MOUR GROUP
ENGINEERING + DESIGN

6593 Riverdale St.
San Diego, CA 92120
619-727-4800

Structural Calculations
for
CBISC-04 Series

Prepared for:

PROVENT / RRS

3847 Wabash Drive
Mira Loma, CA 91725

Date: April 22, 2020

Project Number: PV1805

For wood, concrete and steel attachment see Roof Anchorage Detail, Form No. CB-60.

Welded Isolation springs housingare standard. For bolted spring housing, neoprene pads and spring cups see Weldment and Bolting Detail, Form No. CB-61

FEATURES

- Roof curbs sides and ends are 12 ga.
- Fully welded construction.
- Gasketing package provided.
- Heat treated wood nailer provided.
- insulated deck pans provided.
- Pitched curbs and taller curbs are available.

NOTES

- Attach ductwork to roof curb. Flanges of duct rest on top of the curb, Support ductwork below the curb.
- Thru the curb utillities are available. Contact you York distributor or Provent directly.

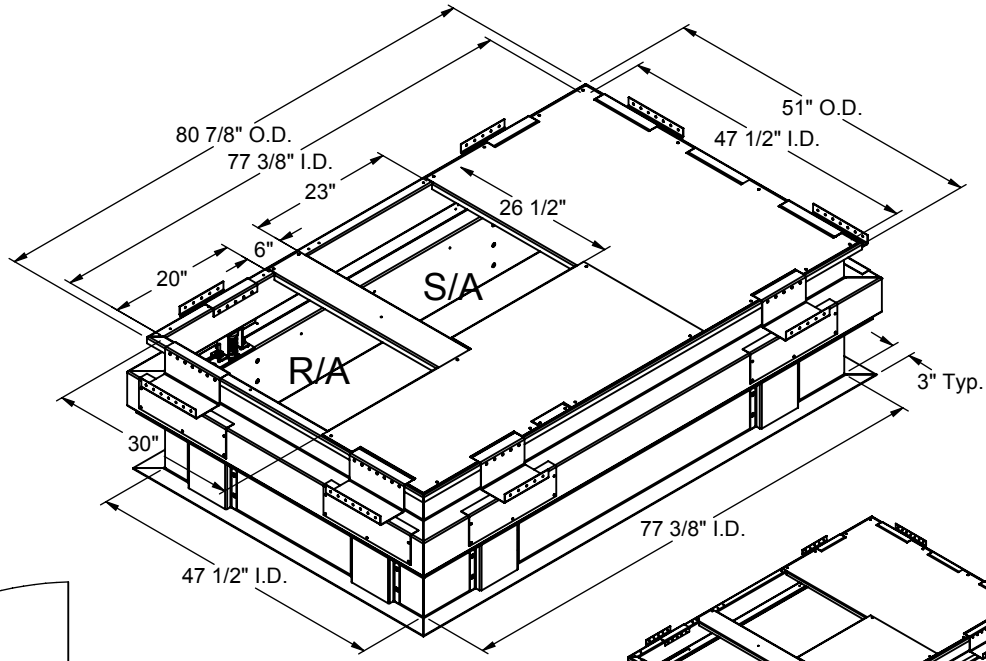
VIBRATION ISOLATION ROOF CURBS
YORK UNITS

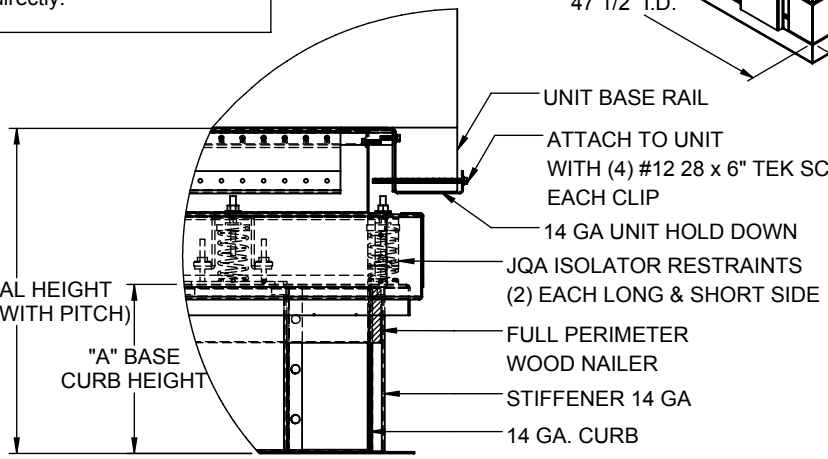
ZT, ZH, ZJ, ZR 037, 049, 061
ZF, ZH, ZJ, ZR, XP 078-150

PROVENT P/N	A	B	EST. WEIGHT
CBISCPRD371518**	8"	18"	325 Lbs
CBISCPRD371521**	11"	21"	347 Lbs
CBISCPRD371524**	14"	24"	370 Lbs

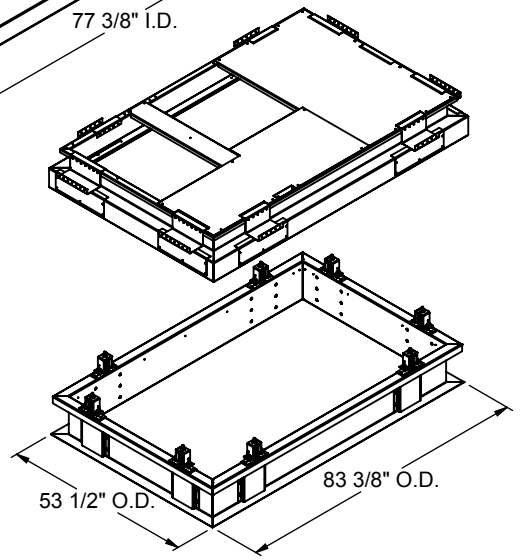
**Note: Spring configuration must be added to part number at time of order

