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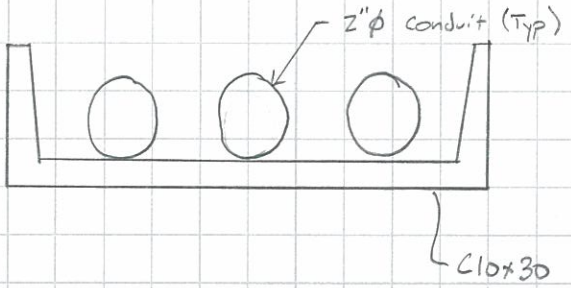
Date 9/20/11	Date 3-17-12	Date 3/19/12	

Conduit Support Design



Conduit support channel will be supported at floorbeam + lateral bracing locations. Design channel as simply supported between largest floorbeam or lateral brace spacing.

Section and Material Properties

C10x30

$A = 8.81\ in^2$ $\quad b_f = 3.03\ in$

$d = 10.0\ in$ $\quad t_f = 0.436\ in$

$t_w = 0.673\ in$

$I_x = 103\ in^4$ $\quad I_y = 3.93\ in^4$

$S_x = 20.7\ in^3$ $\quad S_y = 1.65\ in^3$

$r_x = 3.42\ in$ $\quad r_y = 0.668\ in$

$Z_x = 26.7\ in^3$ $\quad Z_y = 3.78\ in^3$

$J = 1.22\ in^4$

$C_w = 79.5\ in^6$

$h_o = 9.56\ in$

$F_y = 36\ ksi$

$F_u = 58\ ksi$

$E = 29000\ ksi$

Loads

Dead Load

$w_{self} = 0.030\ k/ft$

$w_{con} = 3(0.003\ k/ft) = 0.009\ k/ft$

$w_{DL} = 0.030\ k/ft + 0.009\ k/ft$

$= 0.039\ k/ft$

Ice

Assume 3 psf over surface area

$Area = 2(3.03\ in + 10\ in) = 26.06\ in$

$w_{ice} = (26.06\ in)\left(\frac{ft}{12\ in}\right)(0.003\ k/ft^2) = 0.007\ k/ft$

Treat ice load as a Dead Load

Factored Load

$w_u = 1.05\left[1.5\left(0.039\ k/ft + 0.007\ k/ft\right)\right]$ (Strength IV)

$= 0.072\ k/ft$

Design span length = 28'-7 3/16" (max floorbeam spa)

$= 28.6\ ft$

$M_u = \frac{w_u l^2}{8} = \frac{(0.072\ k/ft)(28.6ft)^2}{8} = 7.36\ k\text{-}ft$

$V_u = \frac{w_u \cdot l}{2} = \frac{(0.072\ k/ft)(28.6\ ft)}{2} = 1.03\ k$

Weak Axis Flexural Capacity of Channel

Ref: AASHTO 6.12.2.2.5 & 6.12.2.2.1

$\eta_f = \frac{b_f}{t_f} = \frac{3.03\ in}{0.436\ in} = 6.95$

$\eta_{pf} = 0.38\sqrt{\frac{E}{F_y}} = 0.38\sqrt{\frac{29000\ ksi}{50\ ksi}} = 9.15$

$\eta_f < \eta_{pf}$ $\therefore$ ok

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$\frac{D}{t_w} = \frac{10.0\ in}{0.673\ in} = 14.9$

$\eta_{pw} = 3.76\sqrt{\frac{E}{F_y}} = 3.76\sqrt{\frac{29000\ ksi}{36\ ksi}} = 106.7$

$\frac{D}{t_w} < \eta_{pw}$ ∴ ok

$M_n = M_p \le 1.6\, F_y \cdot S_y$

$M_p = F_y \cdot Z_y = (36\ ksi)(3.78\ in^2) = 136\ k\cdot in$
$= 11.3\ k\cdot ft$

$1.6\, F_y \cdot S_y = 1.6(36\ ksi)(1.65\ in^2) = 95\ k\cdot in$
$= 7.92\ k\cdot ft$ ←

$M_n = 7.92\ k\cdot ft$

$\phi_f = 1.0$

$\phi M_n = 7.92\ k\cdot ft$

$\phi M_n > M_u$ ∴ ok

Shear Capacity of Channel

Ref: AASHTO 6.12.1.2.3, 6.10.9.2

For weak-axis:

