Design Development Project Manual

Team Middlebury
U.S. Department of Energy
Solar Decathlon 2011

Design Development Project Manual
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Structural Calculations

McFARLAND-JOHNSON, INC.
40 Farrell Street
SOUTH BURLINGTON, VERMONT 05403-6112
PHONE (802) 862-9381
FAX (802) 862-7450

JOB ____________________________

SHEET NO ____________________ OF ______

CALCULATED BY ___________________ DATE ________

CHECKED BY ___________________ DATE ________

SCALE ________________________
Index

A - Load, Code, Assumptions
B - Roof Framing
C - Floor Framing
D - Walls
E - Screw Track Roof
F - Deck
Snow Load

\[ p_{s} = 0.7 C_{e} C_{t} I \]

- \[ p_{s} = 50 \text{ psf} \text{ at middlebury} \]
- \[ C_{e} = 1.0 \text{ (partially exposed)} \]
- \[ C_{t} = 1.1 \]
- \[ I = 10 \]

\[ p_{f} = 38.5 \rightarrow \text{use 40 psf at min} \]

\[ p_{6} = C_{s} p_{f} \]

\[ C_{s} = 7 \]

\[ p_{s} = 28 \text{ psf} \text{ however have solar panels i.e. do not consider } \]

"unobstructed" slipping surface => use \[ p_{s} = 40 \text{ psf} \]

Unbalanced Snow

\[ W = 13 \times 2.0 = 26 \] unbalanced = \[ I_{B} = 50 \text{ psf} \]
Design Typical Reflector

\( \text{Span} = 10\, \text{ft} \) (nominal)

\( W = \frac{\sigma}{2} \left( 0.03 \, \text{kips/ft} \, \text{SL} + 0.05 \, \text{kips/ft} \, \text{KL} \right) = 14 \, \text{kips} \)

\( M = 1.75 \, \text{k} \)

\( V = 0.7 \, \text{k} \)

\( 14" \times 11" \)

\( M_{\text{ref}} = 3.7 \, \text{in}^3 \)

\( V_f = 1.86 \, \text{in} \)

\( \Delta L = 1.07" \) (1/120) \( \Delta L \)

\( \Delta L = 1.07" \times \frac{50}{50} = 0.076" \) \( \Delta L \)

\( 14" \times 11" \) on 2.5\%
Desert Typical Retrofit Edge Beam

Max opening = 6'-8"

\[ w = 0.07 \times f_v \left( \frac{a}{d} \right) + \frac{a'}{w_0} \times \frac{a''}{w_0} \] = 0.44 W, ft²

\[ M = 2.56'' \]

\[ V = 1.54'' \]

1 3/4" x 16" LVL

\[ M_r = 12.1'' \times \frac{ft}{lb} \]

\[ V_r = 4.6'' \times \frac{ft}{lb} \]

\[ \Delta = \frac{5 \times 0.461' \times 6.67' \times 12^3}{384 \times 1,000 \times 2,400 \times \frac{1}{2'^3}} \approx 0.027'' = 4/16'' \]

LCL 1 3/4" x 15" LVL
Preliminary TJI Post Support Beam

\[ W = \left( \frac{3.25 \times 10}{2} \right) \times \left( 0.02 \times 15 \times 105 \times 14 \right) \times \sin \theta = 460 \text{ lb} \]

\[ s_p = 18' \]

\[ M = \frac{46 \times 18}{6} = 18.66 \text{ kips-ft} \]

\[ V = 4.14 \text{ kips} \]

\[ f_y = 8 \times 12 = \frac{75 \times 11.5}{6} = 165 \text{ in}^3 \]

\[ f_b = \frac{M}{s} = 1357 \text{ psi} \]

\[ f_y = 10 \times 14 = 388.6 \text{ psi} \]

\[ f_b = 716 \text{ psi} \]

\[ 10 \times 16 = 380.4 \text{ psi} \]

\[ f_b = 568 \text{ psi} \]

\[ f_y = 3V = \frac{3 \times 4140 \times 11}{2 \times 96 \times 12} = 42 \text{ psi} \]

\[ \Delta = 5 \times 460 \times 18^2 \times 10^{-8} = 3.6 \text{ in} \]

\[ V_{SE} 10 \times 16 \text{ Beam} \]
Design Tension T

\[ T = 1.55^{k} \times a + 0.75^{k} = 3.9^{k} \]

\[ M_{o} = 75^{4} \times 10^{3} = 7.5^{k} \]

\[ T_{ij} = 6^{5} \times 10^{6} \]

\[ S = \frac{1}{6} \times 10^{6} = 3^{1.5} \]

\[ S_{0} = 9.7 \times 10^{3} \times 3^{1.5} = 39^{k} \]

\[ T_{ij} = 8^{8} \times 10^{3} \]

\[ S = 6.67^{m} \]

\[ A = \frac{S \times 75^{4} \times 10^{3} \times 10^{9}}{384 \times 29.000 \times \frac{1}{10} \times 5^{6} \times 8^{2}} = 0.225^{k} \]

Use M = 8^{8}
Design Bolts

\[ T = \frac{3,900}{3/4''} \text{ ft-lb} \]

\[ Z_{11} = 710 \text{ #/bolts (SPF)} \]

\[ C_D = 1.15 \left( \text{snow load} \right) \]

\[ C_g = 0.75 \]

\[ C_A = 1.0 \text{ (snow and dist: } 3'' \text{ } 3' \text{ c-e spec'y)} \]

\[ C_g = 1.0 \]

\[ Z_{11} = 660 \text{ #/bolts} \]

\[ \frac{3,900 \text{ #}}{660 \text{ #}} = 7 \text{ bolts } \approx \left( \frac{7}{6} \right) \]
Design of Metal Lifting Device

Span: 12'

\[ w = \frac{s^4}{12L} = \frac{s^4}{12 \times 12} \]

\[ M = q \cdot l \]

\[ 6'' \times \frac{1}{4''} \quad \Rightarrow \quad S = 1.5 \]

\[ F_b = -72 \text{ kips} \quad M_G = \]

\[ C_x = 9.3 \times M_{29} \]

\[ \Delta = 0.1 \]

\[ C_x = 2.7 \times M_{29} \]

\[ \Delta = 0.3 \]

\[ 8'' \times \frac{1}{4''} \quad l = 7 \quad s = 2.67' \times 2 = 5.33 \]

\[ F_b = 20 \text{ kips} \]

\[ S = 3.8 \text{ in}^3 \quad P = \]

\[ F_b = 14.2 \text{ kips} \]

\[ a = 9 \times 12'' = \frac{1}{2}'' \times \text{arc} \]

\[ 161 \times 15.8 \]

\[ S = 4.477 \]

\[ F_b = 1.2 \text{ kips} \]

\[ C_x = \frac{2'' \times \frac{1}{4''}}{10} \quad F_b = \frac{5'' \times \frac{1}{4''}}{2'' \times \frac{1}{4''}} = 0.5 \text{ ft} \]
Redesign Pro Mod ULT107 Q11

\[ \text{span} = 12' \]

\[ \omega = \frac{7}{12} \]

\[ M = 10.5' \]

\[ 7 \times 1.8 \times \frac{M\omega}{\sqrt{2}} = 12.9 \text{ kip} \]

\[ A = 0.23'' \text{ (w/o C7's) C7's} \]
Floor Framing

LL = 50 p.l.f.

    Sheathing 9/32" - 3 p.l.f.
    Sheathing 3/16" - 1.5 p.l.f.
    Insulation - 2 p.l.f.
    M. n. - 2 1/2 p.l.f.
    Total - 13 1/2 p.l.f. (say 15 p.l.f.)

Typical Floor Joint:

\[ \text{Sp.} = 10' - 10" \]

\[ M = \frac{16'' \times (0.015 \text{ L.F.} + 0.025 \text{ L.F.}) \times 10^{3}}{8} = 1.27'' \times 1.17'' = 1.47'' \text{ O.D.} \]

\[ V = \frac{16'' \times (0.015 + 0.025 \text{ L.F.}) \times 5.5''}{10^{3}} = 5'' \times 6'' \]

9 1/2" TJI 110

\[ M_R = 0.5'' \text{ O.D.} \]

\[ V_T = 1.22'' \text{ M. R. and No. 10 S.} \]

\[ A = 9.25'' \times \frac{1.6'' \times 6.5'' \times 11''}{12} = 2.07 \times 16.67 \times 6.5'' \times 11'' \]

\[ = 0.21'' = 4.25'' \text{ O.D.} \]

\[ V_c = 9 1/2'' \text{ TJI 110 @ 16'' O.D.} \]

\[ = \frac{4.25''}{10''} \cdot 16'' \text{ O.D.} \]
Typical Floor Beam

Try Sect. No. 1/162

Fb = 8 ½ psi \times \frac{1.15 \times 11}{12} = 1106 \text{ psi}

F = \frac{CF}{2} = \frac{1 \frac{3}{4} \times \frac{109}{1}}{34.1 \times 12^3}

= \frac{7.2 \text{ psi}}{12} \text{ OK}

Fv = \frac{2 \times 600^\circ}{2 \times 1 \frac{1}{2}} = 65 \text{ psi} < Fv = 135 \text{ psi \ OK}

\Delta = S \times 16\% = 0.85 \times 10 \times 10^3 \times 12^3

= 984 \times 1400 \times 12 = 198 \text{ ft-lb}

\delta = 2 \times 10 \times 16^\circ / 12
\[ \Delta = \frac{0.6'' \times 116''}{53''} - \frac{0.21''}{454} \cdot \frac{154}{53} \]

\[ 0.6'' \times 9.6'' \text{ ASL} \]
Design 3½" x 9½" RSC Flush Form, concealed flange 1/2" at East West Wall

\[ p = \frac{10}{2} \times \frac{11}{2} \times 0.065 \text{ ksf} + 18 \times 0.020 \text{ ksf} \times \frac{10}{2} + \frac{10}{2} \times 10 \times 0.051 \text{ ksf} \]

Floor \quad Wall \quad Roof

= 2.3" = Design \text{ max} = 3.0" min

HUSC or HUCA

HUSC

\[ HUSC = 10 - 505 \text{ cap} = 3310 \# \text{ w/sf/ft healing time} \text{ } \overline{0.5} \]
Design for 6’ span.

\[ W = 0.0671 \times \frac{10'}{2} = 0.3517 \]  

\[ M = 1.5'' \]  

\[ V = 1.0'' \]  

\[ T_g = 2 \times 10'' \]

\[ J_b = \frac{1.5'' \times 12''}{2 \times 21.4} = 0.360 \text{ psi} \]

\[ J_g = \frac{3 \times 1.0''}{2 \times 2\times 13/4 \times 11/4} = 0.797 \text{ psi} \]

\[ \text{Use } (3) \text{ to } 2 \times 10'' \]

Check: 2'' ripped to 6''

\[ \text{Span: 6’-3’} \]

\[ M = \frac{0.6'' \times 0.65 \times 8.35}{2/8} \]  

\[ M = 27.4'' \]  

\[ V = 36'' \]  

\[ J_b = \frac{17\times 12}{10' \times 6''} = 0.89 \text{ psi} \]

\[ J_g = \frac{2.5'' \times 3}{2 \times 11/4 \times 11/4} = 0.53 \text{ psi} \]

\[ \text{Use } 2\times 10'' \text{ ripped} \]
Check: 3\(\frac{1}{2}\) x 9\(\frac{1}{8}\) PSL for 3\(\frac{1}{2}\) x 11\(\frac{3}{8}\) Post Load

\[ P = 6' \times 800 \text{#/ft} = 4800 \text{lb} \]

\[ M_{max} = \frac{PL}{4} = \frac{4.8' \times 8'}{4} = 9.6' \times \frac{1}{4} \]

\[ V_{max} = 4.8' \]

3\(\frac{1}{2}\) x 9\(\frac{1}{8}\) PSL

\[ M_f = 13 \text{ k}\]

\[ V_f = 6.4 \text{ k} \]

\[ w_0 = 3\frac{1}{8} \times 9\frac{1}{8} \text{ PSL} \]
Design  Box P

Max  11.9 cu

Req'd Area = \frac{11.9^{2}}{1.56} = 7.9 sq ft = \text{ use } 8.0 sq ft

Base = 8 x 8 = 64 cu ft

M = \frac{w \cdot h}{g} = \frac{6.06 \times 8}{303} = 0.173 in

6 x 6, S = 20.73 in²
Fp = 131 psi

6 x 6 (check adequate)

Base P, trial: M x \frac{Fp}{2.5}

Fp = \frac{11.49}{12 \times 12} = 0.83 ksi

= 4 \times \frac{106}{35 \times 36} = \frac{7}{6} = 0.08 ft

\text{i/3/2011}
Check 1 1/2" T5I's & each load capacity is well

\[ F_c' = F_c \times C_a \times C_m \times C_t \times C_p \times C_i \times C_p \]

- \( C_a = 1.10 \) (concrete)
- \( C_m = 1.0 \)
- \( C_t = 1.0 \)
- \( C_p = 1.0 \) (concrete, but see factors related to engineered timber)
- \( C_i = 1.0 \)

\[ C_p = 1 + \frac{F_{ce}}{F_c} = \sqrt{\left(1 + \frac{F_{ce}}{F_c}\right)^2 - \frac{F_{ce}/F_c^2}{C}} \]

\[ F_c' = F_c \]

Flanges designed to comply:
- LVL
- LSL
- MBR

1 1/2" T5I
- Ndl: 3.16" 3/16" = [1/16 x 3/16 x \( F_c \)] x 10.6
- \( F_c = 1500 \) psi

\[ F_c' = 1400 \text{ psi} \]

Use \( F_c = 1400 \) psi

\[ C = 0.9 \]
\[
F_{cc} = \frac{8.035 E_{m0}}{C_{c0}} \\
757.05 \times 150 = 113.78 E_{m0} \\
45^\circ = \frac{360}{7} \leq 50 \text{ (ok)} \\
\frac{8.035 \times 757.05}{360} = 411.7 \text{ psi} \\
F_{cc}/F_{ax} = 411.7 \text{ psi} / 1400 \text{ psi} = 0.387 \\
C_p = \frac{1 + 0.387}{2} - \sqrt{\left(\frac{1 + 0.387}{2}\right)^2 - 0.387} = 0.34 \\
C_p' = 0.34 \\
F_C' = 0.34 \times 1400 \text{ psi} = 475 \text{ psi} \\
M_{ax} \text{ (down force)} = 475 \text{ psi} \times \frac{0.75}{2} \text{ (100)} \times y \times 5.718 y^2 \text{ (2100)} = 1039 \text{ #} \\
\times 2.691 (0.30) = 1373 \text{ lb} \\
\times 3.381 (0.50) = 1510 \text{ lb} \\
\times 4.805 (0.50) = 2286 \text{ lb}
\]
Wall C TVI Roof

Dead Load

S.I.S. Roof
3/4" Sheathing
16" Ties
5/8" Sheathing
Rock Wall (16"
Misc

3 psf
3 psf
1.7 psf
2.2 psf
3.2 psf
5.4 psf

\[ \rho_{\text{major}} = 0.1 \times 11 \times (0.05 \text{ psf} + 0.07 \text{ psf}) = 1.8 \text{ psf} \]

Use 360 series wall studs

1/2 furring
**Design Check Calculation Sheet**

**Size: 8.11**

**LOADS:**

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution Pattern</th>
<th>Location [ft]</th>
<th>Magnitude</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load 2</td>
<td>Dead</td>
<td>Axial UDL</td>
<td>(8cc. = 0.00&quot;)</td>
<td>222</td>
<td>plf</td>
</tr>
<tr>
<td>Load 3</td>
<td>Snow</td>
<td>Axial UDL</td>
<td>(Rcc. = 0.00&quot;)</td>
<td>556</td>
<td>plf</td>
</tr>
<tr>
<td>Load 6</td>
<td>Wind</td>
<td>Full Area</td>
<td></td>
<td>30.00 (24.0&quot;)</td>
<td>psi</td>
</tr>
</tbody>
</table>

*Preliminary Width (in)*

**MAXIMUM REACTIONS (lbs):**

<table>
<thead>
<tr>
<th>Load</th>
<th>Base</th>
<th>Dead</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>210</td>
<td></td>
<td>210</td>
</tr>
</tbody>
</table>

**Lumber Stud, S-P-F, No.1/No.2, 2x4"**

Spaced at 24" o.c.; Self-weight of 1.06 plf included in loads;
Pinned base; Loadface = width(b); Ke x Lb: 1.00 x 3.50= 3.50 [ft]; Ke x Ld: 1.00 x 7.00= 7.00 [ft]; Lateral support: top = Lb, bottom = Ld; Repetitive factor: applied where permitted (refer to online help);

**Analysis vs. Allowable Stress (psi) and Deflection (in) using NDS 2005:**

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td>fv = 60</td>
<td>Fv' = 216</td>
<td>Fv/Fv' = 0.28</td>
</tr>
<tr>
<td>Bending(+)</td>
<td>fb = 1440</td>
<td>Fb = 3625</td>
<td></td>
</tr>
<tr>
<td>Axial</td>
<td>fc = 298</td>
<td>Fc' = 488</td>
<td>Fc/Fc' = 0.61</td>
</tr>
<tr>
<td>Axial Bearing</td>
<td>fc = 298</td>
<td>Fc* = 1521</td>
<td></td>
</tr>
<tr>
<td>Combined (axial compression + side load bending)</td>
<td>Eq.3.9-3 = 0.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live Defl'n</td>
<td>0.43 = L/194</td>
<td>0.47 = L/180</td>
<td></td>
</tr>
<tr>
<td>Total Defl'n</td>
<td>0.43 = L/194</td>
<td>0.47 = L/180</td>
<td></td>
</tr>
</tbody>
</table>

**ADDITIONAL DATA:**

**FACTORs:** E/ Fy C D CM Ct CL/CP CF Cfu Cr Cfrt Cl LC#

- Fy: 135 1.60 1.00 1.00 - - - 1.00 1.00 4
- Fy': 875 1.60 1.00 1.00 0.958 1.500 1.00 1.15 1.00 1.00 4
- Fc: 1150 1.15 1.00 1.00 0.121 1.150 - - 1.00 1.00 2
- Fc' comb: 1150 1.60 - - 0.230 - - - - 3
- E': 1.4 million 1.00 1.00 - - - - 1.00 1.00 4
- Em': 0.51 million 1.00 1.00 - - - - 1.00 1.00 4
- Fc*: 1150 1.15 1.00 1.00 - 1.150 - - 1.00 1.00 2

Shear: LC #4 = 6D+W, V = 210, V design = 210 lbs
Bending(+) : LC #4 = 6D+W, M = 368 lbs-ft
Deflection: LC #4 = 6D+W (live)
LC #4 = 6D+W (total)
EI = 8x6S lb-in2
Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.
Axial: LC #2 = D+S, P = 1563 lbs
Combined: LC #3 = D+S+W, (1 - fc/FcE) = 0.66
D-dead, L-live, S=snow W=wind I=impact R=roof live Lc=concentrated
All LC's are listed in the Analysis output
Load combinations: ICC-IBC

**DESIGN NOTES:**
1. Please verify that the default deflection limits are appropriate for your application.
Design Horizon beam & gallery end wall

\[ W = 18 \text{ ft} \]

\[ M = 6.34 \text{ k}

\[ 3\frac{1}{2} \times 11\frac{3}{4} \text{ FSL} \]

\[ 19\frac{3}{4}'' \]

\[ A = \frac{6.4 \times 0.6}{161 \times 0.01 \times \sqrt{1.6}} \]

\[ = 0.478 \text{ k} \]

\[ 2.5 \]

Try Bottom Chapel / Texas

\[ I = 5\frac{1}{6} \times 1(11\frac{3}{4} - 8\frac{3}{4})^2 = 375 \]

\[ \theta = 180° - \frac{1}{2} \times 45° \text{ ok years material of chinking} \]

\[ \text{Chapel corner} / \text{ext.} \times 6 \times 4.2^2 - 8^2 \times 0.707 \text{ ok} \]

\[ 9.5 \]
Check 3/4" plywood 3/4" to lip of shelf and wall.

\[ \frac{200}{4} \text{ ft} \]
\[ \frac{300}{4} \text{ ft} \]

10"

\[ M_{max} = 14 \text{ kft} \]

\[ 3/4" \times \frac{11/2}{4} = 15.1 \]

\[ S = \frac{1/6 \times (11 - y^2)}{6 \times 11} \]

\[ S = \frac{2.8}{6} \]

\[ S = 5.63 \text{ psi} \]

\[ R = 620 \times 27 \times 3/4" \] (310# x 3 x 16) = 672##
Check will slide w/ drainage 3'-6' (Hail Verification)

\[ F_c' = F_c \times C_0 \times C_f \times C_p \]

\[ C_0 = 115 \] (snow load)

\[ C_f = 1.15 \]

\[ C_p = \frac{150 \text{ psf} \times 1 \text{ ft} \times 1 \text{ ft}}{1 \text{ ft}^2} = 150 \text{ psf} \]

\[ C = 0.8 \]

\[ F_{cc} = \frac{830 \ E_{miz}}{(R_{eff})^2} \]

\[ E_m = 50,000 \text{ psi} \]

\[ \frac{E}{D_1} = \frac{84}{3'} = 27 \]

\[ \frac{E}{D_2} = \frac{43}{1'} = 43 \leq \text{unknwn} \]

\[ = 534 \text{ psf} \]

\[ \frac{F_{cc}}{F_c'} = 0.35 \]

\[ C_p = \frac{1.35 \times 1.6}{0.8} - \sqrt{(1.35 \times 1.6)^2 - 1.35 \times 0.8} \]

\[ = 32 \]

\[ P = \frac{1.32 \times 10}{1' \times 3'} = 2.55 \text{ ft}^2 < 0.04 \times 1.54 \text{ ft}^2 \]
Typical Earth Fast Wall

\[ \text{Spaw} = 5.5' \]

\[ w = 770 \text{#/ft} \]

\[ m = 2.9' \]

\[ V = 2.17'' \]

\[ (\varnothing) 2\times1.2'' \]

\[ F_b = 875 \text{ psi} \times 1.15 = 1006 \text{ psi} \]

\[ R = \frac{2.9'' \times 1.2''}{63.2''} = 0.51 \text{ psi} \]

\[ F_v = \frac{3 \times 2.12''}{2 \times 1.5'' \times 1.12''} = 94 \text{ psi} < 125 \text{ psi} \]

\[ \text{UNC(0) 2x12} \]
Design Solar Wall Sheet

\[ p_s = \frac{1}{2} k_2 \theta \left( \frac{p_{s,0}}{p_{s,0}} \right) \]

\[ k = 1.0 \]

\[ I = 1.0 \]

\[ \lambda = 1.34 \left( \text{exp} \left( \frac{17}{17} \right) \right) \]

\[ p_{s,0} = 1.5 \text{ psi} \left( \text{C}, \text{zone A} \right) \]

\[ p_s = 15 \text{ psi} \]

\[ V = 15 \text{ psi} \times 46.5 \times 13' = \]

Available sidewall length = 16'

\[ R_f \text{ flow capacity} = \frac{17.5^2 \times 13}{16} = 38 \text{ HI/ft} \]

Ice thickness = 0.41, 1/8" thickness, 1/10" under 6" k

\[ = 3.10 \times \frac{1}{10} = 0.31 \text{ HI/ft} \]
Evaluate Screw Jack Posts

Estimate Loads

Roof DL: 5/8" sheathing 3
           Roofing   3
           Trusses   2
           Ceiling   5
           Insulation 5
           Misc. 20 psf

Roof LL = 50 psf (unbalanced)

Floor DL 15 psf (so, pg C1)
           LL 50 psf

Jack @ 8'-0" OL

\[
p_{\text{max}} = 8' \times 11' \left(0.02k_f + 0.05k_f + 0.015 k_f + 0.05 \text{ LF}\right) = 11.9 < 15^t \text{lbf/ sq ft (allowable)}
\]

\[
p_{\text{min}} = 8' \times 5.5' \left(0.02 + .015\right) = 154^t
\]

\[
p_{\text{min}} = 8' \times 11' \left(0.02 + .015\right) = 308^t
\]

\[\text{Load Capacity: } 15^t\]
Evaluate Overturning on Screw Jacks (Preliminary)

\[ M_{oc} = 8 \left( 0.48 \times 10.5^3 \right) + \left( 0.048 \times 8.5 \times 1.25 \right) \]

\[ = 13.2k \]

\[ C \geq M_{kc} = W \times 11 \]

\[ = 0.02 \times 0.05 \times 22 \times 8 \times 6 \times 11 + 0.02 \times 0.03 \times 22 \times 3 \times 11 \times 6 \]

\[ = 47.4k \leq 14.3k \text{ Overturning} \]

Evaluate moment at pole

\[ M_{ot} = 14.3k \]

\[ M_{o} = 14.3 + 185^2 = 1904k \]

\[ \Delta \Delta \]

\[ 11' - 11' \]

\[ \Delta \]

\[ 11' - 10' \]

\[ 11' - 10' \]

\[ A \]

\[ 4 \]

\[ 4 \]

\[ 4 \]

\[ 4 \]

\[ R_c - R_a = 1.291k \]

\[ R_c - R_a = 1.291k + R_a \]
\[ F_U = 0 = -0.924 \times x_2 - 1.85^2 + 1.85 + R_c + R_A \]

\[ R_c + R_A = 1.848 \]

\[ 1.59^2 + R_a + R_c - 1.848 \]

\[ R_A = 0.778 \]

\[ R_c = 1.574 \]

Conclude no net uplift due to overconsolidation of 90 psi used.

Evaluate Slew Jack local overturning:

\[ \Sigma M_{OT} = 2.95 \times 8^2 = 15.8 \text{k} \]

\[ \Sigma M_R = 0.778 \times 0.8 = 0.624 \text{k} \]

If place on 8\' - 8\' - 8\'

\[ \Sigma M_R = 0.778 \times 12 = 33.4 \text{k} \text{m.c.} \]
Total Bldg Vol \( = 45' \times 20' \times 0.03 + 0.15 \) = 31.5'

Total Horizontal Load = \( (14 \text{ psf} \times 9.35' + 8 \text{ psf} \times 7.5') \times 45' \) - 10.19' e q u a l t y

Lowe Capacity = \( \frac{10.19' \times 60^2}{90} \) = 4.53'

Rejection Capacity = \( 31.5' \times 0.33 = 10.49' \)

FS = 2.31 > 2.0 \( \frac{6}{7} \)
Check Net Uplift on Entire Structure

\[ q_2 = 0.00856 K_2 K_v K_d V^2 I \]

\[
\begin{align*}
K_v & = 1.0 \\
K_d & = 1.25 \\
K_2 & = 2.4 \quad (18'' \\& \quad \text{up}) \\
I & = 1.0 \\
V & = 90 \text{ mph} \quad \text{(vermont)}
\end{align*}
\]

\[ q_2 = 15.5 \text{ psf} \]

\[ \rho = q G \rho_p \]

\[ G = 0.85 \]

\[ \rho_p = 0.3 \]

\[ h/0 = 18''/a_0^2 = 0.2 \]

\[ = 4 \text{ psf} \]

Total negative load on roof: \( 4 \text{ psf} x \frac{a_0^2}{a_0} = 80 \text{ psf of 600g} \)

Minimum dead load: \( 0.6 \times 20 \text{ psf roof DL } + 15 \text{ psf} \times 2 \times 20'' = 460 \text{ psf} \)

F.5 against uplift: 5.85
Due for F11 135 psi

\[ q = 8' \]

\[ m = \frac{h}{10} \left( 0 + 1.35 \times 0.5 \right) \times \frac{3}{8} = 1.6' \]

\[ v = 1.6' \]

\[ 2 \times 10 \times 36 = 597 \text{ psi} \quad 0 \text{ psi} \leq 1000 \text{ psi} \]

\[ 50 = 86 \text{ psi} \quad < 133 \text{ psi} \]

\[ \text{Use D10 at 15 psi} \]
Design Load Factors

\[
P_{\text{min}} = 1650, 1950, 1400, 1600, 1620, 1650
\]

\[
\frac{1950}{1000} = 1.95 \text{ ksi} \Rightarrow T_p = \frac{1}{\epsilon} \times \beta_p
\]

\[
T_p = 0.01 \text{ ksi}
\]

\[
T = 5.5 \times \sqrt{0.01} = 0.8 \text{ ksi}
\]

Beam E Face Moment Hinge

\[
P_{\text{max}} = 1192, 730, 1020
\]

\[
LUS 210-2 = 1745.4
\]
Design Bracket & Handrail Posts + Design Post

Posts @ 3' - 0" o/c

W = \frac{5000}{12} \text{ or } 200 \text{ lb\,concentrated} + 7 \text{200 lb\,concentrated}

M = P \cdot L = 25 \times 3.5\text{ ft} = 75\text{ ft-lb}

\frac{M_x}{W} = \frac{F_x \cdot Z}{2} = \frac{350 \times (1.345)}{1.67} = 686 \text{ kN/m}

1\frac{1}{4}" x 5 pipe, S = \frac{3.78}{2} = 1.893\text{ in}^2

\frac{M_y}{E \cdot I} = \frac{735\text{ in-lb}}{812\text{ in}^2} = \frac{4\text{ in}}{1\frac{1}{2}} \text{ in-lb/in}

Design Bracket

M = 7\text{ kN/m}

T = \frac{84\text{ kN}}{2\times1\times1} = 1050\text{ kN/m}

So input

3\frac{1}{8}" @ 60\text{ ft} = \frac{360}{60} = 30\text{ in} \cdot \frac{1}{2} = 15\text{ in} \cdot \frac{1}{2} = 2.0\text{ in}

\frac{1185\text{ kN}}{1.893}
\[ M_{ax} = \frac{3}{4} \frac{C_T}{C_F} \times \frac{2}{3} \times \frac{L}{S} \] 

\[ F_b = 0.75 \rho \times 1.1 \times 1.75 = 110 \text{ lbs} \]

\[ \omega = 1.4'' \left( 0.104 \alpha + 0.056 \phi \right) = 0.153'' \text{ lbs} \]

\[ S = 31.39'' \]

\[ M_{eq} = F_b \times S = 1.97 \omega = \frac{\omega L^2}{8} = \frac{0.153 \times L^2}{8} \]

\[ L_{max} = 10'' \]
Design Cable Hauls

Assume e = 12° of

\[ \omega_{\text{max}} = 251 \]
\[ 308 \times 12/16 = 231 \]
\[ 343 \]
\[ 463 \times 12/16 = 347 \] < Controls
\[ 316 \times 12/16 = 325 \]

\[ M = 350 \# \times 4'' = 14' \]

\[ \frac{3}{4}'' \text{ in.} \]
\[ s = \pi \times \frac{3}{8} \times \frac{3}{4} = 1.04 \]
\[ s_b = 35 \text{ ft} \]

\[ 7/8'' \text{ o} \]
\[ s = 0.085 \]
\[ F_b = 21.5 \text{ lb} \]

\[ 1'' \text{ o} \]
\[ s = 0.18 \]
\[ F_b = 14.3 \text{ lb} \leq \sigma, 1'' \phi \]

\[ T = 750 \# \]
\[ T = 750 \# / 2 \times 4'' = 94 \# \]
\[ V = 187 \# \]
Get High (Continued)

\[ \frac{1}{2} \log W = 0.014/\text{in} \times 1.5\text{in} = 4.30^{41} \]

\[ V_{\text{op}} = 19.0^{\text{in}} \]

\[ \frac{W}{V_{\text{op}}} + \frac{1}{V_{\text{op}}} = \frac{94}{430} + \frac{187}{340} = 0.86 \]

Use 5/8" Taps
Design Water Tank Energy

Total Tank Vol: 6.5 ft³

Tank 60 = 6'-0" = 720 pcf

Design Criteria:

\[ \text{Span} = 5'-0" \]

\[ h = 2 \times 6 \times 12 \cdot \frac{1}{2} \cdot 0.23 \times 5^{0.6} = 718 \text{ ft}^3 \]

\[ f = 1140 \text{ psi} \quad \text{h} \]

\[ 2 \times 8 \cdot 30 = 6 \times 5 \quad \text{pcf} \]

Use 2x8

Beaver Load

\[ \frac{6.5^{3}}{2 \times 6 \times (5.5)^{3/2}} = \frac{1200 \text{ pcf}}{2} \Rightarrow \text{Use (2) 2x6} \]
### Design Check Calculation Sheet

**Sizer 8.11**

**LOADS:**

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution</th>
<th>Pattern</th>
<th>Location [ft]</th>
<th>Magnitude</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load1</td>
<td>Dead</td>
<td>Full Area</td>
<td></td>
<td></td>
<td>15.00</td>
<td>(16.0)* psf</td>
</tr>
<tr>
<td>Load2</td>
<td>Live</td>
<td>Full Area</td>
<td></td>
<td></td>
<td>50.00</td>
<td>(16.0)* psf</td>
</tr>
</tbody>
</table>

**MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):**

- Unfactored: 77
- Factor: 0.7
- Total: 136
- Bearing: 7.94

**Lumber-soft, S-P-F, No.1/No.2, 2x10"**

Lateral support: top= full, bottom= at supports; Repetitive factor: applied where permitted (refer to online help):

**Analysis vs. Allowable Stress (psi) and Deflection (in) using NDS 2005:**

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td>Fv = 29</td>
<td>Fv' = 135</td>
<td>Fv/Fv' = 0.22</td>
</tr>
<tr>
<td>Bending(*)</td>
<td>Fb = 365</td>
<td>Fb' = 1107</td>
<td>Fb/Fb' = 0.33</td>
</tr>
<tr>
<td>Live Def'n</td>
<td>0.06 &lt; L/999</td>
<td>0.26 &lt; L/360</td>
<td>0.15</td>
</tr>
<tr>
<td>Total Def'n</td>
<td>0.06 &lt; L/999</td>
<td>0.39 &lt; L/240</td>
<td>0.15</td>
</tr>
</tbody>
</table>

**ADDITIONAL DATA:**

- Fv': 135
- Fb': 875
- Fcp: 425
- E': 1.4 million
- Emin': 0.51 million

- Shear: LC #2 = D+L, V = 336, V design = 269 lbs
- Bending: LC #2 = D+L, M = 650 lbs-ft
- Deflection: LC #2 = D+L (live)
- LC #2 = D+L (total)
- EI = 139606 lb-in^2

**DESIGN NOTES:**

1. Please verify that the default deflection limits are appropriate for your application.
2. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
### Design Check Calculation Sheet

**Sizer 8.11**

#### LOADS:

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution</th>
<th>Pattern</th>
<th>Location [ft]</th>
<th>Magnitude [psf]</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load1</td>
<td>Dead</td>
<td>Full Area</td>
<td></td>
<td>Start 0.00</td>
<td>15.00</td>
<td>16.00</td>
</tr>
<tr>
<td>Load2</td>
<td>Live</td>
<td>Partial Area</td>
<td></td>
<td>Start 2.25</td>
<td>135.00</td>
<td>16.00</td>
</tr>
<tr>
<td>Load3</td>
<td>Partial Area</td>
<td></td>
<td></td>
<td>Start 6.00</td>
<td>50.00</td>
<td>16.00</td>
</tr>
</tbody>
</table>

*Tributary Width (in)*

#### MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):

![Diagram](image)

Unfactored:
- Dead: 60 lbs
- Other: 407 lbs

Factored:
- Total Bearing:
  - Load Comb: 467 lbs
- Length: 0.73 in
- CD: 1.00 in

*Min. bearing length for joists is 1/2" for exterior supports

### Lumber-soft, S-P-F, No.1/No.2, 2x10"

Floor joist spaced at 16" c/c;
Lateral support: top = full, bottom = at supports; Repetitive factor: applied where permitted (refer to online help)

#### Analysis vs. Allowable Stress (psi) and Deflection (in) using NDS 2005:

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td>Fv = 34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bending (+)</td>
<td>Fb = 306</td>
<td>Fb' = 1107</td>
<td>fb/Fb' = 0.25</td>
</tr>
<tr>
<td>Live Defl'n</td>
<td>0.02 = L/999</td>
<td>0.20 = L/300</td>
<td>0.11</td>
</tr>
<tr>
<td>Total Defl'n</td>
<td>0.03 = L/999</td>
<td>0.30 = L/240</td>
<td>0.09</td>
</tr>
</tbody>
</table>

### ADDITIONAL DATA:

**FACTORS**: F/E CD CM Ct CL CF Cfu Cr Cfcr Cl Cn LC#

- Fv': 135
- Fb': 875
- Fc': 425
- E': 1.4 million
- Emin': 0.5 million

- Shear: LC #2 = D+L, V = 467, V design = 318 lbs
- Bending (+): LC #2 = D+L, N = 546 lbs-ft
- Deflection: LC #2 = D+L (live)
- EI = 1.39e06 lb-in²

Total Design = 1.50(Dead Load Deflection) + Live Load Deflection.
D=dead L=live S=snw W=wind I=impact R=roof live LC=concentrated
All LC's are listed in the Analysis output
Load combinations: ICC-IBC

### DESIGN NOTES:

1. Please verify that the default deflection limits are appropriate for your application.
2. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
## Design Check Calculation Sheet

**SIZE 8.11**

### LOADS:

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution Pattern</th>
<th>Location [ft]</th>
<th>Magnitude Start</th>
<th>Magnitude End</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load 1</td>
<td>Dead</td>
<td>Full UDL</td>
<td>No</td>
<td>483.0</td>
<td>plf</td>
<td></td>
</tr>
</tbody>
</table>

### MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):

<table>
<thead>
<tr>
<th>Unfactored:</th>
<th>1645</th>
<th>1645</th>
<th>1645</th>
<th>1645</th>
<th>1645</th>
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<tbody>
<tr>
<td>Factoried:</td>
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<td>#1</td>
<td>#1</td>
<td>#0.92</td>
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</tr>
<tr>
<td>Total Load</td>
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<td>0.92</td>
<td>0.00</td>
<td>1.41</td>
<td>0.00</td>
<td>0.00</td>
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</tbody>
</table>

### Lumber n-ply, S-P-F, No.1/No.2, 2x10", 2-Plys

Lateral support: top = at supports, bottom = at supports;

### Analysis vs. Allowable Stress (psf) and Deflection (in) using NDS 2005:

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bending (+)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bending (-)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deflection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior Live Total</td>
<td>negligible</td>
<td>0.01 L/999</td>
<td>0.04</td>
</tr>
<tr>
<td>Cantil. Live Total</td>
<td>negligible</td>
<td>0.21 L/240</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.13 L/120</td>
<td></td>
</tr>
</tbody>
</table>

### ADDITIONAL DATA:

**FACTORS:** P/E CD CM Cc CL CF Cfu Cfr Crt Ci Cn LC#

<p>| | | | | | | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>P/E</td>
<td>135</td>
<td>0.90</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1</td>
</tr>
<tr>
<td>Fb'</td>
<td>875</td>
<td>0.90</td>
<td>1.00</td>
<td>1.00</td>
<td>0.994</td>
<td>1.100</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
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<td>1.00</td>
<td>1.00</td>
<td>1</td>
</tr>
<tr>
<td>Fb''</td>
<td>875</td>
<td>0.90</td>
<td>1.00</td>
<td>1.00</td>
<td>0.998</td>
<td>1.100</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
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<td>Emin</td>
<td>1.4</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
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<td>1</td>
</tr>
<tr>
<td>Emin'</td>
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<td>1.00</td>
<td>1.00</td>
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<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1</td>
</tr>
</tbody>
</table>

Shear: LC #1 = D only, V = 1001, V design = 629 lbs
Bending (+): LC #1 = D only, M = 608 lbs-ft
Bending (-): LC #1 = D only, M = 429 lbs-ft
Deflection: LC #0 = Self-weight (Live)
LC #1 = D only (total)

Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.
D=dead L=live S=Snow N=Wind I=Impact R=Roof Live Lif=Concentrated
All LC's are listed in the Analysis output
Load combinations: ICC-IBC
**DESIGN NOTES:**

1. Please verify that the default deflection limits are appropriate for your application.
2. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
4. BUILT-UP BEAMS: it is assumed that each ply is a single continuous member (that is, no butt joints are present) fastened together securely at intervals not exceeding 4 times the depth and that each ply is equally top-loaded. Where beams are side-loaded, special fastening details may be required.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.
### Design Check Calculation Sheet

**Sizer 8.11**

#### LOADS:

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution</th>
<th>Pattern</th>
<th>Location [ft]</th>
<th>Magnitude</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load1</td>
<td>Dead</td>
<td>Full UDL</td>
<td>No</td>
<td>350.0</td>
<td>plf</td>
<td></td>
</tr>
</tbody>
</table>

#### MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):

<table>
<thead>
<tr>
<th></th>
<th>0'</th>
<th>1'-4'</th>
<th>5'</th>
<th>5'-7'</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfactored:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead</td>
<td>1192</td>
<td>1192</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factored:</td>
<td>1192</td>
<td>1192</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td>1192</td>
<td>1192</td>
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<tr>
<td>Bearing:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load Comb</td>
<td>#0</td>
<td>#1</td>
<td>#1</td>
<td>#0</td>
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<tr>
<td>Length</td>
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<td>0.56</td>
<td>0.00</td>
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<tr>
<td>Db</td>
<td>1.67</td>
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<td>1.67</td>
<td>0.00</td>
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</tbody>
</table>

#### Lumber n-ply, S-P-F, No.1/No.2, 2x10", 2-Plys

Lateral support: top= at supports, bottom= at supports;

#### Analysis vs. Allowable Stress (psf) and Deflection (in) using NDS 2005:

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bending(+)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bending(-)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deflection:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior Live</td>
<td>negligeble</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.01 = cL/999</td>
<td>0.21 = L/240</td>
<td>0.03</td>
</tr>
<tr>
<td>Cantil. Live</td>
<td>negligeble</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>-0.00 = cL/999</td>
<td>0.13 = L/120</td>
<td>0.03</td>
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</table>