Meets seismic requirements for the following codes:
CBC 2016
IBC 2015





PROFILE DETAIL



ProVent

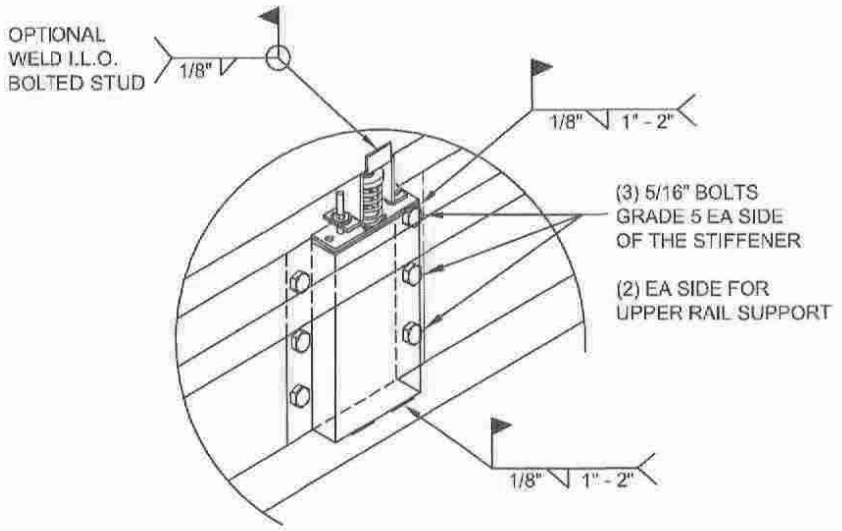
3847 WABASH DRIVE
MIRA LOMA, CA 91752

PHONE (951) 685-1101
FAX (619) 872-9799

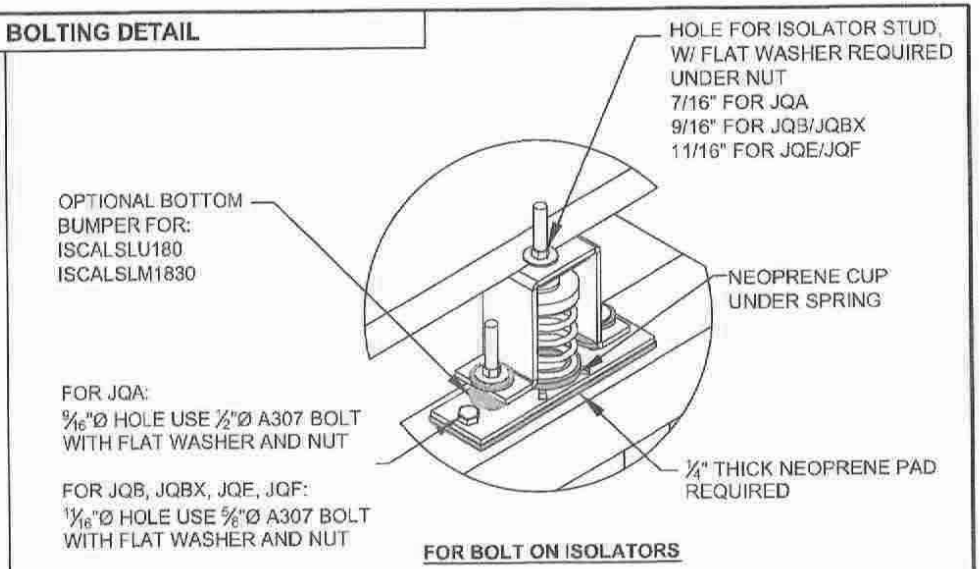
SUBMITED TO:
COMPANY:
JOB NAME:
EQUIPMENT:
NOTES:

FORM NO:	PART NUMBER:	
CBISC-04	-	
DATE:	**REV:**	**DRAWN BY:**
9/27/2018	2	ALL

WELDMENT AND BOLTING DETAIL



BASE CURB SUPPORT



FOR BOLT ON ISOLATORS

ProVent

3847 WABASH DRIVE
MIRA LOMA, CA 91725

PHONE (951) 685-1101
FAX (619) 872-9799

SUBMITTED TO:
COMPANY:
JOB NAME:
EQUIPMENT:
NOTES:

FORM NO:		
CB-61		
DATE:	**REV:**	**DRAWN BY:**
02/08/18	1	ALL

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6593 Riverdale St.
San Diego, CA 92120
(619)727-4800

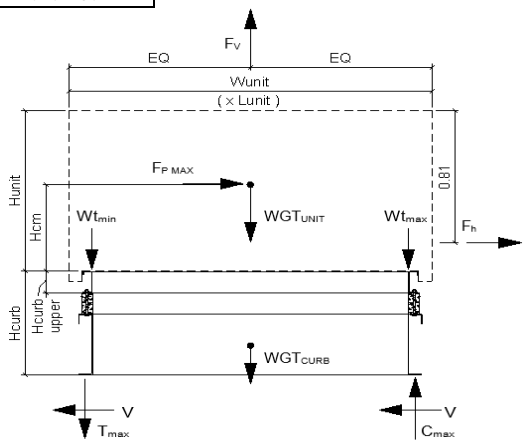
Client: ProVent PV1805
Project: CBISC-04 Iso Curb (CBISCPRD3715**Upper curb rail
Unit: ZT,ZR,ZJ 037-150; ZF,ZH,ZJ,ZR,XP,DH,DM,DF,DR,BP 078-150