$D = b_f = 3.03\ in$

$t_w = 2 \cdot t_f = 2(0.436\ in) = 0.872\ in$

$V_p = 0.58 \cdot F_y \cdot D \cdot t_w = 0.58(36\ ksi)(3.03\ in)(0.872\ in)$
$= 55.2\ k$

$K = 5$ (unstiffened web)

$\frac{D}{t_w} = \frac{3.03\ in}{0.872\ in} = 3.47$

$1.12\sqrt{\frac{E \cdot k}{F_y}} = 1.12\sqrt{\frac{29000\ ksi\ (5)}{36\ ksi}} = 71.1$

$\frac{D}{t_w} < 1.12\sqrt{\frac{E \cdot k}{F_y}}$ ∴ $C = 1$

$V_n = C \cdot V_p = (1)(55.2\ k) = 55.2\ k$

$\phi_v = 1.00$

$\phi V_n = 55.2^k$

$\phi V_n > V_u$ ∴ ok

C10x30 will be acceptable

ME101-1204

STANDARD NOMINAL WEIGHTS AND DIMENSIONS

	PIPE					ELBOWS			COUPLINGS	
SIZE	UL MIN. WGT. PER 100 FOOT IN LBS. INCL. CP.	O.D.	I.D.	THICKNESS	THREADS PER INCH	WEIGHT PER 100 IN LBS.	RADIUS INCHES	OFFSET INCHES	WEIGHT PER 100 IN LBS.	COLOR CODE THREAD PROTECTOR
1/2"	79	.840	.632	.104	14	82	4.000	6.500	11.6	Black
3/4"	105	1.050	.836	.107	14	109	4.500	7.250	17.0	Red
1"	153	1.315	1.063	.126	11 1/2	201	5.750	8.750	30.0	Blue
1 1/4"	201	1.660	1.394	.133	11 1/2	313	7.250	10.500	37.0	Red
1 1/2"	249	1.900	1.624	.138	11 1/2	441	8.250	11.750	51.5	Black
2"	332	2.375	2.083	.146	11 1/2	707	9.500	13.500	67.1	Blue
2 1/2"	527	2.875	2.489	.193	8	1711	10.500	15.000	167.5	Black
3"	682	3.500	3.090	.205	8	1850	13.000	18.000	209.5	Blue
3 1/2"	831	4.000	3.570	.215	8	2979	15.000	20.500	340.0	Black
4"	972	4.500	4.050	.225	8	3528	16.000	22.000	383.9	Blue
5"	1314	5.563	5.073	.245	8	6575	24.000	31.000	446.2	Blue
6"	1745	6.625	6.093	.266	8	9645	30.000	37.500	728.2	Blue

http://www.westerntube.com/rigid_steel_conduit.htm

JS 6/19/12
CDG 6-19-12

HNTB

Aesthetic Lighting Circuits Supported by "C" Channel.

2" PVC Conduit	=	.73 lbs/ft	
2" RIC Conduit	=	.73 lbs/ft	
1½" RIC Conduit	=	.54 lbs/ft	
Ckt Z-1 (3 #4 AWG)	=	.153 lbs/ft	x3 = .459
Ckt Z-2 (3 #4 AWG)	=	.153 lbs/ft	x3 = .459
Ckt Z-3 (3 #2 AWG)	=	.233 lbs/ft	x3 = .699
Ckt Z-4 (3 #2 AWG)	=	.233 lbs/ft	x3 = .699
Ckt Z-5 (3 #8 AWG)	=	.062 lbs/ft	x3 = .186

4.5 #/ft

PVC Industrial Pipe: Schedule 40

Application:

Corrosion resistant pressure pipe, IPS sizes 1/8" through 24", for use at temperatures up to and including 140˚F. Pressure rating (120 psi to 810 psi) varies with schedule, pipe size, and temperature as stated in Harvel Plastics, Inc. engineering bulletin (Product Bulletin 112/401). Pipe is also suitable for PVC plastic drain, waste, and vent (DWV) applications. Generally resistant to most acids, bases, salts, aliphatic solutions, oxidants, and halogens. Chemical resistance data is available and should be referenced for proper material selection. Pipe exhibits excellent physical properties and flammability characteristics (independently tested flame and smoke characteristics-ULC). Typical applications include: chemical processing, plating, high purity applications, potable water systems, water and wastewater treatment, drainage, irrigation, agricultural, and other applications involving corrosive fluid transfer.

