FIRE PROTECTION SYSTEM

Volume V

Operations & Maintenance Manual

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Operations & Maintenance

EJMT FFSS Design Build Project
Project No. C 0703-360, Subaccount 17810

Prepared by:
John Hulett
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8 June 2015

FORWARD

OPERATIONS AND MAINTENANCE MANUAL

There are very few moving parts on the fixed fire suppression systems (FFSS) for the EJMT project. It is only the parts that move that require exercise and maintenance. For example we recommend every valve be opened and closed annually to ensure operation and to exercise the mechanism. This applies to all isolation valves, control valves, and solenoid valves.

The fire pump requires the most exercise with a recommended 10 minutes of operation monthly. While the pump is running is a good time to check the valves which are labeled to ensure they are in their normal positions. While the pump is running listen for strange sound that could indicate a problem,

By far the most important maintenance of the system is ensuring the water does not freeze within the system piping and valves. During the colder months, which is most of the year care should be taken to keep the warm water circulating and insulated. If the pipe insulation becomes damaged, it should be repaired immediately. The doors for the insulated valve enclosures should remain in the closed position and the integrity of the enclosure should be maintained.

Before temperatures drop below 40° the closed loop system shall be circulating warm water. The warm water is required to ensure the smaller pipe within the valve enclosures do not freeze.

Inspections and testing are a very important portion of maintaining the life safety system but this information is found within the commissioning plan.

In summary, become familiar with how the system operates and the rest of this manual to ensure when the time comes the system functions as intended.

EJMT SYSTEMS NARRATIVE

THE FIXED FIRE SUPPRESSION SYSTEM (FFSS) IS SUPPLIED BY THE EXISTING WATER STORAGE TANK FED FROM STRAIGHT CREEK, NORTH OF THE WEST PORTAL. A NEW 10-IN UNDERGROUND PIPE WILL BE INSTALLED FROM THE EXISTING TANK TO WITHIN CLOSE PROXIMITY OF THE PORTAL WHERE THE EXISTING 8-IN DOMESTIC AND STANDPIPE IS SUPPLIED. THE LINE WILL TEE INTO THE EXISTING AT THIS POINT AND REDUCE DOWN TO 8-IN TO SUPPLY THE NEW 1,250 GPM ELECTRIC FIRE PUMP LOCATED IN THE WEST VENTILATION BUILDING.

THE WATER SUPPLY TO THE FIRE PUMP WAS HYDRAULICALLY CALCULATED. THIS CALCULATION ASSUMES THE WORST CASE SCENARIO WITH THE TANK EMPTY. THE ADDITIONAL 5 PSI STATIC PRESSURE AVAILABLE WHEN THE TANK IS FULL WAS NOT UTILIZED. THE ADJUSTED WATER SUPPLY TO THE FIRE PUMP SUCTION FLANGE IS 56.9 PSI STATIC PRESSURE WITH 49.6 PSI AT 1,250 GPM. THIS ADJUSTMENT INCLUDES THE ADDITIONAL 500 GPM HOSE ALLOWANCE FOR THE EXISTING STANDPIPE SYSTEM. THE TOTAL FLOW FOR THIS CALCULATION IS 1,750 GPM.

THE 115 PSI @ 1,250 GPM FIRE PUMP IS SIZED TO PROVIDE THE REQUIRED PRESSURE AND FLOW FOR ANY TWO DELUGE SYSTEMS FLOWING AT THE SAME TIME. THE MOST DEMANDING SYSTEM IS THE EISENHOWER 3 NOZZLE SYSTEM WITH A FLOW OF 1,264.7 GPM. ALL DELUGE SYSTEM HYDRAULIC CALCULATIONS PROVIDE AT LEAST A 10% PRESSURE SAFETY FACTOR TO ALLOW FOR MINOR INSTALLATION CHANGES.

THE FIRE PUMP ASSEMBLY WILL BE PROVIDED WITH BOTH A FLOW METER AND A TEST HEADER. THE FLOW METER ALLOWS TESTING THE PERFORMANCE OF THE FIRE PUMP BY FLOWING WATER BACK TO THE PUMP SUCTION. THE TEST HEADER IS REQUIRED FOR THE ACCEPTANCE TEST AND TO VERIFY THE WATER SUPPLY FROM THE TANK EVERY 5 YEARS. THE FLOW METER CAN BE USED 4 OUT OF 5 YEARS WITH THE BENEFIT OF NOT FLOWING AND WASTING WATER OUTSIDE THE BUILDING FROM THE TEST HEADER.

A NEW WALL HYDRANT WILL BE PROVIDED CLOSE TO A NEW FIRE DEPARTMENT CONNECTION (FDC) AT THE NORTHWEST CORNER OF THE WEST VENTILATION BUILDING. THE WALL HYDRANT CAN SUPPLY A FIRE PUMPER TRUCK THAT CAN SUPPLEMENT THE WATER PRESSURE WITHIN THE FFSS THROUGH THE FDC. THE WALL HYDRANT WILL ALSO SERVE AS THE PUMP TEST HEADER WHEN REQUIRED. AN FDC WILL NOT BE PROVIDED AT THE EAST VENTILATION BUILDING BECAUSE THERE IS NO WATER SUPPLY FROM WHICH A PUMP TRUCK COULD DRAW TO SUPPLY ADDITIONAL WATER TO THE FFSS. JUST TO CLARIFY, A FIRE PUMPER TRUCK IS NOT REQUIRED FOR THE OPERATION OF THE SYSTEM BUT A RESPONDING FIRE DEPARTMENT COULD ASSIST IN THE EVENT OF A FIRE BY SUPPLEMENTING OR REPLACING THE FIRE PUMP.

DURING WINTER MONTHS A WATER TRUCK MAY NOT BE ABLE TO ACCESS THE WATER TANK FOR RE-SUPPLY. AN ARRANGEMENT OF VALVES WITH A BYPASS THAT IS NORMALLY CLOSED WILL BE PROVIDED TO ALLOW A WATER TRUCK LOCATED

BELOW AT THE NORTHWEST VENTILATION BUILDING TO FILL THE WATER SUPPLY TANK UTILIZING THE FIRE PUMP.

IN THE EVENT OF A POWER OUTAGE, THE FIRE PUMP CONTROLLER IS EQUIPPED WITH AN AUTOMATIC TRANSFER SWITCH TO ALLOW OPERATION FROM THE EMERGENCY GENERATOR. ADDITIONALLY THE FIRE PUMP CONTROLLER IS OF THE SOFT START TYPE TO REDUCE THE INRUSH DEMAND ON THE EMERGENCY GENERATOR.

THERE ARE 183 DELUGE SYSTEMS PROVIDING COVERAGE OVER THE TUNNEL ROADWAY. THERE ARE 90 SYSTEMS IN THE EISENHOWER TUNNEL AND 93 SYSTEMS IN THE JOHNSON TUNNEL. THREE (3) OF THE DELUGE VALVES ARE LOCATED WITHIN THE FIRE PUMP ROOM. THE REMAINDERS OF THE DELUGE VALVES ARE LOCATED ON THE 6-IN. X 18,100 FT. LOOP LOCATED WITHIN THE SUPPLY PLENUMS AND THE FAN DECK OF THE VENTILATION BUILDINGS. THE CAPACITY OF THE 6-IN. LOOP IS APPROXIMATELY 30,000 GALLONS.

TEN (10) 6-IN. ISOLATION VALVES WILL BE PROVIDED ON THE 6-IN X 18,100 FT. LOOP. THESE VALVES WILL ALLOW SYSTEM REPAIRS IF REQUIRED TO OCCUR WITHOUT DRAINING THE ENTIRE SYSTEM. EACH OF THESE VALVES WILL HAVE A TAMPERS SWITCH. IN THE EVENT A VALVE IS CLOSED, A TROUBLE SIGNAL WILL BE DISPLAYED AT THE FIRE CONTROL PANEL (FCP).

BOILERS, EXPANSION TANKS, AND CIRCULATION PUMPS WILL BE PROVIDED WITHIN THE FIRE PUMP ROOM TO HEAT THE 6-IN. LOOP PIPING. THE SYSTEM HEAT WILL PROVIDE PROTECTION OF THE ZONE DELUGE VALVES LOCATED WITHIN INSULATED VALVE ENCLOSURE (IVE) CABINETS INSTALLED AROUND EACH ZONE VALVE IN THE PLENUM. THE VALVE ENCLOSURE WILL BE HEATED BY CONVECTIVE HEAT TRANSFER FROM THE CIRCULATING HOT WATER IN THE 6-IN. WET SUPPLY LOOP. THE HEATED WATER WILL BE DIRECTED EAST THRU THE SUPPLY PLENUM OF THE EISENHOWER TUNNEL WHERE IT WILL CROSS THROUGH THE EAST VENTILATION BUILDING ON THE FAN DECK AND RETURN WEST WITHIN THE SUPPLY PLENUM OF THE JOHNSON TUNNEL.

IN THE EVENT OF A FIRE, THE WATER SUPPLY TO THE DELUGE SYSTEMS CAN THEN TRAVEL EAST THRU BOTH SUPPLY PLENUMS TO THE ACTIVATED DELUGE SYSTEM ALLOWING WATER TO DISCHARGE FROM THE NOZZLES.

THERE ARE FOUR DIFFERENT TYPES OF DELUGE SYSTEMS WITHIN THE PROJECT. EACH SYSTEM IS DESIGNED TO PROVIDE AT LEAST 0.16 GALLONS PER SQUARE FOOT OVER THE ROADWAY WHILE TWO SYSTEMS ARE FLOWING. THE HYDRAULIC CALCULATIONS PROVIDED ARE FOR THE MOST DEMANDING AREA FOR EACH SYSTEM TYPE. THE LOCATION WAS DETERMINED BY CHANGING THE HYDRAULIC LOCATION UNTIL THE MOST DEMANDING CONDITION WAS FOUND.

THE DIFFERENCES BETWEEN EACH OF THE SYSTEM TYPES INCLUDE THE SIZE, NOZZLE TYPE, SPACING, PRESSURE, AND FLOW. EACH SYSTEM IS SIMILAR IN THAT IT PROVIDES THE DENSITY OF 0.16 GALLONS PER SQUARE FOOT. ALL OF THE DELUGE SYSTEMS WILL HAVE A MANUAL ISOLATION VALVE WITH A TAMPER SWITCH. IN THE EVENT A VALVE IS CLOSED, A TROUBLE SIGNAL WILL BE DISPLAYED AT THE FIRE

CONTROL PANEL (FCP). IN THE EVENT A DELUGE SYSTEM IS ACTUATED, A PRESSURE SWITCH WILL INDICATE AN ALARM AT THE FCP.

THE DELUGE VALVE ASSEMBLIES ARE LOCATED APPROXIMATELY EVERY 100 FEET IN THE EISENHOWER SUPPLY PLENUM AND 96 FEET IN THE JOHNSON SUPPLY PLENUM. EACH DELUGE SYSTEM IS CONTROLLED BY A 4-IN. FLOW CONTROL VALVE. THIS VALVE IS HELD IN THE CLOSED POSITION BY A SMALL PRIME LINE. THE UPSTREAM SYSTEM WATER PRESSURE HOLDS THE VALVE CLOSED AND WHEN A SOLENOID VALVE IS OPENED BY A 24 VOLT CURRENT FROM THE FCP. THE FLOW CONTROL VALVE WILL OPEN. WHEN THE SOLENOID VALVE IS CLOSED, THE VALVE WILL CLOSE. ADDITIONALLY, THE FLOW CONTROL VALVE CAN OPERATE LIKE A PRESSURE REDUCING VALVE ALLOWING FOR ADJUSTMENT OF THE DOWNSTREAM PRESSURE. WITH THIS FEATURE, A HIGHER UPSTREAM PRESSURE WILL NOT OVER FLOW WHICH WOULD EFFECTIVELY REDUCE THE MINIMUM WATER SUPPLY DURATION OF ONE HOUR.

A 4-IN. CROSS MAIN WILL SUPPLY THE BRANCH LINES THAT SUPPLY THE ASSORTED NOZZLES. THE 4-IN. CROSS MAIN WILL NEED TO PENETRATE THE PLENUM WALL FOR EACH TUNNEL SYSTEM TO ALLOW ACCESS TO THE EXHAUST PLENUM VENTS. WITH EACH DELUGE SYSTEM LOCATED BELOW THE VALVE ASSEMBLY ALL CROSS MAINS AND BRANCH LINES WILL BE REQUIRED TO DRAIN AUTOMATICALLY TO AVOID TRAPPED WATER THAT COULD FREEZE WITHIN THE PIPE. THE BRANCH LINE PIPE WILL AUTOMATICALLY DRAIN FROM NOZZLES. THE CROSS MAIN WILL REQUIRE A ½-IN BALL DRIP THAT WILL AUTOMATICALLY DRAIN TO THE PLENUM FLOOR. THE BALL DRIP WILL AUTOMATICALLY OPEN AFTER THE SYSTEM IS SHUT DOWN AND THE PIPE IS NO LONGER PRESSURIZED.

THE EISENHOWER TUNNEL HAS TWO TYPES OF DELUGE SYSTEMS. BOTH SYSTEMS HAVE THE SAME LARGE BETE NOZZLES WILL THE DIFFERENCE BEING THREE (3) NOZZLES VERSES (4) NOZZLES. THE THREE NOZZLE SYSTEM REQUIRES MORE PRESSURE AT EACH NOZZLE TO PROVIDE THE 0.16 GALLONS PER SQUARE FOOT TO THE ROADWAY BELOW. THE LOCATION OF THE NOZZLES IS DETERMINED BY THE EXISTING PLENUM VENTS WITHIN THE EXHAUST PLENUM.

THE JOHNSON TUNNEL DELUGE SYSTEMS UTILIZE TWELVE (12) SMALLER BETE NOZZLES TO PROVIDE THE 0.16 GALLONS PER SQUARE FOOT TO THE ROADWAY BELOW. THE LOCATION OF THE NOZZLES IS DETERMINED BY THE EXISTING VENTS WITHIN THE SUPPLY AND EXHAUST PLENUM.

THE VENTILATION BUILDING DELUGE SYSTEMS UTILIZE TWELVE (12) HORIZONTAL SIDEWALL SPRINKLERS AS NOZZLES TO PROVIDE THE 0.16 GALLONS PER SQUARE FOOT TO THE ROADWAY BELOW. THE BRANCH LINES SUPPLYING THE NOZZLES AT THE PORTALS WILL BE EXPOSED ON THE WALL JUST BELOW THE LIGHTS. TO ADDRESS CONCERNS REGARDING CORROSION FROM ANTI-ICE SPRAY THAT CAN BECOME AIRBORNE FROM THE ROADWAY AT THE VENTILATION BUILDINGS, WE ARE PROVIDING GALVANIZED PIPE FOR THE BRANCH LINES AND NOZZLES WITH A CORROSION RESISTANT COATING.

CUSTOM BRACKETS AND TRAPEZE SUPPORTS WILL BE PROVIDED WITHIN THE SUPPLY PLENUM TO SUPPORT THE 6-IN. LOOP PIPING. THESE SUPPORTS WILL BE LOCATED AT A MAXIMUM OF 12.5 FT. ON CENTER. THE ENTIRE 6-IN. LOOP PIPING WILL

BE PROVIDED WITH 1-½-IN FIBERGLASS INSULATION WITH A K-VALUE OF 0.23. ADDITIONALLY, RIGID 1-½-IN INSULATED PIPE SUPPORTS WILL BE PROVIDED FOR ALL HANGERS AND SUPPORTS.

THE VALVE ASSEMBLY FOR EACH DELUGE SYSTEM WILL BE INSIDE AN AIR TIGHT IVE. THE IVE'S ARE PROVIDED WITH 3-IN RIGID INSULATION WITH AN R-VALUE OF 18. THE IVE'S WILL HAVE AN ACCESS DOOR ALLOWING FOR EASE OF INSPECTION, TESTING, AND MAINTENANCE.

THE 6-IN. LOOP PIPING AND ITS SUPPLY WILL BE SEISMICALLY BRACED. CALCULATIONS ARE PROVIDED WITHIN THE DRAWINGS FOR THE MOST DEMANDING LONGITUDINAL AND LATERAL BRACE REQUIREMENTS. LONGITUDINAL BRACES WILL BE PROVIDED AT 100 FT. MAXIMUM DISTANCES WITHIN THE SUPPLY PLENUM AND WILL BE LOCATED AS CLOSE AS POSSIBLE TO THE VALVE ASSEMBLIES. EACH OF THE CUSTOM BRACKETS AND TRAPEZE SUPPORTS WITHIN THE PLENUM SERVE AS LATERAL BRACES AT 12.5 FT. MAXIMUM ON CENTER. THE LOOP AND SUPPLY PIPING WITHIN THE PORTALS WILL BE BRACED BY STANDARD METHODS WITH LONGITUDINAL BRACES AT 80 FT. MAXIMUM AND LATERAL BRACES AT 40 FT. MAXIMUM AND LOCATED WITHIN 1 FT. IN A CHANGE OF DIRECTION. ALL RISERS OR VERTICAL PIPING WILL BE PROVIDED WITH FOUR-WAY BRACING IN ACCORDANCE WITH NFPA-13.

A 4-IN. PRESSURE RELIEF VALVE WILL BE PROVIDED AT THE SOUTHEAST VENTILATION BUILDING TO PROVIDE PROTECTION OF SYSTEM COMPONENTS FROM THE POTENTIAL OF WATER HAMMERS THAT MAY OCCUR. WATER HAMMER IS USED TO DESCRIBE A PRESSURE SURGE THAT IS CAUSED WHEN A FLUID IS FORCED TO STOP OR CHANGE DIRECTION SUDDENLY. THE POTENTIAL FOR WATER HAMMER EXIST WHEN A DELUGE VALVE IS CLOSED.

EACH TUNNEL, AND THEIR RESPECTIVE AIR PLENUMS, CURVE NORTH AND SOUTH THROUGH THE MOUNTAIN AND CHANGE IN ELEVATION INCREASING FROM EAST TO WEST. THE CURVATURE OF THE TUNNELS OCCURS SLIGHTLY OVER A LARGE DISTANCE MAKING THE INSTALLATION OF ADDITIONAL FITTINGS AND SWING JOINTS UNNECESSARY. THE DEFLECTION IS MINIMAL BUT MUST BE ADDRESSED.

IN ADDITION, THE AIR PLENUMS ARE SUBJECT TO FREEZING TEMPERATURES IN THE WINTER MONTHS. TO PREVENT THE WATER IN THE PIPE FROM FREEZING, HOT WATER STARTING AT 100°F WITH A MAXIMUM DESIGN BOILER TEMPERATURE OF 130°F, WILL BE CIRCULATED THROUGH THE 6-IN. MAIN SUPPLY LOOP. MAIN PIPING WILL BE INSTALLED WHEN TEMPERATURES HAVE THE POTENTIAL TO BE -30°F. THE WORST CASE TEMPERATURE CHANGE WAS CALCULATED TO BE FROM -30°F TO 130°F. DUE TO DRASTIC CHANGES IN TEMPERATURE, THE 6-IN. PIPE WILL EXPAND AND CONTRACT. WHEN THE PIPE IS TO BE INSTALLED DURING THE COLD WEATHER SEASONS OR WHEN COLD WATER FROM THE STORAGE TANK IS INTRODUCED INTO THE PIPE DURING A FIRE OR TESTING SITUATION, THE STEEL PIPE WILL SHRINK. WHEN THE HOT WATER IS CIRCULATED THROUGH THE PIPE, THE STEEL PIPE WILL EXPAND. THE EXPANSION FROM THE CHANGE IN TEMPERATURE WILL CAUSE A PARALLEL DEFLECTION THAT IS ADDRESSED IN THIS DESIGN.