Curb Information

Hcurb upper =	5.5	in	(Height of upper curb rail)
Lcurb =	80.375	in	(Length of curb)
wcurb =	50.5	in	(Width of curb)
WGTcurb =	370	lbs	(Weight of curb)
# Clips long side =	2	# Clips short side =	2

Unit Information

WGTunit =	1700	lbs	(Weight of Unit)
Wtmax =	329	lbs	(Maximum corner weight)
Wtmin =	191	lbs	(Minimum corner weight)
Hunit =	50.75	in	(Height of unit above curb)
Hcm =	25.375	in	(Height to center of mass)
Lunit =	89	in	(Length of unit)
Wunit =	59	in	(Width of unit)



Seismic Loading - 2015 IBC/2016 CBC

Ss =	2.850		(Worst case for majority of CA - Design Category D)
Fa =	1.000		(Interpolated from Table 11.4-1 ASCE 7-10)
Sms =	2.850		(Fa*Ss)
Sds =	1.900		(2/3*Sms)
Ip =	1.25		(Importance Factor Category III Building)
Fpmax =	3.800	Wp	(1.6*Sds*Ip)*Wp
FpmaxASD =	4522	lbs	(0.7*Fpmax) FpmaxASD = 5506 lbs
	(unit only)		(unit and curb)

Wind Loading - 2015 IBC/2016 CBC

*** Exposure Category C ***

Kz =	1.13		(For 60 ft roof height, Exposure C - Table 29.3-1 ACSE 7-10)
Kzt =	1.0		(No topographic effects assumed for rooftop mounted units)
Kd =	0.85		(Directionality factor Table 26.6-1 ASCE 7-10)
V =	115		(Max wind velocity, mph for Cat III & IV bldgs Exp. Cat C)
$GCr_{(horiz)}$ =	1.9		(Refer Sect 29.5.1 ASCE 7-10)
$GCr_{(vert)}$ =	1.5		(Refer Sect 29.5.1 ASCE 7-10)
qz	32.5	psf	= 0.00256*Kz*Kzt*Kd*V^2 (Eq. 29.3-1 ASCE 7-10)
$F_{h\ ASD\ trans}$ =	1289	lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb upper) (Eq. 29.5-2)
$F_{h\ ASD\ long}$ =	854	lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hcurb upper)
$F_{vert\ ASD}$ =	1067	lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.5-3)

Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	3105	lbs	=[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb
$Tension_{SEISMIC}$ =	2537	lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	509	lbs	=[$F_{h\ transASD}$*Hcm+2*0.6*Wtmax*wcurb-$F_{vertASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	556	lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

---> Negative values indicate Compression load rather than Tension.

Longitudinal:

$Compression_{SEISMIC}$ =	2261	lbs	=[FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb]/Lcurb
$Tension_{SEISMIC}$ =	1693	lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	131	lbs	=[$F_{h\ transASD}$*Hcm+2*0.6*Wtmax*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	178	lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

---> Negative values indicate Compression load rather than Tension.

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	3105	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	2537	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	2261	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	1693	lbs	---> Along short edge of curb.

---> Negative values indicate Compression load rather than Tension.

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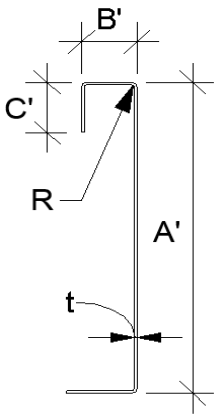
Curb Design

Fy = 50 ksi Fu = 65 ksi t = 0.0713 [14 Gauge]
E = 29500 ksi



Calculate Section Properties of Curb

A'=	[5.500] in		a =	5.144 in	= A'-(2r+t)
B'=	[1.500] in		a'=	5.429 in	= A'-t
C'=	[0.000] in	(0 if no lips)	b =	1.322 in	= B'-[r+t/2+α(r+t/2)]
α =	[0.000]	(0 - no Lip; 1 w/ lip)	b'=	1.464 in	= B'-(t/2+αt/2)
R =	0.1069 in	(Inside bend radius)	c =	0.000 in	= α[C'-(r+t/2)]
t =	0.0713 in		c'=	0.000 in	= α(C'-t/2)
r'=	0.143 in	= R+t/2	u =	0.224 in	= πr/2
x =	0.261 in	(Distance between centroid and web centerline)			
Ix =	2.424 in	(Moment of Inertia about X-Axis)			
Iy =	0.109 in	(Moment of Inertia about Y-Axis)			
A =	0.59 in^2				
rx =	2.03 in				
ry =	0.432 in				
rmin =	0.432 in				

Axial Compression

Pu = 2.261 k (Max Axial Comp) Ω_c = 1.80
Pn/Ωc = 4.894 k
Fe = 17.11 ksi
λc = 1.71
Fn = 15.00 ksi
Ly = 70.38 in Lateral unbraced length
k_yL_y/r_y = 130 (assume k=0.8)

$$\frac{P_n}{\Omega_c} = \frac{F_nA}{\Omega_c} \qquad If\ \lambda_c \le 1.5;\ F_n = \left(0.658^{\lambda_c{}^2}\right)F_y \qquad If\ \lambda_c > 1.5;\ F_n = \frac{0.877}{\lambda_c{}^2}F_y$$

$$\lambda_c = \sqrt{\frac{F_y}{F_e}} \qquad F_e = \frac{\pi^2E}{\left(kl/r\right)^2}$$