#### ADDITIONAL DATA:

<table>
<thead>
<tr>
<th>FACTORS: F/E</th>
<th>CD</th>
<th>CM</th>
<th>Ct</th>
<th>CL</th>
<th>CF</th>
<th>Cfu</th>
<th>Cr</th>
<th>Cfrt</th>
<th>Cj</th>
<th>Cn</th>
<th>LC#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fv'</td>
<td>135</td>
<td>0.90</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Fv''</td>
<td>875</td>
<td>0.90</td>
<td>1.00</td>
<td>1.00</td>
<td>0.994</td>
<td>1.100</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Fp'</td>
<td>875</td>
<td>0.90</td>
<td>1.00</td>
<td>1.00</td>
<td>0.998</td>
<td>1.100</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
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<tr>
<td>Fp''</td>
<td>425</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>E'</td>
<td>1.4 million</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Emin'</td>
<td>0.51 million</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Shear: LC #1 = D only, V = 726, V design = 456 lbs
Bending(+) = LC #1 = D only, M = 441 lbf-ft
Bending(-) = LC #1 = D only, M = 311 lbf-ft
Deflection: LC #1 = Self-weight (live)
LC #1 = D only (total)

EI = 139e6 lb-in²/ply
Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.
D = dead, L = live, S = snow, W = wind, I = impact, R = roof live, Lc = concentrated
All LC's are listed in the Analysis output
Load combinations: ICC-IBC
DESIGN NOTES:
1. Please verify that the default deflection limits are appropriate for your application.
2. Continuous or Cantilevered Beams: NDS Clause 4.2.3.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
4. BUILT-UP BEAMS: It is assumed that each ply is a single continuous member (that is, no butt joints are present) fastened together securely at intervals not exceeding 4 times the depth and that each ply is equally top-loaded. Where beams are side-loaded, special fastening details may be required.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.
### Design Check Calculation Sheet

**Sizer 8.11**

#### LOADS:

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution</th>
<th>Pattern</th>
<th>Location [ft]</th>
<th>Magnitude [Start, End]</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load 1</td>
<td>Dead</td>
<td>Partial UDL</td>
<td>No</td>
<td>0.00, 1.17</td>
<td>200.0, 200.0</td>
<td>plf</td>
</tr>
<tr>
<td>Load 2</td>
<td>Dead</td>
<td>Partial UDL</td>
<td>No</td>
<td>1.17, 6.00</td>
<td>87.0, 87.0</td>
<td>plf</td>
</tr>
<tr>
<td>Load 3</td>
<td>Dead</td>
<td>Point</td>
<td>No</td>
<td>0.00, 1192</td>
<td>1192</td>
<td>lbs</td>
</tr>
</tbody>
</table>

#### MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):

<table>
<thead>
<tr>
<th>Unfactored</th>
<th>1952</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factored:</td>
<td>1952</td>
</tr>
<tr>
<td>Uplift Total</td>
<td>106</td>
</tr>
<tr>
<td>Bearing:</td>
<td>#0</td>
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<tr>
<td>Load Comb</td>
<td>#0</td>
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<td>Length</td>
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<td>Ob</td>
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<tr>
<td>Id</td>
<td>1.16</td>
</tr>
<tr>
<td>Cb</td>
<td>0.00</td>
</tr>
</tbody>
</table>

### Analysis vs. Allowable Stress (psi) and Deflection (in) using NDS 2005:

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td>$f_v = 71$</td>
<td>$f_v' = 121$</td>
<td>$f_v/f_v' = 0.59$</td>
</tr>
<tr>
<td>Bending(-)</td>
<td>$f_b = 468$</td>
<td>$f_b' = 585$</td>
<td>$f_b/f_b' = 0.81$</td>
</tr>
<tr>
<td>Deflection:</td>
<td>negligible</td>
<td>0.24 = L/240</td>
<td>0.06</td>
</tr>
<tr>
<td>Interior Live</td>
<td>0.24 = L/240</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Cantil. Live</td>
<td>0.12 = L/120</td>
<td>0.25</td>
<td></td>
</tr>
</tbody>
</table>

### ADDITIONAL DATA:

**FACTORS:** $F/E$

<table>
<thead>
<tr>
<th>$F_v'$, $F_b'$</th>
<th>135</th>
<th>875</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_{cp}'$</td>
<td>425</td>
<td></td>
</tr>
<tr>
<td>$E'$</td>
<td>1.4 million</td>
<td>0.51 million</td>
</tr>
</tbody>
</table>

**Additional Values:**

- Shear: $LC \#1 = D$ only, $V = 1425$, $V_{design} = 1322$ lbs
- Bending(-): $LC \#1 = D$ only, $M = 1527$ lbs-ft
- Deflection: $LC \#0 = Self-weight (L/487)$
- $LC \#1 = D$ only (total)

**EI = 139e06 lb-in/2/ply**

**Total Deflection = 1.50 (Dead Load Deflection) + Live Load Deflection.**

- D=dead L=live S=snow W=wind I-impact R=roof L=live LC=concentrated
- All LC's are listed in the Analysis output
- Load combinations: ICC-IBC
DESIGN NOTES:
1. Please verify that the default deflection limits are appropriate for your application.
2. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
4. BUILT-UP BEAMS: it is assumed that each ply is a single continuous member (that is, no butt joints are present) fastened together securely at intervals not exceeding 4 times the depth and that each ply is equally top-loaded. Where beams are side-loaded, special fastening details may be required.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.
Design Check Calculation Sheet
Sizer 8.11

LOADS:

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution</th>
<th>Location [ft]</th>
<th>Magnitude [psf]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load1</td>
<td>Dead</td>
<td>Full Area</td>
<td>0.00</td>
<td>15.00 (16.0)</td>
</tr>
<tr>
<td>Load2</td>
<td>Live</td>
<td>Partial Area</td>
<td>4.00</td>
<td>135.00 (16.0)</td>
</tr>
<tr>
<td>Load3</td>
<td>Live</td>
<td>Partial Area</td>
<td>7.75</td>
<td>50.00 (16.0)</td>
</tr>
</tbody>
</table>

*Triangular Width (in)

MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):

Unfactored:
- Dead: 88
- Other: 594

Factored:
- Total Bearing: 682
- Load Comb Length: 1.07
- Load: #2
- Cb: 1.00

Lumber-soft, S-P-F, No.1/No.2, 2x10"
Floor joint spaced at 16" o.c.; Self-weight of 2.8 psf included in loads;
Lateral support: top= full, bottom= at supports; Repetitive factor: applied where permitted (refer to online help);

Analysis vs. Allowable Stress (psi) and Deflection (in) using NDS 2005:

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td>645</td>
<td>1107</td>
<td>0.58</td>
</tr>
<tr>
<td>Bounding</td>
<td>0.07 = L/999</td>
<td>0.26 = L/360</td>
<td>0.29</td>
</tr>
<tr>
<td>Total Def1'</td>
<td>0.09 = L/989</td>
<td>0.39 = L/240</td>
<td>0.24</td>
</tr>
</tbody>
</table>

ADDITIONAL DATA:

FACTORs: F/E
- FV: 1.15
- Fb': 875
- Fcp': 425
- E': 1.4 million
- Emin': 0.51 million

Shear : LC #2 = D+L, V = 682, V design = 531 lbs
Bending: LC #2 = D+L, M = 1149 lbs-ft
Deflection: LC #2 = D+L (live)
LC #2 = D+L (total)

EI = 139e6 lb-in²

Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.
D=dead L=live S=snow W=wind I=impact R=roof live Lc=concentrated
All LC's are listed in the Analysis output
Load combinations: ICC-IBC

DESIGN NOTES:
1. Please verify that the default deflection limits are appropriate for your application.
2. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
WoodWorks®

Software for Wood Design

Mar. 16, 2011 12:44  bb.wwb

Design Check Calculation Sheet
Sizer 8.11

LOADS:

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution Pattern</th>
<th>Location [ft]</th>
<th>Magnitude</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load1</td>
<td>Dead</td>
<td>Full Area</td>
<td>Start End</td>
<td>15.00 (16.0)*</td>
<td>psf</td>
</tr>
<tr>
<td>Load2</td>
<td>Live</td>
<td>Full Area</td>
<td>Start End</td>
<td>50.00 (16.0)</td>
<td>psf</td>
</tr>
</tbody>
</table>

*Tributary Width [in]

MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):

Lumber-soft, S-P-F, No.1/No.2, 2x10"

Floor joist spaced at 18" o.c.;
Lateral support: top= full, bottom= at supports; Repetitive factor: applied where permitted (refer to online help);

Analysis vs. Allowable Stress (psi) and Deflection (in) using NDS 2005:

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td>fv = 28</td>
<td>Fv' = 135</td>
<td>fv/Fv' = 0.21</td>
</tr>
<tr>
<td>Bending(+)</td>
<td>fb = 342</td>
<td>Fb' = 1107</td>
<td>fb/Fb' = 0.31</td>
</tr>
<tr>
<td>Live Defln</td>
<td>0.03 = c/l/999</td>
<td>0.26 = l/360</td>
<td>0.14</td>
</tr>
<tr>
<td>Total Defln</td>
<td>0.05 = c/l/999</td>
<td>0.38 = l/240</td>
<td>0.13</td>
</tr>
</tbody>
</table>

ADDITIONAL DATA:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fv'</td>
<td>135</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fb'</td>
<td>875</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fcp'</td>
<td>425</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E'</td>
<td>1.4 million</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eimin'</td>
<td>0.51 million</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shear</td>
<td>LC #2 = D+L, V = 325</td>
<td>V design = 258 lbs</td>
<td></td>
</tr>
<tr>
<td>Bending(+)</td>
<td>LC #2 = D+L, M = 609</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deflection</td>
<td>LC #2 = D+L (live)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EI</td>
<td>119065 lbf-in^2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Deflection = 1.50 (Dead Load Deflection) + Live Load Deflection.
D=dead L=live S=snow W=wind I=impact R=roof live Lc=concentrated
All LC's are listed in the Analysis output
Load combinations: ICC-IBC

DESIGN NOTES:
1. Please verify that the default deflection limits are appropriate for your application.
2. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
### Design Check Calculation Sheet

**Sizer 8.11**

#### LOADS:

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution</th>
<th>Pattern</th>
<th>Location [ft]</th>
<th>Magnitude</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load1</td>
<td>Dead</td>
<td>Full UDL</td>
<td>No</td>
<td></td>
<td>500.0</td>
<td>plf.</td>
</tr>
</tbody>
</table>

#### MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):

<table>
<thead>
<tr>
<th>0'</th>
<th>1'-4&quot;</th>
<th>4'-6&quot;</th>
<th>5'-10&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfactored: Dead</td>
<td>1458</td>
<td>1458</td>
<td>1458</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factored: Total</td>
<td>1458</td>
<td>1458</td>
<td>1458</td>
</tr>
<tr>
<td>Bearing: Load Comb #0</td>
<td>0.00</td>
<td>0.77</td>
<td>0.77</td>
</tr>
<tr>
<td>Length</td>
<td>1.49</td>
<td>1.49</td>
<td>1.49</td>
</tr>
</tbody>
</table>

#### Lumber n-ply, S-P-F, No.1/No.2, 2x10", 2-Plys

Lateral support: top= at supports, bottom= at supports;

#### Analysis vs. Allowable Stress (psi) and Deflection (in) using NDS 2005:

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td>fv = 22</td>
<td>Fv' = 121</td>
<td>fv/Fv' = 0.18</td>
</tr>
<tr>
<td>Bending(+)</td>
<td>fb = 51</td>
<td>Fb' = 864</td>
<td>fb/Fb' = 0.06</td>
</tr>
<tr>
<td>Bending(-)</td>
<td>fb = 125</td>
<td>Fb' = 864</td>
<td>fb/Fb' = 0.14</td>
</tr>
<tr>
<td>Deflection: Interior Live Total</td>
<td>negligible</td>
<td>0.16 = L/240</td>
<td>0.01</td>
</tr>
<tr>
<td>Cantil. Live Total</td>
<td>negligible</td>
<td>0.13 = L/120</td>
<td>0.02</td>
</tr>
</tbody>
</table>

#### ADDITIONAL DATA:

**FACTORS:** F/E CD CM Ct CL CF Cu Cr Cfrt C1 Cn LC#
- Fv' 135 0.90 1.00 1.00 0.997 1.100 1.00 1.00 1.00 1.00 - 1
- Fb' 875 0.90 1.00 1.00 0.996 1.100 1.00 1.00 1.00 1.00 - 1
- Fcp' 425 - 1.00 1.00 - - - - 1.00 1.00 - -
- E' 4.4 million 1.00 1.00 - - - - - 1.00 1.00 - -
- Efrn' 0.51 million 1.00 1.00 - - - - - 1.00 1.00 - -

Shear: LC #1 = D only, V = 792, V design = 406 lbs
Bending(+) : LC #1 = D only, M = 183 lbs-ft
Bending(-): LC #1 = D only, M = 444 lbs-ft
Deflection: LC #0 = Self-weight (live)
LC #1 = D only (total)

EI = 139666 lb-in²/plv
Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.
D=dead L=live S=snow W=wind I=impact R=roof live LC=concentrated
All LC's are listed in the Analysis output
Load combinations: ICC-IBC
DESIGN NOTES:
1. Please verify that the default deflection limits are appropriate for your application.
2. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
4. BUILT-UP BEAMS: it is assumed that each ply is a single continuous member (that is, no butt joints are present) fastened together securely at intervals not exceeding 4 times the depth and that each ply is equally top-loaded. Where beams are side-loaded, special fastening details may be required.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.
### Design Check Calculation Sheet

#### Size 8.11

<table>
<thead>
<tr>
<th>LOADS:</th>
<th>COMPANY</th>
<th>PROJECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar. 22, 2011 16:48</td>
<td>db.wwb</td>
<td></td>
</tr>
</tbody>
</table>

#### MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution Pattern</th>
<th>Location [ft]</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load1</td>
<td>Dead</td>
<td>Full UDL</td>
<td>No</td>
<td>250.0</td>
</tr>
</tbody>
</table>

#### Lumber n-ply, S-P-F, No.1/No.2, 2x10", 2-Plys

**Lateral support:** top= at supports, bottom= not at supports

| Analysis vs. Allowable Stress (psi) and Deflection (in) using NDS 2005: |
|---|---|---|
| Criterion | Analysis Value | Design Value | Analysis/Design |
| Shear | fv = 11 | PV = 121 | 0.09 |
| Bending(+): | fb = 62 | Fb' = 864 | 0.03 |
| Bending(-): | 0.90 1.00 1.00 | 0.997 1.100 1.00 | 1.00 1.00 1.00 |
| Deflection: | | | |
| Interior Live | negligible | 0.16 = L/240 | 0.00 |
| Total | 0.00 = Cl/999 | | |
| Cantil. Live | negligible | 0.13 = L/120 | 0.01 |
| Total | 0.00 = cl/999 | | |

#### ADDITIONAL DATA:

**FACTORS:** F/E CD CM Ct CL CP Cfu Cr Cfrt Cl Ch LC#

- Fv' = 135 0.90 1.00 1.00
- Fb' = 875 0.90 1.00 1.00 0.997 1.100 1.00 1.00 1.00
- Fb' = 875 0.90 1.00 1.00 0.998 1.100 1.00 1.00 1.00
- Fcp' = 425 1.00 1.00
- E = 1.4 million 1.00 1.00
- Emin' = 0.51 million 1.00 1.00

**Shear:** LC #1 = D only, V = 396, V design = 203 lbs

**Bending(+)**: LC #1 = D only, M = 91 lbs-ft

**Bending(-)**: LC #1 = D only, M = 222 lbs-ft

**Deflection**: LC #0 = Self-weight (live)

**EI** = 119e06 lb-in²/ply

**Total Deflection** = 1.50(Dead Load Deflection) + Live Load Deflection.

D=dead; L=live; S=snow; W=wind; I=impact; R=roof live; L=concentrated

All LC's are listed in the Analysis output

Load combinations: ICC-IBC

---

*Min. bearing length for beams is 1/2" for intermediate supports*
DESIGN NOTES:
1. Please verify that the default deflection limits are appropriate for your application.
2. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
4. BUILT-UP BEAMS: it is assumed that each ply is a single continuous member (that is, no butt joints are present) fastened together securely at intervals not exceeding 4 times the depth and that each ply is equally top-loaded. Where beams are side-loaded, special fastening details may be required.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.
Design Check Calculation Sheet

Company: Project: 

Mar. 22, 2011 16:48 eb.wwb

Sizer 8.11

**LOADS:**

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution</th>
<th>Pattern</th>
<th>Location [ft]</th>
<th>Magnitude</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load2</td>
<td>Dead</td>
<td>Full UDL</td>
<td>No</td>
<td>No</td>
<td>87.0</td>
<td>plf</td>
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<tr>
<td>Load3</td>
<td>Dead</td>
<td>Point</td>
<td>No</td>
<td>0.00</td>
<td>730</td>
<td>lbs</td>
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**MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):**

<table>
<thead>
<tr>
<th>Unfactored</th>
<th>Factor</th>
<th>Load Comb</th>
<th>Length</th>
<th>Bearing Length</th>
<th>2-8&quot;</th>
<th>7-6&quot;</th>
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</thead>
<tbody>
<tr>
<td>Dead</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.91</td>
<td>1.41</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factored:</td>
<td>Uplift</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bearing:</td>
<td>Load Comb</td>
<td></td>
<td>0.00</td>
<td>0.91</td>
<td>1.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cb</td>
<td></td>
<td>0.00</td>
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</table>

**Analysis vs. Allowable Stress (psi) and Deflection (in) using NDS 2005:**

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td>Fv = 49</td>
<td>Fv' = 121</td>
<td>fV/Fv' = 0.40</td>
</tr>
<tr>
<td>Bending(-)</td>
<td>fb = 633</td>
<td>Fb' = 858</td>
<td>fb/Fb' = 0.74</td>
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<tr>
<td>Deflection:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior Live</td>
<td>Total</td>
<td>-0.03 = L/999</td>
<td>0.24 = L/240</td>
</tr>
<tr>
<td>Cantill. Live</td>
<td>Total</td>
<td>0.11 = L/248</td>
<td>0.27 = L/120</td>
</tr>
</tbody>
</table>

**ADDITIONAL DATA:**

<table>
<thead>
<tr>
<th>FACTORS: F/P</th>
<th>CD</th>
<th>CM</th>
<th>Ct</th>
<th>CL</th>
<th>CF</th>
<th>Cfu</th>
<th>Cr</th>
<th>Cfrt</th>
<th>CI</th>
<th>Cn</th>
<th>LC #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fv = 135</td>
<td>0.90</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Fb' = 875</td>
<td>0.90</td>
<td>1.00</td>
<td>1.00</td>
<td>0.991</td>
<td>1.100</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Fb' = 425</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>E' = 1.4 million</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Emin' 0.51 million</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

| Shear: LC #1 = D only, V = 962, V Design = 905 lbs |
| Bending(-): LC #1 = D only, M = 2256 lbs-ft |
| Deflection: LC #0 = Self-weight (live) |
| LC #1 = D only (total) |
| EI = 139e06 lb-in²/ply |

Total Deflection = D (dead Load Deflection) + Live Load Deflection. 
D=dead L=live S=snow W=wind I=impact R=roof live Lc=concentrated

All LC's are listed in the Analysis output

Load combinations: ICC-IBC
DESIGN NOTES:
1. Please verify that the default deflection limits are appropriate for your application.
2. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
4. BUILT-UP BEAMS: It is assumed that each ply is a single continuous member (that is, no butt joints are present) fastened together securely at intervals not exceeding 4 times the depth and that each ply is equally top-loaded. Where beams are side-loaded, special fastening details may be required.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.
**Design Check Calculation Sheet**

**Sizer 8.11**

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution Pattern</th>
<th>Location [ft]</th>
<th>Magnitude</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load1</td>
<td>Dead</td>
<td>Full Area</td>
<td></td>
<td>15.00 (16.0)*</td>
<td>psf</td>
</tr>
<tr>
<td>Load2</td>
<td>Live</td>
<td>Partial Area</td>
<td>0.00 2.25</td>
<td>135.00 (16.0)*</td>
<td>psf</td>
</tr>
<tr>
<td>Load3</td>
<td>Live</td>
<td>Partial Area</td>
<td>2.25 6.00</td>
<td>50.00 (16.0)*</td>
<td>psf</td>
</tr>
</tbody>
</table>

*Preliminary Width (in)*

MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):

Unfactored:
- Dead: 68 lbs
- Other: 407 lbs

Factored:
- Total: 475 lbs

Bearing:
- Load Comb: 0.75 ft
- Length: 0.75 ft

**MIN. bearing length for joists is 1/2" for exterior supports**

**Lumber-soft, S-P-F, No.1/No.2, 2x10"**

Floor joist spaced at 16" c/c; Self-weight of 2.6#f includes in loads;
Lateral support: top= full, bottom=at supports; Repetitive factor: applied where permitted (refer to online help);

### Analysis vs. Allowable Stress (psi) and Deflection (in) using NDS 2005:

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td>Fv = 35</td>
<td>Fv' = 135</td>
<td>Fv/Fv' = 0.26</td>
</tr>
<tr>
<td>Bending(*)</td>
<td>fb = 313</td>
<td>Pb' = 1107</td>
<td>fb/Pb' = 0.28</td>
</tr>
<tr>
<td>Live Defl'n</td>
<td>0.02 = L/999</td>
<td>0.20 = L/360</td>
<td>0.11</td>
</tr>
<tr>
<td>Total Defl'n</td>
<td>0.03 = L/999</td>
<td>0.30 = L/240</td>
<td>0.10</td>
</tr>
</tbody>
</table>

### ADDITIONAL DATA:

<table>
<thead>
<tr>
<th>FACTORS: Fv/Fv'</th>
<th>DC</th>
<th>CM</th>
<th>Ct</th>
<th>CL</th>
<th>CF</th>
<th>Cfu</th>
<th>Cr</th>
<th>Cftt</th>
<th>Ci</th>
<th>Cn</th>
<th>LC#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fv'</td>
<td>135</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>2</td>
</tr>
<tr>
<td>Pb'</td>
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<td>1.00</td>
<td>1.00</td>
<td>1.15</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>Fcp'</td>
<td>425</td>
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<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>E'</td>
<td>1.4 million</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>Em'</td>
<td>0.51 million</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
</tr>
</tbody>
</table>

**Shear**
- LC #2 = D+L, V = 475, V design = 325 lbs

**Bending(+)**
- LC #2 = D+L, N = 550 lbs-ft

**Deflection**
- LC #2 = D+L (live)
- LC #2 = D+L (total)
- EI = 199x08 lb-in2

**Total Deflection** = 1.50 (Dead Load Deflection) + Live Load Deflection.

D=dead, L=live, S=snow, W=wind, I=impact, R=roof live, Lc=concentrated

All LC's are listed in the Analysis output

Load combinations: 10C-90C

### DESIGN NOTES:

1. Please verify that the default deflection limits are appropriate for your application.
2. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
## Design Check Calculation Sheet
### Sizer 8.11

### LOADS:

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution Pattern</th>
<th>Location [ft] Start</th>
<th>Magnitude Start</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load</td>
<td>Dead</td>
<td>Full UDL</td>
<td>No</td>
<td>750.0</td>
<td>plf</td>
</tr>
</tbody>
</table>

### MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):

<table>
<thead>
<tr>
<th>Degree</th>
<th>0'</th>
<th>1-4'</th>
<th>4-6'</th>
<th>5-10'</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2187</td>
<td>2188</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Unfactored:
- Dead
- Other

### Factored:
- Total Bearing:
  - Load Comb: 0
  - Length: 0.00
- Ob: 0.00

### Lumber n-ply, S-P-F, No.1/No.2, 2x10", 2-Plys

Lateral support: top= at supports, bottom= at supports;

### Analysis vs. Allowable Stress (psi) and Deflection (in) using NDS 2005:

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td>$f_v = 33$</td>
<td>$f'_v = 121$</td>
<td>$f_v/f'_v = 0.27$</td>
</tr>
<tr>
<td>Bending(+)</td>
<td>$f_b = 77$</td>
<td>$f'_b = 864$</td>
<td>$f_b/f'_b = 0.09$</td>
</tr>
<tr>
<td>Bending(-)</td>
<td>$f = 187$</td>
<td>$f = 864$</td>
<td>$E = 0.22$</td>
</tr>
<tr>
<td>Deflection:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior Live</td>
<td>negligible</td>
<td>0.16 = 1/240</td>
<td>0.01</td>
</tr>
<tr>
<td>Cantilever Live</td>
<td>negligible</td>
<td>0.13 = 1/120</td>
<td>0.03</td>
</tr>
</tbody>
</table>

### ADDITIONAL DATA:

**FACTORS:** $F/E$

<table>
<thead>
<tr>
<th>Factor</th>
<th>CD</th>
<th>CM</th>
<th>Ct</th>
<th>CL</th>
<th>CF</th>
<th>CFu</th>
<th>Cr</th>
<th>Cfrt</th>
<th>Cl</th>
<th>Ch</th>
<th>LC#</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f_v'$</td>
<td>135</td>
<td>0.90</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>$f_b'$</td>
<td>875</td>
<td>0.90</td>
<td>1.00</td>
<td>1.00</td>
<td>0.997</td>
<td>1.100</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>$f$</td>
<td>875</td>
<td>0.90</td>
<td>1.00</td>
<td>1.00</td>
<td>0.998</td>
<td>1.100</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>$F_c$</td>
<td>425</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$E'$</td>
<td>1.4 million</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$E_{min}$</td>
<td>0.51 million</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Shear:** LC #1 = D only, V = 1188, V design = 610 lbs
**Bending(+)**: LC #1 = D only, M = 274 lbe-ft
**Bending(-)**: LC #1 = D only, M = 666 lbe-ft
**Deflection**: LC #0 = Self-weight (live)
**LC #1 = D only (total)**

$EI = 1139e6$ lb-in²/ply

Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.
D=dead L=live S=snow W=wind I=impact R=roof live Lc=concentrated

All LC's are listed in the Analysis output

Load combinations: ICC-IBC
DESIGN NOTES:
1. Please verify that the default deflection limits are appropriate for your application.
2. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS Clause 4.4.1.
4. BUILT-UP BEAMS: It is assumed that each ply is a single continuous member (that is, no butt joints are present) fastened together securely at intervals not exceeding 4 times the depth and that each ply is equally top-loaded. Where beams are side-loaded, special fastening details may be required.
5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.
Design Check Calculation Sheet
Sizer 8.11

LOADS:

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution Pattern</th>
<th>Location [ft]</th>
<th>Magnitude Start</th>
<th>Magnitude End</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load1</td>
<td>Dead</td>
<td>Full UDL, No</td>
<td></td>
<td>360.0</td>
<td></td>
<td>pif</td>
</tr>
</tbody>
</table>

MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):

Unfactored:
- Dead:
  - Load Comb: #0
  - Length: 0.00
  - Bearing: #1

Factored:
- Total:
  - Load Comb: #0
  - Length: 1.75

*Bearing length for beams is 1/2 for intermediate supports

Lumber n-ply, S-P-F, No.1/No.2, 2x10", 2-Ply
Lateral support: top= at supports, bottom= at supports;

Analysis vs. Allowable Stress (psi) and Deflection (in) using NDS 2005:

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td>fb = 90</td>
<td>fb' = 864</td>
<td>fb/fb' = 0.10</td>
</tr>
<tr>
<td>Bending(+)</td>
<td>fb = 90</td>
<td>fb' = 864</td>
<td>fb/fb' = 0.10</td>
</tr>
</tbody>
</table>

FLEXIBILITY:

- Interior Live
  - Total: 0.00 = qL/999
  - 0.16 = L/240
- Cantil. Live
  - Total: 0.00 = qL/999
  - 0.13 = L/120

ADDITIONAL DATA:

- Shear: LC #1 = D only, V = 570, V design = 293 lbs
- Bending(+) = LC #1 = D only, M = 131 lbs-ft
- Deflection: LC #0 = Self-weight (live)
- LC #1 = D only, (total)

EI = 139066 lb-in^2/ply

Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.
D=dead L=live S=snow W=wind I=impact R=roof live Lc=concentrated
All LC's are listed in the Analysis output
Load combinations: ICC-IBC
<table>
<thead>
<tr>
<th>DESIGN NOTES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Please verify that the default deflection limits are appropriate for your application.</td>
</tr>
<tr>
<td>2. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions</td>
</tr>
<tr>
<td>be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other</td>
</tr>
<tr>
<td>spans.</td>
</tr>
<tr>
<td>3. Sawn lumber bending members shall be laterally supported according to the provisions of NDS</td>
</tr>
<tr>
<td>Clause 4.4.1.</td>
</tr>
<tr>
<td>4. BUILT-UP BEAMS: It is assumed that each ply is a single continuous member (that is, no butt</td>
</tr>
<tr>
<td>joints are present) fastened together securely at intervals not exceeding 4 times the depth and</td>
</tr>
<tr>
<td>that each ply is equally top-loaded. Where beams are side-loaded, special fastening details may</td>
</tr>
<tr>
<td>be required.</td>
</tr>
<tr>
<td>5. The critical deflection value has been determined using maximum back-span deflection.</td>
</tr>
<tr>
<td>Cantilever deflections do not govern design.</td>
</tr>
</tbody>
</table>
LOADS:

<table>
<thead>
<tr>
<th>Load</th>
<th>Type</th>
<th>Distribution</th>
<th>Pattern</th>
<th>Location [ft]</th>
<th>Magnitude</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load 2</td>
<td>Dead</td>
<td>Full UDL</td>
<td>No</td>
<td>No</td>
<td>87.0</td>
<td>plf</td>
</tr>
<tr>
<td>Load 3</td>
<td>Dead</td>
<td>Point</td>
<td>No</td>
<td>0.00</td>
<td>1050</td>
<td>lbs</td>
</tr>
</tbody>
</table>

MAXIMUM REACTIONS (lbs) and BEARING LENGTHS (in):

Lumber n-ply, S-P-F, No.1/No.2, 2x10², 2-Phys
Lateral support: top= at supports, bottom= at supports;

Analysis vs. Allowable Stress (psi) and Deflection (in) using NDS 2005:

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Analysis Value</th>
<th>Design Value</th>
<th>Analysis/Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shear</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bending(−)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deflection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cantilevered Live</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ADDITIONAL DATA:

- FACTORS: F/E
  - CD CM CT CL CF Cfu Cr Cfrt Cg Ch LC
  - Fv' 135 0.90 1.00 1.00 - - - 1.00 1.00 1.00 1
  - Fb' 875 0.90 1.00 1.00 0.991 1.100 1.00 1.00 1.00 1.00 - 1
  - Fcp' 425 - 1.00 1.00 - - - - 1.00 1.00 - -
  - Ey 1.4 million 1.00 1.00 - - - - - 1.00 1.00 - -
  - Emin 0.51 million 1.00 1.00 - - - - - 1.00 1.00 - -

- Shear: LC #1 = D only, V = 1152, V design = 1107 lbs
- Bending(−): LC #1 = D only, M = 1286 lbs-ft
- Deflection: LC #0 = Self-weight (live)
- EI = 139e06 lb-in²/ply
- Total Deflection = L.50(Dead Load Deflection) + Live Load Deflection

- D=dead L=live S=snow W=wind I=impact Lr=roof live Lc=concentrated
- All LC's are listed in the Analysis output
- Load combinations: FCC-IBC
DESIGN NOTES:

1. Please verify that the default deflection limits are appropriate for your application.
2. Continuous or Cantilevered Beams: NDS Clause 4.2.5.5 requires that normal grading provisions be extended to the middle 2/3 of 2 span beams and to the full length of cantilevers and other spans.
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5. The critical deflection value has been determined using maximum back-span deflection. Cantilever deflections do not govern design.
## Detailed Water Budget

<table>
<thead>
<tr>
<th>Function</th>
<th>Water Use (gal)</th>
<th>Calculations</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>gallons per use</td>
<td>number of uses over the course of the competition</td>
</tr>
<tr>
<td>Hot Water Draws</td>
<td>240</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Water Vaporization</td>
<td>2.4</td>
<td>0.6</td>
<td>4</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>23</td>
<td>4.6</td>
<td>5</td>
</tr>
<tr>
<td>Clothes Washer</td>
<td>25</td>
<td>200</td>
<td>8</td>
</tr>
<tr>
<td>Dinner Party</td>
<td>50</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Movie Night</td>
<td>25</td>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation</td>
<td>400</td>
<td>60</td>
<td>5</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>60</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>Fire Protection</td>
<td>300</td>
<td>300</td>
<td>1</td>
</tr>
<tr>
<td>Testing</td>
<td>18</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Initial Systems Fill</td>
<td>90</td>
<td>90</td>
<td>1</td>
</tr>
<tr>
<td>Safety Factor</td>
<td>166.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Water Use</strong></td>
<td><strong>1400 gal</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Team Provided Liquids

<table>
<thead>
<tr>
<th>Liquid</th>
<th>Use</th>
<th>Amount (gallons)</th>
<th>Delivery day*</th>
<th>Pickup day</th>
<th>Container</th>
<th>Rule 9-2 section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-potable water</td>
<td>Pre-delivery irrigation</td>
<td>50</td>
<td>1</td>
<td>N/A</td>
<td>Temporary plastic barrels</td>
<td>b</td>
</tr>
<tr>
<td>Propylene glycol**</td>
<td>Solar hot water heat transfer medium</td>
<td>5</td>
<td>0</td>
<td>21</td>
<td>Manufacturer provided container</td>
<td>f</td>
</tr>
<tr>
<td>R410A refrigerant**</td>
<td>Heat pump refrigerant</td>
<td>1</td>
<td>0</td>
<td>21</td>
<td>Manufacturer provided container</td>
<td>f</td>
</tr>
<tr>
<td>Paint</td>
<td>Touch ups</td>
<td>2</td>
<td>0</td>
<td>7</td>
<td>Paint cans</td>
<td>g</td>
</tr>
<tr>
<td>Varnish</td>
<td>Touch ups</td>
<td>0.125</td>
<td>0</td>
<td>7</td>
<td>Manufacturer provided container</td>
<td>g</td>
</tr>
<tr>
<td>Chlorine bleach</td>
<td>Water system sanitation</td>
<td>0.5</td>
<td>1</td>
<td>7</td>
<td>Manufacturer provided container</td>
<td>g</td>
</tr>
<tr>
<td>Potable water</td>
<td>Personal hydration, cooking</td>
<td>315</td>
<td>1, 8, 15</td>
<td>21</td>
<td>Plastic bottles and jugs</td>
<td>a</td>
</tr>
</tbody>
</table>

* Day 0 indicates that this liquid will arrive with the house.
** MSDS included
PART 1 - All liquids will be held in spillproof construction container when not in use.

Generator Spill Containment Tray

The construction generators shall be contained when in use by a spill prevention tray capable of holding all liquids contained in the generator at full capacity.

The tray shall be made of ribbed, waterproof polyethylene.

The tray shall be a minimum of 32 inches long and wide and 4 inches high.
Material Safety Data Sheet
Propylene glycol MSDS

Section 1: Chemical Product and Company Identification

Product Name: Propylene glycol
Catalog Codes: SLP1162, SLP2974
CAS#: 57-55-6
RTECS: TY2000000
TSCA: TSCA 8(b) inventory: Propylene glycol
CI#: Not applicable.
Synonym: 1,2-propanediol, 1,2-dihydroxypropane
Chemical Name: Propylene Glycol
Chemical Formula: CH₃CHOHCH₂OH

Contact Information:
ScienceLab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396
US Sales: 1-800-901-7247
International Sales: 1-281-441-4400
Order Online: ScienceLab.com
CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300
International CHEMTREC, call: 1-703-527-3887
For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

<table>
<thead>
<tr>
<th>Name</th>
<th>CAS #</th>
<th>% by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propylene glycol</td>
<td>57-55-6</td>
<td>100</td>
</tr>
</tbody>
</table>

Toxicological Data on Ingredients: Propylene glycol: ORAL (LD50): Acute: 20000 mg/kg [Rat]. 22000 mg/kg [Mouse]. DERMAL (LD50): Acute: 20800 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of ingestion. Slightly hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of inhalation.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention.

**Skin Contact:**
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

**Serious Skin Contact:**
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

**Inhalation:**
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

**Serious Inhalation:** Not available.

**Ingestion:**
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or wristband.

**Serious Ingestion:** Not available.

---

## Section 5: Fire and Explosion Data

**Flammability of the Product:** May be combustible at high temperature.

**Auto-Ignition Temperature:** 371°C (699.8°F)

**Flash Points:**
- CLOSED CUP: 99°C (210.2°F).
- OPEN CUP: 107°C (224.6°F) (Cleveland).

**Flammable Limits:**
- LOWER: 2.6%
- UPPER: 12.5%

**Products of Combustion:** These products are carbon oxides (CO, CO2).

**Fire Hazards in Presence of Various Substances:** Slightly flammable to flammable in presence of heat.

**Explosion Hazards in Presence of Various Substances:**
- Risks of explosion of the product in presence of mechanical impact: Not available.
- Risks of explosion of the product in presence of static discharge: Not available.

**Fire Fighting Media and Instructions:**
- SMALL FIRE: Use DRY chemical powder.
- LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

**Special Remarks on Fire Hazards:** When heated to decomposition it emits acrid smoke and irritating fumes.

**Special Remarks on Explosion Hazards:** Not available.

---

## Section 6: Accidental Release Measures

**Small Spill:**
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

**Large Spill:**
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

---

## Section 7: Handling and Storage
Precautions:
Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, acids, alkalis, moisture.

Storage:
Hygroscopic. Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 10 (mg/m3) from AIHA Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Oily liquid.)
Odor: Practically Odorless.
Taste: Practically Tasteless.
Molecular Weight: 76.1g/mole
Color: Colorless. Clear
pH (1% soln/water): Not available.
Boiling Point: 188°C (370.4°F)
Melting Point: -59°C (-74.2°F)
Critical Temperature: Not available.
Specific Gravity: 1.036 (Water = 1)
Vapor Pressure:
0 kPa (@ 20°C) 0.08 mmHg at 20 C 0.129 mmHg at 25 C
Vapor Density: 2.62 (Air = 1)
Volatility: Not available.
Odor Threshold: Not available.
Water/Oil Dist. Coeff.: The product is more soluble in water; log(oil/water) = -0.9
Ionicity (in Water): Not available.
Dispersion Properties: See solubility in water, acetone.
Solubility: Soluble in cold water, hot water, acetone.

### Section 10: Stability and Reactivity Data

**Stability:** The product is stable.

**Instability Temperature:** Not available.

**Conditions of Instability:** Incompatible materials, excess heat, exposure to moist air or water

**Incompatibility with various substances:** Reactive with oxidizing agents, reducing agents, acids, alkalis.

**Corrosivity:** Non-corrosive in presence of glass.

**Special Remarks on Reactivity:** Hygroscopic; keep container tightly closed. Incompatible with chloroformates, strong acids (nitric acid, hydrofluoric acid), caustics, aliphatic amines, isocyanates, strong oxidizers, acid anhydrides, silver nitrate, reducing agents.

**Special Remarks on Corrosivity:** Not available.

**Polymerization:** Will not occur.

### Section 11: Toxicological Information

**Routes of Entry:** Absorbed through skin. Eye contact.

**Toxicity to Animals:**
Acute oral toxicity (LD50): 18500 mg/kg [Rabbit]. Acute dermal toxicity (LD50): 20800 mg/kg [Rabbit].

**Chronic Effects on Humans:** May cause damage to the following organs: central nervous system (CNS).

**Other Toxic Effects on Humans:** Hazardous in case of ingestion. Slightly hazardous in case of skin contact (irritant, permeator), of inhalation.

**Special Remarks on Toxicity to Animals:** Not available.

**Special Remarks on Chronic Effects on Humans:** May affect genetic material (mutagenic). May cause adverse reproductive effects and birth defects (teratogenic) based on animal test data.

**Special Remarks on other Toxic Effects on Humans:** Acute Potential Health Effects: Skin: May cause mild skin irritation. It may be absorbed through the skin and cause systemic effects similar to those of ingestion. Eyes: May cause mild eye irritation with some immediate, transitory stinging, lacrimation, blepharospasm, and mild transient conjunctival hyperemia. There is no residual discomfort or injury once it is washed away. Inhalation: May cause respiratory tract irritation. Ingestion: It may cause gastrointestinal tract irritation. It may affect behavior/central nervous system (CNS depression, general anesthetic, convulsions, seizures, somnolence, stupor, muscle contraction or spasticity, coma), brain (changes in surface EEG), metabolism, blood (intravascular hemolysis, white blood cells - decreased neutrophil function), respiration (respiratory stimulation, chronic pulmonary edema, cyanosis), cardiovascular system (hypotension, bradycardia, arrhythmias, cardiac arrest), endocrine system (hypoglycemia), urinary system (kidneys), and liver. Chronic Potential Health Effects: Skin: Prolonged or repeated skin contact may cause allergic contact dermatitis. Ingestion: Prolonged or repeated ingestion may cause hyperglycemia and may affect behavior/CNS (symptoms similar to that of acute ingestion). Inhalation: Prolonged or repeated inhalation may affect behavior/CNS (with symptoms similar to ingestion), and spleen.

### Section 12: Ecological Information

**Ecotoxicity:**
Ecotoxicity in water (LC50): >5000 mg/l 24 hours [Goldfish]. >10000 mg/l 48 hours [guppy]. >10000 mg/l 48 hours [water flea].

**BOD5 and COD:** Not available.
Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations
Waste Disposal:

Section 14: Transport Information
DOT Classification: Not a DOT controlled material (United States).
Identification: Not applicable.
Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information
Federal and State Regulations:
Pennsylvania RTK: Propylene glycol
Minnesota: Propylene glycol
TSCA 8(b) inventory: Propylene glycol

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:
WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):
R21/22- Harmful in contact with skin and if swallowed. S24/25- Avoid contact with skin and eyes.

HMIS (U.S.A.):
   Health Hazard: 2
   Fire Hazard: 1
   Reactivity: 0
   Personal Protection: h

National Fire Protection Association (U.S.A.):
   Health: 0
   Flammability: 1
   Reactivity: 0
   Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Splash goggles.

Section 16: Other Information
References:
Other Special Considerations: Not available.