TO ACCOMMODATE CHANGES IN THE PIPE LENGTH AND DIRECTION, EXPANSION AND DEFLECTION WILL BE ADDRESSED CONTINUALLY FOR EVERY STICK OF PIPE ALONG

THE ENTIRE LENGTH OF THE TUNNEL BY USING VICTAULIC STYLE 75 FLEXIBLE COUPLINGS AND VICTAULIC STYLE 155 EXPANSION JOINT 6-IN. NIPPLES. THROUGH PRODUCT DATA AS WELL AS EXPANSION AND DEFLECTION CALCULATIONS FOR A 25 FT. SECTION OF PIPE, A SOLUTION WAS DETERMINED TO PROVIDE EXPANSION JOINTS TO ACCOMMODATE THE EXPANSION AND DEFLECTION WITHIN EACH 25 FT. SECTION OF PIPE.

EXPANSION JOINTS SHALL BE INSTALLED AT EACH END OF PIPE APPROXIMATELY EVERY 25 FT. AN EXPANSION JOINT WILL CONSIST OF (2) STYLE 75 COUPLINGS WITH (1) STYLE 155 6-IN. SCHEDULE 40 NIPPLE, 4 INCHES IN LENGTH BETWEEN THE COUPLINGS. EACH EXPANSION JOINT WILL BE INSTALLED IN COLD WEATHER CONDITIONS, THUS EACH COUPLING SHALL BE INSTALLED TO SEPARATE THE TWO ENDS OF THE PIPE TO ALLOW FOR MAXIMUM POSSIBLE SEPARATION. WHEN THE PIPE EXPANDS DUE TO HOT WATER, THERE WILL BE ZERO DEFLECTION BETWEEN EACH PIECE OF PIPE. THE EXPANSION JOINT WILL PROVIDE 0.346-IN. OF EXPANSION WHICH EXCEEDS THE REQUIRED THERMAL EXPANSION LENGTH OF 0.3216-IN.

WHEN ANGULAR DEFLECTION IS REQUIRED, AN ADDITIONAL COUPLING AND NIPPLE SHALL BE ADDED TO ACCOMMODATE THE ANGULAR DEFLECTION BETWEEN THE COUPLINGS THAT ARE PROVIDED FOR THE EXPANSION JOINT. THIS COUPLING WILL NOT BE ABLE TO DEFLECT IN THE PARALLEL DIRECTION AND WILL NOT BE USED AS AN EXPANSION COUPLING.

IN ADDITION, TWO BRACKETS SHALL BE PROVIDED FOR EACH 25 FT. LENGTH OF PIPE. THE WEST BRACKET SHALL BE BRACED TO ALLOW FOR ZERO DEFLECTION AND THE EAST BRACKET SHALL BE INSTALLED UNBRACED TO ALLOW FOR DEFLECTION BETWEEN EACH 25 FT. STICK OF PIPE. LONGITUDINAL BRACE SHALL BE INSTALLED WITH THE BRACED SUPPORT EVERY 100 FT. TO LIMIT MOVEMENT AT THE DELUGE VALVE ASSEMBLIES.

Western States
Fire Protection Co.

Protecting Lives and Property

7026 S. Tucson Way
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(303) 792-0022   Fax (303) 792-9049

Maintenance Plan

EJMT FFSS Design Build Project
Project No. C 0703-360, Subaccount 17810

Prepared by:
John Hulett
Project Manager
9 November 2015

MAINTENANCE PLAN

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The fire pump requires the most exercise with a recommended 10 minutes of operation monthly. While the pump is running, this is a good time to inspect the valves which are labeled to ensure they are in their normal positions. While the pump is running listen for strange sound that could indicate a problem,

By far the most important maintenance of the system is ensuring the water does not freeze within the system piping and valves. During the colder months, which is most of the year care should be taken to keep the warm water circulating and insulated. If the pipe insulation becomes damaged, it should be repaired immediately. The doors for the insulated valve enclosures should remain in the closed position so the integrity of the heated enclosure is maintained.

Before temperatures drop below 40° the closed loop system shall be circulating warm water. The warm water is required to ensure the smaller pipe within the valve enclosures do not freeze.

We recommend CDOT walk the supply plenum's weekly visually observing water coming into the plenum that can form ice on the life safety system.

Inspections and testing is a very important portion of maintaining the life safety system. This information can be found within the commissioning plan.

In summary, please become familiar with how the system operates. With proper inspections, testing, and maintenance the life safety systems will function as intended.

Monthly Fire Pump Run

SCOPE OF WORK

- Take The Fire Alarms off Line with proper authority.
- Disable any Horns and Strobes in buildings.
- Upon entering pump room check all gauges to make sure they are up to full pressure, Record PSI.
- Check to insure that the supply valves on the jockey pump and fire pump are open.
- Check to insure that the discharge valve on the jockey pump is open, and then remove the plug from the bottom of the sensing line. Allow a slight discharge of water until the Jockey Pump activates. Record pressure when the Jockey Pump starts and when it stops.
- Close the discharge valve on the Fire Pump all the way to keep from pressurizing the entire system.
- MANUAL START—Push red start button on fire pump control panel. Record PSI readings.
- While the Fire Pump is running check to see if the casing relief valve is discharging water. (This helps to keep the pump cool during the test).
- After the ten minutes are done Push the stop button and hold until the Fire Pump stops rotating. Then release the button.
- Let system stabilize for approximately 5 minutes.
- Open the discharge valve of the Fire Pump all the way.
- Reset & restore ALL Alarms in the building.
- Call the proper authority back and return your system to Normal.

MATERIAL INDEX

Description	Model	Manufacturer
I. Nozzles		
A. 1” Brass Full Cone Nozzle – North Tunnel	N6 120˚	Bete
B. 1 ½” Brass Full Cone Nozzle – South Tunnel	TF72 150˚	Bete
C. ¾” Extended Coverage Horizontal Sidewall – Portal	VK630	Viking
II. Flow Control On/Off Valves		
A. Electric Pressure Control On-Off Deluge Valve	FP 400E-3DC	Bermad
III. Other Valves		
A. Butterfly Control Valve	705W	Victaulic
B. Check Valve	717	Victaulic
C. OS&Y Valve	KS-FW	Kennedy
D. Gate Valve	C509-Style	Kennedy
E. Wall Post Indicator Valve	Fig 641	Kennedy
F. Pressure Relief Valve	FP 430-UF	Bermad
IV. Fire Pump		
A. Fire Pump 8x6 Horizontal Split	MABSH	Patterson
B. Fire Pump Motor	FF150E1CS-P	Nidec
C. Fire Pump Soft Start Controller & Transfer Switch	MCST	Master
V. Grooved Fittings		
A. Grooved Firelock Fittings	Varies	Victaulic
B. Grooved Standard Fittings	Varies	Victaulic
C. Grooved Firelock Rigid Couplings	Style 005	Victaulic
D. Grooved Flexible Couplings	Style 75	Victaulic
E. Grooved Reducing Coupling	Style 750	Victaulic
F. Grooved Firelock Flange Adapter (175psi max)	Style 744	Victaulic
G. Firelock Outlet-T (175psi max)	Style 922	Victaulic
H. Mechanical-T Outlets	Style 920/920N	Victaulic
I. Grooved Strainer	Style 730	Victaulic
VI. Threaded Fittings		
A. Cast Iron 125	Varies	Anvil
B. Malleable Iron 125	Varies	Anvil
VII. Brass		
A. 4” x 2 ½” x 2 ½” Fire Department Connection	Model 6114	Guardian
B. 3” x 2 ½” Hose Valves	Model 5115	Guardian
C. 2 ½” Caps	Model 5525	Guardian
D. 2 ½” x 2 ½” Adapters	Model 3310	Guardian
VIII. Pipe		
A. 1 ½” and Smaller – Threaded Black Schedule 40	ASTM A-795	Varies
B. 1 ¼” thru 4” – Welded Black Schedule 40	ASTM A-795	Varies
C. 6” thru 8” – Schedule 10 – Wet Systems	ASTM A-795	Varies
D. Welded Outlets	Varies	Varies

IX. Hangers and Support

A.	Drop-In Anchor	HDI	Hilti
B.	Kwik Bolts	KB3	Hilti
C.	3 1/4” x 1 5/8” Unistrut	B11	B-Line
D.	1 5/8” x 1 5/8” Unistrut	B22 & B22A	B-Line
E.	Unistrut Pipe Clamps	B2000 Series	B-Line
F.	All Thread Rod	Fig. 100	Tolco
G.	Clevis Hanger	Fig. 1	Tolco
H.	Adjustable Band Hanger	Fig. 200	Tolco

X. Bracket Materials

A.	Sway Brace Universal Swivel	Fig. 980	Tolco
B.	1 5/8” x 1 5/8” Unistrut	B22 & B22A	B-Line
C.	Unistrut Channel Nut	N225	B-Line
D.	Unistrut Pipe Clamps	B2000 Series	B-Line
E.	Kwik Bolts	KB-TZ	Hilti
F.	Swivel	615	Afcon
G.	All Thread Rod	Fig. 100	Tolco
H.	Rod Coupling	Fig. 70	Tolco

XI. Seismic Bracing

A.	Sway Brace Pipe Clamp	Fig. 4A	Tolco
B.	Surge Restrainers	Fig. 25	Tolco
C.	Sway Brace Universal Swivel	Fig. 980	Tolco
D.	Sway Brace Attachment	Fig. 1001	Tolco

XII. Miscellaneous

A.	Pressure switch	PS10-2	Potter
B.	OS&Y Tamper Switch	OSYSU-2	Potter
C.	Flow meter	K-1500-8	Gerand

BETE "N" FIRE PROTECTION NOZZLE, WIDE 120°

Operations & Maintenance Manual
December 2015

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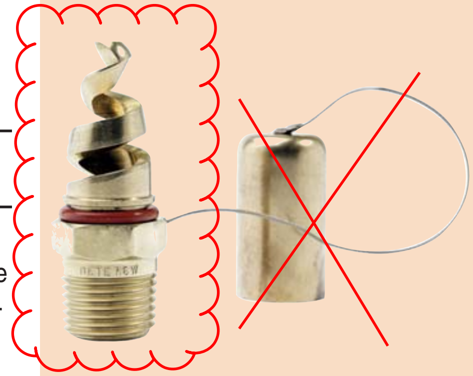
Fire Protection



~~Nozzle with optional protective cover~~

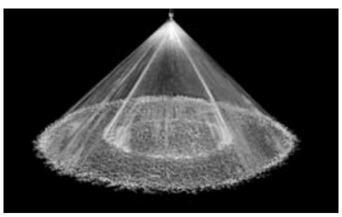
DESIGN FEATURES

- Simplicity of design
- One-piece/no internal parts
- Clog-resistant
- Three standard pipe sizes—1/2”, 1” and 1-1/2”
- Male connection
- Factory Mutual, U.S. Coast Guard, and Lloyd's Register approved models

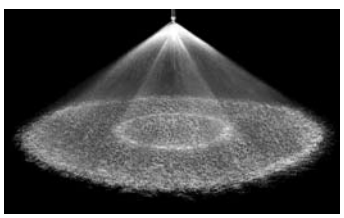
SPRAY CHARACTERISTICS

- Two spray cones: an outer, wide angle cone and a narrower inner cone combine to give full cone effect

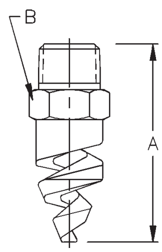
Spray pattern: Full Cone
Spray angles: 90° and 120° standard
Flow rates: 3.0 to 534 gpm



Full Cone 90°



Full Cone 120° (W)



N6 nozzles protect a propane storage tank from fire and explosion.

UL® FM APPROVED Lloyd's Register TA TYPE APPROVED

N3-N5W: U.S. Coast Guard approved

TF24-150° also available in Factory Mutual approved model (see page 20)

Dimensions are approximate. Check with BETE for critical dimension applications.

N Flow Rates and Dimensions

Full Cone, Medium 90° and Wide 120° (W) Spray Angles, 1/2" to 1 1/2" Pipe Sizes

46.24 GPM @ 48.5 PSI FOR DESIGN

Male Pipe Size	Nozzle Number	K Factor	GALLONS PER MINUTE @ PSI 10 PSI	20 PSI	30 PSI	40 PSI	60 PSI	80 PSI	100 PSI	200 PSI	400 PSI	Approx. (in.) Orifice Dia.	Free Pass. Dia.	Approximate Dimensions (inches) A	B	Wt. (oz.) Metal
1/2	N1	0.949	3.00	4.24	5.20	**6.00**	7.35	8.49	9.49	13.4	19.0	0.19	0.13	2.50	0.88	3.00
	N2	1.68	5.30	7.50	9.18	**10.6**	13.0	15.0	16.8	23.7	33.5	0.25	0.13			
	N3	2.61	8.25	11.7	14.3	**16.5**	20.2	23.3	26.1	36.9	52.2	0.31	0.13			
	N4	3.81	12.1	17.0	20.9	**24.1**	29.5	34.1	38.1	53.9	76.2	0.38	0.19			
	N5	5.22	16.5	23.3	28.6	**33.0**	40.4	46.7	52.2	73.8	104	0.43	0.19			
	N6	6.64	21.0	29.7	36.4	**42.0**	51.4	59.4	66.4	93.9	133	0.50	0.19			
1	N6	6.64	21.0	29.7	36.4	**42.0**	51.4	59.4	66.4	93.9	133	0.50	0.19	3.63	1.38	8.50
	N7	10.6	33.5	47.4	58.0	**67.0**	82.1	94.8	106	150	212	0.63	0.25			
1 1/2	N8	15.0	47.5	67.2	82.3	**95.0**	116	134	150	212	300	0.75	0.25	4.38	2.00	27.0
	N9	20.4	64.5	91.2	112	**129**	158	182	204	288	408	0.88	0.31			
	N10	26.7	84.5	120	146	**169**	207	239	267	378	534	1.00	0.31			

Flow Rate (GPM) = $K\sqrt{PSI}$

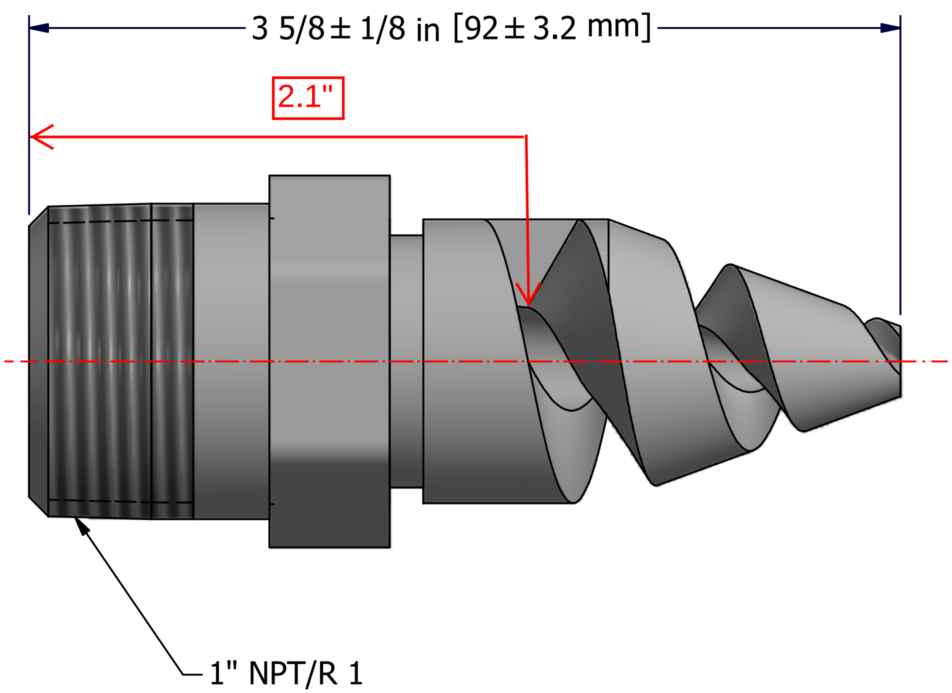
Standard Materials: Brass and 316 Stainless Steel. All 316SS N series covers are 304 Stainless Steel.

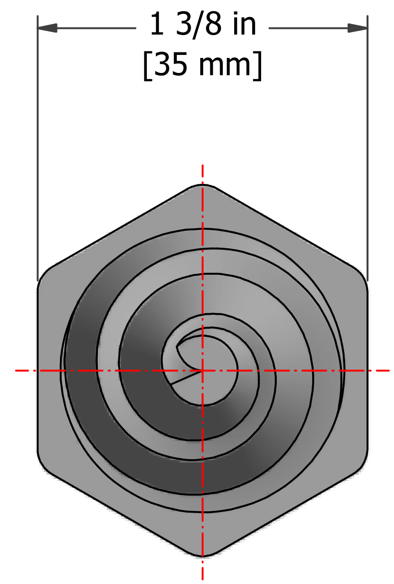
Available in nickel aluminum bronze and titanium, plus other materials on request.

Spray angle performance varies with pressure. Contact BETE for specific data on critical applications.

