Design Development
Project Manual

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

submission name	Design Development Project Manual
submission date	August 11, 2011
contact	MiddSD@middlebury.edu

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self-RELIANCE

Middlebury

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Rule 8-3	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	N/A
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Structural Calculations

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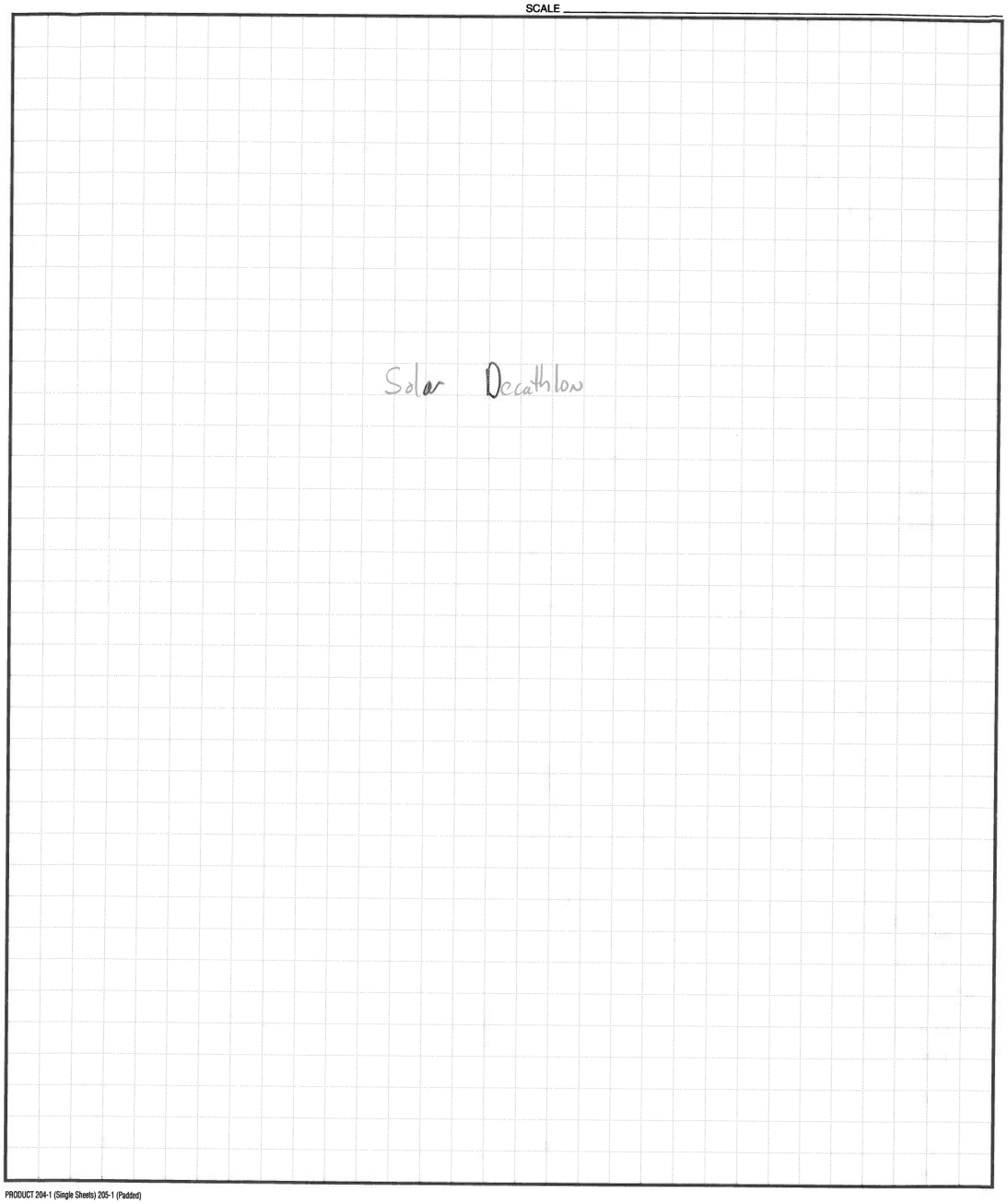

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B Roof Framing

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E- Screw Jack Posts

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Snow Load

$p_f = .7\, C_e\, C_t\, I\, p_g$

$p_g = 50$ psf @ middlebury

$C_e = 1.0$ (partially exposed)

$C_t = 1.1$

$I = 1.0$

$p_f = 38.5 \Rightarrow$ use 40 psf (4 min)

$p_s = C_s\, p_f$

$C_s = .7$

$p_s = 28$ psf $\Rightarrow$ however, have solar panels $\therefore$ do not consider "unobstructed slippery surface" $\Rightarrow$ use $\boxed{P_s = 40 \text{ psf}}$

Unbalanced Snow

$W = 13' \pm < 20' \therefore$ unbalanced $= I p_g = \boxed{50 \text{ psf}}$

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Design Typical Roof Rafter

span ≈ 10' (conservative)

$w = 2'(.02\ ksf\ DL + .05\ ksf\ unbal\ SL) = .14^{k/ft}$

$M = 1.75^{k'}$

$V = .7^{k}$

14" TJI 110, $M_R = 3.74^{k'}$ OK
$V_r = 1.86^{k}$ OK
Max end reaction = 910# OK

$$\Delta_L = \frac{22.5 \times 910^{\#/ft} \times 10^4}{312 \times 10^6} + \frac{267 \times 140^{\#/ft} \times 10^3}{14" \times 10^5}$$

$\Delta_{TL} = .107" = L/1120$ OK

$\Delta_{LL} = .107" \times \frac{50}{70} = .076"$ OK

use 14" TJI 110 @ 24" o/c

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Design Typical Roof Edge Beam

Max opening = 6'-8"

$w = .07 ksf \times \left(\frac{9'-3"}{2} + 2' \text{ overhang}\right) = .461^{k/ft}$

$M = 2.56^{k'}$
$V = 1.54^{k}$

1 3/4" x 16" LVL

$M_r = 12.1^{k'}$ ok
$V_r = 4.6^{k}$ ok

$\Delta = \frac{5 \times .461^{k/ft} \times 6.67'^{4} \times 12^{3}}{384 \times 1900 ksi \times 400 in^{4}} = .027" = 1/2966$ ok

USE 1 3/4" x 16" LVL

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Preliminary TJI Roof Support Beams

$w = \left(\frac{9'-2"}{2} + 2'\right) \times (.02\,k/f^2 DL + .05\,k/f^2 \text{ unbalanced SL}) = .460\,k/ft$

Span = 18'

$M = \frac{.46 \times 18^2}{8} = 18.66^k$

$V = 4.14^k$

Trg 8x12 $S = \frac{7\frac{1}{2} \times 11.5^2}{6} = 165\,in^3$

$F_b = \frac{M}{S} = 1357\,psi$ N.G

Trg 10"x14" S = 288.6
F_b = 776 psi

10"x16" S = 380.4
F_b = 588 psi OK

$F_v = \frac{3V}{2bd} = \frac{3 \times 4140\,\#}{2 \times 9\frac{1}{2} \times 15\frac{1}{2}} = 42\,psi$ OK

$\Delta = \frac{5 \times .460 \times 18^4 \times 12^3}{384 \times 1000k's \times 294\,in^4} = .368" = L/586$ OK

Use 10"x16" Beam

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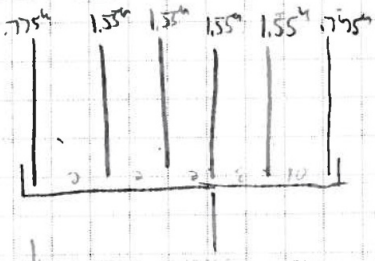
Design Tension Ties:



$T = 1.55^k \times 2 + .775^k = 3.9^k$

$M \simeq .775^{k/ft} \times 10^2/8 = 9.7^{k'}$

Try 6" x 1/2" PL

$S = 1/2 \times 6^2/6 = 3 in^3$

$f_b = 9.7 \times 12 / 3 in^3 = 39 ksi$ N.G.

Try 8" x 5/8" PL

$S = 6.67 in^3$

$f_b = 17.5 ksi$ Ok

$$\Delta = \frac{5 \times .775^{k/ft} \times 10^4 \times 12^3}{384 \times 29{,}000 \times \frac{1}{12} \times 5/8 \times 8^3} = .225" \text{ Ok}$$

Use MIN 8" x 5/8" PL

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Design Bolts

T = 3.9"
Try 3/4" ø Bolts

Z_{11} = 710 #/bolt (SPF)

C_D = 1.15 (snow load)
C_g = .75 (A_m/A_s $\frac{1.5 \times 7\frac{1}{4}}{1\frac{1}{2} \times 6}$ = 3.6 in² / A_m = 11 in²
C_Δ = 1.0 (min end dist = 3", 3" c-c spacing)
C_{eg} = 1.0

Z = 660 #/bolt

Req'd # Bolts = $\frac{3900\#}{660\#}$ > 6 Bolts ⇒ use 7

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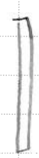
Design Roof Mod Lifting Device

Span = 12'

w = $5^k / 12ft = .5^{k/ft}$

M = $9^{k'}$



try 6"×1/4" PL ⇒ S = 1.5

fb = 72 ksi N.G.

channels

C6×10.5 M/12 = 11.1" ok

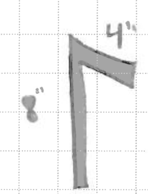
Δ = 1/2"

C7×9.8 M/12 = 12.9

Δ = .37

8×1/4" PL ⇒ S = 2.67 ×2 = 5.33

fb = 20 ksi



S = 3.8 in³ per PL

fb = 14.2 ksi

$$\Delta = \frac{9 \times 12^2}{161 \times 15.8} = 1/2" \approx ok$$

S = 4.477

fb = 12 ksi ok

Check 2"×1/4" PL ⇒ $ft = \frac{5^k \times 1/2}{2" \times 1/4"}$ = 5 ksi ok

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Redesign Roof Mod Lifting Devices

SPAN = 12'

$w = \frac{7^k}{12'} = .583^{k/ft}$

$M = 10.5^k$

C7x9.8 $\frac{M_n}{\Omega} = 12.9^{ki}$ ea OK

$\Delta = .22''$ (w/(2) C7's OK

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Floor Framing

LL = 50psf

DL: Flooring
Sheathing 3/4"
9½" TJI
Sheathing 3/4"
9½" Insulation
Misc

- Assume 3psf
- 3 psf
- 1.5 psf
- 3 psf
- 2 psf
- 2 psf

say 15psf

13'-6"

Typical Floor Joist span = 10'-10"

$M = \frac{16"}{12} \times (.015\ k/sf + .05\ k/sf) \times \frac{10'^2}{8} = 1.27^{k'}$ 1.97k' OK

$V = \frac{16"}{12} (.015 + .05\ k/sf) \times 5'-5" = .5^k$ .6k OK

9½" TJI 110

Superceded

$M_R = 2.5^{k'}$ OK

$V_r = 1.22^k$, Max end reaction = 9.1k OK

$\Delta = \frac{22.5 \times \frac{16"}{12} \times 65 \times 11^4}{157 \times 10^6} + \frac{2.67 \times \frac{16}{12} \times 65 \times 11^2}{9½ \times 10^5}$

$= .21" = L/626$ OK

use 9½" TJI 110 @ 16" o/c

$\Delta = .456"$
$= L/358$ OK

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Redesign
Typical Floor Beam

Try SPF No 1/No 2 2x10

$F_b = 875\ psi \times 1.15^{C} \times 1.1^{C_F} = 1106\ psi$

$f_b = \frac{M}{S} = \frac{1.27^{k'} \times 12''/1}{21.39\ in^3}$

$= 712\ psi$ ok

$f_v = \frac{3 \times 600^{\#}}{2 \times 1\frac{1}{2} \times 9\frac{1}{4}''} = 65\ psi < F_v' = 135\ psi$ ok

$\Delta = \frac{5 \times \frac{16'}{12}, \times .065 ksf \times 10,833^{4} \times 12^3}{384 \times 1400 ksi \times 98.9\ in^4} = .19'' = 4/64$ ok

use 2x10 @ 16" o/c

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Floor Beams

Interior Beam

SPAN = 8'-0" (9'-1½")

w [1' × (.015 ksf DL + .05 ksf LL)] = .72 k/ft

M = 5.8 k' 7.5 k'
V = 2.9 k 3.3 k
3½" × 9½" PSL
Mr = 13.055 k' OK OK
Vr = 6.4 k OK OK

$\Delta = \frac{5 \times .72\ k/ft \times 8' \times 12^3}{384 \times 2000\ k \times 250}$

Δ_{TL} = .13" = L/736 OK = .22" = L/500 OK

Use 3½" × 9½" PSL

Perimeter Beam (3½" × 9½" PSL)
SPAN = 9'-1½" 9'

$w_{floor} = \frac{10}{2} \times .065\ ksf = .33\ k/ft$

$w_{Roof} = \frac{26'}{2} \times (.07\ ksf) = .91\ k/ft$

M = 1.24 k/ft × 9'1½"²/8 = 12.9 k' < 13.055 k' OK
V = 5.65 k < 6.4 k OK
Δ_{TL} = .38" = L/288 OK
Δ_{LL} = .27½" = L/403 OK

Use 3½" × 9½" PSL

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$\Delta = .06'' \times \frac{1.162^{4.33}}{.53^{4.33}} = .21'' < L/454$ OK

Use 3½" × 9½" PSL

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Design 3 1/2 x 9 1/4 PSL Flush Frame concealed flange Hgr at East West Walls

$P \approx \frac{10'}{2} \times \frac{1'-4''}{2} \times .065\ ksf + 18' \times .020\ ksf \times \frac{10'}{2} + \frac{10}{2} \frac{2'-0''}{2} \times .055\ ksf$

flor wall roof

$= 2.3^{k} \Rightarrow$ Design for 3.0k min

HUCQ series concealed flange
or
HUSC

HUCQ410-SDS cap = 3370# w/ SPF/HF Header OK

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Design Header @ entry

span: 6'

w= .065ksf x 10'/3 = .33k/ft

m= 1.5k'
V= 1.0k

Try (2) 2x10

$f_b = \frac{1.5^{k'} \times 12''}{2 \times 21.4} = 420$ psi OK

$f_v = \frac{(3)1.0^k}{2 \times 2 \times 1\frac{1}{2} \times 9\frac{1}{4}} = 59$ psi OK

use (2) 2x10

Check 2x8 ripped to 6½"

span: 8'-3"

m= 16/12 x .065 x 8.25²/8

m = .74k'

V= .36k

$f_b = .74^{k'} \times 12 / 1\frac{1}{2} \times 6\frac{1}{2}^2/6 = 840$ psi < 875 psi OK

$f_v = .36^k \times 3 / 2 \times 1\frac{1}{2} \times 6\frac{1}{2} = 55$ psi OK

use 2x8 ripped

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Check 3½ x 9½" PSL for 3½" x 11⅞" POST Load

P = 6' x 800#/ft = 4.8^k'

$M_{max} = \frac{PL}{4} = \frac{4.8^k \times 8'}{4} = 9.6^{k'}$

$V_{max} = 4.8^k$

3½" x 9½" PSL

$M_r = 13.0^{k'}$ OK

$V_r = 6.4^k$ OK

Use 3½ x 9½" PSL

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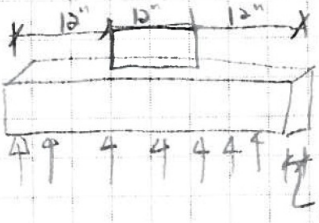
Design Base Pl

Pmax 11.9k

Req'd Area = $\frac{11.9^k}{1.5 k/sf}$ = 7.9 sq ft ⇒ 2-10" sq min ⇒ use 3'0" sq

Design cribbing



Beg = $\frac{11.9^k}{3x3}$ = 1322 psf

= 606#/ft on 6x6

$M = \frac{w \cdot l \cdot l}{2}$ = .606 k/ft × 1' × .5' = .303 ft-k

6x6, S = 27.73 in³

Fb = 131 psi OK

6x6 cribbing adequate

Base Pl, $t_{req'd} = m \times \sqrt{\frac{Fp}{.25 Fy}}$

$F_p = \frac{11.9^k}{12" \times 12"}$ = .083 ksi

= 4" × $\sqrt{\frac{.083}{.25 \times 36}}$ = .38" ⇒ use 5/8" Pl

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Check 11 7/8" TJI's for axial load capacity in wall

$F'_c = F_c \times C_D \times C_M \times C_t \times C_F \times C_i \times C_p$

$C_D = 1.0$ (conservative)
$C_M = 1.0$
$C_t = 1.0$
$C_F = 1.0$ (conservative, but size factor not as applicable to engineered lumber)

Superceded

$C_i = 1.0$

$$C_p = \frac{1 + \frac{F_{cE}}{F_c^*}}{2c} - \sqrt{\left(\frac{1 + \frac{F_{cE}}{F_c^*}}{2c}\right)^2 - \frac{F_{cE}/F_c^*}{c}}$$

$F_c^* = F_c$

Flange material is either:

LVL	2510 psi
LSL	1400 psi
MSR	?

11 7/8 TJI 110, $M_{all} = 3.16^{k'} = [1\frac{3}{4}" \times 1\frac{3}{8}" \times F_c] \times 10\frac{1}{8}"$

$F_c = 1500$ psi

Use $F_c = 1400$ psi

$F_c^* = 1400$ psi

$c = .9$

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$F_{CE} = \frac{.822\, E_{min}'}{(l_e/d)^2}$

$E_{min}' = 787{,}85$ psi for 1.55E LSL

Superceded

$\frac{l_e}{d} \approx 0$ as flange is braced in both directions however use l_e of ½" wall ht = 45"

$\frac{45"}{1\frac{1}{4}"} = 36 < 50$ ok

$= \frac{.822 \times 787{,}815}{36^2} = 499.7$ psi

$F_{ce}/F_{c*} = 499.7 psi / 1400 psi = .357$

$C_p = \frac{1+.357}{2\times.9} - \sqrt{\left[\frac{(1+.357)}{2\times.9}\right]^2 - \frac{.357}{.9}}$

$C_p = .34$

$F_c' = .34 \times 1400 psi = 475$ psi

Max column load = 475 psi × 2.473 in² (110) = 1039 #
× 2.578 in² (210) = 1224 #
× 2.891 (230) = 1373 #
× 3.18 in² (360) = 1510 #
× 4.8125 in² (560) = 2286 #

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Wall @ TJI Roof

Dead Load

S.S. Roof	3 psf
3/4" Sheathing	3 psf
16" TJI @ 2'-0" o/c	1.7 psf
5/8" Sheathing	2.2 psf
Rock Wool Ins (16")	3.2
MISC	5 psf
	say 20psf

Superceded

$P_{max} = 2' \times 11' \times (.05psf + .02psf) = 1.54^{k}$

(.05psf: unbalanced; .02psf: LL)

Use 360 series wall studs

1 3/8" flange

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T
U E
K Y
E

Design ...th Wal Headers

R Roof ≈ 11 × (2+.05k.f) 7

par -0

M 7 ... × 6²/8 - 3.5 k'

V = 2.3 k

... (2) 2x

Fb ... 100 ...

bd²/6 3 × 11¼ /6 ... 3.3 in³

M 5.3 k > 3.5 k' ok

3V/... 3 ... 2.3 k / 2 × 3 × 11 ... Fv - 1 ... Ok

use (2) 2x12

or

3½ ... ¼ PSL

... Max ... 6 4'

self-RELIANCE

Middlebury

D2

WoodWorks® SOFTWARE FOR WOOD DESIGN

COMPANY	PROJECT
Jan. 17, 2011 08:26	Column1.wwc

Typ 2x4 wall stud

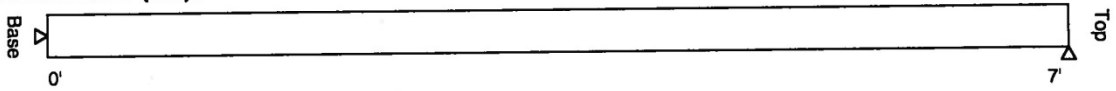
Design Check Calculation Sheet
Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
Load2	Dead	Axial UDL		(Ecc. = 0.00")		222		plf
Load3	Snow	Axial UDL		(Ecc. = 0.00")		556		plf
Load4	Wind	Full Area				30.00 (24.0)*		psf

*Tributary Width (in)

MAXIMUM REACTIONS (lbs):



Unfactored: Dead			
Other	210		210
Factored: Total	210		210

Lumber Stud, S-P-F, No.1/No.2, 2x4"
Spaced at 24" c/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 = Lb; Repetitive factor: applied where permitted (refer to online help);

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

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 60	Fv' = 216	fv/Fv' = 0.28
Bending(+)	fb = 1440	Fb' = 2315	fb/Fb' = 0.62
Axial	fc = 298	Fc' = 488	fc/Fc' = 0.61
Axial Bearing	fc = 298	Fc* = 1521	fc/Fc* = 0.20
Combined (axial compression + side load bending)			Eq.3.9-3 = 0.94
Live Defl'n	0.43 = L/194	0.47 = L/180	0.93
Total Defl'n	0.43 = L/194	0.47 = L/180	0.93

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL/CP	CF	Cfu	Cr	Cfrt	Ci	LC#
Fv'	135	1.60	1.00	1.00	-	-	-	-	1.00	1.00	4
Fb'+	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	0.321	1.150	-	-	1.00	1.00	2
Fc'comb	1150	1.60	-	-	0.238	-	-	-	-	-	3
E'	1.4 million		1.00	1.00	-	-	-	-	1.00	1.00	4
Emin'	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 = 8e06 lb-in2
Total Deflection = 1.50(Dead Load Deflection) + Live Load Deflection.
Axial : LC #2 = D+S, P = 1563 lbs
Combined : LC #3 = D+.75(S+W); (1 - fc/FcE) = 0.66
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: ICC-IBC

DESIGN NOTES:
1. Please verify that the default deflection limits are appropriate for your application.

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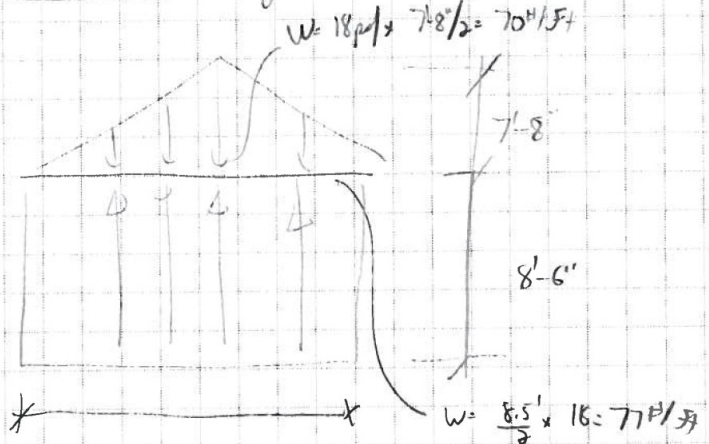
Design Horizontal Beam @ gable end wall



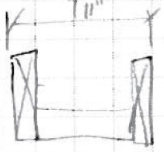
M = 6.34^k'

3½ x 11⅞" PSL Mr = 19.9^k' ✓

$\Delta = \frac{6.4 \times 20^3}{161 \times \frac{2}{29} \times 468} = .47" = L/507$ ✓

use 3½" x 11⅞" PSL

Try Bottom Chord of Trusses



I = 5½" x (11^3 - 8^3)/12 = 375

Δ = .180" = L/292 ok, ignores contribution of sheathing

chord compression/tension = 6.34^k x 12 / 9.5" = 8^k → 970 psi ok

spec min 2x8 botchord

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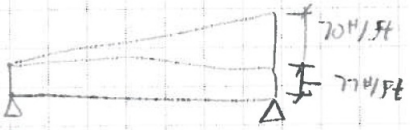
Check 3/4" Plywood to span 10' @ top of gable end wall



10'

$M_{max} = 1.4^{k}$

3/4" ply, $S = \frac{3}{4} \times 11^2/6 = 15.1$

$f_b = 1110$ psi N.G.

Look @ (2) 2x4

$S = \frac{1\frac{1}{2}"(11"^2 - 4^2)}{6 \times 11}$

$= 28.8$

$f_b = 583$ psi OK

$R = 620\# \Rightarrow (2)\ 3/4"\ \phi$ bolts $= (210\#/\text{bolt} \times 2\ \text{bolts} \times 1.6) = 672\#$

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Check 2x4 Wall studs w/ blocking 3'-6" (Hand Verification)

$F_c' = F_c \times C_D \times C_F \times C_p$

$C_D = 1.15$ (Snow load)

$C_F = 1.15$

C_p

$F_c^* = 1{,}150_{psi} \times 1.15 \times 1.15$
$= 1520$ psi

$C = .8$

$F_{cc} = \frac{.822\, E'_{min}}{(l_e/d)^2}$

E'_{min} 510,000 psi

$\frac{l_e}{d_1} = \frac{84"}{3\frac{1}{2}"} = 24$

$\frac{l_e}{d_2} = \frac{42"}{1\frac{1}{2}"} = 28"$ ← controls

$= 534.7$ psi

$F_{cc}/F_c^* = .35$

$C_p = \frac{1.35}{1.6} - \sqrt{\left(\frac{1.35}{1.6}\right)^2 - \frac{.35}{.8}}$

$= .32$

$P_{allow} = .32 \times 1520_{psi} \times 1\frac{1}{2} \times 3\frac{1}{2} = \boxed{2.55^k} < P_{max} = 1.54^k$ OK

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Typical 2x Header in Wall

span = 5.5'

w = 770 #/ft

M = 2.92 k'
V = 2.12 k
(2) 2x12

$F_b' = 875\ psi \times 1.15^{CD} = 1006\ psi$

$f_b = \frac{2.92^{k'} \times 12''/1}{632.3} = 551\ psi$ ok

$f_v = \frac{3 \times 2.12^{k}}{2 \times 1\frac{1}{2}'' \times 11\frac{1}{4}'' \times 2} = 94\ psi < 135\ psi$ ok

use (2) 2x12

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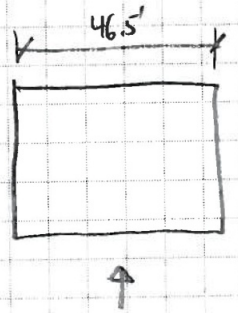
Design Exterior Wall Sheathing



$p_s = \lambda K_{zt} I p_{s30}$

$K_{zt} = 1.0$
$I = 1.0$
$\lambda = 1.24$ (exp cat 17')
$p_{s30} = 11.5$ psf (C)
C conn for roof
= 14.4 (zone 1)
= 12.1 weighted avg

$p_s = 15$ psf

$V = 15 psf \times 46.5' \times 13'$ = (½ of wall load to floor)

Available sidewall length = 16'

Req'd Shear capacity = $\frac{12.2^{k} \times \frac{1}{2}}{16'} = 381 \#/ft$

IBC table 2306.4.1, 15/32 sheathing w/ 10d nails @ 6" o/c
= 310 #/ft × 1.4 (wind increase) = 434 #/ft ok

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Evaluate Screw Jack Posts

Estimate Loads

Roof DL

5/8" sheathing	2
Roofing	3
Trusses	3
Ceiling	2
Insulation	5
Misc	5
	20psf

Roof LL = 50 psf (unbalanced)

Floor DL 15 psf (see pg C1)

LL 50psf

Jacks @ 8'-0" o/c

P_{max} = 8' × 11' (.02ksf + .05ksf + .015 ksf + .05ksf)

= 11.9 < 15k Load Capacity ok

P_{min} = 8' × 5.5' (.02 + .015) = 1.54k

P_{min} = 8 × 11 (.02 + .015) = 3.08k

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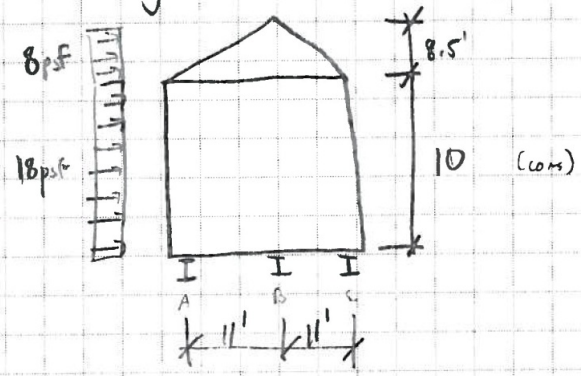
Evaluate Overturning on Screw Jacks (Preliminary)



$\circlearrowright \Sigma M_{OTC} \quad \emptyset = 8'[(.018 \times 10' \times 5') + (.008 \times 8.5' \times 14.25')]$

$= 14.2^{k'}$

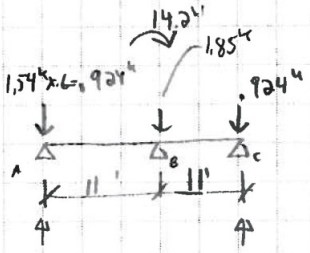
$\circlearrowleft \Sigma M_{RC} = W \times 11$

$= (.02 + .015) \times 22' \times 8' \times .6 \times 11' + 8' \times (.003 + .003 + .002) \times 8' \times 2 \times 11' \times .6$ (walls / sheathing / gyp / ins)

$= 47.4^{k'} > 14.2^{k'}$ ok no overturning

Evaluate min load @ post

$M_{OT} = 14.2^{k'}$



$+\circlearrowright \quad \Sigma M_B = \emptyset = 14.2^{k'} + (.924^k \times 11 - .924^k \times 11) - R_C \times 11 + R_A \times 11$

$R_C \times 11 - R_A \times 11 = 14.2^{k'}$

$R_C - R_A = 1.291^k$

$R_C = 1.291^k + R_A$

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$\uparrow \Sigma F_V = 0 = -.924^k \times 2 - 1.85^k + 1.85 + R_C + R_A$

$R_C + R_A = 1.848^k$

$1.291^k + R_A + R_A = 1.848$

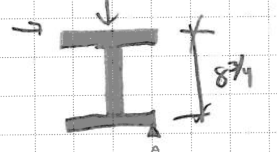
$R_A = .278^k > 0$

$R_C = 1.57^k$

Conclude no net uplift due to overturning effects of 90mph wind

Evaluate Screw Jack local overturning

$P_{max} = 11^k$, $P_{min} = .924^k$. Under wind P_{min} $.278^k$



$V = [(.018 \times 10' + .008 \times 8.5')/3] \times 8'$

$= .661^k$ per jack

$\Sigma M_{or} = .661^k \times 8\tfrac{3}{4} = 5.8^{k''}$

$\Sigma M_R = .278^k \times 2'' = .556^{k''}$ → N.G.