Compression Check = **O.K.**

Check Web Crippling

h =	5.5 in	-- Check limits:		C = 7.50	(See table C3.4.1-2, fastened to support, two flange, end loading)
t =	0.0713 in	h/t =	77.14 ≤ 200	C_R = 0.08	
N =	7.00	N/t =	98.18 ≤ 210	C_N = 0.12	
Ω_w =	1.75	N/h =	1.273 ≤ 2.0	C_h = 0.048	
P_n =	1.947 k	R/t =	1.50 ≤ 12.0		
P_n/Ω_w =	1.112 k				

$$P_n = Ct^2F_y\sin(90)\left(1 - C_R\sqrt{\frac{R}{t}}\right)\left(1 + C_N\sqrt{\frac{N}{t}}\right)\left(1 - C_h\sqrt{\frac{h}{t}}\right)$$

Long side: Pu_{Trans} = 1.553 k **web stiffener REQ'D** # clips = 2
Short side: Pu_{Long} = 1.130 k **web stiffener REQ'D** # clips = 2

Check Web Stiffener

16Ga x 3/4in x 7in (C-channel)

width of stiffener = 7.000 in ts = 0.0566 [16 Gauge]
web of stiff. w = 6.717 in Rs = 0.0849 in
***Check w/ts ≤ 1.28√E/Fys Ω_c = 1.70
w/ts = 118.675
1.28√(E/Fys) = 31.091 --> w/ts over limit Use C3.7.2

$$P_n = 0.7\left(P_{wc} + A_eF_y\right) \ge P_{wc}$$

Pwc = 1.947 k Ae = 0.380 in^2
Pn = 14.669 k
Pn/Ω_c = 8.629 k **O.K.**

Corner Connections

1/4" φ SAE Grade 8 bolts w/ 1/4-20-UNC Threaded inserts

Tcrnmax = 1131 lbs Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax = 1269 lbs (Max Ten/2 corner connections per side)

Bolt:	Tall = [2480] lbs		Vall = [1096] lbs	
Threaded Insert:	Tall = [2860] lbs		Vall = [1714] lbs	
# of Bolts required for Tension =	0.5			
# of Bolts required for Shear =	1.2	***If combined fails:		
# of Bolts Used =	[2.0]		USE --> 3.0	

Check Combined Stress in Bolts & Inserts: 0.807 O.K. StressComb = 0.538 **O.K.**

Check 1/8" welded connection

<--- USE WELD Ω = 2.35
Assume L/t > 25: 25*t = 1.783 in
Lreq'd = 0.858 in

$$P_n/\Omega = \frac{1}{\Omega}0.75tLF_u \ge V_{req} \qquad L_{req'd} = \frac{V_{req}\Omega}{0.75tF_u}$$

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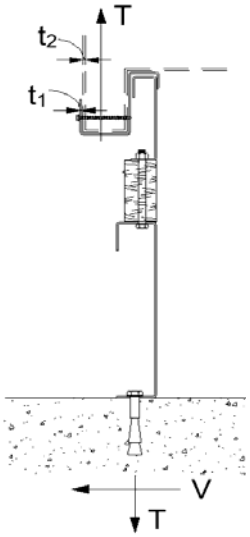
Connection Unit to Curb Clip | #12 SMS screw | Ω = 3.0

t1 = 0.0713 in (clip thickness) | Fu1 = 65 ksi

t2 = 0.0713 in (unit base rail thickness) | Fu2 = 65 ksi

d = 0.216 in (screw diameter) | dw = 0.375 in (nom. washer diameter)

t2/t1 = 1.0



For t2/t1 ≤ 1.0: | Pns = 2416 # | For t2/t1 ≥ 2.5: | Pns = 2703 #

Shear: $P_{ns} = 4.2F_{u2}\sqrt{t_2^3 d}$ 2.42 k

$P_{ns} = 2.7t_1 dF_{u1}$ 2.70 k | $P_{ns} = 2.7t_1 dF_{u1}$ 2.70 k

$P_{ns} = 2.7t_2 dF_{u2}$ 2.70 k | $P_{ns} = 2.7t_2 dF_{u2}$ 2.70 k

Pns/Ω = 805 # <- Controls

Pss/Ω = 840 #

Tension: Pnot = 0.851 k (screw pull-out strength)

$P_{not} = 0.85t_c dF_{u2})$

$t_c = \min(t_1, t_2)$

Pnov = 2.607 k (screw pull-over strength)

$P_{nov} = 1.5t_1 d_w F_{u1}$

Pts/Ω = 284 # <- Controls

Pts/Ω = 845 # (full tensile screw capacity)

	Shear (k)	# clips	V_{clip} (k)	V_{allow}(lb)	# screws	spacing
Long side:	4.522	2	2.26	805 #	4	2.00 in
Short side:	4.522	2	2.26	805 #	4	2.00 in

clip width (in) = 7.00 | clip height = 2.5 in

min spacing = 0.65 in | edge distance = 0.5 in (min. 1.5d)

Check Block shear rupture: O.K. | thinnest part = 0.0713 AISI BSR applies

Fy = 50 ksi | Ω = 2.22 bolt/screw connection

Agv = 0.463 in^2 | Anv = 0.410 in^2 | Ant = 0.081 in^2

Rn/Ω = 8.647 k $R_n = 0.6F_y A_{gv} + F_u A_{nt} \leq 0.6F_u A_{nv} + F_u A_{nt}$

BSR O.K. (AISI Sect. E5.3)

Curb Loads (copied from above)

Transverse: (on long edge)	$Comp_{MAX}$ =	3105	lbs
	$Tens_{MAX}$ =	2537	lbs
	$Shear_{MAX}$ =	2261	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	2261	lbs
	$Tens_{MAX}$ =	1693	lbs
	$Shear_{MAX}$ =	2261	lbs

