City of Puyallup
Development & Permitting Services
ISSUED PERMIT
Building | Planning
Engineering | Public Works
Fire | Traffic

Columbia Fire
SPRINKLER SYSTEM SERVICE & REPAIR
WA CL# COLUMFL795NJ

MATERIAL SUBMITTAL

AUTOMATIC FIRE SUPPRESSION SYSTEM

Centeris Voltage Park: UPS & Battery Rm's

1023 39th Ave SE
Puyallyp, WA 98374

Authority Having Jurisdiction
City of Puyallup

Columbia Fire L.L.C.
111 S Findlay Street
Seattle WA 98108
Phone: (206) 232-8569
Project Number: 231213RL01
By: Luke Thompson

Table of Content

DRY PIPE AUTOMATIC FIRE SPRINKLER SYSTEM

1. PIPING

DRY PIPE AUTOMATIC FIRE SPRINKLER SYSTEM

Schedule 10 and Schedule 40

FM Approved and UL Listed Sprinkler Pipe

Bull Moose Tube Company is a recognized producer of quality pipe products. Our Schedule 10 and Schedule 40 are FM Approved and UL Listed (for U.S. and Canada), even though these products do not require separate approvals and listings. Bull Moose Tube made the decision to have them approved and listed for your peace of mind. Our Sch. 10 and Sch. 40 have been through the same rigorous testing as our other fine pipe products.

Bull Moose Tube's Sch. 10 and Sch. 40 pipes are made to ASTM A135 and ASTM A795. These products are typically supplied with our protective coating but can be supplied without the coating so they can be hot-dip galvanized to meet FM requirements for use in dry systems in accordance with the zinc coating specifications of ASTM A795 or ASTM A53. All Schedule 10 and Schedule 40 pipe has a pressure rating of 300 PSI.

Schedule 10 Pipe

Nominal Pipe Size (in)	Nominal O.D. (in)	Nominal I.D. (in)	Weight/Ft	Bundle Size
1	1.315	1.097	1.41 lbs/ft	91
1 1/4	1.660	1.442	1.81 lbs/ft	61
1 1/2	1.900	1.682	2.09 lbs/ft	61
2	2.375	2.157	2.64 lbs/ft	37
2 1/2	2.875	2.635	3.53 lbs/ft	30
3	3.500	3.260	4.34 lbs/ft	19
4	4.500	4.260	5.62 lbs/ft	19

Schedule 40 Pipe

Nominal Pipe Size (in)	Nominal O.D. (in)	Nominal I.D. (in)	Weight/Ft	Bundle Size
1	1.315	1.049	1.68 lbs/ft	70
1 1/4	1.660	1.380	2.27 lbs/ft	51
1 1/2	1.900	1.610	2.72 lbs/ft	44
2	2.375	2.067	3.66 lbs/ft	30
2 1/2	2.875	2.468	5.80 lbs/ft	30
3	3.500	3.068	7.58 lbs/ft	19
4	4.500	4.026	10.80 lbs/ft	19

PIPE PREPARATION

For proper operation, all pipe surfaces should be cleaned prior to installation. In order to provide a leak-tight seat for the gasket, pipe surfaces should be free from indentations and projections from the end of the pipe to the groove. All loose paint, scale, dirt, chips, grease, and rust must be removed prior to installation. Failure to take these important steps may result in improper coupling assembly, causing leakage. Also, check the manufacturer's instructions for the specific fitting used.

BULL MOOSE TUBE COMPANY
A CAPARO company

1819 Clarkson Road
Chesterfield, MO 63017
(800) 325-4467
FAX: (636) 537-2645
www.bullmoosetube.com
e-mail: sales@bullmoosetube.com

For additional information, contact your salesperson today at (800) 325-4467 or (636) 537-2600 in the USA, or from Canada call (800) 882-4666

c UL us LISTED

FM APPROVED

2. FITTINGS / COUPLINGS

DRY PIPE AUTOMATIC FIRE SPRINKLER SYSTEM

CAST IRON THREADED FITTINGS

Anvil standard and extra heavy cast iron threaded fittings are manufactured in accordance with ASME B16.4. Plugs and bushings are manufactured in accordance with ASME B16.14.

NOTE: Figure 367 Concentric Reducers do not meet the overall length requirement of ASME B16.4. All other dimensions are in compliance.

c UL us

FM APPROVED

For Listings/Approval Details and Limitations, visit our website at www.anvilintl.com or contact an Anvil Sales Representative.

Cast Iron Threaded Fittings
Pressure - Temperature Ratings

Temperature		Pressure			
		Class 125		Class 250	
(°F)	*(°C)*	psi	*bar*	psi	*bar*
-20° to 150°	*-28.9 to 65.6*	175	*12.1*	400	*27.6*
200°	*93.3*	165	*11.4*	370	*25.5*
250°	*121.1*	150	*10.3*	340	*23.4*
300°	*148.9*	140	*9.7*	310	*21.4*
350°	*176.7*	125	*8.6*	300	*20.7*
400°	*204.4*	–	–	250	*17.2*

Standards and Specifications

	Dimensions	Material	Galvanizing*	Thread	Pressure Rating
CAST IRON THREADED FITTINGS					
Class 125	ASME B16.4	ASTM A-126 (A)	ASTM A-153	ASME B1.20.1	ASME B16.4
Class 250	ASME B16.4	ASTM A-126 (A)	ASTM A-153	ASME B1.20.1	ASME B16.4
CAST IRON PLUGS AND BUSHINGS					
	ASME B16.14	ASTM A- 126 (A)	ASTM A-153	ASME B1.20.1	ASME B16.14

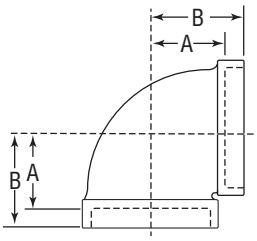
* ASTM B 633. Type I, SC 4, may be supplied as alternate zinc coating per applicable ASME B16 product standard.

General Assembly of Threaded Fittings

1) Inspect both male and female components prior to assembly.
   - Threads should be free from mechanical damage, dirt, chips and excess cutting oil.
   - Clean or replace components as necessary.
2) Application of thread sealant
   - Use a thread sealant that is fast drying, sets-up to a semi hard condition and is vibration resistant. Alternately, an anaerobic sealant may be utilized.
   - Thoroughly mix the thread sealant prior to application.
   - Apply a thick even coat to the male threads only. Best application is achieved with a brush stiff enough to force sealant down to the root of the threads.
3) Joint Makeup
   - For sizes up to and including 2" pipe, wrench tight makeup is considered three full turns past handtight. Handtight engagement for 1/2" through 2" thread varies from 4 1/2 turns to 5 turns.
   - For 2 1/2" through 4" sizes, wrench tight makeup is considered two full turns past handtight. Handtight engagement for 2 1/2" through 4" thread varies from 5 1/2 turns to 6 3/4 turns.

Class 125 (Standard)

FIGURE 351
90° Elbow



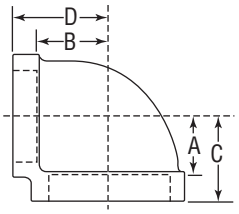
Size		A		B		Unit Weight Black	
NPS	*DN*	in	*mm*	in	*mm*	lbs	*kg*
1/4	*8*	1/2	*13*	13/16	*22*	0.16	*0.07*
3/8	*10*	9/16	*14*	15/16	*24*	0.25	*0.11*
1/2	*15*	11/16	*17*	1 1/8	*29*	0.40	*0.18*
3/4	*20*	13/16	*22*	1 15/16	*33*	0.60	*0.27*
1	*25*	15/16	*24*	1 1/2	*38*	0.92	*0.42*
1 1/4	*32*	1 1/8	*29*	1 3/4	*44*	1.44	*0.65*
1 1/2	*40*	1 5/16	*33*	1 15/16	*49*	1.95	*0.88*
2	*50*	1 9/16	*40*	2 1/4	*57*	3.13	*1.42*
2 1/2	*65*	1 13/16	*47*	2 11/16	*68*	4.94	*2.24*
3	*80*	2 3/16	*56*	3 1/8	*79*	7.21	*3.27*
3 1/2	*90*	2 7/16	*62*	3 7/16	*87*	9.67	*4.39*
4	*100*	2 11/16	*68*	3 13/16	*98*	12.17	*5.52*
5	*125*	3 5/16	*84*	4 1/2	*114*	21.46	*9.73*
6	*150*	3 7/8	*98*	5 1/8	*130*	31.33	*14.21*
8	*200*	5 3/16	*132*	6 9/16	*167*	64.56	*29.28*

Note: See following page for pressure-temperature ratings.

PROJECT INFORMATION	APPROVAL STAMP
Project:	☐ **Approved**
Address:	☐ **Approved as noted**
Contractor:	☐ **Not approved**
Engineer:	**Remarks:**
Submittal Date:	
Notes 1:	
Notes 2:	

Class 125 (Standard)

FIGURE 352
90° Elbow, Reducing



Size				A		B		C		D		Unit Weight Black	
NPS	*DN*	NPS	*DN*	in	*mm*	in	*mm*	in	*mm*	in	*mm*	lbs	*kg*
1/2	*15*	1/4	*8*	5/8	*16*	3/4	*19*	1 1/16	*27*	1 1/16	*27*	0.40	*0.18*
		3/8	*10*	5/8	*16*	11/16	*17*	1 1/16	*27*	1 1/16	*27*	0.34	*0.15*
3/4	*20*	1/2	*15*	11/16	*17*	13/16	*22*	1 1/4	*32*	1 1/4	*32*	0.51	*0.23*
1	*25*	1/2	*15*	11/16	*17*	15/16	*24*	1 3/8	*35*	1 3/8	*35*	0.67	*0.30*
		3/4	*20*	13/16	*22*	15/16	*24*	1 7/16	*37*	1 7/16	*37*	0.76	*0.34*
1 1/4	*32*	1/2	*15*	11/16	*17*	1 1/16	*27*	1 1/2	*38*	1 1/2	*38*	1.07	*0.49*
		3/4	*20*	13/16	*22*	1 1/8	*29*	1 5/8	*41*	1 5/8	*41*	1.02	*0.46*
		1	*25*	15/16	*24*	1 1/8	*29*	1 11/16	*43*	1 11/16	*43*	1.21	*0.55*
1 1/2	*40*	1/2	*15*	3/4	*19*	1 1/4	*32*	1 5/8	*41*	1 5/8	*41*	1.53	*0.69*
		3/4	*20*	7/8	*22*	1 5/16	*33*	1 13/16	*47*	1 13/16	*47*	1.55	*0.70*
		1	*25*	1	*25*	1 1/4	*32*	1 13/16	*47*	1 13/16	*47*	1.44	*0.65*
		1 1/4	*32*	1 3/16	*30*	1 1/4	*32*	1 7/8	*48*	1 7/8	*48*	1.74	*0.79*
2	*50*	1/2	*15*	1 3/16	*30*	1 7/16	*37*	1 3/8	*35*	1 3/8	*35*	2.22	*1.01*
		3/4	*20*	1 5/16	*33*	1 1/2	*38*	2	*51*	2	*51*	2.20	*1.00*
		1	*25*	1 1/16	*27*	1 7/16	*37*	2	*51*	2	*51*	2.08	*0.94*
		1 1/4	*32*	1 3/16	*30*	1 7/16	*37*	2 1/16	*52*	2 1/16	*52*	2.33	*1.06*
		1 1/2	*40*	1 5/16	*33*	1 1/2	*38*	2 1/8	*54*	2 1/8	*54*	2.59	*1.17*
2 1/2	*65*	1	*25*	1	*25*	1 3/4	*44*	2 5/16	*59*	2 5/16	*59*	2.93	*1.33*
		1 1/4	*32*	1 3/16	*30*	1 3/4	*44*	2 3/8	*60*	2 3/8	*60*	3.41	*1.55*
		1 1/2	*40*	1 5/16	*33*	1 13/16	*47*	2 7/16	*62*	2 7/16	*62*	3.68	*1.67*
		2	*50*	1 9/16	*40*	1 7/8	*48*	2 9/16	*65*	2 9/16	*65*	4.01	*1.82*
3	*80*	1 1/4	*32*	1 5/8	*41*	2 5/16	*59*	2 15/16	*75*	2 15/16	*75*	5.98	*2.71*
		1 1/2	*40*	1 5/8	*41*	2 5/16	*59*	2 15/16	*75*	2 15/16	*75*	5.65	*2.56*
		2	*50*	1 5/8	*41*	2 1/4	*57*	2 15/16	*75*	2 15/16	*75*	5.25	*2.38*
		2 1/2	*65*	1 7/8	*48*	2 3/16	*56*	3 1/16	*78*	3 1/16	*78*	6.44	*2.92*
4	*100*	2	*50*	2 3/16	*56*	2 15/16	*75*	3 5/8	*92*	3 5/8	*92*	11.89	*5.39*
		2 1/2	*65*	2 3/16	*56*	2 3/4	*70*	3 5/8	*92*	3 5/8	*92*	11.27	*5.11*
		3	*80*	2 3/16	*56*	2 11/16	*68*	3 5/8	*92*	3 5/8	*92*	10.63	*4.82*
5	*125*	4	*100*	2 13/16	*73*	3 5/16	*84*	4 3/8	*111*	4 3/8	*111*	16.47	*7.47*
6	*150*	3	*80*	2 5/16	*59*	3 13/16	*98*	4 13/16	*124*	4 13/16	*124*	19.43	*8.81*
		4	*100*	2 13/16	*73*	3 7/8	*98*	4 15/16	*125*	4 15/16	*125*	23.53	*10.67*
		5	*125*	3 3/8	*86*	3 13/16	*98*	5	*127*	5	*127*	26.66	*12.09*

Note: See following page for pressure-temperature ratings.

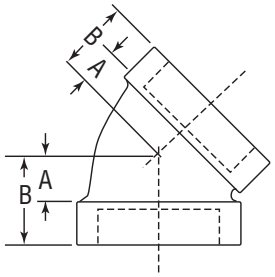
PROJECT INFORMATION	APPROVAL STAMP
Project:	☐ **Approved**
Address:	☐ **Approved as noted**
Contractor:	☐ **Not approved**
Engineer:	**Remarks:**
Submittal Date:	
Notes 1:	
Notes 2:	

Class 125 (Standard)

☐ **FIGURE 356 (Straight)**
☐ **FIGURE 356R (Reducing)**
45° Elbow

FIGURE 356 (Straight)

Figure 356R (Reducing)



Size		A		B		Unit Weight Black	
NPS	*DN*	in	*mm*	in	*mm*	lbs	*kg*
1/4	*8*	7/16	*11*	3/4	*19*	0.16	*0.07*
3/8	*10*	7/16	*11*	13/16	*22*	0.23	*0.10*
1/2	*15*	7/16	*11*	7/8	*22*	0.37	*0.17*
3/4	*20*	1/2	*13*	1	*25*	0.55	*0.25*
1	*25*	9/16	*14*	1 1/8	*29*	0.83	*0.38*
1 1/4	*32*	5/8	*16*	1 1/4	*32*	1.33	*0.60*
1 1/2	*40*	13/16	*22*	1 7/16	*37*	1.79	*0.81*
2	*50*	1	*25*	1 11/16	*43*	2.89	*1.31*
2 1/2	*65*	1 1/16	*27*	1 15/16	*49*	4.29	*1.95*
3	*80*	1 3/16	*30*	2 3/16	*56*	6.44	*2.92*
3 1/2	*90*	1 3/8	*35*	2 3/8	*60*	8.42	*3.82*
4	*100*	1 9/16	*40*	2 5/8	*67*	10.64	*4.83*
6	*150*	2 3/16	*56*	3 7/16	*87*	26.02	*11.80*
8	*200*	2 7/8	*73*	4 1/4	*108*	50.17	*22.75*

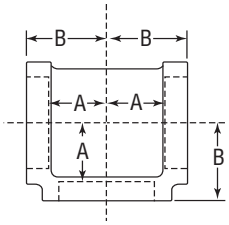
Size		A		B		C		D		Unit Weight Black	
NPS	*DN*	in	*mm*	in	*mm*	in	*mm*	in	*mm*	lbs	*kg*
1 x 1/2	*25 x 15*	1/2	*15*	7/8	*22*	1 1/16	*27*	1 5/16	*33*	0.95	*0.43*

Note: See following page for pressure-temperature ratings.

PROJECT INFORMATION	APPROVAL STAMP
Project:	☐ **Approved**
Address:	☐ **Approved as noted**
Contractor:	☐ **Not approved**
Engineer:	**Remarks:**
Submittal Date:	
Notes 1:	
Notes 2:	

Class 125 (Standard)

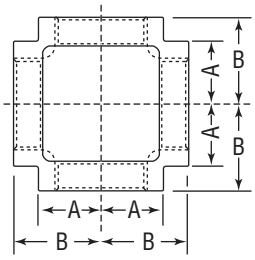
FIGURE 358
Tee



Size		A		B		Unit Weight Black	
NPS	*DN*	in	*mm*	in	*mm*	lbs	*kg*
1/4	*8*	1/2	*13*	13/16	*22*	0.22	*0.10*
3/8	*10*	5/8	*16*	1	*25*	0.35	*0.16*
1/2	*15*	11/16	*17*	1 1/8	*29*	0.56	*0.25*
3/4	*20*	13/16	*22*	1 5/16	*33*	0.84	*0.38*
1	*25*	15/16	*24*	1 1/2	*38*	1.25	*0.57*
1 1/4	*32*	1 1/8	*29*	1 3/4	*44*	2.03	*0.92*
1 1/2	*40*	1 5/16	*33*	1 15/16	*49*	2.70	*1.22*
2	*50*	1 9/16	*40*	2 1/4	*57*	4.23	*1.92*
2 1/2	*65*	1 13/16	*47*	2 11/16	*68*	6.67	*3.02*
3	*80*	2 3/16	*56*	3 1/8	*79*	10.00	*4.54*
3 1/2	*90*	2 7/16	*62*	3 7/16	*87*	13.29	*6.03*
4	*100*	2 11/16	*68*	3 3/4	*95*	16.33	*7.41*
5	*125*	3 5/16	*84*	4 1/2	*114*	27.33	*12.39*
6	*150*	3 7/8	*98*	5 1/8	*130*	40.85	*18.53*
8	*200*	5 3/16	*132*	6 9/16	*167*	79.00	*35.83*

FIGURE 360
Cross

NOT USE



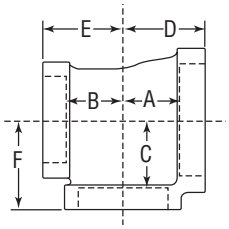
Size		A		B		Unit Weight Black	
NPS	*DN*	in	*mm*	in	*mm*	lbs	*kg*
1/2	*15*	9/16	*14*	13/16	*22*	2.80	*1.27*
3/4	*20*	13/16	*22*	1 5/16	*33*	1.03	*0.47*
1	*25*	15/16	*24*	1 1/2	*38*	1.59	*0.72*
1 1/4	*32*	1 1/8	*29*	1 3/4	*44*	2.42	*1.10*
1 1/2	*40*	1 5/16	*33*	1 15/16	*49*	3.21	*1.46*
2	*50*	1 9/16	*40*	2 1/4	*57*	5.28	*2.39*
2 1/2	*65*	1 13/16	*47*	2 11/16	*68*	8.07	*3.66*
3	*80*	2 3/16	*56*	3 1/8	*79*	11.84	*5.37*
4	*100*	2 3/4	*70*	3 13/16	*98*	19.63	*8.90*

Note: See following page for pressure-temperature ratings.

PROJECT INFORMATION	APPROVAL STAMP
Project:	☐ **Approved**
Address:	☐ **Approved as noted**
Contractor:	☐ **Not approved**
Engineer:	**Remarks:**
Submittal Date:	
Notes 1:	
Notes 2:	

Class 125 (Standard)

FIGURE 359
Tee Reducing



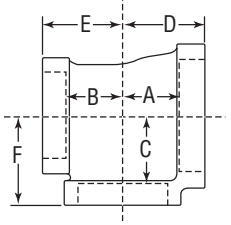
Size						A		B		C		D		E		F		Unit Weight Black	
NPS	DN	NPS	DN	NPS	DN	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lbs	kg
1/2	15	1/2	15	1/4	8	1 1/16	17	11/16	17	13/16	22	1 1/8	29	1 1/8	29	1 1/8	29	0.57	0.26
				3/8	10	1 1/16	17	11/16	17	3/4	19	1 1/8	29	1 1/8	29	1 1/8	29	0.57	0.26
				3/4	20	1 3/16	22	13/16	22	11/16	17	1 1/4	32	1 1/4	32	13/16	22	0.68	0.31
				1	25	1	25	1	25	13/16	22	1 7/16	37	1 7/16	37	1 3/8	35	1.00	0.45
3/4	20	1/2	15	1/2	15	1 1/16	17	11/16	17	13/16	22	13/16	22	1 1/8	29	1 1/4	32	0.64	0.29
				3/4	20	1 3/16	22	13/16	22	13/16	22	15/16	24	1 1/4	32	15/16	24	0.75	0.34
		3/4	20	1/4	8	9/16	14	9/16	14	7/8	22	11/16	17	11/16	17	13/16	22	0.62	0.28
				3/8	10	1 1/16	17	11/16	17	15/16	24	13/16	22	13/16	22	1 1/4	32	0.75	0.34
				1/2	15	1 1/16	17	11/16	17	13/16	22	13/16	22	13/16	22	1 1/4	32	0.76	0.34
				1	25	1 5/16	24	15/16	24	13/16	22	1 7/16	37	1 7/16	37	1 3/8	35	0.99	0.45
1	25	1/4	8	1	25	1 5/16	24	15/16	24	15/16	24	1 1/2	38	1 1/4	32	1 1/2	38	1.08	0.49
		1/2	15	1/2	15	1 1/16	17	3/4	19	15/16	24	1 1/4	32	13/16	22	1 3/8	35	0.90	0.41
				3/4	20	1 3/16	22	13/16	22	15/16	24	1 3/8	35	1 1/4	32	1 7/16	37	0.91	0.41
				1	25	1 5/16	24	15/16	24	15/16	24	1 1/2	38	1 3/8	35	1 1/2	38	1.08	0.49
		3/4	20	1/2	15	1 1/16	17	11/16	17	15/16	24	1 1/4	32	13/16	22	1 3/8	35	0.89	0.40
				3/4	20	1 3/16	22	13/16	22	15/16	24	1 3/8	35	15/16	24	1 7/16	37	1.00	0.45
				1	25	1 5/16	24	15/16	24	15/16	24	1 1/2	38	1 7/16	37	1 1/2	38	1.13	0.51
		1	25	1/4	8	1 1/16	17	11/16	17	1 1/8	29	1 1/8	29	1 1/4	32	1 3/8	35	1.01	0.46
				1/2	15	1 1/16	17	11/16	17	15/16	24	1 1/4	32	1 1/4	32	1 3/8	35	1.01	0.46
				3/4	20	1 3/16	22	13/16	22	15/16	24	1 3/8	35	1 3/8	35	1 7/16	37	1.11	0.50
				1 1/4	32	1 1/8	29	1 1/8	29	15/16	24	1 11/16	43	1 11/16	43	1 9/16	40	1.49	0.68
				1 1/2	40	1 1/4	32	1 1/4	32	1	25	1 13/16	47	1 13/16	47	1 5/8	41	1.84	0.83
				2	50	1 7/16	37	1 7/16	37	1	25	2	50	2	50	1 3/4	44	2.70	1.22

Note: See page 6 for pressure-temperature ratings.

PROJECT INFORMATION	APPROVAL STAMP
Project:	☐ **Approved**
Address:	☐ **Approved as noted**
Contractor:	☐ **Not approved**
Engineer:	**Remarks:**
Submittal Date:	
Notes 1:	
Notes 2:	

Class 125 (Standard)

FIGURE 359
Tee Reducing

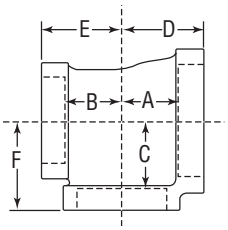


Size						A		B		C		D		E		F		Unit Weight Black	
NPS	DN	NPS	DN	NPS	DN	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lbs	kg
1¼	32	½	15	½	15	13/16	22	13/16	22	1 1/8	29	1 7/16	37	15/16	24	1 5/8	41	1.00	0.45
				1	25	1 5/16	24	15/16	24	1 1/8	29	1 9/16	40	1 3/8	35	1 11/16	43	1.38	0.63
				1¼	32	1 1/8	29	1 1/8	29	1 1/8	29	1 3/4	44	1 9/16	40	1 3/4	44	1.64	0.74
		¾	20	¾	20	13/16	22	13/16	22	1 1/8	29	1 7/16	37	15/16	24	1 5/8	41	1.27	0.58
				1	25	1 5/16	24	15/16	24	1 1/8	29	1 9/16	40	1 7/16	37	1 11/16	43	1.43	0.65
				1¼	32	1 1/8	29	1 1/8	29	1 1/8	29	1 3/4	44	1 5/8	41	1 3/4	44	1.73	0.78
		1	25	½	15	1 1/16	17	11/16	17	1 1/8	29	15/16	24	1 1/4	32	1 9/16	40	1.27	0.58
				¾	20	1 3/16	22	13/16	22	1 1/8	29	1 7/16	37	1 3/8	35	1 5/8	41	1.36	0.62
				1	25	1 5/16	24	15/16	24	1 1/8	29	1 9/16	40	1 9/16	40	1 11/16	43	1.53	0.69
				1¼	32	1 1/8	29	1 1/8	29	1 1/8	29	1 3/4	44	1 11/16	43	1 3/4	44	1.79	0.81
				1½	40	1 1/4	32	1 1/4	32	13/16	22	1 7/8	48	1 13/16	47	1 13/16	47	2.07	0.94
				2	50	1 7/16	37	1 7/16	37	13/16	22	2 1/16	52	2	50	1 7/8	48	2.66	1.21
		1¼	32	½	15	1 1/16	17	11/16	17	1 1/8	29	15/16	24	15/16	24	1 9/16	40	1.47	0.67
				¾	20	1 3/16	22	13/16	22	1 1/8	29	1 7/16	37	1 7/16	37	1 5/8	41	1.57	0.71
				1	25	1 5/16	24	15/16	24	1 1/8	29	1 9/16	40	1 9/16	40	1 11/16	43	1.73	0.78
				1½	40	1 1/4	32	1 1/4	32	13/16	22	1 7/8	48	1 7/8	48	1 13/16	47	2.29	1.04
				2	50	1 7/16	37	1 7/16	37	13/16	22	2 1/16	52	2 1/16	52	1 7/8	48	2.81	1.27
1½	40	½	15	1¼	32	13/16	22	1 1/8	29	1 1/4	32	1 13/16	47	1 9/16	40	1 7/8	48	1.93	0.88
				1½	40	15/16	24	1 1/4	32	15/16	24	1 15/16	49	1 11/16	43	1 15/16	49	2.14	0.97
		¾	20	1½	40	15/16	24	1 1/4	32	15/16	24	1 15/16	49	1 3/4	44	1 15/16	49	2.18	0.99
		1	25	½	15	13/16	22	3/4	19	1 1/4	32	1 7/16	37	15/16	24	1 11/16	43	1.75	0.79
				¾	20	7/8	22	13/16	22	1 1/4	32	1 1/2	38	1 3/8	35	1 3/4	44	1.70	0.77
				1	25	1	25	15/16	24	1 1/4	32	1 5/8	41	1 1/2	38	1 13/16	47	1.72	0.78
				1¼	32	13/16	22	1 1/8	29	1 1/4	32	1 13/16	47	1 11/16	43	1 7/8	48	2.08	0.94
				1½	40	15/16	24	1 1/4	32	15/16	24	1 15/16	49	1 13/16	47	1 15/16	49	2.29	1.04
				2	50	1 1/2	38	1 7/16	37	15/16	24	2 1/8	54	2	50	2	51	2.91	1.32
		1¼	32	½	15	13/16	22	11/16	17	1 1/4	32	1 7/16	37	15/16	24	1 11/16	43	1.67	0.76
				¾	20	7/8	22	13/16	22	1 1/4	32	1 1/2	38	1 7/16	37	1 3/4	44	1.79	0.81
				1	25	1	25	15/16	24	1 1/4	32	1 5/8	41	1 9/16	40	1 13/16	47	1.97	0.89
				1¼	32	13/16	22	1 1/8	29	1 1/4	32	1 13/16	47	1 3/4	44	17/8	48	2.28	1.03
				1½	40	15/16	24	1 1/4	32	15/16	24	1 15/16	49	1 7/8	48	1 15/16	49	2.50	1.13
				2	50	1 1/2	38	1 7/16	37	15/16	24	2 1/8	54	2 1/16	52	2	51	3.07	1.39
		1½	40	½	15	13/16	22	13/16	22	1 1/4	32	1 7/16	37	1 7/16	37	1 11/16	43	1.84	0.83
				¾	20	7/8	22	7/8	22	1 1/4	32	1 1/2	38	1 1/2	38	1 3/4	44	1.95	0.88
				1	25	1	25	1	25	1 1/4	32	1 5/8	41	1 5/8	41	1 13/16	47	2.13	0.97
				1¼	32	13/16	22	13/16	22	1 1/4	32	1 13/16	47	1 13/16	47	1 7/8	48	2.44	1.11
				2	50	1 1/2	38	1 1/2	38	15/16	24	2 1/8	54	2 1/8	54	2	51	3.23	1.46
				2½	65	1 13/16	47	1 13/16	47	15/16	24	2 7/16	62	2 7/16	62	2 3/16	56	4.15	1.88

Note: See page 6 for pressure-temperature ratings.

Class 125 (Standard)

FIGURE 359
Tee Reducing

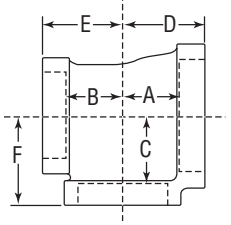


Size						A		B		C		D		E		F		Unit Weight Black	
NPS	DN	NPS	DN	NPS	DN	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lbs	kg
				1 1/2	40	15/16	24	1 3/8	35	1 1/2	38	2	51	1 13/16	47	2 1/8	54	2.95	1.34
		1/2	15	2	50	1 9/16	40	1 7/16	37	1 9/16	40	2 1/4	57	1 7/8	48	2 1/4	57	3.30	1.50
				1 1/4	32	1 3/16	22	1 1/8	29	1 7/16	37	1 7/8	48	1 3/4	44	2 1/16	52	2.50	1.13
		3/4	20	1 1/2	40	1 5/16	24	15/16	24	1 1/2	38	2	51	1 13/16	47	2 1/8	54	3.40	1.54
				2	50	1 9/16	40	1 7/16	37	1 9/16	40	2 1/4	57	1 15/16	49	2 1/4	57	3.31	1.50
				1	25	11/16	17	11/16	17	1 7/16	37	1 3/4	44	1 5/8	41	2	51	2.70	1.22
				1 1/4	32	13/16	22	1 1/8	29	1 1/2	38	1 7/8	48	1 3/4	44	2 1/16	52	2.94	1.33
		1	25	1 1/2	40	15/16	24	1 1/4	32	1 1/2	38	2	51	1 13/16	47	2 1/8	54	2.85	1.29
				2	50	1 9/16	40	1 7/16	37	1 9/16	40	2 1/4	57	2	51	2 1/4	57	3.46	1.57
				2 1/2	65	1 7/8	48	1 13/16	47	1 9/16	40	2 9/16	65	2 3/8	60	2 7/16	62	4.88	2.21
				1/2	15	11/16	17	1	25	1 7/16	37	1 3/4	44	1 5/8	41	2	51	2.48	1.12
				3/4	20	7/8	22	7/8	22	1 7/16	37	1 9/16	40	1 1/2	38	1 15/16	49	2.50	1.13
				1	25	11/16	17	1	25	1 7/16	37	1 3/4	44	1 5/8	41	2	51	2.73	1.24
		1 1/4	32	1 1/4	32	13/16	22	1 1/8	29	1 7/16	37	1 7/8	48	1 3/4	44	2 1/16	52	2.90	1.32
				1 1/2	40	15/16	24	1 1/4	32	1 1/2	38	2	51	1 7/8	48	2 1/8	54	3.13	1.42
2	50			2	50	1 9/16	40	1 7/16	37	1 9/16	40	2 1/4	57	2 1/16	52	2 1/4	57	3.71	1.68
				2 1/2	65	1 7/8	48	1 3/4	44	1 9/16	40	2 9/16	65	2 3/8	60	2 7/16	62	4.54	2.06
				1/2	15	13/16	22	13/16	22	1 7/16	37	1 1/2	38	1 7/16	37	1 7/8	48	2.34	1.06
				3/4	20	7/8	22	7/8	22	1 7/16	37	1 9/16	40	1 1/2	38	1 15/16	49	2.46	1.12
				1	25	11/16	17	1	25	1 7/16	37	1 3/4	44	1 5/8	41	2	51	2.66	1.21
		1 1/2	40	1 1/4	32	13/16	22	13/16	22	1 7/16	37	1 7/8	48	1 13/16	47	2 1/16	52	2.98	1.35
				1 1/2	40	15/16	24	15/16	24	1 1/2	38	2	51	1 15/16	49	2 1/8	54	3.24	1.47
				2	50	1 9/16	40	1 1/2	38	1 9/16	40	2 1/4	57	2 1/8	54	2 1/4	57	3.70	1.68
				2 1/2	65	1 7/8	48	1 15/16	49	1 9/16	40	2 9/16	65	2 9/16	65	2 7/16	62	5.46	2.48
				1/2	15	13/16	22	13/16	22	1 7/16	37	1 1/2	38	1 1/2	38	1 7/8	48	2.74	1.24
				3/4	20	7/8	22	7/8	22	1 7/16	37	1 9/16	40	1 9/16	40	1 15/16	49	2.86	1.30
				1	25	11/16	17	11/16	17	1 7/16	37	1 3/4	44	1 3/4	44	2	51	3.05	1.38
		2	50	1 1/4	32	13/16	22	13/16	22	1 7/16	37	1 7/8	48	1 7/8	48	2 1/16	52	3.38	1.53
				1 1/2	40	15/16	24	15/16	24	1 1/2	38	2	51	2	51	2 1/8	54	3.59	1.63
				2 1/2	65	1 7/8	48	1 7/8	48	1 9/16	40	2 9/16	65	2 9/16	65	2 7/16	62	5.17	2.34
				3	100	3	76	3	76	2 7/16	62	3 11/16	94	3 11/16	94	3 1/2	89	7.87	3.57

Note: See page 6 for pressure-temperature ratings.

Class 125 (Standard)

FIGURE 359
Tee Reducing

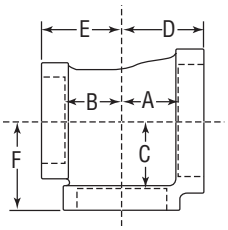


Size						A		B		C		D		E		F		Unit Weight Black	
NPS	DN	NPS	DN	NPS	DN	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lbs	kg
2 1/2	65	1/2	15	2 1/2	65	1 13/16	47	1 13/16	47	1 13/16	47	2 11/16	68	2 1/4	57	2 11/16	68	5.20	2.36
		3/4	20	2 1/2	65	1 13/16	47	1 3/4	44	1 13/16	47	2 11/16	68	2 1/4	57	2 11/16	68	5.10	2.31
		1	25	2	50	1 9/16	40	1 9/16	40	1 7/8	48	2 7/16	62	2 1/8	54	2 9/16	65	5.03	2.28
				2 1/2	65	1 13/16	47	1 3/4	44	1 13/16	47	2 11/16	68	2 5/16	59	2 11/16	68	5.36	2.43
		1 1/4	32	2	50	1 9/16	40	1 1/2	38	1 7/8	48	2 7/16	62	2 1/8	54	2 9/16	65	4.96	2.25
				2 1/2	65	1 13/16	47	1 3/4	44	1 13/16	47	2 11/16	68	2 3/8	60	2 11/16	68	5.40	2.45
		1 1/2	40	1 1/2	40	15/16	24	15/16	22	1 13/16	47	2 3/16	56	1 15/16	49	2 7/16	62	4.23	1.92
				2	50	1 9/16	40	1 1/2	38	1 7/8	48	2 7/16	62	2 1/8	54	2 9/16	65	4.85	2.20
				2 1/2	65	1 13/16	47	1 13/16	47	1 13/16	47	2 11/16	68	2 7/16	62	2 11/16	68	4.85	2.20
		2	50	1/2	15	3/4	19	13/16	22	1 3/4	44	1 11/16	43	1 1/2	38	2 3/16	56	5.82	2.64
				3/4	20	7/8	22	7/8	22	1 3/4	44	1 3/4	44	1 9/16	40	2 1/4	57	3.62	1.64
				1	25	1	25	11/16	17	1 3/4	44	1 15/16	49	1 3/4	44	2 5/16	59	3.92	1.78
				1 1/4	32	13/16	22	13/16	22	1 3/4	44	2 1/16	52	1 7/8	48	2 3/8	60	4.26	1.93
				1 1/2	40	15/16	24	15/16	24	1 13/16	47	2 3/16	56	2	51	2 7/16	62	4.42	2.00
				2	50	1 9/16	40	1 9/16	40	1 7/8	48	2 7/16	62	2 1/4	57	2 9/16	65	5.17	2.34
				2 1/2	65	1 13/16	47	1 7/8	48	1 13/16	47	2 11/16	68	2 9/16	65	2 11/16	68	6.00	2.72
				3	80	2 1/16	52	2 1/8	54	1 7/8	48	3	80	2 7/8	73	2 13/16	73	7.35	3.33
		2 1/2	65	1/2	15	3/4	19	3/4	19	1 3/4	44	1 11/16	43	1 11/16	43	2 3/16	56	4.00	1.81
				3/4	20	7/8	22	7/8	22	1 3/4	44	1 3/4	44	1 3/4	44	2 1/4	57	4.29	1.95
				1	25	1	25	1	25	1 3/4	44	1 15/16	49	1 15/16	49	2 5/16	59	4.48	2.03
				1 1/4	32	13/16	22	13/16	22	1 3/4	44	2 1/16	52	2 1/16	52	2 3/8	60	4.83	2.19
				1 1/2	40	15/16	24	15/16	24	1 13/16	47	2 3/16	56	2 3/16	56	2 7/16	62	5.14	2.33
				2	50	1 9/16	40	1 9/16	40	1 7/8	48	2 7/16	62	2 7/16	62	2 9/16	65	5.88	2.67
				3	80	2 1/16	52	2 1/16	52	1 7/8	48	3	80	3	80	2 13/16	73	8.09	3.67
				4	100	2 3/4	70	2 13/16	73	2 7/16	62	3 11/16	94	3 11/16	94	3 1/2	89	14.03	6.36
3	80	3/4	20	3	80	2 1/8	54	2 1/8	54	2 1/8	54	3 1/8	79	2 11/16	68	3 1/8	79	8.25	3.74
		1	25	3	80	2 1/8	54	2 1/8	54	2 1/8	54	3 1/8	79	2 11/16	68	3 1/8	79	8.30	3.76
		1 1/4	32	3	80	2 1/8	54	2 1/8	54	2 1/8	54	3 1/8	79	2 13/16	73	3 1/8	79	8.46	3.84
		1 1/2	40	3	80	2 1/8	54	2 3/16	56	2 1/8	54	3 1/8	79	2 13/16	73	3 1/8	79	8.13	3.69
		2	50	1 1/2	40	1 3/8	35	1 1/2	38	2 3/16	56	2 5/16	59	2 3/16	56	2 13/16	73	6.83	3.10
				2	50	1 9/16	40	1 9/16	40	2 3/16	56	2 9/16	65	2 1/4	57	2 15/16	75	7.29	3.31
				2 1/2	65	1 7/8	48	1 15/16	49	2 1/8	54	2 13/16	73	2 9/16	65	3 1/16	78	7.10	3.22
				3	80	2 1/8	54	2 3/16	56	2 1/8	54	3 1/8	79	2 15/16	75	3 1/8	79	8.79	3.99
		2 1/2	65	1	25	1	25	15/16	24	2 1/8	54	2 1/16	52	1 15/16	49	2 11/16	68	5.51	2.50
				1 1/4	32	1 1/4	32	13/16	22	2 1/8	54	2 3/16	56	2 1/16	52	2 3/4	70	5.92	2.68
				1 1/2	40	1 3/8	35	15/16	24	2 3/16	56	2 5/16	59	2 3/16	56	2 13/16	73	6.23	2.83
				2	50	1 9/16	40	1 1/2	38	2 3/16	56	2 9/16	65	2 7/16	62	2 15/16	75	6.81	3.09
				2 1/2	65	1 7/8	48	1 13/16	47	2 1/8	54	2 13/16	73	2 11/16	68	3 1/16	78	7.66	3.47
				3	80	2 1/8	54	2 1/8	54	2 1/8	54	3 1/8	79	3 1/16	78	3 1/8	79	9.13	4.14
		3	80	1/2	15	15/16	24	15/16	24	2 3/16	56	1 7/8	48	1 7/8	48	2 5/8	67	6.08	2.76
				3/4	20	15/16	24	15/16	24	2 1/8	54	1 7/8	48	1 7/8	48	2 5/8	67	6.06	2.75
				1	25	1	25	1	25	2 1/8	54	2 1/16	52	2 1/16	52	2 11/16	68	6.27	2.84
				1 1/4	32	1 1/4	32	1 1/4	32	2 1/8	54	2 3/16	56	2 3/16	56	2 3/4	70	6.75	3.06
				1 1/2	40	1 3/8	35	1 3/8	35	2 3/16	56	2 5/16	59	2 5/16	59	2 15/16	75	7.10	3.22
				2	50	1 9/16	40	1 9/16	40	2 3/16	56	2 9/16	65	2 9/16	65	2 7/8	73	7.75	3.51
				2 1/2	65	1 7/8	48	1 7/8	48	2 1/8	54	2 13/16	73	2 13/16	73	3 1/16	78	8.92	4.05
				4	100	2 11/16	68	2 11/16	68	2 7/16	62	3 11/16	94	3 11/16	94	3 1/2	89	12.80	5.80

Note: See page 6 for pressure-temperature ratings.

Class 125 (Standard)

FIGURE 359
Tee Reducing

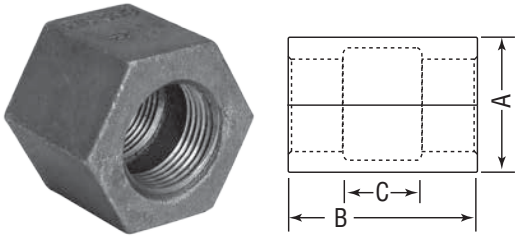


Size						A		B		C		D		E		F		Unit Weight Black	
NPS	DN	NPS	DN	NPS	DN	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lbs	kg
3 1/2	90	3 1/2	90	1 1/2	40	1 3/8	35	1 3/8	35	2 7/16	62	2 3/8	60	2 3/8	60	3 1/16	78	8.87	4.02
				2	50	1 5/8	41	1 5/8	41	2 7/16	62	2 5/8	67	2 5/8	67	3 3/16	81	9.94	4.51
4	100	1	25	4	100	2 3/4	70	2 15/16	75	2 3/4	70	3 3/4	95	3 1/2	89	3 3/4	95	13.52	6.13
		1 1/2	40	4	100	2 3/4	70	2 7/8	73	2 3/4	70	3 3/4	95	3 1/2	89	3 3/4	95	13.47	6.11
		2	50	2	50	1 11/16	43	1 7/8	48	2 3/4	70	2 11/16	68	2 9/16	65	3 1/2	89	11.34	5.14
				4	100	2 3/4	70	2 3/4	70	2 3/4	70	3 3/4	95	3 1/2	89	3 3/4	95	13.89	6.30
		2 1/2	65	2 1/2	65	1 7/8	48	1 13/16	47	2 5/8	67	2 15/16	75	2 13/16	73	3 9/16	90	11.78	5.34
				4	100	2 3/4	70	2 3/4	70	2 3/4	70	3 3/4	95	3 5/8	92	3 3/4	95	15.75	7.14
		3	80	2 1/2	65	1 7/8	48	1 7/8	48	2 5/8	67	2 15/16	75	2 13/16	73	3 9/16	90	11.25	5.10
				3	80	2 1/4	57	2 1/8	54	2 11/16	68	3 1/4	83	3 1/8	79	3 5/8	92	12.50	5.67
				4	100	2 3/4	70	2 11/16	68	2 3/4	70	3 3/4	95	3 5/8	92	3 3/4	95	15.04	6.82
		4	100	1	25	13/16	22	13/16	22	2 3/4	70	2 5/16	59	2 5/16	59	3 5/16	84	10.40	4.72
				1 1/4	32	15/16	24	15/16	24	2 5/8	67	2 5/16	59	2 5/16	59	3 5/16	84	10.38	4.71
				1 1/2	40	1 7/16	37	1 7/16	37	2 11/16	68	2 7/16	62	2 7/16	62	3 5/16	84	10.75	4.88
				2	50	1 11/16	43	1 11/16	43	2 3/4	70	2 11/16	68	2 11/16	68	3 1/2	89	11.63	5.27
				2 1/2	65	2	51	2	51	2 5/8	67	2 15/16	75	2 15/16	75	3 9/16	90	12.85	5.83
				3	80	2 1/4	57	2 1/4	57	2 11/16	68	3 1/4	83	3 1/4	83	3 5/8	92	14.12	6.40
				5	125	3 3/8	86	3 3/8	86	2 13/16	73	4 3/8	111	4 3/8	111	4	102	20.88	9.47
				6	150	3 7/8	98	3 7/8	98	2 7/8	73	4 15/16	125	4 15/16	125	4 1/16	103	26.36	11.95
5	125	5	125	2	50	1 3/4	44	1 3/4	44	3 7/16	87	2 15/16	75	2 15/16	75	4 1/8	105	17.43	7.90
				3	80	2 5/16	59	2 5/16	59	3 1/4	83	3 1/2	89	3 1/2	89	4 1/4	108	20.00	9.07
				4	100	2 13/16	71	2 13/16	71	3 3/8	86	4	102	4	102	4 3/8	111	23.83	10.81
6	150	4		4	100	2 7/8	73	2 13/16	71	3 7/8	98	4 1/16	103	4	102	4 15/16	125	30.00	13.61
		6	150	2 1/2	65	2	51	2	51	3 13/16	97	3 1/4	83	3 1/4	83	4 3/4	121	25.67	11.64
				3	80	2 3/8	60	2 3/8	60	3 13/16	97	3 9/16	90	3 9/16	90	4 13/16	122	27.46	12.45
				4	100	2 7/8	73	2 7/8	73	3 7/8	98	4 1/16	103	4 1/16	103	4 15/16	125	32.44	14.71
				5	125	3 3/8	86	3 3/8	86	3 13/16	97	4 5/8	117	4 5/8	117	5	127	37.00	16.78

Note: See page 6 for pressure-temperature ratings.

