-of-Design Product: Maytag UXT5230 or a comparable product by one of the listed acceptable manufacturers.

2.2 REFRIGERATION APPLIANCES

.1 Refrigerator/Freezer RF-1:

.1 Basis-of-Design Product: Blomberg BRFB 1450 SS 27" right hinge or a comparable product by one of the listed acceptable manufacturers.

2.3 CLEANING APPLIANCES

.1 Dishwasher DW-1:

.1 Basis-of-Design Product: Bosch SPX5ES55UC or a comparable product by one of the listed acceptable manufacturers.

.2 Clothes Washer CW-1:

.1 Basis-of-Design Product: Blomberg WM77110NBL00 or a comparable product by one of the listed acceptable manufacturers.

.3 Clothes Dryer CD-1:

.1 Basis-of-Design Product: Blomberg DV17540NBL00 or a comparable product by one of the listed acceptable manufacturers.

Part 3 Execution

3.1 EXAMINATION

.1 Examine conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

.2 Examine roughing-in for piping and electrical systems to verify actual locations of piping and electrical connections before equipment installation.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

.1 Install in accordance with manufacturer's written instructions.

.2 Securely anchor built-in units to supporting cabinets or countertops with concealed fasteners; verify that clearances are adequate for proper functioning and rough openings are completely concealed.

.3 Place free-standing units in final locations after finishes have been completed in each area; verify that clearances are adequate to properly operate equipment.

3.3 CLEANING AND PROTECTION

.1 Test each residential appliance specified in this Section to verify proper operation; make necessary adjustments.

.2 Verify that accessories required have been furnished and installed.

.3 Remove packing material from residential appliances and leave units in clean condition, ready for operation.

3.4 DEMONSTRATION

.1 Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION

SECTION 20 00 10

MECHANICAL PROJECT SPECIFICATIONS

Part 1 General

1.1 SHORT FORM SPECIFICATIONS

.1 The Mechanical Specification is in Short Form Format and is based on the "MasterFormat" published jointly by Construction Specifications Canada and The Construction Specifications Institute.

.2 The nature of the Short Form Specification Format indicates that detailed execution and regulatory requirements may not be present in this section.

.3 Requirements of work requiring coordination or combined skills will be read as one requirement, applicable to all parties providing work.

.4 These documents include all drawings and specifications and contract requirements; what is required by one component is required by all.

.5 These specifications should be read in conjunction with all other documents; where differences occur between different documents, the most restrictive requirement will apply.

.6 Coordinate activities with other sections and trades to minimize conflicts that may arise.

1.2 DEFINITIONS

.1 Provide: The word provide means to supply, install and make operational, and is applicable to the Contractor of the work of this section.

.2 Alternate: The word alternate will be applied to a product different than specified products, but will function, operate and perform in a manner similar to or better than the specified product; will not alter construction methods or dimensions; and will have the same visual appearance, fit and finish including any additional requirements as listed in item 1.4 below.

1.3 GENERAL PROVISIONS

.1 Provide labour, materials, products, equipment, services and all incidentals required to complete, test and commission all mechanical work shown on the drawings or noted in this specification:

.1 Drawings are diagrammatic except where specific details are given.

.2 Obtain accurate dimensions from the architectural, structural, or by on-site measurements.

.3 Follow manufacturer’s recommended installation detail procedures for equipment, supplemented by requirements of the contract documents.

.2 Work shall be complimentary to the base building design and installations:

.1 Where an exact method of installation has not been indicated, follow the methods used on the base building.

.2 Generally, the standard of work shall be equal to or better than that of the base building.

.3 Additions or changes to existing systems shall be made using equipment identical to that already used in the base building, including sprinkler heads.

.3 Visit the site to thoroughly examine and become familiar with conditions which may affect the work:

.1 No claims for extras will be allowed for work or materials necessary for proper execution and completion of the Contract or for the Bidder's failure, error, or negligence in this regard.

.4 Work shall be completed in accordance with the current Canadian Plumbing Code, CSA Standards, ASHRAE Standards, SMACNA Standards, ASTM Standards, IRC, IBC, City Inspection Authority's requirements, and with the requirements of all authorities having jurisdiction:

.1 Submit the necessary plans to the City Inspection Departments and pay for all permits and fees as required before commencement of work.

1.4 ALTERNATES

.1 Bid price shall be based on materials and equipment specified.

.2 Submit proposed alternates indicating estimated cost saving or improved value to the project in accordance with Section 01 00 06 – General Requirements.

.3 Include costs for additional work required by substitute materials where the change in materials requires a change in the design based on the originally specified equipment, including work required by other divisions to accommodate alternate equipment.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Shop Drawings: Submit manufacturer's detailed drawings showing dimensions, capacities, weights, piping connections, electrical data and performance characteristics for equipment including, but not limited to, the following:

.1 Mechanical equipment

.2 Plumbing fixtures

.3 Accessories

.4 Other items reasonably requested by the Consultant, or as listed in these specifications.

1.6 TESTING AND BALANCING

.1 Testing and balancing shall be performed by an agency that specializes in this type of work. Balance, adjust and test work included in the specifications:

.1 Balance systems to ±10% of design values.

.2 Balance only new work and where existing is indicated to be balanced.

.2 Perform all necessary tests to confirm the correct operation of all systems affected by the renovations.

.3 Submit all test results in duplicate to the Consultant for approval.

1.7 PROJECT CLOSEOUT SUBMISSIONS

.1 Record Documents (Drawings and Specifications): Submit as constructed information in accordance with Section 01 00 06 – General Requirements: Project Record Documents, and as follows:

- .1 Record information using sharp coloured pencils on one (1) set of prints and specification manual dedicated for the use of Record Documents.
- .2 Indicate all changes and variations from Contract Drawings concurrently with construction process; do not conceal any work until required information is recorded.
- .3 Include sufficient information to accurately record actual construction including, but not limited to the following:
- .4 Measured locations of equipment, ducting and piping concealed in construction to be referenced to visible and accessible features of construction.
- .5 Field changes of dimension and detail or changes in construction materials or locations required by on-site conditions and to make components of the Work come together.
- .6 Changes to equipment layout and services.
- .7 Deviations in piping, duct runs, wiring, and utility connections.
- .8 Actual locations of equipment referenced to fixed structural elements for items that are schematically indicated on the Drawing.
- .9 Changes required by Addenda, Bid Revisions, Change Orders, Work Orders and Construction Communications.

.2 Make recordings immediately after the respective Work is completed and not less than once a week; date each recording.

.3 Changes to specification sections shall be legibly noted in the margins of the document or by stapling a sheet of white paper to the margin and referencing the affected article(s); use of adhesive tape or self-sticking removable notes will not be acceptable for this purpose.

1.8 USE OF PERMANENT SYSTEMS FOR TEMPORARY HEAT

.1 Do not use permanent system for temporary heating purposes without written permission from Consultant.

.2 Provide a proposed temporary heat agreement for Owner to review prior to use of permanent building systems for temporary heat; agreement shall include payment schedule for utilities, spare parts listing and confirmation of warranty.

.3 Use of permanent systems for temporary heat shall not modify terms of warranty; equipment manufacturers shall certify that equipment is in "new" condition at start of warranty period, and as follows:

- .1 Block-off system components not required for temporary heat in accordance with manufacturer’s requirement to maintain warranty.
- .2 Thoroughly clean and overhaul permanent equipment used during construction period, replace worn or damaged parts before final inspection.
- .3 Operate heating systems under conditions that ensure no temporary or permanent damage.
- .4 Operate with proper safety devices and controls installed and fully operational.
- .5 Operate systems only with treated water as specified.

.6 Air systems may not be used for temporary heating.

.7 Provide alarm indicating system failure; connect alarm to independent alarm company system.

.8 Replace mechanical seals, regardless of condition, with new mechanical seals where pumps are used for temporary heating prior to Total Performance of the Work.

.9 Avoid thermal shock to heating system during planning, construction and operation of temporary heating system.

1.9 PERMITS, CERTIFICATES AND FEES

.1 Permits and Compliance Monitoring:

.1 Arrange for the services of an agency authorized by Alberta Labour to issue permits and provide compliance monitoring in non-accredited municipalities.

.2 Agency shall not be affiliated with the Contractor in any fashion.

.3 Submit name of agency and other relevant information to the Consultant for review and acceptance.

.2 Compliance monitoring shall consist of a minimum of 3 site inspections: site services, rough-in, and final.

.3 Submit necessary drawings and specifications to the agency before commencement of the Work.

.4 Submit certificate of acceptance issued by the agency on completion of the Work.

.5 Pay associated fees with respect to obtaining permits and certificates.

1.10 WORKMANSHIP AND MATERIAL

.1 Materials shall be new, carry CSA or ASTM labelling indicating approval.

.2 Only use new materials, except where specifically detailed or indicated that existing materials shall be re-used.

.3 Workmanship shall be performed in a neat and professional manner; as a minimum, the Consultant will expect that:

.1 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services to free space.

.2 Remove and replace improperly installed equipment as required to repair or rectify the deficiency at no extra cost.

.3 Damaged or incorrectly installed materials be removed and replaced.

.4 Damaged finishes are restored to match original finishes.

.5 Structural, Architectural or Electrical items are not damaged, altered, or interfered with by installation of materials by this Section, whether caused directly or indirectly because of their work.

.6 Site is left in clean and tidy at the end of each workday by removing tools, equipment, ladders, and empty cardboard boxes from site, and premises are left broom clean at the end of the week.

1.11 EXECUTION OF THE WORK

.1 Obtain Consultant's interpretation or clarification on the specifications and drawings before proceeding with the work:

- .1 Correct completed work installed contrary to the intent of the drawings and specifications at their own expense, where it can be determined that a clarification could have been issued.
- .2 Notify the Consultant as work progresses where additional clarification or interpretation of the specifications and drawings is required.

.2 Clean and touch-up surfaces of shop painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Complete coring, cutting and patching using qualified specialists; obtain written approval from Consultant before starting coring or cutting work.

.4 Coordinate and cooperate with other trades on site to avoid interference of systems installed by this section and those installed by other parts of the Work:

- .1 Protect all finishes and unfinished work of this and other divisions from damage due to carrying out of this work.
- .2 Keep equipment dry and clean at all times.
- .3 Cover openings in equipment and materials.
- .4 Be responsible for and make good any damage caused directly or indirectly to walls, floors, ceilings, woodwork, brickwork, finishes, etcetera
- .5 Pack space between ducting or piping full with mineral wool firestopping and fire rated silicone sealant in accordance with manufacturers written instructions where passing through floors and fire rated walls.

.5 Conduct final cleaning upon completion of work including, but not limited to, the following:

- .1 Clean diffusers, radiation, radiant panels and other surfaces that have been exposed to construction dust and dirt.
- .2 Clean and refinish exposed equipment, and replace any broken or malfunctioning components.

.6 Guaranty materials, equipment, and installations to be free of all defects for a period of twelve months from the date of Substantial Performance in accordance with General Conditions of Contract.

1.12 PIPING

.1 General:

- .1 Install piping approximately as shown, with all lines being carried parallel to building walls as close to the structure as possible, or as detailed on the drawings.
- .2 Align and support all piping properly. Under no circumstances may any piping load be transferred to the equipment or other piping. Make all equipment connections so as to allow disassembly of the piping for equipment removal and maintenance.
- .3 Install all piping to allow for expansion and contraction without unduly stressing pipe or connected equipment.

.2 Piping Material:

.1 Domestic Water:

.1 Type L copper, 95-5 lead free solder joints. Isolation valves to be gate or ball.

.2 Test to 1-1/2 times maximum working pressure or 1035 kPa, whichever is greater, water pressure measured at system low point.

.2 Sanitary Sewer and Plumbing Vents:

.1 Above grade: DWV copper solder joints. Cast iron mechanical joints.

.2 Test by filling with water to produce water pressure to 30 kPa minimum and 62 kPa maximum.

.3 Hot Water Heating:

.1 ASTM A-53 grade B, Schedule 40 carbon steel; sizes up to 50 mm with 1035 kPa malleable screwed fittings; sizes over 50 mm to be welded with forged steel fittings; valves to be ball or gate for isolation, bronze rad valve with adjusting stem for balancing of coils, radiation or radiant panels.

.2 Test to 1-1/2 times maximum working pressure or 1035 kPa, whichever is greater, water pressure measured at system low point.

.4 Refrigeration Piping:

.1 Material, sizing and installation shall be in accordance with the Mechanical Refrigeration Code, CAN/CSA-B52.

.2 Test with nitrogen to 2070 kPa on high pressure side and 1035 kPa on low side and refrigerant halide torch test.

1.13 SPRINKLERS

.1 Temperature rating on fusible links shall suit specific hazard area with minimum margin of safety 25°C.

.2 New sprinkler heads: pendant style, semi-recessed with adjustable escutcheon.

.3 For exposed areas, provide standard upright type, chrome plated.

.4 Light hazard occupancy.

.5 Fire protection contractor is responsible for visiting the site and verifying existing sprinkler installation and piping size. Fire protection contractor to include for necessary verification of existing water supply and hydraulic calculations to confirm adequacy of coverage of new layout. Fire protection contractor must include for additional piping and additional sprinkler heads etc., for new design. Relocate existing sprinkler heads as necessary for new layout. Replaced heads and additional new heads are to match existing in all areas except as identified on drawings. Submit shop drawings of sprinkler head products and complete floor plans showing all head locations for entire contract for review by engineer prior to installation. Installation must be complimentary to architectural ceiling plan. Allow for 10% additional sprinkler heads in excess of NFPA requirements. Install as directed by the engineer and in accordance with NFPA 13 to accommodate architectural symmetry requirements.

1.14 DUCTWORK

.1 General:

.1 Fabricate and install all ductwork in accordance with SMACNA duct construction standards.

.2 Fasteners to be sheet metal screws on low pressure ducts.

.3 Sealants to be water resistant, fire resistive and compatible with mating materials.

.4 Lap metal ducts in direction of airflow. Hammer down edges and slips to leave smooth duct interior.

.5 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled.

.6 Comply with SMACNA duct construction standards for breaking, reinforcement, seams and joints. Upstream of VAV boxes to be Class 1000 Pa. Downstream of VAV boxes to Class 250 Pa. Seal all ducts.

.2 Ductwork Material:

.1 Ducts to be galvanized steel lock forming quality, having galvanized coating to ASTM A525 G90 designation for both sides. Metal gauge shall be as per SMACNA duct construction standards.

.2 All hangers shall comply with SMACNA duct construction standards.

.3 All ductwork: Check for audible leaks at 500 Pa WG above associated fan external static pressure.

.4 Medium Pressure Ductwork: Check for audible leaks. Test for tightness as specified by the SMACNA Manuals with maximum leakage of 1/2% at any branch or main duct at 3.0 kPa WG static pressure for round ductwork and 2.0 kPa WG static pressure for rectangular ductwork.

1.15 PIPING AND DUCTWORK INSULATION

.1 Piping Insulation:

.1 Insulation shall be fibreglass (ASJ/SSL), 80kg/m^3 density, ASJ white fire retardant jackets of vinyl foil kraft laminated reinforced with open mesh fibreglass scrim fabric, 0.035 W/m°C at 24°C.

.2 All piping with ASJ jacket to have additional 75 mm factory furnished ASJ type lap joints adhered with 100% coating of an approved fire retardant lagging adhesive, installed at all butt joints.

.3 Use no staples.

.4 Insulate all new domestic hot with 25 mm insulation.

.5 Insulate all new heating water supply and return piping with 25 mm insulation.

.6 Do not insulate sanitary or fire protection piping.

.7 Exposed insulation is to be recovered with canvas.

.2 Duct Insulation:

.1 Insulation to be fibreglass faced flexible duct insulation with reinforced foil and flame resistant kraft facing, density of 12.02 kg/m^3, 0.041 W/m°C at 24°C.

.2 Insulate all new ductwork carrying outdoor air and all new exhaust ductwork within 10 feet of the exterior of the building.

.3 Do not insulate ducts carrying air at room ambient temperature, exhaust air ductwork except as noted above, return air ductwork, relief air ductwork and ductwork fitted with an approved acoustic thermal lining.

.4 Adhere flexible insulation to ductwork with 100 percent coverage of approved adhesive. Adhere rigid insulation using approved adhesive and welded pin fasteners. Seal vapour barrier at pin penetrations. Space pin adequately to prevent sagging of insulation.

.5 Add extra thickness of insulation at standing seams, flanged joints and any other duct protrusions. Adhere jacket lap joints with an adhesive that will be guaranteed to maintain the adhesion under all conditions.

.6 Ductwork carrying outdoor air must be insulated completely so there is no break in either the insulation thickness or vapour barrier.

.7 Exposed insulation is to be recovered with canvas.

1.16 CONTROLS

.1 Provide electric control for all mechanical equipment shown.

1.17 EQUIPMENT

.1 Refer to drawings for equipment schedules.

END OF SECTION

SECTION 20 01 00

MECHANICAL OPERATIONS AND MAINTENANCE DATA

Part 1 General

1.1 SUMMARY

.1 Work in this section includes required to coordinate and assemble operating and maintenance manuals.

1.2 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.2 Engineer: Work specified in this section must be performed by a professional engineer specializing in this type of work.

Part 2 Products

2.1 OPERATING AND MAINTENANCE MANUALS

.1 Obtain and assemble all necessary literature describing the operation and maintenance of equipment provided to the project; submit and transmit documentation for review to Consultant at project milestones.

.2 Binders: Provide sets of Operations and Maintenance Manuals.

.3 Tabs: Use laminated mylar plastic and coloured according to division and section divider tabs and as follows:

.1 Plastic tabs with typewritten card inserts will not be accepted.

.2 Include tab number and title printed on each tab.

.3 Colouring for tabs for individual sections is as follows:

Colour	System
Green	Air Systems
Brown	Control Systems
Blue	Cooling Systems
Red	Fire Protection
Orange	Heating Systems
Yellow	Miscellaneous Systems
Purple	Plumbing Systems
Grey	Steam Systems
White	Medical Gas

.4 Manual Divisions: Organize each manual into the following divisions:

.1 Operation Division

.2 Maintenance Division

.3 Contract Documentation Division

2.2 OPERATIONS DIVISION

.1 Organize all data into sections according to the system category with individual divider tabs as follows:

- .1 AIR Air Systems
- .2 CTL Control Systems
- .3 CLG Cooling Systems
- .4 FPN Fire Protection Systems
- .5 HTG Heating Systems
- .6 MIS Miscellaneous Systems
- .7 PLG Plumbing Systems

.2 Organize data for each system category (section) into individual sub-systems. Provide an index for each system category and a divider tab for each individual system.

.3 Include the following for each individual sub-system:

.1 System Description - Provide details of system type, composition, areas served, location in the building, design criteria and function of major components. All equipment arranged to operate together as one system must be considered part of that system description. Design criterion, at minimum, includes the following:

- .1 Occupied space conditions
- .2 Outdoor ambient conditions
- .3 Air circulation rate
- .4 Exhaust air rate
- .5 Minimum outside air
- .6 Future load allowances
- .7 Standby capabilities
- .8 Calculated load and design capacity of domestic water supply mains
- .9 Calculated load and design capacity of drainage mains

.2 System Schematic - Provide a system schematic showing all components comprising the central system. Identify each component using DDC system mnemonic and generic name designation. Use this equipment designation in all references to the equipment throughout the manual.

.3 Operating Instructions - Provide, in "operator" layman language, specific instructions for start-up, shutdown and seasonal changeover of each system component. Include exact type, and specific location of each switch and device used in the system operation. Identify safety devices and interlocks that must be satisfied in order for the equipment to start. Also, list conditions that must be fulfilled prior to attempting equipment start-up, such as correct valve positions, proper glycol mixture concentrations, piping filled with fluid, placement of filters/strainers, and similar criteria.

.4 Equipment Identification - Provide data for each system component on equipment identification forms equal to the standard forms obtained from the design consultant.

2.3 MAINTENANCE DIVISION

.1 Organize data into the following sections with divider tabs:

.1 Maintenance Tasks and Schedules
.2 Spare Parts
.3 Suppliers and Contractors
.4 Tags and Directories

.2 Maintenance Tasks and Schedules: Organize data according to the system category, with further breakdown into individual systems as used in the operations division of the manual. Provide section index and divider tabs for each system category. Summarize maintenance tasks from manufacturers maintenance brochures, for each component of each system in the following format:

.1 Monthly
.2 Semi-Annually
.3 Annually
.4 When Required

.3 Spare Part List: Organize data according to the system category, with further breakdown into individual systems as used in the operations division of the manual. Provide section index and divider tabs for each system category. Summarize from manufacturers maintenance brochures the recommended spare parts for each component of each system.

.4 Suppliers and Contractor List: Provide summary of Suppliers and Contractors for each component of each system. List name, address and telephone number of each.

.5 Tags and Directories: Provide a copy of the Mechanical Drawing List, Valve Tag List, Piping Identification Schedule and all other directories as specified in the contract documents.

2.4 CONTRACT DOCUMENTATION DIVISION

.1 Organize all data required by the construction contract into sections with divider tabs as follows:

.1 Drawings List
.2 Shop Drawings and Product Data
.3 Certifications
.4 Warranties and Bonds
.5 Maintenance Brochures
.6 Reports

.2 Shop Drawings and Product Data: Provide final copies of all shop drawings and product data required by the contract documents. Include section index and divider tabs. Maximum of twenty-five (25) sheets or one (1) system shop drawing per tab.

.3 Certifications: Provide copies of Contractor Certifications for the performance of products and systems. Include copies of all pressure tests for piping and ductwork systems, equipment alignment certificates, local authority inspection reviews, backflow prevention certifications, and fire protection certifications. Include section index and divider tabs with maximum of twenty-five sheets (25) or one (1) report per tab.

.4 Warranties and Bonds: Include one copy each of the Contractor's warranty, manufacturers' warranties longer than one year, the bond, and any service contract provided by the contractor. Provide section indexes.

.5 Maintenance Brochures: Include copies of all manufacturers' printed maintenance brochures pertaining to each product, equipment, or system. Provide section index and divider tabs. Maximum of twenty-five (25) sheets or one (1) system brochure per tab.

.6 Reports: Include copies of all reports relating to the testing, adjusting and balancing of equipment, and systems, as required by the contract specification sections. Include all Water Treatment Reports and Manufacturers Start-up Reports. Include section index and divider tabs for each report.

.7 Submissions and Approvals.

Part 3 Execution

3.1 ASSEMBLY

.1 Submit documents to the Consultant for approval prior to transmitting to the Owner.

.2 Final edition must include all outstanding project information and conform to all requirements specified.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 It is the responsibility of Construction Manager to make requirements for affected related specification sections, and any requirements for alternates and substitutions available to Subcontractor's:

- .1 Subcontractors receive a complete set of Documents for preparation of their Bids, and to provide a clear understanding of the complete scope-of-work for the Project.
- .2 Failure to provide required information to Subcontractor's during the Bid and Construction Phases of the Work will not relieve the Construction Manager of their responsibility for coordination of the affected Work.
- .3 Construction Manager are responsible for any additional costs to the Contract arising from Subcontractors not receiving a complete package of Documents.
- .4 Provide complete coordination between Mechanical Divisions to attain a complete and functional building mechanical system; Mechanical Divisions include, but are not limited to, the following:
  - .1 Division 20 – Mechanical Common Requirements
  - .2 Division 21 – Fire Suppression
  - .3 Division 22 – Plumbing
  - .4 Division 23 – Heating, Ventilating and Air Conditioning
  - .5 Division 25 – Integrated Automation

.2 Provide complete, fully tested and operational mechanical systems to meet requirements described herein and in complete accord with applicable codes and ordinances:

- .1 Include costs to obtain permits and to pay for fees and charges, including inspection charges by Authorities Having Jurisdiction that issue permits; coordinate related inspections; permits, fees and inspections include, but are not limited to, the following:
  - .1 Plumbing and Gas
  - .2 Ventilation
  - .3 Sprinklers
  - .4 Fire Protection
  - .5 Building HVAC
  - .6 Electrical
  - .7 CSA Requirements
  - .8 Structural Requirements

.3 Documents for the Project, including Specifications and Drawings, are generally diagrammatic and approximately to scale unless specifically detailed otherwise; they establish scope, material and installation quality, and are not considered as detailed installation instructions.

1.2 RELATED REQUIREMENTS

.1 Section 01 00 06 – General Requirements: Submittals: Submission of shop drawings, samples and product literature.

.2 Section 01 35 31 – LEED Special Project Procedures: Information tracking, special submittal requirements and environmental requirements for LEED Certification requirements.

.3 Section 20 05 13 – Common Motor Requirements for Mechanical Equipment: Connecting mechanical systems having electrical components to building electrical system.

.4 Section 26 05 06 – Common Motor Requirements for Electrical: Electric motor power characteristics.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Cooperate and coordinate with other trades and verify order of installation of overlapping or interconnecting services or equipment before starting Work.

.1 Drawings and Specifications: Drawings and specifications are complementary to each other, and what is called for by one is binding as if called for by both and as follows:

.1 Examine Contract Documents including drawings and specifications, and work of other trades before starting Work and verify that Work can be satisfactorily completed without changes to building.

.2 Consultant will provide a clarification to identified discrepancies between drawings and specifications that leave Construction Manager in doubt as to the true intent and meaning of the documents as follows:

.1 During Bid Period: A written Addendum will be issued to address a written request for clarification.

.2 During Construction: A Construction Communication will be issued to address a written request for information.

.2 Consultant will respond to Requests for Interpretation and determine the requirements for clarification based only on variances contained in the documents as follows:

.1 Clarification based on information and not contained in the documents or in manufacturers written literature will be regarded as a change to the Work.

.2 Clarification will be based on the hierarchy of the complete document package, not just the documents provided to Subcontractor by Construction Manager.

.3 Clarification will include effects or influence of other specified products, adjacent construction, adjacent finishes and methods of construction.

.4 Clarification issued during Construction Phase that affects the cost of the Work will be regarded as a Change to the Work.

.3 Coordinate installation of the Work with manufacturer's recommended installation details and procedures, supplemented by requirements of Contract Documents; provide adequate access space for maintenance and service of equipment and systems.

.4 Coordinate location of access to cleanouts, valves, equipment, and duct access doors above continuous ceilings; coordinate access panel and door requirements with Section 08 31 00.

.5 Coordinate installation of Work with adjacent work by others in accordance with requirements listed in Section 01 73 00 and as follows:

.1 Install material and equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space; remove and replace improperly installed equipment as determined by Consultant.

.2 Refer to electrical, mechanical, structural and architectural drawings when setting out work and coordinate with other applicable components of the Work when setting out locations for ductwork, equipment, and piping so that conflicts are avoided and symmetrical even spacing is maintained.

.3 Provide coordination drawings showing the work of other trades and contractors involved in areas of potential conflict or congestion at no additional cost to the Contract.

.4 Coordinate dimensional details with applicable architectural and structural drawings.

.5 Full size and detailed drawings will take precedence over scale measurements from drawings when laying out the Work.

.6 Coordinate requirements of, and connect to, equipment specified in other Sections, and to equipment supplied and installed by other contractors or by Owner; uncrate equipment, assemble, move in place, and install complete, start-up and test; refer to Section 01 65 00 for owner supplied equipment and equipment furnished by other Divisions.

.2 Declarations: Coordinate declaration of Substantial Performance and Total Performance with requirements of the General Conditions and Supplementary Conditions of Contract and with Section 01 77 00.

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Construction Clarification Drawings: Coordinate construction coordination requirements with Section 01 31 13.20 – Mechanical and Electrical Project Coordination; and as follows:

.1 Prepare drawings in conjunction with all trades concerned, showing sleeves and openings for passage through floor structure.

.2 Prepare a complete set of drawings showing all conduit runs and wiring using the information provided in riser diagrams, circuit numbers on floor plans, relevant details, specifications, and with reference to drawings of other trades.

.3 Prepare composite construction drawings, fully dimensioned in metric, indicating cable, conduit, bus duct, shafts, mechanical and electrical equipment rooms, including switchgear rooms, ceiling spaces and all other critical locations to avoid a conflict of trades. Base equipment drawings upon shop drawings and include, but do not necessarily limit to, all details pertaining to clearances, access, sleeves, electrical connections, location and elevation of pipes, ducts, conduits, and similar criteria, obtained from consultation with and agreement of the trades involved.

.4 Submit a schedule of construction drawings not later than three weeks after the award of Contract, indicating the anticipated date when the drawings will be submitted for approval.

.3 Identify materials and equipment submittals by listing manufacturer, trade name, and model number, and as follows:

.1 Include copies of applicable brochure or catalogue material.

.2 Do not assume that applicable catalogues are available in Consultants office.

.3 Maintenance and operating manuals will not be considered as suitable submittal material.

.4 Leave space on shop drawing to accommodate Consultants review stamp.

.5 Clearly mark each shop drawing with identical name or number where equipment is identified by name or number on drawings or in specifications.

.6 Clearly identify dimensional and technical data sufficient to verify that equipment meets specified requirements.

.7 Clearly identify wiring, piping, service connection data and motor sizes.

.8 Clearly mark each submittal sheet using arrows, underlining, or circling to indicate differences between specifications and options proposed for use in the Work, such as differences in sizes, types, model numbers, rating, capacities, and similar criteria.

.9 Specifically note specified features included as a part of the submittal, such as special tank linings, pump seals, materials or painting.

.10 Strike out non-applicable material.

.4 Review shop drawings prior to submittal to Consultant certifying that:

.1 Site measurements are verified and correct.

.2 Site construction criteria, materials, catalogue numbers and similar data are coordinated with shop drawings and requirements of the Work.

.3 Certify review of each shop drawing by placing Subcontractor's and Construction Manager's review stamps, date and signatures of responsible persons.

.4 Verify installed materials and equipment meet specified requirements where shop drawings are not provided to Consultant for review.

.5 Use of Metric Units and Conversions in Submittals:

.1 Units expressed in these documents are written in Systems International (SI) Metric Units; soft metric conversions are used throughout.

.2 Submit shop drawings and maintenance manuals in SI Units; use same SI Units for submittals as stated in specification or drawings.

.3 Equivalent Nominal Diameters of Pipes – Metric and Imperial:

.1 Provide equivalent nominal Imperial sized pipe and provide adapters to allow compatible connections to SI Metric sized fittings, equipment and piping where pipes are specified with SI Metric dimensions and only Imperial sized pipes are available.

.2 Provide adapters to allow compatible connections between SI Metric pipes and new and existing pipes, fittings, and equipment when CSA approved SI Metric pipes are available and are provided.

.3 Record accurately on "as-built" documents the type of pipe installed.

.4 SI Metric Duct Sizes:

.1 Metric duct sizes are expressed as 25 mm = 1 inch.

1.5 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Quality of Material and Equipment: Verify that materials and equipment installed are new, full weight and of quality specified; use same brand or manufacturer and model for each specific application.

.1 Verify that the manufacturer's name, address, catalogue and serial number appear on each major component of equipment in a conspicuous place.

.2 Replace materials or workmanship below specified quality and relocate work wrongly placed to satisfaction of Consultant and at no cost to Owner.

.3 Install materials and equipment in a quality manner providing good workmanship by competent tradesmen.

.4 Price submitted for this contract includes the use of materials and equipment as specified or as contained within the listing of Acceptable Materials contained in specification Sections.

.5 HVAC equipment and components included in the scope of the Model National Energy Code of Canada for Buildings (MNECB) must comply with the MNECB or the relevant local energy efficiency act.

.2 Availability of Material and Equipment: Notify Consultant in writing a minimum of ten (10) days prior to Bid Closing Date of any materials specified that are required to complete Work and that are not currently available or will not be available for use as specified in these documents as follows:

.1 Bid submission denotes that specified products are available to meet specified requirements.

.2 Acceptance of Bid obliges Construction Manager and Subcontractors to place orders and provide specified products in a timely manner to meet Project Schedule.

.3 Failure to secure specified products will not relieve Construction Manager and Subcontractor’s from providing acceptable substitutions, including other associated costs to secure substitute products, at no additional cost to Owner or impact on Project Schedule.

.4 Submit proposed substitutions to Consultant for acceptance in accordance with Section 01 25 00.

.2 Proposed Substitutions to Specified Material and Equipment:

.1 Requests for substitutes will not be considered during Bidding Period; this does not preclude the submission of proposed substitutes by Subcontractors, manufacturers, and suppliers, provided they submit information to General Contract Bidders.

.2 Acceptance of proposed substitutions to specified products will be based on evaluation of equal or better performance and materials to those specified in every respect, operate as intended, meet the space, capacity, and noise requirements outlined, and require no changes to the structure or configuration of adjacent assemblies or materials.

.3 Contractor is fully responsible for costs for work or materials required by [Subcontractor] [Trade Contractor] or other contractors to accommodate use of materials or equipment other than those specified.

1.6 WARRANTY

.1 Provide a written warranty stating that Work executed in this Contract will be free from defective workmanship and materials for a period of one (1) year starting from the date of substantial performance of work in accordance with the requirements specified in Section 01 78 23.

.2 Warranty makes provision for repair or replacement of any Work that fails or becomes defective during the term of the warranty, providing the operating and maintenance instructions have been complied with.

.3 Duration of the warranty specified does not, in any way, supplant any other guaranties or warranties provided under the Contract for individual pieces of equipment or systems having a longer period provided by Manufacturers or as called for in the project documents.

.4 Unless specified otherwise, Owner will be responsible for routine maintenance requirements as required in the manufacturer's instructions, and will be responsible for supplying filters, grease and belts and other consumables required for routine maintenance.

Part 2 Execution

2.1 EXAMINATION OF EXISTING CONDITIONS

.1 Visit and examine the site and note characteristics and features affecting the Work before submitting Bid.

.2 Report discrepancies in writing to Consultant prior to Bid closing.

.3 No allowances will be made for difficulties encountered or expenses incurred arising from conditions of the site or existing items that are readily visible or known to exist at the time of Bid.

.4 Failure to advise Consultant of discrepancies in writing will mean that Construction Manager accepts documents as presented without potential of additional costs.

.5 Unforeseen conditions or discrepancies that could not be readily ascertained at the time of Bid will be administered as a change to the Contract.

2.2 USE OF PERMANENT SYSTEMS FOR TEMPORARY HEAT

.1 Coordinate requirements for use of permanent heating systems for temporary heat in accordance with Section 01 50 00; do not use permanent system for temporary heating purposes without written permission from Consultant; protect and restore permanent systems as specified in Section 01 50 00.

.2 Provide a proposed temporary heat agreement for Owner to review prior to use of permanent building systems for temporary heat; agreement includes payment schedules for utilities, spare parts listings, and confirmation of warranty.

.3 The terms of warranty are not modified by the use of permanent systems for temporary heat; equipment manufacturers certify that equipment is in "new" condition at start of warranty period, and as follows:

.1 Block-off system components not required for temporary heat in accordance with manufacturer’s requirement to maintain warranty.

.2 Thoroughly clean and overhaul permanent equipment used during construction period, replace worn or damaged parts before final inspection.

.3 Operate heating systems under conditions that allow no temporary or permanent damage.

.4 Operate with proper safety devices and controls installed and fully operational.

.5 Operate systems only with treated water as specified.

.6 Provide alarm indicating system failure; connect alarm to independent alarm company system.

.7 Replace mechanical seals, regardless of condition, with new mechanical seals where pumps are used for temporary heating prior to Total Performance of the Work.

.8 Avoid thermal shock to heating system during planning, construction and operation of temporary heating system.

.4 Review temporary heating procedures with Consultant as follows:

.1 Obtain acceptance by Consultant for thermal insulation work and automatic control equipment associated with use of permanent heating system for temporary heat.

.2 Obtain approval from Provincial Boiler Protection Branch of Department of Labour before use of permanent heating system for temporary heat.

2.3 EQUIPMENT PROTECTION AND CLEAN-UP

.1 Protect equipment and materials in storage on site during and after installation until final acceptance; leave factory covers in place; take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 Protect bearings and shafts during installation: Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

.4 Verify that existing equipment being turned over to Owner or reused is carefully dismantled and not damaged or lost; do not reuse existing materials and equipment unless specifically indicated.

2.4 TEMPORARY OR TRIAL USAGE OF PERMANENT SYSTEMS

.1 Temporary or trial usage requested by Owner of mechanical equipment supplied under contract will not represent acceptance by Owner; operate and maintain equipment and systems during trial usage in a manner that preserves the manufacturer's warranty/guaranty.

.2 Repair or replace equipment damaged as a result of defective materials or workmanship during temporary or trial usage; coordinate with Section 01 50 00 for requirements associated with protection and reconditioning of permanent equipment and systems used during construction.

.3 Pre-test operation of ventilation systems by running the units in a 100% fresh air, 100% exhaust air mode after distribution ductwork is installed.

2.5 SITE UTILITY SERVICES

.1 Maintain liaison with Owner to interrupt, re-route, or connect to water, sewer, heating, or gas systems, with minimum interruption of services.

.2 Confirm elevations and locations of existing services prior to and during excavation.

.3 Provide Consultant with as-built drawings of site services in accordance with Section 01 78 39; dimensioned to grid lines, building exterior walls or other permanent building component.

2.6 ELECTRIC MOTORS

.1 Supply mechanical equipment complete with electrical motors.

.2 Provide a complete listing of motors required on the project within twenty (20) days of contract award; list kW, Voltage, Phasing, efficiency, and other pertinent information and submit list to Consultant and Electrical Contractor for review.

.3 Provide motors designed, manufactured, and tested in accordance with the latest edition of the following codes and standards: NEMA, EEMAC, CSA, CEC Part 1, IEEE and ANSI.

.4 Verify motors are CSA labelled and approved for use in the designated area classification by the Electrical Protection Branch.

.5 Provide motors designed for full voltage starting, EEMAC Design B; motors driving high torque or high inertia loads may be EEMAC Design C or D, unless specified otherwise.

.6 Provide motors for use with variable speed drives that are inverter rated.

.7 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment specifications.

.8 Provide motors with thermal overload protection.

.9 Provide motors with complete nameplate data.

.10 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.

.11 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.

.12 Refer to electrical specifications in Division 26 for voltage, frequency, and phase data; this information takes precedence over any reference in Divisions 20, 21, 22, 23 or 25.

.13 Provide packaged equipment with connections as specified in Division 26.

.14 Nominal motor horsepower conversion factor for motor power stated in watts or kilowatts; multiplied by 746 or 0.746 respectively.

END OF SECTION

SECTION 20 05 10

MECHANICAL SYSTEMS PIPE AND PIPE FITTINGS

Part 1 General

1.1 SUMMARY

.1 This section includes requirements for supply and installation of pipe and pipe fittings including; but not limited to, the following:

- .1 Hot Water Heating System Piping
- .2 Glycol System Piping
- .3 Condenser Water Piping
- .4 Sanitary Drainage and Vent System Piping
- .5 Storm Sewer System Piping
- .6 Domestic Water Piping
- .7 Sprinkler and Standpipe Piping
- .8 Refrigerant Piping

1.2 RELATED REQUIREMENTS

.1 Section 05 05 00 – Common Work Results for Metals

.2 Section 07 05 80 – Common Work Results for Fire Rated Separations and Assemblies

.3 Section 07 71 00 – Roofing Specialties: Prefabricated roof penetration flashings for hot exhaust pipes.

.4 Section 07 84 00 – Firestopping: Firestopping materials for piping penetrating fire rated assemblies.

.5 Section 20 05 23 – Valves for Mechanical Systems

.6 Section 20 05 29 – Pipe Hangers, Supports and Anchors for Mechanical Systems

.7 Section 20 05 48 – Noise and Vibration Control

.8 Section 20 07 00 – Piping and Equipment Insulation

.9 Section 21 10 00 – Water Based Fire Suppression Systems

.10 Section 21 12 00 – Fire Suppression Standpipes

.11 Section 22 13 25 – Plumbing Specialties

.12 Section 23 05 17.13 – Hot Water Heating Piping Specialties: Steam and condensate systems in excess of 103 kPa.

.13 Section 23 05 17.16 – Glycol Heating Specialties

.14 Section 23 23 16 – Refrigeration Piping Specialties

1.3 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME):

.1 ANSI/ASME B16.3-2011, Malleable Iron Threaded Fittings: Classes 150 and 300
.2 ANSI/ASME B31.1-2010, Power Piping
.3 ANSI/ASME B31.9-2011, Building Services Piping

.2 American Society for Testing and Materials (ASTM):

.1 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
.2 ASTM A106/A106M-11, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
.3 ASTM A181/A181M-06, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
.4 ASTM A312/A312M-12a, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
.5 ASTM A536-84 (2009), Standard Specification for Ductile Iron Castings
.6 ASTM A999/A999M-11, Standard Specification for General Requirements for Alloy and Stainless Steel Pipe
.7 ASTM B88-09, Standard Specification for Seamless Copper Water Tube
.8 ASTM B280-08, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
.9 ASTM B306-09, Standard Specification for Copper Drainage Tube (DWV)
.10 ASTM D2000-12, Standard Classification System for Rubber Products in Automotive Applications
.11 ASTM D3034-08, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

.3 American Water Works Association (AWWA):

.1 ANSI/AWWA C606-11, Standard for Grooved and Shouldered Joints
.2 ANSI/AWWA C900-07, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabrication Fittings, 100 mm through 300 mm for Water Transmission and Distribution
.3 ANSI/AWWA C906-07, Standard for Polyethylene (PE) Pressure Pipe and Fittings, 100 mm through 1,575 mm, for Water Distribution and Transmission

.4 Canadian Standards Association (CSA):

.1 CSA A257 Series-09, Standards for Concrete Pipe and Manhole Sections
.2 CSA B52-05 (R2009), Mechanical Refrigeration Code
.3 CAN/CSA B64 Series-07, Backflow Preventers and Vacuum Breakers
.4 CSA B70-06, Cast Iron Soil Pipe, Fittings, and Means of Joining
.5 CSA B137 Series-09, Thermoplastic Pressure Piping Compendium
.6 CAN/CSA B242-05, Groove- and Shoulder-Type Mechanical Pipe Couplings
.7 CSA B1800-06, Thermoplastic Non-Pressure Piping Compendium

.8 CSA W55.3-08, Certification of companies for resistance welding of steel and aluminum

.9 CSA W117.2-06, Safety in Welding, Cutting and Allied Processes

.5 National Fire Protection Association (NFPA):

.1 NFPA (Fire) 13-2010, Standard for the Installation of Sprinkler Systems

.2 NFPA (Fire) 13D-2010, Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes

.3 NFPA (Fire) 13E-2010, Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems

.4 NFPA (Fire) 13R-2010, Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height

.5 NFPA (Fire) 14-2010, Standard for the Installation of Standpipe and Hose Systems

.6 National Plumbing Code of Canada [2005] [2010] (NPC):

.1 Alberta Plumbing Code Regulation 2007

.2 Confirm Provincial adoption of NPC and insert additional regulations if necessary.

.7 Underwriters Laboratories Canada (ULC):

.1 CAN/ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.2 CAN/ULC S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Indicate grooved joint couplings and fittings on drawings and product submittals; specifically identified with applicable style or series designation.

.3 Informational Submittals: Provide the following submittals during the course of the work:

.1 Certificates: Submit statement describing welding procedures proposed for the review of the Consultant.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements:

.1 Fire Rated PVC Materials: Use PVC drainage pipe and fittings for this project conform to CAN/ULC S102.2, and bear the seal of a nationally recognized listing or certifying agency acceptable to authorities having jurisdiction in accordance with Section 07 05 80.

.2 Welding: Weld in accordance with the requirements of the Provincial Boilers Branch on steam systems where the pressure exceeds 103 kPa and on heating water and glycol systems where the pressure exceeds 1100 kPa and the temperature exceeds 121°C, and as follows:

.1 Ensure welded joints are free of defects including: elongated slag, isolated slag, porosity, incomplete penetration, lack of fusion, burn through, cracks, arc burn, internal concavity, hollow beads, internal undercuts, and external undercuts.

.2 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Materials:

.1 Use highest quality piping conforming to the referenced ASTM and CSA Standards.

.2 Non-specified pipe joining and pipe fitting methods such as T-drill and press fit are not permitted in any piping system for this Project.

.2 Installers: Use tradesmen licensed by the Authority Having Jurisdiction for the particular service or component of the work.

.3 Manufacturer: Use a single manufacturer to supply all grooved joint couplings, fittings, valves, and specialties; the same manufacturer will supply grooving tools and grooved components.

.3 Certifications: Provide the following during the course of the Work:

.1 Welding Requirements: Provide proof of skill level and welding certificate having specific annotations for the following:

.1 Use fully qualified welders licensed by the Authority Having Jurisdiction in accordance with Section 05 05 00 – Common Work Results for Metals.

.2 Comply with procedures of current editions of CSA W55.3, CSA W117.2 and ANSI/ASME B31.9.

.3 Use pressure welders for work on systems containing pressures in excess of 103 kPa.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section ; and as established by the Basis-of-Design Materials, use any of the listed manufacturers products in accordance with Section 01 62 00 – Product Options including the following:

.1 Pipe and Fittings:

.1 Crane Supply

.2 Hackney Ladish, Inc.

.3 Taylor Forge Engineered Systems

.4 Victaulic Company for grooved mechanical fittings

.2 Plastic Pipe and Fittings:
- .1 Canplas Industries Ltd.
- .2 EMCO Corporation
- .3 IPEX Inc.
- .4 Orion Fittings

.3 Vacuum Breakers:
- .1 FEBCO
- .2 MIFAB, Inc.
- .3 Watts Water Technologies, Inc.

.2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, use any of the listed manufacturers' products in accordance with Section 01 62 00 – Product Options or submit a proposed substitution in accordance with Section 01 25 00 – Substitutions, Standard Documents Package a minimum of ten (10) days in advance of Bid Closing.

2.2 PIPE

Service	Material
Sanitary drainage, and vent, inside building, above ground	DWV Copper: ASTM B306 Stainless Steel, Schedule 5S: ASTM A312/A312M Cast Iron: CSA B70 PVC – DWV: CSA B1800, CAN/ULC S102.2, Flame Spread less than 25, Smoke Developed less than 50:Except in R/A plenums, vertical shafts, highrises, and underground parking garages greater than 1 storey Flame Spread = 0, Smoke Developed less than 50:Suitable for R/A plenums and highrises. Not suitable for vertical shafts and underground parking garages greater than 1 storey
Sanitary drainage, and vent, inside building, below ground	Cast iron: CSA B70 PVC – DWV: CSA B1800, CAN/ULC S102.2 PVC Sewer pipe: CSA B1800, sizes to 150 mm PVC, SDR-35 for sizes up to1050 mm: ASTM D3034, complete with tracer wire
Sanitary drainage and vent, outside building	Cast iron: CSA B70 PVC, SDR-35 for sizes up to 1050 mm: ASTM D3034, complete with tracer wire Concrete for sizes above 300 mm: CSA A257

Service	Material
Storm drainage, inside building, above ground	Cast Iron: CSA B70 Stainless Steel, Schedule 5S: ASTM A312/A312M DWV Copper: ASTM B306 PVC – DWV: CSA B1800, CAN/ULC S102.2, Flame Spread less than 25, Smoke Developed less than 50:Except in R/A plenums, vertical shafts, highrises, and underground parking garages greater than 1 storey Flame Spread = 0, Smoke Developed less than 50:Suitable for R/A plenums and highrises. Not suitable for vertical shafts and underground parking garages greater than 1 storey
Storm drainage, outside building	Cast Iron: CSA B70 PVC, SDR-35 for sizes to 900 mm: ASTM D3034, complete with tracer wire PVC Ultra Rib CSA B1800, complete with tracer wire Concrete pipe for sizes above 300 mm: CSA A257
Domestic water, above ground (inside building)	Type "L" Hard Copper: ASTM B88 Schedule 40 Stainless Steel: ASTM A999 Stainless Steel, Schedule 5S: ASTM A312/A312M
Domestic water (buried inside building)	Type "K" soft copper, ASTM B88
Domestic cold water for trap seal primers only (buried inside building to trap seal primer)	Polyethylene/Aluminum/Polyethylene pipe (PE/AL/PE), to CSA B137, conform to ULC or Warnock Hershey listed, Flame Spread: 5, Smoke Developed: 5, no joints Cross linked Polyethylene Pressure tubing (PEX), to CSA B137, conform to ULC or Warnock Hershey listed, Flame Spread: 5, Smoke Developed: 5, no joints
Hot water and glycol heating to 120°C	Steel, Schedule 40: ASTM A53, Grade B Stainless Steel, Schedule 5S: ASTM A312/A312M] Type "L" Hard Copper: ASTM B88 Type "K" Soft Copper Buried: ASTM B88
Hot water and glycol in slab heating and snowmelt	PEX (cross-linked polyethylene) with oxygen barrier
Equipment drains and overflows	Steel, Schedule 40, Galvanized Steel: ASTM A53 Stainless Steel, Schedule 5S: ASTM A312/A312M Type "L" Hard Copper: ASTM B88
Fire protection	Meeting NFPA (Fire) 13 and NFPA (Fire) 14: Minimum pipe standard; Schedule 40,10, or 5.

Service	Material
Compressed air	Type "L" Hard Copper: ASTM B88 Steel, Schedule 40, Galvanized: ASTM A53 (for pipes over 65 mm Ø) Stainless Steel, Schedule 5S: ASTM A312/A312M
Refrigerant	ACR copper: ASTM B280
Chilled water Condenser water	Steel, Schedule 40: ASTM A53, Grade B Stainless Steel, Schedule 5S: ASTM A312/A312M Type "L", Hard Copper: ASTM B88
Steam to 103 kPa vents	Steel, Schedule 40: ASTM A53, Grade B
Condensate, pumped condensate	Steel, Schedule 80: ASTM A53

2.3 FITTINGS AND JOINTS

Service	Material	Joint
Sanitary drainage and vent, inside building, above ground	Wrought or cast copper	50-50 Solder or grooved rigid mechanical with angle pattern bolt pad for pipes 75 mm and over
	Stainless steel with elastomer O-ring seals for sizes 50 mm and smaller	Vic-Press 304™
	Cast iron (Hubless fitting)	Gasket & Clamp
	PVC – DWV	Solvent Weld
Sanitary drainage and vent, inside building, below ground	Cast iron (Hubless fittings)	Gasket & Clamp
	PVC – DWV	Solvent Weld
Sanitary drainage and vent, outside building	Cast iron	Hub & Spigot
	PVC – Gravity Sewer	Hub & Spigot with gasket
	Concrete	Hub & Spigot
Storm drainage, inside building, above ground	Cast iron	Gasket & Clamp
	Wrought or cast copper	50-50 Solder [or grooved rigid mechanical with angle pattern bolt pad for pipes 75 mm and over]

Service	Material	Joint
	Stainless steel with elastomer O-ring seals for sizes 50 mm and smaller	Vic-Press 304™
	PVC – DWV	Solvent Weld
Storm drainage, inside building, below ground	Cast iron	Gasket & Clamp
	PVC – DWV	Solvent Weld
Storm drainage, outside building	Cast iron	Hub & Spigot
	PVC – Gravity Sewer	Hub & Spigot with Gasket
	Concrete	Hub & Spigot
Domestic water, above ground	Wrought copper, bronze	95-5 solder, brazed or grooved rigid mechanical for pipes 50 mm and over
	Cast bronze	Screwed
	Stainless steel with elastomer O-ring seals for sizes 50 mm and smaller	Vic-Press 304™
	Stainless steel	Welded, grooved mechanical rigid coupling
Domestic water, buried	PVC	Hub & Spigot with O-ring
	Copper pipe	No joints permitted underground
Hot water to 110°C	Banded malleable iron, 1035 kPa, up to 50 mm	Screwed
	Steel, same schedule as pipe, for sizes 50 mm and larger.	Welded, or grooved mechanical coupling with angle pattern bolt pad.
	Stainless steel with elastomer O-ring seals for sizes 50 mm and smaller	Vic-Press 304™
	Wrought copper, bronze	95-5 solder, brazed for pipes over 50 mm or grooved mechanical with angle pattern bolt pad for pipes 50 mm and over.
	Ductile iron	Grooved mechanical coupling
	Cast brass	Screwed
	Cast bronze	Flared Tube

Service	Material	Joint
Glycol to 110°C	Banded malleable iron, 1035 kPa, up to 50 mm	Screwed
	Steel, same schedule as pipe, for sizes 50 mm and larger	Welded
	Stainless steel with elastomer O-ring seals for sizes 50 mm and smaller	Vic-Press 304™
	Wrought copper, bronze	95-5 solder, brazed for pipes over 50 mm [or grooved rigid mechanical with angle pattern bolt pad for pipes 50 mm and over]
	Cast brass	Screwed
	Ductile iron	Grooved mechanical coupling
	Cast bronze	Flared Tube
Equipment drains and overflows	Galvanized banded malleable iron	Screwed
	Stainless steel with elastomer O-ring seals for sizes 50 mm and smaller	Vic-Press 304™
Fire protection cast iron	Wrought copper, bronze	50-50 Solder [or grooved rigid mechanical with angle pattern bolt pad for pipes 50 mm and over]
	Cast brass	Screwed
	Malleable iron or	Screwed or Flanged
	Ductile iron or steel	Grooved Mechanical
Refrigerant	Steel, same schedule as pipe	Welded
	Galvanized malleable iron	Threaded
	Wrought copper	Brazed, phos-copper allow
	Forged brass	Brazed, silver alloy
Chilled water and condenser water	Banded malleable iron, 1035 kPa, to 50 mm	Screwed
	Steel, same schedule as pipe for sizes 50 mm and larger	Welded

Service	Material	Joint
.1	Stainless steel with elastomer O-ring seals for sizes 50 mm and smaller	Vic-Press 304™
.2 Laboratory drainage and vent	Ductile iron	Grooved mechanical coupling
.3 Use factory fabricated butt welded fittings for welded steel pipes.	Wrought copper, bronze	95-5 solder, brazed or grooved rigid mechanical for pipes over 50 mm
	Cast brass	Screwed
	Cast bronze	Flared Tube
	Glass	Mechanical couplings
Vic-Press 304™ is an acceptable option on applicable piping systems to 2065 kPa CWP.		
Use long radius elbows for steel and cast iron water piping, including grooved mechanical fittings. In equipment rooms 'standard' radius grooved mechanical elbows are permitted.		

2.4 PIPE SIZES

Nominal Metric Size mm	Steel Pipe O.D., mm	Copper Pipe O.D., mm	Cast Iron O.D., mm
12 - 15	21.34	15.88	-
20	26.67	22.23	-
25	33.40	28.58	-
30	42.16	34.95	-
40	38.10	41.28	-
50	60.33	53.98	-
65	73.03	66.68	-
80	88.90	79.38	100.58
100	114.30	104.70	121.92
125	141.30	-	-
150	168.28	-	175.26
200	219.09	-	229.87
300	323.85	-	304.80

2.5 UNIONS AND COUPLINGS

.1 Size 50 mm and under:

.1 2065 kPa stainless steel, type 304/304L, with elastomer O-ring seals: include Vic-Press end unions.