SPECIAL PURPOSE

TO ORDER: *specify pipe size, connection type, nozzle number, and material.*





NOTES

1. MATERIAL: CAST 316 STAINLESS STEEL
2. FLOW RATE: 42.0 GPM @ 40 PSI [159.0 L/MIN @ 2.8 BAR]
3. SPRAY PATTERN: 120° FULL CONE
4. APPROVALS: FM/UL

BETE FOG NOZZLE, INC.
50 GREENFIELD STREET GREENFIELD, MASSACHUSETTS 01301

1" N6W

REV	DATE	BY	CHECKED	DCR

3RD ANGLE PROJECTION

UNLESS OTHERWISE NOTED, REMOVE ALL BURRS AND SHARP EDGES

TOLERANCES: (EXCEPT AS NOTED)

MACHINED DIMENSIONS: ANGLES....±1/2°
FRACTIONAL....±1/32"
TWO PLACE DECIMAL....±.01"
THREE PLACE DECIMAL....±.005"

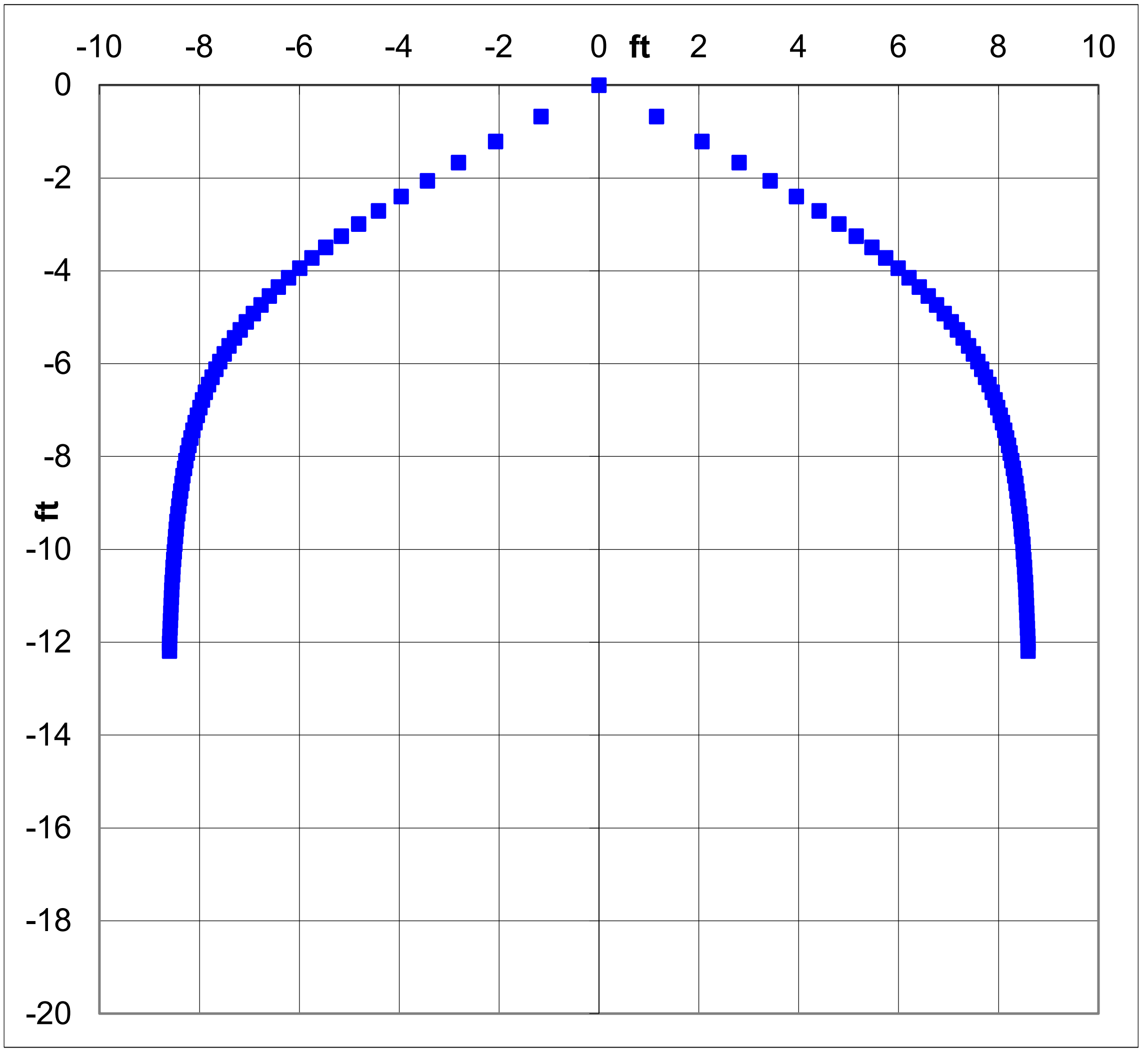
CAST DIMENSIONS: UP TO 1"....±.010"
FOR EACH INCH AFTER ADD ±.003" PER IN.

METRIC: WHOLE NUMBER....±1mm
ONE PLACE DECIMAL....±.4mm
TWO PLACE DECIMAL....±.14mm

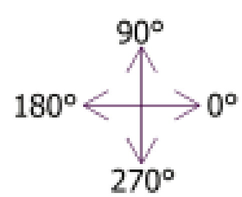
SCALE:	DRAWN:	CHECKED:	REV
1:1	MSG		-
	DATE: 7/7/2014	DATE:	

DRAWING NUMBER: N - 72810 FP - 16

App #141122
N 6 W at 48.5 psi



Nozzle Orientation: 270°
Spraying in Still Air



BETE "TF" WIDE RANGE NOZZLE, WIDE 150°

Operations & Maintenance Manual
December 2015

TF

Wide Range of Flows and Angles

60°, 90°, 120° Metal

DESIGN FEATURES

- The original spiral nozzle invented by BETE and continuously improved!
- High energy efficiency
- One-piece/no internal parts
- Clog-resistant performance
- High discharge velocity
- Male connection standard; female connection available by special order

SPRAY CHARACTERISTICS

- Wide range of flow rates and spray angles
- Fine atomization

Spray patterns: Full Cone.

For Hollow Cone, see page 45

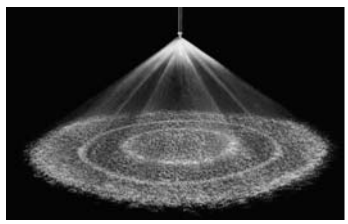
Spray angles: 50° to 180°

Flow rates: 0.5 to 3320 gpm
(Higher flow rates available)

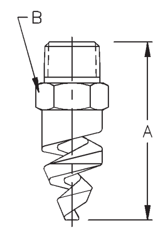
Available with FM approval: N series (page 102), 1/4" TF8 NN, FCN in brass, 1/2" TF24-150 in multiple materials

Full Cone 60° (NN)

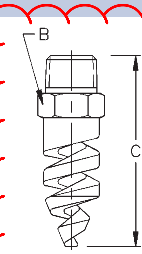
Full Cone 90° (FCN)



Full Cone 150°/170°



90°, 120°



150°, 170°

Dimensions are approximate. Check with BETE for critical dimension applications.

TF Full Cone Flow Rates and Dimensions

Full Cone, 60° (NN), 90° (FCN or FFCN), 120° (FC or FFC), 150° and 170° Spray Angles, 1/8" to 4" Pipe Sizes

196 GPM @ 42 PSI FOR DESIGN

PTFE not recommended above red line

Metal Only above green line

Male Pipe Size	Nozzle Number	Available Spray Angles 60° 90° 120° 150° 170°	K Factor	GALLONS PER MINUTE @ PSI: 5 PSI	10 PSI	20 PSI	30 PSI	40 PSI	50 PSI	60 PSI	80 PSI	100 PSI	200 PSI	400 PSI	Approx. (in.) Orif. Dia.	Free Pass. Dia.	Dim. (in.) for Metal Only* A**	B	C	Wt. (oz.) 60° 90° 120° Metal	Plas.
1/8	TF6	60° 90° 120° 150° 170°	0.221	0.495	0.70	0.99	1.21	**1.40**	1.57	1.71	1.98	2.21	3.13	4.43	0.09	0.09	1.69	0.56	1.69	1.00	0.20
	TF8	60° 90° 120° 150° 170°	0.411	0.919	1.30	1.84	2.25	**2.60**	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13	1.69	0.56	2.19		
1/4	TF6	60° 90° 120° 150° 170°	0.221	0.495	0.70	0.99	1.21	**1.40**	1.57	1.71	1.98	2.21	3.13	4.43	0.09	0.09	1.88	0.56	1.88	1.25	0.20
	TF8	60° 90° 120° 150° 170°	0.411	0.919	1.30	1.84	2.25	**2.60**	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13	1.88	0.56	2.38		
	TF10	60° 90° 120° 150° 170°	0.632	1.41	2.00	2.83	3.46	**4.00**	4.47	4.90	5.66	6.32	8.94	12.6	0.16	0.13	1.88	0.56	2.38		
3/8	TF6	60° 90° 120°	0.221	0.495	0.70	0.99	1.21	**1.40**	1.57	1.71	1.98	2.21	3.13	4.43	0.09	0.09	1.88	0.69	2.38	1.63	0.25
	TF8	60° 90° 120°	0.411	0.919	1.30	1.84	2.25	**2.60**	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13					
	TF10	60° 90° 120°	0.632	1.41	2.00	2.83	3.46	**4.00**	4.47	4.90	5.66	6.32	8.94	12.6	0.16	0.13					
	TF12	60° 90° 120° 150° 170°	0.949	2.12	3.00	4.24	5.20	**6.00**	6.71	7.35	8.49	9.49	13.4	19.0	0.19	0.13					
	TF14	60° 90° 120° 150° 170°	1.28	2.86	4.05	5.73	7.01	**8.10**	9.06	9.92	11.5	12.8	18.1	25.6	0.22	0.13					
	TF16	60° 90° 120° 150° 170°	1.68	3.75	5.30	7.50	9.18	**10.6**	11.9	13.0	15.0	16.8	23.7	33.5	0.25	0.13					
	TF20	60° 90° 120° 150° 170°	2.61	5.83	8.25	11.7	14.3	**16.5**	18.4	20.2	23.3	26.1	36.9	52.2	0.31	0.13					
1/2	TF24	60° 90° 120° 150° 170°	3.81	8.52	12.1	17.0	20.9	**24.1**	26.9	29.5	34.1	38.1	53.9	76.2	0.38	0.19	2.50	0.88	3.06	3.00	0.50
	TF28	60° 90° 120° 150° 170°	5.22	11.7	16.5	23.3	28.6	**33.0**	36.9	40.4	46.7	52.2	73.8	104	0.44	0.19					
3/4	TF32	60° 90° 120° 150° 170°	6.64	14.8	21.0	29.7	36.4	**42.0**	47.0	51.4	59.4	66.4	93.9	133	0.50	0.19	2.75	1.13	3.50	5.50	0.88
1	TF40	60° 90° 120° 150° 170°	10.6	23.7	33.5	47.4	58.0	**67.0**	74.9	82.1	94.8	106	150	212	0.63	0.25	3.63	1.38	4.38	8.50	2.50
	TF48	60° 90° 120° 150° 170°	15.0	33.6	47.5	67.2	82.3	**95.0**	106	116	134	150	212	300	0.75	0.25					
1 1/2	TF56	60° 90° 120° 150° 170°	20.4	45.6	64.5	91.2	112	**129**	144	158	182	204	288	408	0.88	0.31	4.38	2.00	5.38	22.0	4.25
	TF64	60° 90° 120° 150° 170°	26.7	59.7	84.5	120	146	**169**	189	207	239	267	378	534	1.00	0.31			5.38		
	TF72	60° 90° 120° 150° 170°	30.4	67.9	96.0	136	166	**192**	215	235	272	304	429	607	1.13	0.31			5.63		
2	TF88	60° 90° 120° 150° 170°	44.3	99.0	140	**198**	242	280	313	343	396	443	626	885	1.38	0.44	5.63	2.50	5.88	46.0	8.00
	TF96 [1]	60° 90° 120° 150° 170°	55.9	125	177	**250**	306	354	395	433	500	559	791	1120	1.50	0.44	6.88	2.50	7.00	54.0	9.00
3	TF112 [1]	60° 90° 120° 150° 170°	81.0	181	256	**362**	443	512	572	627	724	810	1150	1620	1.75	0.56	8.63	3.50	9.25	114	20.0
	TF128 [1]	60° 90° 120° 150° 170°	107	239	339	**480**	588	679	759	831	960	1070	1510	2150	2.00	0.56					
4	TF160 [1]	60° 90° 120°	166	371	**525**	742	909	1050	1170	1290	1480	1660	2350	3320	2.50	0.63	10.1	4.50		169	27.0

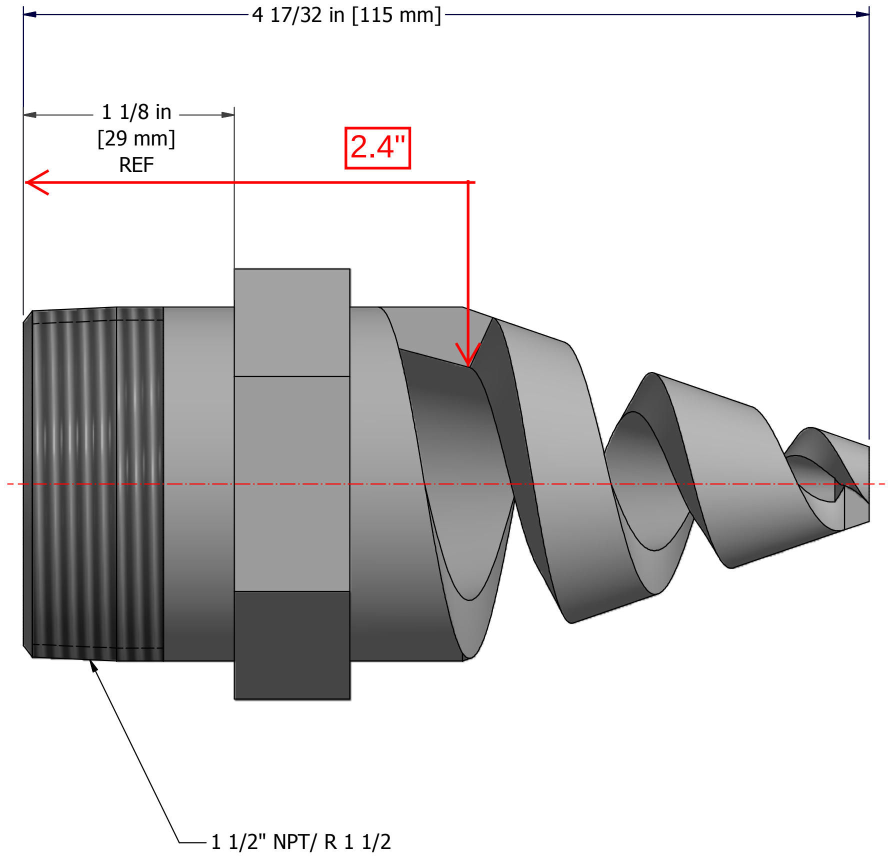
Flow Rate (*GPM*) = $K\sqrt{PSI}$ *Dimensions are for bar stock, cast sizes may vary. **60° nozzles slightly longer, consult BETE. [1] Three turn nozzles

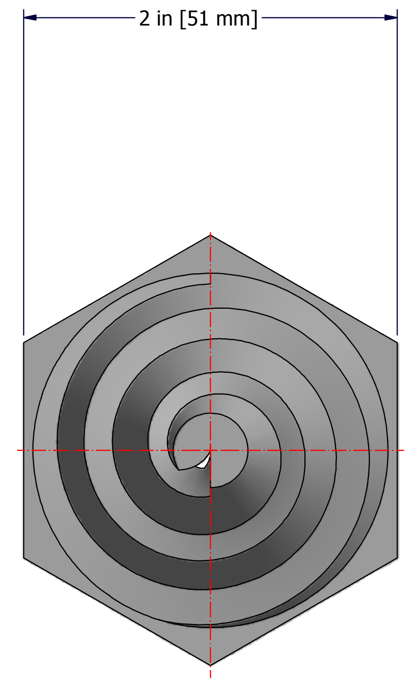
Standard Materials: Brass, 316 Stainless Steel, PVC, Polypropylene, Cobalt Alloy 6, and PTFE (Poly. not available for TF6 thru TF10).

Spray angle performance varies with pressure. Contact BETE for specific data on critical applications.

FP - 19

TO ORDER: specify pipe size, connection type, nozzle number, spray angle, and material.





NOTES

1. MATERIAL: ALLOY
2. FLOW RATE: 192 GPM @ 40 PSI [726.8 L/MIN @ 2.8 BAR]
3. SPRAY PATTERN: 120° FULL CONE

REV	DATE	BY	CHECKED	DCR

3RD ANGLE PROJECTION

UNLESS OTHERWISE NOTED, REMOVE ALL BURRS AND SHARP EDGES

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TOLERANCES: (EXCEPT AS NOTED)

MACHINED DIMENSIONS: ANGLES ±1/2°
FRACTIONAL ±1/32"
TWO PLACE DECIMAL ±.01"
THREE PLACE DECIMAL ±.005"
CAST DIMENSIONS: UP TO 1" ±.010"
FOR EACH INCH AFTER ADD ±.003" PER IN.
METRIC: WHOLE NUMBER ±1mm
ONE PLACE DECIMAL ±.4mm
TWO PLACE DECIMAL ±.14mm