Class 125 (Standard)

FIGURE 366
Screwed Hex Coupling



Size		Across Flats A		B		C		Unit Weight Black	
NPS	*DN*	in	*mm*	in	*mm*	in	*mm*	lbs	*kg*
1	*25*	$1\frac{15}{16}$	*49*	$1\frac{11}{16}$	*43*	$\frac{9}{16}$	*14*	0.82	*0.37*

FIGURE 487
Flanged Union Gasket Type

Assembled with gaskets

NOT USE

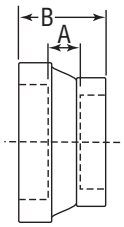
Size		Diam. of Flanges		No. of Bolts	Unit Weight Black		Unit Weight Galv.	
NPS	*DN*	in	*mm*	–	lbs	*kg*	lbs	*kg*
$\frac{1}{2}$	*15*	$2\frac{15}{16}$	*75*	3	1.75	*0.79*	1.75	*0.79*
$\frac{3}{4}$	*20*	3	*76*	3	2.00	*0.91*	2.00	*0.91*
1	*25*	$3\frac{1}{4}$	*83*	3	2.25	*1.02*	2.25	*1.02*
$1\frac{1}{4}$	*32*	$4\frac{3}{16}$	*106*	4	4.75	*2.15*	4.75	*2.15*
$1\frac{1}{2}$	*40*	$4\frac{3}{8}$	*111*	4	5.00	*2.27*	5.00	*2.27*
2	*50*	5	*127*	4	6.50	*2.95*	6.50	*2.95*
$2\frac{1}{2}$	*65*	$5\frac{5}{8}$	*143*	4	8.50	*3.85*	8.50	*3.85*
3	*80*	$6\frac{3}{8}$	*162*	4	11.00	*4.99*	11.00	*4.99*
$3\frac{1}{2}$	*90*	$6\frac{7}{8}$	*175*	4	12.75	*5.78*	–	–
4	*100*	$7\frac{11}{16}$	*195*	5	18.00	*8.16*	18.00	*8.16*
5	*125*	$8\frac{15}{16}$	*227*	5	22.00	*9.98*	–	–
6	*150*	$10\frac{1}{4}$	*260*	6	30.00	*13.61*	30.00	*13.61*
8	*200*	$12\frac{15}{16}$	*329*	8	51.00	*23.13*	51.00	*23.13*

Note: See following page for pressure-temperature ratings.

PROJECT INFORMATION	APPROVAL STAMP
Project:	☐ **Approved**
Address:	☐ **Approved as noted**
Contractor:	☐ **Not approved**
Engineer:	**Remarks:**
Submittal Date:	
Notes 1:	
Notes 2:	

Class 125 (Standard)

☐ **FIGURE 367**
Concentric Reducer



Size				A		B*		Unit Weight Black	
NPS	*DN*	NPS	*DN*	in	*mm*	in	*mm*	lbs	*kg*
3/4	*20*	1/2	*15*	5/8	*16*	1 9/16	*40*	0.40	*0.18*
1	*25*	1/2 (Hex)	*15*	11/16	*17*	1 11/16	*43*	0.54	*0.24*
		3/4 (Hex)	*20*	7/16	*11*	1 1/2	*38*	0.63	*0.29*
1 1/4	*32*	1/2	*15*	9/16	*14*	1 5/8	*41*	0.84	*0.38*
		3/4	*20*	1	*25*	2 1/8	*54*	0.90	*0.41*
		1	*25*	15/16	*24*	2 1/8	*54*	1.07	*0.49*
1 1/2	*40*	1/2	*15*	1/2	*13*	1 5/8	*41*	1.00	*0.45*
		3/4	*20*	1/2	*13*	1 5/8	*41*	1.20	*0.54*
		1	*25*	1/2	*13*	1 3/4	*44*	1.50	*0.68*
		1 1/4	*32*	1	*25*	2 1/4	*57*	1.45	*0.66*
2	*50*	1/2	*15*	5/8	*16*	2	*51*	2.00	*0.91*
		3/4	*20*	3/4	*19*	2	*51*	1.90	*0.86*
		1	*25*	3/4	*19*	2	*51*	1.83	*0.83*
		1 1/4	*32*	13/16	*22*	2 1/8	*54*	1.78	*0.81*
		1 1/2	*40*	7/8	*22*	2 3/16	*56*	1.98	*0.90*
2 1/2	*65*	1 1/2	*40*	3/4	*19*	2	*51*	3.10	*1.41*
		2	*50*	1	*25*	2 9/16	*65*	2.98	*1.35*
3	*80*	3/4	*20*	15/16	*24*	2 1/2	*64*	4.31	*1.95*
		2	*50*	1 1/16	*27*	2 3/4	*70*	3.96	*1.80*
		2 1/2	*65*	15/16	*24*	2 13/16	*73*	4.40	*2.00*
4	*100*	2	*50*	1 3/16	*30*	2 15/16	*75*	6.50	*2.95*
		2 1/2	*65*	1 3/16	*30*	3 1/8	*79*	7.78	*3.53*
		3	*80*	1 1/16	*27*	3 1/8	*79*	7.01	*3.18*
5	*125*	4	*100*	1 1/16	*27*	3 5/16	*84*	10.48	*4.75*
6	*150*	4	*100*	1 1/8	*29*	3 7/16	*87*	13.83	*6.27*
		5	*125*	1 1/8	*29*	3 9/16	*90*	15.53	*7.04*
8	*200*	6	*150*	1 1/4	*32*	3 7/8	*98*	29.10	*13.20*

* Dimension "B" does not conform to ASME standard.

Note: See following page for pressure-temperature ratings.

PROJECT INFORMATION	APPROVAL STAMP
Project:	☐ **Approved**
Address:	☐ **Approved as noted**
Contractor:	☐ **Not approved**
Engineer:	**Remarks:**
Submittal Date:	
Notes 1:	
Notes 2:	

Class 125 (Standard)

☐ FIGURE 390 Countersunk Plugs

NOT USE

See Fig. 390 in Malleable Iron for other available sizes.

Size		Unit Weight			
		Black		Galv.	
NPS	*DN*	lbs	*kg*	lbs	*kg*
1	*25*	0.20	*0.09*	0.20	*0.09*
1 1/4	*32*	0.32	*0.15*	0.32	*0.15*
1 1/2	*40*	0.47	*0.21*	0.47	*0.21*
2	*50*	0.84	*0.38*	0.84	*0.38*
2 1/2	*65*	1.40	*0.63*	–	–
3	*80*	2.25	*1.02*	–	–
3 1/2	*90*	3.02	*1.37*	–	–
4	*100*	3.76	*1.71*	–	–

☐ FIGURE 381 Cap

Size		Unit Weight			
		Black		Galv.	
NPS	*DN*	lbs	*kg*	lbs	*kg*
2 1/2	*65*	2.55	*1.16*	–	–
3	*80*	4.10	*1.86*	–	–
4	*100*	6.40	*2.90*	–	–
5	*125*	10.70	*4.85*	–	–
6	*150*	14.20	*6.44*	14.20	*6.44*
8	*200*	27.23	*12.35*	27.23	*12.35*

☐ FIGURE 370 Locknut

For nominal sizes smaller than 2½" *(65 DN)*, see Fig. 1134 in the Malleable Iron Section.

Size		Minimum Dimensions								Unit Weight
		A		B		C		D		Black
NPS	*DN*	in	*mm*	in	*mm*	in	*mm*	in	*mm*	lbs *kg*
2 1/2	*65*	3.500	*89*	3.180	*81*	.590	*15*	0.90	*2*	1.13 *0.51*
3	*80*	4.270	*108*	3.840	*98*	.670	*17*	0.90	*2*	1.60 *0.73*
4	*100*	5.380	*137*	5.000	*127*	.800	*20*	.130	*3*	1.10 *0.50*

According to specifications, hex bushings and cored plugs should be used with 150# malleable iron and 125# cast iron. Solid plugs and face bushings are recommended for use with 250# and 300# fittings.

Note: See following page for pressure-temperature ratings.

PROJECT INFORMATION	APPROVAL STAMP
Project:	☐ **Approved**
Address:	☐ **Approved as noted**
Contractor:	☐ **Not approved**
Engineer:	**Remarks:**
Submittal Date:	
Notes 1:	
Notes 2:	

Class 125 (Standard)

FIGURE 387 Square Head Plugs, Cored

NOT USE

Size		Unit Weight			
		Black		Galv.	
NPS	*DN*	lbs	*kg*	lbs	*kg*
3/4*	*20*	0.13	*0.06*	0.13	*0.06*
1	*25*	0.25	*0.11*	0.25	*0.11*
1 1/4	*32*	0.39	*0.18*	0.39	*0.18*
1 1/2	*40*	0.50	*0.23*	0.50	*0.23*
2	*50*	0.82	*0.37*	0.82	*0.37*
2 1/2	*65*	1.32	*0.60*	1.32	*0.60*
3	*80*	1.87	*0.85*	1.87	*0.85*
3 1/2	*90*	2.50	*1.13*	2.50	*1.13*
4	*100*	4.00	*1.81*	4.00	*1.81*

* Zinc Plated

FIGURE 388 Square Head Plugs, Solid

Size		Unit Weight			
		Black		Galv.	
NPS	*DN*	lbs	*kg*	lbs	*kg*
1/2	*15*	0.10	*0.05*	0.10	*0.05*
3/4	*20*	0.17	*0.08*	0.17	*0.08*
1	*25*	0.32	*0.15*	0.32	*0.15*
1 1/4	*32*	0.53	*0.24*	0.53	*0.24*
1 1/2	*40*	0.76	*0.34*	0.76	*0.34*
2	*50*	1.23	*0.56*	1.23	*0.56*
2 1/2	*65*	2.00	*0.91*	2.00	*0.91*
3	*80*	3.18	*1.44*	3.18	*1.44*
3 1/2	*90*	4.38	*1.99*	–	–

FIGURE 389 Bar Plugs, Cored

NOT USE

Size		Unit Weight			
		Black		Galv.	
NPS	*DN*	lbs	*kg*	lbs	*kg*
4	*100*	3.82	*1.73*	3.82	*1.73*
5	*125*	6.50	*2.95*	6.50	*2.95*
6	*150*	9.94	*4.51*	9.94	*4.51*
8	*200*	20.26	*9.19*	20.26	*9.19*

FIGURE 380 Bar Plugs, Solid

NOT USE

Size		Unit Weight	
		Black	
NPS	*DN*	lbs	*kg*
4	*100*	5.68	*2.58*
5	*125*	9.60	*4.35*
6	*150*	14.78	*6.70*

According to specifications, hex bushings and cored plugs should be used with 150# malleable iron and 125# cast iron. Solid plugs and face bushings are recommended for use with 250# and 300# fittings.

Note: See following page for pressure-temperature ratings.

PROJECT INFORMATION	APPROVAL STAMP
Project:	☐ **Approved**
Address:	☐ **Approved as noted**
Contractor:	☐ **Not approved**
Engineer:	**Remarks:**
Submittal Date:	
Notes 1:	
Notes 2:	

Malleable Iron Hex Bushing

FIGURE 383
Hex Bushing

Outside Hex – Type A

Inside Hex – Type B

See Cast Iron section on next page for other available sizes.

Size					Unit Weight			
					Black		Galv.	
NPS	*DN*	Hex Type	NPS	*DN*	lbs	*kg*	lbs	*kg*
¾	*10*	A	⅛	*6*	0.12	*0.05*	0.12	*0.05*
		A	¼	*8*	0.14	*0.06*	0.14	*0.06*
		A	⅜	*10*	0.11	*0.05*	0.11	*0.05*
		A	½	*15*	0.09	*0.04*	0.09	*0.04*
1	*25*	B	⅛	*6*	0.24	*0.11*	0.24	*0.11*
		B	¼	*8*	0.18	*0.08*	0.18	*0.08*
		B	⅜	*10*	0.18	*0.08*	0.18	*0.08*
		A	½	*15*	0.20	*0.09*	0.20	*0.09*
		A	¾	*20*	0.16	*0.07*	0.16	*0.07*
1¼	*32*	B	¼	*8*	0.33	*0.15*	0.33	*0.15*
		B	⅜	*10*	0.27	*0.12*	0.27	*0.12*
		B	½	*15*	0.34	*0.15*	0.34	*0.15*
		A	¾	*20*	0.39	*0.18*	0.39	*0.18*
		A	1	*25*	0.30	*0.14*	0.30	*0.14*
1½	*40*	A	1¼	*32*	0.30	*0.14*	0.30	*0.14*
2	*50*	A	1½	*40*	0.64	*0.29*	0.64	*0.29*
2½	*65*	A	2	*50*	1.02	*0.46*	1.02	*0.46*

Note: Hexagon head or octagon head bushings 2½ NPS *(65 DN)* and smaller reducing one size may be made of malleable iron, ductile iron or steel. Other sizes may be made of cast iron, ductile iron, malleable iron or steel. Face bushings 2½ NPS *(65 DN)* and smaller may be made of malleable iron, ductile iron or steel. Face bushings 3NPS *(80 DN)* and larger reducing one size may be made of malleable iron, ductile iron or steel. Face bushings 3NPS *(80 DN)* and larger reducing two sizes or more may be made of cast or malleable iron, ductile iron, or steel. According to specifications, hex bushings and cored plugs should be used with 150# malleable iron and 125# cast iron. Solid plugs and face bushings are recommended for use with 250# and 300# fittings.

Cast Iron Hex Bushings on next page.

PROJECT INFORMATION	APPROVAL STAMP
Project:	☐ **Approved**
Address:	☐ **Approved as noted**
Contractor:	☐ **Not approved**
Engineer:	**Remarks:**
Submittal Date:	
Notes 1:	
Notes 2:	

ANVIL®
INTERNATIONAL
Building Connections That Last

April 2012

For the most current product/pricing information on Anvil products, please visit our website at www.anvilintl.com.

Fire Products

BUILDING CONNECTIONS THAT LAST

GRUVLOK · SPF/ANVIL · Catawissa PERFORMANCE UNDER PRESSURE · ANVIL EPS ENGINEERED PIPE SUPPORTS · JBS · CANVIL · MERIT · BECK · ANVIL-STRUT · SEMINOLE Tubular Products

SPF™ Grooved Couplings & Flanges

SPF™ Grooved Product Line

SPF Grooved products are internationally manufactured to meet the most stringent standards as well as being UL/ULC listed and FM approved.

SPF™ Model C-4 Rigid Coupling

The SPF Model C-4 Rigid Coupling is specially designed to provide a rigid, locked-in pipe connection to meet the specific demands of a rigid piping system not allowing for expansion, contraction or deflection. Fast and easy swing-over installation of the rugged lightweight housing produces a secure, rigid pipe joint. The Model C-4 Rigid Coupling is UL/ULC Listed and FM Approved for fire protection service in both wet and dry systems, with roll grooved or cut grooved steel pipe prepared in accordance with Gruvlok grooving specifications. For the latest UL/ULC listed and FM approved pressure ratings versus pipe schedule, see www.anvilintl.com or contact your local Anvil Representative.

The Model C-4 Rigid Coupling with a Pre-Lubricated Grade "E" EPDM, Type "A" gasket is intended for use in fire protection systems installed in accordance with NFPA Standard 13 "Sprinkler Systems".

Available 1¼" – 8" nominal pipe sizes.

SPF™ Model C-3 Lightweight Flexible Coupling

The SPF Model C-3 Lightweight Flexible Coupling is designed for applications where system flexibility is desired. The Model C-3 Lightweight Flexible Coupling is approximately 30% lighter in weight than the Figure 7001 Coupling. For the latest UL/ULC listed and FM approved pressure ratings versus pipe schedule, see www.anvilintl.com or contact your local Anvil Representative.

The Model C-3 Lightweight Flexible Coupling with a Pre-Lubricated Grade "E" EPDM, Type "A" gasket is intended for use in fire protection systems installed in accordance with NFPA Standard 13 "Sprinkler Systems".

Available 1¼" – 8" nominal pipe sizes.

SPF™ Model RC-2 Reducing Coupling

The SPF Model RC-2 Reducing Coupling makes it possible to directly connect two different pipe sizes, eliminating the need for two couplings and a reducing fitting. The specially designed reducing coupling gasket with a center rib assures proper positioning of the gasket and prevents the smaller pipe from telescoping into the larger during assembly. For the latest UL/ULC listed and FM approved pressure ratings versus pipe schedule, see www.anvilintl.com or contact your local Anvil Representative. Model RC-2 Reducing Coupling comes complete with Grade "E" EPDM Gasket.

Available 2" – 8" nominal pipe sizes.

SPF™ Model F-3 Flange

The SPF Model F-3 Flange allows direct connection of Class 125 or Class 150 flanged components to a grooved piping system. The two interlocking halves of the 2" thru 12" sizes of the SPF Flange are hinged for ease of handling, and are drawn together by a latch bolt which eases assembly on the pipe. Precision machined bolt holes, key and mating surfaces assure concentricity and flatness to provide exact fit-up with flanged, lug, and wafer styles of pipe system equipment. A specially designed gasket provides a leak-tight seal on both the pipe and the mating flange face. For the latest UL/ULC listed and FM approved pressure ratings versus pipe schedule, see www.anvilintl.com or contact your local Anvil Representative.

SPF Flanges have designed-in anti-rotation tines which bite into and grip the sides of the pipe groove to provide a secure, rigid connection. The SPF Model F-3 Flange requires the use of a steel adapter insert when used against rubber faced surfaces, wafer/lug design valves and serrated or irregular sealing surfaces. Flange comes complete with Grade "E" EPDM Gasket.

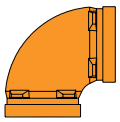
Available 2" – 12" nominal pipe sizes.

SPF™ Fittings for Grooved End Pipe

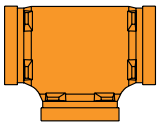
SPF Grooved Couplings and Fittings provide a rigid or flexible pipe connection for fire protection systems with dependable seals over a range of internal pressure situations. SPF also offers Short Pattern Products through 8" to meet all of your fire protection needs.

Material Specifications:

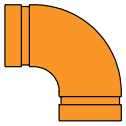
- **Cast Fittings:**
  Ductile iron conforming to ASTM A 536
- **Fabricated Fittings:**
  1-10" Carbon steel, Schedule 40, conforming to ASTM A 53, Grade B
  12" Carbon steel, Standard Wall, conforming to ASTM A 53, Grade B
- **Coating:**
  Rust inhibiting paint Color: ORANGE (standard)
  Hot-dipped zinc galvanized conforming to ASTM A 153 (optional)



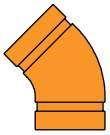
SPF Style SE-1
90° Elbow (Short Body)



SPF Style ST-1
Standard Tee (Short Body)



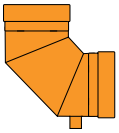
SPF Style E-1
90° Elbow



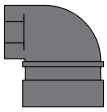
SPF Style E-2
45° Elbow

SPF Style E-3
22½° Elbow

SPF Style E-4
11¼° Elbow

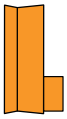


SPF Style E-9
90° Drain Elbow

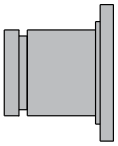


SPF Style SE-5
Reducing 90° Elbow
(Groove x Thread)

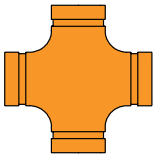
SPF Style SK-1
Cap



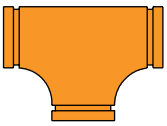
SPF Style K-9
Drain Cap



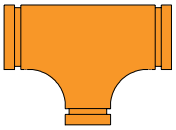
SPF Style F-2
Flange Nipple (ANSI 150)



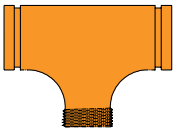
SPF Style X-1
Steel Cross



SPF Style T-1
Straight Tee

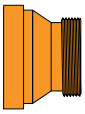


SPF Style T-2
Reducing Tee

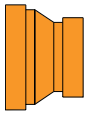


SPF Style T-3
Reducing Tee with
Threaded Branch

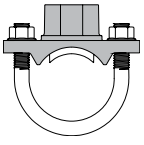
SPF Style R-2
Eccentric Reducer



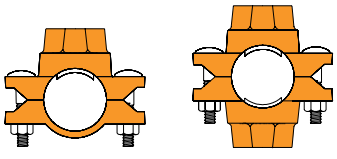
SPF Style R-3
Concentric Reducer (Groove x Thread)



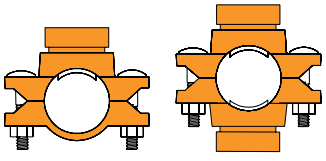
SPF Style R-1
Concentric Reducer



SPF Style MT-30
Mechanical Branch Tee (Threaded)

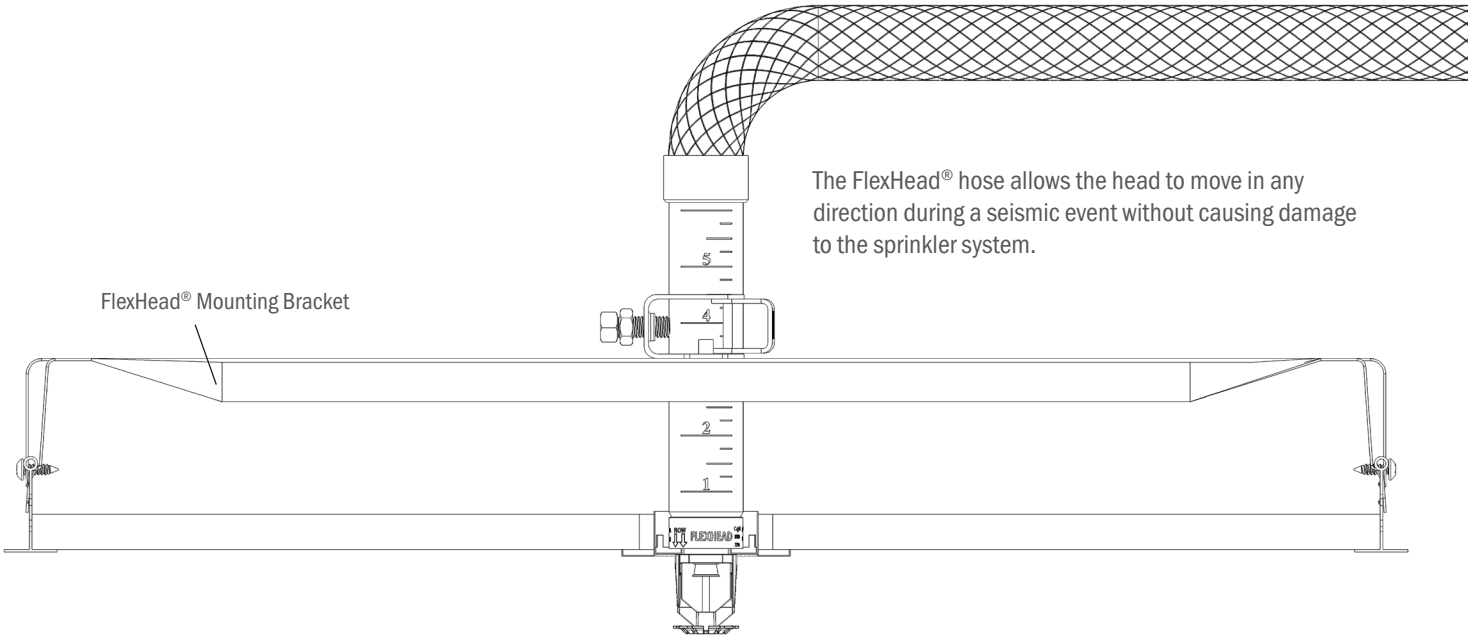


SPF Style MT-1
Mechanical Branch Tee (Threaded)



SPF Style MT-2
Mechanical Branch Tee (Grooved)

FLEXHEAD® SATISFIES SEISMIC CODE REQUIREMENTS

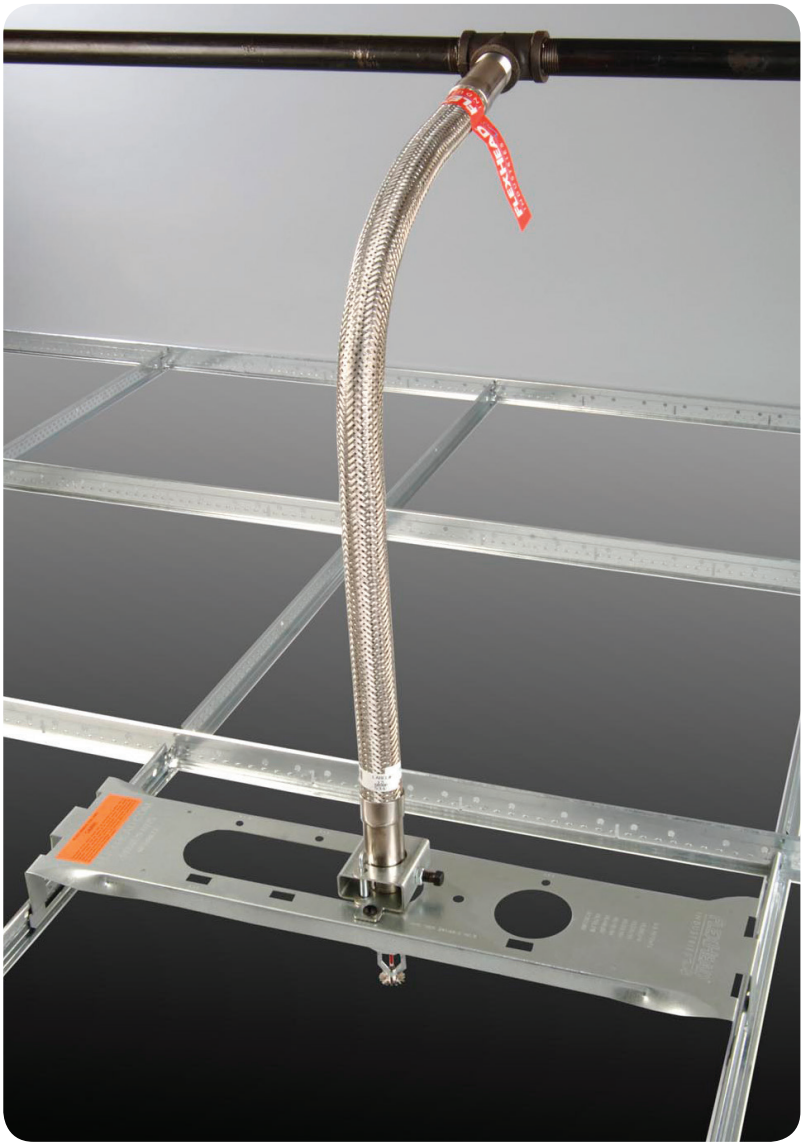


FlexHead® satisfactorily completed full-scale seismic qualification testing at the Structural Engineering Earthquake Simulation Laboratory located at the State University of New York at Buffalo. Tests were conducted using the International Code Council (ICC) acceptance criteria “ICC-ES AC-156 Seismic Qualification Testing of Nonstructural Components”.

- More than 90% of the states in the U.S. are adopting the International Building Code (IBC) that address, among other things, the installation of fire sprinkler systems in seismic zones.
- The latest version of the IBC defers to ASCE 7 and ASTM E580/580M-17 for the sprinkler/ceiling design in Seismic Design Categories C and D, E & F.
- In Seismic Design Category C, suspended ceilings are to be designed and installed in accordance with Ceilings & Interior Systems Construction Association (CISCA) recommendations for Zones 0-2; and sprinkler heads and other penetrations shall have a minimum of ¼ inch clearance on all sides.
- In Seismic Design Categories D, E & F, suspended ceilings are to be designed and installed in accordance with CISCA recommendations for seismic Zones 3 and 4 with some additional requirements. Except where rigid braces are used to limit lateral deflections, sprinkler heads and other penetrations shall have a 2-inch oversized ring, sleeve, or adapter through the ceiling to allow for free movement of at least 1 inch of ceiling movement in all horizontal directions.
- Flexible sprinkler connection provide characteristics that exceed the most stringent seismic code requirements. The flexibility of the hose allows the head to move with the ceiling in any direction during a seismic event without causing damage to the sprinkler system.

FLEXIBLE FIRE SPRINKLER CONNECTIONS

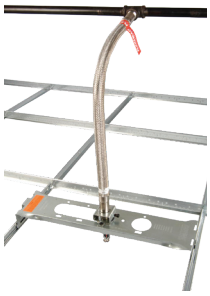
We invented the concept of Flexible Fire Protection™. All our flexible sprinkler pipe and connections are UL Listed and/or FM Approved.



THE ONLY PRODUCT THAT:

- Has undergone full-scale head deployment testing
- Is seismically qualified for use in Seismic Design Categories D, E & F
- Is made of 100% 304 stainless steel including end fittings
- Is fully welded without the need for o-rings or gaskets

FLEXHEAD®
TRUST THE ORIGINAL™



FLEXHEAD® FLEXIBLE FIRE SPRINKLER CONNECTIONS

- UL Listed/ FM Approved
- Undergone full-scale head deployment testing
- Seismically qualified for use in Seismic Design Categories C, D, E & F
- Made of 100% 304 stainless steel including end fittings
- Every FlexHead hose is leak tested before shipment
- Fully welded 304SS hose doesn't contain any O-rings or gaskets

INSTITUTIONAL FLEXIBLE FIRE SPRINKLER CONNECTIONS

- Available in hose lengths from 24" - 72" Designed to be installed in concrete walls or ceiling penetrations
- Available with open hub UHO-3 bracket for easier installation
- Easy installation in tight spaces
- UL Listed / FM Approved

FRICTION LOSS DATA & SPECIFICATIONS

Model Number	Outlet Orifice Size	Hose Assembly Length	Minimum Bend Radius		Maximum Number of 90˚ Bends		Equivalent Length of 1in. Diameter Schedule 40 Pipe (Ft)							Max Rated Pressure	
			FM	UL	UL	FM	UL	FM						FM	LU
								5.6k-factor	8.0k-factor	11.2k-factor	14.0k-factor	16.8k-factor	22.4k-factor		
	in (cm)	in (mm)	in (mm)	in (mm)	in (mm)	in (mm)	Ft (mm)	Ft (mm)	Ft (mm)	Ft (mm)	Ft (mm)	Ft (mm)	Ft (mm)	PSI/Kpa	PSI/Kpa
SUPERFLEX® 1" INTERNAL DIAMETER (I.D.) HOSE SERIES (Data equivalent for all end connection 1" NPT, 1" Cut Groove and SLT)															
2036SF-50	½ (1.27)	36 (914)	7 (178)	2 (50.8)	5	2	30 (9.1)	16.2 (4.9)	16.9 (5.1)	11.5 (3.5)	–	–	–		
2048SF-50		48 (1219)			8	3	47 (14.3)	28.7 (8.7)	29.3 (8.9)	15.4 (4.7)	–	–	–		
2072SF-50		72 (1828)			12	4	71 (21.6)	53.9 (16.4)	54.3 (16.5)	23.2 (7)	–	–	–		
2036SF-75	¾ (1.90)	36 (914)	7 (178)	2 (50.8)	5	2	29 (8.8)	–	21.5 (6.5)	21.6 (6.5)	21.8 (6.6)	22 (6.7)	–		
2048SF-75		48 (1219)			8	3	44 (13.4)	–	30.5 (9.2)	30.6 (9.3)	31.1 (9.4)	30.8 (9.3)	–		
2072SF-75		72 (1828)			12	4	70 (21.3)	–	48.5 (14.7)	48.8 (14.8)	49.9 (15.2)	48.6 (14.8)	–		
FLEXHEAD STANDARD TALL 1" INTERNAL DIAMETER (I.D.) HOSE SERIES															
2024T-50	½ (1.27)	24 (610)	8 (200)	3 (76.2)	3	1	11 (3.4)	18.4 (5.6)	7.7 (2.3)	7.6 (2.3)	–	–	–	175 (1205)	175 (1205)
2036T-50		36 (914)			3	2	16 (4.9)	26.6 (8.1)	11.5 (3.5)	11.5 (3.5)	–	–	–		
2048T-50		48 (1219)			4	3	24 (7.3)	30.3 (9.2)	15.3 (4.6)	15.4 (4.7)	–	–	–		
2060T-50		60 (1524)			4	4	29 (8.8)	35.8 (10.9)	19.1 (5.8)	19.3 (5.8)	–	–	–		
2072T-50		72 (1828)			4	4	35 (10.7)	45.6 (13.9)	23.0 (7)	23.2 (7)	–	–	–		
2024T-75	¾ (1.90)	24 (610)	8 (200)	3 (76.2)	3	1	12 (3.7)	–	7.3 (2.2)	5.9 (1.8)	14.7 (4.5)	7.1 (2.1)	–	175 (1205)	175 (1205)
2036T-75		36 (914)			3	2	18 (5.5)	–	21.5 (6.5)	10.4 (3.1)	21.8 (6.6)	10.9 (3.3)	–		
2048T-75		48 (1219)			4	3	23 (7)	–	30.5 (9.3)	14.9 (4.5)	29 (8.8)	14.8 (4.5)	–		
2060T-75		60 (1524)			4	4	29 (8.8)	–	39.5 (12)	19.4 (4.5)	36.1 (11)	18.7 (5.6)	–		
2072T-75		72 (1828)			4	4	32 (9.8)	–	48.5 (14.7)	24.0 (7.3)	43.2 (13.1)	22.6 (6.8)	–		
FLEXHEAD® STANDARD TALL ELBOW 1" INTERNAL DIAMETER (I.D.) HOSE SERIES															
2024ET-50	½ (1.27)	24 (610)	8 (200)	3 (76.2)	3	1	19 (5.8)	26.4 (8.0)	6.8 (2)	7.4 (2.2)	–	–	–	175 (1205)	175 (1205)
2036ET-50		36 (914)			3	2	23 (7.0)	30.1 (9.2)	11.8 (3.6)	12.5 (3.8)	–	–	–		
2048ET-50		48 (1219)			4	3	27 (8.2)	33.8 (10.3)	16.9 (5.1)	17.6 (5.3)	–	–	–		
2060ET-50		60 (1524)			4	4	32 (9.8)	37.5 (11.4)	21.9 (6.6)	22.7 (6.9)	–	–	–		
2072ET-50		72 (1828)			4	4	35 (10.7)	41.2 (12.5)	27.0 (8.2)	27.8 (8.4)	–	–	–		
2024ET-75	¾ (1.90)	24 (610)	8 (200)	3 (76.2)	3	1	18 (5.5)	-	8.8 (2.6)	8.7 (2.6)	14.7 (4.5)	8.2 (2.5)	–	175 (1205)	175 (1205)
2036ET-75		36 (914)			3	2	23 (7.0)	–	25.5 (7.7)	14.2 (4.2)	21.8 (6.6)	13 (3.9)	–		
2048ET-75		48 (1219)			4	3	23 (7.0)	–	32.9 (10)	18.4 (5.6)	29 (8.8)	17.8 (5.4)	–		
2060ET-75		60 (1524)			4	4	29 (8.8)	–	40.6 (12.3)	22.7 (6.9)	36.1 (11.0)	22.6 (6.8)	–		
2072ET-75		72 (1828)			4	4	32 (9.8)	–	48.5 (14.7)	27.0 (8.2)	43.2 (13.1)	27.5 (8.3)	–		
FLEXHEAD® HIGH PRESSURE 1" INTERNAL DIAMETER (I.D.) HOSE SERIES															
2024H-50	½ (1.27)	24 (610)	8 (200)	3 (76.2)	3	2	11 (3.4)	18.4 (5.6)	7.7 (2.3)	7.6 (2.3)	–	–	–	300 (2068)	300 (2068)
2036H-50		36 (914)			3	3	16 (4.9)	26.6 (8.1)	11.5 (3.5)	11.5 (3.5)	–	–	–		
2048H-50		48 (1219)			4	4	24 (7.3)	30.3 (9.2)	15.3 (4.6)	15.4 (4.7)	–	–	–		
2060H-50		60 (1524)			4	4	29 (8.8)	35.8 (10.9)	19.1 (5.8)	19.3 (5.8)	–	–	–		
2072H50		72 (1828)			4	4	35 (10.7)	45.6(12.5)	23.0 (7)	23.2 (7)	–	–	–		
2024ET-75	¾ (1.90)	24 (610)	8 (200)	3 (76.2)	3	1	12 (3.7)	-	14.7 (4.5)	6.8 (2.0)	14.7 (4.5)	8.2 (2.1)	–	300 (2068)	300 (2068)
2036ET-75		36 (914)			3	2	18 (5.5)	–	21.5 (6.5)	11.4 (3.4)	21.8 (6.6)	10.9 (3.3)	–		
2048ET-75		48 (1219)			4	3	23 (7.0)	–	30.5 (9.2)	16.0 (5.1)	29 (8.8)	14.8 (4.5)	–		
2060ET-75		60 (1524)			4	4	29 (8.8)	–	39.5 (12)	20.6 (6.2)	36.1 (11.0)	18.7 (5.7)	–		
2072ET-75		72 (1828)			4	4	32 (9.8)	–	48.5 (14.7)	25.3 (7.7)	43.2 (13.1)	22.6 (6.5)	–		

FRICTION LOSS DATA & SPECIFICATIONS (CONT'D)

Model Number	Outlet Orifice Size	Hose Assembly Length	Minimum Bend Radius		Maximum Number of 90˚ Bends		Equivalent Length of 1in. Diameter Schedule 40 Pipe (Ft)							Max Rated Pressure	
			FM	UL	UL	FM	UL	FM						FM	LU
								5.6k-factor	8.0k-factor	11.2k-factor	14.0k-factor	16.8k-factor	22.4k-factor		
	in (cm)	in (mm)	in (mm)	in (mm)	in (mm)	in (mm)	Ft (mm)	Ft (mm)	Ft (mm)	Ft (mm)	Ft (mm)	Ft (mm)	Ft (mm)	PSI/Kpa	PSI/Kpa
FLEXHEAD® HIGH PRESSURE ELBOW 1" INTERNAL DIAMETER (I.D.) HOSE SERIES															
2024HE-50	½ (1.27)	24 (610)	8 (200)	3 (76.3)	3	2	19 (5.8)	14.7 (4.5)	6.8 (2)	7.4 (2.2)	–	–	–	300 (2068)	300 (2068)
2036HE-50		36 (914)			3	3	23 (7.0)	21.8 (6.6)	11.8 (3.6)	12.5 (3.8)	–	–	–		
2048HE-50		48 (1219)			4	4	27 (8.2)	29.0 (8.8)	16.9 (5.1)	17.6 (5.3)	–	–	–		
2060HE-50		60 (1524)			4	4	32 (9.8)	36.1 (11)	21.9 (6.6)	22.7 (6.9)	–	–	–		
2072HE-50		72 (1828)			4	4	35 (10.7)	43.2 (13.1)	27.0 (8.2)	27.8 (8.4)	–	–	–		
2024HE-75	¾ (1.90)	24 (610)	8 (200)	3 (76.3)	3	2	18 (5.5)	-	14.7 (4.5)	-	14.7 (4.5)	8.2 (4.5)	–	300 (2068)	300 (2068)
2036HE-75		36 (914)			3	3	23 (7.0)	-	25.2 (7.7)	26 (7.9)	21.8 (8.6)	13 (3.9)	–		
2048HE-75		48 (1219)			4	4	23 (7.0)	–	32.9 (10)	33 (10)	29 (8.8)	17.8 (5.4)	–		
2060HE-75		60 (1524)			4	4	29 (8.8)	-	40.5 (12.3)	40 (12.2)	36.1 (11.0)	22.6 (6.8)	-		
2072HE-75		72 (1828)			4	4	32 (9.8)	-	48.5 (14.8)	47 (14.3)	43.2 (13.1)	27.5 (8.3)	-		
FLEXHEAD® DRY PENDENT SYSTEM 1" INTERNAL DIAMETER (I.D.) HOSE SERIES															
2024-DPS	1 (2.54)	24 (610)	7 (200)	-	-	1	-	18.4 (5.6)	7.7 (2.3)	7.6 (2.3)	–	7.1 (2.1)	10.7 (3.3)	-	175 (1205)
2036-DPS		36 (914)			-	2	-	26.6 (8.1)	11.5 (3.5)	11.5 (3.5)	–	10.9 (3.3)	15.1 (4.6)		
2048-DPS		48 (1219)			-	3	-	30.3 (9.2)	15.3 (4.7)	15.4 (4.7)	–	14.8 (4.5)	21.5 (6.5)		
2060-DPS		60 (1524)			-	4	-	35.8 (10.9)	19.1 (5.8)	19.3 (5.9)	–	18.7 (5.7)	25.3 (7.7)		
2072-DPS		72 (1828)			-	4	-	45.6 (13.9)	23.0 (7)	32.2 (7)	–	22.6 (6.9)	26.9 (8.1)		
FLEXHEAD® INSTITUTIONAL 1" INTERNAL DIAMETER (I.D.) HOSE SERIES															
2024I	½ (1.27)	24 (610)	8 (200)	3 (76.2)	3	1	11 (3.4)	18.4 (5.6)	–	–	–	–	–	175 (1205)	175 (1205)
2036I		36 (914)			3	3	16 (4.9)	26.6 (8.1)	–	–	–	–	–		
2048I		48 (1219)			4	4	24 (7.3)	30.3 (9.2)	–	–	–	–	–		
2060I		60 (1524)			4	4	29 (8.8)	35.8 (10.9)	–	–	–	–	–		
2072ET-50		72 (1828)			4	4	35 (10.7)	45.6 (13.9)	–	–	–	–	–		
2024I	¾ (1.90)	24 (610)	8 (200)	3 (76.2)	3	1	12 (3.7)	-	–	–	11.6 (3.5)	–	–	175 (1205)	175 (1205)
2036I		36 (914)			3	2	18 (5.5)	–	–	–	16 (4.9)	–	–		
2048I		48 (1219)			4	3	23 (7.0)	–	–	–	17.9 (5.4)	–	–		
2060I		60 (1524)			4	4	29 (8.8)	–	–	–	24.7 (7.5)	–	–		
2072I		72 (1828)			4	4	32 (9.8)	–	–	–	28.9 (8.8)	–	–		

Notes:

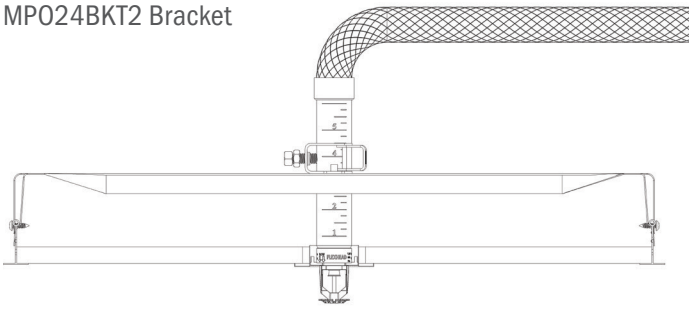
Model Numbers:

- "SF" designates SuperFlex® Hose series.
- "ESF" designates SuperFlex® Elbow Hose series.
- "E" designates elbow drop hose series
- "T" designates straight tall style hose
- "ET" designates elbow tall style hose series.
- "H" designates high pressure 300psi working pressure hose series.
- "HE" designates high pressure 300psi elbow hose series.
- "DPS" designates dry pendant system.
- "DT" designates drain tee hose series used in dry pendent/freezer application.
- "SLT" designates SlideLOK® technology.
- "DPS" and "DT" models are approved for use in cold storage application (Freezer, Cold Chamber) and combine an approved flexible sprinkler hose and an approved dry pendent sprinkler. UHO-1 or UHO-3 is required to connect the flexible sprinkler hose to the dry sprinkler.
- "I" indicates instiutional flexible hose.
- "A" indicates models for use with Amerlux Ceiling System.
- "50" designates 1⁄2" Outlet Hose series. The "75" designates 3⁄4" Outlet Hose series. Inlet size 1".
- Max Ambient Temperature Rating on all model numbers are 300˚ F (148˚ C).
- Equivalent lengths are shown with maximum number of 90˚ bends at the minimum bend radius per agency. 2-45˚ or 3-30˚ bend equal 1-90˚ bend. Different values were obtained by FM and UL due to the difference in minimum bend radius, testing protocol and calculation methods. Please see individual standards for more information relative to Friction Loss (equivalent length of pipe).
- All hoses require a minimum of one bend for installation. Bend radius tool available for 3" bend "T" hose, "SF" hose does not require bend radius tool.
- FM equivalent length calculation includes Sprinkler Head Friction Loss.
- See listing(s) approval agency for the latest approval details.
- Friction loss data and specification of SuperFlex series include all end connection such as 1" NPT, 1" cut groove, and SLT. Specify end connection when ordering.