.2 1034 kPa malleable iron, bronze to iron ground joint unions for threaded ferrous piping, all bronze for copper piping, cast iron 861 kPa for heating: meeting requirements of ANSI/ASME B16.3.

.2 Sizes 65 mm and over: 1034 kPa forged steel slip-on flanges for ferrous piping, 1034 kPa bronze flanges for copper piping with gaskets 1.59 mm thick preformed synthetic rubber bonded asbestos. Use gaskets of red rubber wire inserts in compressed asbestos for steam and condensate. Flanges to ASTM A181. In grooved piping systems, Victaulic Style 741 flange adapter may be used instead of slip-on flanges.

.3 Grooved mechanical couplings must consist of two ductile iron housing segments, elastomer pressure responsive gasket, and zinc-electroplated steel bolts and nuts:

.1 Rigid type grooved mechanical couplings to have angled bolt pad to provide a rigid joint and permit system support and hanging in accordance with ANSI/ASME B31.1 and B31.9., and as follows:

.1 Steel Piping to 300 mm, and as follows:

.1 Victaulic style 07 Rigid Coupling

.2 Type K, L, or DWV Copper Tubing, and as follows:

.1 Victaulic style 606 Rigid Coupling, manufactured to copper tube dimensions

.3 Stainless Steel Piping: The bottom of the groove is engaged by rigid couplings, and as follows:

.1 Victaulic Style 07 Rigid Coupling (ductile iron housings)

.2 Victaulic Style 489 (stainless steel housings)

.4 Flexible Type: For use in locations where vibration attenuation and stress relief are required, and as follows:

.1 Victaulic Style 77

.5 Steel Piping 350 mm through 600 mm: Couplings as follows:

.1 Victaulic Advanced Groove System with wedge shaped groove, lead-in chamfer on housing keys, and wide-width FlushSeal® gasket

.2 Rigid Type: Housing keys fill the wedge shaped AGS groove and provide rigidity and system support and hanging in accordance with ANSI/ASME B31.1 and B31.9, and as follows:

.1 Basis-of-Design Materials: Victaulic Style W07

.3 Flexible Type: Housing keys fit into the wedge shaped AGS groove and allow for linear and angular pipe movement, and as follows:

.1 Basis-of-Design Materials: Victaulic Style W77

.4 Gasket Material: Victaulic compound EPDM (green stripe) for water or glycol service at rated temperature of not less than 110°C. One manufacturer will supply all grooved mechanical couplings.

.4 Three flexible couplings may be used in the vicinity of accessible equipment to accommodate expansion, contraction, movement, and vibration noise [instead of a flexible connector]; make all other joints rigid:

.1 Steel Piping: Victaulic style 77 Flexible Coupling.

.2 Stainless Steel Piping: Victaulic style 77S.

.3 In water systems, use adequate numbers of Victaulic Style 77 flexible couplings to accommodate thermal growth and contraction, and for the elimination of expansion loops. (In accordance with Victaulic recommendations and as approved by the consultant.) Use Style 77 couplings on the loop where expansion loops are required.

2.6 VACUUM BREAKER ASSEMBLIES

.1 Provide pressure type vacuum breaker assembly complete with shut-off valves before and after check valves and test cocks. Assemble with one (1) positive sealing check valve and one (1) atmospheric vent disk with stainless steel or bronze seats complete with shut-off valves before and after check valves and test cocks; meeting AWWA requirements and CAN/CSA B64 standards:

.1 Basis-of-Design Materials: Watts No. 800.

.2 Provide atmospheric type vacuum breaker assembly complete with shut-off valve before assembly. Assemble with one (1) free floating poppet to seal the atmospheric vent under flow conditions. Acceptable material: Watts No. 288A; for bottom inlet and outlet, Watts No. 388ASC.

.3 Provide vandal proof and drainable hose connection type vacuum breaker assembly, consisting of a check valve disc assembly. Acceptable material: Watts No. 8A; for freezing conditions, Watts No. NF8.

2.7 BRAZING (SPRINKLER SYSTEM PIPING)

.1 Using brazing alloy B-Cu-P-4 with high melting point (min. 538°C), or other brazing alloy or equivalent (538°C) melting point and physical properties. Use Airosil flux or equivalent. Do not use borax and alcohol mixture or resins and similar paste fluxes.

.2 Soldering of copper tubing will not be allowed, except as noted later in this Section.

2.8 SOLDER

.1 Generally, use 95-5 solder for pressure service, 50-50 solder for gravity drainage service.

.2 Use brazing alloy B cup 5 with high melting point (min. 538°C) for laboratory gas piping or use other brazing alloy of equivalent (538°C) melting point and physical properties. Use Airosil flux or equivalent. Do not use borax and alcohol mixture or resins and similar paste fluxes.

Part 3 Execution

3.1 PIPING GENERAL

.1 Install piping approximately as shown, with all lines being carried parallel to building walls close to the structure as possible, or as detailed on the drawings.

.2 Align and support all piping properly, under no circumstances may any piping load be transferred to the equipment. Make all equipment connections so as to allow disassembly of the piping for equipment removal and maintenance.

.3 Install piping to allow for expansion and contraction without unduly stressing pipe or connected equipment.

.1 If installation is in accordance with Victaulic recommendations, Victaulic Style 77 flexible couplings may be used for stress relief, contraction, and expansion.

.4 Provide clearance for proper installation of insulation and for access to valves, air vents, drains and unions.

.5 Install piping material specified to 1 m outside of building.

.6 Use the following for branch connections off main:

.1 Mains 100 mm to 200 mm inclusive: Use factory manufactured welding fittings to accommodate the take- off either welded or threaded for branches under 40 mm: Use welding saddles for branches 50 mm to 75 mm; [if the Victaulic system is used, Style 920/920N Mechanical Tee may be used], use standard tee for branches 100 mm and over. Do not use welding saddles for branches greater than ½ size of main.

.2 Mains 76 mm; use factory manufactured welding fittings to accommodate the take-off either welded or threaded for branches under 25 mm; use standard tees for branches over 25 mm.

.3 Mains 65 mm and under: Use standard tees for all branch take-offs.

.4 Mains 250 mm and over: Branches up to and including 2 nominal sizes less than main, welded stub ins, tee or saddles. Use standard tees for branches nominal size smaller and above.

.7 Use only eccentric reducing fittings. Install all reducers in steam lines with the piping in line at the bottom.

.8 Do not use direct welded or screwed connections to valves, equipment or other apparatus. Make all connections with accessible mechanical connection of style consistent with the connecting pipe joints.

.9 Sleeve all pipe passing through partitions, walls and floors.

.10 Provide non-conducting type connections wherever jointing dissimilar metals. Dielectric unions or Victaulic dielectric waterway fittings are the only types acceptable.

.11 Verify no contact between copper and ferrous metal.

.12 Provide drain valves at main shut off valves, low points of piping and apparatus, and at the bottom of all risers.

.13 Keep open ends of pipe free from scale and dirt. Whenever work is suspended during construction protect the open ends by using temporary plugs, burlap or other means approved by the Consultant.

.14 Do not run piping carrying liquids or steam over electrical switchboards, elevator controllers or electrical motor starters. Where this is unavoidable provide 1.2 mm gauge aluminum pans under piping. Each drip pan must have drain piped to discharge over nearest available open drain.

.15 Provide for isolation of systems by section.

.16 Select piping location that will not subject piping to frost damage, under flow, or no flow conditions.

.17 Install and support piping so that strain and weight does not bear on cast iron fittings or apparatus.

.18 Chrome-plate all piping exposed in food preparation areas, and dishwashing areas, central sterilizing areas and laundry areas. Stainless steel cover plates may be substituted to conceal groups of pipes.

.19 Do not be install PE pipe in areas contaminated or potentially contaminated with organic compounds (organic solvents or petroleum products), such as, near buried petroleum fuel tanks, abandoned gas stations, petro storage areas, or petro refinery sites.

3.2 SCREWED CONNECTIONS

.1 American National Taper pipe thread must be used for all screwed connections. Remove burrs and chips and ream or file the pipe ends out to size or bore. Not more than two imperfect threads exposed when joint made up.

.2 Make screw joints metal to metal. Do not use lamp wick or other packing material in making up screwed joints.

.3 Use teflon tape, red lead and linseed oil or other approved non- toxic joint compound applied to male threads only.

.4 Thread chromium-plated piping and make up carefully. Do not expose more than one full turn of thread beyond any fitting.

3.3 GROOVED MECHANICAL COUPLINGS

.1 Permitted on sprinkler and domestic water service in any exposed, or concealed location providing the piping can be easily accessed.

.2 Permitted on heating water and glycol service in mechanical rooms, interstitial spaces, shafts, parking level and crawl spaces.

.3 Permitted on chilled water and condenser water service in mechanical rooms, interstitial spaces, shafts, parking level and crawl spaces.

.4 Permitted on approved air and oil systems in mechanical rooms, interstitial spaces, shafts, parking level and crawl spaces.

.5 Prepare pipe for joining in the manner recommended by the coupling manufacturer.

.6 Each Subcontractor must use the same manufacturer throughout for each service the Subcontractor is responsible for.

.7 The grooved coupling manufacturer's factory trained representative will provide on-site training to the contractor's site personnel in the use of grooving tools and installation of grooved joint products. The manufacturer's representative will periodically visit the jobsite and verify the contractor is following best recommended practices in grooved product installation (a distributor's representative is not considered qualified to conduct the training or jobsite visit(s)).

3.4 WELDED CONNECTIONS

.1 Prepare mating surfaces properly; bevel at least one mating surface. Longitudinally align piping carefully, set 3.2 mm space between mating surfaces and tack, using 6010 rod. Preheat the materials to be joined to at least 21°C. Make minimum of three passes; use 6010 rod for root pass, use 7018 rod for subsequent filler passes and final cover pass. Remove slag and flux after each pass by brushing or grinding. Remove voids from each pass by cutting or grinding and make good by back welding.

.2 Ensure complete penetration by the root pass. Weld a minimum of 1 mm thicker than the pipe thickness, measured at the inner diameter of the piping.

.3 Do not caulk or peen welds.

3.5 SOLDER AND BRAZED CONNECTIONS

.1 Remove burrs and chips and ream or file the pipe ends out to size or bore. In the case of soft copper tubing, restore reaming tubing to full diameter before joining to fitting.

.2 Assemble joints without binding. Brazing material or solder must penetrate fully and fill the joint completely.

.3 Braze all joints on refrigerant and medical gas piping.

.4 Braze all piping joints on copper sprinkler piping. Use of solder to join sprinkler head to the piping only will be permitted.

3.6 VIC-PRESS CONNECTIONS

.1 Install Vic-Press 304™ in accordance with Victaulic recommendations.

.2 Certify pipe for use with the Vic-Press 304™ system, square cut (+/-0.030", properly deburred, and cleaned. Mark pipe ends with a gauge supplied by Victaulic.

.3 Use a Victaulic 'PFT' series tool with the proper sized jaw for pressing.

3.7 SOLVENT WELDED CONNECTIONS

.1 Prepare mating surfaces properly in accordance with manufacturer's instructions. Proper primer and solvent cementing procedures must be followed at all times.

3.8 GRADING OF PIPING AND DRAINS

.1 Grade water heating water, glycol and chilled water piping generally up in the direction of flow, 2% for proper venting at high points.

.2 In all water systems, at each low point, and at all equipment connections inside the isolating valves, install hose bibb drains in accessible locations. Use 15 mm valves unless specifically noted otherwise.

.3 Make connections from all pump casings, relief valves, system drains, air vents, overflows and all major drain points to the nearest accessible hub or funnel or floor drain. Arrange overflow drains so that drips may be readily seen.

.4 Slope steam piping 0.42% in direction of flow and condensate return piping 0.63%. Provide drip trap assembly at low points and points where condensate may collect in front of control valves. Run condensate lines from traps to nearest condensate cooler tank.

.5 Arrange refrigerant piping to return oil to the compressor. Pitch all horizontal lines minimum of 1:250 in the direction of refrigerant flow. Provide traps in the piping systems as required and keep horizontal dimensions of traps as small as possible. Use double risers as required to obtain proper velocity in vertical risers.

3.9 DOMESTIC WATER PIPING INSTALLATION

.1 Complete water piping with service connections to all fixtures, equipment and outlets. Pipe sizes are as shown or as specified.

.2 Exercise care in the laying of soft copper tubing under slabs so it does not bear or is in contact with rocks and that directional changes are gradual to ensure tubing will not be kinked or collapsed.

.3 Ensure all brass and copper pipe and tubing is free from cuts, dents or other surface damage at the time of final inspection. Remove damaged pipe or tubing and replace with new pipe or tubing.

.4 Take branches from water supply mains from the top, bottom or side, using crossover fittings where required by structural or operating conditions.

3.10 DRAINAGE AND VENT PIPE INSTALLATION

.1 Run pipes in straight lines and have uniform grade between elevations noted. Branch drains connected to the main drain will not have lesser grade than the main drian. A 2% uniform grade will be used for pipes where elevations are not given. Where such grade on overhead pipes would reduce the headroom materially, the grade may be reduced to not less than 1%, if so directed by the Consultant. All overhead pipes must be kept as close to ceilings as possible, unless otherwise indicated or noted.

.2 Do not use double hubs, straight crosses, double Ts or double TYs in any soil or waste pipe below any fixture. Do not install branch fitting other than the full Y and an eighth bend on any soil or waste pipe running in horizontal plane. Do not use quarter bends placed on their sides or inverted joints below any fixture.

.3 Fire resistant PVC piping may not be painted.

3.11 VACUUM BREAKERS

.1 Install vacuum breaker on all hose bibbs.

.2 Install vacuum breaker on water supplies to dishwasher, laundry machine, water heating/cooling coils.

.3 Provide air gaps on all atmospheric drains such as drains from coils, blowdowns, tanks, equipment, riser drains, relief valve discharge.

END OF SECTION

SECTION 20 05 13

COMMON MOTOR REQUIREMENTS FOR MECHANICAL EQUIPMENT

Part 1 General

1.1 SUMMARY

.1 This specification covers horizontal, 3-phase, integral horsepower, totally enclosed fan-cooled severe service, squirrel cage induction motors in NEMA frame sizes 143T-449T.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 00 – Common Work Results for Mechanical: Coordination requirements for motors forming a part of the work for Divisions 21, 22 and 23.

.2 Section 26 05 06 – Common Motor Requirements for Electrical: Electric motor power characteristics.

1.3 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 100-04 (R2009), Motors and Generators

.2 National Electrical Manufacturers Association (NEMA):

.1 NEMA MG-1-2009, Revision 1-2010, Motors and Generators

1.4 SUBMITTALS

1.1.1 Submit schedule as shop drawing, prior to ordering pipe and fitting material, showing materials proposed for service, size and application in accordance with Section 01 00 06 – General Requirements: Submittals.

1.1.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Shop Drawings: Submit shop drawings indicating motor manufacturer, frame size, voltage, full load amps, insulation class and motor grade, and dimensions.

1.1.3 Informational Submittals: Provide the following submittals when requested by the Consultant or during the course of the work as required:

1.1.3.1 Certificates: Submit statement describing welding procedures proposed for the review of the Consultant before commencing work.

1.5 PROJECT CLOSEOUT SUBMISSIONS

1.1.4 Operation and Maintenance Data: Submit manufacturer's written maintenance tasks based on application of the motor; include maintenance schedules, list of replacement parts and recommended lubrication products, include name of original installer and contact information in accordance with 01 00 06 – General Requirements: Operation and Maintenance Manuals as required.

1.6 QUALITY ASSURANCE

1.1.5 Regulatory Requirements: Provide motors manufactured in accordance with NEMA MG-1 or CSA C22.2 No. 100; labelled in accordance with Canadian Electric Code; motors designed to IEC Standards are not acceptable.

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Equipment Compatibility: Motors driven by VFD equipment must be 100% compatible to drive manufacturer's data.

1.7 WARRANTY

.1 Manufacturer Warranty: Standard Warranty Certificate – motors are warranted for a period of three (3) years against defects in material and workmanship from date of Substantial Performance for the Project.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, use any of the following listed manufacturers' products in accordance with Section 01 62 00 – Product Options:

.1 Baldor Electric Company
.2 Century Industrial E Plus
.3 Reliance Electric
.4 Siemens AG
.5 TECO-Westinghouse Motor Company
.6 U.S. Electric Motors

.2 Substitutions: Consultant will accept additional manufacturers having similar products to Acceptable Materials listed in this Section provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements; Substitutions.

2.2 SYSTEM DESCRIPTION

.1 Performance Requirements: Provide only inverter grade motors.

.2 Variable Speed Drives: Design motors for operation with Variable Frequency Drives as noted on the Motor Schedule on Drawing.

.3 Electrical Requirements:

.1 Voltage and Frequency:

.1 Rate motors rated for operation on a 3-phase, 60Hz power supply at 575 Volts or 460 Volts or 208 Volts as required. Design and manufacture motors to operate with $\pm$10% voltage and $\pm$5% frequency variations of the nameplate ratings.

.2 Do not exceed a combined voltage and frequency variation of $\pm$10%.

.2 Operating Characteristics:

.1 Torque: Motors must meet or exceed the locked rotor (starting) and minimum breakdown torques specified in NEMA standard for Design B for the ratings specified.

.2 Current: Locked rotor (starting) currents are not to exceed NEMA Design B maximum values for the specified rating. Motors are capable of a 20 second stall at six times full load current without injurious heating to the motor components.

.3 Efficiency: Premium Efficient design Motors will have a minimum and nominal full load efficiency that will meet or exceed the values listed in NEMA MG-1, 12.55 Table 12-6B when tested in accordance with NEMA test standard MG1-12.54.1, IEEE Test Procedure 112, Method B using accuracy improvement by segregated loss determination including stray load loss measurements. The minimum efficiency is guaranteed.

.4 Power Factor: The power factor of 3600 and 1800 rpm, 3 through 186.5 kW 250 HP ratings at full load, at full voltage must be a minimum of 85%. Six pole ratings will be excluded from this requirement.

.3 Service Factor and Ambient:

.1 Standard motors will be rated for a 1.15 service factor in a 400°C ambient.

.4 Insulation:

.1 Install standard motors with a full Class F non-hygroscopic insulation system.

.2 Dip and bake standard motors in polyester varnish to consolidate the winding.

.4 Mechanical Construction:

.1 Motor Type:

.1 Totally Enclosed Fan Cooled (TEFC):

.1 Design motor to prevent free exchange of air between inside and outside of motor housing.

.2 Provide integral fan to direct cooling air over exterior surface of frame; fan constructed from one piece corrosion-resistant material.

.3 Construct fan covers from pressed steel for frames 140T-400T and of cast iron for 440T frames.

.4 Construct motor frame and end brackets from cast iron construction; include stainless steel nameplate.

.5 Provide two (2) drains at lowest point in frame.

.2 Bearings:

.1 All motors must have anti-friction bearings, sized for L-10 life of at least 50,000 hours under minimum V belt heave sizes for maximum loading conditions, refer to NEMA MG-1, 14.41 Table 14-1, or 150,000 hours L-10 life for a direct connected load.

.2 Bearings must be double-shielded, vacuum degassed steel ball bearings selected for electric motor service.

.3 Re-grease bearing housings with provision for purging old grease.

.4 Lubricate bearings with a premium moisture resistant grease of a temperature range of -290°C to +1490°C.

.5 Cast iron inner bearing caps.

.6 Zinc cadmium plate all fasteners and motor hardware.

.7 Use cast iron conduit box, diagonally split and rotatable in 90° increments:

.1 Use four (4) hex head bolts to secure conduit box to frame.

.2 Use four (4) hex head bolts for the conduit box cover.

.8 Zinc cadmium plate external hardware to resist corrosion.

.9 External full gloss epoxy enamel paint withstands industrial environments.

.10 Choose stainless steel and stamped nameplates in accordance with NEMA MG-1, 10.40. Nameplate information must include the nominal efficiency value in accordance with standard NEMA MG-1, 12.54.2.

2.3 SOURCE QUALITY CONTROL

.1 Tests and Inspections:

.1 Production Tests: Each motor will receive a routine commercial testing in accordance with NEMA MG-1, 12. Produce prototype test reports for each rating.

.2 Sound Level: The noise level of each motor must comply with NEMA MG-1, 12.49.

.3 Vibration Level: The vibration level of each motor must not exceed those values listed in NEMA MG-1, 12.05.

Part 3 Execution

3.1 INSTALLATION

.1 Confirm coordination required, final connections, loads and locations of motors prior to installation.

.2 Mechanical subtrades are responsible for installing motors for mechanical equipment; deciding location of motors, conduit and connection points shown for equipment supplied by mechanical and as indicated on Electrical Drawings for estimating purposes only.

.3 Division 26 will provide line voltage connections for all mechanical equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Expansion fittings and loops in this Section includes the following:

.1 Flexible pipe connections.

.2 Expansion joints and compensators.

.3 Pipe loops, offsets, and swing joints.

1.2 REFERENCE STANDARDS

.1 Expansion Joint Manufacturers Association, Inc. (EJMA):

.1 Standards of the Expansion Joint Manufacturers Association 8th Edition-2003 (9th Edition now but no info in Techstreet)

1.3 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Flexible pipe connector shop drawing data include the following:

.1 Maximum allowable temperature and pressure rating,

.2 Overall face-to-face length,

.3 Live length,

.4 Hose wall thickness,

.5 Hose convolutions per 300 mm and per assembly,

.6 Fundamental frequency of assembly,

.7 Braid structure, and

.8 Total number of wires in braid.

.3 Expansion joint shop drawings include the following:

.1 Maximum allowable temperature and pressure rating, and

.2 Maximum expansion compensation.

1.4 DESIGN REQUIREMENTS

.1 Conform to Expansion Joint Manufacturers Association standards and manufacturer's recommendations.

1.5 INSPECTION

.1 Provide inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

Part 2 Products

2.1 MANUFACTURERS

1.1.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section ; and as established by the Basis-of-Design Materials, use any of the listed manufacturers products in accordance with Section 01 00 06 – General Requirements; Product Options including the following:

.1 Flexible Pipe Connections:

.1 Mason Industries

.2 Senior Flexonics (Canada) Limited

.2 Expansion Joints and Compensators:

.1 Mason Industries

.2 Senior Flexonics (Canada) Limited

2.2 FLEXIBLE PIPE CONNECTORS

.1 Flexible Rubber Spools: Neoprene twin sphere connector of moulded multiple plies of nylon tire cord fabric and neoprene, rated for 1035 kPa at 120°C. Union end connections for sizes 50 mm and under; floating galvanized ductile iron flanges for sizes over 50 mm.

.2 Spherical Rubber Spools: Neoprene single sphere elbow connector, construction and service rating same as noted earlier in this Section.

.3 Braided Spools for Copper Piping: Stainless steel inner core and braid brazed to copper tube ends, suitable for 1035 kPa at 120°C.

.4 Braided Spools for Steel Piping: Stainless steel inner core and braid welded to steel pipe nipples, threaded for pipe up to 50 mm diameter, flanged for 65 mm diameter pipe and over. Suitable for service at 1035 kPa at 120°C.

2.3 EXPANSION JOINTS

.1 Copper Piping: Laminated stainless steel bellows brazed to copper tube ends, internal guide, stainless steel external shroud. Suitable for 1035 kPa at 260°C.

.2 Steel Piping up to 100 mm: Laminated stainless steel bellows welded to steel pipe nipples, anti-torque device and threaded ends for sizes to 50 mm, flanged ends for sizes 65 mm and over, internal guide and carbon steel shroud. Suitable for 1035 kPa at 260°C.

.3 Steel Piping l00 mm and Over: Guided externally pressurized laminated stainless steel bellows, flanged ends, internal guide tube and ring, external shroud and guide ring. Suitable for 1035 kPa at 260°C.

2.4 PIPE GUIDES

.1 Four (4) finger "spider" inside a guiding sleeve formed of two halves suitable for clamping onto pipe.

.2 Guided sleeve formed of two parts, suitable for bolting to supporting structure.

.3 Guide length to be minimum 300 mm.

Part 3 Execution

3.1 APPLICATION

.1 Provide flexible pipe connectors on pipes connected to equipment supported by vibration isolation and where indicated on the drawings.

.2 Provide structural work and equipment required to control expansion and contraction of piping, loops, pipe offsets, and swing joints and provide expansion joints where indicated or required.

.3 Provide pipe guides as required to ensure correct pipe alignment for expansion joints. Minimum two (2) guides on each side of expansion joints.

3.2 INSTALLATION

.1 Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.

.2 Rigidly anchor pipe to building structure at points shown, and where necessary, provide pipe guides so that movement takes place along axis of pipe only.

.3 Install flexible connectors and expansion joints in accordance with manufacturer's instructions.

.4 Do not compress or expand connector during installation.

END OF SECTION

SECTION 20 05 23

VALVES FOR MECHANICAL SYSTEMS

Part 1 General

1.1 SUMMARY

.1 Work in this section includes, but is not limited to, the following:

- .1 Gate Valves
- .2 Globe Valves
- .3 Check Valves
- .4 Plug Valves
- .5 Ball Valves
- .6 Butterfly Valves
- .7 Radiator Valves
- .8 Drain Valves
- .9 Relief Valves
- .10 Pressure Differential Control Valves

1.2 RELATED REQUIREMENTS

.1 Division 33 – Piped Utilities Materials

.2 Section 20 05 10 – Mechanical Systems Pipe and Pipe Fittings

.3 Section 21 10 00 – Water Based Fire Suppression Systems

.4 Section 21 12 00 – Fire Suppression Standpipes

.5 Section 22 13 25 – Plumbing Specialties

.6 Section 22 31 00 – Domestic Water Softeners

.7 Section 22 40 00 – Plumbing Fixtures and Trim

.8 Section 23 05 17.13 – Hot Water Heating Piping Specialties

.9 Section 25 09 00 – Instrumentation and Control Devices for Mechanical Systems

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI):

- .1 ANSI/ASME B1.20.1-1983(R2006), Pipe Threads, General Purpose
- .2 ANSI/ASME B16.1-2010, Gray Iron Pipe Flanges and Flanged Fittings
- .3 ANSI/ASME B16.10-2009, Face to Face and End-to-End Dimensions of Valves
- .4 ANSI B16.18-2001(R2005), Cast Copper Alloy Solder Joint Pressure Fittings

.2 American Society for Testing and Materials (ASTM):

- .1 ASTM A126-04(2009), Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

.2 ASTM A536-84(2009), Standard Specification for Ductile Iron Castings

.3 ASTM B21/B21M-06, Standard Specification for Naval Brass Rod, Bar, and Shapes

.4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings

.5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings

.6 ASTM B98/B98M-08, Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes

.7 ASTM B139/B139M-07, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes

.3 American Water Works Association (AWWA):

.1 ANSI/AWWA C606-06, Grooved and Shouldered Joints

.4 Canadian Standards Association (CSA):

.1 CAN/CSA B139-09, Installation Code for Oil Burning Equipment

.2 CSA B149.1-10, Natural Gas and Propane Installation Code

.3 CAN/CSA B242-05, Groove- and Shoulder- Type Mechanical Pipe Couplings

.4 CSA Z305.1-92(R2001), Non-Flammable Medical Gas Piping Systems

.5 National Plumbing Codes Handbook 1997

.5 National Fire Protection Association (NFPA):

.1 NFPA (Fire) 13-2010, Standard for the Installation of Sprinkler Systems

.2 NFPA (Fire) 14-2010, Standard for the Installation of Standpipe and Hose Systems

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit shop drawings of each valve type and a valve application schedule. Indicate on the shop drawings the manufacturer, model, sizes, pressure rating, materials and intended uses.

.3 Submit valve directories in triplicate, typed form. List valve tag number, service and location. Frame one copy under glass for wall mounting.

1.5 PRODUCT OPTIONS

.1 An Armstrong "Flo-trex" control valve may be substituted on pump discharge in lieu of check valve, balancing valve and isolation valve. B & G and Victaulic (for grooved piping systems) equivalents are acceptable.

.2 An Armstrong suction guide may be substituted on pump inlet in lieu of strainer. B & G and Victaulic (for grooved piping systems) equivalents are acceptable.

.3 Pre-manufactured sprinkler valve test stations, approved by the Authority Having Jurisdiction, may be submitted for individual valve components required in the sprinkler test stations.

.4 Ball valves may be substituted for plug valves for balancing service up to and including 50 mm screwed connections, on heating water, glycol, and chilled water services.

.5 Butterfly Valves: Lug type butterfly valves may be used in lieu of conventional valves on chilled water and condenser water and heating water and glycol service in equipment rooms only as follows:

Valve Shown	Line Size (mm)	Butterfly Equivalent
Gate	100 mm & smaller	Valve Item #7.1
Gate	150 mm & larger	Valve Item #7.3
Gate	150 mm & under	Valve Item #7.1
Gate	200 mm & over	Valve Item #7.3

.6 Victaulic Butterfly Valves: Butterfly valves for grooved pipe mechanical coupling connections may be used on lines 50 mm and larger for chilled and condenser water service, heating water, glycol, domestic water, compressed air, and oil service.

.1 Product: Victaulic 300 MasterSeal, EPDM pressure responsive seat, for sizes 50 mm through 300 mm. For sizes 350 mm through 600 mm, Victaulic Series W706 with AGS grooved ends.

.7 Butterfly Valves: UL or ULC listed butterfly valves with actuator and supervisory switches may be used on sprinkler service. Standard of Acceptance: Victaulic Style 705W.

.8 Provide extended shafts on butterfly valves when valves are insulated.

.9 Offset butterfly valve stem from the disc centerline to provide full 360° circumferential seating.

1.6 QUALITY ASSURANCE

.1 Comply with the codes and standards referenced in this section. Base editions of codes and standards to those currently in effect or accepted by the Authorities Having Jurisdiction.

.2 Use grooved joint valves and adjoining couplings from the same manufacturer.

.3 Use valves for fire service that are UL, ULC or FM approved.

.4 Use valves for sprinkler service that are UL, ULC or FM approved.

Part 2 Products

2.1 MATERIALS

.1 Provide valves in accordance with the valve schedule that forms part of this Section.

.2 Use one manufacturer only for all valves of the same type.

.3 Equip valves with renewable seats suitable for the service intended and to provide positive shutoff.

.4 Provide composition discs on globe and check valves that are suitable for temperature and fluid or gas encountered.

.5 Comply with ANSI B16.18 for solder joint ends.

.6 Comply with ANSI/ASME B1.20.1 for threaded ends.

.7 Comply with ANSI/AWWA C606 and CAN/CSA B242 for grooved ends.

.8 Comply with ANSI/ASME B16.1 for cast iron flanges with face-to-face distance to ANSI/ASME B16.10.

.9 Comply with ASTM A126 Cl.B for cast iron valves; bronze valves to ASTM B61 and B62 as noted.

.10 Threaded Valve Stem Materials: Naval brass to ASTM B21/B21M; copper silicone alloys to ASTM B98/B98M; or phosphor bronze to ASTM B139/B139M.

Part 3 Execution

3.1 INSTALLATION

.1 Use line size valves throughout with the exception of control valve bypasses. Size control bypass valves equal to control valve.

.2 Install valves with stems upright or horizontal. Under no circumstances install inverted.

.3 Align valves for easy access and identification when several service lines are installed together.

.4 Provide chain operators on valves installed at high levels in equipment rooms that cannot be reached by an operator standing on the floor or fixed service platform.

.5 Provide one lever handle per 10 plug valves where handles are removable.

3.2 APPLICATION

.1 Install gate or butterfly valves to isolate equipment, sections of systems, at the base of each vertical pressure riser and elsewhere as indicated.

.2 Install a gate or butterfly valve on the inlet and outlet of each piece of heat transfer equipment, exclusive of room heat transfer units. Locate the valves on the main side of the unions or flanges of the equipment. For heat transfer equipment valving, refer to drawings.

.3 Install gate or butterfly valves to isolate the supply and return of each main section or loop of the heating and cooling systems. Locate a balancing valve upstream of the return isolating valve.

.4 Install gate or butterfly valves on all branch connections to the main.

.5 Provide a runout size radiator valve and lockshield valve on each branch to a room heat transfer device and reheat coil.

.6 Use globe valves for throttling service, meter bypass and control valve bypass.

.7 Use spring loaded check valves on discharge of sump, booster, condensate, feedwater and condenser water pumps.

3.3 DRAINS

.1 Provide drain valves at main shutoff valves, low points of piping circuits including base of all risers and at apparatus other than room heat transfer units.

.2 Provide drain valves on strainers size 100 mm and larger.

3.4 PRESSURE RELIEF VALVES

.1 Individual pipe discharge from each relief valve to drain. Terminate in a manner that discharge flow is visible. Pipe discharge of steam relief valves to atmosphere, including drip pan elbows piped to drain.

.2 Pipe discharge of glycol relief valves to the glycol mixing tank.

END OF SECTION

SECTION 20 05 93.13

TESTING OF MECHANICAL MATERIALS

1 General

1.1 SUMMARY

1.1.1 This Section includes requirements for design, supply and installation of.

1.1.1.1 Test condenser water piping.

1.1.1.2 Test domestic water piping.

1.1.1.3 Test sanitary sewer piping.

1.1.1.4 Test sewer vent piping.

1.1.1.5 Test sprinkler system piping.

1.1.1.6 Test control air piping.

1.1.1.7 Test medium and high velocity ducts.

1.2 REFERENCE STANDARDS

1.2.1 American Society of Mechanical Engineers (ASME):

1.2.1.1 ASME Section V, 2010 ASME Boiler and Pressure Vessel Code, Section V: Nondestructive Examination

1.2.1.2 ASME Code Section VIII, Div 1, 2010 ASME Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels

1.2.1.3 ANSI/ASME B31.1-2010, Power Piping

1.2.2 Compressed Gas Association (CGA):

1.2.2.1 CAN/CGA 149.1

1.2.2.2 CAN/CGA 149.2

1.2.3 National Fire Protection Association (NFPA):

1.2.3.1 NFPA (Fire) 13, Standard for the Installation of Sprinkler Systems

1.2.3.2 NFPA (Fire) 14, Standard for the Installation of Standpipe and Hose Systems

1.2.3.3 NFPA (Fire) 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances

1.3 SUBMITTALS

1.3.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

1.3.2 Obtain certificates of approval and acceptance, complying with rules and regulations from authorities having jurisdiction. Submit copies to include in Operating and Maintenance Manuals.

1.3.3 Perform tests as specified. Include test certificates in Operating and Maintenance Manuals.

1.4 LIABILITY

1.4.1 Take charge of plant during tests, assume responsibility for damages in the event of injury to personnel, building or equipment and bear costs for liability, repairs and restoration in this connection.

1.5 QUALITY ASSURANCE

1.5.1 Test equipment and material where required by specification or authority having jurisdiction to demonstrate its proper and safe operation.

1.5.2 Test procedures in accordance with applicable portions of ASME, ASHRAE, SMACNA, N.F.P.A. and other recognized test codes.

1.5.3 Perform tests on site to the satisfaction of the Consultant.

1.5.4 Piping, fixtures or equipment must not be concealed or covered until installation is inspected and approved by the Consultant. Provide written notice to the Consultant at least three (3) days in advance of tests or concealing of piping.

1.5.5 Coordinate with Consultant at start of the project, those tests that will require witnessing by the Consultant.

1.5.6 Submit sample test certificate forms for review two (2) weeks prior to any testing on site.

2 Products

2.1 NOT USED

3 Execution

3.1 PRESSURE TESTS

3.1.1 Provide equipment, materials and labour for tests and pay expenses. Use test instruments from approved laboratory or manufacturer and provide certificate showing degree of accuracy and date of calibration. Install permanent gauges and thermometers used for tests just prior to tests to avoid possible changes in calibration.

3.1.2 Carry out tests for an 8 hour period and maintain pressure with no appreciable pressure drop. Where leakage occurs, repair and re-test and pay necessary costs for re-witnessing.

3.1.3 Water Piping: Test to 1-1/2 times maximum working pressure or 1035 kPa, whichever is greater, water pressure measured at system low point.

3.1.4 Sprinkler System: Test as required by current edition of NFPA 13 and authorities having jurisdiction.

3.1.5 Refrigerant Piping: Test with nitrogen to 2070 kPa on high pressure side and 1035 kPa on low side and refrigerant halide torch test.

3.1.6 Check systems during application of test pressure including visual check for leakage of water test medium, soap bubble test for air.

3.1.7 During heating and cooling piping system tests, check linear expansion at elbows, U bends, expansion joints and offsets for proper clearance.

3.1.8 Check systems during application of test pressure including visual check for leakage of water test medium, soap bubbler test for air or nitrogen test medium and halide torch for refrigerant medium.

3.1.9 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct the defects. Correct leaks by re-making joints in screwed fittings, cutting out and re-welding welded joints, re-making joints in copper lines. Do not caulk.

3.2 RADIOGRAPHIC EXAMINATION OF WELDED JOINTS

3.2.1 Include for a minimum of 5% of the welded joints, unless a greater quantity is specified elsewhere, selected by the Consultant to be examined by radiography, as specified below.

3.2.2 Pipe joints selected for examination must be 100% radiographed.

3.2.3 Base examination method on ASME Code Section V, Article 2.

3.2.4 Base acceptance criteria on ASME Code Section VIII Par UW-51. The standard of weld quality must meet the applicable Standard ANSI/ASME B31.1.

3.2.5 Where a radiograph discloses defects, examine two additional joints. The contractor bears the cost of additional radiography and of the repairs.

END OF SECTION

SECTION 20 05 93.19

BALANCING OF MECHANICAL SYSTEMS

Part 1 General

1.1 SUMMARY

.1 Balance, adjust, and test air and liquid systems and equipment and submit reports using identical units to those shown on contract documents.

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00 – Mechanical Operation and Maintenance Data.

.2 Section 20 05 93.18 – Coordination with Balancing Agency.

1.3 REFERENCE STANDARDS

.1 National Environmental Balancing Bureau (NEBB)

.2 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

.3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)

1.4 QUALITY ASSURANCE

.1 Work specified in this section shall be performed by an Independent Agency specializing in this type of work.

.2 Balancing (of both air and liquid systems) and sound level readings shall be performed by the same agency.

.3 During the one year warranty period, the owner may request re-check or re-setting of outlets or fans as listed in test report. Provide technicians and equipment required during visits for seasonal adjustments.

.4 Obtain sound level readings and submit reports for no less than 5% of the rooms within the building. Rooms where readings to be taken to be selected by the Consultant.

1.5 SITE VISITS

.1 A review of the installation and access to all valves, dampers, and equipment shall be made at the specified site visits and any additional dampers or valves required for proper balancing shall be forwarded in writing to be reviewed by the Consultant.

.2 Begin balancing after equipment start-up and testing and after systems have been completed and are in full working order. Place systems and equipment into full operation and continue operation during each working day of balancing.

1.6 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Balancing Agenda:

.1 General: Submit balancing agenda to the Consultant and commissioning contractor for review at least sixty (60) days prior to the start of balancing work. Start balancing work only after agenda has been approved. Include descriptive data, procedure data, and sample forms in agenda.

.2 Descriptive Data: General description of each system including associated equipment and different operation cycles, listing of flow and terminal measurements to be performed [and selection points for proposed sound measurements].

.3 Procedure Data: Procedures for converting test measurements to establish compliance with requirements, specify type of instrument to be used, method of instrument application (by sketch) and correction factors.

.4 Sample Forms: Form showing application of procedures to typical systems.

.3 Balance Report:

.1 Submit (2) copies of rough balancing reports to the Consultant for review, prior to on-site verification and acceptance of Project.

.2 Provide four (4) copies of final reports to contractor for inserting in Owner's Operating and Maintenance Manuals as described in Section 20 01 00.

.3 Include types, serial number, and dates of calibration of instruments in the reports.

1.7 SYSTEM DATA

.1 Air Handling Equipment

Design Data: See Sheet M-601

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 ECCO

.2 Carrier

.3 The Unico System

2.2 INSTRUMENTS

.1 Provide calibration histories for each instrument. Recalibration or use of other instruments may be requested when accuracy of readings is questionable.

Part 3 Execution

3.1 GENERAL PROCEDURE

.1 Permanently mark, by stick-on labels and/or fluorescent paint, settings on valves, splitters, dampers, and other adjustment devices.

.2 Subsequent to correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.

.3 Where vane anemometer is used to measure supply, return or exhaust air grilles, AK factors shall be determined as follows:

.1 Determine and tabulate similar sized grilles being balanced for AK schedule.

.2 Traverse all ducts serving grilles (outlined in AK schedule) to verify AK factors.

.3 AK factor from schedule, must be approved by Consultant during initial review with balancer on site. (Balancer shall include written procedure for determination of AK factors).

.4 No flow hoods are to be used for measurement of exhaust or return air grilles.

.4 Balancing shall be performed to the following accuracies:

- Air - terminal outlets ±10% (outlets less than 200 l/s)
- Air - terminal outlets ±5% (outlets greater than 200 l/s)
- Air - central equipment ±5%
- Hydronic - terminal outlets ±10%
- Hydronic - pumps and central ±5%

.5 Balancing contractor shall advise mechanical contractor of required revised pulleys, sheaves and impellor shavings to allow proper balancing of systems (Refer to Section 20 05 93.18).

.6 Where pump impellors require shaving, this shall be the responsibility of the mechanical contractor. All adjustments shall be by qualified millwright. All changes shall be documented and included as part of the balancing report.

3.2 AIR SYSTEM PROCEDURE

.1 Perform balancing, adjusting, and testing with building doors and windows in their normal operation position.

.2 The following procedure shall be adopted for central systems:

.1 Ensure dampers or volume control devices are in fully open position.

.2 Balance central apparatus to ±5% air flow.

.3 Balance branches and mains in accordance with 3.1.4.

.4 Recheck central apparatus.

.5 Balance all terminal air outlets in accordance with 3.1.4.

.6 Re-balance central apparatus to ±5%.

.7 Recheck all air outlets.

.8 Perform acoustical measurements.

.3 When balancing air outlets:

.1 Rough balance furthest outlets and then balance sequentially back to source.

.2 Fine balance furthest outlet back to source.

.4 Take static pressure readings and air supply temperature readings at 10 points on the system.

.5 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross sectional area. Take minimum of 16 for rectangular ducts, and 10 on each vertical and horizontal axis for round ducts, traverse readings. If readings are inconsistent across duct, try to obtain straight run of six (6) diameters widths upstream and re-do traverse.

.6 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control only by duct internal devices such as dampers and splitters.

.7 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

.8 Where modulating dampers are provided, take measurements and balance at extreme conditions. (Balance variable volume systems at maximum air flow rate - full cooling, and at minimum air flow rate - full heating).

.9 Verify all terminal unit factory settings for maximum air flow (and minimum if applicable). Adjust terminal unit controller if required. Record adjusted units.

.10 The final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurization levels in variable volume systems throughout full range of fan delivery rates, under both heating and cooling conditions. For multi-storey building test pressure conditions at ground, intermediate and upper levels. Front doors, exits, elevator shafts, should be checked for air flow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.

.11 Complete balancing to achieve positive building pressure unless otherwise instructed. A positive pressure relative to outside of 10 Pa minimum and 20 Pa maximum shall be achieved, measured with negligible outside wind velocity.

3.3 FIRE DAMPER/FIRE STOP FLAP VERIFICATION

.1 Visually inspect all fire dampers and fire stop flaps:

.1 Installation is straight.

.2 Wall angles properly installed.

.3 Duct has break away connection.

.4 Fire stopping material where used is properly installed.

.5 Adequate access.

.6 Clearance between sleeve and wall.

.2 Manually remove each fusible link to ensure damper blade drops properly, then reset damper. Mark dropped fire damper with black felt marker.

.3 Testing of 10% of the fusible links shall be performed with a suitable heat source capable of generating sufficient heat to detonate fusible link without burning or generating carbon deposits on the blades, frame or adjacent ductwork. Selection of links to be test dropped to be as directed by Consultant. Retesting and resetting shall be witnessed by Consultant.

.4 Contact Alberta Building Code enforcement authorities in writing prior to testing each damper and have authorities witness tests as required.

3.4 BALANCING AND ADJUSTING OF FIRE PUMP

.1 Record city water pressure to pumps at two-hour intervals for 48 hours.

.2 Confirm in writing with utility company, maximum and minimum anticipated pressure.

.3 Measure and record pressure at the top of building.

.4 Adjust bypass valve to accommodate installation and prevent pump overload on temperature and pressure.

.5 Run pumps for minimum four (4) hours and re-check pressure at top of building.

.6 Simulate and check the following alarm conditions:

.1 Low utility company pressure (suction pressure).
.2 High pressure.
.3 Pump overload.

3.5 BALANCING AND ADJUSTING OF DOMESTIC WATER SYSTEMS

.1 Adjust PRV on main line to 570 kPa maximum.

.2 Balance domestic hot water recirculating system piping to ensure flow from all points in the system. Ensure all hot and cold supply shut off valves are fully open.

3.6 BALANCING REPORT

.1 Submit draft copies of rough balancing reports prior to final acceptance of project.

.2 Include types, serial number and dates of calibration of instruments.

.3 Record test data on a sepia made from the latest available revised set of mechanical drawings and submit three (3) copies upon completion of the balancing contract for inclusion in equipment and maintenance manuals.

.4 Submit with report, fan and pump curves with operating conditions plotted. Submit grille and diffuser shop drawings and diffusion factors.

.5 Report shall be indexed as follows:

Air

Summary
Procedure
Instrumentation
Drawings
Equipment Summary
Fan Sheets
Fan Curves
Fan Profile Data
Static Data
Air Monitoring Station Data
Traverse Data and Schedule
Terminal Unit Summary
Outlet Data Summary and Schematics (per system)
Building Schematic
Building Pressurization Data
Weather Conditions at Time of Test
Diagnostic
Millwright Reports

Liquid

Summary
Procedure
Instrumentation
Drawings
Pump Data
Pump Curves
Flow Stations
Coils
Equipment Data
Element Data Summary and Schematics (per system)
Diagnostic
Millwright Reports

Acoustics

Summary
Procedure
Instrumentation
Drawings
Profile
Scale Readings

END OF SECTION

SECTION 20 07 00

PIPING AND EQUIPMENT INSULATION

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of pipe and equipment insulation; adhesives, tie wires, and tapes; and recovery jackets for interior and exterior piping and equipment, and other components required for a complete installation.

1.2 RELATED REQUIREMENTS

.1 Section 07 81 23 – Intumescent Fireproofing: Coordinate straight run applied intumescent coatings with application of fire safe insulation wrap and covers specified in this Section.

.2 Section 07 84 00 – Firestopping and Smokeseals: Coordinate insulation type with penetration classification and firestopping systems.

.3 Section 07 92 00 – Joint Sealants

.4 Section 20 05 10 – Mechanical Systems Pipe and Pipe Fittings

.5 Section 20 13 13 – Tanks for Mechanical Systems

.6 Section 20 30 00 – Pumps for Mechanical Systems

.7 Section 23 07 13 – Duct Insulation

.8 Section 23 57 13 – Heat Exchangers for HVAC

1.3 DEFINITIONS

.1 Concealed: Insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces such as crawl spaces and duct shafts.

.2 Exposed: Insulated mechanical services in all other areas visible after final construction will be considered as exposed.

1.4 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A666-10, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

.2 ASTM B209/B209M-07, Specification for Aluminum and Aluminum Alloy Sheet and Plate

.3 ASTM C449/C449M-07, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement

.4 ASTM C547-11e1, Standard Specification for Mineral Fiber Pipe Insulation

.5 ASTM C553-08, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

.6 ASTM C612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation

.7 ASTM C795-08, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel

.8 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

.9 ASTM C1136-10, Standard specification for Flexible, Low Permeance Vapour Retarders for Thermal Insulation

.10 ASTM C1393-08, Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks

.2 Canadian General Standards Board (CGSB):

.1 CGSB 51-GP-52MA, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation

.2 CAN/CGSB 51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts

.3 Thermal Insulation Association of Canada (TIAC):

.1 Mechanical Insulation Best Practices Guide

.4 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.2 CAN/ULC S702-02, Thermal Insulation Mineral Fibre for Buildings

.3 CAN/ULC S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced

.4 CAN/ULC S770-09, Standard Test Method for Determination of Long Term Thermal Resistance of Closed-Cell Thermal Insulating Foams

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Shop Drawings: Submit shop drawings indicating complete material data, K value, temperature rating, density, finish, and recovery jacket of materials proposed for this project and indicate thickness of material for individual services.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: Insulation materials must meet or exceed the requirements of the building code; label packages or containers indicating compliance of packaged materials and as follows:

.1 Environmental Requirements: Provide only insulation that is not produced with, or contain any regulated CFC compounds listed in the Montreal Protocol adopted by the United Nations Environmental Program.

.2 Flame Spread: Use only insulation that meets or exceeds flame spread rating of 25 or less and smoke developed classification of 50 or less in accordance with applicable building codes including insulation materials, recovery jackets, vapour barrier facings, tapes and adhesives.

.2 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Installer: Use installer for work of this Section who has experience with work of similar complexity and extent as required for this project, and that has a minimum three (3) years successful experience, and who is qualified to the standards.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Procedures: Deliver material to job site in original unbroken factory packaging, labelled with manufacturer's density and thickness.

1.8 SITE CONDITIONS

.1 Ambient Conditions: Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer; repair any separation of joints or cracking of insulation arising from thermal movement or poor workmanship.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, use any of the following listed manufacturers' products in accordance with Section 01 62 00 – Product Options:

.1 Fibrex Insulations, Inc.
.2 Isolation Manson Inc.
.3 Johns Manville
.4 Knauf Fiberglass
.5 ECCO
.6 Roxul Inc.

.2 Substitutions: Consultant will accept additional manufacturers having similar products to Acceptable Materials listed in this Section provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 00 06 – General Requirements; Substitutions

2.2 PROPERTIES

.1 Fire and Smoke Hazard Ratings: Provide insulation material, recovery jackets, vapour barrier facings, tapes and adhesives having composite fire and smoke hazard ratings not exceeding Flame Spread 25 and Smoke Developed 50 in accordance with ULC S102.

.2 Service Temperature Rating: Provide insulating materials and accessories that are able to withstand service temperatures without smouldering, glowing, smoking or flaming.

.3 Material Description: Mineral fibre specified includes glass fibre, rock wool, or slag wool meeting the maximum K values listed at the choice of manufacturer.

2.3 PIPING INSULATION MATERIALS

.1 Cold Piping: Formed fine fibrous glass or formed mineral fibre pipe insulation meeting requirements of ULC S702; with factory applied vapour barrier jacket, factory moulded to conform to piping and as follows:

.1 K Value: Maximum 0.035 W/m°C at 24°C
.2 Service Temperature: 4°C to 100°C

.2 Hot Piping: Formed fine fibrous glass or mineral fibre pipe insulation meeting requirements of ULC S702; with factory applied general purpose jacket, factory moulded to conform to piping and as follows:

.1 K Value: Maximum 0.035 W/m°C at 24°C

.2 Service Temperature: Up to 150°C

.3 Roof Drains and Vents: Flexible fibrous glass or mineral fibre insulation meeting requirements of ULC S702; with factory applied reinforced aluminum foil vapour barrier and as follows:

.1 K Value: Maximum 0.035 W/m°C at 24°C

.2 Service Temperature: -14°C to 50°C

.4 Fire Retardant Insulation for PVC and Polypropylene Piping: Formed fine fibrous glass or mineral fibre pipe insulation with cover material having flame spread 0 and smoke developed rating of 35 or less, plenum rated where exposed in return air installations or exposed ceiling installations.

2.4 EQUIPMENT INSULATION MATERIALS

.1 Hot Equipment: Rigid fibrous glass or mineral fibre insulation meeting requirements of ULC S702 and as follows:

.1 K Value: Maximum 0.035 W/m°C at 24°C

.2 Service Temperature: -14°C to 200°C

.2 Cold Equipment: Rigid fibrous glass or mineral fibre insulation meeting requirements of ULC S702; with factory applied reinforced aluminum foil vapour barrier and as follows:

.1 K Value: Maximum 0.035 W/m°C at 24°C

.2 Service Temperature: -10°C to 100°C

Gauge Number	MSG Nominal Steel Core Thickness	Nominal Sheet Aluminum Thickness
8	4.2 mm	--
10	3.4 mm	--
12	2.7 mm	2.1 mm
14	1.9 mm	1.6 mm
16	1.5 mm	1.3 mm
18	1.2 mm	1.0 mm
20	0.9 mm	0.8 mm
22	0.8 mm	0.6 mm
24	0.6 mm	0.5 mm
26	0.5 mm	--
28	0.4 mm	--
29	0.35 mm	--
30	0.30 mm	--

.3 Aluminum: Meeting requirements of ASTM B209 and as follows:

.1 Thickness:

.1 Piping: Nominal 0.5 mm sheet

.2 Equipment, Valves and Fittings, and Engine Exhaust: Nominal 0.8 mm sheet

.3 Installations in Close Proximity to Occupied Areas: Nominal 0.8 mm sheet

.2 Finish: Smooth.

.3 Joining: Longitudinal and circumferential slip joints with [50 mm] laps.

.4 Fittings: 0.5 mm thick die shaped fitting covers with factory attached protective liner.

.5 Metal Jacket Banding and Mechanical Seals: Stainless steel,19 mm wide, 0.5 mm thick at 300 mm spacing.

.6 Exterior Installations: Include integral moisture barrier and weatherproof lap seals and fastenings.

.4 Stainless Steel: Meeting requirements of ASTM A666 and as follows:

.1 Type: 304

.2 Thickness:

.1 Piping: Nominal 0.3 mm sheet

.2 Equipment, Valves and Fittings, and Engine Exhaust: Nominal 0.5 mm sheet

.3 Installations in Close Proximity to Occupied Areas: Nominal 0.5 mm sheet

.3 Finish: Smooth.

.4 Joining: Longitudinal and circumferential slip joints with 50 mm laps

.5 Fittings: Nominal 0.5 mm thick die-shaped fitting covers with factory attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

.7 Exterior Installations: Include integral moisture barrier and weatherproof lap seals and fastenings.

.5 Polyvinyl Chloride (PVC): One-piece moulded type and sheet meeting requirements of CGSB-51.53 with pre-formed shapes as required and as follows:

.1 Colours: As selected by Consultant

.2 Service Temperature Range: -20°C to 65°C

.3 Moisture Vapour Transmission: 0.02 perm

.4 Thickness: 0.35 mm

.5 Fastenings:

.1 Solvent weld adhesive compatible with insulation for lap and joint seals

.2 Tacks

.3 Pressure sensitive vinyl tape of matching colour

.4 Indoor: UV rated materials in areas exposed to fluorescent fixtures

.5 Outdoor: UV rated material minimum 0.5 mm thick

.6 ABS Plastic: One-piece moulded type and sheet with pre-formed shapes as required and as follows:

.1 Colours: As selected by Consultant

.2 Service Temperature Range: -40°C to 82°C

.3 Moisture Vapour Transmission: 0.012 perm

.4 Thickness: 0.750 mm

.5 Fastenings:

.1 Solvent weld adhesive compatible with insulation for lap and joint seals

.2 Tacks

.6 Locations: Outdoor use only

2.5 ACCESSORIES

.1 Canvas Lagging Adhesive: Compatible with insulation and compliant with requirements for ULC listed dilute fire retardant lagging adhesive, washable type.