BETE FOG NOZZLE, INC.
50 GREENFIELD STREET GREENFIELD, MASSACHUSETTS 01301

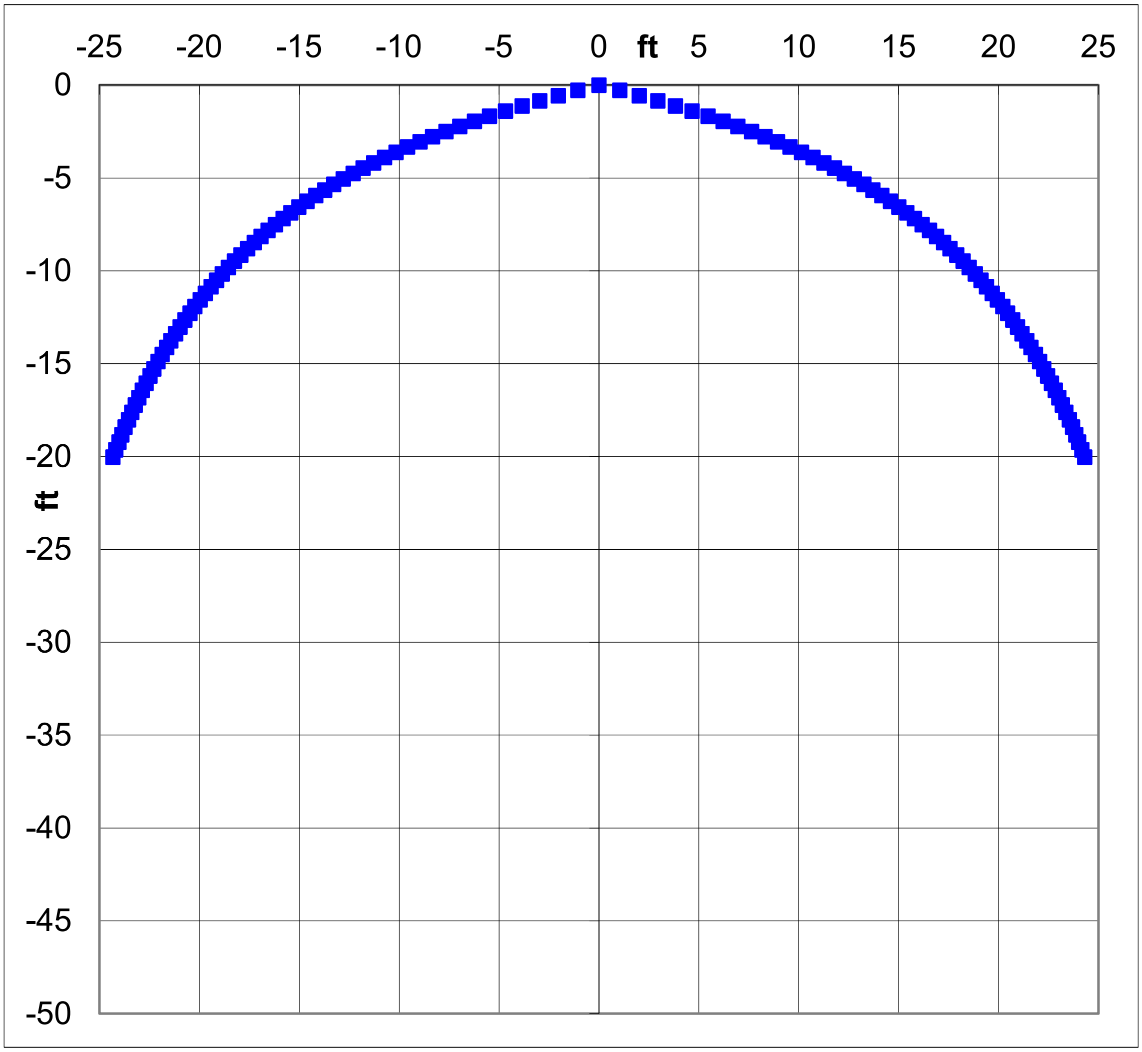
1 1/2" TF 72 FC

APPLICATION #142151

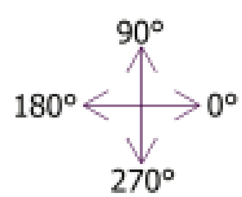
HANSA ENGINEERING AB

SCALE: 3:2	DRAWN: MSG DATE: 8/29/2014	CHECKED: DATE:	REV
DRAWING NUMBER:	TF - 73267		-

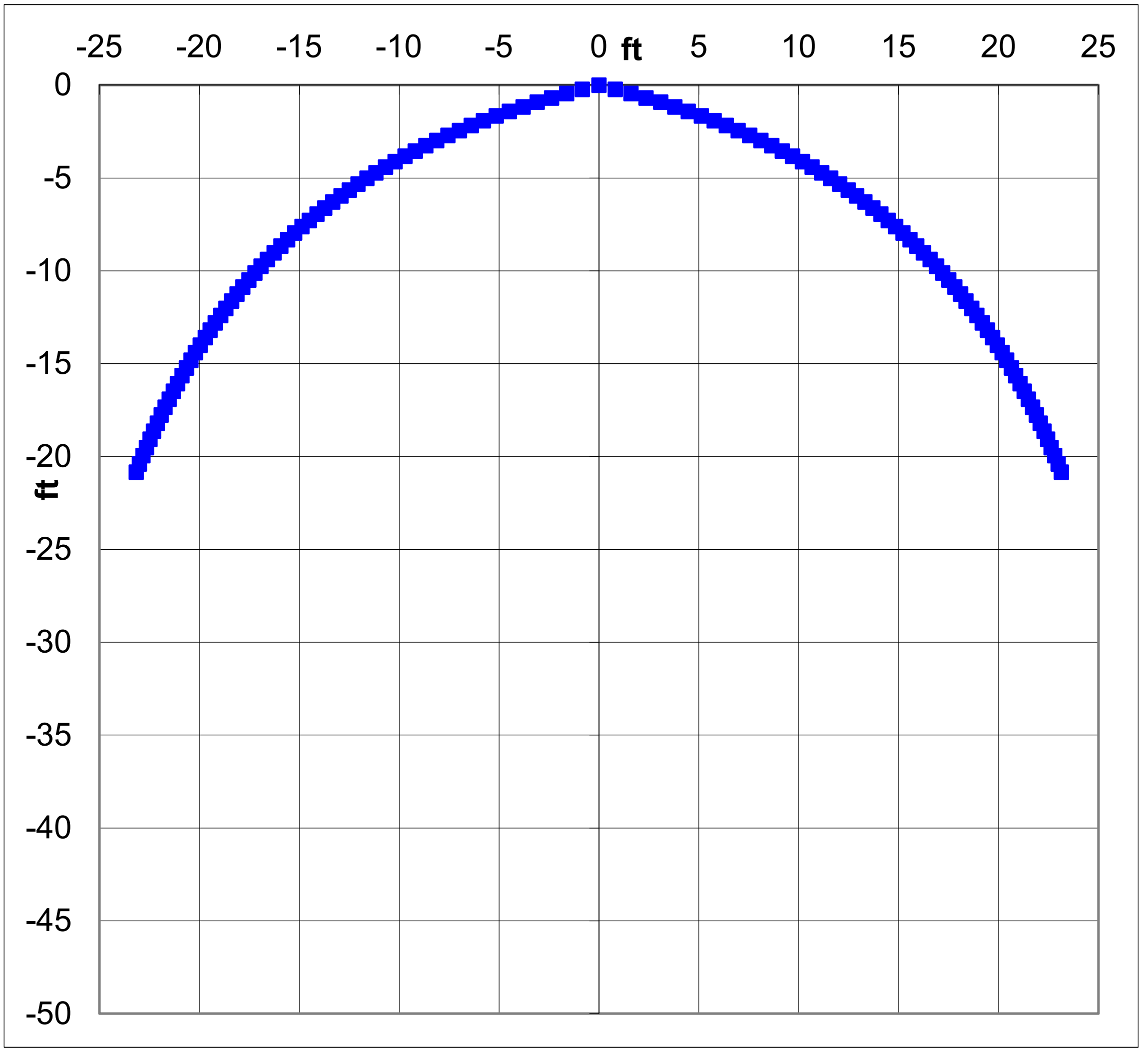
App #141122
TF 72-150 at 41.6 psi



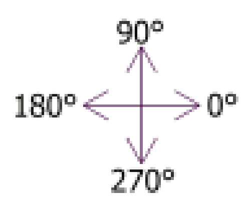
Nozzle Orientation: 270°
Spraying in Still Air



App #141122
TF 72-150 at 25.1 psi



Nozzle Orientation: 270°
Spraying in Still Air



VIKING EXTENDED COVERAGE HORIZONTAL SIDEWALL NOZZLES

Operations & Maintenance Manual
December 2015

VIKING® | TECHNICAL DATA | **QUICK RESPONSE EXTENDED COVERAGE HORIZONTAL SIDEWALL SPRINKLER VK630 (K8.0)**

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

1. DESCRIPTION

Viking Quick Response Extended Coverage Horizontal Sidewall Sprinkler VK630 is a thermosensitive spray sprinkler available in several different finishes and temperature ratings to meet varying design requirements. The glass bulb operating element and special deflector characteristics meet the challenges of quick response extended coverage standards.

The special Polyester, PTFE, and Electroless Nickel PTFE (ENT) coatings can be used in decorative applications where colors are desired. In addition, these coatings have been investigated for installation in corrosive atmospheres and are listed/approved as corrosion resistant as indicated in the Approval Charts. (Note: **FM Global approves the ENT coating as corrosion resistant.** FM Global has no approval classification for PTFE and Polyester coatings as corrosion resistant.)

~~For Light Hazard Occupancies Only~~

~~2. LISTINGS AND APPROVALS~~

~~**cULus Listed:** Category VNIV~~

~~**FM Approved:** Class 2022~~

~~**NYC Approval:** MEA 89-92-E, Volume 32~~

~~Refer to Approval Chart 1 and Design Criteria on pages 80c-d for cULus Listing requirements, and refer to Approval Chart 2 and Design Criteria on page 80e for FM Approval requirements that must be followed.~~

3. TECHNICAL DATA

Specifications:

Maximum Working Pressure: 175 psi (12 bar). Factory tested hydrostatically to 500 psi (34.5 bar).
Thread size: 3/4” (20 mm) NPT
Nominal K-Factor: 8.0 U.S. (115.2 metric†)

† Metric K-factor measurement shown is in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.

Glass-bulb fluid temperature rated to -65 °F (-55 °C)
Overall Length: 2-9/16” (65 mm)
Covered by the following US Patent Nos: 7,854,269 and 7,712,218

Viking Technical Data may be found on The Viking Corporation’s Web site at http://www.vikinggroupinc.com. The Web site may include a more recent edition of this Technical Data Page.

THE GLASS BULB WILL BE REMOVED DURING INSTALLATION FOR THE PORTAL DELUGE SYSTEM APPLICATION

Material Standards:

Sprinkler Frame: Brass UNS-C84400
Deflector: Bronze UNS-C51000
~~Bulb: Glass, nominal 3 mm diameter~~
Pip Cap and Insert Assembly: Copper UNS-C11000 and Stainless Steel UNS-S30400
Compression Screws: 18-8 Stainless Steel
Belleville Spring Sealing Assembly: Nickel Alloy, coated on both sides with PTFE Tape
Yoke: Bronze UNS-C51000
Ejector Spring: 17-7 Stainless Steel
For PTFE Coated Sprinklers: Belleville Spring-Exposed, Screw-Nickel Plated, Pip Cap-PTFE Coated
For Polyester Coated Sprinklers: Belleville Spring-Exposed
For ENT Coated Sprinkler: Belleville Spring-Exposed, Screw, Pipcap, and Yoke-ENT plated.

Ordering Information: (Also refer to the current Viking price list.)

Order Sprinkler VK630 by first adding the appropriate suffix for the sprinkler finish and then the appropriate suffix for the temperature rating to the sprinkler base part number.
Finish Suffix: Brass = A, Chrome = F, White Polyester = M-/W, Black Polyester = M-/B, Black PTFE = N, and ENT = JN
Temperature Suffix: 135 °F (57 °C) = A, 155 °F (68 °C) = B, 175 °F (79 °C) = D
For example, sprinkler VK630 with a Brass finish and a 155 °F (68 °C) temperature rating = Part No. 13500AB.

Available Finishes And Temperature Ratings: Refer to Table 1.

Accessories: (Also refer to the “Sprinkler Accessories” section of the Viking data book.)

Sprinkler Wrenches:

VIKING® TECHNICAL DATA

QUICK RESPONSE EXTENDED COVERAGE HORIZONTAL SIDEWALL SPRINKLER VK630 (K8.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

A. Standard Wrench: Part No. 10896W/B (available since 2000)
B. Wrench for coated and/or recessed sprinklers: Part No. 13655W/B†† (available since 2006)
††A ½" ratchet is required (not available from Viking).

Sprinkler Cabinets:
A. Six-head capacity: Part No. 01724A (available since 1971)
B. Twelve-head capacity: Part No. 01725A (available since 1971)

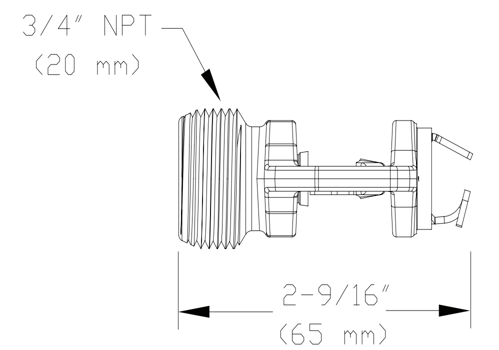


Figure 1: **Sprinkler Dimensions**

4. INSTALLATION
Refer to appropriate NFPA Installation Standards.

5. OPERATION
During fire conditions, the heat-sensitive liquid in the glass bulb expands, causing the bulb to shatter, releasing the yoke, pip cap, and sealing spring assembly. Water flowing through the sprinkler orifice strikes the sprinkler deflector, forming a uniform spray pattern to extinguish or control the fire.

6. INSPECTIONS, TESTS AND MAINTENANCE
Refer to NFPA 25 for Inspection, Testing and Maintenance requirements.

7. AVAILABILITY
The Viking Model VK630 Sprinkler is available through a network of domestic and international distributors. See The Viking Corporation web site for the closest distributor or contact The Viking Corporation.

8. GUARANTEE
For details of warranty, refer to Viking's current list price schedule or contact Viking directly.

TABLE 1: AVAILABLE SPRINKLER TEMPERATURE RATINGS AND FINISHES

Sprinkler Temperature Classification	Sprinkler Nominal Temperature Rating[1]	Maximum Ambient Ceiling Temperature[2]	Bulb Color
Ordinary	135 °F (57 °C)	100 °F (38 °C)	Orange
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow

Available Sprinkler Finishes: Brass, Chrome, White Polyester, Black Polyester, Black PTFE, and ENT

Corrosion-Resistant Coatings[3]: White Polyester, Black Polyester, Black PTFE, and ENT

NOT APPLICABLE

Footnotes

[1] The sprinkler temperature rating is stamped on the deflector.

[2] Based on NFPA-13. Other limits may apply, depending on fire loading, sprinkler location, and other requirements of the Authority Having Jurisdiction. Refer to specific installation standards.

[3] The corrosion-resistant coatings have passed standard corrosion tests required by particular approving agencies as indicated in the Approval Charts. These tests cannot and do not represent all possible corrosive environments. Prior to installation, verify through the end-user that the coatings are compatible with or suitable for the proposed environment. The coatings indicated are applied to the exposed exterior surfaces only. For PTFE coated open sprinklers only, the waterway is coated. For ENT automatic sprinklers, the waterway is coated.

NOTE: The spring is exposed on sprinklers with PTFE, ENT, and Polyester coatings.

VIKING®

TECHNICAL DATA

QUICK RESPONSE EXTENDED COVERAGE HORIZONTAL SIDEWALL SPRINKLER VK630 (K8.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

Sprinkler Base Part Number[1]	NPT Thread Size		Nominal K-Factor		Maximum Water Working Pressure	Overall Length	
	Inches	mm	U.S.	metric[2]		Inches	mm
13500	3/4	20	8.0	115.2	175 psi (12 Bar)	2-9/16	65

Approval Chart 1 (UL)

Quick Response Extended Coverage HSW Sprinkler VK630
For Light Hazard Occupancies Only.
For installation below smooth, flat, horizontal ceilings only.

KEY: A1X — Temperature, Finish, Escutcheon (if applicable)

Maximum Areas of Coverage[3] (Width x Throw)	Minimum Water Supply Requirements[3]	Deflector-to-Ceiling Distance	Listings and Approvals[4] (See Design Criteria on pg 80d.)	
			cULus[5]	NYC[6]
14' x 24' (4.3 m x 7.3 m)	34 gpm @ 18.1 psi (128.7 L/min @ 1.24 Bar)	4 to 6" (102 to 152 mm)	A1X, C2Z	A1Y
14' x 24' (4.3 m x 7.3 m)	36 gpm @ 20.3 psi (136.3 L/min @ 1.4 Bar)	6 to 12" (152 to 305 mm)	A1X, C2Z	A1Y
14' x 26' (4.3 m x 7.9 m)	38 gpm @ 22.6 psi (144 L/min @ 1.56 Bar)	4 to 6" (102 to 152 mm)	B1X, D2Z	B1Y
14' x 26' (4.3 m x 7.9 m)	46 gpm @ 33.1 psi (174.1 L/min @ 2.28 Bar)	6 to 12" (152 to 305 mm)	B1X, D2Z	B1Y
16' x 16' (4.9 m x 4.9 m)	26 gpm @ 10.6 psi (98.4 L/min @ 0.73 Bar)	4 to 12" (102 to 305 mm)	A1X, C2Z	A1Y
16' x 18' (4.9 m x 5.5 m)	29 gpm @ 13.1 psi (109.8 L/min @ 0.91 Bar)	4 to 12" (102 to 305 mm)	A1X, C2Z	A1Y
16' x 20' (4.9 m x 6.2 m)	32 gpm @ 16.0 psi (121.1 L/min @ 1.1 Bar)	4 to 12" (102 to 305 mm)	A1X, C2Z	A1Y
16' x 22' (4.9 m x 6.7 m)	36 gpm @ 20.3 psi (136.3 L/min @ 1.4 Bar)	4 to 12" (102 to 305 mm)	B1X, D2Z	B1Y
16' x 24' (4.9 m x 7.3 m)	39 gpm @ 23.8 psi (147.6 L/min @ 1.64 Bar)	4 to 12" (102 to 305 mm)	B1X, D2Z	B1Y
18' x 18' (5.5 m x 5.5 m)	33 gpm @ 17.0 psi (124.9 L/min @ 1.2 Bar)	4 to 12" (102 to 305 mm)	B1X, D2Z	B1Y
18' x 20' (5.5 m x 6.2 m)	36 gpm @ 20.3 psi (136.3 L/min @ 1.4 Bar)	4 to 12" (102 to 305 mm)	B1X, D2Z	B1Y
18' x 22' (5.5 m x 6.7 m)	40 gpm @ 25.0 psi (151.4 L/min @ 1.73 Bar)	4 to 12" (102 to 305 mm)	B1X, D2Z	B1Y

Approved Temperature Ratings

A - 135 °F (57 °C), 155 °F (68 °C), and 175 °F (79 °C)
B - 135 °F (57 °C) and 175 °F (79 °C)
C - 155 °F (68 °C), and 175 °F (79 °C)
D - 175 °F (79 °C)

Approved Finishes

1 - Brass, Chrome, White Polyester[7], Black Polyester[7], and Black PTFE[7]
2 - ENT[7]

NOT APPLICABLE

Approved Escutcheons

X - Standard surface-mounted escutcheon or the Viking Microfast® Model F-1 Adjustable Escutcheon, or Recessed with the Viking Micromatic® Model E-1, E-2, or E-3 Recessed Escutcheon, or the Model G-1 Recessed Escutcheon.
Y - Standard surface-mounted escutcheon or the Viking Microfast® Model F-1 Adjustable Escutcheon, or Recessed with the Viking Micromatic® Model E-1, E-2, or E-3 Recessed Escutcheon
Z - Standard surface-mounted escutcheons or the Micromatic Model E-1 Recessed Escutcheon.

Footnotes

[1] Part number shown is the base part number. For complete part number, refer to current Viking price list schedule.
[2] Metric K-factor measurement shown is when pressure is measured in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
[3] For areas of coverage smaller than shown, use the "Minimum Water Supply Requirement" for the next larger area listed. Flows and pressures listed are per sprinkler.
[4] This chart shows the listings and approvals available at the time of printing. Other approvals may be in process. Check with the manufacturer for any additional approvals.
[5] Listed by Underwriter's Laboratories, Inc. for use in the U.S. and Canada for Light-Hazard occupancies with smooth, flat, horizontal ceilings only.
[6] Accepted for use, City of New York Department of Buildings, MEA Number 89-92-E, Vol. 32.
[7] cULus Listed as corrosion resistant.

VIKING® | TECHNICAL DATA

QUICK RESPONSE EXTENDED COVERAGE HORIZONTAL SIDEWALL SPRINKLER VK630 (K8.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

DESIGN CRITERIA - UL

(Also refer to Approval Chart 1 on page 80c.)

cULus Listing Requirements:

Quick Response Extended Coverage HSW Sprinkler VK630 is cULus Listed as indicated in the Approval Chart for installation in accordance with the latest edition of NFPA 13 for extended coverage sidewall spray sprinklers:

- Limited to Light Hazard occupancies with smooth, flat, horizontal ceilings only.
- Refer to the Approval Chart for required deflector distance below the ceiling. Install with the leading edge of the deflector and sprinkler frame arms oriented parallel to the ceiling (see Figure 3). **THE TOP SURFACE OF THE DEFLECTOR IS MARKED "TOP".** The sprinkler must be oriented as shown in Figure 3.
- Minimum distance from end walls is 4 in. (102 mm).
- Maximum distance from the end wall shall be no more than one-half of the allowable distance between sprinklers. The distance shall be measured perpendicular to the wall.
- The sprinkler installation and obstruction rules contained in NFPA 13 for extended coverage sidewall spray sprinklers must be followed.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to pages EC1-3 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA, LPCB, APSAD, VdS or other similar organizations, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable.