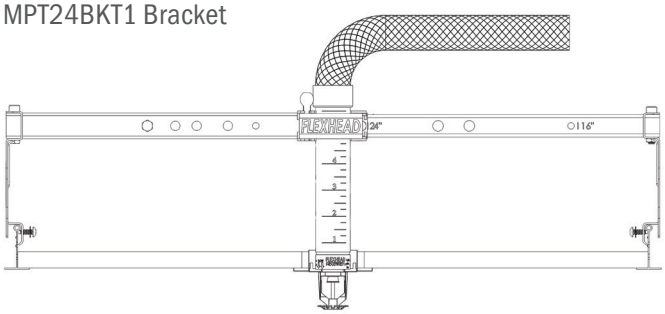
FLEXHEAD® CEILING DETAIL

SUSPENDED CEILING DETAIL

MPO24BKT2 Bracket



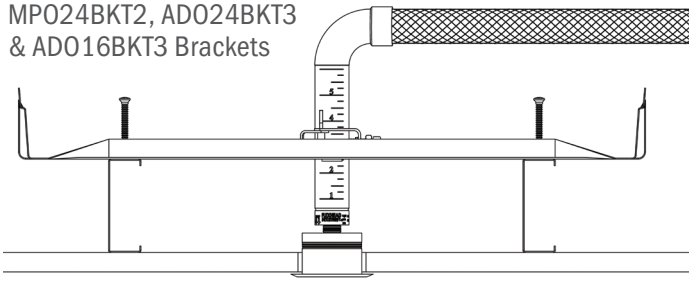
MPT24BKT1 Bracket



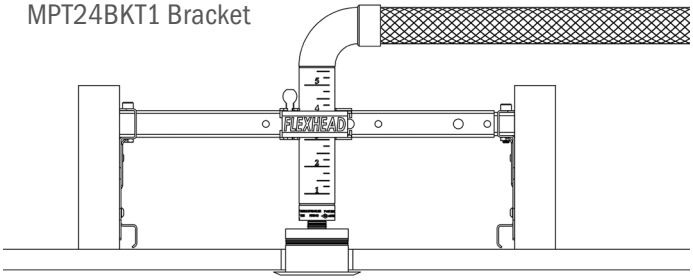
*Allows for bracket installation without pre-installing the ceiling tile

GYPSUM BOARD HARD CEILING DETAIL

MPO24BKT2, ADO24BKT3 & ADO16BKT3 Brackets

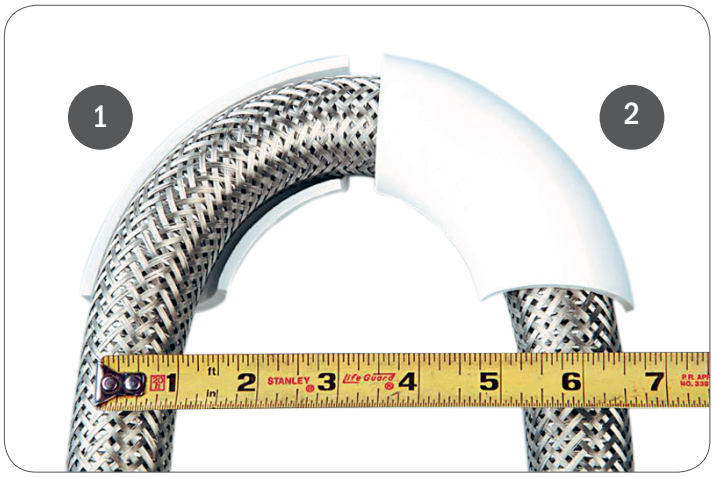


MPT24BKT1 Bracket

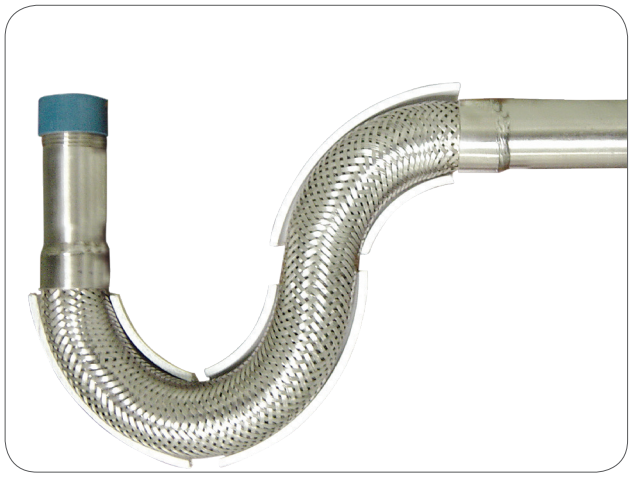


Each FM approved and UL listed unit is ready to install, pressure- and leak-tested, and comes complete with a flexible stainless steel hose and mounting bracket with adjustable hub.

FLEXHEAD® STANDARD HOSE 3" BEND RADIUS PER UL GUIDELINES (2 BENDS SHOWN)*

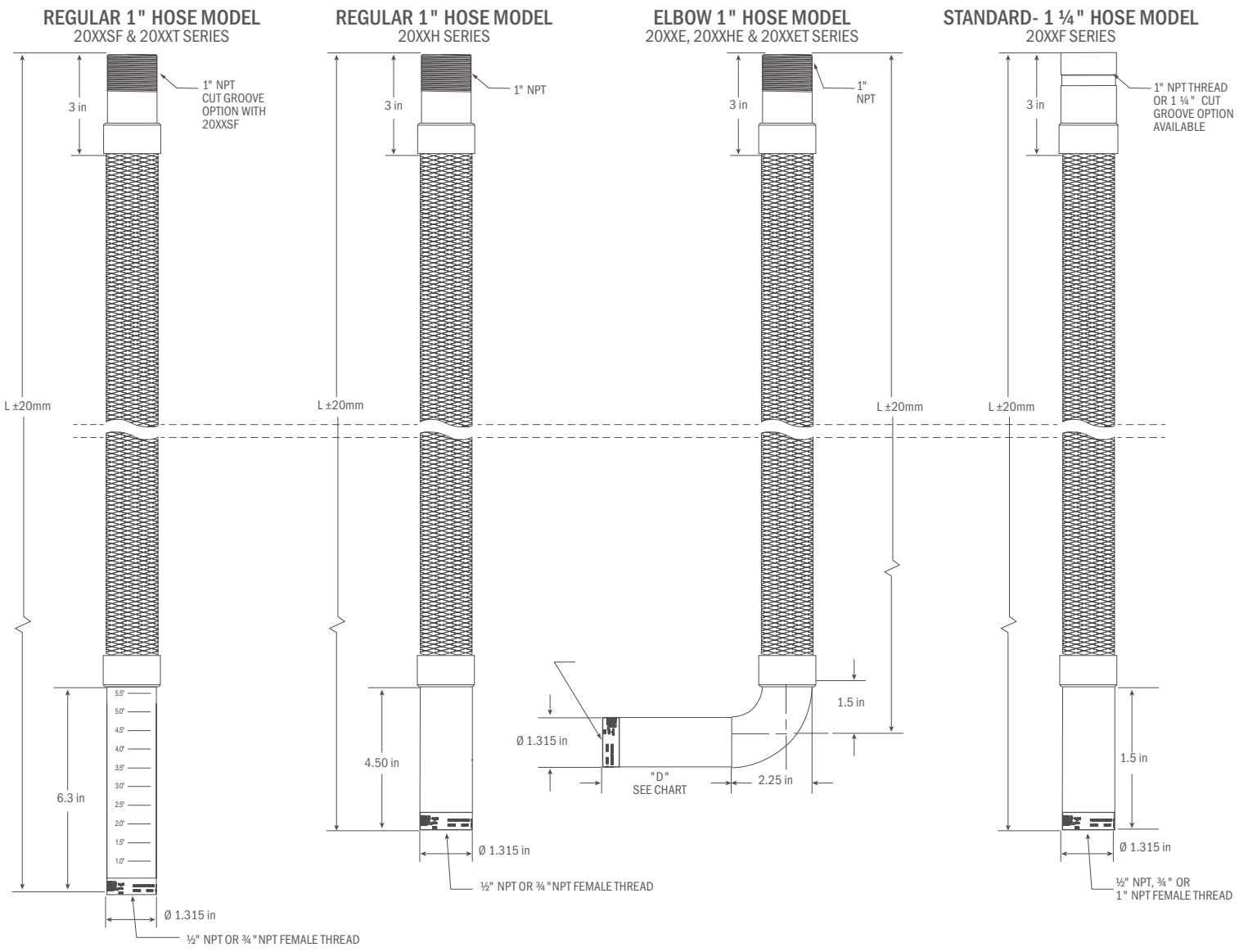


FLEXHEAD® STANDARD HOSE SHOWN WITH 3 BENDS



* Notes: SuperFlex® has a 2" bend radius. For more information on SuperFlex® specification refer to page 10.

FLEXHEAD® CEILING DETAIL

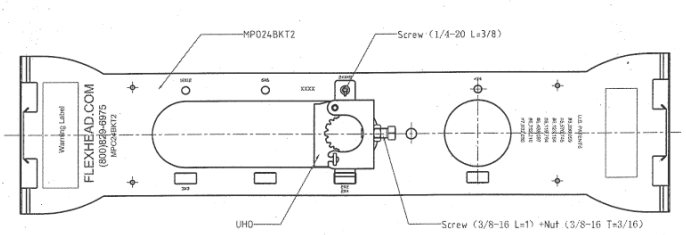


MODEL #	"Hose Assembly (L) Length Inches (mm)"	"Drop ""D"" Size (Inches)"
2024E/2024HE	24 (610)	1.5, 3.0, & 4.0
2036E/2036HE	36 (914)	
2048E/2048HE	48 (1219)	
2060E/2060HE	60 (1524)	
2072E/2072HE	72 (1828)	
2024ET	24 (610)	5.71
2036ET	36 (914)	
2048ET	48 (1219)	
2060ET	60 (1524)	
2072ET	72 (1828)	

BRACKET SPECIFICATION SHEET

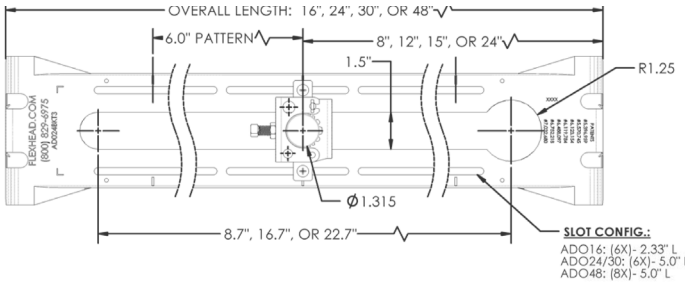
MODEL MP024BKT2

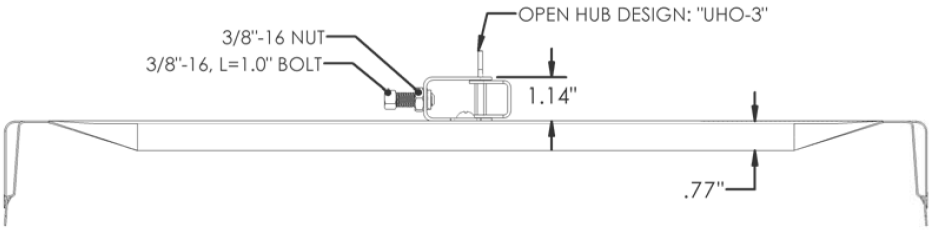
Multiport Design (For use with T-bar and Metal Stud Applications)



MODEL AD016BKT3, AD024BKT3, AD030BKT3, & AD048BKT3

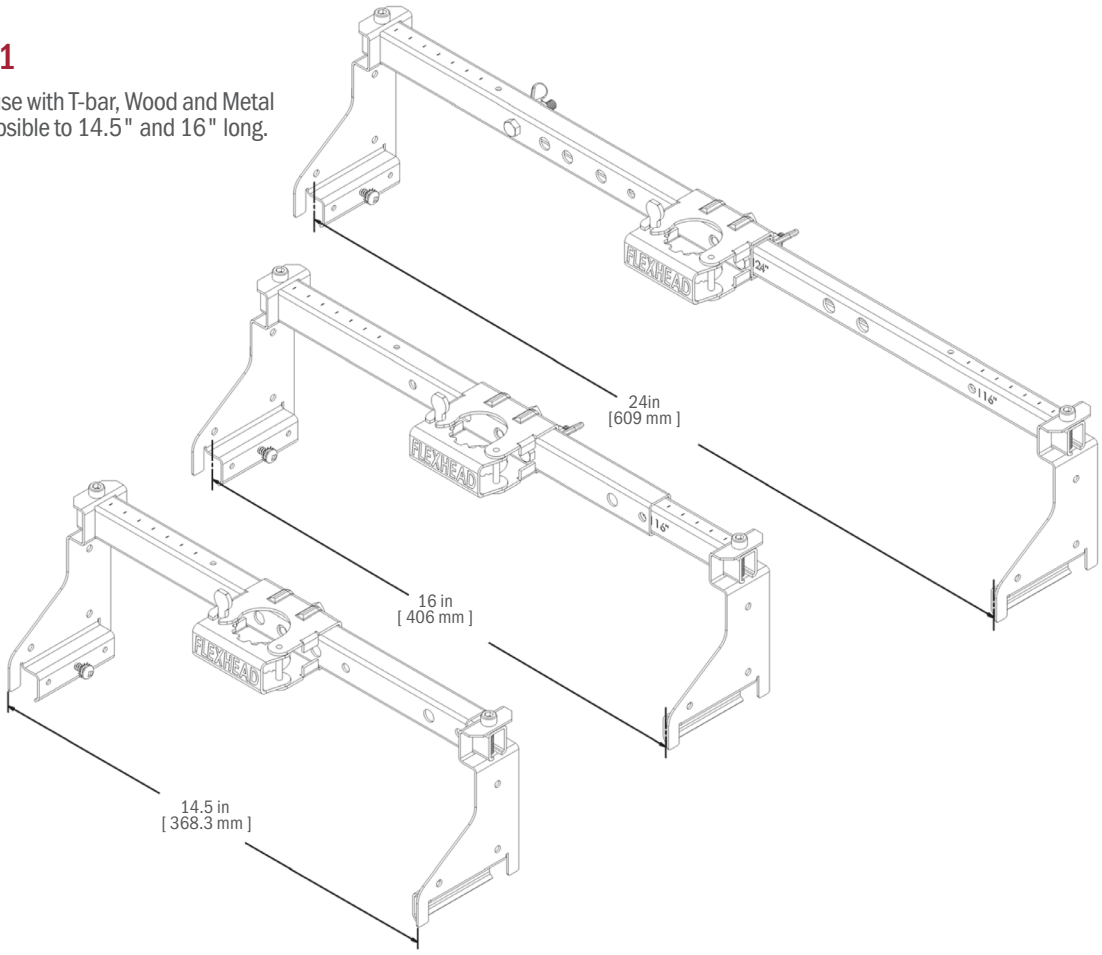
Adjustable Design (For use with T-bar, Metal Stud and Chicago Grid Applications): standard sizes are 16", 24", 30" and 48" long





MODEL MPT24BKT1

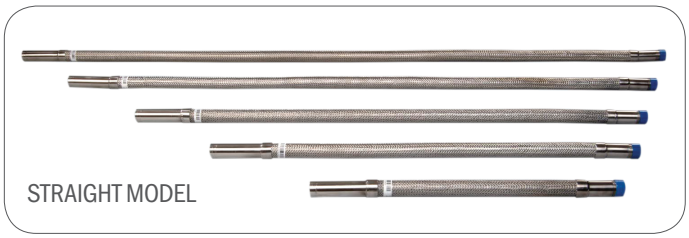
Multi-Position Tall Bracket (For use with T-bar, Wood and Metal Studs): 24" standard size collapsible to 14.5" and 16" long.



FLEXHEAD® COMMERCIAL PRODUCTS

STANDARD FLEXHEAD® HOSE LENGTHS: 24", 36", 48", 60" AND 72"

24", 36", 48", 60",and 72" hose lengths, Rated working pressure 175psi, optional 300psi. Standard 1" I.D., optional 1¼" I.D.



STRAIGHT MODEL

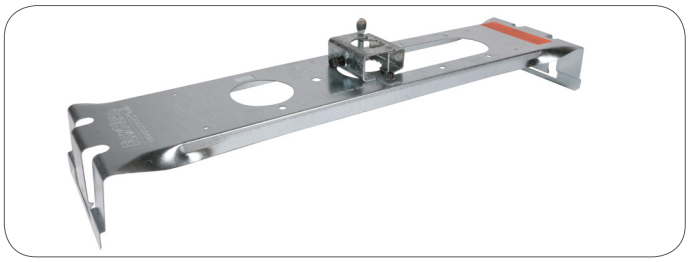
24", 36", 48", 60",and 72" hose lengths. Rated working pressure 175psi, optional 300psi.

ELBOW MODEL

SUPERFLEX® HOSE LENGTHS: 36", 48", AND 72"

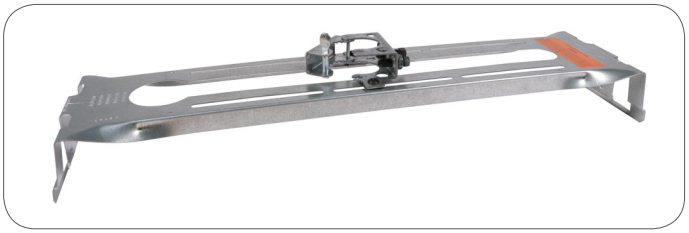
MODEL MP024BKT2

24" Multiport Bracket for T-bar Grid or Metal Stud applications. 6" stable mounting bracket.



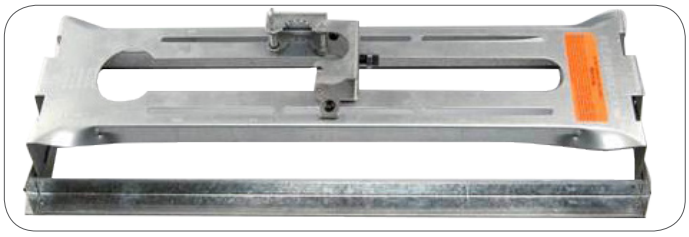
MODELS AD016BKT3, AD024BKT3, AD030BKT3 & AD048BKT3

16", 24", 30", 48" Adjustable Bracket for T-bar Grid, Chicago Grid or Metal Stud applications.



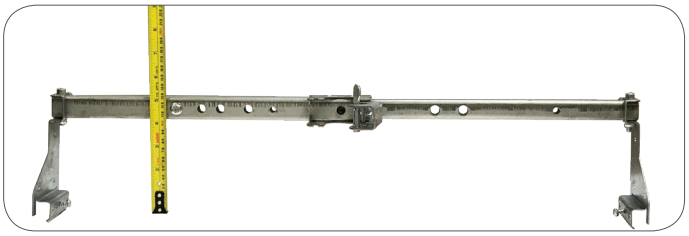
MODEL AD024BKT3 WITH BKT-HTA

Hat Channel Bracket System for Metal Stud or Hat Channel applications.



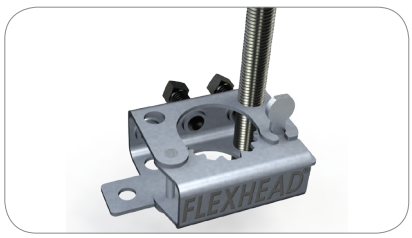
MODEL MPT24BKT1

24" Multi-Position Tall Bracket, collapses to 14 ½" and 16". Installs in suspended ceilings without touching the ceiling tiles.



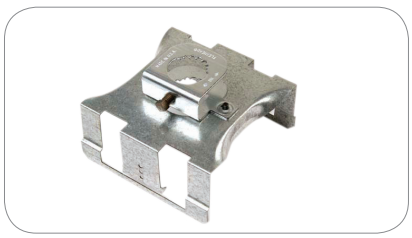
MODEL UHO-3

Designed for quick and easy installation. Ideal for shell applications. Can be installed with ⅜" threaded rod up to 4' off structure and with ½" threaded rod up to 6' off structure.



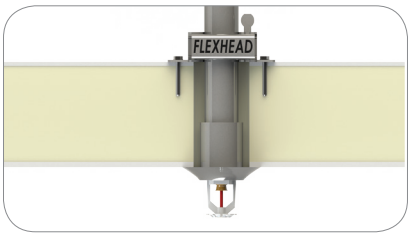
MODEL SP06TZBKT2

Armstrong® TechZone Ceiling Bracket for use with Armstrong TechZone Ceiling systems. Available in 6" widths.



MODEL 20XX-DPS-UHO-3

Dry Pendent System for Freezer and Cold Storage applications



3. SPRINKLER HEADS AND ACCESSORIES

DRY PIPE AUTOMATIC FIRE SPRINKLER SYSTEM

Reliable®

F1FR80 Series
Quick-Response Sprinklers

K-factor 8.0 (115)

Features

- Standard coverage quick-response sprinklers
- Upright and pendent orientations
- Low profile, compact design
- Available in a wide variety of finishes
- Available as Intermediate Level sprinklers

Product Description

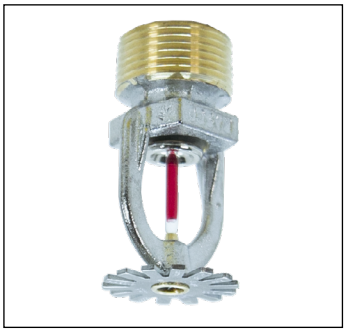
Reliable Model F1FR80 series sprinklers are quick-response standard spray automatic fire sprinklers utilizing a sensitive 3mm glass bulb thermal element.

Pendent sprinklers may be installed exposed, or surface mounted using escutcheons such as the Reliable Models B, C, or HB (reference Technical Bulletin 204). When installed recessed, the Model F1FR80 series sprinklers are specifically listed with and may only be installed with listed Reliable recessed escutcheons. Refer to the technical information on the following pages for specific listings for recessed installations and refer to Figure 3 for dimensional information.

When fitted with an approved Reliable water shield, these sprinklers may considered intermediate sprinklers for use in racks, below grated walkways, and other areas where intermediate level sprinklers are required.

Table A provides a summary of the approvals and availability of specific Model F1FR series sprinkler configurations. Additional technical information for each sprinkler model is provided on the following pages.

Model F1FR80
Upright Sprinkler



Model F1FR80 Pendent Sprinkler

Note: Not all versions of the product are shown.

F1FR80 Series Sprinkler Summary — **Table A**

Sprinkler Model	K-Factor gpm/psi$^{1/2}$ (lpm/bar$^{1/2}$)	Max. Working Pressure psi (bar)	Listings & Approvals	Orientation	Sprinkler Identification Number (SIN)
F1FR80	8.0 (115)	175 (12) 250 (17) (cULus only)	cULus, FM, LPCB, VdS, CE, UKCA	Upright	RA6322
				Pendent	RA6312

Model F1FR80 Upright Sprinkler — SIN RA6322

Technical Specifications
Style: Upright
Threads: 3/4" NPT or ISO 7-R3/4
Nominal K-Factor: 8.0 (115)
Max. Working Pressure:
175 psi (12 bar)
250 psi (17 bar) (cULus only)

Material Specifications
Thermal Sensor: 3 mm Glass Bulb
Sprinkler Frame: Brass Alloy
Cap: Bronze Alloy
Sealing Washer: Nickel with PTFE
Load Screw: Copper Alloy
Deflector: Brass Alloy

Sprinkler Finishes
(See Table B)

Sensitivity
Quick response

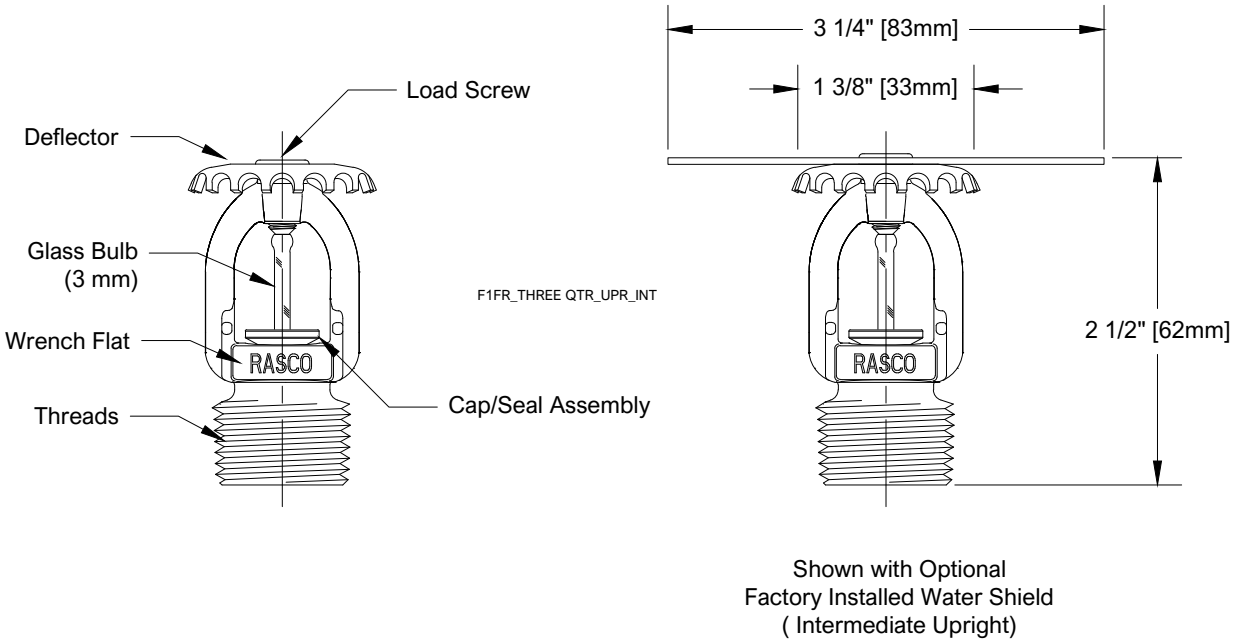
Temperature Ratings
135°F (57°C)
155°F (68°C)
175°F (79°C)
200°F (93°C)
286°F (141°C)

Guards & Shields
F-1 Guard (cULus, FM)
F-2 Guard (FM)
F-3 Guard with Shield (cULus, FM)
Factory Installed Shield (cULus, FM)

Sprinkler Wrenches
Model W2
Model W14 (with guard installed)

Listings and Approvals
cULus
FM
LPCB
VdS
CE
UKCA: 0832-UKCA-CPR-S5078

Model F1FR80 Upright Sprinkler Components and Dimensions — **Figure 1**



Shown with Optional
Factory Installed Water Shield
(Intermediate Upright)

Model F1FR80 Pendent Sprinkler — SIN RA6312

Technical Specifications
Style:
Pendent
Recessed Pendent
Threads: 3/4" NPT or ISO 7-R3/4
Nominal K-Factor: 8.0 (115)
Max. Working Pressure:
175 psi (12 bar)
250 psi (17 bar) (cULus only)

Material Specifications
Thermal Sensor: 3 mm Glass Bulb
Sprinkler Frame: Brass Alloy
Cap: Bronze Alloy
Sealing Washer: Nickel with PTFE
Load Screw: Copper Alloy
Deflector: Brass Alloy

Sprinkler Finishes
(See Table B)

Sensitivity
Quick response

Temperature Ratings[1]
135°F (57°C)
155°F (68°C)
175°F (79°C)
200°F (93°C)
286°F (141°C)

Recessed Escutcheons
Model F1 (cULus)
Model F2 (cULus, FM)
Model FP (cULus)

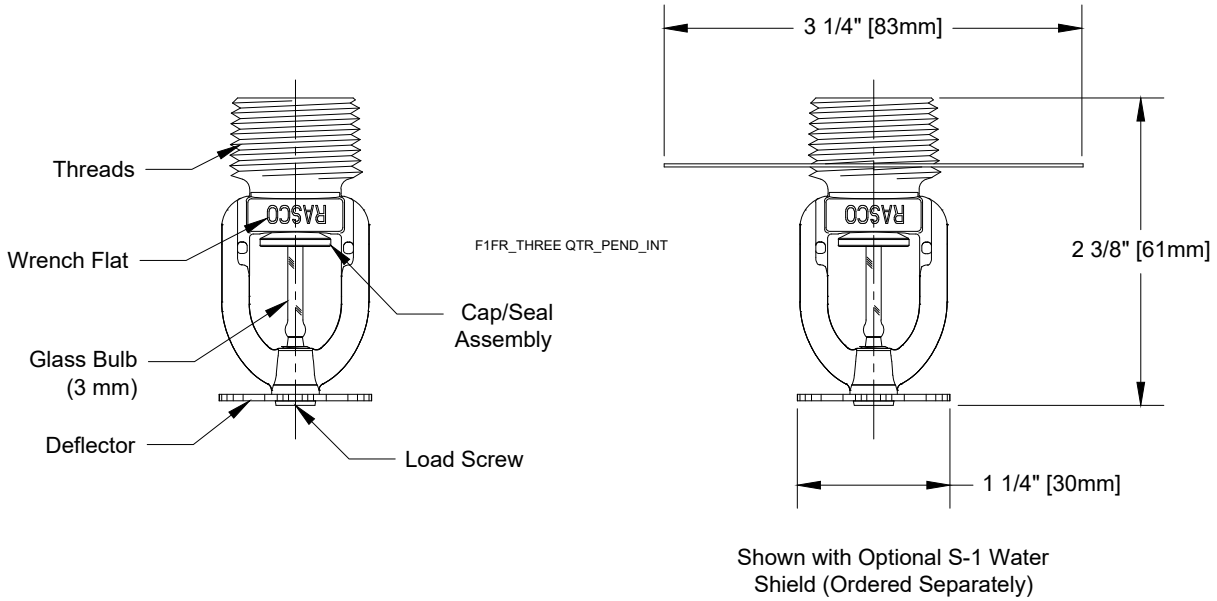
Guards & Shields[2]
F-2 Guard (FM)
F-6 Guard/Shield Kit (FM)
F-7 Guard (cULus)
F-8 Guard/Shield Kit (cULus)
S-2 Shield (cUlus, FM)

Sprinkler Wrenches
Model W2 (pendent)
Model W4 (recessed)
Model W14 (with guard installed)

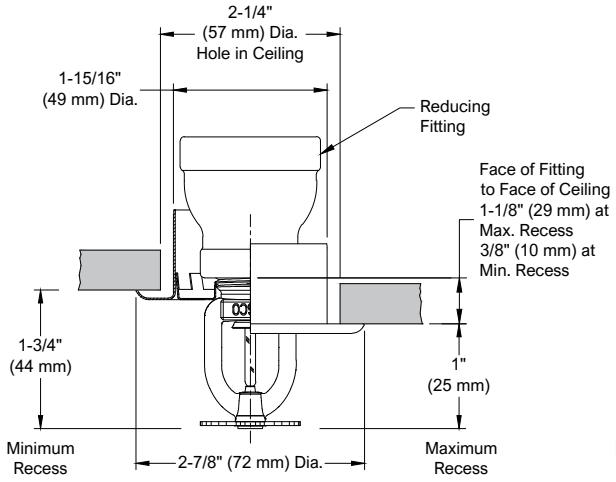
Listings and Approvals[3]
cULus Listed
FM Approved
LPCB
VdS
CE
UKCA: 0832-UKCA-CPR-S5079

Notes:
1. 286°F (141°C) temperature rated sprinkler not listed for recessed use.
2. Not suitable for recessed pendent installations.
3. When used surface mounted or exposed. See Recessed Escutcheon section for specific approvals when installed recessed.

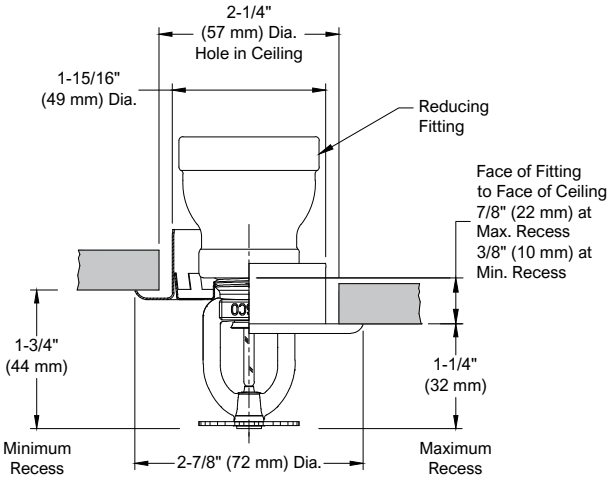
Model F1FR80 Pendent Sprinkler Components and Dimensions — **Figure 2**



Note: Please refer to Figure 3 for recessed installation.

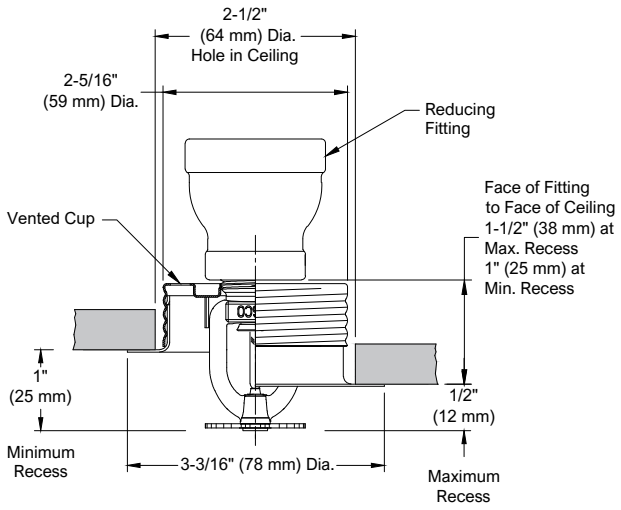


Models F1 & F1FR Pendent Sprinkler
with Model F1 Recessed Escutcheon
3/4" (19mm) Nominal Adjustment



Models F1 & F1FR Pendent Sprinkler
with Model F2 Recessed Escutcheon
1/2" (13mm) Nominal Adjustment

F1_REC_PEND



Models F1 & F1FR Pendent Sprinkler
with Model FP Recessed Escutcheon
1/2" (13mm) Nominal Adjustment

Note: Model FP recessed assemblies may not be used where the pressure in the space above the ceiling is positive with respect to the protected area. Ensure that the openings in the Model FP cup are unobstructed following installation.

F1 Escutcheon
(F2 Similar)

FP Escutcheon

Wrenches

Model W2 (upright, pendent)

Model W14 (with guard installed)

Model W4
(recessed pendent)

Finishes[1]

Table B

Standard Finishes		Special Application Finishes	
Sprinkler	**F1, F2 and FP[2] Escutcheons**	**Sprinkler**	**F1, F2 and FP[2] Escutcheons**
Bronze	Brass	Electroless Nickel PTFE[3][4]	Bright Brass
Chrome Plated	Chrome Plated	Bright Brass[5]	Satin Chrome
White Polyester[3]	White Polyester	Satin Chrome	Custom Color Polyester
		Custom Color Polyester[3][6]	

Notes:

1. Paint or any other coating applied over the factory finish will void all approvals and warranties.
2. Model FP escutcheons utilizes a galvanized steel cup with a finished trim ring.
3. cULus Listed as corrosion resistant.
4. FM Approved as corrosion resistant.
5. For 200°F (93°C) maximum temperature rated sprinklers only.
6. cULus Only.

Installation

Model F1FR Series sprinklers must be installed in accordance with NFPA13 and the requirements of all applicable authorities having jurisdiction. Model F1FR Series sprinklers must be installed with the Reliable sprinkler installation wrench identified in this Bulletin. Any other wrench may damage the sprinkler. The Models W2 and W4 wrenches have two sets of jaws. Use the smallest set of jaws that fit on the wrench flats of the sprinkler. A leak tight sprinkler joint can be obtained with a torque of 8 to 18 lb-ft (11 to 24 N·m). Do not tighten sprinklers over the maximum recommended installation torque. Exceeding the maximum recommended installation torque may cause leakage or impairment of the sprinkler.

Glass bulb sprinklers have orange bulb protectors or protective caps to minimize bulb damage during shipping, handling and installation. Reliable sprinkler installation wrenches are designed to install sprinklers with bulb protectors in place. Remove the bulb protector at the time when the sprinkler system is placed in service for fire protection. Removal of the bulb protector before this time may leave the bulb vulnerable to damage. Remove bulb protectors by undoing the clasp by hand. Do not use tools to remove bulb protectors.

Maintenance

Reliable Model F1FR series sprinklers should be inspected and the sprinkler system maintained in accordance with NFPA 25, as well as the requirements of any Authorities Having Jurisdiction.

Prior to installation, sprinklers should remain in the original cartons and packaging until used. This will minimize the potential for damage to sprinklers that could cause improper operation or non-operation.

Do not clean sprinklers with soap and water, ammonia liquid or any other cleaning fluids. Remove dust by gentle vacuuming without touching the sprinkler.

Replace any sprinkler which has been painted (other than factory applied). A stock of spare sprinklers should be maintained to allow quick replacement of damaged or operated sprinklers. Failure to properly maintain sprinklers may result in inadvertent operation or non-operation during a fire event.

Guarantee

For the guarantee, terms, and conditions, visit www.reliablesprinkler.com.

Ordering Information

Specify the following when ordering:

Model
- F1FR80

Deflector/Orientation
- Upright
- Upright Intermediate
- Pendent

Temperature Rating
- See sprinkler technical specifications

Sprinkler Finish
- See Table B

Recessed Escutcheon
- F1
- F2
- FP

Escutcheon Finish
- See Table B

Sprinkler Wrench
- Model W2 (upright and pendent)
- Model W4 (recessed)
- Model W14 (with guard installed)

P/N 9999970503

4. VALVES

DRY PIPE AUTOMATIC FIRE SPRINKLER SYSTEM

Reliable®

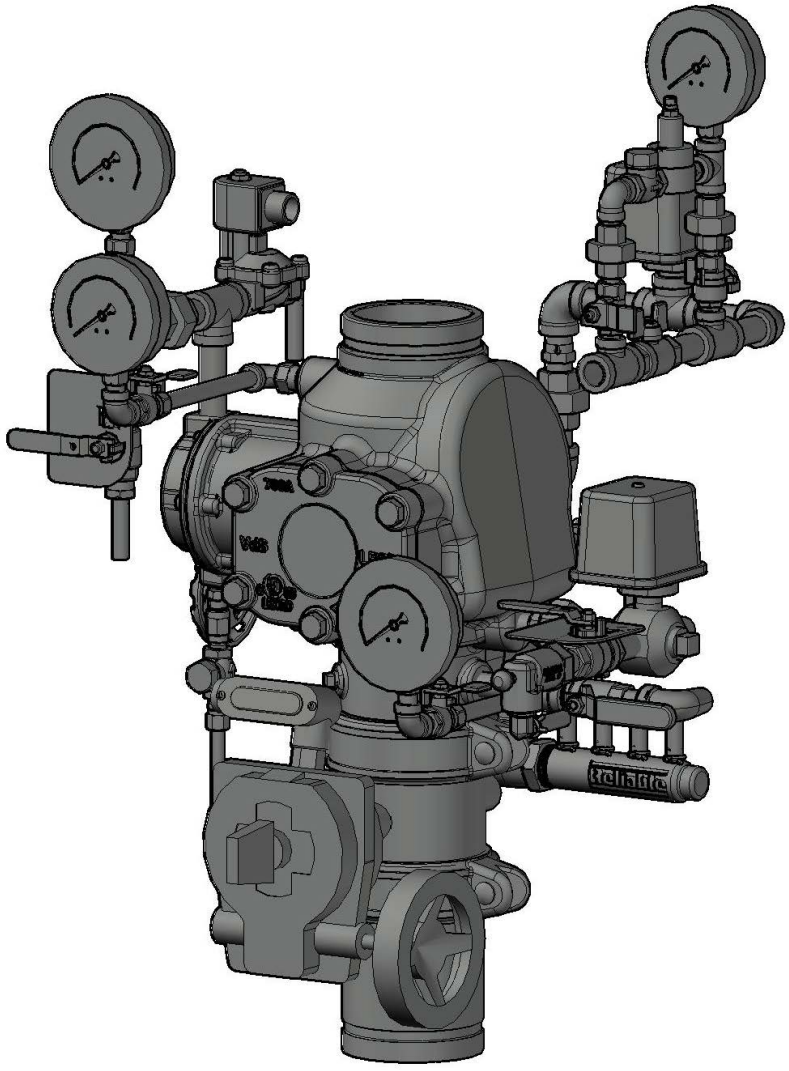
Model DDX Double Interlock Preaction System – Type D
2” (50 mm), 2½” (65 mm), 3” (80 mm), 76 mm, 4” (100 mm), 6” (150 mm), 165 mm & 8” (200 mm)

Bulletin 750 June 2021

Instructions for Installation, Operation, Care, and Maintenance

7 to 10 psi (0.5 to 0.7 bar) Pneumatic Supervising Pressure with Electric/Electric Actuation Controlled by a Cross-Zoned Releasing Control Panel

- Available with 175 psi (12.1 bar) or 300 psi (20.7 bar) Rated Solenoid Valve
- Externally Resettable Clapper
- One Main Drain



Model DDX Type D Double Interlock Preaction

Reliable Automatic Sprinkler Co., Inc., 103 Fairview Park Drive, Elmsford, New York 10523

General

The Reliable Model DDX Type D Double Interlock Preaction system is designed for water sensitive areas that require protection from inadvertent water flow into the sprinkler system piping, but where a mechanical backup for the electric release is not required. Typical applications for this type of system are libraries and computer server rooms.

To release the valve and flow water into a Type D Double Interlock Preaction System, two events must take place: a fire detection device must operate, and the low pressure switch must be operated by the loss of system air or nitrogen pressure due to sprinkler operation (see note 1 below). These two signals must coexist at the releasing control panel, which only then will energize the normally closed solenoid valve (175 psi (12.1 bar) or 300 psi (20.7 bar) rated), causing the water flow into the system.

These systems utilize fire detection devices and system air pressure as separate zones (inputs) to a cross-zoned releasing control panel. The solenoid releasing valve remains closed until energized by the releasing control panel. This will occur only when both a fire detection device is operated and the low air pressure switch has detected sufficient loss of system air pressure generally resulting from the operation of a fire sprinkler.

In the event that the system piping is ruptured, or a sprinkler is accidentally opened, the low air pressure switch will operate and an alarm will sound. The Model DDX Deluge Valve, however, will not release water since the solenoid valve remains closed due since the detection system has not activated.

Conversely, in the event of a false alarm from the detection system, the Model DDX Deluge Valve will not release water provided air pressure in the system is maintained and the low pressue switch is not activated. The requirement for both detector operation and loss of system pressure before the Model DDX Type D Double Interlock Preaction system releases water assures maximum protection against inadvertent water flow.

At the heart of the Reliable Type D Double Interlock Preaction System is the Model DDX Deluge Valve. This deluge valve is a hydraulically operated, straight-through-design, differential latching clapper-type (see Fig. 1). System maintenance is simplified since the deluge valve can be reset extermally without removing the cover plate. This feature provides a significant system-restoration time advantage. The Model DDX Deluge Valve has an intermediate chamber and thereby does not require an in-line air check valve. Subsequently, the deluge valve only requires a single drain connection.

The Reliable Model DDX Type D Double Interlock Preaction System trim set provides all of the necessary equipment for connections to the Model DDX Deluge Valve pushrod chamber inlet and outlet ports, a 1¼" (30 mm) main drain on 2" (50 mm), 2½" (65 mm), 76 mm and 3" (80 mm) valve sizes or a 2" (50 mm) main drain on 4" (100 mm), 165 mm, 6" (150 mm) and 8" (200 mm) valve sizes, alarm devices, air supply, and required pressure gauges. This trim set is available in individual (loose) parts, in time-saving, segmented assembled kit forms or fully assembled to the Model DDX Deluge Valve (with or without a control valve).

Listings & Approvals:

(Only when used with Reliable Trim Sets.)

1. Reliable's Type D Double Interlock Preaction Systems 2" (50 mm), 2½" (65 mm), 76 mm and 3" (80 mm), 4" (100 mm), 165 mm, 6" (150 mm) and 8" (200 mm) are Factory Mutual Approved Refrigerated Area Sprinkler Systems for use in refrigerated rooms or buildings. Refrigerated area sprinkler systems are FM Approved as complete systems. Systems are FM Approved for use with thermal detectors and Class A detector wiring only.
2. Factory Mutual Approved for applications where FM Global Data Sheets allow the use of double-interlock preaction systems.
3. Reliable's Type D Double Interlock Preaction Systems 2" (50 mm), 2½" (65 mm), 76 mm, 3" (80 mm), 4" (100 mm), 165 mm, 6" (150 mm) and 8" (200 mm) are Underwriters Laboratories, Inc. Listed and UL certified for Canada (cULus) in the Special System Water Control Valve-Double Interlock Type (VLJH) category.

Note: Wherever the word "air" is used in this bulletin as a reference to the pneumatic pressure source it shall also mean "air or nitrogen."

System Operation

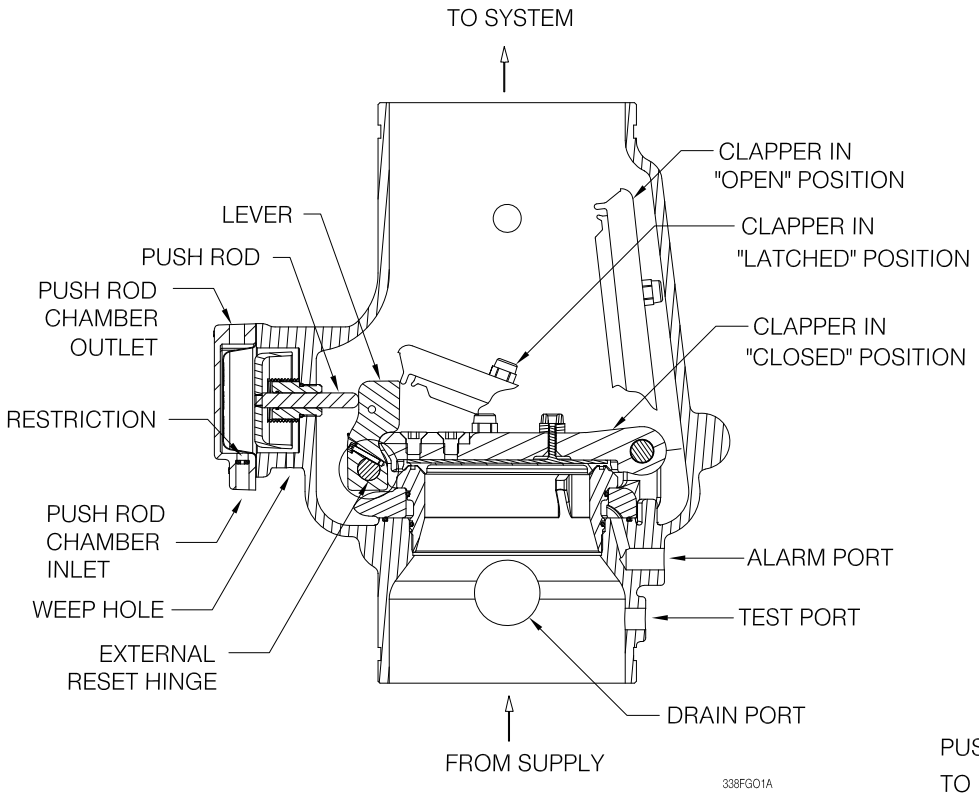
When set correctly for service, the Model DDX Deluge Valve is hydraulically established to separate the supply water from the sprinkler system piping. The Reliable Model DDX Deluge Valve is shown in both closed and open positions in Fig. 1. In the closed position, the supply pressure acts on the underside of the clapper and also on the pushrod through the pushrod chamber inlet restriction. The resultant force due to the supply pressure acting on the pushrod is multiplied by the mechanical advantage of the lever and is more than sufficient to hold the clapper closed against normal supply pressure surges.