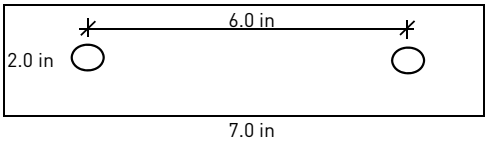
Loads at each Isolator Type: **JQA**

Transverse loading: (on long edge)	$Comp_{MAX}$ =	1552.6	lbs
	$Tens_{MAX}$ =	1268.7	lbs
# isolators: 2	$Shear_{MAX}$ =	565.3	lbs
Longitudinal loading: (on short edge)	$Comp_{MAX}$ =	1130.3	lbs
	$Tens_{MAX}$ =	846.4	lbs
# isolators: 2	$Shear_{MAX}$ =	565.3	lbs

Max compression force on isolator: 1.553 k ⩽ 1.660 k **O.K.**

Max uplift on isolator: 1.269 k ⩽ 1.660 k **O.K.**

Max shear on isolator: 0.565 k ⩽ 0.800 k **O.K.**



Forces on top bolt:

d_b = 0.375 in

upper rail, t = 0.0713 in

Tension = 1.269 k

Shear = 0.565 k

Shear on curb rail: $P_n = teF_u$ Ω = 2.00 (Appendix A, Section E3.1 AISI)

Pn/Ω = 4.635 k e = 1.0 in

Shear O.K.

Net section rupture: $P_n = A_n F_t$ Ω = 2.22 (Appendix A, Section E3.2 AISI)

Pn/Ω = 4.989 k An = 0.116 in

N.S.R. O.K. $F_t = (0.1 + 3d/s)F_u \leq F_u =$ 43.063 ksi

Bolt Bearing Strength: $P_n = Cm_f dtF_u$ Ω = 2.50 (Section E3.3.1 AISI)

Pn/Ω = 2.086 k d/t = 5.26

Bearing O.K. C = 3.00 mf = 1.00

Shear and tension in bolt: (Appendix A, Section E3.4 AISI)

Tension $P_{nt} = A_b F_{nt}$ Fnt = 40.5 ksi A_b = 0.1104 in^2

Pnt/Ω = 1.988 k **Bolt tension O.K.** Ωt = 2.25 (Table E3.4-1, AISI)

Shear $P_{nv} = A_b F_{nv}$ Fnv = 24.0 ksi Ωv = 2.40 (Table E3.4-1, AISI)

Pnv/Ω = 1.104 k **Bolt shear O.K.**

$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \leq F_{nt}$ fv = 5.12 ksi O.K.

Combined Not Applicable F'nt = 31.92 ksi Fnv/Ω = 10.00 ksi

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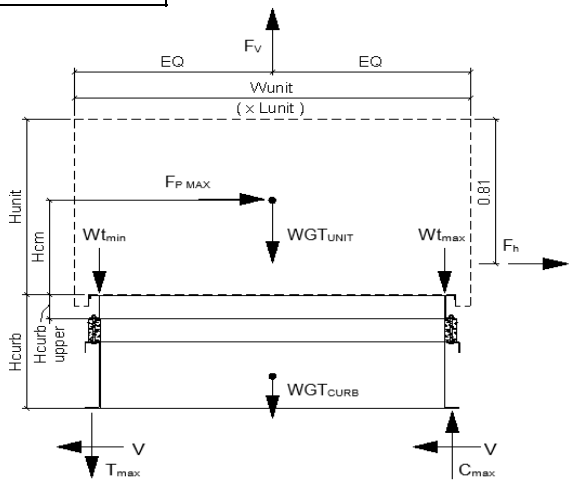
Client: ProVent PV1805
Project: CBISC-04 Iso Curb (CBISCPRD3715**) Base curb
Unit: ZT,ZR,ZJ 037-150; ZF,ZH,ZJ,ZR,XP,DH,DM,DF,DR,BP 078-150

Curb Information

Hcurb =	25	in	(Height of curb)
Lcurb =	83.375	in	(Length of curb)
wcurb =	53.5	in	(Width of curb)
WGTcurb =	370	lbs	(Weight of curb)
# Clips long side =	2		# Clips short side = 2

Unit Information

WGTunit =	1700	lbs	(Weight of Unit)
Wtmax =	329	lbs	(Maximum corner weight)
Wtmin =	191	lbs	(Minimum corner weight)
Hunit =	50.75	in	(Height of unit above curb)
Hcm =	25.375	in	(Height to center of mass)
Lunit =	89	in	(Length of unit)
Wunit =	59	in	(Width of unit)



Seismic Loading - 2015 IBC/2016 CBC

Ss =	2.850		(Worst case for majority of CA - Design Category D)
Fa =	1.000		(Interpolated from Table 11.4-1 ASCE 7-10)
Sms =	2.850		(Fa*Ss)
Sds =	1.900		(2/3*Sms)
Ip =	1.25		(Importance Factor Category III Building)
Fpmax =	3.800	Wp	(1.6*Sds*Ip)*Wp
FpmaxASD =	4522	lbs	(0.7*Fpmax) FpmaxASD = 5506 lbs
	(unit only)		(unit and curb)

Wind Loading - 2015 IBC/2016 CBC

*** Exposure Category C ***

Kz =	1.13		(For 60 ft roof height, Exposure C - Table 29.3-1 ACSE 7-10)
Kzt =	1.0		(No topographic effects assumed for rooftop mounted units)
Kd =	0.85		(Directionality factor Table 26.6-1 ASCE 7-10)
V =	115		(Max wind velocity, mph for Cat III & IV bldgs Exp. Cat C)
$GCr_{(horiz)}$ =	1.9		(Refer Sect 29.5.1 ASCE 7-10)
$GCr_{(vert)}$ =	1.5		(Refer Sect 29.5.1 ASCE 7-10)
qz	32.5	psf	$= 0.00256*Kz*Kzt*Kd*V^2$ (Eq. 29.3-1 ASCE 7-10)
$F_{h\ ASD\ trans}$ =	1736	lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb) (Eq. 29.5-2)
$F_{h\ ASD\ long}$ =	1151	lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hcurb)
$F_{vert\ ASD}$ =	1067	lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.5-3)

Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	2978	lbs	=[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb
$Tension_{SEISMIC}$ =	2410	lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	684	lbs	=[$F_{h\ transASD}$*Hcm+2*0.6*Wtmax*wcurb-$F_{vertASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	732	lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

---> Negative values indicate Compression load rather than Tension.