If place on 24" ℄

$\Sigma M_R = .278^k \times 12'' = 3.34^k$ N.G. ⇒ add kicker Bracing

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Check Sliding

Total Bldg wt ≈ 45' x 20' x (.02 Roof DL + .015) = 31.5^k

Total Horizontal Load = (14psf x 9.25' + 8psf x 7.5') x 45' = 10.14^k @ 90mph

Load 60mph = 10.14^k x 60²/90² = 4.51^k

Resisting capacity = 31.5^k x .33 (coefficient of friction) = 10.49^k

FS = 2.31 > 2.0 OK

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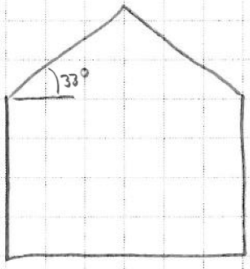
Check Net Uplift on Entire Structure



$q_z = .00256 K_z K_t K_d V^2 I$

$K_t = 1.0$
$K_d = .85$
$K_z = .88$ (18', exp C)
$I = 1.0$
$V = 90$ mph (vermont)

$q_z = 15.5$ psf

$p = q G C_p$

$G = .85$
$C_p = -.3$ $h/0 = 18'/22' = .82$

$= 4$ psf

total negative load on roof = 4psf x 22' = 88#/ft of bldg

min avail dead load = .6(20 psf roof DL + 15 psf floor DL) x 22' = 462#/ft

F.S against uplift = 5.25

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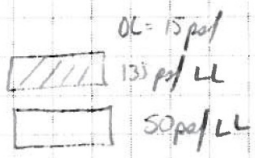
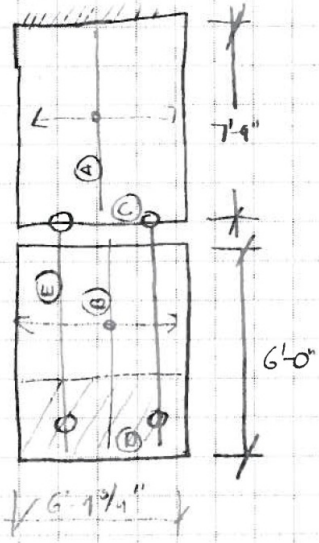
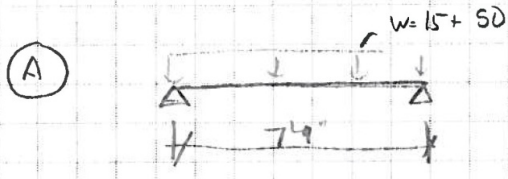
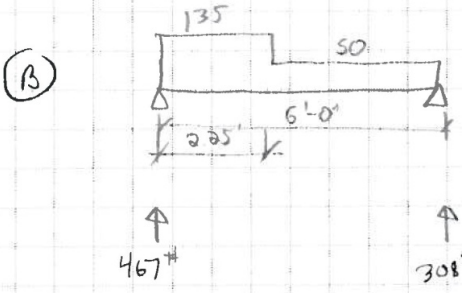
Deck Type A







Use 2x10 @ 16" o/c



Use 2x10 @ 16" o/c

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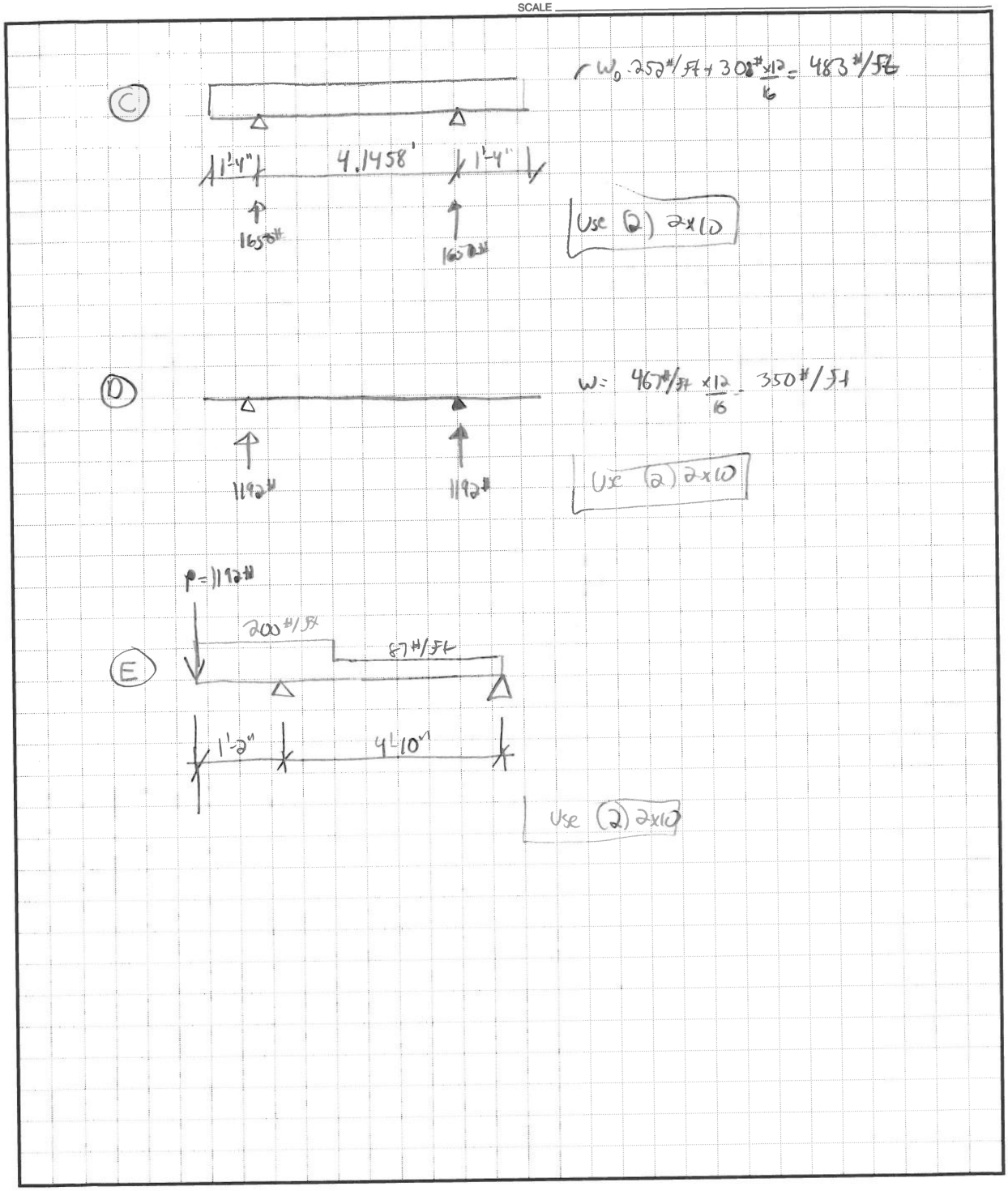

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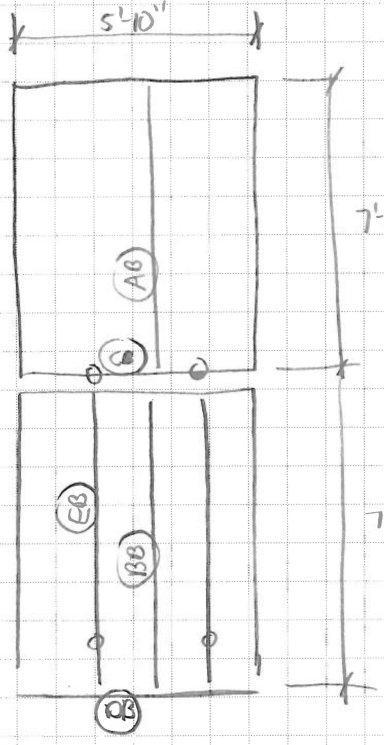
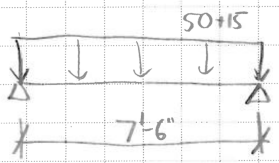
Type B



AB – Same As A → use 2x10 @ 16"o/c

BB



Use 2x10 @ 16"o/c

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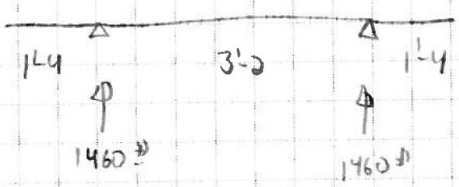
(CB)

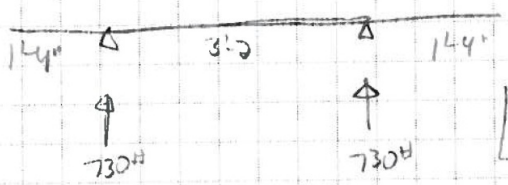


$w = \left(\frac{7.75 + 7.5'}{2}\right)(15+50)$

$= 500\#/FL$

use (2) 2x10

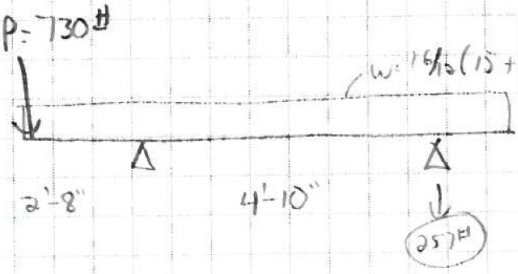
(DB)



$w = \frac{7.5'}{2} \times (15+50) = 250\#/ft$

use (2) 2x10

(EB)



use (2) 2x10

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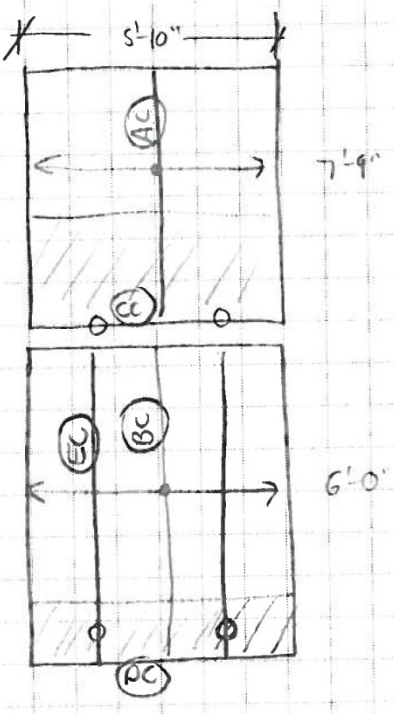

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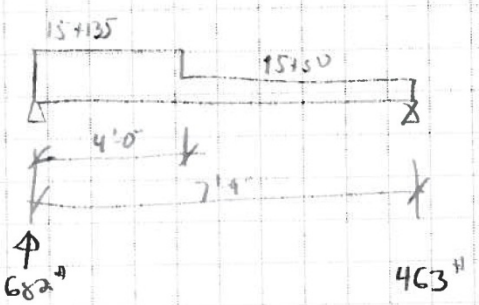
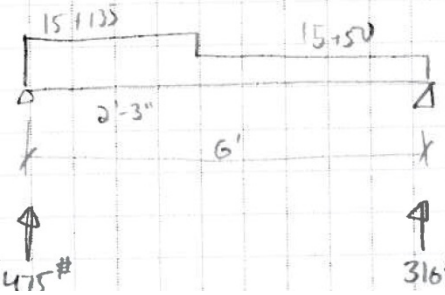


Use 2x10 @ 16" o/c

BC



Use 2x10 @ 16" o/c

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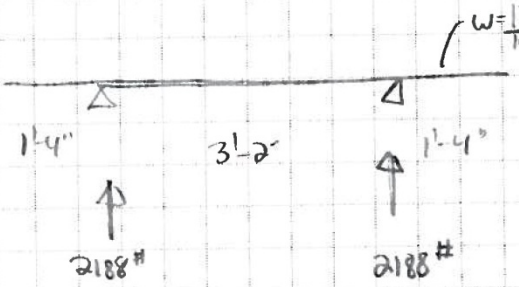
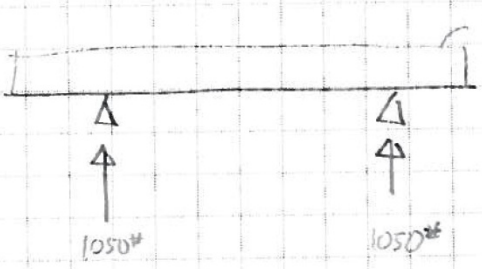


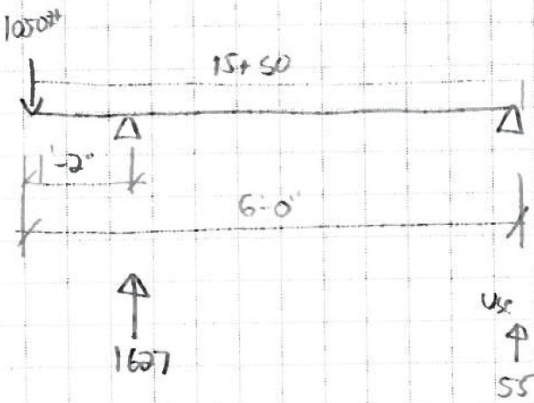
Use (2) 2x10

PC



Use (2) 2x10 @ 16" o/c

EC



Use (2) 2x10

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Joist for Full 135 psf

$\ell = 8'$

$m = \frac{16}{12}(.015 + .135\ k/f) \times 8'/8 = 1.6^{k'}$

$V =$ $.8^{k}$

2x10, $f_b =$ 597 psi OK < 1006 psi Ω

$f_v =$ 86 psi < 135 psi Ω

Use 2x10 @ 16" o/c

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SHEET NO. F8 OF

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Design Deck Footings

C, E

$w_1 = 35$
$w_2 = 55$

CCW

5'

$P_{max} =$ 1650
1952
1460
1639
1050
1627

$\frac{1952^{\#}}{1500\ psf} = 1.3\ sq\ ft \Rightarrow 1'-2"\ \phi\ B.P.$

$T_p = .01\ ksi$

$t = 5.5" \times \sqrt{\frac{.01}{.25 \times 36}} = .18" \Rightarrow$ **1/2" MIN**

Beam E Face Mount Hanger

$P_{max} = 1192 \Rightarrow$ LUS 210-2 $\Rightarrow$ 1745#
730
1050

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Design Bracket at Handrail Posts + Design Posts

Posts @ 3'-0" o/c

w= 50#/ft or 200# concentrated → 200# controls

$M = P \cdot l = .2^k \times 3.5'$

$= .7^{k'}$

1 1/4" XS pipe, $S = .278 \text{ in}^3$
$Z = .393 \text{ in}^3$

$\frac{M_n}{\Omega} = \frac{F_y Z}{\Omega} = \frac{35 \text{ksi} \times .393 \text{ in}^3}{1.67}$

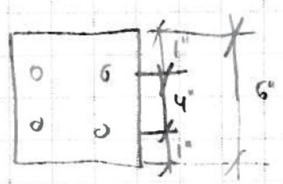
$= .686^{k'}$ N.G.

1 1/2" std, $Z = .421 \text{ in}^3$

$\frac{M_n}{\Omega} = .735^{k'}$ OK

use 1 1/2" std pipes

Design Bracket



$M = .7^{k'} = 8.4^{k''}$

$T = \frac{8.4^{''k}}{2 \text{ bolts} \times 4''} = 1050\# / \text{lag}$

3/4" ø lag into SPF = 395#/in x 1.5" penetration x 2.0 (impact)

= 1185# OK

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Max span of 2x10's @ ramp

$F'_b = 875\,psi \times 1.1 \times 1.15 = 1107\,psi$ (C_F, C_r)

$w = 1\frac{1}{4}" (.100\,k/sf + .05\,k/sf) = .153\,k/ft$ (LL, a)

$S = 21.39\,in^3$

$M_{cap} = F'_b \times S = 1.97\,k\text{-}ft = \frac{wl^2}{8}$

$= \frac{.153 \times l^2}{8}$

$l_{max} = 10'$

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Design Gate Hooks

Assume @ 12" o/c

Wmax = 251
308 x 12/16 = 231
243
463 x 12/16 = 347 ← Controls
316 x 12/16 = 237

M = 350# x 4" = 1.4 k"

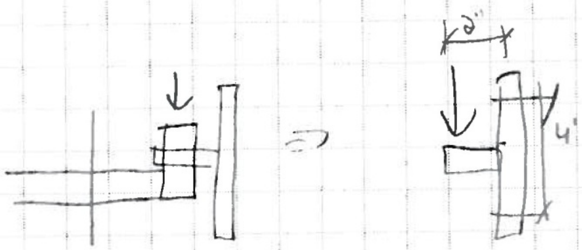
3/4" ⌀ Rod

S = π x 3/8 3/4 = .04

fb = 35 ksi

7/8" ⌀ S = .065 , fb = 21.5 ksi

1" ⌀ S = .098 , fb = 14.3 ksi ← use 1" ⌀



M = 750#"

Try (4) 1/2" lags

T = 750#" / (2 x 4") = 94#

V = 187#

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Gate Hinge (continued)

½" lag $W = 291\ ^{\#}/_{in} \times 1.5" = 430^{\#}$

$V_{cap} = 290^{\#}$

$$\frac{W}{W_{cap}} + \frac{V}{V_{cap}} = \frac{94}{430} + \frac{187}{290} = .86$$

Use 5/8" ø lags

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SP
F13

Design Water Tank Framing

Total Tank Wt = 6.5k

Tank ø = 6'-0" ⇒ 230 psf

Design Cribbing

SPAN = 5'-0"

try 2x6 @ 16" o/c, M = .23 x 5²/8 = 718 #'

F_b = 1140 psi high

2x8, F_b = 655 psi OK

Use 2x8

Bearing Load

$$\frac{6.5^k}{(2 \times 6' \times \frac{5.5"}{12})} = 1200 \text{ psf}$$ ⇒ Use (2) 2x6

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WoodWorks® SOFTWARE FOR WOOD DESIGN

COMPANY	PROJECT
Mar. 22, 2011 16:45	a.wwb

Design Check Calculation Sheet

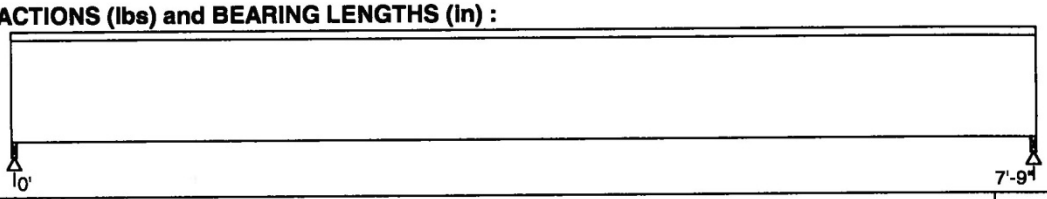
Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
Load1	Dead	Full Area				15.00 (16.0)*		psf
Load2	Live	Full Area				50.00 (16.0)*		psf

*Tributary Width (in)

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



Unfactored:			
Dead	77		77
Other	258		258
Factored:			
Total	336		336
Bearing:			
Load Comb	#2		#2
Length	0.53		0.53
Cb	1.00		1.00

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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 29	Fv' = 135	fv/Fv' = 0.22
Bending(+)	fb = 365	Fb' = 1107	fb/Fb' = 0.33
Live Defl'n	0.04 = <L/999	0.26 = L/360	0.15
Total Defl'n	0.06 = <L/999	0.39 = L/240	0.15

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	135	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	875	1.00	1.00	1.00	1.000	1.100	1.00	1.15	1.00	1.00	-	2
Fcp'	425	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.4 million	1.00	1.00		-	-	-	-	1.00	1.00	-	2
Emin'	0.51 million	1.00	1.00		-	-	-	-	1.00	1.00	-	2

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 = 139e06 lb-in2
Total Deflection = 1.50(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: 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.

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WoodWorks® SOFTWARE FOR WOOD DESIGN

COMPANY	PROJECT
Mar. 22, 2011 16:45	b.wwb

Design Check Calculation Sheet

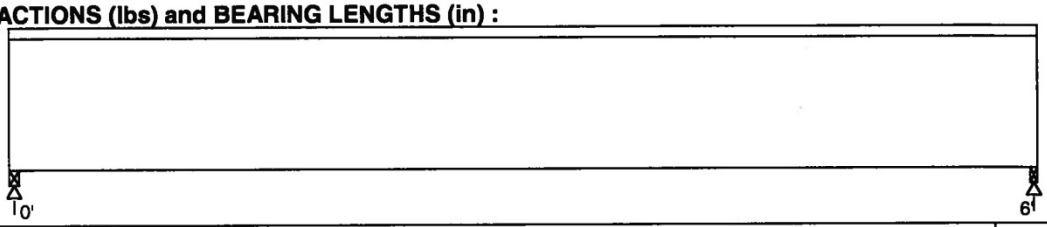
Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
Load1	Dead	Full Area				15.00	(16.0)*	psf
Load2	Live	Partial Area		0.00	2.25	135.00	(16.0)*	psf
Load3	Live	Partial Area		2.25	6.00	50.00	(16.0)*	psf

*Tributary Width (in)

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



Unfactored:			
Dead	60		60
Other	407		248
Factored:			
Total	467		308
Bearing:			
Load Comb	#2		#2
Length	0.73		0.50*
Cb	1.00		1.00

*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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 34	Fv' = 135	fv/Fv' = 0.25
Bending(+)	fb = 306	Fb' = 1107	fb/Fb' = 0.28
Live Defl'n	0.02 = <L/999	0.20 = L/360	0.11
Total Defl'n	0.03 = <L/999	0.30 = L/240	0.09

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	135	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	875	1.00	1.00	1.00	1.000	1.100	1.00	1.15	1.00	1.00	-	2
Fcp'	425	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.4 million	1.00	1.00	-	-	-	-	1.00	1.00	-	2	
Emin'	0.51 million	1.00	1.00	-	-	-	-	1.00	1.00	-	2	

Shear : LC #2 = D+L, V = 467, V design = 318 lbs

Bending(+): LC #2 = D+L, M = 546 lbs-ft

Deflection: LC #2 = D+L (live)

LC #2 = D+L (total)

EI = 139e06 lb-in2

Total Deflection = 1.50(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: 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.

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	Mar. 16, 2011 12:01	c.wwb

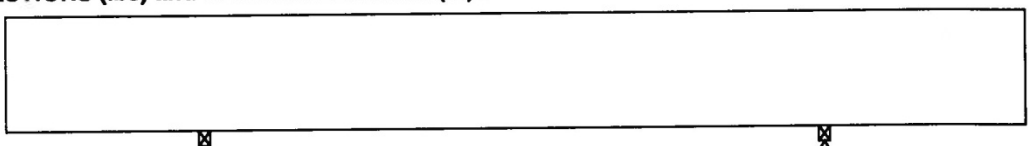
Design Check Calculation Sheet

Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	Location [ft] End	Magnitude Start	Magnitude End	Unit
Load1	Dead	Full UDL	No			483.0		plf

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



Unfactored: Dead			1645			1645		
Other								
Factored: Total			1645			1645		
Bearing: Load Comb	#0		#1			#1		#0
Length	0.00		0.92			0.92		0.00
Cb	0.00		1.41			1.41		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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 34	Fv' = 121	fv/Fv' = 0.28
Bending(+)	fb = 171	Fb' = 861	fb/Fb' = 0.20
Bending(-)	fb = 120	Fb' = 864	fb/Fb' = 0.14
Deflection:			
Interior Live	negligible		
Total	0.01 = <L/999	0.21 = L/240	0.04
Canti1. Live	negligible		
Total	-0.01 = <L/999	0.13 = L/120	0.04

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	135	0.90	1.00	1.00	-	-	-	-	1.00	1.00	1.00	1
Fb'+	875	0.90	1.00	1.00	0.994	1.100	1.00	1.00	1.00	1.00	-	1
Fb'-	875	0.90	1.00	1.00	0.998	1.100	1.00	1.00	1.00	1.00	-	1
Fcp'	425	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.4 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1
Emin'	0.51 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1

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)
EI = 139e06 lb-in2/ply
Total Deflection = 1.50(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: ICC-IBC

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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.

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WoodWorks® SOFTWARE FOR WOOD DESIGN

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Mar. 22, 2011 16:46	d.wwb

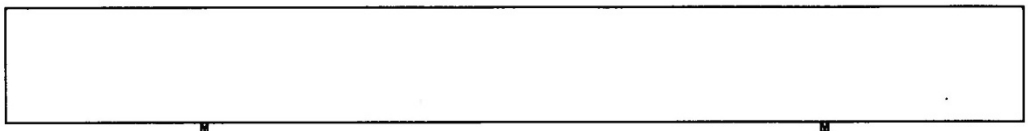
Design Check Calculation Sheet

Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
Load1	Dead	Full UDL	No			350.0		plf

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



Unfactored: Dead			1192			1192		
Other								
Factored: Total			1192			1192		
Bearing: Load Comb	#0		#1			#1		#0
Length	0.00		0.56			0.56		0.00
Cb	0.00		1.67			1.67		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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 25	Fv' = 121	fv/Fv' = 0.20
Bending(+)	fb = 124	Fb' = 861	fb/Fb' = 0.14
Bending(-)	fb = 87	Fb' = 864	fb/Fb' = 0.10
Deflection:			
Interior Live	negligible		
Total	0.01 = <L/999	0.21 = L/240	0.03
Cantil. Live	negligible		
Total	-0.00 = <L/999	0.13 = L/120	0.03

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	135	0.90	1.00	1.00	-	-	-	-	1.00	1.00	1.00	1
Fb'+	875	0.90	1.00	1.00	0.994	1.100	1.00	1.00	1.00	1.00	-	1
Fb'-	875	0.90	1.00	1.00	0.998	1.100	1.00	1.00	1.00	1.00	-	1
Fcp'	425	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.4 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1
Emin'	0.51 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1

Shear : LC #1 = D only, V = 726, V design = 456 lbs
Bending(+): LC #1 = D only, M = 441 lbs-ft
Bending(-): LC #1 = D only, M = 311 lbs-ft
Deflection: LC #0 = Self-weight (live)
LC #1 = D only (total)
EI = 139e06 lb-in2/ply
Total Deflection = 1.50(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: ICC-IBC

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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.

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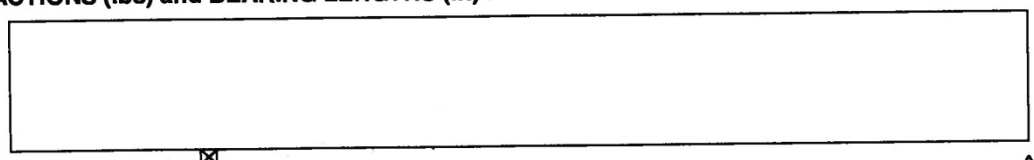
Design Check Calculation Sheet

Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
Load1	Dead	Partial UDL	No	0.00	1.17	200.0	200.0	plf
Load2	Dead	Partial UDL	No	1.17	6.00	87.0	87.0	plf
Load3	Dead	Point	No	0.00		1192		lbs

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



Unfactored: Dead			1952		
Other					
Factored: Uplift					106
Total			1952		
Bearing: Load Comb	#0		#1		#0
Length	0.00		1.16		0.00
Cb	0.00		1.32		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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 71	Fv' = 121	fv/Fv' = 0.59
Bending(-)	fb = 428	Fb' = 858	fb/Fb' = 0.50
Deflection:			
Interior Live	negligible		
Total	-0.02 = <L/999	0.24 = L/240	0.06
Canti1. Live	negligible		
Total	0.03 = L/487	0.12 = L/120	0.25

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	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	-	-
E'	1.4 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1
Emin'	0.51 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1

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 (live)
LC #1 = D only (total)
EI = 139e06 lb-in2/ply
Total Deflection = 1.50(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: ICC-IBC

self-
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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.

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Design Check Calculation Sheet

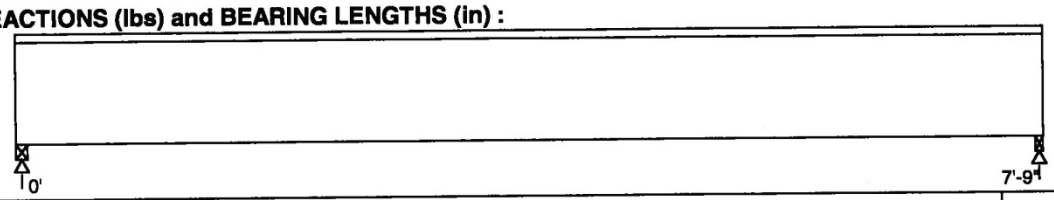
Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
Load1	Dead	Full Area				15.00	(16.0)*	psf
Load2	Live	Partial Area		0.00	4.00	135.00	(16.0)*	psf
Load3	Live	Partial Area		4.00	7.75	50.00	(16.0)*	psf

*Tributary Width (in)

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



Unfactored:			
Dead	88		88
Other	594		375
Factored:			
Total	682		463
Bearing:			
Load Comb	#2		#2
Length	1.07		0.73
Cb	1.00		1.00

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

Floor joist spaced at 16" c/c; Self-weight of 2.8 plf 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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 57	Fv' = 135	fv/Fv' = 0.42
Bending(+)	fb = 645	Fb' = 1107	fb/Fb' = 0.58
Live Defl'n	0.07 = <L/999	0.26 = L/360	0.29
Total Defl'n	0.09 = L/989	0.39 = L/240	0.24

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	135	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	875	1.00	1.00	1.00	1.000	1.100	1.00	1.15	1.00	1.00	-	2
Fcp'	425	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.4 million	1.00	1.00		-	-	-	-	1.00	1.00	-	2
Emin'	0.51 million	1.00	1.00		-	-	-	-	1.00	1.00	-	2

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 = 139e06 lb-in2
Total Deflection = 1.50(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: 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.

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Design Check Calculation Sheet

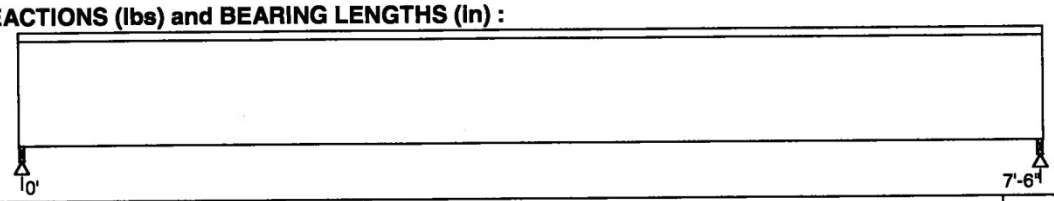
Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
Load1	Dead	Full Area				15.00	(16.0)*	psf
Load2	Live	Full Area				50.00	(16.0)*	psf

*Tributary Width (in)

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



Unfactored:			
Dead	75		75
Other	250		250
Factored:			
Total	325		325
Bearing:			
Load Comb	#2		#2
Length	0.51		0.51
Cb	1.00		1.00

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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 28	Fv' = 135	fv/Fv' = 0.21
Bending(+)	fb = 342	Fb' = 1107	fb/Fb' = 0.31
Live Defl'n	0.03 = <L/999	0.25 = L/360	0.14
Total Defl'n	0.05 = <L/999	0.38 = L/240	0.13

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	135	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	875	1.00	1.00	1.00	1.000	1.100	1.00	1.15	1.00	1.00	-	2
Fcp'	425	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.4 million	1.00	1.00		-	-	-	-	1.00	1.00	-	2
Emin'	0.51 million	1.00	1.00		-	-	-	-	1.00	1.00	-	2

Shear : LC #2 = D+L, V = 325, V design = 258 lbs
Bending(+): LC #2 = D+L, M = 609 lbs-ft
Deflection: LC #2 = D+L (live)
LC #2 = D+L (total)
EI = 139e06 lb-in2
Total Deflection = 1.50(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: 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.

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COMPANY	PROJECT
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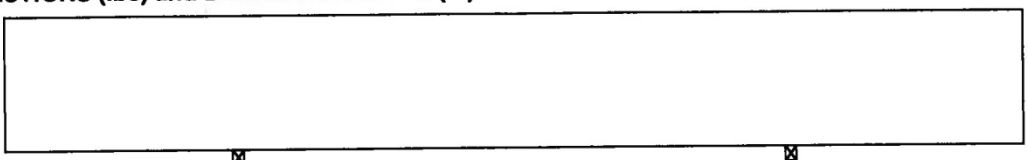
Design Check Calculation Sheet

Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
Load1	Dead	Full UDL	No			500.0		plf

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



	0'		1'-4"		4'-6"		5'-10"
Unfactored: Dead			1458		1458		
Other							
Factored: Total			1458		1458		
Bearing: Load Comb	#0		#1		#1		#0
Length	0.00		0.77		0.77		0.00
Cb	0.00		1.49		1.49		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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 22	Fv' = 121	fv/Fv' = 0.18
Bending(+)	fb = 51	Fb' = 864	fb/Fb' = 0.06
Bending(-)	fb = 125	Fb' = 864	fb/Fb' = 0.14
Deflection:			
Interior Live	negligible		
Total	0.00 = <L/999	0.16 = L/240	0.01
Cantil. Live	negligible		
Total	0.00 = <L/999	0.13 = L/120	0.02

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	135	0.90	1.00	1.00	-	-	-	-	1.00	1.00	1.00	1
Fb'+	875	0.90	1.00	1.00	0.997	1.100	1.00	1.00	1.00	1.00	-	1
Fb'-	875	0.90	1.00	1.00	0.998	1.100	1.00	1.00	1.00	1.00	-	1
Fcp'	425	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.4 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1
Emin'	0.51 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1

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 = 139e06 lb-in2/ply
Total Deflection = 1.50(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: ICC-IBC

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RELIANCE

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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.

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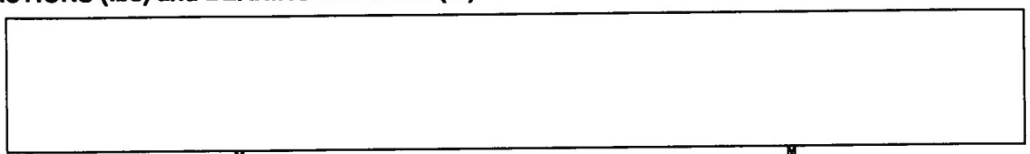
Design Check Calculation Sheet

Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	Location [ft] End	Magnitude Start	Magnitude End	Unit
Load1	Dead	Full UDL	No			250.0		plf

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



Unfactored: Dead			729		729		
Other							
Factored: Total			729		729		
Bearing: Load Comb	#0		#1		#1		#0
Length	0.00		0.50*		0.50*		0.00
Cb	0.00		1.75		1.75		0.00

*Min. bearing length for beams is 1/2" for intermediate supports

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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 11	Fv' = 121	fv/Fv' = 0.09
Bending(+)	fb = 26	Fb' = 864	fb/Fb' = 0.03
Bending(-)	fb = 62	Fb' = 864	fb/Fb' = 0.07
Deflection:			
Interior Live	negligible		
Total	0.00 = <L/999	0.16 = L/240	0.00
Cantil. Live	negligible		
Total	0.00 = <L/999	0.13 = L/120	0.01

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	135	0.90	1.00	1.00	-	-	-	-	1.00	1.00	1.00	1
Fb'+	875	0.90	1.00	1.00	0.997	1.100	1.00	1.00	1.00	1.00	-	1
Fb'-	875	0.90	1.00	1.00	0.998	1.100	1.00	1.00	1.00	1.00	-	1
Fcp'	425	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.4 million	1.00	1.00		-	-	-	-	1.00	1.00	-	1
Emin'	0.51 million	1.00	1.00		-	-	-	-	1.00	1.00	-	1

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)
LC #1 = D only (total)
EI = 139e06 lb-in2/ply
Total Deflection = 1.50(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: ICC-IBC

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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 piy 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.

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COMPANY	PROJECT
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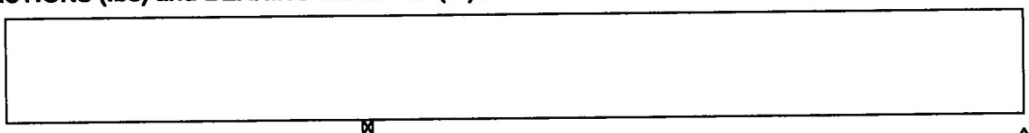
Design Check Calculation Sheet
Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
Load2	Dead	Full UDL	No			87.0		plf
Load3	Dead	Point	No	0.00		730		lbs

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



Unfactored: Dead			1639		
Other					
Factored: Uplift					257
Total			1639		
Bearing: Load Comb	#0		#1		#0
Length	0.00		0.91		0.00
Cb	0.00		1.41		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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 49	Fv' = 121	fv/Fv' = 0.40
Bending(-)	fb = 633	Fb' = 858	fb/Fb' = 0.74
Deflection:			
Interior Live	negligible		
Total	-0.03 = <L/999	0.24 = L/240	0.11
Cantil. Live	negligible		
Total	0.13 = L/248	0.27 = L/120	0.48

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	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	-	-
E'	1.4 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1
Emin'	0.51 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1

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 = 1.50(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: ICC-IBC

self-
RELIANCE

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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.