Whenever the detection system is activated and a low system air pressure condition coexist, the solenoid valve is energized open which vents the pushrod chamber to atmosphere through the chamber outlet. Since the pressure can not be replenished through the inlet restriction as rapidly as it is vented, the pushrod chamber pressure falls instantaneously. When the pushrod chamber pressure approaches approximately on-third of the supply pressure, the upward force of the supply pressure acting beneath the clapper overcomes the lever applied force thereby opening the clapper.

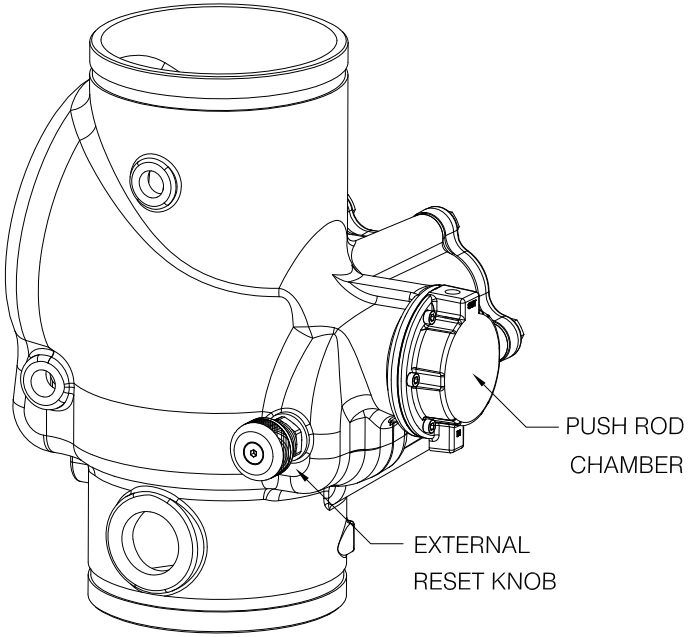
Once the clapper has opened, the lever acts as a latch, preventing the clapper from returning to the closed position. Water from the supply flows through the Deluge Valve into the sprinkler system piping. Water also flows through the alarm outlet to the alarm devices.

Resetting the clapper of the Model DDX Deluge Valve is accomplished using the convenient external reset knob on the rear of the valve. The external reset feature of the Model DDX Deluge Valve provides a means for simple, economical system testing, which is one essential facet of a good maintenance program. The external reset feature does not,

DDX VALVE CLAPPER IN "OPEN," "CLOSED," AND "LATCHED" POSITIONS



REAR VIEW OF MODEL DDX VALVE



PUSH INWARD AND ROTATE KNOB CLOCKWISE (AS VIEWED FROM REAR) TO RESET CLAPPER. NOTE: PUSH ROD CHAMBER MUST BE VENTED TO DRAIN.

Fig. 1

however, eliminate another important facet of good maintenance, namely, periodic cleaning and inspection of the internal valve parts.

A valve body drain is provided in the event that water builds up due to condensate from the air supply system or water left inside form system testing. After closing the main supply valve, the condensate drain can be opened slightly until the water inside the vale body and main pipe column has drained. See the section titled “Draining Excess/Condensate Water from the System” in this bulletin for the detailed procedure.

The Model B Manual Emergency Station is included in the Reliable Type D Double Interlock Preaction System trim sets. It consists of an aluminum nameplate mechanically attached to a ball valve. The valve handle in its OFF position is guarded against accidental turning to the ON position (and system discharge) by a nylon cable tie provided with each trim kit. The cable tie is inserted after the system has been restored for operation. The nylon cable tie is designed to allow, in case of an emergency, forceful turning of the valve handle to the ON position. As an alternative to the Model B Hydraulic Manual Emergency Station, the Model A Hydraulic Manual Emergency Pull Box (see Reliable Bulletin 506) is also available and can be provided as an option.

Whenever ambient temperature conditions are high, the water temperature in the Model DDX Deluge Valve pushrod chamber could possibly increase, thereby increasing the pressure in the chamber to values exceeding the rated pressure of the system. In an indoor installation where standard room temperatures are exceeded, a pressure relief kit may be needed. Pressure relief kit, P/N 6503050001, can be installed into the pushrod chamber’s releasing line to limit the pressure to 250 psi (17.2 bar).

Reliable Model DDX Deluge Valve with associated Type D Double Interlock Preaction Trims sizes 2” (50 mm), 2½” (65 mm), 76 mm, 3” (80 mm), 4” (100 mm), 165 mm, 6” (150 mm) and 8” (200 mm) are rated for use at a minimum water supply pressure of 20 psi (1.4 bar) and a maximum water supply pressure of 250 psi (17.2 bar) for 2” (50mm), 2½” (65mm), 3” (80mm), 76mm and 8” (200mm) valve sizes and 300 psi (20.7 bar) for 4” (100mm), 6” (150mm) and 165mm valve sizes. Water supplied to the inlet of the valve and to the pushrod chamber must be maintained between 40°F (4°C) and 140°F(60°C).

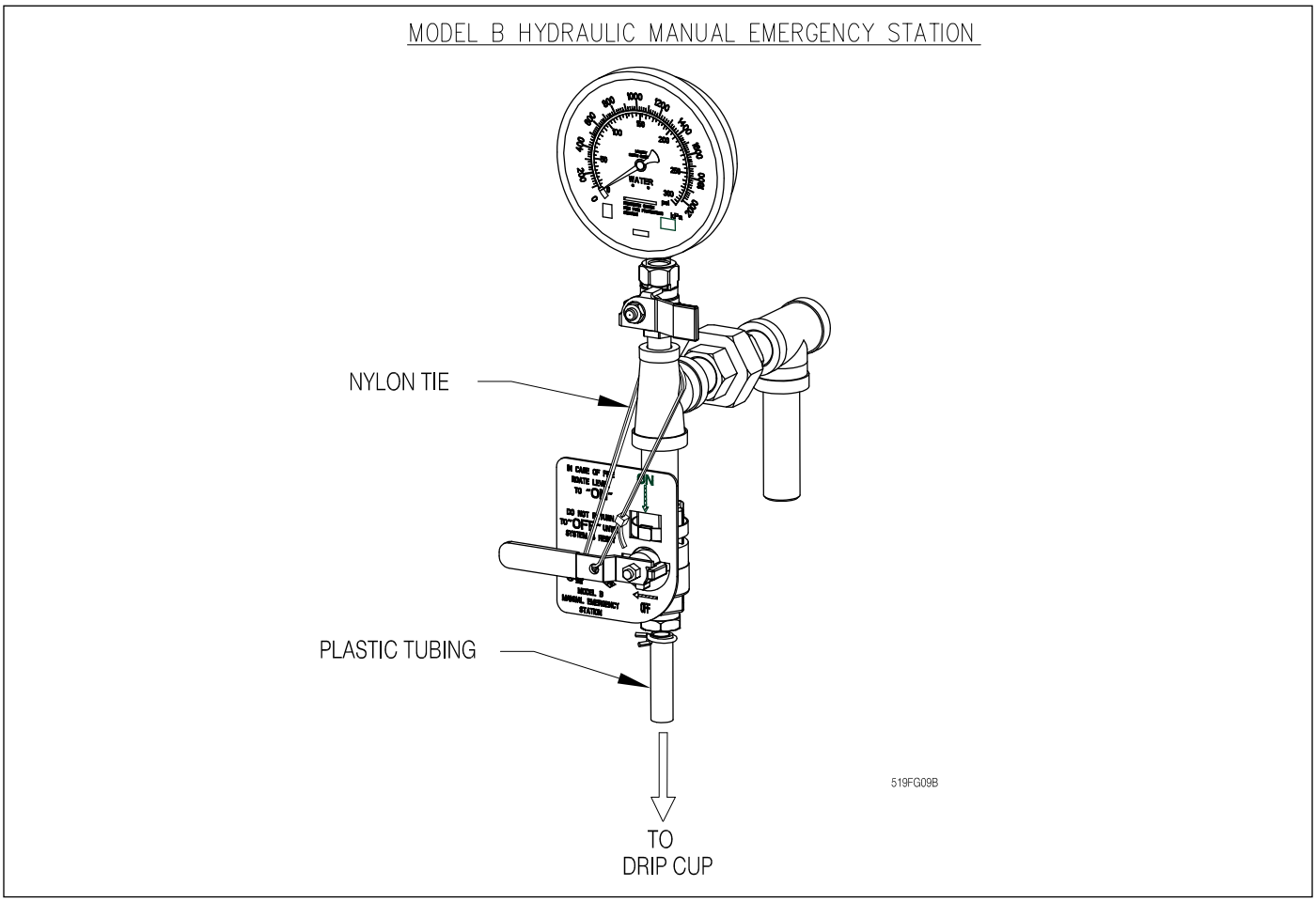


Fig. 2

Pressurizing Line Connection

The water supply for the pushrod chamber must be provided a dedicated connection to the water supply piping. Pressurizing lines for multiple Model DDX Deluge Valve pushrod chambers must never be manifolded together. Each Model DDX Deluge Valve must have its own pushrod chamber pressurizing line connection.

This connection must be made on the supply side of the water supply control valve. This can be accomplished by:

- Using a tapped connection directly below or next to the main water supply control valve using a welded outlet or the appropriate mechanical fittings. A grooved-end outlet coupling is one way to achieve this; or
- Using a water supply control valve that has an available threaded (NPT) supply-side tap design to allow for a direct water supply connection to the Model DDX Deluge Valve's pushrod chamber.

Caution: Reliable's DDX valve is designed with an inlet restriction built into the pushrod chamber. It is important not to introduce additional restrictions into the direct water supply connection or the discharge from the pushrod chamber by installing additional valves or improperly installing the copper lines used in the trim of the valve.

Hydrostatic Testing of DDX Valves and DDX Systems

As required by NFPA 13, fire sprinkler systems with working pressures up to and including 150 psi are to be hydrostatically tested at a water pressure of 200 psi. Fire sprinkler systems with working pressures above 150 psi are required to be hydrostatically tested at 50 psi above the system working pressure. In addition to the hydrostatic tests described above, dry pipe and double interlock preaction systems require an additional low pressure air test.

In some cases, hydrostatic testing (in accordance with the NFPA 13 requirements noted above) will result in pressures that exceed the working pressure of the valve and trim kit for the two-hour test period. **The valve and applicable trim kit have been tested, approved and listed under these conditions and as such, hydrostatic testing in accordance with NFPA 13 is acceptable. In addition, the clapper can remain in the closed position and the trim kit need not be isolated, as each has been designed to withstand hydrostatic testing as required by NFPA 13.**

Hydrostatically testing the valve and trim to pressures higher than their rating is limited to the hydrostatic test as referenced by NFPA 13. It does not address the occurrence(s) of a "water hammer" effect, which can indeed damage the valve. A "water hammer" in the water supply piping of the valve can create pressures in excess of the rated pressure and should be avoided by all necessary means. This condition may be created from improper fire pump settings, underground construction work, or an improper venting of trapped air in the water supply piping.

System Design Considerations

The automatic sprinklers, releasing devices, electric releasing control equipment, fire detection devices, manual pull stations, and signaling devices which are utilized with the Type D Double Interlock Preaction System must be UL or ULC Listed or FM Approved, as applicable.

Factory Mutual requires that detection devices in refrigerated areas be of the fixed temperature type. In addition, they must have a temperature rating lower than that of the sprinklers and preferably as low as possible for the given ambient conditions.

The Deluge Valve, and all interconnecting piping must be located in a readily visible and accessible location and in an area that can be maintained above 40ºF (4ºC). **Note:** Heat Tracing is not permitted.

Pendent sprinklers, other than dry pendents, used on preaction systems shall be installed on return bends per NFPA 13.

The solenoid valve must be operated and the system supervised by a listed releasing control panel.

System Air Pressure Requirements

In accordance with NFPA 13, Double Interlock Preaction Systems require a minimum of 7 psi (0.5 bar) pneumatic pressure to supervise the sprinkler system. The Reliable Model A Pressure Maintenance Device is used to maintain the system pneumatic pressure between 7 and 10 psi (0.5 and 0.7 bar) where a dry nitrogen gas supply or a clean, dependable and continuous (24 hours a day, 7 days a week) compressed air source is available.

To adjust the system pneumatic pressure between 7 and 10 psi (0.5 and 0.7 bar) refer to Reliable Bulletin 251. The low air pressure alarm switch is factory set to operate between 5 and 6 psi (0.3 and 0.4 bar) on decreasing pressure. If necessary, adjustments can be made by following the manufacturer's adjustment procedure as described in the installation and maintenance instructions.

Note: The dew point of the air supply must be maintained below the lowest ambient temperature to which the double interlock preaction system piping will be exposed. Introduction of moisture into the system piping that is exposed to freezing temperatures can create ice blockage, which could prevent proper operation of the sprinkler system. As a minimum, the air supply of air should be taken from the refrigerated area at the lowest temperature. The air supply system must be carefully designed to prevent plugging by frost deposits. Special requirements such as those in FME&R Installation Guidelines for Refrigerated Storage may need to be incorporated.

Each Type D Double Interlock Preaction system is provided with a Reliable Model A Pressure Maintenance Device for individual monitoring of pneumatic pressure and proper operation of the system. The Reliable Model A Pressure Maintenance Device requires a tank mounted air compressor.

System Electrical Requirements

All releasing and detection devices in Reliable's Model DDX Type D Double Interlock Preaction System may be operated and supervised by the PFC-4410-RC Releasing Control Panel. An emergency manual pull station should be provided near the sprinkler riser to facilitate setup of the system.

The power supply, the standby emergency power supply, battery charger, and the rectifier circuitry are all contained within the Potter PFC-4410-RC Releasing Control Panel. Batteries that provide ninety hours of standby power are required for Factory Mutual Approved systems.

The Potter PFC-4410-RC Releasing Control Panel can utilize either 120VAC or 220VAC.

Note:

In order for the solenoid valve to maintain a warranty it must remain sealed as it came from the factory. If there are concerns about the valve's internal components, immediate replacement is recommended.

Standard Solenoid Valve Specifications:

Skinner Model 73218BN4UNLVN0C111C2
Rated working pressure: 175 psi (12.1 bar)
Voltage: 24 VDC
Power: 10 Watts
Current: 0.41 Amps Holding
Enclosure Coil: NEMA 4X
Pipe Size: ½" NPT Female
Cv Factor: 4.0

Alternate Solenoid Valve Specifications:

Skinner Model 73212BN4TNLVN0C322C2
Rated working pressure: 300 psi (20.7 bar)
Voltage: 24 VDC
Power: 22 Watts
Current: 0.83 Amps Holding
Enclosure Coil: NEMA 4X
Pipe Size: ½" NPT Female
Cv Factor: 2.8

Type D Double Interlock Preaction Systems Engineering Specification

2" (50 mm), 2½" (65 mm), 76 mm, 3" (80 mm), 4" (100 mm), 165 mm, 6" (150 mm) and 8" (200 mm)
Model DDX Deluge Valve

Preaction System shall be a Double Interlock Preaction System utilizing a [2" (50 mm)][2½" (65 mm)][76 mm] [3" (80 mm)][4" (100 mm)][165 mm][6" (150 mm][8" (200 mm)] [cULus Listed] [Factory Mutual Approved] Reliable Model DDX Deluge Valve. Deluge valve shall be a [2" (50 mm)][2½" (65 mm)][76 mm] [3" (80 mm)][4" (100 mm)] [165 mm][6" (150 mm][8" (200 mm)] [cULus Listed] [Factory Mutual Approved] hydraulically operated, differential latching-clapper type valve. Deluge Valve construction shall be of lightweight, ductile iron construction with either a "screw in" stainless steel seat and clapper assembly or drop in bronze seat and clapper assembly. Stainless steel or Bronze seat shall have O-ring seals to resist leakage and corrosion. Clapper facing shall be pressure actuated, providing a limited compression seat for the sealing force between the clapper rubber facing and the valve seat. Deluge valve shall have an external reset knob for resetting the clapper without requiring the removal of the valve face plate. Pushrod chamber design shall consist of a stainless steel piston/ pushrod and spring assembly with diaphragm seal secured to the casting through a pushrod guide constructed of a synthetic engineering plastic to resist corrosion. Casting shall have a bleeder hole located on the pushrod chamber for air/water leakage indication. Trip ratio shall be approximately a 3:1 force differential. Deluge valve shall be of the straight through design to minimize friction loss. Inlet restriction orifice shall be factory installed into the inlet port of the deluge valve pushrod cover plate and not be a separate part of the deluge valve trim. End connection style to be [2" (50 mm)][2½" (65 mm)][76 mm] [3" (80 mm)][4" (100 mm)][165 mm][6" (150 mm)][8" (200mm)] grooved, per ANSI/AWWA C606 or flanged per ASME B16.5 or ISO 7005. Deluge valve shall have a rated working pressure of 250 psi (17.2 bar) for 2" (50mm), 2½" (65mm), 3" (80mm), 76mm and 8" (200mm) valve sizes and 300 psi (20.7 bar) for 4" (100mm), 6" (150mm) and 165mm valve sizes and shall be factory hydrostatic tested at 500 psi (34.5 bar) for 2" (50mm), 2½" (65mm), 3" (80mm), 76mm and 8" (200mm) valve sizes and 600 psi (41.4 bar) for 4" (100mm), 6" (150mm) and 165mm valve sizes.

Deluge valve to be [2" (50 mm)][2½" (65 mm)][76 mm] [3" (80 mm)][4" (100 mm)][165 mm][6" (150 mm)][8" (200 mm)] Reliable Model DDX Deluge Valve (Bulletin 519).

Valve trim shall be Type D electric/electric release trim consisting of the following components:

- Hydraulic trim to be galvanized and brass components. All trims and components to be listed/Approved with the Deluge Valve, including associated pressure gauges, 1¼" or 2" drain connection, alarm devices, alarm test and pushrod chamber connections.
- Electrical two-way, normally closed, pilot operated solenoid valve [cULus] [FM Approved] for its intended use. The solenoid valve shall be constructed of a brass body with stainless steel sleeve tube, springs, stop and plunger, and with ½" female NPT end connections. Solenoid valve shall have a maximum working pressure of [175 psi (12.1 bar)] [300 psi (20.7 bar)] and a maximum ambient temperature rating of 150ºF (66ºC). Power consumption of the integrated coil shall be limited to [10 watts for the 175 psi (12.1 bar) rated] [22 watts for the 300 psi (20.7 bar) rated] and require 24 VDC from a releasing Control Panel listed for such service. Solenoid shall be a Skinner ½" normally closed solenoid valve [73218BN4UNLVNOC111C2 (175 psi (12.1 bar) rated)] [73212BN4TNLVNOC322C2 (300 psi (20.7 bar) rated)].

- Low air pressure switch to indicate loss of air pressure in system piping. Pressure switch shall be [cULus Listed][FM Approved] and of the bellows activated type enclosed in a weatherproof NEMA 4/4X rated enclosure incorporating tamper proof screws. There shall be two sets of SPDT (form C) contacts rated 10.0 A @ 125/250 VAC and 2.5 A @ 6/12/24 VDC. The pressure switch shall have a maximum service pressure rating of 250 psi (17.2 bar) and shall be factory adjusted to operate at a pressure of 4 to 8 psi (0.27 to 0.55 bar) with adjustment up to 15 psi (1.03 bar). Switch shall be provided with a ½" NPT male pressure connection. Low air supervisory switch shall be Potter PS10-2.
- Pressure alarm switch to indicate water flow in system. Pressure switch shall be [cULus Listed] [FM Approved] and of the bellows activated type enclosed in a weather proof NEMA 4/4X rated enclosure incorporating tamper proof screws. There shall be two sets of SPDT (form C) contacts rated 10.0 A @ 125/250 VAC and 2.5 A @ 6/13/24 VDC. The pressure switch shall have a maximum service pressure rating of 250 psi (17,2 bar) and shall be factory adjusted to operate at a pressure of 4 to 8 psi (0,27 to 0,55 bar) with adjustment up to the 15 psi (1,03 bar). Switch shall be provided with a 1/2" NPT male pressure connection. Pressure alarm switch shall be Potter PS10-2.
- Pressure maintenance device for maintaining a constant pneumatic system pressure regardless of pressure fluctuations in the compressed air (or nitrogen) source. The pressure maintenance device shall consist of galvanized trim and brass parts, including a strainer, a field adjustable air pressure regulator and associated pressure gauge. The pressure regulator shall have an adjustable outlet pressure range of 5 to 100 psi (0.34 to 6.8 bar). The pressure maintenance device shall have a working pressure of 175 psi (12.1 bar). Recommended supervisory pressure shall be 7 to 10 psi (0.5 to 0.7 bar). Pressure maintenance device shall be Reliable Model A.

Double Interlock Preaction System shall be Reliable Double Interlock Type D Preaction System, Bulletin 750.

Pneumatic Supervisory Pressure Supply Options

Note: See Reliable Bulletins 254 and 251 for complete information on air and nitrogen regulating equipment.

Owner's Air supply

Supervisory air supply shall be provided by an owner supplied air system in conjunction with a listed automatic pressure maintenance device, capable of maintaining a constant system pressure regardless of pressure fluctuations in the compressed air source.

Compressed Air Supply

Supervisory air supply shall be provided by an automatic tank-mounted air compressor sized for the capacity of the double interlock preaction system piping, and be capable of restoring normal air pressure in the system within the time limits specified by NFPA 13. Unit shall include a motor mounted, oil-less, piston compressor, pressure gauge, pressure switch, check valve, drain valve and safety relief valve. Single-phase motor shall have internal thermal protection.

Nitrogen

Nitrogen cylinders provided by an approved source shall provide the nitrogen supply. The nitrogen cylinder pressure shall be regulated and supervised through the use of nitrogen regulating device and low-pressure trim kit. This device shall consist of a brass, single stage pressure regulator, equipped with high pressure inlet and low pressure outlet gauges, and ¼" copper connection tubing with galvanized ¾" x ¼" reducer bushing. This kit shall include a low-pressure switch with associated galvanized connection trim. Assembly shall be a Reliable Nitrogen Regulating Device. This device is to be used in conjunction with the Reliable Model A Pressure Maintenance Device.

Optional System Accessories

System Control Valve

Preaction system control valve shall be a slow close, [cULus Listed] indicating butterfly type valve with a pre-wired supervisory tamper switch assembly. The valve shall be rated for a working pressure of [300 psi (20.7 bar)]. System control valve shall be for a [2" (50 mm)] Reliable RBVG Butterfly Valve or [2½" (65 mm)][3" (80 mm)][4" (100 mm)][6" (150 mm][8" (200 mm] - Reliable BFG-300 Butterfly Valve.

Detection System

To initiate actuation of the preaction system's deluge valve, a supplemental electric detection system shall be provided [Insert applicable product specification].

Releasing/Control Panel

A releasing/control panel shall be used to operate the preaction system. The releasing/control panel shall be a conventional, microprocessor-controlled panel containing two initiating device circuits, and waterflow and supervisory inputs. Output circuits shall include alarm, waterflow, supervisory, and releasing circuits. Mode of operation shall be set for cross zoned operation, requiring both a detection device input and a low air pressure switch input (sprinkler operation) to energize the solenoid valve, causing the deluge valve to operate. Releasing/control panel shall be equipped with a local tone alarm to annunciate loss of AC power, system trouble, circuit trouble, and low auxiliary DC power supply. Panel shall be [cULus Listed] [FM Approved] and be capable of providing power for compatible detectors and auxiliary devices used. Audible alarms shall be able to be silenced at releasing panel. Auxiliary DC power supply shall consist of (2) 12-volt lead acid batteries of the same ampere-hour rating, providing [60 hours – cULus Listed] [90 hours – FM Approved]. Dry contacts shall be provided for remote annunciation of alarm, trouble, and supervisory panel signals. Main power supply to be a dedicated a 120 VAC / 60 Hz circuit.

Technical Data

Reliable Double Interlock Type D Preaction Systems, with associated trim, size 2" (50 mm), 2½" (65 mm), 76 mm, 3" (80 mm), 4" (100 mm), 165 mm, 6" (150 mm), 8" (200 mm) are rated for use at minimum water supply pressure of 20 psi (1.4 bar) and maximum supply pressure of 250 psi (17.2 bar) for 2" (50mm), 21/2" (65mm), 3" (80mm), 76mm and 8" (200mm) valve sizes and 300 psi (20.7 bar) for 4" (100mm), 6" (150mm) and 165mm valve sizes. Water supplied to the inlet of the valve and to the pushrod chamber must be maintained between 40°F (4°C) and 140°F (60°C).

The following list of technical bulletins pertains to valves and devices that may be used in this preaction system:

Deluge Valve	Reliable 519
Hydraulic Emergency Station (Model A)	Reliable 506
Mechanical Sprinkler Alarm	Reliable 612/613
Pressure Maintenance Device	Reliable 251
Nitrogen Regulating Device	Reliable 254
Releasing/Control Panel	Potter #5403550
Low Air Pressure Supervisory Switch	Potter 5400928
Waterflow Pressure Alarm Switch	Potter 5400928

Model DDX Deluge Valve Description

1. Rated working pressure:
   Valve & System - 250 psi (17.2 bar) for 2" (50mm), 2½" (65mm), 3" (80mm), 76mm and 8" (200mm) valve sizes and 300 psi (20.7 bar) for 4" (100mm), 6" (150mm) and 165mm valve sizes.
2. Factory tested to a hydrostatic pressure of 500 psi (34.5 bar) for 2" (50mm), 2½" (65mm), 3" (80mm), 76mm and 8" (200mm) valve sizes and 600 psi (41.7 bar) for 4" (100mm), 6" (150mm) and 165mm valve sizes. (Valve only)
3. End and trim connections:
   - ANSI/AWWA C606 grooved inlet and outlet

Nominal Pipe Size	Outlet Diameter	Groove Diameter	Groove Width	Outlet Face to Groove
2" (50 mm)	2.375" (60 mm)	2.250" (57 mm)	11/32" (9.0 mm)	5/8" (16 mm)
2½" (65 mm)	2.875" (73 mm)	2.720" (69 mm)	11/32" (9.0 mm)	5/8" (16 mm)
76 mm	3.000" (76 mm)	2.845" (72 mm)	11/32" (9.0 mm)	5/8" (16 mm)
3" (80 mm)	3.500" (89 mm)	3.344" (85 mm)	11/32" (9.0 mm)	5/8" (16 mm)
4" (100 mm)	4.500" (114 mm)	4.334" (110 mm)	3/8" (9.5 mm)	5/8" (16 mm)
165 mm	6.500" (165 mm)	6.330" (161 mm)	3/8" (9.5 mm)	5/8" (16 mm)
6" (150 mm)	6.625" (168 mm)	6.455" (164 mm)	3/8" (9.5 mm)	5/8" (16 mm)
8" (200 mm)	8.625" (219 mm)	8.441" (214 mm)	7/16" (11 mm)	3/4" (19 mm)

   - Threaded openings Per ANSI B 2.1
   - Flange Dimensions

Flange Type:	Nominal Pipe Size	Bolt Circle Diameter	Bolt Hole Diameter	Flange Outside Diameter	Flange Thickness	Number of Bolts
ASME B16.5 Class 150	4" (100mm)	7½" (191mm)	¾" (19mm)	9" (229mm)	15/16" (24mm)	8
ISO 7005-2 PN16	4" (100mm)	7 3/32" (180mm)	¾" (19mm)	9" (229mm)	15/16" (24mm)	8
ASME B16.5 Class 150	6" (150mm)	9½" (241mm)	7/8" (22mm)	11" (279mm)	15/16" (24mm)	8
ISO 7005-2 PN16	6" (150mm)	9 7/16" (240mm)	29/32" (23mm)	11" (279mm)	15/16" (24mm)	8
ASME B16.5 Class 150	8" (200mm)	11¾" (298mm)	7/8" (22mm)	13½" (343mm)	1" (25.4mm)	8
ISO 7005-2 PN16	8" (200mm)	11 5/8" (295mm)	29/32" (23mm)	13½" (343mm)	1" (25.4mm)	12

4. Valve Color:

Valve Size	Color
2" (50 mm)	Black or Red
2½" (65 mm)	Black or Red
76 mm	Red
3" (80 mm)	Black or Red
4" (100 mm)	Black or Red
165 mm	Red
6" (150 mm)	Black or Red
8" (200 mm)	Black or Red

5. Face to face dimensions:

Valve Size:	End Connection:	End to End:
2" (50mm), 2½" (65mm), 76mm & 3" (80mm)	Groove/ Groove	12½" (318mm)
4" (100mm)	Groove/ Groove	14" (356mm)
	Flange/ Groove	16" (406mm)
	Flange/ Flange	16" (406mm)
6" (150mm) & 165mm	Groove/ Groove	16" (406mm)
	Flange/ Groove	19" (483mm)
	Flange/ Flange	19" (483mm)
8" (200mm)	Groove/ Groove	19 3/8" (492mm)
	Flange/ Flange	21¼" (540mm)

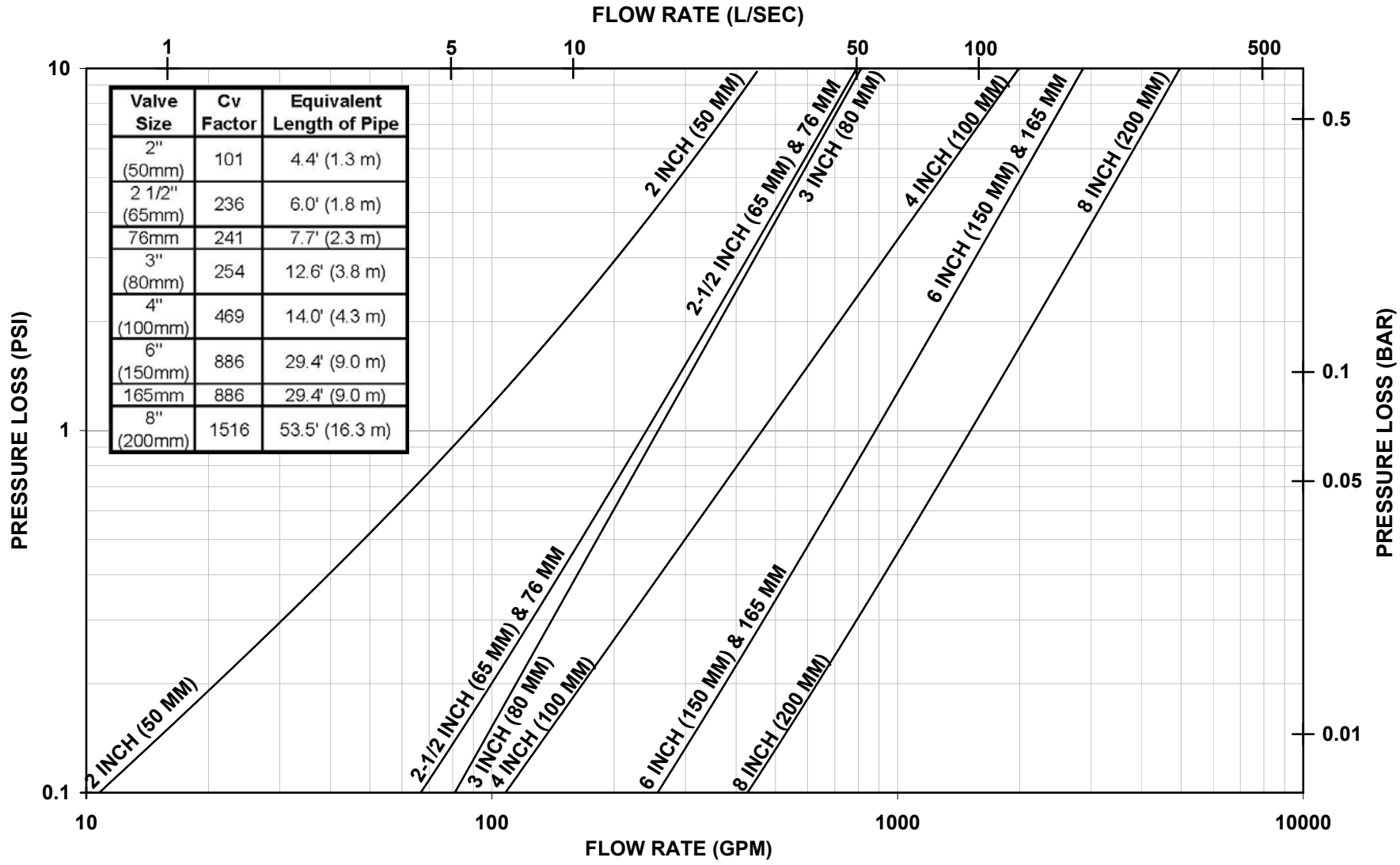
6. Valve shipping weight:

Valve Size:	End Connection:	Weight:
2" (50mm), 2½" (65mm), 76mm & 3" (80mm)	Groove/ Groove	34 lbs (15 kg)
4" (100mm)	Groove/ Groove	64 lbs (29 kg
	Flange/ Groove	79 lbs (36 kg)
	Flange/ Flange	92 lbs (42 kg)
6" (150mm) & 165mm	Groove/ Groove	95 lbs (43 kg)
	Flange/ Groove	122 lbs (56 kg)
	Flange/ Flange	138 lbs (69 kg)
8" (200mm)	Groove/ Groove	148 lbs (67 kg)
	Flange/ Flange	197 lbs (90 kg)

7. Trim shipping weight:

Trim Configuration	2" (50 mm), 2½" (65 mm), 3" (80 mm) & 76 mm	4" (100 mm), 6" (150 mm), 8" (200 mm) & 165 mm
Type D Double Interlock	47 lbs (21 kg)	52 lbs (24 kg)

MODEL DDX HYDRAULIC FRICTION LOSS GRAPH



Valve Size	Cv Factor	Equivalent Length of Pipe
2" (50mm)	101	4.4' (1.3 m)
2 1/2" (65mm)	236	6.0' (1.8 m)
76mm	241	7.7' (2.3 m)
3" (80mm)	254	12.6' (3.8 m)
4" (100mm)	469	14.0' (4.3 m)
6" (150mm)	886	29.4' (9.0 m)
165mm	886	29.4' (9.0 m)
8" (200mm)	1516	53.5' (16.3 m)

Fig. 3

8. Friction loss (Expressed in equivalent length of Schedule 40 pipe, based on Hazen & Williams formula:

Valve Size:	Equivalent Length:		Cv
	C = 120	C = 100	
2" (50mm)	4.4 ft (1.3 m)	3.1 ft (1.0 m)	101
2½" (65mm)	6.0 ft (1.8 m)	4.3 ft (1.3 m)	236
76mm	7.7 ft (2.3 m)	5.5 ft (1.7 m)	241
3" (80mm)	12.6 ft (3.8 m)	9.0 ft (2.7 m)	254
4" (100mm)	14 ft (4.3 m)	10 ft (3.0 m)	469
165mm	29.4 ft (9.0 m)	20.9 ft (6.4 m)	886
6" (150mm)	29.4 ft (9.0 m)	20.9 ft (6.4 m)	886
8" (200mm)	53.5 ft (16.3 m)	38.1 ft (11.6 m)	1516

9. Installation position: Vertical

Trim Descriptions

The Type D Double Interlock Preaction Trims for the Reliable Model DDX Deluge Valve are arranged for rapid, easy, and compact attachment, and serve as connection points to Reliable Model C Mechanical Alarms and other devices.

The Double Interlock Type D Preaction System trim configurations can be ordered as individual parts, in time-saving segmentally assembled kit forms, or fully assembled to the Model DDX Deluge Valve (with or without a control valve).

The Model B Hydraulic Manual Emergency Station is a standard item of all Deluge Valve trim sets. It consists of an aluminum nameplate mechanically attached to a ball valve. The valve handle in its OFF position is guarded against accidental turning to the ON position (and system discharge) by a nylon cable tie provided with each trim kit. The cable tie is inserted, after the system has been restored for operation. The nylon cable tie is designed to allow, in case of an emergency, forceful turning of the valve handle to the ON position. As an alternative to the Model B Hydraulic Manual Emergency Station, the Model A Hydraulic Manual Emergency Pull Box (see Bulletin 506) is also available and can be provided as an option.

Resetting Model DDX Type D Double Interlock Preaction System

1. Close the valve controlling water supply to the Deluge Valve and close the air or nitrogen supply to the sprinkler system.
2. Close the pushrod chamber supply valve.
3. Open main drain valve and drain system.
4. Open all drain valves and vents at low points throughout the system, closing them when flow of water has stopped. Open the Model B Manual Emergency Station to relieve pressure in the pushrod chamber of the Deluge Valve.
5. With the alarm line valve open, push in the plunger of ball drip valve, forcing the ball from its seat, and drain the alarm line.
6. With the Model B Manual Emergency Station open, push in and rotate the Deluge Valve's external reset knob counterclockwise (when facing the valve), until you hear a distinct noise indicating that the clapper has reset. **Note:** The reset knob can be rotated only while pressure in the pushrod chamber is vented to atmospheric conditions (0 psig).
7. Inspect and replace any portion of the detection system and/or sprinkler system subjected to fire conditions.
8. Open the pushrod chamber supply valve and allow water to fill the pushrod chamber. Close the Model B Manual Emergency Station.
9. Bleed all air from the actuation piping: Open the solenoid valve by operating a detector or an electric manual emergency station. While water is flowing through the solenoid valve, cause it to close using the release control panel reset.
10. Close the alarm line valve. Open the air or nitrogen supply quick fill valve to restore 10 psi (0.7 bar) supervisory pressure in the sprinkler system, then set the pneumatic supply to automatic operation. Note: To build supervisory air pressure in the sprinkler system, it may be necessary to temporarily close the main drain valve until air pressure has built up to the recommended level.
11. Open the alarm line valve. Verify the main drain valve is open. Open slightly the main valve controlling water supply to the Model DDX Deluge Valve, closing the main drain valve when water flows. Observe if water leaks through the ball drip valve into the drip cup. If no leak occurs, the Deluge Valve clapper is sealed. Open slowly and verify the main valve controlling water supply is fully opened and properly monitored.
12. Verify that the pushrod chamber supply valve and alarm line valve are open. The pushrod chamber supply valve must remain open when the Deluge Valve has been reset, to maintain water pressure in the pushrod chamber.
13. Verify that the Model B Manual Emergency Station is secured in the OFF position with the appropriate nylon tie.

Inspection and Testing

1. Water supply — Confirm that valves controlling water supply to the Deluge Valve are opened fully and properly monitored.
2. Alarm line — Confirm that the alarm line valve is open and remains in this position.
3. Other trim valves — Confirm that the pushrod chamber supply valve is open, as well as all pressure gauge valves. The main drain valve, condensate drain valve, and alarm test valve should be closed.
4. Ball drip valve — Push in on the plunger to be sure ball check is off its seat. If no water appears, the Deluge Valve water seat is tight. Inspect the bleed hole on the underside of the pushrod chamber for leakage.
5. Dry pilot trim — Inspect air pressure for conformance to Table A.
6. Releasing device — Check outlet of the releasing device (i.e., solenoid valve and hydraulic manual emergency station) for leakage. Also verify that tubing drain lines from releasing devices are not pinched or crushed which could prevent proper releasing of the Deluge Valve.
7. Testing alarms — Open the alarm test valve permitting water from the supply to flow to the electric sprinkler alarm switch and to the mechanical sprinkler alarm (water motor). After testing, close this valve securely. Push in on the plunger of ball drip valve until all water has drained from the alarm line.

8. Operational test — Open the Model B Manual Emergency Station. Alternatively, operate the electrical detection system and deplete pneumatic pressure from the sprinkler system.

Note: AN OPERATIONAL TEST WILL CAUSE THE DELUGE VALVE TO OPEN AND FLOW WATER INTO THE SPRINKLER SYSTEM.

9. Secure the Model B Manual Emergency Station in the OFF position with nylon tie after Deluge Valve is reset.

Testing Detection System Without Operating Deluge Valve

1. Close the valve controlling water supply to the deluge valve and open the main drain valve.
2. Verify that valve supplying hydraulic pressure to the piston/pushrod chamber is open, allowing water to enter the pushrod chamber.
3. Operate the electrical detection system and deplete pneumatic pressure from the sprinkler system.
4. Operation of the detection combined with loss of pneumatic pressure must result in a sudden drop of water pressure in the pushrod chamber, as indicated by the pressure gauge on the hydraulic release trim.
5. Reset the valve per the reset instructions.

Maintenance

The owner is responsible for maintaining the fire protection system in proper operating condition. Any system maintenance or testing that involves placing a control valve or detection/control system out of service may eliminate the fire protection that is provided by the fire protection system.

The Reliable Model DDX valve and associated equipment shall periodically be given a thorough inspection and test. NFPA 25, "Inspection, Testing, and Maintenance of Water Based Fire Protection Systems," provides minimum maintenance requirements. System components shall be tested, operated, cleaned, and inspected at least annually, and parts replaced as required. Replace any components found to be corroded, damaged, worn, or non-operable. Increase the frequency of inspections when the valve is exposed to corrosive conditions or chemicals that could impact materials or operation of the assembly.

If face plate is removed during maintenance, torque face plate bolts to the following values during re-installation:

- 35 ft-lbs. (47 N-m) for 2" through 4" valves
- 70 ft-lbs. (95 N-m) for 6"-8" valves

Troubleshooting

1. Mechanical sprinkler alarm not operating: This is most likely caused by a clogged screen in the strainer of the water motor. Proceed as follows: Remove plug from the strainer. Remove and clean the screen. Replace the screen and the plug, and then tighten securely (Ref. Bulletin 613).
2. Water leaking from Ball Drip. This can be caused by either a water column on top of the clapper or a supply water leakage.
   a. Leakage due to water column. This condition is caused by leakage past the clapper seal assembly. Be sure the clapper seal and seat are free of any type of de-bris or damage. If necessary, follow steps below to replace the seal assembly and/or seat.
   b. Supply water leakage. This condition is caused by leakage past the lower seat O-ring. Follow steps below for inspection and/or replacement of lower seat O-ring.

Repair Procedures - Model DDX Deluge Valve

The following section provides instructions to correct both conditions:

1. Disable detection system.
2. Shut down the valve controlling the water supply to the Deluge Valve and open the main drain valve. Open the condensate drain valve. Close the pushrod chamber supply valve and open the Model B Manual Emergency Station.
3. Remove the Deluge Valve front (handhold) cover and inspect the seat, clapper, and seal assembly for damage. If inspection indicates damage to the seal assembly, replace as follows:
4. Remove the bumpstop nuts and remove the seal assembly. Install a new seal assembly and thread the bumpstop nuts onto the threaded studs of the seal assembly. Tighten finger tight plus ¼ to ½ turn.
5. If inspection indicates damage to the clapper, proceed to step 6.
6. At the rear of the valve, disconnect the condensate drain trim section starting with the elbow connector. Then remove the ¼" globe valve, followed by the ¾"x¼" reducing bushing. Remove the retaining rings from the clapper hinge pin, push the hinge through the condensate drain opening and remove the clapper subassembly. Install a new clapper subassembly in the reverse order making sure the clapper spacers are in their proper position.
7. If the seat is damaged, or it is suspected that the leakage is through the seat O-rings, proceed to step 8.
8. Using Reliable P/N 6881603000 Seat Wrench for 2" (50mm), 2½" (65mm), 76mm and 3" (80mm) valve sizes, Reliable P/N 6881604000 for 4" (100mm) valve size, Reliable P/N 6881606000 for the 6" (150mm) and 165mm valve sizes or Reliable P/N 6881608000 Seat Wrench for 8" (200mm) valve size, remove the seat by unscrewing. This will loosen the seat-clapper-mounting ring subassembly. Reach into the valve and grasp the seat and remove it from the valve. Then remove the clapper-mounting ring subassembly from the valve. Visually examine all components of the seat-clapper-mounting ring subassembly and replace any component that appears damaged. New O-rings should always be used for reassembly.

9. Reassembly: clean the bore of the valve body. Lubricate the bore with O-ring grease. Lubricate and install the O-rings onto the seat. Lubricate and install the mounting ring O-ring into the body (8" (200mm) valve size only). Insert the clapper-mounting-ring subassembly into the handhold opening of the Deluge Valve using caution to not damage or dislodge the mounting ring O-ring (8" (200mm) valve size only). Align the mounting ring so that the Lever is near the pushrod and the mounting ring "ears" are between the tabs of the valve body. Insert the seat into the valve body and through the clapper-mounting ring subassembly. Start to tread the seat into the body by hand, then tighten the seat with the seat wrench until it bottoms out on the mounting ring. Verify that the seat-clapper-mounting ring subassembly is in the fully down position between the tabs of the body, and check to see that the lever lines up with the pushrod. Reassemble the handhold cover and set up the Model DDX Deluge Valve as per the section "Resetting Model DDX Type D Double Interlock Preaction System."

Pushrod Chamber Maintenance - Model DDX Deluge Valve

A small bleed hole is located on the underside of the pushrod chamber. Water leakage from the bleed hole can be caused by a ruptured pushrod diaphragm:

a) Disable detection system.

b) Shut down the valve controlling water supply to the Deluge Valve. Relieve the inlet pressure by opening the main drain valve. Close the pushrod chamber supply valve and open the Model B Manual Emergency Station.

c) Remove the trim at the unions nearest to the pushrod chamber cover.

d) Take the pushrod chamber cover off by removing the six retaining screws.

e) Visually inspect the pushrod chamber cover and piston to determine what could have damaged the diaphragm and then correct. Install a new diaphragm.

Note: The diaphragm has two different surfaces; it is not bi-directional and will fail if installed backwards. Roll the diaphragm so that the smooth surface (the pressure side) conforms to the inside of the pushrod chamber cover and the fabric side engages the pushrod.

f) Reassemble the six retaining screws with an installation torque of 15 foot-pounds in a star pattern.

g) Set up the Model DDX Deluge Valve as per the section "Resetting Model DDX Type D Double Interlock Preaction System."