Longitudinal:

$Compression_{SEISMIC}$ =	2209	lbs	=[FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb]/Lcurb
$Tension_{SEISMIC}$ =	1641	lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	211	lbs	=[$F_{h\ transASD}$*Hcm+2*0.6*Wtmax*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	259	lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

---> Negative values indicate Compression load rather than Tension.

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	2978	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	2410	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	2209	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	1641	lbs	---> Along short edge of curb.

---> Negative values indicate Compression load rather than Tension.

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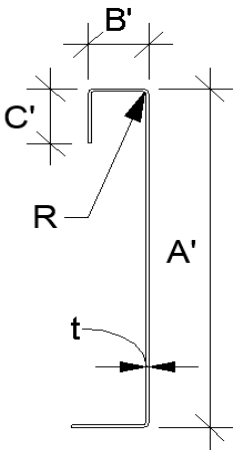
Curb Design

Fy = 50 ksi Fu = 65 ksi t = 0.0713 [14 Gauge]
E = 29500 ksi



Calculate Section Properties of Curb

A'=	[25.000] in	a =	24.644	in	= A'-(2r+t)
B'=	[1.750] in	a'=	24.929	in	= A'-t
C'=	[0.000] in (0 if no lips)	b =	1.572	in	= B'-[r+t/2+α(r+t/2)]
α =	[0.000] (0 - no Lip; 1 w/ lip)	b'=	1.714	in	= B'-(t/2+αt/2)
R =	0.1069 (Inside bend radius)	c =	0.000	in	= α[C'-(r+t/2)]
t =	0.0713 in	c'=	0.000	in	= α(C'-t/2)
r'=	0.143 in = R+t/2	u =	0.224	in	= πr/2

x = 0.104 in (Distance between centroid and web centerline)
Ix = 128.737 in (Moment of Inertia about X-Axis)
Iy = 0.218 in (Moment of Inertia about Y-Axis)
A = 2.01 in^2
rx = 8.00 in
ry = 0.329 in
rmin = 0.329 in

Axial Compression

Pu = 2.261 k (Max Axial Comp) Ω_c = 1.80
Pn/Ωc = 8.960 k
Fe = 9.14 ksi
λc = 2.34
Fn = 8.01 ksi
Ly = 73.38 in Lateral unbraced length
k_yL_y/r_y = 179 (assume k=0.8)

$$\frac{P_n}{\Omega_c}=\frac{F_nA}{\Omega_c} \qquad If\ \lambda_c \le 1.5;\ F_n=\left(0.658^{\lambda_c{}^2}\right)F_y \qquad If\ \lambda_c > 1.5;\ F_n=\frac{0.877}{\lambda_c{}^2}F_y$$

$$\lambda_c=\sqrt{\frac{F_y}{F_e}} \qquad F_e=\frac{\pi^2E}{\left(kl/r\right)^2}$$

Compression Check = O.K.

Check Web Crippling

h = 25 in -- Check limits: C = 4.00
t = 0.0713 in h/t = 350.63 ≤ 200 C_R = 0.14
N = 7.00 N/t = 98.18 ≤ 210 C_N = 0.35
Ω_w = 1.75 N/h = 0.28 ≤ 2.0 C_h = 0.02
P_n = 2.105 k R/t = 1.50 ≤ 9.0
P_n/Ω_w = 1.203 k
Long side: Pu_{Trans} = 1.489 k **web stiffener REQ'D** # clips = 2
Short side: Pu_{Long} = 1.105 k **O.K.** # clips = 2

(See table C3.4.1-2, fastened to support, one flange, end loading)

$$P_n = Ct^2F_y\sin(90)\left(1-C_R\sqrt{\frac{R}{t}}\right)\left(1+C_N\sqrt{\frac{N}{t}}\right)\left(1-C_h\sqrt{\frac{h}{t}}\right)$$

*****h/t > 200; use web stiffeners**

Check Web Stiffener

16Ga x 1.5in x 7in (C-channel)

width of stiffener = 7.000 in ts = 0.0566 [16 Gauge]
web of stiff. w = 6.717 in Rs = 0.0849 in
***Check w/ts ≤ 1.28√E/Fys Ω_c = 1.70
w/ts = 118.675
1.28√(E/Fys) = 31.091 --> w/ts over limit Use C3.7.2

$$P_n = 0.7\left(P_{wc}+A_eF_y\right) \ge P_{wc}$$

Pwc = 2.105 k Ae = 0.380 in^2
Pn = 14.780 k
Pn/Ω_c = 8.694 k **O.K.**

Corner Connections

1/4" φ SAE Grade 8 bolts w/ 1/4-20-UNC Threaded inserts

Tcrnmax = 1131 lbs Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax = 1205 lbs (Max Ten/2 corner connections per side)

Bolt:	Tall =	[2480] lbs	Vall =	[1096] lbs
Threaded Insert:	Tall =	[2860] lbs	Vall =	[1714] lbs

# of Bolts required for Tension = 0.5
# of Bolts required for Shear = 1.1 ***If combined fails:
# of Bolts Used = [2.0] USE --> 4.0

Check Combined Stress in Bolts & Inserts: 0.778 O.K. StressComb = 0.389 **O.K.**

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Check 1/8" welded connection <--- USE WELD Ω = 2.35