.2 Tape: Self-adhesive, aluminum, plain, 50 mm wide minimum

.3 Contact Adhesive: Quick setting type

.4 Tie wire: 1.5 mm diameter stainless steel

.5 Bands: Stainless steel, 19 mm wide, 0.6 mm thick

.6 Thermal Insulating and Finishing Cement: Hydraulic setting or Air drying (as required) for use on mineral wool meeting requirements of ASTM C449.

.7 Vapour Retarder Lap Adhesive: Water based, fire retardant type, compatible with insulation.

.8 Indoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.

.9 Outdoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation; fibrous glass reinforcing fabric; untreated 305 g/m^2.

.10 Sealants: Joint and weatherproofing sealants of type compatible with adjacent materials and as specified in Section 07 92 00 - Joint Sealants.

Part 3 Execution

3.1 PREPARATION

.1 Install covering after piping and equipment are functioning correctly and is tested and accepted by Consultant; verify the following:

.1 Verify that surface is clean and dry before installation

.2 Verify that insulation is dry before and during application

.2 Finish installation when systems are running at normal operating conditions, where possible.

3.2 INSTALLATION

.1 Install insulation and recovery jacket in accordance with TIAC Best Practices Guide, manufacturer's written instructions and requirements of this specification.

.2 Install insulation so that it is continuous through inside walls; pack around pipes with fireproof self supporting insulation material, properly sealed in accordance with Section 07 84 00.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes; hangers and supports must be outside vapour retarder jacket.

.5 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided at supports and hanger locations.

.6 Insulate complete system including, but not limited to: piping; fittings; valves; unions; flanges; and strainers, except for flexible connections and expansion joints; terminate insulation neatly with plastic material trowelled on a bevel.

.7 Insulate piping fittings and valves except for unions, flanges (except on flanged valves), Victaulic couplings, strainers (except on chilled water lines), flexible connections and expansion joints; terminate insulation neatly with plastic material trowelled on a bevel.

.8 Cold Piping: Seal lap joints with 100% coverage of vapour barrier adhesive; seal butt joints with 50 mm wide strips of vapour barrier sealed with vapour barrier adhesive; apply hydraulic insulating cement for fittings and valves or apply factory fabricated insulation half shells, seal all laps and joints.

.9 Hot Piping: Apply hydraulic insulating cement or apply factory fabricated insulation half shells for fittings and valves; flare-out staples may be used to secure jacket laps on hot systems applied on 100 mm centres.

.10 Refrigerant Piping: Cover fittings and valves with equivalent thickness of pipe insulation material; apply with edges tightly butted; seal joints with sealant.

.11 Roof Drains and Vents: Adhere flexible insulation with adhesive applied to all laps and as follows:

.1 Provide annealed tie wire tied at 400 mm centers for securing insulation.

.2 Butt insulation and seal joints and breaks with 50 mm of foil tape adhered over joint.

.3 Use pre-formed pipe covering insulation with canvas or aluminum (as required) recovery jacket if exposed.

.12 Equipment: Apply insulation with edges tightly butted, joints staggered and secured in place by metal bands and as follows:

.1 Weld on suitable anchors where necessary.

.2 Provide sufficient clearance around openings for normal operation of equipment.

.3 Finish surface of cold equipment insulation with vapour barrier jacket sealed with vapour barrier adhesive.

.4 Make uneven surfaces smooth with insulating cement.

.13 Radiant Panels: Install 25 mm thick aluminum foil back fibrous glass or mineral fibre insulation onto the back of all radiant panels; hold in place with wire retainers sprung in at 900 mm on centre.

3.3 FINISHING

.1 Finish insulation neatly at hangers, supports and other protrusions.

.2 Provide recovering jackets on exposed insulation throughout, including equipment rooms:

.3 Indoor Exposed Finishing Applications, in accordance with TIAC CPF/1:

.1 Apply factory integral service jacket to receive treated fabric jacket applied using recommended fabric adhesive.

.2 Cover fittings, valves and strainers not finished with PVC covers with a hard coat cement and finished with treated fitting fabric applied with using recommended fabric adhesive.

.3 Locate insulation seams in least visible locations.

.4 Finish fabric with one (1) coat of fabric coating.

.4 Indoor Concealed Finishing Applications in accordance with TIAC CPF/2:

.1 Leave insulation on concealed piping left as factory finished with no further finish required.

.2 Apply pipe insulation with an integral all service jacket.

.3 Secure jacket using appropriate fastenings on 100 mm centres.

.4 Locate insulation seams on piping on side of the pipe visible to access point of concealed space, such as: underside of pipe in concealed ceiling applications.

.5 Cover longitudinal and circumferential joints with jacket finishing tape neatly applied or secure jacketing using integral self sealing lap and self sealing circumferential joint strips depending on system used.

.6 Cover fittings, valves and strainers not finished with PVC covers with a hard coat cement and finish with treated fitting fabric applied with fabric adhesive.

.5 Indoor/Outdoor Exposed Finishing Applications (Metal Recovery Jacket), in accordance with TIAC CPF/3:

.1 Apply stainless steel jacket over the pipe insulation using necessary fastenings on 150 mm centres.

.2 Apply metal jacket or preformed metal fittings over insulated fittings, valve bodies, valve bonnets, strainers and flanges to provide a complete jacket system.

.3 Lap circumferential joints 50 mm minimum and seal with compatible waterproof lap cement

.4 Lock form longitudinal joints and seal.

.5 Locate metal jacket seams in least visible locations.

.6 Secure with recommended fastenings.

.6 Indoor/Outdoor Exposed Finishing Applications (PVC Recovery Jacket), in accordance with TIAC CPF/4:

.1 Apply PVC Jacket over the pipe insulation using necessary fastenings on 100 mm centres.

.2 Cover longitudinal and circumferential joints with finishing tape neatly applied.

.3 Apply PVC jacket or preformed PVC fitting covers over insulated fittings, valve bodies, valve bonnets, strainers and flanges to provide a complete jacket system.

.4 Locate PVC jacket seams in least visible locations.

.5 Secure with appropriate fastenings and jacket finishing tape.

.7 Outdoor Concealed, in accordance with TIAC CPF/5: Apply 2 ply weatherproof coating to insulated surfaces:

.1 First Ply: Apply minimum 1 litre per 1.5 m length of pipe weatherproof coating applied to insulated surfaces, increase application rate based on pipe diameter and manufacture's recommendations.

.2 Embed a layer of reinforcing membrane while still wet.

.3 Second Ply: Apply minimum 1 litre per 1.5 m length of pipe weatherproof coating applied to insulated surfaces, increase application rate based on pipe diameter and manufacture's recommendations.

3.4 INSULATION INSTALLATION THICKNESS SCHEDULE

.1 Insulation thicknesses listed below are based on based on Maximum K Value of least efficient insulation materials such as glass fibre and mineral fibre; thickness can be decreased for higher efficiency insulation materials such as polyurethane while maintaining overall K Value for the installation:

Piping or Equipment	Pipe Sizes mm	Insulation Thickness mm	Recovery Jacket
Domestic Cold Water Piping	13 to 40 50 and over	25 38	[Canvas] [Aluminum] [Stainless Steel] [PVC]
Domestic Hot Water Supply and Recirculation Piping	13 to 50 65 and over	25 38	[Canvas] [Aluminum] [Stainless Steel] [PVC]
Domestic Hot Water Supply and Recirculation Piping (through unconditioned spaces)	13 to 50 65 to 100 125 and over	50 65 75	[Canvas] [Aluminum] [Stainless Steel] [PVC]
Drinking Water Piping	All sizes	38	[Canvas] [Aluminum] [Stainless Steel] [PVC]
Irrigation Piping Inside Building	All sizes	25	Canvas, Aluminum Stainless Steel, or PVC as required.
Glycol Heating Piping	13 to 40 50 to 75 100 to 150 200 and Over	25 38 50 65	Canvas, Aluminum, Stainless Steel, or PVC as required.

Piping or Equipment	Pipe Sizes mm	Insulation Thickness mm	Recovery Jacket
Hot Water Heating Piping; Do not insulate within Radiation Enclosures except for mains	13 to 40 50 to 75 100 to 150 200 and Over	25 38 50 65	Canvas, Aluminum, Stainless Steel, or PVC as required.
Refrigerant Suction Piping	Controlled branch run-outs or risers in heated spaces below 50 mm less than 3.7 m in length	25	Aluminum or Stainless Steel as required.
Roof Drains, Vertical Connections Below Roof Drains and 3 m of Horizontal Piping.	Controlled branch run-outs or risers in heated spaces above 50 mm or greater than 3.7 m in length	As schedules	Canvas, Aluminum, Stainless Steel, or PVC as required.
Vents within 3 m of Roof Outlet	≤25 mm >25 mm	25 38	Canvas, Aluminum, Stainless Steel, or PVC as required.
	All sizes	38	
	All sizes	38	
Shell and Tube Heat Exchangers		65	Aluminum or Stainless Steel as required.
Hot Water Storage Tanks		65	Aluminum or Stainless Steel as required.
Air Separators		38	Aluminum or Stainless Steel as required.
Deaerators	All sizes	65	Aluminum or Stainless Steel as required.

Piping or Equipment	**Pipe Sizes mm**	**Insulation Thickness mm**	**Recovery Jacket**
Condenser Water Piping to (indoors)	25 30 to 150 200 and over	25 38 50	Canvas, Aluminum, Stainless Steel, or PVC.
Note: Pipe insulation for piping installed in 38 mm x 92 mm wall cavity can be reduced to 16 mm, for pipe sizes 38 mm to 65 mm; install insulation to thickness specified for piping outside the wall cavity.			

END OF SECTION

SECTION 20 13 13

TANKS FOR MECHANICAL SYSTEMS

Part 1 General

1.1 SUMMARY

.1 Tanks specified in this Section include, but are not limited to, the following:

.1 Domestic hot water storage tanks
.2 Expansion tanks
.3 Accessories and connections
.4 Saddles and supports

1.2 RELATED REQUIREMENTS

.1 Section 20 05 23 – Valves for Mechanical Systems
.2 Section 20 07 00 – Piping and Equipment Insulation
.3 Section 20 30 00 – Pumps for Mechanical Systems
.4 Section 22 08 13 – Cleaning and Start-Up of Piping Systems
.5 Section 25 09 00 – Instrumentation and Control Devices for Mechanical Systems

1.3 REFERENCE STANDARDS

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

.1 ANSI/ASHRAE 90.1-2010 (I-P), Energy Standard for Buildings Except Low-Rise Residential Buildings

.2 American Society of Mechanical Engineers (ASME):

.1 ASME 2010 Boiler and Pressure Vessel Code

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A515/A515M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

1.4 SUBMITTALS

.1 Submit shop drawings for tanks including specifications and installation instructions for tank lining method, incorporating all details of construction and mountings on same plan or a separate sheet of the same size.

.1 Consultant will review these submissions within one (1) week of receipt and, if found acceptable, the supplier will be permitted to ship the vessel(s) to the site.

1.5 QUALITY ASSURANCE

.1 Construct pressure tanks to ASME Code for unfired pressure vessels.

.2 Obtain inspection certificates of approval for pressure vessel tanks installation from Authority Having Jurisdiction.

.3 Comply with Provincial Government Regulations.

Part 2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section [provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 25 00 – Substitutions a minimum of [ten (10) days] in advance of Bid Closing]; manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 Expansion Tanks, Diaphragm Type: Velux, Bell and Gossett, Armstrong, Hamlet and Garneau, X-Trol.

.2 Domestic Hot Water Storage Tanks (Stonecoat): Velux, Clemmer, Leitch, Ace.

.3 Domestic Hot Water Storage Tank (Monel): Velux, Leitch, Ace.

.4 Condensate Receivers.

2.2 EXPANSION TANKS

.1 Use closed type tank, welded steel rated for working pressure, cleaned, prime coated and supplied with steel support saddles.

.2 Construct tank with necessary tappings for installation of accessories.

.3 Provide gauge glass set consisting of brass compression stops and guard.

.4 Provide glass long enough to cover the tank from 50 mm above the bottom to 50 mm below the top. Maximum length of each glass must be 600 mm.

.5 Provide quick connect air inlet of automotive tire valve type, pipe from top of tank to accessible location on wall, and tank drain hose bibb on bottom of tank.

.6 Provide pressure relief valve, and automatic cold water fill assembly complete with positive displacement meter, pressure reducing valve, reduced pressure back flow preventer valve with test cocks, strainer, pressure gauge, and valved bypass around reducing valve only, as shown on drawings.

2.3 EXPANSION TANKS, DIAPHRAGM TYPE

.1 Welded steel, rated for working pressure, supplied with steel support structure.

.2 Precharged air chamber, heavy duty butyl diaphragm bonded with polypropylene liner to steel shell separating air chamber from water.

.3 Provide with air side charge connection and water side inlet connection.

.4 Provide glass long enough to cover the tank from 50 mm above the bottom to 50 mm below the top. Maximum length of each glass must be 600 mm.

.5 Provide quick connect air inlet of automotive tire valve type, pipe from top of tank to accessible location on wall, and tank drain hose bibb on bottom of tank.

2.4 DOMESTIC HOT WATER STORAGE TANKS (STONECOAT)

.1 Tank: Steel, rated for working pressure, with access manhole and steel support saddles, and as follows:

- .1 Clean and prime coat before lining.
- .2 Line with internal corrosive resistant concrete lining of approximately 19 mm thickness.
- .3 Line flanged connections.
- .4 Screwed Connections: Stainless steel.

.2 Fabricate tank with tappings required for installation of accessories, tank drain, bottom water inlet and top outlet, thermometer having a range of 5°C to 93°C and pressure relief valve suitable for maximum working pressure.

2.5 DOMESTIC HOT WATER STORAGE TANKS (MONEL)

.1 Tank: Annealed and pickled Monel Grade SB127 ASME material, minimum 6 mm thick, rated for working pressure with welded seams and access manhole, and as follows:

- .1 Screwed Connections: Monel rated for 20690 kPa.
- .2 Flanged Nozzles: Schedule 40S pipe with vanstone lap joint type flange face.
- .3 Legs:
  - .1 Mount tank on four rigid steel legs.
  - .2 Do not weld legs directly to the vessel wall: weld legs to 305 mm x 406 mm Monel reinforcing pads; weld reinforcing pats to vessel wall.

.2 Fabricate tank with tappings required for installation of accessories, tank drain, bottom water inlet and top outlet, thermometer having a range of 5°C to 93°C and pressure relief valve suitable for maximum working pressure of 860 kPa at 93°C.

.3 Supply tanks with the following connections:

- .1 200 mm heating medium inlet
- .2 65 mm heating medium outlet
- .3 100 mm cold water inlet
- .4 100 mm hot water outlet
- .5 25 mm thermometer
- .6 25 mm temperature and pressure relief
- .7 50 mm drain
- .8 305 mm x 400 mm diameter manhole
- .9 Two (2) 25 mm tappings for control sensors

.4 Equip each tank with one (1) Leitch shrouded tank heater, refer to schedule for capacity.

.5 Tank heater material:

- .1 Tube Sheet: Type 304 Stainless Steel, hard drawn, seamless
- .2 Copper Tubes: 19 mm diameter x 1.214 mm thickness
- .3 Baffles: Type 304 Stainless Steel baffles
- .4 Shroud: Monel
- .5 Saddles: Steel, sized to meet supported loads

.6 Support heater shell using a Monel bracket designed so that entire element is easily removed from shell for cleaning or inspection; test elements subject to hydrostatic pressure test of 100% in excess of working pressure but not less than 1380 kPa.

.7 Provide heavy section cast iron element head containing steam and return connections complete with provision for installation of an air vent and vacuum breaker.

.8 Construct all parts in contact with water of non-ferrous materials.

2.6 DOMESTIC HOT WATER STORAGE (GLASS LINED)

.1 Tank: Steel, rated for working pressure, with access manhole and steel support saddles and cathodic protection, and as follows:

- .1 Screwed Connections: Stainless Steel
- .2 Shell:
  - .1 Tank Interior: Alkaline borosilicate composition glass lined that is fused to the steel base by firing at a temperature of 871°C; line internal surfaces exposed to water in accordance with ASME HLW Code procedures using NSF approved nickel oxide glass compound lining compound material.
  - .2 Insulation: Foam insulation meeting or exceeding requirements of ASHRAE 90.1B efficiency requirements, and minimum RSI 1.25.
  - .3 Tank Exterior: Baked enamel finished outer jacket and threaded openings.
- .3 Working Pressure: 861 kPa (125 PSI)
- .4 Mounting:
  - .1 Horizontal Tanks: Saddle Type
  - .2 Vertical Tanks: Stand Type
- .5 Warranty: Manufacturer's standard 5 year warranty

.2 Fabricate tank with tappings for installation of accessories, tank drain, bottom water inlet and top outlet, thermometer having a range of 5°C to 93°C and pressure relief valve suitable for maximum working pressure.

.3 Provide blowdown separator and automatic after cooler that will cool the boiler blowdown effluent to 60°C or less; consisting of a temperature gauge, cooling pipe and appropriate tappings.

Part 3 Execution

3.1 INSTALLATION

.1 Support tanks inside building from building structure as indicated on drawings.

.2 Provide 100 mm high housekeeping bases on floor mounted tanks.

.3 Provide 13 mm compressed air line with flexible coiled hose at each expansion tank and charging tank complete with fitting compatible with quick connect on the tank; extend line and hose down to 1220 mm above floor level.

3.2 PERFORMANCE

.1 Provide tanks of dimensions and capacities indicated on the Tank Schedule on Drawing.

END OF SECTION

SECTION 20 15 19

METERS AND GAUGES FOR MECHANICAL SYSTEMS

Part 1 General

1.1 SUMMARY

.1 Provide meters and gauges and taps where shown on drawings and as specified in this Section.

1.2 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit shop drawings of proposed products to the Consultant for review.

.3 Submit data sheets on thermometers and pressure gauges indicating service, and temperature or pressure ranges, to the Consultant for review.

.4 Submit list of all meters, including location, service, flow and corresponding reading for flow.

Part 2 Products

2.1 MANUFACTURERS

.1 Thermometers:

- .1 Ashcroft Inc.
- .2 Marsh-Bellofram
- .3 H.O. Trerice Co.
- .4 Weksler Gauges
- .5 WIKA Instruments Ltd.

.2 Venturi Flow Meters:

- .1 Gerand Engineering Co.
- .2 Preso Flow Metering Equipment - Division of Racine Federated Inc.

2.2 THERMOMETERS

.1 Dial Thermometers: 100 mm diameter dial in drawn steel case, bimetallic helix actuated, brass separable socket or flange and bushing, glass cover, adjustable pointer.

.2 Installation:

- .1 Install pressure/temperature taps into threaded pipe nipples welded to wall of pipe. Locate fittings in accessible spaces.
- .2 Provide one pressure/temperature taps test kit.

Part 3 Execution

3.1 INSTALLATION

.1 Install positive displacement meters with isolating valves. Provide valve bypass for liquid service meters.

.2 Install flow meters in uninterrupted straight pipe, minimum 2 pipe diameters downstream and 5 pipe diameters upstream, or according to manufacturers recommendations.

.3 Select gauges so that normal operating point is approximately mid-point of instrument range.

.4 On pipes 65 mm and smaller, place well in tee; used in lieu of an elbow to accommodate well.

3.2 METERS AND GAUGES INSTALLATION SCHEDULE

.1 Flow Meters:

- .1 Heating Water System
- .2 Chilled Water System
- .3 Glycol System
- .4 and where shown on drawings.

.2 Thermometers:

- .1 Boiler (inlet and outlet)
- .2 Supply and Return Headers of central equipment
- .3 Heat Exchangers (inlet and outlet tube and shell side)
- .4 Heating Water Zone Supply and Return Mains
- .5 Air Handling Units, Hydronic Heating and Cooling Coils (inlet and outlet)
- .6 Heat Recovery Coils (inlet and outlet)
- .7 Where shown on drawings.

END OF SECTION

SECTION 20 30 00

PUMPS FOR MECHANICAL SYSTEMS

Part 1 General

1.1 SUMMARY

.1 This section includes requirements for supply and installation of the following:

- .1 Base mounted end suction pumps
- .2 Base mounted double suction split case pumps
- .3 Vertical in-line end suction pumps
- .4 In-line circulators
- .5 In-line all bronze circulators
- .6 Bilge and sewage pumps
- .7 Fire and jockey pumps
- .8 Packaged booster pumps
- .9 Positive displacement pumps
- .10 Pump controls where self contained
- .11 Pump seals

1.2 RELATED REQUIREMENTS

.1 Section 20 05 00 – Common Work Results for Mechanical

.2 Section 20 05 93.19 – Balancing of Mechanical Systems

.3 Section 20 08 13 – Coordination with Commissioning Agency

.4 Section 20 13 13 – Tanks for Mechanical Systems

.5 Section 21 10 00 – Water Based Fire Suppression Systems

1.3 REFERENCE STANDARDS

.1 National Fire Protection Association (NFPA):

- .1 NFPA 20-2009, Standard for the Installation of Stationary Pumps for Fire Protection

1.4 SUBMITTALS

.1 Provide required information in accordance with 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

- .1 Product Data: Submit manufacturer's product data showing pump materials, dimensional data and ratings and the following:
  - .1 Details of pump drive motor
  - .2 Details of drive assembly, including the rated capacity of the drive at the specified r/min

.3 Details of bearings including manufacturers ratings of full load operating hours

.4 Details of pump seals, listing maximum operating temperatures and material limitations

.2 Shop Drawings: Submit shop drawings of all pumps specified complete with certified pump curves showing performance characteristics, including NSPH curve where applicable and seal types.

.3 Informational Submittals: Provide the following submittals during the course of the work:

.4 Certificates: Provide factory certified performance curve for fire pumps specified in this Section.

1.5 PROJECT CLOSEOUT SUBMISSIONS

.1 Site Quality Control Submissions – Fire Pump Test: Submit Acceptance Test Report containing pump flow curves, wiring diagrams and operating data at the time of the witnessed fire pump test; record all test results and provide copies to Owner, Consultant and Local Authority Having Jurisdiction, include name of original installer and contact information in accordance with Section 01 00 06 – General Requirements: Operation and Maintenance Manuals.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: Provide fire pumps that are CSA and ULC approved and bear a ULC label, and that are equipped with controllers meeting requirements of NFPA 20

.2 Qualifications: Provide proof of qualifications during the course of the work of this Section:

.1 Materials: Provide pumps that operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.

.2 Installers: Use qualified millwrights to align base mounted pumps and that can certify alignment.

Part 2 Products

2.1 MANUFACTURERS

1.1.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, use any of the following listed manufacturers' products in accordance with Section 01 00 06 – General Requirements; Product Options:

.1 In-line Circulator (Horizontal):

.1 Red lion

.2 Armstrong

.3 Bell & Gossett

.4 Darling

.5 Grundfos

.6 Taco

.2 In-line Circulator (Vertical):
- .1 Armstrong
- .2 Bell & Gossett
- .3 Darling
- .4 Gauardian

.3 Fire Booster Pumps:
- .1 Armstrong
- .2 Aurora
- .3 Darling
- .4 Peerless
- .5 Leitch

.4 Submersible Bilge or Sewage Pumps:
- .1 Flawtec
- .2 Myers
- .3 Hydromatic

2.2 PERFORMANCE REQUIREMENTS

.1 Acceptable Fire Pump Testing Agencies: Subject to compliance with Consultant's testing requirements, testing agencies acceptable to ULC or Factory-Mutual Global for testing in accordance with NFPA 20.

.2 Capacity: Provide fire pumps that deliver a minimum of 150% of rated capacity at a discharge pressure of not less than 65% of the total rated pump head, with shut-off pressure not exceeding 120% of total rated pump head.

2.3 MANUFACTURED MATERIALS

.1 Provide manufactured pumps as described in this Section that have statically and dynamically balance rotating parts; manufactured to permit complete servicing without breaking piping or motor connections and as follows:

- .1 Pumps Operating Speed: 1750 RPM unless different rating is reviewed and accepted by Consultant
- .2 Pump Connections: Flanged, and having pressure gauge tappings

.2 Base Mounted End Suction Pumps: Centrifugal, bronze fitted, single suction as designated by model specified and as follows:

- .1 Split casing, volute or cast iron, rated for the greater, of 1225 kPa or 1¼ times the specified working pressure. Provide the following casing accessories: air vent cock at high point of casing, drain plug at low point of casing, renewable bronze wear rings (high temperature applications only), flanged inlet and outlet connections.
- .2 Bronze impeller or equivalent alloy, keyed to shaft, held in place by self locking bronze cap screw and nut
- .3 Steel shaft of high grade alloy with stainless steel or bronze shaft sleeve
- .4 Bearings of ball or roller type, oil lubricated with oil reservoir with integral seals
- .5 Flexible coupling with guard
- .6 Refer to the schedules for seal type if other than mechanical with recirculating flushing - use packing glands on all condensate pump application

.7 Structural steel or cast iron base with integral pan and drip connection, common mounting for pump and motor

.8 Refer to schedule for construction material other than above.

.3 Double Suction Split Case Pumps: Centrifugal, single stage, direct connected, bronze fitted double suction as designated by model specified and as follows:

.1 Axially split casing, cast iron, rated for greater of 1225 kPa of 1¼ times the specified working pressure. Provide the following casing accessories: air vent cock at high point of casing, drain plug at low point of casing, renewable bronze wearing rings, flanged inlet and outlet accessories.

.2 Carbon steel shaft with stainless steel or bronze shaft sleeve

.3 Bearings of ball type with flush through grease lubrication.

.4 Flexible coupling and guard

.5 Bronze impeller, double suction type, keyed to shaft.

.6 Mechanical seals with recirculating flushing unless otherwise indicated; carbon/ni resistance or tungsten carbide

.7 Structural steel base, internal bar with drain connection below each stuffing box, common mounting for pump and motor

.4 Vertical In-Line End Suction Pumps: Centrifugal in-line single or double suction as specified; direct coupled for up to 5.6 kW and split spacer coupling for 7.5 kW and over and as follows:

.1 Volute of cast iron rated for 1225 kPa or ductile iron for 2500 kPa. Provide the following casing accessories: drain plug, flanged inlet and outlet, separate tapped flush line and gauge connections.

.2 Bronze dynamically balanced impeller or equivalent alloy, keyed to shaft, held in place by self-locking bronze cap screw.

.3 Equip direct coupled pumps with steel shaft with bronze shaft sleeve; equip spacer coupling pumps with stainless steel shaft.

.4 Equip direct coupled pumps with carbon/ni-resist or tungsten carbide mechanical seal; equip spacer coupling pumps with Durametallic Type RA outside mechanical seal.

.5 Equip all pumps with flush lines piped from pump discharge to mechanical seals.

.5 In-Line Circulators (All Bronze): Centrifugal, close coupled, in-line, single stage, and bronze fitted, single suction, suitable for vertical or horizontal installation and as follows:

.1 Single casing, bronze, rated for the greater of 1225 kPa or 1¼ times the specified working pressure

.2 Bronze impeller held in place by self-locking bronze cap screw and nut.

.3 Steel shaft of high grade alloy complete with integral thrust collar and two lubricated bronze sleeve bearings.

.4 Mechanical seals of carbon rotating against ceramic seat

.6 Bilge and Sewage Pumps: Direct connected vertical centrifugal, simplex or duplex and as follows:

.1 Single casing, volute or cast iron, radial clearance around impeller

.2 Bronze or cast iron impeller as scheduled, keyed to shaft held in place by bronze cap screw and nut.

.3 Steel shaft of corrosion resistant alloy

.4 Forced grease lubricated bronze sleeve every 1800 mm and forced grease lubricated ball thrust above.

.5 Flexible coupling with guard

.6 Cast iron pedestal support, registered and dowelled with inspection openings on cast iron sub-cover plate, bolted to steel cover plate with gas tight gaskets.

.7 Controls: [Simplex controls: integral diaphragm type level controls and separate mercury bulb type high liquid level audible and visual alarm] [Duplex controls: packaged pre-wired alternator with mercury bulb type liquid level controls and control panel to cut in second pump on rising level or pump failure, and separate liquid level control for high level audible and visual alarm].

.7 Fire Booster Pumps: Centrifugal, single stage, ULC listed and labelled, complete with starter, controller, and jockey pump; with entire package preassembled, tested, wired, and skid mounted, conforming to NFPA 20 and local fire department Authority Having Jurisdiction and as follows:

.1 Casing: Cast iron, (horizontal split volute) vertical in-line, double suction, rated for 1725 kPa working pressure, renewable bronze wearing rings, flanged suction and discharge.

.2 Impeller: Bronze, fully enclosed double suction, keyed to shaft and secured by adjustable sleeves.

.3 Shaft: Carbon steel with bronze sleeves.

.4 Bearings: Grease lubricated ball bearings, single row on inboard side, double row on outboard side.

.5 Drive: Flexible coupling with coupling safety guard.

.6 Seals: Interwoven, graphite asbestos packing rings, bronze lantern rings, split packing glands.

.7 Base plate: Steel with drip rim and drain connection.

.8 Pump Accessories:

.1 Check valve in discharge pipe

.2 Monitored OS&Y gate valves on system side of check valve on supply side of pump

.3 Fire pump bypass fitted with approved check valve

.4 Relief valve

.5 Pressure gauges, suction, and discharge

.6 Circulation relief valve

.7 Umbrella cock, automatic air release

.8 Splash shield between pump and motor

.9 Intake screen

.10 Wire monitored gate valves on inlet and outlet of pump to fire control panel; provide dry contact in panel.

.11 Venturi flow meter element and permanent wall mounted gauge for fire pump testing.

.9 Electric Motor Drive: Squirrel cage type electric motor.

.10 Fire Pump Controller: Reduced voltage type starter enclosed in EEMAC-12 drip-proof enclosure, with controls as follows:

.1 Two circuit breakers of 100,000 A (Tripac) interrupting capacity (one for emergency start).

.2 Magnetic starter (auto transformer type) capable of being energized by pressure switch or manually

.3 Run period timer (approximately 5 minutes)

.4 Alarm and signal devices in controller to indicate trouble on controller and pumping unit and circuit breaker open. Provide one common double pole - double throw dry contact for fire alarm monitoring.

.5 Means on controller to operate alarm signal continuously while pump is running

.11 Jockey Pump: Electric operated pump to maintain higher pressure in fire pump discharge piping, including:

.1 Control valves

.2 Check valves and relief valves

.3 Suction connections on suction side of fire pump

.4 Manual/automatic control by low pressure switch on fire pump discharge line

.5 Control panel.

.8 Turbine Pumps: Turbine single stage, direct connected and as follows:

.1 Casing: Cast bronze with bronze channel rings, rated for 2070 kPa working pressure, self-venting top discharge.

.2 Impeller: Bronze, self-centering, hydraulically balanced.

.3 Shaft: Type 416 stainless steel.

.4 Bearings: Re-greasable ball bearings on inboard and outboard ends.

.5 Drive: Flexible coupling with coupling safety guard.

.6 Seals: Carbon rotating against stationary ceramic seat.

.7 Base Plate: Cast iron with integral drip rim and drain connector.

.8 Motor: Totally enclosed, fan cooled.

.9 Pressure Booster Pump Assembly: Packaged pump pressure boosting system, factory assembled and tested and as follows:

.1 Low Flow Provision: Flow through pump at all times sufficient to prevent overheating during low or no flow periods.

.2 Low Inlet Pressure: Low pressure control to stop pump operation if incoming water pressure drops to atmospheric pressure.

.3 Excess Inlet Pressure: Pressure switch to shut off pumps upon adequate inlet pressure from City mains.

.4 Manual Operation: Each pump with switch to permit manual or automatic operation.

.5 Pressure Regulation: Pilot operated combination pressure reducing and check valves on discharge to maintain constant system pressure.

.10 Positive Displacement Pumps: Rotary gear, single stage and as follows:

.1 Single casing, cast iron rated for the greater of 1225 kPa or 1¼ times the specified working pressure. Provide integral bypass type adjustable relief valve.

.2 Steel impeller keyed to shaft.

.3 Steel shaft of high grade alloy with stainless steel sleeves.

.4 Bronze ball bearings

.5 Belt drive with guard

.6 Mechanical seals of carbon coating against ceramic seat

.7 Screwed inlet and outlet connections

.11 Seals and Packing: Supply all pumps with mechanical seals as detailed in individual sections and as follows:

.1 Provide a stuffing box integral with pump casing and lantern rings where packing glands are specified on schedule, equipped with four Teflon coated rings.

.2 Provide shield over stuffing box to prevent water spray; provide stainless steel shafts on associated pumps where packing glands are used.

Part 3 Execution

3.1 INSTALLATION

.1 Provide drains for bases and stuffing boxes piped to and discharging into floor drains.

.2 Support vertical in-line pumps from piping, provide pipe supports outboard of pump flanges.

.3 Booster Pump System to be mounted on skid package and then mounted on external isolators.

.4 Provide air cock and drain connections on horizontal pump casings.

.5 Provide line sized gate valve and strainer on suction line and line sized check valve and globe valve on discharge line unless otherwise shown.

.6 Decrease from line size, with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 100 mm and over.

.7 Check and align base mounted pump prior to start-up.

.8 Install all base mounted pumps on vibration isolation before start-up.

.9 Make seal re-circulation connections from the pump casing or flange on the discharge of the pump, with external piping to the seal flushing connection. Install the flushing connection complete with regulating valve suitable for service and working pressure of pump served.

3.2 SITE QUALITY CONTROL

.1 Fire Pump Flow Test: Include for all labour and material costs required to provide approved Testing Agent to verify fire pump operation and flows performed in accordance with requirements specified in Section 01 00 06 – General Requirements, Quality Control and as follows:

.1 Arrange to have pump supplier in attendance at pre-test

.2 Arrange to have pump supplier, Owner’s insurance agent and local Authority Having Jurisdiction in attendance to witness flow test.

.3 Perform fire pump flow test in accordance with NFPA 20 Requirements.

.4 Record setting of timing relays for cool down time and minimum run time; adjust if required.

.5 Record operating pressures for jockey pump and main fire pump.

.6 Use testing agent to conduct the pre-test and local Authority Having Jurisdiction approval tests.

.7 Each test shall demonstrate full automatic operation of the fire pump 5 times on normal power, 5 times on emergency power and once running on normal power with a normal power failure switching to emergency power.

.8 Testing Agent must provide all test equipment including play pipes, gauges, flow measurement devices, and fire hoses.

.9 Anchor fire hoses securely by means of a mechanical assembly for flow test; discharge water into an area having suitable drainage.

.10 Record all test results and provide an Acceptance Test Report issued to the Consultant and Local Authority Having Jurisdiction.

3.3 SCHEDULED PUMP PERFORMANCE

.1 Refer to pump schedule on Drawings.

END OF SECTION

SECTION 21 10 00

WATERBASED FIRE SUPPRESSION SYSTEMS

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for design, supply and installation of materials for piping, fittings, valves, supports, sleeves, fire department connections and accessories and sprinkler system testing and certification.

1.2 RELATED REQUIREMENTS

.1 Section 07 84 00 – Firestopping: Protection of penetrations required by sprinkler systems through fire rated construction.

.2 Section 20 05 10 – Mechanical Systems Pipe and Pipe Fittings

.3 Section 20 05 23 – Valves for Mechanical Systems

.4 Section 20 05 29 – Hangers, Supports and Anchors for Mechanical Systems

.5 Section 20 30 00 – Pumps for Mechanical Systems

.6 Section 21 12 00 – Fire Suppression Standpipes

.7 Section 21 20 00 – Fire Extinguishing Systems

.8 Section 26 05 00 – Common Work Results for Electrical: Coordination and connection of electrically operated components to building electrical system.

.9 Section 26 23 13.16 – Low Voltage Switching with Addressable Switches and Networking: Low voltage relays and low voltage wiring for fire alarm system.

.10 Section 28 31 00 – Fire Detection and Alarm System: Single stage fire alarm and detection systems.

1.3 REFERENCE STANDARDS

.1 Canadian Automatic Sprinkler Association (CASA):

.1 CASA Member Listings of Design Professionals, Contractors, Manufacturers and Suppliers

.2 National Fire Protection Association (NFPA):

.1 NFPA 13-2010, Standard for the Installation of Sprinkler Systems

.2 NFPA 14-2010, Standard for the Installation of Standpipe and Hose Systems

.3 NFPA 15-2007, Standard for Water Spray Fixed Systems for Fire Protection

.4 NFPA 16-2011, Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems

.5 NFPA 17-2009, Standard for Dry Chemical Extinguishing Systems

.6 NFPA 17A-2009, Standard for Wet Chemical Extinguishing Systems

.7 NFPA 25-2011, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

.8 NFPA 96-2011, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

.3 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S543-09, Standard for Internal Lug Quick-Connect Couplings for Fire Hose

.2 ULC/ORD C1254.6-95, Fire Testing of Restaurant Cooking Area Fire Extinguishing System Units

1.1 ADMINISTRATIVE REQUIREMENTS

.4 Pre-Construction Meetings: Conduct pre-construction meeting in accordance with Section 01 00 06 – General Requirements; Project Meetings to review work of this Section and sections affected by work of this Section, and Consultant to discuss coordination between major pieces of equipment , piping exposed as an architectural elements and piping layouts to avoid obstructions and unforeseen changes in piping direction.

.5 Coordination: Coordinate sprinkler head layout with reflected ceiling plan and ceiling mounted equipment, including diffusers, lights, security cameras, fire alarm devices, exit signs, and other devices and as follows:

.1 Coordinate ceiling interference hierarchy in accordance with installation guidelines listed in Section 01 06 00 – General Requirements: Execution.

.1 Sprinkler heads are indicated on the drawings for areas where layout is critical to the architectural requirements of the space; design sprinkler system and locate sprinkler heads in accordance with applicable NFPA Standard and Authority Having Jurisdiction for the remainder of the spaces.

.2 Coordinate contact type and wiring for fire alarm sensor system with Division 28.

.3 Select sprinkler head locations to respect the architecture of the room, and where possible, align with ceiling elements such as bulkheads, valances, light fixtures, and suspended ceiling grids.

.4 Allow for installation of 5% additional sprinkler heads in excess to the requirements of NFPA Standards, Authority Having Jurisdiction, and as shown on the drawings for the purposes of architectural coordination of sprinkler heads and ceiling elements; Consultant will coordinate sprinkler head locations after review of sprinkler head layout shop drawings.

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer’s product data indicating model, type and size of each item proposed for the project and including installation requirements the following components:

.1 Dry pipe valves

.2 Preaction valves

.3 Gate and check valves

.4 Globe valves
.5 Backflow preventers
.6 Water motor alarms
.7 Sprinkler heads
.8 Pressure and water flow switches
.9 Tamper switches
.10 Inspector's test station
.11 Retard chamber
.12 Fire department connections
.13 Signs
.14 Hose valves
.15 Air Compressor

.2 Preliminary Design Drawings: Submit preliminary layout showing only head locations for review by Consultant a minimum of [eight (8)] weeks prior to starting work of this Section; Consultant may move location of sprinkler heads indicated on preliminary layout to account for coordination with other ceiling mounted elements , include interference drawings indicating detailed piping layouts in areas having congestion arising from structure, ductwork, plumbing systems and electrical systems.

.3 Shop Drawings: Submit sprinkler and fire protection systems shop drawings and calculations in accordance with applicable standards and requirements of the Authorities Having Jurisdiction, and as follows:

.1 Stamp shop drawings with review mark from the Authority Having Jurisdiction.

.2 Stamp shop drawings and calculations with seal of delegated design professional engineer.

.4 Samples: Submit two (2) sets of samples for each type of sprinkler head required for the project for review by Consultant before ordering materials.

.5 Informational Submittals: Provide the following submittals during the course of the work:

.1 Hydrostatic Test Certificate: Submit completed hydrostatic test certificates to Owner’s insurance underwriter; submit addition certification of testing that may be requested by the Consultant and submit to the Owner’s insurance underwriter.

.2 Site Quality Control Submission: Submit sprinkler system certification as required by applicable codes and standards, and Authorities Having Jurisdiction; certification sealed by delegated design engineer registered in the province of the Work.

1.5 PROJECT CLOSEOUT SUBMISSIONS

.1 Operation and Maintenance Data: Submit manufacturer’s written instructions for operations and maintenance procedures, include name of original installer and contact information in accordance with Section 01 00 06 – General Requirements: Operation and Maintenance Manuals and as follows:

.1 Include specific make and model of check valves, detector check valves, alarm valves, dry pipe valve and deluge valve assemblies, water flow and tamper switches, backflow preventers, and other trim provided to the project.

.2 Include serial numbers and ordering information.

.3 Place one copy of instruction manual; in addition to copies required by Section 01 00 06 – General Requirements: Operation and Maintenance Manuals, in a flexible, oil resistant protective binder and mount in an accessible location in the vicinity of each dry pipe or preaction control valve.

.4 Record Documentation: Submit as constructed information in accordance with Section 01 00 06 – General Requirements: Project Record Documents, indicate any deviations from reviewed shop drawings and include hydraulic calculations indicating changes resulting from any deviations.

.5 Spare Parts and Tools: Provide cabinet for storage of maintenance materials, spare sprinkler heads and special tools; constructed to sprinkler head manufacturer‘s standard in accordance with Section 01 00 06 – General Requirements: Spare Parts containing the following:

.1 Include extra sprinkler heads of each sprinkler head type.

.2 Include a wrench suitable for each sprinkler head type.

.3 Provide one (1) extra sprinkler heads for systems having less than 300 sprinkler heads of each type.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: Sprinkler equipment and installation is governed by NFPA 13 and recommendations of Owner's insurance requirements, and as acceptable by local Authority Having Jurisdiction.

.2 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Source of Supply: Obtain sprinkler system components from distributor or supplier listed by Canadian Automatic Sprinkler Association that maintains a stock of repair parts compatible with system components and that has sufficient experience to repair installed system during the term of the warranty period.

.2 Installer: Install sprinkler equipment using qualified and licensed [Subcontractor]s regularly engaged in installation of automatic fire sprinkler equipment having a minimum of three (3) years successful experience with projects of similar size and complexity.

.3 Delegated Design Engineer: Professional engineer licensed in the province of the Work, having relevant experience in fire protection engineering, and who is responsible for design of sprinkler system required by the Contract Documents meeting requirements of NFPA 13 and Authorities Having Jurisdiction and provide who can provide submittals required by Section 01 33 50 – Delegated Design Submittals.

.3 Certifications: Provide proof of the following during the course of the Work:

.1 Compliance Certification: Provide certificates from manufacturer indicating tested performance requirements required by Authorities Having Jurisdiction.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver products to project site in original, unopened packages with intact and legible manufacturers’ labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.

.2 Storage and Handling Requirements: Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use and as follows:

.1 Remove from site and discard wet or damaged materials.

.2 Keep automatic sprinkler components in original packaging until they are installed; loose carrying or storage is not permitted; discard and replace loose sprinklers immediately at no expense to Owner or Consultant.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with regulatory requirements and properties specified in this Section, manufacturers offering products that may be incorporated into the Work include any associate manufacturer listed by Canadian Automatic Sprinkler Association.

.2 Provide a combined sprinkler and standpipe system as specified in Section 21 12 00.

.3 Delegated Design Requirements: Design sprinkler system required by the Contract Documents meeting requirements of NFPA 13 and Authorities Having Jurisdiction and as follows:

.1 Hazard: Occupancy type indicated below, and as further identified on Drawings:

.1 Group 1 – Ordinary Hazard Occupancy, Commodity Class II

.2 Seismic Requirement: Design sprinkler systems and bracing for earthquake protection based on Zones as applicable to the Place of Work acceleration factor and in accordance with requirements of NFPA 13.

.3 Pipe Size and Layout: Hydraulic design or pipe schedule sizing design using sprinkler head layout meeting NFPA 13 or as directed by Authority Having Jurisdiction and accounting for ceiling obstructions and coordination with other ceiling mounted equipment or accessories.

.4 Water Supply: Conduct flow and pressure test of water supply in vicinity of project to obtain criteria for bases of design in accordance with NFPA 13 .

.5 Zoning: System zoning as indicated on Drawings.

.6 Water Distribution: Verify uniform water distribution throughout area covered by sprinkler heads; allow for variation in discharge from individual heads in hydraulically most remote area between 100% and 120% percent of specified density.

.7 Clearance from Electrical Equipment: Piping and automatic sprinklers are prohibited directly over the following equipment unless drip pans are provided under piping to protect the equipment:

.1 Transformers

.2 Substations

.3 Switchboards

.4 Motor control centers

.5 Emergency generators

.6 Bus ducts

.7 Electrical panels

2.2 MATERIALS

.1 Sprinkler Pipe, Fittings and Valves: Provide system components meeting requirements of NFPA 13 as described in Sections 20 05 10, 20 05 23 and 20 05 29, and as follows:

- .1 Pipe: Ferrous
- .2 Fittings and Joints: Ferrous, welded, flanged or roll grooved or Copper - screwed, soldered, and brazed
- .3 Valves: ULC listed for fire protection service and as follows:
  - .1 Up to NPS 2: Bronze, screwed ends; OS and Y; gate.
  - .2 NPS 2½ and More: Cast iron, flanged or roll grooved ends, indicating butterfly valve.
  - .3 Swing check valves
  - .4 Ball drip
- .4 Pipe hangers: ULC listed for fire protection services.
- .5 Drains: Provide galvanized drain piping and auxiliary drains in accordance with NFPA 13 to discharge at safe points outside of building or to sight cones attached to drains sized to readily receive full flow from each drain under maximum pressure; provide splash guards where necessary at discharge outlets
- .6 Pipe Sleeves and Seals: Provide sleeves and seals where conduit or piping passes through walls, floors, roofs and partitions with adequate clearance between exterior of piping and interior of sleeve in accordance with NFPA 13 and as follows:
  - .1 Provide penetration firestopping in accordance with Section 07 84 00 for sleeves and seals through fire-rated assemblies.
  - .2 Secure sleeves in proper position and location during construction.
  - .3 Provide sleeves of sufficient length to pass through the entire thickness of walls, floors, roofs, and partitions and as follows:
    - .1 Sleeves in Masonry and Concrete Walls, Floors, and Roofs: Provide Schedule 40 zinc coated steel pipe sleeves; extend sleeves in floor assemblies 100 mm above finished floors to prevent seepage.
    - .2 Sleeves in Partitions and Other than Masonry and Concrete Walls, Floors and Roofs: Provide either zinc coated Schedule 40 steel pipe or zinc coated 26 gauge steel sheet.
    - .3 Escutcheon Plates: Provide one piece or split hinge type metal plates for piping passing through floor, walls, and ceilings in exposed and concealed areas:
      - .1 Provide chromium plated or color coordinated metal plates where pipe passes through finished ceilings.
      - .2 Securely anchor plates in proper position.
      - .3 Provide sprinkler escutcheon plates to match sprinkler head finish.

.2 Sprinkler Heads: Meeting requirements of NFPA 13 and ULC listed for fire services, and as follows:

- .1 Temperature Rating: Provide temperature rating on fusible links to suit specific hazard area with minimum margin of safety

.2 Upright Heat Fittings: Provide 25 mm diameter nipple and 25 mm x 15 mm reducing fitting for each upright head.

.3 Check Valves: Provide double check valve assembly to sprinkler system take-off using water utility approved and ULC listed supervised OS&Y gate valves on both sides.

.4 Isolation Valves: Provide isolation valves; including those on antifreeze loops in areas subject to freezing, having contacts that can be monitored on the building fire alarm system.

.5 Suspended Ceilings: [Standard] [and] [Pendant type] with [white finish] and [white] escutcheon.

.6 Exposed Areas:

.1 Ceiling Mounted: standard upright type with [brass] finish.

.7 Crawlspace and Attic Areas: Standard upright type with brass finish.

.3 Alarm Check Valve: Alarm check valve with retard chamber in accordance with NFPA 13 and ULC listed for fire service.

.4 Sprinkler Valve: Water gong in accordance with NFPA 13 and ULC listed for fire service; location as indicated.

.5 Excess Pressure Pump: Provide pump capable of pumping sprinkler system to 275 kPa in excess of normal pressure with supports, gauge, relief valve, starter and connections to sprinkler system and as follows:

.1 Rating: ULC listed, compatible with delegated design of sprinkler system.

.2 Motor Enclosure: EEMAC Class B, maximum temperature rise 50°C, 0.25 kW, 120V/1 Ph/60 Hertz.

.3 Electrical Wiring: Refer to Division 26

.4 Shut-off valve and strainer on pump inlet.

.5 Relief valve, check valve and shut-off valve on discharge connections.

.6 Siamese Fire Department Connection:

.1 Provide standard connectionfor fire department connection meeting the requirements of NFPA 13 and ULC S543 with brass finish, having threads compatible with local fire department thread, threaded metal dust caps and chains, 19 mm automatic drip connected to drain marked "Sprinkler Fire Department Connection" and identifying sign cast on plate.

.2 Match Siamese fire department connection for sprinkler system to connection for standpipe and hose system.

.7 Kitchen Fire Suppression System: Supply and install a complete, pre-engineered, UL-300 approved, wet chemical, kitchen fire suppression system as follows:

.1 Compatibility of Systems: System components and installation in accordance with the latest editions of NFPA 96, NFPA 17A, ULC/ORD-1254C.6, Building Code and Local Authority Having Jurisdiction.

.2 Installation includes cylinders, control heads, brackets, detection lines, nozzles, piping, electrical and fire alarm connections, as required, to protect exhaust hoods, plenums, ductwork and required cooking appliances and accessories for a complete operational system.

.3 Connect system to gas shut-off valve or electric contractor (as required), and to fire alarm system.

.8 Signs: Bilingual signs for control drain and test valves in accordance with NFPA 13 requirements and as follows:

.1 Material: Engraved metal or polycarbonate

.2 Location: At each valve or alarm device

.3 Content: Signs on valves must describe sprinkler zone that it controls and state that it is to remain open

.4 Configuration: Permanently affix design data nameplate to riser of each system

.9 Inspector's Test Connection: Provide test connections no higher than 1800 mm above floor for each sprinkler system or portion of each sprinkler system equipped with an alarm device; locate at the [hydraulically most remote part of each system and at the] control valve/drain assembly and as follows:

.1 Provide combination drain valve and test connection.

.2 Discharge must be readily visible from the inspector's test connection, either by direct observation of the discharge or through a sight glass.

.3 Pipe discharge to either an open building drain or to the outside.

.4 Drainage and test valves shall be bronze globe, angle, or gate valves.

.10 Antifreeze: Antifreeze loops in accordance with NFPA 13; to locations as indicated, and as follows:

.1 Expansion Tank: Diaphragm type expansion tank with pressure gauge on all anti-freeze loops.

.2 Antifreeze Type: Antifreeze materials in accordance with NFPA 13 for potable or non-potable water connection as appropriate to system.

.3 Temperature Range: Antifreeze material shall test at -40°C.

Part 3 Execution

3.1 INSTALLERS

.1 Subject to compliance with requirements of this Section, installers offering services that may be incorporated into the Work include the following:

.1 Edwards Sprinkler

.2 The Gisborne Group

.3 Viking Fire Protection Inc.

.4 Vipond Inc.

.2 Coordinate with Competition requirements for installation of sprinkler systems by original installer, refer to Section 01 00 06 – General Requirements.

3.2 INSTALLATION

.1 Install, inspect and test to acceptance in accordance with NFPA 13.

.2 Install excess pressure pump across alarm valve in accordance with manufacturer‘s instructions.

.3 Protect sprinkler heads against mechanical injury with standard guards when necessary.

.4 Locate outside alarms on wall of building adjacent to siamese fire department connection; install water gong as indicated.

.5 Install spare parts cabinet on wall near sprinkler valve.

.6 Locate zone shut-off valves visible from the floor; do not conceal from view, locate in janitor, storage rooms, or stairwells as approved by the Consultant.

.7 Centre heads in two directions in ceiling tile, coordinate with reflected ceiling layout; maintain spacing required by Building Code.

.8 Arrange sprinkler piping and provide drain valves such that it is completely drainable, and as follows:

.1 Extend drain lines to the floor level within the reach of a floor drain with a 15 meter hose.

3.3 SITE QUALITY CONTROL

.1 Site Testing and Inspections: Site testing and inspections will be performed in accordance with requirements specified in Section 01 00 06 – General Requirements, Quality Control and as follows:

.1 Sprinkler Testing: Perform sprinkler flow test connections in accordance with NFPA 13 and NFPA 25; conduct testing and issue certificate of compliance with testing witnessed by Authority Having Jurisdiction.

END OF SECTION

SECTION 21 20 00

FIRE EXTINGUISHING SYSTEMS

Part 1 General

1.1 SUMMARY

.1 Supply and install fire protection specialties including, but is not limited to, the following:

.1 Portable fire extinguishers.

.2 Mounting brackets for fire extinguishers.

1.2 RELATED REQUIREMENTS

.1 Section 21 10 00 – Water Based Fire Suppression Systems

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM E814-11a Standard Test Method for Fire Tests of Penetration Firestop Systems

.2 National Fire Protection Association (NFPA):

.1 NFPA 10-2010, Standard for Portable Fire Extinguishers

.3 Underwriters Laboratories Canada (ULC):

.1 CAN/ULC S508-02, Rating and Testing of Fire Extinguishers and Extinguishing Agents

.2 CAN/ULC S522-07, Standard for Fire Extinguishers and Booster Hose

1.4 SUBMITTALS

.1 Provide requested information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit product data including, but not limited to, construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection specialties, and as follows:

.1 Fire Extinguishers: Include rating and classification.

.3 Submit samples for initial selection of factory applied colour finishes for cabinets.

1.5 PROJECT CLOSEOUT SUBMISSIONS

.1 Submit maintenance data for fire extinguishers to include in maintenance manuals in accordance with Section 01 00 06 – General Requirements: Operations and Maintenance Data.

1.6 QUALITY ASSURANCE

.1 Obtain fire extinguishers through one source from a single manufacturer.

.2 Fabricate and label fire extinguishers in accordance with NFPA 10, ULC S522 and ULC S508, and meeting the requirements of the local Authority Having Jurisdiction.

.3 Fire extinguishers shall be listed and labelled for type, rating, and classification by an independent testing agency acceptable to Authority Having Jurisdiction.

1.7 WARRANTY

.1 Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.