Scope:

This specification outlines minimum manufacturing requirements for Polyvinyl Chloride (PVC) Schedule 40 iron pipe size (IPS) pressure pipe. This pipe is intended for use in applications where the fluid conveyed does not exceed 140˚F. This pipe meets and or exceeds the industry standards and requirements as set forth by the American Society for Testing and Materials (ASTM D1785 & D2665) and the National Sanitation Foundation (NSF International STD 61 & Std 14).

PVC Materials:

The material used in the manufacture of the pipe shall be domestically produced rigid polyvinyl chloride (PVC) compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784, trade name designation H707 PVC. This compound shall be white or gray in color as specified, and shall be approved by NSF International for use with potable water (NSF Std 61).

Dimensions:

All sizes of PVC Schedule 40 pipe shall be manufactured in strict accordance to the requirements of ASTM D1785 for physical dimensions and tolerances. PVC Sch 40 pipe sizes 1¼" through 24" diameters shall also meet the requirements of ASTM D2665 Standard Specification for PVC plastic drain, waste and vent (DWV) pipe and shall be dual marked as such. Each production run of pipe manufactured in compliance to the standard, shall also meet or exceed the test requirements for materials, workmanship, burst pressure, flattening, and extrusion quality defined in ASTM D1785 and ASTM D2665 as applicable. All belled-end pipe shall have tapered sockets to create an interference-type fit, which meet or exceed the dimensional requirements and the minimum socket length for pressure-type sockets as defined in ASTM D2672. All PVC Schedule 40 pipe must also meet the requirements of NSF Standard 14 and CSA Standard B137.3 rigid PVC pipe for pressure applications, and shall bear the mark of these Listing agencies. This pipe shall have a flame spread rating of 0-25 when tested for surface burning characteristics in accordance with CAN/ULC-S102-2-M88 or equivalent.

Marking:

Product marking shall meet the requirements of ASTM D1785 and ASTM D2665 as applicable and shall include: the manufacturer's name (or the manufacturer's trademark when privately labeled); the nominal pipe size; the material designation code; the pipe schedule and pressure rating in psi for water @ 73˚F; the ASTM designation D1785; the ASTM designation D2665 (when dual marked); the independent laboratory's seal of approval for potable water usage; and the date and time of manufacture.

Sample Specification:

All PVC Schedule 40 pipe shall be manufactured from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM D1785 and D2665 (where applicable), consistently meeting and/or exceeding the Quality Assurance test requirements of these standards with regard to material, workmanship, burst pressure, flattening, and extrusion quality. The pipe shall be manufactured in the USA, using domestic materials, by an ISO 9001 certified manufacturer. Standard lengths of pipe sizes 6" and larger shall be beveled each end by the pipe manufacturer. All pipe shall be stored indoors after production at the manufacturing site until shipped from factory. This pipe shall carry the National Sanitation Foundation (NSF) seal of approval for potable water applications. All pipe shall be manufactured by HARVEL® PLASTICS, INC.

PVC Industrial Pipe: Schedule 40

Schedule 40 Dimensions

	Nom. Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nom. Wt./Ft.	Max. W.P.
	1/8	0.405	0.249	0.068	0.051	810
	1/4	0.540	0.344	0.088	0.086	780
	3/8	0.675	0.473	0.091	0.115	620
	1/2	0.840	0.602	0.109	0.170	600
	3/4	1.050	0.804	0.113	0.226	480
	1	1.315	1.029	0.133	0.333	450
*	1-1/4	1.660	1.360	0.140	0.450	370
*	1-1/2	1.900	1.590	0.145	0.537	330
*	2	2.375	2.047	0.154	0.720	280
	2-1/2	2.875	2.445	0.203	1.136	300
*	3	3.500	3.042	0.216	1.488	260
	3-1/2	4.000	3.521	0.226	1.789	240
*	4	4.500	3.998	0.237	2.118	220
	5	5.563	5.016	0.258	2.874	190
*	6	6.625	6.031	0.280	3.733	180
*	8	8.625	7.942	0.322	5.619	160
*	10	10.750	9.976	0.365	7.966	140
*	12	12.750	11.889	0.406	10.534	130
*	14	14.000	13.073	0.437	12.462	130
*	16	16.000	14.940	0.500	16.286	130
*	18	18.000	16.809	0.562	20.587	130
*	20	20.000	18.743	0.593	24.183	120
*	24	24.000	22.544	0.687	33.652	120

* Denotes these sizes are dual marked as being in compliance with both ASTM D1785 (pressure pipe) and ASTM D2665 (drain, waste & vent pipe- DWV).