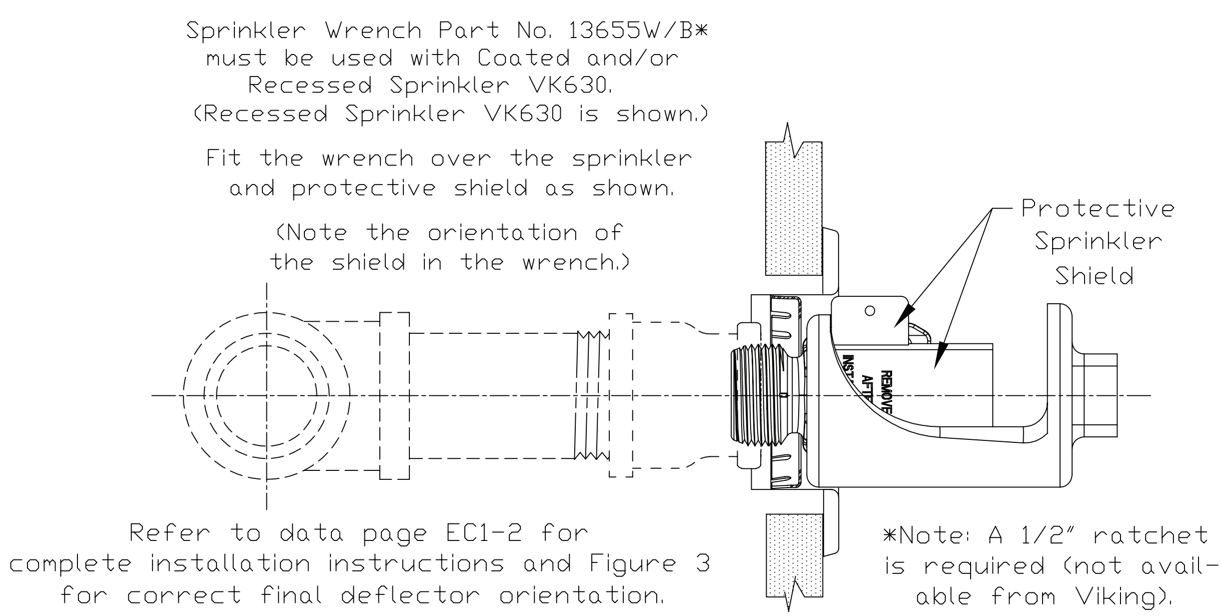


Figure 2: **Installation of Coated and/or Recessed Sprinkler VK630**

VIKING® TECHNICAL DATA

QUICK RESPONSE EXTENDED COVERAGE HORIZONTAL SIDEWALL SPRINKLER VK630 (K8.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

Sprinkler Base Part Number[1]	NPT Thread Size		Nominal K-Factor		Maximum Water Working Pressure	Overall Length	
	Inches	mm	U.S.	metric[2]		Inches	mm
13500	3/4	20	8.0	115.2	175 psi (12 Bar)	2-9/16	65

Approval Chart 2 (FM)

Quick Response Extended Coverage HSW Sprinkler VK630

KEY: A1X — Temperature, Finish, Escutcheon (if applicable)

Maximum Areas of Coverage[3] (Width x Throw)	Minimum Water Supply Requirements[3]	FM Approvals[4] (See Design Criteria below.)
16' x 16' (4.9 m x 4.9 m)	32 gpm @ 16.0 psi (121,1 L/min @ 1.1 Bar)	A1X, B1Z
16' x 18' (4.9 m x 5.5 m)	36 gpm @ 20.3 psi (136.3 L/min @ 1.4 Bar)	A1X, B1Z
16' x 20' (4.9 m x 6.2 m)	40 gpm @ 25.0 psi (151.4 L/min @ 1.73 Bar)	A1X, B1Z
16' x 22' (4.9 m x 6.7 m)	44 gpm @ 30.3 psi (166.6 L/min @ 2.09 Bar)	A1X, B1Z
16' x 24' (4.9 m x 7.3 m)	48 gpm @ 36.0 psi (181.7 L/min @ 2.48 Bar)	A1X, B1Z

Approved Temperature Ratings

A - 135 °F (57 °C), 155 °F (68 °C), and 175 °F (79 °C)
B - 155 °F (68 °C), and 175 °F (79 °C)

Approved Finishes

1 - Brass, Chrome, White Polyester, and Black Polyester, ENT[5]

Approved Escutcheons

X - Standard surface-mounted escutcheon or the Viking Microfast® Model F-1 Adjustable Escutcheon[9], or Recessed with the Viking Micromatic® Model E-1, E-2, or E-3 Recessed Escutcheon, or the Model G-1 Recessed Escutcheon.
Z - Standard surface-mounted escutcheons or the Micromatic Model E-1 Recessed Escutcheon.

Footnotes

[1] Part number shown is the base part number. For complete part number, refer to current Viking price list schedule.
[2] Metric K-factor measurement shown is when pressure is measured in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.
[3] For areas of coverage smaller than shown, use the "Minimum Water Supply Requirement" for the next larger area listed. Flows and pressures listed are per sprinkler.
[4] This chart shows the FM Approvals available at the time of printing. Other approvals may be in process. Check with the manufacturer for any additional approvals.
[5] FM Approved as corrosion-resistant.

NOT APPLICABLE

DESIGN CRITERIA - FM

(Also refer to Approval Chart 2 above.)

FM Approval Requirements:

QREC Horizontal Sidewall Sprinkler VK630 is FM Approved as a quick response **Non-Storage** extended coverage sidewall sprinkler as indicated in the FM Approval Guide. For specific application and installation requirements, reference the latest applicable FM Loss Prevention Data Sheets (including Data Sheet 2-0). FM Global Loss Prevention Data Sheets contain guidelines relating to, but not limited to: minimum water supply requirements, hydraulic design, ceiling slope and obstructions, minimum and maximum allowable spacing, and deflector distance below the ceiling.

NOTE: The FM installation guidelines may differ from cULus and/or NFPA criteria.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to pages EC1-2 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA, FM Global, LPCB, APSAD, VdS or other similar organizations, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable.

TECHNICAL DATA

QUICK RESPONSE EXTENDED COVERAGE HORIZONTAL SIDEWALL SPRINKLER VK630 (K8.0)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

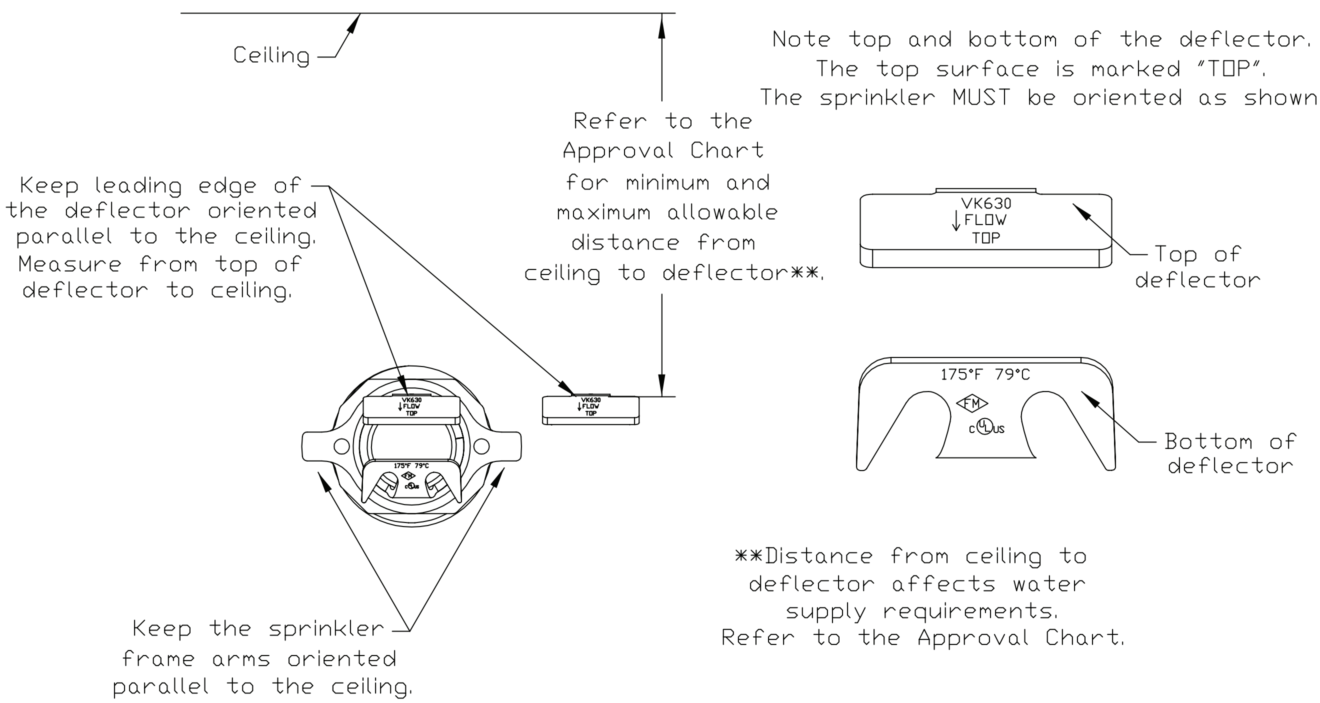


Figure 3: **Correct Deflector Orientation**

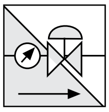
BERMAD ELECTRIC PRESSURE CONTROL, ON-OFF DELUGE VALVE

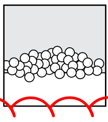
Operations & Maintenance Manual
December 2015

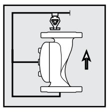
Electric
Pressure Control,
On-Off Deluge Valve

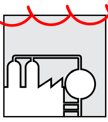
Model: FP 400E-3DC

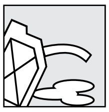
Typical Applications

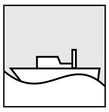

Fluctuating or over pressure

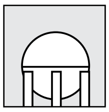

Water/foam fire systems

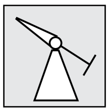

Deluge & spray systems


Petrochemical facilities


Flammable materials storage


Marine environments


Gas storage tanks


Remote monitor

Features and Benefits

UL LISTED

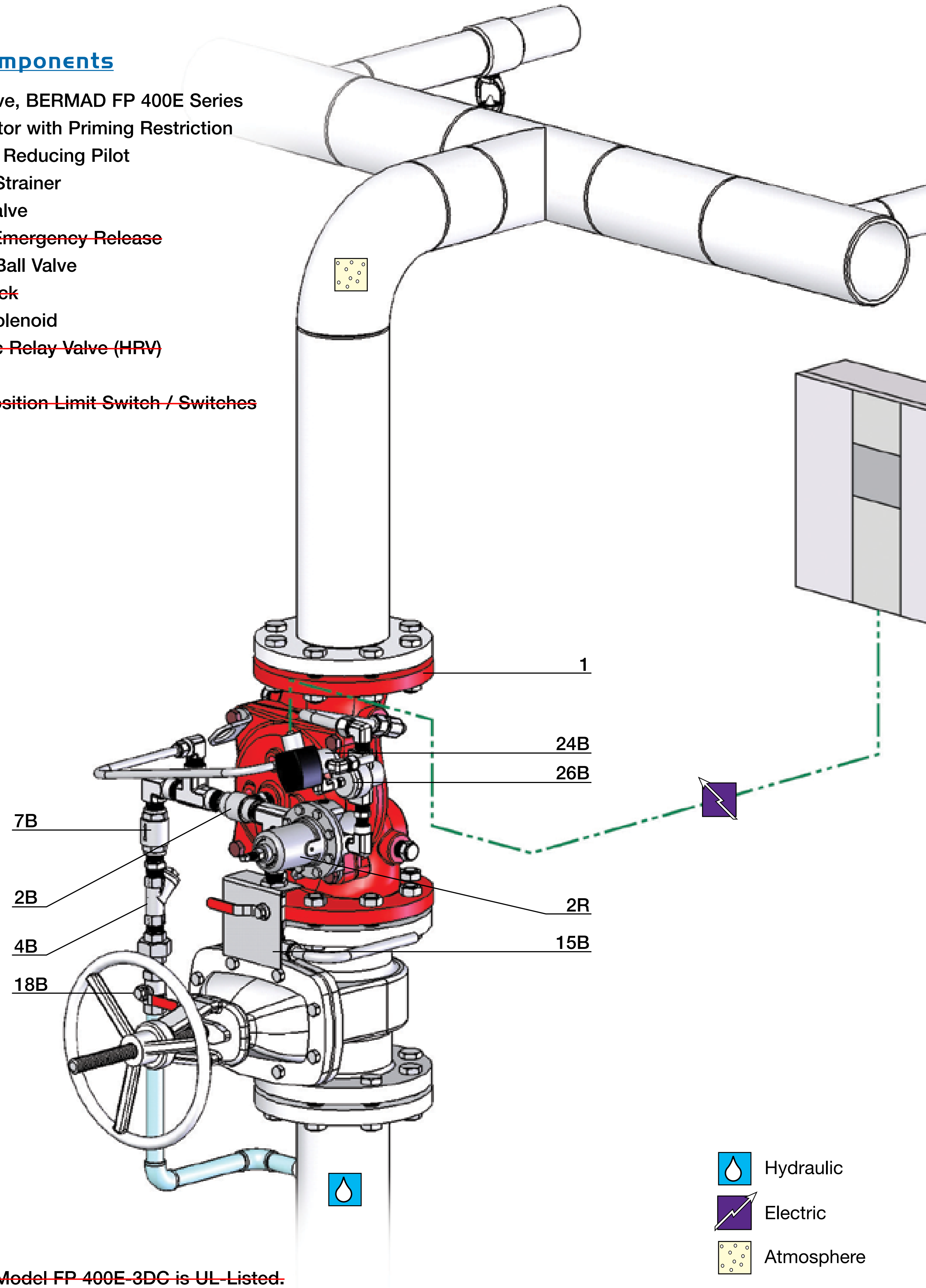
- **Pressure control function –** Constant preset downstream pressure
- **Remote reset –** Shut-off on remote command
- **One-piece molded elastomeric moving part –** No maintenance required
- **Simple design –** Cost effective
- **Obstacle-free full bore –** Uncompromising reliability
- **Factory pre-assembled trim –** Out-of-box quality
- **In-line serviceable –** Minimal down time

Optional Features

- **Alarm pressure-switch** (code: P or P7)
- ~~**Explosion-proof for hazardous locations** (code: 7/8/9)~~
- ~~**Fail-safe open** (energized to close main valve)~~
- ~~**Seawater service** (add FS as prefix to model)~~
- ~~**Valve Position Single/Double Limit Switches**~~

System Components

1 - Main Valve, BERMAD FP 400E Series
2B - Accelerator with Priming Restriction
2R - Pressure Reducing Pilot
4B - Priming Strainer
7B - Check Valve
~~15B - Manual Emergency Release~~
18B - Priming Ball Valve
~~19B - Drip Check~~
24B - 3-Way Solenoid
~~26B - Hydraulic Relay Valve (HRV)~~
~~Optional~~
~~S - Valve Position Limit Switch / Switches~~



~~UL Listed~~
~~The BERMAD Model FP 400E-3DC is UL-Listed.~~
~~The installation shall include Indicating and Drain Components.~~

BERMAD Fire Protection

EJMT Project
Data Sheet

Model: FP 400E-D3C (Modified – EJMT Project) Sizes: 4”

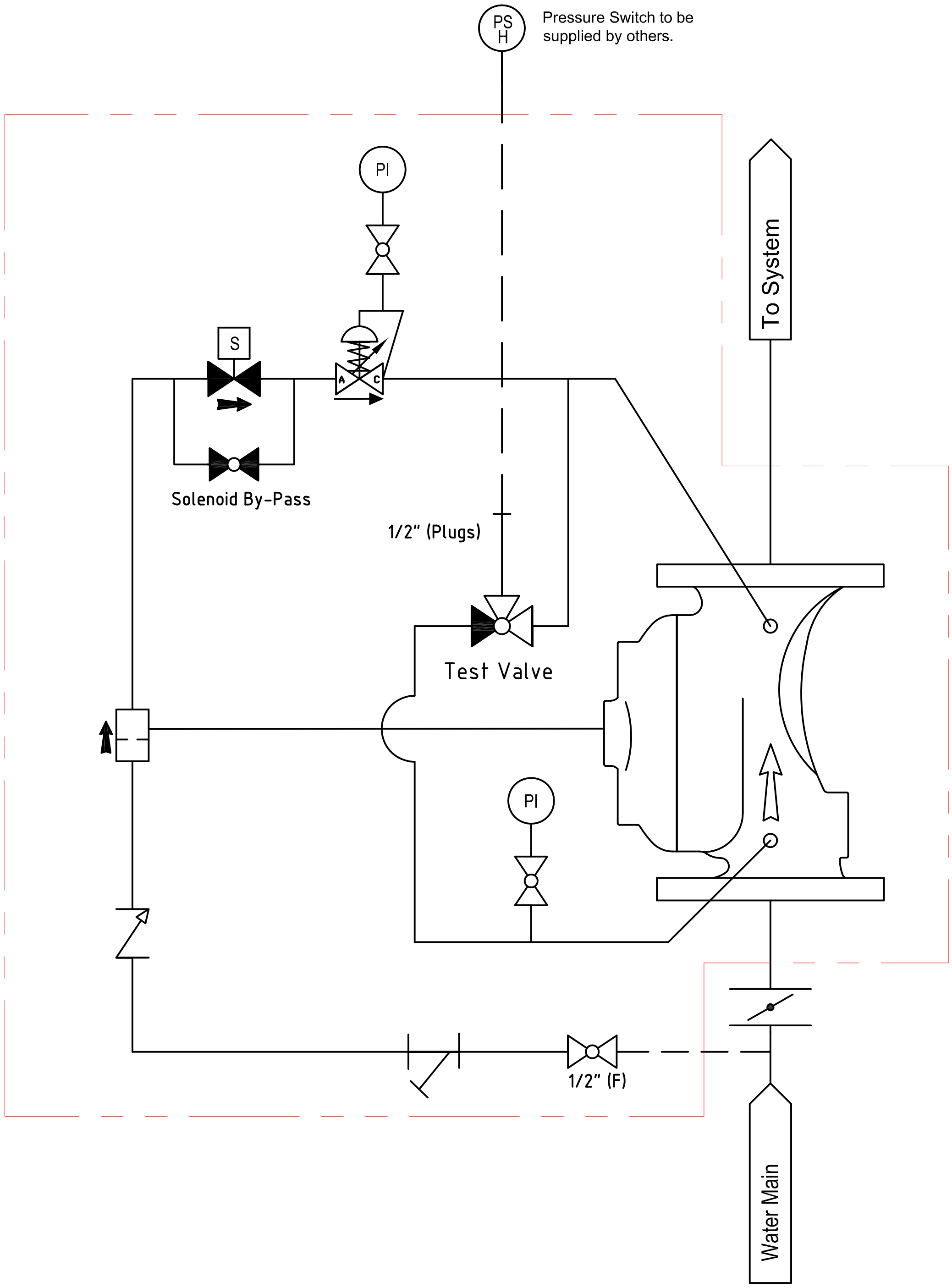
Electric Pressure Control, On-Off Deluge Valve