.2 Failures include, but are not limited to, the following:

.1 Failure of hydrostatic test according to NFPA 10.

.2 Faulty operation of valves or release levers.

.3 Warranty Period: Six (6) years from date of Substantial Performance.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 Ansul Incorporated

.2 National Fire Equipment Ltd.

.3 Pyro-Chem/Flag Fire

.4 Simplex-Grinnell

2.2 PORTABLE FIRE EXTINGUISHERS

.1 Multi-Purpose Dry Chemical (Type 1):

.1 Operation: Stored pressure rechargeable type with shut-off nozzle.

.2 Construction: Manufacturer’s standard tank construction; with manufacturer’s standard wall bracket].

.2 Wet Chemical Kitchen Extinguisher (Type 5):

.1 Operation: Stored pressure rechargeable type with hose and shut-off nozzle.

.2 Construction: Manufacturer’s standard tank construction [[; with manufacturer’s standard wall bracket.

.3 Size: 6.0 L .

.4 ULC Label: Class A K Protection.

.5 ULC Classification Rating: 1-A:K

.6 Acceptable Material:

.1 Ansul K-Guard Model K01-2.

2.3 FIRE EXTINGUISHER BRACKETS

.1 Mounting Brackets:

- .1 Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure.
- .2 Sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- .3 Colour: Black.

.2 Identification:

- .1 Identify extinguishers in accordance with recommendations of ULC S508.
- .2 Attach bilingual tag or label to extinguishers, indicating month and year of installation; include space for service dates.
- .3 Location: As directed by the Consultant.

Part 3 Execution

3.1 EXAMINATION

.1 Examine fire extinguishers for proper charging and tagging; remove and replace damaged, defective, or undercharged units.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

.1 Install extinguishers in accordance with manufacturer’s written instructions and to meet specified standards and requirements of the Authorities Having Jurisdiction.

.2 Install extinguishers so that the top of extinguisher is no more than 1530 mm with the bottom of the extinguisher mounted a minimum of 100 mm above floor in accordance with NFPA 10.

.3 Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

3.3 ADJUSTING AND CLEANING

.1 Remove temporary protective coverings and strippable films as fire protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION

SECTION 22 08 13

CLEANING AND STSRT-UP OF PIPING SYSTEMS

Part 1 General

1.1 SUMMARY

.1 This Section includes procedures and cleaning solutions for cleaning mechanical piping systems including, but not limited to, the following:

.1 Cleaning and degreasing of hot water heating, glycol.

.2 All necessary equipment and chemicals to treat hot water heating, glycol.

.3 Provide for flushing and disinfection of domestic water systems.

.4 Isolate and bypass equipment as required to complete work of this Section.

1.2 RELATED REQUIREMENTS

.1 Section 01 91 13 General Commissioning Requirements

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM E202-10, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit literature having complete description of proposed chemicals, quantities, calculations, procedures, test kits and equipment supplied, and copies of data sheets, procedure instructions and analysis reports proposed for use in the Work.; submit within 10 workings days of the award of Contract.

.3 Provide written reports containing procedure of system cleaning and degreasing, giving times, dates, conditions of water and problems and actions encountered.

.4 Submit written reports to the Construction Manager, Consultant and Mechanical Subcontractor containing results of tests taken every seven days after completion of chemical treatment; perform tests every seven days for a minimum time period of 35 days.

.5 Provide written reports to the Owner after each visit with a copy to the Consultant.

1.5 QUALITY ASSURANCE

.1 Perform the cleaning and degreasing operation on site in conjunction with the mechanical contractor and submit written reports on all situations found, actions taken and final results.

.2 Provide chemical treatment as specified herein and provide written reports. Reports shall be signed by the chemical treatment agency, mechanical contractor and commissioning agency.

.3 Include for the costs of an independent testing agency, selected by the Owner, to take samples of all chemically treated hydronic systems, perform lab analysis of the chemical treatment levels, and submit a written report of their findings to the Owner. Should chemical treatment levels not meet the requirements of the specifications, the Contractor shall adjust treatment levels accordingly and cover the costs of the independent testing agency to take additional samples and tests.

Part 2 Products

2.1 MATERIALS

.1 Provide sufficient chemicals to treat and test the systems from the time of activation and acceptance of the building for the first year of operation by the owner.

.2 Materials which may contact finished areas shall be colorless and non-staining. Chemicals used must comply with environmental and health standards applicable to the usage on this project.

.3 System Cleaner: Alkaline compound which in solution removes grease and petroleum products.

.4 Closed System Treatment: Sequestering agent to reduce deposits and adjust PH, and a corrosion inhibitor.

Part 3 Execution

3.1 ACCEPTABLE AGENCIES

.1 Chemical treatment agencies will be responsible for providing all equipment, chemicals and site supervision to fully comply with all requirements and their intent contained within this specification section.

.2 Chemical treatment agencies offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 SAI Engineering Labs

.2 G.E. Betz Ltd.

.3 Sumco Technologies Ltd.

3.2 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.3 SYSTEM CLEANING

.1 Ensure reasonable care is exercised to prevent debris, dirt and other foreign material from entering the pipe during construction. This is to include proper protection of piping on site prior to installation, temporary caps on partial systems, and complete evacuation of moisture within systems being hydrostatically pressure tested.

.2 Chemical treatment agency shall, in conjunction with the mechanical contractor, review connections for complete draining and venting of the systems. The mechanical contractor shall provide adequate drain connections to completely drain the systems within one hour. Utilize water meter to record capacity within each system.

.3 Protect and/or remove control devices from systems during cleaning. All terminal control valves shall be in open position during cleaning. Particular attention is to be made to control valves which have a normally closed position. Isolate and bypass the following equipment during flushing and chemical treating: Cooling towers, plate and frame heat exchangers.

.4 Make systems completely operational, totally filled, thoroughly vented, and completely started.

.5 Add system cleaner and degreasant to flow systems at the following concentrations:

.1 Hot Systems: 1 kg/1000L of water contained in systems.

.2 Cold Systems: 1 kg/500L of water contained in systems.

.6 For hot water heating systems apply heat while circulating, raise temperature to 71°C slowly and maintain at 71°C for a minimum of 12 hours. Remove heat and circulate systems to 38°C or less. Drain system, entirely at one time, including all low points and coils. Intermittent start/stop of drainage is not approved. The mechanical contractor to provide additional temporary pipe, pumps as necessary and drainage location for complete drainage. Refill the entire system with clean water, circulate for six hours at design temperature, provide complete venting and deairation, repeat the draining procedure. Refill complete system with clean water and retest.

.7 For glycol systems utilize the same procedure for hot water heating systems specified above.

.8 For open systems clean, degrease and flush in the same methods utilized for closed systems of same temperature. Drain completely and refill.

.9 Inspect, clean of sludge and flush all low points with clean water after cleaning and degreasing process is completed. Include disassembly of components as required. All cleaning and flushing of low points, coils and boilers shall be done prior to final fill and chemical treatment.

.10 All domestic hot, cold and domestic recirculation water systems will be required to be flushed and disinfected. Add chlorine to water in system to 50 milligrams per litre (50 ppm) and let stand for 24 hours. Check chlorine content after 24 hours and insure the content is not less than 20 milligrams per litre (20 ppm). If less than 20 milligrams per litre (20 ppm) repeat process. Flush system until the chlorine content of water being drained is equal to the chlorine content of the make-up water. Utilize plumbing fixtures (i.e. lav, sinks, flushometers, and similar criteria.) for drainage.

3.4 HEATING WATER, CHILLED WATER AND GLYCOL SYSTEMS

.1 Provide and install one pot feeder for each individual system. Install complete with isolating and drain valves and necessary piping. Install as indicated on schematics.

.2 Treat closed systems with closed systems treatment introduced through pot feeder when required or indicated by test.

.3 Provide and install one side stream micron filter (between pump suction and discharge) per system, complete with isolation valves, drain valve, union, site glass, and flow regulating valve to limit flow thru filter to manufacturers recommendations.

END OF SECTION

SECTION 22 13 23

PLUMBING SPECIALTIES

Part 1 General

1.1 SUMMARY

.1 Plumbing specialties in this Section includes the following:

- .1 Roof Drains
- .2 Floor Drains
- .3 Cleanouts
- .4 Backwater Valves
- .5 Sump Pits
- .6 Water Hammer Arrestors
- .7 Backflow Preventers

1.2 RELATED REQUIREMENTS

.1 Section 05 50 00 – Metal Fabrications

.2 Section 20 05 10 – Mechanical Systems Pipe and Pipe Fittings

.3 Section 20 05 23 – Valves for Mechanical Systems

.4 Section 20 13 13 – Tanks for Mechanical Systems

.5 Section 20 30 00 – Pumps for Mechanical Systems

.6 Section 23 57 13 – Heat Exchangers for HVAC

.7 Section 26 05 19.16 – Self-Regulating Heating Cable: De-icing cabling for roof drain bodies and rainwater leaders.

.8 Section 33 05 13 – Manholes and Structures

.9 Section 33 11 16 – Water Utility Distribution Piping

.10 Section 33 31 00 – Sanitary Utility Sewerage Piping

.11 Section 33 41 00 – Storm Utility Drainage Piping

1.3 REFERENCE STANDARDS

.1 American Society of Sanitary Engineering (ASSE):

- .1 ANSI/ASSE (Plumbing) 1010-2004, Performance Requirements for Water Hammer Arresters

.2 Canadian Standards Association (CSA):

- .1 CAN/CSA B64 Series-07, Backflow Preventers and Vacuum Breakers

.3 The Plumbing and Drainage Institute (PDI):

- .1 PDI-WH 201 (R2010), Water Hammer Arresters

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's product data for devices specified in this section; indicate applicable options or modifications applicable to project requirements.

1.5 PROJECT CLOSEOUT SUBMISSIONS

.1 Submit certification sheets for inclusion in the operations and maintenance manuals required information in accordance with Section 01 00 06 – General Requirements: Operations and Maintenance Manuals.

1.6 QUALITY ASSURANCE

.1 Provide materials, equipment and labour to install plumbing as required by Provincial and Local Codes as specified herein.

.2 Provide water and drainage connections to equipment furnished in other sections of this specification and by the Owner.

Part 2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design Products: Products named in this Section are used as the basis-of-design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section, provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 25 00 – Substitutions.

.2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; and as established by the Basis-of-Design Materials, use any of the listed manufacturers' products in accordance with Section 01 00 06 – General Requirements ; Product Options including the following:

.1 Cleanouts:

.1 Jay R. Smith Manufacturing Co.
.2 Mifab Canada
.3 Zurn Engineered Water Solutions
.4 Watts

.2 Water Hammer Arrestors:

.1 Jay R. Smith Manufacturing Co.
.2 Mifab Canada
.3 Zurn Engineered Water Solutions
.4 Watts

.3 Roof and Floor Drains:
- .1 Jay R. Smith Manufacturing Co.
- .2 Mifab Canada
- .3 Zurn Engineered Water Solutions
- .4 Watts

.4 Backflow Preventers:
- .1 Febco
- .2 Hersey Products
- .3 Mifab Canada
- .4 Singer Valve
- .5 Watts

.5 Backwater Valves:
- .1 Jay R. Smith Manufacturing Co.
- .2 Mifab Canada
- .3 Zurn Engineered Water Solutions

.6 Trench Drains:
- .1 Aco Drain
- .2 Jay R. Smith Manufacturing Co.
- .3 Mifab Canada
- .4 Zurn Engineered Water Solutions
- .5 Watts

.3 Materials other than the named products for the Project may be acceptable to the Consultant, submit information in accordance with Section 01 62 00 – Product Options.

2.2 MATERIALS

.1 Cleanouts and Cleanout Access Covers: Provide caulked or threaded type extended to finished floor or wall surface; include bolted cover plate cleanouts on vertical rainwater leaders only; allow ample clearance at cleanout for rodding of drainage system, and as follows:

- .1 Provide round nickel bronze scoriated frames and plates for floor cleanout access covers in unfinished areas.
- .2 Provide round access covers in finished areas with depressed centre section to accommodate floor finish.
- .3 Provide chrome plated caps for wall cleanouts.

.2 Water Hammer Arrestors: Fit water supply to each fixture or group of fixtures with an air chamber, and as follows:

- .1 Provide air chambers same size as supply line or 19 mm minimum, and minimum 450 mm long.
- .2 Install stainless steel bellows type water hammer arrestors complete, with accessible isolation valve, on water lines connected to solenoid valves (including flush valves); water hammer arresting devices, conforming to ASSE 1010 and WH-201 and as follows:

.1 Bodies: Hard drawn copper with internal mirror finish

.2 Piston: Delrin PL

.3 Seals: Three (3) “O” ring seal 70D, Buna N

.4 Seal Lubricant: Dow Corning Silicone compound #111 FDA approved for use in potable water systems

.5 Operating Pressure: Designed to operate on all domestic and commercial lines at 1.034 MPa

.6 Temperature range: 0.5°C to 120°C

.7 Connection Size: 13 mm

.8 Basis-of-Design Material: Watts, Ancon Shok-Gard

.3 Shower and Washroom Floor Drains: Removable perforated sediment bucket.

.4 Floor Drains in Equipment Rooms: 100 mm x 225 mm epoxy coated funnel type strainer and extension for floating floor if applicable; no hub drains are allowed.

.5 Floor Drains for Warehouses and Vehicle Areas: Lacquered extra heavy duty type drain body with 305 mm x 305 mm hinged grate and sediment bucket; factory coat entire drain assembly, body, sump, and grate with 3 M Scothkote 206 standard for fusion bonded epoxy coating.

.6 Basis-of-Design Materials: Watts, Ancon FD-460AF.

.3 Sumps: Reinforced concrete sumps will provide necessary drainage fittings, 10 mm checkered steel plate covers with gasket seal frames and anchor bolts. Provide grated cover over one sump compartment when used for area drain.

.4 Pressure Reducing Valves: Provide with gate valve and union on inlet and outlet, globe valve bypass, pressure gauge on inlet and outlet, and pressure relief valve on reduced pressure side:

.1 25 mm and Smaller: Bronze body, stainless steel integral strainer, renewable stainless steel seat, high temperature rated diaphragm suitable for hot or cold water; rated at maximum inlet pressure of 2100 kPa, minimum reduced pressure 175 kPa, maximum temperature 90°C.

.2 30 mm and Larger: Pilot operated, cast iron body, modified globe design, threaded ends to 50 mm flanged ends 65 mm and larger; maximum inlet pressure 1225 kPa maximum temperature 90°C; bronze trim; pilot control system: bronze with stainless steel trim, hydraulically operated, diaphragm actuated.

.3 Size to suit flow capacities and service.

Part 3 Execution

3.1 INSTALLATION

.1 Bury outside water and drainage pipe minimum 2400 mm.

.2 Install plumbing lines outside the building with separation by a minimum of 1 m horizontally between the outside surface of the lines; the lines are not permitted to be stacked.

.3 Install cast iron connections from weeping tile to sanitary drainage system including backwater valve, deep seal P-trap and cleanout; provide access for servicing of backwater valve.

.4 Lubricate cleanout plugs with mixture of graphite and linseed oil; remove cleanout plugs, re-lubricate and re-install using only enough force to provide permanent leak proof joint before building turnover.

.5 Install backflow preventer or vacuum breaker assemblies on water lines where contamination of domestic water may occur such as on boiler make-up lines, sprinkler mains, hose bibbs and flush valves and where required by the Authority Having Jurisdiction.

.6 Install gas piping in open or ventilated spaces; pitch lines and provide drip legs for condensation collection points; provide ventilation grilles as required where gas piping is run in a concealed space.

.7 Floor drains located in floating floors with no membrane provide lead flashing pan 900 mm x 900 mm at 39 kg/m^2; flash membrane or lead into flashing clamp on drain body.

.8 Install trap primers on all floor drains.

.9 Provide trap primers on the following drains: Fill all traps, except elevator pit drain traps with linseed oil.

.10 Grade 2% per foot for drainage lines, unless otherwise noted on drawings.

.11 Install roof drains with 800 mm x 800 mm at 39 kg/m^2 sheet lead.

.12 Install pressure reducing valves to limit maximum static pressure at plumbing fixtures to 550 kPa or to the rated maximum operating pressure of the devices downstream, whichever is lower.

.13 Locate plumbing vents minimum 5 m from air intakes.

.14 Mount reduced pressure backflow preventers in easily serviceable locations within reach from a 1830 mm ladder. (such as in mechanical room, not in ceiling spaces.)

.15 Mount reduced pressure backflow preventers in the horizontal position; double checks can be in horizontal or vertical position, depending on manufacturers installation instructions.

.16 Provide individual isolation valve for each hose bibb.

.17 Backflow Preventer Assemblies: Install line size reduced pressure backflow preventer on each water supply to the project, and as follows:

- .1 Install line size reduced pressure backflow preventer assembly on water supply to: expansion tanks -hot water system, chilled water system.
- .2 Provide an air gap funnel floor drain under each reduced pressure backflow preventer.
- .3 Pipe drain to sanitary sewer.
- .4 Test and verify all backflow preventer assemblies in accordance with the requirements of Authorities Having Jurisdiction; provide certification sheets for insertion in operating and maintenance manuals.

END OF SECTION

SECTION 22 13 53

FACILITY SEPTIC TANKS

Part 1 General

1.1 REFERENCE STANDARDS

.1 American Society For Testing of Materials (ASTM):

- .1 ASTM C117-04, Test Method for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing
- .2 ASTM C136-06, Method for Sieve Analysis of Fine and Coarse Aggregates
- .3 ASTM D698-07 e1, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m3)

.2 Canadian Standards Association (CSA):

- .1 CAN/CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction
- .2 CAN3-A23.4/A251-09, Pre-cast Concrete – Materials and Construction / Qualification Code for Architectural and Structural Pre-cast Concrete Products
- .3 CAN/CSA-B66-10, Prefabricated Septic Tanks and Sewage Holding Tanks

.3 Canadian General Standards Board (CGSB):

- .1 CAN/CGSB-8.1-88, Sieves Testing, Woven Wire
- .2 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric

1.2 DESIGN CRITERIA

.1 Design precast concrete septic tank in accordance with CAN/CSA-B66, and to carry handling stresses and indicated service loads.

.2 Tanks to have minimum total working capacity as indicated on Drawings.

1.3 SUBMITALLS

.1 Make submittals in accordance with Section 01 00 06 – General Requirements, and in accordance with CAN3-A23.4.

.2 Shop drawings to indicate:

- .1 Design calculations for items designed by manufacturer.
- .2 Tables and bending diagrams of reinforcing steel.
- .3 Camber.
- .4 Formwork.
- .5 Finishing schedules.
- .6 Methods of handling and erection.
- .7 Storage facilities.

.8 Openings, sleeves, inserts and related reinforcement.

Part 2 Products

2.1 CONCRETE MIXES AND MATERIALS

.1 Concrete mixes and materials: to CAN/CSA-B66 and CAN/CSA-A23.1.

.2 Concrete exposure classification: C-2, Air Content Category 1.

2.2 MANUFACTURE

.1 Manufacture units in accordance with CAN3-A23.4 and CSA A251, except where specified otherwise.

2.3 FINISHES

.1 Finish tanks to commercial grade to CAN3-A23.4.

2.4 SIPHON CHAMBER

.1 Siphon chamber to meet design requirements specified for septic tanks.

.2 Provide siphon chamber vents.

2.5 BACKFILL MATERIAL

.1 In accordance with Section 31 05 00.

Part 3 Execution

3.1 INSTALLATION

.1 Installation in accordance with manufacturers written instructions by licensed installer.

.2 Place bedding and surround material in unfrozen condition.

.3 Do excavation in accordance with Section 31 05 00.

.4 Place tank bedding material in accordance with details as indicated. Compact to 98% corrected maximum dry density.

.5 Make inlet and outlet joints of septic tank watertight.

.6 Conduct leakage test on septic tank in presence of Construction Manager and Consultant, before backfilling. Fill tank to level of effluent pipe, and allow standing for 24h. Allowable leakage is zero.

.7 Do backfilling in accordance with Section 31 05 00.

.1 Compact to 98% corrected maximum dry density.

END OF SECTION

SECTION 22 14 29.19

SUMP PUMP BASINS AND PITS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 03 31 00 – Structural Concrete

.2 Section 33 46 13 – Foundation Drainage Systems

.3 Section 31 05 00 – Common Work Results for Earthwork

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

.1 CAN/CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction

.2 CAN/CSA A23.4-09, Precast Concrete - Materials and Construction

.3 CAN/CSA A3000-08, Cementitious Materials Compendium

.4 CSA B66-10, Design, Material, and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks

.5 CSA W186-M1990 (R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction

1.3 QUALITY ASSURANCE

.1 Certify manufacturers and erectors of precast concrete elements in accordance with CSA A251, for products specified in this Section.

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals, and in accordance with CAN/CSA 23.4.

.2 Shop drawings to indicate:

.1 Design calculations for items designed by manufacturer.

.2 Tables and bending diagrams of reinforcing steel.

.3 Camber.

.4 Formwork.

.5 Finishing schedules.

.6 Methods of handling and erection.

.7 Storage facilities.

.8 Openings, sleeves, inserts and related reinforcement.

.3 Stamp and sign each drawing submission by a qualified Professional Engineer registered or licensed in the province of the Work.

Part 2 Products

2.1 DESIGN REQUIREMENTS

.1 Design criteria for precast concrete sumps is based on similar requirements for septic tanks in accordance with CSA B66, since handling stresses and service loads have similar characteristics.

.2 Design precast concrete sump in accordance with CAN/CSA-B66, and to carry handling stresses and anticipated service loads for conditions indicated on Drawings.

.3 Loads indicated on Drawings (if any) are not factored, unless specifically indicated otherwise.

2.2 FABRICATION

.1 Fabricate units in accordance with CSA A23.4 and CSA A251.

2.3 FINISHES

.1 Finish sumps to commercial grade to CSA A23.4.

2.4 TANK BEDDING AND SURROUND MATERIAL

.1 Granular Material: 13 mm (½") crushed or screened stone or gravel.

2.5 BACKFILL MATERIAL

.1 Backfill in accordance with Section 31 00 00.

2.6 SUMP PIT COVER AND FRAME

.1 Provide drainage fittings for reinforced concrete sumps with 10 mm chequered steel plate covers with gasket seal frames and anchor bolts. Provide grated cover over one sump compartment when used for area drain.

.2 Fabricate frames from steel angles, 35 mm x 35 mm x 6 mm for opening size as indicated.

.3 Weld angles together to form continuous frame for sump pit cover, sizes as indicated.

.4 Provide hygienic EPDM seals continuous around perimeter of sanitary sump pit as indicated.

.5 Weld stud anchors to angle frame at 600 mm o/c.

.6 Form 8 mm thick checkered plate cover, reinforced with 35 mm x 35 mm x 6 mm angle stiffeners spaced at 600 mm O/C, welded to chequer plate cover, and made flush to adjacent concrete surfaces. Provide two (2) recessed pull rings on opposite sides of cover. Provide four (4) stand off legs to underside of cover to provide a minimum of 75 mm clear space when cover sits on concrete floor slab.

.7 Secure checkered plate cover to sump pit frame with ¼ turn quick connectors to ensure a tight fit between frame and cover.

.8 Welding Classification: Level 4, as specified in Section Section 05 50 00 – Miscellaneous Metal Fabrications.

.9 Finish: hot dipped galvanized 300 g/m^2 minimum, as specified in Section 05 50 00 – Miscellaneous Metal Fabrications.

Part 3 Execution

3.1 INSTALLATION

.1 Place bedding and surround material in unfrozen condition.

.2 Do excavation in accordance with Section 31 00 00.

.3 Place sump bedding material in accordance with manufacturer's recommendations and compact to 100% corrected maximum dry density as directed by geotechnical testing and inspection agency.

.4 Make inlet and outlet joints of sumps watertight.

.5 Conduct leakage test on sumps tank in presence of Consultant, before backfilling. Fill tank to level of overflow pipe, and allow standing for 24h; allowable leakage is zero.

.6 Do backfilling in accordance with Section 31 00 00, and compact to 98% corrected maximum dry density as directed by geotechnical testing and inspection agency.

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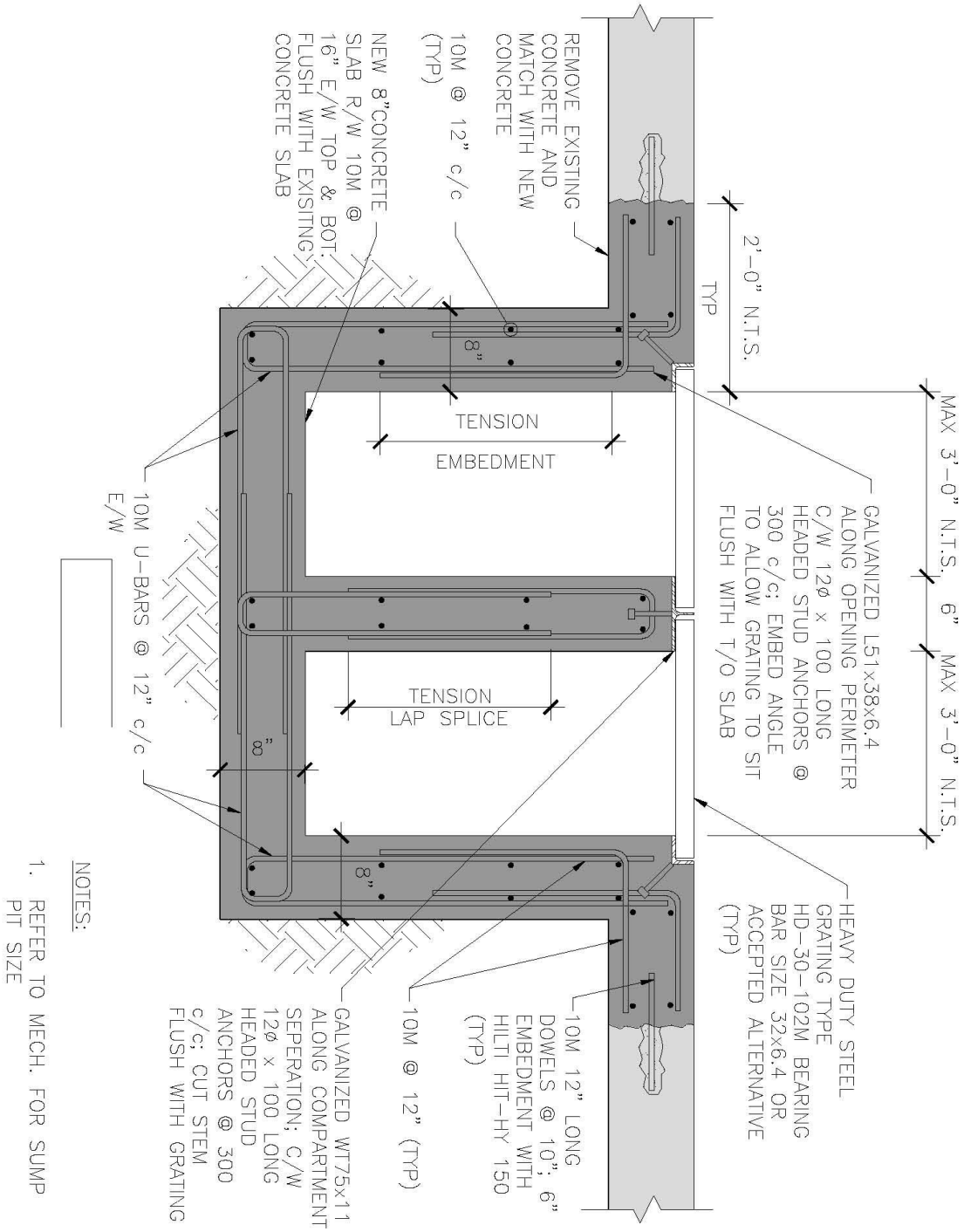

END OF SECTION

SECTION 22 33 00

DOMESTIC WATER HEATERS

1 General

1.1 SUMMARY

1.1.1 Work in this section includes, but is not limited to, the following:

1.1.1.1 Domestic solar water heaters.

1.1.1.2 Domestic water storage tanks.

1.2 RELATED REQUIREMENTS

1.2.1 Section 20 05 23 – Valves for Mechanical Systems

1.2.2 Section 25 09 00 – Instrumentation and Control Devices for Mechanical Systems

1.3 REFERENCE STANDARDS

1.3.1 Underwriters Laboratories Canada (ULC):

1.3.2 National Sanitation Foundation (NSF):

1.3.3 Canadian Standards Association (CSA):

1.3.4 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

1.3.4.1 ANSI/ASHRAE 90.1-2010 (SI), Energy Standard for Buildings Except Low-Rise Residential Buildings, SI Edition

1.4 SUBMITTALS

1.4.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

1.4.2 Submit shop drawings including all trim and control wiring drawings.

1.5 QUALITY ASSURANCE

1.5.1 Completely pre-assemble and test water heaters at factory.

1.5.2 Rated for 1 MPa working pressure.

1.5.3 Heaters must meet all applicable energy codes. The water heater will comply with the thermal efficiency, standby loss, insulation, and all other requirements of the latest version of ASHRAE 90.1 and the Model National Energy Code.

2 Products

2.1 MANUFACTURERS

2.1.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

2.1.1.1 A.O. Smith

2.1.1.2 Stiebel-Eltron

2.1.1.3 Bradford White

2.2 ELECTRIC DOMESTIC WATER DISHWASHER BOOSTER HEATER

2.2.1 Ensure heater(s) listed by Underwriters' Laboratories and approved by the National Sanitation Foundation. Provide an extruded magnesium anode rod. All internal surfaces of the vessel(s) exposed to water must be glass-lined with an alkaline borosilicate composition that has been fused-to-steel by firing at a temperature range of 760 C to 870 C.

2.2.2 Elements are medium watt density triple loop construction with incoloy sheath. Provide switched through magnetic contractor(s) for element(s). Fused 120 volt control circuit shall include manual reset high temperature cutoff switch and thermostat with sensing element immersed directly in water. Low water cutoff (optional) to prevent element burnout due to possible low water conditions.

2.2.3 Provide straight-line rectangular cabinet with baked enamel with stainless steel front panel (SU models only). All stainless steel jacket (CMC models only) and provide full size access to controls and elements for ease in servicing and enclose tank with fibre glass insulation. Provide heater tank with a three (3) year limited warranty.

3 Execution

3.1 INSTALLATION

3.1.1 Install heaters where indicated on the drawings.

3.1.2 Provide 100 mm concrete housekeeping pads.

3.2 PERFORMANCE

3.2.1 Performance data to include Energy Factor and indicate compliance with the latest version of ASHRAE 90.1.

3.2.2 Refer to Domestic Water Heaters Schedule on Drawings.

END OF SECTION

SECTION 23 05 17.13

HOT WATER HEATING PIPING SPECILATIES

Part 1 General

1.1 SUMMARY

.1 Hot water heating specialties in this Section includes the following:

- .1 Manual and automatic air vents.
- .2 Air separators.
- .3 Relief valves and fittings.
- .4 Radiation valves.
- .5 Pressure Reducing Valves.
- .6 Quantity Meters.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 10 – Mechanical Systems Pipe and Pipe Fittings

.2 Section 20 05 23 – Valves for Mechanical Systems

.3 Section 20 07 00 – Piping and Equipment Insulation

.4 Section 20 15 19 – Meters and Gauges for Mechanical Systems

.5 Section 20 13 13 – Tanks for Mechanical Systems

.6 Section 20 30 00 – Pumps for Mechanical Systems

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- .1 Air Separators:
  - .1 S.A. Armstrong Ltd.
  - .2 Bell and Gossett/ITT Industries
  - .3 Taco Inc.
- .2 Relief Valves:
  - .1 S.A. Armstrong Ltd.
  - .2 Bell and Gossett/ITT Industries
  - .3 Taco Inc.
- .3 Pressure Reducing Valves:
  - .1 S.A. Armstrong Ltd.
  - .2 Bell and Gossett/ITT Industries
  - .3 Taco Inc.

2.2 MANUAL AIR VENTS

.1 Provide manual air vents with 25 mm or line diameter pipe whichever is the greater, to form air collection chamber. Provide collection chambers a minimum of 150 mm high.

2.3 AIR SEPARATORS

.1 Provide centrifugal type with 861 kPa WSP steel tank, galvanized steel 5 mm perforated strainer, perforated stainless steel air collector tube and drain connection.

2.4 RELIEF VALVES

.1 Provide ASME rated direct spring loaded type, lever operated non-adjustable factory set. Relief pressure as indicated.

2.5 HANDWHEEL RADIATOR VALVES

.1 Refer to Section 20 05 23.

2.6 RADIATOR BALANCING VALVES

.1 Refer to Section 20 05 23.

2.7 QUANTITY METERS

.1 Refer to Section 20 15 19.

2.8 PRESSURE REDUCING VALVES

.1 Pressure reducing valve 20 mm with low inlet pressure check valve, removable strainer, Brass body and adjustable pressure of 55 kPa to 173 kPa and 175 kPa to 415 kPa:

.1 Acceptable Materials: Bell and Gossett Model B-7 and 7.

Part 3 Execution

3.1 AIR VENTS

.1 Provide manual type at system high points and convection type heating units.

.2 Where large air quantities can accumulate, provide enlarged air collection standpipe.

3.2 AIR SEPARATOR

.1 Provide on suction side of system circulation pump and connect to expansion tank.

3.3 RELIEF VALVES

.1 Provide relief valves on pressure tanks, low pressure side of reducing valves, heating converters, expansion tanks and where indicated.

.2 Drain relief valve to nearest floor drain.

.3 Relief Valve Capacity:

.1 System Relief Valve Capacity: Valve capacity shall equal make-up pressure reducing valve capacity.

.2 Equipment Relief Valve Capacity: Valve capacity shall exceed input rating of connected equipment.

.4 Cross sectional area shall exceed sum of individual vent areas where one line vents several relief valves.

3.4 QUANTITY METERS

.1 Install quantity meters, isolation valves and line size bypass.

3.5 RADIATOR BALANCING VALVES

.1 Provide on water outlet from terminal heating units.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC DUCTING

Part 1 General

.1 This Section includes requirements for supply and installation of the following:

.1 Duct hangers and supports.

.2 Flashing for mechanical equipment.

.3 Sleeving required for mechanical ducting.

1.2 RELATED REQUIREMENTS

.1 Section 05 12 00 – Structural Steel Framing: Structural grade steel required for equipment supports.

.2 Section 05 50 00 – Metal Fabrications: Platforms, catwalks and ladders required for access to HVAC piping and equipment.

.3 Section 07 53 00 – Elastomeric Membrane Roofing: Coordinate flashing requirements with roof membrane installer.

.4 Section 07 62 00 – Sheet Metal Flashings: Coordinate flashing materials with project requirements for flashings and sheet metals.

.5 Section 07 92 00 – Joint Sealants: Through wall caulking requirements.

.6 Section 09 91 05 – Painting: Priming of hangers and supports ready for site finishing.

.7 Section 23 31 00 – Ductwork

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM A36/A36M-08, Standard Specification for Carbon Structural Steel

.2 ASTM A125-96(2007), Standard Specification for Steel Springs, Helical, Heat-Treated

.3 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

.4 ASTM A563-07a, Standard Specification for Carbons and Alloy Steel Nuts

.5 ASTM A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.6 ASTM B749-03(2009), Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products

.2 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):

.1 MSS SP-58-2009, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

.2 ANSI/MSS SP-69-2003, Pipe Hangers and Supports: Selection and Application

.3 MSS SP-58, Pipe Hangers and Supports: Fabrication and Installation Practices

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 SMACNA 1958, HVAC Systems - Duct Design, 4th Edition

.2 ANSI/SMACNA 1966, HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals]

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Shop Drawings: Submit shop drawings and product data for each factory fabricated component including, but not limited to, the following:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies and equipment supports, including design calculations.

.2 Samples: Submit samples of hangers and anchors proposed for use on the Project.

1.5 PERFORMANCE REQUIREMENTS

.1 Provide hangers and supports to secure equipment in place, prevent vibration, prevent excessive heat transmission to structure, maintain grade, and allow for expansion and contraction using manufacturer's regular production components, parts and assemblies.

.2 Install supports of strength and rigidity to suit loading without unduly stressing building; locate adjacent to equipment to prevent undue stresses in equipment.

.3 Select hangers and supports for the service indicated in accordance with maximum load ratings on allowable stresses prescribed by MSS SP-58, and in accordance with manufacturer's recommended maximum loading to sustain without failure a load equal to a load:

.1 Equal to six times the load imposed when installed in unit masonry.

.2 Equal to four times the load imposed when installed in concrete.

.3 Equal to five times the load imposed when installed in other types of materials.

.4 Fasten hangers and supports to building structure or inserts in concrete construction; discuss proposed hanging systems and methods with structural Consultant and obtain acceptance as follows:

.1 Prior to drilling for inserts and supports for duct system.

.2 Prior to using percussion type fastenings.

.3 Prior to welding ductwork and equipment supports to building metal decking or building structural steel.

.4 Use of piping or equipment for hanger supports and use of perforated band iron, wire or chain as hangers will not be permitted.

.5 Provide and set sleeves or block-outs required for equipment, including openings required for placing equipment; provide sleeves for duct penetrations through walls, ceilings, floors and footings; provide locations and dimensions for block-outs or embedded material if provided or installed by others.

1.6 SHEET METAL FLASHINGS

.1 Zinc Galvanized Sheet Steel Flashing: Tension levelled, Commercial Steel (CS) designation, Type A, Grade 230 (33) in accordance with ASTM A653/A653M and as follows:

.1 Thickness:

.1 Flashing: Minimum 0.455 mm base metal thickness.

.2 Caps: 0.759 mm base metal thickness.

.3 Fire Resistant Construction 1.519 mm base metal thickness.

.2 Galvanizing Designation: Z275 (G90) applied evenly to both sides.

.3 Surface Texture: Smooth.

.4 Finish: Natural finish ready for field painting.

.2 Lead Sheet Flashing: Copper bearing lead sheet in accordance with ASTM B749, Type L51121 and as follows:

.1 Waterproofing: 24.4 kg/m^2 nominal weight.

1.7 SLEEVES

.1 Size sleeves large enough to allow for movement due to expansion and to provide for continuous insulation, and fabricate as follows:

.1 Pipes through Floors: Form with steel pipe or approved PVC sleeves.

.2 Pipes through Beams, Walls, Fire Proofing, Footings, Potentially Wet Floor: Form using steel pipe.

.3 Ducts: Form with galvanized steel.

1.8 INSERTS

.1 Post-installation Inserts:

.1 Expansion Inserts: Zinc coated carbon or Stainless steel, internally threaded inserts, sized to suit supported loads and threaded rod diameter, having expansion section that adapts to the base material:

.1 Basis of design materials: Hilti HDI Drop-In Anchor System.

.2 Chemical Inserts: Carbon or Stainless steel, chisel pointed, internally threaded inserts or threaded rod insert, sized to suit supported loads and threaded rod diameter, having dual chamber foil capsule containing vinyl urethane methacrylate resin:

.1 Basis of design materials: Hilti HVA Chemical Anchor System.

1.9 HANGER RODS AND STRAPS

.1 Provide prime coated or stainless steel hanger rods, threaded both ends, threaded one end, or continuous threaded as required for the equipment being supported.

.2 Straps and Rod Sizes: In accordance with SMACNA HVAC Duct Construction manual and MSS SP-58 for sheet steel width and thickness and for steel rod diameters.

1.10 HANGERS AND SUPPORTS

.1 Ducts: In accordance with SMACNA HVAC Duct Construction manuals and as follows:

.1 Band Type Hangers: Same material as duct.

.2 Rod Type Hangers:

.1 Material Mild low carbon steel fully threaded or threaded each end, with two removable nuts each end for positioning and locking rod in place.

.2 Finish: Cadmium Plated or Shop coat with zinc chromate primer paint.

.2 Pipes: In accordance with MSS SP-58, SP-69 and SP-89 Pipe Hangers and Support manuals.

1.11 TRAPEZE AND RISER SUPPORTS

.1 Steel shapes in accordance with ASTM A36/A36M.

.2 Supports for Galvanized Steel Ducts: Galvanized steel shapes and plates.

.3 Supports for Stainless Steel Ducts: Stainless-steel support materials.

.4 Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

1.12 FASTENERS AND ACCESSORIES

.1 Equipment Anchor Bolts and Templates: Provide templates to ensure accurate location of anchor bolts.

.2 Miscellaneous Fasteners and Upper Hanger Attachments:

.1 Sheet Metal Screws: Same material as duct.

.2 Machine Bolts and Nuts: Galvanized or cadmium plated steel.

.3 C Clamps: Locking nut and retaining strap assembly.

.4 Welding Studs: Capacitor discharge, low carbon steel, copper flashed.

.5 Structural Steel Shapes and Plates: ASTM A36, shop primed.

.3 Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488.

.4 Percussion Type Fastenings: Are not permissible for this project.

.5 Bolts: In accordance with ASTM A307.

.6 Nuts: In accordance with ASTM A563.

.7 Adjustable Clevis: Clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis in accordance with MSS SP-69 UL listed or FM approved; include "U" hole in bottom for riveting to insulation shields.

.8 Yoke Style Pipe Roll: Carbon steel yoke, rod and nuts with cast iron roll in accordance with to MSS SP-69.

.9 U-Bolts: Carbon steel in accordance with MSS SP-69 with 2 nuts at each end meeting ASTM A563.

.10 Pipe Rollers: Cast iron roll and roll stand with carbon steel rod meeting MSS SP-69.

.11 Riser Clamps:

.1 Steel or Cast Iron Pipe: galvanized or black carbon steel meeting MSS SP-58, Type 42, UL listed] [FM approved].

.2 Copper Pipe: Carbon steel Copper plated meeting MSS SP-58, Type 42.

.12 Insulation Protection Shields:

.1 Insulated Cold Piping: 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel; length designed for maximum 3 m span.

.2 Insulated Hot Piping: Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel in accordance with MSS SP-69.

.13 Constant Support Spring Hangers:

.1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report(CMTR).

.2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

.14 Variable Support Spring Hangers:

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger to be complete with factory calibrated travel stops ; provide certificate of calibration for each hanger.

.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

.15 Equipment Supports:

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section [05 12 00 - Structural Steel Framing]; submit calculations with shop drawings.

.16 Other Equipment Supports:

.1 Fabricate from structural grade steel in accordance with requirements of Section 05 12 00.

.2 Submit structural calculations with shop drawings.

1.13 FABRICATION

.1 Fabricate hangers, supports and sway braces in accordance with MSS SP-58 and SMACNA HVAC Duct Construction manuals.

.2 Use components for intended design purpose only; do not use for rigging or erection purposes.

Part 2 Execution

2.1 INSERTS

.1 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

.2 Finish inserts flush with slab surface where concrete slabs form finished ceiling.

2.2 PIPE HANGERS AND SUPPORTS

.1 Install in accordance with manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, elsewhere as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipe work using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to be to industry standards.

.3 Steel pipes: Install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: Install below joint.

.4 Clevis plates: Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 Vertical movement of pipe work is 13 mm or more.

.2 Transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

.1 Transfer of load to adjacent piping or to connected equipment is not critical.

.2 Variation in supporting effect does not exceed 25% of total load.

.8 Hanger Spacing:

.1 Plumbing Piping: Most stringent requirements of the National Plumbing and in accordance with the authority having jurisdiction.

2.3 DUCT HANGERS AND SUPPORTS

.1 Support duct work in accordance with SMACNA, and as a minimum as follows:

.1 Low Pressure Duct Hangers and Supports:

.1 Hanger Minimum Sizes:

.1 Less than or equal to 750 mm: 25 mm x 1.5 mm at 3 m spacing;

.2 775 mm to 1220 mm: 38 mm x 1.5 mm at 3 m spacing;

.3 Greater than or equal to 1220 mm: 38 mm x 1.5 mm at 3.4 m spacing.

.2 Horizontal Duct on Wall Supports Minimum Sizes:

.1 Less than or equal to 450 mm wide: 38 mm x 1.5 mm or 25 mm x 3 mm at 2.4 m spacing;

.2 475 mm to 1000 mm wide: 38 mm x 38 mm x 3 mm at 1.2 m spacing.

.3 Vertical Duct on Wall Supports Minimum Sizes:

.1 At 3.6 mm spacing;

.2 Less than or equal to 610 mm: 38 mm x 1.5 mm;

.3 625 mm to 915 mm: 25 mm x 25 mm x 3 mm;

.4 925 mm to 1220 mm: 30 mm x 30 mm x 3 mm.

.4 Vertical Duct Floor Supports Minimum Sizes:

.1 Riveted or screwed to duct;

.2 Less or equal to 1500 mm: 38 mm x 38 mm x 3 mm;

.3 Greater than 1500 mm: 50 mm x 50 mm x 3 mm.

.2 Medium and High Pressure Duct Hangers and Supports:

.1 Rectangular Duct Hangers Minimum Sizes:

.1 Less than or equal to 915 mm: 2 at 25 mm x 1.5 mm at 3 m spacing;

.2 925 mm to 1500 mm: 2 at 25 mm x 1.5 mm at 2.4 m spacing and 50 mm x 50 mm x 6 mm trapeze;

.3 1525 mm to 3000 mm wide: 2 at 38 mm x 3 mm, at 2.4 m spacing and 50 mm x 50 mm x 6 mm trapeze;

.4 3200 mm to 6000 mm: 3 at 10 mm diameter at 1.2 m spacing and 65 mm x 65 mm x 6 mm trapeze.

.2 Round Duct Hangers Minimum Sizes:

.1 At 3 m spacing;

.2 Less than or equal to 450 mm diameter: 25 mm x 1.5 mm;

.3 475 mm to 915 mm diameter: 25 mm x 3 mm;

.4 925 mm to 1250 mm diameter: 38 mm x 3 mm;

.5 1300 mm to 2000 mm diameter: 2 at 38 mm x 3 mm from girth reinforcing angle.

.3 Vertical Duct Floor Supports Minimum Sizes:

.1 Rivet to duct and tie angles together with rod, angles or "band iron".

.2 Less than or equal to 1220 mm: 38 mm x 38 mm x 3 mm;

.3 Greater than 1220 mm: 50 mm x 50 mm x 5 mm.

.4 Angle reinforcing may be used for support omitting trapeze.

2.4 EQUIPMENT BASES AND SUPPORTS

.1 Provide reinforced concrete housekeeping bases poured directly on structural floor slab; provide templates, anchor bolts and accessories required for mounting and anchoring equipment.

.2 Construct supports of structural steel members or steel pipe and fittings; brace and fasten with flanges bolted to structure.

.3 Provide rigid anchors for ducts and pipes immediately after vibration isolation connections to equipment unless spring hangers are specified.

2.5 PRIMING

.1 Prime coat exposed steel hangers and supports in accordance with Section 09 91 00.

2.6 FLASHING

.1 Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors and roofs.

.2 Flash vent and soil pipes projecting 80 mm minimum above finished roof surface with lead worked 25 mm minimum into hub, 200 mm minimum clear on sides with minimum 610 mm x 610 mm sheet size; turn flange back into wall and caulk in accordance with Section 07 92 00 for pipes extending through outside walls.

.3 Flash floor drains over finished areas with lead 250 mm clear on sides with minimum 900 mm x 900 mm sheet size; fasten flashing to drain clamp device.

.4 Provide lead acoustic flashing around duct and pipes passing from equipment rooms, installed according to manufacturer's data for sound control.

2.7 SLEEVES

.1 Set sleeves in position in advance of concrete work; provide suitable reinforcing around sleeve.

.2 Extend sleeves through potentially wet floors 25 mm above finished floor level; caulk sleeves full depth in accordance with Section 07 92 00 and provide floor plate.

.3 Ductwork passing through floor, ceiling or wall, close off space between duct and sleeve with non-combustible insulation; provide tight fitting metal caps on both sides and caulk in accordance with Section 07 92 00.

2.8 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Verify that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of the following:

- .1 Duct thermal insulation
- .2 Duct acoustic insulation
- .3 Breeching insulation
- .4 Adhesives, tie wires, and tapes
- .5 Recovery jackets for interior and exterior ductwork

1.2 RELATED REQUIREMENTS

.1 Section 07 84 00 – Firestopping: Coordinate insulation type with penetration classification and firestopping systems.

.2 Section 07 92 00 – Joint Sealants: General provisions for installation of sealants and sealant types.

.3 Section 20 07 00 – Piping and Equipment Insulation: Insulation for HVAC equipment and other accessories.

.4 Section 23 31 00 – HVAC Ducts and Casings

1.3 DEFINITIONS

.1 Concealed: Insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces such as crawl spaces and duct shafts.

.2 Exposed: Insulated mechanical services in all other areas visible after final construction will be considered as exposed.

1.4 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

- .1 ASTM A666-10, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- .2 ASTM B209/B209M-10, Specification for Aluminum and Aluminum Alloy Sheet and Plate
- .3 ASTM C449/C449M-07, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
- .4 ASTM C547-11e1, Standard Specification for Mineral Fiber Pipe Insulation
- .5 ASTM C553-11, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- .6 ASTM C612-10, Standard Specification for Mineral Fiber Block and Board Thermal Insulation
- .7 ASTM C795-08, Specification for Thermal Insulation for Use with Austenitic Stainless Steel

.8 ASTM C921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

.9 ASTM C1136-10, Standard specification for Flexible, Low Permeance Vapour Retarders for Thermal Insulation

.2 Canadian General Standards Board (CGSB):

.1 CGSB 51-GP-52MA, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation

.3 Thermal Insulation Association of Canada (TIAC):

.1 Mechanical Insulation Best Practices Guide

.4 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.2 CAN/ULC S702-09, Thermal Insulation Mineral Fibre for Buildings

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Shop Drawings: Submit shop drawings indicating complete material data, K value, temperature rating, density, finish, and recovery jacket of materials proposed for this project and indicate thickness of material for individual services.

.2 Samples: Submit samples of proposed insulating and recovery jacket materials.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: Insulation materials must meet or exceed the requirements of the building code; label packages or containers indicating compliance of packaged materials and as follows:

.1 Environmental Requirements: Provide only insulation that is not produced with, or contain any regulated CFC compounds listed in the Montreal Protocol adopted by the United Nations Environmental Program.

.2 Flame Spread: Use only insulation that meets or exceeds flame spread rating of 25 or less and smoke developed classification of 50 or less in accordance with applicable building codes including insulation materials, recovery jackets, vapour barrier facings, tapes and adhesives.

.2 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Installer: Use installer for work of this Section who has experience with work of similar complexity and extent as required for this project, and that has a minimum three (3) years successful experience.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Procedures: Deliver material to job site in original unbroken factory packaging, labelled with manufacturer's density and thickness.

1.8 SITE CONDITIONS

.1 Ambient Conditions: Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer; repair any separation of joints or cracking of insulation arising from thermal movement or poor workmanship.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, use any of the listed manufacturers' products in accordance with Section 01 62 00 – Product Options or submit a proposed substitution in accordance with Section 01 25 00 – Substitutions, Standard Documents Package a minimum of [ten (10) days] in advance of Bid Closing:

.1 Isolation Manson Inc.

.2 Johns Manville

.3 Knauf Fiberglass

.4 Owens-Corning

.5 Roxul Inc.

2.2 PROPERTIES

.1 Fire and Smoke Hazard Ratings: Provide insulation material, recovery jackets, vapour barrier facings, tapes and adhesives having composite fire and smoke hazard ratings not exceeding Flame Spread 25 and Smoke Developed 50 in accordance with ULC S102.

.2 Service Temperature Rating: Provide insulating materials and accessories that are able to withstand service temperatures without smouldering, glowing, smoking or flaming.

.3 Material Description: Mineral fibre specified includes glass fibre, rock wool, or slag wool meeting the maximum K values listed at the choice of manufacturer.

2.3 DUCT INSULATION MATERIALS

.1 External Duct Insulation: Provide insulation to ductwork and plenums in accordance with TIAC Best Practices Guide and as follows:

.2 Internal Duct Insulation: Provide insulation to ductwork and plenums in accordance with TIAC Best Practices Guide and as follows:

.1 Acoustic Insulation: Rigid fibrous glass or mineral fibreboard insulation meeting requirements of ULC S702 and as follows:

.1 K Value: Maximum 0.035 W/m°C, at 24°C

.2 Surface Roughness: Absolute roughness of exposed surface not to exceed 0.580 mm

.3 Erosion Control: Coat insulation to prevent fibre erosion as recommended by manufacturer for air velocities as follows:

.1 Ductwork up to 25.4 m/s: Minimum 24 kg/m^2

.2 Plenums: Minimum 75 kg/m^2

.4 Colour: Substrate must not be dark in colour.

.5 Service Temperature: -40°C to 65°C

.3 Breeching Insulation: Semi-rigid mineral fibre insulation with glass mat reinforcement meeting requirements of ULC S702 and as follows:

.1 K Value: 0.035 W/m°C maximum at 24°C

.2 Service Temperature: 65°C to 450°C

2.4 ACCESSORIES

.1 Vapour Retarder Lap Adhesive: Compatible with insulation, water based; fire retardant type.

.2 Canvas Lagging Adhesive: Compatible with insulation and compliant with requirements for ULC listed dilute fire retardant lagging adhesive, washable type

.3 Indoor Vapour Retarder Finish: Vinyl emulsion type acrylic, compatible with insulation.

.4 Insulating Cement: Hydraulic setting type for use on mineral wool, meeting requirements of ASTM C449.

.5 Outdoor Vapour Retarder Mastic: Vinyl emulsion type acrylic, compatible with insulation with 305 g/m^2 fibrous glass reinforcing fabric, untreated.

.6 Tape: Self adhesive, aluminum, plain minimum nominal 50 mm wide.

.7 Contact Adhesive: Quick setting type

.8 Tie wire: 1.5 mm diameter stainless steel

.9 Banding: 13 mm wide, 0.5 mm thick stainless steel.

.10 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face.

.11 Fasteners: 2 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 PREPARATION

.1 Install covering after ductwork and equipment is tested and accepted by Consultant; verify the following:

.1 Verify that surface is clean and dry before installation

.2 Verify that insulation is dry before and during application

.2 Finish installation when systems are running at normal operating conditions, where possible.

3.2 INSTALLATION

.1 Install insulation and recovery jacket in accordance with TIAC Best Practices Guide, manufacturer's written instructions and requirements of this specification.

.2 Install insulation so that it is continuous through inside walls; pack around ducts with fireproof self supporting insulation material, properly sealed in accordance with Section 07 84 00.

.3 Finish insulation neatly at hangers, supports and other protrusions.

.4 Do not insulate ductwork with external thermal insulation where acoustic duct insulation is required.

.5 Locate insulation or cover seams in least visible locations; locate seams on ductwork in ceiling spaces on the underside of the duct.

.6 Provide recovery jackets on exposed insulation throughout, including equipment rooms:

.1 Insulation located in crawl spaces, shafts and suspended ceiling spaces is not considered exposed.