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WoodWorks® SOFTWARE FOR WOOD DESIGN

COMPANY	PROJECT
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Design Check Calculation Sheet

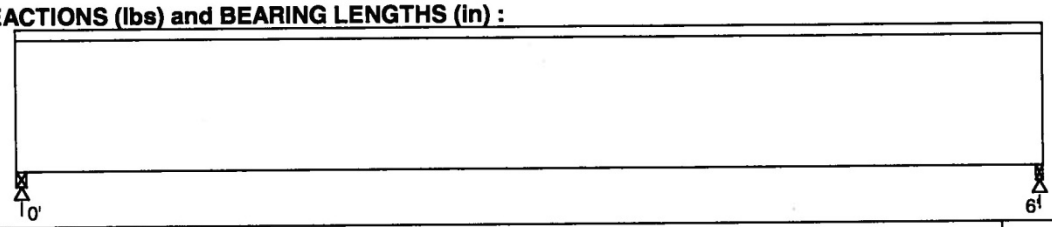
Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
Load1	Dead	Full Area				15.00	(16.0)*	psf
Load2	Live	Partial Area		0.00	2.25	135.00	(16.0)*	psf
Load3	Live	Partial Area		2.25	6.00	50.00	(16.0)*	psf

*Tributary Width (in)

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



Unfactored:			
Dead	68		68
Other	407		248
Factored:			
Total	475		316
Bearing:			
Load Comb	#2		#2
Length	0.75		0.50*
Cb	1.00		1.00

*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 2.8 plf 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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 35	Fv' = 135	fv/Fv' = 0.26
Bending(+)	fb = 313	Fb' = 1107	fb/Fb' = 0.28
Live Defl'n	0.02 = <L/999	0.20 = L/360	0.11
Total Defl'n	0.03 = <L/999	0.30 = L/240	0.10

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	135	1.00	1.00	1.00	-	-	-	-	1.00	1.00	1.00	2
Fb'+	875	1.00	1.00	1.00	1.000	1.100	1.00	1.15	1.00	1.00	-	2
Fcp'	425	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.4 million		1.00	1.00	-	-	-	-	1.00	1.00	-	2
Emin'	0.51 million		1.00	1.00	-	-	-	-	1.00	1.00	-	2

Shear : LC #2 = D+L, V = 475, V design = 325 lbs
Bending(+): LC #2 = D+L, M = 558 lbs-ft
Deflection: LC #2 = D+L (live)
LC #2 = D+L (total)
EI = 139e06 lb-in2
Total Deflection = 1.50(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: 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.

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WoodWorks® SOFTWARE FOR WOOD DESIGN

COMPANY	PROJECT
Mar. 16, 2011 13:15	cc.wwb

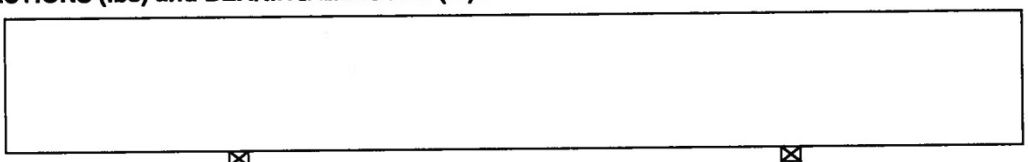
Design Check Calculation Sheet

Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	Location [ft] End	Magnitude Start	Magnitude End	Unit
Load1	Dead	Full UDL	No			750.0		plf

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



Unfactored: Dead			2187			2188		
Other								
Factored: Total			2187			2188		
Bearing:								
Load Comb	#0		#1			#1		#0
Length	0.00		1.34			1.34		0.00
Cb	0.00		1.28			1.28		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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 33	Fv' = 121	fv/Fv' = 0.27
Bending(+)	fb = 77	Fb' = 864	fb/Fb' = 0.09
Bending(-)	fb = 187	Fb' = 864	fb/Fb' = 0.22
Deflection:			
Interior Live	negligible		
Total	0.00 = <L/999	0.16 = L/240	0.01
Cantil. Live	negligible		
Total	0.00 = <L/999	0.13 = L/120	0.03

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	135	0.90	1.00	1.00	-	-	-	-	1.00	1.00	1.00	1
Fb'+	875	0.90	1.00	1.00	0.997	1.100	1.00	1.00	1.00	1.00	-	1
Fb'-	875	0.90	1.00	1.00	0.998	1.100	1.00	1.00	1.00	1.00	-	1
Fcp'	425	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.4 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1
Emin'	0.51 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1

Shear : LC #1 = D only, V = 1188, V design = 610 lbs
Bending(+): LC #1 = D only, M = 274 lbs-ft
Bending(-): LC #1 = D only, M = 666 lbs-ft
Deflection: LC #0 = Self-weight (live)
LC #1 = D only (total)
EI = 139e06 lb-in2/ply
Total Deflection = 1.50(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: ICC-IBC

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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.

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WoodWorks® SOFTWARE FOR WOOD DESIGN

COMPANY	PROJECT
Mar. 22, 2011 16:48	dc.wwb

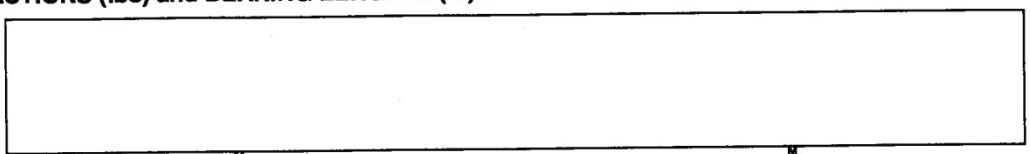
Design Check Calculation Sheet

Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
Load1	Dead	Full UDL	No			360.0		plf

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



Unfactored: Dead			1050		1050		
Other							
Factored: Total			1050		1050		
Bearing:							
Load Comb	#0		#1		#1		#0
Length	0.00		0.50*		0.50*		0.00
Cb	0.00		1.75		1.75		0.00

*Min. bearing length for beams is 1/2" for intermediate supports

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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 16	Fv' = 121	fv/Fv' = 0.13
Bending(+)	fb = 37	Fb' = 864	fb/Fb' = 0.04
Bending(-)	fb = 90	Fb' = 864	fb/Fb' = 0.10
Deflection:			
Interior Live	negligible		
Total	0.00 = <L/999	0.16 = L/240	0.00
Cantil. Live	negligible		
Total	0.00 = <L/999	0.13 = L/120	0.01

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	LC#
Fv'	135	0.90	1.00	1.00	-	-	-	-	1.00	1.00	1.00	1
Fb'+	875	0.90	1.00	1.00	0.997	1.100	1.00	1.00	1.00	1.00	-	1
Fb'-	875	0.90	1.00	1.00	0.998	1.100	1.00	1.00	1.00	1.00	-	1
Fcp'	425	-	1.00	1.00	-	-	-	-	1.00	1.00	-	-
E'	1.4 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1
Emin'	0.51 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1

Shear : LC #1 = D only, V = 570, V design = 293 lbs
Bending(+): LC #1 = D only, M = 131 lbs-ft
Bending(-): LC #1 = D only, M = 320 lbs-ft
Deflection: LC #0 = Self-weight (live)
LC #1 = D only (total)
EI = 139e06 lb-in2/ply
Total Deflection = 1.50(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: ICC-IBC

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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.

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COMPANY	PROJECT
Mar. 22, 2011 16:48	ec.wwb

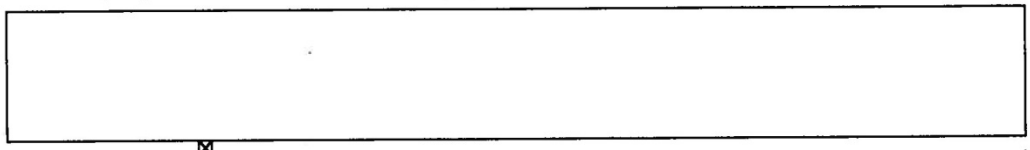
Design Check Calculation Sheet

Sizer 8.11

LOADS:

Load	Type	Distribution	Pat-tern	Location [ft] Start	End	Magnitude Start	End	Unit
Load2	Dead	Full UDL	No			87.0		plf
Load3	Dead	Point	No	0.00		1050		lbs

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



Unfactored:					
Dead			1627		
Other					
Factored:					
Uplift					55
Total			1627		
Bearing:					
Load Comb	#0		#1		#0
Length	0.00		0.90		0.00
Cb	0.00		1.42		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 :

Criterion	Analysis Value	Design Value	Analysis/Design
Shear	fv = 60	Fv' = 121	fv/Fv' = 0.49
Bending(-)	fb = 360	Fb' = 858	fb/Fb' = 0.42
Deflection:			
Interior Live	negligible		
Total	-0.01 = <L/999	0.24 = L/240	0.05
Cantil. Live	negligible		
Total	0.02 = L/595	0.12 = L/120	0.20

ADDITIONAL DATA:

FACTORS:	F/E	CD	CM	Ct	CL	CF	Cfu	Cr	Cfrt	Ci	Cn	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	-	-
E'	1.4 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1
Emin'	0.51 million		1.00	1.00	-	-	-	-	1.00	1.00	-	1

Shear : LC #1 = D only, V = 1152, V design = 1107 lbs
Bending(-): LC #1 = D only, M = 1284 lbs-ft
Deflection: LC #0 = Self-weight (live)
LC #1 = D only (total)
EI = 139e06 lb-in2/ply
Total Deflection = 1.50(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: ICC-IBC

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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.

Detailed Water Budget

Function	Water Use (gal)	Calculations		Notes
		gallons per use	number of uses over the course of the competition	
Hot Water Draws	240	15	16	
Water Vaporization	2.4	0.6	4	
Dishwasher	23	4.6	5	
Clothes Washer	25	200	8	
Dinner Party	50	25	8	Cooking, rinsing, wiping tables (all water consumed will be team-provided)
Movie Night	25	25	1	Cooking, rinsing, wiping tables (all water consumed will be team-provided)
Vegetation	400	60	5	
Greenhouse	60	15	5	
Fire Protection	300	300	1	
Testing	18	2	9	2 gallons per day of testing
Initial Systems Fill	90	90	1	
Safety Factor	166.6			Fill tanks to capacity to allow for error in these estimates
Total Water Use	**1400 gal**			

Team Provided Liquids

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

* 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.

ScienceLab.com
Chemicals & Laboratory Equipment

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:

Name	CAS #	% by Weight
Propylene glycol	57-55-6	100

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 waistband.

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, hydrofluloric 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:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Supplier MSDS -LOLI -RTECS -HSDB

Other Special Considerations: Not available.

Created: 10/10/2005 08:24 PM

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

NATIONAL REFRIGERANTS™

Material Safety Data Sheet

R-410A

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: R-410A
DISTRIBUTOR: National Refrigerants, Inc.
661 Kenyon Avenue
Bridgeton, 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

INGREDIENT NAME	CAS NUMBER	WEIGHT %
Difluoromethane	75-10-5	50
Pentafluoroethane	354-33-6	50

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.

INGREDIENT NAME	NTP STATUS	IARC STATUS	OSHA LIST
No ingredients listed in this section			

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

FLASH POINT:	Gas, not applicable per DOT regulations
FLASH POINT METHOD:	Not applicable
AUTOIGNITION TEMPERATURE:	>750°C
UPPER FLAME LIMIT (volume % in air):	None by ASTM D-56-82
LOWER FLAME LIMIT (volume % in air):	None by ASTM E-681
FLAME PROPAGATION RATE (solids):	Not applicable
OSHA FLAMMABILITY CLASS:	Not applicable

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

INGREDIENT NAME	ACGIH TLV	OSHA PEL	OTHER LIMIT
Difluoromethane	None	None	None
Pentafluoroethane	None	None	*1000 ppm TWA (8hr)

* = Workplace Environmental Exposure Level (AIHA)

OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS:

Hydrogen Fluoride: ACGIH TLV: 3 ppm ceiling

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	Clear, colorless liquid and vapor
PHYSICAL STATE:	Gas at ambient temperatures
MOLECULAR WEIGHT:	72.6
CHEMICAL FORMULA:	CH_2F_2, CHF_2CF_3
ODOR:	Faint ethereal odor
SPECIFIC GRAVITY (water = 1.0):	1.08 @ 21.1°C (70°F)
SOLUBILITY IN WATER (weight %):	Unknown
pH:	Neutral
BOILING POINT:	-48.5°C (-55.4°F)
FREEZING POINT:	Not determined
VAPOR PRESSURE:	215.3 psia @ 70°F 490.2 psia @ 130°F
VAPOR DENSITY (air = 1.0):	3.0
EVAPORATION RATE:	>1 **COMPARED TO:** $CC1_4$ = 1
% VOLATILES:	100
FLASH POINT:	Not applicable

(Flash point method and additional flammability data are found in Section 5.)

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R-410A

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_{50} : 4 hr. (rat) - $\geq$ 520,000 ppm
Pentafluoroethane:	Cardiac Sensitization threshold (dog) $\geq$ 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_{ow} = 1.48 (pentafluoroethane), 0.21 (difluoromethane)

NATIONAL REFRIGERANTS™

R-410A

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.

INGREDIENT NAME	SARA / CERCLA RQ (lb.)	SARA EHS TPQ (lb.)
No ingredients listed in this section		

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.

INGREDIENT NAME	COMMENT
No ingredients listed in this section	

NATIONAL REFRIGERANTS™

R-410A

STATE RIGHT-TO-KNOW

In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

INGREDIENT NAME	WEIGHT %	COMMENT
No ingredients listed in this section		

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 Pentafluoroethane (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

CURRENT ISSUE DATE: December, 2008
PREVIOUS ISSUE DATE: August, 2007

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:

1. OSHA regulations for compressed gases: 29 CFR 1910.101
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 HEREIN. 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.

Interconnection Application Form

_____Middlebury College __*Lot* 107_____

Team Name and Lot Number

PV Systems

Module Manufacturer	Short Description of Array	DC Rating of Array (sum of the DC ratings)
Sunpower	10 x 225W PV Modules wired in series	2.25 kW DC @STC
Sunpower	10 x 225W PV Modules wired in series	2.25 kW DC @STC
Sunpower	10 x 225W PV Modules wired in series	2.25 kW DC @STC

Total DC power of all arrays is _____6.8_____ kW (in tenths)

INVERTERS

Inverter Manufacturer	Model Number	Voltage	Rating (kVA or KW)	Quantity
SunPower	SPR-7000m Inverter	240V Output	7 KW AC Nominal Rating	1

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		655 VA		
Outdoor unit		6720 VA		
Heating Total		7375 VA	=	30.7 A
25% of Largest Motor:	(6720)(.25) =	1680 VA	=	7.0 A
General Loads				
Lighting: 1000 ft² @ 3VA/ft² (Table 220.3(A)		3000 VA		
2 20A kitchen Appliance Circuits @1500VA		3000 VA		
Laundry Circuit		1500 VA		
		7500		
NEC Table 220.42				
3000 VA@ 100% Demand Factor		3000		
3001-120,000 VA @ 35% Demand Factor		1575		
		4575 VA	=	19.1 A
Fixed Equipment				
Induction Cooktop (Range)		7680 VA		
Oven		5760 VA		
65% Demand Facter (NEC Table 220.55)		8736 VA	=	36.4 A
Dryer (NEC 220.54 - 100%DF)		5760 VA	=	24 A
Domestic Water Pump		1152 VA		
H20 Heater		4500 VA		
ERV		690 VA		
Solar Thermal Pump		373 VA		
Sewage Pump		373 VA		
120V Appliances — Dishwasher		1800 VA		
Refrigerator		540 VA		
Microwave		1500 VA		
Range Hood		500 VA		
75% Demand Factor (NEC 220.53)		8571 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

PRIMARY ENERGY VALUE

Building:	Middlebury Solar Decathlon		Building Type/Use:	Single Family Residence	
Location:			Treated Floor Area $A_{(TFA)}$:	1119	ft²
			Space Heat Demand incl. Distribution	16.2	kBTU/(ft2yr)
			Useful Cooling Demand:	0.8	kBTU/(ft2yr)

			Final Energy	Primary Energy	Emissions CO_2-Equivalent
		CHOOSE UNITS: kBTU/(ft2yr)		kBTU/(ft2yr)	lb/(ft²yr)
Electricity Demand (without Heat Pump)				PE Value	CO_2-Emissions Factor (CO_2-Equivalent)
Covered Fraction of Space Heat Demand		(Project)	0%	kBTU/kBTU	lb/kBTU
Covered Fraction of DHW Demand		(Project)	100%	2.7	0.44
Direct Electric Heating	$Q_{H,de}$		0.0	0.0	0.00
DHW Production, Direct Electric (without Wash&Dish)	$Q_{DHW,de}$	(DHW+Distribution, SolarDHW)	0.4	1.0	0.16
Electric Postheating DHW Wash&Dish		(Electricity, SolarDHW)	0.1	0.2	0.04
Electricity Demand Household Appliances	Q_{EHH}	(Electricity worksheet)	5.4	14.4	2.35
Electricity Demand - Auxiliary Electricity			1.5	4.0	0.66
Total Electricity Demand (without Heat Pump)			7.3	19.7	3.21
			kBTU/(ft2yr)	kBTU/(ft2yr)	lb/(ft²yr)
Heat Pump				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heat Demand		(Project)	100%	kBTU/kBTU	lb/kBTU
Covered Fraction of DHW Demand		(Project)	0%	2.7	0.44
					lb/kBTU
Energy Carrier - Supplementary Heating			Electricity	2.7	
Annual Coefficient of Performance - Heat Pump		Separate Calculation	2.30		
Total System Performance Ratio of Heat Generator		Separate Calculation	0.44		
Electricity Demand Heat Pump (without DHW Wash&Dish)	$Q_{e,P}$		7.1	19.2	3.13
Non-Electric Demand, DHW Wash&Dish		(Electricity worksheet)	0.0	0.0	0.00
Total Electricity Demand Heat Pump			7.1	19.2	3.13
			kBTU/(ft2yr)	kBTU/(ft2yr)	lb/(ft²yr)

Passive House Planning

SPECIFIC USEFUL COOLING DEMAND
MONTHLY METHOD

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

Climate: Burlington PHIUS Set
Building: Middlebury Solar Decathlon
Location:
Spec. Capacity: 17 BTU/(ft³°F) (Enter in Summer worksheet.)

Interior Temperature Summer: 77 °F
Building Type/Use: Single Family Residenc
Treated Floor Area A_{TFA}: 1119 ft²

	Building Element	Temperature Zone	Area ft²	R-Value hr·ft²·F/BTU	Mon. Red. Fac.	Q_t °F·day/yr		kBTU/yr	per ft² Treated Floor Area
1.	Exterior Wall - Ambient	A	2042	38.3	1.00	5435	→	6946	
2.	Exterior Wall - Ground	B	244	37.4	1.00	5487	→	859	
3.	Roof/Ceiling - Ambient	A	1146	68.4	1.00	5435	→	2185	
4.	Ground 1	B	817	28.5	1.00	5487	→	3780	
5.	Ground 2	B			1.00		→		
6.	Ground 3	B			1.00		→		
7.		A			1.00		→		
8.		A			1.00		→		
9.		A			1.00		→		
10.		A			1.00		→		
11.		X			0.75		→		
12.		Y			0.85		→		
13.		Z			0.95		→		
14.	Windows	A	244	6.1	1.00	5435	→	5216	
15.	Exterior Door	A	40	2.0	1.00	5435	→	2609	
16.	Exterior TB (length/m)	A			1.00		→		
17.	Perimeter TB (length/m)	P			1.00		→		
18.	Ground TB (length/m)	B			1.00		→		
							Total	21594	19.30 kBTU/(ft²yr)

Transmission Losses Q_T (Negative: Heat Loads)

	Effective Air Volume V_v	A_{TFA} ft²		Clear Room Height ft		ft³
		1119	*	8	=	9173

	Heat Transfer Coefficient Ventilation BTU/hr°F		Q_t °F·day/yr		kBTU/yr	kBTU/(ft²yr)
Exterior	81.2	*	5435	=	10597	9.47
Ground	0.0	*	5487	=	0	0.00

Additional Summer Ventilation

Passive House Planning

COOLING LOAD

Building:	Middlebury Solar Decathlon					Building Type/Use:	Single Family Resic	Interior Temperature:	77	°F	
Location:						Treated Floor Area A_{TFA}:	1119	ft²			
Spec. Capacity:	17	BTU/(ft²*F) (Enter in "Summer" worksheet.)				Climate (Cooling Load):	Burlington PHIUS Set				
	Ambient Air		Sky		Ground		Radiation:	North	East	South	West	Horizontal
Design Temperature:	85	°F	72	°F	63	°F		21	56	47	61	111

BTU/hr.ft²

	Building Elements	Temperature Zone	Area ft²	R-Value hr.ft².F/BTU	Factor Always 1 (except "X")	TempDiff °F		BTU/hr
1.	Exterior Wall - Ambient	A	2042	38.3	1.00	7.8	→	415
2.	Exterior Wall - Ground	B	244	37.4	1.00	-14.4	→	-94
3.	Roof/Ceiling - Ambient	A	1146	68.4	1.00	7.8	→	131
4.	Ground 1	B	817	28.5	1.00	-14.4	→	-412
5.	Ground 2	B			1.00	-14.4	→	
6.	Ground 3	B			1.00	-14.4	→	
7.		A			1.00	7.8	→	
8.		A			1.00	7.8	→	
9.		A			1.00	7.8	→	
10.		A			1.00	7.8	→	
11.		X			0.75	7.8	→	
12.		Y			0.85	7.8	→	
13.		Z			0.95	7.8	→	
14.	Windows	A	244	6.1	1.00	7.8	→	312
15.	Exterior Door	A	40	2.0	1.00	7.8	→	156
16.	Exterior TB (length/m)	A			1.00	7.8	→	
17.	Perimeter TB (length/m)	P			1.00	-14.4	→	
18.	Ground TB (length/m)	B			1.00	-14.4	→	
19.	House/DU Partition Wall	I			1.00	5.4	→	

		$L_{ambient}$ BTU/hr*F		TempDiff °F		L_{sky} BTU/hr*F	*	TempDiff °F		
20.	Radiation Correction	-7	*	7.8	+	7	*	-5.4	-	-95

Transmission Heat Losses P_T Total - 413

Ventilation System:

	A_{TFA} ft²		Clear Room Height ft		ft³
Effective Air Volume, V_V	1119	*	8	-	9173

	Vent. Transm. BTU/hr*F	TempDiff °F day/yr		BTU/hr
Exterior	81	325	→	634
Ground	0	-598	→	0

Passive House Planning

SPECIFIC ANNUAL HEAT DEMAND

Climate: Burlington PHIUS Set
Building: Middlebury Solar Decathlon
Location:

Interior Temperature: 68.0 °F
Building Type/Use: Single Family Residence
Treated Floor Area A_{TFA}: 1119 ft²

	Building Element	Temperature Zone	Area ft²	R-Value hr.ft2.F/BTU	Temp. Factor f_t	G_t (Heating Degree Day) °F.day/yr		kBTU/yr	per ft² Treated Floor Area
1.	Exterior Wall - Ambient	A	2042	38.3	1.00	7271	→	9292	
2.	Exterior Wall - Ground	B	244	37.4	0.58	7271	→	655	
3.	Roof/Ceiling - Ambient	A	1146	68.4	1.00	7271	→	2923	
4.	Ground 1	B	817	28.5	0.58	7271	→	2883	
5.	Ground 2	B			0.58		→		
6.	Ground 3	B			0.58		→		
7.		A			1.00		→		
8.		A			1.00		→		
9.		A			1.00		→		
10.		A			1.00		→		
11.		X			0.75		→		
12.		Y			0.85		→		
13.		E			0.95		→		
14.	Windows	A	244	6.1	1.00	7271	→	6979	
15.	Exterior Door	A	40	2.0	1.00	7271	→	3490	
16.	Exterior TB (length/m)	A			1.00		→		
17.	Perimeter TB (length/m)	P			0.58		→		
18.	Ground TB (length/m)	B			0.58		→		
	Total of All Building Envelope Areas		4533						kBTU/(ft²yr)

Transmission Heat Losses Q_T — Total: 26221 — 23.44

	A_{TFA} ft²		Clear Room Height ft		ft²
Ventilation System: Effective Air Volume, V_V	1119	*	8.20	=	9173

Effective Heat Recovery Efficiency of Heat Recovery η_{eff}: 80%

Efficiency of Subsoil Heat Exchanger η_{SHX}: 0%

$\eta_{V,system}$ Φ_{HR} $\eta_{V,Rec}$

Passive House Planning

SPECIFIC SPACE HEATING LOAD

Building: Middlebury Solar Decathlon
Location:

Building Type/Use: Single Family Residence
Treated Floor Area A_{TFA}: 1119 ft² Interior Temperature: 68
Climate (HL): Burlington PHIUS Set

	Design Temperature		Radiation:	North	East	South	West	Horizontal	
Weather Condition 1:	-1	°F		9	22	53	22	31	BTU/hr.ft²
Weather Condition 2:	2	°F		7	9	22	13	17	BTU/hr.ft²
Ground Design Temp.	42	°F							

	Building Element	Temperature Zone	Area ft²	R-Value hr.ft².F/BTU	Factor Always 1 (except "X")	TempDiff 1 °F		TempDiff 2 °F		P_T 1 BTU/hr		P_T 2 BTU/hr
1.	Exterior Wall - Ambient	A	2042	38.3	1.00	69	or	66	→	3693	or	3524
2.	Exterior Wall - Ground	B	244	37.4	1.00	26	or	26	→	169	or	169
3.	Roof/Ceiling - Ambient	A	1146	68.4	1.00	69	or	66	→	1162	or	1109
4.	Ground 1	B	817	28.5	1.00	26	or	26	→	743	or	743
5.	Ground 2	B			1.00	26	or	26	→		or	
6.	Ground 3	B			1.00	26	or	26	→		or	
7.		A			1.00	69	or	66	→		or	
8.		A			1.00	69	or	66	→		or	
9.		A			1.00	69	or	66	→		or	
10.		A			1.00	69	or	66	→		or	
11.		X			0.75	69	or	66	→		or	
12.		Y			0.85	69	or	66	→		or	
13.		Z			0.95	69	or	66	→		or	
	Windows	A	244	6.1	1.00	69	or	66	→	2774	or	2647
14.	Exterior Door	A	40	2.0	1.00	69	or	66	→	1387	or	1324
15.	Exterior TB (length/m)	A			1.00	69	or	66	→		or	
16.	Perimeter TB (length/m)	P			1.00	26	or	26	→		or	
17.	Ground TB (length/m)	B			1.00	26	or	26	→		or	
18.	House/DU Partition Wall	I			1.00	5	or	5	→		or	

Transmission Heat Losses P_T

Total = 9928 or 9515

Ventilation System:

Effective Air Volume, V_v: A_{TFA} 1119 ft² × Clear Room Height 8.2 ft = 9173 ft³

Efficiency of Heat Recovery of the Heat Exchanger η_{HR}: 80%
Heat Recovery Efficiency SHX: 0%
Efficiency SHX: η_{SHX} 1: 0% or η_{SHX} 2: 0%

Energetically Effective Air Exchange n_v:

n_v,Res (Heating Load) 1/h		$n_{v,system}$ 1/h		Φ_{HR}		Φ_{HR}		1/h		1/h
0.163	+	0.300	*(1-	0.80	or	0.80	)=	0.223	or	0.223

Passive House Planning

ELECTRICITY DEMAND

Building: Middlebury Solar Decathlon

# Households	1	HH	
Persons	3.0	P	
Living Area	1119	ft²	
Annual Heat Demand	16.18	kBTU/(ft²yr)	

Solar Fraction of DHW Wash&Dish	77%
Marginal Performance Ratio DHW	100%
Marginal Performance Ratio Heating	43%

Primary Energy Factors:	Electricity	Natural Gas	
Energy Carrier for Space Heating/DHW:	2.7	1.1	kWh/kWh kBTU/kBTU

Column Nr.	1	2	3		4		5		6		7		8	8a		9		10		11		12		13		14
Application	Used ? (1/0)	Within the Thermal Envelope? (1/0)	Norm Demand		Utilization Factor		Frequency		Reference Quantity		Useful Energy (unit/yr)		Electric Fraction	Non-Electric Fraction		Electricity Demand (kWh/yr)		Additional Demand		Marginal Performance Ratio		Solar Fraction		Non-Electric Demand (kWh/yr)		Primary Energy-Demand (kWh/yr)
Dishwashing	1	1	0.76	kWh/Use	* 1.00	*	65	/(P*yr)	* 3.0	P	= 148	*	50%		=	74									199
DHW Connection												*	50%				* (1+	0.30	) *	1.00	*(1-	0.77	) =	22	60
Clothes Washing	1	1	0.35	kWh/Use	* 1.00	*	57	/(P*yr)	* 3.0	P	= 59	*	55%		=	32									87
DHW Connection												*	45%				* (1+	0.05	) *	1.00	*(1-	0.77	) =	6	17
Clothes Drying with:	1	1	3.50	kWh/Use	Residual dampness 0.60	0.88	* 57	/(P*yr)	* 3.0	P	= 518	*	100%		=	518									1399
Condensation Dryer											= 0		0%							1.00	*			0	0
Energy Consumed by Evaporation	0	1	3.13	kWh/Use	*	0.60	* 57	/(P*yr)	* 3.0	P	= 0	*	100%				* (1+	0.00	) *	0.43	*(1-	0.56	) =	0	0
Refrigerating	0	1	0.78	kWh/day	*	1.00	* 365	day/yr	* 1	HH	= 0	*	100%		=	0									0
Freezing	0	1	0.88	kWh/day	*	1.00	* 365	day/yr	* 1	HH	= 0	*	100%		=	0									0
or Combined Unit	1	1	1.26	kWh/day	*	1.00	* 365	day/yr	* 1	HH	= 459	*	100%		=	459									1239
Cooking with:	1	1	0.20	kWh/Use	*	1.00	* 500	/(P*yr)	* 3.0	P	= 297	*	100%		=	297									802
Electricity					Percentage CFLs 100%							*	0%											0	0
Lighting	1	1	11	W	*	1.00	* 2.90	kh/(P*yr)	* 3.0	P	= 95	*	100%		=	95									256
Consumer Electronics	1	1	80	W	*	1.00	* 0.55	kh/(P*yr)	* 3.0	P	= 131	*	100%		=	131									353
Small Appliances, etc.	1	1	50	kWh	*	1.00	* 1.00	/(P*yr)	* 3.0	P	= 148	*	100%		=	148									401
Total Aux. Electricity											490					490									1323
Other:																									
											0					0									0
											0					0									0
											0					0									0
											0					0									0
											0					0									0
											0					0									0
Total											2345	kWh				2244	kWh		DHW Non-Electric - Wash&Dish 134	kWh			28	6138
Specific Demand																2.0	kWh/(ft²yr)		Non-Renewable Non-Electric DHW Wash&Dish 0.03	kWh/(ft²yr)			0.03	5.5
																6.8	kBTU/(ft²yr)		Non-Renewable Non-Electric DHW Wash&Dish 0.09	kBTU/(ft²yr)			0.1	18.7
Recommended Maximum Value																5.71	kBTU/(ft²yr)							kBTU/(ft²yr)	15.85

Passive House Planning

HEAT DISTRIBUTION AND DHW SYSTEM

Building:	Middlebury Solar Decathlon	
Location:		
Interior Temperature:	68	°F
Building Type/Use:	Single Family Residence	
Treated Floor Area A_{TFA}:	1119	ft²
Occupancy:	3.0	Pers
Number of Residences:	1.0	
Annual Heat Demand $q_{heating}$	18104	kBTU/yr
Length of Heating Period:	205	d
Average Heat Load P_{ave}	4	kBTU/hr
Marginal Utilizability of Additional Heat Gains:	97%	

			Parts: Warm Region 1	Cold Region 2	Cold Region 3	Total	
Space Heat Distribution							
Length of Distribution Pipes	L_H (Project)						ft
Heat Loss Coefficient per m Pipe	Ψ (Project)						BTU/hr.ft.°F
Temperature of the Room Through Which the Pipes Pass	ϑ_R Mechanical Room		68				°F
Design Flow Temperature	ϑ_{dist} Flow, Design Value		67				°F
Design System Heat Load	$P_{heating}$ (exist./calc.)						kBTU/hr
Flow Temperature Control (check)							
Design Return Temperature	ϑ_R	=0.714*(ϑ_{dist}-36)+36	67.3	42.3	42.3		°F
Annual Heat Emission per foot of Plumbing	q'_{HL}	= Ψ (ϑ_m-ϑ_R) $t_{heating}$*0.024	0.0	0.0	0.0	Total 1,2,3	kBTU/(ft·yr)
Possible Utilization Factor of Released Heat	$\eta_{ü}$		97%	0%	0%		-
Annual Losses	Q_{HL}	= L_H · q'_{HL} · (1-$\eta_{ü}$)	0	0	0	0	kBTU/yr
Specif. Losses	q_{HL}	= ΣQ_{HL} / A_{TFA}					kBTU/(ft²yr) 0.0
Utilization Factor of Space Heat Distribution	h_{HL}	= q_H / (q_H + q_{HL})				100%	-
DHW: Standard Useful Heat							
DHW Consumption per Person and Day (60 °C)	V_{DHW} (Project or Average Value 25 Litres/Pd)					6.6	Gal/Person/day
Average Cold Water Temperature of the Supply	ϑ_{DW} Temperature of Drinking Water (10°)					50.0	°F
DHW Non-Electric Wash and Dish	(Electricity worksheet)					422	kBTU/yr
Useful Heat - DHW	Q_{DHW}					5781	kBTU/yr
Specif. Useful Heat - DHW	q_{DHW}	= Q_{DHW} / A_{TFA}					kBTU/(ft²yr) 5.2

			Warm Region 1	Cold Region 2	Cold Region 3	Total	
DHW Distribution and Storage							
Length of Circulation Pipes (Flow + Return)	L_{HS} (Project)		72.0				ft
Heat Loss Coefficient per m Pipe	Ψ (Project)		0.088				BTU/hr.ft.°F
Temperature of the Room Through Which the Pipes Pass	ϑ_R Mechanical Room		68				°F
Design Flow Temperature	ϑ_{dist} Flow, Design Value		120.0				°F
Daily circulation period of operation.	td_{Circ} (Project)		18.0				hr/day
Design Return Temperature	ϑ_R	=0.875*(ϑ_{dist}-20)+20	114	37	37		°F

Passive House Planning

HOT WATER PROVIDED BY SOLAR

Building:	Middlebury Solar Decathlon			Building Type/Use:	Single Family Residence
Location:				Treated Floor Area A_{TFA}:	1119 ft²

Solar Fraction with DHW Demand including Washing and Dish-Washing

Heat Demand DHW	q_{pDHW}	7870	kBTU/yr	from DHW+Distribution worksheet
Latitude:		45	°	from Climate Data worksheet
Selection of collector from list (see below):		8	Selection:	8 Vacuum Tube Collector
Solar Collector Area		64.00	ft²	
Deviation from North		180	°	
Angle of Inclination from the Horizontal		33	°	
Height of the Collector Field		8	ft	
Height of Horizon	h_{Horiz}	0.00	ft	
Horizontal Distance	w_{Horiz}	60.00	ft	
Additional Reduction Factor Shading	r_{other}	1004	%	
Occupancy		3.0	Persons	
Specific Collector Area		22	ft²/Pers	
Estimated Solar Fraction of DHW Production		**93%**		
Solar Contribution to Useful Heat		**7354**	kBTU/yr	**8.57** kBTU/(ft²yr)

Secondary Calculation of Storage Losses

Selection of DHW storage from list (see below):	7	Selection:	7 Simple Solar Storage
Total Storage Volume	79	gallons	
Volume Standby Part (above)	24	gallons	
Volume Solar Part (below)	55	gallons	
Specific Heat Losses Storage (total)	5	BTU/hr.°F	
Typical Temperature DHW	120	°F	
Room Temperature	68	°F	
Storage Heat Losses (Standby Part Only)	212	BTU/hr	
Total Storage Heat Losses	278	BTU/hr	

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

096400- Wood Flooring & Wall Paneling

099100- Painting

Division 10 – Specialties

101400- Signage

102800- Toilet, Bath, and Laundry Accessories

104416- Fire Extinguishers (See drawing G-102)

Division 11 - Equipment

113100- Residential Appliances

Division 12 - Furnishings

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:

1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M**,** hot-dip galvanized.
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.