Assume L/t > 25: 25*t = 1.783 in
Lreq'd = 0.815 in

$$P_n/\Omega = \frac{1}{\Omega}0.75tLF_u \geq V_{req} \qquad L_{req'd} = \frac{V_{req}\Omega}{0.75tF_u}$$

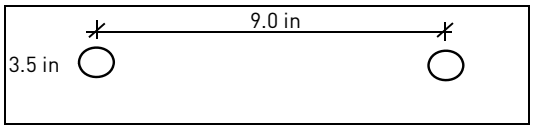
Curb Loads (copied from upper rail calcs)

Transverse: (on long edge)	$Comp_{MAX}$ =	3105	lbs
	$Tens_{MAX}$ =	2537	lbs
	$Shear_{MAX}$ =	2261	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	2261	lbs
	$Tens_{MAX}$ =	1693	lbs
	$Shear_{MAX}$ =	2261	lbs

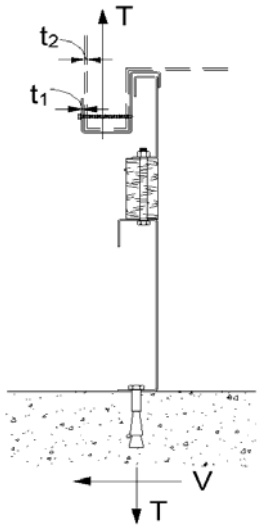
Loads at each Isolator Type: **JQBX**

Transverse loading: (on long edge) # isolators: 2	$Comp_{MAX}$ =	1552.6	lbs
	$Tens_{MAX}$ =	1268.7	lbs
	$Shear_{MAX}$ =	565.3	lbs
Longitudinal loading: (on short edge) # isolators: 2	$Comp_{MAX}$ =	1130.3	lbs
	$Tens_{MAX}$ =	846.4	lbs
	$Shear_{MAX}$ =	565.3	lbs

Max compression force on isolator: 1.553 k ⩽ 2.000 k **O.K.**
Max uplift on isolator: 1.269 k ⩽ 2.000 k **O.K.**
Max shear on isolator: 0.565 k ⩽ 1.500 k **O.K.**



10.5 in



Forces on bottom bolts:

d_b = 0.625 in
base curb, t = 0.0713 in
Tension = 0.634 k / bolt
Shear = 0.283 k / bolt

Shear on base curb: $P_n = teF_u$ Ω = 2.00 (Appendix A, Section E3.1 AISI)
Pn/Ω = 4.635 k e = 1.0 in
Shear O.K.

Net section rupture: $P_n = A_nF_t$ Ω = 2.22 (Appendix A, Section E3.2 AISI)
Pn/Ω = 6.372 k An = 0.098 in
N.S.R. O.K. $F_t = (0.1 + 3d/s)F_u \leq F_u$ = 65.000 ksi

Bolt Bearing Strength: $P_n = Cm_f dtF_u$ Ω = 2.50 (Section E3.3.1 AISI)
Pn/Ω = 3.476 k d/t = 8.77
Bearing O.K. C = 3.00 mf = 1.00

Shear and tension in bolt: (Appendix A, Section E3.4 AISI)

Tension $P_{nt} = A_bF_{nt}$ Fnt = 45.0 ksi A_b = 0.3068 in^2
Pnt/Ω = 6.136 k **Bolt tension O.K.** Ωt = 2.25

Shear $P_{nv} = A_bF_{nv}$ Fnv = 27.0 ksi Ωv = 2.40
Pnv/Ω = 3.451 k **Bolt shear O.K.** ***(Table E3.4-1, AISI)***

$$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}}f_v \leq F_{nt}$$

fv = 0.92 ksi O.K.
Combined Not Applicable F'nt = 45.0 ksi Fnv/Ω = 11.25 ksi

Connection of Curb to Supporting Structure

Roof Loading SEISMIC: (0.6-0.14SDS)D + 0.7E WIND: 0.6D + W

Transverse: $Uplift_{MAX}$ = 5804 lbs $Shear_{MAX}$ = 2753 lbs

$Compression_{SEISMIC}$ = 6495 lbs =[FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*wcurb]/wcurb
$Tension_{SEISMIC}$ = 5804 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)
$Compression_{WIND}$ = 1722 lbs =[$F_{h\ transASD}$*(Hcm+Hcurb)+0.6*($WGT_{unit+curb}$/2)*wcurb-$F_{vertASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ = 1547 lbs =[$F_{h\ transASD}$*(Hcm+Hcurb)-0.6*($WGT_{unit+curb}$/2)*wcurb+$F_{vertASD}$*wcurb/2]/wcurb

Longitudinal: $Uplift_{MAX}$ = 3946 lbs $Shear_{MAX}$ = 2753 lbs

$Compression_{SEISMIC}$ = 4637 lbs =[FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*Lcurb]/Lcurb
$Tension_{SEISMIC}$ = 3946 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)
$Compression_{WIND}$ = 783 lbs =[$F_{h\ transASD}$*(Hcm+Hcurb)+0.6*($WGT_{unit+curb}$/2)*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ = 608 lbs =[$F_{h\ transASD}$*(Hcm+Hcurb)-0.6*($WGT_{unit+curb}$/2)*Lcurb+$F_{vertASD}$*Lcurb/2]/Lcurb

Wood Attachment: **1/4" φ wood lag screws** **w/ 3.5" Min. Embed** (SGmin = 0.43)

Transverse:
$Tall_{metal}$ = 946.67 lbs $Vall_{metal}$ = 1043.33 lbs
$Tall_{wood}$ = 671.25 lbs $Vall_{wood}$ = 224 lbs

# of Screws Req'd for Uplift = 8.65
# of Screws Req'd for Shear = 12.29
Total # of screws required = 22

COMBINED LOADING: 0.952 O.K.
Req'd Min Spacing = 3.6 in o.c.