.2 Make smooth any uneven insulated surface before recovery jacket installation.

.7 Cover insulation exposed to outdoors with stainless steel jacket secured with stainless steel bands on 200 mm centres:

.1 Longitudinal slip joints: lap circumferential joints 75 mm minimum and seal all joints with compatible waterproof lap cement.

.8 Exposed Rectangular Ducts:

.1 Secure rigid insulation with galvanized anchors, or weld pins on 400 mm centres.

.2 Secure in place with retaining clips.

.3 Seal all insulation joints and breaks with joint tape.

.4 Use vapour barrier tape for insulation joints or breaks on cold ducts.

.9 Round Ducts and Concealed Rectangular Ducts:

.1 Adhere flexible insulation to ductwork with adhesive applied in 150 mm wide strips on 400 mm centres.

.2 Provide annealed tie wire tied at 400 mm centres for securing duct insulation.

.3 Butt insulation and seal joints and breaks with lap seal adhesive; cover joints with joint tape.

.4 Use vapour barrier tape for cold ducts.

.10 Acoustic Lining:

.1 Apply to interior of ducts where shown.

.2 Secure to ductwork with adhesive using 50% coverage and anchors or weld pins on 400 mm centres.

.3 Secure in place with retaining clips.

.4 Cut off excess fastener length and cover with brush coat of mastic over protrusions and all raw edges.

.5 Use 25 mm thick insulation unless otherwise noted.

.6 Provide vapour barrier located on the warm side for outside air intakes.

.7 Bevel corners at joints and butt together.

.8 Install acoustic gauze over all cut corners and joints and brush coat with lap seal adhesive.

.9 Cover insulation with nominal 0.8 mm perforated galvanized sheet steel with 24% free area where duct velocities exceed 10 m/s.

.11 Breeching Insulation:

.1 Face breeching with 10 mm rib lath turn out to provide 13 mm space between insulation and hot surface and 13 mm mesh expanded lath on the outside.

.2 Butt blankets firmly together and secure with 1.519 mm galvanized wire.

.3 Lace metal mesh together.

.4 Coat with 13 mm thick insulating cement.

.5 Finish with a final 13 mm coat of insulating cement.

.6 Trowel to a smooth hard finish.

.7 Recover with stainless steel jacket.

.12 Fasten stainless steel recovery jacket in place with stainless steel banding on 200 mm centres or screws or rivets on 150 mm centres; longitudinal slip joints and 50 mm lap joints.

END OF SECTION

SECTION 23 08 00

COMMISSIONING OF HVAC

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for commissioning HVAC system and its subsystems and equipment.

.2 This Section supplements general requirements specified in Section 20 08 00.

1.2 RELATED REQUIREMENTS

.1 Section 23 09 93 – Sequence of Operation for HVAC Controls

1.3 DEFINITIONS

.1 Consultant: Includes Consultant identified in Contract for Construction between Owner and Contractor, plus design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.

.2 BoD: Basis of Design.

.3 BoD-HVAC: HVAC systems basis of design.

.4 CxA: Commissioning Authority.

.5 OPR: Owner's Project Requirements.

.6 Systems, Subsystems, and Equipment: These terms include as-built systems, subsystems, and equipment whether these terms are used together or separately.

.7 TAB: Testing, Adjusting, and Balancing.

1.4 CONTRACTOR'S RESPONSIBILITIES

.1 Requirements listed in this Section are additional to documentation specified in Section 20 08 00.

.2 Contractor:

.1 Attend procedures meeting for TAB Work.

.2 Certify that TAB Work is complete.

.3 Mechanical Subcontractor:

.1 Attend TAB verification testing.

.2 Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for complete range of testing for required test period.

.4 HVAC Instrumentation and Control Subcontractor:

.1 Review control designs with CxA for compliance to OPR and BoD, controllability with respect to actual equipment being installed, and recommend adjustments to control designs and sequence of operation descriptions.

.5 TAB Subcontractor:

.1 Contract Documents Review:

.1 Review Contract Documents with CxA before developing TAB procedures:

.2 Verify following:

.1 Accessibility of equipment and components required for TAB Work.

.2 Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.

.3 Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.

.4 Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.

.5 Air and water flow rates have been specified and compared to central equipment output capacities.

.3 Identify discontinuities and omissions in Contract Documents.

.2 Additional Responsibilities:

.1 Participate in tests specified in Section 23 09 93 relating to HVAC instrumentation and controls, and sequence of operation.

.6 Electrical Subcontractor:

.1 Obtain from Electrical Subcontractor requirements to coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.

.2 Notify Electrical Subcontractor that they are to attend TAB verification testing.

1.5 COMMISSIONING DOCUMENTATION

.1 Requirements listed in this Section are additional to documentation specified in Section 20 08 00.

.2 BoD HVAC: Owner to provide BoD-HVAC documents, prepared by Consultant and approved by Owner, to CxA and [each] Contractor for use in developing commissioning plan, systems manual, and operation and maintenance training plan.

.3 Test Checklists:

.1 CxA [with assistance of Consultant] to develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems.

.2 CxA to prepare separate checklists for each mode of operation and provide space to indicate whether mode under test responded as required.

.3 In addition to requirements specified in Section 20 08 00, checklists to include, but not be limited to, following:

.1 Calibration of sensors and sensor function.

.2 Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact results of test.

.3 Control sequences for HVAC systems.

.4 Strength of control signal for each set point at specified conditions.

.5 Responses to control signals at specified conditions.

.6 Sequence of response(s) to control signals at specified conditions.

.7 Electrical demand or power input at specified conditions.

.8 Power quality and related measurements.

.9 Expected performance of systems, subsystems, and equipment at each step of test.

.10 Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether observed performance at each step meets expected results.

.11 Interaction of auxiliary equipment.

.12 Issues log.

1.6 SUBMITTALS

.1 Requirements listed in this Section are additional to documentation specified in Section 20 08 00.

.2 Testing Procedures: CxA to submit detailed testing plan, procedures, and checklists for each series of tests. Submittals include samples of data reporting sheets that will be part of reports.

.3 Certificate of Readiness: CxA to compile certificates of readiness from [each] Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.

.4 Certificate of Completion of Installation, Pre-start, and Start-up: CxA to certify that installation, pre-start, and start-up activities have been completed.

.5 Certified Pipe Cleaning and Flushing Report: CxA to certify that pipe cleaning, flushing, hydrostatic testing, and chemical treating have been completed.

.6 Test and Inspection Reports: CxA to compile and submit test and inspection reports and certificates, and to include them in systems manual and commissioning report.

.7 Corrective Action Documents: CxA to submit corrective action documents.

.8 Certified TAB Reports: CxA to submit verified, certified TAB reports.

Part 2 Execution

2.1 TESTING PREPARATION

.1 Prerequisites for Testing:

.1 Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating in accordance with OPR, BoD, and Contract Documents; and that Certificates of Readiness are signed and submitted.

.2 Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating in accordance with OPR, BoD, and Contract Documents; and that pre-test set points have been recorded.

.3 Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

.4 Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.

.5 Set systems, subsystems, and equipment into operating mode tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

.6 Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.

.7 Inspect and verify position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.

.8 Check safety cut-outs, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

.9 Annotate checklist or data sheet when a deficiency is observed.

.10 Verify equipment interface with monitoring and control system and TAB criteria; include following:

.1 Supply and return flow rates for VAV and constant volume systems in each operational mode.

.2 Operation of terminal units in both heating and cooling cycles.

.3 Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.

.4 Building pressurization.

.5 Total exhaust airflow and total outdoor-air intake.

.6 Operation of indoor-air-quality monitoring systems.

.11 Verify proper responses of monitoring and control system controllers and sensors to include following:

.1 Record indicated monitoring and control system reading and test instrument reading for each controller or sensor.

.2 Check calibration of installed device and adjust as required where initial test indicates that test reading is outside of control range of installed device.

.3 Retest malfunctioning devices and record results on checklist or data sheet.

.4 Report deficiencies and prepare an issues log entry.

.12 Verify that HVAC equipment site quality-control testing has been completed and approved; CxA to direct, witness, and document site quality-control tests, inspections, and start-up specified in individual Mechanical Specification Sections affecting work of this Section.

.2 Testing Instrumentation:

.1 Install measuring instruments and logging devices to record test data for required test period.

.2 Instrumentation: Monitor and record full range of operating conditions and allow for calculation of total capacity of system for each mode of operation.

.3 Provide temporary heaters to impose a cooling load for individual room cooling tests indicated in BoD.

.4 Operational modes include following:

.1 Occupied and unoccupied.

.2 Warm up and cool down.

.3 Economizer cycle.

.4 Emergency power supply.

.5 Life-safety and safety systems.

.6 Smoke control.

.7 Fire safety.

.8 Stair pressurization system.

.9 Temporary upset of system operation.

.10 Partial occupancy conditions.

.11 Special cycles.

2.2 TAB VERIFICATION

.1 TAB Subcontractor to coordinate with CxA; TAB Subcontractor to copy CxA with required reports, sample forms, checklists, and certificates.

.2 HVAC Subcontractor, and CxA to witness TAB Work.

.3 TAB Preparation:

.1 TAB Subcontractor to provide CxA with data required for Pre-Site TAB Engineering Reports.

.2 CxA to use this data to certify that pre-start and start-up activities have been completed for systems, subsystems, and equipment installation.

.4 Ductwork Air Leakage Testing:

.1 Consultant will identify for HVAC Subcontractor and CxA, portions of duct systems to have ductwork air leakage testing.

.2 Ductwork air leakage testing performed and witnessed by CxA.

.3 CxA to coordinate verification testing of ductwork air leakage testing on approval of preliminary ductwork air leakage testing report.

.4 Verification testing to include random retests of portions of duct section tests, reported in preliminary ductwork air leakage testing report.

.5 HVAC Subcontractor to perform tests using same instrumentation (by model and serial number) as for original testing; CxA to witness verification testing.

.5 Verification of Final TAB Report:

.1 CxA to select, at random, 10% of report for site verification.

.2 CxA to notify TAB Subcontractor ten (10) days in advance of date of site verification; however, notice to not include data points will be verified.

.3 TAB Subcontractor to use same instruments (by model and serial number) that were used when original data were collected.

.4 Failure of an item is defined as follows:

.1 Readings other than sound: A deviation of more than 10%.

.2 Sound pressure readings: A deviation of 3 dB, coordinate measurement with variations in background and ambient noise levels.

.5 Failure of more than 10% of selected items result in rejection of final TAB report.

.6 CxA to notify HVAC Subcontractor and Consultant where deficiencies are identified during verification testing and take action to remedy deficiency.

.7 Consultant will review final tabulated checklists and data sheets to determine if verification is complete and that system is operating in accordance with Contract Documents.

.8 CxA to certify that TAB Work has been successfully completed.

2.3 TESTING

.1 Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

.2 Perform tests using design conditions whenever possible:

.1 Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA.

.2 Calibrate testing instruments before simulating conditions.

.3 Set and document simulated conditions and methods of simulation.

.4 Return settings to normal operating conditions after tests.

.5 Alter set points when simulating conditions is not practical and when written approval is received from CxA.

.6 Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical.

.7 Do not use sensor to act as signal generator to simulate conditions or override values.

.3 Scope of HVAC Subcontractor Testing:

.1 Testing scope to include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space; and include measuring capacities and effectiveness of operational and control functions.

.2 Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

.4 Detailed Testing Procedures: CxA, with HVAC Subcontractor, TAB Subcontractor, and HVAC Instrumentation and Control Subcontractor to prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.

.5 HVAC Instrumentation and Control System Testing:

.1 Site testing plans and testing requirements are specified in Section 23 09 13 and Section 23 09 93.

.2 CxA, HVAC Subcontractor, and HVAC Instrumentation and Control Subcontractor to collaborate to prepare testing plans.

.3 CxA to convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.

.6 Pipe cleaning, flushing, hydrostatic tests for HVAC piping requirements:

.1 Mechanical Subcontractor to prepare pipe system cleaning, flushing, and hydrostatic testing.

.2 CxA will review and comment on plan and final reports.

.3 CxA will certify that pipe cleaning, flushing, hydrostatic tests, and chemical treatment have been completed.

.4 Plan includes the following:

.1 Sequence of testing and testing procedures for each section of pipe tested, identified by pipe zone or sector identification marker, and as follows:

.1 Markers are keyed to Drawings for each pipe sector showing physical location of each designated pipe test section.

.2 Drawings keyed to pipe zones or sectors formatted to allow each section of piping to physically locate and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.

.2 Description of equipment for flushing operations.

.3 Minimum flushing water velocity.

.4 Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

.7 Energy Supply System Testing:

.1 Mechanical Subcontractor to prepare a testing plan to verify performance of hot-water and solar systems and equipment.

.2 Plan includes the following:

.1 Sequence of testing and testing procedures for each equipment item and pipe section tested, identified by pipe zone or sector identification marker, and as follows:

.1 Markers are keyed to Drawings for each pipe sector showing physical location of each designated pipe test section.

.2 Drawings keyed to pipe zones or sectors formatted to allow each section of piping to physically locate and identified when referred to in system testing plan.

.2 Tracking checklist for managing and ensuring that all pipe sections have been tested.

.8 Heat-Generation System Testing:

.1 Mechanical Subcontractor to prepare a testing plan to verify performance of boilers, feed water equipment, furnaces, and auxiliary equipment.

.2 Plan includes the following:

.1 Sequence of testing and testing procedures for each item of equipment and section of pipe tested, identified by identification marker, and as follows:

.1 Markers are keyed to Drawings for each pipe sector showing physical location of each item of equipment and pipe test section.

.2 Drawings formatted to allow each item of equipment and section of piping to physically locate and identified when referred to in system testing plan.

.2 Tracking checklist for managing and ensuring that all pipe sections have been tested.

.9 Refrigeration System Testing:

.1 Mechanical Subcontractor to prepare a testing plan to verify performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems.

.2 Plan includes the following:

.1 Sequence of testing and testing procedures for each item of equipment and section of pipe tested, identified by identification marker, and as follows:

.1 Markers are keyed to Drawings showing physical location of each item of equipment and pipe test section.

.2 Drawings formatted to allow each item of equipment and section of piping to physically locate and identified when referred to in system testing plan.

.2 Tracking checklist for managing and ensuring that all pipe sections have been tested.

.10 HVAC Distribution System Testing:

.1 Mechanical Subcontractor to prepare a testing plan to verify performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems.

.2 Include HVAC terminal equipment and unitary equipment.

.3 Plan to include following:

.1 Sequence of testing and testing procedures for each item of equipment and section of pipe tested, identified by identification marker, and as follows:

.1 Markers are keyed to Drawings showing physical location of each item of equipment and pipe test section.

.2 Drawings formatted to allow each item of equipment and section of piping to physically locate and identified when referred to in system testing plan.

.2 Tracking checklist for managing and ensuring that all pipe sections have been tested.

.11 Vibration and Sound Tests:

.1 HVAC Subcontractor to prepare testing plans to verify performance of vibration isolation and seismic controls.

.2 CxA to witness and certify tests and inspections.

.12 Deferred Testing:

.1 Document and report deficiency to Owner where tests cannot be completed because of a deficiency outside scope of HVAC system.

.2 Deficiencies resolved and corrected by appropriate parties and test rescheduled.

.3 Complete and document appropriate initial performance test where testing plan indicates specific seasonal testing and any additional tests scheduled.

.13 Testing Reports:

.1 Reports include measured data, data sheets, and a comprehensive summary describing operation of systems at time of testing.

.2 Include data sheets for each controller to verify proper operation of control system, system it serves, service it provides, and its location.

.3 Provide space for recording it readout for each controller, reading at controller's sensor(s), plus comments.

.4 Provide space for testing personnel to sign off on each data sheet.

.5 Prepare a preliminary test report.

.6 Deficiencies will be evaluated by Consultant to determine corrective action.

.7 Deficiencies corrected and test repeated.

.8 Owner will decide whether modifications required to bring performance of system to OPR and BoD documents implemented or where tests will be accepted as submitted where it is determined that system is constructed in accordance with Contract Documents.

.9 Owner will decide if tests will be repeated and a revised report submitted where corrective Work is performed.

END OF SECTION

SECTION 23 09 93

SEQUENCE OF OPERATIONS

Part 1 General

1.1 SUMMARY

.1 The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden.

.2 Consult with the Consultant during the shop drawing stage to finalize the control sequences for each system.

1.2 RELATED REQUIREMENTS

.1 Section 25 09 00 – Instrumentation and Control Devices for Mechanical Systems

.2 Section 25 50 00 – Integrated Automation Facility Controls

.3 Section 25 06 00 – Schedules for Integrated Automation

Part 2 Products

2.1 NOT USED

Part 3 Execution

.1 Provide data BMS for all hardware points listed for system operation to meet specification operating sequences.

3.2 HEATING SYSTEM

.1 Building Heating Loop

.1 The building heating loop consists of pumps of 50% capacity each piped in a primary-secondary configuration to the boiler loop. Both pumps are [complete with variable frequency drive(s), and are] normally activated via the BMS.

.2 Loop temperature control is achieved by modulating a 3-way control valve. Supply temperature to building heating loop is reset as follows:

O/A Temp.	HWS
-20°C	93°C
20°C	65°C

.3 The pump variable frequency drives are modulated to maintain a constant differential pressure as measured across the heating loop by a pressure transmitter.

.4 The BMS shall provide lead/lag pump control and ramp pumps as required to maintain static pressure. The lead pump shall be normally activated when the outdoor air temperature drops below 15°C (adjustable). The lag pump shall be energized upon any failure of the lead pump. Program shall have a dead band to prevent excessive pump cycling.

.5 A 2-way bypass valve is modulated to maintain a constant differential pressure as measured across the heating loop by a pressure transmitter.

.6 The BMS shall provide lead/lag pump control. The lead pump shall be normally activated when the outdoor air temperature drops below 15°C (adjustable). The lag pump shall be energized upon any failure of a lead pump or when outdoor air temperature drops below 0°C (adjustable). Program shall have 5°C dead band to prevent excessive pump cycling.

.2 Domestic Hot Water.

.1 The domestic hot water system consists of 2 domestic hot water storage tanks, complete with insertion heat exchangers, and a domestic hot water circulation pump.

.2 Each domestic hot water storage tank's temperature is to be maintained by the BMS system to a 60°C set point (adjustable), by modulating the heat exchanger 3-way heating control valve on the primary hot water loop. Provide alarm points for low or high water temperature condition.

.3 Domestic hot water circulation pump is to operate continually and pump status is monitored by the BMS.

3.3 AIR SYSTEM AIR HANDLING UNIT (AHU)

.1 Air system is a single duct, variable volume, air system serving. The system consists of a return fan (VFD), an outside air intake, mixing section, summer pre-filter section, supply fan (VFD), winter pre-filter, final filter and a grid dehumidifier.

.2 System Start/Stop.

.1 The air system will normally be energized via the BMS.

.2 DDC control sequences shall interlock the starting and stopping of exhaust fans with the air system.

.3 Minimum Outdoor Damper Position

.1 The minimum outdoor damper position will be set by using calculation method to ensure minimum outdoor air is brought in. Outdoor air quantity will be computed by using the return air temperature, outdoor air temperature and mix air temperature. Computations will be carried out at the same sampling interval as the mix and return air temperature sampling interval. Outdoor air damper position will be reset to ensure minimum outdoor air is brought in.

.4 Temperature Control

.1 The mixed air dampers, preheat coil valve and cooling coil valve shall be modulated in sequence to maintain a supply air temperature setpoint. A preheat air temperature low limit setpoint will be used to prevent the air system from tripping on freeze.

.2 The heating coil circulation pump shall be started when the Outdoor air temperature is less than 4°C or when the return fan is on and the preheat coil valve is modulating. The program shall have minimum ON and OFF times to prevent excessive pump cycling.

.3 On air system startup, if the OAT is below 4°C the heating coil valve will be opened fully and then throttled to maintain setpoint so as to prevent the unit from tripping on freeze.

.5 Humidity Control

.1 Humidification is provided by a steam grid humidifier located in the air system.

.2 The Humidifier valves are only allowed to open when the supply fan is operating.

.3 The humidifier control valve is modulated to control the return air humidity as sensed by duct humidity sensors in the return air ductwork.

.4 A humidity transmitter located in the AHU discharge duct limits the discharge humidity to 75%.

.5 Humidity set point is reset in accordance with an outdoor temperature schedule.

O/A Temp	% R.H
-30°C	25
10°C	40

.6 Air Flow Control

.1 The supply and return fans are complete with variable speed drives. Air flow measurement is taken at the inlet of the supply fan and return fan.

.2 The supply fan speed shall be modulated to maintain a constant end of line static duct pressure. The supply fan discharge pressure shall not be permitted to exceed a pre-set value.

.3 The return fan VFD is modulated to maintain a constant flow volume differential between the supply fan and the sum of the air system associated exhaust fans and return fan, so as to maintain a positive zone pressure.

.4 The air flow stations send total pressure and static pressure signals to the pressure transmitters. The differential pressure transmitter's signals through the SCU are processed and made linear to air velocity and volume and scaled to litres per second.

.5 Static pressure sensors located in ducts send static pressure signals to a static pressure transmitter. This signal is processed at the SCU and is scaled in Pascal.

.7 Purge Mode

.1 All air handling units will be placed on a building purge mode for 30 to 60 minutes at a preselected time before building occupancy.

.8 During purge mode:

.1 Set mix air set point at 5°C

.2 Set supply air temperature setpoint at 18°C

.3 De-energize cooling coil

.4 Allow all variable air volume boxes to full open position

.5 Energize all washroom and general exhaust fans.

.9 Morning Warm-Up Mode

.1 The air handling units will be placed on a morning warm-up mode for a pre-selected time period.

.2 In this mode, system will operate at 100% recirculation, heating coil valves will modulate to maintain a higher supply temperature. All variable air volume boxes will be allowed to open fully. Radiation valves will modulate open to maintain space temperature set point.

.10 Smoke Exhaust Mode

.1 Each AHU system is designed to exhaust smoke from the area served.

.2 The smoke exhaust mode is activated by the fire department via switches located near the main fire alarm annunciator panel.

.3 In the smoke exhaust mode, supply fan is shut down, outdoor dampers closed, return dampers closed, exhaust dampers wide open, and return fan started at full speed.

.4 The smoke exhaust mode is manually turned off by the fire department.

.5 The system is brought to normal operation through the BMS.

3.4 AIR SYSTEM (COMMON CONTROLS)

.1 System Start/Stop

.1 The air handling units will normally be energized via the BMS.

.2 On units with return fans, the return fan shall be energized first. After a 30 second time delay, the mix air dampers shall be energized and opened to their minimum position. This will be followed by supply fan energization.

.3 On 100% outdoor air units, upon system energization, the outdoor air dampers will be energized open. A damper end-switch upon sensing damper full open position will permit the supply fan energization.

.4 For systems with interlocked exhaust fans, the exhaust fan shall start with supply fan.

.5 On fans with two speed motors, provide time delay between high and low starts.

.2 Minimum Outdoor Damper Position

.1 The minimum outdoor damper position will be set by using calculation method to ensure minimum outdoor air is brought in. Outdoor air quantity will be computed by using the return air temperature, outdoor air temperature and mix air temperature. Computations will be carried out at the same sampling interval as the mix and return air temperature sampling interval. Outdoor air damper position will be reset to ensure minimum outdoor air is brought in.

.3 Freeze Stats

.1 Provide averaging type freeze stat in each air processing unit at location indicated. Upon sensing a low temperature, the supply fan shall stop, and all outdoor and exhaust air dampers shall close. On units with return fans, the return fan shall remain energized. The freeze stat must be reset manually.

.4 Mix Air Control

.1 Mix air dampers position shall be modulated to maintain mix air temperature set point.

.5 Space Humidity Control

.1 Humidification is provided by steam grid humidifiers located in the AHU's.

.2 Humidifier is allowed to energize only when the supply fan is operating.

.3 A space humidistat controls the steam grid humidifier valve.

.4 A high limit humidistat located in the AHU discharge duct limits the humidity to 75%.

.5 Humidity set point is reset in accordance with an outdoor temperature schedule.

O/A Temp	% R.H.	O/A Temp	% R.H.
-30 °C	25	10 °C	40

.6 Purge Mode

.1 All air handling units will be placed on a building purge mode for 30 to 60 minutes at a preselected time before building occupancy.

.1 During purge mode:

.1 Set mix air set point at 5°C

.2 Set supply air temperature setpoint at 18°C

.3 De-energize cooling coil

.4 Run two-speed fans at high speed

.5 Allow all variable air volume boxes to full open position

.6 Energize all washroom and general exhaust fans.

.7 Morning Warm-Up Mode

.1 The air handling units will be placed on a morning warm-up mode for a pre-selected time period.

.2 In this mode, system will operate at 100% recirculation, heating coil valves will modulate to maintain a higher supply temperature. All variable air volume boxes will be allowed to open fully. Radiation valves will modulate open to maintain space temperature set point.

3.5 FIRE ALARM

.1 The supply fan is stopped, the inlet damper closed and the smoke exhaust damper is opened when a fire alarm is initiated from the floor served.

Fire fighters can then exhaust smoke from the floor through the open smoke exhaust damper by starting smoke exhaust fan F-41 via a key switch.

3.6 MECHANICAL ROOM VENTILATION UNIT

.1 Supply fan operates continuously and is normally activated through the BMS.

3.7 FAN COIL UNITS

.1 Supply fan operates continuously, and is normally activated through the BMS.

.2 The mixed air temperature shall be maintained above 10°C.

3.8 DAY/NIGHT THERMOSTATS

.1 The day-night thermostats shall be zoned on a per air processing unit BMS is. The thermostats in the area serviced by the AHU shall be placed in night mode when that particular AHU is turn off. Other thermostats will remain in day mode as long as the respective AHU's are operating.

3.9 TERMINAL HIGH VELOCITY UNITS

.1 An electronic sensor via the BMS shall modulate the variable volume damper operator. Where reheat or radiant panel is also provided, sequence the box volume, reheat coil and radiant panel in sequence, through separate outputs from the BMS.

3.10 REHEAT COIL

.1 Room sensor via the BMS shall modulate a floating 2-way non-spring return heating control valve. Sequencing to be done by separate output from BMS.

3.11 DOMESTIC BOOSTER PUMPS

.1 The domestic booster pumps are a supplied packaged equipment including all control components. Pump failure alarm to be tie to the BMS.

3.12 OUTSIDE AIR TEMPERATURE

.1 A OAT calculated value will be used for all control references. This calculated value will be determined from the four outdoor air temperature sensors. Any individual OAT sensor that is determined to be in error will not be used in determination of the calculated value.

END OF SECTION

SECTION 23 31 00

DUCTWORK

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of the following:

- .1 Supply, return and exhaust ductwork
- .2 Fasteners
- .3 Sealants
- .4 Duct cleanliness
- .5 Built-up plenum
- .6 Flexible ductwork

1.2 RELATED REQUIREMENTS

.1 Section 07 84 00 – Firestopping: Firestop and smokeseal design requirements and materials.

.2 Section 23 07 13 – Duct Insulation

.3 Section 23 01 30.51 – HVAC Duct Cleaning – General

.4 Section 23 01 30.52 – HVAC Duct Cleaning – Detailed

.5 Section 23 05 29 – Hangers and Supports for HVAC Ducting and Equipment

.6 Section 20 05 93.16- Balancing of Mechanical Systems

.7 Section 23 33 00 – Duct Accessories

.8 Section 23 33 19 – Duct Silencers

.9 Section 23 37 13 – Diffusers, Registers and Grilles

.10 Section 23 40 00 – HVAC Air Cleaning Devices

1.3 REFERENCE STANDARDS

.1 Air Diffusion Council (ADC):

- .1 Flexible Duct Performance and Installation Standards.

.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):

- .1 Duct Fitting Database, 2002.
- .2 2003 ASHRAE Handbook – HVAC Applications.

.3 American Society for Testing and Materials (ASTM):

.1 ASTM A36/A36M-05, Standard Specification for Carbon Structural Steel.

.2 ASTM A167-99 (2004), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.3 ASTM A635/A635M-05, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements.

.4 ASTM A653/A653M-05, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.5 ASTM B209/B209M-04, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.6 ASTM B221/B221M-05, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

.7 ASTM E488-96 (2003), Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.

.4 Canadian General Standards Board (CGSB):

.1 CGSB 37-GP-9-MA83, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.

.2 CAN/CGSB 37.50-M89, Hot Applied, Rubberized Asphalt for Roofing and Waterproofing.

.5 National Fire Protection Association (NFPA):

.1 NFPA 90A-2002, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-2005, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

.3 NFPA 96-2004, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.6 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 1995, 2nd Edition and Addendum No. 1, 1997.

.2 SMACNA HVAC Air Duct Leakage Test Manual, 1985, 1st Edition.

.3 IAQ Guideline for Occupied Buildings Under Construction, 1995, 1st Edition.

.7 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S110-M86, Standard Methods of Test for Air Ducts.

.8 Underwriters Laboratories Inc. (UL):

.1 UL 181-2005, Standard for Factory-Made Air Ducts and Air Connectors.

1.4 DEFINITIONS

.1 Low Pressure: Static pressure in duct less than 500 Pa and velocities less than 10 m/s.

.2 Medium Pressure: Static pressure in duct less than 1500 Pa and velocities greater than 10 m/s.

.3 High Pressure: Static pressure over 1500 Pa and less than 2500 Pa and velocities greater than 10 m/s.

.4 Inside Clear Dimensions: Duct sizes shown on Drawings are inside clear dimensions; maintain inside duct sizes for acoustically lined or internally insulated ducts.

1.5 SUBSTITUTIONS

.1 Materials other than the named products for the Project may be acceptable to the Consultant. Submit information in accordance with Section 01 62 00 – Product Options.

.2 Obtain written acceptance from Consultant prior to making variations in duct configuration or sizes. Size alternatives using ASHRAE table for circular equivalents of rectangular ducts

1.6 QUALITY ASSURANCE

.1 Supply and install ductwork meeting the requirements of NFPA 90A.

.2 Fabricate ductwork in accordance with SMACNA duct manuals and ASHRAE handbooks as a minimum where more stringent requirements are not identified in the contract documents.

.3 Construct ductwork to meet duct leakage testing requirements specified in Section 20 05 93.16

.4 Construct flexible air ducts to meet the requirements of NFPA 90A and UL 181 standard for factory made air duct materials and air duct connectors[; flexible ducts are required to have a minimum fire rating of 30 minutes in accordance with UL 181].

.5 Alternatives to Indicated Duct Configurations and Sizes: Obtain written permission from Consultant prior to making and changes or variations in duct configuration or sizes; size alternatives using ASHRAE table for circular equivalents of rectangular ducts.

1.7 SUBMITTALS

.1 Provide required information in accordance with 01 00 06 – General Requirements: Submittals.

.2 Submit shop drawings and samples of duct fittings for approval, including material thickness, welds and configurations prior to start of work of this Section.

1.8 PROJECT CONDITIONS

.1 Site Measurements: Verify dimensions by site measurements before fabrication and indicate measurements on Shop Drawings; coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.9 PRE-CONSTRUCTION MEETING

.1 Arrange a pre-construction meeting in accordance with Section 01 00 06 – General Requirements: Project Meetings; arrange to have Consultant, Constructor and affected Subcontractor’s on site

.2 Coordinate requirements for firestopping around ductwork on both sides of fire separations with Section 07 84 00; installed firestopping material must not distort duct; provide number of ductwork transits through fire rated construction and notify Section 07 84 00 when ductwork is ready for firestopping work.

Part 2 Products

2.1 MATERIALS

.1 Waterproof Duct Coating:

.1 Primer: Primer meeting manufacturers requirements for substrates and in accordance with CGSB 37-GP-9M and as follows:

.1 Basis of Design Material: Bakor 910-01.

.2 Primary Membrane: Hot applied rubberized asphalt membrane meeting the requirements of CGSB 37.50 and as follows:

.1 Basis of Design Material: Bakor 790-11.

.3 Fabric Reinforcement: Polyester fabric reinforcement for duct joints as recommended by manufacturer.

2.2 PREMANUFACTURED FLEXIBLE DUCTS:

.1 Low Pressure:

.1 Location: Use flexible air duct where shown on Drawings.

.2 Length: Not greater than 600 mm.

.3 Composition: CPE liner banded to steel wire helix, wrapped with fibreglass insulation and outer fibreglass reinforced metalized vapour barrier jacket.

.4 Velocity Rating: Flexible duct rated for 12 m/s velocity and pressure rated for 500 Pa positive and 500 Pa negative.

.5 Basis of Design Material: Thermaflex M-KE.

.2 Medium and High Pressure:

.1 Location: Use flexible air duct to connect terminal units to metal ductwork.

.2 Length: Not greater than 300 mm.

.3 Composition: Woven and vinyl coated fibreglass liner bonded to a steel wire helix; furnish flexible air duct with fibreglass insulation and outer fibreglass reinforced metalized vapour barrier jacket where flexible air duct is attached to metal insulated duct.

.4 Velocity Rating: Flexible duct rated for 30 m/s velocity and pressure rated for 4.0 kPa positive and 500 Pa negative.

.5 Basis of Design Material:

.1 Un-insulated: Thermaflex S-TL.

.2 Insulated: Un-insulated: Thermaflex M-KC.

2.3 FASTENERS

.1 Use rivets and bolts throughout; sheet metal screws accepted on low pressure ducts.

2.4 KITCHEN HOOD AND DISHWASHER EXHAUST DUCTS

.1 Ducts: Minimum 1.214 mm carbon steel or 0.912 mm Type 304 stainless steel with welded seams and joints fabricated in accordance with Construct in accordance with NFPA 96.

.2 Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer

.1 Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger.

.2 Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond. compatible with mating materials.

2.5 FABRICATION

.1 Round Ducts:

.1 Factory fabricated, spiral wound, with matching fittings and specialties meeting SMACNA requirements.

.2 Transverse Joints up to [900 mm]: Slip type with tape and sealants.

.3 Transverse Joints over [900 mm]: Vanstone type.

.4 Fittings:

.1 Elbows: Smooth radius Five (5) piece (for 90° turns)
Three (3) piece (for 45° turns), having minimum centreline radius of 1.5 times the diameter.

.2 Branches: Conical transition with conical branch at 45° and 45° elbow.

.2 Rectangular Ducts:

.1 Fabricated ducts, fittings and specialties meeting SMACNA requirements.

.2 Transverse Joints: Welded.

.3 Fittings:

.1 Elbows: Smooth radius; minimum centreline radius [1.5 times the width of duct].

.2 Branches: Conical branch at 45° and 45° elbow.

.3 Provide 75 mm reinforced concrete curb for plenum walls and floor mounted casings; rivet panels on 200 mm centres to angles at floor [; provide 1.214 mm core metal thickness expanded metal mesh liner, turned up 300 mm at sides with sheet metal shields where floors are acoustically insulated].

.4 Reinforce door frames with steel angle tied to horizontal and vertical plenum supporting angles; install hinged access doors where shown, specified or where required for access to equipment for cleaning and inspection.

.5 Fabricated acoustic plenums of galvanized steel from 1.519 mm back facing and 0.759 mm perforated front facing with 2.5 mm diameter holes on 5 mm centres; construct panels 75 mm thick packed with nominal 72 kg/m^3 glass fibre acoustical insulation, on reinforced concrete curb.

.6 Provide necessary baffling in mixed air plenums to ensure good mixed air temperature with variations of not more than ±3°C under all operating conditions.

.7 Fabricate fan plenums and plenums downstream of fan to match thickness of ducts.

.8 Fabricate plenums between fan and upstream apparatus using 1.519 mm material.

.9 Fabricate plenums between filters and upstream apparatus using 1.214 mm thick

2.6 OPERATING ROOM SUPPLY DUCTS

.1 Fabricate ductwork downstream of HEPA filters using 1.214 mm thick Type 304 stainless steel.

Part 3 Execution

3.1 CONSTRUCTION

.1 Construct ductwork from site measurements and not from plans and shop drawings exclusively; failure to do so will not constitute an extra to the Contract.

.2 Complete metal ducts within themselves with no single partition between ducts; cross brace ducts for rigidity where width of duct exceeds 450 mm; open corners are not acceptable.

.3 Lap metal ducts in direction of air flow; hammer down edges and slips to leave interior of duct smooth.

.4 Construct ductwork using materials in thicknesses indicated; reinforced and sealed for pressure class indicated, and as follows:

.1 Increase duct size gradually, not exceeding 15° divergence wherever possible; do not exceed 30° divergence upstream of equipment; do not exceed 45° convergence downstream of equipment.

.2 Construct tees, bends and elbows with radius of not less than 1.5 times the width of duct on centreline; provide double wall air foil type turning vanes where turning radius is not possible and where rectangular elbows are specified; provide turning vanes of perforated metal type with fibreglass inside, where acoustical lining is provided.

.5 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag; caulk duct joints and connections using sealant as ducts are being assembled; seal seams on fresh air and exhaust ducts watertight with mastic or high velocity duct sealant.

.6 Weld stainless steel ductwork and ensure a smooth finish on all interiors.

.7 Fabricate continuously welded round and oval duct fittings two gauge thicknesses heavier than duct gauges indicated in SMACNA Standard.

.8 Provide floor drains in fresh air and humidifier sections with deep seal traps.

.9 Provide residue traps at base of vertical risers with provisions for cleanout for kitchen exhaust ducts.

.10 Set plenum doors 150 mm above floor; arrange door swings so that fan static holds door in closed position.

3.2 DUCT SEALING

.1 Seal all supply, return and exhaust duct joints, longitudinal as well as transverse, using the following:

.1 Low Pressure Ductwork:

.1 Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.519 mm use heavy mastic type sealant.

.2 Flanged Joints: Soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.

.3 Other Joints: Heavy mastic type sealant.

.2 Medium and High Pressure Ductwork: Combination of woven fabrics and sealing compound followed by an application of high pressure duct sealant.

.2 Duct tapes as sealing method are not permitted.

.3 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.

.4 Prior to sealing all ductwork, demonstrate sealing of a section of each type of duct and obtain approval from the Consultant.

.5 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application.

3.3 INSTALLATION

.1 Locate ducts with sufficient space around equipment to allow normal operation and maintenance activities.

.2 Coordinate the location of duct access doors as specified in Section 23 33 00.

.3 Provide openings in ductwork where required to accommodate thermometers and controllers.

.4 Provide pitot tube openings where required for testing of systems, including metal cap with spring device or screw to prevent air leakage; install insulation material inside a metal ring where openings are provided in insulated ductwork.

.5 Interrupt duct linings at fire, balancing, backdraft and smoke dampers so as not to interfere with operation of devices; provide sheet metal edge protection over linings on both side of damper device.

.6 Shield ductwork from dust and construction material during construction; clean any ductwork found to be dirty at no extra cost to the Contract.

.7 [Protect carbon steel ductwork exposed to weather by painting or coating with suitable weather resistant material.]

.8 Install ducts associated with fans subject to forced vibration with flexible connections immediately adjacent to equipment, refer to Section 23 33 00.

.9 Do not use flexible duct to change direction.

.10 Provide a minimum of three (3) duct diameters of straight metal duct between box inlet and flexible connector.

.11 Connect diffusers or troffer boots to low pressure ducts with 300 mm maximum stretched length of flexible duct; hold in place with sealant, and strap or clamp.

.12 Prove that ductwork is substantially air tight before covering or concealing.

.13 Slope underground ducts to plenums or low pump out points at 2.0%; provide access doors for inspection; encase ducts in 75 mm minimum of concrete; provide adequate tie-down points to prevent ducts from floating during concrete pour. Introduce no heat into ducts until 20 days after pouring of concrete.

.14 Coat underground ducts with one coat [and seams and joints with additional coat of asphalt solvent base waterproof coating]. [Insulate supply duct runs over 21 metres long with 25 mm thick insulation covered with plastic vapour barrier].

.15 Clean duct systems and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning.

.16 Clean systems with power vacuum machines in accordance with Section 23 01 30.51.

.17 Clean and disinfect systems in accordance with Section 23 01 30.52.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACESSORIES

Part 1 General

1.1 SUMMARY

.1 Work in this section includes requirements for supply and installation of the following:

- .1 Duct Access doors
- .2 Fire dampers
- .3 Combination fire and smoke dampers
- .4 Fire stop flaps
- .5 Balancing dampers
- .6 Flexible connections
- .7 Backdraft dampers
- .8 Industrial ventilation hoods
- .9 Test holes

1.2 RELATED REQUIREMENTS

.1 Section 07 84 00 – Firestopping: Firestop and smokeseal design requirements and materials.

.2 Section 23 01 30.51 – HVAC Duct Cleaning – General

.3 Section 23 01 30.52 – HVAC Duct Cleaning – Detailed

.4 Section 23 31 00 – Ductwork

.5 Section 23 05 29 – Hangers and Supports, Sleeves and Flashings for HVAC Piping and Equipment

1.3 REFERENCE STANDARDS

.1 National Fire Protection Association (NFPA):

- .1 NFPA 90A-2012, Installation of Air Conditioning and Ventilating Systems

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

- .1 ANSI/SMACNA 1966-006-2006, HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition

.3 Underwriters Laboratories Canada (ULC):

- .1 CAN/ULC S112-10, Standard Methods of Fire Test of Fire-Damper Assemblies
- .2 CAN/ULC S112.1-10, Standard for Leakage Rated Dampers for Use in Smoke Control Systems
- .3 CAN/ULC S112.2-07, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies

.4 ULC S505-1974, Fusible Links for Fire Protection Services

1.4 SUBMITTALS

.1 Provide required information in accordance with 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit product data for standard components including, but not limited to manufacturer's printed product literature, specifications and data sheet for the following items:

.1 Flexible connections

.2 Dampers

.3 Duct access doors

.4 Turning vanes

.5 Instrument test ports

.2 Shop Drawings: Submit shop drawings of factory fabricated assemblies.

.3 Samples: Submit samples of shop fabricated assemblies as requested by the Consultant.

1.5 PROJECT CLOSEOUT SUBMISSIONS

.1 Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Operations and Maintenance Data.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: Construct fire dampers and fusible links on fire dampers in accordance with referenced ULC standards; attach required labels indicating ULC listing numbers, and as follows:

.1 Demonstrate resetting of fire dampers to Authorities Having Jurisdiction and Owner's representative.

.2 Label fire rated access doors in accordance with ULC requirements.

.3 Construct accessories to meet the requirements of NFPA 90A and fabricate in accordance with ASHRAE Handbooks and SMACNA Duct Manuals.

.4 Prove all dampers to inspector at job completion.

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section; where multiple listings of manufacturers occur, use any of the following listed manufacturers' products in accordance with Section 01 62 00 – Product Options and as follows:

.1 Access Doors:

.1 Ductmate Industries Inc.

.2 Kees Incorporated

.3 Nailor Industries Inc.

.2 Fire and Control Dampers:

.1 Aire Technologies Inc.

.2 Nailor Industries Inc.

.3 E.H. Price

.4 Ruskin Company

.2 Substitutions: Consultant will accept additional manufacturers having similar products to Acceptable Materials listed in this Section provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 25 00 – Substitution Procedures a minimum of [ten (10) days] in advance of Bid Closing.

.3 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 25 00 – Substitution Procedures.

2.2 MATERIALS AND FABRICATION

.1 Duct Access Doors: Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and suitable quick fastening locking devices:

.1 Duct access panels with screws are not acceptable.

.2 Install minimum 25 mm thick insulation with suitable sheet metal cover frame for insulated ductwork.

.3 Fabricate with two butt hinges and two sash locks for sizes up to 450 mm; two hinges and two compression latches with outside and inside handles for sizes up to 610 mm x 1220 mm and an additional hinge for larger sizes.

.2 Fire Dampers: Fabricate of galvanized steel or prime coated black steel weighted to close and lock in closed position when released by fusible link:

.1 Provide curtain type fire dampers with damper blades retained out of air stream in a recess so that free area of connecting ductwork is not reduced.

.2 Set fusible links to activate at 73.9°C (165°F).

.3 Combination Fire and Smoke Dampers: Fabricate combination fire and smoke dampers of multiple blades readily adjustable in open position, labelled for ULC rating:

.4 Fire Stop Flaps: Fabricate of heat retardant fabric in galvanized or prime coated black steel frame, spring loaded action to close and lock in closed position when released by fusible link:

.1 Blanket shall be retained in a recess so free area of connecting ductwork is not reduced.

.2 Set fusible links to activate at 160°C.

.5 Splitter Dampers: Fabricate splitter dampers of double thickness sheet metal to streamline shape, properly stiffened to avoid vibration:

.1 Fabricate galvanized steel, minimum nominal 1.5 mm core metal thickness, and provide with adjustable rod and locking screw.

.2 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism.

.6 Balancing Dampers: Fabricate of galvanized steel, minimum nominal 1.5 mm core metal thickness; full blade length shafts of hollow square construction with blades rigidly fastened along entire blade length and as follows:

.1 Lockable quadrant type operating mechanism with end bearings on accessible rectangular ducts up to 400 mm deep and on accessible round ducts.

.2 Wide pitch screw operating mechanism with crank operator and end bearings on accessible rectangular ducts 425 mm and over in depth and on all inaccessible rectangular and round ducts.

.3 On rectangular ducts up to 275 mm deep construct of single blade (butterfly) type.

.4 On rectangular ducts 300 mm to 400 mm deep construct of two opposed blades mechanically interlocked with pivots at quarter points.

.5 On rectangular ducts over 425 mm deep construct of multiple opposed blades, mechanically interlocked with blades no greater than 200 mm deep and pivots equally spaced.

.6 On round ducts construct of single blade (butterfly) type. On 500 Pa Class and on all dampers over 300 mm diameter fabricate with full blade-length shaft.

.7 Construct damper blades for medium and high pressure systems to block air passage 70% maximum. Provide complete with locking type handles.

.8 Provide override limiting stops on all operating mechanisms.

.9 Identify the air flow direction and blade rotation and open and close positions on operating mechanism.

.10 On round ductwork, install operating mechanism on a steel mounted base firmly secured to the ductwork.

.11 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism.

.7 Flexible Connections: Fabricate of ULC approved neoprene coated flameproof glass fabric approximately 150 mm wide tightly crimped into metal edging strip and attached to ducting and equipment by screws or bolts at 150 mm intervals; flexible connection airtight at 500 Pa.

.8 Backdraft Dampers: Construct of minimum 1.214 mm core metal thickness galvanized steel channel frame and as follows:

.1 Construct of minimum 0.635 mm aluminum blades, having stiffeners along trailing edge; fabricate single blade dampers for duct sizes less than or equal to 240 mm, multi-blade dampers for ducts greater than 240 mm.

.2 Provide full blade-length shafts complete with brass or nylon bearings.

.3 Provide neoprene anti-clatter blade strips on pivot side of blades.

.4 Construct blade connecting linkage of minimum 2.00 mm aluminum rod with eyelet, pin bearings, and adjustable counter weight to assist blade opening action.

.5 Maximum blade length of 750 mm.

.6 Backdraft damper suitable for 10 m/s face velocity.

.9 Industrial Ventilation Hoods: Fabricate hoods of galvanized sheet steel in accordance with SMACNA Duct Manuals, Industrial Ventilation Guidelines and ASHRAE Handbooks as a minimum where not specifically identified by more stringent requirements in the documents:

.1 Refer to mechanical sketches for hood details and exhaust duct connections to equipment and hoods.

.10 Test Holes: Flat gaskets for rectangular ductwork and moulded rubber gaskets for round ductwork, having extenders for insulation thickness; cut holes with hole saw and de-burr edges; install test holes with rivets or bolts with head on the interior of the ductwork:

.1 Basis-of-Design Materials: Duro Dyne IP Series.

Part 3 Execution

3.1 INSTALLATION

.1 Provide access door minimum 450 mm x 350 mm or 50 mm smaller than duct dimension for cleaning and inspection at positions indicated by drawings and as follows:

.1 At 6.0 m intervals on all horizontal ducts
.2 At 12.0 m intervals in all vertical duct systems
.3 At the base of all duct risers
.4 Both sides of turning vanes in all ducts
.5 At each fire damper location
.6 At each side of all heating or cooling coils
.7 At all locations of internally duct mounted devices including automatic dampers, damper motors, duct mounted smoke detectors and heat detectors, and control sensors and devices

.2 Provide 100 mm x 100 mm quick opening access doors within ductwork for inspection of all balancing dampers.

.3 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Fire dampers shall be complete with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

.4 Seal opening around duct at each point where ducts pass through partitions with non-combustible material with the exception of fire dampered ductwork.

.5 Provide balancing dampers at points on low pressure supply, return and exhaust systems where branches are taken from larger ducts.

.6 Provide balancing dampers on medium and high pressure systems where indicated. Splitter dampers shall not be used on medium and high pressure system.

.7 Install ducts associated with fans and equipment subject to forced vibration with flexible connections, immediately adjacent to equipment and/or where indicated on drawing.

.8 Install 15 mm thick neoprene pad over fabric and hold in place with additional metal straps for connections to medium and high pressure fans.

.9 Leave all fire dampers and fire stop flaps in the closed position for balancing contractor to fix open.

.10 Support ceiling fire stops from the structure above the fire stop and not from air outlets on associated ductwork.

END OF SECTION

SECTION 23 34 00

HVAC FANS

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of the following:

- .1 Centrifugal Fans
- .2 In-line Duct Fans
- .3 Roof Mounted Fans
- .4 Belted Vent Sets
- .5 Axial Fans
- .6 Propeller Fans
- .7 Bathroom Exhaust Fans
- .8 Kitchen Range Hoods
- .9 Fan Accessories
- .10 Roof Curbs

1.2 RELATED REQUIREMENTS

.1 Section 23 01 30.51 – HVAC Duct Cleaning – General

.2 Section 23 01 30.52 – HVAC Duct Cleaning – Detailed

.3 Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment

.4 Section 20 05 13 – Common Motor Requirements for Mechanical Equipment

.5 Section 20 05 48 – Noise and Vibration Control

.6 Section 20 05 93– Testing of Mechanical Equipment

.7 Section 23 31 00 – Ductwork

.8 Section 23 33 00 – Air Duct Accessories

1.3 REFERENCE STANDARDS

.1 Air Conditioning and Mechanical Contractors (AMCA):

- .1 AMCA Publication 99-2003, Standards Handbook.
- .2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.
- .3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).

.1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

1.4 SUBSTITUTIONS

.1 Materials other than the named products for the Project may be acceptable to the Consultant. Submit information in accordance with Section 01 00 06 – General Requirements; Product Options.

1.5 QUALITY ASSURANCE

.1 Conform to AMCA Bulletins regarding construction and testing; label fans with AMCA certified rating seal for performance and sound ratings; label fans with CSA conformance tag.

1.6 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit with shop drawings acoustical data and fan curves showing fan performance with fan and system operating point plotted on curves.

.3 Submit manufacturer's printed product literature, specifications and datasheet in indicating product characteristics, performance criteria, and limitations.

.4 Submit shop drawings signed by a professional engineer registered in the province of the Work, and product data indicating, but not limited to, the following:

.1 Fan performance curves showing point of operation, kW and efficiency.

.2 Sound rating data at point of operation.

.3 Motors, sheaves, bearings, shaft details.

.4 Minimum performance achievable with variable speed controllers

.5 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.7 PROJECT CLOSEOUT SUBMISSIONS

.1 Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Operations and Maintenance Data including a list of manufacturer's recommended spare parts and specific information with regards to bearings and belts, addresses of suppliers, and a list of specialized tools necessary for adjusting, repairing or replacing components.

1.8 JOB CONDITIONS

.1 Do not operate fans for any purpose, temporary or permanent until ductwork is clean, filters are in place, bearings are lubricated and fan has been run under close supervision of unit manufacturer.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 Centrifugal Fans:
- .1 Acme Engineering and Manufacturing Corp.
- .2 Chicago Blower Corporation
- .3 Unico System
- .4 PennBarry
- .5 Trane
- .6 Twin City Fans and Blowers

.2 Bathroom Exhaust Fans:
- .1 Acme Engineering and Manufacturing Corp.
- .2 Broan
- .3 General Electric
- .4 Greenheck Fan Corp.

.3 Kitchen Range Hoods:
- .1 Broan
- .2 General Electric
- .3 Lau Industries
- .4 Nutone

.4 Kitchen Hood Exhaust Fans:
- .1 Acme Engineering and Manufacturing Corp.
- .2 Carnes
- .3 Greenheck Fan Corp.
- .4 Loren Cook Company
- .5 JencoFan
- .6 PennBarry
- .7 Garland Canada Inc.

.5 In Line Duct Fans:
- .1 Acme Engineering and Manufacturing Corp.
- .2 Ammerman Co. Inc.
- .3 Greenheck Fan Corp.
- .4 ILG/American Coolair
- .5 Loren Cook Company

2.2 MATERIALS, GENERAL

.1 Fans:

.1 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.

.2 Provide balanced variable sheaves for motors 11.2 kW and under and fixed sheave for 15 kW and over.

.3 Provide fans capable of accommodating static pressure variations of ±10% with no objectionable operating characteristics.

.2 Motors:

.1 Size motors for parallel operating fans for non-overloading operation with only one fan operating.

.2 Provide motors for use with variable speed controllers.

.3 Sizes as specified.

.4 Two speed with two windings and speeds of approximately as indicated.

.5 Two speed with split winding, constant or variable torque.

.6 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.3 Flexible Connections: to Section 23 33 00 - Air Duct Accessories.

.4 Accessories and Hardware:

.1 External static pressure means external to the fan cabinet and all accessories such as back draft dampers, mixing boxes, filters and coils; these accessories if supplied as part of the unit are considered as internal losses for fan.

.2 Matched sets of V-belt drives, adjustable motor bases, belt guards, coupling guards fan inlet and outlet safety screens as indicated and as specified in Section 20 05 13; inlet and outlet dampers and vanes and as indicated.

.3 Supply replacement pulleys and sheaves for fans as required to properly balance the systems to design flows at actual job site static pressure conditions; obtain requirements from balancing agency, refer to Section 20 05 93.

.5 Scroll Casing Drains: as indicated.

.6 Finishes:

.1 Factory primed before assembly in colour standard to manufacturer.

2.3 ROOF MOUNTED FANS

.1 Provide direct motor driven with fan and motor mounted to main housing through neoprene anti-vibration pads.

.2 Heavy aluminum dome type housings shall be reinforced as necessary.

.3 Provide with multi-blade, rattle free, back draft damper with felt lined blade edges, bird screen, disconnect switch and pre-manufactured roof curb.

.4 Unit shall be complete with electrical disconnect switch.

.5 For fume hood exhaust and lab canopy exhaust fans, finish exterior steel fan parts with baked enamel primer and enamel final paint coat. Finish fan interior, including blades and other parts in contact with the air stream with two coats of acid resistant paint.