B. Interior Loft Ladder. Custom fabricated to match drawings using 1-1/4” bar stock steel.

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.
3. Self-adhering flexible flashing.

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).
2. International Code Council (ICC), ICC-ESR1474 (ZIP System Wall Sheathing).
3. International Code Council (ICC), ICC-ESR2227 (ZIP System Tape).

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.
5. Performance Standard: DOC PS2 and ICC-ES ESR-1474.Factory laminated integral water-resistive barrier facer.
7. Perm Rating of Integral Water-Resistive Barrier: 12-16 perms.
8. 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).
9. 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.
5. Performance Standard: DOC PS2 and ICC-ES ESR-1473.
6. Factory laminated integral roofing underlayment facer.
7. Exposure Time: Designed to resist weather exposure for 120 days.

2.04 FASTENERS

A. General: Provide fasteners of size and type that comply with requirements specified in this article by the authority having jurisdiction, International Building Code, International Residential Code, Wood Frame Construction manual, and National Design Specification..

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. Code Compliance: Comply with requirements of authorities having jurisdiction and ICC Evaluation Service, Inc. "AC148 (2006) - Acceptance Criteria for Flexible Flashing Material."EXECUTION

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

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

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.

B. Quality Standard: Architectural Woodwork Institute's "Architectural Woodwork Quality Standards."

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

B. Quality Standard: Architectural Woodwork Institute's "Architectural Woodwork Quality Standards."

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
   1. Hardboard: AHA A135.4.
   2. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
   3. Softwood Plywood: DOC PS 1.
   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
4. Wood Species and Cut for Exposed Surfaces: Ash, plainsawn.
5. Grain Direction: As indicated.
6. Matching of Veneer Leaves: Book match.

7. Veneer Matching within Panel Face: Center-balance match.
8. Semiexposed Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.
9. Drawer Sides and Backs: Solid-hardwood lumber, same species indicated for exposed surfaces.
10. Drawer Bottoms: Hardwood plywood.

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

A. ASTM C 739 – Standard Specification for Cellulosic Fiber Loose-Fill Thermal Insulation.

B. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

C. ASTM E 119 – Standard Test Methods for Fire Tests of Building Construction and Materials.

D. CPSC Standard 16 CFR Parts 1209 and 1404.

E. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.

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.

B. Metallic-Coated Steel Sheet: 'Galvalume Plus' aluminum-zinc alloy-coated structural-steel sheet, ASTM A 792/A 792M, 24 gauge, nominal thickness.

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 galvanized steel or Series 300 stainless steel.

I. Butyl Sealant: ASTM C 1311, 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:

1. Brosco Solid Core Flush Birch Wood Veneer Doors.
    a. Faces: Grade A plain-sliced select white birch.
    b. Veneer Matching: Book and balance match.
    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.

1. Sheen: Satin.

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

B. Performance Requirements: AAMA/WDMA/CSA 101/I.S.2/A440.

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%
4. Forced-Entry Resistance: Performance Grade <Insert value> per ASTM F 842.

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

C. Performance Requirements: AAMA/WDMA/CSA 101/I.S.2/A440.

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*.

B. ASTM E 330 – *Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.*

C. ASTM E 331 – *Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.*

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*.

E. ASTM E 1996 – *Standard Specifications for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.*

F. National Fenestration Rating Council, NFRC 100, *Procedure for Determining Fenestration Product U-factors.*

G. National Fenestration Rating Council, NFRC 200, *Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.*

H. National Fenestration Rating Council, NFRC 300, *Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems*.

I. Occupational Safety & Health Administration, OSHA Standards – 29 CFR 1910.23, *Guarding Floor Openings and Holes*.

J. Underwriters Laboratories Inc., UL 325, *Standard for Door, Drapery, Gate, Louver and Window Operators and Systems, Fifth Edition*.

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/I.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

VS and VSE Technical Information					
Glass	**04**	**05**	**06****	**08**	**10**
Structural Performance [Performance Grade or DP] *					
Tested Size	**Uplift** (lbs/ft^2)				
S06	50	50	55	50	60
M08	85	75	75	85	65
C06	n.r.	n.r.	n.r.	n.r.	70
Tested Size	**Download** (lbs/ft^2)				
S06	235	370	175	235	365
M08	280	550	230	280	270
C06	n.r.	n.r.	n.r.	n.r.	605

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 Btu/hr*ft² * F° or less, SHGC = 0.23 or less and Vt = 0.52 or greater (clear) or Vt = 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.

C. Unit Skylight Standard: Comply with AAMA/WDMA 101/I.S.2./NAFS, *North American Fenestration Standard Voluntary Performance specifications for Windows, Skylights and Glass Doors*, and all later editions for minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.

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

a. Manual control rods and extension poles available for manually operated venting skylights (VS).

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

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:

1. Hinges: Matching finish of lockset/latchset.
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.

END OF SECTION 087100

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.

D. 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 (J-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.
4. Cementitious Backer Unit Joint-Treatment Materials: Products recommended by cementitious backer unit manufacturer.

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.
2. Single-Layer Fastening Methods: Fasten gypsum panels to supports with screws.
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”
7. Joint Width: Hand tight.
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:

1. Product Data. "MPI Approved Products List" with product highlighted.
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.
4. Color-code mechanical piping in accessible ceiling spaces.
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.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

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.
3. Mounting: Surface mounted with concealed anchorage.
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

2. Mounting: Flanges with concealed fasteners.
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.

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NIT3065UC

30” Induction Cooktop with Touch Control
300 Series - Black

- Overview
- Technical specs
- Additional documents

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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.

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HBN3450UC

27" Single Wall Oven
300 Series - Stainless Steel

- Overview
- Technical specs
- Additional documents

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General Properties

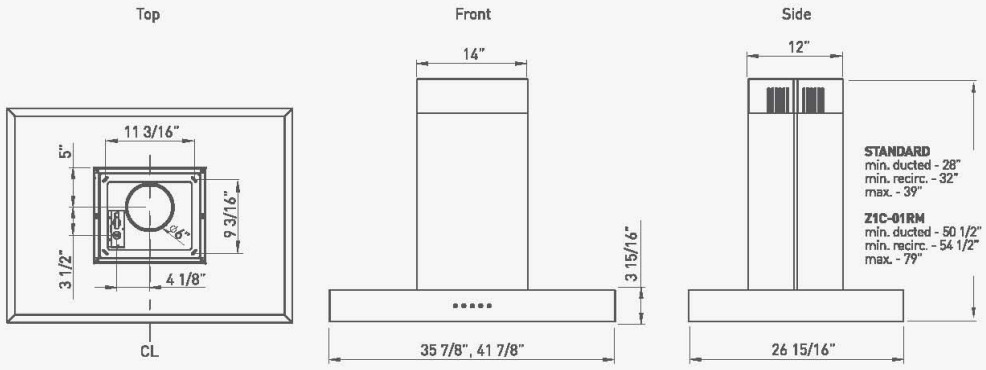
Product name / series name: built-in/under single oven
SKU: HBN3450UC
Product color: Stainless steel
Energy source: Electric
Watts (W): 5,800 W
Current (A): 30; 25 A
Volts (V): 240/208 V
Frequency (Hz): 60 Hz
Approval certificates: CSA
Plug type: Fixed connection, No plug
Cooking method first cavity: 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

MODEL	ZRM-E36BS / ZRM-E42BS	ZRM-E36BS290 / ZRM-E42BS290
SIZE	36", 42"	36", 42"
NET WIDTH	35-7/8" / 41-7/8"	35-7/8" / 41-7/8"
PERFORMANCE		
Blower CFM, Min. - Max.	240 - 600 CFM	210 - 290 CFM
Sones, Min. - Max.	1.8 - 6	1.4 - 2.8
COLOR		
Stainless Steel	SS	SS
FEATURES		
Controls	Electronic LED	Electronic LED
Speed Levels	3	3
Delay-Off	No	No
Lighting	Halogen, 50W	Halogen, 50W
Dual-Level Lighting	Yes	Yes
Filters	Aluminum Mesh	Aluminum Mesh
Recirculating	Yes	Yes
Extension Duct Cover Option	Yes, Up to 12' Ceiling	Yes, Up to 12' Ceiling
DUCT SPECIFICATIONS		
Internal Blower - Vertical	6"	6"
Internal Blower - Horizontal	NA	NA
AC INPUT	120V - 60Hz	120V - 60Hz
AC POWER	Max. 500W at 4.2 Amps	Max. 271W at 2.3 Amps
OPTIONAL ACCESSORIES		
Recirculating Kit	ZRC-00RM / ZRC-01RM	ZRC-00RM / ZRC-01RM
Extension Duct Cover	Z1C-01RM	Z1C-01RM
MOUNTING HEIGHT*	26"- 34"	26"- 34"

CEILING HEIGHT		8'	8.5'	9'	9.5'	10'	10.5'	11'	12'
STANDARD DUCT COVER	Ducted Mounting Height*	26"-32"	27"-34"	33"-34"	N/A	N/A	N/A	N/A	N/A
	Recirc. Mounting Height*	26"-28"	27"-34"	33"-34"	N/A	N/A	N/A	N/A	N/A
EXTENSION DUCT COVER	Ducted Mounting Height*	N/A	N/A	N/A	26"-27.5"	26"-33.5"	26"-34"	26"-34"	29"-34"
	Recirc. Mounting Height*	N/A	N/A	N/A	N/A	26"-29.5"	26"-34"	26"-34"	29"-34"

*Mounting height refers to distance between top of cooking surface and bottom of hood.

ESSENTIALS
ZEPHYR

Zephyr Corporation
2277 Harbor Bay Parkway
Alameda, CA 94502
1.888.880.VENT
www.zephyronline.com jan10.0101

C. Refrigerator/Freezer: Kitchenaid-KBLS22KWMS. 22 cu. Ft standard depth freestanding manual-defrost, two-door refrigerator with bottom-mounted freezer, fiberglass reinforced plastic interior cabinet liners.

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*

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

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

PERFORMANCE

Freezer Capacity	6.3 Cu. Ft.
Refrigerator Capacity	15.6 Cu. Ft.
Total Capacity	21.9 Cu. Ft.
ENERGY STAR® Qualified	▪

CONTROLS

Door Alarm	▪
Control Type	Expanded Electroncs 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.

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.

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SHX4AP05UC

24" Ascenta Integra Dishwasher
Dishwasher

- Overview
- Technical specs
- Additional documents

Click to enlarge

Color option

- SHX4AP06UC
- SHX4AP02UC

Accessories

- SMZ5002UC
- SGZ1052UC
- SGZ1010UC

General Properties

Product group: Dishwasher
Brand: Bosch
SKU: SHX4AP05UC
Installation Type: Built-under

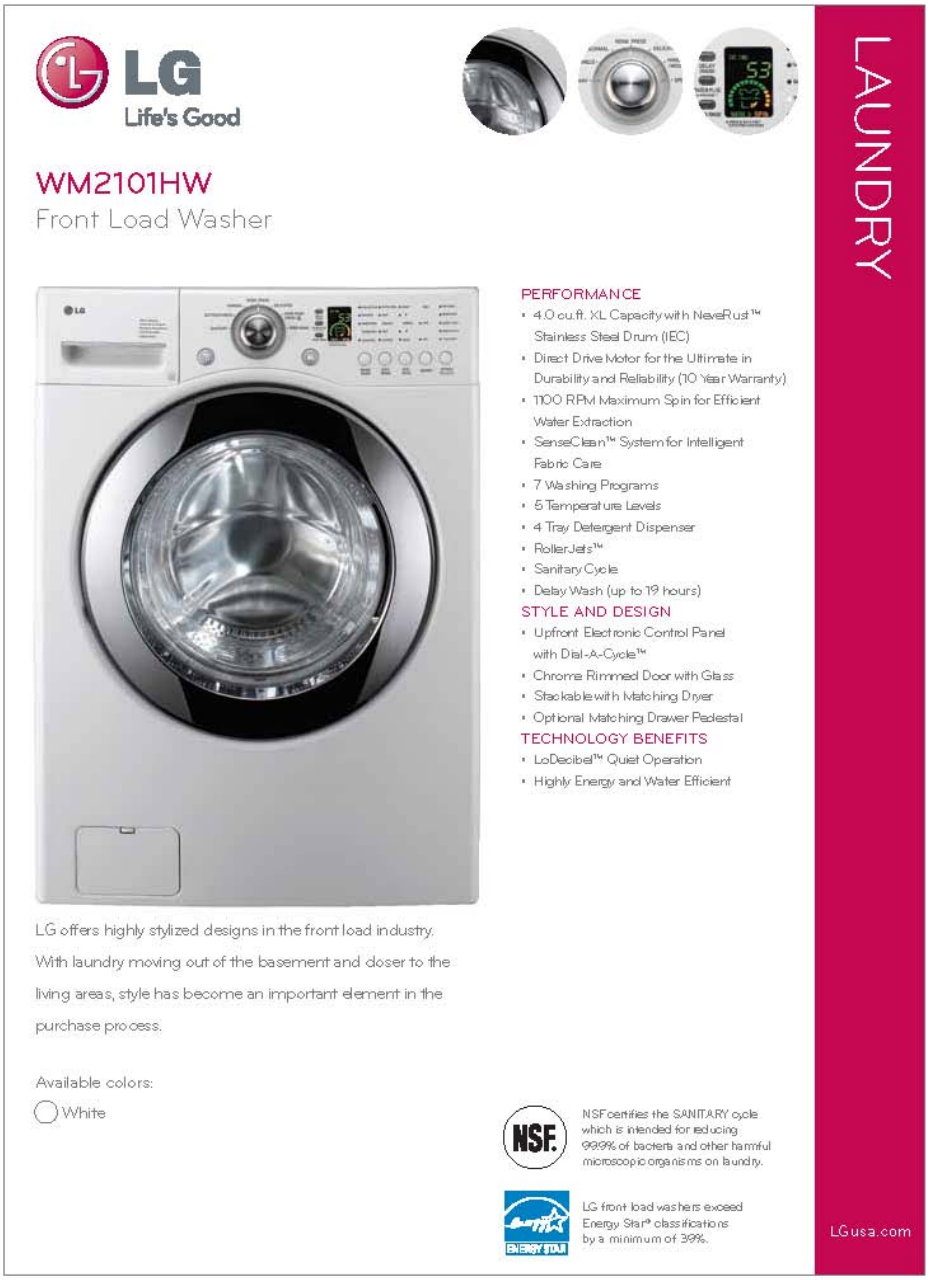
Panel ready: Not possible
Tub material: Stainless steel/Polinox
Concealed heating element: Yes
Watts (W): 1400 W
Current (A): 12 A
Volts (V): 120 V
Frequency (Hz): 60 Hz
Approval certificates: CSA, UL
Power cord length (cm): 0.0 cm
Plug type: Fixed connection
Length inlet hose (cm): 0 cm
Length outlet 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" - 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
Life's Good

WM2101HW
Front Load Washer

LAUNDRY

PERFORMANCE
- 4.0 cu.ft. XL Capacity with NeveRust™ Stainless Steel Drum (IEC)
- Direct Drive Motor for the Ultimate in Durability and Reliability (10 Year Warranty)
- 1100 RPM Maximum Spin for Efficient Water Extraction
- SenseClean™ System for Intelligent Fabric Care
- 7 Washing Programs
- 5 Temperature Levels
- 4 Tray Detergent Dispenser
- RollerJets™
- Sanitary Cycle
- Delay Wash (up to 19 hours)

STYLE AND DESIGN
- Upfront Electronic Control Panel with Dial-A-Cycle™
- Chrome Rimmed Door with Glass
- Stackable with Matching Dryer
- Optional Matching Drawer Pedestal

TECHNOLOGY BENEFITS
- LoDecibel™ Quiet Operation
- Highly Energy and Water Efficient

LG offers highly stylized 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

NSF certifies the SANITARY cycle which is intended for reducing 99.9% of bacteria and other harmful microscopic organisms on laundry.

LG front load washers exceed Energy Star® classifications by a minimum of 39%.

LGusa.com

LAUNDRY

WM2101HW

Front Load Washer

LG Life's Good

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.

TYPE	
Front Loader	•
Design Look	Front Control
Intelligent Electronic Controls	•
Dial-A-Cycle™	•
Capacity	4.0 cu.ft.
Dry Linen Capacity	>10.1 kg
ENERGY	
Energy Star Compliant	•
WASH PROGRAMS	
8 Programs	Sanitary, Cotton/Towels, Normal, Perm Press, Bulky/Large, Delicates, Hand Wash, Speed Wash
5 Wash/Rinse Temps	Extra Hot/Cold, Hot/Cold, Warm/Warm, Warm/Cold, Cold/Cold
Spin Speeds	Extra High (1100 max), High (1020/980), Medium (980/600), Low (950/600/400), No Spin
No. of Water Levels	Automatically adjusts to size of load
No. of Soil Levels	5
9 Options	Prewash, Quick Cycle, Extra Rinse, Rinse + Spin, Stain Cycle, Tub Clean, Water Plus, SpinSense™, Delay Wash (up to 19 hours)
FABRIC CARE FEATURES	
SenseClean™ System	•
RollerJets™	•
CONVENIENCE FEATURES	
4 Tray Dispenser	Prewash, Main Wash (with liquid detergent cup), Bleach, Softener
End of Cycle Beeper	•
Child Lock	•
Self-Diagnosis	•
Auto Balancing	•
Auto Suds Removal	•
Forced Drain System	•
Status Indicator(s)	•
Internal Water Heater (1000W)	•
Leveling Legs	4 Adjustable Legs
LoDecibel™ Quiet Operation	•
MOTOR AND AGITATOR	
Motor Type / Motor Speed	BPM Direct Drive / Variable
Axis	Horizontal
MATERIALS AND FINISHES	
NeveRust™ Stainless Steel Drum	•
Cabinet	Painted Steel
Control Panel	Plastic
Top Plate	Painted
Transparent Door Glass	•
Door Rim	Chrome
Available Colors	White (W)
POWER SOURCE	
Ratings	UL Listed
Electrical Requirements / Type	120V, 10 Amps / Electric
OPTIONS	
Pedestal	WDP3W
Pedestal (WxHxD)	27" x 13 3/5" x 28 2/5"
Stacking Kit	WSTK1
DIMENSIONS	
Product (WxHxD)	27" x 38 11/16" x 29 3/4" (51"D with door open)
Carton (WxHxD)	29 1/2" x 43 5/16" x 31 5/16"
Weight: Product / Shipping	188 lbs. / 206.5 lbs.
WARRANTY	
	1 Year Parts and Labor, 2 Years Control Board, 10 Years Motor, Lifetime on Drum
UPC CODES	
WM2101HW	048231 010313
WDP3W	048231 008556
WSTK1	048231 008327

LG Electronics U.S.A., Inc.
1000 Sylvan Avenue, Englewood Cliffs, NJ 07632
Customer Service and Technical Support: (800) 243-0000

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HAL-WM2101-SS 04/09

E. Electric Clothes Dryer: LG DLE2301W. Freestanding, front-loading clothes dryer, 7.3CF capacity with stainless-steel interior.

LG
Life's Good

LAUNDRY

DLE2301R/W
DLG2302R/W
Electric/Gas Dryers

PERFORMANCE
- XL Load Capacity (7.3 cu.ft.)
- Sensor Dry System for Intelligent Fabric Care and Energy Efficiency
- 9 Drying Programs
- 5 Temperature Levels
- Precise Temperature Control with Variable Heat Source
- FlowSense™
- Drying Rack
- Wrinkle Care Option
- Delicate and Ultra Delicate Cycles
- Custom Program

STYLE AND DESIGN
- Upfront Electronic Control Panel with Dual LED Display and Dial-A-Cycle™
- Large Chrome Rimmed Door with Clear Glass
- Stackable with Matching Washer
- Optional Matching Drawer Pedestal

TECHNOLOGY BENEFITS
- LoDecibel™ Quiet Operation

LG offers the most designer colors and highly stylized 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:
Wild Cherry Red ○ White

NSF International certifies that the ANTI BACTERIAL option reduces 99.9% of bacteria on laundry.

LGusa.com

LAUNDRY

DLE2301R/W
DLG2302R/W

Electric/Gas Dryers

LG Life's Good

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.

TYPE	
Front Loader	•
Design Look	Front Control
Intelligent Electronic Controls with Dual LED Display	•
Dial-A-Cycle™	•
Capacity	7.3 cu.ft.
Dry Linen Capacity	>10.1 kg
DRYING PROGRAMS	
9 Programs	Sensor Dry: Heavy Duty, Cotton/Towels, Normal, Perm Press, Delicates, Ultra Delicate, Manual Dry: Speed Dry, Air Dry, Freshen Up
7 Options	Custom Program, Damp Dry Beep, Wrinkle Care, Rack Dry, Anti Bacterial, More Time, Less Time
5 Temperature Levels	High, Medium High, Medium, Low, Ultra Low
5 Drying Levels	Very Dry, More Dry, Normal Dry, Less Dry, Damp Dry
Dry Times	60 min., 50 min., 40 min., 30 min., 20 min., More Time/Less Time
Custom Program	•
FABRIC CARE FEATURES	
Sensor Dry	•
FlowSense™	•
Precise Temperature Control with Variable Heater	•
CONVENIENCE FEATURES	
End of Cycle Beeper	•
Child Lock	•
Venting Option	Electric: 4 Way Venting Gas: 3 Way Venting
Drum Light	•
Reversible Door	•
Remaining Time Display/Status Indicator(s)	•
Leveling Legs	4 Adjustable Legs
Drying Rack	•
LoDecibel™ Quiet Operation	•
MATERIALS AND FINISHES	
Drum	Aluminized Alloy Steel
Top Plate	Painted (W, R)
Cabinet	Painted Steel
Control Panel	Plastic
Transparent Door Glass	•
Door Rim	Chrome
Available Colors	White (W), Wild Cherry Red (R)
POWER SOURCE	
Ratings	UL Listed
Requirements	120V, 15 Amps/240V, 30 Amps
Type	Gas / Electric
OPTIONS	
Pedestal	WDP3W, WDP3R
Pedestal (WxHxD)	27" x 13 3/5" x 28 2/5"
Stacking Kit	WSTK1, RSTK1
DIMENSIONS	
Product (WxHxD)	27" x 38 11/16" x 30" (50"D with door open)
Carton (WxHxD)	29 1/2" x 43" x 31 1/4"
Weight: Product / Shipping	126 lbs. / 144 lbs.
WARRANTY	
	1 Year Parts and Labor
UPC CODES	
DLE2301W	048231 010269
DLG2302W	048231 010276
WDP3W	048231 008556
WSTK1	048231 008327
DLE2301R	048231 010290
DLG2302R	048231 010306
WDP3R	048231 008976
RSTK1	048231 008983

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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.

D. PVC Pipe: ASTM D 1785, Schedule 40.

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 ANCHORAGES

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

SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

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

A. Steel Pipe: ASTM A 53, ASTM A 135, ANSI B36.10M, or ASTM A 795.

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.

E. Cast-Iron Threaded Fittings: ASME B16.4, Class 250, standard pattern.

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.

I. Steel Fittings: ASME B 16.9 with ASME B 16.25, or ASTM A234, ASM B 16.5, or ASM B16.11.

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.

B. Fire Suppression Pipe Flow Calculations:

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MC SD FP1rev

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Date

Hydraulic Design Information Sheet

Name - SOLAR DECATHALON - MIDDLEBURY COLLEGE Date - 4/28/11
Location - MIDDLEBURY COLLEGE, MIDDLEBURY, VERMONT
Building - SOLAR DECATHALON System No. -
Contractor - NORTH COUNRTRY FIRE PROTECTION, INC Contract No. - 11030
Calculated By - CHASE ENGINEERING, PC Drawing No. - FP-1
Construction: (X) Combustible ( ) Non-Combustible Ceiling Height - VARIES
Occupancy - RESIDENTIAL

SYSTEM DESIGN

(X) NFPA 13 (X) Lt. Haz. Ord.Haz.Gp. ( ) 1 ( ) 2 ( ) 3 ( ) Ex.Haz.
( ) NFPA 231 ( ) NFPA 231C ( ) Figure Curve
Other FM DS 3-26
Specific Ruling Made By Date

Area of Sprinkler Operation - 1500	System Type	Sprinkler/Nozzle
Density - .1	(X) Wet	Make VICTAULIC
Area Per Sprinkler - 120	( ) Dry	Model V27
Elevation at Highest Outlet - 10.75	( ) Deluge	Size 1/2
Hose Allowance - Inside -	( ) Preaction	K-Factor 5.6
Rack Sprinkler Allowance -	( ) Other	Temp.Rat.155 °F
Hose Allowance - Outside - 250		

Note

Calculation Summary: Flow Required - 500.408 Press Required - 57.9507 At Node TEST
C-Factor Used: 120 Overhead 150 Underground

WATER SUPPLY

Water Flow Test: Pump Data: Tank or Reservoir:
Date of Test - 7/22/08 Cap. -
Time of Test - Rated Cap.- Elev.-
Static Press - 115 @ Press -
Residual Press - 98 Elev. -
Flow - 1520 Well Proof Flow
Elevation - 0

Location - AT PROCTOR HALL

Source of Information -

COMMODITY STORAGE

Commodity Class Location
Storage Ht. Area Aisle W.
Storage Method: Solid Piled % Palletized % Rack

( ) Single Row ( ) Conven. Pallet ( ) Auto. Storage ( ) Encap.
( ) Double Row ( ) Slave Pallet ( ) Solid Shelf ( ) Non
( ) Mult. Row ( ) Open Shelf

Flue Spacing Clearance:Storage to Ceiling
Longitudinal Transverse

Horizontal Barriers Provided:

Water Supply Curve (C)

Chase Engineering, PC
MC SD FP1rev

City Water Supply:
C1 - Static Pressure : 115
C2 - Residual Pressure: 98
C2 - Residual Flow : 1520

Demand:
D1 - Elevation : 4.656
D2 - System Flow : 250.408
D2 - System Pressure : 57.951
Hose (Adj City) : 250
Hose (Demand) : 500.408
D3 - System Demand : 54.873
Safety Margin : 54.873

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Fittings Used Summary

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Fitting Legend Abbrev.	Name	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
C	Roll Groove Coupling	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
E	NFPA 13 90° Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	NFPA 13 Gate Valve	1	1	1	1	1	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
T	NFPA 13 90° Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zwc	Watts 709	Fitting generates a Fixed Loss Based on Flow																			

Units Summary

Diameter Units	Inches
Length Units	Feet
Flow Units	US Gallons per Minute
Pressure Units	Pounds per Square Inch

Pressure / Flow Summary - STANDARD

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Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
DP01	8.0	5.6	7.0	na	14.82	0.1	120	7.0
EQ01	9.0		6.64	na				
DP02	9.75	5.6	7.0	na	14.82	0.1	120	7.0
EQ02	10.75		6.64	na				
DP03	8.0	5.6	7.0	na	14.82	0.1	120	7.0
EQ03	9.0		7.02	na				
112	10.75	K = K @ EQ02	6.77	na	14.96			
16	10.75		6.85	na				
111	10.75	5.6	7.0	na	14.82	0.1	120	7.0
110	10.75	5.6	7.63	na	15.47	0.1	120	7.0
109	10.75	5.6	7.86	na	15.7	0.1	120	7.0
15	10.75		8.73	na				
14	10.75		9.57	na				
7	9.0		11.56	na				
6	9.0		11.86	na				
5	9.0		12.17	na				
4	9.0		12.41	na				
3	9.0		12.89	na				
17	9.0		16.68	na				
2	9.0		22.14	na				
1	0.0		36.75	na				
TEST	0.0		57.95	na	250.0			
105	10.74	5.6	8.13	na	15.97	0.1	120	7.0
10	9.0		9.59	na				
9	9.0		10.23	na				
107	9.0	K = K @ EQ01	9.26	na	17.49			
11	9.0		9.36	na				
106	10.74	5.6	8.73	na	16.55	0.1	120	7.0
101	9.0	5.6	15.73	na	22.21	0.1	120	7.0
103	9.0	K = K @ EQ01	13.94	na	21.46			
102	9.0	K = K @ EQ03	15.02	na	21.68			
114	10.75	5.6	9.17	na	16.96	0.1	120	7.0
13	10.75		10.19	na				
12	10.75		10.57	na				
113	9.0	K = K @ EQ01	10.62	na	18.73			
8	9.0		11.55	na				
108	9.0	K = K @ EQ01	10.91	na	18.99			
104	9.0	K = K @ EQ01	11.42	na	19.42			

The maximum velocity is 25.96 and it occurs in the pipe between nodes 1 and TEST

Final Calculations - Hazen-Williams

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Hyd. Ref. Point	Qa / Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	******* Notes ******
DP01	14.82	1.049		0.0	1.000	7.000		K Factor = 5.60
to		120.0		0.0	0.0	-0.433		
EQ01	14.82	0.0750		0.0	1.000	0.075		Vel = 5.50
	0.0							
	14.82					6.642		K Factor = 5.75
DP02	14.82	1.049		0.0	1.000	7.000		K Factor = 5.60
to		120.0		0.0	0.0	-0.433		
EQ02	14.82	0.0750		0.0	1.000	0.075		Vel = 5.50
	0.0							
	14.82					6.642		K Factor = 5.75
DP03	14.82	1.049	1T	5.0	1.000	7.000		K Factor = 5.60
to		120.0		0.0	5.000	-0.433		
EQ03	14.82	0.0747		0.0	6.000	0.448		Vel = 5.50
	0.0							
	14.82					7.015		K Factor = 5.60
112	14.96	1.38	1E	3.0	1.000	6.770		K Factor @ node EQ02
to		120.0		0.0	3.000	0.0		
16	14.96	0.0200		0.0	4.000	0.080		Vel = 3.21
16	0.0	1.38		0.0	7.490	6.850		
to		120.0		0.0	0.0	0.0		
111	14.96	0.0200		0.0	7.490	0.150		Vel = 3.21
111	14.82	1.38		0.0	8.820	7.000		K Factor = 5.60
to		120.0		0.0	0.0	0.0		
110	29.78	0.0714		0.0	8.820	0.630		Vel = 6.39
110	15.46	1.38	1T	6.0	6.490	7.630		K Factor = 5.60
to		120.0		0.0	6.000	0.0		
14	45.24	0.1550		0.0	12.490	1.936		Vel = 9.70
	0.0							
	45.24					9.566		K Factor = 14.63
109	15.70	1.049		0.0	10.580	7.855		K Factor = 5.60
to		120.0		0.0	0.0	0.0		
15	15.7	0.0832		0.0	10.580	0.880		Vel = 5.83
15	0.0	1.049	1T	5.0	4.000	8.735		
to		120.0	1C	1.0	6.000	0.0		
14	15.7	0.0831		0.0	10.000	0.831		Vel = 5.83
14	45.24	1.61	1T	8.0	1.750	9.566		
to		120.0		0.0	8.000	0.758		
7	60.94	0.1269		0.0	9.750	1.237		Vel = 9.60
7	18.73	2.067		0.0	4.860	11.561		
to		120.0		0.0	0.0	0.0		
6	79.67	0.0617		0.0	4.860	0.300		Vel = 7.62
6	18.99	2.067		0.0	3.360	11.861		
to		120.0		0.0	0.0	0.0		
5	98.66	0.0917		0.0	3.360	0.308		Vel = 9.43
5	16.96	2.067		0.0	1.980	12.169		
to		120.0		0.0	0.0	0.0		
4	115.62	0.1227		0.0	1.980	0.243		Vel = 11.05
4	19.42	2.067		0.0	2.920	12.412		
to		120.0		0.0	0.0	0.0		
3	135.04	0.1637		0.0	2.920	0.478		Vel = 12.91

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Final Calculations - Hazen-Williams