Draining Excess/Condensate Water from the System

1. Notify the owner and monitoring company that maintenance is being performed on the system.
2. Close the main water control valve.
3. Open the Main Drain Valve.
4. Open the Condensate Drain Valve until all water has drained.
5. Close Condensate Drain Valve.
6. Partially open the Main Water Control Valve.
7. Slowly close the Main Drain Valve.
8. Fully open the Main Water Control Valve.
9. Notify the owner and monitoring company that the system has been returned to service.

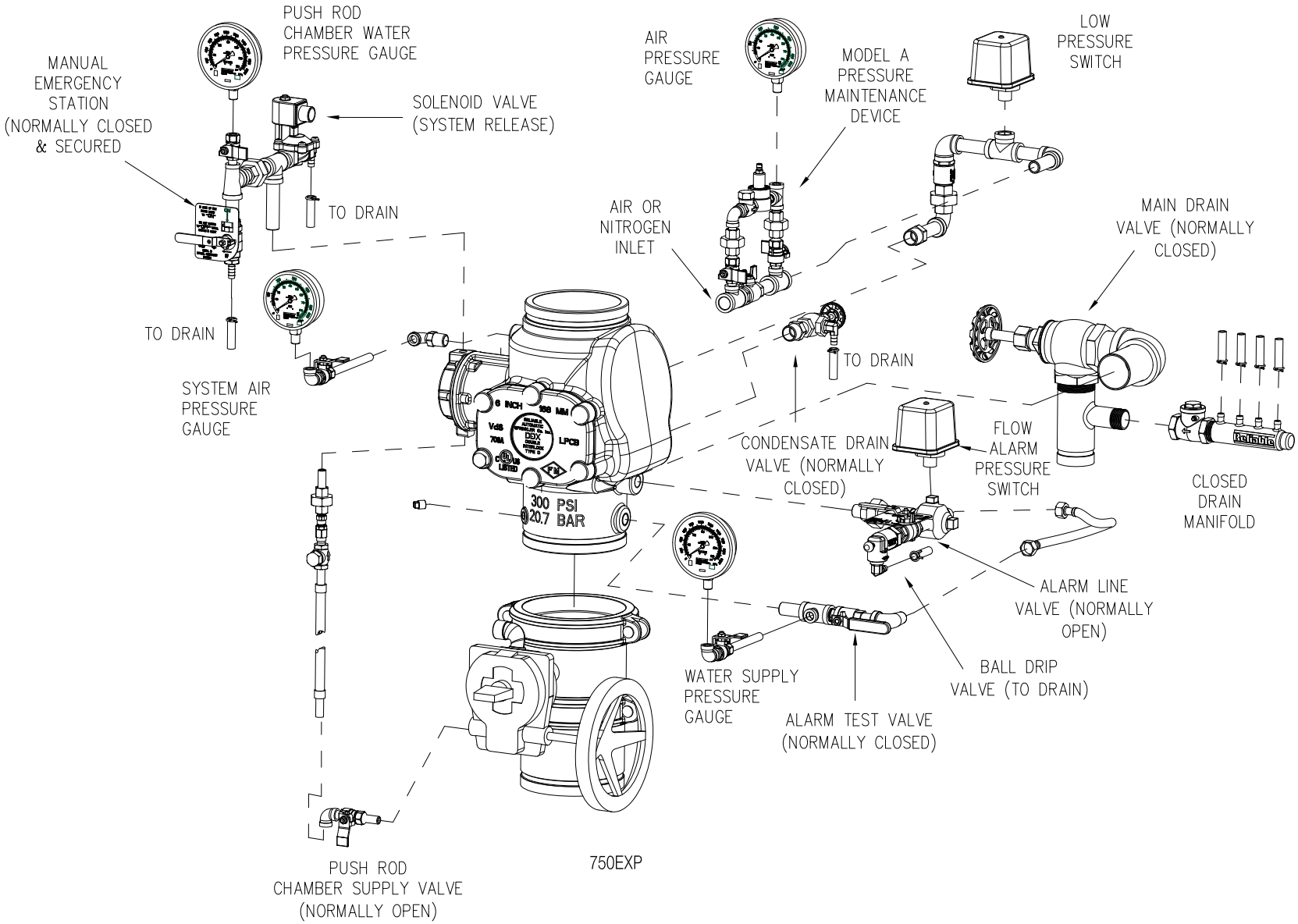
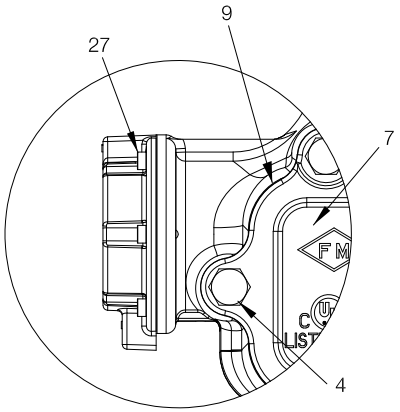
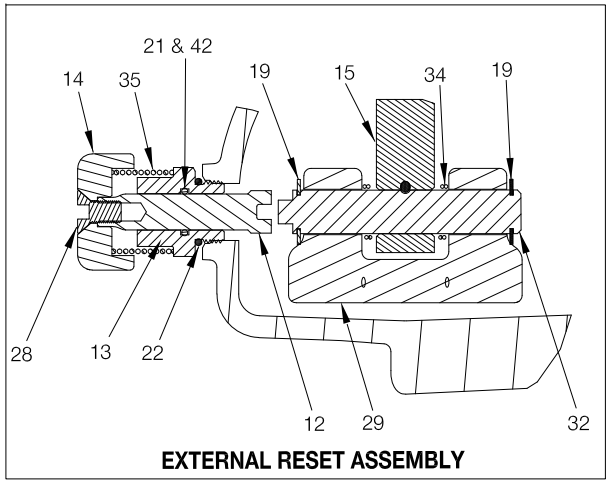

PUSH ROD
CHAMBER WATER
PRESSURE GAUGE
MANUAL
EMERGENCY
STATION
(NORMALLY CLOSED
& SECURED
SOLENOID VALVE
(SYSTEM RELEASE)
TO DRAIN
TO DRAIN
SYSTEM AIR
PRESSURE
GAUGE
AIR
PRESSURE
GAUGE
MODEL A
PRESSURE
MAINTENANCE
DEVICE
LOW
PRESSURE
SWITCH
AIR OR
NITROGEN
INLET
MAIN DRAIN
VALVE (NORMALLY
CLOSED)
TO DRAIN
CONDENSATE DRAIN
VALVE (NORMALLY
CLOSED)
FLOW
ALARM
PRESSURE
SWITCH
CLOSED
DRAIN
MANIFOLD
6 INCH
150 MM
300 PSI
20.7 BAR
ALARM LINE
VALVE (NORMALLY
OPEN)
BALL DRIP
VALVE (TO DRAIN)
WATER SUPPLY
PRESSURE
GAUGE
ALARM TEST VALVE
(NORMALLY CLOSED)
PUSH ROD
CHAMBER SUPPLY VALVE
(NORMALLY OPEN)
750EXP

Fig. 4

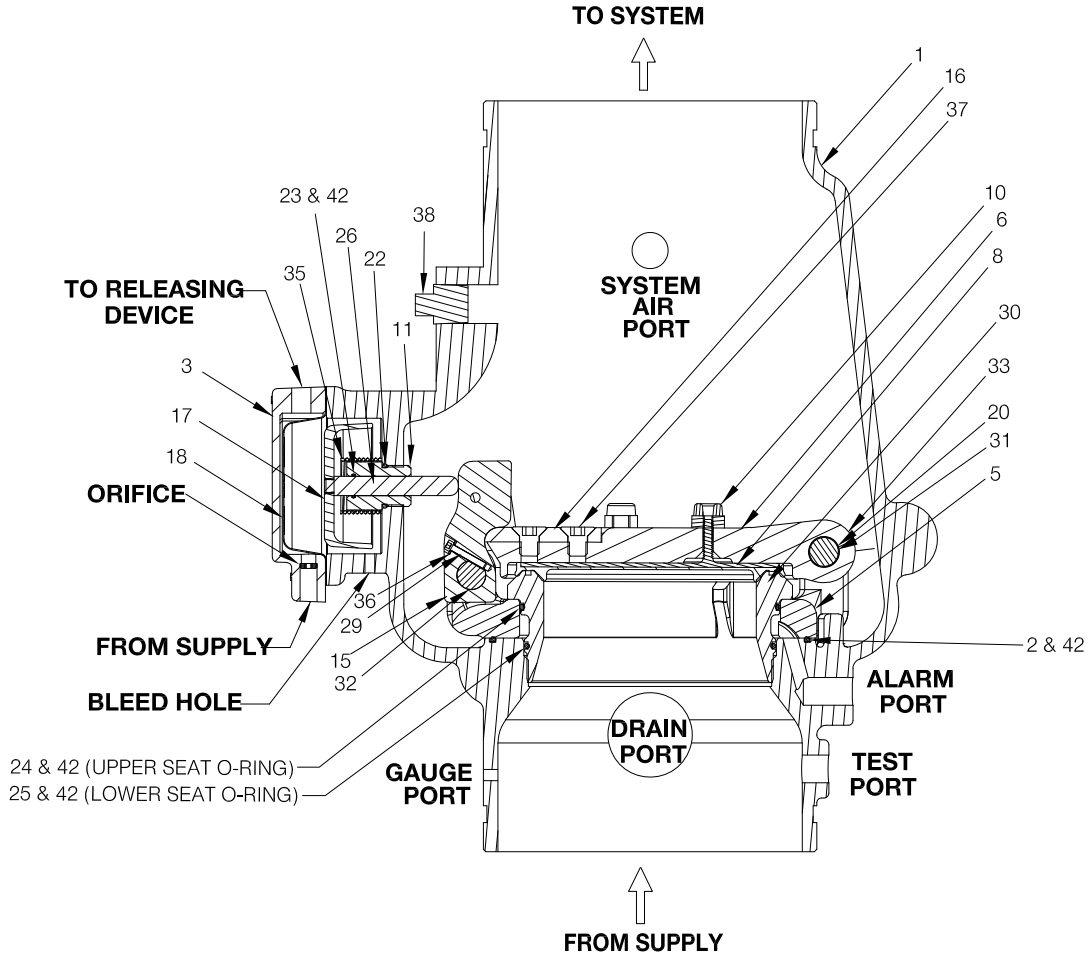
MODEL DDX VALVE WITH STAINLESS STEEL SCREW-IN SEAT

IMPORTANT NOTE: Early generation 4" and 6" DDX valves may incorporate a brass drop-in seat. Prior to ordering replacement parts, confirm the presence of a stainless steel screw-in seat or brass drop-in seat. For replacement parts for valves with brass drop-in seat, please contact Reliable Sprinkler Company Technical Services (techserv@reliablesprinkler.com)





EXTERNAL RESET ASSEMBLY



519FG12B

Fig.5

Model DDX (Screw-In Seat Configuration) Deluge Valves Parts List (Refer to Fig. 5)

Item No.	Part No.								Part Description	QTY.	Material
	2" (50mm)	2½" (65mm)	76mm	3" (80mm)	4" (100mm)	165mm	6" (150mm)	8" (200mm)			
1	91006011	91006012	91006023	91006013	91006005	91006027	91006007	91006028	Valve Body Groove/Groove	1	Ductile Iron 65-45-12
	N/A	N/A	N/A	N/A	91006045	N/A	91006067	N/A	Valve Body Flange/Groove		
	N/A	N/A	N/A	N/A	91006035	N/A	91006037	91006039	Valve Body Flange/Flange		
2	N/A	N/A	N/A	N/A	N/A	N/A		95406414	O-ring (Mounting Ring)	1	Buna-N
3	71040416								Pushrod Cover Assembly	1	Ductile Iron 65-45-12 & Brass C360000
4	91106123				N/A	N/A		N/A	Hex Bolt ½"-13 x 1¼"	6	Zinc Plated Steel
	N/A				95606107	N/A		N/A	Hex Bolt ½"-13 x 1½"	6	
	N/A				N/A	91106006		N/A	Hex Bolt ⅝"-11 x 1¾"	6	
	N/A				N/A	N/A		95606110	Hex Bolt ⅝"-11 x 2"	8	
5	91306013				91306014	91306016		91306018	Mounting Ring	1	Stainless Steel CF8 or CF8M
6	91916003				91916014	91916016		91916008	Clapper	1	Stainless Steel CF8 or CF8M
7	92116063				92116064	92116065	92116066	92116068	Access Cover	1	Ductile Iron 65-45-12
8	93416003				93416014	93416016		93416008	Seal Assembly	1	Stainless Steel 304 & EPDM
9	93706003				93706004	93706006		93706008	Access Cover Gasket	1	Buna-N or Neoprene
10	93722000				93722000	N/A		N/A	Bumpstop Assembly	1	Stainless Steel UNS S31600 & EPDM
	N/A				N/A	93722000		N/A		2	
	N/A				N/A	N/A		93722000		3	
11	93916006								Pushrod Guide	1	Acetal
12	93916066								Reset Shaft	1	Brass UNS C36000
13	94106066								Reset Housing	1	Brass UNS C36000
14	94356006								Reset Knob	1	Aluminum 6061
15	94506003				94506004	94506016		94506008	Lever	1	Stainless Steel UNS S17400
16	95006414				94006412	95006410		95006410	Striker	1	Aluminum Bronze C95400
17	95106006								Piston	1	Stainless Steel CF8M
18	95276006								Diaphragm	1	EPDM & Polyester
19	95306267				N/A	N/A		N/A	Retaining Ring, ⅜" Shaft, Lever Pin	2	Stainless Steel 15-7 or 17-7
	N/A				95306267	N/A		N/A	Retaining Ring, ½" Shaft, Lever Pin		
	N/A				N/A	95306269		N/A	Retaining Ring, ⅝" Shaft, Lever Pin		
	N/A				N/A	N/A		95316408	Retaining Ring, ¾" Shaft, Lever Pin		
20	95306268				N/A	N/A		N/A	Retaining Ring, ⅜" Shaft, Hinge Pin	2	Stainless Steel 15-7 or 17-7
	N/A				95306267	95306267		N/A	Retaining Ring, ½" Shaft, Hinge Pin		
	N/A				N/A	N/A		95316408	Retaining Ring, ¾" Shaft, Hinge Pin		
21	95406007								O-Ring, Reset Housing ID	1	Buna-N
22	95406024								O-Ring, Reset Housing & Pushrod Guide OD	2	Buna-N
23	95406407								O-Ring, Pushrod Guide ID	1	Buna-N
24	95406410				95406409	95436126		95406413	O-Ring, Upper Seat	1	Buna-N
25	95406411				95406420	95446226		95406412	O-Ring, Lower Seat	1	Buna-N
26	95506006								Pushrod	1	Stainless Steel UNS S30300
27	95606114								Socket Head Screw, ¼"-20 x ⅝"	6	Steel
28	95606127								Flat Head Socket Cap Screw ⅜"-16 x ¾"	1	Steel
29	95606133				N/A	N/A		N/A	Socket Head Screw #6-32 x ½"	1	Stainless Steel 18-8
	N/A				95606130	95606130		95606130	Socket Head Screw #10-32 x 1"		Stainless Steel UNS S31600
30	96016003				96016014	96016016		96016008	Seat	1	Stainless Steel CF8M
31	96206003				N/A	N/A		N/A	Hinge Pin	1	Stainless Steel UNS S30400
	N/A				96216086	96216086		96206008			Stainless Steel UNS S21800
32	96216003				N/A	N/A		N/A	Lever Pin	1	Stainless Steel UNS S17400
	N/A				96216044	96216047		96216008			Stainless Steel UNS S21800
33	96310003				96906904	96906904		96310008	Clapper Spacer	2	Teflon or Acetal
34	96406003				N/A	N/A		N/A	Lever Spring	1	Stainless Steel UNS S30400
	N/A				96406004	96406005		96406008			Stainless Steel UNS S31600
35	96406906								Piston/ Reset Spring	2	Stainless Steel UNS S31600

Model DDX (Screw-In Seat Configuration) Deluge Valves Parts List (Refer to Fig. 5) (Cont.)

Item No.	Part No.								Part Description	QTY.	Material
	2" (50mm)	2½" (65mm)	76mm	3" (80mm)	4" (100mm)	165mm	6" (150mm)	8" (200mm)			
36	96906112				N/A	N/A		N/A	Spring Lock Washer, #6	1	Stainless Steel 18-8
	N/A				96906111	96906111		96906111	Spring Lock Washer, #10		Stainless Steel UNS S31600
37	95606140				N/A	N/A		N/A	Flat Head Socket Cap Screw ¼"-20 x ½"	2	Stainless Steel 18-8
	N/A				95606139	N/A		N/A			Stainless Steel UNS S31600
	N/A				N/A	N/A		95606135	Flat Head Socket Cap Screw ½"-13 x ¾"		Stainless Steel UNS S31600
38	98604402								Plug, ½" NPT	1	Steel
39	94616921								Knob Caution Label (Not Shown)	1	Polystyrene
40	91556922								Ball Chain, 1/8" (Not Shown) (Length is in Inches)	6	Nickel Plated Brass
41	91556923								Clamping Link, Ball Chain (Not Shown)	1	
42	699993406								O-Ring Grease, Dupont™ Krytox® GPL-205	A/R	Krytox®

Ordering Information

Specify:

Model DDX Type D Double Interlock Preaction System

- **Size**
- **End Configuration**
- **Trim Assembly**
  - Loose Trim
  - Segmentally Assembled
  - Fully Assembled no Control Valve
  - Fully Assembled with Control Valve*
- **Optional 300 psi (20,7 bar) solenoid valve**

***Note:** This trim assembly will include a spool piece with 1/4" outlet to accommodate push rod chamber supply piping. Not available for 76mm or 165mm systems, or systems using a flanged inlet Model DDX valve.

Service Kits

Service kits are available for routine servicing of the valve (reference Figure 5). Service kits for the Model DDX Deluge Valve include the following components:

- Clapper Seal Assembly (item 8)
- Cover Gasket (item 9)
- Bumpstop(s) (item 10)
- Push rod chamber diaphragm (item 18)
- Grease (item 42)

2", 2-1/2", and 3" Model DDX Service Kit: PN 6501200R03
4" Model DDX Service Kit: PN 6501200R04
6" Model DDX Service Kit: PN 6501200R05
8" Model DDX Service Kit: PN 6501200R06

Note: Early generation 4" and 6" Model DDX valves utilize a drop-in brass clapper. Service kits for early Model DDX valves are as follows:

4" Early generation DDX Deluge Valve Service Kit: PN 6501200R07
6" Early generation DDX Deluge Valve Service Kit: PN 6501200R08

Nominal Pipe Size	Installation Dimensions in Inches (mm)									
	A	B	C	D[1]	D[2]	E	F	G	H	J
2" (50mm)	9-1/2 (241)	8 (203)	9-1/2 (241)	12-1/2 (318)	NA	8-1/2 (216)	8-3/4 (222)	10-1/2 (267)	9-1/2 (241)	5 (127)
2-1/2" (65 mm), 76 mm, & 3" (80 mm)	9-1/2 (241)	8 (203)	9-1/2 (241)	12-1/2 (318)	NA	8-1/2 (216)	9-1/4 (235)	10-1/2 (267)	9-1/2 (241)	5 (127)
4" (100 mm)	10-1/2 (270)	8 (203)	10 (254)	14 (356)	16 (406)	7 (178)	10 (254)	11-5/8 (295)	13 (324)	6 (148)
6" (150 mm) & 165 mm	12-1/2 (318)	8-1/2 (215)	10-1/2 (267)	16 (406)	19 (483)	7 (178)	10-3/4 (273)	12-1/4 (311)	13 (324)	6 (148)
8" (200 mm)	13-1/2 (343)	11-1/4 (286)	9-1/2 (241)	19-3/8 (492)	21-1/4 (540)	3-3/4 (95)	11-1/4 (286)	14-1/4 (362)	12-5/8 (312)	5-3/4 (140)

Notes:

1. End to end take out of Model DDX valve with grooved inlet.
2. End to end take out of Model DDX valve with flanged inlet where available (see page 8; also reference Bulletin 519).
3. Not applicable to 76mm or 165mm systems, or systems using a flanged inlet Model DDX valve.

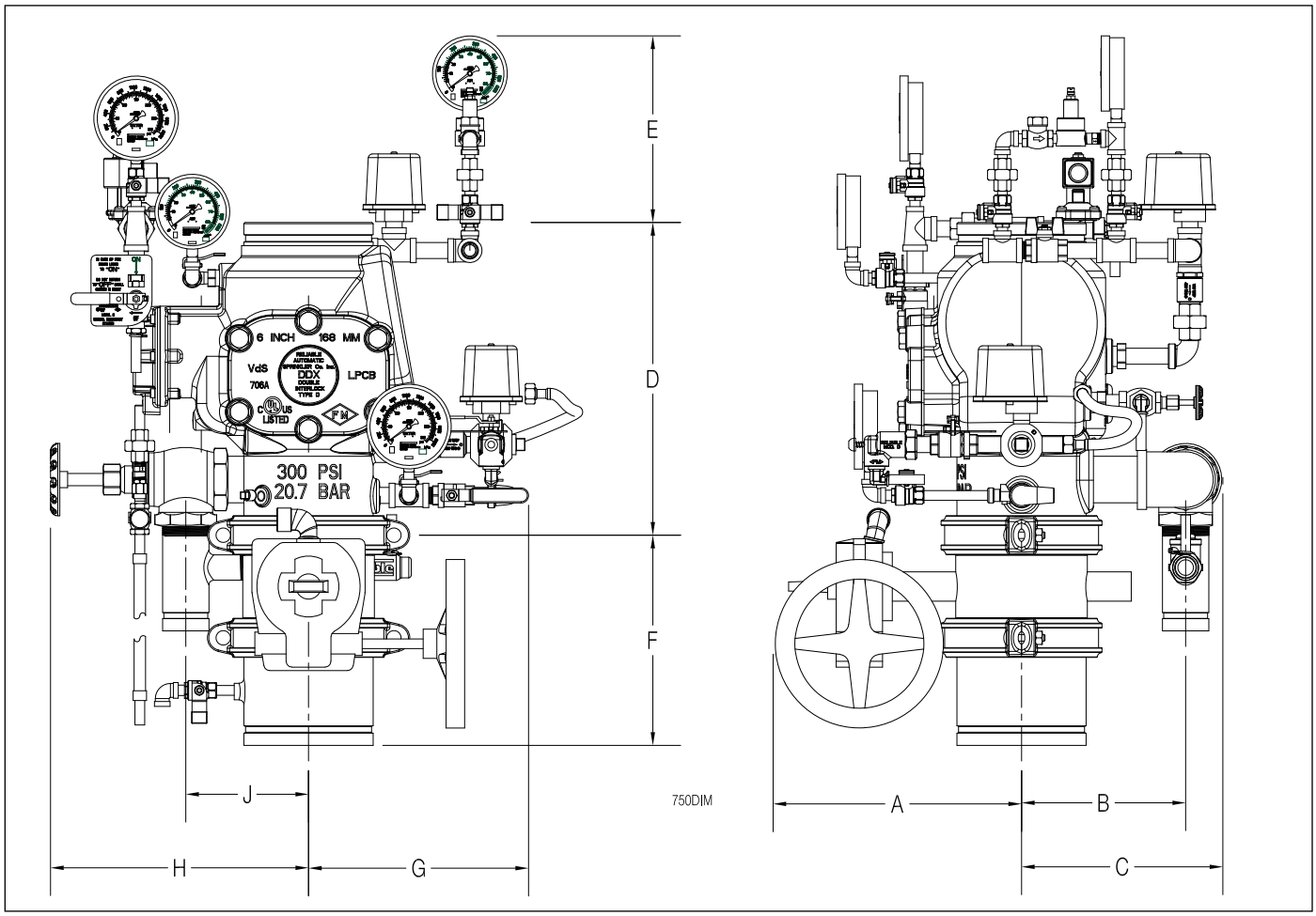


Fig. 7

The equipment presented in this bulletin is to be installed in accordance with the latest published Standards of the National Fire Protection Association, Factory Mutual Research Corporation, or other similar organizations and also with the provisions of governmental codes or ordinances whenever applicable.

Products manufactured and distributed by Reliable have been protecting life and property for almost 100 years.

Manufactured by

Reliable®

Reliable Automatic Sprinkler Co., Inc.
(800) 431-1588 Sales Offices
(800) 848-6051 Sales Fax
(914) 829-2042 Corporate Offices
www.reliablesprinkler.com Internet Address

Recycled Paper

Revision lines indicate updated or new data.

EG. Printed in U.S.A. 06/21 P/N 9999970441

5. ELECTRICAL / FIRE ALARM COMPONENTS

DRY PIPE AUTOMATIC FIRE SPRINKLER SYSTEM

PS10 SERIES
PRESSURE SWITCH

UL, cUL, and CSFM Listed, FM and LPC Approved, NYMEA Accepted, CE Marked

Dimensions: 3.78" (9,6cm)W x 3.20" (8,1cm)D x 4.22" (10,7cm)H

Conduit Entrance: Two knockouts provided for 1/2" conduit. Individual switch compartments and ground screws suitable for dissimilar voltages.

Enclosure: Cover - Die-cast with textured red powdercoat finish, single cover screw and rain lip.

Base - Die-cast

Pressure Connection: Nylon 1/2" NPT Male

Factory Adjustment: 4 - 8 PSI (0,27 - 0,55 BAR)
Differential: 2 PSI (0,13 BAR) typical

Maximum System Pressure: 300 PSI (20,68 BAR)

Switch Contacts: SPDT (Form C)
10.1 Amps at 125/250VAC, 2.0 Amps at 30VDC
One SPDT in PS10-1, Two SPDT in PS10-2

Environmental Specifications:
NEMA 4/IP66 Rated Enclosure - indoor or outdoor when used with NEMA 4 conduit fittings.
Temperature range: -40°F to 140°F (-40°C to 60°C)

Service Use:

Automatic Sprinkler	NFPA-13
One or two family dwelling	NFPA-13D
Residential Occupancy up to four stories	NFPA-13R
National Fire Alarm Code	NFPA-72

Ordering Information

Model	Description	Stock No.
PS10-1	Pressure switch with one set SPDT contacts	1340103
PS10-2	Pressure switch with two sets SPDT contacts	1340104
	Hex Key	5250062
	Cover Tamper Switch Kit	0090200

Tamper
Cover incorporates tamper resistant fastener that requires a special key for removal. One key is supplied with each device. For optional cover tamper switch kit, order Stock No. 0090200. See bulletin #5401200 PSCTSK.

Installation
The Potter PS10 Series Pressure Actuated Switches are designed for the detection of a waterflow condition in automatic fire sprinkler systems of particular designs such as wet pipe systems with alarm check valves, dry pipe, preaction, or deluge valves. The PS10 is also suitable to provide a low pressure supervisory signal; adjustable between 4 and 15 psi (0,27 and 1,03 BAR).

1. Apply Teflon tape to the threaded male connection on the device. (Do not use pipe dope)
2. Device should be mounted in the upright position (threaded connection down).
3. Tighten the device using a wrench on the flats on the device.

Wiring Instructions

1. Remove the tamper resistant screw with the special key provided.
2. Carefully place a screwdriver on the edge of the knockout and sharply apply a force sufficient to dislodge the knockout plug. See Fig 9
3. Run wires through an approved conduit connector and affix the connector to the device.
4. Connect the wires to the appropriate terminal connections for the service intended. See Figures 2,4,5, and 6. See Fig 7 for two switch, one conduit wiring.

Testing
The operation of the pressure alarm switch should be tested upon completion of installation and periodically thereafter in accordance with the applicable NFPA codes and standards and/or the authority having jurisdiction (manufacturer recommends quarterly or more frequently).

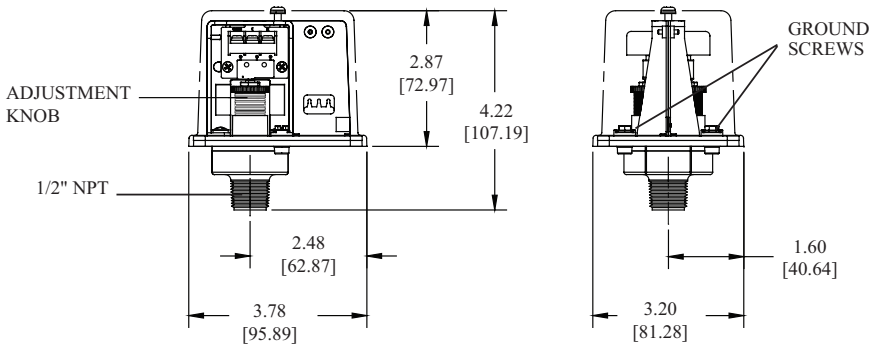
Wet System
Method 1: When using PS10 and control unit with retard - connect PS10 into alarm port piping on the input side of retard chamber and electrically connect PS10 to control unit that provides a retard to compensate for surges. Insure that no unsupervised shut-off valves are present between the alarm check valve and PS10.
Method 2: When using the PS10 for local bell application or with a control that does not provide a retard feature - the PS10 must be installed on the alarm outlet side of the retard chamber of the sprinkler system.
Testing: Accomplished by opening the inspector's end-of-line test valve. Allow time to compensate for system or control retard.
Note: Method 2 is not applicable for remote station service use, if there is an unsupervised shut-off valve between the alarm check valve and the PS10.

Wet System With Excess Pressure
Connect PS10 into alarm port piping extending from alarm check valve. Retard provisions are not required. Insure that no unsupervised shut-off valves are present between the alarm check valve and the PS10.
Testing: Accomplished by opening the water by-pass test valve or the inspector's end-of-line test valve. When using end-of-line test, allow time for excess pressure to bleed off.

Dry System
Connect PS10 into alarm port piping that extends from the intermediate chamber of the alarm check valve. Install on the outlet side of the in-line check valve of the alarm port piping. Insure that no unsupervised shut-off valves are present between the alarm check valve and the PS10.
Testing: Accomplished by opening the water by-pass test valve.
Note: The above tests may also activate any other circuit closer or water motor gongs that are present on the system.

Dimensions

Fig. 1

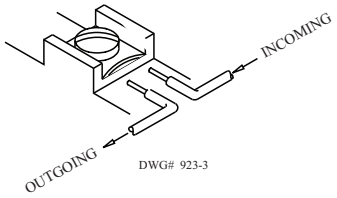


NOTE: To prevent leakage, apply Teflon tape sealant to male threads only.

DWG# 930-1

Switch Clamping Plate Terminal

Fig. 2

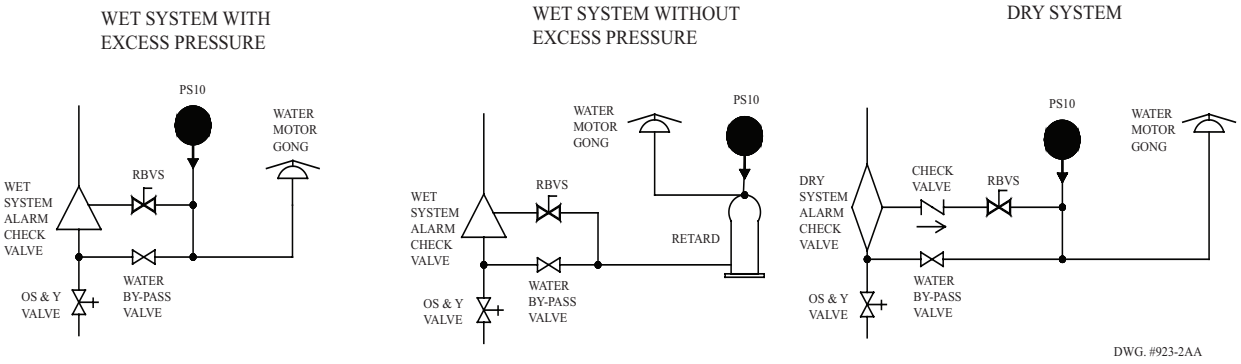


⚠ WARNING

An uninsulated section of a single conductor should not be looped around the terminal and serve as two separate connections. The wire must be severed, thereby providing supervision of the connection in the event that the wire becomes dislodged from under the terminal.

Typical Sprinkler Applications

Fig. 3

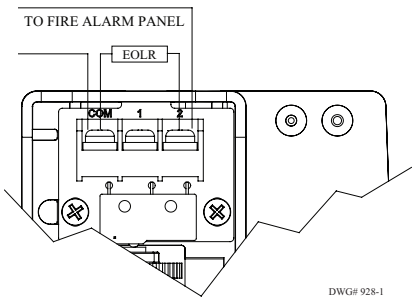


⚠ CAUTION

Closing of any shutoff valves between the alarm check valve and the PS10 will render the PS10 inoperative. To comply with NFPA-72 any such valve shall be electrically supervised with a supervisory switch such as Potter Model RBVS.

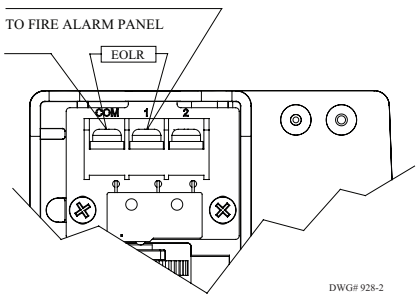
Low Pressure Signal Connection

Fig. 4



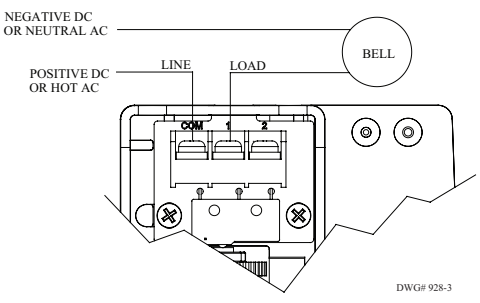
Waterflow Signal Connection

Fig. 5



Local Bell For Waterflow Connection

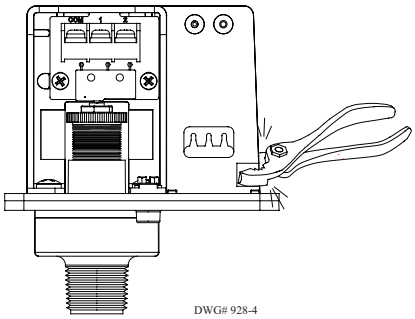
Fig. 6



One Conduit Wiring

Fig. 7

Break out thin section of divider to provide path for wires when wiring both switches from one conduit entrance.



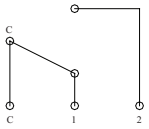
DWG# 928-4

Switch Operation

Fig. 8

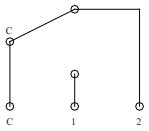
Terminal
C: Common
1: Closed when installed under normal system pressure.
2: Open when installed under normal system pressure. Closes on pressure drop. Use for low pressure supervision.

W/ PRESSURE APPLIED



Terminal
1: Open with no pressure supplied. Closes upon detection of pressure. Use for waterflow indication.
2: Closed with no pressure applied.

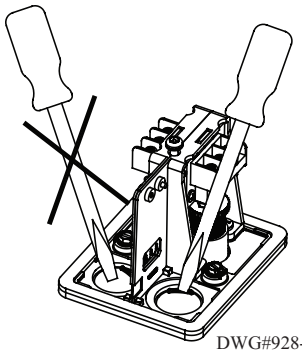
W/O PRESSURE APPLIED



DWG#928-6

Removing Knockouts

Fig. 9



DWG#928-5

⚠ WARNING

- Installation must be performed by qualified personnel and in accordance with all national and local codes and ordinances.
- Shock hazard. Disconnect power source before servicing. Serious injury or death could result.
- Read all instructions carefully and understand them before starting installation. Save instructions for future use. Failure to read and understand instructions could result in improper operation of device resulting in serious injury or death.
- Risk of explosion. Not for use is hazardous locations. Serious injury or death could result.

⚠ CAUTION

- Do not tighten by grasping the switch enclosure. Use wrenching flats on the bushing only. Failure to install properly could damage the switch and cause improper operation resulting in damage to equipment and property.
- To seal threads, apply Teflon tape to male threads only. Using joint compounds or cement can obstruct the pressure port inlet and result in improper device operation and damage to equipment.
- Do not over tighten the device, standard piping practices apply.

Engineer/Architect Specifications Pressure Type Waterflow Switch

Pressure type waterflow switches; shall be a Model PS10 as manufactured by Potter Electric Signal Company, St Louis MO., and shall be installed on the fire sprinkler system as shown and or specified herein.

Switches shall be provided with a ½" NPT male pressure connection and shall be connected to the alarm port outlet of; Wet Pipe Alarm Valves, Dry Pipe Valves, Pre-Action Valves, or Deluge Valves. The pressure switch shall be actuated when the alarm line pressure reaches 4 - 8 PSI (0,27 - 0,55 BAR).

Pressure type waterflow switches shall have a maximum service pressure rating of 300 PSI (20,68 BAR) and shall be factory adjusted to operate on a pressure increase of 4 - 8 PSI (0,27 - 0,55 BAR)

Pressure switch shall have one or two form C contacts, switch contact rating 10.1 Amps at 125/250 VAC, 2.0 Amps at 30 VDC.

Pressure type waterflow switches shall have two conduit entrances one for each individual switch compartment to facilitate the use of dissimilar voltages for each individual switch.

The cover of the pressure type waterflow switch shall be Zinc die-cast with rain lip and shall attach with one tamper resistant screw. The Pressure type waterflow switch shall be suitable for indoor or outdoor service with a NEMA 4/IP66 rating.

The pressure type waterflow switch shall be UL Ulc and CSFM listed, FM and LPC approved and NYMEA accepted.

POTTER
The Symbol of Protection

PS40 SERIES
SUPERVISORY PRESSURE SWITCH

UL, cUL, and CSFM Listed, FM and LPC Approved, NYMEA Accepted, CE Marked

Dimensions: 3.78" (9,6cm)W x 3.20" (8,1cm)D x 4.22" (10,7cm)H

Conduit Entrance: Two knockouts provided for 1/2" conduit. Individual switch compartments and ground screw suitable for dissimilar voltages

Enclosure: Cover- Die-cast with textured red powdercoat finish, single cover screw and rain lip.
Base- Die-cast

Pressure Connection: Nylon 1/2" NPT male

Factory Adjustment: PS40-1 operates on decrease at 30 PSI (2,1 BAR)
PS40-2 operates in increase at 50 PSI (3,5 BAR) and on decrease at 30 PSI (2,1 BAR)

Pressure Range: 10-60 PSI (,7 - 4,1 BAR)

Differential: Typical 1 lb. at 10 PSI (,07 at ,7 BAR)
4 lbs at 60 PSI (,28 at 4,1 BAR)

Maximum System Pressure: 300 PSI (20,68 BAR)

Switch Contacts: SPDT (Form C)
10.1 Amps at 125/250VAC, 2.0 Amps at 30VDC
One SPDT in PS40-1, Two SPDT in PS40-2

Environmental Specifications:
NEMA 4/IP66 Rated Enclosure - indoor or outdoor when used with NEMA 4 conduit fittings.
Temperature range: -40°F to 140°F (-40°C to 60°C)

Tamper: Cover incorporates tamper resistant fastener that requires a special key for removal. One key is supplied with each device. For optional cover tamper switch kit, order Stock No. 0090200. See bulletin #5401200 PSCTSK.

Service Use:

Automatic Sprinkler	NFPA-13
One or two family dwelling	NFPA-13D
Residential Occupancy up to four stories	NFPA-13R
National Fire Alarm Code	NFPA-72

Ordering Information

Model	Description	Stock No.
PS40-1	Pressure switch with one set SPDT contacts	1340403
PS40-2	Pressure switch with two sets SPDT contacts	1340404
	Hex Key	5250062
	Cover Tamper Switch Kit	0090200
BVL	Bleeder valve	1000018

Installation

The Potter PS40 Series Supervisory Pressure Actuated Switches are designed primarily to detect an increase and/or decrease from normal system pressure in automatic fire sprinkler systems. Typical applications are: Dry pipe systems, pre-action air/nitrogen supervision, pressure tanks, air supplies, and water supplies. The PS40 switch is factory set for 40 PSI (2,8 BAR) normal system pressure. The switch marked with the word LOW is set to operate at a pressure decrease of 10 PSI (,7 BAR) at 30 PSI (2,1 BAR). The switch marked with the word HIGH is set to operate at a pressure increase of 10 PSI (,7 BAR) at 50 PSI (3,5 BAR). See section heading **Adjustments and Testing** if other than factory set point is required.

1. Connect the PS40 to the system side of any shutoff or check valve.
2. Apply Teflon tape to the threaded male connection on the device. (Do not use pipe dope)
3. Device should be mounted in the upright position. (Threaded connection down)
4. Tighten the device using a wrench on the flats on the device.

Wiring Instructions

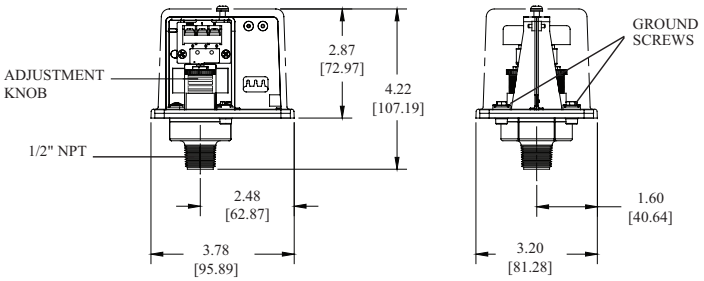
1. Remove the tamper resistant screw with the special key provided.
2. Carefully place a screwdriver on the edge of the knockout and sharply apply a force sufficient to dislodge the knockout plug. See Fig. 9
3. Run wires through an approved conduit connector and affix the connector to the device. A NEMA-4 rated conduit fitting is required for outdoor use.
4. Connect the wires to the appropriate terminal connections for the service intended. See Figures 2,4,5,6, and 8

Adjustment And Testing

The operation of the pressure supervisory switch should be tested upon completion of installation and periodically thereafter in accordance with the applicable NFPA codes and standards and/or the authority having jurisdiction (manufacturer recommends quarterly or more frequently).
Note: Testing the PS40 may activate other system connected devices.
The use of a Potter BVL (see product bulletin 8900067 for details) is recommended to facilitate setting and testing of the PS40 pressure switch. When a BVL (bleeder valve) is used, the pressure to the switch can be isolated and bled from the exhaust port on the BVL without effecting the supervisory pressure of the entire system. See Fig. 3
The operation point of the PS40 Pressure Switch can be adjusted to any point between 10 and 60 PSI (0,7 - 4,11 BAR) by turning the adjustment knob(s) clockwise to raise the actuation point and counter clockwise to lower the actuation point. In the case of the PS40-2, both switches operate independent of each other. Each switch may be independently adjusted to actuate at any point acrosss the switch adjustment range. Initial adjustment can be made with a visual reference from the top of the adjustment knob across to the printed scale on the switch bracket. Final adjustments should be verified with a pressure gauge.

PS40 SERIES
SUPERVISORY PRESSURE SWITCH

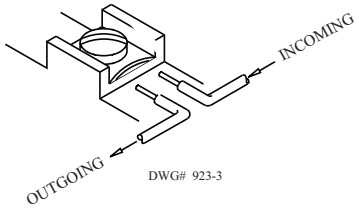
Dimensions
Fig. 1



NOTE: To prevent leakage, apply Teflon tape sealant to male threads only.

DWG# 930-1

Switch Clamping Plate Terminal
Fig. 2

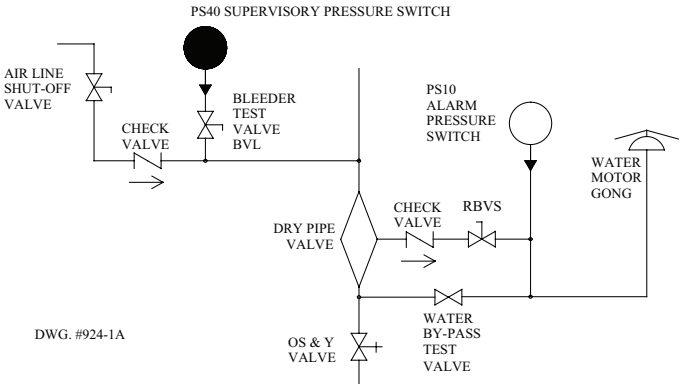


DWG# 923-3

⚠ WARNING

An uninsulated section of a single conductor should not be looped around the terminal and serve as two separate connections. The wire must be severed, thereby providing supervision of the connection in the event that the wire becomes dislodged from under the terminal.

Typical Sprinkler Applications
Fig. 3



DWG. #924-1A

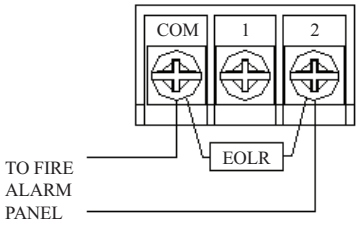
⚠ CAUTION

Closing of any shutoff valves between the alarm check valve and the PS10 will render the PS10 inoperative. To comply with IBC, IFC, and NFPA-13, any such valve shall be electrically supervised with a supervisory switch such as Potter Model RBVS.

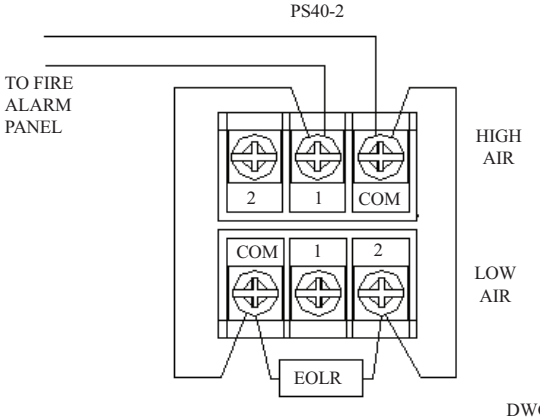
Typical Connections
Fig. 4

WITH NORMAL SYSTEM PRESSURE APPLIED LOW -TERMINAL 2 CLOSES ON PRESSURE DROP.

PS40-1



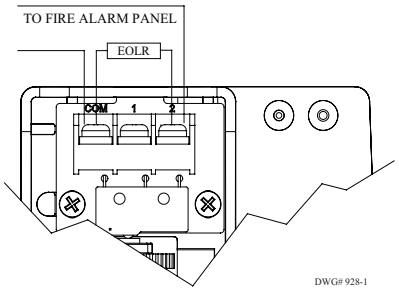
PS40-2



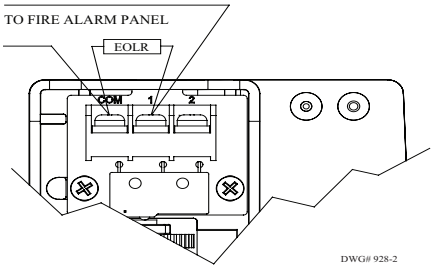
WITH NORMAL SYSTEM PRESSURE APPLIED HIGH - TERMINAL 1 WILL CLOSE ON PRESSURE INCREASE.