2.4 AXIAL FANS

.1 Provide [adjustable die cast impeller blades with motor integral part of hub design][die formed blades with belt drive and motor mounted outside air stream].

.2 The blades shall have fixed pitch.

.3 Extend lubrication fitting to outside of fan casing.

.4 Housing shall have flanges for connection of ductwork. When not connected to ducting, provide inlet cones.

.5 Provide variable inlet vanes where indicated, complete with linkage and pneumatic actuators.

.6 Fans operating at over 374 Pa shall be of vane axial design for improved operating efficiency.

2.5 PROPELLER FANS

.1 Motor shall have self-aligning ball or sleeve bearings with adequate lubricating arrangements.

.2 Mounting shall be cast or die formed to smooth curves. Supply size to fit openings provided.

.3 Provide safety screens in inlet and back draft dampers on outlet.

.4 Use neoprene vibration isolation between fan assembly and mounting plate.

2.6 BATHROOM EXHAUST FANS

.1 Provide multi-blade, forward curved wheel in steel housing for between stud mounting.

.2 Resiliently mount direct driven fan and motor. Motor shall be plug-in type with permanently lubricated bearings.

.3 Provide one-piece aluminum or plastic intake grille.

2.7 KITCHEN RANGE HOODS

.1 Resiliently mount multi-blade direct driven fan and motor. Motor shall be two-speed plug-in type with permanently lubricated bearings.

.2 Finish hood in colour selected by Consultant, baked on enamel, with rocker type switches for light and two speed fan. Provide washable type filter of aluminum mesh.

2.8 SIDEWALL EXHAUST FANS

.1 Provide direct motor driven with fan and motor mounted to main housing through neoprene anti-vibration pads.

.2 Heavy aluminum dome type housings shall be reinforced as necessary on sizes with 500 mm wheel and larger.

.3 Provide with multi-blade, rattle free, back draft damper with felt lined blade edges, bird screen and disconnect switch.

Part 3 Execution

3.1 INSTALLATION

.1 Install fans in accordance with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

.2 Provide safety screen where inlet or outlet is exposed.

.3 Provide belt guards on belt driven fans complete with tachometer access.

.4 Provide sheaves as necessary for final air balancing.

.5 Set roof mounted fans on curbs 200 mm minimum above roof; provide acoustic insulation on duct to below roof line and on fan inlet plenum, and drip pan for collecting condensation with drain line to nearest drain.

.6 Provide 100 mm high housekeeping base for floor mounted units.

3.2 PRIMING

.1 Prime coat fan wheels and housing factory inside and outside. Prime coating on aluminum parts is not required.

.2 Provide two additional coats of paint on fans handling air downstream of humidifiers.

3.3 PERFORMANCE

.1 Fan performance based on sea level conditions.

.2 Refer to Mechanical Schedule on Drawings

END OF SECTION

SECTION 23 36 00

TERMINAL AIR UNITS

Part 1 General

1.1 SUMMARY

.1 Work for this section includes, but is not limited to, the following:

- .1 Basic terminal units
- .2 Variable volume regulators complete with damper motor operator
- .3 Sound attenuator
- .4 Heating coils

1.2 RELATED REQUIREMENTS

.1 Section 23 01 30.51 – HVAC Duct Cleaning – General

.2 Section 23 31 00 – Ductwork

.3 Section 23 33 19 – Duct Silencers

.4 Section 23 33 00 – Duct Accessories

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)/ Air Movement and Control Association (AMCA):

- .1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.2 Air-Conditioning, Heating and Refrigeration Institute (AHRI):

- .1 AHRI 300-2000, Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment.
- .2 AHRI 310/380-2004/CAN/CSA C744-04, Standard for Packaged Terminal Air Conditioners and Heat Pumps (Bi-National Standard).
- .3 AHRI 880-98, Air Terminals (with addenda).
- .4 AHRI 885-98, Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets (with addenda).

.3 National Fire Protection Association (NFPA):

- .1 NFPA 90A-2002, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.4 Underwriters Laboratories Inc. (ULI):

- .1 UL 181-2005, Standard for Factory-Made Air Ducts and Air Connectors.

1.4 PERFORMANCE REQUIREMENTS

.1 Differential static pressure of the unit shall not exceed 30 Pa with inlet velocities of 10 m/s or less; Static pressure across the assembly with a 10 m/s or less inlet velocity shall not exceed 110 Pa with an attenuator but with no other accessories.

.2 Unit operation shall be independent of inlet static pressure. Flow (within adjustable range) shall not vary by more than 5% for inlet static pressures between minimum specified and 1500 Pa.

.3 Volume regulators shall be capable of maintaining minimum set flows within 5% at inlet velocities down to 3 m/s.

.4 Unit air volumes shall be adjustable as follows:

.1 Maximum - down to 40% unit capacity.

.2 Minimum - between 70% and 25% of unit capacity or fully closed.

.5 A 90° elbow immediately before the inlet shall not alter the maximum or minimum factory setting by more than 10%.

.6 Unit shall be field adjustable to within 5% of actual flow. One set of any special tools or instruments required to field adjust units shall be provided to the owner.

.7 Pneumatic consumption for the operation of the unit shall not exceed [0.008 sl/s at 138 kPa for single duct] [0.019 sl/s at 138 kPa for dual duct].

.8 Unit coils, where indicated, shall be 1-row minimum, with minimum capacity indicated with 88°C entering water; 77°C leaving water and minimum air flow capacity.

1.5 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit schedule of all units supplied indicating size, maximum and minimum settings, and performance with respect to inlet static pressure; use identification marks to match those indicated on the Drawings.

.3 Submit shop drawings stamped and signed by professional engineer registered or licensed in the province of the Work indicating, but not limited to, the following:

.1 Capacity, pressure drop, noise rating and leakage.

.2 Discharge and radiated sound power level schedules for each of second through sixth octave bands with inlet pressures of 250 Pa to 1000 Pa at specified maximum airflow.

.3 Manufacturer's printed product literature, specifications and datasheets indicating units proposed for use on Project, and any modifications required by Project.

.4 Include schedule of all units supplied indicating size, maximum and minimum settings and performance with respect to inlet static pressure.

.5 Include discharge and radiated sound power level schedules with shop drawings, for each of second through sixth octave bands and inlet pressures of 250 Pa to 1000 Pa at specified maximum airflow.

.6 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.6 PROJECT CLOSEOUT SUBMISSIONS

.1 Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Operations and Maintenance Data including instructions for resetting constant volume regulators and a list of manufacturer's recommended spare parts including specific information with regards to bearings and seals, addresses of suppliers, and a list of specialized tools necessary for adjusting, repairing or replacing components.

.2 Provide for inclusion in maintenance manuals, instructions for resetting constant volume regulators.

1.7 QUALITY ASSURANCE

.1 The terminal units shall be tested, labelled and certified in accordance with applicable AHRI equipment test codes.

.2 Insulation materials, coatings, vapour barrier facings, tapes and adhesives: Composite fire and smoke hazard rating shall not exceed 25 for flame spread and 50 for smoke developed.

.3 Label units with capacities as factory adjusted including minimum maximum ratings of volume regulators.

1.8 COORDINATION

.1 Coordinate location of ceiling access panels required for terminal units mounted above suspended gypsum board ceilings; coordinate dimensions and type of access panel with Section 08 31 00.

.2 Coordinate suspension requirements for terminal units; verify that structures in place will support terminal unit loads.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 E. H. Price Ltd.
.2 Krueger
.3 Nailor Industries Inc.
.4 Titus

2.2 MANUFACTURED UNITS

.1 Provide terminal units of same generic type, using products from one manufacturer; provide factory installed terminal unit damper operators.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer's written instructions.

.2 Arrange for suitable ceiling access to units; provide access doors or locate above easily removable ceiling components.

.3 Install units individually from the structure; do not support from adjacent ductwork.

.4 Provide a minimum of three inlet diameters of straight duct at inlet of units, refer to Section 23 31 00.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS AND GRILLES

Part 1 General

1.1 SUMMARY

.1 Work for this section includes, but is not limited to, the following:

- .1 Supply air diffusers, registers and grilles
- .2 Return air grilles
- .3 Exhaust air grilles
- .4 Transfer grilles

1.2 RELATED REQUIREMENTS

.1 Section 07 84 00 – Firestopping: Firestop and smokeseal requirements for diffusers, registers and grilles installed in fire rated construction.

.2 Section 08 14 16 – Flush Wood Doors

.3 Section 09 51 00 – Acoustical Panel Ceilings: Coordination of ceiling grid sizes for grilles and diffusers used in suspended ceiling systems.

.4 Section 09 91 00 – Painting: Blackout painting for interior of ductwork before installation of diffusers, registers and grilles.

.5 Section 23 01 30.51 – HVAC Duct Cleaning – General

.6 Section 23 01 30.52 – HVAC Duct Cleaning – Detailed

.7 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

.8 Section 23 31 00 – Ductwork

.9 Section 23 33 00 – Air Duct Accessories

1.3 REFERENCE STANDARDS

.1 Air-Conditioning, Heating and Refrigeration Institute (AHRI):

- .1 AHRI 890-2001, Air Diffusers and Air Diffuser Assemblies

.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):

- .1 ANSI/ASHRAE 70-2006, Method of Testing the Performance of Air Outlets and Air Inlets

.3 National Fire Protection Association (NFPA):

.1 NFPA (Fire) 90A-2008, Installation of Air Conditioning and Ventilating Systems

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit manufacturer's printed product literature, specifications and datasheets including, but not limited to, the following:

.1 Product characteristics, performance criteria, and limitations.
.2 Identify each Product with tag numbers matching Drawings and Specifications.
.3 Capacity.
.4 Throw and terminal velocity.
.5 Noise criteria.
.6 Pressure drop.
.7 Neck velocity.
.8 Fire rating and approval agency.
.9 List additional requirements to suit Project.

.3 Submit confirmation of performance requirements including, but not limited to, catalogued or published ratings for manufactured items: tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.5 PROJECT CLOSEOUT SUBMISSIONS

.1 Provide keys required for volume control adjustment and airflow pattern adjustment in accordance with Section 01 00 06 – General Requirements: Spare Parts.

1.6 QUALITY ASSURANCE

.1 Carry out airflow tests and noise measurements in accordance with applicable ASHRAE and AHRI Standards, and label fire rated assemblies in accordance with the requirements of the Authorities Having Jurisdiction.

1.7 PRE-CONSTRUCTION MEETING

.1 Arrange a pre-construction meeting in accordance with Section 01 00 06 – General Requirements: Project Meetings.

.2 Attendees shall include, but not be limited to, the Consultant, Construction Manager, responsible for this Section, and other subcontractors affected by work of this Section.

.3 Agenda shall include, but not be limited to, the following:

.1 Requirements for roughing-in and supply of blocking, supports and reinforcements.

.2 Confirmation of measurements and configurations of Products supplied for Project.

.3 Confirmation of delivery schedules to allow Products of this Section to be incorporated into the work of other subcontractors.

.4 Confirmation of actual layout and location of diffusers, registers and grilles.

1.8 COORDINATION

.1 Coordinate metric measure for diffusers, registers and grilles installed in suspended unit ceiling systems with Section 09 51 00; examples of coordination are as follows:

.1 Supply imperial measure 24” x 24” units where 610 mm x 610 mm ceiling grid is indicated.

.2 Supply true metric measure 600 mm x 600 mm units where 600 mm x 600 mm ceiling grid is indicated.

.2 Coordinate actual locations of diffusers, registers and grilles to suit on site conditions; dimensions and locations indicated on Drawings are approximate only; actual locations shall align with adjacent architectural features and finishes as directed by the Consultant.

.3 Coordination of blank-off panels and requirements for concealed fasteners in diffusers, registers and grilles with architectural drawings; confirm location of blank-off panels and fastener types before ordering materials.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 Diffusers:

.1 E. H. Price Ltd.

.2 Krueger

.3 Nailor Industries Inc.

.4 Titus

.2 Grilles and Registers:

.1 E. H. Price Ltd.

.2 Krueger

.3 Nailor Industries Inc.

.4 Titus

2.2 MATERIALS

.1 Provide supply outlet units having space noise level of NC 35 maximum and with sponge rubber seal around edges.

.2 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.

.3 Provide frames for diffusers to complement surfaces they are being installed into (i.e.: plaster trim for plaster surfaces); provide continuous trims for linear products where possible; notify the Consultant where continuous trims are not achievable and obtain written confirmation of where joints will be acceptable.

.4 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces (i.e.: acoustical spray applied ceiling finishes).

2.3 MANUFACTURED UNITS

.1 Supply Grilles:

.1 Sidewall supply grilles shall have streamlined and individually adjustable blades, depth of which exceeds 20 mm maximum spacing. Provide spring tension or other device to set blades. Provide units with vertical or horizontal face, single or double deflection bar style grilles as required.

.2 Provide 32 mm margin frame with countersunk screw holes.

.3 Fabricate of steel with 1 mm minimum frames and 0.8 mm minimum thickness blades, steel and aluminum with 1 mm minimum frame, or heavy aluminum extrusions.

.4 Provide grilles with integral, gang-operated opposed blade dampers with removable key operator, operable from face.

.2 Grid Core Return And Exhaust Grille:

.1 Fabricate fixed grilles of 13 mm x 13 mm x 13 mm.

.2 Provide 32 mm margin frame with countersunk screw holes and lay-in frame for suspended grid ceilings as required.

.3 Fabricate from aluminum.

.4 Provide exhaust grilles, where not individually connected to exhaust fans, with integral, gang-operated opposed blade dampers with removable key operator, operable from face.

.3 Round Supply Diffuser:

.1 Provide round, adjustable pattern, stamped or spun, multi-core type diffuser to discharge air in 360° pattern, with sectorizing baffles where indicated or required.

.2 Project diffuser collar not more than 25 mm above ceiling face and connect to duct with duct ring.

.3 Fabricate of steel with baked enamel finish.

.4 Provide radial opposed blade, butterfly, or combination splitter damper as required and multi-louvered equalizing grid with damper adjustable from diffuser face.

.4 Rectangular Supply Diffuser:

.1 Provide rectangular, adjustable pattern, stamped, multi-core type diffuser to discharge air in 360° pattern with sectorizing baffles where indicated or required.

.2 Diffusers shall have surface mount snap-in, inverted T-bar, or spline type frame.

.3 Fabricate of steel with baked enamel off white finish.

.4 Provide radial opposed blade, butterfly, or combination splitter damper as required and multi-louvered equalizing grid with damper adjustable from diffuser face.

Part 3 Execution

3.1 PREPARATION

.1 Locations for diffusers, registers and grilles indicated on Drawings are not intended to be used as exact; confirm location of all outlets and inlets and adjust location to conform with adjacent architectural features, symmetry, sprinkler head locations, lighting and communication devices.

.2 Paint ductwork behind air outlets matte black, refer to Section 09 91 00.

3.2 INSTALLATION

.1 Install diffusers, registers and grilles in accordance with manufacturers written requirements.

.2 Install using flat head, oval head, stainless steel, or cadmium plated screws as required in countersunk holes where fastenings are visible.

.3 Fire Rated Construction:

.1 Provide fire dampers, collars, sleeves and perimeter angles as required to preserve integrity of fire separations where diffusers, registers and grilles installed in fire rated construction.

.2 Provide enclosures constructed of gypsum board having same type and thickness as ceiling to cover sides and tops of diffusers, registers and grilles mounted in ceilings that form part of a fire rated assembly.

.3 Protect inlet and outlet of diffusers, registers and grilles at the enclosure penetration with a fire stop flap.

3.3 SCHEDULE

.1 Sizing: Provide size and configuration of diffusers, registers and grilles as indicated on Drawings.

END OF SECTION

SECTION 23 37 34

INTAKE LOUVERS, EXHAUSTS AND RELIEF VENTS

Part 1 General

1.1 SUMMARY

.1 Work in this section includes, but is not limited to, the following:

- .1 Outside louvers.
- .2 Roof hoods.
- .3 Goosenecks.

1.2 RELATED REQUIREMENTS

.1 Section 07 62 00 – Sheet Metal Flashing and Trim: Counter flashing requirements for louvers and vents installed in exterior construction.

.2 Section 08 90 00 – Louvers and Vents: Architectural louvers and vents.

.3 Section 23 01 30.51 – HVAC Duct Cleaning – General

.4 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

.5 Section 23 31 00 – Ductwork

.6 Section 23 33 00 – Air Duct Accessories

1.3 REFERENCE STANDARDS

1.1.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

1.1.1.1 ANSI/SMACNA 1966, HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit manufacturer's printed product literature, specifications and datasheets including, but not limited to, the following:

- .1 Product characteristics, performance criteria, and limitations.
- .2 Identify each Product with tag numbers matching Drawings and Specifications.
- .3 Capacity.
- .4 Noise criteria.
- .5 Pressure drop.
- .6 Water penetration.

.3 Submit confirmation of performance requirements including, but not limited to, catalogued or published ratings for manufactured items: tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

.4 Submit samples for verification of finishes and profiles.

1.5 QUALITY ASSURANCE

.1 Use highest quality materials conforming to the appropriate ASTM and ANSI specifications.

.2 Install using tradesmen licensed by authority having jurisdiction.

.3 Where indicated, comply with, or otherwise be guided by, standards issued by SMACNA.

.4 Louver shall bear AMCA seal for free area and water penetration.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 Louvers:

.1 The Airolite Company

.2 Western Ventilation Products Ltd., Westvent

.3 Ruskin Manufacturing

2.2 MATERIALS

.1 Bird Screens: Wire diameter 2 mm, aluminum, formed U frame around perimeter.

.2 Outside Louvers:

.1 Louvers 150 mm deep with blades on 40° slope [with double drainable blade and drainable heavy channel frame, bird screen with 15 mm square mesh.

.2 Fabricate of 2.00 mm extruded aluminum blades and frame; make jamb frames 2.50 mm thickness where openings exceed 1800 mm in height; fully welded assembly.

.3 Finish in factory baked enamel finish; colour as selected by Consultant from full range.

.3 Roof Hoods:

.1 Air inlet or exhaust hoods shall have removable hood, curb flange and bird screen with 15 mm square mesh.

.2 Fabricate of galvanized steel minimum 1.519 mm base and 0.912 mm hood; provide suitable reinforcing to hood; louvers shall be storm proof.

.3 Mount unit on minimum 300 mm high curb base with insulation between duct and curb.

.4 Goose Necks:

.1 Fabricate goosenecks of minimum 1.214 mm galvanized steel.

.2 Mount on minimum 300 mm high curb base where size exceeds 225 mm x 225 mm.

Part 3 Execution

3.1 INSTALLATION

.1 Flash and counter flash all openings in all exterior walls and roofs.

.2 Install field or factory fabricated curbs under all roof mounted intakes and relief vents, of sufficient height for 350 mm clearance from roof to horizontal discharge on hoods.

.3 Equip relief and exhausts with back draft dampers unless motorized dampers specified.

.4 Provide blank-off panels for inactive portions of stationary louvers.

3.2 SIZING

.1 Size outside air louvers as indicated on Drawings.

.2 Size roof hoods and goosenecks as indicated on Drawings.

END OF SECTION

SECTION 23 40 00

HVAC AIR CLEANING DEVICES

Part 1 General

1.1 SUMMARY

.1 Work in this section includes, but is not limited to, the following:

- .1 Panel filters.
- .2 Cube filters.
- .3 Pleated filters.
- .4 High efficiency bag filters.
- .5 Roll filters.
- .6 Electronic air filters.
- .7 Grease filters.
- .8 HEPA filters.

1.2 RELATED REQUIREMENTS

.1 Section 23 31 00 – Ductwork

1.3 REFERENCE STANDARDS

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):

- .1 2011 ASHRAE Handbook – HVAC Applications
- .2 ASHRAE 52.1-1992, Gravimetric and Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
- .3 ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI/ASHRAE Approved)

.2 Canadian General Standards Board (CGSB):

- .1 CAN/CGSB 115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems
- .2 CAN/CGSB 115.11-M85, Filters, Air, High Efficiency, Disposable, Bag Type
- .3 CAN/CGSB 115.12-M85, Filters, Air, Medium Efficiency, Disposable, Bag Type
- .4 CAN/CGSB 115.13-M85, Filter Media, Automatic Roll
- .5 CAN/CGSB 115.14-M91, High Efficiency Cartridge Type Filters for the Removal of Particulate Matter from Ventilating Systems
- .6 CAN/CGSB 115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems
- .7 CAN/CGSB 115.16-M82, Activated Carbon for Odour Removal from Ventilating Systems
- .8 CAN/CGSB 115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency
- .9 CAN/CGSB 115.20-95, Polarized Media Air Filter

.3 National Fire Protection Association (NFPA):

.1 ANSI/NFPA (Fire) 96-2010, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

.4 Underwriters Laboratories of Canada (ULC):

.1 ULC S111-07, Standard Method of Fire Tests for Air Filter Units

.2 ULC S649-06, Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens

.5 Underwriters Laboratories Inc. (UL):

.1 UL 900-2004, Test Performance of Air Filter Units

1.4 PERFORMANCE REQUIREMENTS

.1 Refer to the Mechanical Equipment Schedule on Drawing M601.

1.5 QUALITY ASSURANCE

.1 Supply filters specified in this Section fabricated and supplied by one manufacturer.

.2 Keep filter media consistent with UL 900 Class 1 or Class 2 and ASHRAE 52.1.

.3 Form filter banks using filter components assembled from products of same manufacturer.

.4 Filters containing asbestos, urea formaldehyde or fibreglass will not be acceptable for this Project.

1.6 PROJECT CLOSEOUT SUBMISSIONS

.1 Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Operations and Maintenance Data.

.2 Provide list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 Panel Filters:

.1 American Air Filter International

.2 Cambridge Filter Corporation

.2 Cube Filters:

.1 American Air Filter International

.2 Cambridge Filter Corporation

.3 Pleated Filters:

.1 American Air Filter International

.2 Cambridge Filter Corporation

.4 High Efficiency Bag Filters:
- .1 American Air Filter International
- .2 Cambridge Filter Corporation

.5 Roll Filters:
- .1 American Air Filter International
- .2 Cambridge Filter Corporation

.6 Electronic Air Filters:
- .1 American Air Filter International
- .2 Cambridge Filter Corporation

.7 Grease Filters:
- .1 American Air Filter International
- .2 Cambridge Filter Corporation

.8 HEPA Filters:
- .1 American Air Filter International
- .2 Cambridge Filter Corporation
- .3 Camil Farr (Canada) Inc.

.2 Size, media face area, material, test efficiency, initial and final air resistance of alternative manufacturers to be as specified.

2.2 FRAMES

.1 Fabricate filter frames and supporting structures of galvanized steel or extruded aluminum with necessary gasketing between frames and walls. Provide holding frames 1.519 mm core metal thickness; "T" section construction.

.2 Provide standard size frames to provide interchangeability of filter media of other manufacturers.

2.3 PANEL FILTERS

.1 Media: The airfilter to consist of a 3 ply panel filter element in a uniform non woven structure. The filter to be fabricated from variable denier Dacron fibres offering a graduated media with minimum loft of 40 mm and to be progressively bonded with a fire retardant latex binder.

.2 Panel filters shall meet MERV 13 standard or higher.

.3 The filter to contain a non migrating tackifier impregnated between the second and third ply to prevent unloading of the tackifier downstream.

.4 Holding Frames: 1.214 mm core metal thickness minimum galvanized frame with expanded metal grid on leaving air side and steel rod grid on air entering side, hinged with pull and retaining handles.

.5 The filter to be Class II listed UL.

.6 Filters containing asbestos, urea formaldehyde or fibreglass will not be accepted.

.7 The filter to have an average dust spot efficiency of 45% in accordance with ASHRAE 52 at 2.54 m/s maximum face velocity at a final resistance of 125 Pa.

Part 3 Execution

3.1 INSTALLATION

.1 Construct and install filters to prevent passage of unfiltered air. Provide felt, rubber or neoprene gaskets.

.2 Do not operate fan system connected to filter banks until filters (temporary or permanent) are in place. Provide new filters at take-over by the Owner. Replace filters used during construction.

.3 Provide filter banks in arrangement shown with removal and access indicated.

END OF SECTION

SECTION 23 57 13

HEAT EXCHANGERS FOR HVAC

Part 1 General

1.1 SUMMARY

.1 Provide heat exchanger systems consisting of, but not limited to, the following:

- .1 Heat exchangers
- .2 Relief and drain valves
- .3 Instrumentation
- .4 Insulation
- .5 Piping connections
- .6 Steel supports

1.2 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME):

- .1 ASME Boiler and Pressure Vessel Code:
  - .1 BPVC-VIII B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 1
  - .2 BPVC-VIII-2 B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 2 - Alternative Rules
  - .3 BPVC-VIII-3 B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 3 - Alternative Rules High Press Vessels

.2 Canadian Standards Association (CSA):

- .1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code

1.3 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit manufacturer's printed product literature, specifications and datasheet for heat exchangers; indicate materials being proposed for use on Project.

.3 Submit shop drawings indicating project layout including, but not limited to the following:

- .1 Layout of individual components, dimensions of heat exchangers and systems, and locations and size of tappings.
- .2 Manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.
- .3 Certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturer's installation instructions.

1.4 PROJECT CLOSEOUT SUBMISSIONS

.1 Submit maintenance and engineering data in accordance with Section 01 00 06 – General Requirements: Operations and Maintenance Data.

1.5 PRE-CONSTRUCTION MEETING

.1 Arrange a pre-construction meeting in accordance with Section 01 00 06 – General Requirements: Project Meetings to discuss the following:

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Coordination with other subcontractors.

.4 Review manufacturer's installation instructions and warranty requirements.

1.6 QUALITY ASSURANCE

.1 Design and construction shall meet requirements of ASME code for unfired pressure vessels and provincial codes.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 Shell and Tube Type:

.1 Armstrong International Inc.

.2 ITT Industries Bell & Gossett

.3 Taco Canada Ltd.

.2 Plate Type:

.1 Alfa Laval

.2 Armstrong International Inc.

.3 Tranter

2.2 MATERIALS

.1 Units shall be suitable for 865 kPa working pressure and 150°C working temperatures.

.2 Heads shall be cast iron or steel, with steel or bronze tube sheets, threaded or flanged for piping connections.

.3 Water chamber and tube bundle shall be removable for inspection and cleaning.

.4 Prime coat exterior of units.

2.3 PLATE TYPE HEAT EXCHANGERS

.1 Carbon steel frame consisting of one stationary plate cover with inlet and outlet flanged connections, moveable plate cover, upper carrying bar, lower guiding bar, and support column.

.2 Neoprene gaskets and channel seals.

2.4 SHELL AND TUBE HEAT EXCHANGER

.1 Shell shall be steel, with threaded or flanged piping connections and necessary tappings.

.2 Tubes shall be 1.3 mm thickness copper.

.3 Provide steel saddle supports and attaching U-bolts.

.4 Units shall be designed for heating fluid in shell and heated fluid in tubes.

.5 Provide for temperature regulator sensor at heated fluid outlet.

.6 Provide ASME rated pressure and temperature relief valve on the heated fluid side.

.7 Provide thermometers and pressure gauge tappings in fluid inlets and outlets.

.8 Provide ASME rated pressure relief valve on shell.

.9 Provide valved shell drain and vent.

2.5 IMMERSION TUBE HEATER

.1 Provide thermometers and pressure gauge tappings in fluid inlets and outlets.

Part 3 Execution

3.1 INSTALLATION

.1 Provide welded structural steel stands for floor mounting of heat exchangers. Bolt stand to floor.

.2 Ensure installation permits removal of tubes without disturbing installed equipment or piping.

.3 Pipe relief valves to floor drain.

.4 Refer to drawings for details of installation and piping connections.

3.2 PERFORMANCE

.1 Refer to Heat Exchanger Schedule on Drawing M-601.

END OF SECTION

SECTION 23 62 13

PACKAGED AIR-COOLED COMPRESSOR AND CONDENSER UNITS

Part 1 General

1.1 SUMMARY

.1 Provide air cooled refrigerant compressor and condensing systems consisting of, but not limited to, the following:

- .1 Condensing unit package
- .2 Refrigerant piping and accessories
- .3 Controls
- .4 Charge of refrigerant and oil

1.2 QUALITY ASSURANCE

.1 Conform to requirements of CSA, UL, Provincial and Municipal Codes.

.2 Test and rate cooling system to AHRI Standard 210.

.3 Materials in contact with refrigerant shall be corrosion resistant.

.4 Units shall be product of manufacturer regularly engaged in production of refrigeration units and who issues complete catalogue data on such products.

1.3 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals]

.2 Submit with shop drawings, schematic layouts showing condensing units, cooling coils, refrigerant piping and accessories required for complete system.

1.4 START-UP AND TESTING

.1 Supply and charge with the initial charge of refrigerant and oil for each refrigeration system. Losses of oil or refrigerant prior to acceptance of equipment or due to defects covered under guarantee shall be replaced. Supply to the Owner, one complete charge of refrigerant and lubricating oil in addition to that placed in the system.

.2 Test entire system for leaks after completion of installation, repair leaks, put system into operation and test equipment performance.

.3 Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

.4 Provide cooling season start-up, winter season shut-down for first year of operation.

.5 Inspect and test for refrigerant leaks every 3 months during first year of operation.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 Trane
.2 Carrier
.3 Engineered Air
.4 Lennox

2.2 TYPE

.1 Units shall be self-contained, packaged, factory assembled and pre-wired suitable for outdoor use consisting of casing, compressors, condensing coil and fans, integral sub-cooling coil, controls screens, crankcase heater, tubing package, control transformer.

2.3 CABINET

.1 Construct of heavy gauge galvanized steel with baked enamel finish, easily removed access doors or panels with quick fasteners.

2.4 COMPRESSOR

.1 Provide timer circuits to prevent rapid loading and unloading for system stabilization, on multiple compressor units.

2.5 CONDENSER

.1 Coil: Seamless copper tubing with mechanically bonded aluminum fins.

.2 Fans: Vertical discharge, direct-drive axial fans, resiliently mounted with guard and motor.

.3 Motors: Permanently lubricated ball bearing motors with built-in current and overload protection.

.4 Provide removable, washable lint screens at air inlet.

2.6 CONTROLS

.1 Provide high and low pressure cutouts for compressor, oil pressure control, non-recycling pump-down and reset relay and low ambient lockout.

.2 Provide controls and insulated refrigerant receiver of sufficient capacity to permit operation down to -35°C ambient temperature at minimum compressor load.

Part 3 Execution

3.1 INSTALLATION

.1 Refer to Section 23 23 16 – Refrigerant Piping Specialties

3.2 PERFORMANCE

.1 Refer to Air Cooled Condensing Units Schedule on Drawings

END OF SECTION

SECTION 28 82 16

COILS

Part 1 General

1.1 SUMMARY

.1 Work in this section includes, but is not limited to, the following:

- .1 Water coils
- .2 Glycol coils
- .3 Refrigerant coils
- .4 Coil installation
- .5 Coil piping and accessories

1.2 QUALITY ASSURANCE

.1 Coils shall be the product of manufacturer regularly engaged in production of coils who issues complete catalogue data on such products.

.2 Coil capacities, pressure drops, and selection procedures shall be certified in accordance with AHRI Standards and bear AHRI seal.

1.3 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Shop drawings shall include dimensions, materials of construction and performance data to match specifications.

.3 Submit coil selection sheets or computer calculations with shop drawings.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

- .1 Trane
- .2 Engineered Air
- .3 McQuay
- .4 Lennox

2.2 GENERAL

.1 Provide extended surface type coils with tubes of copper or brass, and plate or helical type fins of copper or aluminum.

.2 Space fins 14 over 25 mm maximum. Helical fins may be crimped.

.3 Mount coil section in galvanized steel casing designed for bolting to other sections of ductwork.

2.3 WATER AND GLYCOL HEATING COILS

.1 Design for maximum operating limits of 1380 kPa and 104°C.

.2 Coil headers shall be cast iron, copper tube or steel pipe.

.3 Face length shall not exceed 3 m.

2.4 COOLING COILS

.1 Design for maximum operating limits of 1380 kPa at 104°C.

.2 Face length shall not exceed 3 m per section.

.3 Provide moisture eliminator of 0.617 mm galvanized steel where air velocity exceeds 2.5 m/s.

.4 Provide drip pan and drain connection for each field assembled coil section.

.5 Coil headers shall be cast iron, copper tube or steel pipe.

.6 Refrigerant coils shall be serpentine type with brass or copper header arranged to prevent trappings of oil and to distribute liquid refrigerant to circuits. Silver soldered or brazed joints. Maximum operating pressure 1722 kpa.

Part 3 Execution

3.1 INSTALLATION

.1 Support coil sections on steel channel or double angle frames and secure to casings. Arrange supports for cooling coils so they do not pierce or short circuit drip pans. Level serpentine coils and install drainable tube coils with pitch within casing. Arrange galvanized steel casings for bolting to other section, ductwork or unit casings. Provide airtight seal between coils and duct or unit cabinets.

.2 Make necessary connections to coils, including valves, air vents, unions and connections from drip pans. Provide gate valve on supply line and eccentric plug valve on return line to each water coil.

.3 Locate water supply at bottom of supply header and return water connection at top to provide self-venting and reverse return arrangement. Provide manual air vents at high points complete with stop valve. Ensure water coils are drainable and provide drain connection at low points.

.4 Protect coils so fins and flanges are not damaged. Replace loose and damaged fins. Comb out bent fins unless required to be replaced.

.5 Install steam coils with 2% pitch.

.6 If turn over occurs during winter months, turn over systems to the owners with all chilled water cooling coils drained and valved off from the system.

3.2 PERFORMANCE

.1 Refer to Air Handling Unit Section for AHU Coils.

.2 Refer to Schedule on Drawings.

END OF SECTION

SECTION 23 82 19

FAN COIL UNITS

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of fan coil units, and testing and verification of completed work.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 13 – Common Motor Requirements for Mechanical Equipment

.2 Section 20 05 48 – Noise and Vibration Control

.3 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

.4 Section 23 09 53 – Pneumatic and Electronic Control System for HVAC

.5 Section 23 31 00 - Ductwork

1.3 REFERENCE STANDARDS

1.1.1 Air Movement and Control Association International Inc. (AMCA):

1.1.1.1 AMCA Publication 99-2007, Standards Handbook

1.1.1.2 AMCA 300-08, Reverberant Room Method for Sound Testing of Fans

1.1.1.3 AMCA 301-06, Methods for Calculating Fan Sound Ratings from Laboratory Test Data

.1 Air-Conditioning, Heating and Refrigeration Institute (AHRI):

.1 AHRI 440-2008 Performance Rating of Room Fan-Coils

.2 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 46-M1988 (R2006), Electric Air-Heaters

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Product Data: Submit manufacturer's printed product literature, specifications and datasheets including characteristics, performance criteria, and limitations for the following:

.1 Filters, fan accessibility

.2 Suspension of cabinet

.3 Physical size

.4 Thermostat, transformer, controls where integral

.5 Finish

.6 kW rating, voltage, phase

.7 Cabinet material thicknesses

.2 Shop Drawings: Submit shop drawings indicating dimensions, materials of construction and performance data to match specifications, coil selection sheets or computer calculations, and manufacturer's installation instructions.

.3 Informational Submittals: Provide the following submittals during the course of the work:

.4 Site Quality Control Submittals: Submit certificates signed by manufacturer certifying that materials meet specified performance characteristics and physical properties.

1.5 PROJECT CLOSEOUT SUBMISSIONS

Provide operations and maintenance information in accordance with Section 01 00 06 – General Requirements: Operations and Maintenance Data including a list of manufacturer's recommended spare parts and specific information with regards to bearings and belts; addresses of suppliers, and a list of specialized tools necessary for adjusting, repairing or replacing components.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver, store and handle in accordance with manufacturer's written instructions.

Part 2 Products

2.1 MANUFACTURERS

.1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section provided they meet the performance requirements established by the named products and provided they submit requests for substitution in accordance with Section 01 25 00 – Substitutions a minimum of [ten (10) days] in advance of Bid Closing.

.2 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section and as established by the Basis-of-Design Materials, manufacturers offering products that may be incorporated into the Work include the following:

2.2 MATERIALS

.1 Fan Coil Units (FCU-1):

.1 Cabinet: Steel, 1.2 mm thick, floor mounting, surface; front inlet top outlet

.2 Elements: Stainless steel sheathed with corrosion protected steel fins covering full length of element

.3 Blower Motors: Two speed, single phase

.4 Thermostat: Built-in thermostat with integral relay Fan delay switch

.5 On/Off switch (for wall mount unit only)

.6 Fresh air duct adapter

.7 Filter: Replaceable

.8 Trim: Flush installation

.9 Finish: Three stage phosphatised treatment followed by [2] baked enamel with final coat grey coloured

.10 Assembly fully wired to one outlet location

.11 Multiple knockouts for up to 38 mm diameter conduit

Part 3 Execution

3.1 INSTALLATION

.1 Install fan coil units in accordance with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

.2 Mount units; connect power and control to dry points and coordinate ducting of fresh air at floor with Section 23 31 00.

3.2 CLOSEOUT ACTIVITIES

.1 Cleaning: Perform final cleaning in accordance with Section 01 74 23 – Final Cleaning, remove surplus materials, rubbish, tools and equipment after testing and verification is finished.

.2 Testing: Perform tests in accordance with Section 23 05 93 and submit required site quality control certificates listed in this Section.

.3 Demonstration: Demonstrate adjustments and servicing, filter maintenance and lubrication requirements to Owner in accordance with Section 01 79 00 – [Non-]Commissioned Demonstration and Training.

.4 Commissioning: Perform start-up, testing and verification in accordance with Section 01 91 13 – General Commissioning Requirements and Section 20 08 13 – Coordination with Commissioning Agency.

END OF SECTION

SECTION 25 06 91

MEASUREMENT AND VERIFICATION

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for the Owner's implementation of Measurement and Verification Plan with supply and installation of the following systems:

- .1 Domestic Water Heaters
- .2 Fans and Pumps $\geq$ 1 HP
- .3 Heating System (coils, boilers and related system components)
- .4 Lighting Systems and Controls
- .5 Water Meters

.2 This section is included for the information of the Construction Manager, and mechanical and electrical Subcontractor so that they can coordinate their activities with the Owner's Measurement and Verification Plan; costs for implementing the Measurement and Verification Plan will be paid for by the Owner directly; Construction Manager and Subcontractors shall include coordination costs only, do not include any costs for actual Measurement and Verification Plan and ongoing maintenance.

1.2 RELATED REQUIREMENTS

.1 Section 25 79 00 – Integrated Automation Systems Demonstration and Instruction

.2 Section 26 08 31 – Electrical Equipment and Systems Demonstration and Instruction

1.3 DEFINITIONS

.1 Measurement and Verification (M&V) Plan: Procedure performed by the Owner so that they can incorporate corrective actions where results of the Measurement and Verification Plan indicate that energy savings anticipated for the project are not being achieved.

1.4 REFERENCE STANDARDS

.1 International Performance Measurement and Verification Protocol (IPMVP):

- .1 Volume III: Concepts and Options for Determining Energy Savings in New Construction, April 2003

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Post-Construction Training Program: Provide training for the Owner's building operation staff on methods for accessing, downloading and storing equipment operating parameters in accordance with Section 01 79 00 – Demonstration and Training for Commissioned Buildings.

Part 2 Products

1.1 NOT USED

Part 3 Execution

3.1 CONTROLS SYSTEM

.1 Owner will use information submitted by building automation provider to build trending and reporting capabilities through the combined performance of the Building Management System, and associated mechanical and electrical components as outlined below for each system or component.

.2 Identify diagnostic within controls system to alert staff when equipment is not being optimally operated as indicated by the metric for each component:

Item	Reporting
Lighting Systems	
Lighting Circuits	Daily and monthly energy consumption
Metric	kW*hrs per month
Fan and Pump Energy	
Pumps	Daily and monthly energy consumption for total pumping energy
Fans	Daily and monthly energy consumption for total fan energy
Air Handling Units, Fans:	Daily and monthly energy consumption for AHU fan energy
Metric	kW*hrs
Cooling Energy	
Heat Pump Cooling	Daily and monthly energy consumption Entering and leaving fluid temperature and flow rate.
Metric	kW*hrs
Heating Energy	
Heat Pump Heating	Daily and monthly energy consumption.
Reheat Coils	Daily and monthly energy consumption.
De-Humidification	Daily and monthly energy consumption Time on/Time off.
Solar Thermal Pumps	Daily and monthly energy consumption.
Metric	kW*hrs

Item	Reporting
Utility Meters	
Electricity meter	Daily and monthly total electricity consumption
Water meter	Daily and monthly total water consumption

3.2 ATTACHMENTS

.1 Measurement and Verification Plan: Owner's Measurement and Verification Plan is attached to this Section for information purposes only; and to allow Team Crew to coordinate information requirements for project submissions.

END OF SECTION

SECTION 25 09 00

INSTRUMENTATION AND CONTROL DEVICES

Part 1 General

1.1 SUMMARY

.1 Work in this section includes, but is not limited to, the following:

- .1 Piping, Tubing, Wiring.
- .2 Thermostats.
- .3 Control Valves, Operators.
- .4 Dampers.
- .5 Control Panels.

1.2 RELATED REQUIREMENTS

.1 Section 20 01 00 – Mechanical Operation and Maintenance Data

.2 Section 20 05 00 – Common Work Results for Mechanical

.3 Section 25 50 00 – Integrated Automation Facility Controls

1.3 QUALITY ASSURANCE

.1 A complete system of automatic controls for mechanical systems is to be provided. Refer to Section 25 50 00 and for the remainder of the control system description.

.2 The equipment shall have service for the system from manufacturer representative service departments resident in the Province of Alberta and the state of California.

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit shop drawings for all components in accordance with Division 1 and Section 20 05 00 – General Mechanical Provisions.

.3 Provide shop drawings including complete operating data, system drawings, wiring diagrams and written detailed operational description of sequences and control data on each control system component. Include sizing and arrangements as requested. Include calculations for control valve selections.

1.5 WARRANTY

.1 Include warranty provisions identified in the Division 28 – Mechanical.

.2 Provide a 2-year warranty on all items provided under this contract including all equipment and wiring. The warranty period shall commence on the date of final acceptance.

1.6 SYSTEM DOCUMENTATION

.1 Refer to Section 20 01 00 - Operation and Maintenance Documentation.

.2 The Operating and Maintenance Manuals shall contain operational, product data, cleaning and maintenance information on all products and components.

1.7 RECORD DRAWINGS

.1 Before the certification of substantial performance will be issued the contractor must provide the Consultant with complete record drawings. Refer to Section 20 05 00 and Division 1.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 Johnson Controls
.2 Honeywell
.3 Siemens Building Technology
.4 Trane
.5 Keene
.6 Schneider Controls

2.2 AIR PIPING AND FILTERS

.1 Piping, shall be hard or soft drawn copper or polyethylene plastic tubing. Plastic tubing must meet current F.R. requirements.

.2 Use copper for all control air lines:

.1 Where lines are subject to damage or temperatures in excess of 93°C.
.2 Where lines are run adjacent to heating pipes passing through a common sleeve, or where not readily accessible.
.3 Where life support or warning systems are to be controlled including VAV box control and air system dampers.
.4 Where control air is supplied to fire and smoke dampers.
.5 Where lines are run exposed in mechanical rooms, parkade, maintenance shops, gymnasiums.

.3 In mechanical rooms bundled plastic tubing with suitable junction boxes or single plastic tubing with tray may be used.

.4 Leave two spares and pair of communication lines in bundled plastic tubing.

2.3 CONTROL PANELS

.1 Mount panels on vibration free walls. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

.2 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120 volt supply.

.3 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments.

.4 Identify all wiring by means of stamped markings on heat shrinkable tubing. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, where practical, contained in plastic wiring channels with covers. Maximum 25 conductors to each wire bundle.

.5 Provide terminal blocks, tabular clamp, 300 V, complete with track. Each terminal shall be clearly indelibly marked with the wire number connection to it. Each field connecting conductor shall be served by one terminal. Provide 20% spare unit terminals, with a minimum of two spare terminals. Provide all necessary terminal block accessories such as manufacturer jumpers and marking tape.

.6 Install "Hand-Off-Auto" selector switches such that safety controls and electrical over current protection are not overridden when selector switch is in the "Hand" position. "Hand-Off-Auto" selector switches shall be provided for all ventilation fans and sump pumps.

.7 Control Power for control panel shall be 120 Volts A.C. from panel circuits provided by Division 16.

.8 Install bonding conductor between main control and auxiliary panels complete with grounding lugs, in addition to CSA grounding requirements.

2.4 WIRE

.1 Control wiring for digital functions shall be 18 AWG minimum with 300 Volt insulation.

.2 Control wiring for analog functions shall be 18 AWG minimum with 300 Volts insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.3 Sensor wiring shall be 18 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware or 16 AWG as required by code.

.4 Transformer current wiring shall be 16 AWG minimum.

2.5 CONDUITS AND CABLES

.1 Install wiring in conduit or trays. Conform to Division 16 requirements for conduit and trays specifications.

.2 Seal conduit where such conduit leaves heated areas and enters unheated area.

.3 In the field panel, run low level signal lines in separate conduit from high level signal and power transmission lines.

.4 Identify each cable and wire at every termination point.

.5 Provide instrumentation complete with standard electrical conduit box for termination unless otherwise noted.

.6 Where applicable, mount field interface equipment (i.e. relays, transducers, etc.) in local device cabinets adjacent to field interface panels.

.7 Separate conduits shall be provided for pneumatic tubing and electrical wiring runs.

2.6 THERMOSTATS

.1 All thermostats and humidstats must be programmable with built in time clock capable of a minimum of 5 separate states including daytime, night time, away, on and off. Temperature and humidity is to be displayed on an LCD display panel built into the thermostat.

2.7 DAMPERS

.1 Automatic dampers shall be extruded aluminum multiple blade mounted in extruded aluminum flanged frame. Individual blades shall not exceed 150 mm in width or 1200 mm in length. Provide interlocking edges and compressible seals. Provide oil impregnated bronze or nylon bearings with additional thrust bearings for vertical blades. Damper configuration to be as shown on drawings.

.1 Acceptable material: Tamco Series 9000 BF Thermally insulated damper with thermally broken frames. Tel: 800-561-3449.

.1 Extruded aluminum (6063T5) damper frame shall not be less than .080" (2.03mm) in thickness. Damper frame to be 100 mm deep.

.2 Entire frame shall be thermally broken by means of polyurethane resin pockets, complete with thermal cuts.

.3 Blades to be extruded aluminum (6063T5) profiles, internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.

.4 Blade and frame seals shall be of extruded silicone and be secured in an integral slot within the aluminum extrusions.

.5 Bearings are to be composed of a Celcon inner bearing fixed to a 11mm aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.

.6 Linkage hardware shall be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.

.7 Dampers are to be designed for operation in temperatures ranging between -40°C and 85°C.

.8 Leakage shall not exceed 15.2 l/s/m² against 25 kPa w.g. differential static pressure.

.9 Pressure drop of a fully open 1220mm x 1220mm damper shall not exceed .007kPa) w.g. at 5.08 m/s.

.10 Dampers shall be available as "Flanged to Duct" mounting type.

.11 Smoke dampers shall be UL listed.

2.8 DAMPER OPERATORS

.1 Piston or gear drive type damper operators with spring return to "fail-safe" in normally open or normally closed position.

.2 Provide pilot positioners on all dampers that are to be sequenced with other operators or actuators.

.3 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one damper operator per damper section.

.4 Inlet vane operators shall have pilot positioners and sufficient force to move the vane when the fan is started with the vanes in the closed position and be capable of driving the vanes fully open with the fan operating. The vane operator shall "fail-safe" spring return to the closed position.

2.9 CONTROL VALVES

.1 Two-way and three-way valves for liquids: Two-way valves shall have equal percentage characteristics and three-way valves shall have linear characteristics. Size two-way valve operators to close against maximum pump shut-off head.

.2 Size control valves as per following criteria:

.1 Select two-way control valves for coils, heat exchangers, terminal units, etc., with a nominal pressure drop of 30 kPa.

.2 Select three-way control valves for coils, heat exchangers, terminal units etc., for pressure drop equal to three times the equipment pressure drop up to maximum 30 kPa.

.3 Provide pilot positioners on all valves that are to be sequenced (on all steam valves).

.4 Valves shall "fail-safe", spring return to normal position.

.5 Provide valves complete with electronic operators for valves 38 mm and under. Valves over 38 mm shall be provided with pneumatic operators.

.6 All control valve selections are to be included in shop drawing submission to the Consultant.

Part 3 Execution

3.1 INSTALLATION

.1 Verify location of thermostats and other exposed control sensors with drawings before installation. Locate thermostats 1500 mm above floor.

.2 Install damper motors on outside of ducts. Do not locate in outside air stream.

.3 Wire "hand/off/auto" selector switches such that only automatic operating controls and not safety controls and electrical over current protection shall be overridden when switch is in the "hand" position.

.4 Unless specified otherwise, install all outdoor air sensors on the north exposure of the building.

.5 Install all safety limits at the operator's level.

.6 Install pressure gauges on branch lines and actuator excepting individual room thermostats.

.7 Provide air lines, checks, charging valves and pressure gauges to expansion tanks. Charging valves to be located at operator's level.

.8 Provide hardwire interlocking capability for all mechanical systems operated from the fire alarm system.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Drawings and General Conditions of the Contract, including Supplementary Conditions and Division 01 – General Requirements specification sections, affect all Work of Division 25 – Integrated Automation, Division 26 – Electrical, Division 27 Communications and Division 28 – Electronic Safety and Security.

.2 Specific requirements of the following Specification Sections apply directly to the General Electrical Provisions of this Section:

.1 Section 01 00 06 – General Requirements; Submittals

.2 Section 01 35 50 – Delegated Design Submittals

.3 Section 07 84 00 – Firestopping and Smokeseals: Design and installation of firestopping and smokeseals related to electrical work.

.4 Section 08 71 00 – Door Hardware: Electronic hardware connections.

.5 Section 20 05 00 – Common Work Results for Mechanical: Connections to mechanical equipment.

1.2 DEFINITIONS

.1 Provide: The term Provide as used in this Division means to supply, install and make operable.

.2 Equal: The term Equal as used in this Division means an “Acceptable Material” as defined in Section 01 25 00 and Section 01 62 00, and refers to a product that fully complies with or exceeds the requirements of the specification or specified product in every aspect. For the material to be considered as acceptable, it must match the specified product with regard to function, operation, construction, performance, dimensions, visual appearance, fit and finish, and require no changes to the surrounding systems or construction.

1.3 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

.1 Model National Energy Code of Canada for Buildings, 1997

.2 CSA C22.1-06, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations

.2 Institute of Electrical and Electronic Engineers (IEEE):

.1 IEEE C37.90-2005, Standard for Relays and Relay Systems Associated with Electric Power Apparatus

.2 IEEE C37.90.1-2002, Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

.3 IEEE C37.90.2-2004, Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers

.4 IEEE C37.90.3-2001, Standard for Electrostatic Discharge Tests for Protective Relays

.3 National Fire Protection Agency (NFPA):

.1 NFPA 70: National Electrical Code

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination of Permits, Certificates and Fees: On completion of the work, submit certificate of acceptance from inspection authority to the Consultant:

.1 Prior to commencement of work, submit the necessary drawings to the Electrical Inspection Department and the Electrical Supply Authority.

.2 Pay all associated fees.

.2 Coordination with Drawings and Specifications:

.1 Electrical Drawings and Specifications are governed by the General Conditions of the Contract and General Requirements listed in Divisions 00 and 01, and are complementary to all other drawings and specifications forming a part of the project documentation, and shall be used as follows:

.1 Drawings indicate schedules, details and floor plans that identify the general location of lights, switches, receptacles, equipment, and other electrical items.

.2 Drawings shall be read in conjunction with the Specifications to determine complete scope of work required by Divisions 25, 26, 27 and 28 – Electrical; drawings and specifications are complementary to each other and what is called for by one shall be binding as if called for by both.

.3 Drawings and Specifications for Work covered by Divisions 25, 26, 27 and 28 shall be coordinated between individual Sections for this work, and with other Divisions of the Work to identify potential conflicts between other systems or structural components.

.4 Obtain a clarification or ruling from the Consultant should any discrepancy occur between Drawings and Specifications before submitting bid.

.5 No additional payment will be considered where clarifications are not requested in this manner, and a subsequent conflict arises between Divisions 25, 26, 27 and 28 Sections or Work of other Divisions affected by or affecting Divisions 25, 26, 27 and 28 that could have been identified during the bid period.

.6 Conflicts that arise as a result of construction activities will be considered as a Change to the Work and will be administered in accordance with the General Conditions of the Contract.

.2 Drawings and Specifications form an integral part of the Contract Documents and will serve as the working documents for the Project, subject to the following limitations:

.1 Drawings only indicate the general layout of the complete electrical system, arrangement of feeders, circuits, outlets, switches, controls, panel boards, distribution centres, fixtures and other work.

.2 Drawings only indicate the general location and route followed by conduit or wiring, and cannot show all structural, mechanical and as-constructed details that may affect Divisions 25, 26, 27 and 28 Work.

.3 Bring discrepancies or conflicts shown on different plans, or between plans and specifications promptly to the attention of the Consultant for a decision before proceeding with Work.

.4 Systems and items indicated on Drawings and Specifications are only nominally described and may not be completely specified or noted, however, where additional components are obviously necessary to make a complete working installation, they shall be included as if specified in their entirety.

.5 Drawings indicate various electrical devices, particularly wall mounted devices, that take up more space on the Drawings than the device does in the actual installation:

.1 This allows the Drawings to provide sufficient detail and a maximum degree of clarity when indicating the intent of work using symbols.

.2 Drafting limitations allow only for indication of symbolic locations rather than exact physical locations of the devices.

.3 Devices shall be installed with prime regard for convenience of operation and the best usage of wall space for this and other purposes rather than stringing the devices out along a wall so as to coincide with the scaled locations of the symbols.

.4 Coordinate and confirm locations of devices and fixtures provided by other Divisions of Work, and confirm location of devices with Consultant before completing installation.

1.5 SUBMITTALS

.1 Provide required shop drawings and other submittals information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit shop drawings and other relevant submittals for approval by electrical utilities and authorities having jurisdiction before submission to Consultant, and as follows:

.1 Details of construction, dimensions, capacities, weights, all electrical data and performance characteristics.

.2 Wiring diagrams, control schematics and descriptions of operation.

.3 Action Submittals: Submit shop drawings for the following; but not limited to, and any additional shop drawings requested in individual technical sections:

.1 Primary and secondary switchgear, including panel board, disconnect switches, circuit breaker and fuse details and tripping characteristics, instrument transformers and protection relays, and related equipment, complete with protection coordination study required by Section 26 18 00 – Building Voltage Circuit Protective Devices and descriptions of operation for at least primary and secondary switchgear and at least the following drawings:

.1 Physical sizes, assemblies, and weights of components

.2 Single line and three line drawings

.3 Wiring diagrams

.4 Schematic and control diagrams

.2 Transformers with complete technical data including size, weight, noise rating, percentage impedances, taps, class of insulation, cable termination data, details of special features etc. Also all data on transformer support and/or suspension systems, fan control diagrams and descriptions, etc.