GENERAL	1	Code		FP 400E-3DC-G-C-VI-ER-4DC-CB-66-EJMT	
	2	Type		Elastomeric Globe Valve	
	3	Fluid Type		Firewater	
	4	Pressure Rating		Main Valve 235 psi / Solenoid Valve 175 psi	
	5	Main Valve Pressure Test / Design		460 psi / 300 psi	
	6	Required Air Pressure Supply		-	
	7	Temp. Rating		33 to 122° F	
	8	Normal Position		Closed Main Valve when De-energized	
	9	Approvals		Lloyd’s Register, ABS type approved	
MAIN VALVE	10	Material: Body	Cover	Ductile Iron ASTM A536 65-45-12	Ductile Iron ASTM A536 65-45-12
	11	End Connections		Grooved ANSI/AWWA C606	
	12	Body Pattern		Globe	Line serviceable type
	13	Leakage	Class	Drip tight	Class VI
	14	Valve Internals		Elastomer Reinforced VRSD	
	15	Coating Color	Type	Red, RAL 3002	High Build Epoxy Coat
	16	Elastomers	Type	Diaphragm: NR	Fabric reinforced Polyisoprene
PILOT VALVE	17	Model	Description	2-UL	Pressure Reducing Pilot valve
	18	Body Materials	Internals	Brass	Brass / Stainless Steel & NBR
CONTROL ACCESSORIES	19	Control Filter	Material	Y type (for water control line)	Brass
	20	Ball Valves	Material	Floating ball type	Brass
	21	Manual Override	Material	¼” Ball Valve	Brass
	22	Tubing	Fittings	Copper	Brass
	23	Check Valve	Material	Spring type	Brass
	24	Other	Material	Accelerator & Priming Restrictor	Brass
	24A	PS Test Valve	Material	3-Way Ball Valve	Brass
INDICATORS	25	Pressure Gauge	Material	2 units, 0-25 barg & 300 psi , 4” x ¼”	Stainless Steel 316
	26	Pressure Switch	Material	-	
	27	Terminal Box	Material	-	
	28	Others	Material	-	
SOLENOID	29	Brand	Model	ASCO	HT8210G207
	30	Type	Normally	2-way	De-energized
	31	Electric Rating	Power	24V DC	10.6 Watts
	32	Body Materials	Enclosure	Brass	Epoxy Molded
	33	Class	Entry	UL / CSA SO & ACT 104R (Class H)	½” NPT

Notes:
FP 400E-3DC
Modified to project requirements:

- Main drain valve removed
- Control trim system modified to vent all open ports downstream

Client: Victaulic		Project: EJMT (Eisenhower Tunnel)	
Designed by: CK	Drawn by: CK	Approved by: RT	File Name: FP-400E-3DC-CER-66 EJMT
Design Date: 11/26/2014	Drawing Date: 11/26/2014	Approved date: 11/26/2014	Status: Rev. 02



NOTE:	Designed By:	Checked By:	Appov. By:	Date:	File Name:	Rev.	Scale
	CK	RT	RT	11/26/2014	400E-3DC-66 EJMT.DWG	2.0	N/A

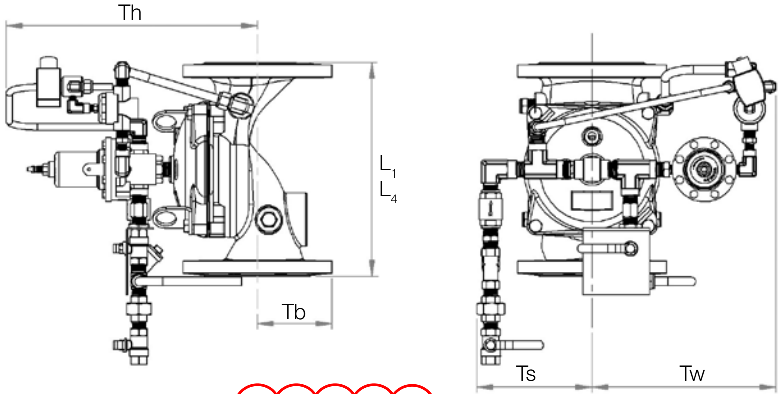
FP-400E-3DC
Modified to project requirements:

- Main drain valve removed
- Control trim system modified to vent all open ports downstream

BERMAD

Electric Pressure Control, On - Off Deluge Valve
FP-400E-3DC (Modified - EJMT Project)
Model: FP-40E-3DC-66-EJMT

Technical Data



Size		1½", 2"		2½"		3"		4"		6"		8"		10"		12"	
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
Dimensions	L_1 (1)	205	8 1/16	205	8 1/16	257	10 1/8	320	12 5/8	415	16 5/16	500	19 11/16	605	23 13/16	725	28 9/16
	L_4 (2)	205	8 1/16	N/A	N/A	250	9 13/16	320	12 5/8	415	16 5/16	500	19 11/16	N/A	N/A	N/A	N/A
	Tw	228	9	220	8 11/16	243	9 9/16	253	10	312	12 5/16	326	12 13/16	346	13 5/8	391	15 3/8
	Ts	228	9	220	8 11/16	243	9 9/16	253	10	318	12 ½	326	12 13/16	326	12 13/16	391	15 3/8
	Th	226	8 7/8	242	9 ½	262	10 5/16	261	10 5/16	356	14	407	16	407	16	546	21 ½
	Tb	278	10 1/16	289	11 3/8	300	11 13/16	337	13 1/4	378	14 7/8	405	15 15/16	413	16 1/4	473	18 5/8

Notes:
1. L_1 is for flanged ANSI #150 and ISO PN16.
2. L_4 is for grooved end connections (Ductile Iron Only).
3. Provide adequate space around valve for maintenance.
4. Data is for envelope dimensions, specific component positioning may vary.

Connection Standard
- Flanged: ANSI B16.42 (Ductile Iron), B16.5 (Steel & Stainless Steel), B16.24 (Bronze) or ISO PN16
- Grooved: ANSI/AWWA C606 for 2, 3, 4, 6 & 8"

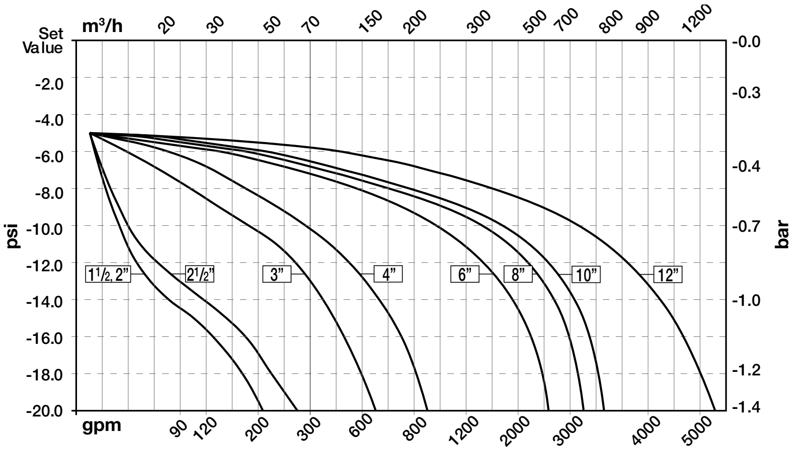
Water Temperature
- 0.5 – 50°C (33 – 122°F)

Available Sizes
- 1½, 2, 2½, 3, 4, 6, 8, 10 & 12"
- UL-Listed for sizes 1½, 2, 2½, 3, 4, 6, 8 & 10"

Pressure Rating*
- Max. inlet: 250 psi (17 bar)
- Set: 30-165 psi (4.5-11.5 bar)

* Pressure rating might be limited due to solenoid valve rating

Valve Outlet Pressure Fall-off Characteristics On Inlet Under Set Pressure



Manufacturers Standard Materials
Main valve body and cover
- Ductile Iron ASTM A-536

Main valve internals
- Stainless Steel 304 & Cast Iron

Control Trim System
- Brass control components/accessories
- Forged Brass pressure reducing pilot with St. St. 304 internals & NBR elastomers
- ~~Stainless Steel 316 tubing & fittings~~

~~**Elastomers**~~
- ~~Nylon fabric reinforced polyisoprene NR~~

Coating
- Electrostatic Powder Coating Polyester, Red (RAL 3002)

Optional Materials
~~**Main valve body**~~
- ~~Carbon Steel ASTM A-216 WCB~~
- ~~Stainless Steel 316~~
- ~~Ni-Al-Bronze ASTM B-148~~

~~**Control Trim**~~
- ~~Stainless Steel 316~~
- ~~Monel® and Ni-Al-Bronze~~
- ~~Hastalloy C-276~~

Elastomers
- ~~NBR~~
- EPDM

~~**Coating**~~
- ~~High Build Epoxy Fusion-Bonded with UV Protection, Anti-Corrosion~~

Solenoid Pilot Valves See attachments
~~**Standard**~~
- ~~3-Way direct actuated type~~
- ~~Brass body~~
- ~~Main valve closed when de-energized~~
- ~~Enclosure: General purpose watertight, NEMA 4 and 4X / IP65, Class F~~
- ~~Power: 24VDC, 8 watts~~
- ~~UL - Listed~~

~~**Options (see also ordering guide)**~~
- ~~Hazardous locations:~~
  - ~~Class I Division 1, Gr. A, B, C, D, T4 (code 7)~~
  - ~~Class I Division 2, Gr. A, B, C, D, T4~~
  - ~~ATEX, EEx d IIC T5 (code 9)~~
- ~~Voltage: see ordering guide (voltage option table)~~
- ~~Stainless steel 316 body material (code K)~~

BALL DRIP VALVES

Operations & Maintenance Manual
December 2015

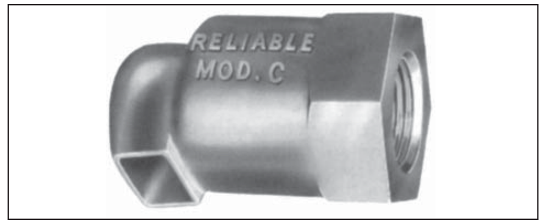
Bulletin 206 Rev. Q

Reliable®

Ball Drip
Sight Drain
Drum Drip
Control Valve Seal
Fill Cup
Inspectors Test Connections
Pressure Gauges

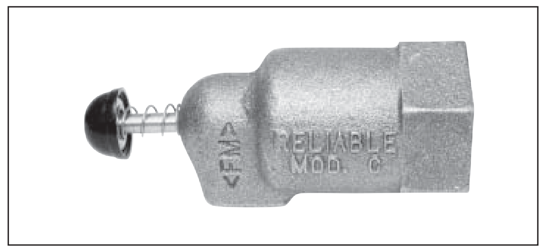
Model C — Automatic Ball Drip

An automatic drain valve horizontally installed at the low point in the fire department connection piping of automatic sprinkler systems. Water pressure from a fire department pumper automatically closes this valve. It automatically re–opens when pressure ceases, permitting this piping to drain and thereby preventing freezing. Made of bronze and available with $^3/_4$" (R$^3/_4$) or $^1/_2$" NPT (R$^1/_2$) female inlet connection. FM approved. Length: 2$^9/_{16}$". Maximum working pressure: 175psi (12bar).



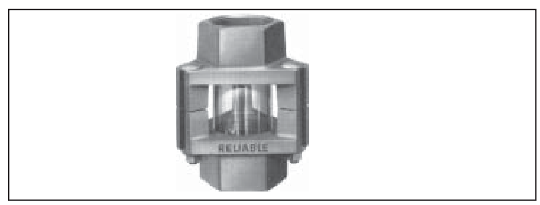
Model C - Mechanical Ball Drip Valve

The Model C Mechanical Ball Drip Valve is a listed trim component used in the alarm line of Reliable Model A & D dry valves, Model DDX deluge and DDX preaction valves. The mechanical ball drip valve is designed to close upon activation of the dry or deluge valve when sufficient flow is present in the alarm line. In the normal or open position the mechanical ball drip allows for the relieving of pressure in the alarm chamber of the valve. After valve activation, push in the plunger of the mechanical ball drip valve to manually release the water pressure and to drain the alarm line of the valve. Made of bronze and available with ½" NPT (R½) female inlet connection. FM approved. Length: 3½". Maximum working pressure: 175 psi (12 bar).



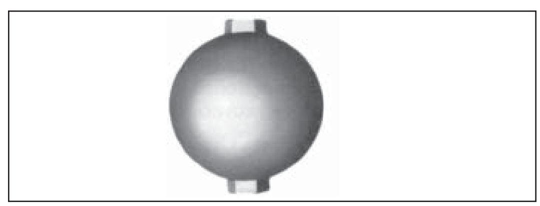
Model C — 2" (50 mm) Sight Drain

Designed for installation in drain lines of sprinkler systems that connect with closed drains. Made of cast iron with clear plastic tube. Has 2" NPT (50mm) female pipe connection.
Length: 6" (152mm).



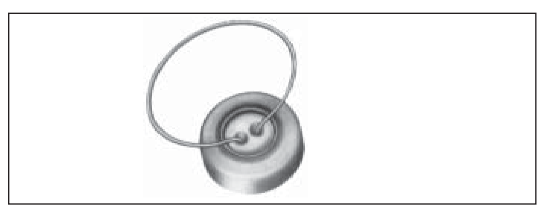
Model B — Drum Drip

Permits draining the low points of dry pipe systems without tripping the system. Made of cast iron with $^3/_4$" NPT (R¾) female pipe connection at each end.
Diameter: 6$^1/_2$" (165mm). Length: 7$^3/_4$" (197mm).



Model A — Control Valve Seal

Made of tin–plated steel. Two piece, snap type construction. Outer piece holes are sized for use with standard sealing wire (wire not included).
Diameter: $^7/_8$" (22mm).



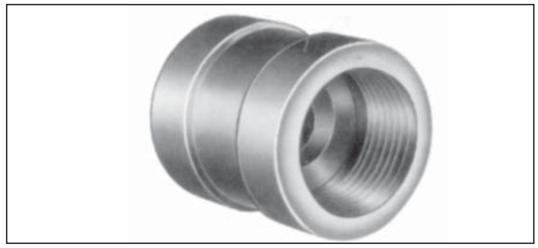
Model A — Fill Cup

Made of cast iron. Available with $^1/_2$" or $^3/_4$" NPT (R$^1/_2$ or R$^3/_4$) female pipe connection.
Cup Diameter: 3$^3/_4$" (95mm). Length: 2$^1/_4$" (57mm).

Inspectors Test Connections

Installed in the test line of sprinkler systems to test alarms by simulating the flow of water through a sprinkler.

• Model A — Blind Test Connection

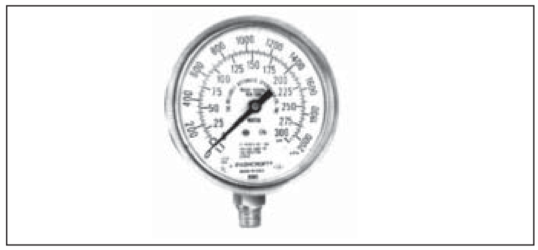


Designed for installation in test lines of sprinkler systems that connect to open drains. Made of bronze with 1” NPT female pipe connections. Orifice gives flow equivalent to one nominal $^1/_2$” (15mm) orifice sprinkler.
Length: $1^7/_8$” (48mm).
Maximum working pressure: 175psi (12bar).

• Model B — Sight Test Connection

Designed for installation on the drain side of the test valve in a test line that connects to a closed drain.
Made of cast iron with clear tube. Smooth bore non–corrosive orifice gives flow equivalent to one nominal $^1/_2$” (15mm) orifice sprinkler. Has 1” NPT pipe connections.
Length: $5^1/_{16}$” (129mm).

• Model UA — Water Pressure Gauge



Range 0 to 300psi in 5psi increments, and 0 to 2000 kPa in 50kPa increments. $^1/_4$” NPT (R$^1/_4$) male pipe connection. Case: $3^1/_2$” diameter (89mm). Height: $4^3/_4$” (121mm). Also available (not shown) with a range of 0 to 600psi (4000kPa) with 10psi (100kPa) increments.

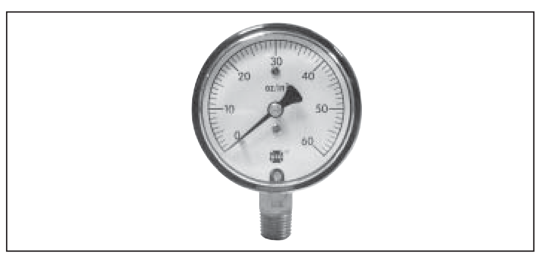
Accuracy: ANSI B40.1 Grade B (3–2–3%)
Underwriters Laboratories Listed, WIKA Instrument
Model 111.10, UL Listed file EX5232
Factory Mutual Approved

• Model UA — Air Pressure Gauge

Range 0 to 80psi in 1psi increments, and 0 to 550kPa in 10kPa increments. Retard to 250psi and 1750kPa. $^1/_4$” NPT (R$^1/_4$) male pipe connection. Case: $3^1/_2$” diameter (89mm). Height: $4^3/_4$” (121mm).

Accuracy: ANSI B40.1 Grade B (3–2–3%)
Underwriters Laboratories Listed, WIKA Instrument
Model 111.10, UL Listed file EX5232
Factory Mutual Approved

• Low Air Pressure Diaphragm Gauge



Range 0 to 60 oz. in 1 oz. increments, and $^1/_4$” NPT (R $^1/_4$) male pipe connection. Case: $^1/_2$” diameter (63.5mm). Height: $3^1/_2$” (88.9mm).

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 over 90 years, and are installed and serviced by the most highly qualified and reputable sprinkler contractors located throughout the United States, Canada and foreign countries.

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VITAULIC FIRELOCK BUTTERFLY VALVE

Operations & Maintenance Manual
December 2015

FireLock® Butterfly Valve

SERIES 705
WITH WEATHERPROOF ACTUATOR

cULus LISTED FM VdS LPCB 104j/04

The Series 705 Butterfly Valve features a weatherproof actuator housing Approved for indoor or outdoor use, a ductile iron body and disc with EPDM seats. Designed for fire protection services only. Victaulic FireLock Series 705 Butterfly Valve is cULus Listed, LPCB Listed, FM and VdS Approved for 300 psi/2068 kPa service. Contact Victaulic for details of agency approvals.