DWG# 930-2

Low Pressure Signal Connection
Fig. 5

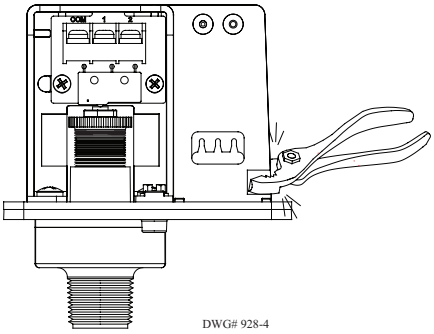


High Pressure Signal Connection
Fig. 6



One Conduit Wiring
Fig. 7

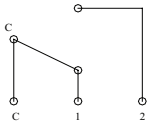
Break out thin section of divider to provide path for wires when wiring both switches from one conduit entrance.



Changing Pressure
(With normal system pressure)
Fig. 8

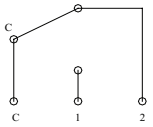
Terminal
C: Common
1: Closed when installed under normal system pressure.
2: Open when installed under normal system pressure. Closes on pressure drop. Use for low air signal.

LOW PRESSURE SWITCH



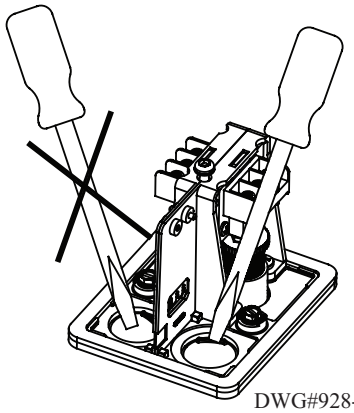
Terminal
1: Open when installed under normal system pressure. Closes on increase in pressure. Use for high air signal.
2: Closed under normal system pressure.

HIGH PRESSURE SWITCH



DWG# 930-3

Removing Knockouts
Fig. 9



DWG#928-5

Engineer/Architect Specifications Pressure Type Waterflow Switch

Pressure type supervisory switches; shall be a Model PS40 as manufactured by Potter Electric Signal Company, St. Louis, MO., and shall be installed on the fire sprinkler system as shown and or specified herein.

Switches shall be provided with a 1/2" NPT male pressure connection to be connected into the air supply line on the system side of any shut-off valve. A Model BVL bleeder valve as supplied by Potter Electric Signal Company of St. Louis, MO., or equivalent shall be connected in line with the PS40 to provide a means of testing the operation of the supervisory switch. (See Fig. 3)

The switch unit shall contain SPDT (Form C) switch(es). One switch shall be set to operate at a pressure decrease of 10 PSI (0,7 BAR) from normal. If two switches are provided, the second switch shall be set to operate at a pressure increase of 10 PSI (0,7 BAR) from normal.

Switch contacts shall be rated at 10.1 Amps at 125/250VAC and 2.0 Amps at 30VDC. The units shall have a maximum pressure rating of 300 PSI (20,68 BAR) and shall be adjustable from 10 to 60 PSI (0,7 to 4,1 BAR).

Pressure switches shall have two conduit entrances, one for each individual switch compartment to facilitate the use of dissimilar voltages for each individual switch.

The cover of the pressure switch shall be zinc die-cast with rain lip and shall attach with one tamper resistant screw. The pressure switch shall be suitable for indoor or outdoor service with a NEMA-4/IP66 rating.

The pressure switch shall be UL, ULC, and CSFM listed, FM and LPC approved and NYMEA accepted.

⚠ WARNING

- Installation must be performed by qualified personnel and in accordance with all national and local codes and ordinances.
- Shock hazard. Disconnect power source before servicing. Serious injury or death could result.
- Read all instructions carefully and understand them before starting installation. Save instructions for future use. Failure to read and understand instructions could result in improper operation of device resulting in serious injury or death.
- Risk of explosion. Not for use is hazardous locations. Serious injury or death could result.

⚠ CAUTION

- Do not tighten by grasping the switch enclosure. Use wrenching flats on the bushing only. Failure to install properly could damage the switch and cause improper operation resulting in damage to equipment and property.
- To seal threads, apply Teflon tape to male threads only. Using joint compounds or cement can obstruct the pressure port inlet and result in improper device operation and damage to equipment.
- Do not over tighten the device, standard piping practices apply.
- Do not apply any lubricant to any component of the pressure switch.

6. PIPE HANGERS

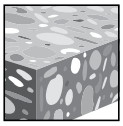
DRY PIPE AUTOMATIC FIRE SPRINKLER SYSTEM

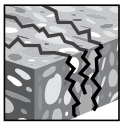
3.3.13 HDI-P TZ DROP-IN ANCHORS

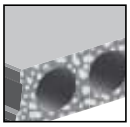
PRODUCT DESCRIPTION

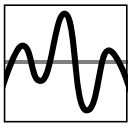
HDI-P TZ Flush anchors

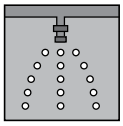
Anchor System		Features and Benefits
	Carbon steel HDI-P TZ	• Drop-in anchor with optimized length for reliable fastenings in post-tensioned cable concrete slabs • Suitable for uncracked and cracked concrete including seismic areas • Productive installation with HDI-P TZ automatic setting tool with hammer drill • Used with Hilti Dust Removal System (DRS) for compliance with Table 1 of OSHA 1926.1153 regulations for silica dust exposure • Shallow drilling for fast installations • Easy installation with Auto Setting Tool • Lip provides flush installation, consistent anchor depth, and easy rod alignment • Auto Setting Tool includes stop drill bit and setting tool, no tool change necessary
	Auto-setting tool HDI-P TZ	
	Hand-setting tool HDI-P TZ	


Uncracked concrete


Cracked concrete


Hollow core concrete


Seismic design categories A-F


Fire sprinkler listings

Approvals/Listings	
ICC-ES (International Code Council)	ESR-4236 in concrete per ACI 318 Ch. 17 / ACI 355.2 / ICC-ES AC193
City of Los Angeles	2017 LABC Supplement (within ESR-4236)
Florida Building Code	2017 FBC Supplement (within ESR-4236)
FM (Factory Mutual)	Pipe hanger components for automatic sprinkler systems for 3/8 (4-inch nominal pipe diameter)
UL (Underwriters Laboratory)	Pipe hanger equipment for fire protection services for 3/8 (4-inch nominal pipe diameter)

MATERIAL SPECIFICATIONS

HDI-P TZ drop-in anchors are manufactured from carbon steel with zinc plating per DIN EN ISO 4042 A2K.

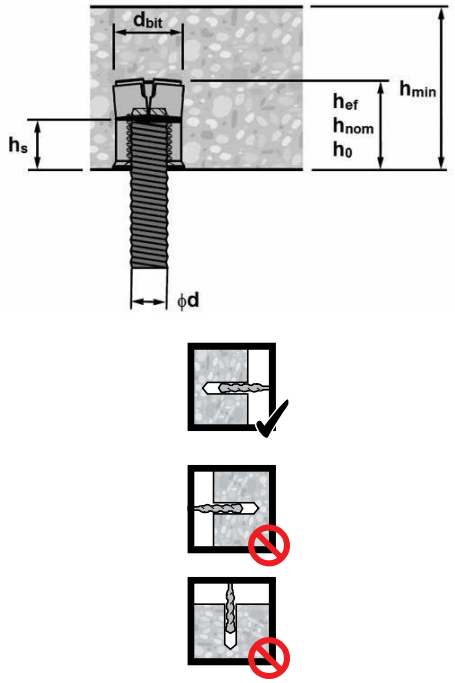
INSTALLATION PARAMETERS

Table 1 — Hilti HDI-P TZ setting information

Setting information	Symbol	Unit	Nominal anchor size / internal thread dia. (in)	
			3/8	
Internal thread diameter	d	in.	3/8	
Nominal bit diameter	d_{bit}	in.	9/16	
Nominal embedment	h_{nom}	in. (mm)	3/4 (19)	
Hole depth in base material	h_0	in. (mm)	3/4 (19)	
Effective embedment	h_{ef}	in. (mm)	3/4 (19)	
Thread engagement length	h_a	in. (mm)	3/8 (10)	
Maximum installation torque for threaded element	T_{max}	ft-lb (Nm)	5 (7)	
Minimum base material thickness — concrete	h_{min}	in. (mm)	2-1/2 (64)	4 (102)
Minimum edge distance — concrete	c_{min}	in. (mm)	6 (152)	2-1/2 (64)
Minimum anchor spacing — concrete	s_{min}	in. (mm)	8 (203)	3 (76)
Minimum base material thickness — hollow core concrete panels	h_{min}	in. (mm)	1/3/8 (35)	
Minimum edge distance — hollow core concrete panels	c_{min}	in. (mm)	6 (152)	
Minimum anchor spacing — hollow core concrete panels	s_{min}	in. (mm)	8 (203)	

For **SI:** 1 inch = 25.4mm, 1 ft-lb = 1.356 Nm

Figure 1 — Hilti HDI-P TZ installation parameters



DESIGN DATA IN CONCRETE PER ACI 318

ACI 318 Chapter 17 Design

The design tables in Tables 2 to 4 are Hilti Simplified Design Tables. The load values were developed using the design parameters and variables of ICC Evaluation Services ESR-4236 and the equations within ACI 318 Chapter 17 as amended by ICC-ES AC193. The strength design capacities calculated from the tables below are to be compared to the factored loads determined from strength design load combinations. For a detailed explanation of the Hilti Simplified Design Tables, refer to Section 3.1.8. Data tables from ESR-4236 are not contained in this section, but can be found at www.hilti.com or www.icc-es.org.

Table 2 — Hilti HDI-P TZ design strength based on concrete failure modes in uncracked concrete per ACI 318 14 Ch. 17 [1,2,3,4,5]

Nominal anchor diameter in.	Nominal embed. in. (mm)	Tension (lesser of concrete breakout / pullout) - φN_n				Shear (lesser of concrete breakout or pryout) - φV_n			
		f'_c = 2500 psi (17.2 MPa) lb (kN)	f'_c = 3000 psi (20.7 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 6000 psi (41.4 MPa) lb (kN)	f'_c = 2500 psi (17.2 MPa) lb (kN)	f'_c = 3000 psi (20.7 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 6000 psi (41.4 MPa) lb (kN)
3/8	3/4 (19)	310 (1.4)	340 (1.5)	395 (1.8)	485 (2.1)	350 (1.6)	385 (1.7)	445 (2.0)	545 (2.4)

Table 3 — Hilti HDI-P TZ design strength based on concrete failure modes in cracked concrete per ACI 318 14 Ch. 17 [1,2,3,4,5,6,7]

Nominal anchor diameter in.	Nominal embed. in. (mm)	Tension (lesser of concrete breakout / pullout) - φN_n				Shear (lesser of concrete breakout or pryout) - φV_n			
		f'_c = 2500 psi (17.2 MPa) lb (kN)	f'_c = 3000 psi (20.7 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 6000 psi (41.4 MPa) lb (kN)	f'_c = 2500 psi (17.2 MPa) lb (kN)	f'_c = 3000 psi (20.7 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 6000 psi (41.4 MPa) lb (kN)
3/8	3/4 (19)	190 (0.8)	200 (0.9)	220 (1.0)	255 (1.1)	250 (1.1)	270 (1.2)	315 (1.4)	385 (1.7)

The following footnotes apply to both Table 2 and 3:

1 See Section 3.1.8.6 of the Anchor Tech Guide Ed. 17 to convert design strength value to ASD value.
2 Linear interpolation between concrete compressive strengths is not permitted.
3 Tabular values are for a single anchor with a minimum edge distance of 6-1/2-in (166mm) and a minimum spacing of 8-in (204mm). For a 6-in (153mm) edge distance multiply uncracked concrete tension and shear values by 0.92. No reduction needed for cracked concrete.
4 Compare to the steel values in Table 4. The lesser of the values is to be used for the design.
5 Tabular values are for normal weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: For sand-lightweight, λ_a = 0.68. For all-lightweight, λ_a = 0.60.
6 Tabular values are for static loads only. For seismic tension loads, multiply cracked concrete tabular values in tension by $\alpha_{N,seis}$ = 0.74.
7 No additional reduction needed for seismic shear for concrete breakout or pryout failure. See Section 3.1.8.7 of the Anchor Tech Guide Ed. 17 for additional information on seismic applications.

Table 4 — Hilti HDI-P TZ design strength based on steel failure per ACI 318 Ch. 17 [1,2,3]

Nominal anchor diameter in.	Steel strength of HDI-P TZ anchor			Steel strength of ASTM A36 threaded rod		
	Tensile[4] φN_{sa} lb (kN)	Shear[5] φV_{sa} lb (kN)	Seismic Shear[6,9] φV_{sa} lb (kN)	Tensile[4] $\varphi N_{sa,rod}$ lb (kN)	Shear[7] $\varphi V_{sa,rod}$ lb (kN)	Seismic Shear[8,9] $\varphi V_{sa,rod,eq}$ lb (kN)
3/8	4,065 (18.1)	585 (2.6)	585 (2.6)	3,370 (15.0)	1,885 (8.4)	1,320 (5.9)

1 See Section 3.1.8.6 of the Anchor Tech Guide Ed. 17 to convert design strength value to ASD value.
2 Steel strength in tension and shear determined from the lesser of the HDI-P TZ or the inserted threaded rod.
3 Hilti HDI-P TZ anchors are considered a brittle steel element. ASTM A36 threaded rod is considered a ductile steel element.
4 Tensile $\varphi N_{sa} = \varphi A_{se,N} f_{uta}$ as noted in ACI 318 Ch. 17.
5 Shear values for HDI-P TZ determined by static shear tests with $\varphi V_{sa} \le \varphi\ 0.60\ A_{se,V} f_{uta}$ as noted in ACI 318 Ch. 17.
6 Seismic shear values for HDI-P TZ determined by seismic shear tests with $\varphi V_{sa} < \varphi\ 0.60\ A_{se,V} f_{uta}$ as noted in ACI 318 Ch. 17.
7 Shear values for threaded rod determined by $\varphi V_{sa,rod} = \varphi\ 0.60\ A_{se,V} f_{uta}$ as noted in ACI 318 Ch. 17.
8 Seismic shear values for threaded rod determined by $\varphi V_{sa,rod,eq} = \varphi\ 0.70\ V_{sa,rod}$.
9 See Section 3.1.8.7 of the Anchor Tech Guide Ed. 17 for additional information on seismic applications

DESIGN DATA IN CONCRETE PER CSA A23.3

CSA A23.3 Annex D Design

Limit State Design of anchors is described in the provisions of CSA A23.3 Annex D for post-installed anchors tested and assessed in accordance with ACI 355.2 for mechanical anchors and ACI 355.4 for adhesive anchors. Tables 8 and 9 in this section contains the Limit State Design tables that are based on the published loads in ICC Evaluation Services ESR-4236 and converted for use with CSA A23.3 Annex D. Tables 5 to 7 below are Hilti Simplified Design Tables which are pre-factored resistance tables based on the design parameters and variables in Tables 8 and 9. All the figures in the previous ACI 318 14 Chapter 17 design section are applicable to Limit State Design and the tables will reference these figures.

For a detailed explanation of the tables developed in accordance with CSA A23.3 Annex D, refer to Section 3.1.8. Technical assistance is available by contacting Hilti Canada at (800) 363-4458 or at www.hilti.ca.

Table 5 — Hilti HDI-P TZ factored resistance based on concrete failure modes in uncracked concrete per CSA A23.3 Annex D [1,2,3,4,5]

Nominal anchor diameter in.	Nominal embed. in. (mm)	Tension (lesser of concrete breakout / pullout) - N_r				Shear (lesser of concrete breakout or pryout) - V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
3/8	3/4 (19)	325 (1.5)	365 (1.6)	400 (1.8)	460 (2.1)	380 (1.7)	425 (1.9)	465 (2.1)	540 (2.4)

Table 6 — Hilti HDI-P TZ factored resistance based on concrete failure modes in cracked concrete per CSA A23.3 Annex D [1,2,3,4,5,6,7]

Nominal anchor diameter in.	Nominal embed. in. (mm)	Tension (lesser of concrete breakout / pullout) - N_r				Shear (lesser of concrete breakout or pryout) - V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
3/8	3/4 (19)	195 (0.9)	210 (0.9)	220 (1.0)	245 (1.1)	270 (1.2)	300 (1.3)	330 (1.5)	380 (1.7)

The following footnotes apply to both Table 5 and 6:

1 See Section 3.1.8.6 of the Anchor Tech Guide Ed. 17 to convert design strength value to ASD value.
2 Linear interpolation between concrete compressive strengths is not permitted.
3 Tabular values are for a single anchor with a minimum edge distance of 6-1/2-in (166mm) and a minimum spacing of 8-in (204mm). For a 6-in (153mm) edge distance multiply uncracked concrete tension and shear values by 0.92. No reduction needed for cracked concrete.
4 Tabular values are for normal weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: For sand-lightweight, λ_a = 0.68. For all-lightweight, λ_a = 0.60.
5 Tabular values are for static loads only. For seismic tension loads, multiply cracked concrete tabular values in tension by $\alpha_{N,seis}$ = 0.74.
6 No additional reduction needed for seismic shear for concrete breakout or pryout failure. See Section 3.1.8.7 of the Anchor Tech Guide Ed. 17 for additional information on seismic applications.

Table 7 — Hilti HDI-P TZ factored resistance based on steel failure per CSA A23.3 Annex D [1,2,3]

Nominal anchor diameter in.	Steel strength of HDI-P TZ anchor			Steel strength of ASTM A36 threaded rod		
	Tensile[4] N_{sar} lb (kN)	Shear[5] V_{sar} lb (kN)	Seismic Shear[6,9] $V_{sar,eq}$ lb (kN)	Tensile[4] N_{sar} lb (kN)	Shear[7] V_{sar} lb (kN)	Seismic Shear[8,9] $V_{sar,eq}$ lb (kN)
3/8	3,720 (16.5)	540 (2.4)	540 (2.4)	3,055 (13.6)	1,720 (7.7)	1,200 (5.3)

1 See Section 3.1.8.6 of the Anchor Tech Guide Ed. 17 to convert design strength value to ASD value.
2 Steel strength in tension and shear determined from the lesser of the HDI-P TZ or the inserted threaded rod.
3 Hilti HDI-P TZ anchors are considered a brittle steel element. ASTM A36 threaded rod is considered a ductile steel element.
4 Tensile $N_{sar} = A_{se,N}\ \varphi_s\ f_{uta}$ as noted in CSA A23.3 Annex D.
5 Shear values for HDI-P TZ determined by static shear tests with $V_{sar} \le 0.6\ A_{se,V}\ \varphi s\ f_{uta}$ R as noted in CSA A23.3 Annex D.
6 Seismic shear values for HDI-P TZ determined by seismic shear tests with $V_{sar,eq} \le 0.60\ A_{se,V}\ \varphi_s\ f_{uta}$ R as noted in CSA A23.3 Annex D.
7 Shear values for threaded rod determined by $V_{sar} = 0.6\ A_{se,V}\ \varphi_s\ f_{uta}$ R as noted in CSA A23.3 Annex D.
8 Seismic shear values for threaded rod determined by $V_{sar,rod,eq} = 0.70\ V_{sar,rod}$.
9 See Section 3.1.8.7 of the Anchor Tech Guide Ed. 17 for additional information on seismic applications.

Table 8 — Design information, Hilti HDI-P TZ, in accordance with CSA A23.3[1]

Setting information	Symbol	Unit	Nominal anchor size/internal thread dia. (in)	Ref
			3/8	CSA A23.3
Anchor O.D.	d_a	in. (mm)	0.561 (14.25)	
Effective embedment	h_{ef}	in. (mm)	3/4 (19)	
Steel embed. material resistance factor for reinforcement	φ_s	-	0.85	8.4.3
Resistance modification factor for tension, steel failure modes [2,3]	$R_{s,N}$	-	0.70	D.5.3 b)
Min. specified yield strength	f_{ya}	psi (N/mm²)	70,400 (484)	
Min. specified ultimate strength	f_{uta}	psi (N/mm²)	88,000 (605)	
Effective-cross sectional steel area in tension	$A_{se,N}$	in² (mm²)	0.071 (45.8)	
Factored steel resistance in tension [4]	N_{sa}	lb (kN)	6,250 (27.8)	D.6.1.2 Eq. D.2
Concrete material resistance factor	φ_c	-	0.65	8.4.2
Anchor category	-	-	1	D.5.3 c)
Resistance modification factor for tension, concrete failure [3]	$R_{c,N}$	-	0.60	
Coeff. for factored conc. breakout resistance, uncracked concrete	$k_{c,uncr}$	in-lb (SI)	24 (10.0)	D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete	$k_{c,cr}$	in-lb (SI)	17 (7.1)	D.6.2.2
Modification factor for anchor resistance, tension, uncracked conc. [5]	$\psi_{c,N}$	-	1.0	D.6.2.6
Critical edge distance	c_{ac}	in. (mm)	6 (152)	
Factored pullout resistance in 20 MPa uncracked concrete [6]	$N_{pr,uncr}$	lb (kN)	N/A	D.6.3.2
Factored pullout resistance in 20 MPa cracked concrete [6]	$N_{pr,cr}$	lb (kN)	495 (2.2)	D.6.3.2
Factored pullout resistance in 20 MPa cracked concrete, seismic [6]	$N_{pr,eq}$	lb (kN)	490 (2.2)	D.6.3.2
Resistance modification factor for shear, steel failure modes [2,3]	$R_{s,V}$	-	0.65	D.5.3 b)
Factored steel resistance in shear [7]	V_{sa}	lb (kN)	975 (4.3)	D7.1.2
Factored steel resistance in shear, seismic [7]	$V_{sa,eq}$	lb (kN)	975 (4.3)	
Resistance modification factor for shear, concrete failure modes [3]	$R_{c,V}$	-	0.70	
Coefficient for pryout resistance	k_{cp}	-	1.0	D.7.3

1 Design information is taken from ICC-ES ESR-4236, dated July 2018, table 2, and converted for use with CSA A23.3 Annex D.
2 The HDI-P TZ is considered a brittle steel element as defined by CSA A23.3 Annex D Section D.2.
3 All values of R are applicable with the load combinations of CSA A23.3 Chapter 8. For concrete failure modes, no increase for Condition A is permitted.
4 $N_{sar} = N_{sa}\ \varphi_s\ R_{s,N}$ where N_{sa} tabular value above is precalculated from $A_{se,N}\ f_{uta}$.
5 For all design cases, $\psi_{c,N} = 1.0$. The appropriate effectiveness factor for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.
6 For all design cases, $\psi_{c,P} = 1.0$. Tabular value for pullout resistance is for a concrete compressive strength of 20 MPa (2,900 psi). Pullout resistance for concrete compressive strength greater than 20 MPa (2,900 psi) may be increased by multiplying the tabular pullout resistance by $(f'_c / 20)^{0.35}$ for MPa or $(f'_c / 2{,}900)^{0.35}$ for psi. NA (not applicable) denotes that pullout strength does not need to be considered for design.
7 Shear and seismic shear tests are all performed in cracked concrete member per ICC-ES AC193 section 9.4 and 9.6 respectively. Value of $V_{sa(,eq)} < 0.6\ A_{se,V}\ f_{uta}$ for all cases. Multiply V_{sa} tabular value above by $\varphi_s\ R_{s,V}$ to get V_{sar} and $V_{sar,eq}$.

Table 9 - Steel design information for inserted threaded rod, in accordance with CSA A23.3[1]

Setting information	Symbol	Unit	Nominal anchor size / internal thread dia. (in)
			3/8
Nominal rod diameter	d_{rod}	in.	0.375
Steel embed. material resistance factor for reinforcement	φ_s	-	0.85
Resistance modification factor for tension, steel failure modes, ASTM A36 steel material [2]	$R_{s,N}$	-	0.80
Min. specified ult. strength, ASTM A36 steel material	f_{uta}	psi (MPa)	58,000 (400)
Rod effective cross-sectional area	$A_{se,rod}$	in.^{2} (mm^2)	0.0775 (50)
Factored steel resistance in tension ASTM A36 steel material [3]	$N_{sa,rod}$	lb (kN)	4,495 (20.0)
Factored steel resistance in tension, seismic ASTM A36 steel material [3]	$N_{sa,rod,eq}$	lb (kN)	4,495 (20.0)
Resistance modification factor for steel in shear ASTM A36 steel material [2]	$R_{sa,rod,V}$	-	0.75
Factored steel resistance in shear ASTM A36 steel material [4]	$V_{sa,rod}$	lb (kN)	2,695 (12.0)
Factored steel resistance, seismic ASTM A36 steel material [4]	$V_{sa,rod,eq}$	lb (kN)	1,885 (8.4)

1 Values provided for steel element material types, or equivalent, based on minimum specified strengths and calculated in accordance with CSA A23.3 14 Eq. D.2 and Eq. D.30, as applicable.

2 All values of R are applicable with the load combinations of CSA A23.3 Chapter 8. Values correspond to a ductile steel element.

3 $N_{sar,rod(eq)} = N_{sa,rod(eq} \varphi_s R_{s,N}$ where $N_{sa,rod(eq)}$ tabular value above is precalculated from $A_{se,rod} f_{uta}$. N_{sar} shall be the lower of $N_{sar,rod}$ or $N_{sar,HDI\text{-}P\ TZ}$ for static steel strength in tension; for seismic loads, $N_{sar,eq}$ shall be the lower of $N_{sar,rod,eq}$ or $N_{sar,eq}$, HDI-P TZ.

4 $V_{sar,rod(eq)} = V_{sa,rod(eq)} \varphi_s R_{s,V}$ where $V_{sa,rod}$ tabular value above is precalculated from 0.6 $A_{se,rod} f_{uta}$, and $V_{sa,rod,eq}$ must be taken as 0.7 $V_{sa,rod}$. V_{sar} shall be the lower of $V_{sar,rod}$ or $V_{sar,HDI\text{-}P\ TZ}$ for static steel strength in tension; for seismic loading, $V_{sar,eq}$ shall be the lower of $V_{sar,eq}$,rod or $V_{sar,eq,HDI\text{-}P\ TZ}$.

INSTALLATION INSTRUCTIONS

Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com or www.hilti.ca. Because of the possibility of changes, always verify that downloaded IFU are current when used. Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

ORDERING INFORMATION

Description	Item number
Flush anchor HDI-P TZ 3/8"	2204029
HDI-P TZ 3/8" MC (1200 PCS / MC)	3596870
HDI-P TZ 3/8" (1/3 Pallet = 9600 PCS)	3596872
HDI-P TZ 3/8" Pallet	3597043
HDI-P TZ 3/8" (300) with auto set tool	3597044
HDI-P TZ 3/8" (600) with auto set tool	3597045
HDI-P TZ 3/8" (1200) with 3 auto set tools	3597046

Accessories

Description	Item number
Auto setting tool HDI-P TZ 3/8"	2204112
Setting tool HST HDI-P TZ 3/8"x20	2204110

3.3.5.1 KWIK Bolt TZ product description

The KWIK Bolt TZ (KB-TZ) is a torque controlled expansion anchor which is especially suited to seismic and cracked concrete applications. This anchor line is available in carbon steel, type 304 and type 316 stainless steel versions. The anchor diameters range from 3/8-, 1/2-, 5/8- and 3/4-inch in a variety of lengths. Applicable base materials include normal-weight concrete, structural lightweight concrete, and lightweight concrete over metal deck.

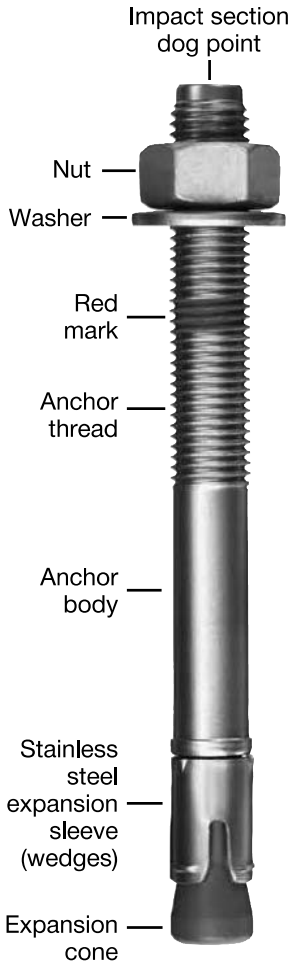
Guide specifications

Torque controlled expansion anchors shall be KWIK Bolt TZ (KB-TZ) supplied by Hilti meeting the description in Federal Specification A-A 1923A, type 4. The anchor bears a length identification mark embossed into the impact section (dog point) of the anchor surrounded by four embossed notches identifying the anchor as a Hilti KWIK Bolt TZ. Anchors are manufactured to meet one of the following conditions:

- The carbon steel anchor body, nut, and washer have an electroplated zinc coating conforming to ASTM B633 to a minimum thickness of 5 µm. The stainless steel expansion sleeve conforms to type 316.
- Stainless steel anchor body, nut and washer conform to type 304. Stainless steel expansion sleeve conforms to type 316.
- Stainless steel anchor body, nut, washer, and expansion sleeve conform to type 316 stainless steel.

Product features

- Product and length identification marks facilitate quality control after installation.
- Through fixture installation and variable thread lengths improve productivity and accommodate various base plate thicknesses.
- Type 316 stainless steel wedges provide superior performance in cracked concrete.
- Ridges on expansion wedges provide increased reliability.
- Mechanical expansion allows immediate load application.
- Raised impact section (dog point) prevents thread damage during installation.
- Bolt meets ductility requirements of ACI 318 Section D1.
- ACI 349-01 Nuclear Design Guide is available. Call Hilti Technical Support.



Listings/Approvals

ICC-ES (International Code Council)
ESR-1917

City of Los Angeles
Research Report No. 25701

FM (Factory Mutual)
Pipe Hanger Components for Automatic Sprinkler Systems for 3/8 through 3/4

UL LLC
Pipe Hanger Equipment for Fire Protection Services for 3/8 through 3/4

Independent code evaluation

IBC® / IRC® 2012
IBC® / IRC® 2009
IBC® / IRC® 2006

3.3.5 KWIK Bolt TZ Expansion Anchor

3.3.5.2 Material specifications

Carbon steel with electroplated zinc

Carbon steel KB-TZ anchors have the following minimum bolt fracture loads.[1]

Anchor diameter (in.)	Shear (lb)	Tension (lb)
3/8	NA	6,744
1/2	7,419	11,240
5/8	11,465	17,535
3/4	17,535	25,853

Carbon steel anchor components plated in accordance with ASTM B633 to a minimum thickness of 5 µm.

Nuts conform to the requirements of ASTM A563, Grade A, Hex.

Washers meet the requirements of ASTM F844.

Expansion sleeves (wedges) are manufactured from type 316 stainless steel

Stainless steel

Stainless steel KB-TZ anchors are made of type 304 or 316 material and have the following minimum bolt fracture loads.[1]

Anchor diameter (in.)	Shear (lb)	Tension (lb)
3/8	5,058	6,519
1/2	8,543	12,364
5/8	13,938	19,109
3/4	22,481	24,729

All nuts and washers are made from type 304 or type 316 stainless steel respectively.

Nuts meet the dimensional requirements of ASTM F594.

Washers meet the dimensional requirements of ANSI B18.22.1, Type A, plain.

Expansion sleeve (wedges) are made from type 316 stainless steel.

1 Bolt fracture loads are determined by testing in a universal tensile machine for quality control at the manufacturing facility. These loads are not intended for design purposes. See tables 4 and 16 for the steel design strengths of carbon steel and stainless steel, respectively.

3.3.5.3 Technical data

The technical data contained in this section are Hilti Simplified Design Tables. The load values were developed using the Strength Design parameters and variables of ESR-1917 and the equations within ACI 318-11 Appendix D. For a detailed explanation of the Hilti Simplified Design Tables, refer to section 3.1.7. Data tables from ESR-1917 are not contained in this section, but can be found at www.icc-es.org or at www.us.hilti.com.

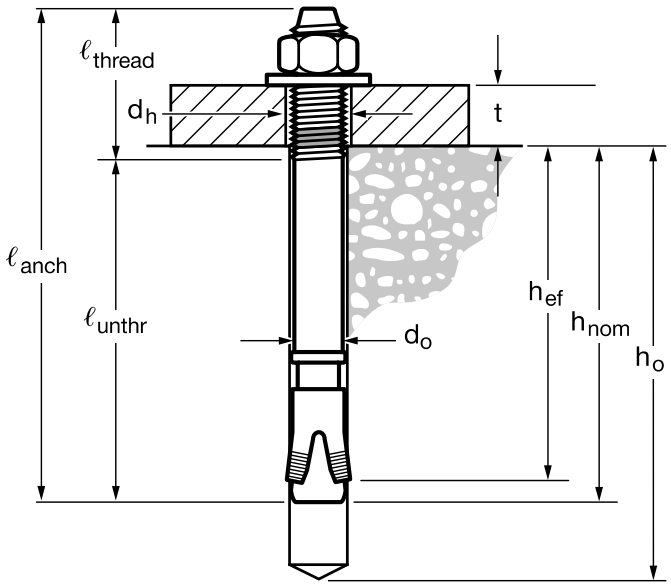
KWIK Bolt TZ Expansion Anchor 3.3.5

Table 1 - KWIK Bolt TZ specifications

Setting information	Symbol	Units	Nominal anchor diameter d_o											
			3/8			1/2			5/8				3/4	
Nominal bit diameter	d_{bit}	in.	3/8			1/2			5/8				3/4	
Minimum nominal embedment	h_{nom}	in.	2-5/16			2-3/8	3-5/8		3-9/16	4-7/16			4-5/16	5-9/16
		(mm)	(59)			(60)	(91)		(91)	(113)			(110)	(142)
Effective minimum embedment	h_{ef}	in.	2			2	3-1/4		3-1/8	4			3-3/4	4-3/4
		(mm)	(51)			(51)	(83)		(79)	(102)			(95)	(121)
Min. hole depth	h_o	in.	2-5/8			2-5/8	4		3-3/4	4-3/4			4-5/8	5-3/4
		(mm)	(67)			(67)	(102)		(95)	(121)			(117)	(146)
Min. thickness of fixture[1]	t_{min}	in.	1/8			1/8	n/a		1/8	n/a			1/8	n/a
		(mm)	(3)			(3)			(3)				(3)	
Max. thickness of fixture	t_{max}	in.	2-1/4			4	2-3/4		5-5/8	4-3/4			4-5/8	3-5/8
		(mm)	(57)			(101)	(70)		(143)	(121)			(117)	(92)
Installation torque	T_{inst}	ft-lb	25			40			60				110	
		(Nm)	(34)			(54)			(81)				(149)	
Fixture hole diameter	d_h	in.	7/16			9/16			11/16				13/16	
		(mm)	(11.1)			(14.3)			(17.5)				(20.6)	
Available anchor lengths	ℓ_{anch}	in.	3	3-3/4	5	3-3/4	4-1/2	5-1/2	7	4-3/4	6	8-1/2	10	5-1/2	8	10
		(mm)	(76)	(95)	(127)	(95)	(114)	(140)	(178)	(121)	(152)	(216)	(254)	(140)	(203)	(254)
Threaded length including dog point	ℓ_{thread}	in.	7/8	1-5/8	2-7/8	1-5/8	2-3/8	3-3/8	4-7/8	1-1/2	2-3/4	5-1/4	6-3/4	1-1/2	4	6
		(mm)	(22)	(41)	(73)	(41)	(60)	(86)	(178)	(38)	(70)	(133)	(171)	(38)	(102)	(152)
Unthreaded length	ℓ_{unthr}	in.	2-1/8			2-1/8			3-1/4				4	
		(mm)	(54)			(54)			(83)				(102)	

1 Minimum thickness of fixture is a concern only when the anchor is installed at the minimum nominal embedment. When KWIK Bolt TZ anchors are installed at this embedment, the anchor threading ends near the surface of the concrete. If the fixture is sufficiently thin, it could be possible to run the nut to the bottom of the threading during application of the installation torque. If fixtures are thin, it is recommended that embedment be increased accordingly.

Figure 1 - KWIK Bolt TZ specifications



3.3.5 KWIK Bolt TZ Expansion Anchor

Table 2 - Hilti KWIK Bolt TZ carbon steel design strength with concrete / pullout failure in uncracked concrete[1,2,3,4]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - ϕN_n				Shear - ϕV_n			
			f'_c = 2500 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)"	f'_c = 6000 psi lb (kN)	f'_c = 2500 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 6000 psi lb (kN)
3/8	2	2-5/16	1,635	1,790	2,070	2,535	2,375	2,605	3,005	3,680
	(51)	(59)	(7.3)	(8.0)	(9.2)	(11.3)	(10.6)	(11.6)	(13.4)	(16.4)
1/2	2	2-3/8	2,205	2,415	2,790	3,420	2,375	2,605	3,005	3,680
	(51)	(60)	(9.8)	(10.7)	(12.4)	(15.2)	(10.6)	(11.6)	(13.4)	(16.4)
	3-1/4	3-5/8	3,585	3,925	4,535	5,555	9,845	10,785	12,450	15,250
	(83)	(91)	(15.9)	(17.5)	(20.2)	(24.7)	(43.8)	(48.0)	(55.4)	(67.8)
5/8	3-1/8	3-9/16	4,310	4,720	5,450	6,675	9,280	10,165	11,740	14,380
	(79)	(91)	(19.2)	(21.0)	(24.2)	(29.7)	(41.3)	(45.2)	(52.2)	(64.0)
	4	4-7/16	5,945	6,510	7,520	9,210	13,440	14,725	17,000	20,820
	(102)	(113)	(26.4)	(29.0)	(33.5)	(41.0)	(59.8)	(65.5)	(75.6)	(92.6)
3/4	3-3/4	4-5/16	5,380	5,895	6,810	8,340	12,200	13,365	15,430	18,900
	(95)	(110)	(23.9)	(26.2)	(30.3)	(37.1)	(54.3)	(59.5)	(68.6)	(84.1)
	4-3/4	5-9/16	6,940	7,605	8,780	10,755	17,390	19,050	22,000	26,945
	(121)	(142)	(30.9)	(33.8)	(39.1)	(47.8)	(77.4)	(84.7)	(97.9)	(119.9)

Table 3 - Hilti KWIK Bolt TZ carbon steel design strength with concrete / pullout failure in cracked concrete[1,2,3,4,5]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - ϕN_n				Shear - ϕV_n			
			f'_c = 2500 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 6000 psi lb (kN)	f'_c = 2500 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 6000 psi lb (kN)
3/8	2	2-5/16	1,475	1,615	1,865	2,285	1,685	1,845	2,130	2,605
	(51)	(59)	(6.6)	(7.2)	(8.3)	(10.2)	(7.5)	(8.2)	(9.5)	(11.6)
1/2	2	2-3/8	1,565	1,710	1,975	2,420	1,685	1,845	2,130	2,605
	(51)	(60)	(7.0)	(7.6)	(8.8)	(10.8)	(7.5)	(8.2)	(9.5)	(11.6)
	3-1/4	3-5/8	3,195	3,500	4,040	4,950	6,970	7,640	8,820	10,800
	(83)	(91)	(14.2)	(15.6)	(18.0)	(22.0)	(31.0)	(34.0)	(39.2)	(48.0)
5/8	3-1/8	3-9/16	3,050	3,345	3,860	4,730	6,575	7,200	8,315	10,185
	(79)	(91)	(13.6)	(14.9)	(17.2)	(21.0)	(29.2)	(32.0)	(37.0)	(45.3)
	4	4-7/16	4,420	4,840	5,590	6,845	9,520	10,430	12,040	14,750
	(102)	(113)	(19.7)	(21.5)	(24.9)	(30.4)	(42.3)	(46.4)	(53.6)	(65.6)
3/4	3-3/4	4-5/16	4,010	4,395	5,075	6,215	8,640	9,465	10,930	13,390
	(95)	(110)	(17.8)	(19.5)	(22.6)	(27.6)	(38.4)	(42.1)	(48.6)	(59.6)
	4-3/4	5-9/16	5,720	6,265	7,235	8,860	12,320	13,495	15,585	19,085
	(121)	(142)	(25.4)	(27.9)	(32.2)	(39.4)	(54.8)	(60.0)	(69.3)	(84.9)

1 See section 3.1.7.3 to convert design strength value to ASD value.

2 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.

3 Apply spacing, edge distance, and concrete thickness factors in tables 6 to 11 as necessary. Compare to the steel values in table 4. The lesser of the values is to be used for the design.

4 Tabular values are for normal weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: for sand-lightweight, λ_a = 0.68; for all-lightweight, λ_a = 0.60

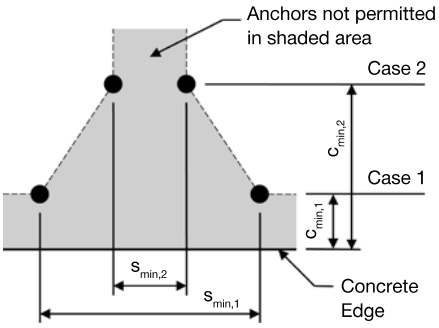
5 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75. See section 3.1.7.4 for additional information on seismic applications.

Table 4 - Steel strength for Hilti KWIK Bolt TZ carbon steel anchors[1,2]

Nominal anchor diameter	Tensile[3] ϕN_{sa} lb (kN)	Shear[4] ϕV_{sa} lb (kN)	Seismic shear[5] ϕV_{sa} lb (kN)
3/8	4,875 (21.7)	2,335 (10.4)	1,465 (6.5)
1/2	8,030 (35.7)	3,570 (15.9)	3,570 (15.9)
5/8	12,880 (57.3)	5,260 (23.4)	4,940 (22.0)
3/4	18,840 (83.8)	8,890 (39.5)	7,635 (34.0)

1 See section 3.1.7.3 to convert design strength value to ASD value.
2 Hilti KWIK Bolt TZ carbon steel anchors are to be considered ductile steel elements.
3 Tensile $\phi N_{sa} = \phi A_{se,N} f_{uta}$ as noted in ACI 318 Appendix D.
4 Shear values determined by static shear tests with $\phi V_{sa} < \phi\ 0.60\ A_{se,V} f_{uta}$ as noted in ACI 318 Appendix D.
5 Seismic shear values determined by seismic shear tests with $\phi V_{sa} < \phi\ 0.60\ A_{se,V} f_{uta}$ as noted in ACI 318 Appendix D. See section 3.1.7.4 for additional information on seismic applications.

Figure 2



For a specific edge distance, the permitted spacing is calculated as follows:

$$s \geq s_{min,2} + \frac{(s_{min,1} - s_{min,2})}{(c_{min,1} - c_{min,2})} (c - c_{min,2})$$

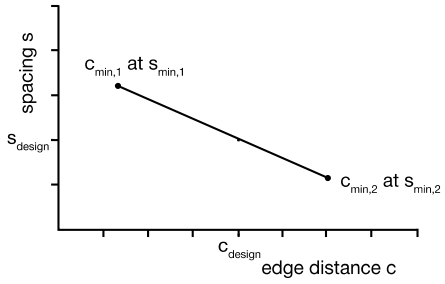


Table 5 - KWIK Bolt TZ carbon steel installation parameters[1]

Setting information	Symbol	Units	Nominal anchor diameter d_o											
			3/8		1/2				5/8			3/4		
Effective minimum embedment	h_{ef}	in. (mm)	2 (51)		2 (51)		3-1/4 (83)		3-1/8 (79)	4 (102)		3-3/4 (95)		4-3/4 (121)
Min. member thickness	h_{min}	in. (mm)	4 (102)	5 (127)	4 (102)	6 (152)	6 (152)	8 (203)	5 (127)	6 (152)	8 (203)	6 (152)	8 (203)	8 (203)
Case 1	$c_{min,1}$	in. (mm)	2-1/2 (64)		2-3/4 (70)		2-3/8 (60)		3-5/8 (92)	3-1/4 (83)		4-3/4 (121)		4-1/8 (105)
	for $s_{min,1} \geq$	in. (mm)	5 (127)		5-3/4 (146)		5-3/4 (146)		6-1/8 (156)	5-7/8 (149)		10-1/2 (267)		8-7/8 (225)
Case 2	$c_{min,2}$	in. (mm)	3-5/8 (92)		4-1/8 (105)		3-1/2 (89)		4-3/4 (121)	4-1/4 (108)		9-1/2 (241)		7-3/4 (197)
	for $s_{min,2} \geq$	in. (mm)	2-1/2 (64)		2-3/4 (70)		2-3/8 (60)		3-1/2 (89)	3 (76)		5 (127)		4 (102)

1 Linear interpolation is permitted to establish an edge distance and spacing combination between Case 1 and Case 2. Linear interpolation for a specific edge distance c, where $c_{min,1} < c < c_{min,2}$, will determine the permissible spacings.