.3 Lighting fixtures dimensions, weights, etc. complete with photometric data, lamp information, ballast information and internal wiring diagrams, voltage and sound ratings.

.4 All wiring devices including receptacles and switches.

.5 All equipment and wiring data of low voltage switching system, and exterior lighting controls, including control and interconnection schematics and descriptions of operation.

.6 All component information, wiring diagrams and system operation of all communication systems such as:

.1 Cable TV

.2 HDMI System

.3 LAN Network

.7 Schedule of all nameplates.

.4 Construction Clarification Drawings: Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals, and as follows:

.1 Prepare drawings in conjunction with all trades concerned, showing sleeves and openings for passage through floor structure.

.2 Prepare composite construction drawings, fully dimensioned in metric, indicating cable, conduit, bus duct, shafts, mechanical and electrical equipment rooms, ceiling spaces and all other critical locations to avoid a conflict of trades. Base equipment drawings upon shop drawings and include, but do not necessarily limit to, all details pertaining to clearances, access, sleeves, electrical connections, location and elevation of pipes, ducts, conduits, etc., obtained from consultation with and agreement of the trades involved.

.3 Prepare a complete set of drawings showing all conduit runs and wiring using the information provided in riser diagrams, circuit numbers on floor plans, relevant details, specifications and with reference to drawings of other trades.

.4 Submit a schedule of construction drawings not later than three weeks after the award of Contract, indicating the anticipated date when the drawings will be submitted for approval.

1.6 PROJECT CLOSEOUT SUBMISSIONS

.1 Record Drawings and Specifications (As-Builts): Submit record drawings provide the following as a minimum:

- .1 Inverts of all services entering and leaving the building and at property lines;
- .2 Exact dimensioned location of all services embedded in the structure;
- .3 Exact dimensioned location of all services left for future work;
- .4 All changes to the work during construction and ensure that corrections are made on floor plans and riser diagrams, etc, as applicable.
- .5 All conduit and wiring and all deviations from circuit numbers shown on the Contract Documents.
- .6 For the sake of clarity, produce separate lighting, power and communications drawings and show all conduit and wiring.
- .7 Revise or draw new riser and connection diagrams as necessary to indicate actual site conditions.
- .8 Revise motor control schedules, motor control centre elevations and schematic as necessary.

.2 Operation and Maintenance Manuals: Submit operation and maintenance data manuals as follows:

- .1 Manuals shall be in binders, clearly identified and separated, and prepared as follows:
  - .1 Manual content may all be accommodated in one binder or a series of binders depending upon the size of the project.
  - .2 Each binder shall only be loaded so that the binder in its unexpanded state will still have approximately 10% spare capacity for future material.
  - .3 Mark multiple binders with Volume 1, Volume 2, etcetera, if more than one binder is required.
- .2 Configure the manual similar to the following:

Index Sheet

Section 1: List of Major Electrical Materials/Manufacturer/Local Supplier.

Section 2: Low Voltage Power Distribution:
- Subsection 2.1: System Description
- Subsection 2.2: Maintenance Instructions
- Subsection 2.4: 240V Distribution Panel Shop Drawings
- Subsection 2.5: 120/240V Panelboard Shop Drawings
- Subsection 2.6: Transformer Shop Drawings
- Subsection 2.7: Disconnect Switch Shop Drawings
- Subsection 2.8: Panelboard – Load Balance Readings

Section 3: Motor Control:
- Subsection 3.1: System Description
- Subsection 3.2: Maintenance Instructions
- Subsection 3.3: Loose Motor Starter Shop Drawings
- Subsection 3.4: Manual Motor Starter Shop Drawings
- Subsection 3.5: Motor-Load Readings

Section 4: Lighting and Controls:
- Subsection 4.1: System Description
- Subsection 4.2: Maintenance Instructions
- Subsection 4.3: Lighting Fixture Schedule
- Subsection 4.4: Light Fixture Shop Drawings
- Subsection 4.5: Low Voltage Switching Shop Drawings
- Subsection 4.6: Dimming System Shop Drawings

Section 5: Fire Alarm System
- Subsection 5.1: System Description
- Subsection 5.2: Maintenance Instructions
- Subsection 5.3: Fire Alarm Shop Drawings
- Subsection 5.4: Manufacturer's Report

Section 6: Telecom Cabling System
- Subsection 6.1: Shop Drawings
- Subsection 6.2: Test Reports

Section 7: Wiring Devices
- Subsection 7.1: Switch and Receptacle Shop Drawings
- Subsection 7.2: Dimming Switch Shop Drawings

Section 8: Miscellaneous Equipment and Systems
- Subsection 8.1: Multi-Service Outlet Shop Drawings

Section 9: Certificates and Reports
- Subsection 9.1: Warranty Certificate
- Subsection 9.2: Final Electrical Inspection Report
- Subsection 9.3: Commissioning and Testing Report

.3 Prepare operation and maintenance manuals to provide complete information, so that the Owner's maintenance personnel have easy access to:

.1 All pertinent data on each piece of equipment, how it fits into the building systems and how it operates

.2 Complete data on recommended maintenance procedures, maintenance intervals and maintenance tools

.3 Complete information on the details and the duration of the Warranty

.4 Complete list of spare parts, clearly identifying those spare parts that the Owner should hold in his stores at all times

.5 Names of the closest servicing agents and suppliers. Provide complete addresses, contact persons' names and phone numbers, especially for emergency service

.6 All approved Shop Drawings

.7 All test results

.8 Provide divider tabs to separate the various index sections.

.1 Use dividers with 45 mm coloured tabs to divide each major system section.

.2 Use dividers with 35 mm clear tabs to sub-divide within each major system section.

.9 The final index is subject to change as defined by the final project requirements

.10 The final index will be subject to approval by the Consultant

.4 As a minimum, provide operation and maintenance information for the following identified types of equipment, containing information listed above and additional specific information as noted in following table and items:

Equipment Description	Secondary Switchgear	Transformers	Distribution Panels and Branch Circuit Panels	Circuit Breakers and Fuses		Data collection and energy monitoring		Lighting Fixtures	Lighting Dimming Control Systems	Motor Controls	Fire Alarm, Communication and Security Systems and other miscellaneous systems
Approved shop drawings	X	X	X	X		X		X	X	X	X
Complete list of materials or parts	X	X	X			X		X	X	X	X
Complete description of operation	X	X				X					X
Complete wiring and control diagrams, and complete description of controls.	X	X	X			X			X	X	X
Complete maintenance information and instructions.	X	X	X	X		X		X		X	X
All test results and certificates.	X	X	X	X		X		X	X	X	X
Warranty.	X	X	X	X		X		X	X	X	X

Equipment Description	Secondary Switchgear	Transformers	Distribution Panels and Branch Circuit Panels	Circuit Breakers and Fuses		Data collection and energy monitoring		Lighting Fixtures	Lighting Dimming Control Systems	Motor Controls	Fire Alarm, Communication and Security Systems and other miscellaneous systems
Detailed information on all components, which shall be clearly identified and referenced on drawings.						X				X	
Nameplate data.		X									X

.5 In addition to the above information, provide the following component specific information for the following items:

.1 Circuit Breakers and Fuses:

.1 Pertinent information on circuit breakers and fuses will be included with the relevant items, such as switchgear, panel boards, motor control equipment, auto-transfer switches, and related equipment.

.2 Complete information on construction and operation.

.3 Complete technical data on interrupting capacities, trip curves, and similar data.

.4 Control diagrams and description of controls, where pertinent.

.2 Lighting Fixtures:

.1 Specific catalogue information on:

.1 Lighting Fixtures

.2 Lamps

.3 Ballasts

.4 Wiring Diagrams

.2 Complete list of parts, including lamps, ballasts and other related components.

.3 Motor Controls:

.1 Complete information on over current trips, instrument transformers and relays, etc. and the selected settings.

1.7 QUALITY ASSURANCE

.1 Standards Organizations: Reference is made to the following standards organizations within the text of these specifications:

.1 American National Standards Institute (ANSI)

.2 Canadian Standards Association (CSA)

.3 Electrical Equipment Manufacturers Advisory Council (EEMAC) of the Electro-Federation of Canada (EFC)

.4 Institute of Electrical and Electronic Engineers (IEEE)

.5 Insulated Cable Engineers Association (ICEA)

.6 National Electrical Manufacturers Association (NEMA)

.7 National Fire Protection Agency (NFPA)

.2 Regulatory Requirements: Materials used for this Project shall carry labels indicating CSA, CUL and UL approval and conform to EEMAC Standards where specifically specified; equipment wiring and wiring devices shall meet the requirements of CSA C22.1, Safety Standard for Electrical Installations:

.1 The requirements of the Canadian Electrical Code shall take precedence in any instance in this Specification or on the Drawings where material or construction methods called for are less than minimum requirements of the Code.

.2 Supply and install materials, and perform the work as though called for to minimum Code standards.

.3 Performance Requirements: Comply with the requirements of all provincial and local authorities having jurisdiction, and as follows:

.1 Perform work on overhead and underground systems in accordance with CSA C22.3 Series of Standards except where specified otherwise as exceeding the minimum requirements contained in the standards.

1.1 **UTILITY POWER SERVICE**

1.1.1 Provide all necessary conduit, wire, etcetera for a complete service connection.

1.1.2 Coordinate service requirements and connection with the service provider.

1.1.3 Provide pull strings in all empty conduits.

1.2 **TELEPHONE AND CABLE TV SERVICE**

1.2.1 Provide service conduits to the designated service point as required by the local service providers. All service conduits to be minimum 103mm or as required by the service providers.

1.2.2 Coordinate service requirements and connection with the service providers.

1.2.3 Provide pull wires in all empty conduits.

Part 2 Products

2.1 MATERIALS

.1 Where materials or equipment are specified by the technical description only without reference to manufacturer or trade name, these shall be of the best commercial quality obtainable for the purpose.

.2 Where materials are specified by reference to “Acceptable Materials” or similar words, use any one of the materials listed maintaining same source of supply and manufacture where related products are used in a system, as follows:

.1 Where equipment or materials are specified by manufacturer or trade name, this is for the purpose of establishing a standard of quality and Subcontractors quoting on materials other than those specified or approved for substitution do so at their own risk.

.2 Manufacturers named as acceptable materials are required to comply completely with the intent of the specifications, even if this implies custom made products or standard products modified to comply.

.3 Naming an acceptable material does not imply that a standard product of the manufacturer will be accepted. If it deviates from the specifications in any way whatsoever, the standard product will not be approved for use on the project.

.4 Any substitute material or equipment installed without prior approval or acceptance from the Consultant will be removed and replaced at this Contractor's expense with the acceptable material selected by the Consultant.

.3 Material and equipment of any particular service shall be by one manufacturer only. Do not indiscriminately mix equipment of different manufacturers.

.4 Materials installed in hazardous locations, shall be suitable for area classifications defined.

2.2 FIRESTOPPING AND SMOKESEALS.

.1 Coordinate detailed fireproofing requirements of Divisions 25, 26, 27 and 28 with scope-of-work requirements for Section 07 84 00, and provide quantities, types of openings, and penetrating materials to Section 07 84 00 so that the correct fireproofing details can be designed and detailed; laying-in of wiring and communications cabling may be affected by the requirements of Section 07 84 00.

.2 Cooperate with the Construction Manager and Subcontractor responsible for firestopping and smokeseals; Divisions 25, 26, 27 and 28 is not responsible for the supply or installation of firestopping and smokeseal materials.

2.3 FASTENINGS AND SUPPORTS

.1 All equipment loads imposed on the building structure must be reviewed by the Consultant.

.2 All supports and attachments to the building structure are the Contractor's responsibility and shall be designed by a professional engineer registered in the Province of the Work.

Part 3 Execution

3.1 WORKMANSHIP

.1 Work shall be performed in a professional and workmanlike manner in accordance with applicable building codes and professional industry standards, and comply with the minimum standards set forth in the Canadian Electrical Code, except where these specifications indicate a higher degree of workmanship in excess of the minimum requirements including, but not limited to, the following:

.1 Exposed conduit runs including runs in ceiling spaces shall be perpendicular or parallel to the building lines.

.2 Panels, boxes, covers, and other wall mounted items shall be installed plumb and level using spirit levels and plumb bobs.

.3 Immediately replace bolts or nuts that have been "stripped" or "cross threaded".

.4 Do not connect dissimilar metals together.

.5 Do not use corrosive materials in wet or damp locations.

.6 Conceal all electrical rough-in in public areas, unless specific request is made in writing to the Consultant stating which adjustments are required, and approval is granted before proceeding with work.

3.2 PROTECTION

.1 Protect all finished and unfinished work of this and other Divisions from damage due to carrying out of this work.

.2 Keep equipment dry and clean at all times.

.3 Cover openings in equipment and materials.

.4 Be responsible for and make good any damage caused directly or indirectly to walls, floors, ceilings, woodwork, brickwork, finishes, etc.

.5 Store switchgear, transformers and sensitive electrical equipment in a dry heated location.

3.3 INSPECTION OF WORK/TESTS

.1 Before energizing any portion of the electrical system, perform megger tests on all feeders and branch circuits. Results shall conform to Canadian Electrical Code, and be in accordance with the requirements of the authorized inspection authority and the Consultant.

.2 Perform all necessary tests to confirm the correct operation of all systems including but not necessarily limited to the following:

.1 Power distribution and generation including testing and coordination of all protective devices by the relevant manufacturers. Submit manufacturer's coordination study to Consultant for review, at the same time as switchgear shop drawings.

.2 Test all meters, control devices, breaker auxiliary contacts and operation, meter scaling and associated instrument transformer ratios including remote control devices.

.3 Circuit breakers employing electrical trip and/or electrical close functions shall be tested to ascertain correct operation including any interlocking devices that may be part of that function.

.4 Lighting systems and controls.

.5 Motor controls.

.6 All systems, including fire alarm system, all communications systems, uninterruptable power/inverter systems and emergency power generation, etc.

.7 Grounding.

.3 Submit letters from manufacturers of all systems indicating that they have checked, tested and verified the respective systems and are satisfied with the methods of installation, connection and operation.

.4 Inform the consultant well in advance of the dates when the tests will be carried out.

.5 Submit all test results in duplicate to the consultant for approval.

.6 Upon completion of the building and immediately prior to final inspection and takeover, check load balance on all feeders and at distribution centres, panels, etc. Conduct tests by turning on all possible loads in the building and checking the load current balance. If load unbalance exceeds 15%, reconnect circuits to balance the load.

.7 Perform voltage checks throughout the building and if directed by the Consultant, adjust the transformer tap settings.

.8 In cooperation with the mechanical sub-contractor, take clip-on ammeter readings on all phases of all mechanical equipment motors with motors operating

3.4 ELECTRICAL SYSTEMS IDENTIFICATION

.1 Equipment Identification:

.1 Panels, pull boxes, disconnect switches, starters, motor control centres, substations, switchgear, and transformers shall be prefinished in accordance with colour code specified herein.

.2 In addition, identify electrical equipment with nameplates.

.3 Nameplates: Lamacoid 3 mm thick plastic engraving sheet, black face, white core, mechanically attached:

.1 Nameplate sizes to correspond to the size of the equipment to be identified.

.2 Submit schedule of nameplates, size of each nameplate, wording and corresponding size of letters for approval.

.4 Identify also, the following with nameplates:

.1 Panels: Identify power panels, isolated power panels, distribution panels and branch circuit panels as indicated on drawings and indicate main voltages and current ratings. Provide typed panel directories.

.2 Transformers: Indicate capacity, primary and secondary voltages.

.3 Disconnect switches, starters, contactors, and motor control centres: Indicate equipment being controlled and voltage.

.4 Terminal cabinets and pull boxes: Indicate system and voltage.

.5 On/Off switches: Indicate areas being served.

3.5 SCHEDULE OF VALUES

.1 Include the following items in the schedule of values submitted prior to first application for payment:

.1 Electrical Service

.2 Telephone Service

.3 Site Lighting and other site electrical installations

.4 Power Transformers

.5 Panel boards

.6 Conduit and Fittings

.7 Outlet Boxes

.8 Branch Circuit Wiring

.9 Luminaires
.10 Lamps
.11 Wiring Devices
.12 Mechanical Equipment Connections
.13 Miscellaneous

.2 This Schedule of Values may be modified to suit the scope of the project; confirm final configuration with the Consultant before first application for payment.

END OF SECTION

SECTION 26 05 06

COMMON MOTOR REQUIREMENTS FOR ELECTRICAL

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 20 05 00 – Common Work Results for Mechanical: Motors required for mechanical equipment.

.2 Section 20 05 13 – Common Motor Requirements for Mechanical Equipment

.3 Section 26 05 00 – Common Work Results for Electrical: General electrical provisions and coordination requirements.

.4 Section 26 05 28 – Conduits , Outlet Boxes and Fittings for Electrical Systems

.5 Section 26 05 19 – Electrical Power Conductors and Cables: Variable frequency drive cables connecting between variable frequency drives and motors.

Part 2 Products

2.1 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

.1 GE Canada

.2 Toshiba Industrial Products

.3 Reliance Electric

.4 TECO-Westinghouse

.5 Grundfos

.6 Unico

2.2 MOTORS

.1 Motors 370 W or Less: 120 V, single phase, 60 Hz.

Part 3 Execution

3.1 INSTALLATION

.1 Confirm coordination required, final connections, loads and locations of motors prior to installation.

.2 Motors for mechanical equipment installed by that trade; location of motors, conduit and connection points shown for equipment supplied by mechanical are for estimating purposes only.

.3 Provide line voltage connections for all mechanical equipment.

END OF SECTION

SECTION 26 05 07

MECHANICAL EQUIPMENT CONNECTIONS

Part 1 General

1.1 SUMMARY

.1 Provide complete electrical power connections for mechanical equipment.

1.2 RELATED REQUIREMENTS

.1 Section 20 30 00 – Pumps for Mechanical Systems

.2 Section 21 10 00 – Water Based Fire Suppression System

.3 Section 23 73 13 – Modular Indoor Central Station Air Handling Units

.4 Section 23 34 00 – HVAC Fans

.5 Section 26 05 10 – Common Work Results for Electrical

.6 Section 26 05 28 – Conduits, Outlet Boxes and Fittings for Electrical Systems

.7 Section 26 05 19 – Electrical Power Conductors and Cables

.8 Section 26 28 19 – Motor and Circuit Disconnects

Part 2 Products

2.1 MATERIALS

.1 Include motor starters, disconnects, conduits, wire fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical equipment.

2.2 EXTERIOR EQUIPMENT

.1 All equipment mounted on the exterior of the building shall be weatherproof.

Part 3 Execution

3.1 POWER WIRING

.1 Install motor feeders, starters disconnects and associated equipment and make connections to all motors.

.2 Install wiring to starters furnished with equipment and from starters to motors and equipment.

3.2 CONTROLS

.1 Wire and connect thermostats for force flows and unit heaters.

.2 Wire and connect electrical interlocks for starters supplied by this division.

3.3 SPRINKLER SYSTEM

.1 Wire and connect flow and tamper switches to fire alarm control panel.

.2 Wire and connect preaction valves to fire alarm control panel.

END OF SECTION

SECTION 26 05 19

ELECTRICAL POWER CONDUCTORS AND CABLES

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 10 – Common Work Results for Electrical

.2 Section 26 05 53 – Electrical Identification Systems

.3 Section 26 05 28 – Conduits, Outlet Boxes and Fittings for Electrical Systems

.4 Section 26 05 06 – Common Motor Requirements for Electrical

.5 Section 26 05 07 – Mechanical Equipment Connections

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 0.3-09, Test Methods for Electrical Wires and Cables

.2 CAN/CSA C22.2 No. 38-05, Thermoset-Insulated Wires and Cables (Tri-National standard, with UL 44 and ANCE NMX-J-451)

.3 CAN/CSA C22.2 No. 75-08, Thermoplastic-Insulated Wires and Cables

.4 CAN/CSA C22.2 No. 198.2-05, Underground Cable Splicing Kits

.5 CSA C22.2 No. 203.1-94 (R2004), Manufactured Wiring Products

.2 Underwriters Laboratories Canada (ULC):

.1 CAN/ULC S102.4-07 Standard Method of Test for Fire and Smoke Characteristics of Electrical Wiring and Cables.

.3 National Fire Protection Agency (NFPA):

.1 NFPA 70: National Electrical Code

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate fire alarm system wiring requirements with Division 28, schedule and perform work so as not to create any delays to performance of work of this Section.

Part 2 Products

2.1 PERFORMANCE REQUIREMENTS

.1 Wiring Guidelines:

.1 Lighting Circuits Controlled from Dimmer: Provide separate neutral wire for every circuit or dimming channel; minimum 14 AWG for neutral wire.

.2 Branch Wiring: Size wire for branch circuits to limit voltage drop from the panelboard to the furthest receptacle at 3% with a test current of 80% of branch circuit breaker rating.

2.2 MATERIALS

.1 Building Wiring: 98% conductivity copper conductors; size as indicated with 600 V insulation, cross linked thermosetting polyethylene material rated RW90.

.2 Branch Circuit Wiring:

.1 Conductors smaller than 14 AWG not permitted

.2 Wire for 120 volt circuits using separate neutrals, minimum wire sizes for the phase conductor as follows:

.1 14 AWG for runs up to 20 m

.2 12 AWG for runs of 20 m to 35 m

.3 Use wire size that complies with requirements for Branch Wiring listed above for runs in excess of 35 m.

.4 Use minimum 14 AWG for homeruns.

.3 Control Circuit Wiring:

.1 Minimum 18 AWG

.2 Wire types same as for building wiring listed above.

.4 Conduit as specified in Section 26 05 28.

.5 Connectors:

.1 Pressure type connectors, fixture type splicing connectors, cable clamps as required.

.2 Connectors for conductors 4 AWG or larger: FCI/Burndy Hylug Type YA or acceptable alternate; lugs using threaded type pressure connections will not be acceptable.

.3 Connectors for conductors up to and including 6 AWG: Scotchlok spring type.

Part 3 Execution

3.1 INSTALLATION

.1 Conductor length for parallel feeders must be identical.

.2 Lace or clip groups of feeder conductors at all distribution centres, pull boxes, wire ways, and other locations.

.3 Follow manufacturer's recommended methods of installation and ground at one end only for cables sized 1/0 or larger, for single conductor cables.

.4 Do not install PVC jacketed cables in return air plenums, unless plenum cables are specially rated.

.5 Lace wire and cable neatly in switchboards, panel boards, cabinets, wire ways and other similar enclosures.

3.2 COLOUR CODING SCHEDULE

.1 Colour code throughout building, same colour for same phase throughout, by insulation colour or permanently applied colour banding at all distribution centres, panels and outlet boxes.

.2 Use following colour codes:

Wire Type	Colour
Equipment Grounding Conductor	Green
Neutral Conductor	White
Standard 120/240 V Phase Wires	In accordance with CEC and NEC

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

Part 1 General

1.1 SUMMARY

.1 This section includes requirements for supply of a complete grounding system as indicated, installed in accordance with requirements of the Canadian Electrical Code, and electrical inspection Authority Having Jurisdiction.

1.2 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical

1.3 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

.1 CAN/CSA B27-M87 (R2008), Installation Code for Lightning Protection Systems

.2 CSA C22.2 No. 0.4-04, Bonding of Electrical Equipment, including updates

.3 CSA C22.2 No. 41-07, Grounding and Bonding Equipment

.4 CSA T527-94 (R1999), Grounding and Bonding for Telecommunications in Commercial Buildings

.2 American National Standards Institute/Institute of Electrical and Electronics Engineers (IEEE).

.1 IEEE 837-2002, Qualifying Permanent Connections Used in Substation Grounding

.3 National Fire Protection Agency (NFPA):

.1 NFPA 70: National Electrical Code

Part 2 Execution

2.1 INSTALLATION

.1 Install complete, permanent, continuous system and circuit, equipment, grounding systems including electrodes, conductors, connectors, accessories, as indicated, to conform to requirements of Consultant and local authorities having jurisdiction over installation. Install ground conductors in all raceways.

.2 Install connectors to manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Use mechanical connectors for grounding connections to equipment provided with lugs.

.5 Soldered joints not permitted.

.6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Bonding conductor shall be installed within the conduit.

.7 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.8 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.9 Bond single conductor, metallic armoured cables to ground at supply end, and provide non-metallic entry plate at load end and run separate ground conductor.

.10 Ground all low tension conduits that terminate in telecom rooms/closets/panels and at cable trays, using grounding clamps or grounding bushings.

.11 Equipment Grounding: Install grounding connections from the equipment ground bus to typical equipment included in, but not necessarily limited to the following list. Service equipment, transformers, switch gear, panels, duct systems, frame of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

2.2 SITE QUALITY CONTROL

.1 Measure ground continuity and grid resistance with an earth test megger and install additional ground rods and conductors as required until resistance to ground complies with Code requirements.

.2 Conduct tests before energizing the system and disconnect ground fault indicators during tests; include costs for tests in contract price.

END OF SECTION

SECTION 26 05 28

CONDUITS, BOXES AND FITTINGS FOR ELECTRICAL SYSTEMS

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for supply and installation of conduit, outlet boxes and fittings for electrical systems and other low voltage systems; control, data and communications systems; and alarm and security systems coordinated by this Section.

1.2 RELATED REQUIREMENTS

.1 Other sections of the specification requiring conduit refer to this section; coordinate requirements of referencing sections including, but not limited to the sections listed below.

.2 Section 06 10 00 – Rough Carpentry: Conduit built into wood framed construction.

.3 Section 07 84 00 – Firestopping and Smokeseals

.4 Section 26 05 10 – Common Work Results for Electrical

.5 Section 26 05 19 – Electrical Power Conductors and Cables

.6 Section 26 05 53 – Electrical Identification Systems

.7 Section 26 20 13 – Switches, Receptacles, Plates and other Devices

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM F512-06, Standard Specification for Smooth-Wall Poly Vinyl Chloride (PVC) Conduit and Fittings for Underground Installation

.2 Canadian Standards Association (CSA), Including Updates:

.1 CAN/CSA C22.2 No.18.1-04 (R2009), Metallic Outlet Boxes (Tri-National standard, with ANCE NMX-J-023/1 and UL 514A)

.2 CSA C22.2 No.18.2-06, Nonmetallic Outlet Boxes

.3 CAN/CSA C22.2 No.18.3-04, Conduit, Tubing and Cable Fittings (Tri-National standard, with ANCE NMX-J-017 and UL 514B)

.4 CSA C22.2 No.18.4-04, Hardware for the Support of Conduit, Tubing, and Cable (Bi-National standard, with UL 2239)

.5 CSA C22.2 No.40-M1989 (R2004), Cutout, Junction and Pull Boxes

.6 CAN/CSA C22.2 No.45.1-07, Electrical Rigid Conduit - Steel, including updates

.7 CSA C22.2 No.56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit

.8 CSA C22.2 No.83-M1985 (R2008), Electrical Metallic Tubing

.9 CSA C22.2 No.211.2-06, Rigid PVC (Un-Plasticized) Conduit, including updates

.10 CSA C22.2 No.227.2.1-04, Liquid-Tight Flexible Nonmetallic Conduit, including updates

.3 National Fire Protection Agency (NFPA):

.1 NFPA 70: National Electrical Code

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordination of this Section is required since drawings are diagrammatic and include only references to known multi-service outlet configurations and do not purport to include full architectural or structural elements and possible conduit and outlet box configurations required by specific applications or equipment:

.1 Placement of Conduits and Outlet Boxes: Coordinate work results for installation of conduit and outlet boxes concurrent with work associated in listed related requirements and others affected by work of this Section.

.2 Low Voltage, Control and Security Systems: Coordinate requirements for cable television systems and communication systems; electronic door controls, security systems, card access systems; and sound masking and audio systems; and other low voltage systems and provide products appropriate to the systems specified.

.3 System Installation: Include required conduit, outlet boxes, fittings and fastenings required for wired systems and that are necessary for a complete and functioning installation.

Part 2 Products

2.1 MANUFACTURERS

1.1.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section.

2.2 CONDUIT MATERIALS

.1 Electrical Metal Tubing (EMT): Steel galvanized with reamed ends, manufactured in accordance with CSA 22.2 No.83 including the following:

.1 Couplings:

.1 Conduits 53 mm Ø and Larger: Steel set screw type

.2 Conduits Less than 53 mm Ø: Zinc die cast or steel set screw type

.2 Connectors:

.1 Conduits 53 mm Ø and Larger: Steel set screw type with nylon insulated throats

.2 Conduits Less than 53 mm Ø: Zinc die cast or set screw type with nylon insulated throats

.2 PVC Conduit: Rigid Schedule 40, in accordance with ASTM F512 CSA and/or UL

.3 Liquid Tight Flexible Conduit: Flexible conduit, with overall PVC jacket and connectors having liquid tight nylon isolated with 'O' ring gasket and retainer, in accordance with CSA C22.2 No.227.2.

.4 Fittings: Fittings such as condulets, conduit straps, hangers, clamps, mounting brackets and other appurtenances necessary for solid support and attachment of conduits, boxes and raceways to the building structure shall be supplied and installed to the approval of the Consultant; perforated steel strapping, tie wire or field made hangers and fittings will not be permitted.

.5 Sealant: Butyl, non-hardening, solvent release type conforming to ASTM C1311.

2.3 OUTLET BOX MATERIALS

.1 Metal Outlet Boxes:

.1 CSA and UL labelled and certified components.

.2 Fabricated from pressed sheet steel, galvanized to Z275

.3 Blanked conduit openings

.4 Sized for 16 mm or 21 mm conduit as required, with attached lugs

.5 Box Sizes:

.1 100 mm octagonal or square box

.2 100 mm x 54 mm wide utility box

.6 Depth:

.1 38 mm standard depth

.2 54 mm for applications requiring additional volume

.7 Basis-of-Design Materials: Thomas & Betts Steel City Boxes and Covers (SC) in the following configurations as required to suit project conditions:

.1 Ceiling Boxes: 54171 or 72171 Series

.2 Boxes for Framed Construction: 58361 or 72171 Series

.3 Gang Boxes and Multi-Service Boxes: #G or H#BD Series

.2 Coverplates:

.1 Surface Mounted Boxes: Same construction and manufacturer as outlet boxes having surface cover configured for switching or receptacle requirements indicated; include weatherproof covers to match boxes for exterior installations and for interior installations where wetting or dust penetration protection is a requirement.

.3 Air/Vapour Hats: Polyethylene, minimum 0.40 mm thick, with minimum 25 mm wide flanges, designed to be installed over electrical boxes and provide an effective air/vapour retarder when sealed with flexible sealant materials specified in this Section.

.4 Accessories: Box supports, channel bars, box and channel fasteners, partitions, grounding devices and cable protectors, and other items required for a complete installation.

Part 3 Execution

3.1 CONDUIT INSTALLATION

.1 Install conduit concealed in all areas where possible except mechanical and electrical rooms. Material used shall be as follows:

.2 Rigid PVC: As an alternate to rigid galvanized conduit up to and including 103 mm trade size (except for fire alarm system):

- .1 All areas exposed to the weather.

.3 Electrical Metallic Tubing:

- .1 All indoor locations.

.4 Flexible Conduit:

- .1 Final single drop connection to lighting fixtures.

.5 Liquid Tight Flexible Conduit:

- .1 Final connections to motors, transformer and other equipment subject to vibration or movement.
- .2 If required, final connections to equipment located in damp locations.

.6 Use EMT conduit for all wiring installation except where EMT conduit is:

- .1 Subject to damage
- .2 Exposed to weather
- .3 Not allowed by NEC.

.7 Install and attach surface mounted conduit with clamps for exposed as well as in-ceiling runs, which shall be parallel or perpendicular to building lines; use rigid galvanized steel conduit for exposed installations up to 3050 mm above floor where there is a risk of mechanical damage.

.8 Install rigid PVC or galvanized steel conduit in concrete slabs and underground; encase conduits below ground in minimum 78 mm concrete all around if not protected by concrete slab or asphalt pavement.

.9 Make connections to mechanical motors and equipment such as transformers with PVC jacketed flexible conduit and liquid tight connectors; minimum size 16 mm for motor connections, 10 mm flexible conduit only permitted for fixture and control wiring; of sufficient length to avoid transmission of vibration.

.10 Install conduit free from dents and bruises; plug ends to prevent entry of dirt or moisture.

.11 Clean out conduit before installation of conductors.

.12 Install all wiring in conduit with number of wires per conduit and size of conduit, as indicated or required by Code where the size indicated is inadequate; do not combine homeruns without the Consultant's approval.

.13 Alter routing to avoid structural obstructions keeping crossovers to a minimum.

.14 Seal conduit with sealant where conduits leave heated area and enter unheated area.

.15 Provide necessary flashing making watertight joints where conduits pass through roof or waterproofing membranes

.16 Install CSA approved expansion fitting complete with grounding jumper where conduits cross building expansion joints with bend or offset in conduit adjacent to building expansion joint where conduit is installed above suspended ceilings.

.17 Install a continuous nylon cord, 180 kg test, in each conduit left empty and identify the nylon cord at both ends; cap all empty conduits and clearly identify in accordance with Section 26 05 53.

.18 Seal conduits with ULC approved firestopping system in accordance with Section 07 84 00 where conduits pass through fire separating floors, ceiling or walls.

.19 Under no circumstances shall conduits be installed surface mounted across an open floor area.

.20 Conduit for fire alarm system and exterior underground wiring shall be minimum 16 mm in size.

.21 Use conduit racks to support conduit runs.

.22 Terminate low tension conduit systems with an insulated bushing; bushings shall be insulated grounding type when conduit terminates in telecom closets, rooms or cable trays.

3.2 OUTLET BOX INSTALLATION

.1 Install outlet boxes flush mounted in exposed areas except electrical and mechanical rooms.

.2 Mounting may be surface in concealed areas such as above suspended ceilings.

.3 Adjust position of outlet boxes in finished masonry walls to suit course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes.

.4 Where two gang box required for single gang device, provide special plate with device opening in one gang and blank second gang.

.5 Install blank cover plates on boxes without wiring devices.

1.1.2 Do not install outlet boxes back-to-back in walls and as follows:

1.1.2.1 Non-Acoustic Walls: Allow minimum 150 mm horizontal clearance between boxes.

1.1.2.2 Acoustically Rated Walls: Offset outlet boxes by 610 mm separated by one stud space or gypsum board baffle; coordinate with Section 09 21 16.

1.1.2.3 Party Walls: Offset outlet boxes by 1000 mm separated by two stud spaces and gypsum board baffles; coordinate with Section 09 21 16.

.6 Allow for a variation of 3050 mm from locations shown without extra cost; confirm final location before installation.

.7 Use gang plates where two or more outlets are located together:

1.1.2.4 Align all cover plates parallel and perpendicular to building lines.

1.1.2.5 Provide blank cover plates for boxes without wiring devices.

1.1.2.6 Where lighting dimmers are shown, use separate single gang boxes only.

3.3 OUTLET BOX MOUNTING HEIGHTS

.1 Mounting heights from finished floor to centre line of device are generally as listed in the table below, unless specifically indicated otherwise on drawings or details:

Location	Distance
Outlet boxes above counters or splash backs	225 mm above counter
Outlet boxes above base board heaters and radiation cabinets	200 mm above enclosure
General receptacles, TV and communications outlet boxes	400 mm
Receptacles in mechanical and shop areas; washer and dryer outlet boxes	950 mm
Switches, dimmers, push buttons	1220 mm
Wall mounted communications outlet boxes, fire alarm pull stations	1350 mm
Panel boards, annunciator panels, etcetera	1900 mm to top of panel
Heights as above or in bottom of nearest block or brick course.	

.2 Coordinate with Architectural elevation drawings and specifications and reconfirm mounting heights and positions before roughing-in any outlet boxes, i.e.: outlet boxes placed in the middle of feature walls will not be acceptable.

.3 Confirm heights of counters, millwork, work benches and other counter top assemblies and verify that outlet boxes are located at the correct rough-in location.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

1 General

1.1 RELATED REQUIREMENTS

1.1.1 Section 26 05 28 – Conduits, Outlet Boxes and Fittings for Electrical Systems

2 Products

2.1 CONDUIT SUPPORTS

2.1.1 Single runs: Galvanized conduit straps or ringbolt type hangers.

2.1.2 Vertical runs: Channel support with conduit fittings/clamps.

3 Execution

3.1 SUPPORT SPACING

3.1.1 Comply with maximum support spacing stated below.

3.1.2 Where building structure, equipment details or mass dictate, spacings shall be closer.

3.1.3 Spacings:

3.1.3.1 Bus duct horizontal 1.8 m $^{o}/_{c}$ and at fittings.

3.1.3.2 Conduit runs: Vertical racks, 1.5 m $^{o}/_{c}$.

3.1.3.3 Conduit runs: Horizontal racks, 1.5 m $^{o}/_{c}$ and at all changes in direction.

3.2 INSTALLATION

3.2.1 Install to maintain head room, neat mechanical appearance, and to support equipment loads.

3.2.2 Do not secure equipment or supports from: Bottom of precast concrete tees, bottom of cast-in-place concrete pan webs, from the edge of the chords of open web steel joist; from suspended gypsum board ceilings.

3.2.3 The Contractor is responsible for the design of all connections between structure and support systems, and must ensure that support systems are structurally sound.

3.2.4 Retain a Professional Consultant, Registered in the province of the Work, to design connections and support systems. Provide all design notes and calculations to the Consultant for his review upon request.

3.2.5 Fasten exposed conduit or cables to building construction or support system using straps.

3.2.5.1 One-hole malleable iron or steel straps to secure surface conduits and cables 38 mm diameter and smaller.

3.2.5.2 Two-hole steel straps for conduits and cables larger than 38 mm.

3.2.6 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

3.2.7 Do not use wire lashing or perforated straps to support or secure raceways or cables.

3.2.8 Do not use supports or equipment installed for other trades for conduit or cable support except with approval of Consultant.

3.2.9 Install fastenings and supports as required for each type of equipment cables and conduits, in accordance with manufacturer's installation recommendations.

END OF SECTION

SECTION 26 05 53

ELECTRICAL SYSTEMS IDENTIFICATION

Part 1 General

1.1 SUMMARY

.1 This Section covers the identification of various electrical equipment, wire and conduit using:

- .1 Voltage Markers
- .2 Equipment Tags and Nameplates
- .3 Chart and Directory Frames
- .4 Custom and Standard Applied Labels

.2 This section will identify and label the systems, conduit and equipment to the painting contractor that require painting in the specified colour schemes.

1.2 RELATED REQUIREMENTS

.1 Section 20 05 43 – Mechanical Systems Identification

1.3 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

- .1 CSA C22.1-06, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations

.2 National Fire Protection Agency (NFPA):

- .1 NFPA 70: National Electrical Code

1.4 DESIGN CRITERIA

.1 Wording on nameplates, tags and labels shall be submitted for review and accepted by the Consultant before manufacture.

.2 Identification on nameplates, labels and tags shall be in English

.3 Nameplates for terminal cabinets and junction boxes to indicate system and voltage characteristics.

1.5 SUBMITTALS

.1 Provide the following submittals in accordance with Section 01 00 06 – General Requirements:

- .1 Submit schedule of nameplates, size of each nameplate, wording and corresponding size of letters for approval.
- .2 Submit a complete schedule of all equipment to have identification complete with symbol and description engraved on lamacoid plates.
- .3 Submit manufacturers catalogue literature for each product specified, identifying use for interior or exterior installations.

.4 Submit two labels, indicating type and quality of installed products.

.5 Submit manufacturer's installation instructions indicating special procedures, and installation methods.

Part 2 Products

2.1 MATERIALS

.1 Select identification materials to suit surfaces to which they are being applied including but not limited to:

.1 Exterior Weather Exposed Surfaces

.2 Interior Building Surfaces

.3 Surfaces Exposed to High Temperature or Cryogenic Conditions

.4 Surfaces Exposed to High Humidity Conditions

.5 Surfaces Subject to Wear or Abrasion

2.2 TAGS AND LABELS

.1 Wire Identification Materials: Use one of the following:

.1 Wrap-on strips, pre-numbered.

.2 Slip-on identification bead markers or sleeves, blank or pre-numbered.

.3 Colour Banding Tape: Adhesive backed plastic tape, integrally coloured.

.2 Site Printed Identification Labels: Site-printed, machine-printed, adhesive backed plasticized minimum 13 mm high strip labels colours as indicated in **Error! Reference ource not found.**.

2.3 DIRECTORIES

.1 Provide a typewritten directory for each system identified, minimum size 216 mm x 279 mm, or larger as required to accommodate information requirements.

.2 Mount each directory in an individual metal frame and protect with clear, unbreakable acrylic sheet, permanently mounted.

.3 Provide additional copies for inclusion in each Operating and Maintenance Manual.

2.4 ACCEPTABLE MATERIALS

.1 Subject to compliance with requirements of this section, products that may be incorporated into the Work include, but are not limited to, the following:

.1 Pre-Printed Conduit and Wire Marking Systems:

.1 Brady Signmark

.2 Seton Safety and Identification

.2 Site Printed Identification Labels: Portable label printer and tapes as manufactured by:

.1 Brady Handimark

.2 Brother PT1800

.3 Kroy K2500

Part 3 Execution

3.1 PREPARATION, PROTECTION AND CLEAN-UP

.1 Degrease and clean surfaces to receive identification materials.

.2 Prepare surfaces in accordance with Section 09 91 00 for stencil painting.

.3 Ensure that new and existing equipment and surfaces are carefully covered with tarping, or heavy-duty plastic.

.4 Ensure that spills and splatter on finishes and equipment are cleaned up totally and promptly.

3.2 NAMEPLATE IDENTIFICATION OF EQUIPMENT

.1 Identify equipment with lamacoid nameplates, as indicated in Equipment Identification Schedule.

3.3 PANEL BOARD DIRECTORIES

.1 Identify loads controlled by each over current protective device in each panel board, by means of a typewritten panel board directory.

3.4 COMMUNICATIONS CABLE AND EQUIPMENT LABELLING

.1 Label communication outlets, panels and ports with lamacoid nameplates as specified in Equipment Identification Schedule.

.2 Label each of cables with other ends address using Wire Identification Materials.

.3 Label outlets with labels vertically aligned in each row.

.4 Position panel labels in the same position on each panel.

3.5 COLOUR IDENTIFICATION OF WIRING

.1 Identify No. 4/0 AWG wiring and smaller by continuous insulation colour.

.2 Colour coding shall be in accordance with Canadian Electrical Code, and as follows:

Voltage	Colour
120/240 V, 1 phase	Red, & black

.3 Where multi-conductor cables are used, use same colour coding system for identification of wiring throughout each system.

.4 Maintain phase sequence and colour coding throughout each system.

3.6 NAME/NUMBER IDENTIFICATION OF WIRING

.1 Identify No. 8 AWG wiring and smaller using one of the wire identification materials specified in 2.2.1, or 2.2.2 above.

.2 Type or print on blank wire identification materials using indelible black ink.

.3 Identify each conductor as to panel and circuit, terminal, terminal numbers, system number scheme, and polarization, as applicable.

.4 Wiring terminations, lugs, terminals, and screws used for termination of wiring shall be suitable for either copper or aluminum conductors.

3.7 MANUFACTURERS AND CSA LABELS

.1 Visible and legible after equipment is installed.

3.8 EQUIPMENT IDENTIFICATION SCHEDULE

Equipment	Colour	Nameplate Identification	Lamacoid Nameplate Size
Panelboards	Voltage Colour	Panelboard designation	2
On/Off Switches	N/A	Load controlled	1
Disconnect Switches, Magnetic Motor Starters and Contactors	Voltage Colour	Voltage and equipment controlled and mnemonics	2
Transformers	Voltage Colour	Transformer designation, capacity, secondary and primary voltages	2
Line Voltage Cabinets and Enclosures	Voltage Colour	Designation and voltage	2
Low Voltage Cabinets and Enclosures	System Colour	System name; system name and number if more than one cabinet or enclosure	2
Communication Outlet and Outlet Assemblies	N/A	Major components within cabinets and enclosures	1
		Outlet Designation	1
Communication Panels	N/A	Panel Designation	1
Communication Ports	N/A	Port Designation	1

END OF SECTION

SECTION 26 06 50.21

LIGHTING FIXTURE DATA

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical

.2 Section 26 06 50.16 – Lighting Fixture Schedule

.3 Section 26 50 00 – Lighting

.4 Section 26 50 13 – Lamps

.5 Section 26 50 16 – Ballasts and Accessories

.6 Section 26 51 00 – Interior Lighting

.7 Section 26 56 00 – Exterior Lighting

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 LIGHTING FIXTURE DATA SHEETS

.1 Refer to Lighting Fixture Schedule drawing E-501 for project related technical descriptions.

.2 Contractor may submit alternative fixture for approval up to and including 14 days prior to installation.

END OF SECTION

SECTION 26 08 13

STARTING OF EQUIPMENT AND SYSTEMS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 08 31 – Electrical Equipment and Systems Demonstration and Instruction

1.2 ADMINISTRATION PROCEDURES

.1 Scheduling and Coordinating Facility Start-Up Procedures: A detailed start-up and commissioning procedure is required for this project, schedule sufficient time to all for testing, adjusting, fine tuning and verification procedures.

.2 Coordination: Coordinate starting of electrical equipment and systems with testing, adjusting and balancing, and demonstration and instruction of the following after verifying that equipment of system requiring testing is fully adjusted and balanced prior to starting of electrical equipment and systems:

- .1 Division 21 – Fire Suppression: Coordination of pipes and pipe fittings and other materials.
- .2 Division 22 – Plumbing: Coordination of pipes and pipe fittings and other materials.
- .3 Division 23 – Heating, Ventilation and Air Conditioning: Coordination of ductwork and other materials.
- .4 Division 26 – Electrical: Coordination conduit, wiring, communications cabling, cable trays and other materials.
- .5 Division 27 – Communications: Coordination conduit, wiring, communications cabling, cable trays and other materials.
- .6 Other equipment and systems specified in other Divisions of the Project Manual.

.3 Manufacturer's Site Services: Arrange and pay for appropriately qualified manufacturer's representatives to supervise starting of the following electrical equipment and systems:

- .1 Solar Electricity Generation System
- .2 Data Collection System

1.3 NOT USED

Part 2 Execution

2.1 PROCEDURES

.1 Energizing Main Electrical System: Verify the following before energizing main electrical system:

- .1 Supply authority voltage and phase rotation
- .2 Correct mechanical operation by closing and opening operable devices

.2 Starting Motors: Verify the following before starting motors:

.1 Phase rotation at motor control centres

.2 Motor nameplate data matches with motor starter heater overloads

.3 Energizing Equipment: Verify equipment nameplate data match characteristics of power supply before energizing equipment provided under other Sections and equipment provided by Owner.

END OF SECTION

SECTION 26 08 19

TESTING, ADJUSTING AND BALANCING OF ELECTRICAL EQUIPMETN AND SYSTEMS

Part 1 General

1.1 INTENT

.1 Arrange and pay for testing, adjusting and balancing, and related requirements as specified in this section.

.2 Repair, replace, adjust or balance equipment and systems where test results do not conform with applicable requirements.

.3 Repeat testing and adjusting until acceptable results are achieved.

1.2 RELATED REQUIREMENTS

.1 Section 26 08 13 – Starting of Equipment and Systems

.2 Section 26 08 31 – Electrical Equipment and Systems Demonstration and Instruction.

1.3 SITE TESTING REPORTS

.1 Submit forms to Consultant for review and acceptance prior to use.

.2 Submit completed test report form immediately after tests are performed.

1.4 REFERENCE DOCUMENTS

.1 Perform tests in accordance with:

.1 The Contract Documents.
.2 Requirements of authorities having jurisdiction.
.3 Manufacturer's published instructions.
.4 Applicable CSA, UL, NFPA, IEEE, IPCEA, EEMAC and ASTM standards.

.2 Notify Consultant before proceeding with test and obtain clarification where requirements of any items listed in 1.4.1 above conflict.

1.5 MANUFACTURER'S SITE SERVICES

.1 Arrange and pay for the site services of appropriately qualified manufacturer's representatives where site testing, adjusting or balancing of electrical equipment and systems performed by manufacturer's representative is:

.1 Specified, or
.2 Required by manufacturer or authority having jurisdiction to verify that electrical equipment and systems are operational in compliance with the Contract Documents.

1.6 SEQUENCING AND SCHEDULING

.1 Perform testing, adjusting, balancing and related requirements before declaration of Substantial Performance.

.2 Perform voltage testing and adjusting after user occupancy or utilization of facility.

Part 2 Products

2.1 TEST EQUIPMENT

.1 Provide all equipment and tools necessary to perform testing, adjusting and balancing specified herein and as otherwise required.

Part 3 Execution

3.1 STARTING AND TESTING

.1 Refer to Section 26 08 23.

END OF SECTION

1 General

1.1 INTENT

1.1.1 Read this Section in conjunction with Section 26 08 19 – Electrical Starting and Testing, and other related starting and test sections.

1.2 REFERENCE STANDARDS

1.2.1 Canadian Standards Association (CSA):

1.2.1.1 CSA C22.2 NO. 0.4-M1982 (R1999), Bonding and Grounding of Electrical Equipment (Protective Grounding)

1.3 NATIONAL FIRE PROTECTION AGENCY (NFPA):

1.3.1 NFPA 70: National Electrical Code

2 Products

2.1 NOT USED

3 Execution

3.1 BASIC ELECTRICAL START-UP AND TESTING

3.1.1 Energizing Main Electrical System: Perform the following operations prior to energizing main electrical system:

3.1.1.1 Verify supply authority voltage and phase rotation.
3.1.1.3 Verify that testing as specified has been completed and deficiencies have been corrected.
3.1.1.4 Megger all feeders and record results on approved test report forms.

3.1.2 Testing and Wiring and Wiring Devices:

3.1.2.1 Test conductors at distribution centres and panelboards for insulation resistance to ground (megger test).
3.1.2.2 Test service grounding conductors for ground resistance.
3.1.2.3 Test all wiring devices for correct operation and circuitry.

3.1.3 Ground Resistance Testing:

3.1.3.1 Measure ground resistance of ground grids with earth test megger to verify compliance with CSA C22.2 No. 0.4 and Canadian Electrical Code.

3.1.4 Load Balance Testing:

3.1.4.1 Perform load tests with as many building loads activated as possible.
3.1.4.2 Test load balance on feeders at distribution centres, motor control centres, and panelboards.
3.1.4.3 Reconnect circuits to balance loads where directed by the Consultant where load unbalance exceeds 15% and revise panelboard directories and wiring identification accordingly.

3.1.5 Voltage Testing and Adjusting:

3.1.5.1 Test voltage at service entry point, motor control centres, and secondary of transformers above 45 kVA.
3.1.5.2 Adjust transformer tap settings to compensate for under-voltage or over-voltage conditions, if directed to do so by the Consultant.

3.1.6 Starting Motors: Perform the following operations prior to starting motors:

3.1.6.1 Confirm motor nameplate data with motor starter heater overloads, setting of MCP's and sizing of fuses.
3.1.6.2 Verify rotation.
3.1.6.3 Verify that disconnects are installed.
3.1.6.4 Confirm labelling of motors, disconnects, and starters.

3.1.7 Measure and record operating load amp readings for three phase motors.

3.2 LIGHTING

3.2.1 Function test all light switches, luminaires, dimmers, and lighting control equipment such as photo-cells and time clock settings.

3.2.2 Function test low voltage lighting control system.

3.2.3 Function test light dimming systems.

3.3 FIRE SAFETY SYSTEMS

3.3.1 Prior to requesting verification of the Fire Alarm system by an Engineer, Division 16 and the system manufacturer's technical staff shall perform the following operations:

3.3.1.1 Inspect system in conjunction with the Manufacturer and verify that fire alarm system is correctly installed, connected, and fully operational in accordance with requirements of the Contract Documents and Manufacturer's recommendations including, but not limited to, the following:
3.3.1.1.1 Sprinklers
3.3.1.1.2 Smoke Detectors
3.3.1.1.3 Other devices.
3.3.1.2 Verify that any subsequent work remaining to be performed on the above noted items will not invalidate examinations and tests performed during verification procedure.
3.3.1.3 Verify that operation and maintenance data has been submitted.
3.3.1.4 Verify that spare parts and maintenance materials have been delivered.

3.3.2 Notify Engineer in writing certifying that prerequisites listed in 3.3.1 above fulfilled and specifying known exceptions in the form of a list of items to be completed or corrected, prior to proceeding with the verification.

3.4 CABLE TELEVISION (CATV)

3.4.1 Arrange for cable TV company to check that all equipment has been properly installed, cable connections have been completed, and to test signal at each outlet for quality of reception.

END OF SECTION

SECTION 26 08 31

ELECTRICAL EQUIPMENT AND SYSTEMS DEMONSTRATION AND INSTRUCTION

Part 1 General

1.1 INTENT

.1 Provide demonstration and instruction sessions to familiarize Owner's operation and maintenance personnel with the electrical systems and their operation and maintenance.

.2 Do not commence this instructional period until all electrical systems are complete and proven operational.

1.2 MANUFACTURER'S SITE SERVICES

.1 Arrange and pay for appropriately qualified manufacturer's representative to provide or assist in providing electrical equipment and systems demonstration and instruction as specified herein.

1.3 CONTRACTOR/OWNER COORDINATION

.1 The Contractor will chair demonstration and instruction sessions.

.2 Establish agendas for demonstration and instruction sessions in conjunction with Engineer and Owner. Coordinate scheduling of sessions with Owner.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 SYSTEMS DEMONSTRATIONS AND INSTRUCTION

.1 Systems demonstration and instruction shall include, but not necessarily be limited to, the following:

- .1 Normal Power System:
  - .1 Circuit breaker operation.
  - .2 Ground fault protection (if applicable).
  - .3 Solid state circuit breaker setting.
  - .4 Metering operation.
- .2 Lighting Control System:
  - .1 Remote station operation.
  - .2 Ancillary device operation.

.3 Fire Alarm System:
  .1 Alarm silence.
  .2 Trouble alarm and silence.
.4 Light Fixtures:
  .1 Lamp replacement.
  .2 Ballast replacement.

.2 Include the operating and maintenance manuals all instructions and information given to the Owner's staff and instructions and information given by equipment manufacturer's representatives.

.3 Instruct and demonstrate the method of preparation of all equipment for seasonal service.

.4 If, in the opinion of the Contractor, the members of the Owner's staff instructed on the operation and maintenance of the electrical systems have not assimilated the instructions during the instructional period and are therefore not qualified to assume responsibility for the operation of the electrical systems, notify the Engineer in writing.