Use 22 - 1/4" φ wood lag screws @ 3.6 in o.c. along long side of curb w/ 3.5" Min. Embed

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Longitudinal:

# of Screws Req'd for Uplift =	5.88	COMBINED LOADING:	0.956 O.K.
# of Screws Req'd for Shear =	12.29	Screw Spacing =	2.5 in o.c.
Total # of screws required =	19		

Use 19 - 1/4" ϕ wood lag screws @ 2.5 in o.c. along short side of curb w/ 3.5" Min. Embed

Steel Deck Attachment: 1/2" φ A307 Bolts to steel angle below deck

	$Tall_{bolt}$ = 6903 lbs		$Vall_{bolt}$ = 3682 lbs
Transverse:	6903 lbs		3682 lbs
# of Bolts Req'd for Uplift =	0.84	COMBINED LOADING:	0.794 O.K.
# of Bolts Req'd for Shear =	0.75	Bolt Spacing =	71.4 in o.c.
Total # of bolts required =	2		

Use 2 - 1/2" ϕ A307 Bolts to steel angle below deck @ 71.4 in o.c. along long side of curb

Longitudinal:

# of Bolts Req'd for Uplift =	0.57	COMBINED LOADING:	0.660 O.K.
# of Bolts Req'd for Shear =	0.75	Bolt Spacing =	41.5 in o.c.
Total # of bolts required =	2		

Use 2 - 1/2" ϕ A307 Bolts to steel angle below deck @ 41.5 in o.c. along short side of curb

For Concrete anchorage: SEISMIC $(0.6-0.14SDS)D + 0.7\Omega_o E$ (Ω_o = 2.5)

Concrete Attachment: 3/4" φ thrd'd rods in Hilti Hit-HY 200 epoxy w/ 4" embed

$Tall_{LRFD}$ = 1919 lbs $Vall_{LRFD}$ = 3188 lbs $\propto = (1 + 0.2SDS)D + 2.5E$ =1.87

$Tall_{ASD} = Tall_{LRFD}/\alpha$ = 1026.2 lbs $Vall_{ASD} = Vall_{LRFD}/\alpha$ = 1704.8 lbs $(D = 0.465, E = 0.535)$

Transverse: $Uplift_{MAX}$ = 13580 lbs $Shear_{MAX}$ = 6883 lbs

$Compression_{SEISMIC}$ = 14272 lbs =[2.5*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*wcurb]/wcurb

$Tension_{SEISMIC}$ = 13580 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Shear_{SEISMIC}$ = 6883 lbs =2.5*FpmaxASD/2

Min Bolts Req'd Uplift = 13.23 spacing = 4.57 in o.c. Tapplied = 905.4 lbs

Min Bolts Req'd Shear = 4.04 spacing = 14.84375 in o.c. Vapplied = 458.9 lbs

Try using 15 bolts spaced at 5.10 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 1.15

Use 15 - 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy @ 5.1 in o.c. max. along long side of curb w/ 4" embed

Longitudinal: $Uplift_{MAX}$ = 8936 lbs $Shear_{MAX}$ = 6883 lbs

$Compression_{SEISMIC}$ = 9627 lbs =[2.5*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*Lcurb]/Lcurb

$Tension_{SEISMIC}$ = 8936 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Shear_{SEISMIC}$ = 6883 lbs =2.5*FpmaxASD/2

Min Bolts Req'd Uplift = 8.71 spacing = 3.6875 in o.c. Tapplied = 812.4 lbs

Min Bolts Req'd Shear = 4.04 spacing = 7.375 in o.c. Vapplied = 625.7 lbs

Try using 11 bolts spaced at 4.15 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 1.16

Use 11 - 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy @ 4.2 in o.c. max. along short side of curb w/ 4" embed

CURB DESIGN SUMMARY: CBISC-04 (CBISCPRD37 Unit: ZT,ZR,ZJ 037-150; ZF,ZH,ZJ,ZR,XP,DH,DM,DF,DR,BP 078-150

UPPER CURB RAIL THICKNESS:	0.0713 in 14 Gauge
UNIT CLIP THICKNESS:	0.0713 in 14 Gauge
# OF CLIPS (LONG SIDE) -	2 clips with 4 - #12 SMS screws each clip
WEB STIFFENER:	16Ga x 3/4in x 7in (C-channel) stiffener at each clip
# OF CLIPS (SHORT SIDE) -	2 clips with 4 - #12 SMS screws each clip
WEB STIFFENER:	16Ga x 3/4in x 7in (C-channel) stiffener at each clip
VIBRATION ISOLATOR TYPE:	JQBX Top stud diameter: 3/8
Anchor bolt diameter:	5/8 Anchor hole diamter: 11/16
BASE CURB THICKNESS:	0.0713 in 14 Gauge
WEB STIFFENER:	16Ga x 1.5in x 7in (C-channel) stiffener at each clip on base curb
CORNER CONNECTION:	Use minimum 4 - 1/4" ϕ SAE Grade 8 bolts w/ 1/4-20-UNC Threaded inserts

CURB ANCHORAGE	WOOD 1/4" ϕ wood lag screws w/ 3.5" Min. Embed (SGmin = 0.43)	STEEL 1/2" ϕ A307 Bolts to steel angle below deck	CONCRETE 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy w/ 4" embed
LONG DIRECTION	22 @ 3.59 in o.c.	2 @ 71.38 in o.c.	15 @ 5.1 in o.c.
SHORT DIRECTION	19 @ 2.53 in o.c.	2 @ 41.5 in o.c.	11 @ 4.15 in o.c.