Created: 10/10/2005 08:24 PM

Last Updated: 11/01/2010 12:00 PM

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Material Safety Data Sheet

R-410A

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: R-410A
DISTRIBUTOR: National Refrigerants, Inc.
661 Kenyon Avenue
Bridgeport, New Jersey 08302

FOR MORE INFORMATION CALL: (Monday-Friday, 8:00am-5:00pm)
1-800-262-0012

IN CASE OF EMERGENCY CALL:
CHEMTREC: 1-800-424-9300

2. COMPOSITION / INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>INGREDIENT NAME</th>
<th>CAS NUMBER</th>
<th>WEIGHT %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difluoromethane</td>
<td>75-10-5</td>
<td>50</td>
</tr>
<tr>
<td>Pentfluoroethane</td>
<td>354-33-6</td>
<td>50</td>
</tr>
</tbody>
</table>

Trace impurities and additional material names not listed above may also appear in Section 15 toward the end of the MSDS. These materials may be listed for local “Right-To-Know” compliance and for other reasons.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Colorless, volatile liquid with ethereal and faint sweetish odor. Non-flammable material. Overexposure may cause dizziness and loss of concentration. At higher levels, CNS depression and cardiac arrhythmia may result from exposure. Vapors displace air and can cause asphyxiation in confined spaces. At higher temperatures (>250°C), decomposition products may include Hydrofluoric Acid (HF) and carbonyl halides.

POTENTIAL HEALTH HAZARDS

SKIN: Irritation would result from a defatting action on tissue. Liquid contact could cause frostbite.

EYES: Liquid contact can cause severe irritation and frostbite. Mist may irritate.

INHALATION: R-410A is low in acute toxicity in animals. When oxygen levels in air are reduced to 12-14% by displacement, symptoms of asphyxiation, loss of coordination, increased pulse rate and deeper respiration will occur. At high levels, cardiac arrhythmia may occur.
INGESTION: Ingestion is unlikely because of the low boiling point of the material. Should it occur, discomfort in the gastrointestinal tract from rapid evaporation of the material and consequent evolution of gas would result. Some effects of inhalation and skin exposure would be expected.

DELAYED EFFECTS: None known.

Ingredients found on one of the OSHA designated carcinogen lists are listed below.

<table>
<thead>
<tr>
<th>INGREDIENT NAME</th>
<th>NTP STATUS</th>
<th>IARC STATUS</th>
<th>OSHA LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ingredients listed in this section</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. FIRST AID MEASURES

SKIN: Promptly flush skin with water until all chemical is removed. If there is evidence of frostbite, bathe (do not rub) with lukewarm (not hot) water. If water is not available, cover with a clean, soft cloth or similar covering. Get medical attention if symptoms persist.

EYES: Immediately flush eyes with large amounts of water for at least 15 minutes (in case of frostbite water should be lukewarm, not hot) lifting eyelids occasionally to facilitate irrigation. Get medical attention if symptoms persist.

INHALATION: Immediately remove to fresh air. If breathing has stopped, give artificial respiration. Use oxygen as required, provided a qualified operator is available. Get medical attention. Do not give epinephrine (adrenaline).

INGESTION: Ingestion is unlikely because of the physical properties and is not expected to be hazardous. Do not induce vomiting unless instructed to do so by a physician.

ADVICE TO PHYSICIAN: Because of the possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, should be used with special caution and only in situations of emergency life support. Treatment of overexposure should be directed at the control of symptoms and the clinical conditions.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLASH POINT</td>
<td>Gas, not applicable per DOT regulations</td>
</tr>
<tr>
<td>FLASH POINT METHOD</td>
<td>Not applicable</td>
</tr>
<tr>
<td>AUTOIGNITION TEMPERATURE</td>
<td>&gt;750°C</td>
</tr>
<tr>
<td>UPPER FLAME LIMIT (volume % in air)</td>
<td>None by ASTM D-56-82</td>
</tr>
<tr>
<td>LOWER FLAME LIMIT (volume % in air)</td>
<td>None by ASTM E-681</td>
</tr>
<tr>
<td>FLAME PROPAGATION RATE (solids)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>OSHA FLAMMABILITY CLASS</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

EXTINGUISHING MEDIA:
Use any standard agent – choose the one most appropriate for type of surrounding fire (material itself is not flammable)
UNUSUAL FIRE AND EXPLOSION HAZARDS:
R-410A is not flammable at ambient temperatures and atmospheric pressure. However, this material will become combustible when mixed with air under pressure and exposed to strong ignition sources. Contact with certain reactive metals may result in formation of explosive or exothermic reactions under specific conditions (e.g. very high temperatures and/or appropriate pressures).

SPECIAL FIRE FIGHTING PRECAUTIONS/INSTRUCTIONS:
Firefighters should wear self-contained, NIOSH-approved breathing apparatus for protection against possible toxic decomposition products. Proper eye and skin protection should be provided. Use water spray to keep fire-exposed containers cool.

6. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR OTHER RELEASE: (Always wear recommended personal protective equipment.)
Evacuate unprotected personnel. Protected personnel should remove ignition sources and shut off leak, if without risk, and provide ventilation. Unprotected personnel should not return until air has been tested and determined safe, including low-lying areas.

Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.

7. HANDLING AND STORAGE

NORMAL HANDLING: (Always wear recommended personal protective equipment.)
Avoid breathing vapors and liquid contact with eyes, skin or clothing. Do not puncture or drop cylinders, expose them to open flame or excessive heat. Use authorized cylinders only. Follow standard safety precautions for handling and use of compressed gas cylinders.

R-410A should not be mixed with air above atmospheric pressure for leak testing or any other purpose.

STORAGE RECOMMENDATIONS:
Store in a cool, well-ventilated area of low fire risk and out of direct sunlight. Protect cylinder and its fittings from physical damage. Storage in subsurface locations should be avoided. Close valve tightly after use and when empty.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS:
Provide local ventilation at filling zones and areas where leakage is probable. Mechanical (general) ventilation may be adequate for other operating and storage areas.

PERSONAL PROTECTIVE EQUIPMENT

SKIN PROTECTION:
Skin contact with refrigerant may cause frostbite. General work clothing and gloves (leather) should provide adequate protection. If prolonged contact with the liquid or gas is anticipated, insulated gloves constructed of PVA, neoprene or butyl rubber should be used. Any contaminated clothing should be promptly removed and washed before reuse.
EYE PROTECTION:
For normal conditions, wear safety glasses. Where there is reasonable probability of liquid contact, wear chemical safety goggles.

RESPIRATORY PROTECTION:
None generally required for adequately ventilated work situations. For accidental release or non-ventilated situations, or release into confined space, where the concentration may be above the PEL of 1,000 ppm, use a self-contained, NIOSH-approved breathing apparatus or supplied air respirator. For escape: use the former or a NIOSH-approved gas mask with organic vapor canister.

ADDITIONAL RECOMMENDATIONS:
Where contact with liquid is likely, such as in a spill or leak, impervious boots and clothing should be worn. High dose-level warning signs are recommended for areas of principle exposure. Provide eyewash stations and quick-drench shower facilities at convenient locations. For tank cleaning operations, see OSHA regulations, 29 CFR 1910.132 and 29 CFR 1910.133.

EXPOSURE GUIDELINES

<table>
<thead>
<tr>
<th>INGREDIENT NAME</th>
<th>ACGIH TLV</th>
<th>OSHA PEL</th>
<th>OTHER LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difluoromethane</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Pentfluoroethane</td>
<td>None</td>
<td>None</td>
<td>*1000 ppm TWA (8hr)</td>
</tr>
</tbody>
</table>

* = Workplace Environmental Exposure Level (AIHA)

OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS:
Hydrogen Fluoride: ACGIH TLV: 3 ppm ceiling

9. PHYSICAL AND CHEMICAL PROPERTIES

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPEARANCE:</td>
<td>Clear, colorless liquid and vapor</td>
</tr>
<tr>
<td>PHYSICAL STATE:</td>
<td>Gas at ambient temperatures</td>
</tr>
<tr>
<td>MOLECULAR WEIGHT:</td>
<td>72.6</td>
</tr>
<tr>
<td>CHEMICAL FORMULA:</td>
<td>CH₂F₂, CHF₂CF₃</td>
</tr>
<tr>
<td>ODOR:</td>
<td>Faint ethereal odor</td>
</tr>
<tr>
<td>SPECIFIC GRAVITY (water = 1.0):</td>
<td>1.08 @ 21.1°C (70°F)</td>
</tr>
<tr>
<td>SOLUBILITY IN WATER (weight %):</td>
<td>Unknown</td>
</tr>
<tr>
<td>pH:</td>
<td>Neutral</td>
</tr>
<tr>
<td>BOILING POINT:</td>
<td>-48.5°C (-55.4°F)</td>
</tr>
<tr>
<td>FREEZING POINT:</td>
<td>Not determined</td>
</tr>
<tr>
<td>VAPOR PRESSURE:</td>
<td>215.3 psia @ 70°F</td>
</tr>
<tr>
<td>VAPOR DENSITY (air = 1.0):</td>
<td>3.0</td>
</tr>
<tr>
<td>EVAPORATION RATE:</td>
<td>&gt;1</td>
</tr>
<tr>
<td>% VOLATILES:</td>
<td>100</td>
</tr>
<tr>
<td>FLASH POINT:</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

(Flash point method and additional flammability data are found in Section 5.)
10. STABILITY AND REACTIVITY

NORMALLY STABLE? (CONDITIONS TO AVOID):
The product is stable.
Do not mix with oxygen or air above atmospheric pressure. Any source of high temperature, such as lighted cigarettes, flames, hot spots or welding may yield toxic and/or corrosive decomposition products.

INCOMPATIBILITIES:
(Under specific conditions: e.g. very high temperatures and/or appropriate pressures) – Freshly abraded aluminum surfaces (may cause strong exothermic reaction). Chemically active metals: potassium, calcium, powdered aluminum, magnesium and zinc.

HAZARDOUS DECOMPOSITION PRODUCTS:
Halogens, halogen acids and possibly carbonyl halides.

HAZARDOUS POLYMERIZATION:
Will not occur.

11. TOXICOLOGICAL INFORMATION

IMMEDIATE (ACUTE) EFFECTS:
Difluoromethane: LC<sub>50</sub>: 4 hr. (rat) - > 520,000 ppm
Pentafluoroethane: Cardiac Sensitization threshold (dog) > 100,000 ppm

DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:
Teratology – negative
Subchronic inhalation (rat) NOEL – 50,000 ppm

OTHER DATA:
Not active in four genetic studies

12. ECOLOGICAL INFORMATION

Degradability (BOD): R-410A is a gas at room temperature; therefore, it is unlikely to remain in water.
Octanol Water Partition Coefficient: Log P<sub>ow</sub> = 1.48 (pentafluoroethane), 0.21 (difluoromethane)
13. DISPOSAL CONSIDERATIONS

RCRA

Is the unused product a RCRA hazardous waste if discarded? Not a hazardous waste.
If yes, the RCRA ID number is: Not applicable.

OTHER DISPOSAL CONSIDERATIONS:
Disposal must comply with federal, state, and local disposal or discharge laws. R-410A is subject to U.S. Environmental Protection Agency Clean Air Act Regulations Section 608 in 40 CFR Part 82 regarding refrigerant recycling.

The information offered here is for the product as shipped. Use and/or alterations to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

14. TRANSPORT INFORMATION

US DOT PROPER SHIPPING NAME: Liquefied gas, n.o.s., (Pentafluoroethane, Difluoromethane)
US DOT HAZARD CLASS: 2.2
US DOT PACKING GROUP: Not applicable
US DOT ID NUMBER: UN3163

For additional information on shipping regulations affecting this material, contact the information number found in Section 1.

15. REGULATORY INFORMATION

TOXIC SUBSTANCES CONTROL ACT (TSCA)
TSCA INVENTORY STATUS: Components listed on the TSCA inventory
OTHER TSCA ISSUES: None

SARA TITLE III / CERCLA
“Reportable Quantities” (RQs) and/or “Threshold Planning Quantities” (TPQs) exist for the following ingredients.

<table>
<thead>
<tr>
<th>INGREDIENT NAME</th>
<th>SARA / CERCLA RQ (lb.)</th>
<th>SARA EHS TPQ (lb.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ingredients listed in this section</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Spills or releases resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center [(800) 424-8802] and to your Local Emergency Planning Committee.

SECTION 311 HAZARD CLASS: IMMEDIATE PRESSURE

SARA 313 TOXIC CHEMICALS:
The following ingredients are SARA 313 “Toxic Chemicals”. CAS numbers and weight percents are found in Section 2.

<table>
<thead>
<tr>
<th>INGREDIENT NAME</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ingredients listed in this section</td>
<td></td>
</tr>
</tbody>
</table>
STATE RIGHT-TO-KNOW
In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

<table>
<thead>
<tr>
<th>INGREDIENT NAME</th>
<th>WEIGHT %</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ingredients listed in this section</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ADDITIONAL REGULATORY INFORMATION:
R-410A is subject to U.S. Environmental Protection Agency Clean Air Act Regulations at 40 CFR Part 82.

WARNING: Do not vent to the atmosphere. To comply with provisions of the U.S. Clean Air Act, any residual must be recovered. Contains Pentane (HFC-125) and Difluoromethane (HFC-32), greenhouse gases which may contribute to global warming.

WHMIS CLASSIFICATION (CANADA):
This product has been evaluated in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

FOREIGN INVENTORY STATUS:
EU – EINECS # 2065578 – HFC-125

16. OTHER INFORMATION

<table>
<thead>
<tr>
<th>CURRENT ISSUE DATE:</th>
<th>December, 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREVIOUS ISSUE DATE:</td>
<td>August, 2007</td>
</tr>
</tbody>
</table>

OTHER INFORMATION:
HMIS Classification: Health – 1, Flammability – 1, Reactivity – 0
NFPA Classification: Health – 2, Flammability – 1, Reactivity – 0
ANSI / ASHRAE 34 Safety Group – A1

Regulatory Standards:
2. DOT classification per 49 CFR 172.101
Toxicity information per PAFT Testing

17. DISCLAIMER
National Refrigerants, Inc. believes that the information and recommendations contained herein (including data and statements) are accurate as of the date hereof. NO WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE, WARRANTY OF MERCHANTABILITY, OR ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, IS MADE CONCERNING THE INFORMATION PROVIDED HEREFIN. The information provided herein relates only to the specific product designated and may not be valid where such product is used in combination with any other methods or use of the product and of the information referred to herein are beyond the control of National Refrigerants. National Refrigerants expressly disclaims any and all liability as to any results obtained or arising from any use of the product or reliance on such information.

MSDS: R-410A
Current Issue Date: December, 2008
# Interconnection Application Form

**Middlebury College**  
Lot 107  
Team Name and Lot Number

## PV Systems

<table>
<thead>
<tr>
<th>Module Manufacturer</th>
<th>Short Description of Array</th>
<th>DC Rating of Array (sum of the DC ratings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunpower</td>
<td>10 x 225W PV Modules wired in series</td>
<td>2.25 kW DC @STC</td>
</tr>
<tr>
<td>Sunpower</td>
<td>10 x 225W PV Modules wired in series</td>
<td>2.25 kW DC @STC</td>
</tr>
<tr>
<td>Sunpower</td>
<td>10 x 225W PV Modules wired in series</td>
<td>2.25 kW DC @STC</td>
</tr>
</tbody>
</table>

Total DC power of all arrays is **6.8** kW (in tenths)

## INVERTERS

<table>
<thead>
<tr>
<th>Inverter Manufacturer</th>
<th>Model Number</th>
<th>Voltage</th>
<th>Rating (kVA or KW)</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SunPower</td>
<td>SPR-7000m Inverter</td>
<td>240V Output</td>
<td>7 KW AC Nominal Rating</td>
<td>1</td>
</tr>
</tbody>
</table>

Total AC power of all inverters is **7** kVA or kW (in whole numbers)

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)

1. One-Line Electrical schematic – the loads do not have to be detailed.  
   E-601
2. Calculations of service/feeder net computed load and neutral load (NCE 220)  
   E-603
3. Plan view of the lot showing the house, decks, ramps, tour paths, the service point and the distribution panel or load center.  
   E-102

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

Please see the “SD2011_Microgrid_Interconnection_Process_v1” file located the Files/Rules/Team Interconnection Process section of the Yahoo Group for more details on the interconnection process.
### Service Entrance Calculations - Standard Method

#### Heat Pump
- Indoor Unit: 055 VA
- Outdoor Unit: 6720 VA
- Heating Total: 7875 VA = 36.7 A

25% of Largest Motor: 
\[
(6720 \times 0.25) = 1680 VA = 7.0 A
\]

#### General Loads
- Lighting: 1000 ft² @ 3 VA/ft² (Table 220.31(A))
  - 3000 VA
- 2 20A Kitchen Appliance Circuits @ 1500VA
  - 3000 VA
- Laundry Circuit
  - 1500 VA
- NEC Table 220.42
  - 3000 VA @ 100% Demand Factor
  - 3000 VA
  - 3001-120,000 VA @ 35% Demand Factor
  - 1575 VA

- Total General Loads: 9475 VA = 19.1 A

#### Fixed Equipment
- Induction Cooktop (Range)
  - 7680 VA
- Oven
  - 5760 VA
- 65% Demand Factor (NEC Table 220.53)
  - 8736 VA = 36.4 A
- Dryer (NEC 220.54 - 100% DP)
  - 5760 VA = 24 A

- Domestic Water Pump
  - 1152 VA
- H2O Heater
  - 4560 VA
- ERV
  - 690 VA
- Solar Thermal Pump
  - 373 VA
- Sewage Pump
  - 373 VA
- Dishwasher
  - 1800 VA
- Refrigerator
  - 540 VA
- Microwave
  - 1560 VA
- Range Hood
  - 360 VA

- Total Fixed Equipment: 18571 VA = 35.7 A

#### Minimum Ampacity Required for Ungrounded SE Conductors
- = 152.9 A

#### Conclusion: Install 200A Service Entrance and Main Panel

Use: XHHW Aluminum 4/0 SE wiring for ungrounded conductors (Table 310.15(B)(6))

### Neutral Load Calculations (NEC 220.61)

- General Loads Total: 4575 VA
- Range & Oven (70% maximum unbalanced)
  - 6115.2 VA
- Dryer (70% maximum unbalanced load)
  - 4032 VA
- 120V Appliances (w/ 75% DF)
  - 3814.5 VA
- 25% Largest 120V motor load (refrigerator)
  - 135 VA

- Total Neutral Load: 18671.7 VA = 77.8 A

Use 2 AWG Aluminum Wire (Table 310.15(B)(6))
Energy Analysis Results and Discussion

The energy analysis was conducted using a Passive House Planning Package through the Vermont Energy Investment Corporation. Such software is typically used to gauge whether a home meets the requirements of the Passive Standard (which is a measure of the energy demand of the house and not whether or not the home is self-reliant). The annual net AC power production of our solar installation is projected to be 7900 kWh. The annual net power consumption of the home is projected to be 6500 kWh; this composes 82% of our production.
### Passive House Planning

**SPECIFIC USEFUL COOLING DEMAND MONTHLY METHOD**

(This page displays the sums of the monthly method over the cooling period)

<table>
<thead>
<tr>
<th>Building Element</th>
<th>Temperature Zone</th>
<th>Area</th>
<th>R-Value (in R/ft²)</th>
<th>Mon. Red. Fac</th>
<th>Q&lt;sub&gt;c&lt;/sub&gt; (BTU/hr·°F·ft²)</th>
<th>per ft²</th>
<th>Treated Floor Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior Wall - Ambient</td>
<td>A</td>
<td>2042</td>
<td>1.00</td>
<td>5435</td>
<td>6946</td>
<td></td>
<td>1119</td>
</tr>
<tr>
<td>Roof/Ceiling - Ambient</td>
<td>B</td>
<td>1146</td>
<td>1.00</td>
<td>5435</td>
<td>2135</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Ground 1</td>
<td>B</td>
<td>817</td>
<td>1.00</td>
<td>5435</td>
<td>3780</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Ground 2</td>
<td>B</td>
<td>426</td>
<td>1.00</td>
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**Transmission Losses Q<sub>T</sub> (Negative: Heat Loads)**

- Effective Air Volume V<sub>e</sub> = 1119 ft³
- Clear Room Height = 8 ft
- Heat Transfer Coefficient G<sub>c</sub> = 0.00
- Ventilation STOKES = 81.2

**Additional Summer Ventilation**
### Passive House Planning

**COOLING LOAD**

<table>
<thead>
<tr>
<th>Building</th>
<th>Middlebury Solar Decathlon</th>
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<tbody>
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<table>
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<th>Area (sq ft)</th>
<th>E (in Summer)</th>
<th>Factor</th>
<th>TempDiff (°F)</th>
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**Radiation Correction**

\[ \text{Radiation correction} = -7 \times 7.8 + 7 \times (7 - 5.4) = -95 \]

**Transmission Heat Losses**

\[ P_1 = 413 \]

**Effective Air Volume, V_e**

\[ V_e = 1119 \]

**Clear Room Height, \( h \)**

\[ h = 8 \]

**Effective Ventilation, V_v**

\[ V_v = 224 \]

**Temperature, TempDiff**

| Exterior | 81 | 329 | -94 |
| Ground  | 0  | -598 | 0  |
# Passive House Planning

## Specific Annual Heat Demand

**Location:** Middlebury Solar Decathlon

### Climate: Burlington DHSUS Set

<table>
<thead>
<tr>
<th>Building Element</th>
<th>Temperature Zone</th>
<th>Area</th>
<th>R-Value</th>
<th>Temp. Factor</th>
<th>$G_o$ (Degree Day)</th>
<th>per sq ft Treated Floor Area</th>
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<tbody>
<tr>
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<td>Ground TB (length/m)</td>
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Total of All Building Envelope Areas: 4533

Transmission Heat Losses $Q_T$

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<tr>
<th>Effective Air Volume, $V_e$</th>
<th>$\Delta T_{\text{eff}}$</th>
<th>$A_{\text{Area}}$</th>
<th>Clear Room Height, $H$</th>
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<tr>
<td>80%</td>
<td>0%</td>
<td>1119</td>
<td>8.20</td>
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**Interior Temperature:** 68.0°F

**Building Type/Use:** Single Family Residence

**Treated Floor Area:** 1119 sq ft

**Total Heat Demand:** 26221 BTU/yr

**Net Heat Demand:** 23.44 BTU/yr
## Passive House Planning

### Specific Space Heating Load

<table>
<thead>
<tr>
<th>Building Element</th>
<th>Temperature Zone</th>
<th>R-Value</th>
<th>Factor</th>
<th>TempDiff 1</th>
<th>TempDiff 2</th>
<th>Pf 1</th>
<th>Pf 2</th>
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<td>or</td>
<td>66</td>
<td>→</td>
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<tr>
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<td>37.4</td>
<td>1.00</td>
<td>69</td>
<td>or</td>
<td>66</td>
<td>→</td>
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<tr>
<td>Roof/Ceiling - Ambient</td>
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<td>1.00</td>
<td>69</td>
<td>or</td>
<td>66</td>
<td>→</td>
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<tr>
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<td>28.5</td>
<td>1.00</td>
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<td>or</td>
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### Transmission Heat Losses Pf

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### Ventilation System

- **Effective Volume, \( V_e \)**
- **Clear Room Height, \( n \)**
- **Efficiency of Heat Recovery**
- **Heat Recovery Efficiency, \( R \)**
- **Efficiency of Heat Exchanger, \( \eta_L \)**
- **Energetically Effective Air Exchange, \( n_e \)**

**Total 1**

**Total 2**

---

[Status]

U.S. D.O.E. Solar Decathlon 2011

Published 5/3/2011

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### Passive House Planning

#### Electricity Demand

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<th>Loss Factor</th>
<th>KVA</th>
<th>Factor</th>
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**Total: 2344**

**Specific Demand: 5.78 kW**

**Recommended Maximum Value: 15.65 kW**
# Passive House Planning

## HEAT DISTRIBUTION AND DHW SYSTEM

<table>
<thead>
<tr>
<th>Building Location: Middlebury Solar Decathlon</th>
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<tbody>
<tr>
<td>Interior Temperature: 70°F</td>
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<tr>
<td>Building Type/Use: Single Family Residence</td>
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<tr>
<td>Treated Floor Area: 1,119 ft²</td>
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<tr>
<td>Occupancy: 4 persons</td>
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<td>Length of Heating Period: 728 days</td>
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<td>Average Heat Load: 77°F</td>
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<td>Marginal Utilization of Additional Heat Gain: 0.0%</td>
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### Space Heat Distribution

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<td>Ψ (Projected)</td>
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<td>Σₚ, Mechanical Room</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Σₚ, Final, design view</td>
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<td></td>
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<tr>
<td>Pₚ,vent (wind,net)</td>
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<tr>
<td>Flow Temperature Control (check)</td>
<td></td>
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<tr>
<td>Design Return Temperature</td>
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</tr>
<tr>
<td>Annual Heat Emission per foot of Plumbing</td>
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<tr>
<td>Possible Utilization Factor of Released Heat</td>
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<td>Annual Losses</td>
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<tr>
<td>Utilization Factor of Space Heat Distribution</td>
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</table>

### DHW: Standard Useful Heat

- DHW Consumption per Person and Day (60°C)
- Average Cold Water Temperature of the Supply
- DHW Hot/Cold Water and Dish
- Useful Heat - DHW
- Specif. Useful Heat - DHW

### DHW Distribution and Storage

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Warm Region</th>
<th>Cold Region</th>
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<tbody>
<tr>
<td>Lₚ (Projected)</td>
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<tr>
<td>Ψ (Projected)</td>
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<td>Σₚ, Mechanical Room</td>
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<tr>
<td>Σₚ, Final, design view</td>
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<tr>
<td>Daily circulation period of operation</td>
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<tr>
<td>Design Return Temperature</td>
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<tr>
<td>Σₓₚ (Flow, design view)</td>
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<td>114</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Warm Region</th>
<th>Cold Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHW consumption per person/day</td>
<td>6.6</td>
<td></td>
</tr>
<tr>
<td>Average cold water temperature</td>
<td>50.0</td>
<td></td>
</tr>
<tr>
<td>DHW temperature of drinking water</td>
<td>5781 MBTU/yr</td>
<td></td>
</tr>
</tbody>
</table>

- DHW consumption per person/day: 6.6 Gals/person/day
- Average cold water temperature: 50.0°F
- DHW temperature of drinking water: 5781 MBTU/yr

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**Published 5/3/2011**

Construction Specifications

Division 02 - Site Construction
  028700 - Site Furnishings

Division 05 - Metals
  051200 - Structural Steel Framing (See Structural Drawings)
  055000 - Metal Fabrications
  055200 - Metal Railings

Division 06 - Wood, Plastics, and Composites
  061000 - Rough Carpentry (See structural drawings)
  061600 - Sheathing (Exterior only)
  061610 - Structural Sheathing (See structural drawings)
  061760 - Trusses (See structural drawings)
  061776 - Metal Plate Connected Wood Trusses (See structural drawings)
  061800 - Glued Laminated Construction (See structural drawings)
  064013 - Exterior Architectural Woodwork
  064023 - Interior Architectural Woodwork

Division 07 - Thermal and Moisture Protection
  072100 - Thermal Insulation
  076100 - Sheet Metal Roofing and Accessories
  076200 - Sheet Metal Flashing and Trim

Division 08 - Openings
  081416 - Flush Wood Doors
  081479 - Side-Hinged Wood-Frame Glass Doors
  085200 - Wood Windows
  086100 - Roof Windows
  087100 - Door Hardware

Division 09 - Finishes
  092900 - Gypsum Board
  093033 - Stone Tiling
<table>
<thead>
<tr>
<th>Division</th>
<th>Description</th>
</tr>
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</table>
| Division 10 – Specialties | 096400- Wood Flooring & Wall Paneling  
099100- Painting |
| Division 11 - Equipment | 101400- Signage  
102800- Toilet, Bath, and Laundry Accessories  
104416- Fire Extinguishers (See drawing G-102) |
| Division 12 - Furnishings | 113100- Residential Appliances  
123640- Stone Countertops |
| Division 21 – Fire Suppression | 210500- Common Work Results For Fire Suppression  
211000- Water-Based Fire Suppression Systems |
| Division 22 - Plumbing | 220500- Plumbing Specifications  
220523- General-Duty Valves for Plumbing Piping  
221116- Domestic Water Piping  
221216- Facility Elevated, Potable-Water Storage Tanks  
221316- Sanitary Waste and Vent Piping |
| Division 23 – Heating, Ventilating, and Air-conditioning (HVAC) | 230500- Heating, Ventilating, and Air-Conditioning Specifications |
| Division 26 - Electrical | 260500- Electrical Specifications |
| Division 28 – Electronic Safety and Security | 283100- Fire Detection and Alarm (see drawing F-101) |
| Division 32- Exterior Improvements | 329200- Exterior Plants |
SECTION 028700 – SITE FURNISHINGS

PART 2 - GENERAL

2.01 DESCRIPTION

Site furnishings will be moveable units, consisting of custom and pre-made planters, benches, table and chairs.

PART 3 - PRODUCTS

3.01 MATERIALS

A. Steel and Iron:

2. Steel Sheet: ASTM A 1011/A 1011M.

B. Wood: Surfaced smooth on four sides with eased edges; kiln dried, free of knots, solid stock of species indicated, with tongue and groove where indicated.

1. Wood Species: White Oak

C. Plywood: Free of defects

3.02 SITE FURNISHINGS

A. Planters

1. Materials: White Oak

a. 5/4"x3”, 4”, or 5” white oak boards (sawn locally from wood harvested on Middlebury College lands) free of warping and structural imperfections.

b. 3/4" plywood

2. Construction

a. Planters shall be constructed by team members prior to transport to DC. Team members shall comply with all construction specifications and safety requirements.
3. **Installation**
   a. Planters will be placed, not fastened, on the deck surface at the locations specified in the plan. Planters shall be at least 1.5” from the edge of the deck where applicable. Soil and plants shall be installed after planters are in place on the deck.

   **B. Benches**
   1. **Materials**
      a. WOOD: 3/4”x6” white oak boards (sawn locally from wood harvested on college lands) free of warping and structural imperfections.

      **2. Construction**
      a. Benches shall be constructed by team members prior to transport to DC. Team members shall comply with all construction specifications and safety requirements.

      **3. Installation**
      a. Benches will be placed, not fastened, on the deck surface at the locations specified in the plan. Benches shall be at least 1.5” from the edge of the deck where applicable.

   **C. Table and Chairs**
   1. **Products**
      a. Emeco Navy Chair

      b. Custom 4’ radius outdoor table of steel bar and steel mesh.

**PART 4 - EXECUTION**

4.01 **INSTALLATION**

A. All elements shall be placed on or adjacent to decking according the site plan. Where necessary, elements shall be temporarily secured. No element may be placed within 1.5” of the edge of the deck. All planters near the edge of the deck shall be tested for stability and secured as needed.

**END OF SECTION 028700**
SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS
   A. Submittals: Shop Drawings showing details of fabrication and installation.

PART 2 - PRODUCTS

2.01 METALS
   A. Greenhouse shelving. Custom fabricated to match drawings using aluminum mesh, 1/8” angle iron. ASTM A 36/A 36M and ASTM B 26/B 26M, Alloy 443.0-F.

2.02 STEEL AND IRON FINISHES
   A. Hot-dip galvanize steel fabrications at exterior locations.

PART 3 - EXECUTION

3.01 INSTALLATION
   A. Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack.
   B. Fit exposed connections accurately together to form hairline joints.

END OF SECTION 055000
SECTION 055200 – METAL RAILINGS

PART 1 - SECTION REQUIREMENTS

1.01  Provide railings capable of withstanding a uniform load of 50 lbf/ ft. (0.73 kN/m) and a concentrated load of 200 lbf (0.89 kN) applied to handrails and top rails of guards in any direction. Uniform and concentrated loads need not be assumed to act concurrently.

1.02  Provide railing infill capable of withstanding a concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m). Infill load and other railing loads need not be assumed to act concurrently.

1.03  RAILING SYSTEMS

PART 2 - PRODUCTS

2.01  Manufacturers:

1.  Fabricated by Lou Nop’s Metal Shop to match drawings.

2.02  METALS

A.  Stainless-Steel rod: ASTM A 554, Grade MT 304. 3/8” diameter

B.  Steel bar: Grade A36

2.03  FABRICATION

A.  Assemble railing systems in shop to the greatest extent possible. Use connections that maintain structural value of joined pieces.

B.  Form changes in direction of railing members by mitering at elbow bends, use of prefabricated fittings.

C.  Fabricate railing systems and handrails for connecting members with concealed mechanical fasteners and fittings.

D.  Provide manufacturer’s standard wall brackets, flanges, miscellaneous fittings, and anchors to connect handrail and railing members to other construction.
2.04 FINISHES

A. EasyBlack-55

B. Valspar Clear Satin

PART 3 - EXECUTION

3.01 INSTALLATION

A. Fit exposed connections accurately together to form tight, hairline joints.

B. Set railings accurately in location, alignment, and elevation and free of rack.

END OF SECTION 055200
SECTION 061600 – SHEATHING (ZIP SYSTEM)

PART 1 - Section Requirements

1.01 SUMMARY
A. Section Includes:
   1. Combination wall sheathing, water-resistive barrier, and air barrier.
   2. Combination roof sheathing and roof underlayment.

1.02 ACTION SUBMITTALS
A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. For panels with integral water resistive barrier, include data on air-/moisture-infiltration protection based on testing according to referenced standards.

1.03 QUALITY ASSURANCE
A. Manufacturer Qualifications: Capable of demonstrating that all wood procurement operations are conducted in accordance with procedures and policies of the Sustainable Forestry Initiative (SFI) Program.

   B. Code Compliance: Comply with requirements of the following:
      1. International Code Council (ICC), ICC-ESR1473 (ZIP System Roof Sheathing).

1.04 DELIVERY, STORAGE, AND HANDLING
A. Outdoor Storage: Comply with manufacturer’s recommendations
   1. Set panel bundles on supports to keep off ground.
   2. Cover panels loosely with waterproof protective material.
   3. Anchor covers on top of stack, but keep away from sides and bottom to assure adequate air circulation.
   4. When high moisture conditions exist, cut banding on panel stack to prevent edge damage.
1.05 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of sheathing system that fail due to manufacturing defects within specified warranty period.

1. System Warranty Period: 15 years from date of Substantial Completion.
2. Panel Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 WOOD PANEL PRODUCTS

All Huber Engineered Woods panels contained in this Section are manufactured using orientated strand board.

A. Oriented Strand Board: DOC PS 2.
B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
C. Factory mark panels to indicate compliance with applicable standard.

2.02 COMBINATION WALL SHEATHING, WATER-RESISTIVE BARRIER, AND AIR BARRIER

A. Oriented-Strand-Board Wall Sheathing: With integral water-resistive barrier, Exposure 1 sheathing.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Huber Engineered Woods LLC; ZIP System Wall Sheathing.
2. Span Rating and Nominal Thickness: Not less than 32/16; 1/2 inch (13 mm).
3. Edge Profile: Self-spacing profile.
4. Provide fastening guide on top panel surface with pre-spaced fastening symbols for 24-inches (610 mm) on centers spacings.
7. Assembly maximum air leakage of 0.0072 cfm/sq. ft. (0.037 L/s x sq. *m) infiltration and 0.0023 cfm/ sq. ft. (0.012 L/s x sq.*m) exfiltration at a pressure differential of 1.57 psf (75 Pa).
8. Exposure Time: Designed to resist weather exposure for 120 days.

2.03 COMBINATION ROOF SHEATHING AND ROOF UNDERLAYMENT
A. Oriented-Strand-Board Roof Sheathing: [With integral water-resistive barrier, Exposure 1, Structural I] [With integral water-resistive barrier, Exposure 1] sheathing.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Huber Engineered Woods LLC; ZIP System Roof Sheathing.
2. Span Rating and Nominal Thickness: Not less than; 5/8 inch (15.9 mm).
3. Edge Profile: Tongue and groove.
4. Provide fastening guide on top panel surface with pre-spaced fastening symbols for 24-inches (610 mm) on center spacings.
7. Exposure Time: Designed to resist weather exposure for 120 days.

2.04 FASTENERS


2.05 MISCELLANEOUS MATERIALS

A. Self-Adhering Tape: Pressure-sensitive, self-adhering, cold-applied, proprietary seam tape consisting of polyolefin film with acrylic adhesive.

1. Basis-of-Design Product: Subject to compliance with requirements provide Huber Engineered Woods; ZIP System Tape.
2. Thickness: 0.012 inch (0.3 mm).

3.01 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Chapter 23 in ICC's "International Building Code."
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Only mechanically attached and drainable EIFS and exterior insulation should be used with ZIP System wall sheathing.

### 3.02 WOOD STRUCTURAL PANEL INSTALLATION


B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:
   a. Nail to wood framing.
   b. Screw to cold-formed metal framing.
   c. APA Recommends spacing panels 1/8 inch apart at edges and ends.
   d. Space panels 1/8 inch (3 mm) apart at edges and ends.
   e. Install fasteners 3/8 inch (9.5 mm) to 1/2 inch (12.7 mm) from panel edges.
   f. Space fasteners in compliance with requirements of authority having jurisdiction.

### 3.03 SHEATHING JOINT TREATMENT

A. Seal sheathing joints according to sheathing manufacturer's written instructions.

   1. Apply proprietary seam tape to joints between sheathing panels.
   2. Utilize self-adhering tape gun or hard rubber roller provided by manufacturer to ensure tape is completely adhered to substrates.

### 3.04 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturers written instructions.
1. After flashing has been applied, roll surfaces with a hard rubber to ensure that flashing is completely adhered to substrates.

END OF SECTION 061600
SECTION 064013 - EXTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS
   A. Submittals: Shop Drawings.
   C. Forest Certification: Provide woodwork produced from wood either sustainably harvested from Middlebury College’s own forests or from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

PART 2 - PRODUCTS

2.01 MATERIALS
   A. Hardboard: AHA A135.4.
   B. Softwood Plywood: DOC PS 1.
   C. Preservative Treatment: Comply with WDMA I.S.4 for items indicated to receive water-repellent preservative treatment.
   D. Fasteners for Exterior Woodwork:
      1. Nails: hot-dip galvanized or stainless steel.
      2. Screws: hot-dip galvanized or stainless steel.

2.02 EXTERIOR WOODWORK
   A. Wood Siding: Premium grade Eastern White Cedar. 1” x 8” shiplap.
   B. Wood Moisture Content: 7 to 12 percent.
   C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
   D. Exterior Standing and Running Trim: Premium grade, made from white cedar as indicated on drawings.
   E. Exterior Frames and Jambs: Premium grade, made from white cedar.
   F. Shop prime woodwork for opaque finish with one coat of specified wood primer.
   G. Shop seal woodwork for transparent finish with stain (if required), other required pretreatments, and first coat of specified finish.
   H. Backprime with one coat of sealer or primer, compatible with finish coats. Apply two coats to surfaces installed in contact with concrete and to end-grain surfaces.
   I. Use Cedar Breather or approved equal behind siding. Install per manufacturer’s instructions.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Install woodwork to comply with referenced quality standard for grade specified.

B. Install woodwork true and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Fasten with countersunk concealed fasteners and blind nailing. Use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork.

E. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches (900 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

END OF SECTION 064013
SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Shop Drawings


C. Forest Certification: Provide woodwork produced from wood obtained from Middlebury College Forests or from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

D. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is completed, and HVAC system is operating.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Includes material for kitchen cabinetry, desk, window sills, dining table, partition screens, bathroom vanity, closet doors and gussets

   4. Kliptech ecotop for sink surround on bathroom vanity and bathtub surround.
   5. Hardwood Plywood and Face Veneers: HPVA HP-1, made with adhesive containing no urea formaldehyde.
   6. Maple hardwood, finish grade lumber.

2.02 CABINET HARDWARE AND ACCESSORY MATERIALS

A. Butt Hinges: 2-3/4-inch (70-mm), 5-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:

   1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
   2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening.

C. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long.

D. Catches: Magnetic catches, BHMA A156.9, B03141.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

F. Drawer Slides: BHMA A156.9, B05091.

   1. Box Drawer Slides: Grade 1HD-100.
2. File Drawer Slides: Grade 1HD-100
3. Pencil Drawer Slides: Grade 2.
4. Keyboard Slides: Grade 1HD-100.
5. Trash Bin Slides: Grade 1HD-100.

G. Drawer Locks: BHMA A156.11, E07041.

H. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

I. Exposed Hardware Finishes: Comply with BHMA A156.18 for BHMA code number indicated.
   1. Finish: satin stainless

J. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to 15 percent moisture content.

2.03 INTERIOR WOODWORK

A. Complete fabrication to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

C. Interior Standing and Running Trim for Transparent Finish: Premium maple or white birch.

D. Interior Standing and Running Trim for Opaque Finish: Premium eastern white pine.

E. Flush Wood Paneling for Transparent Finish: Premium grade.
   1. Wood Species: Hard Maple
   2. Matching of Adjacent Veneer Leaves: Book
   3. Veneer Matching within Panel Face: Center-balance match.
   4. Panel Matching: No matching between panels is required. Select and arrange panels for similarity of grain pattern and color between adjacent panels

F. Interior Ornamental Work for Transparent Finish: Premium maple or white birch.

G. Wood Cabinets for Transparent Finish: Premium grade.
   1. AWI Type of Cabinet Construction: Face frame
   2. WI Construction Style: Face frame
   3. WI Door and Drawer Front Style: Face frame
   5. Grain Direction: As indicated.
7. Veneer Matching within Panel Face: Center-balance match.
8. Semiexposed Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.

2.04 SHOP FINISHING OF INTERIOR ARCHITECTURAL WOODWORK

A. Finishes: Same grades as items to be finished.

B. Finish architectural woodwork at the fabrication shop; defer only final touch up until after installation.
   1. Apply one coat of sealer or primer to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces.

C. Transparent Finish: Vermont Natural Coatings clear furniture finish.

D. Transparent Finish: Vermont Natural Coatings clear furniture finish.

2.05 GUSSETS

A. MDF for paint finish.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Install woodwork to comply with referenced quality standard for grade specified.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Fasten with countersunk concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed nailing, countersunk and filled flush with woodwork.

F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches (900 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

G. Anchor paneling to supports with concealed panel-hanger clips and by blind nailing on back-up strips, splined-connection strips, and similar associated trim and framing.

H. Cabinets: Install so doors and drawers are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
   1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips.
I. Anchor countertops securely to base units. Seal space between backsplash and wall.

END OF SECTION 064023
SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS
   A. Submit manufacturer's product data, including installation instructions
   B. Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended applications.
   C. Warranty: submit manufacturer's standard warranty.

PART 2 - PRODUCTS

2.01 INSULATION PRODUCTS
   A. Cellulose insulation pneumatically blown dry into floors, walls, and roof assemblies/cavities.