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Hyd. Ref. Point	Qa / Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	******* Notes ******
3	50.01	2.067	1T	10.0	2.920	12.890		
to		120.0		0.0	10.000	0.0		
17	185.05	0.2934		0.0	12.920	3.791		Vel = 17.69
17	22.21	2.067	1T	10.0	5.080	16.681		
to		120.0		0.0	10.000	0.0		
2	207.26	0.3618		0.0	15.080	5.456		Vel = 19.82
2	43.15	2.635	1E	8.237	9.000	22.137		
to		120.0	1Zwc	0.0	8.237	11.898		* Fixed loss = 8
1	250.41	0.1574		0.0	17.237	2.713		Vel = 14.73
1	0.0	1.985	1G	1.241	50.000	36.748		
to		150.0		0.0	1.241	0.0		
TEST	250.41	0.4138		0.0	51.241	21.203		Vel = 25.96
	250.00							Qa = 250.00
	500.41					57.951		K Factor = 65.73
105	15.97	1.049	1T	5.0	3.160	8.132		K Factor = 5.60
to		120.0		0.0	5.000	0.754		
10	15.97	0.0858		0.0	8.160	0.700		Vel = 5.93
10	17.49	1.38		0.0	7.320	9.586		
to		120.0		0.0	0.0	0.0		
9	33.46	0.0887		0.0	7.320	0.649		Vel = 7.18
9	16.55	1.38	1C	1.0	7.240	10.235		
to		120.0	1T	6.0	7.000	0.0		
3	50.01	0.1864		0.0	14.240	2.655		Vel = 10.73
	0.0							
	50.01					12.890		K Factor = 13.93
107	17.49	1.38	1E	3.0	1.000	9.256		K Factor @ node EQ01
to		120.0		0.0	3.000	0.0		
11	17.49	0.0268		0.0	4.000	0.107		Vel = 3.75
11	0.0	1.38		0.0	8.320	9.363		
to		120.0		0.0	0.0	0.0		
10	17.49	0.0268		0.0	8.320	0.223		Vel = 3.75
	0.0							
	17.49					9.586		K Factor = 5.65
106	16.55	1.049	1T	5.0	3.160	8.733		K Factor = 5.60
to		120.0		0.0	5.000	0.754		
9	16.55	0.0917		0.0	8.160	0.748		Vel = 6.14
	0.0							
	16.55					10.235		K Factor = 5.17
101	22.21	1.049	1T	5.0	1.000	15.733		K Factor = 5.60
to		120.0		0.0	5.000	0.0		
17	22.21	0.1580		0.0	6.000	0.948		Vel = 8.24
	0.0							
	22.21					16.681		K Factor = 5.44
103	21.46	1.049	1E	2.0	5.340	13.936		K Factor @ node EQ01
to		120.0		0.0	2.000	0.0		
102	21.46	0.1484		0.0	7.340	1.089		Vel = 7.97
102	21.69	1.049	1E	2.0	6.180	15.025		K Factor @ node EQ03
to		120.0	1T	5.0	7.000	0.0		
2	43.15	0.5396		0.0	13.180	7.112		Vel = 16.02

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Hyd. Ref. Point	Qa / Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	******* Notes ******
	0.0							
	43.15					22.137		K Factor = 9.17
114	16.96	1.049		0.0	10.650	9.167		K Factor = 5.60
to		120.0		0.0	0.0	0.0		
13	16.96	0.0959		0.0	10.650	1.021		Vel = 6.30
13	0.0	1.049		0.0	4.000	10.188		
to		120.0		0.0	0.0	0.0		
12	16.96	0.0960		0.0	4.000	0.384		Vel = 6.30
12	0.0	1.049	1T	5.0	1.750	10.572		
to		120.0	1E	2.0	7.000	0.758		
5	16.96	0.0959		0.0	8.750	0.839		Vel = 6.30
	0.0							
	16.96					12.169		K Factor = 4.86
113	18.73	1.049	1T	5.0	1.080	10.619		K Factor @ node EQ01
to		120.0	1E	2.0	7.000	0.0		
8	18.73	0.1153		0.0	8.080	0.932		Vel = 6.95
8	0.0	2.067		0.0	2.390	11.551		
to		120.0		0.0	0.0	0.0		
7	18.73	0.0042		0.0	2.390	0.010		Vel = 1.79
	0.0							
	18.73					11.561		K Factor = 5.51
108	18.99	1.049	1T	5.0	1.080	10.906		K Factor @ node EQ01
to		120.0	1E	2.0	7.000	0.0		
6	18.99	0.1182		0.0	8.080	0.955		Vel = 7.05
	0.0							
	18.99					11.861		K Factor = 5.51
104	19.42	1.049	1T	5.0	1.080	11.416		K Factor @ node EQ01
to		120.0	1E	2.0	7.000	0.0		
4	19.42	0.1233		0.0	8.080	0.996		Vel = 7.21
	0.0							
	19.42					12.412		K Factor = 5.51

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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 ¼ 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 bibs, 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

Keynote	Location	Fixture/Fitting	Description	Manufacturer	Model Number
11 31 13.A1	Kitchen	Refrigerator	stainless steel	Kitchenaid	KBS22KW
11 31 13.A3	Kitchen	Cooktop	30”, Induction	Bosch	NIT3065UT
11 31 13.A5	Kitchen	Oven	27” width	Bosch	HBN3450UC
	Exterior	Hose Bib	1/2"	Mueller	103-013
	Laundry Nook	Hose Bib	½”	Mueller	103-104
11 31 13.A7	Kitchen	Dishwasher	stainless steel	Bosch	SHX4AP05UC
11 31 23.A1 11 31 23.A2	Laundry Nook	Washer/Dryer	Freestanding	LG	LG-WM2101HW LG-DLE2301W
22 05 16	Mechanical Room	Tank	Thermal Expansion	Amtrol	ST-12
22 11 23	Exterior	Pump	Pressure Boosting Pump	Gunfos	MQ
22 11 23.A2	Exterior	Pump	sump pump system	Liberty	LowPro41lp
22 12 16	Exterior	Tank	Potable Water (2x)	Custom Roto-Molding, Inc.	750 VTS B

22 33 30.26	Mechanical Room	Tank	78 gallon	Vaillant Solar Systems	ST 60
22 41 13.A1	Bathroom	Toilet	Persuade® Circ comfort height two-piece elongated toilet - K-3753	Kohler	K-3753
22 41 16.A5	Kitchen	Sink	single basin, white acrylic	Kohler	K-2330
	Kitchen	Faucet	pull-down, stainles steel	Kohler	K-647
22 41 16.A7	Bathroom	Sink	Bachata® stainless steel lavatory with overflow - K-2609	Kohler	K-2609
22 41 19	Bathroom	Bathtub	Underscore® 5' acrylic bath - K-1130	Kohler	K-1130
22 41 23.B1	Bathroom	Mixer	Loure™ widespread lavatory faucet - K-14661-4	Kohler	K-14661-4
	Bathroom	Bath and Shower Faucets and Control	Oblo® Rite-Temp® bath and shower trim - K-T10055-9	Kohler	K-T10055-9-BN
23 56 13.19	Roof	Solar Water Collector	evacuated tube collector (2x)	Solar U.S.	SL-20
23 56 16	Mechanical Room	Pump	solar water pump	Solar U.S.	S011
33 36 00	Exterior	Tank	750 gallon steel storage (2x)	Custom Roto-Molding, Inc.	750 VTS B

self-RELIANCE

Middlebury

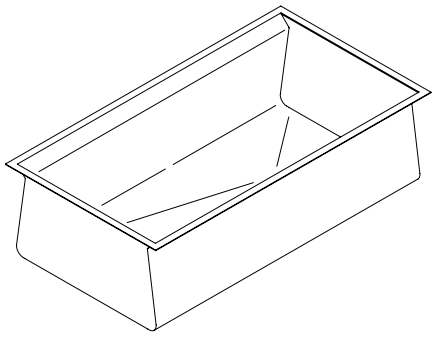
KOHLER®

8 DEGREE™

UNDERCOUNTER SINK
K-3673

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

Model	Description	Colors/Finishes	
K-3673	Undercounter sink	❑ NA	
Included Accessories			
K-6133	Wine glass rack	❑ NA	
K-6137	Bottom basin rack	❑ ST	
Optional Accessories			
K-2989	Countertop cutting board	❑ NA	
K-3140	Bamboo cutting board	❑ NA	
K-8801	Duostrainer® sink strainer	❑ CP	❑ Other_____

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

8 DEGREE™

Technical Information

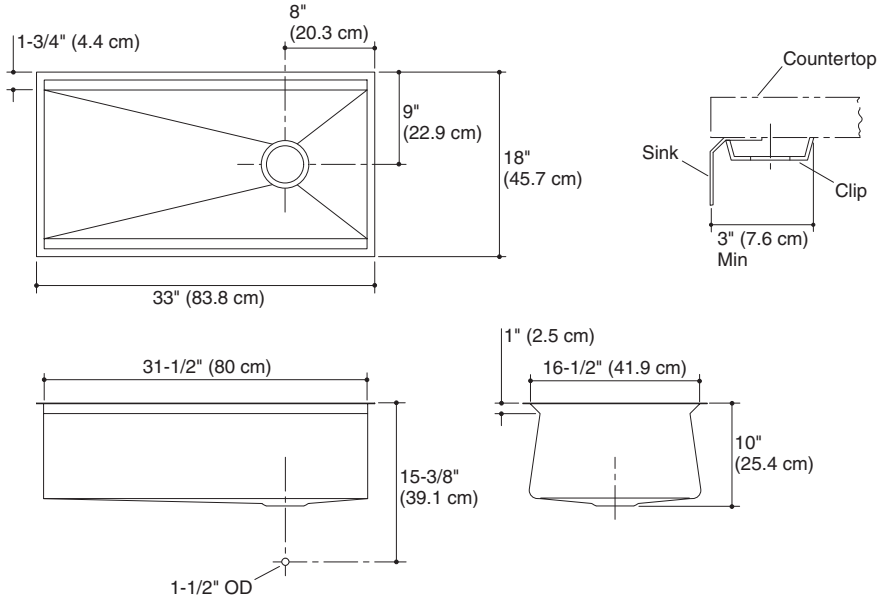
Fixture*:	
Basin area	31-1/2″ (80 cm) x 16-1/2″ (41.9 cm)
Water depth	9-3/4″ (24.8 cm)
Drain hole	3-5/8″ (9.2 cm) D.
*Approximate measurements for comparison only.	

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

self-RELIANCE

Middlebury

KOHLER FAUCETS

PURIST®

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*

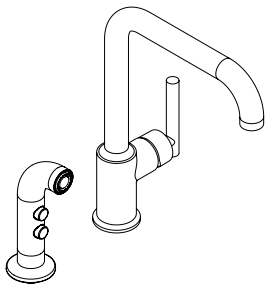
Codes/Standards Applicable

Specified model meets or exceeds the following at date of manufacture:

- *ADA*
- *ICC/ANSI A117.1*
- *ASME A112.18.1/CSA B125.1*
- *Energy Policy Act of 1992*
- *NSF 61*
- *All applicable US Federal and State material regulations*

KITCHEN SINK FAUCET
K-7507
ALSO K-7508, K-7509, K-7511

ADA



Colors/Finishes

- CP: Polished Chrome
- Other: Refer to Price Book for additional colors/finishes

Accessories

- NA: None applicable

Specified Model

Model	Description	Colors/Finishes	
K-7507	Kitchen sink faucet – 8″ (20.3 cm) swing spout reach, without sidespray	❑ CP	❑ Other ____
K-7508	Kitchen sink faucet – 8″ (20.3 cm) swing spout reach, with sidespray (shown)	❑ CP	❑ Other ____
K-7509	Kitchen sink faucet – 6″ (15.2 cm) swing spout reach, without sidespray	❑ CP	❑ Other ____
K-7511	Kitchen sink faucet – 6″ (15.2 cm) swing spout reach, with sidespray	❑ CP	❑ Other ____

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-____-____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

PURIST®

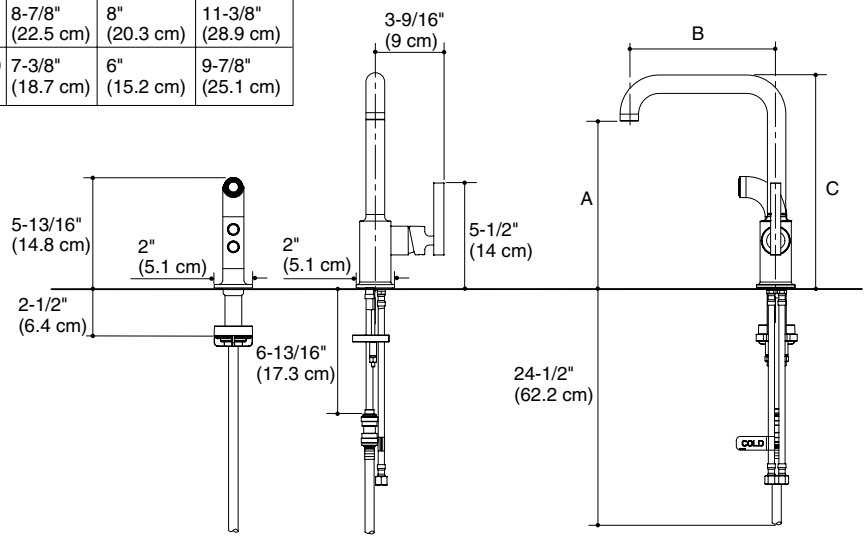
Optional Accessories		
1030920	Sidespray deep roughing-in kit	❑ NA
1088956	Aerator kit – 2.2 gpm (8.3 lpm)	❑ NA
1089003	Low flow aerator kit – 1.5 gpm (5.7 lpm)	❑ NA

Installation Notes

Install this product according to the installation guide.

ADA compliant when installed to the specific requirements of the regulation.

Model	A	B	C
K-7507 **K-7508**	8-7/8" (22.5 cm)	8" (20.3 cm)	11-3/8" (28.9 cm)
K-7509 **K-7511**	7-3/8" (18.7 cm)	6" (15.2 cm)	9-7/8" (25.1 cm)



Product Diagram

KOHLER®

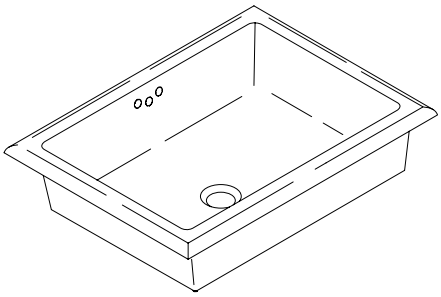
KATHRYN®

UNDERCOUNTER SINK
K-2330

ADA

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

Model	Description	Colors/Finishes	
K-2330	Undercounter sink less glazed underside	❑ 0	❑ Other_____
K-2330-G	Undercounter sink with glazed underside	❑ 0	❑ Other_____

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-_____-____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

KATHRYN®

Technical Information

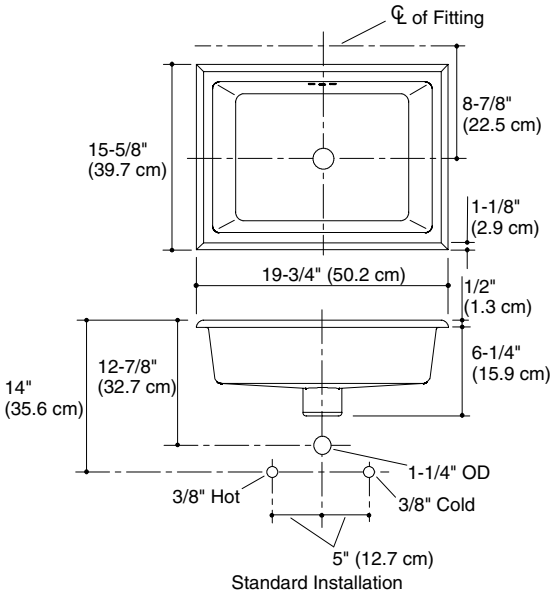
Fixture*:	
Basin area	17″ (43.2 cm) x 13″ (33 cm)
Water depth	3″ (7.6 cm)
Drain hole	1-3/4″ (4.4 cm) D.
* Approximate measurements for comparison only.	

Included components:	
Basin clamp assembly	52047
Cut-out template	1006809-7

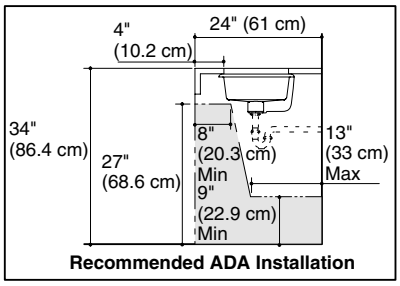
Installation Notes

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.



Standard Installation



Recommended ADA Installation

Product Diagram

self-RELIANCE

Middlebury

KOHLER FAUCETS

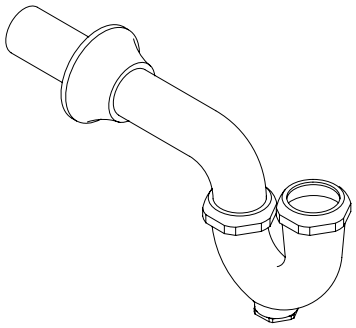
Features

- *Cast brass construction*
- *Adjustable rotation on tube outlet*
- *Slip-joint inlet*
- *Cleanout plug*
- *Flange*

P-TRAP

K-8998

ALSO K-8999, K-9000



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

Model	Description	Colors/Finishes
K-8998	P-trap with 1-1/4″ OD inlet and 1-1/4″ OD outlet	❑ CP
K-8999	P-trap with 1-1/4″ OD inlet and 1-1/2″ OD outlet	❑ CP
K-9000	P-trap with 1-1/2″ OD inlet and 1-1/2″ OD outlet	❑ CP

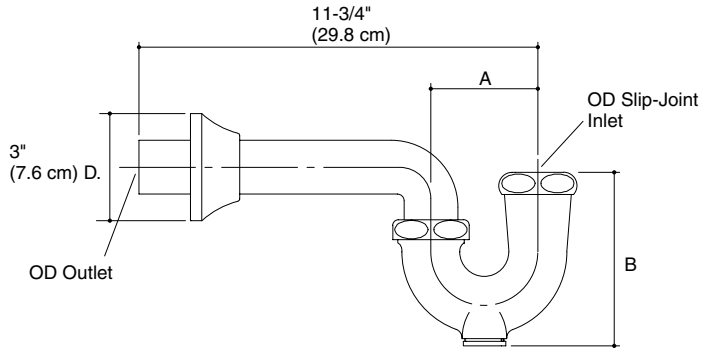
Product Specification

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-_____-_____.

USA: 1-800-4-KOHLER
Canada: 1-800-964-5590
kohler.com

Installation Notes

Install this product according to the installation guide.



	A	B	OD Outlet	OD Inlet
K-8998	2-3/4" (7 cm)	4-3/8" (11.1 cm)	1-1/4" (3.2 cm)	1-1/4" (3.2 cm)
K-8999	3" (7.6 cm)	4-7/8" (12.4 cm)	1-1/2" (3.8 cm)	1-1/4" (3.2 cm)
K-9000	3" (7.6 cm)	4-7/8" (12.4 cm)	1-1/2" (3.8 cm)	1-1/2" (3.8 cm)

Product Diagram

P-TRAP
Page 2 of 2
115170-4-**BB**

THE BOLD LOOK OF KOHLER.

self-RELIANCE

Middlebury

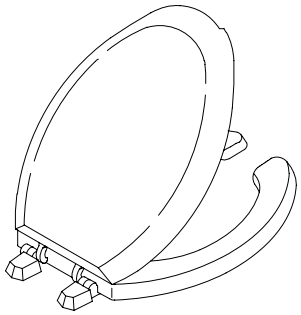
KOHLER®

LUSTRA™

TOILET SEAT
K-4660

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

Model	Description	Colors/Finishes	
K-4660	Toilet seat – round open-front	❑ 0	❑ Other_____

Product Specification

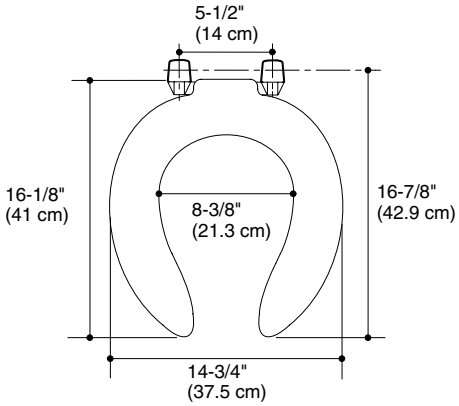
The round open-front toilet seat shall be made of solid polypropylene plastic. Toilet seat shall have cover. Toilet seat shall be Kohler Model K-4660-_____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

LUSTRA™

Installation Notes

Install this product according to the installation guide.



Product Diagram

self-RELIANCE

Middlebury

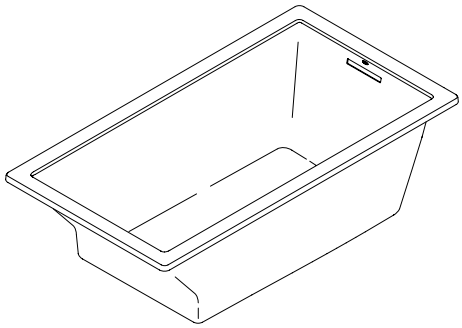
KOHLER®

UNDERSCORE™

5’ (1.5 m) BATH
K-1130

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

Model	Description	Colors/Finishes	
K-1130	5’ (1.5 m) bath – drop-in	❑ 0	❑ Other_____
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-____.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

UNDERSCORE™

Technical Information

Fixture*:	
Bathing well:	
Basin area, bottom	42″ (106.7 cm) x 23-1/2″ (59.7 cm)
Basin area, top	55-1/8″ (140 cm) x 27-1/8″ (68.9 cm)
Weight	75 lbs (34 kg)
To overflow:	
Water depth	17-1/8″ (43.5 cm)
Capacity	81 gal (306.6 L)
* Approximate measurements for comparison only.	

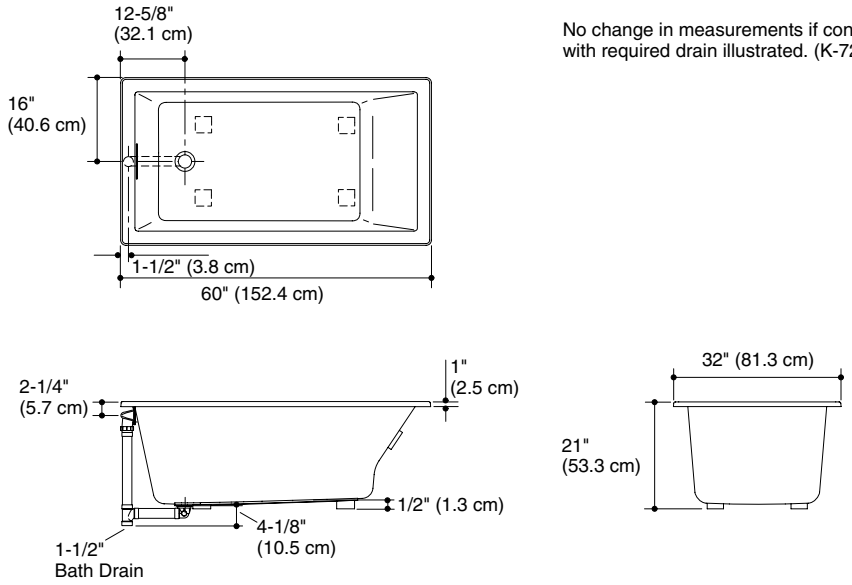
Drop-in cut-out	59-1/2″ (151.1 cm) x 31-1/2″ (80 cm)

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)

Product Diagram

self-RELIANCE

Middlebury

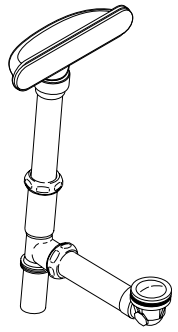
KOHLER FAUCETS

CLEARFLO

SLOTTED OVERFLOW BATH DRAIN
K-7271

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

Model	Description	Colors/Finishes	
K-7271	Slotted overflow bath drain	❑ CP	❑ Other_____

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-____.

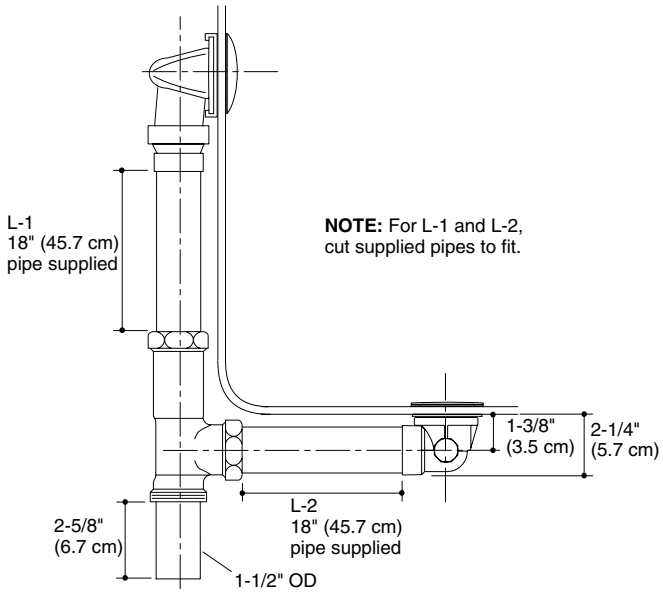
USA/Canada: 1-800-4-KOHLER
(1-800-456-4537)
www.kohler.com

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

CLEARFLO SLOTTED OVERFLOW BATH DRAIN
Page 2 of 2
1101729-4-**A**

THE BOLD LOOK OF KOHLER.

self-RELIANCE

Middlebury

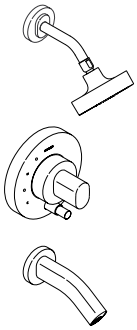
KOHLER FAUCETS

OBLO® RITE-TEMP®

BATH/SHOWER VALVE TRIM
K-T10055-9
ALSO K-10044, K-T10056-9, K-T10057-9

Features

- *Metal construction*
- *Brass valve bodies*
- *High-temperature limit setting for added safety*
- *Rite-Temp® pressure-balancing diaphragm design*
- *Mixing valve cycles from "cold" to "hot"*
- *Intended for use with Rite-Temp® or HiFlow Rite-Temp® 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

Model	Description	Colors/Finishes	
K-T10055-9	Bath/shower valve trim with 1/2" IPS threaded spout	❑ CP	❑ Other ____
K-T10056-9	Shower valve trim, less diverter spout	❑ CP	❑ Other ____
K-T10057-9	Mixing valve trim	❑ CP	❑ Other ____
K-10044	Bath spout	❑ CP	❑ Other ____

Required Accessories		
K-304-*	Rite-Temp® valve **OR**	❑ NA
K-2971-KS	HiFlow Rite-Temp valve with stops **OR**	❑ NA
K-11748-K	Rite-Temp valve with diverter **OR**	❑ NA
K-11748-KS	Rite-temp valve with diverter and stops	❑ NA

* 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.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

OBLO® RITE-TEMP®

Optional Accessories						
88526	HiFlow Rite-Temp® thin wall installation kit	❑ CP			❑ Other __	
1073881	Deep rough-in kit – for use with K-304-K, K-304-KP, K-304-KS, and K-2971-KS					❑ NA
1092535	Deep rough-in kit for valves with push button diverter – for use with K-11748-K and K-11748-KS	❑ CP	❑ BN	❑ SN		

Installation Notes

Install this product according to the installation guide.

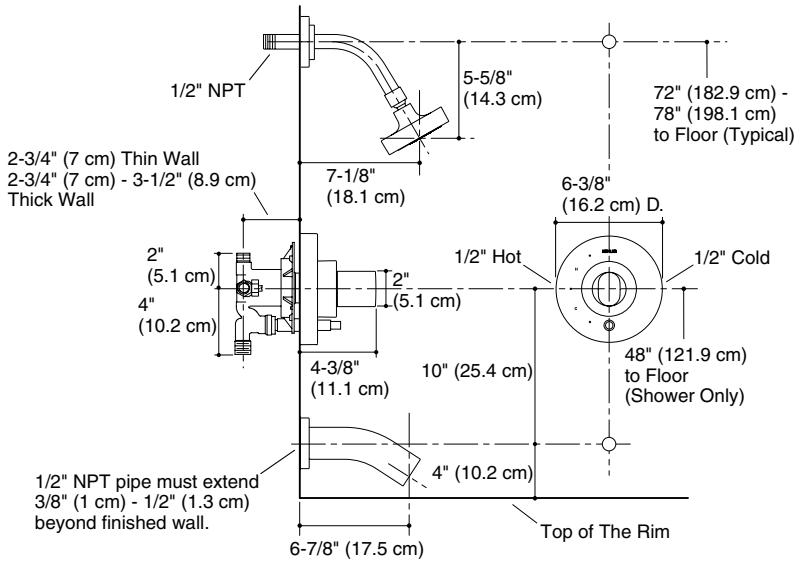
Install the Rite-Temp valve according to the installation guide.

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

self-RELIANCE

Middlebury

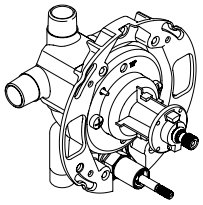
KOHLER FAUCETS

RITE-TEMP®

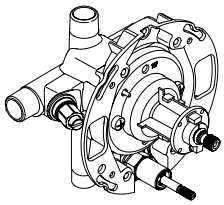
PRESSURE-BALANCING VALVE
K-11748

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*



K-11748-K



K-11748-KS

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

Model	Description	Colors/Finishes
K-11748-K	Pressure-balancing valve without screwdriver stops	❑ NA
K-11748-KS	Pressure-balancing valve with screwdriver stops	❑ NA

Optional Accessories			
73418	Deep rough-in kit for Rite-Temp® valve (all handles)	❑ CP	❑ Other_____
1016154	Deep roughing-in kit for Rite-Temp® valve (lever and cross handles)	❑ CP	❑ Other_____

Product Specification

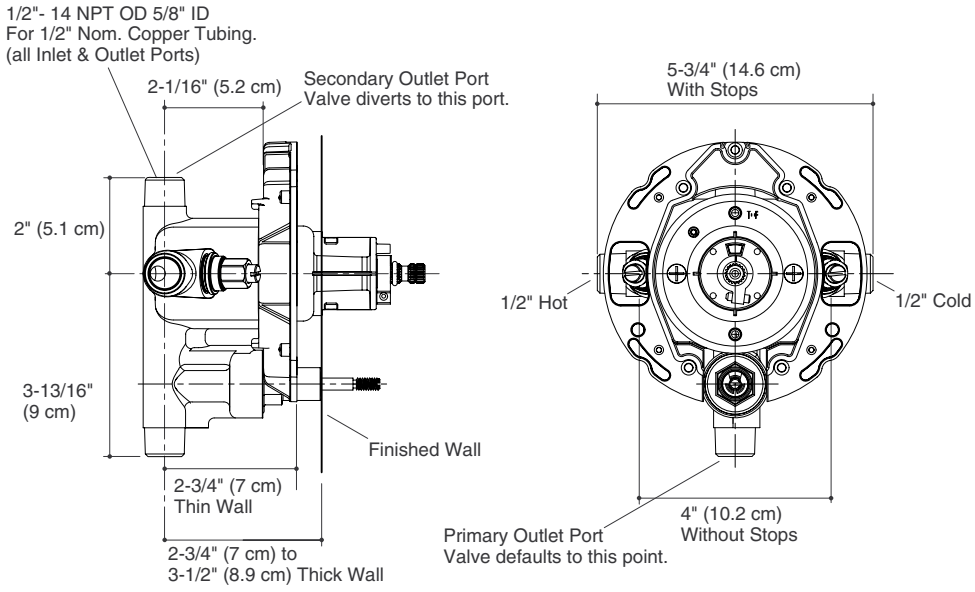
Rite-Temp® pressure-balancing single-control valve shall feature a brass valve body. Product shall feature mixing valve cycles from "cold" to "hot" and a high-temperature limit setting for added safety. Product shall feature a Rite-Temp pressure-balancing diaphragm design and a pressure-balancing mechanism 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.

USA/Canada: 1-800-4KOHLER
(1-800-456-4537)
www.kohler.com

RITE-TEMP®

Installation Notes

Avoid cross-flow conditions. Do not install shut-off device on either valve outlet.



Product Diagram

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 -BVBP

- Pump range: 3
- Rated flow [m^3/h]: -35
- Max. head [m]
- Code for pump version: A: Standard
- Code for pipework connection: B: External thread
- Code for materials: A: Standard
- Code for shaft seal: BVBP

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. 26 ft (8 m) .
Liquid temperature:	32°F to +95°F (0°C to +35°C) .
Ambient temperature:	32°F to +113°F (0°C to +45°C) .

Technical data

Mains voltage:

- 115V models: 1 x 110-120 V, 60 Hz
- 230V models: 1 x 220-240 V, 60 Hz.

Voltage tolerances:	–10% / +6%.
Enclosure class:	IP54.
Insulation class:	B.
Sound pressure level:	55 dB(A).
Agency approvals:	UL, cUL

Features and benefits

- Complete system
  The MQ is a complete, all-in-one unit, incorporating pump, motor, diaphragm tank, pressure and flow sensor, controller and check valve.
  The controller ensures that the pump starts auto matically when water is consumed and stops auto matically when the 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-priming pump
  As it is self-priming, 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 installa tion and start-up of the pump and provides more re liable water supply in installations where there is a risk of dry running and leakages in suction hose or pipes.
- Built-in protective functions
  If exposed to dry running, excessive temperature, or any overload 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 de activated.
- 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 leakages in the pipe sys tem, causing less wear on the pump.
- Maintenance
  No maintenance of the pump is required.

self-RELIANCE

Middlebury

Liberty Pumps®

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).

Fully Assembled System!