APPROVALS AND LISTINGS

	Approval/Listing Service Pressures Series 705 Butterfly Valve			
	cULus	FM	VdS	LPCB
2"/50mm	up to 300psi/2068kPa	n/a	up to 300psi/2068kPa	up to 300psi/2068kPa
2 1/2"/65mm	up to 300psi/2068kPa	up to 300psi/2068kPa	n/a	up to 300psi/2068kPa
76.1mm	up to 300psi/2068kPa	up to 300psi/2068kPa	up to 300psi/2068kPa	up to 300psi/2068kPa
3"/80mm	up to 300psi/2068kPa	up to 300psi/2068kPa	up to 300psi/2068kPa	up to 300psi/2068kPa
4"/100mm	up to 300psi/2068kPa	up to 300psi/2068kPa	up to 300psi/2068kPa	up to 300psi/2068kPa
5"/125mm	up to 300psi/2068kPa	up to 300psi/2068kPa	n/a	up to 300psi/2068kPa
139.7mm	up to 300psi/2068kPa	up to 300psi/2068kPa	up to 300psi/2068kPa	up to 300psi/2068kPa
6"/150mm	up to 300psi/2068kPa	up to 300psi/2068kPa	up to 300psi/2068kPa	up to 300psi/2068kPa
165.1mm	up to 300psi/2068kPa	up to 300psi/2068kPa	n/a	up to 300psi/2068kPa
8"/200mm	up to 300psi/2068kPa	up to 300psi/2068kPa	up to 300psi/2068kPa	up to 300psi/2068kPa
10"/250mm	up to 300psi/2068kPa	up to 300psi/2068kPa	n/a	up to 300psi/2068kPa
12"/300mm	up to 300psi/2068kPa	up to 300psi/2068kPa	n/a	up to 300psi/2068kPa

JOB/OWNER	CONTRACTOR	ENGINEER
System No. ______	Submitted By ______	Spec Sect ______ Para ______
Location ______	Date ______	Approved ______
		Date ______

FireLock® Butterfly Valve

SERIES 705
WITH WEATHERPROOF ACTUATOR

MATERIAL SPECIFICATIONS

Body: Ductile iron conforming to ASTM A-536, grade 65-45-12

End Face, 2 – 6"/50 – 150 mm: Ductile iron conforming to ASTM A-536, grade 65-45-12

Seal Retainer, 8 – 12"/200 – 300 mm: Ductile iron conforming to ASTM A-536, grade 65-45-12

Coating: Black alkyd enamel

Disc: Ductile iron conforming to ASTM A-536, grade 65-45-12, with electroless nickel coating conforming to ASTM B-733

Seat:

- **Grade "E" EPDM**

Stems: 416 stainless steel conforming to ASTM A-582

Stem Seal Cartridge: C36000 brass

Bearings: Stainless Steel with TFE lining

Stem Seals: EPDM

Stem Retaining Ring: Carbon steel

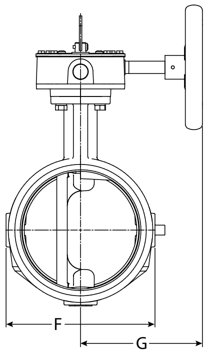
Actuator:

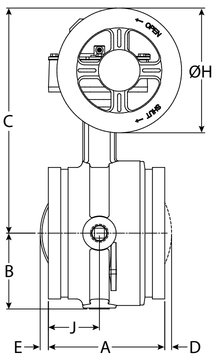
- 2 - 8"/50 - 200mm: Brass or bronze traveling nut on a steel lead screw, in a ductile iron housing
- 10 - 12"/250 - 300mm: Steel worm and cast iron quadrant gear, in a cast iron housing

FireLock® Butterfly Valve

SERIES 705
WITH WEATHERPROOF ACTUATOR

DIMENSIONS –





Note: Optional ½"/15mm tap available.
Contact Victaulic for details.

Size	Dimensions – Inches/millimeters									
Size	Outside Diameter	End to End A	B	C	D	E	F	G	DIA H	J
2" 60.3 mm	2.375 60.3	4.25 108.0	2.28 57.9	6.41 162.8	—	—	4.00 101.6	4.22 107.2	4.50 114.3	2.12 53.8
2½" 73 mm	2.875 73.0	3.77 95.8	2.28 57.9	7.54 191.5	—	—	4.00 101.6	4.22 107.2	4.50 114.3	1.77 45.0
76.1 mm	3.000 76.1	3.77 95.8	2.28 57.9	7.54 191.5	—	—	4.00 101.6	4.22 107.2	4.50 114.3	1.77 45.0
3" 88.9 mm	3.500 88.9	3.77 95.8	2.53 64.3	7.79 197.9	—	—	4.50 114.3	4.22 107.2	4.50 114.3	1.77 45.0
108 mm	4.250 108.0	4.63 117.6	2.88 73.2	8.81 223.8	—	—	5.50 139.7	4.22 107.2	4.50 114.3	2.20 55.9
4" 114.3 mm	4.500 114.3	4.63 117.6	2.88 73.2	8.81 223.8	—	—	5.50 139.7	4.22 107.2	4.50 114.3	2.20 55.9
133 mm	5.250 133.0	5.88 149.4	3.35 85.1	10.88 276.4	—	—	6.56 166.6	6.19 157.2	6.30 160.0	2.58 65.5
139.7 mm	5.500 139.7	5.88 149.4	3.35 85.1	10.88 276.4	—	—	6.56 166.6	6.19 157.2	6.30 160.0	2.58 65.6
5" 141.3 mm	5.563 141.3	5.88 149.4	3.35 85.1	10.88 276.4	—	—	6.56 166.6	6.19 157.2	6.30 160.0	2.58 65.5
159 mm	6.250 159.0	5.88 149.4	3.84 97.5	11.38 289.1	—	0.41 10.4	7.52 191.0	6.19 157.2	6.30 160.0	2.58 65.5
165.1 mm	6.500 165.1	5.88 149.4	3.84 97.5	11.38 289.1	—	0.41 10.4	7.52 191.0	6.19 157.2	6.30 160.0	2.58 65.5
6" 168.3	6.625 168.3	5.88 149.4	3.84 97.5	11.38 289.1	—	0.41 10.4	7.52 191.0	6.19 157.2	6.30 160.0	1.90 48.3
8" 219.1 mm	8.625 219.1	5.33 135.4	5.07 128.8	13.53 343.6	0.80 20.3	1.47 37.3	10.00 254.0	6.19 157.2	8.10 205.7	2.33 59.2
10" 273 mm	10.750 273.0	6.40 162.6	6.37 161.8	15.64 397.3	1.41 35.8	1.81 46.0	12.25 311.2	8.10 205.7	9.00 228.6	—
12" 323.9 mm	12.750 323.9	6.50 165.1	7.36 186.9	16.64 422.7	2.30 58.4	2.80 71.1	14.25 362.0	8.10 205.7	9.00 228.6	—

FireLock® Butterfly Valve

SERIES 705
WITH WEATHERPROOF ACTUATOR

PERFORMANCE

The chart expresses the frictional resistance of Victaulic Series 705 Butterfly Valve in equivalent feet/meters of straight pipe.

Size			Size		
Nominal Size Inches mm	Actual Outside Diameter Inches mm	Equiv. Feet/m of Pipe	Nominal Size Inches mm	Actual Outside Diameter Inches mm	Equiv. Feet/m of Pipe
2 50	2.375 60.3	6 1.8	6 150	6.625 168.3	14 4.2
2½ 65	2.875 73.0	6 1.8	159 mm	159 mm	14 4.3
76.1 mm	3.000 76.1	6 1.8	165.1 mm	6.500 165.1	14 4.2
3 80	3.500 88.9	7 2.1	8 200	8.625 219.1	16 4.9
4 100	4.500 114.3	8 2.4	10 250	10.750 273.0	18 5.5
108 mm	108 mm	8 2.4	12 300	12.750 323.9	19 5.8
5 125	5.563 141.3	12 3.7			
133 mm	133 mm	12 3.7			
139.7 mm	5.500 139.7	12 3.7			

FireLock® Butterfly Valve

SERIES 705
WITH WEATHERPROOF ACTUATOR

PERFORMANCE

C_V values for flow of water at +60°F/+16°C with a fully open valve are shown in the table below. For additional details, contact Victaulic.

Formulas for C_V Values:

$$\Delta P = \frac{Q^2}{C_v^2}$$

$$Q = C_v \times \sqrt{\Delta P}$$

Where:
Q = Flow (GPM)
ΔP = Pressure Drop (psi)
C_v = Flow Coefficient

Size		C_V	Size		C_V	Size		C_V
Nominal Size Inches mm	Actual Outside Diameter Inches mm	(Full Open)	Nominal Size Inches mm	Actual Outside Diameter Inches mm	(Full Open)	Nominal Size Inches mm	Actual Outside Diameter Inches mm	(Full Open)
2	2.375 60.3	170	5 125	5.563 141.3	1200	8 200	8.625 219.1	3400
2½ 65	2.875 73.0	260	133 mm	133 mm	1200	10 250	10.750 273.0	5800
76.1 mm	3.000 76.1	260	139.7 mm	5.500 139.7	1200	12 300	12.750 323.9	9000
3 80	3.500 88.9	440	6 150	6.625 168.3	1800			
4 100	4.500 114.3	820	159 mm	159 mm	1800			
108 mm	108 mm	820	165.1 mm	6.500 165.1	1800			

Formulas for K_V Values:

$$\Delta P = \frac{Q^2}{K_v^2}$$

$$Q = K_v \times \sqrt{\Delta P}$$

Where:
Q = Flow $\left(\frac{m^3}{hr.}\right)$
ΔP = Pressure (bar)
K_v = Flow Factor

Size		K_V	Size		K_V	Size		K_V
Nominal Size Inches mm	Actual Outside Diameter Inches mm	(Full Open)	Nominal Size Inches mm	Actual Outside Diameter Inches mm	(Full Open)	Nominal Size Inches mm	Actual Outside Diameter Inches mm	(Full Open)
2	2.375 60.3	147	5 125	5.563 141.3	1040	8 200	8.625 219.1	2940
2½ 65	2.875 73.0	225	133 mm	133 mm	1040	10 250	10.750 273.0	5020
76.1 mm	3.000 76.1	225	139.7 mm	5.500 139.7	1040	12 300	12.750 323.9	7790
3 80	3.500 88.9	380	6 150	6.625 168.3	1560			
4 100	4.500 114.3	710	159 mm	159 mm	1560			
108 mm	108 mm	710	165.1 mm	6.500 165.1	1560			

FireLock® Butterfly Valve

SERIES 705
WITH WEATHERPROOF ACTUATOR

SWITCH AND WIRING

1. The supervisory switch contains two single pole, double throw, pre-wired switches.
2. Switches are rated:

   10 amps @ 125 or 250 VAC/60 Hz

   0.50 amps @ 125 VDC

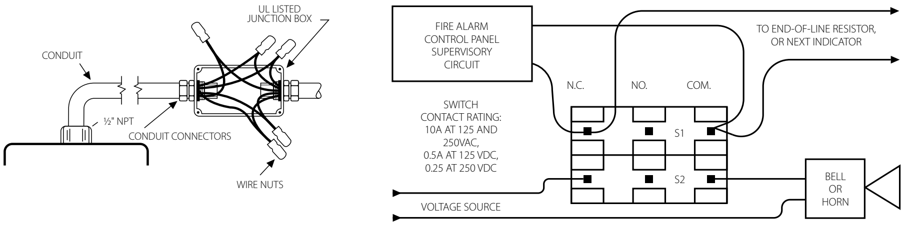
   0.25 amps @ 250 VDC
3. **Switches supervise the valve in the "OPEN" position.**
4. One switch has two #18 insulated wires per terminal, which permit complete supervision of leads (refer to diagrams and notes below). The second switch has one #18 insulated wire per terminal. This double circuit provides flexibility to operate two electrical devices at separate locations, such as an indicating light and an audible alarm, in the area that the valve is installed.
5. A #14 insulated ground lead (green) is provided.

   Switch #1 = S1 For connection to the supervisory circuit of a UL Listed alarm control panel

   Switch #2 = S2 Auxiliary switch that may be connected to auxiliary devices, per the authority having jurisdiction

S1 { Normally Closed: (2) Blue
Common: (2) Yellow

S2 { Normally Closed: Blue with Orange Stripe
Normally Open: Brown with Orange Stripe
Common: Yellow with Orange Stripe



NOTE: The above diagram shows a connection between the common terminal (yellow – S1 and yellow-with-orange stripe – S2) and the normally closed terminal (blue – S1 and blue-with-orange stripe – S2). In this example, the indicator light and alarm will stay on until the valve is fully open. When the valve is fully open, the indicator light and alarm will go out. Cap off any unused wires (e.g. brown with orange stripe).

Only S1 (two leads per terminal) may be connected to the fire alarm control panel.

The connection of the alarm switch wiring shall be in accordance with NFPA 72 and the auxiliary switch per NFPA 70 (NEC).

FireLock® Butterfly Valve

SERIES 705
WITH WEATHERPROOF ACTUATOR

WARRANTY

Refer to the Warranty section of the current Price List or contact Victaulic for details.

NOTE

This product shall be manufactured by Victaulic or to Victaulic specifications. All products to be installed in accordance with current Victaulic installation/assembly instructions. Victaulic reserves the right to change product specifications, designs and standard equipment without notice and without incurring obligations.

INSTALLATION

Reference should always be made to the installation sheet included with the valve. Verify you have the latest revision by visiting our website at www.victaulic.com. Further reference can be found in the I-100 Victaulic Field Installation Handbook.

VITAULIC FIRELOCK CHECK VALVES

Operations & Maintenance Manual
December 2015

FireLock® Check Valves
Series 717 & 717H

victaulic 10.08

Series 717
(2½ – 3"/65 – 80 mm)

Series 717
(4 – 12"/100 – 300 mm)

Series 717H
High Pressure Check Valve
(2 – 3"/50 – 80 mm)

Approvals/Listings:

c UL us LISTED FM VdS LPCB

See Victaulic Publication 10.01 for more details.

The FireLock Series 717 Check Valve and Series 717H High Pressure Check Valves are CAD designed for hydrodynamic efficiency and available in 2"/50 mm – 3"/80 mm (Series 717H) and 2 ½"/65 mm – 12"/300 mm (Series 717) sizes.

Series 717H valves are cULus Listed and FM Approved for service up to 365 psi/2517 kPa. See chart below for approved services for the Series 717 valves.

In both valve designs, the single-disc mechanism incorporates a spring-assisted feature for nonslamming operation. This spring-assisted, single-disc design achieves a leak-free seal with as little as 5ft /1.5m of head. Series 717 and 717H FireLock Check Valves can be installed either vertically (flow upwards only) or horizontally. A cast flow arrow indicator is provided to assist with proper valve orientation. Both valves include upstream and downstream pressure taps. Each valve is factory-tested to the rated working pressure. For systems requiring a Riser Check option, refer to publication 10.09.

Grooved ends allow fast, easy installation with just two Victaulic couplings or the valve may be mounted to flanged (ANSI CL.150) equipment using either to Victaulic Style 741 Vic-Flange® or Style 744 FireLock flange adapters on either end.

Job/Owner

System No.	
Location	

Contractor

Submitted By	
Date	

Engineer

Spec Section	
Paragraph	
Approved	
Date	

Material Specifications:

Housing:

Ductile iron conforming to ASTM A-536, grade 65-45-12. Ductile iron conforming to ASTM A-395, grade 65-45-15, is available upon special request.

Body Coating:

Series 717H Body: Black Paint
Series 717H Endface: Electroless Nickel
Series 717 (2 ½ – 3"): PPS Coating
Series 717 (4 – 12"): Black Paint

Body Seat:

Series 717H – Nitrile O-ring installed into an electroless nickel plated endface
Series 717 (2 ½ – 3"): PPS Coated ductile iron
Series 717 (4 – 12"): Electroless Nickel plated

Disc Seal or Coating: (specify choice[1])

☐ Grade "T" nitrile (Series 717H Only)

Nitrile (Orange color code). Temperature range –20°F to +180°F/–29°C to +82°C. Recommended for petroleum products, air with oil vapors, vegetable and mineral oils within the specified temperature range; except hot, dry air over +140°F/+60°C and water over +150°F/+66°C. NOT RECOMMENDED FOR HOT WATER SERVICES.

☐ Grade "E" EPDM (Series 717 Only)

EPDM (green color code). Temperature range -30°F to +230°F/-34°C to +110°C. Recommended for cold and hot water service within the specified temperature range plus a variety of dilute acids, oil-free air and many chemical services. NOT RECOMMENDED FOR PETROLUEM SERVICES.

[1] Services listed are General Service Recommendations only. It should be noted that there are services for which these gaskets are not recommended. Reference should always be made to the latest Victaulic Gasket Selection Guide for specific gasket service recommendations and for a listing of services which are not recommended.

Discs:

- Series 717H (2 – 3"/50 – 80 mm): CF8M Cast Stainless Steel
- Series 717 (2 ½ – 3"): Aluminum bronze with elastomer seal
- Series 717 (4 – 12"/100 – 300 mm): Elastomer encapsulated disc with electroless nickel plated seat

Shaft:

- Series 717H (2 – 3"/50 -80 mm): Brass
- Series 717 (2 ½ – 3"): Type 416 Stainless Steel
- Series 717 (4 – 12"/100 – 300 mm) Type 316 Stainless Steel

Spring: All sizes Type 302/403 Stainless Steel

Shaft Plug:

- Series 717H (2 – 3"/50 – 80 mm): Type 416 Stainless Steel
- Series 717 (2 ½ – 12"/65 – 300 mm): Carbon steel zinc plated

Pipe Plug:

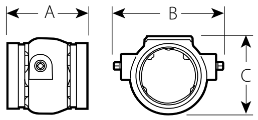
- Series 717H (2 – 3"/50 – 80 mm): carbon steel zinc plated
- Series 717 (4 – 12"/100 – 300 mm): Carbon steel zinc plated

Approval/Listing:

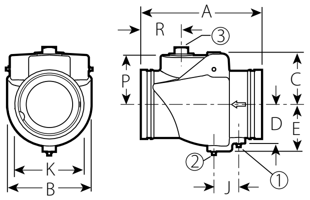
Size	Approval/Listing Service Pressures			
	Series 717H			
	cULus	FM	LPCB	Vds
2"/50 mm	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa
2½"/65 mm	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa
76.1 mm	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa
3"/80 mm	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa
4"/100 mm	n/a	n/a	n/a	n/a
5"/125 mm	n/a	n/a	n/a	n/a
139.7 mm	n/a	n/a	n/a	n/a
6"/150 mm	n/a	n/a	n/a	n/a
165.1 mm	n/a	n/a	n/a	n/a
8"/200 mm	n/a	n/a	n/a	n/a
10"/250 mm	n/a	n/a	n/a	n/a
12"/300 mm	n/a	n/a	n/a	n/a

Size	Approval/Listing Service Pressures			
	Series 717			
	cULus	FM	LPCB	Vds
2"/50 mm	n/a	n/a	n/a	n/a
2½"/65 mm	up to 250 psi/1725 kPa	n/a	up to 365 psi/2517 kPa	n/a
76.1 mm	up to 250 psi/1725 kPa	n/a	up to 365 psi/2517 kPa	up to 16bar/232 psi
3"/80 mm	up to 250 psi/1725 kPa	n/a	up to 365 psi/2517 kPa	up to 16bar/232 psi
4"/100 mm	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 16bar/232 psi
5"/125 mm	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	n/a
139.7 mm	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 16bar/232 psi
6"/150 mm	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 16bar/232 psi
165.1 mm	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	n/a
8"/200 mm	up to 365 psi/2517 kPa	up to 365 psi/2517 kPa	up to 348 psi/2400 kPa	up to 16bar/232 psi
10"/250 mm	up to 250 psi/1725 kPa	up to 250 psi/1725 kPa	up to 1725 kPa/250 psi	n/a
12"/300 mm	up to 250 psi/1725 kPa	up to 250 psi/1725 kPa	up to 1725 kPa/250 psi	n/a

Dimensions - Series 717:

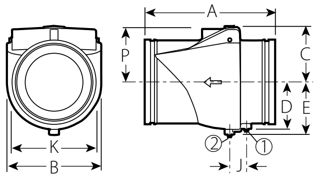


Typical 2 ½ – 3"/65 – 80 mm



① ½" NPT Upstream Drain
② ½" NPT Downstream Drain
③ 2" NPT (Drain Optional)