2.02 MANUFACTURER
   A. National Fiber
      www.nationalfiber.com

2.03 REFERENCE STANDARDS
   D. CPSC Standard 16 CFR Parts 1209 and 1404.

PART 3 - EXECUTION

3.01 INSTALLATION
   A. Install insulation in areas and in thicknesses indicated or required to produce R-values indicated. Cut and fit tightly around obstructions and fill voids with insulation.

3.02 QUALITY CONTROL
   A. Manufacturer's Qualifications: Manufacturer regularly engaged, for past 10 years, in manufacture of cellulose insulation of similar type to that specified.
   B. Installer's Qualifications:
1. Installer regularly engaged, for past 1 year, in installation of cellulose insulation of similar type to that specified.
2. Employ persons trained for installation of cellulose insulation.
3. Installer: Certified by cellulose insulation manufacturer.

C. Installer’s Equipment: Approved by cellulose insulation manufacturer.

END OF SECTION 072100
SECTION 076100 – SHEET METAL ROOFING & ACCESSORIES

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data and Color Samples.
B. Comply with SMACNA's "Architectural Sheet Metal Manual" unless otherwise indicated.
C. Warranties: Provide manufacturer's standard written warranty, signed by manufacturer agreeing to promptly repair or replace roofing sheet metal that shows evidence of deterioration of factory-applied finishes within 25 years from date of Substantial Completion.
D. Warranties: Standard form in which roofing Installer agrees to repair or replace sheet metal roofing that fails in materials or workmanship within two years from date of Substantial Completion and Installation on the Middlebury College campus.

PART 2 - PRODUCTS

2.01 ROOFING SHEET METALS

A. Manufacturer: Englert, Inc., or approved equal.
   1. Finish: Manufacturer's standard clear acrylic finish (with Galvalume Plus)
   2. Concealed Finish: Manufacturer's standard white or light-colored acrylic or polyester backer finish.

2.02 ACCESSORIES

A. Roof Accessories
   1. Metal ridge cap: Custom design to match metal roofing.
B. Custom fabricated boots at all roof penetrations. Metal to match roofing.
C. Metal flashing at eave and rake. Custom fabricated as drawn. Metal to match roofing.
D. Flashing to cover heat dissipaters for solar hot water system. Metal to match roofing.
E. Flashing to cover eastern egress door. Metal to match roofing.
F. Felt Underlayment: ASTM D 226, Type II (No. 30), asphalt-saturated organic felts.
G. Self-Adhering Sheet Underlayment at eaves and ridge, High Temperature: Butyl or SBS-modified asphalt; slip-resisting-polyethylene surfaced; with release paper backing; cold applied. Stable after testing at 240 deg F (116 deg C) and passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
H. Fasteners for Metallic-Coated Steel Sheet: Hot-dip galvanizned steel or Series 300 stainless steel.
I. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

J. Metal Accessories: Matching sheet metal roofing in finish and material required for a complete weathertight roofing system, including: clips, flashings, ridge closure strips, trim, copings, custom fasciae, custom gutters, boots, and louvers.

K. Seam-Mounted, S-5 clips for solar panel mounting to vertical ribs of standing-seam sheet metal roofing.

L. Battens: Fabricate from same Galvalume Plus material custom battens for roof panel joints. See roof panel details.

2.03 FABRICATION

A. Fabricate sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of installation indicated.

1. Standing-Seam Roofing: Form standing-seam pans with finished seam height of 1-1/2 inches (38 mm).

PART 3 - EXECUTION

3.01 INSTALLATION

A. Apply self-adhering sheet underlayment at eaves, ridge, and rakes from edges of roof to at least 24 inches (600 mm) inside exterior wall line.

B. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment.

C. Anchor roofing securely in place, with provisions for thermal and structural movement. Install with concealed fasteners unless otherwise indicated.

D. Separate dissimilar metals with a bituminous coating or polymer-modified, bituminous sheet underlayment.

E. Seal joints as shown and as required for leakproof construction. Note that roof panel seams will need provision of a neoprene, or approved equal, gasket for ease of assembly and disassembly.

END OF SECTION 076100
SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and Samples.

B. Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

C. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.01 SHEET METAL

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, not less than 0.032 inch (0.8 mm) thick; and with mill finish.

2.02 FABRICATION

A. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.

B. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with SMACNA's "Architectural Sheet Metal Manual." Allow for thermal expansion; set true to line and level. Install Work with laps, joints, and seams permanently watertight and weatherproof; conceal fasteners where possible.

B. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

C. Fabricate nonmoving seams in sheet metal with flat-lock seams. For aluminum, form seams and seal with epoxy seam sealer.

END OF SECTION 076200
SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Samples for factory-finished doors.

PART 2 - PRODUCTS

2.01 DOOR CONSTRUCTION, GENERAL

A. Quality Standard: WDMA I.S.1-A.

B. Forest Certification: Provide doors made with all wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

C. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

D. WDMA I.S.1-A Performance Grade:
   1. Heavy Duty unless otherwise indicated.

2.02 FLUSH WOOD DOORS

A. Doors for Transparent Finish:
      a. Faces: Grade A plain-sliced select white birch.
      c. Frames: Pre-hung doors. Frames to match door veneer species and finish.

2.03 FABRICATION AND FINISHING

A. Factory fit doors to suit frame-opening sizes indicated and to comply with clearances specified.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3.

C. Cut and trim openings to comply with referenced standards.
   1. Trim light openings with moldings indicated.
   2. Factory install glazing in doors indicated to be factory finished.
   3. Factory install louvers in prepared openings.

D. Factory finish doors indicated for transparent finish with clear finish as specified in ‘Painting’ specification.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Install doors to comply with manufacturer's written instructions and WDMA I.S.1-A, and as indicated.

B. Clearances: As follows unless otherwise indicated:
   1. 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors.
   2. 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering.
   3. 1/4 inch (6.4 mm) from bottom of door to top of threshold.
   4. Comply with NFPA 80 for fire-rated doors.

C. Repair, refinish, or replace factory-finished doors damaged during installation, as directed by Architect.

END OF SECTION 081416
SECTION 081479 - SIDE HINGED WOOD-FRAMED GLASS DOORS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data and color Samples.

B. Provide AAMA or WDMA-certified, side-hinged wood-framed glass doors with an attached label.

PART 2 - PRODUCTS

2.01 Side Hinged Wood-Framed Glass Doors

A. Products:

1. Optiwin Alu2-wood French Door


1. Performance Class: R
2. Thermal Transmittance: Maximum whole fenestration product U-factor of 0.14
3. Solar Heat-Gain Coefficient (SHGC): Whole-fenestration product SHGC of 0.52%

C. Provide aluminum-clad doors.

1. Operation: Tilt & Turn
2. Exterior Color: Gray
3. Interior Wood Species: Pine
4. Hardware Finish: Satin stainless steel

D. Sill: Exterior type, low profile, ADA-ABA compliant.

E. Lock: Install manufacturer's keyed cylinder lock and locking device on each movable panel, lockable from the inside only.

F. Screens: Equip units with charcoal-gray, coated-aluminum mesh insect screens for each operable door panel.

G. Glaze units with argon-filled safety glass complying with Division 08 Section "Glazing" and with testing requirements in 16 CFR 1201 for Category II materials.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Set units level, plumb, and true to line, without warp or rack of frames and panels and anchor securely in place.

B. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

C. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.

D. Adjust operating panels, screens, and hardware to provide a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

E. Clean frame surfaces and glass immediately after installing side-hinged wood-framed glass doors. Remove nonpermanent labels from glass surfaces.

END OF SECTION 08147
SECTION 085200 - WOOD WINDOWS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and color Samples.
   1. Provide AAMA- or WDMA-certified wood windows with an attached label.

PART 2 - PRODUCTS

2.01 WOOD WINDOWS

A. Products:
   1. Optiwin Alu2-wood Window

B. Window & Door Types:
   1. Fixed
   2. Hopper
   3. Tilt-turn

   1. Performance Class: R
   2. Thermal Transmittance: Whole-window U-factor not more than 0.14
   3. Solar Heat-Gain Coefficient: Whole-window SHGC of 0.52

D. Trim: Provide indicated trim, matching material and finish of frame members.

E. Provide gear-type rotary operators with folding handles for operable windows.

F. Equip units with charcoal-gray, coated-aluminum mesh insect screens on operable sashes.

G. Exterior Color: gray

H. Glaze units with argon-filled, sealed insulating glass.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Set units level, plumb, and true to line, without warp or rack of frames and panels. Provide proper support and anchor securely in place.

B. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.
C. Adjust operating panels, screens, and hardware to provide a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

D. Clean glass surfaces immediately after installing windows. Remove nonpermanent labels from glass surfaces.

END OF SECTION 085200
SECTION 086100- Roof Windows

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance and product component information for VELUX top hinged VS manual deck mount venting skylight]

B. VELUX Skylight Adhesive Underlayment provided with flashing kits.

C. Engineered flashings for metal roofing materials like standing seam

1.02 REFERENCE STANDARDS

A. ASTM E 283 – Standard Test Method for Determining Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors While under Specific Pressure differences Across the Specimen.


D. ASTM E 1886 – Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missiles(s) and Exposed to Cyclic Pressure Differentials.


1.03 SYSTEM DESCRIPTION

A. Skylight: Top hinged ventilated deck mounted skylight that consists of the following integrated components – an interior condensation drainage gasket Stain grade wooden frame and sash a operator, exterior maintenance free [aluminum] or [Copper] cladding/counter flashing, ASA corner keys, and an insulating thermal pane glass unit with two seals, warm edge spacer system, three coats of low e silver to increase visible light transmittance while reducing solar heat and a continuous deck seal mounting system with durable foam seal.

B. Configuration: Outward opening, continuous top hinged, production-installed electric or manual chain operator, engineered deck seal mounting system with durable foam seal to seal the skylight to the roof deck. Pre-installed accessory mounting brackets and pre-wired for VSE electric venting models.

C. Operation: Sash is operated by either a manual skylight operator.

   a. Manual venting skylight (VS) is operated by a manual, gear driven Truth operator.

D. Condensation Control: Integral internal condensation collection system and drainage slots.

1.04 PERFORMANCE REQUIREMENTS

A. The VS and VSE deck mount skylights independently tested in accordance with listed standards for compliance with the unit skylight provisions of the 2003, 2006 and 2009 IBC, IECC, and IRC. Performance is dependent on skylight size and glazing type. The maximum values have been listed in (a) below but size specific values can be substituted from the chart.
a. AAMA/WDMA/CSA 101/1.S.2/A440-05 (NAFS – 05) and/or AAMA/WDMA/CSA 101/1.S.2/A440-08 (NAFS – 08) performance grades must be greater than or equal to the following listed in i and ii. Size specific data is listed in the chart just below.
   i.  Downward design pressure = 175 psf
   ii. Uplift Design Pressure = 50 psf

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<tr>
<th>Glass</th>
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<tr>
<td>Tested Size</td>
<td>Structural Performance</td>
<td>Uplift (lbs/ft²)</td>
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| Tested Size | Download (lbs/ft²) |
| S06 | 235 | 175 | 235 | 365 |
| M08 | 280 | 230 | 280 | 270 |
| C06 | n.r. | n.r. | n.r. | n.r. |

B. Air leakage: Less than or equal to 0.7 l/s/m² (0.13 CFM/ft²) of total unit area, measured at a pressure of 75 Pa (1.57 psf) as measured in accordance with ASTM E 283, on test sizes listed per the NAFS in (A).

C. Water infiltration: No water penetration noted as measured in accordance with ASTM E 331 with a test pressure differential of 720 Pa (15.0 psf). Exceeds requirements of NAFS standards in (A).

D. Model VSE skylight is pending UL approval.

E. Thermal Performance:  \( U = 0.43 \text{ Btu/hr*ft²°F} \) or less, SHGC = 0.23 or less and \( V_t = 0.52 \) or greater (clear) or \( V_t = 0.39 \) or greater (white). Tested and certified in accordance with NFRC 100 and 200 procedures. Meets ENERGY STAR® criteria for all zones.

F. VS and VSE skylights with impact glazing (06): Tested and certified in accordance with ASTM E 1886 and ASTM E 1996, cycle pressure +/- 50, Missile level C, Wind Zone 3.

G. Limit member deflection to flexure limit of glass with full recovery of glazing materials.

H. System accommodates without damage to components or deterioration of seals, movement between sash and frame and perimeter framing.
I. Weep drainage system designed to channel water entering joints, condensation, or migrating moisture occurring within system to exterior by means of Santoprene® gasket with integrated condensation gasket.

J. 1.05 SUBMITTALS

A. Product Data: Manufacturer’s installation details and product data sheets included:
   
   a. Preparation details and installation instructions
   
   b. Product Data sheets with storage and handling information
   
   c. Architectural roof sectional drawings can be found at www.VELUXusa.com.
   
   d. Code compliance information can be found within these specifications, or by contacting VELUX at 800-888-3589, or by visiting www.VELUXusa.com.

B. Shop Drawings

   a. Indicate material types, gauge, finishes, and installation details.

C. Maintenance data: For unit skylights to include in maintenance manuals.

D. Warranty: Sample of warranty or special warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications:

   a. Skylight manufacturer shall have a minimum of ten years experience in design and fabrication of deck mount glass skylights.

   b. Skylights shall be manufactured to the highest standards of quality and craftsmanship in ISO 9001 and ISO 14001-certified facilities.
c. Flashings shall be engineered and manufactured for the roofing material and skylight.

d. Skylight installed with three layers of protection: Deck seal mounting system, adhesive underlayment wrapped round the skylight frame and onto the roof deck, and engineered flashings, carries a “No Leak” installation warranty.

B. Source Limitations: Obtain unit skylights, flashings, and accessories from single source and from a single manufacturer.


a. Provide WDMA Hallmark certified unit skylight with an attached label.

D. Thermal Performance – rated per applicable NFRC procedures.

a. Provide NFRC certified unit skylight ratings on an attached label.

b. Qualify under Energy Star criteria in all 50 states and attach verifying label.

1.07 COORDINATION

A. Coordinate unit skylight flashing requirements with roofing system.

1.08 WARRANTY

A. Standard VELUX warranty, as specified in VELUX Warranty, publication XUS 20194.

B. 10-Year “No Leak” installation warranty, as specified in VELUX Warranty, publication XUS 20194.

1.09 DELIVERY, HANDLING, STORAGE

A. Deliver products in manufacturer’s original containers, dry, undamaged, seals and labels intact.
B. Store and protect products in accordance with manufacturer’s recommendations.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufacturer: VELUX America Inc., P.O. Box 5001, Greenwood, SC 29648-5001; Toll Free Tel: 800-888-3589; Fax: 864-943-2631; Web: www.VELUXusa.com

2.02 MATERIALS

A. Wood: Kiln-dried, laminated Ponderosa Pine pre-painted with two coats of white finish. Special order stain grade variant available upon request.

B. Maintenance free exterior cladding: Roll formed 0.65 mm aluminum frame coverings, 0.57 mm aluminum sash coverings, 0.55 mm copper frame coverings, 0.50 copper sash coverings prefinished, production engineered, and fabricated to fit exterior exposed surfaces.

C. Dual sealed Glazing

a. Dual sealed thermal pane with warm edge technology, 95% argon gas, and with three layers of LoE³ silver that increases visible light over standard low e coatings while lowering the solar heat gain. The following glazing options are available:
   i. 10 – Tempered LoE³ pane over a laminated tempered interior pane with a (0.030”) vinyl interlayer to achieve higher snow load ratings.

D. Operators and Manual Operator Accessories


E. Fasteners: 1-1/4 inch ring shank nails provided for attaching deck seal mounting flange to roof decking. Ring shank nails are double hot dipped zinc coated.

F. Weather stripping: Factory applied neoprene and thermoplastic elastomer weather stripping throughout entire frame and sash, profiled to effect weather seal.
G. Screen: Aluminum screen profile, spring metal clip attachment, 0.28 mm glass fiber thread with PVC coating, charcoal in color.

H. Mounting System: Continuous corrosion resistant steel mounting system with a durable foam seal and rough opening alignment notches.

2.03 FLASHING OPTIONS

A. Type EDM Flashing is a prefabricated flashing system designed for use with metal roofing materials and for roof slopes of 15 degrees to 85 degrees. Sill flashing section consists of corrugated apron to allow form fit of roofing material profile.

2.04 FABRICATION

A. Fabricate frame with slip mortise and tendon corners that are glued and nailed for strength and stability.

B. Fabricate frame components with precision tolerances enabling installation and movement of sash and dynamic movement of perimeter weather stripping.

C. Provide permanent external drainage channels to manage water flow and drain to the exterior. Provide internal drainage of glazing spaces to exterior through gasketing.

D. Assemble insect screen of rolled aluminum rectangular sections. Sections are square cut and assembled using square corner keys. Fit mesh taut and secure with vinyl spline.

E. All units factory glazed with hot melt silicone-based exterior seal.

F. No site fabrication needed.

G. Rough opening to be framed per manufacturer’s listed dimensions.

2.05 FINISHES
Roof Windows Section 086100

A. **Exterior surfaces:** Exposed exterior wood surfaces to be covered with roll formed maintenance free aluminum cladding pieces. Aluminum has a neutral gray, Kynar® 500 polyvinylidene fluoride resin finish.

B. **Maintenance-free flashing:** Roll formed aluminum, neutral gray, baked on polyester polyamid primer and finish coats. Copper is roll formed, mill finish.

C. **Interior surface:** All exposed interior wood surfaces to be finished white with a 10-year maintenance free finish.

D. **Screens:** Frames – white aluminum, mesh – charcoal.

E. **Operator - concealed beneath white removable cover.**

**PART 3 EXECUTION**

3.01 **EXAMINATION**

A. Verify rough opening dimensions and proper orientation of skylight.

3.02 **INSTALLATION**

A. Install skylight in accordance with manufacturer’s installation instructions.

B. Use the alignment notches on the deck seal mounting system to align skylight flush with the rough opening, free of warp or twist; maintain dimensional tolerances.

C. Attach and seal the skylight to roof sheathing by nailing through the predrilled holes in the deck seal mounting system.

D. Apply one layer of adhesive underlayment around the perimeter of the skylight frame.

E. Install the manufacturer’s engineered perimeter flashing in accordance with manufacturer’s installation instructions to achieve weather tight installation.

F. Provide thermal isolation when components penetrate or disrupt building insulation. Pack fibrous insulation in rough opening to maintain continuity of thermal barriers.

**End of Section 086100**
SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL
1.01 SECTION REQUIREMENTS

   A. Submittals: Hardware schedule.
   B. Deliver keys to Owner.

PART 2 - PRODUCTS
2.01 HARDWARE

   A. Manufacturers:
      1. Hewi (Exterior Doors), Emtek (Interior Doors)
   B. Hinges:
      1. Stainless-steel hinges with stainless-steel pins for exterior.
      2. Non-removable hinge pins for exterior and public interior exposure.
      3. 3 hinges for 1-3/4-inch- (45-mm-) thick doors 90 inches (2300 mm) or less in height; 4 hinges for doors more than 90 inches (2300 mm) in height.
   C. Locksets and Latchsets:
      1. BHMA A156.2, Series 4000, Grade 1 for bored locks and latches.
      2. Lever handles on locksets and latchsets.
      3. Provide trim on exit devices matching locksets.
   D. Key locks to Middlebury College’s existing master-key system.
      1. Cylinders with five and removable cores.
      2. Provide cylinders for other locking doors that do not require other hardware.
      3. Provide construction keying.
   E. Provide wall stops or floor stops for doors without closers.
   F. Provide hardware finishes as follows:
      2. Locksets, Latchsets, and Exit Devices: Matching finish of lockset/latchset
      3. Other Hardware: Matching finish of lockset/latchset.

PART 3 - EXECUTION
3.01 INSTALLATION

   A. Mount hardware in locations recommended by the Door and Hardware Institute unless otherwise indicated.
SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing and inspecting agency.

2.02 PANEL PRODUCTS

A. Provide in maximum lengths available to minimize end-to-end butt joints.

B. Interior Gypsum Board: ASTM C 1396/C 1396M, in thickness indicated, with manufacturer's standard edges. Regular type unless otherwise indicated.

C. Glass-Mat, Water-Resistant Gypsum Backing Board: ASTM C 1178/C 1178M, of thickness indicated. Regular type unless otherwise indicated.
   1. Product: G-P Gypsum; Dens-Shield Tile Guard.
   2. Cementitious Backer Units: ANSI A118.9.

2.03 ACCESSORIES

A. Trim Accessories: ASTM C 1047, formed from galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet. For exterior trim, use accessories formed from hot-dip galvanized-steel sheet, plastic, or rolled zinc.
   1. Provide cornerbead at outside corners unless otherwise indicated.
   2. Provide LC-bead (U-bead) at exposed panel edges.
   3. Provide control joints where indicated.

B. Joint-Treatment Materials: ASTM C 475/C 475M.
   1. Joint Tape: Paper unless otherwise recommended by panel manufacturer.
   2. Joint Compounds: Drying-type, ready-mixed, all-purpose compounds.
   3. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.
C. Acoustical Sealant for Exposed and Concealed Joints: Non-sag, paintable, non-staining latex sealant complying with ASTM C 834.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install gypsum board to comply with ASTM C 840.
   1. Isolate gypsum board assemblies from abutting structural and masonry work. Provide edge trim and acoustical sealant.
   3. Multilayer Fastening Methods: Fasten base layers and face layer separately to supports with screws.

B. Install cementitious backer units to comply with ANSI A108.11.

C. Finishing Gypsum Board: ASTM C 840.
   1. At concealed areas, unless a higher level of finish is required for fire-resistance-rated assemblies, provide Level 1 finish: Embed tape at joints.
   2. At substrates for tile, provide Level 2 finish: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges.

D. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer’s written instructions.

E. Cementitious Backer Units: Finish according to manufacturer’s written instructions.

F. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns.

END OF SECTION 092900
SECTION 093033 - STONE TILING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS
   A. Submittals: Product Data and Samples.

PART 2 - PRODUCTS

2.01 STONE PRODUCTS
   A. Varieties and Sources: Vermont Structural Slate, Heathermoor.
   B. Abrasion Resistance of Stone Tile for Floors: Provide stone with a value of not less than 10, as determined per ASTM C 1353 or ASTM C 241.
   C. Pattern Orientation: For stone varieties with a directional pattern, provide tile with pattern as shown on drawings.

2.02 DIMENSION STONE TILE
   A. Stone Tile Type Slate tile:
      1. Stone Type: Slate, complying with ASTM C 629, Classification II, Interior.
      2. Varieties and Sources:
         a. Vermont Structural Slate
      3. Finish: Natural Cleft.
      4. Edges: Square.
      5. Module Size: 12” x 12”
      6. Nominal Tile Thickness: 3/8”
      8. Grout Color: gray

2.03 INSTALLATION MATERIALS
   A. Cementitious Backer Units or Fiber Cement Board: ANSI A118.9 or ASTM C 1325, 1/2 inch (12.7 mm) thick.
   B. VOC Limit for Adhesives and Fluid-Applied Waterproofing Membranes: 65 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   C. Setting and Grouting Materials: Comply with material standards in ANSI's "Specifications for the Installation of Ceramic Tile" that apply to materials and methods indicated.
      1. Thin-Set Mortar Type for Wood Subfloors: EGP latex-portland cement.
a. Products: as recommended by supplier.

2. Grout Type: as recommended by supplier.

D. Floor Sealer: Colorless, slip and stain resistant, not affecting color or physical properties of stone surfaces.

1. Products: as recommended by supplier.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For tile floors, follow procedures in ANSI A108 for providing 95 percent mortar coverage.

B. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

C. Lay tile in grid pattern unless otherwise indicated. Align joints where adjoining tiles on floor, base, walls, and trim are the same size.

D. Install cementitious backer units or fiber-cement underlayment and treat joints according to ANSI A108.11.

E. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

F. Install waterproofing to comply with ANSI A108.13.

G. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

H. Apply sealer to cleaned stone tile flooring according to sealer manufacturer's written instructions.

I. Interior Floor Tile Installation Method(s):

   1. Over Waterproof Membranes on Wood Subfloors: TCA F121 (cement mortar bed).

J. Interior Wall Tile Installation Method(s):

   1. Bathtub/Shower Wall Installations, Wood Studs or Furring: TCA B419 with organic adhesive (organic adhesive on glass-mat, water-resistant backer board).

END OF SECTION 093033
SECTION 096400 - WOOD FLOORING AND WALL PANELING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS
   A. Submittals: Material Samples.

PART 2 - PRODUCTS

2.01 FIELD-FINISHED WOOD FLOORING
   A. Solid-Wood Strip and Plank Flooring and Gable-end wall paneling: Kiln dried and as follows:
      1. Species and Grade: sugar maple
      2. Cut: Plain sawn.
      3. Thickness: 3/4 inch (19 mm).
      4. Face Width: 3”, 4”, 5”, and 6” widths to minimize waste.
      5. Lengths: Random-length strips.

2.02 FINISHING MATERIALS
   A. Use Vermont Natural Coatings floor finish. Apply as recommended by manufacturer.

2.03 ACCESSORY MATERIALS
   A. Fasteners: As recommended in NWFA's "Installation Guidelines: Wood Flooring."

PART 3 - EXECUTION

3.01 INSTALLATION
   A. Provide expansion space at walls and other obstructions and terminations of flooring of not less than 1/2 inch (19 mm)
   B. Felt Underlayment: Where strip or plank flooring is nailed to solid-wood subfloor, install flooring over a layer of asphalt-saturated felt.
   C. Solid-Wood, Strip and Plank Flooring: Blind nail or staple flooring to substrate.
      1. Plank Flooring: For flooring of face width more than 3 inches (75 mm), install countersunk screws at each end of each piece in addition to blind nailing. Cover screw heads with wood plugs glued flush with flooring.
3.02 SANDING AND FINISHING

A. Machine-sand flooring to remove offsets, ridges, cups, and sanding-machine marks that would be noticeable after finishing. Vacuum and tack with a clean cloth immediately before applying finish.

B. Fill open-grained hardwood.

C. Apply floor-finish materials in number of coats recommended by finish manufacturer for application indicated.

END OF SECTION 096400
SECTION 099100 - PAINTING

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals:
   2. Samples.

B. Mockups: Full-coat finish Sample of each type of coating, color, and substrate, applied where directed.

C. Extra Materials: Plan for extra supply of [1 gal. (3.8 L)] of each color and type of finish coat paint used on Project, in containers, properly labeled and sealed.

PART 2 - PRODUCTS

2.01 PAINT & COATINGS

A. Products:
   1. CBR Products, BRODA Pro-Tek-Tor
   2. Mythic Acrylic Latex primer
   3. Mythic Acrylic paint, egg-shell finish
   4. Vermont Natural Coatings Furniture Finish
   5. Vermont Natural Coatings Floor Finish

B. MPI Standards: Provide materials that comply with MPI standards indicated and listed in its "MPI Approved Products List."

C. Material Compatibility: Provide materials that are compatible with one another and with substrates.
   1. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

D. Colors
   1. Wall Paint: Mythic paint “Grace’s Smile” White
   2. Exterior Stain: Broda “Ebony”
   3. Wood Finish: Vermont Naturals “Caspian Clear”

PART 3 - EXECUTION

3.01 PREPARATION

A. Comply with recommendations in MPI's "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, lighting fixtures, and similar items that are not to be painted. Mask items that cannot be removed. Reinstall items in each area after painting is complete.
C. Clean and prepare surfaces in an area before beginning painting in that area. Schedule painting so cleaning operations will not damage newly painted surfaces.

3.02 APPLICATION

A. Comply with recommendations in MPI’s "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Paint exposed surfaces unless otherwise indicated on drawings or in specifications.
   1. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.
   2. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Paint the back side of access panels.
   5. Do not paint prefinished items, items with an integral finish, operating parts, and labels unless otherwise indicated.

C. Apply paints according to manufacturer's written instructions.
   1. Use brushes only for exterior painting and where the use of other applicators is not practical.
   2. Use rollers for finish coat on interior walls and ceilings.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
   1. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

E. Apply stains and transparent finishes to produce surface films without color irregularity, cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other imperfections. Use multiple coats to produce a smooth surface film of even luster.

3.03 EXTERIOR PAINT APPLICATION SCHEDULE

A. Steel:
   1. Semigloss, Quick-Dry Enamel: Semigloss, Alkyd Enamel: Two coats] over rust-inhibitive primer: MPI EXT 5.1D.

B. Galvanized Metal:
   1. Semigloss Latex: Two coats over waterborne galvanized-metal primer: MPI EXT 5.3H.

C. Aluminum:
   1. Semigloss, Alkyd Enamel: Two coats over quick-drying primer for aluminum: MPI EXT 5.4F.

D. Dressed Lumber: Including architectural woodwork and doors.
   1. Semitransparent Stain: Two coats: MPI EXT 6.3D.
E. Wood Panel Products: Including siding, fascias, soffits, as noted on drawings.
   1. Semitransparent Stain: Two coats: MPI EXT 6.4D.

3.04 INTERIOR PAINT APPLICATION SCHEDULE

A. Steel:
   1. Alkyd Enamel: Two coats over alkyd anticorrosive primer: MPI INT 5.1E.

B. Galvanized Metal:
   1. Semigloss Latex: Two coats over waterborne galvanized-metal primer: MPI INT 5.3J.

C. Dressed Lumber: Including architectural woodwork, millwork, trim, doors.
   1. Semigloss or Eggshell Latex: Two coats over primer: MPI INT 6.3T.
   2. Satin Tung-Oil or Whey-based Clear Wood Finish: Three coats: MPI INT 6.3K.

D. Gypsum Board:
   1. Eggshell Latex: Two coats over primer/sealer: MPI INT 9.2A.

END OF SECTION 099100
SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and Samples.
   1. Submit full-size rubbings for metal plaques.


C. Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304.

B. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).

C. Plastic Laminate: High-pressure laminate engraving stock with face and core in contrasting colors.

D. White Oak

2.02 SIGNS

A. Interior Panel Signs: Reverse silk-screened clear acrylic with opaque background with square-cut edges and square corners.
   1. Finishes and Colors: As indicated.
   2. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch (0.8 mm) above surface with contrasting colors.
   3. Provide signs for the following rooms mounted on the room door wall beside the room door:
      a. Kitchen
      b. Living room
      c. Bedroom
d. Breakfast nook

B. Exterior Framed Panel Signs: Extruded-wooden frames with translucent acrylic panels and matte-finished opaque acrylic characters chemically welded to faces of panels.

1. Finishes and Colors: As indicated
2. Illuminated Signs: Manufacturer's standard fluorescent tube lighting including transformers, insulators, and other components.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Locate signs where indicated or directed by Architect. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.

B. Wall-Mounted Signs:
   1. Mechanical Fasteners: Use removable mechanical fasteners placed through predrilled holes.

C. Dimensional Characters: Mount characters with backs in contact with wall surface
SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL
1.01 SECTION REQUIREMENTS
   A. Submittals: Product Data.

PART 2 - PRODUCTS
2.01 MATERIALS
   A. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin), 0.0312-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
   B. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
   C. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.02 TOILET AND BATH ACCESSORIES
   A. Manufacturers:
      1. Kohler
   B. Toilet Tissue Dispenser:
      1. Basis-of-Design Product: Kohler Stillness toilet tissue holder K-14444
      2. Type: Single-roll dispenser.
      4. Material: Brushed nickel finish
   C. Mirror Unit:
      1. Custom Wall-Mounted Glass by Desabrais Glass
   D. Robe Hook:
      1. Basis-of-Design Product: Kohler Stillness robe hook
      2. Description: Single-prong unit.
      3. Material and Finish: brushed chrome
   E. Toothbrush and Tumbler Holder:
      1. Basis-of-Design Product: Kohler Stillness soap dish and tumbler
      2. Material and Finish: nickel finish
   F. Towel Bar:
      1. Basis-of-Design Product: Kohler Stillness towel bar
3. Length: 24 inches (610 mm).
4. Material and Finish: brushed nickel

G. Bath Door
   1. Hemp shower curtain with curtain rod

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install accessories using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
   1. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

B. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

END OF SECTION 102800
SECTION 113100 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS
   A. Allowances: See Division 01 Section "Price and Payment Procedures" for appliance allowances.
   B. Submittals: Product Data.
   C. Regulatory Requirements: Comply with provisions of the following product certifications:
      1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
      2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
      3. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.
      4. NAECA: Provide residential appliances that comply with NAECA standards.
   D. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines
   E. Energy Ratings: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

PART 2 - PRODUCTS

2.01 RESIDENTIAL APPLIANCES
A. Induction Cooktop: Bosch- NIT3065UT. 30-inch (762-mm) built-in cooktop with four burner elements.

**General Properties**

SKU: NIT3065UC  
Energy source: Electric  
Total number of cooktop burners: 4  
Number of gas burners: 0  
Number of electric cooking zones: 4  
Number of induction elements: 4  
Watts (W): 7,200 W  
Current (A): 40 A  
Volts (V): 208-240 V  
Frequency (Hz): 60 Hz  
Approval certificates: CSA  
Plug type: No plug  
Location of 1st heating element: front left  
Power of 1st heating element (kW): 2.2 kW  
Location of 2nd heating element: back left  
Power of 2nd heating element (kW): 1.4 kW  
Location of 3rd heating element: back right  
Power of 3rd heating element (kW): 2.4 kW  
Location of 4th heating element: Cooking zone front right  
Power of 4th heating element (kW): 1.4 kW  
UPC code: 825225876526  
Power cord length (in): 37**  
Required cutout size (HxWxD) (in): 4 1/8" x 28 3/4" x 20" **  
Minimum distance from counter front (in): 2 1/4" **  
Minimum distance from rear wall (in): 2" **  
Overall appliance dimensions (HxWxD) (in): 1/4"=4 1/8" x 31" x 21 1/4" **
Product packaging dimensions (HxWxD) (in):  7 1/16" x 36 5/8" x 26 5/8" 
Net weight (lbs):  39 lbs
Gross weight (lbs):  49 lbs
Dimension of 1st heating element (in):  9"
Dimension of 2nd heating element (in):  6"
Dimension of 3rd heating element (in):  11"
Dimension of 4th heating element (in):  11"
Dimension of 5th heating element (in):  6"
Sealed Burners:  No
Burners with booster:  All
SERIES:  300 Series
Electric Wall Oven: Bosch- HBN3450UC. Built-in, 27” single electric continuous cleaning wall oven with broiler unit.

**General Properties**

- **Product name / series name**: built-in/under single oven
- **SKU**: HBN3450UC
- **Product color**: Stainless steel
- **Energy source**: Electric
- **Watts (W)**: 5,800 W
- **Current (A)**: 30; 25 A
- **Volts (V)**: 240/208 V
- **Frequency (Hz)**: 60 Hz
- **Approval certificates**: CSA
- **Plug type**: Fixed connection, No plug
- **Cooking method first cavity**: Bake, Broil, Convection Bake, Convection Broil, Convection Roast, Pie, Pizza, Proof, Top heating, 1/3 bottom heat., Warm
- **Cleaning system - cavity 1**: Self Clean
- **Interior Lights - cavity 1**: 1
- **Included accessories**: 3 x Oven racks /upper
- **Timer settings**: Alarm, timer
- **Cavity type**: Shelf support rails
- **UPC code**: 825225840183
- **Power cord length (in)**: 50"
- **Appliance Dimensions (h x w x d) (in)**: 29 1/16" x 26 3/4" x 23 7/8" *
- **Product packaging dimensions (HxWxD) (in)**: 34" x 34" x 31" *
- **Required cutout size (HxWxD) (in)**: 28 1/4" x 25 1/2" x 24" *
Net weight (lbs):  153 lbs
Gross weight (lbs):  179 lbs
Bake Element Wattages cavity 1 (W):  2000 kW
Broil Element Wattages cavity 1 (W):  3600 W
Convection Element Wattages cavity 1 (W):  2000 kW
SERIES:  300 Series
B. Exhaust Hood: Zephyr ZRm-E36B 36”x 27” Chimney style island hood from the roma island series.
   1. Fan Control: Unit-mounted switch, with separate light switch.
   2. Weatherproof wall cap with backdraft damper and rodent-proof screening.

ESSENTIALS

ROMA ISLAND

A sharp, angular island design as distinctively bold as its namesake city, Roma’s sleek presence is ideal for the design-savvy renovator, the high-rise developer who strives for quality, or the builder who needs mass but won’t settle for mediocrity. Designed with the innovative Quick-Lock installation system Roma island can be installed in as little as 20 minutes. A 600-CFM ultra quiet fan and 3-speed electronic controls with LED illumination makes cooking with Roma as pleasant as looking at its contemporary European design.

- Easiest island range hood to install
- Quick-Lock installation system
- Contemporary design
- Electronic LED controls
- 290-CFM version

1. Fresh Food Compartment Volume: 15.6 CF
2. Freezer Compartment Volume: 6.3 CF
22 Cu. Ft. Standard-Depth Architect® Series II

Base model: KBLS22KWMS | MSRP: $1,899.00*

PERFORMANCE
- Freezer Capacity: 6.3 Cu. Ft.
- Refrigerator Capacity: 15.6 Cu. Ft.
- Total Capacity: 21.9 Cu. Ft.
- ENERGY STAR® Qualified
- Max Cool helps regulate temperatures in the refrigerator and freezer during excessive use.

CONTROLS
- Door Alarm
- Control Type: Expanded Electronics w/ADC

FREEZER FEATURES
- Basket 1 Description: Upper Basket
- Basket 2 Description: Lower Basket

REFRIGERATOR FEATURES
- Drawer 1: Crisper Pan
- Bin Mat Quantity: 4
- Door Bin Quantity: 4
- Total Shelves: 4

DIMENSIONS
- Depth With Door Open 90 Degree: 62 Inches
- Height To Top Of Cabinet: 68 1/2 Inches

ELECTRICAL
- 15 Amps. 60 Hz. 120 V.

PRODUCT FEATURES
- 2 pull-out freezer baskets provide easy access, viewing, and cleaning of freezer.
- ClearVue™ bins with window allow the contents of bins to be easily seen from the outside.
- ENERGY STAR® Qualified
- FreshChill™ temperature-controlled deli locker keeps deli items at appropriate temperatures for maximum taste and texture.
- Max Cool helps keep the refrigerator and freezer cold.

This sleek Architect® Series II bottom-freezer refrigerator features a left-hand door swing and ClearVue® bins so contents can be seen easily. MaxCool helps regulate temperatures in the refrigerator and freezer during excessive use. Pull-out freezer baskets provide easy access.

temperatures cool during times of excessive use
• FreshChill™ Temperature Management System regulates temperatures to keep ingredients in optimum storage conditions
• FreshSeal™ humidity-controlled crispers help retain humidity for optimum storage of fresh fruits and vegetables
• Optional automatic ice maker sold separately (Part number IC-13B)

AVAILABLE COLORS

MONOCHROMATIC STAINLESS STEEL | KBLS22KWMS
MSRP*: $1,899.00

For questions regarding major appliances, call 1-800-422-1230. Monday - Friday 8 a.m. - 6 p.m. local time

*MSRP is Manufacturer's Suggested Retail Price and may not necessarily be the price at which the product is sold in the consumer’s area. Dealer alone determines actual price.
D. Dishwasher: Bosch- KUDS30CXSS. Built-in, undercounter, automatic dishwasher, sized to replace 24-inch-(610-mm-) base cabinet, 9 wash cycles with hot-air and heat-off drying cycles, stainless-steel tub and door liner, PVC-coated sliding dish racks.
Panel ready: Not possible
Tub material: Stainless steel/Polinox
Concealed heating element: Yes
Watts (W): 1400 W
Current (A): 12 A
Volts (V): 120 V
Frequency (Hz): 60 Hz
Approval certificates: CSA, UL
Power cord length (cm): 0.0 cm
Plug type: Fixed connection
Length inlet hose (cm): 0 cm
Length outlet hose (cm): 230 cm
Adjustable feet: No
Overall appliance dimensions (HxWxD) (mm): 860 x 598 x 573 mm
Product packaging dimensions (HxWxD) (mm): 920 x 670 x 660 mm
Required cutout size (HxWxD) (mm): 860 x 610 x 610 mm
Net weight (kg): 45.00 kg
Gross weight (kg): 51.00 kg
Number of place settings: 14
Total annual water consumption (l): 0 l
Number of wash cycles: 4
Leak Protection System: 24/7 Overflow Protection
Water softener: No
Start delay time max (h): 9 h
Status indicator: Programme status
Display: No
ChildLock: No
INTERIOR_LIGHT_DISH: No
Adjustable upper rack: Single
Glass protection: No
Top basket type: 100
Bottom basket type: 100
Business field: E36
Program 1: Power Scrub Plus US
Program 2: Auto US
Program 3: Regular US
Program 4: Quick Wash US
Silence level (dBA): 53 dB
Load Sensor: No
Variable spray pressure: No
Energy Star® qualified: Yes
Total annual energy consumption (kWh): 279 kWh
Number of Options: 2
Flip tines in upper rack: 1
Fine Cutlery and Silver Tray: No
Mezzanine Rack: No
Silverware Basket: Standard
Extra-tall item sprinkler: No
LED: No
Multi-Function LED: Yes
Multi-function text LCD: No
Sanitized indicator light: Yes
Tub type: TallTub
Triple Filtration System: Yes
Five-Level Wash: Yes
NSF Certified: Yes
Required cutout size (HxWxD) (in): 33 15/16" x 35" x 24 " x 24 "
Overall appliance dimensions (HxWxD) (in): 33 7/8" x 23 9/16" x 22 9/16"
ADA Compliant: No
Product packaging dimensions (HxWxD) (in): 36 5/8" x 26 3/8" x 26"
Net weight (lbs): 100 lbs
Gross weight (lbs): 111 lbs
Length outlet hose (in): 90 1/2"
UPC code: 825,225,878,735
Main color of product: Stainless steel
Additional operational options: half load, time delay
3rd Rack: no
Bottom basket Inserts: 0
Upper rack cup shelf: 1
Included accessories 2: 2 small item clips
SERIES: Ascenta
Interior light: No

Accessories

- SMZ5002UC
- SGZ1052UC
- SGZ1010UC
Clothes Washer: LG- WM2101HW. Freestanding, top-loading, automatic clothes washer with 4.0CF capacity stainless-steel tub and 16 wash cycles including regular, delicate, and permanent press; 3/4-hp (0.56-kW) reversible motor.