(toilet not included)

Features:

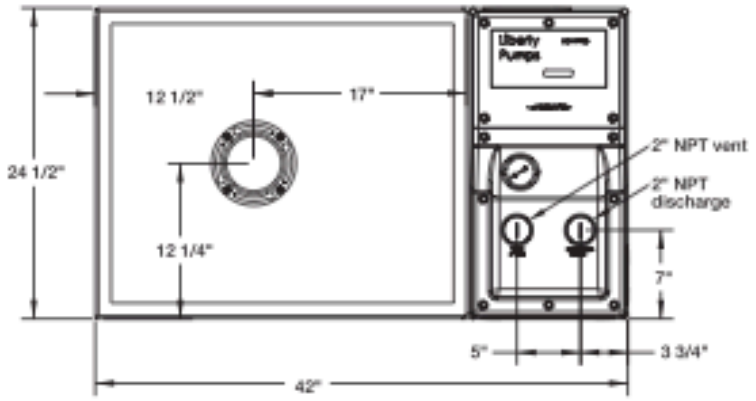
- 2" solids-handling sewage pump
- 4/10 hp 115V
- Durable poly tank with separate access opening to switch
- Fully assembled unit, including pump, piping and switch. Saves valuable installation time.

Patent Pending, U.S. Patent No. 6,430,757

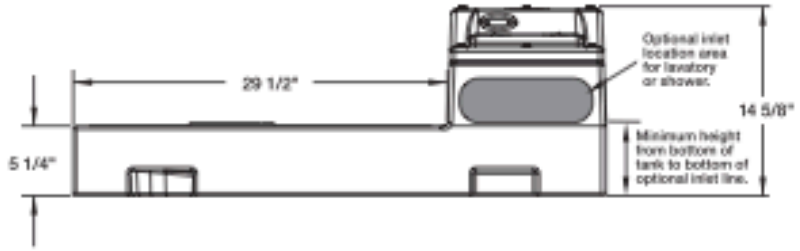
innovate. evolve.

DIMENSIONAL DATA — LowPro41LP

top view



side view



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.

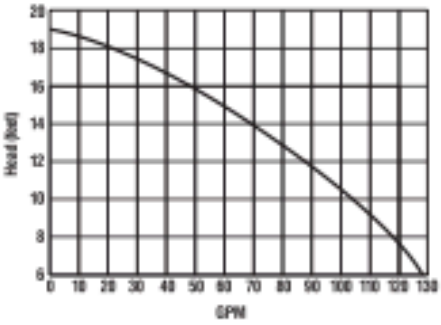
SPECIFICATIONS:

4/10 hp 115V 12 amps 60Hz 1550 RPM

Maximum fluid temperature: 140°F.

Assembled weight: 91 lbs.

PERFORMANCE CURVE



22 33 30.26- Vaillant auroTANK Solar Hot Water Tank

auroTANK® Solar Tanks

Solar Hot Water Storage

Vaillant® Solar Systems

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

PRODUCT SPECIFICATIONS

		auroTANK classic 80	auroTANK classic 100	auroTANK exclusive 80	auroTANK exclusive 100
Storage Capacity	gallons	78	107	76	105
Max. Tank Pressure	PSI	145	145	145	145
Max. Heating Circuit Pressure	PSI	145	145	145	145
Max. Heating Circuit Temperature	°F	230°	230°	230°	230°
Max. Tank Water Temperature	°F	185°	185°	185°	185°
Solar Heat Exchanger Area	ft^2	17.2	16.1	17.2	16.1
Solar Heat Exchanger Volume	gallons	2.8	2.61	2.8	2.61
Heat Auxiliary Exchanger Area	ft^2	N/A	N/A	7.5	7.53
Heat Auxiliary Exchanger Volume	gallons	N/A	N/A	1.2	1.24
Tank Dimensions					
Diameter without Insulation	inches	19.7"	25.6"	19.7"	25.6"
Diameter with Insulation	inches	25.9"	31.9"	25.9"	31.9"
Height	inches	69.9"	57.9"	69.9"	57.9"
Cold Mains Inlet, DHW Outlet	inches	1" thread	1" thread	1" thread	1" thread
Recirculation	inches	3/4" thread	3/4" thread	3/4" thread	3/4" thread
Heating and Solar Connections	inches	1" thread	1" thread	1" thread	1" thread
Weight Including Insulation & Packing	pounds	273	320	330	372

Thermal Expansion Absorbers

auroTANK WARRANTY

Vaillant Solar Systems offers a two year warranty on the auroTANK® solar water tanks (see warranty conditions).

Vaillant® Solar Systems Inc.
512 Via de la Valle, Suite 200
Solana Beach, CA 92075
858-259-0305 phone
858-259-0793 fax

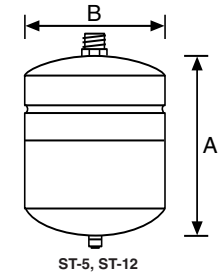
auroTANK_002_10-08-09

AMTROL INC

THERM-X-TROL®

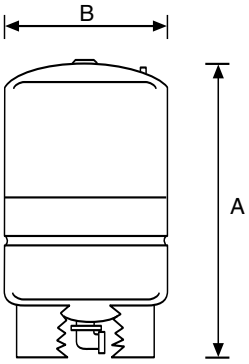
Thermal Expansion Absorbers, ST-Series (Non-ASME)

150 PSIG Working Pressure



ST-5, ST-12

ANSI/NSF 61



ST-25V through ST-210V

ANSI/NSF 61

In-Line Models

Model No.	Tank Vol.		Max. Accept.	A Height		B Diameter		Sys. Conn.	Ship Wt.	
	Lit.	Gal.	Factor	cm	ins.	cm	ins.	NPTM	kg	lbs.
ST-5	8	2.0	0.45	321	12 5/8	203	8	3/4	2.3	5
ST-12	17	4.4	0.73	381	15	279	11	3/4	4.0	9

Stand Models

Model No.	Tank Vol.		Max. Accept.	A Height		B Diameter		Sys. Conn.	Ship Wt.	
	Lit.	Gal.	Factor	cm	ins.	cm	ins.	NPTF	kg	lbs.
ST-25V	39	10.3	1.00	489	19 1/4	391	15 3/8	1	10.5	23
ST-30V	53	14.0	0.81	605	23 7/8	391	15 3/8	1	11.4	25
ST-42V	76	20.0	0.57	802	31 5/8	391	15 3/8	1	15.0	33
ST-60V	129	34.0	1.00	913	29 5/8	559	22	1 1/4	28.0	61
ST-80V	167	44.0	0.77	913	36	559	22	1 1/4	31.0	69
ST-180V	235	62.0	0.55	1186	46 3/4	559	22	1 1/4	41.0	92
ST-210V	326	86.0	0.54	1199	47 1/4	660	26	1 1/4	56.0	123

Maximum Operating Conditions

Operating Temperature	200°F (93°C)
Working Pressure	150 PSIG (10.5 kg/cm²)

Specifications

Description	Standard Construction
Standard Factory Pre-charge	40 PSIG (2.8 kg/cm²)
System Connection	Brass (ST5,12)
	Stainless Steel (Stand Models)
Diaphragm	Butyl/EPDM
Liner Material	Polypropylene

All dimensions and weights are approximate.

Job Name _____ Contractor _____

Location _____ Contractor P.O. No. _____

_____ Sales Representative _____

_____ Model No. Ordered _____

Engineer _____

(11/04)

*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.*

SolarUS Solar Collector Owner's Guide & Installation Manual

4.7. SolarUS Collector Specifications

4.7.1. Overall Collector Dimensions & Weight

Collector Size	10 tubes	20 tubes	30 tubes
Overall Length [1]	1935 mm / 76.2 in.		
Overall Height [2]	145mm / 5.7 in. (Standard Back frame & Manifold Case)		
Overall Width [3]	790mm / 31.1 in.	1540mm / 60.6 in.	2290mm / 90.2 in.
Effective Absorber Area [4]	0.812m² / 8.74 ft.²	1.624m² / 17.49 ft.²	2.436m² / 26.22 ft.²
Net Weight	32kg / 70.5 lbs.	65kg / 143.3 lbs.	98kg / 216 lbs.
Volume of Manifold Header	600ml / 0.159 gal.	1170ml / 0.31 gal.	1740ml / 0.46 gal.

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)

Material	TP_2 Copper, Cu≥99.9%
Overall Length of Header Pipe	***L= (N-1)*75mm + 82.5mm*2 / L= (N-1) *2.95 in. + 3.25 in*2***
Header Pipe Specification	OD: Φ35mm, WT: 1.0mm / OD: Φ1.38 in., WT: 0.039 in.
Inlet & outlet	OD：Φ22mm / Φ0.87 in.
Temperature Sensor Port	OD: Φ0.8mm*(0.5~0.65) / OD: Φ0.032 in.* (0.2~0.023)
Maximum Operating Pressure Rating	0.7 MPa / 102 psi
Maximum Flow Rate	8L/tube/min. | 2.11 gal./tube/min.

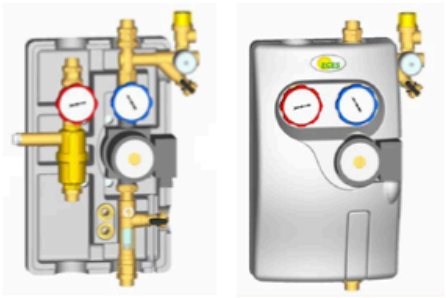
Art. S011 **SOLAR PUMP STATION WITH DELIVERYAND RETURN CONNECTIONS**

Technical Information sheet 0001/07/Rev01 ENG

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/head) and regulation and control devices governing the operating circuit.

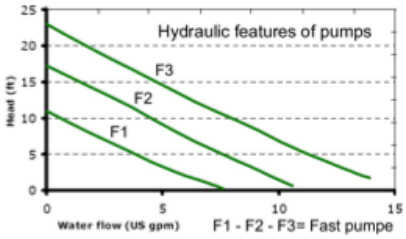
Art.S011

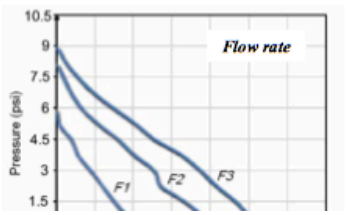


TECHNICAL FEATURES

Fluid used	Water, glycol solutions (glycol 25% - 50% max)
Calibration of safety valve	60 psi
Connection	3/4" NPT
Permitted temperature range	+14 °F / +320°F
Max. ambient temperature	+104°F
Max. operative pressure	150 psi
Min. pressure on intake opening with temperatures of:	+122 °F : 0,8 psi +203 °F : 4.4 psi +230 °F : 14.5 psi
Body	brass EN 12165 CW617N
Thermometer	steel/alluminium
Seals	PTFE
Sealing elements	EPDM-Perox
Flat seals	Betaflex
Insulation shell	PPE, Conducibility λ(ΔT): 0.041 (W/mK)
Pressure gauge scale	0 - 90 psi
Thermometer scale	32 - 320 °F
Connections	¾" NPT
Hose fitting, for connection with expansion tank	¾" 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"

Model Wilo Solar pump STAR S 21 U 15 130 PR 3
Center-to-center distance: 5.12 inches between connections
Electrical power supply: 115V - 60Hz
Operating temperature: 14°- 230°F approx.
Max. temperature: 284°F for max 2 hours
Max. operating pressure: 145 psi
Protection level: NEMA 2





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 1 - End Connections: Threads shall comply with ANSI B1.20.1. Flanges shall comply with ANSI B16.1 for cast-iron valves and with ANSI B16.24 for bronze valves. Solder-joint connections shall comply with ANSI B16.18.

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

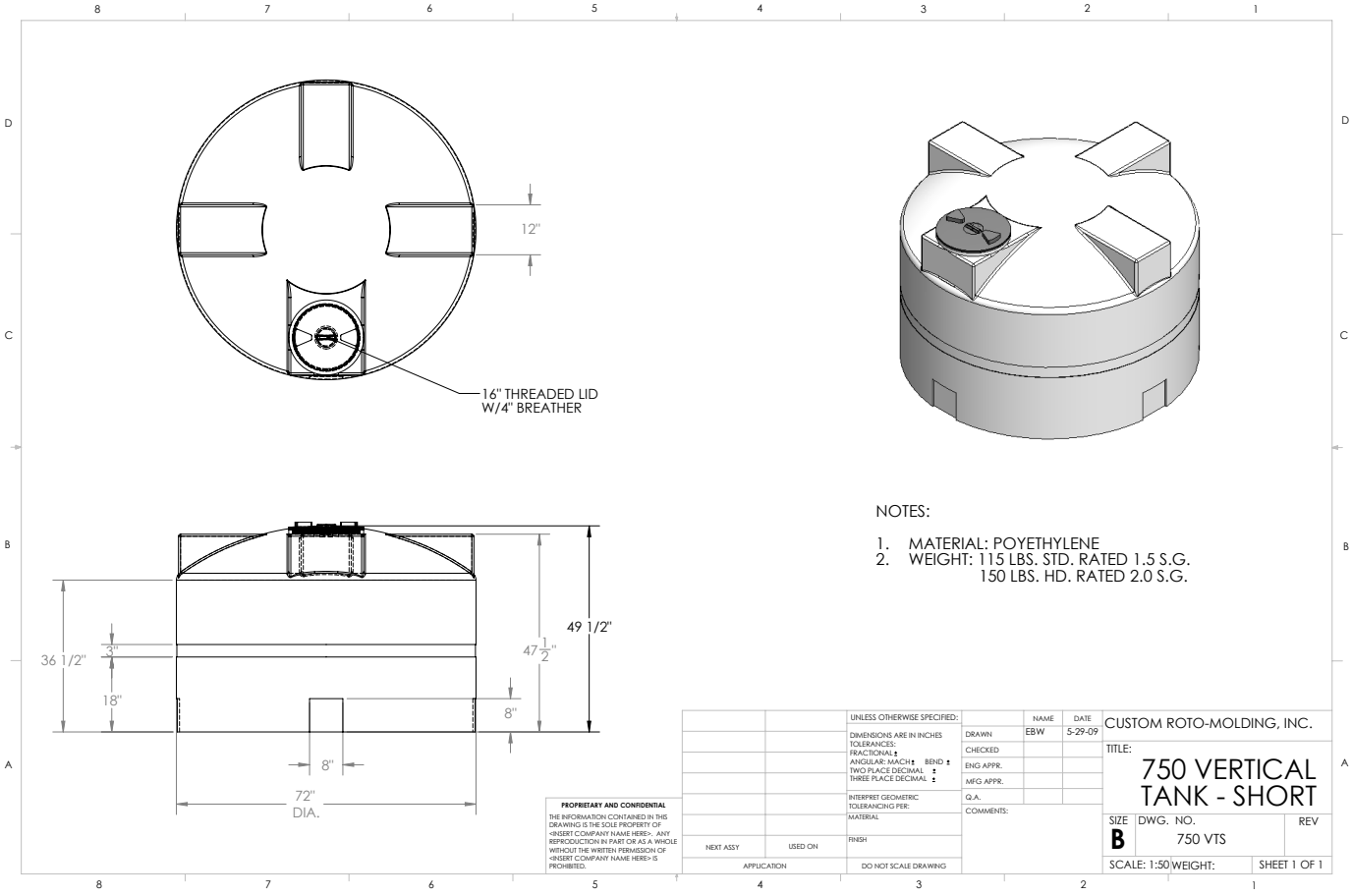
A. Manufacturer (Custom Roto-molding) regularly and presently manufactures the item submitted as one of their principal products.

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.

PART 2 - PRODUCTS

2.01 TANK



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.

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

PRODUCT DATA SHEET 0 - Minimum Pressure Requirement for Soil, Waste, and Vent: 10-foot head of water (30 kPa).

PRODUCT DATA SHEET 1 - Comply with NSF 14, "Plastic Piping Components and Related Materials," for plastic piping components.

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 ComfoTubes
- Indoor return air through diffusers in kitchen and bathroom via 3” diameter flexible ComfoTubes

• Outputs

- Outdoor return air through 3” diameter flexible ComfoTubes
- Indoor supply air through 3” diameter flexible ComfoTubes 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.

Keynote	Location	Item	Description	Manufacturer	Model Number
23 38 13	Kitchen	Range Hood	Recirculating	Zephyr	ZRM-E36B
23 57 00	Mechanical Attic	Fan Coil Unit	36 kBtu/hr	Mitsubishi	PEAD-A36AA
23 62 00	Exterior	Heat Pump	Outdoor Unit	Mitsubishi	PUZHA36NHA3
23 72 00	Mechanical Room	ERV		Zehnder	ComfoAir 200

23 57 00- Mitsubishi Mr. Slim Fan Coil and Outdoor Unit

MITSUBISHI ELECTRIC

Mr. SLIM
Split-ductless A/C and Heat Pumps

SUBMITTAL DATA: PEAD-A36AA & PUZ-A36NHA3

36,000 BTU/H HORIZONTAL-DUCTED HEAT-PUMP SYSTEM

Job Name: Location: Date:

Purchaser: Engineer:

Submitted to: For ☐ Reference ☐ Approval ☐ Construction

Unit Designation: Schedule No.:

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 wired remote controller is 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-YU25HT)
- CN24 Relay Kit (CN24RELAY-KIT-CM2)
- Remote Temperature Sensor (PAC-SE41TS)
- Wireless Remote Controller (PAR-FL32MA)
- Wireless Remote Receiver (PAR-FA32MA)

Outdoor Unit

- M-NET Adapter (PAC-SF81MA-E)
- Air Outlet Guide (PAC-SG59SG-E)
- Wind Baffle (WB-PA2)

Cooling*
Rated Capacity . . . . . 35,000 Btu/h
Minimum Capacity . . . . . 12,000 Btu/h
SEER . . . . . 15.0 Btu/h/W
Total Input . . . . . 4,850 W

Heating at 47°F*
Rated Capacity . . . . . 37,000 Btu/h
Minimum Capacity . . . . . 12,000 Btu/h
HSPF (IV) . . . . . 9.8 Btu/h/W
Total Input . . . . . 3,290 W

Heating at 17°F*
Rated Capacity . . . . . 25,000 Btu/h
Rated Total Input . . . . . 2,810 W
Maximum Capacity . . . . . 25,000 Btu/h
Maximum Total Input . . . . . 2,810 W

* Rating Conditions (Cooling) - Indoor: 80°F (27°C) DB / 67°F (19°C) WB. Outdoor: 95°F (35°C) DB / 75°F (24°C) WB.
(Heating) - Indoor: 70°F (21°C) DB / 60°F (16°C) WB. Outdoor: 47°F (8°C) DB / 43°F (6°C) WB.
(Heating at 17°F) - Indoor: 70°F (21°C) DB / 60°F (16°C) WB. Outdoor: 17°F (-8°C) DB / 15°F (-9°C) WB.

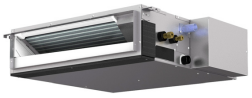
Electrical Requirements
Power Supply . . . . . 208 / 230V, 1-Phase, 60 Hz
Breaker Size . . . . . 40 A

Voltage
Indoor - Outdoor S1-S2 . . . . . AC 208 / 230V
Indoor - Outdoor S2-S3 . . . . . DC24V
Indoor - Remote Controller DC12V

OPERATING RANGE

		Indoor Intake Air Temp.	Outdoor Intake Air Temp.
Cooling	Maximum	95°F (35°C) DB, 71°F (22°C) WB	115°F (46°C) DB
	Minimum	67°F (19°C) DB, 57°F (14°C) WB	0°F** (-18°C) DB
Heating	Maximum	80°F (27°C) DB, 67°F (19°C) WB	70°F (21°C) DB, 59°F (15°C) WB
	Minimum	70°F (21°C) DB, 60°F (16°C) WB	12°F (-11°C) DB, 10°F (-12°C) WB

** With optional wind baffle accessory installed. If not installed, the minimum temperature will be 23°F (-5°C) DB.


Indoor Unit: PEAD-A36AA


Remote Controller: PAR-21MAA


Outdoor Unit: PUZ-A36NHA3

Indoor Unit
MCA . . . . . 3.30 A
Fan Type x Quantity . . . . . Sirocco fan x 2
Fan Motor Type . . . . . Direct-driven DC Brushless Motor
Fan Motor . . . . . 2.64 F.L.A.
Fan Motor Output . . . . . 244 W
Airflow (Lo - Med - Hi) . . . . . 847 - 1,024 - 1,201 Dry CFM
777 - 953 - 1,130 Wet CFM
Air Filter . . . . . Polypropylene Honeycomb
External Static Pressure . . . . . 0.14 - 0.20 - 0.28 - 0.40 - 0.60"WG
Sound Pressure Level (Lo - Med - Hi) . . . . . 33 - 38 - 42 dB(A)

DIMENSIONS	UNIT INCHES / MM
W	55-1/8 / 1,400
D	28-7/8 / 732
H	9-7/8 / 250

Weight . . . . . 91 lbs. / 41 kg
External Finish . . . . . Galvanized-steel Sheet
Field Drainpipe Size O.D. . . . . 1-1/4" / 32 mm
Wall-mounted Remote Controller PAR-21MAA
(See Data Submittal Sheet)

Outdoor Unit
Compressor . . . . . DC Inverter-driven Twin Rotary
MCA . . . . . 25 A
Fan Motor . . . . . 0.75 F.L.A.
Sound Pressure Level
Cooling . . . . . 48 dB(A)
Heating . . . . . 50 dB(A)

DIMENSIONS	INCHES / MM
W	37-3/8 / 950
D	13 + 1-3/16 / 330 + 30
H	37-1/8 / 943

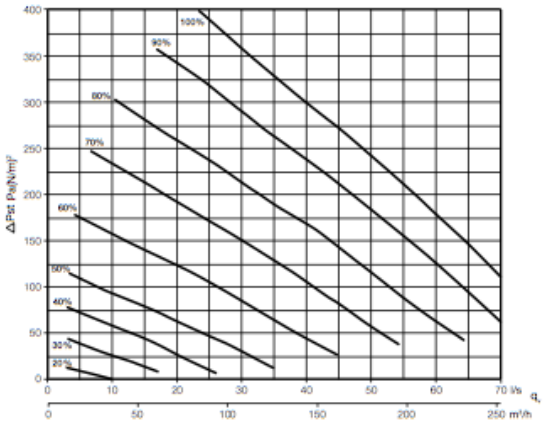
Weight . . . . . 165 lbs. / 75 kg
External Finish . . . . . Munsell No. 3Y 7.8 / 1.1
Refrigerant Type R410A
Refrigerant Pipe Size O.D.
Gas Side . . . . . 5/8" / 15.88 mm
Liquid Side . . . . . 3/8" / 9.52 mm
Max. Refrigerant Pipe Length . . . . . 165' / 50 m
Max. Refrigerant Pipe Height Difference . . . . . 100' / 30 m
Connection Method . . . . . Flared

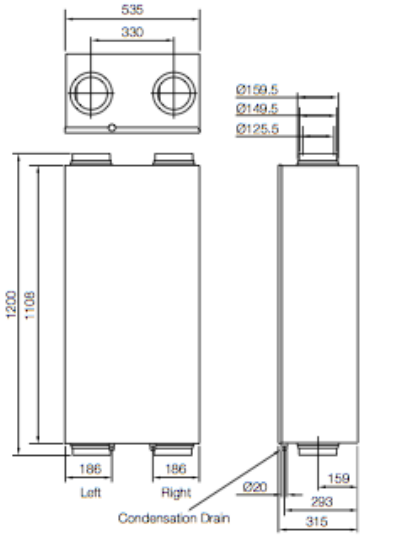
R410A INVERTER

*heat pump contains refrigerant

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





Ancillaries

GD8 Ducting

Flat51 Ducting

	Product Specification
Max House Size EST	110m²/264m³
Case Size in mm (W x D x H)	535 x 1200 x 315
Weight	30kg
Airflow in free air (l/s)	6 – 70
Noise dB(A)	36 - 73
Power (Watts)	9 – 143
Specific Fan Power (W/l/s)	0.90 – 1.36 (0.90)
Spigot Size ID	125.5mm
Filters	G4 standard
Heat efficiency	90 – 93 (90%)
Summer bypass/Frost protection	Yes/Yes
Pre-heater	Optional
Condensate Drain	20mm

	Electrical Specification
	230V ~ 50Hz Class I
Consumption	Trickle – 17W, Medium – 30W, Boost – 68W
Wiring	Must comply with IEE or local wiring regulations
Fuse	3 amp (when fan is supplied from a 6A lighting circuit no local fuse is required)

9 ComfoUnit – The Range

END OF SECTION 230500

SECTION 260500- Electrical Specifications

Electrical Schedule

Equipment Schedule:

Keynote	Quantity	Device	Product	Model #	Details/Notes
26 31 00	30	Solar Modules	SunPower 225 Black PV Modules	Sunpower 225BK	
48 19 16	1	Inverter	SunPower 7000 Watt Inverter	SPR-7000m	Integrated DC Disconnect
26 24 22	1	PV AC Disconnect	Cutler Hammer DG322URB	DG322URB	60A 3P GD NEMA3R
26 24 16.A1	1	Load Center	200A SquareD Panel Board	QO140M200	200A, 40SP
26 24 25	1	Meter/Utility Disconnect	Milbank 200A 4 Meter Socket w/ 200A Breaker	U3990-XL-200	200A, NEMA 3R
33 79 00	2	Specialized Grounding Electrodes	Grounding Electrode as described in SD Building Code 6-9	Custom	
	23	Circuit Breakers	See E-603 for Itemized list of breaker sizes		AFCI protection for applicable breakers
Wiring Schedule (All are copper unless specified otherwise):					
	150 ft	PV Source Circuit	#10-2 AWG USE-2 Wiring		Refer to calculations on E-602
	100 ft	PV Source EGC	#6 AWG Uncoated Wire		Refer to calculations on E-602
	80 ft	Inverter Output Circuit	#8-3 w/GG NM-B Wire		Refer to calculations on E-602
	50 ft	DC GEC	#8 AWG Uncoated Wire		Refer to calculations on E-

					602
	50 ft	SE EGC	#6 AWG Uncoated Wire		Refer to calculations on E-602
	20 ft	Grounding Electrode	#4 AWG Uncoated Wire		Refer to calculations on E-602
	50 ft	SE Cabling	4/0-3 AWG Aluminum XHHW Wire		Refer to calculations on E-602
	~500 ft	Home Circuits	#12-2 w/GG NM-B Wire		Refer to List on E-603 for circuits
	~50 ft	Home Circuits	#12-3 w/GG NM-B Wire		Refer to List on E-603 for circuits
	~100 ft	Home Circuits	#10-2 w/GG NM-B Wire		Refer to List on E-603 for circuits
	~80 ft	Home Circuits	#8-2 w/GG NM-B Wire		Refer to List on E-603 for circuits
Additional Components:					
	23	Circuit Breakers	See E-603 for Itemized list of breaker sizes		AFCI protection for applicable breakers
	10	Light Switch	2-Way Toggle Switch		
	2	Light Switch	2-Way Dimmer Switch		
	2	Light Switch	3-Way Dimmer Switch		
	24	Receptacle	Normal 120V Duplex Receptacle		
	6	GFCI Receptacle	120V GFCI Duplex Receptacle		
	3	240V Receptacle	240V Receptacle		
	35	Wire Splice Kit	NSi Wire Splice Kit: 2 Wire w/GG – #12AWG-#14AWG UL Listed	NMS-2	To connect circuits between modular home

					sections
	3	Wire Splice Kit	NSi Wire Splice Kit: 3 Wire w/GG – #12AWG-#14AWG UL Listed	NMS-3	To connect circuits between modular home sections
Additional Junction boxes and other components to be specified					
PV Balance of System Components:					
	1	PV Racking	SnapNrack Mounting System		
	1	Conduit Entry Box	Acme ACE Conduit Entry Box	ACE-PT	UL Listed
	Var.	Equipment Grounding Devices	Weeb PMC, Weeblug, Weeb bonding jumpers		UL Listed

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 CO_2 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.

Type	Description
C1	Surface mounted, 12 inch linear LED fixture with wide beam distribution and 3000K color temperature at 12 watts per foot.
	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.

Date: _____ Type: _____

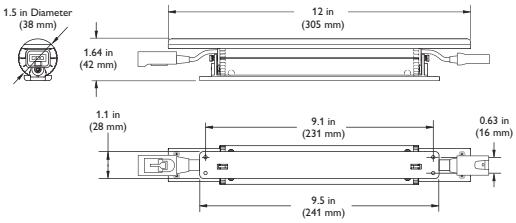
Firm Name: _____

Project: _____

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 180° turns, eW Cove MX Powercore fixtures are easy to position in even the most challenging mounting circumstances. Fixtures rotate in 10° increments through 170° 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/

ENERGY STAR

ENERGY STAR® certified
As an ENERGY STAR certified LED luminaire, eW Cove MX Powercore exceeds ENERGY STAR requirements for efficacy, color rendering, color consistency, useful life, and power factor.

PHILIPS

self-RELIANCE

Middlebury

Specifications

Due to continuous improvements and innovations, specifications may change without notice.

Item	Specification	3000 K*, wide beam angle
Output	Lumens†	534
	Efficacy (lm / W)	45.3
	CRI	84
	Lumen Maintenance‡	50,000 hours L70 @ 25° C 37,000 hours L70 @ 50° C 90,000 hours L50 @ 25° C 80,000 hours L50 @ 50° C
Electrical	Input Voltage	100 / 120 / 208 / 220 – 240 / 277 VAC, auto-switching, 50 / 60 Hz
	Power Consumption	12.0 W maximum at full output, steady state
	Power Factor	.99
Control	Dimming	Compatible with many commercially available ELV, trailing edge, or reverse-phase control dimmers§
Physical	Dimensions *(Height x Width x Depth)*	1.64 x 12 x 1.5 in (42 x 305 x 38 mm)
	Weight	0.19 lbs (85 g)
	Housing	Die-cast aluminium, white powder-coated finish
	Lens	Polycarbonate
	Fixture Connections	Integral male / female connectors
	Temperature Ranges	-4° – 122° F (-20° – 50° C) Operating -4° – 122° F (-20° – 50° C) Startup -40° – 176° F (-40° – 80° C) Storage
	Humidity	0 – 95%, non-condensing
	Maximum Fixture Run Length‖	50 @ 100 VAC 60 @ 120 VAC 104 @ 208 VAC 115 @ 220 – 240 VAC 139 @ 277 VAC *Configuration: Fixtures installed end-to-end, 20 A circuit, standard 10 ft (3.1 m) Leader Cable*
Certification and Safety	Certification	UL / cUL, FCC, CE, CCC
	LED Class	Class 2 LED product
	Environment	Dry / Damp Location, IP50
	Energy Efficiency	ENERGY STAR, California Title 24 Compliant

* Color temperatures conform to nominal CCTs as defined in ANSI Chromaticity Standard C78.377A.

† Lumen measurement complies with IES LM-79-08 testing procedures.

‡ L70 = 70% maintenance of lumen output (when light output drops below 70% of initial output). L50 = 50% maintenance of lumen output (when light output drops below 50% of initial output). Ambient temperatures specified. Based on measurements that comply with IES LM-80-08 testing procedures. See www.colorkinetics.com/support/appnotes/lm-80-08.pdf for more information.

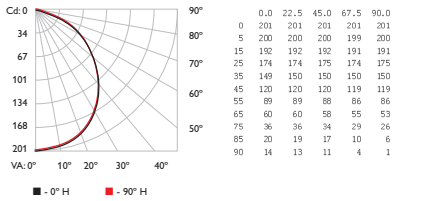
§ See www.colorkinetics.com/support/appnotes/notes/ for specific details.

‖ These figures, provided as a guideline, are accurate for this configuration only. Changing the configuration can affect the fixture run lengths.

Photometrics

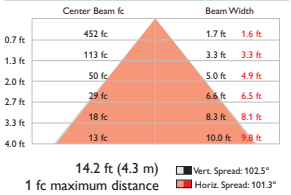
3000 K, wide beam angle

Polar Candela Distribution



	0.0	22.5	45.0	67.5	90.0
0	201	201	201	201	201
5	200	200	200	199	200
15	192	192	192	191	191
25	174	174	175	174	175
35	149	150	150	150	150
45	120	120	120	119	119
55	89	89	88	86	86
65	60	60	58	55	53
75	36	36	34	29	26
85	20	19	17	10	6
90	14	13	11	4	1

Illuminance at Distance



14.2 ft (4.3 m)
1 fc maximum distance

Vert. Spread: 102.5°
Horiz. Spread: 101.3°

Lumens	534
Efficacy	45.3 lm/W

For lux multiply fc by 10.7

Fixtures

Type	Beam Angle	Item Number	Philips 12NC
2700 K	Wide	523-000050-02	910503700980
3000 K	Wide	523-000050-06	910503700984
3500 K	Wide	523-000050-10	910503700988
4000 K	Wide	523-000050-14	910503700992
Red	Wide	223-000050-00	910503701104
Green	Wide	223-000050-01	910503701105
Blue	Wide	223-000050-02	910503701106
Amber	Wide	223-000050-03	910503701107

Accessories

Item	Type		Item Number	Philips 12NC
Leader Cable with terminator and strain relief	UL / cUL	10 ft (3 m)	108-000047-00	910503700972
	CE / CCC	10 ft (3 m)	108-000047-01	910503700973
Wiring Compartment with terminator	UL / cUL		120-000077-01	910503700994
Terminators, Qty 10			120-000058-01	910503701119
Jumper Cable	UL / cUL	1 ft (305 mm)	108-000048-00	910503700974
		5 ft (1.5 m)	108-000048-01	910503700975
	CE / CCC	1 ft (305 mm)	108-000048-02	910503700976
		5 ft (1.5 m)	108-000048-03	910503700977
Mounting Track, White	1 @ 4 ft (1219 mm)		120-000124-00	910503701787

Use Item Number when ordering in North America.

Philips Color Kinetics
3 Burlington Woods Drive
Burlington, Massachusetts 01803 USA
Tel 888.385.5742
Tel 617.423.9999
Fax 617.423.9998
www.philipscolorkinetics.com

DAS-000069-02 R05 10-10

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:

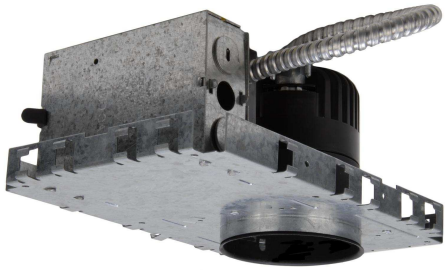
Remarks: Contractor to specify fixture support rails.