3.3.5 KWIK Bolt TZ Expansion Anchor

Table 6 - Load adjustment factors for 3/8-in. diameter carbon steel KWIK Bolt TZ in uncracked concrete[1,2]

3/8-in. KB-TZ CS uncracked concrete			Spacing factor in tension f_{AN}	Edge distance factor in tension f_{RN}	Spacing factor in shear[3] f_{AV}	Edge distance in shear		Conc. thickness factor in shear[4] f_{HV}
						⊥ Toward edge f_{RV}	∥ To edge f_{RV}	
Effective embed. h_{ef}		in. (mm)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)
Nominal embed. h_{nom}		in. (mm)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-1/2	(64)	0.71	0.60	0.60	0.49	0.60	n/a
	3	(76)	0.75	0.69	0.62	0.64	0.69	n/a
	3-1/2	(89)	0.79	0.80	0.64	0.81	0.81	n/a
	3-5/8	(92)	0.80	0.83	0.65	0.85	0.85	n/a
	4	(102)	0.83	0.91	0.67	0.99	0.99	0.81
	4-1/2	(114)	0.88	1.00	0.69	1.00	1.00	0.86
	5	(127)	0.92		0.71			0.91
	5-1/2	(140)	0.96		0.73			0.95
	6	(152)	1.00		0.75			1.00
	7	(178)			0.79			
	8	(203)			0.83			
	9	(229)			0.87			
	10	(254)			0.91			
	11	(279)			0.95			
	12	(305)			1.00			

Table 7 - Load adjustment factors for 3/8-in. diameter carbon steel KWIK Bolt TZ in cracked concrete[1,2]

3/8-in. KB-TZ CS cracked concrete			Spacing factor in tension f_{AN}	Edge distance factor in tension f_{RN}	Spacing factor in shear[3] f_{AV}	Edge distance in shear		Conc. thickness factor in shear[4] f_{HV}
						⊥ Toward edge f_{RV}	∥ To edge f_{RV}	
Effective embed. h_{ef}		in. (mm)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)
Nominal embed. h_{nom}		in. (mm)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-1/2	(64)	0.71	0.87	0.60	0.49	0.87	n/a
	3	(76)	0.75	1.00	0.62	0.65	1.00	n/a
	3-1/2	(89)	0.79	1.00	0.65	0.82	1.00	n/a
	3-5/8	(92)	0.80	1.00	0.65	0.86	1.00	n/a
	4	(102)	0.83		0.67	1.00		0.82
	4-1/2	(114)	0.88		0.69	1.00		0.87
	5	(127)	0.92		0.71			0.91
	5-1/2	(140)	0.96		0.73			0.96
	6	(152)	1.00		0.75			1.00
	7	(178)			0.79			
	8	(203)			0.83			
	9	(229)			0.87			
	10	(254)			0.92			
	11	(279)			0.96			
	12	(305)			1.00			

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 5 and figure 2 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

Table 8 - Load adjustment factors for 1/2-in. diameter carbon steel KWIK Bolt TZ in uncracked concrete[1,2]

1/2-in. KB-TZ CS uncracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}		in. (mm)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)
Nominal embed. h_{nom}		in. (mm)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-3/8	(60)	n/a	0.62	n/a	0.41	n/a	0.54	n/a	0.13	n/a	0.26	n/a	n/a
	2-1/2	(64)	n/a	0.63	n/a	0.42	n/a	0.55	n/a	0.14	n/a	0.28	n/a	n/a
	2-3/4	(70)	0.73	0.64	0.51	0.44	0.62	0.55	0.51	0.16	0.51	0.33	n/a	n/a
	3	(76)	0.75	0.65	0.55	0.46	0.63	0.55	0.55	0.19	0.55	0.37	n/a	n/a
	3-1/2	(89)	0.79	0.68	0.64	0.51	0.65	0.56	0.64	0.23	0.64	0.47	n/a	n/a
	4	(102)	0.83	0.71	0.73	0.56	0.68	0.57	0.73	0.29	0.73	0.56	0.84	n/a
	4-1/8	(105)	0.84	0.71	0.75	0.57	0.68	0.57	0.75	0.30	0.75	0.57	0.85	n/a
	4-1/2	(114)	0.88	0.73	0.82	0.61	0.70	0.58	0.82	0.34	0.82	0.61	0.89	n/a
	5	(127)	0.92	0.76	0.91	0.67	0.72	0.59	0.91	0.40	0.91	0.67	0.94	n/a
	5-1/2	(140)	0.96	0.78	1.00	0.73	0.74	0.60	1.00	0.46	1.00	0.73	0.98	n/a
	5-3/4	(146)	0.98	0.79		0.77	0.75	0.60		0.49		0.77	1.00	n/a
	6	(152)	1.00	0.81		0.80	0.76	0.61		0.53		0.80		0.66
	7	(178)		0.86		0.93	0.81	0.63		0.66		0.93		0.71
	8	(203)		0.91		1.00	0.85	0.64		0.81		1.00		0.76
	9	(229)		0.96			0.89	0.66		0.97				0.81
	10	(254)		1.00			0.94	0.68		1.00				0.85
	11	(279)					0.98	0.70						0.89
	12	(305)					1.00	0.72						0.93
	14	(356)						0.75						1.00
	16	(406)						0.79						
	18	(457)						0.83						
	> 20	(508)						0.86						

Table 9 - Load adjustment factors for 1/2-in. diameter carbon steel KWIK Bolt TZ in cracked concrete[1,2]

1/2-in. KB-TZ CS cracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}		in. (mm)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)
Nominal embed. h_{nom}		in. (mm)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-3/8	(60)	n/a	0.62	n/a	0.63	n/a	0.54	n/a	0.13	n/a	0.26	n/a	n/a
	2-1/2	(64)	n/a	0.63	n/a	0.65	n/a	0.55	n/a	0.14	n/a	0.29	n/a	n/a
	2-3/4	(70)	0.73	0.64	0.93	0.68	0.62	0.55	0.62	0.16	0.93	0.33	n/a	n/a
	3	(76)	0.75	0.65	1.00	0.71	0.63	0.55	0.71	0.19	1.00	0.38	n/a	n/a
	3-1/2	(89)	0.79	0.68	1.00	0.79	0.65	0.56	0.89	0.24	1.00	0.47	n/a	n/a
	4	(102)	0.83	0.71	1.00	0.86	0.68	0.57	1.00	0.29	1.00	0.58	0.84	n/a
	4-1/8	(105)	0.84	0.71	1.00	0.88	0.68	0.58	1.00	0.30	1.00	0.61	0.85	n/a
	4-1/2	(114)	0.88	0.73		0.94	0.70	0.58		0.34		0.69	0.89	n/a
	5	(127)	0.92	0.76		1.00	0.72	0.59		0.40		0.81	0.94	n/a
	5-1/2	(140)	0.96	0.78			0.74	0.60		0.47		0.93	0.98	n/a
	5-3/4	(146)	0.98	0.79			0.75	0.60		0.50		1.00	1.00	n/a
	6	(152)	1.00	0.81			0.76	0.61		0.53		1.00		0.66
	7	(178)		0.86			0.81	0.63		0.67				0.71
	8	(203)		0.91			0.85	0.65		0.82				0.76
	9	(229)		0.96			0.90	0.66		0.98				0.81
	10	(254)		1.00			0.94	0.68		1.00				0.85
	11	(279)					0.98	0.70						0.90
	12	(305)					1.00	0.72						0.94
	14	(356)						0.76						1.00
	16	(406)						0.79						
	18	(457)						0.83						
	> 20	(508)						0.86						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 5 and figure 2 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

3.3.5 KWIK Bolt TZ Expansion Anchor

Table 10 - Load adjustment factors for 5/8-in. diameter carbon steel KWIK Bolt TZ in uncracked concrete[1,2]

5/8-in. KB-TZ CS uncracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}		in. (mm)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)
Nominal embed. h_{nom}		in. (mm)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	3	(76)	n/a	0.63	n/a	n/a	n/a	0.55	n/a	n/a	n/a	n/a	n/a	n/a
	3-1/4	(83)	n/a	0.64	n/a	0.46	n/a	0.55	n/a	0.17	n/a	0.34	n/a	n/a
	3-1/2	(89)	0.69	0.65	n/a	0.48	0.57	0.56	n/a	0.19	n/a	0.38	n/a	n/a
	3-5/8	(92)	0.69	0.65	0.60	0.48	0.57	0.56	0.28	0.20	0.56	0.40	n/a	n/a
	4	(102)	0.71	0.67	0.64	0.51	0.58	0.56	0.32	0.23	0.64	0.47	n/a	n/a
	4-1/4	(108)	0.73	0.68	0.67	0.53	0.58	0.57	0.35	0.26	0.67	0.51	n/a	n/a
	4-1/2	(114)	0.74	0.69	0.70	0.56	0.59	0.57	0.38	0.28	0.70	0.56	n/a	n/a
	4-3/4	(121)	0.75	0.70	0.73	0.58	0.59	0.58	0.42	0.30	0.73	0.58	n/a	n/a
	5	(127)	0.77	0.71	0.77	0.60	0.60	0.58	0.45	0.33	0.77	0.60	0.63	n/a
	5-1/2	(140)	0.79	0.73	0.85	0.64	0.61	0.59	0.52	0.38	0.85	0.64	0.66	n/a
	5-7/8	(149)	0.81	0.74	0.90	0.67	0.62	0.59	0.57	0.42	0.90	0.67	0.68	n/a
	6	(152)	0.82	0.75	0.92	0.69	0.62	0.59	0.59	0.43	0.92	0.69	0.69	0.62
	6-1/8	(156)	0.83	0.76	0.94	0.70	0.62	0.60	0.61	0.44	0.94	0.70	0.69	0.62
	8	(203)	0.93	0.83	1.00	0.91	0.66	0.63	0.91	0.66	1.00	0.91	0.79	0.71
	10	(254)	1.00	0.92		1.00	0.70	0.66	1.00	0.92		1.00	0.89	0.80
	12	(305)		1.00			0.74	0.69		1.00			0.97	0.87
	14	(356)					0.77	0.72					1.00	0.94
	16	(406)					0.81	0.75						1.00
	18	(457)					0.85	0.78						
	20	(508)					0.89	0.82						
	22	(559)					0.93	0.85						
	> 24	(610)					0.97	0.88						

Table 11 - Load adjustment factors for 5/8-in. diameter carbon steel KWIK Bolt TZ in cracked concrete[1,2]

5/8-in. KB-TZ CS cracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}		in. (mm)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)
Nominal embed. h_{nom}		in. (mm)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	3	(76)	n/a	0.63	n/a	n/a	n/a	0.55	n/a	n/a	n/a	n/a	n/a	n/a
	3-1/4	(83)	n/a	0.64	n/a	0.66	n/a	0.55	n/a	0.17	n/a	0.35	n/a	n/a
	3-1/2	(89)	0.69	0.65	n/a	0.69	0.57	0.56	n/a	0.19	n/a	0.39	n/a	n/a
	3-5/8	(92)	0.69	0.65	0.83	0.71	0.57	0.56	0.28	0.20	0.56	0.41	n/a	n/a
	4	(102)	0.71	0.67	0.89	0.75	0.58	0.56	0.33	0.24	0.65	0.47	n/a	n/a
	4-1/4	(108)	0.73	0.68	0.93	0.78	0.58	0.57	0.36	0.26	0.71	0.52	n/a	n/a
	4-1/2	(114)	0.74	0.69	0.97	0.81	0.59	0.57	0.39	0.28	0.78	0.56	n/a	n/a
	4-3/4	(121)	0.75	0.70	1.00	0.84	0.59	0.58	0.42	0.31	0.84	0.61	n/a	n/a
	5	(127)	0.77	0.71		0.87	0.60	0.58	0.45	0.33	0.91	0.66	0.63	n/a
	5-1/2	(140)	0.79	0.73		0.93	0.61	0.59	0.52	0.38	1.00	0.76	0.66	n/a
	5-7/8	(149)	0.81	0.74		0.98	0.62	0.59	0.58	0.42		0.84	0.68	n/a
	6	(152)	0.82	0.75		1.00	0.62	0.60	0.60	0.43		0.87	0.69	0.62
	6-1/8	(156)	0.83	0.76			0.62	0.60	0.62	0.45		0.89	0.69	0.62
	8	(203)	0.93	0.83			0.66	0.63	0.92	0.67		1.00	0.79	0.71
	10	(254)	1.00	0.92			0.70	0.66	1.00	0.93			0.89	0.80
	12	(305)		1.00			0.74	0.69		1.00			0.97	0.87
	14	(356)					0.78	0.72					1.00	0.94
	16	(406)					0.82	0.75						1.00
	18	(457)					0.85	0.79						
	20	(508)					0.89	0.82						
	22	(559)					0.93	0.85						
	> 24	(610)					0.97	0.88						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 5 and figure 2 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

Table 12 - Load adjustment factors for 3/4-in. diameter carbon steel KWIK Bolt TZ in uncracked concrete[1,2]

3/4-in. KB-TZ CS uncracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}	in. (mm)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)
Nominal embed. h_{nom}	in. (mm)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (142)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	4 (102)	n/a	0.64	n/a	n/a	n/a	0.56	n/a	n/a	n/a	n/a	n/a	n/a
	4-1/8 (105)	n/a	0.64	n/a	0.55	n/a	0.56	n/a	0.21	n/a	0.41	n/a	n/a
	4-1/2 (114)	n/a	0.66	n/a	0.57	n/a	0.56	n/a	0.24	n/a	0.47	n/a	n/a
	4-3/4 (121)	n/a	0.67	0.49	0.59	n/a	0.57	0.35	0.26	0.49	0.51	n/a	n/a
	5 (127)	0.72	0.68	0.51	0.61	0.59	0.57	0.38	0.28	0.51	0.55	n/a	n/a
	5-1/2 (140)	0.74	0.69	0.55	0.65	0.60	0.58	0.43	0.32	0.55	0.64	n/a	n/a
	6 (152)	0.77	0.71	0.60	0.69	0.60	0.58	0.49	0.36	0.60	0.69	0.65	n/a
	7 (178)	0.81	0.75	0.70	0.78	0.62	0.60	0.62	0.46	0.70	0.78	0.70	n/a
	7-3/4 (197)	0.84	0.77	0.78	0.86	0.63	0.61	0.72	0.53	0.78	0.86	0.73	n/a
	8 (203)	0.86	0.78	0.80	0.89	0.64	0.61	0.76	0.56	0.80	0.89	0.75	0.67
	8-7/8 (225)	0.89	0.81	0.89	0.99	0.65	0.63	0.89	0.65	0.89	0.99	0.78	0.71
	9-1/2 (241)	0.92	0.83	0.95	1.00	0.66	0.63	0.98	0.72	0.98	1.00	0.81	0.73
	10 (254)	0.94	0.85	1.00		0.67	0.64	1.00	0.78	1.00		0.83	0.75
	10-1/2 (267)	0.97	0.87			0.68	0.65		0.84			0.85	0.77
	12 (305)	1.00	0.92			0.71	0.67		1.00			0.91	0.82
	14 (356)		0.99			0.74	0.70					0.99	0.89
	16 (406)		1.00			0.78	0.73					1.00	0.95
	18 (457)					0.81	0.75						1.00
	20 (508)					0.85	0.78						
	22 (559)					0.88	0.81						
	> 24 (610)					0.92	0.84						

Table 13 - Load adjustment factors for 3/4-in. diameter carbon steel KWIK Bolt TZ in cracked concrete[1,2]

3/4-in. KB-TZ CS cracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}	in. (mm)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)
Nominal embed. h_{nom}	in. (mm)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (142)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	4 (102)	n/a	0.64	n/a	n/a	n/a	0.56	n/a	n/a	n/a	n/a	n/a	n/a
	4-1/8 (105)	n/a	0.64	n/a	0.69	n/a	0.56	n/a	0.21	n/a	0.42	n/a	n/a
	4-1/2 (114)	n/a	0.66	n/a	0.73	n/a	0.56	n/a	0.24	n/a	0.48	n/a	n/a
	4-3/4 (121)	n/a	0.67	0.88	0.75	n/a	0.57	0.35	0.26	0.70	0.52	n/a	n/a
	5 (127)	0.72	0.68	0.91	0.77	0.59	0.57	0.38	0.28	0.76	0.56	n/a	n/a
	5-1/2 (140)	0.74	0.69	0.98	0.83	0.60	0.58	0.44	0.32	0.87	0.64	n/a	n/a
	6 (152)	0.77	0.71	1.00	0.88	0.60	0.59	0.50	0.37	1.00	0.73	0.65	n/a
	7 (178)	0.81	0.75	1.00	0.99	0.62	0.60	0.63	0.46	1.00	0.92	0.70	n/a
	7-3/4 (197)	0.84	0.77	1.00	1.00	0.64	0.61	0.73	0.54	1.00	1.00	0.74	n/a
	8 (203)	0.86	0.78	1.00		0.64	0.61	0.77	0.56	1.00		0.75	0.67
	8-7/8 (225)	0.89	0.81	1.00		0.65	0.63	0.90	0.66	1.00		0.79	0.71
	9-1/2 (241)	0.92	0.83	1.00		0.67	0.64	0.99	0.73	1.00		0.81	0.74
	10 (254)	0.94	0.85			0.67	0.64	1.00	0.79			0.84	0.75
	10-1/2 (267)	0.97	0.87			0.68	0.65		0.85			0.86	0.77
	12 (305)	1.00	0.92			0.71	0.67		1.00			0.92	0.83
	14 (356)		0.99			0.74	0.70					0.99	0.89
	16 (406)		1.00			0.78	0.73					1.00	0.95
	18 (457)					0.81	0.76						1.00
	20 (508)					0.85	0.78						
	22 (559)					0.88	0.81						
	> 24 (610)					0.92	0.84						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 5 and figure 2 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

3.3.5 KWIK Bolt TZ Expansion Anchor

Table 14 - Hilti KWIK Bolt TZ stainless steel design strength with concrete / pullout failure in uncracked concrete[1,2,3,4]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - ϕN_n				Shear - ϕV_n			
			f'_c = 2500 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 6000 psi lb (kN)	f'_c = 2500 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 6000 psi lb (kN)
3/8	2	2-5/16	1,710	1,875	2,160	2,650	2,375	2,605	3,005	3,680
	(51)	(59)	(7.6)	(8.3)	(9.6)	(11.8)	(10.6)	(11.6)	(13.4)	(16.4)
1/2	2	2-3/8	1,865	2,045	2,360	2,890	2,375	2,605	3,005	3,680
	(51)	(60)	(8.3)	(9.1)	(10.5)	(12.9)	(10.6)	(11.6)	(13.4)	(16.4)
	3-1/4	3-5/8	3,745	4,100	4,735	5,800	9,845	10,785	12,450	15,250
	(83)	(91)	(16.7)	(18.2)	(21.1)	(25.8)	(43.8)	(48.0)	(55.4)	(67.8)
5/8	3-1/8	3-9/16	4,310	4,720	5,450	6,675	9,280	10,165	11,740	14,380
	(79)	(91)	(19.2)	(21.0)	(24.2)	(29.7)	(41.3)	(45.2)	(52.2)	(64.0)
	4	4-7/16	6,240	6,835	7,895	9,665	13,440	14,725	17,000	20,820
	(102)	(113)	(27.8)	(30.4)	(35.1)	(43.0)	(59.8)	(65.5)	(75.6)	(92.6)
3/4	3-3/4	4-5/16	5,665	6,205	7,165	8,775	12,200	13,365	15,430	18,900
	(95)	(110)	(25.2)	(27.6)	(31.9)	(39.0)	(54.3)	(59.5)	(68.6)	(84.1)
	4-3/4	5-9/16	7,825	8,575	9,900	12,125	17,390	19,050	22,000	26,945
	(121)	(142)	(34.8)	(38.1)	(44.0)	(53.9)	(77.4)	(84.7)	(97.9)	(119.9)

Table 15 - Hilti KWIK Bolt TZ stainless steel design strength with concrete / pullout failure in cracked concrete[1,2,3,4,5]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - ϕN_n				Shear - ϕV_n			
			f'_c = 2500 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 6000 psi lb (kN)	f'_c = 2500 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 6000 psi lb (kN)
3/8	2	2-5/16	1,520	1,665	1,925	2,355	1,685	1,845	2,130	2,605
	(51)	(59)	(6.8)	(7.4)	(8.6)	(10.5)	(7.5)	(8.2)	(9.5)	(11.6)
1/2	2	2-3/8	1,750	1,915	2,210	2,710	2,375	2,605	3,005	3,680
	(51)	(60)	(7.8)	(8.5)	(9.8)	(12.1)	(10.6)	(11.6)	(13.4)	(16.4)
	3-1/4	3-5/8	3,235	3,545	4,095	5,015	6,970	7,640	8,820	10,800
	(83)	(91)	(14.4)	(15.8)	(18.2)	(22.3)	(31.0)	(34.0)	(39.2)	(48.0)
5/8	3-1/8	3-9/16	3,050	3,345	3,860	4,730	6,575	7,200	8,315	10,185
	(79)	(91)	(13.6)	(14.9)	(17.2)	(21.0)	(29.2)	(32.0)	(37.0)	(45.3)
	4	4-7/16	3,795	4,160	4,800	5,880	9,520	10,430	12,040	14,750
	(102)	(113)	(16.9)	(18.5)	(21.4)	(26.2)	(42.3)	(46.4)	(53.6)	(65.6)
3/4	3-3/4	4-5/16	5,270	5,775	6,670	8,165	12,200	13,365	15,430	18,900
	(95)	(110)	(23.4)	(25.7)	(29.7)	(36.3)	(54.3)	(59.5)	(68.6)	(84.1)
	4-3/4	5-9/16	5,720	6,265	7,235	8,860	12,320	13,495	15,585	19,085
	(121)	(142)	(25.4)	(27.9)	(32.2)	(39.4)	(54.8)	(60.0)	(69.3)	(84.9)

1 See section 3.1.7.3 to convert design strength value to ASD value.

2 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.

3 Apply spacing, edge distance, and concrete thickness factors in tables 18 to 25 as necessary. Compare to the steel values in table 16. The lesser of the values is to be used for the design.

4 Tabular values are for normal weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: for sand-lightweight, λ_a = 0.68; for all-lightweight, λ_a = 0.60

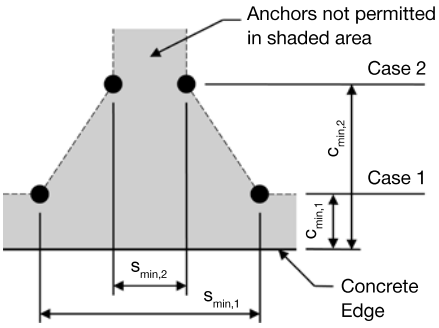
5 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75. See section 3.1.7.4 for additional information on seismic applications.

Table 16 - Steel strength for Hilti KWIK Bolt TZ stainless steel anchors[1,2]

Nominal anchor diameter	Tensile[3] ϕN_{sa} lb (kN)	Shear[4] ϕV_{sa} lb (kN)	Seismic shear[5] ϕV_{sa} lb (kN)
3/8	4,475 (19.9)	3,070 (13.7)	1,835 (8.2)
1/2	8,665 (38.5)	4,470 (19.9)	4,470 (19.9)
5/8	13,410 (59.7)	6,415 (28.5)	6,080 (27.0)
3/4	18,040 (80.2)	10,210 (45.4)	8,380 (37.3)

1 See section 3.1.7.3 to convert design strength value to ASD value.
2 Hilti KWIK Bolt TZ stainless steel anchors are to be considered ductile steel elements.
3 Tensile $\phi N_{sa} = \phi\ A_{se,N}\ f_{uta}$ as noted in ACI 318 Appendix D.
4 Shear values determined by static shear tests with $\phi V_{sa} < \phi\ 0.60\ A_{se,V}\ f_{uta}$ as noted in ACI 318 Appendix D.
5 Seismic shear values determined by seismic shear tests with $\phi_{Vsa} < \phi\ 0.60\ A_{se,V}\ f_{uta}$ as noted in ACI 318 Appendix D. See section 3.1.7.4 for additional information on seismic applications.

Figure 3



For a specific edge distance, the permitted spacing is calculated as follows:

$$s \geq s_{min,2} + \frac{(s_{min,1} - s_{min,2})}{(c_{min,1} - c_{min,2})}\ (c - c_{min,2})$$

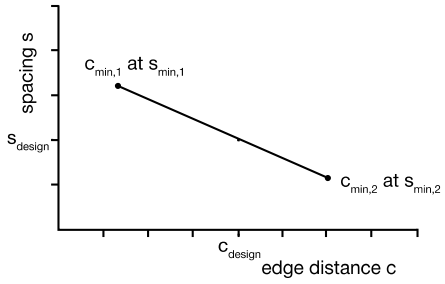


Table 17 - Stainless steel KWIK Bolt TZ installation parameters[1]

Setting information	Symbol	Units	Nominal anchor diameter d_o											
			3/8		1/2				5/8			3/4		
Effective minimum embedment[1]	h_{ef}	in. (mm)	2 (51)		2 (51)		3-1/4 (83)		3-1/8 (79)	4 (102)		3-3/4 (95)		4-3/4 (121)
Min. member thickness	h_{min}	in. (mm)	4 (102)	5 (127)	4 (102)	6 (152)	6 (152)	8 (203)	5 (127)	6 (152)	8 (203)	6 (152)	8 (203)	
Case 1	$c_{min,1}$	in. (mm)	2-1/2 (64)		2-7/8 (73)		2-1/8 (54)		3-1/4 (83)	2-3/8 (60)		4-1/4 (108)		4 (102)
	for $s_{min,1} \geq$	in. (mm)	5 (127)		5-3/4 (146)		5-1/4 (133)		5-1/2 (140)	5-1/2 (140)		10 (254)		8-1/2 (216)
Case 2	$c_{min,2}$	in. (mm)	3-1/2 (89)		4-1/2 (114)		3-1/4 (83)		4-1/8 (105)	4-1/4 (108)		9-1/2 (241)		7 (178)
	for $s_{min,2} \geq$	in. (mm)	2-1/4 (57)		2-7/8 (73)		2 (51)		2-3/4 (70)	2-3/8 (60)		5 (127)		4 (102)

1 Linear interpolation is permitted to establish an edge distance and spacing combination between Case 1 and Case 2. Linear interpolation for a specific edge distance c, where $c_{min,1} < c < c_{min,2}$, will determine the permissible spacings.

3.3.5 KWIK Bolt TZ Expansion Anchor

Table 18 - Load adjustment factors for 3/8-in. diameter stainless steel KWIK Bolt TZ in uncracked concrete[1,2]

3/8-in. KB-TZ SS uncracked concrete			Spacing factor in tension f_{AN}	Edge distance factor in tension f_{RN}	Spacing factor in shear[3] f_{AV}	Edge distance in shear		Conc. thickness factor in shear[4] f_{HV}
						⊥ toward edge f_{RV}	∥ to edge f_{RV}	
Effective embed. h_{ef}		in. (mm)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)
Nominal embed. h_{nom}		in. (mm)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-1/4	(57)	0.69	n/a	0.59	n/a	n/a	n/a
	2-1/2	(64)	0.71	0.60	0.60	0.49	0.60	n/a
	3	(76)	0.75	0.69	0.62	0.64	0.69	n/a
	3-1/2	(89)	0.79	0.80	0.64	0.81	0.81	n/a
	4	(102)	0.83	0.91	0.67	0.99	0.99	0.81
	4-1/2	(114)	0.88	1.00	0.69	1.00	1.00	0.86
	5	(127)	0.92		0.71			0.91
	5-1/2	(140)	0.96		0.73			0.95
	6	(152)	1.00		0.75			1.00
	7	(178)			0.79			
	8	(203)			0.83			
	9	(229)			0.87			
	10	(254)			0.91			
	11	(279)			0.95			
	12	(305)			1.00			

Table 19 - Load Adjustment Factors for 3/8-in. Diameter Stainless Steel KWIK Bolt TZ in Cracked Concrete[1,2]

3/8-in. KB-TZ SS cracked concrete			Spacing factor in tension f_{AN}	Edge distance factor in tension f_{RN}	Spacing factor in shear[3] f_{AV}	Edge distance in shear		Conc. thickness factor in shear[4] f_{HV}
						⊥ toward edge f_{RV}	∥ to edge f_{RV}	
Effective embed. h_{ef}		in. (mm)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)
Nominal embed. h_{nom}		in. (mm)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)	2-5/16 (59)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-1/4	(57)	0.69	n/a	0.59	n/a	n/a	n/a
	2-1/2	(64)	0.71	0.87	0.60	0.49	0.87	n/a
	3	(76)	0.75	1.00	0.62	0.65	1.00	n/a
	3-1/2	(89)	0.79	1.00	0.65	0.82	1.00	n/a
	4	(102)	0.83		0.67	1.00		0.82
	4-1/2	(114)	0.88		0.69			0.87
	5	(127)	0.92		0.71			0.91
	5-1/2	(140)	0.96		0.73			0.96
	6	(152)	1.00		0.75			1.00
	7	(178)			0.79			
	8	(203)			0.83			
	9	(229)			0.87			
	10	(254)			0.92			
	11	(279)			0.96			
	12	(305)			1.00			

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 17 and figure 3 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

Table 20 - Load adjustment factors for 1/2-in. diameter stainless steel KWIK Bolt TZ in uncracked concrete[1,2]

1/2-in. KB-TZ SS uncracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}		in. (mm)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)
Nominal embed. h_{nom}		in. (mm)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2	(51)	n/a	0.60	n/a	n/a	n/a	0.54	n/a	n/a	n/a	n/a	n/a	n/a
	2-1/8	(54)	n/a	0.61	n/a	0.39	n/a	0.54	n/a	0.11	n/a	0.22	n/a	n/a
	2-7/8	(73)	0.74	0.65	0.53	0.45	0.63	0.55	0.53	0.17	0.53	0.35	n/a	n/a
	3	(76)	0.75	0.65	0.55	0.46	0.63	0.55	0.55	0.19	0.55	0.37	n/a	n/a
	3-1/4	(83)	0.77	0.67	0.59	0.49	0.64	0.56	0.59	0.21	0.59	0.42	n/a	n/a
	3-1/2	(89)	0.79	0.68	0.64	0.51	0.65	0.56	0.64	0.23	0.64	0.47	n/a	n/a
	4	(102)	0.83	0.71	0.73	0.56	0.68	0.57	0.73	0.29	0.73	0.56	0.84	n/a
	4-1/2	(114)	0.88	0.73	0.82	0.61	0.70	0.58	0.82	0.34	0.82	0.61	0.89	n/a
	5	(127)	0.92	0.76	0.91	0.67	0.72	0.59	0.91	0.40	0.91	0.67	0.94	n/a
	5-1/4	(133)	0.94	0.77	0.95	0.70	0.73	0.60	0.95	0.43	0.95	0.70	0.96	n/a
	5-1/2	(140)	0.96	0.78	1.00	0.73	0.74	0.60	1.00	0.46	1.00	0.73	0.98	n/a
	6	(152)	1.00	0.81		0.80	0.76	0.61		0.53		0.80	1.00	0.66
	7	(178)		0.86		0.93	0.81	0.63		0.66		0.93		0.71
	8	(203)		0.91		1.00	0.85	0.64		0.81		1.00		0.76
	9	(229)		0.96			0.89	0.66		0.97				0.81
	10	(254)		1.00			0.94	0.68		1.00				0.85
	11	(279)					0.98	0.70						0.89
	12	(305)					1.00	0.72						0.93
	14	(356)						0.75						1.00
	16	(406)						0.79						
	18	(457)						0.83						
	> 20	(508)						0.86						

Table 21 - Load adjustment factors for 1/2-in. diameter stainless steel KWIK Bolt TZ in cracked concrete[1,2]

1/2-in. KB-TZ SS cracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}		in. (mm)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)	2 (51)	3-1/4 (83)
Nominal embed. h_{nom}		in. (mm)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)	2-3/8 (60)	3-5/8 (92)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2	(51)	n/a	0.60	n/a	n/a	n/a	0.54	n/a	n/a	n/a	n/a	n/a	n/a
	2-1/8	(54)	n/a	0.61	n/a	0.60	n/a	0.54	n/a	0.11	n/a	0.22	n/a	n/a
	2-7/8	(73)	0.74	0.65	0.97	0.70	0.60	0.55	0.47	0.18	0.94	0.35	n/a	n/a
	3	(76)	0.75	0.65	1.00	0.71	0.60	0.55	0.50	0.19	1.00	0.38	n/a	n/a
	3-1/4	(83)	0.77	0.67	1.00	0.75	0.61	0.56	0.56	0.21	1.00	0.42	n/a	n/a
	3-1/2	(89)	0.79	0.68	1.00	0.79	0.62	0.56	0.63	0.24	1.00	0.47	n/a	n/a
	4	(102)	0.83	0.71	1.00	0.86	0.64	0.57	0.77	0.29	1.00	0.58	0.75	n/a
	4-1/2	(114)	0.88	0.73	1.00	0.94	0.66	0.58	0.92	0.34	1.00	0.69	0.79	n/a
	5	(127)	0.92	0.76		1.00	0.67	0.59	1.00	0.40		0.81	0.84	n/a
	5-1/4	(133)	0.94	0.77			0.68	0.60		0.43		0.87	0.86	n/a
	5-1/2	(140)	0.96	0.78			0.69	0.60		0.47		0.93	0.88	n/a
	6	(152)	1.00	0.81			0.71	0.61		0.53		1.00	0.92	0.66
	7	(178)		0.86			0.74	0.63		0.67			0.99	0.71
	8	(203)		0.91			0.78	0.65		0.82			1.00	0.76
	9	(229)		0.96			0.81	0.66		0.98				0.81
	10	(254)		1.00			0.85	0.68		1.00				0.85
	11	(279)					0.88	0.70						0.90
	12	(305)					0.92	0.72						0.94
	14	(356)					0.99	0.76						1.00
	16	(406)					1.00	0.79						
	18	(457)						0.83						
	> 20	(508)						0.86						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 17 and figure 3 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

3.3.5 KWIK Bolt TZ Expansion Anchor

Table 22 - Load adjustment factors for 5/8-in. diameter stainless steel KWIK Bolt TZ in uncracked concrete[1,2]

5/8-in. KB-TZ SS uncracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}	in. (mm)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)
Nominal embed. h_{nom}	in. (mm)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-3/8 (60)	n/a	0.60	n/a	0.39	n/a	0.54	n/a	0.11	n/a	0.21	n/a	n/a
	2-3/4 (70)	0.65	0.61	n/a	0.41	0.55	0.54	n/a	0.13	n/a	0.27	n/a	n/a
	3 (76)	0.66	0.63	n/a	0.43	0.56	0.55	n/a	0.15	n/a	0.30	n/a	n/a
	3-1/4 (83)	0.67	0.64	0.51	0.45	0.56	0.55	0.24	0.17	0.47	0.34	n/a	n/a
	3-1/2 (89)	0.69	0.65	0.54	0.47	0.57	0.56	0.26	0.19	0.53	0.38	n/a	n/a
	4 (102)	0.71	0.67	0.59	0.51	0.58	0.56	0.32	0.23	0.59	0.47	n/a	n/a
	4-1/2 (114)	0.74	0.69	0.65	0.55	0.59	0.57	0.38	0.28	0.65	0.55	n/a	n/a
	5 (127)	0.77	0.71	0.71	0.59	0.60	0.58	0.45	0.33	0.71	0.59	0.63	n/a
	5-1/2 (140)	0.79	0.73	0.79	0.63	0.61	0.59	0.52	0.38	0.79	0.63	0.66	n/a
	6 (152)	0.82	0.75	0.86	0.68	0.62	0.59	0.59	0.43	0.86	0.68	0.69	0.62
	7 (178)	0.87	0.79	1.00	0.79	0.64	0.61	0.75	0.54	1.00	0.79	0.74	0.67
	8 (203)	0.93	0.83		0.90	0.66	0.63	0.91	0.66		0.90	0.79	0.71
	10 (254)	1.00	0.92		1.00	0.70	0.66	1.00	0.92		1.00	0.89	0.80
	12 (305)		1.00			0.74	0.69		1.00			0.97	0.87
	14 (356)					0.77	0.72					1.00	0.94
	16 (406)					0.81	0.75						1.00
	18 (457)					0.85	0.78						
	20 (508)					0.89	0.82						
	22 (559)					0.93	0.85						
	> 24 (610)					0.97	0.88						

Table 23 - Load adjustment factors for 5/8-in. diameter stainless steel KWIK Bolt TZ in cracked concrete[1,2]

5/8-in. KB-TZ SS cracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}	in. (mm)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)
Nominal embed. h_{nom}	in. (mm)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)	3-9/16 (90)	4-7/16 (113)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	2-3/8 (60)	n/a	0.60	n/a	0.57	n/a	0.54	n/a	011	n/a	0.22	n/a	n/a
	2-3/4 (70)	n/a	0.61	n/a	0.61	n/a	0.54	n/a	0.13	n/a	0.27	n/a	n/a
	3 (76)	0.66	0.63	n/a	0.64	0.56	0.55	n/a	0.15	n/a	0.31	n/a	n/a
	3-1/4 (83)	0.67	0.64	0.77	0.66	0.56	0.55	0.24	0.17	0.48	0.35	n/a	n/a
	3-1/2 (89)	0.69	0.65	0.81	0.69	0.57	0.56	0.27	0.19	0.53	0.39	n/a	n/a
	4 (102)	0.71	0.67	0.89	0.75	0.58	0.56	0.33	0.24	0.65	0.47	n/a	n/a
	4-1/2 (114)	0.74	0.69	0.97	0.81	0.59	0.57	0.39	0.28	0.78	0.56	n/a	n/a
	5 (127)	0.77	0.71	1.00	0.87	0.60	0.58	0.45	0.33	0.91	0.66	0.63	n/a
	5-1/2 (140)	0.79	0.73		0.93	0.61	0.59	0.52	0.38	1.00	0.76	0.66	n/a
	6 (152)	0.82	0.75		1.00	0.62	0.60	0.60	0.43		0.87	0.69	0.62
	7 (178)	0.87	0.79			0.64	0.61	0.75	0.55		1.00	0.74	0.67
	8 (203)	0.93	0.83			0.66	0.63	0.92	0.67			0.79	0.71
	10 (254)	1.00	0.92			0.70	0.66	1.00	0.93			0.89	0.80
	12 (305)		1.00			0.74	0.69		1.00			0.97	0.87
	14 (356)					0.78	0.72					1.00	0.94
	16 (406)					0.82	0.75						1.00
	18 (457)					0.85	0.79						
	20 (508)					0.89	0.82						
	22 (559)					0.93	0.85						
	> 24 (610)					0.97	0.88						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 17 and figure 3 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

Table 24 - Load adjustment factors for 3/4-in. diameter stainless steel KWIK Bolt TZ in uncracked concrete[1,2]

3/4-in. KB-TZ CS uncracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}		in. (mm)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)	3-1/8 (79)	4 (102)
Nominal embed. h_{nom}		in. (mm)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (142)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	4	(102)	n/a	0.64	n/a	0.54	n/a	0.56	n/a	0.20	n/a	0.40	n/a	n/a
	4-1/4	(108)	n/a	0.65	0.46	0.56	n/a	0.56	0.29	0.22	0.46	0.43	n/a	n/a
	4-1/2	(114)	n/a	0.66	0.48	0.57	n/a	0.56	0.32	0.24	0.48	0.47	n/a	n/a
	5	(127)	0.72	0.68	0.51	0.61	0.59	0.57	0.38	0.28	0.51	0.55	n/a	n/a
	5-1/2	(140)	0.74	0.69	0.55	0.65	0.60	0.58	0.43	0.32	0.55	0.64	n/a	n/a
	6	(152)	0.77	0.71	0.60	0.69	0.60	0.58	0.49	0.36	0.60	0.69	0.65	n/a
	7	(178)	0.81	0.75	0.70	0.78	0.62	0.60	0.62	0.46	0.70	0.78	0.70	n/a
	8	(203)	0.86	0.78	0.80	0.89	0.64	0.61	0.76	0.56	0.80	0.89	0.75	0.67
	9	(229)	0.90	0.82	0.90	1.00	0.66	0.63	0.91	0.67	0.91	1.00	0.79	0.71
	9-1/2	(241)	0.92	0.83	0.95		0.66	0.63	0.98	0.72	0.98		0.81	0.73
	10	(254)	0.94	0.85	1.00		0.67	0.64	1.00	0.78	1.00		0.83	0.75
	12	(305)	1.00	0.92			0.71	0.67		1.00			0.91	0.82
	14	(356)		0.99			0.74	0.70					0.99	0.89
	16	(406)		1.00			0.78	0.73					1.00	0.95
	18	(457)					0.81	0.75						1.00
	20	(508)					0.85	0.78						
	22	(559)					0.88	0.81						
	> 24	(610)					0.92	0.84						

Table 25 - Load adjustment factors for 3/4-in. diameter stainless steel KWIK Bolt TZ in cracked concrete[1,2]

3/4-in. KB-TZ SS cracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Effective embed. h_{ef}		in. (mm)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)	3-3/4 (95)	4-3/4 (121)
Nominal embed. h_{nom}		in. (mm)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (141)	4-5/16 (110)	5-9/16 (142)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	4	(102)	n/a	0.64	n/a	0.68	n/a	0.56	n/a	0.20	n/a	0.40	n/a	n/a
	4-1/4	(108)	n/a	0.65	0.81	0.70	n/a	0.56	0.21	0.22	0.42	0.44	n/a	n/a
	4-1/2	(114)	n/a	0.66	0.85	0.73	n/a	0.56	0.23	0.24	0.46	0.48	n/a	n/a
	5	(127)	0.72	0.68	0.91	0.77	0.57	0.57	0.27	0.28	0.54	0.56	n/a	n/a
	5-1/2	(140)	0.74	0.69	0.98	0.83	0.58	0.58	0.31	0.32	0.62	0.64	n/a	n/a
	6	(152)	0.77	0.71	1.00	0.88	0.58	0.59	0.35	0.37	0.71	0.73	0.58	n/a
	7	(178)	0.81	0.75	1.00	0.99	0.60	0.60	0.44	0.46	0.89	0.92	0.62	n/a
	8	(203)	0.86	0.78	1.00	1.00	0.61	0.61	0.54	0.56	1.00	1.00	0.67	0.67
	9	(229)	0.90	0.82	1.00		0.62	0.63	0.65	0.67	1.00		0.71	0.72
	9-1/2	(241)	0.92	0.83	1.00		0.63	0.64	0.70	0.73	1.00		0.73	0.74
	10	(254)	0.94	0.85			0.64	0.64	0.76	0.79			0.74	0.75
	12	(305)	1.00	0.92			0.67	0.67	1.00	1.00			0.82	0.83
	14	(356)		0.99			0.69	0.70					0.88	0.89
	16	(406)		1.00			0.72	0.73					0.94	0.95
	18	(457)					0.75	0.76					1.00	1.00
	20	(508)					0.78	0.78						
	22	(559)					0.81	0.81						
	> 24	(610)					0.83	0.84						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with table 17 and figure 3 of this section to calculate permissable edge distance, spacing and concrete thickness combinations.

3.3.5 KWIK Bolt TZ Expansion Anchor

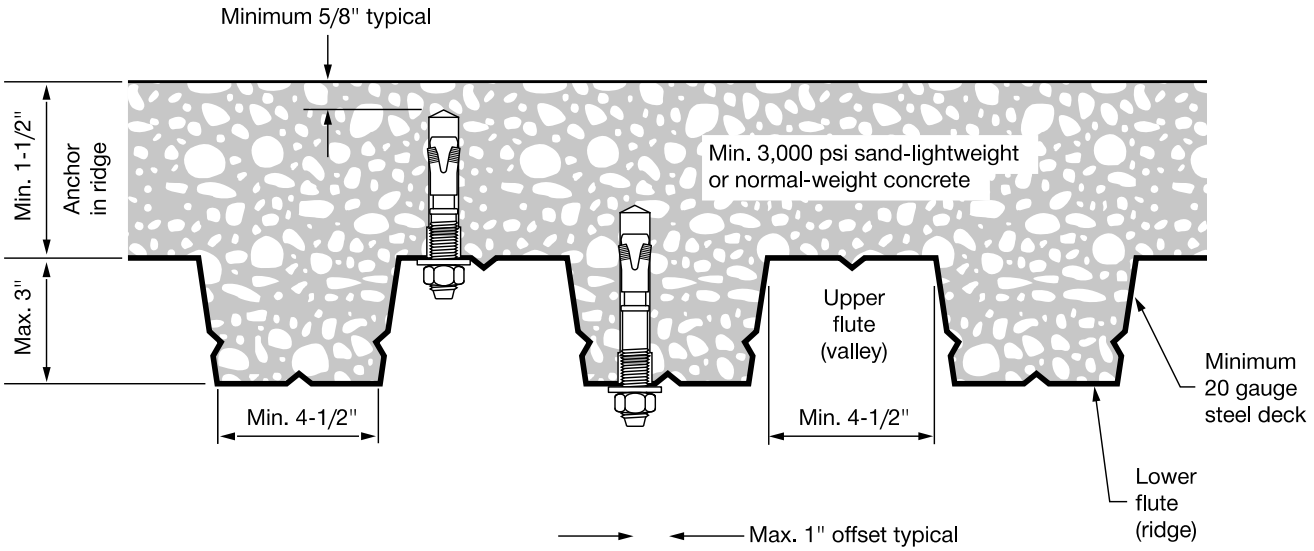


Figure 4 - Installation of KWIK Bolt TZ in the soffit of concrete over metal deck floor and roof assemblies - W Deck

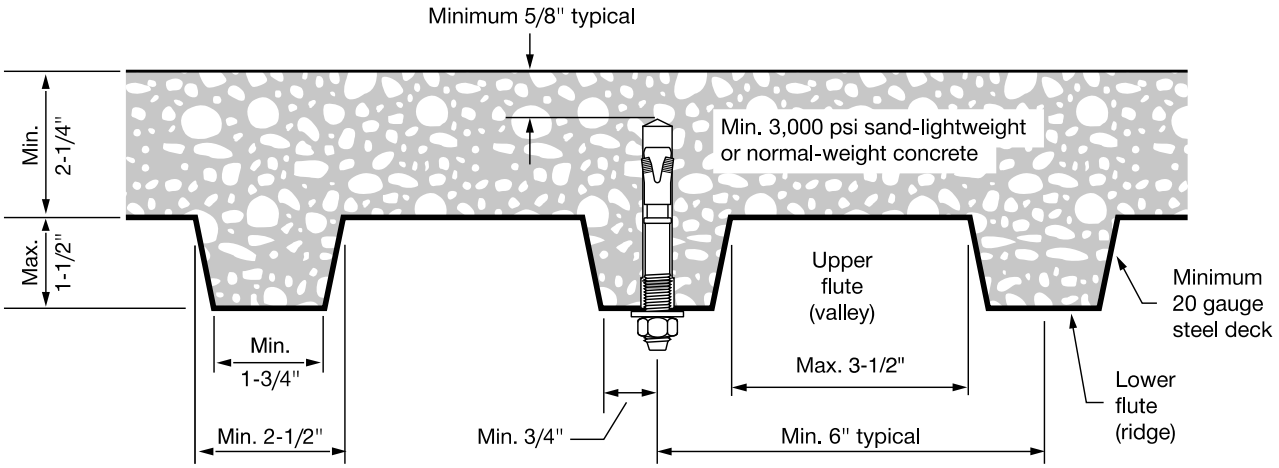


Figure 5 - Installation of KWIK Bolt TZ in the soffit of concrete over metal deck floor and roof assemblies - B Deck

Table 26 - Hilti KWIK Bolt TZ carbon steel design strength in the soffit of uncracked lightweight concrete over metal deck[1,2,3,4,5,6]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Loads according to Figure 4				Loads according to Figure 5			
			Tension - ϕN_n		Shear - ϕV_n		Tension - ϕN_n		Shear - ϕV_n	
			f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)
3/8	2 (51)	2-5/16 (59)	1,340 (6.0)	1,545 (6.9)	1,385 (6.2)	1,385 (6.2)	1,200 (5.3)	1,385 (6.2)	1,850 (8.2)	1,850 (8.2)
1/2	2 (51)	2-3/8 (60)	1,340 (6.0)	1,545 (6.9)	1,950 (8.7)	1,950 (8.7)	1,210 (5.4)	1,395 (6.2)	1,680 (7.5)	1,680 (7.5)
	3-1/4 (83)	3-5/8 (92)	2,400 (10.7)	2,770 (12.3)	3,215 (14.3)	3,215 (14.3)	2,195 (9.8)	2,535 (11.3)	2,565 (11.4)	2,565 (11.4)
5/8	3-1/8 (79)	3-9/16 (90)	1,835 (8.2)	2,120 (9.4)	2,990 (13.3)	2,990 (13.3)	2,640 (11.7)	3,050 (13.6)	3,060 (13.6)	3,060 (13.6)
	4 (102)	4-7/16 (113)	4,260 (18.9)	4,920 (21.9)	3,925 (17.5)	3,925 (17.5)	n/a	n/a	n/a	n/a

Table 27 - Hilti KWIK Bolt TZ carbon steel design strength in the soffit of cracked lightweight concrete over metal deck[1,2,3,4,5,6,7]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Loads according to Figure 4				Loads according to Figure 5			
			Tension - ϕN_n		Shear - ϕV_n		Tension - ϕN_n		Shear - ϕV_n	
			f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)
3/8	2 (51)	2-5/16 (59)	950 (4.2)	1,095 (4.9)	1,385[8] (6.2)	1,385[8] (6.2)	1,080 (4.8)	1,245 (5.5)	1,850[8] (8.2)	1,850[8] (8.2)
1/2	2 (51)	2-3/8 (60)	950 (4.2)	1,095 (4.9)	1,950 (8.7)	1,950 (8.7)	860 (3.8)	995 (4.4)	1,680 (7.5)	1,680 (7.5)
	3-1/4 (83)	3-5/8 (92)	1,705 (7.6)	1,970 (8.8)	3,215 (14.3)	3,215 (14.3)	1,955 (8.7)	2,255 (10.0)	2,565 (11.4)	2,565 (11.4)
5/8	3-1/8 (79)	3-9/16 (90)	1,300 (5.8)	1,500 (6.7)	2,990[8] (13.3)	2,990[8] (13.3)	1,875 (8.3)	2,165 (9.6)	3,060[8] (13.6)	3,060[8] (13.6)
	4 (102)	4-7/16 (113)	3,020 (13.4)	3,485 (15.5)	3,925[8] (17.5)	3,925[8] (17.5)	n/a	n/a	n/a	n/a

1 See section 3.1.7.3 to convert design strength value to ASD value.

2 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.