LG offers highly styled designs in the front load industry. With laundry moving out of the basement and closer to the living areas, style has become an important element in the purchase process.

Available colors:

- White

NFS certified SANITARY cycle which is intended for reducing B. subtilis spores and other harmful microorganisms on laundry.
WM2101HW
Front Load Washer

Electronic Control Panel
with Dial-A-Cycle™
Intuitive controls allow you to 'press and go'.

Direct Drive Motor
Power is delivered right to the drum from the motor without belts, resulting in a highly durable, powerful and quiet washing machine.

Sanitary Cycle
Get tough stains and bacteria out of dirty clothes with this special cycle that boosts water to 158°F.

LoDecibel™ Quiet Operation
Direct Drive and auto balancing reduce noise dramatically compared to conventional motors.

SenseClean™ System
The water level and wash time are set automatically based on the weight and size of each load for optimal washing care.

Stackable or Side by Side?
Your choice. Less space? Try stacking the washer and dryer. More space? Place them side by side or under a counter. Don't want to bend down so far to load or unload clothing? Add our 13.7” high drawer pedestals. They're also a great place to store laundry detergent supplies.

FABRIC CARE FEATURES
SenseClean™ System

CONVENIENCE FEATURES
4 Tray Dispenser
End of Cycle Keefer
Child Lock
Auto Balancing
Auto Soil Removal
Sanitary Cycle
Internal Water Heater (1000W)
Levering Legs
LoDecibel™ Quiet Operation

MOTOR AND AGITATOR!
Motor Type / Motor Speed
BPM Direct Drive / Variable

MATERIALS AND FINISHES
Stainless Steel Drum

Control Panel Type Plate
Painted

Available Colors
White (W)

POWER SOURCE
RSUs UL Listed

Electrical Requirements / Type
120V, 10 Amps / Electric

Pedestal

WDP3W
Pedestal (WithUID)
27" x 13 3/5" x 28 2/5"
Stacking Kit
WSTK1

DIMENSIONS

Product (WxHxD)
27" x 36 11/16" x 30 3/5" (RTD with door open)
Carton (WxHxD)
29 1/2" x 43 5/16" x 31 5/16"

Weight Product / Shipping
148 lbs / 225.5 lbs

WARRANTY
1 Year Parts and Labor, 2 Years Control Board, 10 Years Motor, Lifetime on Drum

UPC CODES
WM2101HW
048231 010313
WDP3W
048231 008856
WSTK1
048231 008827

LG Electronics U.S.A., Inc.
100 Sylvan Avenue, Englewood Cliffs, NJ 07632
Customer Service and Technical Support (800) 243-0000

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[Status]
U.S. D.O.E. Solar Decathlon 2011
Residential Appliances

Published 5/3/2011
Page - 168
Section 113100
E. Electric Clothes Dryer: LG DLE2301W. Freestanding, front-loading clothes dryer, 7.3CF capacity with stainless-steel interior.
LAUNDRY

DLE2301R/W
DLG2302R/W
Electric/Gas Dryers

Intelligent Electronic Controls with Dual LED Display and Dial-A-Cycle™
Intuitive controls allow you to 'set it and go.' You can also save your favorite dry cycle by pressing Custom Program. You'll have optimized drying performance with the push of a button.

FlowSense™ Duct Clogging Indicator
Detects lint build-up and decreased airflow in the duct system and signals that the duct should be cleaned.

Sensor Dry System
Measures moisture in the drum during the cycle, then automatically adjusts the drying time and temperature for enhanced fabric care.

LoDecibel™ Quiet Operation
Anti-Vibration motor and one-piece cabinet structure reduce unnecessary noises.

<table>
<thead>
<tr>
<th>TYPE</th>
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<tbody>
<tr>
<td>Front Load</td>
<td>Front Control</td>
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<tr>
<td>Design Level</td>
<td>Dial-A-Cycle</td>
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<tr>
<td>Intelligent Electrical Controls with Dual LED Display</td>
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<td>7 Options</td>
<td>Custom Program, Damp Dry, Dry, Wrinkle Care, Cool Down, Anti Bacterial, More Time, Less Time</td>
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<td>9 Programs</td>
<td>Sensor Dry, Heavy Duets, Cotton, Normal, Perm Press, Delicates, Ultra Dry, Manual Dry, Speed Dry, Air Dry, Finish Up</td>
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<td>113100</td>
<td>Dryer Capacity: 1.1 Cu. Ft.</td>
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<th>FABRIC CARE FEATURES</th>
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<td>Sensor Dry</td>
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<td>FlowSense™</td>
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<td>Pressed Temperature Control with Variable Hanger</td>
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<td>END OF CYCLE BEEPER</td>
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<td>CHILD LOCK</td>
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<td>Drying Option</td>
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<td>Electric Dry</td>
<td>Get 3 Way Venting</td>
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<td>Drying Time</td>
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<td>60 min, 50 min, 40 min, 30 min, 20 min, More Time/Less Time</td>
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| MATERIALS AND FINISHES |       |
| Drums                 | Stainless Steel |
| Top Frame             | Painted (W)     |
| Cabinet               | Painted Steel   |
| Control Panel         | Plastic         |
| Transparent Door Glass|                 |
| Door Frame            | Chrome          |
| Available Colors      | White (W), White Cherry Red (R) |

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<th>POWER SOURCE</th>
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<td>120V, 16 Amps/240V, 30 Amps</td>
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<td>Gas/Electric</td>
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<tr>
<td>Pedestal</td>
<td>WDP50</td>
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<td>Pedestal (White)</td>
<td>WDTX1, WDTX1A</td>
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<td>DIMENSIONS</td>
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<tr>
<td>Product (Width)</td>
<td>27.5 x 26.5 x 39.5</td>
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<tr>
<td>Product (Height)</td>
<td>75.5 x 19.5 x 30.6</td>
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<tr>
<td>Product (Depth)</td>
<td>45 x 26.3 x 30.6</td>
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<tr>
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LG Electronics U.S.A., Inc.
100 Sylvan Avenue, Englewood Cliffs, NJ 07632
Customer Service and Technical Support (800) 283-0000

LGusa.com
PART 3 - EXECUTION

3.01 INSTALLATION

A. Built-in Appliances: Securely anchor to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

B. Freestanding Appliances: Place in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

C. Test each item of residential appliances to verify proper operation. Make necessary adjustments.

D. Verify that accessories required have been furnished and installed.

END OF SECTION 113100
SECTION 123640 - STONE COUNTERTOPS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Shop Drawings and Samples at least 12 inches (300 mm) square.

B. Verify dimensions of stone countertops by field measurements and indicate on Shop Drawings.

PART 2 - PRODUCTS

2.01 STONE

A. Slate

1. Color: Heathermoor

2. Finish: Honed

3. Manufacturer: Vermont Structural Slate

2.02 SETTING MATERIALS

A. Use adhesives, grout, and sealant as recommended by manufacturer. Adhesive and grout must be water-cleanable.

B. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.

2.03 COUNTERTOP FABRICATION

A. Comply with recommendations in MIA's "Dimensional Stone - Design Manual IV."

1. Thickness: [1-1/2 inches (30 mm)].

2. Edge Detail: Straight, slightly eased at top.

B. Fabricate molded edges with machines having abrasive shaping wheels made to reverse contour of edge profile. Form corners of molded edges as indicated with outside corners slightly eased.

C. Seams: Fabricate countertops without seams, if possible.

D. Cutouts and Holes:

1. Undercounter Fixtures: Make cutouts for undercounter fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

   a. Edge Detail: [Vertical, slightly eased at top and bottom surfaces and projecting 3/16 inch (5 mm) into fixture opening.]

2. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.
PART 3 - EXECUTION

3.01 INSTALLING COUNTERTOPS

A. Install countertops over plywood subtops with a full spread of water-cleanable, manufacturer-recommended adhesive.

B. Space seams, if seams are necessary, with 1/16-inch (1.5-mm) gap for filling with grout sealant. Use temporary shims to ensure uniform spacing and use clamps to eliminate slipping.

C. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts while cutting.

D. Install backsplash and end splashes by adhering to wall with water-cleanable, manufacturer-recommended, adhesive. Leave 1/16-inch (1.5-mm) gap between countertop and splash for filling with sealant. Use temporary shims to ensure uniform spacing.

3.02 CLEANING

A. Clean countertops as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.

B. Clean stone countertops not less than six days after completion of sealant installation, using clean water and soft rags. Do not use materials or methods that could damage stone.

C. Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions.

END OF SECTION 123640
SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS
A. Submittals: Product Data.

PART 2 - PRODUCTS

2.01 SLEEVES
A. Mechanical Sleeve Seals: Modular rubber sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
B. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
C. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2.02 ESCUTCHEONS
A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
B. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

2.03 GROUT
A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

2.04 VIBRATION ISOLATION AND SEISMIC CONTROL DEVICES
A. Description: Follow all vibration and seismic codes required by NFPA 13. Not stated in NFPA 13D code.
PART 3 - EXECUTION

3.01 MOTOR INSTALLATION

A. Anchor motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions.

3.02 GENERAL PIPING INSTALLATIONS

A. Install piping free of sags and bends.

B. Install fittings for changes in direction and branch connections.

C. Install sleeves for pipes passing through gypsum board partitions.

D. Exterior Wall, Pipe Penetrations: Mechanical sleeve seals installed in steel or cast-iron pipes for wall sleeves.

E. Install unions at final connection to each piece of equipment.

F. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in water piping.

3.03 GENERAL EQUIPMENT INSTALLATIONS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.04 BASES, SUPPORTS, AND ANCHORAGE

A. Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.

2. Install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base to connect concrete base to concrete floor.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete".

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors. Place grout, completely filling equipment bases.

END OF SECTION 210500
PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Submittals: Product Data for valves, sprinklers, specialties, and alarms.

1. Submit sprinkler system drawings identified as "working plans" and calculations according to NFPA 13D. Submit required number of sets to authorities having jurisdiction for review, comment, and approval. Include system hydraulic calculations.

2. Submit test reports and certificates as described in NFPA 13D.

B. Design and Installation Approval: Acceptable to authorities having jurisdiction.

C. Hydraulically design sprinkler systems according to NFPA 13D.

D. Comply with NFPA 13R and NFPA 70.

E. UL-listed and -labeled and FM-approved pipe and fittings.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS


B. Copper Tube: ASTM B 88, ASTM B 251, or ASTM B 75; drawn temper.

C. CPVC Plastic Pipe: ASTM F 442, 175-psig (1207-kPa) rating, made in NPS (DN) for sprinkler service. Include "Listed" and "CPVC Sprinkler Pipe" marks on pipe.

D. Cast-Iron Threaded Flanges: ASME B16.1, Class 250, raised ground face, bolt holes spot faced.


F. Grooved-End Fittings: UL-listed and FM-approved, ASTM A 536, Grade 65-45-12 ductile iron or ASTM A 47 Grade 32510 malleable iron, with grooves or shoulders designed to accept grooved couplings.

G. Grooved-End Couplings: UL 213, ASTM A 536 ductile-iron or ASTM A 47 malleable-iron housing, with enamel finish. Include gaskets, bolts, and accessories.
H. Wrought-Copper Fittings: ASME B16.22, streamlined pattern; also ASME B16.18.


J. CPVC Plastic Pipe Fittings: ASTM F 438 for NPS 3/4 to NPS 1-1/2 (DN 20 to DN 40) and ASTM F 439 for NPS 2 (DN 50), UL listed, 175-psig (1207-kPa) rating, for sprinkler service. Include "Listed" and "CPVC Sprinkler Fitting" marks on fittings.

K. Provide hangers, supports, and seismic restraints with UL listing and FM approval for fire-protection systems.

L. Welded Outlets may also be used and shall comply with AWS D10.9.

2.02 VALVES

A. Fire-Protection Service Valves: UL listed and FM approved, with 175-psig (1207-kPa) nonshock minimum working-pressure rating. Indicating valves shall be butterfly or ball type, bronze body, and integral indicating device with visual 115-V ac, electric, single-circuit supervisory switch indicator.

B. Gate Valves: UL 262, cast bronze, solid wedge, outside screw and yoke, rising stem.

C. Swing Check Valves, NPS 2 (DN50) and Smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc.

D. Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze-disc ring.

E. Alarm Check Valves: UL 193, 175-psig (1200-kPa) working pressure, designed for horizontal or vertical installation, with cast-iron, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Include trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, retarding chamber, fill-line attachment with strainer, and drip cup assembly.

F. Ball Drip Valves: UL 1726, automatic drain valve, NPS 3/4 (DN 20), ball check device.

2.03 SPRINKLERS

A. Automatic Sprinklers: With heat-responsive element complying with the following: UL 1626, for residential applications.

B. Sprinkler Types and Categories: Nominal 1/2-inch (12.7-mm) orifice for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

C. Sprinkler types include the following: Quick-response upright, semi-recessed pendent, and dry pendent sprinklers.
D. Sprinkler Finishes: Sprinklers shall not be painted or enameled unless applied by the manufacturer and the sprinkler has been listed with such finishes; if so, white enamel.

E. Sprinkler Escutcheons: White enamel, steel, one piece, flat; with finish to match sprinklers.

F. Sprinkler Guards: Wire-cage type, including fastening device.

2.04 PIPING SPECIALTIES AND ALARM DEVICES

A. Fire Department Connection: UL 405, flush, wall type, with cast-brass body; NH-standard thread inlets matching local fire department threads.

1. Finish: Polished chrome-plated.

B. Water-Motor-Operated Alarms: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings, and sleeve to suit wall construction and 10-inch- (250-mm-) diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS 3/4 (DN 20) inlet and NPS 1 (DN 25) drain connections. Local waterflow alarms shall be provided on all sprinkler systems in homes not equipped with smoke alarms or smoke detectors in accordance with NFPA 72.

C. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 250-psig (1725-kPa) pressure rating; and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

D. Pressure Switches: UL 753; electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.

E. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

F. Pressure Gages: UL 393, 3-1/2- to 4-1/2-inch- (90- to 115-mm-) diameter dial with dial range of 0 to 250 psig (0 to 1725 kPa).

PART 3 - EXECUTION

3.01 PIPE AND FITTING APPLICATION

A. Use steel pipe with threaded, press-seal, roll-grooved, or cut-grooved joints; copper tube with wrought-copper fittings and brazed joints; or CPVC plastic pipe and fittings and metal-to-plastic transition fittings with solvent-cemented joints.
1. For steel pipe joined by threaded fittings, use Schedule 40.
2. For steel pipe joined by welding or roll-grooved pipe and fittings, use Schedule 10.
3. For steel pipe NPS 2 (DN 50) and smaller, joined by press-seal fittings, use Schedule 5 pipe, fabricated with manufacturer's press-seal tools.

B. Pipe between Fire Department Connections and Check Valves: Use galvanized-steel pipe with flanged or threaded joints.

C. Install shutoff valve, check valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water service piping.

3.02 PIPING INSTALLATION

A. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve.

B. Install sprinkler zone control valves, test assemblies, and drain headers adjacent to standpipes.

C. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

D. Install alarm devices in piping systems and connect to fire-alarm system.

E. Protect piping from earthquake damage as required by NFPA 13. Not stated in NFPA 13D code.

F. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Install gages to permit removal, and install where they will not be subject to freezing.

G. Install fire-protection service valves supervised-open, located to control sources of water supply except from fire department connections. Where there is more than one control valve, provide permanently marked identification signs indicating portion of system controlled by each valve.

H. Install check valve in each water supply connection. Install backflow preventers in potable-water supply sources.

I. Install alarm check valves for proper direction of flow, including bypass check valve and retard chamber drain line connection.

3.03 SPRINKLER APPLICATIONS

A. Rooms with Suspended Ceilings: Recessed and upright sprinklers.

B. Wall Mounting: Sidewall sprinklers.

C. Sprinklers Subject to Freezing: Dry pendent sprinklers as indicated.
D. Special Applications: Extended coverage or quick-response sprinklers as indicated.

E. Sprinkler Finishes: Sprinklers shall not be painted or enameled unless applied by the manufacturer and the sprinkler has been listed with such finishes; if so, white enamel in finished spaces, rough bronze in unfinished spaces, and white in residential spaces. Provide escutcheons in finished and residential spaces.

F. Install sprinklers in suspended ceilings as indicated.

3.04 TESTING

A. Flush, test, and inspect sprinkler piping systems according to NFPA 13D.

3.5 SUMMARIES AND CALCULATIONS

A. Tank Capacity and Calculations: NFPA 13D, 2009 edition two head calculation requires 7 minutes of fire sprinkler flow. The worst case two head sprinkler flow requires 30 gpm, which requires 210 gallons of storage. We are specifying 300 gallons of storage designed specifically to support the fire protection system.
### Fire Suppression Pipe Flow Calculations:

#### Hydraulic Design Information Sheet

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#### Calculation

**Flow Required**: 500.408 gpm

**Pressure Required**: 57.9507 psi

**At Node TEST**

**Summary**

- **C-Factor Used**: 120
- **Overhead**: 150
- **Underground**

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#### Supply

- **Location**: AT PROCTOR HALL

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*State of Vermont*

*Matthew R. Chase, M.E.*

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**U.S. D.O.E. Solar Decathlon 2011**

**Water-Based Fire Suppression Systems**

**Published 5/3/2011**

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**Section 211000**
## Pressure / Flow Summary - STANDARD

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# Final Calculations - Hazen-Williams

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## Final Calculations - Hazen-Williams

### Chase Engineering, PC
**MC SD FP1rev**

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**Notes:**
- K Factor = 65.73
- K Factor = 5.80
- * Fixed loss = 8
- K Factor = 13.93
- K Factor @ node EQ01
- K Factor = 5.65
- K Factor = 5.60
- K Factor = 5.17
- K Factor = 5.44
- K Factor @ node EQ03
- K Factor @ node EQ01

---

**Computer Programs by Hydratec Inc. Route 111 Windham N.H. USA 03087**

**U.S. D.O.E. Solar Decathlon 2011**

**Water-Based Fire Suppression Systems**

**Published 5/3/2011**

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**Section 211000**
### Final Calculations - Hazen-Williams

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<td>0.1233</td>
<td>1E</td>
<td>5.0  0.0</td>
<td>0.0</td>
<td>K Factor = 5.51</td>
</tr>
<tr>
<td>0 to 19.42</td>
<td>19.42</td>
<td>19.42</td>
<td>120.0</td>
<td>0.1233</td>
<td>1E</td>
<td>5.0  0.0</td>
<td>0.0</td>
<td>Vel = 5.51</td>
</tr>
</tbody>
</table>
END OF SECTION 211000
SECTION 220500 - Plumbing Specifications

General Plumbing: The plumbing system shall be fully functional, consisting of water supply, drainage, and venting. Water supply pipes shall connect to external potable water tanks on the exterior, and drainpipes connect to external waste tanks on the exterior. All pipes shall be laid out so as to minimize the number of breaks in the floor framing.

Drain-Waste Vent

Drainage Piping: The system shall be constructed using schedule 40 PVC pipe (22 13 16) throughout the house. Locations requiring piping include mechanical room, laundry nook, bathroom, and kitchen. All joint connections shall be reinforced using PVC cement or other appropriate joint compound. All pipes of diameter less than 3 inches shall slope a minimum of 1/4 inch per foot. The main drainpipe, extending from the bathroom out to the waste tank, shall be 3 inches in diameter and slope 1/8 inch per foot.

Laundry Nook: A 2-inch standpipe, in which the washing machine’s drain hose shall be inserted, will be installed above the machine’s water level (approx. 36 inches). The standpipe shall include a P-trap.

Bathroom: The bathtub will have a waste overflow unit that connects to a 2-inch P-trap. The 2-inch trap leads to the 3-inch main drainpipe. The 1 ½ inch P-trap for the sink shall lead to a 2-inch drain which flows into the 3-inch main drain. A 4 by 3 reducing closet bend of the toilet will connect directly to the main drainpipe.

Kitchen: A 2-inch pipe shall connect the greenhouse, sink, and dishwasher to the main drainpipe. A drain hose shall run from the dishwasher to a 1 ½ inch P-trap under the sink.

Venting: The main true vent shall be 3-inches in diameter. It will extend through the flat ceiling behind the toilet and be angled to penetrate the north roof. A cleanout shall be located at the base of the stack, 42 inches above the floor.

Laundry Nook: An auxiliary vent shall extend from the 2-inch standpipe and connect to the auxiliary vents of the bathroom.

Bathroom: Auxiliary 2-inch vents, running at least 6 inches above the fixtures’ flood level, shall connect waste pipes from the bathroom sink and shower to the main stack. A wet vent shall be permitted for the bathtub.

Kitchen: An air admittance valve (22 13 19.36) shall be connected to kitchen sink and dishwasher pipes.

(22 33 30.26 "RESIDENTIAL, COLLECTOR-TO-TANK, HEAT-EXCHANGER-COIL, SOLAR-ELECTRIC DOMESTIC WATER HEATERS") Water Heater: Solar hot water heater shall be installed in accordance with the International Residential Code and manufacturer’s installation recommendations. Water heater shall have necessary shut off, backflow prevention, and pressure relief valves.
**Water Supply:** The system shall be constructed using predominantly cross-linked polyethylene (PEX) piping. A flow-based pressure boosting pump (22 11 23) will pump water from the external potable water tanks, through 1-inch piping into the house. An in-house main shut off valve will be located in the mechanical room between a water meter and the pressurized pump. The main line, which supplies water from the pressure tank to each room, shall have a minimum thickness of ¾ inch. Pipes supplying water to individual fixtures and appliances will be ½ inch thick to the stop valve, then composed of flexible, ¼ inch thick tubing. Hammer arresters shall be installed with washing machine, bathroom sink, shower, and kitchen sink.

**Exterior Hose Bibs:** Branching off the main line, ½ inch piping shall supply water to two hose bbs, one on the south façade and one on the east. These supply pipes will run through the exterior walls of the house.

**Mechanical Room:** ¾ inch piping shall supply water to the solar hot water tank from the pressure tank. Piping shall connect the solar hot water collectors (23 56 13.19) to the solar hot water heater (22 33 30.26). ¾ inch piping shall provide heated water to the house.

**Laundry Nook:** A washing machine supply box shall be installed with a single-lever stop valve to control both hot and cold water.

**Bathroom:** The toilet and bathroom sink shall have 3/8-inch supply tubes.

**Kitchen:** ½ inch flexible PEX lines branch off the sink supply lines to supply the dishwasher.

### Fitting and Fixture Schedule

<table>
<thead>
<tr>
<th>Keynote</th>
<th>Location</th>
<th>Fixture/Fitting</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 31 13.A3</td>
<td>Kitchen</td>
<td>Cooktop</td>
<td>30”, Induction</td>
<td>Bosch</td>
<td>NIT3065UT</td>
</tr>
<tr>
<td>11 31 13.A5</td>
<td>Kitchen</td>
<td>Oven</td>
<td>27” width</td>
<td>Bosch</td>
<td>HBN3450UC</td>
</tr>
<tr>
<td>11 31 13.A7</td>
<td>Exterior</td>
<td>Hose Bib</td>
<td>1/2”</td>
<td>Mueller</td>
<td>103-013</td>
</tr>
<tr>
<td></td>
<td>Laundry Nook</td>
<td>Hose Bib</td>
<td>¾”</td>
<td>Mueller</td>
<td>103-104</td>
</tr>
<tr>
<td>11 31 23.A1</td>
<td>Kitchen</td>
<td>Dishwasher</td>
<td>stainless steel</td>
<td>Bosch</td>
<td>SHX4AP05UC</td>
</tr>
<tr>
<td>11 31 23.A2</td>
<td>Laundry Nook</td>
<td>Washer/Dryer</td>
<td>Freestanding</td>
<td>LG</td>
<td>LG-WM2101HW</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>LG-DE2301W</td>
</tr>
<tr>
<td>22 05 16</td>
<td>Mechanical Room</td>
<td>Tank</td>
<td>Thermal Expansion</td>
<td>Amtrol</td>
<td>ST-12</td>
</tr>
<tr>
<td>22 11 23</td>
<td>Exterior</td>
<td>Pump</td>
<td>Pressure Boosting Pump</td>
<td>Gunfos</td>
<td>MQ</td>
</tr>
<tr>
<td>22 11 23.A2</td>
<td>Exterior</td>
<td>Pump</td>
<td>sump pump system</td>
<td>Liberty</td>
<td>LowPro41lp</td>
</tr>
<tr>
<td>22 12 16</td>
<td>Exterior</td>
<td>Tank</td>
<td>Potable Water (2x)</td>
<td>Custom Roto-Molding, Inc.</td>
<td>750 VTS B</td>
</tr>
<tr>
<td>Code</td>
<td>Location</td>
<td>Description</td>
<td>Manufacturer</td>
<td>Model</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>22 33 30.26</td>
<td>Mechanical Room</td>
<td>Tank 78 gallon</td>
<td>Vaillant Solar Systems</td>
<td>ST 60</td>
<td></td>
</tr>
<tr>
<td>22 41 16.A5</td>
<td>Kitchen</td>
<td>Sink single basin, white acrylic - K-2330</td>
<td>Kohler</td>
<td>K-2330</td>
<td></td>
</tr>
<tr>
<td>22 41 19</td>
<td>Bathroom</td>
<td>Bathtub Underscore® 5' acrylic bath - K-1130</td>
<td>Kohler</td>
<td>K-1130</td>
<td></td>
</tr>
<tr>
<td>22 41 23.B1</td>
<td>Bathroom</td>
<td>Mixer Bachata® stainless steel lavatory with overflow - K-2609</td>
<td>Kohler</td>
<td>K-2609</td>
<td></td>
</tr>
<tr>
<td>23 56 16</td>
<td>Mechanical Room</td>
<td>Pump solar water pump - K011</td>
<td>Solar U.S.</td>
<td>S011</td>
<td></td>
</tr>
<tr>
<td>33 36 00</td>
<td>Exterior</td>
<td>Tank 750 gallon steel storage (2x) - Custom Roto-Molding, Inc. 750 VTS B</td>
<td>Custom Roto-Molding, Inc.</td>
<td>750 VTS B</td>
<td></td>
</tr>
</tbody>
</table>
Features
• 16-gauge stainless steel
• Undercounter
• Single compartment
• Includes installation hardware
• Includes wine glass rack and bottom basin rack
• 31-1/2" (80 cm) x 16-1/2" (41.9 cm)

Codes/Standards Applicable
Specified model meets or exceeds the following:
• ASME A112.19.3/CSA B45.4

Colors/Finishes
• NA: None applicable

Accessories:
• CP: Polished Chrome
• ST: Stainless Steel
• NA: None applicable
• Other: Refer to Price Book for additional colors/finishes

Specified Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Colors/Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-3673</td>
<td>Undercounter sink</td>
<td>NA</td>
</tr>
</tbody>
</table>

Included Accessories

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Colors/Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-6133</td>
<td>Wine glass rack</td>
<td>NA</td>
</tr>
<tr>
<td>K-6137</td>
<td>Bottom basin rack</td>
<td>ST</td>
</tr>
</tbody>
</table>

Optional Accessories

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Colors/Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-2989</td>
<td>Countertop cutting board</td>
<td>NA</td>
</tr>
<tr>
<td>K-3140</td>
<td>Bamboo cutting board</td>
<td>NA</td>
</tr>
<tr>
<td>K-8801</td>
<td>Duostrainer® sink strainer</td>
<td>CP</td>
</tr>
</tbody>
</table>

Product Specification

The undercounter sink shall be 31-1/2" (80 cm) in length and 16-1/2" (41.9 cm) in width. Sink shall be made of 16-gauge stainless steel. Sink shall be single compartment. Sink shall include wine glass rack, bottom basin rack, and installation hardware. Sink shall be Kohler Model K-3673.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

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1090921-4-C

Published 5/3/2011
U.S. D.O.E. Solar Decathlon 2011
Plumbing Performance Specifications
Section 220500
8 DEGREE™ UNDERCOUNTER SINK

Technical Information

<table>
<thead>
<tr>
<th>Fixture*:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Basin area</td>
<td>31-1/2” (80 cm) x 16-1/2” (41.9 cm)</td>
</tr>
<tr>
<td>Water depth</td>
<td>29-3/4” (76.8 cm)</td>
</tr>
<tr>
<td>Drain hole</td>
<td>3-5/8” (9.2 cm) D.</td>
</tr>
<tr>
<td>*Approximate measurements for comparison only.</td>
<td></td>
</tr>
</tbody>
</table>

Included components:

| Hardware kit                    | 91915           |
| Cut-out template                | 1093327-7       |

Installation Notes

Install this product according to the installation guide.

Allow a minimum of 3” (7.6 cm) clearance around the sink rim for clip attachment.

Product Diagram
Features

- Metal construction
- One-piece, self-contained ceramic disc valve allows both volume and temperature control
- Temperature memory allows faucet to be turned on and off at any temperature setting
- Flexible connections for easy installation
- Available with or without matching finish sidespray
- 360° spout rotation with 8-7/8” (22.5 cm) or 7-3/8” (18.7 cm) clearance below the spout
- Single-hole mounting
- Available with 8” (20.3 cm) or 6” (15.2 cm) swing spout reach
- Optional aerator kits available
- 1.8 gallons (6.8 L) per minute maximum flow rate
- Meets CalGreen requirements for kitchen faucets

Codes/Standards Applicable

Specified model meets or exceeds the following at date of manufacture:
- ADA
- ICC/ANSI A117.1
- ASME A112.18.1/CSA B125.1
- NSF 61
- All applicable US Federal and State material regulations

Colors/Finishes

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

Accessories

- NA: None applicable

Specified Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Colors/Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-7507</td>
<td>Kitchen sink faucet – 8” (20.3 cm) swing spout reach, without sidespray</td>
<td>☑ CP ☑ Other</td>
</tr>
<tr>
<td>K-7508</td>
<td>Kitchen sink faucet – 8” (20.3 cm) swing spout reach, with sidespray (shown)</td>
<td>☑ CP ☑ Other</td>
</tr>
<tr>
<td>K-7509</td>
<td>Kitchen sink faucet – 6” (15.2 cm) swing spout reach, without sidespray</td>
<td>☑ CP ☑ Other</td>
</tr>
<tr>
<td>K-7511</td>
<td>Kitchen sink faucet – 6” (15.2 cm) swing spout reach, with sidespray</td>
<td>☑ CP ☑ Other</td>
</tr>
</tbody>
</table>

Product Specification

The kitchen sink faucet shall be made of metal construction. Product shall feature a 1.8 gallon (6.8 L) per minute maximum flow rate. Product shall feature a one-piece, self-contained ceramic disc valve, which allows both volume and temperature control. Product shall feature temperature memory, allowing the faucet to be turned on and off at any temperature setting. Product shall feature 360° spout rotation with 8-7/8” (22.5 cm) or 7-3/8” (18.7 cm) clearance below the spout, and flexible connections for easy installation. Product shall be for single-hole mounting. Product shall be available with an 8” (20.3 cm) or 6” (15.2 cm) swing spout reach. Product shall be available with or without matching finish sidespray. Product shall be available with optional aerator kits. Product shall meet CalGreen requirements for kitchen faucets. Kitchen faucet shall be Kohler Model K______.
Optional Accessories

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1030920</td>
<td>Sidespray deep roughing-in kit</td>
<td>NA</td>
</tr>
<tr>
<td>1088956</td>
<td>Aerator kit – 2.2 gpm (8.3 lpm)</td>
<td>NA</td>
</tr>
<tr>
<td>1089003</td>
<td>Low flow aerator kit – 1.5 gpm (5.7 lpm)</td>
<td>NA</td>
</tr>
</tbody>
</table>

Installation Notes

Install this product according to the installation guide.
ADA compliant when installed to the specific requirements of the regulation.

<table>
<thead>
<tr>
<th>Model</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-7507</td>
<td>8-7/8&quot;</td>
<td>8&quot;</td>
<td>11-3/8&quot;</td>
</tr>
<tr>
<td>K-7508</td>
<td>(22.5 cm)</td>
<td>(20.3 cm)</td>
<td>(28.9 cm)</td>
</tr>
<tr>
<td>K-7509</td>
<td>7-3/8&quot;</td>
<td>6&quot;</td>
<td>9-7/8&quot;</td>
</tr>
<tr>
<td>K-7511</td>
<td>(18.7 cm)</td>
<td>(15.2 cm)</td>
<td>(25.1 cm)</td>
</tr>
</tbody>
</table>

Product Diagram

PURIST® KITCHEN SINK FAUCET
Page 2 of 2
1140937-4-D
Features
- Vitreous china
- Undercounter
- With overflow
- Includes 52047 clamp assembly
- 17" (43.2 cm) x 13" (33 cm)

Codes/Standards Applicable
Specified model meets or exceeds the following:
- ADA
- ASME A112.19.2/CSA B45.1
- ICC/ANSI A117.1

Colors/Finishes
- 0: White
- Other: Refer to Price Book for additional colors/finishes

Specified Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Colors/Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-2330</td>
<td>Undercounter sink less glazed underside</td>
<td>0</td>
</tr>
<tr>
<td>K-2330-G</td>
<td>Undercounter sink with glazed underside</td>
<td>0 Other</td>
</tr>
</tbody>
</table>

Product Specification
The undercounter sink shall be made of vitreous china. Sink shall be 17" (43.2 cm) in length and 13" (33 cm) in width. Sink shall be available with overflow. Sink shall include 52047 clamp assembly. Sink shall be Kohler Model K-________.
**Technical Information**

<table>
<thead>
<tr>
<th>Fixture*</th>
<th>Basin area</th>
<th>17'' (43.2 cm) x 13'' (33 cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water depth</td>
<td>3'' (7.6 cm)</td>
</tr>
<tr>
<td></td>
<td>Drain hole</td>
<td>1-3/4'' (4.4 cm) D.</td>
</tr>
</tbody>
</table>

* Approximate measurements for comparison only.

**Included components:**
- Basin clamp assembly 52047
- Cut-out template 1006809-7

**Installation Notes**

Install this product according to the installation guide.

**NOTICE:** The countertop manufacturer or cutter must use the cut-out template provided with the product, or a current one provided by the Kohler Co. (Call 1-800-4-KOHLER.) Kohler Co. is not responsible for cut-out errors when the incorrect cut-out template is used.

---

**Product Diagram**

---

**KATHRYN® UNDERCOUNTER SINK**

Page 2 of 2

1006809-4-J
Features

- Cast brass construction
- Adjustable rotation on tube outlet
- Slip-joint inlet
- Cleanout plug
- Flange

Codes/Standards Applicable
Specified model meets or exceeds the following:

- ASME A112.18.1/CSA B125.1
- IAPMO/UPC

Colors/Finishes

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

Specified Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Colors/Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-8998</td>
<td>P-trap with 1-1/4” OD inlet and 1-1/4” OD outlet</td>
<td>☑ CP</td>
</tr>
<tr>
<td>K-8999</td>
<td>P-trap with 1-1/4” OD inlet and 1-1/2” OD outlet</td>
<td>☑ CP</td>
</tr>
<tr>
<td>K-9000</td>
<td>P-trap with 1-1/2” OD inlet and 1-1/2” OD outlet</td>
<td>☑ CP</td>
</tr>
</tbody>
</table>

Product Specification

P-trap shall be of cast brass construction. Adjustable P-trap shall include cleanout plug, and flange. P-trap shall feature 1-1/4” or 1-1/2” OD slip-joint inlet and 1-1/4” or 1-1/2” OD outlet. Product shall be Kohler Model K-____-----.
Installation Notes
Install this product according to the installation guide.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>OD Outlet</th>
<th>OD Inlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-8998</td>
<td>2-3/4&quot; (7 cm)</td>
<td>4-3/8&quot; (11.1 cm)</td>
<td>1-1/4&quot; (3.2 cm)</td>
<td>1-1/4&quot; (3.2 cm)</td>
</tr>
<tr>
<td>K-8999</td>
<td>3&quot; (7.6 cm)</td>
<td>4-7/8&quot; (12.4 cm)</td>
<td>1-1/2&quot; (3.8 cm)</td>
<td>1-1/4&quot; (3.2 cm)</td>
</tr>
<tr>
<td>K-9000</td>
<td>3&quot; (7.6 cm)</td>
<td>4-7/8&quot; (12.4 cm)</td>
<td>1-1/2&quot; (3.8 cm)</td>
<td>1-1/2&quot; (3.8 cm)</td>
</tr>
</tbody>
</table>
**Features**
- Solid polypropylene plastic
- Round open-front
- With cover

**Codes/Standards Applicable**
Specified model meets or exceeds the following:
- ANSI Z124.5

**Colors/Finishes**
- 0: White
- Other: Refer to Price Book for additional colors/finishes

**Specified Model**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Colors/Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-4660</td>
<td>Toilet seat – round open-front</td>
<td>0, Other</td>
</tr>
</tbody>
</table>

**Product Specification**
The round open-front toilet seat shall be made of solid polypropylene plastic. Toilet seat shall have cover. Toilet seat shall be Kohler Model K-4660.
Installation Notes

Install this product according to the installation guide.

Product Diagram

LUSTRATM TOILET SEAT
Page 2 of 2
115722-4-AB
Features

- Acrylic
- Drop-in installation
- Molded lumbar support
- 81 gallon (306.6 L) capacity
- 60” (152.4 cm) x 32” (81.3 cm) x 21” (53.3 cm)

Codes/Standards Applicable

Specified model meets or exceeds the following:

- ANSI Z124.1.2
- CSA B45.0
- CSA B45.5
- ASTM E162
- ASTM E662

Colors/Finishes

- 0: White
- Other: Refer to Price Book for additional colors/finishes

Accessories

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes
- NA: None applicable

Specified Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Colors/Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-1130</td>
<td>5’ (1.5 m) bath – drop-in</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other_____</td>
</tr>
</tbody>
</table>

Required Accessories

| K-7271 | Clearflo slotted overflow brass bath drain OR | CP | Other_____ |
| K-7272 | Clearflo slotted overflow bath drain – PVC pipe | CP | Other_____ |

Optional Accessories

| K-590 | Undermount kit                 | NA |

Product Specification

The acrylic bath shall be 60” (152.4 cm) in length, 32” (81.3 cm) in width, and 21” (53.3 cm) in height. Bath shall be for drop-in installation. Bath shall have an 81 gallon (306.6 L) capacity. Bath shall have a molded lumbar support. Bath shall be Kohler Model K-1130_____.
Technical Information

<table>
<thead>
<tr>
<th>Fixture*:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bathing well:</td>
</tr>
<tr>
<td>Basin area, bottom</td>
</tr>
<tr>
<td>Basin area, top</td>
</tr>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>To overflow:</td>
</tr>
<tr>
<td>Water depth</td>
</tr>
<tr>
<td>Capacity</td>
</tr>
</tbody>
</table>

* Approximate measurements for comparison only.

Drop-in cut-out | 59-1/2" (151.1 cm) x 31-1/2" (80 cm)

Installation Notes

Install this product according to the installation guide.

Floor support under bath must provide for a minimum of 58 lbs/square foot (284 kg/square meter) loading.

The hot water supply should be 70% of the capacity of the bath or greater. Installations will vary.

No change in measurements if connected with required drain illustrated. (K-7272)
Features
• Brass construction
• Toe-activated closing
• No internal linkages to reduce clogging
• Swivel-ball joint construction
• Above or through-the-floor installation ensures flexibility during installation
• Includes a tee, drain ell, and overflow ell
• Vibrant PVD coating

Codes/Standards Applicable
Specified model meets or exceeds the following:
• ASME A112.18.2/CSA B125.2

Colors/Finishes
• CP: Polished Chrome
• Other: Refer to Price Book for additional colors/finishes

Specified Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Colors/Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-7271</td>
<td>Slotted overflow bath drain</td>
<td>CP Other</td>
</tr>
</tbody>
</table>

Product Specification
The slotted overflow bath drain shall be of brass construction. Product shall feature toe-activated closing with no internal linkages which reduces clogging. Product shall feature swivel-ball joint construction that allows proper fit and sealing to the bath. Product shall feature a vibrant PVD coating. Product shall include a tee, drain ell, and overflow ell. Product shall be for above or through-the-floor installation, which ensures flexibility during installation. Bath drain shall be Kohler Model K-7271.
**CLEARFLO**

**Installation Notes**

Install this product according to the installation guide. The PVC tubing noted as L-1 and L-2 are supplied and must be cut to the correct length.

**Product Diagram**

Note: For L-1 and L-2, cut supplied pipes to fit.

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2&quot; OD</td>
<td>18&quot; (45.7 cm)</td>
<td>Pipe supplied</td>
</tr>
<tr>
<td>1-3/8&quot;</td>
<td>18&quot; (45.7 cm)</td>
<td>Pipe supplied</td>
</tr>
<tr>
<td>2-1/4&quot;</td>
<td>18&quot; (45.7 cm)</td>
<td>Pipe supplied</td>
</tr>
<tr>
<td>2-5/8&quot;</td>
<td>(6.7 cm)</td>
<td>Pipe supplied</td>
</tr>
<tr>
<td>1-1/2&quot; OD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Features**

- Metal construction
- Brass valve bodies
- High-temperature limit setting for added safety
- Rite-Temp<sub>®</sub> pressure-balancing diaphragm design
- Mixing valve cycles from “cold” to “hot”
- Intended for use with Rite-Temp<sub>®</sub> or HiFlow Rite-Temp<sub>®</sub> valves
- Pressure-balancing mechanism of one-piece diaphragm cartridge design for ease of maintenance
- Oblong handle

**Codes/Standards Applicable**

Specified model meets or exceeds the following:

- ASME A112.18.1/CSA B125.1
- ASSE 1016

**Colors/Finishes**

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

**Accessories**

- NA: None applicable

**Specified Model**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Colors/Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-T10055-9</td>
<td>Bath/shower valve trim with 1/2&quot; IPS threaded spout</td>
<td>CP, Other</td>
</tr>
<tr>
<td>K-T10056-9</td>
<td>Shower valve trim, less diverter spout</td>
<td>CP, Other</td>
</tr>
<tr>
<td>K-T10057-9</td>
<td>Mixing valve trim</td>
<td>CP, Other</td>
</tr>
<tr>
<td>K-10044</td>
<td>Bath spout</td>
<td>CP, Other</td>
</tr>
</tbody>
</table>

**Required Accessories**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Colors/Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-304-*</td>
<td>Rite-Temp&lt;sub&gt;®&lt;/sub&gt; valve OR</td>
<td>NA</td>
</tr>
<tr>
<td>K-2971-KS</td>
<td>HiFlow Rite-Temp&lt;sub&gt;®&lt;/sub&gt; valve with stops OR</td>
<td>NA</td>
</tr>
<tr>
<td>K-11748-K</td>
<td>Rite-temp valve with diverter OR</td>
<td>NA</td>
</tr>
<tr>
<td>K-11748-KS</td>
<td>Rite-temp valve with diverter and stops</td>
<td>NA</td>
</tr>
</tbody>
</table>

* For a complete listing of all the Rite-Temp valves, refer to the K-304-* Specification Sheet or Roughing-In sheet.