The pressure ratings given are for water, non-shock, @ 73˚F. The following temperature de-rating factors are to be applied to the working pressure ratings (WP) listed when operating at elevated temperatures.

Multiply the working pressure rating of the selected pipe at 73˚F, by the appropriate de-rating factor to determine the maximum working pressure rating of the pipe at the elevated temperature chosen.

EX:
10" PVC SCH 40 @ 120˚F = ?
140 psi x 0.40 = 56 psi max.
@ 120˚F

De-Rating Factor

Operating Temp (°F)	De-Rating Factor
73	1.00
80	0.88
90	0.75
100	0.62
110	0.51
120	0.40
130	0.31
140	0.22

THE MAXIMUM SERVICE TEMPERATURE FOR PVC IS 140˚F.

Solvent-cemented joints should be utilized when working at or near maximum temperatures. Harvel Plastics does not recommend the use of PVC for threaded connections at temperatures above 110˚F; use flanged joints, unions, or roll grooved couplings where disassembly is necessary at elevated temperatures.

Threading of Schedule 40 PVC pipe is not a recommended practice due to insufficient wall thickness. Thread only Schedule 80 or heavier walls. *Threading requires a 50% reduction in pressure rating stated for plain end pipe @ 73˚F.*

Chemical resistance data should be referenced for proper material selection and possible de-rating when working with fluids other than water. Refer to Harvel Plastics 112/401 Product Bulletin for chemical resistance, installation data, and additional information.

ASTM STANDARD D1784 MATERIAL EQUIVALENTS:

Cell Classification 12454 = PVC Type I Grade I = PVC1120

Pipe sizes shown are manufactured in strict compliance with ASTM D1785 and ASTM D2665 where applicable.

TABLE 5. *Wire table, standard annealed copper*

American Wire Gage. English units. Values at 20 °C.