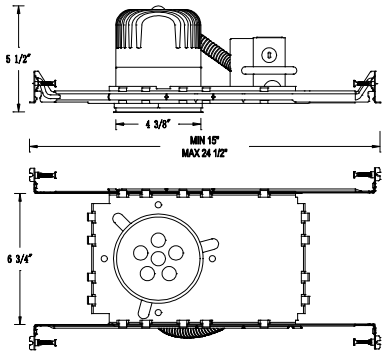
WAC LIGHTING
Responsible Lighting

615 South Street
Garden City, NY 11530
Tel:516-515-5000 Fax:516-515-5050
www.waclighting.com

CATALOG NUMBER	TYPE
PROJECT	

4" LEDme™ DOWNLIGHT HR-LED418-N





Ordering Matrix

Series	Lamp	Model Number	Installation Type	Options	Color Temperature
HR	LED	418	N = New construction	Non-IC rated	W = 3000K C = 4500K

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
U.L. and C.U.L. listed.
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

Finish	Interior	Trim
BK/WT	Black	White
BKBN	Black	Brushed Nickel
WT/WT	White	White

HR-LED421 Step Baffle Trim

Finish	Interior	Trim
BK/WT	Black	White
BKBN	Black	Brushed Nickel
WT/WT	White	White

HR-LED431 Shower Trim

Finish	Interior	Trim
WT	NA	White
CH	NA	Chrome

HR-LED451 Square Open Trim

Finish	Interior	Trim
BK/WT	Black	White
BK/BN	Black	Brushed Nickel
WT/WT	White	White

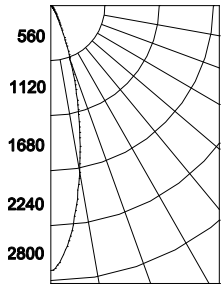
HR-LED471 Square Shower Trim

Finish	Interior	Trim
WT	NA	White
CH	NA	Chrome

Photometry

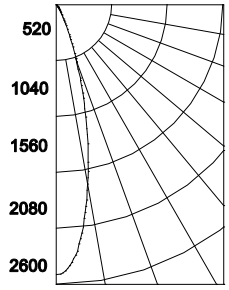
18W 4500K OPEN TRIM

Candlepower Distribution



ANGLE	MEAN CP	LUMENS
0	2723	0
5	2517	59
10	1949	142
15	1343	163
20	800	138
25	395	89
30	183	49
35	87	28
40	46	16
45	29	11
50	19	8
55	15	7
60	13	6
65	11	5
70	8	4
75	6	3
80	4	2
85	2	1
90	0	1

18W 3000K OPEN TRIM



ANGLE	MEAN CP	LUMENS
0	2512	0
5	2301	56
10	1694	132
15	1082	147
20	560	115
25	252	69
30	102	37
35	53	21
40	32	12
45	20	9
50	12	6
55	11	5
60	10	5
65	8	4
70	6	3
75	4	3
80	3	2
85	2	1
90	0	0

self-RELIANCE

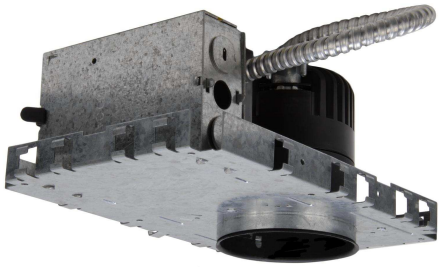
Middlebury

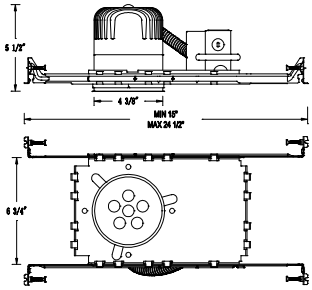
WAC LIGHTING
Responsible Lighting

615 South Street
Garden City, NY 11530
Tel:516-515-5000 Fax:516-515-5050
www.waclighting.com

CATALOG NUMBER	TYPE
PROJECT	

4" LED DOWNLIGHT HR-LED418-NIC





Ordering Matrix

Series	Lamp	Model Number	Installation TypeOptions	Options	Color Temperature
HR	LED	418	N = New construction	IC rated	W = 3000K C = 4500K

Ordering Example (series – lamp - model - installation type &options- color temperature): HR–LED418-NIC-W

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 U.L. and C.U.L. listed. 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

Finish	Interior	Trim
BK/WT	Black	White
BKBN	Black	Brushed Nickel
WT/WT	White	White

HR-LED421 Step Baffle Trim

Finish	Interior	Trim
BK/WT	Black	White
BKBN	Black	Brushed Nickel
WT/WT	White	White

HR-LED431 Shower Trim

Finish	Interior	Trim
WT	NA	White
CH	NA	Chrome

HR-LED451 Square Open Reflector Trim

Finish	Interior	Trim
BK/WT	Black	White
BK/BN	Black	Brushed Nickel
WT/WT	White	White

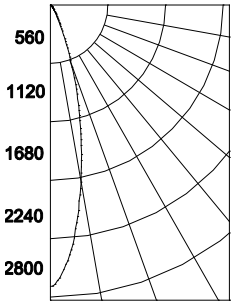
HR-LED471 Square Shower Trim

Finish	Interior	Trim
WT	NA	White
CH	NA	Chrome

Photometry

11W 4500K OPEN TRIM

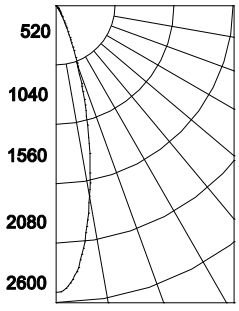
Candlepower Distribution



ANGLE	MEAN CP	LUMENS
0	2010	0
5	1829	44
10	1408	105
15	1000	122
20	576	103
25	304	68
30	142	38
35	64	22
40	35	12
45	23	8
50	14	6
55	12	6
60	10	5
65	8	4
70	6	3
75	5	3
80	3	2
85	2	1
90	0	0

11W 3000K OPEN TRIM

Candlepower Distribution



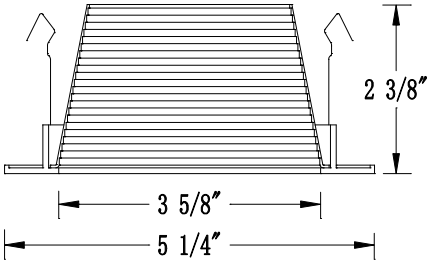
ANGLE	MEAN CP	LUMENS
0	1913	0
5	1700	42
10	1232	100
15	808	111
20	433	88
25	202	54
30	82	29
35	42	16
40	25	10
45	17	7
50	10	5
55	9	4
60	8	4
65	6	3
70	5	3
75	3	2
80	2	1
85	1	1
90	0	0

WAC LIGHTING
Responsible Lighting

615 South Street
Garden City, NY 11530
Tel:516-515-5000 Fax:516-515-5050
www.waclighting.com

CATALOG NUMBER	TYPE
PROJECT	

4" LEDme™ DOWNLIGHT HR-LED421



Ordering Matrix

Series	Model Number	Finish(Baffle/Trim)
HR	LED421	BK = Black WT = White BN = Brushed Nickel

Ordering Example (series – model number – finish): HR–LED421–WT/WT

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)

HR-LED418-NIC-W New construction IC housing Dimming with thermal protection 6 LEDs Max wattage 11W Color Temperature: 3000K		HR-LED418-NIC-C New construction IC housing Dimming with thermal protection 6 LEDs Max wattage 11W Color Temperature: 4500K	

Compatible Housings (Sold Separately)			
HR-LED418-N-W New construction NON-IC housing Dimming with thermal protection 6 LEDs Max Wattage 18W Color Temperature: 3000K		HR-LED418-N-C New construction NON-IC housing Dimming with thermal protection 6 LEDs Max Wattage 18W Color Temperature: 4500K	
HR-LED418-RIC-W Remodel IC housing Dimming with thermal protection 6 LEDs Max Wattage 11W Color Temperature: 3000K		HR-LED418-RIC-C Remodel IC housing Dimming with thermal protection 6 LEDs Max Wattage 11W Color Temperature: 4500K	
HR-LED418-R-W Remodel NON-IC housing Dimming with thermal protection 6 LEDs Max Wattage 18W Color Temperature: 3000K		HR-LED418-R-C Remodel NON-IC housing Dimming with thermal protection 6 LEDs Max Wattage 18W Color Temperature: 4500K	

Note: The full catalog number for a complete downlight includes the model numbers for both the trim and the housing.

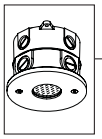
D2 Recessed, wet location LED downlight fixture with 5 inch diameter faceplate, medium flood optics and integral driver for use with one (1) 8 watt LED at 3000K CCT. Satin White finish.

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.



the power of e

VERSA STAR™

PROJECT:	
TYPE:	
CATALOG NUMBER:	
NOTES:	

CATALOG NUMBER LOGIC

Example:	S	-	VS	-	LED	-	e25	-	SP	-	MAC	-	13	-	11

Material
- **Blank** - Aluminum
- **B** - Brass
- **S** - Stainless Steel

Series
- **VS** - Versa Star™

Source
- **LED** - **'e'** Technology with Integral Driver

LED Type
- **e22** - 8WLED/3K
- **e23** - 8WLED/4K
- **e24** - 8WLED/Red
- **e25** - 8WLED/Green
- **e26** - 8WLED/Blue
- **e27** - 8WLED/Amber

Optics*
- **NSP** - Narrow Spot (Red Indicator)
- **SP** - Spot (Green Indicator)
- **MFL** - Medium Flood (Yellow Indicator)
- **WFL** - Wide Flood (Blue Indicator)

Finish

Aluminum & Brass Finish

Powder Coat Color	Satin	Wrinkle
Bronze	BZP	BZW
Black	BLP	BLW
White (Gloss)	WHP	WHW
Aluminum	SAP	—
Verde	—	VER

Brass Finish

Machined	MAC
Polished	POL
Mitique™	MIT

Stainless Finish

Machined	MAC
Polished	POL
Brushed *Interior Use Only*	BRU

Also available in Premium Finishes See submittal SUB-1439-00

Lens Type
- **12** - Soft Focus Lens
- **13** - Rectilinear Lens

Shielding
- **11** - Honeycomb Baffle

LM79 DATA

BK No.	CCT (Typ.)	Input Watts (Typ.)	CRI (Typ.)
e22	3100K	8.4	80
e23	4100K	8.4	66
e24	Red (627nm)	7.9	~
e25	Green (530nm)	8.4	~
e26	Blue (470nm)	8.4	~
e27	Amber (590nm)	7.9	~

L70 DATA

Minimum Rated Life (hrs.) 70% of initial lumens (L_{70})
50,000
50,000
50,000
50,000
50,000
50,000

*OPTICAL DATA

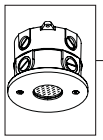
Beam Type	Angle	Visual Indicator
Narrow Spot	14°	Red Dot
Spot	18°	Green Dot
Medium Flood	25°	Yellow Dot
Wide Flood	36°	Blue Dot

B-K LIGHTING

40429 Brickyard Drive • Madera, CA 93636 • USA
559.438.5800 • FAX 559.438.5900
www.bklighting.com • info@bklighting.com

SUBMITTAL DATE 1-11-10

DRAWING NUMBER SUB001016



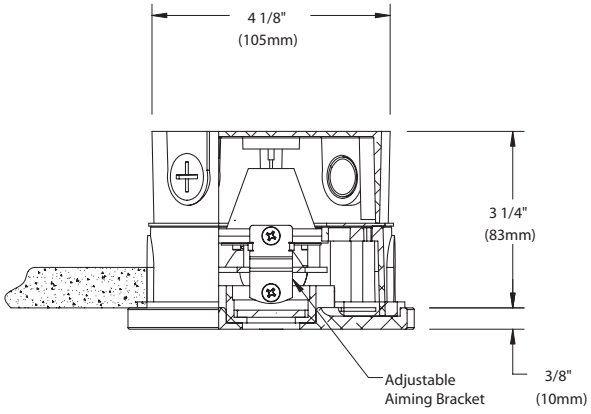
BKSSL SOLID STATE LIGHTING

the power of e

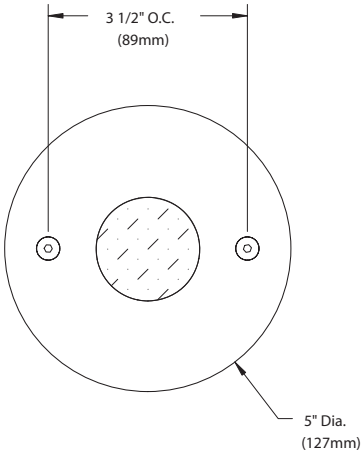
VERSA STAR™

PROJECT:	
TYPE:	

SIDE VIEW

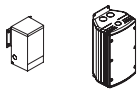


FACEPLATE DETAIL



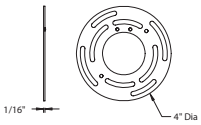
Accessories *(Configure separately)*

Remote options:



TR Series PMRM™

UNIVERSAL RING



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 [5] 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 1/8" thick HT-805A 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 (#12) or rectilinear (#13) lens.

BKSSL™
Integrated solid state system with 'e' 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-80 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.

Optics
Interchangeable OPTIKIT™ modules permit field changes to optical distribution. Color-coded for easy reference: Narrow Spot (NSP) = Red. Spot (SP) = Green. Medium Flood (MFL) = Yellow. Wide Flood = Blue. Adjustable optical bracket provides up to 24° vertical aiming.

Transformer
For use with 12VAC BKSSL remote transformer.

Wiring
Teflon® coated, 18AWG, 600V, 250° C rated and certified to UL 1659 standard.

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 'A' 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
ITL tested to IESNA LM-79. Lighting Facts Registration per USDOE (www.lightingfacts.com). ETL Listed to ANSI/UL Standard 1838 and UL Subject 8750 and Certified to CAN/CSA Standard C22.2 No. 9. RoHs compliant. Suitable for indoor or outdoor use. Suitable for installation in combustible materials (Type Non-IC). Suitable for use in wet locations. Suitable for installation within 4' of the ground. Made in USA.

MADE IN THE USA lighting facts

**Teflon is a registered trademark of DuPont Corporation.*
**Energy Star is a registered trademark of the United States Environmental Protection Agency.*

B-K LIGHTING

40429 Brickyard Drive • Madera, CA 93636 • USA
559.438.5800 • FAX 559.438.5900
www.bklighting.com • info@bklighting.com

SUBMITTAL DATE	DRAWING NUMBER
1-11-10	SUB001016

Versa Star™ - Narrow Spot

lighting factsCM
A Program of the U.S. DOE

Light Output (Lumens)	365
Watts	8.2
Lumens per Watt (Efficacy)	44
Color Accuracy	68
Color Rendering Index (CRI)	

Light Color — Correlated Color Temperature (CCT): 4102 (Bright White)

Warm White	Bright White	Daylight
2700K 3000K	4500K	6500K

All results are according to IESNA LM-79-2008: *Approved Method for the Electrical and Photometric Testing of Solid-State Lighting*. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the *Label Reference Guide*.

Registration Number: GCXV-R6X37A
Model Number: VS-LED-e23-NSP-12
Type: Surface-mounted downlight

Versa Star™ - Spot

lighting factsCM
A Program of the U.S. DOE

Light Output (Lumens)	354
Watts	8.1
Lumens per Watt (Efficacy)	43
Color Accuracy	68
Color Rendering Index (CRI)	

Light Color — Correlated Color Temperature (CCT): 4080 (Bright White)

Warm White	Bright White	Daylight
2700K 3000K	4500K	6500K

All results are according to IESNA LM-79-2008: *Approved Method for the Electrical and Photometric Testing of Solid-State Lighting*. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the *Label Reference Guide*.

Registration Number: GCXV-EH83XB
Model Number: VS-LED-e23-SP-12
Type: Surface-mounted downlight

Versa Star™ - W. Flood

lighting factsCM
A Program of the U.S. DOE

Light Output (Lumens)	345
Watts	8.3
Lumens per Watt (Efficacy)	41
Color Accuracy	67
Color Rendering Index (CRI)	

Light Color — Correlated Color Temperature (CCT): 3981 (Bright White)

Warm White	Bright White	Daylight
2700K 3000K	4500K	6500K

All results are according to IESNA LM-79-2008: *Approved Method for the Electrical and Photometric Testing of Solid-State Lighting*. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the *Label Reference Guide*.

Registration Number: GCXV-AW47F6
Model Number: VS-LED-e23-WFL-12
Type: Surface-mounted downlight

Versa Star™ - Med. Flood

lighting factsCM
A Program of the U.S. DOE

Light Output (Lumens)	346
Watts	8.2
Lumens per Watt (Efficacy)	42
Color Accuracy	68
Color Rendering Index (CRI)	

Light Color — Correlated Color Temperature (CCT): 4047 (Bright White)

Warm White	Bright White	Daylight
2700K 3000K	4500K	6500K

All results are according to IESNA LM-79-2008: *Approved Method for the Electrical and Photometric Testing of Solid-State Lighting*. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the *Label Reference Guide*.

Registration Number: GCXV-JMYRVL
Model Number: VS-LED-e23-MFL-12
Type: Surface-mounted downlight

Versa Star™ - Med. Flood - Rectilinear

lighting factsCM
A Program of the U.S. DOE

Light Output (Lumens)	299
Watts	8.5
Lumens per Watt (Efficacy)	35
Color Accuracy	66
Color Rendering Index (CRI)	

Light Color — Correlated Color Temperature (CCT): 4022 (Bright White)

Warm White	Bright White	Daylight
2700K 3000K	4500K	6500K

All results are according to IESNA LM-79-2008: *Approved Method for the Electrical and Photometric Testing of Solid-State Lighting*. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the *Label Reference Guide*.

Registration Number: GCXV-LLPF4T
Model Number: VS-LED-e23-MFL-13
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 # PH5-1/23/CF MEDIUM-120V-WHT

Lamp & Mfg: Lamp included with Fixture.

Accessories:

Remarks: Overall suspension height of fixture to be determined.

PH 5

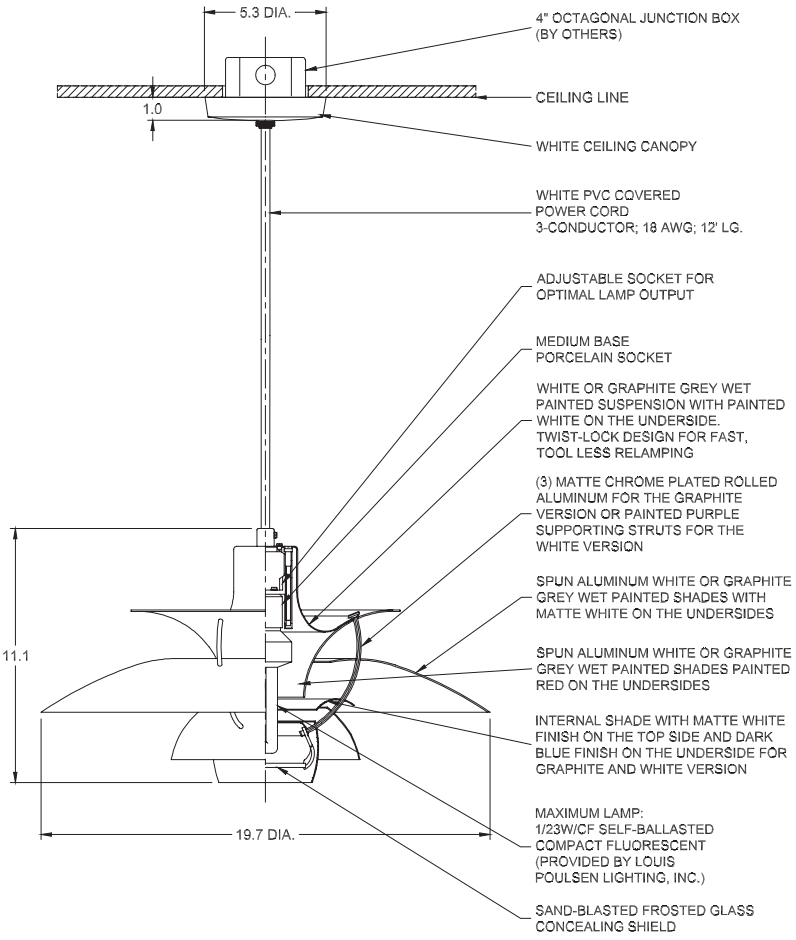
compact fluorescent

Design: Poul Henningsen

Type:

Project:

Catalog Number:



louis poulsen

Louis Poulsen Lighting, Inc., 3260 Meridian Parkway, Fort Lauderdale, FL 33331 Telephone: (954) 349-2525 Fax: (954) 349-2550

www.louispoulsen.com

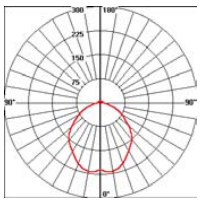
self-RELIANCE

Middlebury

PH 5

pendants

compact fluorescent



Photometric Report: PH5-1-23W-CF MEDIUM.IES
Report No.: LP1379
Poulsen Report No.: PH5-1-23W-CF MEDIUM.IES
Luminaire: PH 5 Plus Pendant
Lamp: 1/23W/CF MEDIUM
Efficiency: 41.0%
Description: All data shown are per 1500 lumens. Use only actual lumen data when calculating.

Candlepower Distribution

Vertical Angle	Candela
0	211
5	219
10	219
25	189
40	153
55	95
70	49
85	12
90	2

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0-30	170	11.3	27.6
0-40	275	18.3	44.7
0-60	473	31.5	76.9
0-90	592	39.5	96.3
90-120	15	1.0	2.4
90-130	18	1.2	2.9
90-150	21	1.4	3.4
90-180	23	1.5	3.7
0-180	615	41.0	100.0

Coefficients of Utilization - Zonal Cavity Method
Effective Floor Cavity Reflectance 20%

Ceiling Reflectance (%)	80				70				50			30			10			0
Wall Reflectance (%)	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
Room Cavity Ratio																		
0	48	48	48	48	47	47	47	47	45	45	45	42	42	42	40	40	40	39
1	44	42	41	39	43	41	40	38	39	38	37	37	36	35	36	35	34	33
2	40	37	34	32	39	36	34	31	34	32	30	33	31	29	31	30	29	28
3	37	33	29	27	26	32	29	26	30	28	26	29	27	25	28	26	24	23
4	34	29	25	23	33	28	25	22	27	24	22	26	23	21	25	23	21	20
5	31	26	22	20	30	25	22	19	24	21	19	23	21	19	22	20	18	17
6	29	23	20	17	28	23	19	17	22	19	17	21	18	16	20	18	16	15
7	27	21	18	15	26	21	17	15	20	17	15	19	17	15	19	16	14	14
8	25	19	16	14	24	19	16	13	18	15	13	18	15	13	17	15	13	12
9	23	18	14	12	23	17	14	12	17	14	12	16	14	12	16	13	12	11
10	22	16	13	11	21	16	13	11	16	13	11	15	13	11	15	12	11	10

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
Shades: Spun aluminum. Concealing shield: Sand-blasted, glass. Struts: Matte chrome plated or purple, rolled aluminum.

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.

Product code	Light source	Voltage	Finish
PH5	1/23W/CF medium 1/200W/A-23/IF medium	120V	GRP GREY WHT

Specification notes:
a. CF variants provided with a 1/23W/CF medium base self-ballasted lamp in 120V.

Info notes:
I. Graphite grey variant is only available with matte chrome plated struts.
II. White variant is only available with purple struts.
III. The comparable EU version has the following classification: Ingress Protection Code: IP20.

louis poulsen
Louis Poulsen Lighting, Inc., 3260 Meridian Parkway, Fort Lauderdale, FL 33331 Telephone: (954) 349-2525 Fax: (954) 349-2550
www.louispoulsen.com

P2 Pendant (white cord) mounted decorative fixture

Manufacturer: Light Years

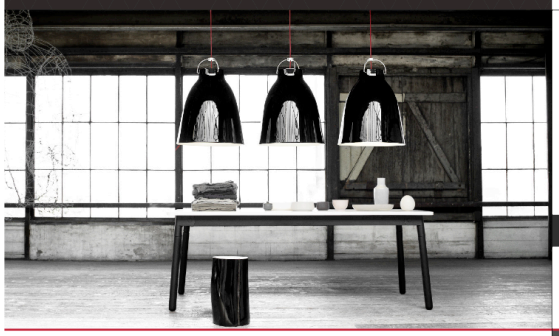
Lamp & Mfg: Caravaggio

Remarks: Overall suspension height of fixture to be determined.

CARAVAGGIO P4 2x42w

Designed by Cecilie Manz 2006

LIGHT YEARS



Colours:

White/ Grey

Black/ Red

Caravaggio P4 GX24q-4

Caravaggio P4 is a series of metal pendants with an eye-catshing high gloss lacquer. The suspension technology is masculine in construction, creating the right counterbalance to the shade's feminine lines. This pendant looks its best in large high ceiling rooms, whether this is business premises, public environments or in private homes. There are three different versions of the P4 large room pendent. The two compact fluorescent lamp versions are recommended where there is a need for higher lighting levels and greater energy efficiency. They are both supplied with electronic dimmable ballasts. This pendant is named after the Italian Baroque painter Caravaggio, who is known for his dramatic paintings with large constrast between light and shadow.

Surface

High gloss lacquer.

Material

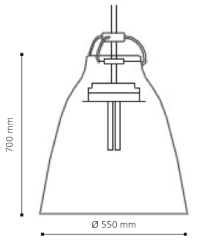
Shade: Drawn aluminium.
Suspension: Curved steel roods and turned brass coated in matt chrome for the Black/Red and White/Grey.

Installation

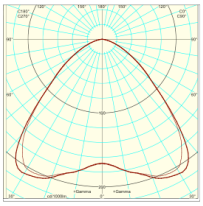
Suspension: Textile cable 2x0,75mm². Cable and wire length: 6m.
Canopy: Black/Red and White/Grey: White.

Class

IP20, ⊏F, Class of insulation II.



Product family



Product code	EAN no.	Surface	Light source	Max light source dimensions	Total weight
64009008	5702370090081	Black, red cord	GX24q-4 2x42W	Max length: 390 mm	4,2 kg
64009105	5702370091057	White, grey cord		Max diameter: 100 mm	

Lightyears A/S · Balticagade 15 · DK-8000 Aarhus C · Tel. +45 8730 1240 · Fax +45 8730 1249 · www.lightyears.dk

P3 Pendant (white cord) mounted decorative fixture

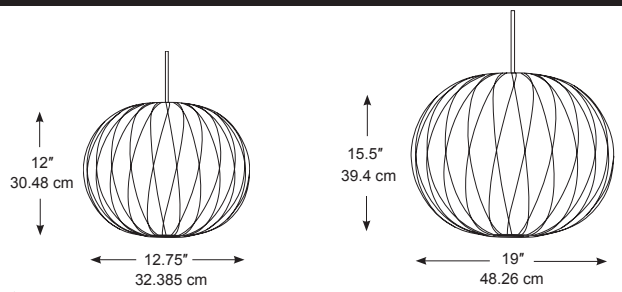
Manufacturer: Modernica

Lamp & Mfg: Nelson ball Criss Cross Pendant

Remarks: Overall suspension height of fixture to be determined.

MODERNICA®

GEORGE NELSON® BUBBLE LAMP®



Bubble Lamp Ball Crisscross Pendant
Designed by George Nelson in 1947.
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 MODERNICA®

T1 Floor lamp with adjustable arm and task light. Chromed steel finish.

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

Michele De Lucchi, Giancarlo Fassina 2009

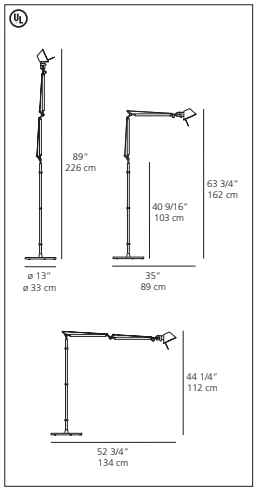
Floor standing luminaires for adjustable direct task incandescent, fluorescent, or LED lighting.

- 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)

eco♡design



Tolomeo classic/classic LED floor

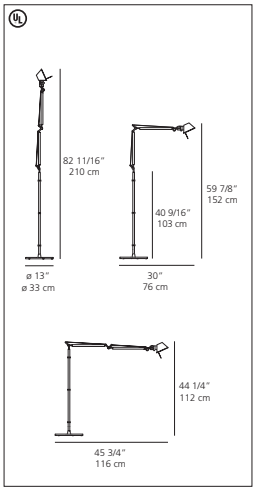
incandescent source
• 1 x 100W (E26/A19)

or

fluorescent source
• 1 x 13W (GX23-2/T4)

or

LED source
• 5 LEDs/10W supplied

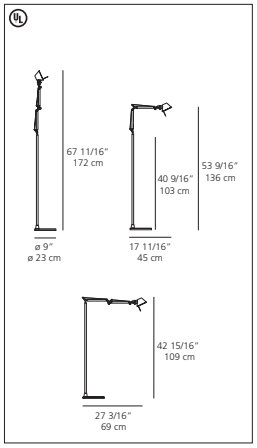


Tolomeo mini floor

incandescent source
• 1 x 100W (E26/A19)

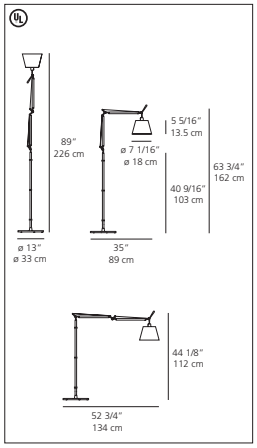
or

fluorescent source
• 1 x 13W (GX23-2/T4)



Tolomeo micro floor

incandescent source
• 1 x 60W (E26/G16 ½)

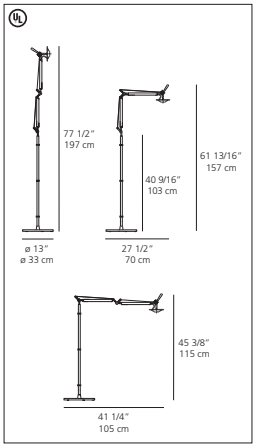


Tolomeo with shade floor

incandescent source
• 1 x 75W (E26/A19)

or

fluorescent source
• 1 x 13W (GX24q-1/T4)



Tolomeo micro LED floor

LED source
• 7 LEDs/6W supplied

T2 Desk lamp with adjustable arm and task light. Chromed steel finish

Manufacturer: ARTEMIDE

Lamp & Mfg: Tolomeo mini LED desk lamp

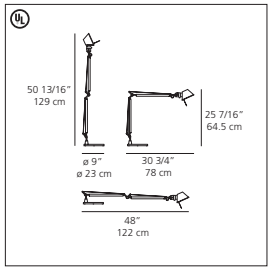
Tolomeo classic LED table

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)



Tolomeo classic LED table

LED source
- 1 x 10W (LED) supplied

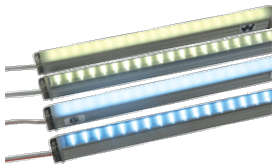
W1 Exterior, East Porch Light

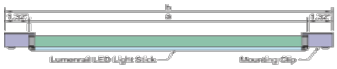
Manufacturer: Wagner Companies

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.

GREEN

All metals have a recycled content and high reclamation rate. Contact Wagner for data relating to your specific product selection

LED SPECIFICATIONS

	Warm White	Cool White
Color Temperature:	3100K	5400K
Lens Angle:	60 Degrees	60 Degrees
Light Output:		
Transparent Lens:	87.3 lm/ft	109.3 lm/ft
Matte Lens:	57.9 lm/ft	64.4 lm/ft
Luminaire Efficacy:		
Transparent Lens:	49.6 lm/W	48.4 lm/W
Matte Lens:	32.8 lm/W	28.6 lm/W
Housing:	Aluminum	
Size:	3/4" x 6", 12", 18", 24", 30", 36", 42", 48", 54" and 60"	
Listings:	ETL - for wet and dry locations* * Not Suitable for submerged applications.	

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

Ambient Temperature: Approximately 87° F (30° C)

LUMENRAIL LED LIGHT STICKS

3K Operating Temperature - Warm White
60° Beam pattern; Transparent or Matte (Diffused) Lens.

Transparent Lens 87.3 lms/ft	Matte Lens 57.9 lms/ft	a	b
LULS3K60T-6	**LULS3K60M-6**	7-3/16"	10"
LULS3K60T-12	**LULS3K60M-12**	13-1/8"	15-15/16"
LULS3K60T--18	**LULS3K60M--18**	18-15/16"	21-3/4"
LULS3K60T-24	**LULS3K60M-24**	24-15/16"	27-3/4"
LULS3K60T-30	**LULS3K60M-30**	30-15/16"	33-3/4"
LULS3K60T-36	**LULS3K60M-36**	36-11/16"	39-1/2"
LULS3K60T-42	**LULS3K60M-42**	42-11/16"	45-1/2"
LULS3K60T-48	**LULS3K60M-48**	48-5/8"	51-1/2"
LULS3K60T-54	**LULS3K60M-54**	54-5/8"	57-1/2"
LULS3K60T-60	**LULS3K60M-60**	60-1/2"	63-1/4"

LUMENRAIL LED LIGHT STICKS

5K Operating Temperature - Cool White
60° Beam pattern; Transparent or Matte (Diffused) Lens.