**Product Specification**

The bath/shower valve trim shall be made of metal construction with brass valve bodies. Product shall have a Rite-Temp pressure-balancing diaphragm design valve and pressure-balancing mechanism of one-piece diaphragm cartridge design for ease of maintenance. Product shall feature mixing valve cycles from “cold” to “hot,” a high-temperature limit stop for added safety, and an oblong handle. Product is intended for use with Rite-Temp or HiFlow Rite-Temp valves. Bath/shower valve trim shall be Kohler Model K-T-____-9-____ and required Rite-Temp valve shall be K-____-____-NA.
Optional Accessories

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>88526</td>
<td>HiFlow Rite-Temp® thin wall installation kit</td>
<td>CP</td>
</tr>
</tbody>
</table>

Installation Notes

Install this product according to the installation guide.
Install the Rite-Temp valve according to the installation guide.

**NOTICE:** Risk of product damage. Long screws, for installing trim, can damage the K-2971-KS valve. Consult the trim installation guide to verify if the thin wall installation kit (88526) is needed.
Avoid cross-flow conditions. Do not install a shut-off device on either valve outlet.
Cap the shower outlet if the deck-mounted spout, diverter, or handshower is connected to the spout outlet.
Install a 7" (17.8 cm) to 18" (45.7 cm) straight pipe or straight tube with single bath elbow between the valve and the wall-mount spout.

Product Diagram
Features
- Brass valve body
- Rite-Temp® pressure-balancing diaphragm design
- Pressure-balancing mechanism of one-piece diaphragm cartridge design for ease of maintenance
- Mixing valve cycles from “cold” to “hot”
- Integral diverter mechanism
- High-temperature limit setting for added safety
- Available with or without screwdriver stops
- Designed for showerhead and handshower applications

Codes/Standards Applicable
Specified model meets or exceeds the following:
- ASME A112.18.1/CSA B125.1
- ASSE 1016

Colors/Finishes
- NA: None applicable

Accessories
- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

Specified Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Colors/Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-11748-K</td>
<td>Pressure-balancing valve without screwdriver stops</td>
<td>☑️ NA</td>
</tr>
<tr>
<td>K-11748-KS</td>
<td>Pressure-balancing valve with screwdriver stops</td>
<td>☑️ NA</td>
</tr>
</tbody>
</table>

Optional Accessories

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Colors/Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>73418</td>
<td>Deep rough-in kit for Rite-Temp® valve (all handles)</td>
<td>☑️ CP ☑️ Other</td>
</tr>
<tr>
<td>1016154</td>
<td>Deep roughing-in kit for Rite-Temp® valve (lever and cross handles)</td>
<td>☑️ CP ☑️ Other</td>
</tr>
</tbody>
</table>

Product Specification
Rite-Temp® pressure-balancing single-control valve shall feature a brass valve body. Product shall feature mixing valve cycles from “cold” to “hot” and a high-temperature limit setting for added safety. Product shall feature a Rite-Temp pressure-balancing diaphragm design and a pressure-balancing mechanism of one-piece diaphragm cartridge design for ease of maintenance. Product shall have integral diverter mechanism. Product shall be available with or without screwdriver stops. Product shall be designed for showerhead and handshower applications. Rite-Temp® valve shall be Kohler Model K-11748-_______-NA.
RITE-TEMP®

Installation Notes

Avoid cross-flow conditions. Do not install shut-off device on either valve outlet.

Product Diagram

RITE-TEMP® PRESSURE-BALANCING VALVE
Page 2 of 2
1114241-4-A
# Product Guide

## MQ Flow Based Pressure Boosting System

### Application
The MQ pump is designed for water supply and pressure boosting -
- homes
- cabins, cottages
- on farms as well as
- gardens

The pump is suitable for pumping of potable water and rain water.

### Type Key

| Example | MQ 3-35 A-B-A-BVP | 22 11 23-
|---------|-------------------|---------
| Pump range | 109 psi (7.5 bar) |
| Rawd flow [min] | 44 psi (3 bar) |
| Max. head [m] | 36 ft (9 m) |

### Pumped liquids
Potable water, rain water or other clean, thin, non-aggressive liquids not containing solid particles or fibers.

### Operating conditions

| System pressure | Max. 109 psi (7.5 bar) |
| Inlet pressure | Max. 44 psi (3 bar) |
| Suction lift | Max. 36 ft (9 m) |
| Liquid temperature | 32°F to +93°F (0°C to +35°C) |
| Ambient temperature | 32°F to +113°F (0°C to +45°C) |

### Technical data

| Main voltage | 110V models: 1 x 110-120V, 60 Hz |
| Voltage tolerances | 1 x 220-240 V, 60 Hz |
| Enclosure class | IP54 |
| Insulation class | B |
| Sound pressure level | 55 dBA |
| Agency approvals | UL, CUL |

### Features and benefits
- **Complete system**
  - The MQ is a complete, all-in-one unit, incorporating pump, motor, pressure tank, pressure and flow sensor, controller and check valve.
  - The controller ensures that the pump starts automatically when water is consumed and stops automatically when consumption ceases. In addition, the controller protects the pump in case of faults.
- **Installation**
  - Due to its compact design, the pump does not take up much space and is easy to install. No space around the pump is required.
- **Simple operation**
  - The pump features a user-friendly control panel with ON/OFF button and indicator lights for indication of the operational state of the pump.
- **Self-prime pump**
  - As it is self-primeable, the MQ is able to pump water from a level below the pump. Provided it is filled with water, the pump is able to lift water from a depth of 26 ft (8 m) in less than 5 minutes. This facilitates installation and start-up of the pump and provides more reliable water supply in installations where there is a risk of dry running and leaks in suction hose or pipes.
- **Built-in protective functions**
  - If exposed to dry running, excessive temperature, or any overflood condition the pump will stop automatically, thus preventing a motor burnout.
- **Automatic reset**
  - The pump features an automatic reset function. In case of dry running or similar alarm, the pump will stop. Restarting will be attempted every 30 minutes for a period of 24 hours. The reset function can be deactivated.
- **Low noise level**
  - Thanks to its hydraulic design and internal cooling, the pump is very quiet, which makes it suitable for many applications.
- **Pressure tank**
  - The built-in pressure tank reduces the number of starts and stops in case of leaks in the pipeline system, causing less wear on the pump.
- **Maintenance**
  - No maintenance of the pump is required.

---

**23.A2 - Liberty LowPro41lp**

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**Middlebury**

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**Grundfos Pressure Boosting Water Pump**

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**U.S. D.O.E. S. Plumbing Pac**

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**Published 5/3/2011**

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**Section 220500**
LowPro41LP

Low Profile Sewage System

For addition of a toilet without breaking concrete floors. Mounts freestanding or can be built-in using 2” x 6” joists for a more professional looking installation. Additional fixtures such as a shower or sink can be easily added using the optional inlet seal (provided).

Features:
- 2” solids-handling sewage pump
- 4/10 hp 115V
- Durable poly tank with separate access opening to switch
- Fully assembled unit, including pump, piping and switch. Saves valuable installation time.

Patent Pending, U.S. Patent No. 6,430,757

[Image of LowPro41LP system with text: Fully Assembled System!]

(tilet not included)
**FULLY ASSEMBLED SYSTEM FEATURES:**

- Durable one-piece poly tank with split cover design – allows access to switch area without disturbing discharge and vent piping.
- 4/10 hp cast iron sewage pump, 2" solids-handling.
- Pre-mounted float switch.
- Schedule 80 PVC discharge pipe (internal).
- 2" check valve.
- Closet flange with extra spacers for optional floor heights. (1/4" and 1/2" provided)
- Pipe grommet seal for additional 2" inlet pipe from a shower or sink.
- Engineered water jet provides a powerful spray within the tank to help break down solids and reduce potential jamming.
- Flow-adjusted pump maximizes pump cycle time and increases pump life.

**SPECIFICATIONS:**

- 4/10 hp 115V 12 amps 60Hz 1550 RPM
- Maximum fluid temperature: 140°F.
- Assembled weight: 91 lbs.

**PERFORMANCE CURVE**

![Performance Curve Graph](image-url)
22 33 30.26- Vaillant auroTANK Solar Hot Water Tank

**auroTANK® Solar Tanks**
Solar Hot Water Storage

---

**Removable Insulation:** Need to install the tank in a room with a narrow doorway? No problem. The removable insulation reduces the tank diameter by 6.3 inches so the installer can easily move it into a tight space and then reattach the insulation once in place.

**Thick Insulation:** With over three inches of insulation, the tank can store water up to 185°F with low standby losses.

**Revision Opening:** It's important to monitor and service solar tanks on a regular basis, especially in hard water areas. With a 6 inch opening on the front of the tank, installers are able to quickly and easily access the inside of the tank to keep the system running efficiently.

**Heat Exchanger Options:** Vaillant offers single heat exchangers for preheating domestic hot water or dual heat exchangers for a boiler backup, providing flexibility in system design.

**Backup Flexibility:** These tanks are compatible with a variety of auxiliary water heating solutions, including traditional water heaters, tankless water heaters, heat pumps and electrical elements.

---

**OVERVIEW**

Vaillant® solar hot water tanks combine premium quality materials and advanced German engineering to provide maximum efficiency and durability that you can depend on for years to come. Manufactured from glass-lined steel, the tanks and coils are enameled to resist corrosion and prolong the life of the tank. An integral component of a complete Vaillant solar thermal system, these tanks store solar-heated water efficiently.

For more information visit us online at [www.vaillantsolarsystems.com](http://www.vaillantsolarsystems.com)
## PRODUCT SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>auroTANK classic 80</th>
<th>auroTANK classic 100</th>
<th>auroTANK exclusive 80</th>
<th>auroTANK exclusive 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Capacity</td>
<td>gallons</td>
<td>78</td>
<td>107</td>
<td>79</td>
</tr>
<tr>
<td>Max. Tank Pressure</td>
<td>PSI</td>
<td>145</td>
<td>145</td>
<td>145</td>
</tr>
<tr>
<td>Max. Heating Circuit Pressure</td>
<td>PSI</td>
<td>145</td>
<td>145</td>
<td>145</td>
</tr>
<tr>
<td>Max. Heating Circuit Temperature</td>
<td>°F</td>
<td>230°</td>
<td>230°</td>
<td>230°</td>
</tr>
<tr>
<td>Max. Tank Water Temperature</td>
<td>°F</td>
<td>185°</td>
<td>185°</td>
<td>185°</td>
</tr>
<tr>
<td>Solar Heat Exchanger Area</td>
<td>ft²</td>
<td>17.2</td>
<td>16.1</td>
<td>17.2</td>
</tr>
<tr>
<td>Solar Heat Exchanger Volume</td>
<td>gallons</td>
<td>2.9</td>
<td>2.61</td>
<td>2.9</td>
</tr>
<tr>
<td>Heat Auxiliary Exchanger Area</td>
<td>ft²</td>
<td>N/A</td>
<td>N/A</td>
<td>7.5</td>
</tr>
<tr>
<td>Heat Auxiliary Exchanger Volume</td>
<td>gallons</td>
<td>N/A</td>
<td>N/A</td>
<td>1.2</td>
</tr>
<tr>
<td>Tank Dimensions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diameter without Insulation</td>
<td>inches</td>
<td>19.3&quot;</td>
<td>25.6&quot;</td>
<td>19.3&quot;</td>
</tr>
<tr>
<td>Diameter with Insulation</td>
<td>inches</td>
<td>21.9&quot;</td>
<td>31.9&quot;</td>
<td>21.9&quot;</td>
</tr>
<tr>
<td>Height</td>
<td>inches</td>
<td>69.9&quot;</td>
<td>79.9&quot;</td>
<td>69.9&quot;</td>
</tr>
<tr>
<td>Gold Mains Inlet, DIW Outlet</td>
<td>inches</td>
<td>1&quot; thread</td>
<td>1&quot; thread</td>
<td>1&quot; thread</td>
</tr>
<tr>
<td>Heating and Solar Connections</td>
<td>inches</td>
<td>1&quot; thread</td>
<td>1&quot; thread</td>
<td>1&quot; thread</td>
</tr>
<tr>
<td>Weight Including Insulation &amp; Packing</td>
<td>pounds</td>
<td>275</td>
<td>320</td>
<td>380</td>
</tr>
</tbody>
</table>

### auroTANK WARRANTY

Vaillant Solar Systems offers a two year warranty on the auroTANK® solar water tanks (see warranty conditions).

---

**Vaillant® Solar Systems Inc.**  
522 Via de la Valle, Suite 200  
Solar Beach, CA 92075  
056 259-0000 phone  
056 259-0793 fax  
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Submittal data sheets can ONLY be ordered as a “Submittal Data Sheet Pack”, using MC# 4400. They are not available to order on an individual basis, however each data sheet is available on the Amtrol Web Site and can be downloaded and printed for use as needed.

### THERM-X-TROL®

**Thermal Expansion Absorbers, ST-Series (Non-ASME)**

150 PSIG Working Pressure

#### Specifications

<table>
<thead>
<tr>
<th>Description</th>
<th>Standard Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Factory Pre-charge</td>
<td>40 PSIG (2.8 kg/cm²)</td>
</tr>
<tr>
<td>System Connection</td>
<td>Brass (ST5-12)</td>
</tr>
<tr>
<td></td>
<td>Stainless Steel (Stand Models)</td>
</tr>
<tr>
<td>Diaphragm</td>
<td>Butyl/EPDM</td>
</tr>
<tr>
<td>Liner Material</td>
<td>Polypropylene</td>
</tr>
</tbody>
</table>

All dimensions and weights are approximate.

### In-Line Models

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ST-5</td>
<td>8</td>
<td>2.0</td>
<td>321</td>
<td>203</td>
<td>3/4</td>
<td>2.3</td>
</tr>
<tr>
<td>ST-12</td>
<td>17</td>
<td>4.4</td>
<td>381</td>
<td>279</td>
<td>3/4</td>
<td>4.0</td>
</tr>
</tbody>
</table>

### Stand Models

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ST-25V</td>
<td>39</td>
<td>10.3</td>
<td>489</td>
<td>391</td>
<td>1/15</td>
<td>1</td>
</tr>
<tr>
<td>ST-50V</td>
<td>53</td>
<td>14.0</td>
<td>605</td>
<td>391</td>
<td>1/15</td>
<td>1</td>
</tr>
<tr>
<td>ST-60V</td>
<td>76</td>
<td>20.0</td>
<td>802</td>
<td>391</td>
<td>1/15</td>
<td>1</td>
</tr>
<tr>
<td>ST-80V</td>
<td>125</td>
<td>34.0</td>
<td>913</td>
<td>559</td>
<td>1/15</td>
<td>1/4</td>
</tr>
<tr>
<td>ST-180V</td>
<td>326</td>
<td>66.0</td>
<td>1109</td>
<td>559</td>
<td>1/15</td>
<td>1/4</td>
</tr>
</tbody>
</table>

### Maximum Operating Conditions

- **Operating Temperature**: 200°F (93°C)
- **Working Pressure**: 150 PSIG (10.5 kg/cm²)

---

[Status]
U.S. D.O.E. Solar Decathlon 2011
Plumbing Performance Specifications
4.7. SolarUS Collector Specifications

4.7.1. Overall Collector Dimensions & Weight

<table>
<thead>
<tr>
<th>Collector Size</th>
<th>10 tubes</th>
<th>20 tubes</th>
<th>30 tubes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Length 1</td>
<td>1935 mm / 76.2 in.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Height 2</td>
<td>145 mm / 5.7 in. (Standard Back frame &amp; Manifold Case)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Width 3</td>
<td>780 mm / 31.1 in.</td>
<td>1540 mm / 60.6 in.</td>
<td>2290 mm / 90.2 in.</td>
</tr>
<tr>
<td>Effective Absorber Area 4</td>
<td>0.812 m² / 8.74 ft²</td>
<td>1.624 m² / 17.49 ft²</td>
<td>2.436 m² / 26.22 ft²</td>
</tr>
<tr>
<td>Net Weight</td>
<td>32 kg / 70.5 lbs.</td>
<td>65 kg / 143.3 lbs.</td>
<td>98 kg / 216 lbs.</td>
</tr>
<tr>
<td>Volume of Manifold Header</td>
<td>800 ml / 0.159 gal.</td>
<td>1170 ml / 0.31 gal.</td>
<td>1740 ml / 0.46 gal.</td>
</tr>
</tbody>
</table>

1. Overall Length shows the length of the entire solar collector.
2. Overall Height shows the total height of the back frame plus manifold case.
3. Overall Width shows the width of the manifold case, not including the left and right side outlets.
4. Effective Absorber Area: N*(47mm*1800mm)*96%, N is the number of tubes, 47mm is the O.D. of inner tube.

4.7.2. Copper Heat Exchanger (Header)

<table>
<thead>
<tr>
<th>Material</th>
<th>TP: Copper, Cu≥99.9%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Length of Header Pipe</td>
<td>( L = (N-1) \times 75 \text{ mm} + 82.5 \text{ mm}^2 / L = (N-1) \times 2.95 \text{ in.} + 3.25 \text{ in.}^2 )</td>
</tr>
<tr>
<td>Header Pipe Specification</td>
<td>OD: φ35 mm, WT: 1.0 mm / OD: φ1.38 in., WT: 0.039 in.</td>
</tr>
<tr>
<td>Inlet &amp; outlet</td>
<td>OD: φ22 mm / φ0.87 in.</td>
</tr>
<tr>
<td>Temperature Sensor Port</td>
<td>OD: φ0.8 mm / 0.032 in. * (0.2-0.032)</td>
</tr>
<tr>
<td>Maximum Operating Pressure Rating</td>
<td>0.7 MPa / 102 psi</td>
</tr>
<tr>
<td>Maximum Flow Rate</td>
<td>8 L/tube/min.</td>
</tr>
</tbody>
</table>
**Art. S011**

**SOLAR PUMP STATION WITH DELIVERY AND RETURN CONNECTIONS**

**FUNCTION**

The S011 circulation unit is applied to the primary circuit of solar systems and oversees management of the solar panel - storage tank fluid thermodynamic cycle for subsequent supply to utilities via hydraulic distribution circuits. They consist essentially of a circulator with appropriate performance (rate of flow/heat) and regulation and control devices governing the operating circuit.

**TECHNICAL FEATURES**

- **Fluid used**: Water, glycol solutions (glycol 25% - 50% max)
- **Calibration of safety valve**: 60 psi
- **Connection**: NPT
- **Permitted temperature range**: +14°F / +320°F
- **Max. ambient temperature**: +194°F
- **Max. operating pressure**: 150 psi
- **Min. pressure on start-up**: opening with temperatures of:
  - +122°F: 0.8 psi
  - +203°F: 4.4 psi
  - +230°F: 14.5 psi
- **Body**: brass EN 12165 OAW17N
- **Thermometer**: stainless steel
- **Seals**: PTFE
- **Sealing elements**: EPDM Perfluor
- **Flange**: Betaflex
- **Insulation shell**: PPR, Conductivity Δ(T)= 0.041 (W/mK)
- **Pressure gauge scale**: 0 - 90 psi
- **Thermometer scale**: 32 - 320°F
- **Connections**: NPT
- **Hose fitting, for connection with expansion tank**: NPT
- **Calibration of safety valve**: 60 psi
- **Min. pressure for opening on/off and check valve**: Δp 0.29 psi
- **Filling/emptying connections with hose connection**: 5/8"
END OF SECTION 220500
SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

SCHEDULE 0 - SECTION REQUIREMENTS

PRODUCT DATA SHEET 0 - Submittals: Product Data.

PRODUCT DATA SHEET 1 - NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 5 - PRODUCTS

SCHEDULE 0 - GENERAL-DUTY VALVES

PRODUCT DATA SHEET 0 - Valve Sizes: Same as upstream piping unless otherwise indicated.


PRODUCT DATA SHEET 2 - One-Piece, Copper-Alloy Ball Valves: Brass or bronze body with chrome-plated bronze ball, PTFE or TFE seats, and 600-psig (4140-kPa) CWP rating.

PRODUCT DATA SHEET 3 - Two-Piece, Copper-Alloy Ball Valves: Forged-brass body with full port, chrome-plated bronze ball; Teflon seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.

PRODUCT DATA SHEET 4 - Bronze, Swing Check Valves: Class 125, bronze body with nonmetallic disc and seat.

PART 6 - EXECUTION

SCHEDULE 0 - INSTALLATION

PRODUCT DATA SHEET 0 - Use gate and ball valves for shutoff duty; globe and ball for throttling duty.

PRODUCT DATA SHEET 1 - Locate valves for easy access and provide separate support where necessary.

PRODUCT DATA SHEET 2 - Install valves for each fixture and item of equipment.

PRODUCT DATA SHEET 3 - Install three-valve bypass around each pressure-reducing valve using throttling-type valves.

PRODUCT DATA SHEET 4 - Install valves in horizontal piping with stem at or above center of pipe.
PRODUCT DATA SHEET 5 - Install valves in a position to allow full stem movement.

PRODUCT DATA SHEET 6 - Install check valves for proper direction of flow in horizontal position with hinge pin level.

END OF SECTION 220523
SECTION 221116 - DOMESTIC WATER PIPING

SCHEDULE 0 - SECTION REQUIREMENTS

PRODUCT DATA SHEET 0 - Comply with NSF 14 for plastic, potable domestic water piping and components.

PRODUCT DATA SHEET 1 - Comply with NSF 61 for potable domestic water piping and components.

PART 8 - PRODUCTS

SCHEDULE 0 - PIPE AND FITTINGS

PRODUCT DATA SHEET 0 - PEX Tube and Fittings: ASTM F 877, SDR 9 PEX tubing and ASTM F 1807, metal insert-type fittings with copper or stainless-steel crimp rings.

8.01 Manifold: ASTM F 877 plastic or corrosion-resistant-metal assembly, with a plastic or corrosion-resistant-metal valve for each outlet.

PRODUCT DATA SHEET 1 - PVC Pipe: ASTM D 1785, Schedule 40.

8.01 PVC Fittings: ASTM D 2466, Schedule 40, socket type.

PRODUCT DATA SHEET 2 - Transition Fittings: Manufactured piping coupling or specified piping system fitting. Same size as pipes to be joined and pressure rating at least equal to pipes to be joined.

PRODUCT DATA SHEET 3 - Flexible Connectors: Stainless-steel, corrugated-metal tubing with wire-braid covering. Working-pressure rating a minimum of 200 psig (1380 kPa).

PART 9 - EXECUTION

SCHEDULE 0 - INSTALLATION

PRODUCT DATA SHEET 0 - Comply with requirements in Division 15 Section "Common Work Results for Plumbing" for basic piping installation requirements.

PRODUCT DATA SHEET 1 - Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Division 15 Section "Common Work Results for Plumbing" for wall penetration systems.
PRODUCT DATA SHEET 2 - Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 15 Section "Common Work Results for Plumbing" for pressure gages and Division 15 Section "Domestic Water Piping Specialties" for drain valves and strainers.

PRODUCT DATA SHEET 3 - Install domestic water piping without pitch for horizontal piping and plumb for vertical piping.

PRODUCT DATA SHEET 4 - Rough-in domestic water piping for water-meter installation according to utility company's requirements.

PRODUCT DATA SHEET 5 - Comply with requirements in Division 15 Section "Common Work Results for Plumbing" for basic piping joint construction.

9.01 Soldered Joints: Comply with procedures in ASTM B 828 unless otherwise indicated.

PRODUCT DATA SHEET 6 - Comply with requirements in Division 15 Section "Common Work Results for Plumbing" for pipe hanger and support devices.

PRODUCT DATA SHEET 7 - Support vertical piping at each floor.

PRODUCT DATA SHEET 8 - Install flexible connectors in suction and discharge piping connections to each domestic water pump.

SCHEDULE 1 - INSPECTING AND CLEANING

PRODUCT DATA SHEET 0 - Inspect and test piping systems as follows:

9.01 Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
9.02 Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

PRODUCT DATA SHEET 1 - Clean and disinfect all domestic water piping by filling system with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

SCHEDULE 2 - PIPING SCHEDULE

PRODUCT DATA SHEET 0 - Aboveground Distribution Piping: PEX piping.
SCHEDULE 3 - VALVE SCHEDULE

PRODUCT DATA SHEET 0 - Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

9.01 Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
9.02 Throttling Duty: Use bronze ball or globe valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
9.03 Hot-Water-Piping, Balancing Duty: Memory-stop balancing valves.
9.04 Drain Duty: Hose-end drain valves.

PRODUCT DATA SHEET 1 - Install gate valves close to main on each branch and riser serving two or more plumbing fixtures or equipment connections and where indicated.

PRODUCT DATA SHEET 2 - Install gate or ball valves on inlet to each plumbing equipment item, on each supply to each plumbing fixture not having stops on supplies, and elsewhere as indicated.

PRODUCT DATA SHEET 3 - PVC ball, butterfly, and check valves may be used in matching piping materials.

PRODUCT DATA SHEET 4 - Install drain valve at base of each riser, at low points of horizontal runs, and where required to drain water distribution piping system.

PRODUCT DATA SHEET 5 - Install swing check valve on discharge side of each pump and elsewhere as indicated.

PRODUCT DATA SHEET 6 - Install ball valves in each hot-water circulating loop and discharge side of each pump.

END OF SECTION 221116
SECTION 221216 – FACILITY ELEVATED, POTABLE-WATER STORAGE TANKS

PART 1 - GENERAL

1.01 DESCRIPTION

A. We will use four 750-gallon capacity water tanks. The two Eastern tanks will be wastewater tanks, and the two Western tanks will be potable water tanks. Each set of tanks will operate as if it were a single tank: they will be joined at the base with a connecting pipe. The manufacturer, Custom Roto-molding, makes the gaskets and fasteners needed to make this connection but does not install them. Holes will need to be cut in the base of the tanks to receive the pipes, and the gaskets and receptacles for the pipes will need to be applied. Purchase and installation of these connections shall comply with food-grade safety requirements. Per the Solar Decathlon Rules and Building code, the tanks will need to be elevated a minimum of 4 inches above the ground and will need to be shaded from 8am to 4pm. We will use 4 ½” wood cribbing placed directly on the site to elevate the tanks (load will not exceed 1500psf). We will shade the tanks with a timber frame covering the top, East and West sides of the tank. Each tank is 6’ in diameter and 3’8” in height, with a manway (handle extends another 4” above). The tanks are constructed of polyethylene, and are suitable for both potable and greywater storage. Since bathrooms will not be used in the Solar Decathlon competition, our wastewater storage is, for practical purposes, greywater storage.

1.02 QUALITY ASSURANCE

A. Manufacturer (Custom Roto-molding) regularly and presently manufactures the item submitted as one of their principal products.

B. Installation team will be advised by plumbing and metalwork professionals in the installation and connection of the tanks and related features.

C. Tank will comply with all associated load requirements, and will not exceed 1500psf loading on the ground surface.
### 2.01 TANK

- The tank shall be set on wood cribbing as specified by our engineer. As per Solar Decathlon requirements, the tank will be elevated a minimum of 4" off the ground, and the foundation pad will not exceed 1500psf loading on the ground surface.

### 2.02 FOUNDATION/RISER

#### A.

The tank shall be set on wood cribbing as specified by our engineer. As per Solar Decathlon requirements, the tank will be elevated a minimum of 4" off the ground, and the foundation pad will not exceed 1500psf loading on the ground surface.

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**NOTES:**
1. MATERIAL: POYETHYLENE
2. WEIGHT: 115 LBS. STD. RATED 1.5 S.G.
150 LBS. HD. RATED 2.0 S.G.

---

**Drawing Information:**
- CUSTOM ROTO-MOLDING, INC.
- DRAWN: EBW 5-29-09
-規模 JOHN B. MFG APPR.
- Q.A.
- DATE: DATENAME
- SHEET 1 OF 1
- DO NOT SCALE DRAWING

---

**Dimensions:**

- **DIA.:** 72"
- **8"**
- **8"**
- **18"**
- **3"**
- **47 1/2"**
- **23 1/2"**
- **49 1/2"**

---

**Notes:**
- MATERIAL: POYETHYLENE
- WEIGHT: 115 LBS. STD. RATED 1.5 S.G.
150 LBS. HD. RATED 2.0 S.G.
2.03 ACCESSORIES

A. All fittings, pipes, and connections shall be selected under the guidance of industry professionals, and installed to comply with all potable/greywater standards.

B. Potable water tanks will be shaded between 8am and 4pm during the competition by 6’x4’ wood panels on the East and West, and a 6’x6’ panel over the top. The house will shade the tanks from the South.

C. A manhole at the top of each tank will be accessible to the hose of a fill-truck at the start of the competition.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Tank and accessories shall be installed with the required safety precautions, and under the guidance of plumbing, metalworking, and construction professionals.

3.02 FLUSHING

A. After tests, flush tank and connecting pipelines.

3.03 DISINFECTION/STERILIZATION

A. After flushing thoroughly disinfect and sterilize the tank and connecting piping with a chlorine and Hypochlorite solution. Following a contact period of 24 hours, flush the system with clean water until the residual chlorine content is not greater than that of the water supply. All valves in water line being disinfected shall be opened and closed several times during the 24 hour period.

END OF SECTION 221216
SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 4 - GENERAL

SCHEDULE 0 - SECTION REQUIREMENTS


PART 5 - PRODUCTS

SCHEDULE 0 - PIPES AND FITTINGS

PRODUCT DATA SHEET 0 - Copper Drainage Tube and Fittings: ASTM B 306, Type DWV drawn temper with [wrought] [cast]-copper, Type DWV drainage fittings. DENES SAID THIS DOESN'T APPLY

PRODUCT DATA SHEET 1 - Hub-and-Spigot Cast-Iron Soil Pipe and Fittings: ASTM A 74, Service class; ASTM C 564 rubber gaskets.

PRODUCT DATA SHEET 2 - Hubless Cast-Iron Soil Pipe and Fittings: ASTM A 888 or CISPI 301, with ASTM C 1277 shielded couplings.

PRODUCT DATA SHEET 3 - PVC Plastic, DWV Pipe and Fittings: ASTM D 2665, Schedule 40, plain ends with PVC socket-type, DWV pipe fittings.

PART 6 - EXECUTION

SCHEDULE 0 - PIPING INSTALLATION

PRODUCT DATA SHEET 0 - Comply with requirements in Division 15 Section "Common Work Results for Plumbing" for basic piping installation requirements.

PRODUCT DATA SHEET 1 - Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
PRODUCT DATA SHEET 2 - Install wall penetration system at each pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Division 15 Section "Common Work Results for Plumbing" for wall penetration systems.

6.01 Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

PRODUCT DATA SHEET 3 - Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

PRODUCT DATA SHEET 4 - Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

PRODUCT DATA SHEET 5 - Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

6.01 Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
6.02 Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
6.03 Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

PRODUCT DATA SHEET 6 - Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

PRODUCT DATA SHEET 7 - Install underground PVC soil and waste drainage piping according to ASTM D 2321.

PRODUCT DATA SHEET 8 - Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

PRODUCT DATA SHEET 9 - Comply with requirements in Division 15 Section "Common Work Results for Plumbing" for basic piping joint construction.

PRODUCT DATA SHEET 10 - Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure unless otherwise indicated.

PRODUCT DATA SHEET 11 - Comply with requirements in Division 15 Section "Common Work Results for Plumbing" for pipe hanger and support devices.
SCHEDULE 1 - PIPE SCHEDULE

PRODUCT DATA SHEET 0 - Aboveground Applications: PVC plastic, DWV pipe and fittings with solvent-cemented joints.

PRODUCT DATA SHEET 1 - Belowground Applications: PVC plastic, DWV pipe and drainage-pattern fittings with cemented joints.

END OF SECTION 221316
SECTION 230500 - Heating, Ventilating, and Air-conditioning (HVAC)

Air-Air Heat Exchanger

• Heat Pump (23 62 00 outdoor unit, positioned on ground outside north wall)
  - Make and Model: Mitsubishi Mr. Slim PUZ-HA36NHA3
  - Inputs: power feed (230V, 30A breaker) and control wire
  - Outputs: 5/8” Liquid line and suction line lead out to Fan Coil unit

• Fan Coil (23 57 00 indoor unit, positioned above ceiling on east end of house)
  - Make and Model: Mitsubishi Mr. Slim PEAD-A36AA
  - Inputs: liquid line and suction line from condenser; ducted return air feed
  - Outputs: supply air through 12”x14” plenum; PVC drain to bathroom stack
  - Condensate drains to 10 gallon roto-molded plastic tank above refrigerator in kitchen; this tank services a non-potable water spigot for greenhouse use, and drains into the bathtub in the bathroom in the event of an overflow.

Energy Recovery Ventilator (ERV)

• Make and Model: Zehnder ComfoAir 200 (23 72 00)

• Inputs
  - Outdoor supply air through 3” diameter flexible Comfo Tubes
  - Indoor return air through diffusers in kitchen and bathroom via 3” diameter flexible Comfo Tubes

• Outputs
  - Outdoor return air through 3” diameter flexible Comfo Tubes
  - Indoor supply air through 3” diameter flexible Comfo Tubes joining fan coil return

Range Hood

• Make and Model: Zephyr ZRM-E36B (23 38 13)

• Recirculating unit

Ductwork and Vents

Aluminum Ductwork (23 31 13.19) supplied through New England Air Systems, Inc.
<table>
<thead>
<tr>
<th>Keynote</th>
<th>Location</th>
<th>Item</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Model Number</th>
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<tr>
<td>23 38 13</td>
<td>Kitchen</td>
<td>Range Hood</td>
<td>Recirculating</td>
<td>Zephyr</td>
<td>ZRM-E36B</td>
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<tr>
<td>23 57 00</td>
<td>Mechanical Attic</td>
<td>Fan Coil Unit</td>
<td>36 kBtu/hr</td>
<td>Mitsubishi</td>
<td>PEAD-A36AA</td>
</tr>
<tr>
<td>23 62 00</td>
<td>Exterior</td>
<td>Heat Pump</td>
<td>Outdoor Unit</td>
<td>Mitsubishi</td>
<td>PUZHA36NHA3</td>
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<tr>
<td>23 72 00</td>
<td>Mechanical Room</td>
<td>ERV</td>
<td></td>
<td>Zehnder</td>
<td>ComfoAir 200</td>
</tr>
</tbody>
</table>
**23 57 00- Mitsubishi Mr. Slim Fan Coil and Outdoor Unit**

**U.S. D.O.E. Solar Decathlon 2011**

**Middlebury**

**RELIANCE**

**SUBMITTAL DATA: PEAD-A36AA & PUZ-A36NHA3**

36,000 BTUH HORIZONTAL-DUCTED HEAT-PUMP SYSTEM

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**Job Name:** Location: Date:

**Purchaser:** Engineer:

Submitted to: For Reference Approval Construction

Unit Designation:

**GENERAL FEATURES**

- Horizontal-ducted indoor unit features medium static pressure capability
- Thin body: 9-7/8" high
- Built-in drain mechanism for condensate removal; lifts to 27'-9/16"
- Air filter is included with indoor unit
- Quiet operation—both indoor and outdoor units
- PAR-21MAA remote controller included; wireless remote controller available as an option
- Automatic fan speed control
- Auto restart following a power outage
- Self-check function—integrated diagnostics
- Knockout for ventilation air
- Limited warranty: five years on parts and defects and seven years on compressors

**OPTIONAL ACCESSORIES**

- **Indoor Unit**
  - External Heat Adapter (PAC-YUBSHT)
  - CN24 Relay Kit (CN24RELAY-KIT-CM2)
  - Remote Temperature Sensor (PAC-SEP24TS)
  - Wireless Remote Controller (PAR-FL32MA)
  - Wireless Remote Receiver (PAR-FAZ23MA)

- **Outdoor Unit**
  - M-NEI Adapter (PAC-SF181MA-E)
  - Air Outlet Guide (PAC-SG059SG-E)
  - Wind Baffle (WB-PA2)

**Electrical Requirements**

Power Supply: 208 / 230V, 1-Phase, 60 Hz

- **Indoor Unit**
  - Voltage: 208 / 230V
  - Electric Requirements: 12,000 Btu/h
  - Fan Type: Direct-driven DC Brushless Motor
  - Fan Motor: 2.64 Fl.A.
  - Fan Motor Output: 244 W
  - Airflow (Lo - Med - Hi): 847 - 1,024 - 1,201 Dry CFM
  - Air Filter: Polypropylene Honeycomb
  - External Static Pressure: 0.14 - 0.20 - 0.28 - 0.40 - 0.60 W/G

- **Outdoor Unit**
  - Voltage: 208 / 230V
  - Electric Requirements: 37,000 Btu/h
  - Fan Type: Direct-driven DC Brushless Motor
  - Fan Motor: 2.64 Fl.A.
  - Fan Motor Output: 244 W
  - Airflow (Lo - Med - Hi): 847 - 1,024 - 1,201 Dry CFM
  - Air Filter: Polypropylene Honeycomb
  - External Static Pressure: 0.14 - 0.20 - 0.28 - 0.40 - 0.60 W/G

**Sound Pressure Level**

- **Indoor Unit**: 48 dBA
- **Outdoor Unit**: 50 dBA

**Weight**

- Indoor Unit: 91 lbs. / 41 kg
- Outdoor Unit: 165 lbs. / 75 kg

**Dimensions**

- Indoor Unit: 35-1/8 / 900 x 30-1/4 / 770 x 12-3/4 / 324 mm
- Outdoor Unit: 41-3/16 / 1,049 x 16-1/2 / 420 x 7-5/8 / 198 mm

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*heat pump contains refrigerant*

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**U.S. D.O.E. Solar Decathlon 2011**

**Published 5/3/2011**

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**Section 230500**
CA200 ComfoAir 200 Model

- Heat recovery performance up to 90%
- Ultra efficient EC motors offer distinct energy savings
- Summer bypass
- Grade G4 Dust Filters
- Frost Protection
- Simple maintenance for both dust filters and heat exchanger

### Product Specification

- **Max House Size EST**: 110m² (1200 sqft)
- **Case Size in mm (W x D x H)**: 535 x 1200 x 315
- **Weight**: 38kg
- **Airflow in free air (m³/h)**: 26 - 70
- **Noise dB(A)**: 9 - 143
- **Power (Watts)**: 0.20 - 1.30 (0.30)
- **Spigot Size ID**: 125.5mm
- **Filter**: G4 standard
- **Heat efficiency**: 90 - 93 (90%)
- **Summer bypass/Frost protection**: Yes
- **Pre-heater**: Optional
- **Condensate Drain**: 20mm

### Electrical Specification

- **Consumption**: 230V - 50Hz Class I
- **Wiring**: Trickle - 17W, Medium - 30W, Boost - 68W
- **Fuse**: Must comply with IEE or local wiring regulations
- **3 amp (when fan is supplied from a 6A lighting circuit no local fuse is required)**

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**END OF SECTION 230500**
## SECTION 2605000- Electrical Specifications

### Electrical Schedule

#### Equipment Schedule:

<table>
<thead>
<tr>
<th>Keynote</th>
<th>Quantity</th>
<th>Device</th>
<th>Product</th>
<th>Model #</th>
<th>Details/Notes</th>
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<tr>
<td>26 31 00</td>
<td>30</td>
<td>Solar Modules</td>
<td>SunPower 225 Black PV Modules</td>
<td>Sunpower 225BK</td>
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<tr>
<td>48 19 16</td>
<td>1</td>
<td>Inverter</td>
<td>SunPower 7000 Watt Inverter</td>
<td>SPR-7000m</td>
<td>Integrated DC Disconnect</td>
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<tr>
<td>26 24 22</td>
<td>1</td>
<td>PV AC Disconnect</td>
<td>Cutler Hammer DG322URB</td>
<td>DG322URB</td>
<td>60A 3P GD NEMA3R</td>
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<tr>
<td>26 24 16.A1</td>
<td>1</td>
<td>Load Center</td>
<td>200A SquareD Panel Board</td>
<td>QO140M200</td>
<td>200A, 40SP</td>
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<tr>
<td>26 24 25</td>
<td>1</td>
<td>Meter/Utility Disconnect</td>
<td>Milbank 200A 4 Meter Socket w/ 200A Breaker</td>
<td>U3990-XL-200</td>
<td>200A, NEMA 3R</td>
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<tr>
<td>33 79 00</td>
<td>2</td>
<td>Specialized Grounding Electrodes</td>
<td>Grounding Electrode as described in SD Building Code 6-9</td>
<td>Custom</td>
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<tr>
<td>23</td>
<td></td>
<td>Circuit Breakers</td>
<td>See E-603 for Itemized list of breaker sizes</td>
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<td>AFCI protection for applicable breakers</td>
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### Wiring Schedule (All are copper unless specified otherwise):

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<thead>
<tr>
<th>150 ft</th>
<th>PV Source Circuit</th>
<th>#10-2 AWG USE-2 Wiring</th>
<th>Refer to calculations on E-602</th>
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<tbody>
<tr>
<td>100 ft</td>
<td>PV Source EGC</td>
<td>#6 AWG Uncoated Wire</td>
<td>Refer to calculations on E-602</td>
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<td>80 ft</td>
<td>Inverter Output Circuit</td>
<td>#8-3 w/GG NM-B Wire</td>
<td>Refer to calculations on E-602</td>
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<tr>
<td>50 ft</td>
<td>DC GEC</td>
<td>#8 AWG Uncoated Wire</td>
<td>Refer to calculations on E-602</td>
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</table>
### Electrical Specifications

<table>
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<th>Distance</th>
<th>Type</th>
<th>Wire/Receptacle Details</th>
<th>Notes</th>
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<tr>
<td>50 ft</td>
<td>SE EGC</td>
<td>#6 AWG Uncoated Wire</td>
<td>Refer to calculations on E-602</td>
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<tr>
<td>20 ft</td>
<td>Grounding</td>
<td>#4 AWG Uncoated Wire</td>
<td>Refer to calculations on E-602</td>
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<td>Electrode</td>
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<tr>
<td>50 ft</td>
<td>SE Cabling</td>
<td>4/0-3 AWG Aluminum XHHW Wire</td>
<td>Refer to calculations on E-602</td>
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<tr>
<td>~500 ft</td>
<td>Home Circuits</td>
<td>#12-2 w/GG NM-B Wire</td>
<td>Refer to List on E-603 for circuits</td>
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<tr>
<td>~50 ft</td>
<td>Home Circuits</td>
<td>#12-3 w/GG NM-B Wire</td>
<td>Refer to List on E-603 for circuits</td>
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<tr>
<td>~100 ft</td>
<td>Home Circuits</td>
<td>#10-2 w/GG NM-B Wire</td>
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<tr>
<td>~80 ft</td>
<td>Home Circuits</td>
<td>#8-2 w/GG NM-B Wire</td>
<td>Refer to List on E-603 for circuits</td>
</tr>
</tbody>
</table>

### Additional Components:

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>23 Circuit</td>
<td>Breakers</td>
</tr>
<tr>
<td></td>
<td>See E-603 for itemized list of breaker sizes</td>
</tr>
<tr>
<td>10 Light</td>
<td>Switch</td>
</tr>
<tr>
<td></td>
<td>2-Way Toggle Switch</td>
</tr>
<tr>
<td>2 Light</td>
<td>Switch</td>
</tr>
<tr>
<td></td>
<td>2-Way Dimmer Switch</td>
</tr>
<tr>
<td>2 Light</td>
<td>Switch</td>
</tr>
<tr>
<td></td>
<td>3-Way Dimmer Switch</td>
</tr>
<tr>
<td>24 Receptacle</td>
<td>Normal 120V Duplex Receptacle</td>
</tr>
<tr>
<td>6 GFCI</td>
<td>Receptacle</td>
</tr>
<tr>
<td></td>
<td>120V GFCI Duplex Receptacle</td>
</tr>
<tr>
<td>3 240V</td>
<td>Receptacle</td>
</tr>
<tr>
<td></td>
<td>240V Receptacle</td>
</tr>
<tr>
<td>35 Wire Splice Kit</td>
<td>NSi Wire Splice Kit: 2 Wire w/GG – #12AWG-#14AWG UL Listed</td>
</tr>
<tr>
<td></td>
<td>NMS-2</td>
</tr>
<tr>
<td></td>
<td>To connect circuits between modular home</td>
</tr>
</tbody>
</table>

[Status]

U.S. D.O.E. Solar Decathlon 2011
Electrical Specifications

Published 5/3/2011
Page - 236
Section 260500
### Electrical Specifications

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Wire Splice Kit</td>
<td>NSi Wire Splice Kit: 3 Wire w/GG – #12AWG-#14AWG UL Listed</td>
<td>NMS-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To connect circuits between modular home sections</td>
<td></td>
</tr>
</tbody>
</table>

Additional Junction boxes and other components to be specified

---

**PV Balance of System Components:**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PV Racking</td>
<td>SnapNrack Mounting System</td>
</tr>
<tr>
<td>1</td>
<td>Conduit Entry Box</td>
<td>Acme ACE Conduit Entry Box</td>
</tr>
<tr>
<td>Var.</td>
<td>Equipment Grounding Devices</td>
<td>Weeb PMC, Weeblug, Weeb bonding jumpers</td>
</tr>
</tbody>
</table>

---

**Building Dashboard**

We will implement an eMonitor “building dashboard system” from Intellergy Inc. The eMonitor is a circuit-by-circuit energy monitoring system that also includes flow meter monitoring through a Web Energy Logger datalogger. The eMonitor also provides for monitoring of photovoltaic installation health and panel performance. The eMonitor output will be displayed on an iPad for ease of access to all building occupants. Intellergy also provides a service to alert building occupants by phone or email in the event of dangerous power conditions or at the signal of a smoke or CO₂ detector.