3 Tabular value is for one anchor per flute. Minimum spacing along the length of the flute is 3 x h_{ef} (effective embedment).

4 Tabular values are lightweight concrete and no additional reduction factor is needed.

5 No additional reduction factors for spacing or edge distance need to be applied.

6 Comparison to steel values in table 4 is not required. Values in tables 26 and 27 control.

7 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75. See section 3.1.7.4 for additional information on seismic applications.

8 For the following anchor sizes, an additional factor for seismic shear must be applied to the cracked concrete tabular values for seismic conditions:
3/8-inch diameter - $\alpha_{v,seis}$ = 0.63
5/8-inch diameter - $\alpha_{v,seis}$ = 0.94

3.3.5 KWIK Bolt TZ Expansion Anchor

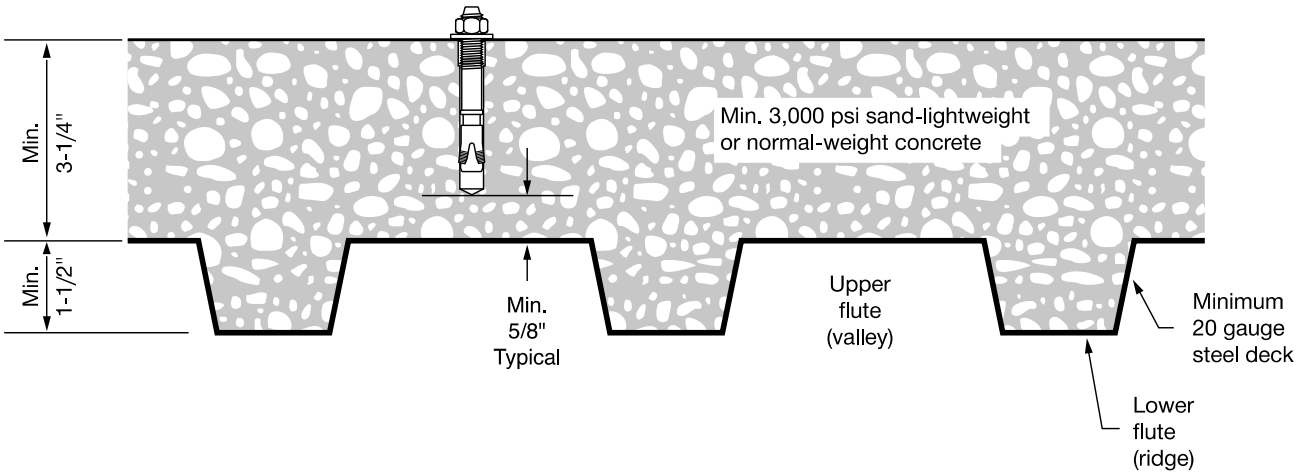


Figure 6 - Installation of the KWIK Bolt TZ on the top of sand-lightweight concrete over metal deck floor and roof assemblies

Table 28 - Hilti KWIK Bolt TZ carbon steel design strength in the top of uncracked concrete over metal deck[1,2,3,4]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - ϕN_n		Shear - ϕV_n	
			f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)
3/8	2 (51)	2-5/16 (59)	1,790 (8.0)	2,070 (9.2)	2,605 (11.6)	3,005 (13.4)
1/2	2 (51)	2-3/8 (60)	2,415 (10.7)	2,790 (12.4)	2,605 (11.6)	3,005 (13.4)

Table 29 - Hilti KWIK Bolt TZ carbon steel design strength in the top of cracked concrete over metal deck[1,2,3,4,5]

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Tension - ϕN_n		Shear - ϕV_n	
			f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)
3/8	2 (51)	2-5/16 (59)	1,615 (7.2)	1,865 (8.3)	1,845 (8.2)	2,130 (9.5)
1/2	2 (51)	2-3/8 (60)	1,710 (7.6)	1,975 (8.8)	1,845 (8.2)	2,130 (9.5)

1 See section 3.1.7.3 to convert design strength value to ASD value.

2 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.

3 Apply spacing, edge distance, and concrete thickness factors in tables 30 and 31 as necessary. Compare to the steel values in table 4. The lesser of the values is to be used for the design.

4 Tabular values are for normal weight concrete only. For lightweight concrete multiply design strength by λa as follows: for sand-lightweight, λ_a = 0.68; for all-lightweight, λ_a = 0.60

5 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75. See section 3.1.7.4 for additional information on seismic applications.

Table 30 - Load adjustment factors for carbon steel KWIK Bolt TZ in the top of uncracked concrete over metal deck[1,2]

3/8-in. and 1/2-in. KB-TZ CS uncracked concrete over metal deck		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Anchor diameter d_a	in. (mm)	3/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)	/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)
Effective embed. h_{ef}	in. (mm)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)
Nominal embed. h_{nom}	in. (mm)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)
Spacing (s)/edge distance (c_a)/concrete thickness (h) - in. (mm)	3 (76)	n/a	n/a	0.33	n/a	n/a	n/a	0.64	n/a	0.64	n/a	n/a	n/a
	3-1/4 (83)	n/a	n/a	0.36	n/a	n/a	n/a	0.72	n/a	0.72	n/a	0.73	0.75
	3-1/2 (89)	n/a	n/a	0.39	n/a	n/a	n/a	0.81	n/a	0.81	n/a	0.76	0.78
	4 (102)	0.83	n/a	0.44	n/a	0.67	n/a	0.99	n/a	0.99	n/a	0.81	0.84
	4-1/2 (114)	0.88	n/a	0.50	0.50	0.69	n/a	1.00	1.00	1.00	1.00		
	5 (127)	0.92	n/a	0.56	0.56	0.71	n/a						
	5-1/2 (140)	0.96	n/a	0.61	0.61	0.73	n/a						
	6 (152)	1.00	n/a	0.67	0.67	0.75	n/a						
	6-1/2 (165)		1.00	0.72	0.72	0.77	0.78						
	7 (178)			0.78	0.78	0.79	0.81						
	8 (203)			0.89	0.89	0.83	0.85						
	9 (229)			1.00	1.00	0.87	0.89						
	10 (254)					0.91	0.94						
	11 (279)					0.95	0.98						
	12 (305)					1.00	1.00						

Table 31 - Load adjustment factors for carbon steel KWIK Bolt TZ in the top of cracked concrete over metal deck[1,2]

3/8-in. and 1/2-in. KB-TZ CS cracked concrete over metal deck		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear ⊥ toward edge f_{RV}		Edge distance in shear ∥ to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Anchor diameter d_a	in. (mm)	3/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)	/8 (9.5)	1/2 (12.7)	3/8 (9.5)	1/2 (12.7)
Effective embed. h_{ef}	in. (mm)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)	2 (51)
Nominal embed. h_{nom}	in. (mm)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)	2-5/16 (59)	2-3/8 (60)
Spacing (s)/edge distance (c_a)/concrete thickness (h) - in. (mm)	3 (76)	n/a	n/a	1.00	n/a	n/a	n/a	0.65	n/a	1.00	n/a	n/a	n/a
	3-1/4 (83)	n/a	n/a		n/a	n/a	n/a	0.73	n/a		n/a	0.74	0.76
	3-1/2 (89)	n/a	n/a		n/a	n/a	n/a	0.82	n/a		n/a	0.76	0.79
	4 (102)	0.83	n/a		n/a	0.67	n/a	1.00	n/a		n/a	0.82	0.84
	4-1/2 (114)	0.88	n/a		1.00	0.69	n/a		1.00		1.00		
	5 (127)	0.92	n/a			0.71	n/a						
	5-1/2 (140)	0.96	n/a			0.73	n/a						
	6 (152)	1.00	n/a			0.75	n/a						
	6-1/2 (165)		1.00			0.77	0.79						
	7 (178)					0.79	0.81						
	8 (203)					0.83	0.85						
	9 (229)					0.87	0.90						
	10 (254)					0.92	0.94						
	11 (279)					0.96	0.98						
	12 (305)					1.00	1.00						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Anchor Design software or perform anchor calculation using design equations from ACI 318 Appendix D.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.

- For concrete thickness greater than or equal to 4-inches, the anchor can be designed using either table 2 or table 3 of this section.

3.3.5

3.3.5 KWIK Bolt TZ Expansion Anchor

3.3.5.4 Installation instructions

Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at **www.us.hilti.com (US)** and **www.hilti.ca (Canada)**. Because of the possibility of changes, always verify that downloaded IFU are current when used. Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

3.3.5.5 Ordering information[1]

Description			Length	Threaded length	Box quantity
KB-TZ 3/8x3	KB-TZ SS304 3/8x3	KB-TZ SS316 3/8x3	3	7/8	50
KB-TZ 3/8x3-3/4	KB-TZ SS304 3/8x3-3/4	KB-TZ SS316 3/8x3-3/4	3-3/4	1-5/8	50
KB-TZ 3/8x5	KB-TZ SS304 3/8x5		5	2-7/8	50
KB-TZ 1/2x3-3/4	KB-TZ SS304 1/2x3-3/4	KB-TZ SS316 1/2x3-3/4	3-3/4	1-5/8	20
KB-TZ 1/2x4-1/2	KB-TZ SS304 1/2x4-1/2	KB-TZ SS316 1/2x4-1/2	4-1/2	2-3/8	20
KB-TZ 1/2x5-1/2	KB-TZ SS304 1/2x5-1/2	KB-TZ SS316 1/2x5-1/2	5-1/2	3-3/8	20
KB-TZ 1/2x7	KB-TZ SS304 1/2x7		7	4-7/8	20
KB-TZ 5/8x4-3/4	KB-TZ SS304 5/8x4-3/4	KB-TZ SS316 5/8x4-3/4	4-3/4	1-1/2	15
KB-TZ 5/8x6	KB-TZ SS304 5/8x6	KB-TZ SS316 5/8x6	6	2-3/4	15
KB-TZ 5/8x8-1/2	KB-TZ SS304 5/8x8-1/2		8-1/2	5-1/4	15
KB-TZ 5/8x10	KB-TZ SS304 5/8x10		10	6-3/4	15
KB-TZ 3/4x5-1/2	KB-TZ SS304 3/4x5-1/2	KB-TZ SS316 3/4x5-1/2	5 1/2	1-1/2	10
KB-TZ 3/4x8	KB-TZ SS304 3/4x8		8	4	10
KB-TZ 3/4x10	KB-TZ SS304 3/4x10	KB-TZ SS316 3/4x10	10	6	10

1 All dimensions in inches

Table 32 - KWIK Bolt TZ length identification system

Length ID marking on bolt head		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Length of anchor, ℓ_{anch} in.	From	1 ½	2	2 ½	3	3 ½	4	4 ½	5	5 ½	6	6 ½	7	7 ½	8	8 ½	9	9 ½	10	11	12	13	14	15
	Up to but not including	2	2 ½	3	3 ½	4	4 ½	5	5 ½	6	6 ½	7	7 ½	8	8 ½	9	9 ½	10	11	12	13	14	15	16

Figure 7 — Bolt head with length identification mark and KWIK Bolt TZ head notch embossment

TOLCO™ Fig. 65 - Reversible Steel C-Type Beam Clamp 3/4" (19.0mm) Throat Opening

Size Range:

Fig. 65 - 1/2"-13 rod sizes, and 5/8"-11 rod sizes
Fig. 65XT - 3/8"-16 rod size (see below)

Material: Steel with hardened cup point set screw and jam nut

Function: Recommended for hanging from steel beam where flange thickness does not exceed 3/4" (19.0mm).

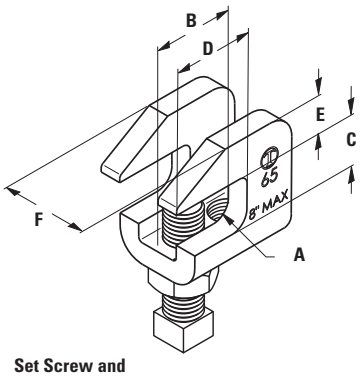
Features: All steel construction eliminates structural deficiencies associated with casting type beam clamps. May be used on top or bottom flange of beam. (Beveled lip allows hanging from top flange where clearance is limited.) May be installed with set screw in up or down position. Offset design permits unlimited rod adjustment by allowing the rod to be threaded completely through the clamp. Open design permits inspection of thread engagement.

Approvals: Underwriters Laboratories Listed in the USA **(UL)** and Canada **(cUL).** Exceeds requirements of the National Fire Protection Association **(NFPA)**, pamphlet 13,
3/8"-16 rod will support 1/2" (15mm) thru 4" (100mm) pipe
1/2"-13 rod will support thru 8" (200mm) pipe

Finish: Plain or Electro-Galvanized. Contact customer service for alternative finishes and materials.

Order By: Figure number and finish

Fig. 65 Patent #4,570,885



Set Screw and Locknut Included

Part No.	Rod Size A	B in.	B (mm)	C in.	C (mm)	D in.	D (mm)	E in.	E (mm)
65-1/2	1/2"-13	1 1/2"	(38.1)	3/4"	(19.0)	1"	(25.4)	9/16"	(14.3)
65-5/8	5/8"-11	1 1/2"	(38.1)	3/4"	(19.0)	1"	(25.4)	9/16"	(14.3)

Part No.	F in.	F (mm)	Approx. Wt./100 Lbs.	Approx. Wt./100 (kg)
65-1/2	1 1/4"	(31.7)	55	(24.9)
65-5/8	1 1/4"	(31.7)	55	(24.9)

TOLCO™ Fig. 65XT - Reversible Steel C-Type Beam Clamp 3/4" (19.0mm) Throat Opening

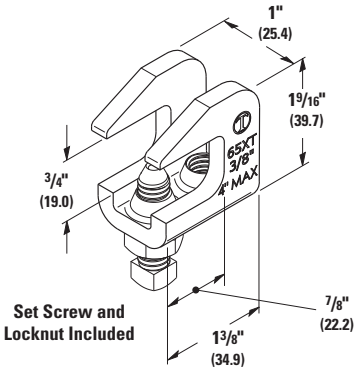
Feature: Extruded holes allows for more thread engagement of threaded rod and set screw.

Finish: Plain or Electro-Galvanized

Order By: Figure number and finish

Approvals: Underwriters Laboratories Listed **(cULus)** and FM Approved **(FM)** for up to 4" (100mm) pipe.

Designed to meet or exceed requirements of FM DS 2-0 and NFPA 13.

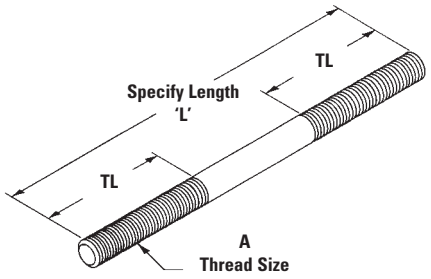


Set Screw and Locknut Included

Part No.	For Rod Size	Approx. Wt./100 Lbs.	Approx. Wt./100 (kg)
65XT	3/8"-16	28.0	(12.7)

All dimensions in charts and on drawings are in inches. Dimensions shown in parentheses are in millimeters unless otherwise specified.

B3205 - Threaded Rod (right-hand threads - both ends)
B3205L - Threaded Rod (right & left hand threads)



Size Range: 3/8"-16 thru 7/8"-9 rod

Material: Steel

Function: Recommended for use as a hanger support in hanger assemblies. Rod is threaded on both ends with right hand threads of the length shown. Also available with left and right hand threads - specify Fig. B3205L when ordering.

Maximum Temperature: 750°F (399°C)

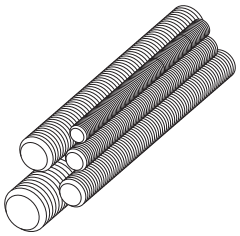
Finish: Plain or Electro-Galvanized. Contact customer service for alternative finishes and materials.

Order By: Figure number, rod size, length and finish

Part No.	Thread Size A	Standard Thread Length TL in.	(mm)	Design Load 650°F (343°C) Lbs.	(kN)	750°F (399°C) Lbs.	(kN)
B3205-3/8 x 'L'	3/8"-16	2 1/2"	(63.5)	730	(3.25)	572	(2.54)
B3205-1/2 x 'L'	1/2"-13	2 1/2"	(63.5)	1350	(6.00)	1057	(4.70)
B3205-5/8 x 'L'	5/8"-11	2 1/2"	(63.5)	2160	(9.61)	1692	(7.52)
B3205-3/4 x 'L'	3/4"-10	3"	(76.2)	3230	(14.37)	2530	(11.25)
B3205-7/8 x 'L'	7/8"-9	3 1/2"	(88.9)	4480	(19.93)	3508	(15.60)

For larger sizes consult full line pipe hanger catalog.

ATR - All Threaded Rod - 120" (3.05m) Lengths
TOLCO™ Fig. 99 - All Threaded Rod Cut To Length



OPM

Size Range: 1/4"-20 thru 7/8"-9 rod in 120" lengths or cut to length

Material: Steel

Maximum Temperature: 750°F (399°C)

Finish: Plain or Electro-Galvanized. Contact customer service for alternative finishes and materials.

Approvals: Included in our Seismic Engineering Guidelines approved by the State of California Office of Statewide Health Planning and Development **(OSHPD)**. For additional load, spacing and placement information relating to OSHPD projects, please refer to our Seismic Engineering Guidelines, OPM-0052-13.

Order By: Figure number, rod size, length and finish

Part No. - Size x Length ATR	Fig. 99	Threads Per Inch	Recommended Load Lbs.	(kN)	Approx. Wt./100 Ft. Lbs.	(kg)
ATR 1/4" x 120	99-1/4" x length	20	240	(1.07)	12	(5.44)
ATR 3/8" x 120	99-3/8" x length	16	730	(3.24)	29	(13.15)
ATR 1/2" x 120	99-1/2" x length	13	1350	(6.00)	53	(24.04)
ATR 5/8" x 120	99-5/8" x length	11	2160	(9.60)	89	(40.37)
ATR 3/4" x 120	99-3/4" x length	10	3230	(14.37)	123	(55.79)
ATR 7/8" x 120	99-7/8" x length	9	4480	(19.93)	170	(77.11)

For larger sizes consult full line pipe hanger catalog.

All dimensions in charts and on drawings are in inches. Dimensions shown in parentheses are in millimeters unless otherwise specified.

TOLCO™ Fig. 200 - "Trimline" Adjustable Band Hanger
TOLCO™ Fig. 200F - "Trimline" Adjustable Band Hanger with Felt Lining for Copper Tubing
TOLCO™ Fig. 200C - "Trimline" Adjustable Band Hanger with Plastic Coated
TOLCO™ Fig. 200S - "Trimline" Adjustable Band Hanger with Removable Nut (For sizes 1" thru 2")

Size Range:
Fig. 200 - 1/2" (15mm) thru 8" (200mm) pipe

Material: Steel, Pre-Galvanized

Function: For fire sprinkler and other general piping purposes. Knurled swivel nut design permits hanger adjustment after installation.

Features:

- 1/2" (15mm) thru 2" (50mm) sizes have flared edges for ease of installation on all pipe types and protects CPVC plastic pipe from abrasion. Captured knurled nut design (flared top) on 1" thru 2" sizes keep nut from separating with hanger. Hanger is easily installed around pipe.
- 1/2" (15mm), 3/4" (20mm), and 2 1/2" (65mm) thru 8" (200mm)) Spring tension on nut holds it securely in hanger before installation. Knurled nut is easily removed.
- For 1/2" (15mm) and 3/4" (20mm) sizes with non-captured knurl nuts order Fig. 200S

Approvals: Underwriters Laboratories listed (1/2" (15mm) thru 8" (200mm)) in the USA **(UL)** and Canada **(cUL)** for steel and CPVC plastic pipe and Factory Mutual Engineering Approved **(FM)** (3/4" (20mm) thru 8" (200mm)). Conforms to Federal Specifications WW-H-171E & A-A-1192A, Type 10 and Manufacturers Standardization Society ANSI/MSS SP-69 & SP-58, Type 10.

Maximum Temperature: 650°F (343°C)

Finish: Pre-Galvanized. Stainless Steel materials will be supplied with (2) hex nuts in place of a knurl nut.

Order By: Part number and pipe size

**** Note:** For metric hanger rod sizes add the metric rod size to the figure number. Example: 200M8-1 1/2 or 200M10-1 1/2

A
Overall Height

B
Center of pipe to top of knurled hanger rod nut.

D
Top of pipe to bottom of hanger rod nut.

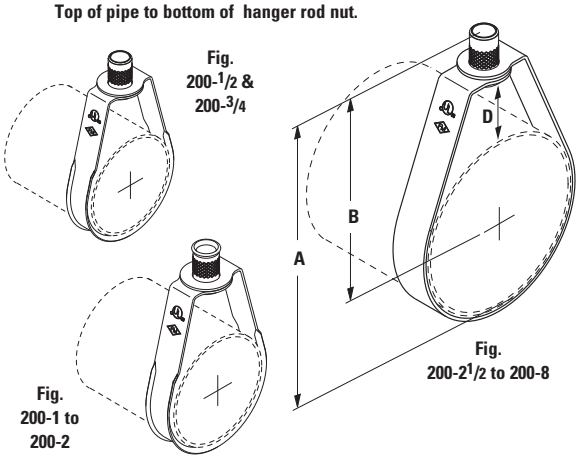


Fig. 200C
200C-1 1/2 shown

Fig. 200F
200F-1 1/2 shown

Fig. 200
shown with captured nut
1" thru 2" sizes only

Fig. 200 & Fig. 200S
shown with
non-captured nut

Part No.**	Pipe Size in.	(mm)	Rod Size in.	mm**	A in.	(mm)	B in.	(mm)	D in.	(mm)	Max. Rec. Load lbs.	(kN)	Approx. Wt./100 lbs.	(kg)
200-1/2	1/2"	(15)	3/8"-16	M8 or M10	3 1/8"	(79.4)	2 5/8"	(66.7)	1 11/32"	(34.1)	400	(1.78)	11	(5.0)
200-3/4	3/4"	(20)	3/8"-16	M8 or M10	3 1/8"	(79.4)	2 1/2"	(63.5)	1 1/16"	(27.0)	400	(1.78)	11	(5.0)
200-1	1"	(25)	3/8"-16	M8 or M10	3 3/8"	(85.7)	2 5/8"	(66.7)	1 1/8"	(28.6)	400	(1.78)	12	(5.5)
200-1 1/4	1 1/4"	(32)	3/8"-16	M8 or M10	3 3/4"	(94.0)	2 7/8"	(73.0)	1 5/32"	(29.3)	400	(1.78)	13	(5.9)
200-1 1/2	1 1/2"	(40)	3/8"-16	M8 or M10	3 7/8"	(98.4)	2 7/8"	(73.0)	1 3/16"	(30.2)	400	(1.78)	14	(6.4)
200-2	2"	(50)	3/8"-16	M8 or M10	4 1/2"	(114.3)	3"	(76.3)	1 3/16"	(30.2)	400	(1.78)	15	(6.9)
200-2 1/2	2 1/2"	(65)	3/8"-16	M10	5 5/8"	(142.9)	4 1/8"	(104.7)	1 7/16"	(36.5)	600	(2.67)	27	(12.3)
200-3	3"	(75)	3/8"-16	M10	5 7/8"	(149.1)	4"	(101.6)	1 1/4"	(31.7)	600	(2.67)	29	(13.3)
200-3 1/2	3 1/2"	(90)	3/8"-16	M10	7 3/8"	(187.3)	5 1/4"	(133.3)	2 3/16"	(55.6)	600	(2.67)	34	(15.6)
200-4	4"	(100)	3/8"-16	M10	7 3/8"	(187.3)	5"	(127.0)	1 3/8"	(34.9)	1000	(4.45)	35	(16.0)
200-5	5"	(125)	1/2"-13	M12	9 1/8"	(231.8)	6 1/4"	(158.7)	3 11/32"	(84.9)	1250	(5.56)	66	(30.2)
200-6	6"	(150)	1/2"-13	M12	10 1/8"	(257.2)	6 3/4"	(171.4)	2 7/32"	(56.3)	1250	(5.56)	73	(33.4)
200-8	8"	(200)	1/2"-13	M12	13 1/8"	(333.4)	8 3/4"	(222.2)	3 7/32"	(81.7)	1250	(5.56)	136	(62.3)

All dimensions in charts and on drawings are in inches. Dimensions shown in parentheses are in millimeters unless otherwise specified.

7. SEISMIC BRACING COMPONENTS

DRY PIPE AUTOMATIC FIRE SPRINKLER SYSTEM

TOLCO™ Fig. 980 - Universal Swivel Sway Brace Attachment - 3/8" to 3/4" (UL Listed)

OPM

Size Range: One size fits bracing pipe 1" (25mm) thru 2" (50mm), B-Line series 12 gauge (2.6mm) channel, and all structural steel up to 1/4" (31.7mm) thick.

Material: Steel

Function: Multi-functional attachment to structure or braced pipe fitting.

Features: This product's design incorporates a concentric attachment opening which is critical to the performance of structural seismic connections. NFPA 13 (2016) 9.3.5.8.4 indicates clearly that fastener table load values are based only on concentric loading. Mounts to any surface angle. Break off bolt head assures verification of proper installation.

Installation: Fig.980 is the structural or transitional attachment component of a longitudinal or lateral sway brace assembly. It is intended to be combined with the "bracing pipe" and TOLCO "braced pipe" attachment, Fig. 1000, 1001, 2002, 3000, 4L, 4LA, 4A or approved attachment to pipe to form a complete bracing assembly. NFPA 13 guidelines should be followed.

To Install: Place the Fig. 980 onto the "bracing pipe". Tighten the set bolt until the head breaks off. Attachment can pivot for adjustment to proper brace angle.

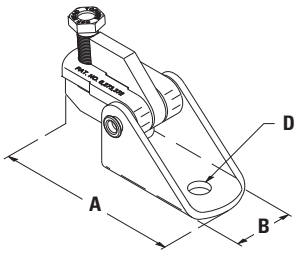
Approvals: —Underwriters Laboratories Listed in the USA **(UL)** and Canada **(cUL)**. Included in our Seismic Engineering Guidelines approved by the State of California Office of Statewide Health Planning and Development **(OSHPD)**. For additional load, spacing and placement information relating to OSHPD projects, please refer to our Seismic Engineering Guidelines, OPM-0052-13.
For FM Approval information refer to FM Approved page 61.

Note: Fig. 980 Swivel Attachment and Fig. 1001, 1000, 2002, 4A, 4L, 4LA, or approved attachment to pipe that make up a sway brace system of UL Listed attachments and bracing materials which satisfies the requirements of Underwriters Laboratories and the National Fire Protection Association **(NFPA)**

Finish: Plain, Electro-Galvanized or Stainless Steel. Contact customer service for alternative finishes.

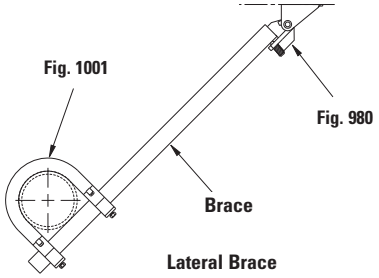
Order By: Figure number and finish.

Pat. #6,273,372, Pat. #6,517,030, Pat. #6,953,174, Pat. #6,708,930, Pat. #7,191,987, Pat. #7,441,730, Pat. #7,669,806

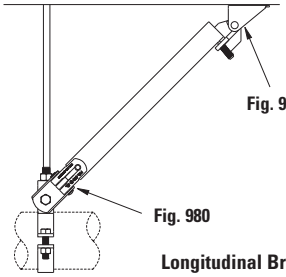


Set Bolt Included

Mounting Hardware Is Not Included



Lateral Brace



Longitudinal Brace

Fig. 4B shown

Part Number	Mtg. Hdw. Size in.	(mm)	A in.	(mm)	B in.	(mm)	Mounting Hole D in.	(mm)	Max. Design Load (cULus) in.	(mm)	Approx. Wt./100 lbs.	(kg)
980-3/8	3/8"	(9.5)	5 1/4"	(133.3)	1 7/8"	(47.6)	13/32"	(10.3)	2015	(8.96)	149	(67.6)
980-1/2 *	1/2"	(12.7)	5 1/4"	(133.3)	1 7/8"	(47.6)	17/32"	(13.5)	2015	(8.96)	148	(67.1)
980-5/8	5/8"	(15.9)	5 1/4"	(133.3)	1 7/8"	(47.6)	11/16"	(17.5)	2015	(8.96)	147	(66.7)
980-3/4	3/4"	(19.0)	5 1/4"	(133.3)	1 7/8"	(47.6)	13/16"	(20.5)	2015	(8.96)	146	(66.2)

* Standard size.

Important! - For load information when using Fig. 980 with pre-installed or post-installed concrete anchors in compliance with NFPA 13 (2016) or ASCE 7-10, including prying factors, see load tables on pages AL-1 thru AL-21.

Eaton's B-Line series seismic bracing components are designed to be compatible only with other B-Line series bracing components, resulting in a listed seismic bracing assembly. Eaton B-Line Division warranty for seismic bracing components will be the warranty provided in Eaton B-Line Division standard terms and conditions of sale made available by Eaton, except that, in addition to the other exclusions from Eaton B-Line Division warranty, Eaton makes no warranty relating to B-Line series seismic bracing components that are combined with products not provided by Eaton.

All dimensions in charts and on drawings are in inches. Dimensions shown in parentheses are in millimeters unless otherwise specified.

TOLCO™ Fig. 1001 - Sway Brace Attachment (UL Listed)

OPM

Size Range: Pipe size to be braced: 1" (25mm) thru 8" (200mm) IPS.
Pipe size used for bracing: 1" (25mm) and 1¼" (32mm) Schedule 40 IPS.

Material: Steel

Function: For bracing pipe against sway and seismic disturbance. The pipe attachment component of a sway brace system: Fig. 1001 is used in conjunction with a Fig. 900 Series fitting and joined together with bracing pipe per NFPA 13, forming a complete sway brace assembly.

Features: Can be used to brace schedule 7 through schedule 40 IPS. Field adjustable, making critical pre-engineering of bracing pipe length unnecessary. Unique design requires no threading of bracing pipe. Comes assembled and ready for installation. Fig. 1001 has built-in visual verification of correct installation. See installation note below.

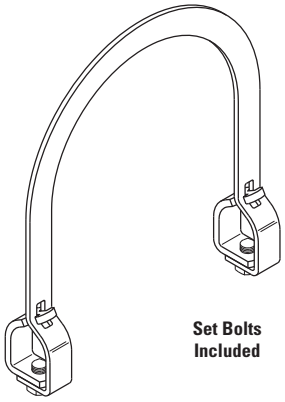
Installation Note: Position Fig. 1001 over the pipe to be braced and tighten two hex head cone point set bolts until heads bottom out. A minimum of 1" (25mm) pipe extension is recommended. Brace pipe can be installed on top or bottom of pipe to be braced.

Approvals: Underwriters Laboratories Listed in the USA **(UL)** and Canada **(cUL)**. Included in our Seismic Engineering Guidelines approved by the State of California Office of Statewide Health Planning and Development **(OSHPD)**. For additional load, spacing and placement information relating to OSHPD projects, please refer to our Seismic Engineering Guidelines, OPM-0052-13.
For FM Approval information refer to FM Approved page 67.

Finish: Plain or Electro-Galvanized. Contact customer service for alternative finishes and materials.

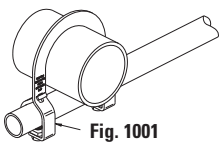
Order By: Order by figure number, pipe size to be braced, followed by pipe size used for bracing (1" (25mm) or 1¼" (32mm)), and finish.

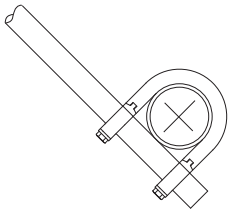
Important Note: Fig. 1001 is precision manufactured to perform its function as a critical component of a complete bracing assembly. To ensure performance, the UL Listing requires that Fig. 1001 must be used only with other TOLCO bracing products.

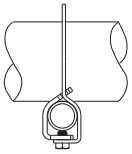


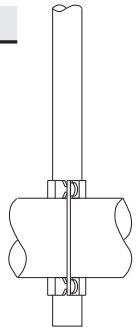
Pipe Size	Part Number & Approx. Wt./100				Design Load - Lbs. For Brace Pipe Size 1" / 1¼"		
	1" (24mm) Brace Pipe		1¼" (32mm) Brace Pipe		Sch. 7	Sch. 10	Sch. 40
in. (mm)		Lbs. (kg)		Lbs. (kg)	1" / 1¼"	1" / 1¼"	1" / 1¼"
1" (25)	**1001-1 X 1**	100.0 (45.3)	**1001-1 X 1¼**	118.0 (53.5)	-- / --	1000 / 1000	1000 / 1000
1¼" (32)	**1001-1¼ X 1**	100.0 (45.3)	**1001-1¼ X 1¼**	114.0 (51.7)	1000 / 1000	1000 / 1000	1000 / 1000
1½" (40)	**1001-1½ X 1**	100.0 (45.3)	**1001-1½ X 1¼**	115.0 (52.1)	1000 / 1000	1500 / 1500	1500 / 1500
2" (50)	**1001-2 X 1**	108.0 (49.0)	**1001-2 X 1¼**	121.0 (54.8)	1000 / 1000	2015 / 2015	2015 / 2015
2½" (65)	**1001-2½ X 1**	138.6 (62.8)	**1001-2½ X 1¼**	160.4 (72.7)	1600 / 1600	2015 / 2765	2015 / 2765
3" (80)	**1001-3 X 1**	147.2 (66.7)	**1001-3 X 1¼**	168.7 (76,5)	1600 / 1600	2015 / 2765	2015 / 2765
4" (100)	**1001-4 X 1**	160.9 (73.0)	**1001-4 X 1¼**	182.4 (82.7)	1600 / 1600	2015 / 2765	2015 / 2765
6" (150)	**1001-6 X 1**	190.0 (86.2)	**1001-6 X 1¼**	211.4 (95.9)	1600 / 1600	2015 / 2765	2015 / 2765
8" (200)	**1001-8 X 1**	217.4 (98.6)	**1001-8 X 1¼**	238.8 (108.3)	1600 / 1600	2015 / 2765	2015 / 2765

Note: Metric sizes are available, contact factory.









All dimensions in charts and on drawings are in inches. Dimensions shown in parentheses are in millimeters unless otherwise specified.

TOLCO™ Fig. 4L - Longitudinal In-Line Sway Brace Attachment (UL Listed)

OPM

Size Range: 2" (50mm) through 8" (200mm) IPS.

Material: Steel

Function: For bracing pipe against sway and seismic disturbance.

Approvals: Underwriters Laboratories Listed in the USA **(UL)** and Canada **(cUL)** 2 1/2" (65mm) through 8" (200mm) pipe.
For FM Approval information refer to FM Approved page 75.
Included in our Seismic Engineering Guidelines approved by the State of California Office of Statewide Health Planning and Development **(OSHPD)**. For additional load, spacing and placement information relating to OSHPD projects, please refer to our Seismic Engineering Guidelines, OPM-0052-13.

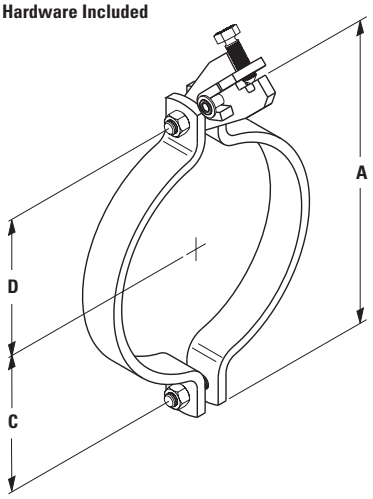
Installation Instructions: Fig. 4L is the "braced pipe" attachment component of a longitudinal sway brace assembly. It is intended to be combined with the "bracing pipe" and TOLCO structural attachment component to form a complete bracing assembly. NFPA 13 guidelines should be followed.

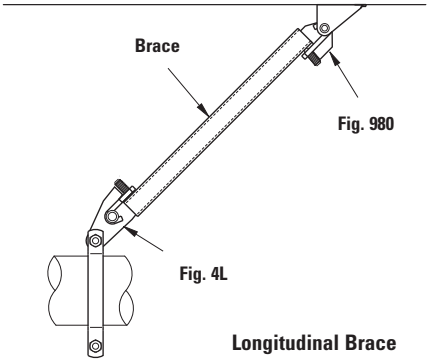
To Install: Place the Fig. 4L over the pipe to be braced and tighten bolts. Then engage "bracing pipe" into jaw opening and tighten set bolt until head snaps off. Jaw attachment can pivot for adjustment to proper brace angle.

Finish: Plain. Contact customer service for alternative finishes and materials.

Order By: Figure number, pipe size and finish.

Set Bolt & Hardware Included





Longitudinal Brace

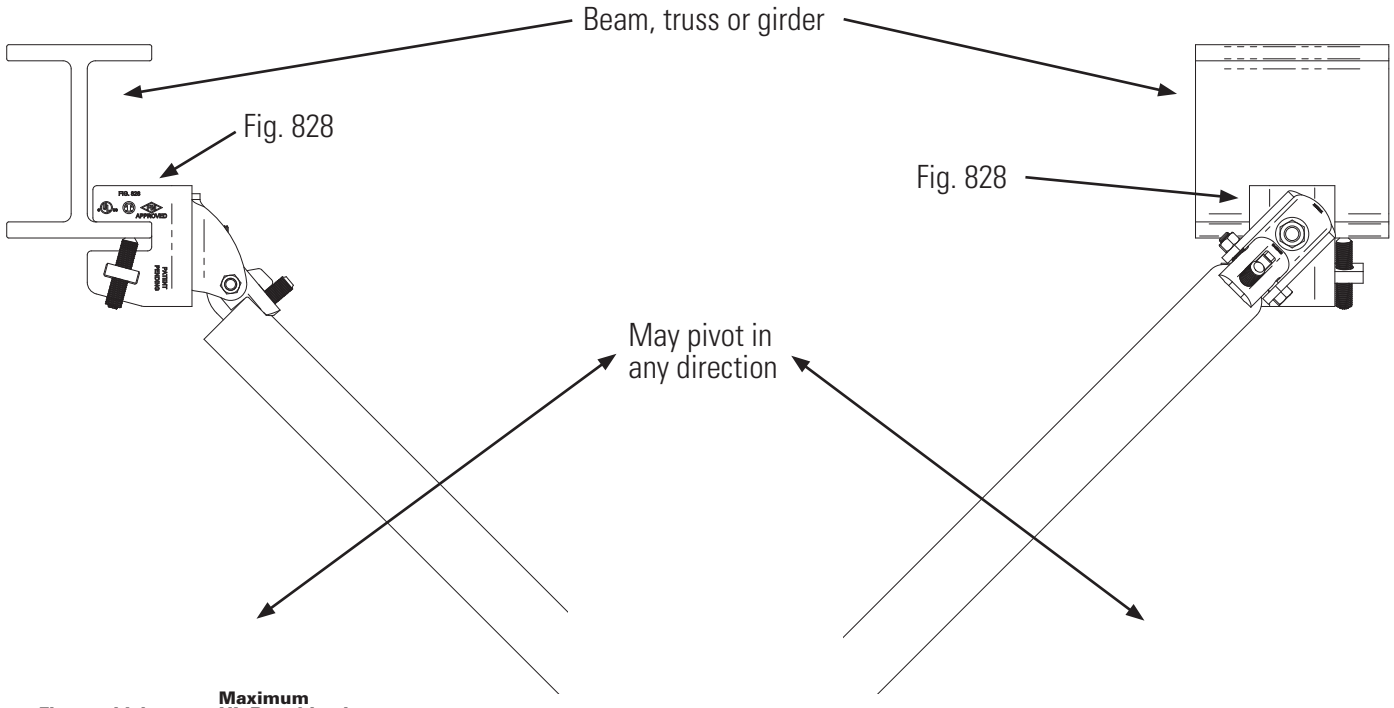
Part No.	Pipe Size in.	(mm)	A in.	(mm)	C in.	(mm)	D in.	(mm)	Bolt Size	Max. Rec. Load (cULus) lbs.	(kN)	Approx. Wt./100 lbs.	(kg)
4L-2	2"	(50)	5 3/8"	(136.5)	2 1/16"	(52.4)	2 1/16"	(52.4)	1/2"-13	2015	(8.96)	243	(110.2)
4L-2 1/2	2 1/2"	(65)	6 7/16"	(163.5)	2 1/2"	(63.5)	2 3/4"	(69.8)	1/2"-13	2015	(8.96)	253	(114.7)
4L-3	3"	(80)	7"	(177.8)	2 3/4"	(69.8)	3 1/16"	(77.8)	1/2"-13	2015	(8.96)	268	(121.5)
4L-4	4"	(100)	8 1/2"	(215.9)	3 3/8"	(85.7)	3 11/16"	(93.7)	1/2"-13	2015	(8.96)	348	(157.8)
4L-5	5"	(125)	9 3/4"	(247.6)	3 7/8"	(98.4)	4 3/8"	(111.1)	1/2"-13	2015	(8.96)	380	(172.3)
4L-6	6"	(150)	11 1/2"	(292.1)	5"	(127.0)	5 1/8"	(130.2)	1/2"-13	2015	(8.96)	640	(290.3)
4L-8	8"	(200)	13 1/4"	(336.5)	5 5/8"	(142.8)	5 5/8"	(142.9)	1/2"-13	2015	(8.96)	728	(330.2)

Eaton's B-Line series seismic bracing components are designed to be compatible only with other B-Line series bracing components, resulting in a listed seismic bracing assembly. Eaton B-Line Division warranty for seismic bracing components will be the warranty provided in Eaton B-Line Division standard terms and conditions of sale made available by Eaton, except that, in addition to the other exclusions from Eaton B-Line Division warranty, Eaton makes no warranty relating to B-Line series seismic bracing components that are combined with products not provided by Eaton.

All dimensions in charts and on drawings are in inches. Dimensions shown in parentheses are in millimeters unless otherwise specified.

Fig. 828 – TOLCO universal sway brace attachment

Function: To attach sway bracing to various types of steel structural members that have a flange thickness between 3/8" and 7/8". The Fig. 828 is the structural attachment component of a longitudinal or lateral swaybrace assembly. It is intended to be combined with a TOLCO™ transitional attachment, "bracing pipe" sized in accordance with the transitional attachment instruction sheet, and a TOLCO "braced pipe" attachment to form a complete bracing assembly. Sway brace assemblies are intended to be installed in accordance with NFPA 13 and the manufacturer's installation instructions.



Flange thickness	Maximum UL Rated load
3/8"	1090 lbs
½" – 7/8"	1300 lbs

c UL us LISTED

FM APPROVED

Installation Instructions: Slide the Fig. 828 on the flange of the beam, truss, or girder. Be sure the attachment is fully engaged to the rear of the opening. Tighten the cone point set screws until the heads break off. Remove the flange nut from the carriage bolt. Install a TOLCO swivel fitting (Fig, 909, 910, 980, *986). Use flange nut to secure the swivel fitting.

*Not UL listed when used in combination with Fig. 986

Powering Business Worldwide

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

13201 Dahlia Street, Suite 200
Fontana, CA 92337
United States
Phone: 800-851-7415

Printed in USA
Publication No. IL309003EN
September 2020 B-Line Division