Transparent Lens 109.3 lms/ft	Matte Lens 64.4 lms/ft	a	b
LULS5K60T-6	**LULS5K60M-6**	7-3/16"	10"
LULS5K60T-12	**LULS5K60M-12**	13-1/8"	15-15/16"
LULS5K60T--18	**LULS5K60M--18**	18-15/16"	21-3/4"
LULS5K60T-24	**LULS5K60M-24**	24-15/16"	27-3/4"
LULS5K60T-30	**LULS5K60M-30**	30-15/16"	33-3/4"
LULS5K60T-36	**LULS5K60M-36**	36-11/16"	39-1/2"
LULS5K60T-42	**LULS5K60M-42**	42-11/16"	45-1/2"
LULS5K60T-48	**LULS5K60M-48**	48-5/8"	51-1/2"
LULS5K60T-54	**LULS5K60M-54**	54-5/8"	57-1/2"
LULS5K60T-60	**LULS5K60M-60**	60-1/2"	63-1/4"

W3 Bathroom vanity light

Manufacturer: FLOS

Lamp & Mfg: Mini Glo Ball

FLOS

MINI GLO-BALL C/W

Mounting	: Ceiling, wall or mirror
Lamps description	: 1 x MAX 25W G9 HSGS
Environment	: Indoor
Finish	: White
Technical description	: Lamp for ceiling, wall or mirror providing diffused light. Diffuser consisting of an externally acidetched, 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.

ELECTRICAL

Emergency	: Without
Voltage (V)	: 230

PHYSICAL

Supply	: Terminal block
Construction material	: Glass, PPS
Weight (kg)	: 0,3

Mini Glo-Ball C/W
design by Jasper Morrison

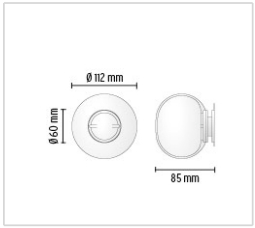
Lamp for ceiling, wall or mirror providing diffused light

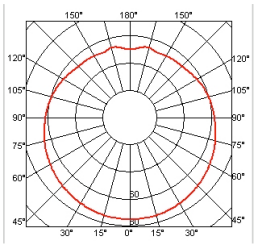
Reference Code

○ **F4190009** **White/White**

Certifications

IP 40





www.flos.com
info@flos.it

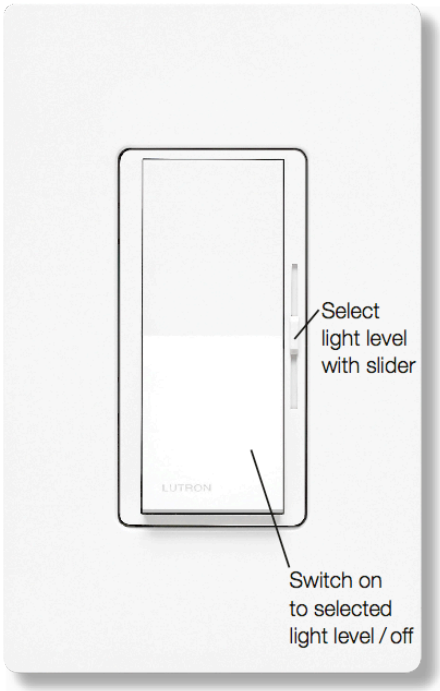
Light Switches:

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



* Faceplate sold separately

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
  or
- 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/dimcfiled

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

LUTRON. SPECIFICATION SUBMITTAL Page

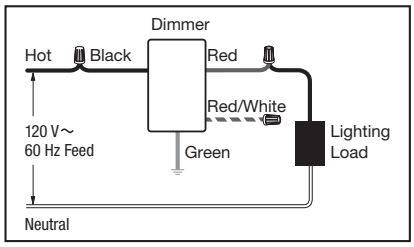
Job Name:	Model Numbers:
Job Number:	

LUTRON® DIVA® / C•L™ DIMMER Wallbox Controls

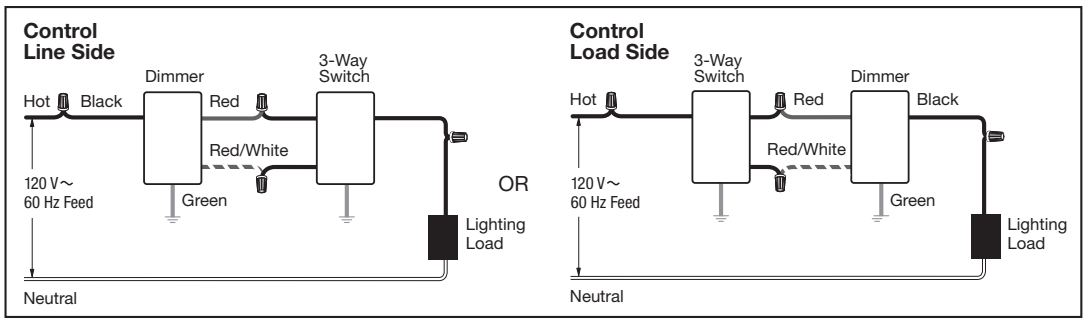
369-308a 10.07.10

Wiring Diagrams

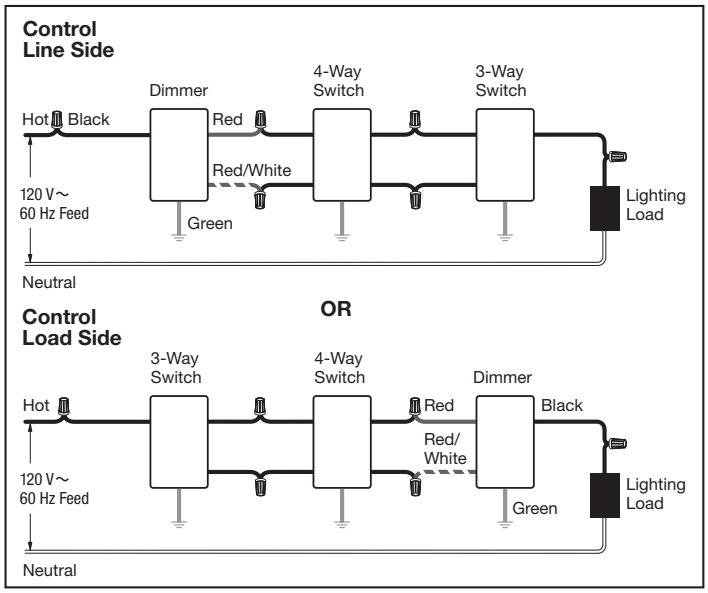
Single-Pole Wiring



3-Way Wiring



4-Way Wiring



LUTRON® SPECIFICATION SUBMITTAL Page

Job Name:	Model Numbers:
Job Number:	

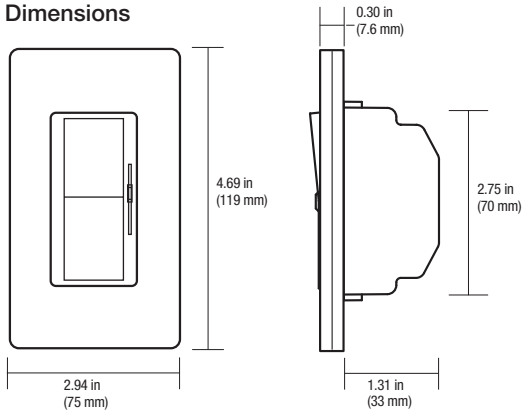
Multigang and Mixed-Bulb-Type Ratings

Total CFL•LED Wattage Installed (CFL, LED) (Watts per bulb x # of bulbs)		Maximum Allowable Incandescent/Halogen Wattage* (INC/HAL)		
		No sides removed	1 side removed	2 sides removed
0 W	+	600 W	500 W	400 W
1 W – 25 W	+	500 W	400 W	300 W
26 W – 50 W	+	400 W	300 W	200 W
51 W – 75 W	+	300 W	200 W	100 W
76 W – 100 W	+	200 W	100 W	50 W
101 W – 125 W	+	100 W	50 W	0 W
126 W – 150 W	+	0 W	0 W	0 W

LUTRON® DIVA® / C•L™ DIMMER Wallbox Controls

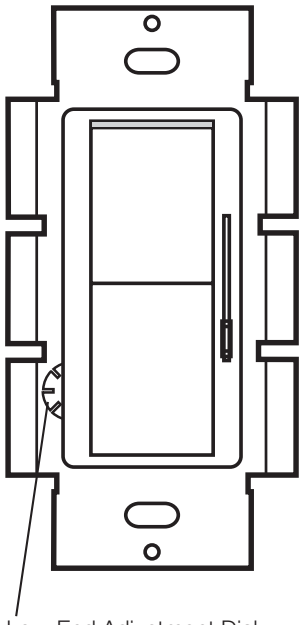
369-308a 10.07.10

Dimensions



Low-End Adjustment Dial

View with faceplate removed



Low-End Adjustment Dial

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

LUTRON® SPECIFICATION SUBMITTAL Page

Job Name:	Model Numbers:
Job Number:	

SUNP WER

E18 / 225 SOLAR PANEL

EXCEPTIONAL EFFICIENCY AND PERFORMANCE

BENEFITS

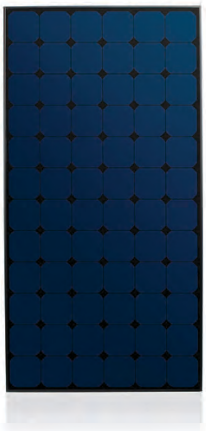
Highest Efficiency
SunPower™ Solar Panels are the most efficient photovoltaic panels on the market today.

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.

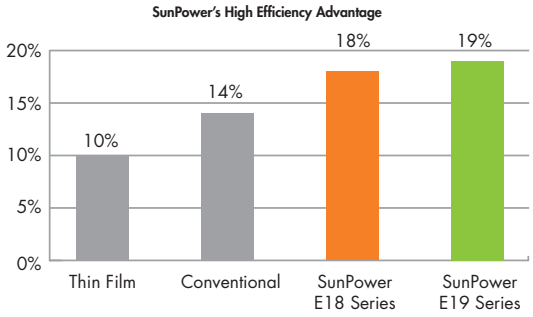
Reliable and Robust Design
Proven materials, tempered front glass, and a sturdy anodized frame allow panel to operate reliably in multiple mounting configurations.

SPR-225-BLK-U



E18 SERIES

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.



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SUNPOWER™

E18 / 225 SOLAR PANEL

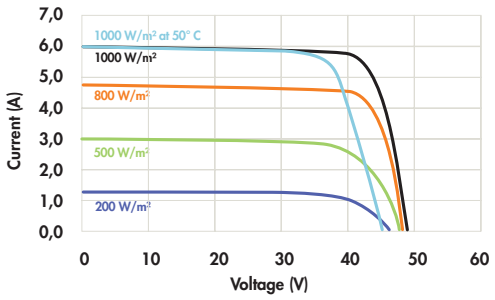
EXCEPTIONAL EFFICIENCY AND PERFORMANCE

Electrical Data

Measured at Standard Test Conditions (STC): irradiance of 1000W/m², AM 1.5, and cell temperature 25° C

Peak Power (+5/3%)	P_{max}	225 W
Efficiency	η	18.1 %
Rated Voltage	V_{mpp}	41.0 V
Rated Current	I_{mpp}	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})	-132.5mV / K
	Current (I_{sc})	3.5mA / 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)

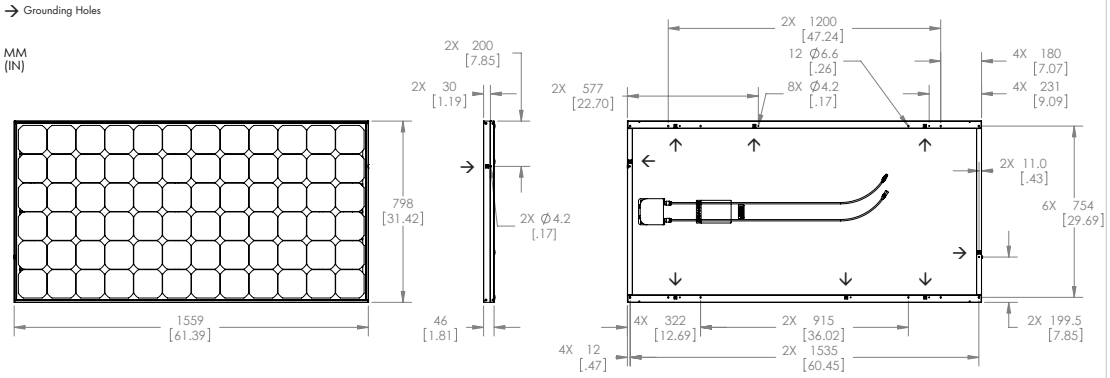
Mechanical Data

Solar Cells	72 SunPower all-back contact monocrystalline
Front Glass	High transmission tempered glass
Junction Box	IP-65 rated with 3 bypass diodes Dimensions: 32 x 155 x 128 (mm)
Output Cables	1000mm length cables / MultiContact (MC4) connectors
Frame	Anodized aluminum alloy type 6063 (black)
Weight	33.1 lbs. (15.0 kg)

Warranties and Certifications

Warranties	25 year limited power warranty
	10 year limited product warranty
Certifications	Tested to UL 1703. Class C Fire Rating

Dimensions



CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

Visit sunpowercorp.com for details

sunpowercorp.com

Document #001-42188 Rev*C / LTR_EN

SUNPOWER

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

SPR-5000m, SPR-6000m & SPR-7000m

5000m, 6000m & 7000m INVERTERS

EXCEPTIONAL RELIABILITY AND PERFORMANCE

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

self-RELIANCE

Middlebury

SUNPOWER

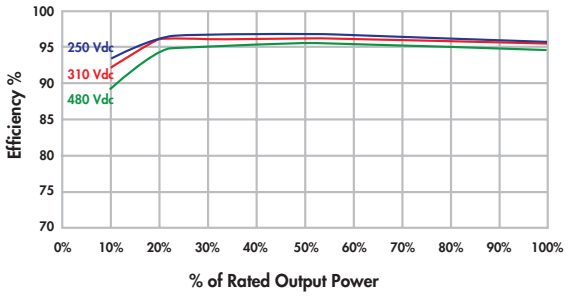
5000m, 6000m & 7000m INVERTERS

EXCEPTIONAL RELIABILITY AND PERFORMANCE

Electrical Data

	SPR–5000m	SPR–6000m	SPR–7000m
AC Power	5000 W	6000 W	7000 W
AC Max Output Current (@ 208V, 240V, 277V):	24A, 20.8A, 18A	29A, 25A, 21.6A	34A, 29A, 25.3A
AC Nominal Voltage / Range	183 – 229 V @ 208 VAC 211 – 264 V @ 240 VAC 244 – 305 V @ 277 VAC	183 – 229 V @ 208 VAC 211 – 264 V @ 240 VAC 244 – 305 V @ 277 VAC	183 – 229 V @ 208 VAC 211 – 264 V @ 240 VAC 244 – 305 V @ 277 VAC
AC Freq / Range	60 Hz / 59.3 Hz – 60.5 Hz	60 Hz / 59.3 Hz – 60.5 Hz	60 Hz / 59.3 Hz – 60.5 Hz
Power Factor	1	1	1
Peak Inverter Efficiency	96.8%	97.0%	97.1%
CEC Weighted Efficiency	95.5 % @ 208 V 95.5 % @ 240 V 95.5 % @ 277 V	95.5 % @ 208 V 95.5 % @ 240 V 96.0 % @ 277 V	96.0 % @ 208 V 96.0 % @ 240 V 96.0 % @ 240V
Recommended Array Input Power (DC @ STC)	5300 W	6400 W	7500 W
DC Input Voltage Range	250 – 600 V	250 – 600 V	250 – 600 V
Peak Power Tracking Voltage	250 – 480 V	250 – 480 V	250 – 480 V
DC Max. Input Current	21 A	25 A	30 A
DC Voltage Ripple	< 5%		
No. of Fused String Inputs	4		
Power Consump: Standby / Nighttime	< 7 W / 0.25 W		
Fused DC & AC Disconnect	Standard; Complies with NEC Standards		
Grounding	Positive Ground		

SPRm Efficiency Curves

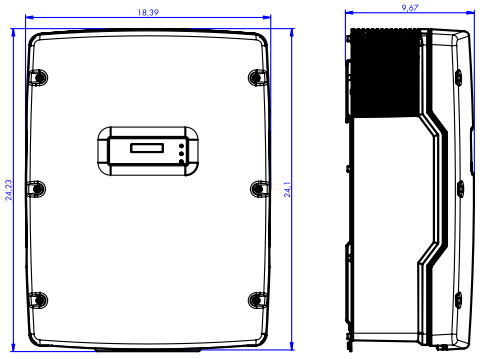


Mechanical Data

Shipping Dimensions W x H x D inches	23.5" x 31.0" x 16.0"
Unit Dimensions W x H x D inches	18.4" x 24.1" x 9.5"
Inverter Weight	143 lbs
Shipping Weight	154 lbs
Cooling	Forced Air / Sealed Electronics Enclosure
Enclosure	NEMA 3R
Mounting	Wall Mount Bracket Standard
Ambient Temperature Range	–13 to +113 °F

Warranty and Certifications

Warranty	10 year limited warranty
Certifications	Compliance: IEEE–929, IEEE–1547, UL 1741–2005, UL 1998, FCC Part 15 A & B



About SunPower

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.

Document # 001–16967 Rev **

General-duty safety switches (disconnects)

Three-Pole—240 Vac (Suitable for Service Entrance Use with a Neutral or Ground Lug Kit)

Catalog Number	Current Rating (A)	Type	Enclosure Type	Max. HP Ratings Single-Phase 240 Vac	Max. HP Ratings Three-Phase 240 Vac
DG321NGB	30	Fusible with neutral	NEMA 1	1.5–3	3–7.5
DG321UGB	30	Non-fusible	NEMA 1	3	7.5
DG321NRB	30	Fusible with neutral	NEMA 3R	1.5–3	3–7.5
DG321URB	30	Non-fusible	NEMA 3R	3	7.5
DG322NGB	60	Fusible with neutral	NEMA 1	3–10	7.5–15
DG322UGB	60	Non-fusible	NEMA 1	10	15
DG322NRB	60	Fusible with neutral	NEMA 3R	3–10	7.5–15
DG322URB	60	Non-fusible	NEMA 3R	10	15
DG323NGB	100	Fusible with neutral	NEMA 1	7.5–15	15–30
DG323UGB	100	Non-fusible	NEMA 1	15	30
DG323NRB	100	Fusible with neutral	NEMA 3R	7.5–15	15–30
DG323URB	100	Non-fusible	NEMA 3R	15	30

Neutral and Ground Lug Kits

Catalog Number	Description
DG030NB	Neutral kit for 30A switches
DG100NB	Neutral kit for 60–100A switches
DG030GB	Ground lug kit for 30–100A switches

Product Data Sheet

QO140M200

LOAD CENTER QO MB 240V 200A 1PH 40SP

SQUARE D by Schneider Electric

List Price $1,034.00 USD

Availability **Stock Item: This item is normally stocked in our distribution facility.**

Technical Characteristics

Main Type	Convertible - Factory installed main breaker
Maximum Single Pole Circuits	40
Maximum Tandem Circuit Breakers	0
Phase	1-Phase
Spaces	40
Ampere Rating	200A
Voltage Rating	120/240VAC
Wire Size	#4 to 250 AWG/kcmil(Al/Cu)
Application	Designed to meet residential, commercial and industrial requirements to protect electrical systems, equipment and people.
Wiring Configuration	3-Wire
Depth	3.75 Inches
Approvals	UL Listed
Height	33.78 Inches
Width	14.25 Inches
Cover Type	Order separately
Bus Material	Tin Plated Copper
Enclosure Type	Indoor
Box Number	10
Enclosure Rating	NEMA 1
Grounding Bar	Order separately
Short Circuit Current Rating	22kA

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	00785901867654
Package Quantity	1
Weight	20.97 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y

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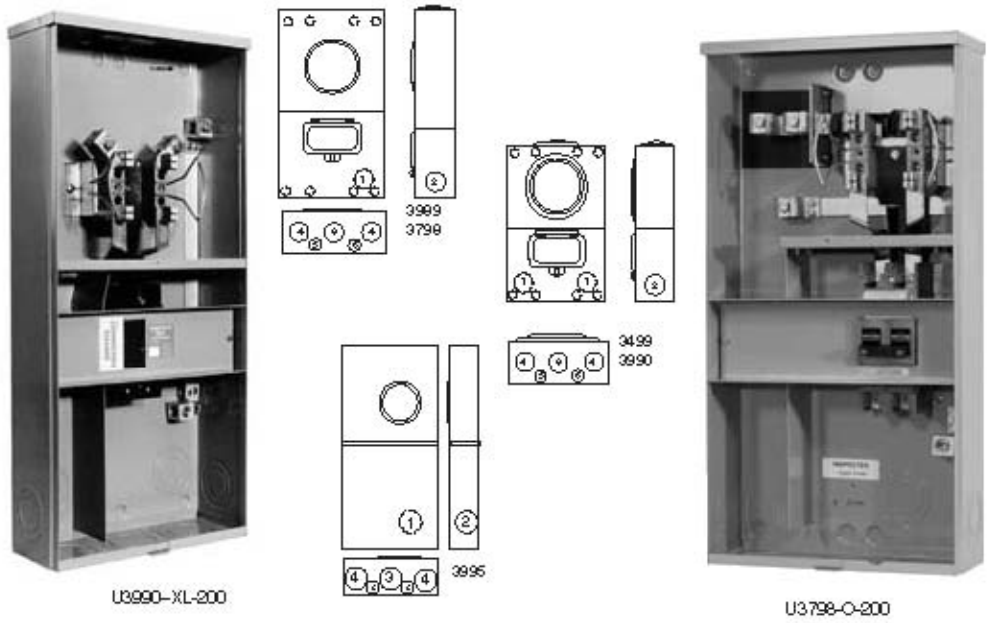
Schneider Electric



METER-MAIN–4 TERMINAL–RINGLESS–1Ø3W

AMPS	SERVICE	RINGLESS CATALOG NUMBER	HUB	CONNECTOR CU/AL		BY-PASS	DIMENSIONS			CONCENTRIC K.O.'S					
				LINE	LOAD		D**	W**	H**	1	2	3	4	5	6
100	OH/UG	U3499-XL-100	C.P.	#6-2/0	#6-1/0	NONE	3¾	11	22	2	2	2	2	–	¼½
100	OH/UG	U3989-XL-100	C.P.	#6-2/0	BLANK	NONE	3¾	11	22	2	2	2	2	–	¼½
150	OH/UG	U3990-XL-150	C.P.	#2-350 kcmil	#1/0-300 kcmil	NONE	4⅞	13	29	2½	2½	3	3	¼	¼½
200	OH/UG	U3990-XL-200	C.P.	#2-350 kcmil	#1/0-300 kcmil	NONE	4⅞	13	29	2½	2½	3	3	¼	¼½
200	UG	U3798-O-200	BLANK	#2-350 kcmil	#1/0-300 kcmil	NONE	4⅞	13	25⅜	2½	2½	3	3	¼	¼½
200	OH/UG	U3995-XL-200	C.P.	#6-350 kcmil	#1/0-300 kcmil	LEVER	4⅞	16	35	2½	2½	3	3	¼	¼½

FIFTH TERMINAL: For field installed fifth terminal on U3499 and U3989, order catalog number ST8K2 (9 o'clock position only). For field installed fifth terminal on U3990 and U3798, order catalog number KST (9 o'clock position only). For U3995, order fifth terminal kit K3865 for 6 or 9 o'clock position.

HUBS: For proper hub selection refer to the hub suffix chart on the Accessory page.

BREAKERS: The U3989 is supplied with a Milbank MQP2100 plug-in style breaker.

FACTORY INSTALLED CIRCUIT BREAKERS: The U3499-XL-100 has a factory installed Milbank MQP2100 breaker. The U3990-XL-150 and U3990-XL-200 have factory installed Milbank UQFB(AMP)-X1 breakers. The U3798-O-200 has a factory installed UQFB-200 breaker. The U3995-XL-200 has a factory installed UQFB-M-200 breaker and provisions for (2) double pole or (4) single pole circuit breakers.

BYPASS: The lever on the U3995-XL unit supplies clamping action on meter spades and also operates bypass device.

self-RELIANCE

Middlebury

Intertek

AUTHORIZATION TO MARK

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Control Number: 3098177 **Authorized by:** for Michelle Hoke

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 607-756-6699

Applicant:	Wiley Electronics, LLC	**Manufacturer:**	Wiley Electronics, LLC
Address:	PO Box 361 Saugerties, NY 12477	**Address:**	PO Box 361 Saugerties, NY 12477
Country:	USA	**Country:**	USA
Contact:	Mr. Brian Wiley	**Contact:**	Mr. Brian Wiley
Phone:	845-247-3852	**Phone:**	845-247-3852
FAX:	845-839-2792	**FAX:**	845-839-2792
Email:		**Email:**	

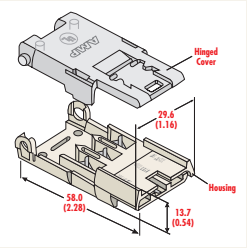
Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Cortland, NY

Standard(s):	UL Standard for Safety for Grounding and Bonding Equipment, UL 467, 9th Edition and Grounding and Bonding Equipment, CSA C22.2 #41, 5th Edition, September 2007
Product :	Bonding Devices
Models:	Bonding Devices Model numbers WEEB-9.5, WEEB-9.5NL, WEEB-CL, WEEBL-6.7, WEEBL-8.2, WEEBL-8.0, WEEB-DMC, WEEB-PMC, WEEB-CMC, WEEB-SMC, WEEB-Bonding Jumper-6.7, WEEB-Bonding Jumper-8.0, WEEB-Bonding Jumper-8.2, WEEB-KMC, WEEB-UGC2, WEEB-UMC, WEEB-DPF, WEEB-11.5, WEEBWMC, WEEB-CSG and Double Wedge Solar Giant.

NM Splice & Tap

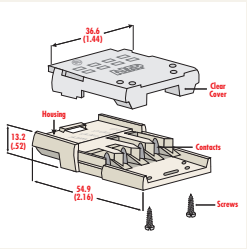
NON-METALLIC CABLE SPLICES AND TAPS

NMS-2 (SPLICE)



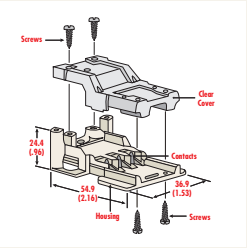
For splicing 12 or 14 awg solid conductor, 2-conductor cable with ground. Hinged cover makes termination fast and easy. The NMS-2 kit includes everything required to make a two conductor splice.

NMS-3 (SPLICE)



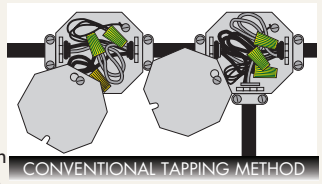
For splicing 12 or 14 awg solid conductor, 3-conductor cable with ground. The NMS-3 kit includes everything required to make a three conductor splice.

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.

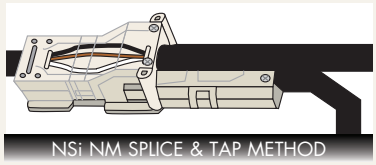
ELIMINATE COSTLY AND TIME-CONSUMING JUNCTION BOXES


CONVENTIONAL TAPPING METHOD

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.

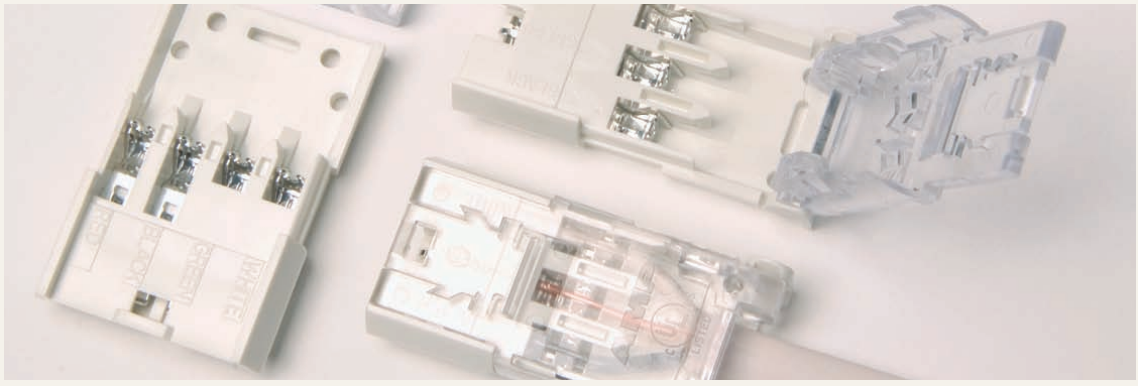
In factory installations within pre-fabricated structures, the NM connectors eliminate costly time-consuming on-site wiring. As individual modules are joined, splices and taps are simply snapped together easily by assembly crews with no special training or tools.

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.


NSi NM SPLICE & TAP METHOD

NON-METALLIC CABLE SPLICES AND TAPS

CATALOG NO.	UPC CODE	WIRE RANGE	KIT DESCRIPTION	CARTON QUANTITY
NMS-2	00320	12 – 14 AWG	splice for 2-conductor cable with ground	25
NMS-3	00321	12 – 14 AWG	splice for 3-conductor cable with ground	25
NMT-2	00322	12 – 14 AWG	splice and tap kit for 2-conductor cable	12



Intertek

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Applicant:	WILEY ELECTRONICS, LLC	**Manufacturer:**	WILEY ELECTRONICS, LLC
Address:	P.O. Box 361 SAUGERTIES, NY 12477	**Address:**	44 Peoples Road Saugerties, NY 12477
Country:	USA	**Country:**	USA
Contact:	Mr. Brian Wiley	**Contact:**	Mr. Brian Wiley
Phone:	(845) 247-2875	**Phone:**	(845) 247-2875
FAX:	(845) 246-0189	**FAX:**	(845) 246-0189
Email:	btw@we-llc.com	**Email:**	btw@we-llc.com

Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Cortland, NY

Control Number: 3098177 **Authorized by:** for William T. Starr, Certification Manager

c ETL LISTED US
Intertek

This document supersedes all previous Authorizations to Mark for the noted Report Number.

This Authorization to Mark is for the exclusive use of Intertek's Client and is provided pursuant to the Certification agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this Authorization to Mark. Only the Client is authorized to permit copying or distribution of this Authorization to Mark and then only in its entirety. Use of Intertek's Certification mark is restricted to the conditions laid out in the agreement and in this Authorization to Mark. Any further use of the Intertek name for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. Initial Factory Assessments and Follow up Services are for the purpose of assuring appropriate usage of the Certification mark in accordance with the agreement, they are not for the purposes of production quality control and do not relieve the Client of their obligations in this respect.

Intertek Testing Services NA Inc.
165 Main Street, Cortland, NY 13045
Telephone 800-345-3851 or 607-753-6711 Fax 607-756-6699

Standard(s):	UL Standard for Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources, UL 1741. First Edition, May 7th 1999, Including Revisions through November 7, 2005.). 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
Models:	ACE-PT, ACE-1P, ACE-2P, ACE-3P, ACE- 4P, ACE-2C, ACE-3C,AND ACE-4C

ATM for Report 3145135CRT-002 Page 1 of 1 ATM Issued: 23-Aug-2010
ED 8.9.4 (8-Jan-10) Mandatory

Specifications

Maximum Input Voltage	**600V DC**
Maximum Input Current	**64A DC Continuous**
Maximum Input Short Circuit Current	**51A DC**
Input Wire Diameter Range	**5.0 - 6.8mm [0.20 - 0.27in] #10-12AWG USE-2/PV Wire**
Maximum number of input conductor slots	**9**
Maximum number of PV strings	**4**
Maximum number of combined strings	**4**
Equipment Ground Conductor Diameter range	**4.0 - 6.8mm [0.16 - 0.27in]**
Acceptable Conduit sizes	**19.05mm, 25.4mm [0.75in, 1.0in]**
Internal Volume	**1840cm^3 [112in^3]**
Knockouts	**Side and Bottom, 3/4" and 1"**
Minimum Fuse Holder Tightening Torque	**2.5 N-m [22 in-lb] for #18-8 AWG wires**
Minimum Combiner Bus Tightening Torque	**4.0 N-m [35 in-lb] for #14-6 AWG wires**
Minimum Terminal Block Tightening Torque	**2.0 N-m [18 in-lb] for #14-6 AWG wires**
Minimum Grounding Terminal Tightening Torque	**3.0 N-m [26 in-lb] for #10-6 AWG wires**
Fuse Holder Wire Strip Length	**12mm [0.47in]**
Combiner Bus Terminal Wire Strip Length	**12mm [0.47in]**
Terminal Block Wire Strip Length	**10mm [0.39in]**
Grounding Terminal Wire Strip Length	**14mm [0.55in]**
Fuse Type	**Midget 10 X 38mm, 600V DC**

Table 3: Specifications

TECHNICAL & CONSUMER INFORMATION

Specifications
EM5000is
Dimensions

Model (Type)	EM5000is
Power product description code	EAJJ
Length [Handle in up position]	31.9 in (810 mm) [45.5 in (1,155 mm)]
Width	26.4 in (670 mm)
Height [Handle in up position]	27.2 in (690 mm) [28.0 in (710 mm)]
Dry weight*	209 lbs (95 kg)

* Without battery

Engine

Model	GX340K1
Engine Type	4-stroke, overhead valve, single cylinder
Displacement	20.6 cu-in (337 cm^3)
Bore x Stroke	3.2 × 2.5 in (82 × 64 mm)
Compression Ratio	8.0:1
Engine Speed	2,400−3,600 rpm〈EcoThrottle™ 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

ITEM	SPECIFICATION	MAINTENANCE
Spark plug gap	0.028−0.031 in (0.70−0.80 mm)	Refer to page: 51
Valve clearance(cold)	IN: 0.15±0.02 mm EX: 0.20±0.02 mm	See your authorized Honda dealer
Other specifications	No other adjustments needed.	

Specifications may vary according to the types, and are subject to change without notice.

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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:
   1. Ratio of Loose Compost to Topsoil by Volume: 1:4.
   2. Ratio of Loose Wood Derivatives to Topsoil by Volume: 1:4.

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