---

**Lighting Equipment Schedule**

General Notes:

**A. Submittals**

Contractor shall submit a complete list of lighting products he intends on furnishing with manufacturer and catalog designations, along with currently quoted lead times for delivery of same. Should the Contractor anticipate that the delivery schedule of any specified product may adversely impact the construction schedule, he shall bring it to the attention of the Owner at this time.

Contractor shall provide a complete list of all lamps which will be furnished on the project. This list shall be organized alphabetically by the luminaire types indicated on the Fixture Schedule and Specifications, and include the manufacturer and exact model number for each lamp.
Substitutions will be considered only if the proposed substitution is a true equal to the specified product.

B. Construction / Post-Construction

The Contractor shall verify lighting fixture clearance in all interior and exterior mounting conditions and compatibility with wall and ceiling systems. Report any discrepancies to the lighting consultant for action prior to ordering fixtures.

Contractor shall verify electrical system voltage. Ballasts furnished shall be of correct voltage for the electrical system and listed for operation of the specified lamps.

When dimming ballasts for fluorescent lamps are used, lamps must first be operated at 100% full output for not less than 100 consecutive hours.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Surface mounted, 12 inch linear LED fixture with wide beam distribution and 3000K color temperature at 12 watts per foot.</td>
</tr>
</tbody>
</table>

**Manufacturer:** COLOR KINETICS # 523-000050-06

**Lamp & Mfg:** LEDs are included in fixture part number.

**Accessories:** COLOR KINETICS # 108-000047-00 (Leader Cable)

**Remarks:** Fixture mounts continuously end-to-end, concealed in-between collar ties above diffusion glass. See manufacturer’s website for all connection cables and mounting hardware.
eW Cove MX Powercore
3000 K, Wide Beam Angle

Maximum output linear LED fixture for cove, general, and accent lighting

eW® Cove MX Powercore delivers the highest light output in the line of solid white linear cove lights from Philips Color Kinetics. With its superior light output, wide beam angle, and a range of fixed colors and color temperatures, eW Cove MX Powercore can be used for accent lighting and indirect general illumination, as well as the full range of wall and ceiling cove applications. eW Cove MX Powercore meets or exceeds the performance of comparable linear fluorescent strip cove lights while lowering installation, energy and maintenance costs. eW Cove MX Powercore offers environmentally conscious buyers a green, energy-efficient lighting solution without sacrificing quality or quantity of light.

- Maximum light output — Delivers white or colored light at up to 632 lumens per foot.
- Superior binning algorithm sets new standard for color consistency — eW Cove MX Powercore exceeds the recognized standards for color quality to guarantee uniformity and consistency of hue and color temperature across LEDs, fixtures, and manufacturing runs.
- Lower cost than comparable fluorescent strip lighting — With efficacy of up to 53.1 lm / W, long useful life, and low-maintenance operation, eW Cove MX Powercore offers lower first and total cost than dimmable T5HO and 2-lamp T8 strip lights in typical cove applications.
- Multiple options for design and application flexibility — Available in four color temperatures, ranging from a warm 2700 K to a cool 4000 K, and four solid colors (Red, Green, Blue, and Amber). Beam angle options include narrow, medium, and wide.
- Integrates patented Powercore® technology — Powercore rapidly, efficiently, and accurately controls power output to fixtures directly from line voltage, eliminating the need for external power supplies and allowing long product runs. Contractor-friendly installation dramatically simplifies installation and lowers total system cost.
- Support for multiple voltages — Accepts line voltage input of 100, 120, 208, 220 – 240, and 277 VAC for consistent installation and operation in a variety of locations.
- Dimming capability — Patented DiMand® technology offers smooth dimming capability with many two- and three-wire electronic low voltage (ELV) dimmers for all input voltages.
- Easy mounting and positioning — With end-to-end locking power connectors that can make 180º turns, eW Cove MX Powercore fixtures are easy to position in even the most challenging mounting circumstances. Fixtures rotate in 10º increments through 170º for precise aiming and color mixing. Optional mounting tracks allow quick project setup in linear applications, and support vertical and overhead positioning. Available jumper cables can add extra space between fixtures.

For detailed product information, please refer to the eW Cove MX Powercore Product Guide at www.colorkinetics.com/ls/essentialwhite/ewcovemxpc/
Specifications
Due to continuous improvements and innovations, specifications may change without notice.

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
<th>3000 K*, wide beam angle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumen*</td>
<td>534</td>
<td></td>
</tr>
<tr>
<td>Lumen Efficiency (lm/W)</td>
<td>45.3</td>
<td></td>
</tr>
<tr>
<td>CRI</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>Lumen Maintenance*</td>
<td>50,000 hours L70 @ 25° C</td>
<td>37,000 hours L70 @ 50° C</td>
</tr>
<tr>
<td></td>
<td>90,000 hours L50 @ 25° C</td>
<td>80,000 hours L50 @ 50° C</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>100 / 120 / 208 / 220 – 240 / 277 VAC, auto-switching, 50 / 60 Hz</td>
<td></td>
</tr>
<tr>
<td>Power Consumption</td>
<td>12.0 W maximum at full output, steady state</td>
<td></td>
</tr>
<tr>
<td>Power Factor</td>
<td>99</td>
<td></td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimming</td>
<td>Compatible with many commercially available ELV, trailing edge, or reverse-phase control dimmers1</td>
<td></td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>(Height x Width x Depth)</td>
<td>14.2 ft (4.3 m)</td>
</tr>
<tr>
<td>Weight</td>
<td>0.19 lbs (85 g)</td>
<td></td>
</tr>
<tr>
<td>Housing</td>
<td>Die-cast aluminium, white powder-coated finish</td>
<td></td>
</tr>
<tr>
<td>Lens</td>
<td>Polycarbonate</td>
<td></td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>0 – 95%, non-condensing</td>
<td></td>
</tr>
<tr>
<td>Maximum Fixture Run Length*</td>
<td>50 @ 100 VAC</td>
<td>60 @ 120 VAC</td>
</tr>
<tr>
<td></td>
<td>104 @ 208 VAC</td>
<td>115 @ 220 – 240 VAC, 139 @ 277 VAC</td>
</tr>
<tr>
<td><strong>Certification and Safety</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certification</td>
<td>UL, cUL, FCC, CE, CCC</td>
<td></td>
</tr>
<tr>
<td><strong>Certification and Safety</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td>Dry / Damp Location, IP50</td>
<td></td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td>ENERGY STAR, California Title 24 Compliant</td>
<td></td>
</tr>
<tr>
<td><strong>Photometrics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumen Maintenance‡</td>
<td>50,000 hours L50 @ 25° C</td>
<td>80,000 hours L50 @ 50° C</td>
</tr>
<tr>
<td><strong>Electrical and Safety</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Voltage</td>
<td>100 / 120 / 208 – 220 / 277 VAC, auto-switching, 50 / 60 Hz</td>
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</tr>
<tr>
<td>Power Consumption</td>
<td>12.0 W maximum at full output, steady state</td>
<td></td>
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<tr>
<td>Power Factor</td>
<td>99</td>
<td></td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>0 – 95%, non-condensing</td>
<td></td>
</tr>
<tr>
<td>Temperature Ranges</td>
<td>-4° – 122° F (-20° – 50° C) Operating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-4° – 122° F (-20° – 50° C) Startup</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-40° – 176° F (-40° – 80° C) Storage</td>
<td></td>
</tr>
<tr>
<td><strong>Run Length</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Fixture Run Length*</td>
<td>50 @ 100 VAC</td>
<td>60 @ 120 VAC</td>
</tr>
<tr>
<td></td>
<td>104 @ 208 VAC</td>
<td>115 @ 220 – 240 VAC, 139 @ 277 VAC</td>
</tr>
<tr>
<td><strong>Certification and Safety</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certification</td>
<td>UL, cUL, FCC, CE, CCC</td>
<td></td>
</tr>
<tr>
<td><strong>Certification and Safety</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td>Dry / Damp Location, IP50</td>
<td></td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td>ENERGY STAR, California Title 24 Compliant</td>
<td></td>
</tr>
</tbody>
</table>

1 Color temperatures conform to nominal CCTs as defined in ANSI Chromaticity Standard C78.377A.
2 Lumen measurement complies with IES LM-79-08 testing procedures.
3 L70 = 70% maintenance of lumen output (when light output drops below 70% of initial output).
4 L50 = 50% maintenance of lumen output (when light output drops below 50% of initial output).
5 Ambient temperatures specified. Based on measurements that comply with IES LM-80-08 testing in ANSI Chromaticity Standard C78.377A.
7 These figures, provided as a guideline, are accurate for this configuration only. Changing the configuration can affect the fixture run lengths.

**Fixtures**

<table>
<thead>
<tr>
<th>Type</th>
<th>Beam Angle</th>
<th>Item Number</th>
<th>Philips 12NC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2700 K</td>
<td>Wide</td>
<td>523-000050-02</td>
<td>91053700980</td>
</tr>
<tr>
<td>3000 K</td>
<td>Wide</td>
<td>523-000050-06</td>
<td>91053700984</td>
</tr>
<tr>
<td>3500 K</td>
<td>Wide</td>
<td>523-000050-10</td>
<td>91053700988</td>
</tr>
<tr>
<td>4000 K</td>
<td>Wide</td>
<td>523-000050-14</td>
<td>91053700992</td>
</tr>
<tr>
<td>Red</td>
<td>Wide</td>
<td>223-000050-00</td>
<td>91053701014</td>
</tr>
<tr>
<td>Green</td>
<td>Wide</td>
<td>223-000050-01</td>
<td>91053701015</td>
</tr>
<tr>
<td>Blue</td>
<td>Wide</td>
<td>223-000050-02</td>
<td>91053701016</td>
</tr>
<tr>
<td>Amber</td>
<td>Wide</td>
<td>223-000050-03</td>
<td>91053701017</td>
</tr>
</tbody>
</table>

**Photometrics**

**3000 K, wide beam angle**

**Polar Candela Distribution**

**Illuminance at Distance**

For lux multiply fc by 10.7

<table>
<thead>
<tr>
<th>Center Beam L</th>
<th>Beam Width</th>
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</thead>
<tbody>
<tr>
<td>400 fc</td>
<td>1.5 ft</td>
</tr>
<tr>
<td>200 fc</td>
<td>2.0 ft</td>
</tr>
<tr>
<td>100 fc</td>
<td>2.5 ft</td>
</tr>
<tr>
<td>50 fc</td>
<td>3.0 ft</td>
</tr>
<tr>
<td>25 fc</td>
<td>3.5 ft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lumens</th>
<th>Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>534</td>
<td>45.3 lm/W</td>
</tr>
</tbody>
</table>

**Accessories**

<table>
<thead>
<tr>
<th>Item</th>
<th>Type</th>
<th>Item Number</th>
<th>Philips 12NC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leader Cable</td>
<td>dUL, UL</td>
<td>108-000007-01</td>
<td>910537070972</td>
</tr>
<tr>
<td>Wiring Compartment</td>
<td>dUL, UL</td>
<td>120-000077-01</td>
<td>910537070994</td>
</tr>
<tr>
<td>Terminators, Qty</td>
<td>10 ft (3 m)</td>
<td>120-000058-01</td>
<td>91053701119</td>
</tr>
<tr>
<td>Jumper Cable</td>
<td>dUL, UL</td>
<td>108-000048-00</td>
<td>910537070974</td>
</tr>
<tr>
<td>Mounting Track</td>
<td>White, $1 (1219 mm)</td>
<td>120-000124-00</td>
<td>91053707187</td>
</tr>
</tbody>
</table>

Use Item Number when ordering in North America.

Copyright © 2009 – 2010 Philips Solid-State Lighting Solutions, Inc. All rights reserved. Chromacore, Chroma, CK, the CK logo, Color Kinetics, the Color Kinetics logo, ColorBlaze, ColorBurst, ColorGraze, ColorPlay, ColorReach, iW Reach, iW Fuse, DIFand, EssentialsWhite, whiteLED, Color. ColorBlast, iW Player, Optima, and Powercore are either registered trademarks or trademarks of Philips Solid-State Lighting Solutions, Inc. in the United States and/or other countries. All other brand or product names are trademarks or registered trademarks of their respective owners. Due to continuous improvements and innovations, specifications may change without notice.
D1  Recessed LED downlight fixture with 3-5/8 inch aperture, white reflector with white trim and integral 120 volt driver for use with six (6) 3 watt LEDs at 3000K CCT.

**Manufacturer:** WAC Lighting

**Lamp & Mfg:** 4in LEDme Downlight

**Accessories:**

**Remarks:** Contractor to specify fixture support rails.
**Ordering Matrix**

<table>
<thead>
<tr>
<th>Series</th>
<th>Lamp</th>
<th>Model Number</th>
<th>Installation Type</th>
<th>Options</th>
<th>Color Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td>LED</td>
<td>418</td>
<td>N = New construction</td>
<td>Non-IC rated</td>
<td>W = 3000K C = 4500K</td>
</tr>
</tbody>
</table>

Ordering Example (series – lamp - model - installation type - color temperature): HR–LED418-N-W

**Product Details**

**Description:**
4 inch LED NON-IC new construction housing with 6 LED lamp

**Materials:**
Die-cast aluminum painted black heat sink. Housing and junction box is 20 gauge steel, Frame and hanger bars are heavy gauge galvanized steel.

**J-Box:**
Seven knockouts and four non-metallic sheathed cable style wiring connectors provided for ease of installation. Rated for branch wiring.

**Driver:**
Input Voltage: 120V AC /60Hz, Power Factor > 0.9
Dimming with thermal protection.
Load: MAX 18W

**Lamping:**
Using 6 LED lamps
Color Temperature: 3000K  4500K
CRI: 80  75

**Ratings:**
IC rated. Cannot be completely covered with insulation
Residential Energy Star Rated.

**Mounting:**
Supplied with hanger bars, adjustable from 12"-24" to accommodate various joist construction and grid sizes. Hanger bars include a captive mounting “screw-nail” for ease of installation.

**Specification Features**

- Provides 70% average lumen maintenance at 50,000 hrs.
- Provided with Push-in wire connector for easy installation.
- Accommodate up to a 3/4” ceiling thickness.
- Dimming range from 100% to 1%.
- ANSI compliant Warm/Neutral LEDs.
- 35° Visual cut off angle.
- Replacement modules
- Far more resistant to vibration than incandescent or fluorescent downlights.
- 5 year WAC Lighting product warranty.

Approved dimmer
- Lutron C.W.D.
- Leviton VPE04

---

WAC Lighting reserves the right to modify the design of our products as part of the company’s continuous improvement program. Dec 2009
Compatible Trims (Sold Separately):

<table>
<thead>
<tr>
<th>Trim Style</th>
<th>Finish</th>
<th>Interior</th>
<th>Trim</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR-LED411 Open Reflector Round Trim</td>
<td>BK/WT</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td>BKBN</td>
<td>Black</td>
<td>Brushed Nickel</td>
</tr>
<tr>
<td></td>
<td>WT/WT</td>
<td>White</td>
<td>White</td>
</tr>
<tr>
<td>HR-LED421 Step Baffle Trim</td>
<td>BK/WT</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td>BKBN</td>
<td>Black</td>
<td>Brushed Nickel</td>
</tr>
<tr>
<td></td>
<td>WT/WT</td>
<td>White</td>
<td>White</td>
</tr>
<tr>
<td>HR-LED431 Shower Trim</td>
<td>WT</td>
<td>NA</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td>CH</td>
<td>NA</td>
<td>Chrome</td>
</tr>
<tr>
<td>HR-LED451 Square Open Trim</td>
<td>WT</td>
<td>NA</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td>CH</td>
<td>NA</td>
<td>Chrome</td>
</tr>
<tr>
<td>HR-LED471 Square Shower Trim</td>
<td>WT</td>
<td>NA</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td>CH</td>
<td>NA</td>
<td>Chrome</td>
</tr>
</tbody>
</table>

Photometry

**18W 4500K OPEN TRIM**

<table>
<thead>
<tr>
<th>Angle</th>
<th>MEAN CP</th>
<th>Lumens</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2723</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>2517</td>
<td>59</td>
</tr>
<tr>
<td>10</td>
<td>1949</td>
<td>142</td>
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<tr>
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**18W 3000K OPEN TRIM**

<table>
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<tr>
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</tbody>
</table>

WAC Lighting reserves the right to modify the design of our products as part of the company's continuous improvement program. Dec 2009.
### Product Details

**Description:**
4 inch LED IC new construction housing with 6 LED lamp

**Materials:**
Die-cast aluminum painted black heat sink. Housing and junction box is 20 gauge steel, Frame and hanger bars are heavy gauge galvanized steel.

**J-Box:**
Seven knockouts and four non-metallic sheathed cable style wiring connectors provided for ease of installation. Rated for branch wiring.

**Driver:**
Input Voltage: 120V AC /60Hz, Power Factor > 0.9
Dimming with thermal protection.
Load: MAX 11W

**Lamping:**
6 LED lamps
Color Temperature: 3000K 4500K
CRI: 80 75

**Ratings:**
IC rated. Can be completely covered with insulation
Residential Energy Star Rated.

**Mounting:**
Supplied with hanger bars, adjustable from 12”-24” to accommodate various joist construction and grid sizes. Hanger bars include a captive mounting “screw-nail” for ease of installation.

### Specification Features

- Provides 70% average lumen maintenance at 50,000 hrs.
- Provided with Push-in wire connector for easy installation.
- Accommodate up to a 3/4” ceiling thickness.
- Dimming range from 100% to 1%.
- ANSI compliant Warm/Neutral LEDs.
- 35° Visual cut off angle.
- Replacement modules
- Far more resistant to vibration than incandescent or fluorescent downlights.
- 5 year WAC Lighting product warranty.

**Approved dimmer**
- Lutron
- Leviton

**SELV-300P-WH**
**VPE04**
Compatible Trims (Sold Separately):

**HR-LED411 Open Reflector Round Trim**

<table>
<thead>
<tr>
<th>Finish</th>
<th>Interior</th>
<th>Trim</th>
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<tbody>
<tr>
<td>BK/WT</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>BKBN</td>
<td>Black</td>
<td>Brushed Nickel</td>
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<tr>
<td>WT/WT</td>
<td>White</td>
<td>White</td>
</tr>
</tbody>
</table>

**HR-LED421 Step Baffle Trim**

<table>
<thead>
<tr>
<th>Finish</th>
<th>Interior</th>
<th>Trim</th>
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</thead>
<tbody>
<tr>
<td>BK/WT</td>
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<tr>
<td>BKBN</td>
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<td>Brushed Nickel</td>
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<td>WT/WT</td>
<td>White</td>
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**HR-LED431 Shower Trim**

<table>
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<th>Finish</th>
<th>Interior</th>
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<td>White</td>
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<tr>
<td>CH</td>
<td>NA</td>
<td>Chrome</td>
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**HR-LED441 Square Shower Trim**

<table>
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<th>Finish</th>
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<td>White</td>
</tr>
<tr>
<td>CH</td>
<td>NA</td>
<td>Chrome</td>
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Photometry

**11W 4500K OPEN TRIM**

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**11W 3000K OPEN TRIM**

<table>
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<tr>
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</table>
4” LEDme™ DOWNLIGHT  

**Product Details**

**Description:** Recessed trim with interior step baffle reflector. For use with HR-LED418 series housing.

**Materials:** Powder coated or plated brushed nickel finish on die-cast aluminum. Fingered retention clips firmly hold trim to housing.

**Finish:**
- BK/WT = Black reflector with white trim
- BK/BN = Black reflector with brushed nickel trim
- WT/WT = White reflector with white trim

**Listing:** UL & CUL Listed. Residential Energy Star Rated.

**Specification Features**

- Handles surfaces up to 3/4”.
- Deep regression of source produces a very low glare system with 33˚ cut-off angle.
- 5 years WAC Lighting product warranty.

**Compatible Housings (Sold Separately)**

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>HR-LED418-NIC-W</td>
<td>New construction IC housing</td>
</tr>
<tr>
<td></td>
<td>Dimming with thermal protection</td>
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<tr>
<td></td>
<td>6 LEDs</td>
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<td></td>
<td>Max wattage 11W</td>
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<td></td>
<td>Color Temperature: 3000K</td>
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<table>
<thead>
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<td>Dimming with thermal protection</td>
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<tr>
<td></td>
<td>6 LEDs</td>
</tr>
<tr>
<td></td>
<td>Max wattage 11W</td>
</tr>
<tr>
<td></td>
<td>Color Temperature: 4500K</td>
</tr>
<tr>
<td>Compatible Housings (Sold Separately)</td>
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</tr>
<tr>
<td>--------------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>HR-LED418-N-W</td>
<td>HR-LED418-N-C</td>
</tr>
<tr>
<td>New construction NON-IC housing</td>
<td>New construction NON-IC housing</td>
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<tr>
<td>Dimming with thermal protection</td>
<td>Dimming with thermal protection</td>
</tr>
<tr>
<td>6 LEDs</td>
<td>6 LEDs</td>
</tr>
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<td>Max Wattage 18W</td>
</tr>
<tr>
<td>Color Temperature: 3000K</td>
<td>Color Temperature: 4500K</td>
</tr>
</tbody>
</table>

| HR-LED418-RIC-W                     | HR-LED418-RIC-C              |
| Remodel IC housing                  | Remodel IC housing           |
| Dimming with thermal protection      | Dimming with thermal protection|
| 6 LEDs                               | 6 LEDs                      |
| Max Wattage 11W                      | Max Wattage 11W              |
| Color Temperature: 3000K             | Color Temperature: 4500K     |

| HR-LED418-R-W                       | HR-LED418-R-C                |
| Remodel NON-IC housing               | Remodel NON-IC housing       |
| Dimming with thermal protection      | Dimming with thermal protection|
| 6 LEDs                               | 6 LEDs                      |
| Max Wattage 18W                      | Max Wattage 18W              |
| Color Temperature: 3000K             | Color Temperature: 4500K     |

Note: The full catalog number for a complete downlight includes the model numbers for both the trim and the housing.
D2  Recessed, wet location LED downlight fixture with 5 inch diameter faceplate, medium flood optics and integral driver for use with one (1) 8 watt LED at 3000K CCT. Satin White finish.

**Manufacturer:**  B-K LIGHTING # VS-LED-e22-MFL-WHP-12

**Lamp & Mfg:**  LED is included in fixture part number.

**Accessories:**

**Remarks:**  Contractor to confirm that LED power supply is integral to fixture.
### CATALOG NUMBER LOGIC

**Example:**

<table>
<thead>
<tr>
<th>VS</th>
<th>LED</th>
<th>e25</th>
<th>SP</th>
<th>MAC</th>
<th>13</th>
<th>11</th>
</tr>
</thead>
</table>

*Material*
- Blank
- Aluminum (A)
- Brass (B)
- Stainless Steel (S)

*Series*
- V5 - Versa Star™

*Source*
- LED: 'e' Technology with Integral Driver

*LED Type*
- e22 - BALED/3K
- e23 - BALED/4K
- e24 - BALED/Red
- e25 - BALED/Green
- e26 - BALED/Blue
- e27 - BALED/Amar

*Optics*
- SP - Spot (Green Indicator)
- MFL - Medium Flood (Yellow Indicator)
- WFL - Wide Flood (Blue Indicator)

*Finish*
- Aluminum & Brass Finish
  - Powder Coat Color: Satin (S), Wrinkle (W), Stainless Finish (F)
  - Brass Finish: Machined (MAC), Polished (POL), Mitique™ (MIT)
- Also available in Premium Finishes

*Shielding*
- 11 - Honeycomb Baffle
- 12 - Soft Focus Lens
- 13 - Rectilinear Lens

### LM79 DATA

<table>
<thead>
<tr>
<th>BK No.</th>
<th>CCT (typ)</th>
<th>Input Watts (Typ)</th>
<th>CRI (Typ)</th>
<th>L70 DATA Minimum Rated Life (hrs.)</th>
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<tbody>
<tr>
<td>e22</td>
<td>3100K</td>
<td>8.4</td>
<td>80</td>
<td>50,000</td>
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<td>4100K</td>
<td>8.4</td>
<td>80</td>
<td>50,000</td>
</tr>
<tr>
<td>e24</td>
<td>Red (627nm)</td>
<td>7.9</td>
<td>80</td>
<td>50,000</td>
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<td>e25</td>
<td>Green (530nm)</td>
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<td>50,000</td>
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<td>e26</td>
<td>Blue (470nm)</td>
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<td>~</td>
<td>50,000</td>
</tr>
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<td>e27</td>
<td>Amber (595nm)</td>
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<td>50,000</td>
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### L70 DATA

<table>
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<tr>
<th>Minimum Rated Life (hrs.)</th>
<th>70% of initial lumens (l70)</th>
<th>Beam Type</th>
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<td>50,000</td>
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<td>Narrow Spot</td>
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<tr>
<td>50,000</td>
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<td>Spot</td>
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<tr>
<td>50,000</td>
<td></td>
<td>Medium Flood</td>
</tr>
<tr>
<td>50,000</td>
<td></td>
<td>Wide Flood</td>
</tr>
</tbody>
</table>

### B-K LIGHTING

40425 Brokine Drive • Madera, CA 93638 • USA
559.438.5800 • FAX 559.438.5900
www.bklighting.com • info@bklighting.com

*OPTICAL DATA*

<table>
<thead>
<tr>
<th>Beam Type</th>
<th>Angle</th>
<th>Visual Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow Spot</td>
<td>14°</td>
<td>Red Dot</td>
</tr>
<tr>
<td>Spot</td>
<td>18°</td>
<td>Green Dot</td>
</tr>
<tr>
<td>Medium Flood</td>
<td>25°</td>
<td>Yellow Dot</td>
</tr>
<tr>
<td>Wide Flood</td>
<td>36°</td>
<td>Blue Dot</td>
</tr>
</tbody>
</table>

Published 5/3/2011
Page - 249
Section 260500
**SPECIFICATIONS**

**GreenSource Initiative™**
Metal and packaging components are made from recycled materials. Manufactured using renewable solar energy, produced onsite. Returnable to manufacturer at end of life to ensure cradle-to-cradle handling. Packaging contains no chlorofluorocarbons (CFC’s). Use of this product may qualify for GreenSource efficacy and recycling rebate(s).

Consult www.bklighting.com/greensource for program requirements.

**Materials**
Furnished in Copper-Free Aluminum (Type 6061-T6), Brass (Type 360) or Stainless Steel (Type 316).

**Backbox**
Round. 4-1/4" dia. x 3-1/8" deep construction with (2) mounting tabs. Front access for wire connection and inspection. Provided with (3) 1/2" NPS tapped holes and (4) plugs. Suitable for concrete pour.

**Faceplate**
Fully machined from solid billet. Countersunk holes provide for flush hardware mounting with (2) tamper-resistant, stainless steel mounting screws. Stainless steel universal mounting ring for faceplate adjustment and 1-1/8" thick HT-80A silicone foam gasket with acrylic adhesive for water-tight seal. Accommodates (1) lens or louver media.

**Lens**
Shock resistant, tempered, glass lens is factory adhered to faceplate. Specify soft focus (#1) or rectilinear (#13) lens.

**BKSSL™**
Integrated solid state system with 'Y' technology is scalable for field upgrade. Modular design with electrical quick disconnects, permit field maintenance. High power, forward throw source complies with ANSI C78.377 binning requirements. Exceeds ENERGY STAR® lumen maintenance requirements. LM-60 certified. Integral non-dimming driver. Minimum 50,000 hour rated life at 70% of initial lumens (L70). BKSSL technology provides long life, significant energy reduction and exceptional thermal management.

**Options**
Interchangeable OPTIKIT™ modules permit field changes to optical distribution. Color-coded for easy reference:
- Narrow Spot (NOS) = Red
- Spot (SP) = Green
- Medium Flood (MFU) = Yellow
- Wide Flood = Blue

Adjustable optical bracket provides up to 24° vertical aiming.

**Hardware**
Tamper resistant, stainless steel hardware. Faceplate screws are additionally black oxide treated for additional corrosion resistance.

**Finish**
StarGuard® (Pat. Pend.), a RoHs compliant, 15 stage chromate-free process cleans and conversion coats aluminum components prior to application of Class 'X' TGIC polyester powder coating. Brass components are available in powder coat or handcrafted metal finish. Stainless steel components are available in handcrafted metal finish. (Brushed finish for interior use only).

**Warranty**
5 year limited warranty.

**Certification and Listing**

**Optics**
for use with 12VAC remote transformer.

**Wiring**
Teflon® coated, 18AWG, 600V, 250° C rated and certified to UL 1699 standard.

**VAC®**
Remote transformer.

**REMOTE OPTIONS**

- **T** (Configure separately)
- **R**
- **Series PMRM™**

**T** Remote transformer

**R Series PMRM™**

**SIDE VIEW**

**FACEPLATE DETAIL**

**ACCESSORIES**
(Configuration separately)

**Remote options:**

- **FMB™**
- **FMW™**

**B-K LIGHTING**

- **40429 Brickyard Drive • Madera, CA 93636 • USA 559.438.5800 • FAX 559.438.5900**
- **www.bklighting.com • info@bklighting.com**

**U.S. D.O.E. Solar Decathlon 2011**

**Electrical Specifications**

**VERSA STAR™**

**PROJECT:**

**TYPE:**

**SUBMITTAL DATE**

**DRAWING NUMBER**

**PAGE 250**

**SECTION 260500**

Published 5/3/2011
### Electrical Specifications

#### Section 260500 |

**Vena Star™ - Med. Flood**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Output (Lumens)</td>
<td>346</td>
<td></td>
</tr>
<tr>
<td>Watts</td>
<td>8.2</td>
<td></td>
</tr>
<tr>
<td>Lumens per Watt (Efficacy)</td>
<td>42</td>
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</tr>
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</table>

**Color Accuracy**

| Color Rendering Index (CRI) | 68 | |

**Light Color**

- **Color Temperature (CCT):** 6000K
- **Color Temperature (CCT):** 4000K
- **Color Temperature (CCT):** 3000K
- **Color Temperature (CCT):** 2700K

**Visually Appealing Colors**

- **Reds:** Rich, saturated
- **Yellows:** Warm, inviting
- **Blues:** Calm, soothing
- **Greens:** Fresh, lively

**Visit:** [www.lightingfacts.com for the Label Reference Guide.](https://www.lightingfacts.com)

**Registration Number:** DCX1-04M1L

**Model Number:** VS-LED-422-AMFL-12

**Type:** Surface-mounted downlight

---

**Vena Star™ - Spot**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>Watts</td>
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<td></td>
</tr>
<tr>
<td>Lumens per Watt (Efficacy)</td>
<td>44</td>
<td></td>
</tr>
</tbody>
</table>

**Color Accuracy**

| Color Rendering Index (CRI) | 68 | |

**Light Color**

- **Color Temperature (CCT):** 6000K
- **Color Temperature (CCT):** 4000K
- **Color Temperature (CCT):** 3000K
- **Color Temperature (CCT):** 2700K

**Visually Appealing Colors**

- **Reds:** Rich, saturated
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- **Blues:** Calm, soothing
- **Greens:** Fresh, lively

**Visit:** [www.lightingfacts.com for the Label Reference Guide.](https://www.lightingfacts.com)

**Registration Number:** DCX1-04M1X1B

**Model Number:** VS-LED-422-SP-12

**Type:** Surface-mounted downlight

---

**Vena Star™ - Narrow Spot**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Output (Lumens)</td>
<td>365</td>
<td></td>
</tr>
<tr>
<td>Watts</td>
<td>8.2</td>
<td></td>
</tr>
<tr>
<td>Lumens per Watt (Efficacy)</td>
<td>44</td>
<td></td>
</tr>
</tbody>
</table>

**Color Accuracy**

| Color Rendering Index (CRI) | 68 | |

**Light Color**

- **Color Temperature (CCT):** 6000K
- **Color Temperature (CCT):** 4000K
- **Color Temperature (CCT):** 3000K
- **Color Temperature (CCT):** 2700K

**Visually Appealing Colors**

- **Reds:** Rich, saturated
- **Yellows:** Warm, inviting
- **Blues:** Calm, soothing
- **Greens:** Fresh, lively

**Visit:** [www.lightingfacts.com for the Label Reference Guide.](https://www.lightingfacts.com)

**Registration Number:** DCX1-04M1X1A

**Model Number:** VS-LED-422-NSP-12

**Type:** Surface-mounted downlight

---

**Vena Star™ - W. Flood**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Output (Lumens)</td>
<td>299</td>
<td></td>
</tr>
<tr>
<td>Watts</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>Lumens per Watt (Efficacy)</td>
<td>35</td>
<td></td>
</tr>
</tbody>
</table>

**Color Accuracy**

| Color Rendering Index (CRI) | 66 | |

**Light Color**

- **Color Temperature (CCT):** 6000K
- **Color Temperature (CCT):** 4000K
- **Color Temperature (CCT):** 3000K
- **Color Temperature (CCT):** 2700K

**Visually Appealing Colors**

- **Reds:** Rich, saturated
- **Yellows:** Warm, inviting
- **Blues:** Calm, soothing
- **Greens:** Fresh, lively

**Visit:** [www.lightingfacts.com for the Label Reference Guide.](https://www.lightingfacts.com)

**Registration Number:** DCX1-04M1F1T

**Model Number:** VS-LED-622-AMFL-13

**Type:** Surface-mounted downlight

---

**Vena Star™ - W. Flood - Resilience**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Output (Lumens)</td>
<td>345</td>
<td></td>
</tr>
<tr>
<td>Watts</td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td>Lumens per Watt (Efficacy)</td>
<td>41</td>
<td></td>
</tr>
</tbody>
</table>

**Color Accuracy**

| Color Rendering Index (CRI) | 67 | |

**Light Color**

- **Color Temperature (CCT):** 6000K
- **Color Temperature (CCT):** 4000K
- **Color Temperature (CCT):** 3000K
- **Color Temperature (CCT):** 2700K

**Visually Appealing Colors**

- **Reds:** Rich, saturated
- **Yellows:** Warm, inviting
- **Blues:** Calm, soothing
- **Greens:** Fresh, lively

**Visit:** [www.lightingfacts.com for the Label Reference Guide.](https://www.lightingfacts.com)

**Registration Number:** DCX1-04M1P1P1E

**Model Number:** VS-LED-422-AMFL-12

**Type:** Surface-mounted downlight
P1  Pendant (white cord) mounted decorative fixture with spun aluminum components for use with one (1) 23 watt self-ballasted compact fluorescent lamp with medium base. White finish.

**Manufacturer:** LOUIS POULSEN # PHS-1/23/CF MEDIUM-120V-WHT

**Lamp & Mfg:** Lamp included with Fixture.

**Accessories:**

**Remarks:** Overall suspension height of fixture to be determined.
**PH 5**

**compact fluorescent**

**Design:** Paul Henningsen

---

**Type:**

**Project:**

**Catalog Number:**

---

**4" OCTAGONAL JUNCTION BOX (BY OTHERS)**

**CEILING LINE**

**WHITE CEILING CANOPY**

**WHITE PVC COVERED POWER CORD 3 CONDUCTOR, 18 AWG, 12 L.G.**

**ADJUSTABLE SOCKET FOR OPTIMAL LAMP OUTPUT**

**MEDIUM BASE PORCELAIN SOCKET**

**WHITE OR GRAPHITE GREY WET PAINTED SOSPENSIION WITH PAINTED WHITE ON THE UNDERSIDES. TWIST-LOCK DESIGN FOR FAST, TOOL LESS RELAMPING**

**3" MATTE CHROME PLATED ROLLED ALUMINUM FOR THE GRAPHITE VERSION OR PAINTED PURPLE SUPPORTING STRUTS FOR THE WHITE VERSION**

**SPUN ALUMINUM WHITE OR GRAPHITE GREY WET PAINTED SHADES WITH MATTE WHITE ON THE UNDERSIDES**

**SPUN ALUMINUM WHITE OR GRAPHITE GREY WET PAINTED SHADES PAINTED RED ON THE UNDERSIDES**

**INTERVAL SHADE WITH MATTE WHITE FINISH ON THE TOP SIDE AND DARK BLUE FINISH ON THE UNDERSIDE FOR GRAPHITE AND WHITE VERSION**

**MAXIMUM LAMP: 1/25W/25W/50W SELF-BALLASTED COMPACT FLUORESCENT (PROVIDED BY LOUIS POULSEN LIGHTING, INC.)**

**SAND-BLASTED FROSTED GLASS CONCEALING SHIELD**

---

Louis Poulsen Lighting, Inc., 3260 Meridian Parkway, Fort Lauderdale, FL 33331 Telephone: (954) 349-2525 Fax: (954) 349-2550

www.louispoulsen.com

[Status]

U.S. D.O.E. Solar Decathlon 2011

Electrical Specifications  

Published 5/3/2011  

Page - 253  

Section 260500
**PH 5**

**pendants**

**compact fluorescent**

---

**Design**

Poul Henningsen

**Concept**

PH 5 (1958) provides a glare free illumination. The design of the visible reflectors ensures that light is directed both vertically and horizontally. Light is diffused through a sandblasted glass shield located in the lower shade. The inside cone is painted red, and together with the small blue reflector creates a warmer tone of light.

**Finish**

White or graphite grey, wet painted.

**Material**


**Mounting**

Canopy: White. Cord type: 3-conductor, 18 AWG white PVC power cord. Cord length: 12’.

**Weight**

Max. 5 lbs.

**Label**

cUL, Dry location. IBEW.

---

<table>
<thead>
<tr>
<th>Product code</th>
<th>Light source</th>
<th>Voltage</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHS</td>
<td>1/23W/4 medium</td>
<td>120V</td>
<td>GRP GREY</td>
</tr>
<tr>
<td></td>
<td>1/200W/A-23/8 medium</td>
<td></td>
<td>WHT</td>
</tr>
</tbody>
</table>

---

**Specifications**

- All data shown are per 1500 lumens. Use only actual lumens when calculating.
- Only grey variant is only available with matte chrome plated strut.
- White variant is only available with purple struts.
- III. The comparable EUN version has the following classification: ingress Protection Code: IP20.
P2  Pendant (white cord) mounted decorative fixture

**Manufacturer:** Light Years

**Lamp & Mfg:** Caravaggio

**Remarks:** Overall suspension height of fixture to be determined.
CARAVAGGIO P4 2x42w
Designed by Cecilie Manz 2006

Caravaggio P4 is a series of metal pendants with an eye-catching high gloss lacquer. The suspension technology is made large in the pendants, creating the right counterbalance to the shade's feminine lines. This pendant looks its best in large high-ceiling rooms, whether it is a bustling premises, public environment or in private homes. There are three different versions of the P4 lamp with a pendant. The two light sources are recommended, where there is a need for higher lighting levels and greater energy efficiency. They are both supplied with bulbs, dimmable by switch. The pendant is named after the Italian Baroque painter Caravaggio, who is known for his dramatic paintings with large contrast between light and shadow.