Gage	Diameter in mils	Cross section: Circular mils	Cross section: Square inch	Ohms per 1,000 Pet	Feet per ohm	Pounds per 1,000 feet	Feet per pound	Ohms per pound	Pounds per ohm
0000	460.0	211 600	0.1662	0.049 01	20 400	640.5	1.561	0.000 076 52	13 070
000	409.6	167 800	.1318	.061 82	16 180	507.8	1.969	.000 121 7	8215
00	364.8	133 100	.1045	.077 93	12 830	402.8	2.482	.000 193 5	5169
0	324.9	105 600	.082 91	.098 25	10 180	319.5	3.130	.000 307 5	3252
1	289.3	83 690	.065 73	.1239	8070	253.3	3.947	.000 489 1	2044
2	257.6	66 360	.052 12	.1563	6398	200.9	4.978	.000 778 1	1285
3	229.4	52 620	.041 33	.1971	5074	159.3	6.278	.001 237	808.3
4	204.3	41 740	.032 78	.2485	4024	126.3	7.915	.001 967	508.5
5	181.9	33 090	.025 99	.3134	3190	100.2	9.984	.003 130	319.5
6	162.0	26 240	.020 61	.3952	2530	79.44	12.59	.004 975	201.0
7	144.3	20 820	.016 35	.4981	2008	63.03	15.87	.007 902	126.5
8	128.5	16 510	.012 97	.6281	1592	49.98	20.01	.012 57	79.58
9	114.4	13 090	.010 28	.7925	1262	39.62	25.24	.020 00	49.99
10	101.9	10 380	.008 155	.9988	1001	31.43	31.82	.031 78	31.47
11	90.7	8230	.006 46	1.26	793	24.9	40.2	.0506	19.8
12	80.8	6530	.005 13	1.59	629	19.8	50.6	.0804	12.4
13	72.0	5180	.004 07	2.00	500	15.7	63.7	.127	7.84
14	64.1	4110	.003 23	2.52	396	12.4	80.4	.203	4.93
15	57.1	3260	.002 56	3.18	314	9.87	101	.322	3.10
16	50.8	2580	.002 03	4.02	249	7.81	128	.514	1.94
17	45.3	2050	.001 61	5.05	198	6.21	161	.814	1.23
18	40.3	1620	.001 28	6.39	157	4.92	203	1.30	0.770
19	35.9	1200	.001 01	8.05	124	3.90	256	2.06	.485
20	32.0	1020	.000 804	10.1	98.7	3.10	323	3.27	.306
21	28.5	812	.000 638	12.8	78.3	2.46	407	5.19	.193
22	25.3	640	.000 503	16.2	61.7	1.94	516	8.36	.120
23	22.6	511	.000 401	20.3	49.2	1.55	647	13.1	.0761
24	20.1	404	.000 317	25.7	39.0	1.22	818	21.0	.0476
25	17.9	320	.000 252	32.4	30.9	0.970	1030	33.4	.0300
26	15.9	253	.000 199	41.0	24.4	.765	1310	53.6	.0187
27	14.2	202	.000 158	51.4	19.4	.610	1640	84.3	.0119
28	12.6	159	.000 125	65.3	15.3	.481	2080	136	.007 36
29	11.3	128	.000 100	81.2	12.3	.387	2590	210	.004 76
30	10.0	100	.000 078 5	104	9.64	.303	3300	343	.002 92
31	8.9	79.2	.000 062 2	131	7.64	.240	4170	546	.001 83
32	8.0	64.0	.000 050 3	162	6.17	.194	5160	836	.001 20
33	7.1	50.4	.000 039 6	206	4.86	.153	6550	1350	.000 742
34	6.3	39.7	.000 031 2	261	3.83	.120	8320	2170	.000 460
35	5.6	31.4	.000 024 6	331	3.02	.0949	10 500	3480	.000 287
36	5.0	25.0	.000 019 6	415	2.41	.0757	13 200	5480	.000 182
37	4.5	20.2	.000 015 9	512	1.95	.0613	16 300	8360	.000 120
38	4.0	16.0	.000 012 6	648	1.54	.0484	20 600	13 400	.000 074 7
39	3.5	12.2	.000 009 62	847	1.18	.0371	27 000	22 800	.000 043 8
40	3.1	9.61	.000 007 55	1080	0.927	.0291	34 400	37 100	.000 027 0
41	2.8	7.84	.000 006 16	1320	.756	.0237	42 100	55 700	.000 017 9
42	2.5	6.25	.000 004 91	1660	.603	.0189	52 900	87 700	.000 011 4
43	2.2	4.84	.000 003 80	2140	.467	.0147	68 300	146 000	.000 006 84
44	2.0	4.00	.000 003 14	2590	.386	.0121	82 600	214 000	.000 004 67
45	1.76	3.10	.000 002 43	3350	.299	.00938	107 000	357 000	.000 002 80
46	1.57	2.46	.000 001 94	4210	.238	.00746	134 000	564 000	.000 001 77
47	1.40	1.96	.000 001 54	5290	.189	.00593	169 000	892 000	.000 001 12
48	1.24	1.54	.000 001 21	6750	.148	.00465	215 000	1 450 000	.000 000 690
49	1.11	1.23	.000 000 968	8420	.119	.00373	268 000	2 260 000	.000 000 443
50	0.99	0.980	.000 000 770	10600	.0945	.00297	337 000	3 570 000	.000 000 280
51	0.88	0.774	.000 000 608	13400	.0747	.00234	427 000	5 710 000	.000 000 175
52	0.78	0.608	.000 000 478	17000	.0587	.00184	543 000	9 260 000	.000 000 108
53	0.70	0.490	.000 000 385	21200	.0472	.00148	674 000	14 300 000	.000 000 070 1
54	0.62	0.384	.000 000 302	27000	.0371	.00116	859 000	23 200 000	.000 000 043 1
55	0.56	0.302	.000 000 238	34300	.0292	.000916	1 090 000	37 400 000	.000 000 026 7
56	0.49	0.240	.000 000 189	43200	.0232	.000727	1 380 000	59 400 000	.000 000 016 8

NOTE 1.—The fundamental resistivity wed in calculating the tables is the International Annealed Copper Standard, viz, 0.153 28 ohm-g/m² at 20°C. The temperature coefficient, for this particular resistivity, is $\alpha_{15} = 0.003\ 93$ per °C. or $\alpha_0 = 0.004\ 27$. However, the temperature coefficient is proportional to the conductivity, and hence the change of resistivity per °C is a constant. 0.000 597 ohm-g/m². The "constant mass" temperature coefficient of any sample is

$$\alpha_t = \frac{0.000\ 597 + 0.000\ 005\ t}{\text{resistivity in ohm-g/m}^2 \text{ at } t\ ^\circ\text{C}}$$

The density is 8.89 g/cm³ at 20 °C.

NOTE 2.—The values given in the table are only for annealed copper of the standard resistivity. The user of the table must apply the proper correction for copper of any other resistivity. Hard-drawn copper may be taken as about 2.5 percent higher resistivity than annealed copper.