.5 Provide demonstration and instruction for other systems as required for proper building operations or where requested by the Owner or Engineer.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL EQUIPMENT

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical

1.2 SYSTEM

.1 Provide lighting control systems as outlined on schematics and specified herein.

1.3 SUBSTITUTIONS

.1 Materials other than the named products for the Project may be acceptable to the Consultant. Submit information in accordance with Section 01 00 06 – General Requirements

.2 Notwithstanding the requirements of Section 01 00 06, the Consultant will review all proposed alternates prior to close of bids when submitted no later than seven (7) days prior to bid closing date as follows:

.1 Proposed alternates shall match technical criteria and performance characteristics of named products, and shall not require a change to the Project.

.2 Proposed alternates found acceptable by the Consultant will be listed in the form of an Addendum.

.3 The Consultant is not obliged to accept any materials presented for their review and does not need to provide reasons for rejection of proposed alternates..

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit shop drawings indicating complete wiring schematics for this specific installation, and as follows:

.1 Use of typical drawings is not acceptable.

.2 Wiring schematics shall show and individually identify all wiring from the individual field device to its termination point.

.3 All terminals in panels and wiring conductors to be identified and field tagged by a numerical numbering system.

.4 Indicate identification marks for terminals in panels and wiring conductors to be identified and field tagged by a numerical numbering system.

Part 2 Products

2.1 MANUFACTURERS

.1 Materials for this section are based on materials manufactured by the named manufacturers, other materials may be acceptable for use on this project and shall be fabricated by one manufacturer and assembled from compatible components:

.1 Douglas Lighting Controls Ltd.
.2 Gentec
.3 SensorSwitch
.4 WattStopper
.5 Other acceptable substitution.

2.2 WALL SWITCHES AND ACCESSORIES

.1 Switches: Remote control switches and switch hardware to mount to standard wall boxes; standard switches mount up to 3 switches per gang, and as follows:

.1 Switches shall be toggle switches, Decora type.
.2 Switch shall have a plastic cap to permit holding a paper identification label.
.3 Dimmable switches shall have 0-10V dimming capabilities

.2 Switch Plates:

.1 Select switch plates to suit number of switches as shown on the plans.
.2 Up to 3 switches can be installed in a 1 gang box.
.3 Use filler plugs where appropriate.
.4 Switch plates shall be stainless steel, white, or other as specified.

2.3 PHOTOCELL AND DAYLIGHT CONTROLS

.1 Outdoor and Skylight Photocell:

.1 Provide a photometric sensor capable of sensing from 1-10,000 foot candles, for outdoor installation; connected by 2 conductor, #18 AWG wire to control unit located in panel, and as follows:

.1 Existing light levels shall be continuously displayed by LED's.
.2 Set point adjustments shall be easy to set with UP and DOWN control buttons.
.3 Instructions shall be printed on the label of the control unit.

.2 Control unit shall have two sets of outputs; capable of being overridden by a remote switch or by a button built into the photocell control unit.

.2 Indoor Task Area Daylight Sensor for Dimmable Ballasts:

.1 Provide indoor daylight sensor to harvest daylight by regulating the electronic dimmable fluorescent ballasts; regulating ballasts so that a constant minimum light level is maintained; ceiling mounted in a location that measures light reflected upward from the surface below.

.2 Sensor shall have a range setting jumper and a set-point slider located under the front faceplate; instructions shall be printed on the inside of the faceplate.

.3 Sensor shall be compatible with Phillips/Advance Mark VII, or any other ballast that uses the same 0-10VDC dimming control protocol.

.4 Sensor shall connect with 2 wires connected in parallel to a maximum of 10 ballasts; sensors shall require no other connections for the dimming function.

Part 3 Execution

3.1 INSTALLATION

.1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.

3.2 CONTROL SEQUENCE: EXTERIOR LIGHTING

.1 For lights controlled by photocell (PC) only:

.1 All lights turn “on” as dusk.

.2 All lights turn “off” at sunrise.

.3 All lights have a manual override inside the house.

3.3 CONTROL SEQUENCE: INTERIOR LIGHTING

.1 Allow for programming of automatically controlled interior lighting zones as determined by the building owner.

.2 Confirm zones and control times with building owner. Program as required.

END OF SECTION

SECTION 26 18 00

BUILDING VOLTAGE CIRCUIT PROTECTIVE DEVICES

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical

.2 Section 26 24 00 – Switchboards and Panelboards

.3 Section 26 24 16 – Branch Circuit Panelboards

1.2 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI):

.1 ANSI C37.16-2000, Recommendations for Low Voltage Power Circuit Breakers and AC Power Circuit Protectors, Preferred Ratings, Related Requirements and Application

.2 Canadian Standards Association (CSA):

.1 CAN/CSA C22.2 No. 5.1-M91 (R2000), Moulded Case Circuit Breakers

.2 CSA C22.2 No. 59.1-M1987 (R2001), Fuses (Both Plug and Cartridge-Enclosed Types)

.3 CAN/CSA-C22.2 No. 106-M92, (R2001), HRC Fuses

.3 National Fire Protection Agency (NFPA):

.1 NFPA 70: National Electrical Code

1.3 REGULATORY REQUIREMENTS

.1 Overcurrent protection devices shall meet standards of an electrical testing laboratory and bear a CSA, $_{c}$UL, $_{c}$UL$_{us}$, or $_{c}$ETL label and shall be sized in accordance with the Canadian Electrical Code; labels bearing only the marks UL, UL$_{us}$, or ETL will not be acceptable for work of this Project.

1.4 SUBMITTALS

.1 Provide requested submittals in accordance with Section 01 33 50 – Submittal Procedures; coordinated with Section 26 05 00.

.2 Submit complete coordination study for overcurrent and ground fault protective devices for the complete system as follows:

.1 Protection Coordination Study shall indicate fault levels throughout the system, and the equipment selected shall be based on the results of this study.

.2 Selection for final breaker and fuse sizes will be determined from the coordination study.

.3 Fuse and breaker sizes indicated on Drawings are for estimating purposes.

Part 2 Products

2.1 COMPONENTS

.1 Moulded Case Automatic Air Circuit Breakers: 250 V bolt-in type with thermal and magnetic trip, trip free position separate from "On" or "Off" positions, and as follows:

.1 Temperature compensation: 40°C ambient.

.2 Common-trip breakers with single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting.

.4 Trip settings on breakers with adjustable trips to range from 3 - 10 times current rating.

.5 Ground fault circuit breaker shall be as above with integral class A group 1 ground fault interrupter.

.6 Breakers supplying circuits in dwelling units shall incorporate arc fault protection as required by the NEC.

.2 Acceptable materials:

.1 Industrial Air Circuit Breakers and Moulded Case Circuit Breakers:

.1 Cutler Hammer

.2 Schneider Electric

.3 Siemens

.2 Fuses:

.1 Bussman

.2 Gould/Ferraz Shawmut

.3 Siemens

Part 3 Execution

3.1 INSTALLATION

.1 Install overcurrent protective devices as indicated, in accordance with manufacturer's written instructions.

.2 Fasten overcurrent protective devices without causing mechanical stresses, twisting or misalignment of equipment in final position.

.3 Set field-adjustable trip settings as indicated subsequent to installation.

.4 Overcurrent protective device sizes and identification as specified in respective equipment schedules.

.5 Install with work of related Sections.

3.2 TESTING AND ADJUSTING

.1 Coordinate testing and adjusting of installed system with Section 26 05 00.

END OF SECTION

SECTION 26 20 13

SWITCHES, RECEPTACLES, PLATES AND OTHER DEVICES

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical

.2 Section 26 05 28 – Conduits, Outlet Boxes and Fittings for Electrical Systems

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

.1 CAN/CSA C22.2 No. 111-00 (R2005), General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition)

.2 National Electrical Manufacturers Association (NEMA):

.1 NEMA WD1-1999, General Colour Requirements for Wiring Devices

.2 NEMA WD6-2002, Wiring Devices-Dimensional Requirements

.3 National Fire Protection Agency (NFPA):

.1 NFPA 70: National Electrical Code

Part 2 Products

2.1 SWITCHES

.1 Switches: Commercial Specification Grade AC and ANSI/NEMA WD6; quiet, slow make, slow break design, toggle handle, with totally enclosed case with wide face body and full gang matching type and as follows:

.1 Rated at 15 A 120/240 VAC

.2 Configuration: Toggle as indicated on Drawings and as follows:

.1 Single pole switch

.2 Double pole switch

.3 3 way switch

.4 4 way switch

.2 Wall plates: nylon or stainless steel, ganged for groups of 2 or more, coordinate configuration with Consultant for groups larger than 4

.3 Colour: In accordance with NEMA WD1, and as follows:

.1 Provide red polycarbonate and nylon switches in service areas.

.2 Provide white polycarbonate and nylon switches in all public and finished areas.

.4 Acceptable materials:

.1 Hubbell Canada Incorporated/Bryant

.2 Leviton Manufacturing of Canada Ltd.,

.3 Pass & Seymour/Legrand

2.2 DIMMING SWITCHES

.1 Electronic Dimmer Controls: Solid-state circuitry with a single-slider control combining on-off switch and full range dimming control, and as follows:

.1 0-10V low-voltage dimming capability.

.2 Torroid filter in circuitry for suppressing radio frequency interference (RFI).

.3 600, 1000, or 1500 watt, CSA certified for installation in single gang boxes.

.2 Acceptable materials:

.1 Lutron Electronics Co.

.2 Other acceptable alternate in accordance with Section 01 62 00 – Product Options.

2.3 RECEPTACLES

.1 Receptacles: Full gang size, U-grounding type, rated as shown on drawings, with parallel slots, slots having double or triple wipe jaws complete with saddle mounting strip around back of body.

.2 All receptacles are to be Tamper Resistant.

.3 Special Receptacles: Located as indicated on Drawings.

.4 Colour: General in all Areas: White.

.5 Acceptable materials:

.1 Hubbell

.2 Bryant

.3 Arrow Hart.

2.4 PLATES

.1 White nylon or match device colours for all finished areas other than service rooms.

.2 Stainless steel: Type 302 and 304. No. 4 finish, 1 mm thick, accurately die cut, protective release paper for service areas.

.3 Gaskets: Resilient rubber or closed cell foam urethane.

.4 Components:

.1 Plates: Bevelled type with smooth rolled outer edge, plain design.

.2 Weatherproof plates: PVC gasketted cover plates for receptacles, spring loaded gasketted doors. Double doors for standard duplex receptacle.

Part 3 Execution

3.1 INSTALLATION

.1 Mount switches at heights noted in Section 26 05 28 unless shown otherwise on Drawings.

.2 Mount receptacles vertically as indicated in 26 05 28 unless shown otherwise on Drawings; provide matching plugs for all special receptacles utilized, i.e. other than 15A 120V straight blade receptacles.

.3 Install cover plates at all wiring device boxes.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical

.2 Section 26 05 53 – Electrical Systems Identification: Lamicoid identification labels.

.3 Section 26 05 28 – Conduits, Outlet Boxes and Fittings for Electrical Systems

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 29-M1989 (R2004), Panelboards and Enclosed Panelboards

.2 National Fire Protection Agency (NFPA):

.1 NFPA 70: National Electrical Code

Part 2 Products

2.1 MANUFACTURERS

.1 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section.

.1 Eaton Electrical, Cutler Hammer

.2 Schneider Electric, Square D

.3 Siemens Canada Ltd.

2.2 DESCRIPTION

.1 Factory Assembled Components: This section includes for distribution panels and branch circuit panels, their construction, and load requirements and as follows:

.1 Construct panel boards to CSA standards and to bear CSA approval.

.2 Use only single tub design for all 120/240V branch circuit panelboards.

.2 Enclosure: Fabricate as follows:

.1 Panels: Mounting: Flush and Surface Mounted, as indicated in panelboard schedules on Drawing E5.01 and as follows:

.1 Trim: Manufacturer's standard panel trim having concealed hinges and trim mounting screws, hinged door-in-door construction with locking catch.

.2 Sprinkler drip shields.

.3 Keys: Provide two keys for each panel, interchangeable with panels of same voltage.

.3 120/240 V Panelboards: 1 phase, 3 wire, solid neutral design with sequence style bussing and full capacity neutral of capacity indicated, composed of an assembly of bolt-in-place moulded case automatic air circuit breakers as indicated with thermal and magnetic trip and trip free position separate from either the "On" or the "Off" positions. Two pole breakers must have common simultaneous trip, and as follows:

.1 Fabricate panelboards with hinged door-in-door construction.

.2 Bus Material: Copper.

.3 Rate circuit breakers in 120/240 V branch circuit panels for minimum 22,000 A symmetrical interrupting capacity, unless noted otherwise or as determined by the short circuit study.

.4 Equipment selected must provide for higher interrupting capacities where the required interrupting capacities, according to the Protection Coordination Study, are higher than those indicated above. Submit Protection Coordination Study with the first set of shop drawings on switchgear and panelboards in accordance with Section 26 05 00.

.5 Equip panelboards with normal ground bus.

Part 3 Execution

3.1 INSTALLATION

.1 Provide all mounting brackets, busbar drillings and filler pieces for spaces.

.2 Affix typewritten directory to the inside cover of each panelboard indicating loads controlled by each circuit.

.3 Install spare conduits from recessed panels as specified under Section 26 05 28.

.4 Provide lamicoid nameplate beside breakers in all distribution panels indicating the load serviced by the breaker in accordance with Section 26 05 53.

3.2 PANELBOARD SCHEDULES

.1 Refer to Section 26 06 20.16 for Panelboard Schedules.

END OF SECTION

SECTION 26 27 16

CABINETS, SPLITTERS, JUNCTION AND PULL BOXES

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Electrical Requirements

.2 Section 26 05 53 – Electrical Systems Identification

.3 Section 26 05 28 - Conduits, Outlet Boxes and Fittings for Electrical Systems

1.2 LOCATION

.1 Locate splitters, junction and pull boxes as indicated.

Part 2 Products

2.1 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs, to match required size and number of incoming and outgoing conductors as indicated.

.3 Provide minimum three spare terminals on each set of lugs in splitters less than 400 A.

2.2 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface or recessed mounting.

.2 Covers with 2 mm minimum extension all around, for flush-mounted pull and junction boxes.

.3 PVC type with gasketted covers where exposed to weather.

2.3 CABINETS

.1 Type E: Sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

.2 Type T: Sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19 mm GIS fir plywood, backboard. Cabinets to be flush or surface mounted as indicated.

Part 3 Execution

3.1 SPLITTER INSTALLATION

.1 Install splitters as indicated and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 1.9 m above finish floor.

.3 Install terminal blocks, as indicated.

.4 Only main junction and pull boxes are indicated. Provide pull boxes so as not to exceed 30 m of conduit length in any particular run.

.5 Boxes and cabinets to be installed plumb and square with building lines.

.6 Install junction and pull boxes clear of all mechanical duct work and piping.

3.3 IDENTIFICATION

.1 Identify splitters and cabinets with 20 mm x 90 mm nameplates with 5 mm letters.

.2 Identify junction and pullboxes with 10 mm x 50 mm nameplates with 3 mm letters.

END OF SECTION

SECTION 26 31 00

SOLAR PHOTOVOLTAIC SYSTEMS

Part 1 General

1.1 SECTION INCLUDES

.1 This section applies to supply and installation of roof mounted poly-crystalline photovoltaic (PV) solar modules.

1.2 RELATED REQUIREMENTS

.1 Section 06 10 00 – Rough Carpentry

.2 Section 26 05 00 – Common Work Results for Electrical

.3 Section 26 05 19 – Electrical Power Conductors and Cables

1.3 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

.1 Canadian Electrical Code (CEC):

.2 National Fire Protection Agency (NFPA):

.1 NFPA 70: National Electrical Code

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit complete photovoltaic data prepared by independent testing laboratory for PV Panels for review.

.3 Certificates: submit certified evidence of installer's qualifications and experience record in installation of photovoltaic systems, or submit certification from manufacturer of photovoltaic modules that proposed installer has been trained by manufacturer's representatives and is considered by manufacturer to be fully qualified to install the system

1.5 QUALITY ASSURANCE:

.1 Installer: company with a minimum of 3 years documented experience in the installation of solar power systems and single ply roof systems, approved by manufacturers of both.

.2 Submit a list of at least five 5 installations that have been in use for a minimum of two years using solar power systems similar to the systems specified.

.3 Compliance with regulatory requirements: the installation of solar modules and electrical components shall be performed in compliance with IEEE 928, IEEE 929, IEEE 1374, IEEE 1277, NFPA 70 article 690 and 705, the national electrical safety code, occupational safety and health administration (OSHA) regulations, international building code (IBC), state and local codes.

.4 Pre-installation meeting: after approval of submittals but prior to beginning installation of work of this section, conduct a meeting at the site attended by architect, contractor, installers of roof panel system and related electrical work to be installed with the system, to describe in detail the installation process and to establish agreement, coordination, safety and responsibilities. prepare a detailed report of this meeting and furnish copies to the architect and attendees.

1.6 WARRANTY

.1 Provide certified copies of the following manufacturer's product warranties:

.1 Solar module manufacturer's 20-year warranty covering power output of modules, and 5-year warranty of rebated material and workmanship.

.2 DC to AC inverter manufacturer's 10-year warranty

1.7 DILEVERY, STORAGE AND HANDLING:

.1 Solar modules shall be stored in an ambient temperature of 40 f to 80 f. modules shall be delivered to the site in the original unopened containers or wrappings.

.2 Handle materials carefully to prevent damage.

.3 Place materials on pallets and fully protect from moisture. Leave protective packaging in place until modules are installed.

.4

Part 2 Products

2.1 BASE OF DESIGN

.1 Provide products indicated in this section and on the drawings, or accepted substitute products subject to the compliance requirements of this section.

.2 Wherever applicable, photovoltaic system components must be listed as *eligible equipment* by the state of California, California solar initiative program.

2.2 PHOTOVOLTAIC PANELS:

.1 Minimum nominal peak power of 250 watts per panel

.2 Single pre-engineered unit combining photovoltaic panel, interlocking frame, and non-penetrating mounting system.

.3 CSA, UL, and ULC listed.

2.3 DC TO AC INVERTER

.1 DC-to-AC inverter: high efficiency, UL listed, utility interactive, phase, voltage and current matched to line and load, with maximum power point tracking (mppt) electronics, over- and under-voltage and frequency protection in accordance with requirements of ul 1741, harmonic control in accordance with ieee 519, and anti-islanding protection as required by ieee 929. Inverter shall have automatic start-up, shut-down, self-diagnosis, and fault detection. Units shall comply to fcc electromagnetic interference (emi) part 15, subparts a, b and j, and iec 1727.

2.4 ROOF MOUNTED PV SYSTEM

.1 A positive roof attachment system shall be coordinated with the roofing work as specified in division 07. This mounting system shall be approved by the architect, the PV module manufacturer, and the authorities having jurisdiction. the attachment system shall resist uplift winds up to 100 mph.

.2 The photovoltaic roof module shall combine solar panel, frame, and mounting system into a single pre-engineered unit.

.3 The roof-mounted tiles shall be flat mounted at the same slope as the roof.

.4 The weight of the rooftop PV system shall be no more than 4 lbs/sf.

.5 Each solar module shall be capable of generating DC power.

.6 The system shall be formulated for stability in low light and continuous exposure to ambient weather conditions.

.7 The wiring interconnecting the PV modules shall be provided by the PV module manufacturer.

.8 The roof-mounted system shall be nominally rated 10kW.

2.5 BALLANCE OF SYSTEM COMPONENTS

.1 Solar array combiner boxes: ul listed, series fusing or circuit breakers for solar roof panel source circuits in nema3r enclosure as required.

.2 AC disconnect switch: UL listed heavy duty fused safety switch on the output of the inverter in nema3r enclosure as required.

.3 KWH meter socket and meter main, as required by the local electrical utility company, shall be phase, voltage, and current matched to load, 22k rms amperes short circuit current rated or higher with utility approval, UL listed, nema 3r enclosure as required, including required openings and lugs.

.4 Electric service panel interconnection: ul listed circuit breaker, in accordance with national electrical code, local codes and local electric utility company requirements. Circuit breaker shall be located in new electric service panel enclosure as required

.5 Wiring shall be copper conductors in rigid PVC conduit as well as Tyco MC4 solar cables. Metal clad cable and exposed conductors are not allowed

.6 Provide permanently adhered, riveted, bakelite-type labels indicating the identification of eACh device in the system (combiner box, inverter, disconnect, etc.) visible from the equipment enclosure exterior.

2.6 ENERGY DATA MONITORING SYSTEM

.1 Photovoltaic systems shall include an energy data monitoring system to support monitoring of system output and operating conditions.

.2 Energy data monitoring system shall include utility grade electrical meters for the monitoring and recordation of DC/AC energy and power data from the inverters, at least one pyranometer, temperature thermocouples, and sub systems for the measurement of ambient and PV surface temperature for each photovoltaic system

.3 Photovoltaic system energy data monitoring system shall be compatible with and output recorded data to the campus energy management and controls (emcs) system. the following data shall be available to the campus emcs:

.1 AC system power output.
.2 Horizontal surface solar irradiation.
.3 Ambient temperature.
.4 PV cell temperature.
.5 Roof surface temperature.

.4 Configured campus emcs to calculate and trend the following data points for the photovoltaic systems:

.1 Instantaneous system output in kw.
.2 Instantaneous and year to date irradiation on watts/square meter.
.3 Instantaneous ambient, cell, surface, and sub-surface temperature in degrees Fahrenheit.
.4 Daily system output in kwh: any day, and day to hour.
.5 Monthly system output kwh: any month, and month to date.

2.7 MANUFACTURERS

.1 List of approved manufacturers:

.1 CanadianSolar
.2 Invensun
.3 Sharp

Part 3 Execution

3.1 EXIMANINATION

.1 Verify that the DC to AC inverters have ground fault protection and that the DC circuits of the PV system are not earth-grounded.

3.2 SEQUENCE OF INSTALLATION

.1 Make a solar panel roof layout drawing to include conduit runs, junction boxes, combiner boxes and electrical homerun to the DC disconnect switch and inverter.

.2 Clean the roof deck surface of dirt, debris and foreign materials.

.3 Locate the modules as indicated and in accordance with ansi/asce c2-1990 and ansi/asce 7-88. do not install wiring in conduit at this time.

.4 Locate the modules as indicated. do not install wiring in conduit until after solar panel are installed.

.5 Install conduit, junction boxes and combiner boxes on the roof deck per standard commercial practices and codes.

.6 Before installing solar modules, feed a mandrel through conduit to ensure that conduit is clear of roofing nails or screws. Install solar modules in accordance with manufacture's recommendations and approved submittals.

.7 Feed the solar panel wiring into the junction box and conduit.

.8 Attach the solar panel perimeter to the roof membrane in accordance with the recommendations of panel manufacturer, roofing manufacturer and the approved submittals.

.9 Complete the panel wiring in the combiner box and array homerun.

.10 Install and connect the balance of system (BOS) equipment (consisting of combiner box, inverter, isolation transformer, AC disconnect switch and utility interconnection equipment) in accordance with IEEE 929 and IEEE 1173.

.11 Inspect, test, and startup the solar power system in accordance with the panel solar panel manufacturer's installation manual and in accordance with IEEE 1373.

3.3 SPECIAL CAUSIONS

.1 Do not cut or drive screws into any part of the system solar modules or wiring are present which includes, but is not limited to, solar modules, inter-panel wiring assembly, and solar array wiring. (PV systems contain live electrical components enclosed and protected within.)

.2 Avoid electrical hazards when installing, wiring, operating, and maintaining the solar roof panel and other electrical equipment.

.3 Modules generate DC electricity when exposed to sunlight or other light sources.

.4 Do not touch the exposed copper wire leads while the panel is exposed to light or during installation. use properly insulated tools only.

.5 Work only under dry conditions with a dry panel and tools.

.6 Use extreme caution and proper roof safety practices when working on or near the modules. solar roof modules are slippery when wet.

.7 Do not stand or step on the modules.

.8 Do not drop modules or allow objects to fall on the modules. do not place equipment on the modules.

.9 Cover solar modules with an opaque material before making wiring connections to reduce the risk of electric shock or sparks.

.10 Do not leave PV modules unsecured.

.11 Keep the PV module front and back surfaces free from foreign objects.

.12 Do not install modules where flammable gases or vapors are present since sparks may be produced.

.13 Do not drill or cut holes in the panel solar modules or wiring. Avoid sharp edges.

.14 Artificially concentrated sunlight shall not be directed on the panel.

.15 Use the panel for its intended use only. do not disassemble the panel or remove any part or label installed by the manufacturer.

3.4 INSTALLATION

.1 Wire solar PV membrane roofing system as specified in division 26.

.2 Install solar array combiner box, array, inverter, isolation transformers, and other equipment in accordance with requirements of division 26

.3 An authorized representative of the manufacturer shall inspect the installation periodically during construction and at completion to ensure that the system is installed in compliance with these specifications.

.4 Upon completion, in addition to code required testing of electrical components and system, megger test each circuit, and furnish a report of the tests to the owner.

3.5 ADJUSTING AND CLEANING

.1 Adjust electrical components for proper operation.

.2 Adjust energy management system components for proper operation.

.3 Immediately prior to final acceptance, clean the modules, energy management system components and electrical components

END OF SECTION

SECTION 26 50 00

LIGHTING

Part 1 General

1.1 SECTION INCLUDES

.1 This section applies to supply and installation of luminaires, lamps, ballasts, supports and accessories, and for supply of plaster frames, trim rings and back boxes for gypsum board ceilings.

1.2 RELATED REQUIREMENTS

.1 Section 09 21 16 – Gypsum Board Assemblies

.2 Section 26 05 28 – Conduits and Backboxes for Electrical Systems: Outlet boxes for lighting.

.3 Section 26 06 50.16 – Lighting Fixture Schedule

.4 Section 26 51 00 – Interior Lighting

.5 Section 26 56 00 – Exterior Lighting

.6 Section 26 50 13 – Lamps

.7 Section 26 50 16 – Ballasts and Accessories

1.3 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

.1 CAN/CSA C860-01, Performance of Internally Lighted Exit Signs

.2 CAN/CSA E598-Series-98, Luminaires.

.2 National Fire Protection Agency (NFPA):

.1 NFPA 70: National Electrical Code

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

.2 Submit samples of custom made luminaires for review and acceptance before starting final production.

.3 Submit complete photometric data prepared by independent testing laboratory for luminaires for review including VCP Table and spacing criteria.

1.5 COORDINATION

.1 Confirm compatibility and interface with other materials with luminaire and ceiling system, and report discrepancies to the Consultant; defer ordering materials until discrepancies are clarified.

.2 Supply plaster frames, trim rings, and back boxes to other trades, as the work requires.

.3 Coordinate with mechanical subcontractor to avoid conflicts between luminaires, supports and fittings with mechanical equipment; do not suspend fixtures from mechanical equipment, pipes or ducts.

1.6 WARRANTY

.1 Replace completely free of charge:

.1 LED lamps burning out within 12 months of takeover.

.2 Ballasts or drivers that fail or exceed their original noise level rating within 12 months of takeover.

Part 2 Products

2.1 RECESSED FIXTURES

.1 Supply recessed fixtures complete with trim type required for ceiling system installed.

.2 Before ordering, confirm the ceiling construction details and architectural finish for each area.

.3 Recessed pot-light style fixtures (fluorescent, and LED): Provide pre-wired type with junction box forming an integral part of the assembly with satisfactory access complete with necessary plaster rings, supports, and other required accessories for complete installation.

.4 Recessed fluorescent fixtures: Maintain maximum 150 mm depth, including mounting yokes or bridges with distance from back face of fixture or lens to centre of lamp minimum 65 mm; design reflector and lamp positions to provide high efficiency, even brightness and lack of lamp lines.

2.2 SUSPENDED FIXTURES

.1 Coordinate supply of ceiling support for fixtures so that they are suitable for ceiling system installed.

2.3 EXIT SIGNS

Part 3 Execution

3.1 SUPPORTS

.1 Recessed Fixtures:

- .1 In areas without suspended ceilings, support fluorescent fixtures directly from the building structure by rod hangers and inserts
- .2 Provide plaster frames or plaster trim as required and turn same over to the ceiling section for installation
- .3 Install recessed fixtures to permit removal from below, to gain access to outlet or pre-wired fixture box.
- .4 Connect recessed fixtures to boxes with flexible conduit and approved fixture wire.

.2 Suspended Fixtures:

- .1 Install suspended linear fluorescent fixtures with airplane cable and fittings having field adjustable length.
- .2 Fixtures shall be installed level unless specifically noted otherwise on Drawings, with less than 10 mm variation over 2440 mm.

3.2 LUMINAIRE WIRING

.1 Connect recessed luminaires to outlet boxes with 10 mm flexible conduit using 90°C wire.

3.3 ADJUSTMENT AND CLEANING

.1 Specular reflector protection to remain in place through construction

.2 Align luminaries and clean diffusers, baskets and remove reflector protection prior to final acceptance.

3.4 LIGHTING FIXTURE SCHEDULE

.1 Refer to Drawing E5.01 for lighting fixture schedule.

.2 Not all fixture types indicated may be used for this Project, refer to Drawings for fixture types required.

END OF SECTION

SECTION 26 50 13

LAMPS

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical

.2 Section 26 50 00 – Lighting

.3 Section 26 06 50.16 – Lighting Fixture Schedule

.4 Section 26 51 00 – Interior Lighting

.5 Section 26 56 00 – Exterior Lighting

.6 Section 26 50 16 – Ballasts and Accessories

1.2 DEFINITIONS

.1 TCLP Compliant: Products that do not leach toxic materials at levels exceeding regulatory limits as defined by the Environmental Protection Agencies (EPA) shall be labelled as Toxic Characteristic Leaching Procedure (TCLP) compliant.

.2 Low Mercury Lamps: Comply with EPA's TCLP test; yield less than 0.2 mg of mercury per litre when tested in accordance with NEMA LL 1.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate with Section 26 06 50.16, and supply and install lamps of appropriate type required for each fixture type scheduled.

1.4 REFERENCE STANDARDS

.1 National Electrical Manufacturers Association (NEMA):

.1 NEMA LL 1-1997, Procedures for Linear Fluorescent Lamp Sample Preparation and the TCLP

1.1 PROJECT CLOSEOUT SUBMISSIONS

.2 Operation and Maintenance Data: Submit a list of recommended spare lamps listing manufacturer, model number, and supplier name and phone number for inclusion in the operations and maintenance data in accordance with 01 00 06 – General Requirements: Operations and Maintenance Data.

Part 2 Products

2.1 MANUFACTURERS

1.1.1 Basis-of-Design Products: Products named in this Section were used as the basis-of-design for the project; additional manufacturers offering similar products may be incorporated into the work of this Section. Substitutions a minimum of ten 10 days in advance of Bid Closing as follows:

2.2 LED LAMPS AND REPLACEMENT BULBS

.1 Provide LED lamps of types indicated in Lighting Fixture Schedule and as follows:

.1 Medium base LED replacement lamps having the following requirments:

Initial Wattage	Colour Temperature (K)	Design Lumens	CRI	Average Life (hours)	Comments
13-22	3000-4000	>600	>80%	>25,000	

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 09 21 16 – Gypsum Board Assemblies: Lighting fixtures installed in suspended gypsum board ceiling assemblies.

.2 Section 26 05 00 – Common Work Results for Electrical

.3 Section 26 05 13 – Electrical Conductors and Cable

.4 Section 26 05 29 – Hangers and Supports for Electrical

.5 Section 26 50 00 – Lighting

.6 Section 26 50 13 – Lamps

.7 Section 26 09 23 – Lighting Control Devices

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

.1 CAN/CSA C860-01, Performance of Internally Lighted Exit Signs
.2 CAN/CSA E598-Series-98, Luminaires

.2 National Fire Protection Agency (NFPA)

.1 NFPA 70: National Electrical Code

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with lighting fixture manufacturer's written instructions and in accordance with local Building Code requirements.

3.2 LUMINAIRE SUPPORTS

.1 In areas without suspended ceilings, support fluorescent fixtures directly from building structure by rod hangers, chains or both, and inserts in accordance with Section 26 05 29; coordinate with and obtain acceptance from the Consultant for each application prior to proceeding with support work.

.2 Provide plaster frames or plaster trim as required and turn same over to the ceiling section for installation.

.3 Coordinate with Section 09 51 00 when installing recessed fluorescent fixtures mounted in suspended gypsum board or T-bar ceiling systems and verify that ceiling can accept weight of fixture weight; provide additional support as follows where ceiling system cannot support weight of fixture:

.1 Provide a minimum of two (2) or four (4) hangers for each fixture for recessed fluorescent fixtures mounted in acoustical suspended ceiling systems; a minimum of four (4) hangers will be required for fixtures greater than 610 mm wide; support fixtures independent of ceiling grid.

.2 Support fixture using field adjustable aircraft cable for suspended direct/indirect or indirect linear fluorescent fixtures.

3.3 ADJUSTMENT AND CLEANING

.1 Align luminaires and clean diffusers prior to final acceptance.

3.4 FIXTURE SCHEDULE

.1 Refer to Drawing E5.01 for lighting fixture schedule.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00 – Common Work Results for Electrical

.2 Section 26 05 13 – Electrical Conductors and Cable

.3 Section 26 05 29 – Hangers and Supports for Electrical

.4 Section 26 50 00 – Lighting

.5 Section 26 06 50.16 – Lighting Fixture Schedule

.6 Section 26 50 13 – Lamps

.7 Section 26 50 16 – Ballasts and Accessories

Part 2 Products

2.1 FIXTURES

.1 Provide fixtures complete with gaskets forming weatherproof assembly where exposed to weather.

.2 Fixture finishes to be non-corrosive types.

.3 Provide low temperature ballasts as required.

2.2 UNDERGROUND CONDUIT

.1 Conduit: Rigid PVC with watertight connectors and accessories.

Part 3 Execution

3.1 INSTALLATION

.1 Install underground wiring in specified conduit, with watertight connections.

.2 Conductors shall be RW90 X-link.

.3 Install green insulated grounding conductor in all runs.

.4 Seal all conduit runs at building panels, pullboxes, etc.

3.2 FIXTURE SCHEDULE

.1 Refer to Drawing E5.01

END OF SECTION

SECTION 26 08 23

ELECTRICAL STARTING AND TESTING BY CONTRACTOR

Part 1 General

1.1 INTENT

.1 Read this Section in conjunction with Section 26 08 19 – Electrical Starting and Testing, and other related starting and test sections.

1.2 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 NO. 0.4-M1982 (R1999), Bonding and Grounding of Electrical Equipment (Protective Grounding)

.2 National Fire Protection Agency (NFPA):

.1 NFPA 70: National Electrical Code

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 BASIC ELECTRICAL START-UP AND TESTING

.1 Energizing Main Electrical System: Perform the following operations prior to energizing main electrical system:

.1 Verify supply authority voltage and phase rotation.

.2 Verify that testing as specified has been completed and deficiencies have been corrected.

.3 Megger all feeders and record results on approved test report forms.

.2 Testing and Wiring and Wiring Devices:

.1 Test conductors at distribution centres and panelboards for insulation resistance to ground (megger test).

.2 Test service grounding conductors for ground resistance.

.3 Test all wiring devices for correct operation and circuitry.

.3 Load Balance Testing:

.1 Perform load tests with as many building loads activated as possible.

.2 Test load balance on feeders at distribution centres, motor control centres, and panelboards.

.3 Reconnect circuits to balance loads where directed by the Consultant where load unbalance exceeds 15% and revise panelboard directories and wiring identification accordingly.

.4 Voltage Testing and Adjusting:

.1 Adjust transformer tap settings to compensate for under-voltage or over-voltage conditions, if directed to do so by the Consultant.

.5 Starting Motors: Perform the following operations prior to starting motors:

.1 Confirm motor nameplate data with motor starter.

.2 Verify that disconnects are installed.

.3 Confirm labelling of motors, disconnects, and starters.

3.2 LIGHTING

.1 Function test all light switches, luminaires, dimmers, and lighting control equipment such as photo-cells and time clock settings.

.2 Function test low voltage lighting control system.

.3 Function test light dimming systems.

3.3 FIRE SAFETY SYSTEMS

.1 Prior to requesting verification of the Fire Alarm system by an Engineer, Division 16 and the system manufacturer's technical staff shall perform the following operations:

.1 Inspect system in conjunction with the Manufacturer and verify that fire alarm system is correctly installed, connected, and fully operational in accordance with requirements of the Contract Documents and Manufacturer's recommendations with auxiliary equipment connected to the fire alarm system including, but not limited to, the following:

.1 Fan shut-down

.2 Sprinklers

.3 Other devices.

.2 Verify that any subsequent work remaining to be performed on the above noted items will not invalidate examinations and tests performed during verification procedure.

.3 Verify that operation and maintenance data has been submitted.

.4 Verify that spare parts and maintenance materials have been delivered.

.2 Notify Engineer in writing certifying that prerequisites listed in 3.3.1 above fulfilled and specifying known exceptions in the form of a list of items to be completed or corrected, prior to proceeding with the verification.

.3 Fire Alarm Verification by an Engineer

.1 Assist and cooperate in the verification procedure. Provide and pay for the following:

.1 Arrange and pay for the services of a professional engineer to verify the complete fire alarm system. Submit 3 copies of the report.

.2 Provide the following equipment:
  .1 Artificial Smoke
  .2 Minimum of four portable communication devices
.3 Do not proceed with the verification unless the following parties are present at all times during verification procedure:
  .1 Electrical Contractor
  .2 Fire Alarm System Manufacturer's Representative
  .3 Engineer's verification representative
.4 Disassemble and reassemble system components.
.5 Disconnect and reconnect wiring.
.6 Perform required field adjustments.
.7 Repair defective work and replace defective components.
.8 Perform all other work on system required by verification procedure.

3.4 CABLE TELEVISION (CATV)

.1 Arrange for cable TV company to check that all equipment has been properly installed, cable connections have been completed, and to test signal at each outlet for quality of reception.

END OF SECTION

SECTION 27 16 00.06

COMMUNICATIONS HORIZONTAL CABLING

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for communications horizontal cabling system that will provide efficient data and voice signal transmission up to 250 MHz performance in accordance with TIA/EIA 568-B for Category 6 Systems:

.1 System shall provide efficient operation from patch panels located in mechanical room to workstation outlets.

.2 Cabling system is based on home run cabling requirements with distribution being achieved by above ceiling using individual four (4) pair Category 6 rated cables and components to distribute communication signals from patch panels located in communications room.

.3 Provide materials, equipment and labour required for a complete and operating Category 6 horizontal cabling system for data and voice as indicated on Drawings, and as follows:

.1 Provide all cabling and associated components as described herein.

.2 Cable system shall have end-to-end Category 6 rated products with components manufactured by different manufacturers fully compatible with each other.

.3 Provide cable tray or conduit system to route cables.

.4 Provide additional materials, equipment and labour for voice system to include installation and termination of trunk cables from main telephone room to various sub-telephone rooms:

.1 Provide an individual trunk cable to each sub-telephone room

.2 Size trunk cable for the number of outlets shown on the Drawings plus 50% spare

.3 Provide Category 5e, FT-6 rated trunk cables

.4 Provide sufficient quantity of ports based on one (1) pair of wires per port where trunk cables are terminated at patch panels

1.2 RELATED REQUIREMENTS.

.1 Section 26 05 00 – Common Work Results for Electrical

.2 Section 26 05 53 – Identification for Electrical Systems

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM):

.1 ASTM D4566-08, Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable

.2 Canadian Standards Association (CSA):

.1 CAN/CSA C22.2 No. 182.4-M90 (R2010), Plugs, Receptacles, and Connectors for Communication System

.2 CAN/CSA C22.2 No. 214-08, Communications Cables (Bi-national standard, with UL 444)

.3 CSA T568.1-05 (R2010), Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements (and all addenda)

.4 CSA T568.2-05 (R2010), Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted-Pair Cabling Components (and all addenda)

.5 CAN/CSA T530-99, Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A)

.3 Electronic Components Association (CEA)/Electronic Industries Association (EIA):

.1 ECA/EIA 310-E-2005, Cabinets, Racks, Panels, and Associated Equipment

.4 Electronic Industries Association (EIA)/Telecommunications Industry Association (TIA):

.1 TIA/EIA 568-B SET 2008, Commercial Building Telecommunications Cabling Standards - Parts 1, 2, 3 Complete

.2 TIA/EIA 569B-2008, Commercial Building Standard for Telecommunication Pathways and Spaces

.3 TIA 604-2-2004, Fibre Optic Connector Intermateability Standards (FOCIS-2)

.4 TIA/EIA 604-3-2004 Fibre Optic Connector Intermateability Standards (FOCIS-3)

.5 TIA/EIA 606-A-2002, Administration Standard for Telecommunications Infrastructure

.5 Underwriters Laboratories Canada (ULC):

.1 ULC S102.4-10, Standard Method of Test for Fire and Smoke Characteristics of Electrical Wiring and Cables

.2 ULC S139-00, Standard Method of Fire Test for Evaluation of Integrity of Electrical Cables

.6 National Fire Protection Agency (NFPA)

.1 NFPA 70: National Electrical Code

1.4 SUBMITTALS

.1 Provide required information in accordance with Section 01 00 06 – General Requirements: Submittals.

1.1.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Shop Drawings: Submit shop drawings of detailed elevation for data backboard, showing complete layout of all termination equipment complete with dimensions and indicating detailed elevation of front and rear for each data equipment rack showing layout of all termination equipment complete with dimensions; completed using AutoCAD drawing format.

.2 Labelling: Submit proposed cabling system labelling for cable installation based on TIA/EIA 606-A for review and acceptance by Consultant; proposed labelling shall clearly identify all components of the cabling system including; but not be limited to, racks, cables, panels and outlets, and as follows:

.1 Label each cable with a unique identifier designating cable origin and destination within the system.

.2 Label racks and patch panels to identify location within cabling system infrastructure.

1.1.2 Informational Submittals: Provide the following submittals when requested by the Consultant:

.3 Certificates: Submit written confirmation that installation will meet certification requirements; submit Certification Documentation and Final Report to Consultant at completion of work of this Section.

.4 Site Quality Control Submittals: Submit a sample of proposed test forms and procedures as required below prior to start of testing.

1.5 PROJECT CLOSEOUT SUBMISSIONS

1.1.3 Operation and Maintenance Data: Submit manufacturer's written instructions for repair and servicing procedures, include name of original installer and contact information in accordance with Section 01 00 06 – General Requirements: Operation and Maintenance Manuals.

1.1.4 Record Documentation: Submit as constructed information in accordance with 01 00 06 – General Requirements: Project Record Documents, including; but not limited to, the following:

.1 Record accepted labelling information on project record drawings and use accepted labelling information for all testing documentation.

1.6 QUALITY ASSURANCE

.1 Qualifications: Provide proof of qualifications when requested by Consultant:

.1 Installer: Use system installer that has actively carried out data and voice cabling installation for a period of not less than five consecutive years, and shall be approved by the manufacturer to offer a 15 year warranty.

1.1.5 Certifications: Provide the following during the course of the Work:

.2 Compliance Certification: Submit to the Consultant a letter from the cabling manufacturer verifying that they are qualified and capable of installing Category 6 cabling system meeting or exceeding all TIA/EIA certification requirements.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened protective containers and packaging labelled clearly to identify product name and manufacturer.

.2 Storage and Handling Requirements:

.1 Store materials in secure, clean, dry area in a heated indoor location in accordance with manufacturer's instructions

.2 Protect materials and finishes from damage and moisture during handling and installation

1.8 WARRANTY

.1 Special Warranty: In addition to standard construction warranty required by the General Conditions of the Contract, provide a system warranty on supply of components covering the following:

.1 Installation: Installing Subcontractor shall warrant the cabling system against defects arising from defects in workmanship for a period of one year from the date of Substantial Performance for the Project covering all labour and materials necessary to correct any failed portion of the system and to demonstrate performance to within the original installation specifications after repairs are completed.

.2 Cabling System Warranty: Manufacturer shall warrant system performance of cabling system against defects in functionality of all components used in the system for a minimum period of 15 years from the date of Substantial Performance for the Project covering:

.1 Installed horizontal copper cabling.

Part 2 Products

2.1 MANUFACTURERS

1.1.6 Acceptable Materials Manufacturers: Subject to compliance with requirements specified in this Section, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following provided they meet the performance requirements established by the specifications; all components shall meet the technical performance requirement for Category 6 systems; systems specified are based on the following:

.1 Alcatel-Lucent

.2 Belden Inc. Nordex/CDT

.3 Hubbell Inc. Premise Wiring

.4 Leviton Manufacturing Co., NextLAN

.5 The Siemon Company

.6 Tyco Electronics, AMP NetConnect

1.1.7 Acceptable Cabling System Installers: Subject to compliance with requirements specified in this Section, the following installers will be acceptable for the Work of this section provided they meet the performance requirements established by these specifications:

1.1.7.1 Chermik Communications

1.1.7.2 Other approved installer

.7 Properties:

.1 Rating: ULC rated for OFNR (Riser) or OFNP (Plenum).

.2 Attenuation Rating: 3.5 dB/km @ 850 nm and 1.5 dB/km @ 1300 nm.

.3 Bandwidth: 500 MHz/km @ 1300 nm.

2.2 HORIZONTAL CABLING SYSTEM

.1 Communication Room Hardware:

.1 Design all hardware to fit into a standard a standard 480 mm rack.

.2 Acceptable Materials:

.1 AMP NetConnect

.2 Chatsworth Products, Inc.

.3 Middle Atlantic Products, Inc.

.3 Patch Panels:

.1 Provide patch panels having a capacity of 12-18 ports x 1U-2U rack spaces high; ports shall be blank to accept snap-in unshielded RJ45 jacks in for snap-in interface housings, six jacks per housing; constructed from 1.519 mm core metal thickness cold rolled steel with polyurethane powder coat finish; housings constructed from polyphenylene oxide with spaces provided for port identification labelling.

.2 Provide Category 6 modular data jacks for multimedia jack patch panels; unkeyed four (4) pair fitting into nominal 20 mm x 15 mm opening; terminate modular jacks using a non-impact termination tool to eliminate connector damage and promote consistent termination; colour code jacks for T568A wiring; wire each jack to T568A.

.2 Horizontal Cable:

.1 Plenum Rated (FT6) Rated Category 6 Cable: 24 AWG, four (4) pair UTP, ULC CMR rated having lead free PVC jacket, third party verified meeting the requirements of TIA/EIA 568-B.2.1, meeting performance requirements listed below.

.2 Horizontal Cabling Performance Requirements:

Insertion Loss (Attenuation) dB/100 m						NEXT (dB)				
Frequency MHz	Cat6 CMR			Cat6 CMP		Cat6 CMR			Cat6 CMP	
	Standard	Maximum	Typical	Maximum	Typical	Standard	Minimum	Typical	Minimum	Typical
0.772	1.8	1.6	1.6	1.6	1.5	76.0	80.0	87.0	86.0	93.0
1	2.0	1.8	1.8	1.8	1.7	74.3	78.0	86.0	86.0	92.0
4	3.8	3.8	3.7	3.5	3.4	65.3	68.0	77.0	73.0	82.0
8	5.3	5.3	5.0	4.9	4.8	60.8	67.0	76.0	72.0	81.0
10	6.0	5.8	5.5	5.6	5.4	59.3	66.0	72.0	71.0	76.0
16	7.6	7.4	7.0	7.1	6.9	56.2	66.0	70.0	70.0	75.0
20	8.5	8.4	7.9	7.9	7.7	54.8	55.0	64.0	66.0	68.0
25	9.5	9.2	8.9	8.4	8.7	53.3	55.0	62.0	59.0	66.0
31.125	10.7	10.3	10.1	9.9	9.8	51.9	55.0	65.0	59.0	69.0
62.5	15.4	14.8	14.5	14.4	14.3	47.4	54.0	61.0	57.0	65.0
100	19.8	18.7	18.5	18.8	18.5	44.3	52.0	56.0	55.0	60.0
200	29.0	27.0	27.8	27.9	27.5	39.8	50.0	52.0	53.0	56.0
250	32.8	30.5	32.0	31.8	31.3	38.3	48.0	52.0	52.0	56.0
300	36.4	33.5	35.0	35.5	34.9	37.1	45.0	51.0	48.0	55.0
350	39.8	37.0	37.0	38.9	36.3	36.1	42.0	49.0	45.0	52.0
400	43.0	39.3	40.1	41.1	39.6	35.3	39.0	45.0	42.0	49.0
500	48.9	44.3	46.2	48.6	45.4	33.8	38.0	43.0	41.0	46.0
550	51.8	46.4	49.0	51.7	48.3	33.2	37.0	40.0	40.0	43.0
600	54.5	49.5	51.2	54.5	50.8	32.6	34.0	33.0	37.0	35.0

.3 Work Area: Configure work area outlets using a minimum of three (3) Category 6 cables with appropriate Category 6 connectors as listed in Item 2.2.2.4 below.

.4 Horizontal Connectors: Category 6 modular (data) jacks; unkeyed four (4) pair meeting Category 6 performance requirements; fitting 20 mm x 15 mm opening; terminate modular jacks using a non-impact termination tool to eliminate connector damage and promote consistent terminations; ; colour code jacks for T568A; wire each jack to T568A; each modular jack shall be ULC listed.

Part 3 Execution

3.1 EXAMINATION

.1 Examine areas receiving network cabling system and verify that conditions are acceptable for installation.

.2 Notify the Consultant of conditions adversely affecting installation or subsequent use of the cabling system.

.3 Proceed with installation only after unsatisfactory conditions have been corrected; installation will be interpreted as acceptance of site conditions.

3.2 INSTALLATION

.1 Installation, General:

.1 Coordinate installation of network cabling system with other work in progress.

.2 Install 19 mm thick, fire retardant treated plywood backboard as indicated on Drawings for mounting of termination blocks, coordinate with Section 06 10 00.

.3 Install all cables in EMT conduit up the wall and routed through base building communications zone boxes and cable trays to terminal boards.

.2 Horizontal Distribution Cable Installation:

.1 Install cable in accordance with manufacturer's written instructions and best industry practices.

.2 Install cables in continuous lengths from origin to destination with no splices.

.3 Do not exceed manufacturer's recommended minimum bend radius or maximum pulling tension; restrict bending radius of unshielded twisted pair cable to a minimum of four (4) times the outside diameter of the cable; restrict pulling tension of four (4) pair UTP cables to a maximum of 10 kg for a single cable or cable bundle.

.4 Replace any cable damaged during installation or exceeding manufacturer's recommended installation parameters before final acceptance at no additional cost to the Contract.

3.3 SITE QUALITY CONTROL

.1 Site Testing: Test each cable for length, continuity and wire map all pairs and conductors as follows:

.1 Voice Backbone: Test twisted pair cables for continuity, pair reversals, shorts and opens using green light test set.

.2 Data: Test twisted pair cables for continuity, pair reversals, shorts and opens using green light test set, and for installed cable performance.

.3 Use a Level III Scanner to perform tests.

.4 Continuity/Wire Map:

.1 Test each installed cable using green light test set that shows opens, shorts, polarity and pair reversals, and splits.

.2 Test shielded or screened cables using a device that verifies shield continuity in addition to the requirements listed in Item 3.3.1.4.1 above.

.3 Record tests as pass/fail as indicated by the test set in accordance with manufacturer's recommended procedures; referenced to appropriate cable identification number, and circuit or pair number.

.4 Correct any faults and retest prior to final acceptance.

.5 Consultant may consider alternate auto-test procedure for each wire in accordance with TIA/EIA 568-B using Level III Scanner.

.5 Length:

.1 Test each installed cable for length using a TDR Type device.

.2 Test cables from patch panel area outlet; maximum length of cable permitted shall be in accordance with TIA/EIA 568-B

.3 Record cable lengths referenced to appropriate cable identification number, and circuit or pair number; record longest pair length as length of cable for multi-pair cables.

.2 Copper - Performance Verification:

.1 Verify performance of Category 6 data cabling systems using an automated test set using a Level III qualified tester approved by the cabling manufacturer; test shall be a permanent link testing for the following performance parameters:

.1 Wire Map
.2 Length
.3 Insertion Loss
.4 Pair-to-Pair Near End Crosstalk (NEXT)
.5 Power Sum Near End Crosstalk (PSNEXT)
.6 Equal Level Far End Crosstalk (ELFWXT)
.7 Power Sum Equal Level Far End Crosstalk (PSELFEXT)
.8 Return Loss (RL)
.9 Propagation Delay
.10 Delay Skew

.2 Verify performance of Category 6 data cabling using an automated test set with results automatically evaluate by the equipment using most current criteria listed in TIA/EIA 568-B, 2.1; show results as pass/fail; print test results directly from testing unit or from a download file using application from test equipment manufacturer; indicate tests performed, the expected test results and the actual test result achieved.

END OF SECTION

SECTION 27 40 16

CABLE TELEVISION (CATV) SYSTEMS

Part 1 General

1.1 SUMMARY

.1 Provide a complete cabling and raceway system to facilitate the delivery of cable TV signals to all outlet and user locations.

.2 Provide all installations necessary for a complete working system.

1.2 RELATED REQUIREMENTS

.1 Section 06 10 00 – Rough Carpentry: Materials and finishing requirements for data and voice back boards.

.2 Section 26 05 00 – Common Work Results for Electrical

.3 Section 26 05 28 – Conduits, Outlet Boxes and Fittings for Electrical Systems

.4 Section 26 27 16 – Cabinets, Splitters, Junction and Pull Boxes

.5 Section 26 05 29 – Hangers Supports for Electrical Systems

1.3 COORDINATION WITH CABLE COMPANY

.1 Coordinate with the local Cable TV company and arrange for the necessary equipment and cabling required.

Part 2 Products

2.1 RACEWAYS

.1 Raceway system components include but are not limited to conduit, fittings, cabinets, outlet boxes, junction boxes, and other components as required, and as indicated on the drawings.

2.2 BACKBOARDS

.1 Provide plywood backboards and cable TV distribution cabinets as required. Refer to Section 06 10 00.

2.3 SIGNAL DISTRIBUTION EQUIPMENT

.1 Provide all cable, amplifiers, splitters and accessories required for a complete working system.

.2 Provide individual “homeruns” from each outlet jack. Daisy chaining of outlets will not be accepted.

Part 3 Execution

3.1 SERVICE SIGNAL

.1 Extend CATV service signal to each telecom room as shown on drawings.

.2 From each telecom room provide cable TV signals to the outlets as shown on the drawings.

3.2 RACEWAYS

.1 Install cabinets, boxes, conduit, plywood backboards, etc. as indicated.

3.3 POWER SUPPLY CIRCUITS

.1 Install branch circuit wiring for power supply circuits.

.2 Install one duplex receptacle below each backboard or cabinet.

END OF SECTION