Surface
High gloss lacquer

Material
Shade: Drawn aluminium
Suspension: Curved steel rods and turned brass coated in mirror chrome for the Black/Red and White/Grey.

Installation
Suspension: Tinsel cable 2x0.75mm². Cable and wire length: 6m
Canopy: Black/Red and White/Grey: White

Class
IP20: Class of insulation II

Product family

<table>
<thead>
<tr>
<th>Product code</th>
<th>EAN code</th>
<th>Surface</th>
<th>Light source</th>
<th>Max light source dimensions</th>
<th>Total weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>64020001</td>
<td>570280000881</td>
<td>Basic, red cord</td>
<td>G924W 2x42W</td>
<td>Max length: 350 mm</td>
<td>6.2 kg</td>
</tr>
<tr>
<td>64020005</td>
<td>570280000887</td>
<td>White, grey cord</td>
<td>G924W 2x42W</td>
<td>Max diameter: 100 mm</td>
<td></td>
</tr>
</tbody>
</table>

P3 Pendant (white cord) mounted decorative fixture

Manufacturer: Modernica

Lamp & Mfg: Nelson ball Criss Cross Pendant
Remarks: Overall suspension height of fixture to be determined.

**T1**  Floor lamp with adjustable arm and task light. Chromed steel finish.

**Bubble Lamp Ball Crisscross Pendant**  
Plastic and steel wire frame.  
Each assembly kit includes a 5.25-inch diameter brushed nickel ceiling plate and 6 feet of cord.  
UL-listed. Bulb not included. 150W/120V  
Each lamp is built to George Nelson’s original specifications.  
Handcrafted in Michigan, U.S.A.

7366 Beverly Boulevard, Los Angeles CA 90036  
TEL: 323-933-0383  
MODERNICA.NET  
distributed by GEORGENELSONBUBBLELAMP

- 12" 30.48 cm  
- 12.75" 32.385 cm  
- 15.5" 39.4 cm  
- 19" 48.26 cm
Manufacturer: ARTEMIDE

Lamp & Mfg: Tolomeo LED reading floor lamp

Tolomeo classic floor
Tolomeo mini floor
Tolomeo micro floor
Tolomeo with shade floor
Tolomeo classic LED floor
Tolomeo micro LED floor

Fabricated by: Michele De Lucchi, Giancarlo Fassina 2009

Floor standing luminaires for adjustable direct task incandescent, fluorescent, or LED lighting:

- Floor support consisting of weighted steel base with stamped aluminum cover and stem in chromed steel, combined with Tolomeo table models for conversion to floor models
- Optional set of castors in molded thermoplastic attach to base for easy mobility (not available for micro)

**Awards**

Tolomeo classic floor
Compasso d’Oro / A.D.I. 1989 - Milano (Italia)

**Tolomeo classic/classic LED floor**

- Incandescent source
  - 1 x 100W (E26/A19)
  - or
  - Fluorescent source
  - 1 x 13W (GX23-2/T4)
  - or
  - LED source
  - 5 LEDs/10W supplied

**Tolomeo mini floor**

- Incandescent source
  - 1 x 100W (E26/A19)
  - or
  - Fluorescent source
  - 1 x 13W (GX23-2/T4)
  - or
  - LED source
  - 7 LEDs/6W supplied

**Tolomeo micro floor**

- Incandescent source
  - 1 x 60W (E26/G161/2)
  - or
  - Fluorescent source
  - 1 x 13W (GX24q-1/T8)

**Tolomeo micro LED floor**

- LED source
  - 7 LEDs/6W supplied

**Tolomeo with shade floor**

- Incandescent source
  - 1 x 75W (E26/A19)
  - or
  - Fluorescent source
  - 1 x 13W (GX24q-1/T8)

**T2** Desk lamp with adjustable arm and task light. Chromed steel finish

Manufacturer: ARTEMIDE
Tolomeo classic LED table

Michele De Lucchi, Giancarlo Fassina 2009

Table standing luminaire for adjustable direct task LED lighting.

- fully adjustable articulated arm structures in polished aluminum
- joints and tension control knobs in polished die-cast aluminum
- internal tension springs and external tension control cables in stainless steel
- tiltable diffuser in aluminum with incorporated touch dimmer rotates 90° side to side

Choice of table mountings:
- ø 9" (23 cm) base in weighted steel with stamped aluminum cover
- table clamp in die-cast aluminum, maximum opening is 2" (5 cm)
- table in-set pivot in die-cast aluminum, maximum table thickness is 2 1/2" (6.4 cm), hole is ø 3/4" (1.9 cm)

LED source
- 1 x 10W (LED) supplied

W1   Exterior, East Porch Light
Manufacturer: Wagner Companies

Lamp & Mfg: Light Stick LED

LED Light Stick

- 50,000 Hours
- Handrail or Guardrail
- Latest LED Technology
- Accent or Practical Lighting
- Improve Safety and Security

LUMENRAIL®
At just 3⁄4” wide, the Wagner Lumenrail® ETL listed luminaries produce brilliant cool or warm white light and come in lengths from 6 to 60 inches.

Wagner Lumenrail® fixtures can be installed indoors or out in both wet and dry locations. They may be wall, ceiling, or under-cabinet mounted within 48” of the ground.

The Wagner fixtures are fully dimmable when used in conjunction with listed DC voltage controllers – supplied by others.

Contact Wagner regarding independent photometric test reports and IES format data.

To maintain ETL listing, power must be supplied by a Wagner provided Class 2, 24VDC Driver.

NOTE: Do not exceed 80% of the driver’s maximum amperage rating. Read and follow all installation instructions from the Class 2 Driver manufacturer.

The fixtures are fully dimmable using controllers listed for the purpose - dimmers are supplied by others. All wiring must be done by a qualified electrician per national and local electrical codes. Turn off the power before terminating the Driver. DO NOT WIRE HOT!

Contact Wagner regarding structural test data.

All metals have a recycled content and high reclamation rate. Contact Wagner for data relating to your specific product selection.

LED SPECIFICATIONS

<table>
<thead>
<tr>
<th>Color Temperature</th>
<th>Warm White</th>
<th>3100K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lens Angle</td>
<td>60 Degrees</td>
<td>60 Degrees</td>
</tr>
<tr>
<td>Light Output:</td>
<td>87.3 lm/ft</td>
<td>109.3 lm/ft</td>
</tr>
<tr>
<td>Transparent Lens</td>
<td>57.9 lm/ft</td>
<td>64.4 lm/ft</td>
</tr>
<tr>
<td>Matte Lens</td>
<td>49.6 lm/W</td>
<td>48.4 lm/W</td>
</tr>
<tr>
<td>Housing:</td>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>Size:</td>
<td>3/4” x 6”, 12”, 18”, 24”, 30”, 36”, 42”, 48”, 54” and 60”</td>
<td></td>
</tr>
<tr>
<td>Listings:</td>
<td>ETL - for wet and dry locations*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Not Suitable for submerged applications.</td>
<td></td>
</tr>
</tbody>
</table>

ELECTRICAL SPECIFICATIONS

- Power Requirement: 24VDC
- Power Consumption: 2 Watts per foot
- Power Supply: Wagner provided Class 2 - 24VDC
- Temperature Range: -22°F to 120°F (-30°C to 49°C) Operating Temperature
- LED Life: 50,000 hours (approximately)
- NEMA Rating: NEMA 3R

NEMA 3R
### LUMENRAIL LED LIGHT STICKS

#### 3K Operating Temperature - Warm White

60° Beam pattern; Transparent or Matte (Diffused) Lens.

<table>
<thead>
<tr>
<th>Transparent Lens</th>
<th>Matte Lens</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>LULS3K60T-6</td>
<td>LULS3K60M-6</td>
<td>7-3/16&quot;</td>
<td>10&quot;</td>
</tr>
<tr>
<td>LULS3K60T-12</td>
<td>LULS3K60M-12</td>
<td>13-1/8&quot;</td>
<td>15-1/16&quot;</td>
</tr>
<tr>
<td>LULS3K60T-18</td>
<td>LULS3K60M-18</td>
<td>18-15/16&quot;</td>
<td>21-3/4&quot;</td>
</tr>
<tr>
<td>LULS3K60T-24</td>
<td>LULS3K60M-24</td>
<td>24-15/16&quot;</td>
<td>27-3/4&quot;</td>
</tr>
<tr>
<td>LULS3K60T-30</td>
<td>LULS3K60M-30</td>
<td>30-15/16&quot;</td>
<td>33-3/4&quot;</td>
</tr>
<tr>
<td>LULS3K60T-36</td>
<td>LULS3K60M-36</td>
<td>36-11/16&quot;</td>
<td>39-1/2&quot;</td>
</tr>
<tr>
<td>LULS3K60T-42</td>
<td>LULS3K60M-42</td>
<td>42-11/16&quot;</td>
<td>45-1/2&quot;</td>
</tr>
<tr>
<td>LULS3K60T-48</td>
<td>LULS3K60M-48</td>
<td>48-5/8&quot;</td>
<td>51-1/2&quot;</td>
</tr>
<tr>
<td>LULS3K60T-54</td>
<td>LULS3K60M-54</td>
<td>54-5/8&quot;</td>
<td>57-1/2&quot;</td>
</tr>
<tr>
<td>LULS3K60T-60</td>
<td>LULS3K60M-60</td>
<td>60-1/2&quot;</td>
<td>63-1/4&quot;</td>
</tr>
</tbody>
</table>

#### 5K Operating Temperature - Cool White

60° Beam pattern; Transparent or Matte (Diffused) Lens.

<table>
<thead>
<tr>
<th>Transparent Lens</th>
<th>Matte Lens</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>LULS5K60T-6</td>
<td>LULS5K60M-6</td>
<td>7-3/16&quot;</td>
<td>10&quot;</td>
</tr>
<tr>
<td>LULS5K60T-12</td>
<td>LULS5K60M-12</td>
<td>13-1/8&quot;</td>
<td>15-1/16&quot;</td>
</tr>
<tr>
<td>LULS5K60T-18</td>
<td>LULS5K60M-18</td>
<td>18-15/16&quot;</td>
<td>21-3/4&quot;</td>
</tr>
<tr>
<td>LULS5K60T-24</td>
<td>LULS5K60M-24</td>
<td>24-15/16&quot;</td>
<td>27-3/4&quot;</td>
</tr>
<tr>
<td>LULS5K60T-30</td>
<td>LULS5K60M-30</td>
<td>30-15/16&quot;</td>
<td>33-3/4&quot;</td>
</tr>
<tr>
<td>LULS5K60T-36</td>
<td>LULS5K60M-36</td>
<td>36-11/16&quot;</td>
<td>39-1/2&quot;</td>
</tr>
<tr>
<td>LULS5K60T-42</td>
<td>LULS5K60M-42</td>
<td>42-11/16&quot;</td>
<td>45-1/2&quot;</td>
</tr>
<tr>
<td>LULS5K60T-48</td>
<td>LULS5K60M-48</td>
<td>48-5/8&quot;</td>
<td>51-1/2&quot;</td>
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<tr>
<td>LULS5K60T-54</td>
<td>LULS5K60M-54</td>
<td>54-5/8&quot;</td>
<td>57-1/2&quot;</td>
</tr>
<tr>
<td>LULS5K60T-60</td>
<td>LULS5K60M-60</td>
<td>60-1/2&quot;</td>
<td>63-1/4&quot;</td>
</tr>
</tbody>
</table>
W3  Bathroom vanity light

**Manufacturer:**  FLOS

**Lamp & Mfg:**  Mini Glo Ball
MINI GLO-BALL C/W

Mounting: Ceiling, wall or mirror  
Lamps description: 1 x MAX 25W G9 HSSG  
Environment: Indoor  
Finish: White  
Technical description: Lamp for ceiling, wall or mirror providing diffused light. Diffuser consisting of an externally acid etched, hand blown, flashed opaline glass and of a white, injection-molded PPS threaded ring nut. Injection-molded PPS white mirror ring nut. MIRROR HOLE: ø 35 mm.

<table>
<thead>
<tr>
<th>ELECTRICAL</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency: Without</td>
<td></td>
</tr>
<tr>
<td>Voltage (V): 230</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PHYSICAL</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply: Terminal block</td>
<td></td>
</tr>
<tr>
<td>Construction material: Glass, PPS</td>
<td></td>
</tr>
<tr>
<td>Weight (kg): 0.3</td>
<td></td>
</tr>
</tbody>
</table>

Mini Glo-Ball C/W  
design by Jasper Morrison  
Lamp for ceiling, wall or mirror providing diffused light.

Reference Code  
F4190009 White/White

Certifications

Light Switches:

[Status]  
U.S. D.O.E. Solar Decathlon 2011  
Electrical Specifications  
Published 5/3/2011  
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Section 260500
DIVA© / C•L™ Dimmer
Dimmer for CFL • LED dimmable bulbs.

**Features**
- Large paddle switch with a captive linear-slide dimmer for a standard designer wallplate opening
- HED™ Technology: Lutron’s advanced dimming circuitry designed for compatibility with most high efficacy light bulbs
- UL Listed to control:
  - Dimmable compact fluorescent (CFL) with integrated ballast
  - Dimmable LED with integrated driver
  - Halogen
  - Incandescent
- Low-end adjustment dial to accommodate a wide range of bulbs

**Specifications**

**Regulatory Approvals**
- UL Listed to US and Canadian safety standards UL1472 / CSA C22.2 184.1

**Power and Ratings**
- 120 V~ 60 Hz
- 150 W Dimmable CFL/LED or 600 W Incandescent/Halogen

**Mixed bulb type per Multigang and Mixed Bulb Type Ratings table (see page 3)**

**Application Requirements**
- *When using CFLs or LEDs, only bulbs marked or rated as Dimmable can be used.*
- For a complete list of approved DIMMABLE CFLs and LEDs please call 1.800.523.9466 or visit www.lutron.com/dimmed

**Environment**
- For indoor use only.
- Operating temperatures 0°C (32 °F) to 40 °C (104 °F).

**Performance**
- Power-failure memory
- Captive linear slider
- Electrostatic discharge tested
- Precise color matching
- Voltage compensation
- Mechanical air-gap switch to disconnect load power

**Warranty**
- 1 Year Limited Warranty
  For additional Warranty information, please visit http://www.lutron.com/TechnicalDocumentLibrary/369-119_Wallbox_Warranty.pdf

**Available Model Numbers**
- DVCL-153P-____  Gloss Finish
- DVSCCL-153P-____ Satin Colors

<table>
<thead>
<tr>
<th>Job Name:</th>
<th>Model Numbers:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job Number:</td>
<td></td>
</tr>
</tbody>
</table>
Wiring Diagrams

Single-Pole Wiring

3-Way Wiring

4-Way Wiring
## Multigang and Mixed-Bulb-Type Ratings

<table>
<thead>
<tr>
<th>Total CFL•LED Wattage Installed (Watts per bulb x # of bulbs)</th>
<th>Maximum Allowable Incandescent/Halogen Wattage*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No sides removed</td>
</tr>
<tr>
<td>0 W</td>
<td>+ 600 W</td>
</tr>
<tr>
<td>1 W – 25 W</td>
<td>+ 500 W</td>
</tr>
<tr>
<td>26 W – 50 W</td>
<td>+ 400 W</td>
</tr>
<tr>
<td>51 W – 75 W</td>
<td>+ 300 W</td>
</tr>
<tr>
<td>76 W – 100 W</td>
<td>+ 200 W</td>
</tr>
<tr>
<td>101 W – 125 W</td>
<td>+ 100 W</td>
</tr>
<tr>
<td>126 W – 150 W</td>
<td>+ 0 W</td>
</tr>
</tbody>
</table>
**Dimensions**

3.04 in (76.8 mm)

2.75 in (70 mm)

1.31 in (33 mm)

0.39 in (7.6 mm)

4.69 in (119 mm)

**Standard Colors and Finishes**

**Gloss Finishes**

Add color suffix to model #

*Example: DVCL-153P-WH*

- WH White
- IV Ivory
- AL Almond
- LA Light Almond
- GR Gray
- BR Brown
- BL Black

**Satin Colors**

Add color suffix to model #

*Example: DVSCCL-153P-SW*

- HT Hot
- MR Merlot
- PL Plum
- TQ Turquoise
- SG Sea Glass
- TP Taupe
- ES Eggshell
- BI Biscuit
- SW Snow
- PD Palladium
- MN Midnight
- TC Terracotta
- SI Sienna
- GB Green Briar
- BG Bluestone
- MS Mocha Stone
- GS Goldstone
- DS Desert Stone
- ST Stone
- LS Limestone

**Low-End Adjustment Dial**

View with faceplate removed
**SUNP WER®**

**E18 / 225 SOLAR PANEL**

**EXCEPTIONAL EFFICIENCY AND PERFORMANCE**

### BENEFITS

**Highest Efficiency**
SunPower™ Solar Panels are the most efficient photovoltaic panels on the market today.

**Attractive Design**
Unique design combines high efficiency and a sleek, black appearance to blend elegantly with the roof.

**More Power**
Our panels produce more power in the same amount of space—up to 50% more than conventional designs and 100% more than thin film solar panels.

**Reliable and Robust Design**
Proven materials, tempered front glass, and a sturdy anodized frame allow panel to operate reliably in multiple mounting configurations.

---

The SunPower™ 225 signature black™ solar panel provides a revolutionary combination of high efficiency and attractive, sleek appearance. Utilizing 72 back-contact solar cells and a black backsheet, the SunPower 225 blends elegantly with the roof and delivers a total panel conversion efficiency of 18.1%. The panel’s reduced voltage-temperature coefficient and exceptional low-light performance attributes provide outstanding energy delivery per peak power watt.

---

**SunPower’s High Efficiency Advantage**

<table>
<thead>
<tr>
<th></th>
<th>Thin Film</th>
<th>Conventional</th>
<th>SunPower E18 Series</th>
<th>SunPower E19 Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>10%</td>
<td>14%</td>
<td>18%</td>
<td>19%</td>
</tr>
</tbody>
</table>

---

SPR-225-BLK-U
Electrical Data

- **Peak Power (±5/3%)** $P_{max}$: 225 W
- **Efficiency** $\eta$: 18.1%
- **Rated Voltage** $V_{mppt}$: 41.0 V
- **Rated Current** $I_{mppt}$: 5.49 A
- **Open Current Voltage** $V_{oc}$: 48.5 V
- **Short Circuit Current** $I_{sc}$: 5.97 A
- **Maximum System Voltage** UL: 600 V
- **Temperature Coefficients**
  - Power ($P$): -0.38% / K
  - Voltage ($V_{oc}$): -132.5 mV / K
  - Current ($I_{sc}$): 3.5 mA / K
- **NOCT**: 46° C ±/−2° C
- **Series Fuse Rating**: 20 A

I-V Curve

Current/voltage characteristics with dependence on irradiance and module temperature.

Tested Operating Conditions

- **Temperature**: -40° F to +185° F (-40° C to +85° C)
- **Max load**: 113 psf 550kg/m² (5400 Pa) front – e.g. snow; 50 psf 245kg/m² (2400 Pa) front and back – e.g. wind
- **Impact Resistance**: Hail 1 in (25 mm) at 52mph (23 m/s)

Warranties and Certifications

- **Warranties**: 25 year limited power warranty; 10 year limited product warranty
- **Certifications**: Tested to UL 1703. Class C Fire Rating

Dimensions

- **Grounding Holes**

CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.
Visit sunpowercorp.com for details
**Electric Solar Power Inverter**

**SUNPOWER**

**5000m, 6000m & 7000m INVERTERS**

**EXCEPTIONAL RELIABILITY AND PERFORMANCE**

**BENEFITS**

- **Reliable and Robust Design**
  Proven track record for durability and longevity

- **Effective Power Range**
  Enables most systems to use a single inverter rather than multiple units

- **Commercial Use**
  Flexible AC voltage output and scalable building blocks create an easy solution for commercial applications

- **High Efficiency**
  Weighted CEC efficiency over 95.5% and peak efficiency over 97%

- **Reduced Installation Cost**
  Integrated AC-DC disconnect with fuses lowers material costs and labor requirements

- **Attractive Aesthetics**
  Integrated disconnect eliminates need for visible conduits to inverter

The SunPower inverters 5000m, 6000m & 7000m provide exceptional reliability and market-leading design flexibility. The SPRm line of Solar Inverters can be easily applied in residential or commercial installations. All models come with a 10-year warranty.

www.sunpowercorp.com

---

**SPR-5000m, SPR-6000m & SPR-7000m**
SunPower designs, manufactures and delivers high-performance solar electric technology worldwide. Our high-efficiency solar cells generate up to 50 percent more power than conventional solar cells. Our high-performance solar panels, roof tiles and trackers deliver significantly more energy than competing systems.
General-duty safety switches (disconnects)

Three-Pole—240 Vac (Suitable for Service Entrance Use with a Neutral or Ground Lug Kit)

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Current Rating (A)</th>
<th>Type</th>
<th>Max. HP Ratings</th>
<th>Enclosure Type</th>
<th>Max. HP Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Single-Phase</td>
<td>Three-Phase</td>
<td>240 Vac</td>
</tr>
<tr>
<td>DG321NGB</td>
<td>30</td>
<td>Fusible with neutral</td>
<td>1.5–3</td>
<td>NEMA 1</td>
<td>3–7.5</td>
</tr>
<tr>
<td>DG321UGB</td>
<td>30</td>
<td>Non-fusible</td>
<td>3</td>
<td>NEMA 1</td>
<td>7.5</td>
</tr>
<tr>
<td>DG321NRB</td>
<td>30</td>
<td>Fusible with neutral</td>
<td>1.5–3</td>
<td>NEMA 3R</td>
<td>3–7.5</td>
</tr>
<tr>
<td>DG321URB</td>
<td>30</td>
<td>Non-fusible</td>
<td>3</td>
<td>NEMA 3R</td>
<td>7.5</td>
</tr>
<tr>
<td>DG322NGB</td>
<td>60</td>
<td>Fusible with neutral</td>
<td>3–10</td>
<td>NEMA 1</td>
<td>7.5–15</td>
</tr>
<tr>
<td>DG322UGB</td>
<td>60</td>
<td>Non-fusible</td>
<td>10</td>
<td>NEMA 1</td>
<td>15</td>
</tr>
<tr>
<td>DG322NRB</td>
<td>60</td>
<td>Fusible with neutral</td>
<td>3–10</td>
<td>NEMA 3R</td>
<td>7.5–15</td>
</tr>
<tr>
<td>DG322URB</td>
<td>60</td>
<td>Non-fusible</td>
<td>10</td>
<td>NEMA 3R</td>
<td>15</td>
</tr>
<tr>
<td>DG323NGB</td>
<td>100</td>
<td>Fusible with neutral</td>
<td>7.5–15</td>
<td>NEMA 1</td>
<td>15–30</td>
</tr>
<tr>
<td>DG323UGB</td>
<td>100</td>
<td>Non-fusible</td>
<td>15</td>
<td>NEMA 1</td>
<td>30</td>
</tr>
<tr>
<td>DG323NRB</td>
<td>100</td>
<td>Fusible with neutral</td>
<td>7.5–15</td>
<td>NEMA 3R</td>
<td>15–30</td>
</tr>
<tr>
<td>DG323URB</td>
<td>100</td>
<td>Non-fusible</td>
<td>15</td>
<td>NEMA 3R</td>
<td>30</td>
</tr>
</tbody>
</table>

Neutral and Ground Lug Kits

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG030NB</td>
<td>Neutral kit for 30A switches</td>
</tr>
<tr>
<td>DG100NB</td>
<td>Neutral kit for 60–100A switches</td>
</tr>
<tr>
<td>DG030GB</td>
<td>Ground lug kit for 30–100A switches</td>
</tr>
</tbody>
</table>
# Product Data Sheet

**QO140M200**  
LOAD CENTER QO MB 240V 200A 1PH 40SP

## Technical Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Type</td>
<td>Convertible - Factory installed main breaker</td>
</tr>
<tr>
<td>Maximum Single Pole Circuits</td>
<td>40</td>
</tr>
<tr>
<td>Maximum Tandem Circuit Breakers</td>
<td>0</td>
</tr>
<tr>
<td>Phase</td>
<td>1-Phase</td>
</tr>
<tr>
<td>Spaces</td>
<td>40</td>
</tr>
<tr>
<td>Ampere Rating</td>
<td>200A</td>
</tr>
<tr>
<td>Voltage Rating</td>
<td>120/240VAC</td>
</tr>
<tr>
<td>Wire Size</td>
<td>#4 to 250 AWG/kcmil (Al/Cu)</td>
</tr>
<tr>
<td>Application</td>
<td>Designed to meet residential, commercial and industrial requirements to protect electrical systems, equipment and people.</td>
</tr>
<tr>
<td>Wiring Configuration</td>
<td>3-Wire</td>
</tr>
<tr>
<td>Depth</td>
<td>3.75 Inches</td>
</tr>
<tr>
<td>Approvals</td>
<td>UL Listed</td>
</tr>
<tr>
<td>Height</td>
<td>33.78 Inches</td>
</tr>
<tr>
<td>Width</td>
<td>14.25 Inches</td>
</tr>
<tr>
<td>Cover Type</td>
<td>Order separately</td>
</tr>
<tr>
<td>Bus Material</td>
<td>Tin Plated Copper</td>
</tr>
<tr>
<td>Enclosure Type</td>
<td>Indoor</td>
</tr>
<tr>
<td>Box Number</td>
<td>10</td>
</tr>
<tr>
<td>Enclosure Rating</td>
<td>NEMA 1</td>
</tr>
<tr>
<td>Grounding Bar</td>
<td>Order separately</td>
</tr>
<tr>
<td>Short Circuit Current Rating</td>
<td>22kA</td>
</tr>
</tbody>
</table>

**Notes:**  
22kA main circuit breaker UL Listed for use ahead of QO, QOT and QO-PL 10kA branch circuit breakers to permit their application on systems with up to 22kA available fault current.

## Shipping and Ordering

| Category                    | 00001 - Load Centers, Indoor, 1 phase 12-42 CKT, NEMA1 |
|                            | Discount Schedule                   | DE3A                                               |
|                            | GTIN                                 | 0078901867654                                      |
|                            | Package Quantity                     | 1                                                  |
|                            | Weight                               | 20.87 lbs.                                         |
|                            | Availability Code                    | Stock Item: This item is normally stocked in our distribution facility. |
|                            | Returnability                        | Y                                                  |

Generated: 04/30/2011 22:57:11

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### Meter Main-4 Terminal-Ringless-120/240 Vac-120/208 Vac

#### Specifications

**AMPS** | **SERVICE** | **RINGLESS CATALOG NUMBER** | **HUB** | **CONNECTOR WIRING** | **BY-PASS** | **DIMENSIONS** | **CONCENTRIC K.O.'S**
---|---|---|---|---|---|---|---
100 | OHUG | U5899-XL-100 | C.P. | W6-2/0 | KONE | 2 1/4 | 11 | 22 | 2 | 2 | 2 | 2 | 1/4 |
100 | OHUG | U5898-XL-100 | C.P. | W6-2/0 | BLANK | KONE | 2 1/4 | 11 | 22 | 2 | 2 | 2 | 2 | 1/4 |
100 | OHUG | U5898-XL-100 | C.P. | W6-2/0 | #10-200 lead | KONE | 2 1/4 | 11 | 22 | 2 | 2 | 2 | 2 | 1/4 |
200 | OHUG | U5999-XL-200 | C.P. | W6-2/0 | #10-200 lead | KONE | 2 1/4 | 11 | 22 | 2 | 2 | 2 | 2 | 1/4 |
200 | LG | U799-XL-200 | BLANK | W6-2/0 | #10-200 lead | KONE | 2 1/4 | 11 | 22 | 2 | 2 | 2 | 2 | 1/4 |
200 | OHUG | U5998-XL-200 | C.P. | W6-2/0 | #10-200 lead | BL | 2 1/4 | 13 | 25 7/8 | 3 | 2 | 4 | 3 | 1/4 |

**Fifth Terminal:** For field installed fifth terminal on U5999 and U5998, order catalog number W799 (9 o'clock position only). For field installed fifth terminal on U5899 and U5998, order catalog number K197 (1 o'clock position only). For U5998, order fifth terminal kit P3889 for 6 or 9 o'clock position.

**Hubs:** For proper hub selection refer to the hub selection chart on the accessory page.

**Breakers:** The U5998 is supplied with a Milbank MQP100 plug-in style breaker.

**Factory Installed Circuit Breakers:** The U5999-XL-100 has a factory installed Milbank MQP100 breaker. The U5999-XL-200 has a factory installed Milbank UGFB (MIP1) X1 breaker. The U5999-XL-200 has a factory installed UGFB-M400 breaker and provisions for (2) double pole or (4) single pole circuit breakers.

**By-Pass:** The lever on the U5999-XL unit supplies clamping action on meter spaces and also operates the bypass device.

---

Middlebury

U.S. D.O.E. Solar Decathlon 2011

Electrical Specifications

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Section 260500
AUTHORIZATION TO MARK

This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s) Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing Report.

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Control Number: 3098177

Authorized by: William T. Starr, Certification Manager

This document supersedes all previous Authorizations to Mark for the noted Report Number.

Intertek Testing Services NA Inc.
165 Main Street, Cortland, NY 13045
Telephone 800-345-3851 or 607-753-6711 Fax 607-756-6899

Applicant: Wiley Electronics, LLC
Address: PO Box 381
Saugerties, NY 12477
Country: USA
Contact: Mr. Brian Wiley
Phone: 845-247-3852
FAX: 845-839-2792
Email:

Manufacturer: Wiley Electronics, LLC
Address: PO Box 381
Saugerties, NY 12477
Country: USA
Contact: Mr. Brian Wiley
Phone: 845-247-3852
FAX: 845-839-2792
Email:

Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Cortland, NY


Product: Bonding Devices
**NM Splice & Tap**

**NON-METALLIC CABLE SPLICES AND TAPS**

**NMS-2 (SPLICE)**

For splicing 12 or 14 awg solid conductor, 2-conductor cable with ground. The NMS-2 kit includes everything required to make a two conductor splice.

**NMS-3 (SPLICE)**

For splicing 12 or 14 awg solid conductor, 3-conductor cable with ground. The NMS-3 kit includes everything required to make a three conductor splice.

**NMT-2 (TAP)**

For tapping into 12 or 14 awg solid conductor 2-conductor cable with ground. The NMT-2 kit includes everything required to complete a two conductor tap.

**ELIMINATE COSTLY AND TIME-CONSUMING JUNCTION BOXES**

The NSi NM Splice & Tap method provides a fast and reliable way to connect 12 and 14 AWG circuits using non-metallic (NM) cable. It eliminates the need for junction boxes, covers, fittings, connectors – and is approved for use in a variety of applications including: residential branch circuits, manufactured housing and pre-fabricated building structures. When adding new circuits in residential applications, NM connectors eliminate both the need to cut into the existing wiring and the extra junction boxes and associated hardware required for the tap connection.

In factory installations within pre-fabricated structures, the NM connectors eliminate costly time-consuming on-site wiring. As individual modules are joined, splices and taps are simply snapped together easily by assembly crews with no special training or tools. Termination is easy. Split the cable, remove the sheathing and cut the splice conductors to length (if necessary). With the tap, individual conductors do not need to be stripped, only exposed. Clear cover installation is done with slip-joint pliers. The installation displacement contacts eliminate the need to strip individual conductors. Simply plug the connectors together and the installation is complete.

**NON-METALLIC CABLE SPLICES AND TAPS**

<table>
<thead>
<tr>
<th>CATALOG NO.</th>
<th>UPC CODE</th>
<th>WIRE RANGE</th>
<th>KIT DESCRIPTION</th>
<th>CARTON QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMS-2</td>
<td>00320</td>
<td>12 – 14 AWG</td>
<td>splice for 2-conductor cable with ground</td>
<td>25</td>
</tr>
<tr>
<td>NMS-3</td>
<td>00321</td>
<td>12 – 14 AWG</td>
<td>splice for 3-conductor cable with ground</td>
<td>25</td>
</tr>
<tr>
<td>NMT-2</td>
<td>00322</td>
<td>12 – 14 AWG</td>
<td>splice and tap kit for 2-conductor cable</td>
<td>12</td>
</tr>
</tbody>
</table>

www.nsiindustries.com

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U.S. D.O.E. Solar Decathlon 2011
Electrical Specifications

Published 5/3/2011
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Section 260500
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Applicant: WILEY ELECTRONICS, LLC
Address: P.O. Box 361
Saugerties, NY 12477
Country: USA
Contact: Mr. Brian Wiley
Phone: (845) 247-2875
Fax: (845) 246-0189
Email: btw@we-llc.com

Manufacturer: WILEY ELECTRONICS, LLC
Address: 44 Peoples Road
Saugerties, NY 12477
Country: USA
Contact: Mr. Brian Wiley
Phone: (845) 247-2875
Fax: (845) 246-0189
Email: btw@we-llc.com

Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Cortland, NY
Control Number: 3098177

Authorized by: William T. Starr, Certification Manager

Intertek

This document supersedes all previous Authorizations to Mark for the noted Report Number.

Intertek Testing Services NA Inc.
165 Main Street, Cortland, NY 13045
Telephone 800-345-3561 or 607-753-6711 Fax 607-756-6599


Standard(s):
CAN/CSA C22.2 No. 107.1-01 General Use Power Supplies
CAN/CSA C22.2 No. 0.4-04 Bonding of Electrical Equipment
CAN/CSA C22.2 No. 0.12-M1985 Wiring Space and Wire Bending Space in Enclosures for Equipment Rated 750 V or Less
CAN/CSA-C22.2 No. 0-M91 General Requirements-Canadian Electrical Code, Part II

Product: PV Combiner boxes
Brand Name: N/A

ATM for Report 3145135CRT-002
Page 1 of 1
ATM Issued: 23-Aug-2010
ED 8.4 (J-Jun-50) Mandatory
**Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Input Voltage</td>
<td>600V DC</td>
</tr>
<tr>
<td>Maximum Input Current</td>
<td>64A DC Continuous</td>
</tr>
<tr>
<td>Maximum Input Short Circuit Current</td>
<td>51A DC</td>
</tr>
<tr>
<td>Input Wire Diameter Range</td>
<td>5.0 - 6.8mm [0.20 - 0.27in] #10-12AWG USE-2/PV Wire</td>
</tr>
<tr>
<td>Maximum number of input conductor slots</td>
<td>9</td>
</tr>
<tr>
<td>Maximum number of PV strings</td>
<td>4</td>
</tr>
<tr>
<td>Maximum number of combined strings</td>
<td>4</td>
</tr>
<tr>
<td>Equipment Ground Conductor Diameter range</td>
<td>4.0 - 6.8mm [0.16 - 0.27in]</td>
</tr>
<tr>
<td>Acceptable Conduit sizes</td>
<td>19.05mm, 25.4mm [0.75in, 1.0in]</td>
</tr>
<tr>
<td>Internal Volume</td>
<td>1840cm$^3$ [112in$^3$]</td>
</tr>
<tr>
<td>Knockouts</td>
<td>Side and Bottom, 3/4&quot; and 1&quot;</td>
</tr>
<tr>
<td>Minimum Fuse Holder Tightening Torque</td>
<td>2.5 N-m [22 in-lb] for #18-8 AWG wires</td>
</tr>
<tr>
<td>Minimum Combiner Bus Tightening Torque</td>
<td>4.0 N-m [35 in-lb] for #14-6 AWG wires</td>
</tr>
<tr>
<td>Minimum Terminal Block Tightening Torque</td>
<td>2.0 N-m [16 in-lb] for #14-6 AWG wires</td>
</tr>
<tr>
<td>Minimum Grounding Terminal Tightening Torque</td>
<td>3.0 N-m [26 in-lb] for #10-6 AWG wires</td>
</tr>
<tr>
<td>Fuse Holder Wire Strip Length</td>
<td>12mm [0.47in]</td>
</tr>
<tr>
<td>Combiner Bus Terminal Wire Strip Length</td>
<td>12mm [0.47in]</td>
</tr>
<tr>
<td>Terminal Block Wire Strip Length</td>
<td>10mm [0.39in]</td>
</tr>
<tr>
<td>Grounding Terminal Wire Strip Length</td>
<td>14mm [0.55in]</td>
</tr>
<tr>
<td>Fuse Type</td>
<td>Midget 10 X 38mm, 600V DC</td>
</tr>
</tbody>
</table>

**Table 3: Specifications**
### TECHNICAL & CONSUMER INFORMATION

#### Specifications

**EM5000is**

### Dimensions

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model (Type)</td>
<td>EM5000is</td>
</tr>
<tr>
<td>Power product description code</td>
<td>EAJ2</td>
</tr>
<tr>
<td>Length (Handle in up position)</td>
<td>31.9 in (810 mm)</td>
</tr>
<tr>
<td></td>
<td>[45.5 in (1,155 mm)]</td>
</tr>
<tr>
<td>Width</td>
<td>26.4 in (670 mm)</td>
</tr>
<tr>
<td>Height (Handle in up position)</td>
<td>27.2 in (680 mm)</td>
</tr>
<tr>
<td></td>
<td>[28.0 in (710 mm)]</td>
</tr>
<tr>
<td>Dry weight*</td>
<td>209 lbs (95 kg)</td>
</tr>
</tbody>
</table>

* Without battery

#### Engine

- **Model**: GX340K1
- **Engine Type**: 4-stroke, overhead valve, single cylinder
- **Displacement**: 29.6 cu-in (337 cm³)
- **Bore x Stroke**: 3.2 × 2.5 in (82 × 64 mm)
- **Compression Ratio**: 8.0:1
- **Engine Speed**: 2,400 – 3,600 rpm; Eco Throttle™ ON:
- **Cooling System**: Forced air
- **Ignition System**: Full transistor
- **Oil Capacity**: 1.16 US qt (1.10 L)
- **Fuel Tank Capacity**: 4.49 US gal (17.0 L)
- **Spark Plug**: BPR5ES (NGK) W16EPR-U (DENSO)

#### Generator

- **Type**: A
- **AC output**
  - Rated voltage: 120/240 V
  - Rated frequency: 60 Hz
  - Rated Ampere: 37.5/18.8 A
  - Rated Output: 4.5 kVA
  - Maximum Output: 5.0 kVA

#### Tuneup Specifications

<table>
<thead>
<tr>
<th>ITEM</th>
<th>SPECIFICATION</th>
<th>MAINTENANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spark plug gap</td>
<td>0.025 – 0.031 in (0.635 – 0.79 mm)</td>
<td>Refer to page 51</td>
</tr>
<tr>
<td>Valve clearance(cold)</td>
<td>IN: 0.15 ± 0.02 mm  EX: 0.20 ± 0.02 mm</td>
<td>See your authorized Honda dealer</td>
</tr>
</tbody>
</table>

Specifications may vary according to the types, and are subject to change without notice.

END OF SECTION 260500
SECTION 329200 - EXTERIOR PLANTS

PART 1 - GENERAL

1.01 SECTION REQUIREMENTS

A. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1, as listed in the following table ("planting matrix").

B. Planting Restrictions: Plant during the specific periods listed on table attached ("planting matrix") for each individual plant, except backyard bushes maintained by Cobble Creek Nursery in Monkton, VT. All vegetation is potted or in standing planters.

C. Maintain trees and shrubs during competition, per plant loan requirements determined by Cobble Creek Nursery.

D. Maintain flower, vegetable, and herb plants up to and during competition, but not less than growing period necessary for healthy, mature plant.

PART 2 - PRODUCTS

2.01 PLANTING MATERIALS

A. Tree and Shrub Material: Nursery grown, with healthy root systems, well shaped, fully branched, healthy, and free of insects, eggs, larvae, defects, and disfigurement.

B. Ground Covers and Plants: Established and well rooted in pots or similar containers.

2.02 SOIL AND AMENDMENTS

A. Topsoil: ASTM D 5268, with pH range of 5.5 to 7, free of stones 1 inch (25 mm) or larger and other extraneous materials harmful to plant growth.

B. Compost: Well-composted, stable, and weed-free organic matter; pH range of 5.5 to 8.

C. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture, free of chips, stones, sticks, soil, or toxic materials.

D. Organic Mulch: shredded hardwood, ground or shredded bark, or pine straw.
2.03 PLANTING SOIL MIX

A. To be used in growing pots for plants. Mix topsoil with the following soil amendments in the following quantities:

PART 3 - EXECUTION

3.01 PREPARATION

A. Planting Bed Establishment (within deck planters): Loosen subgrade to a depth of 4 inches (100 mm) to 14 inches (355 mm), depending on need of plant. Remove stones sticks, roots, and rubbish. Spread planting soil mixture to a depth of 4 inches (100 mm) to 14 inches (355 mm), but not less than required to meet finish grades. Work first layer into top of loosened subgrade.

B. Trees and Shrubs (All potted): Set trees and shrubs along edges of deck structure, in specific locations to be determined. All vegetation will remain in pots/planters at all times. Place trees first, then shrubs according to height and type. Make sure the trees and shrubs are on level ground, using wooden props if necessary. Maintain less than 1500 pounds per square foot pressure on ground below. Manage water and drain holes to prevent any drainage from contacting the turf.

C. Set plants into liners according to spacing listed in attached table, or as close as possible with plants still in pots. Water after planting. Do not cover plant crowns with wet soil.

D. Mulching: Place newspaper, hay and/or mulch around potted trees, shrubs, and plants in their designated spots, and finish level with adjacent finish grades. Do not place mulch against trunks or stems.

E. Edgings: Place wooden border, matching porch, around backyard tree and shrub pots so as to disguise the staging.

3.02 MAINTENANCE

A. Tree and Shrub Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, restoring planting saucers, adjusting and repairing, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings.

B. Ground Cover and Plant Maintenance: Maintain and establish plantings by watering, weeding, mulching, and other operations as required to establish healthy, viable plantings.

C. General Irrigation: Vegetation will be irrigated by hand using a watering can filled at the outdoor spigot on the Southern wall of the house (See water budget). Irrigation requirements will depend on the demand of the plants, and will avoid over-watering to avoid the necessity of draining excess water.
END OF SECTION 329200