Typical 4 – 8"/100 – 200 mm

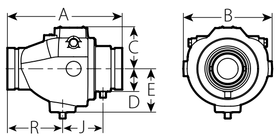


① ½" NPT Upstream Drain
② ½" NPT Downstream Drain

Typical 10 – 12"/250 – 300 mm

Nominal Size	Actual Outside Diameter	Dimensions									Approx. Weight Each
		E to E A	B	C	D	E	J	K	P	R	
inches mm	inches mm	inches mm	inches mm	inches mm	inches mm	inches mm	inches mm	inches mm	inches mm	inches mm	lbs. kg
2½ 65	2.875 73.0	3.88 99	4.26 108	3.57 91	–	–	–	–	–	–	3.6 1.6
76.1 mm	3.000 76.1	3.88 99	4.26 108	3.57 91	–	–	–	–	–	–	3.6 1.6
3 80	3.500 88.9	4.25 108	5.06 129	4.17 106	–	–	–	–	–	–	4.5 2.0
4 100	4.500 114.3	9.63 245	6.00 152	3.88 99	2.75 70	3.50 89	2.00 51	4.50 114	3.50 89	3.35 85	20.0 9.1
5 125	5.563 141.3	10.50 267	6.80 173	4.50 114	–	4.17 106	2.15 55	5.88 149	4.08 104	3.98 101	27.0 12.3
139.7 mm	5.500 139.7	10.50 267	6.80 173	4.50 114	–	4.17 106	2.15 55	5.88 149	4.08 104	3.98 101	27.0 12.3
6 150	6.625 168.3	11.50 292	8.00 203	5.00 127	–	4.50 114	2.38 61	6.67 169	4.73 120	3.89 99	38.0 17.2
165.1 mm	6.500 165.1	11.50 292	8.00 203	5.00 127	–	4.50 114	2.38 61	6.67 169	4.73 120	3.89 99	38.0 17.2
8 200	8.625 219.1	14.00 356	9.88 251	6.06 154	5.05 128	5.65 144	2.15 55	8.85 225	5.65 144	5.75 146	64.0 29.0
10 250	10.750 273.0	17.00 432	12.00 305	7.09 180	5.96 151	6.69 170	2.15 55	10.92 277	6.73 171	–	100.0 45.4
12 300	12.750 323.9	19.50 495	14.00 356	8.06 205	6.91 176	7.64 194	2.51 64	12.81 925	7.73 196	–	140.0 63.5

Dimensions - Series 717H:

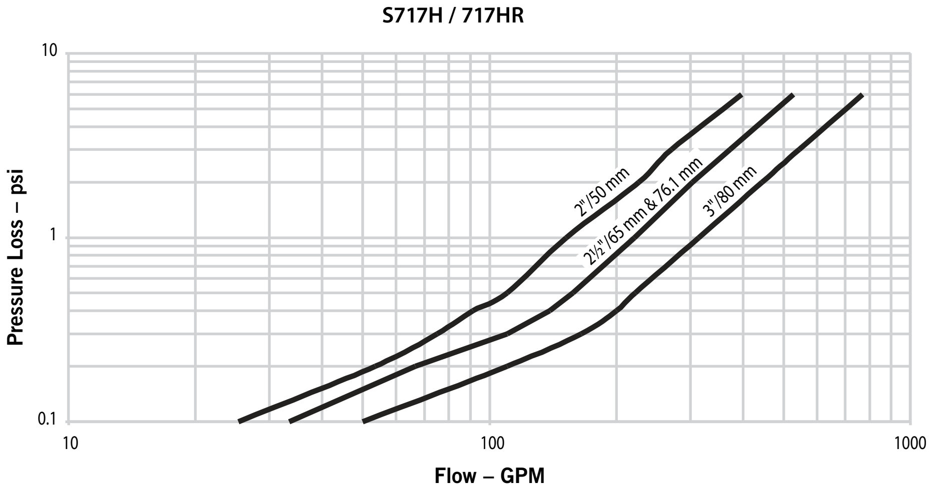


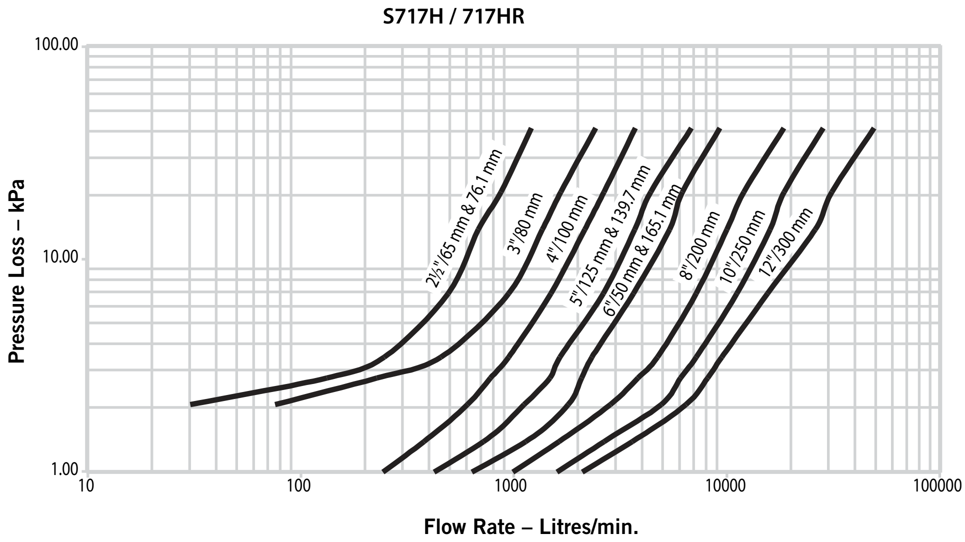
Typical 2"/50 mm – 3"/80 mm

Nominal Size	Dimensions									Approx. Weight Each
	E to E A	B	C	D	E	J	K	P	R	
inches mm	inches mm	inches mm	inches mm	inches mm	inches mm	inches mm	inches mm	inches mm	inches mm	lbs. kg
2 50	8.66 219.8	6.46 164.1	3.23 82.1	1.48 37.5	3.02 76.7	2.80 71.0	–	–	4.25 108.0	10.7 4.9
2½ 65	9.37 238.0	6.94 176.3	3.31 84.1	1.66 42.2	3.40 86.4	3.38 85.9	–	–	4.38 111.3	13.8 6.3
76.1 mm	9.37 238.0	6.94 176.3	3.31 84.1	1.66 42.2	3.40 86.4	3.38 85.9	–	–	4.38 111.3	13.8 6.3
3 80	9.62 244.3	7.44 189.0	3.53 89.7	1.91 48.5	3.65 92.7	3.38 85.9	–	–	4.63 117.6	20.0 9.1

Flow Characteristics

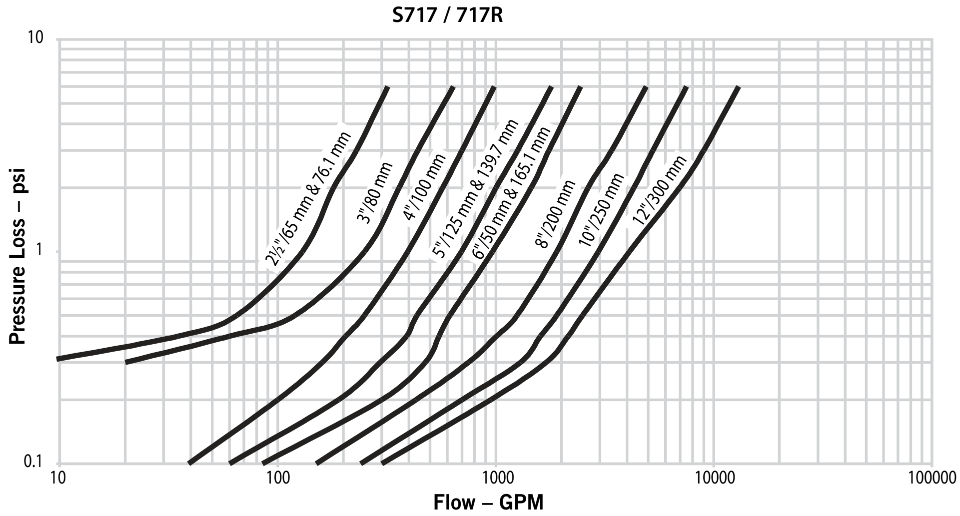
The charts below express the flow of water at 60°F/16°C through valve.

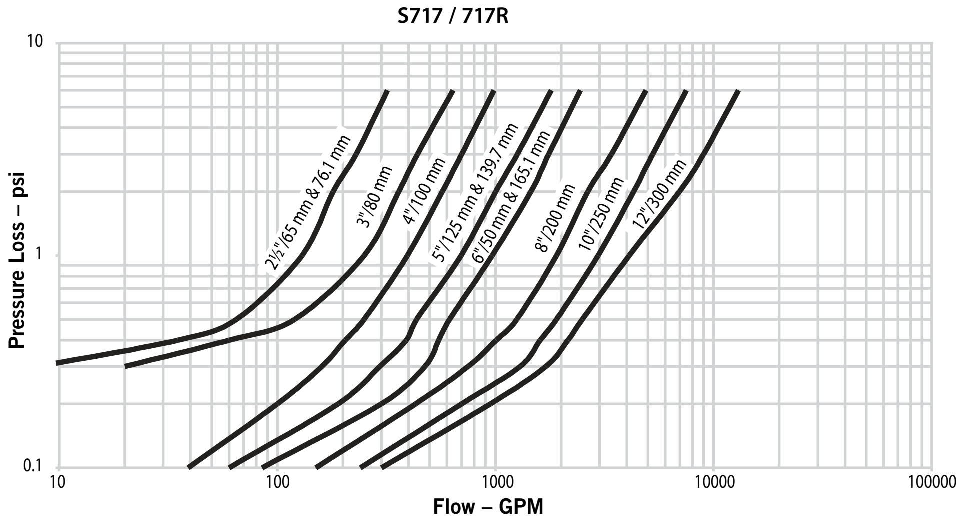




Flow Characteristics

The charts below express the flow of water at 60°F/16°C through valve.





Installation
Reference should always be made to the I-100 Victaulic Field Installation Handbook for the product you are installing. Handbooks are included with each shipment of Victaulic products for complete installation and assembly data, and are available in PDF format on our website at www.victaulic.com.

Warranty
Refer to the Warranty section of the current Price List or contact Victaulic for details.

Note
This product shall be manufactured by Victaulic or to Victaulic specifications. All products to be installed in accordance with current Victaulic installation/assembly instructions. Victaulic reserves the right to change product specifications, designs and standard equipment without notice and without incurring obligations.

Trademarks
Victaulic and FireLock are registered trademarks of Victaulic Company.

KENNEDY FLANGE VALVES, RESILIENT SEAT GATE VALVES, & WALL TYPE INDICATOR POSTS

Operations & Maintenance Manual
December 2015

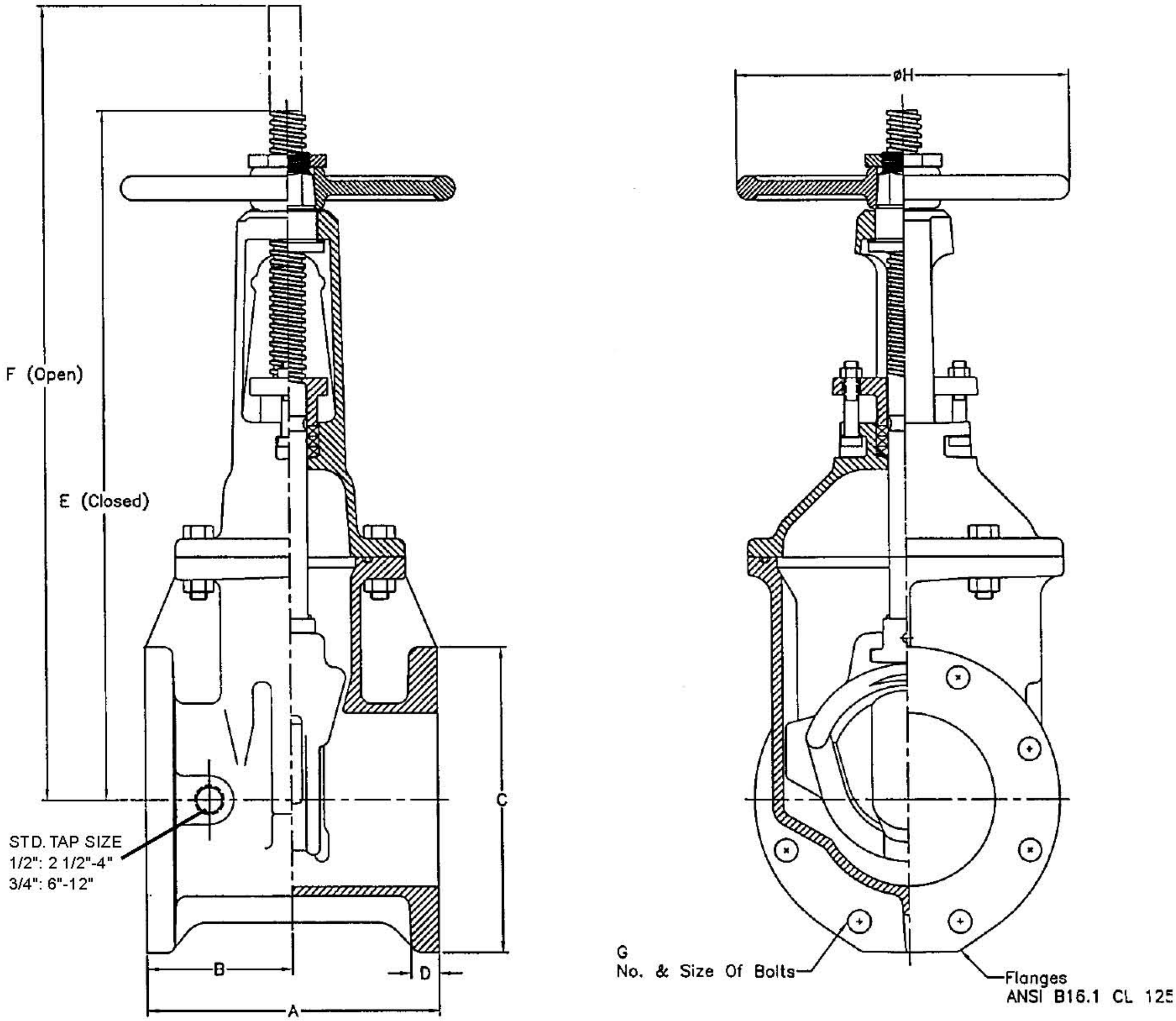
LISTED UL 888H · FM APPROVED · ULC

Complies with applicable requirements of AWWA C509

2" - 12" R/S VALVE FLANGE ENDS OS&Y GENERAL DIMENSIONS

KENNEDY VALVE MODEL KS-FW

8068A



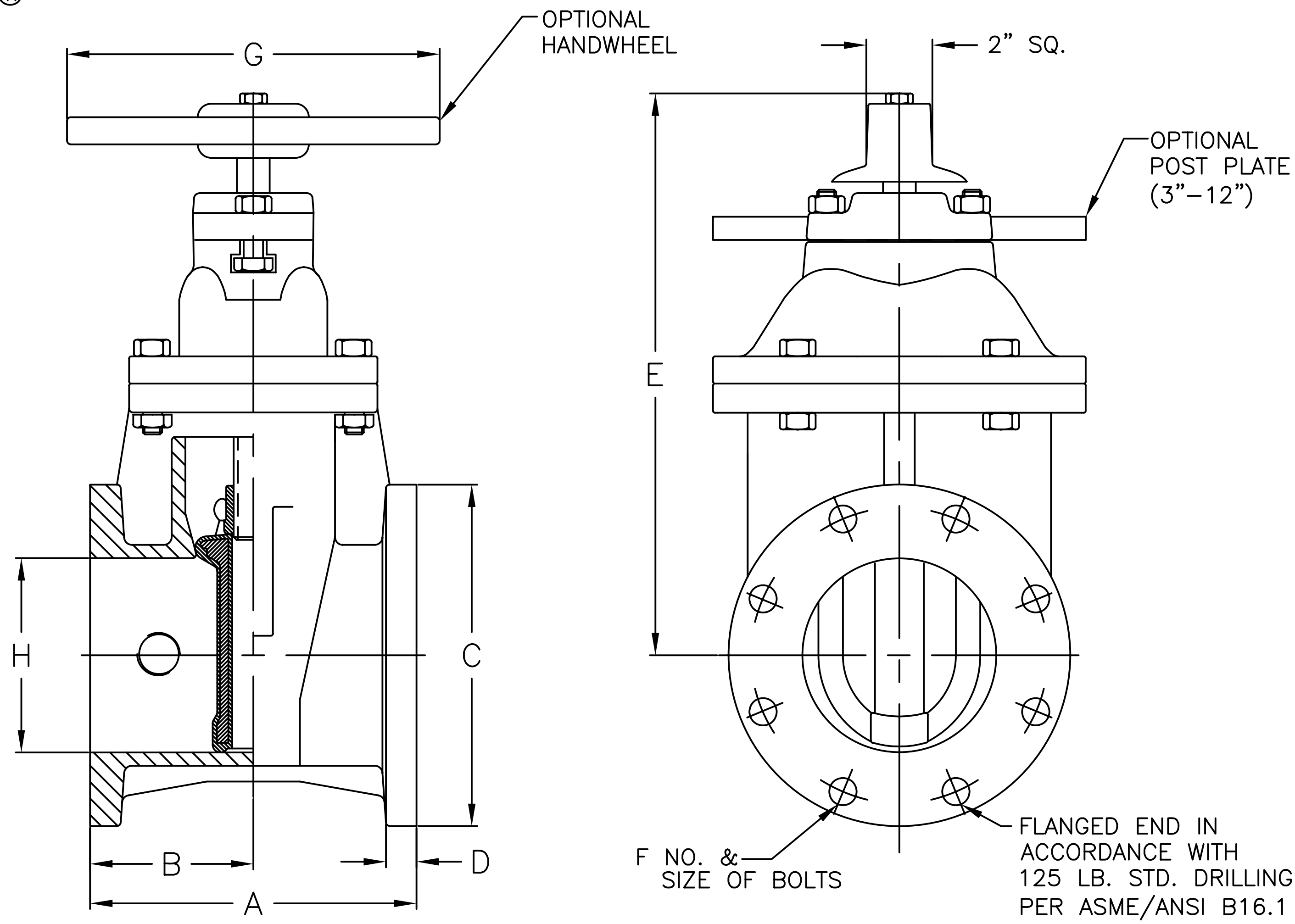
VALVE SIZE	A	B	C	D	E	F	G	H	WEIGHT
2	7	3 1/2	6	11/16	12	10	4 5/8	7 1/4	N/A
2 1/2	7 1/2	3 3/4	7	11/16	13 7/8	16 3/8	4 5/8	7 1/4	51
3	8	4	7 1/2	3/4	15 5/8	18 7/8	4 5/8	10	64
4	9	4 1/2	9	15/16	18 1/4	22 3/4	8 5/8	10	105
6	10 1/2	5 1/4	11	1	23 3/4	30 1/8	8 3/4	12	152
8	11 1/2	5 3/4	13 1/2	1 1/8	29 1/4	37 3/4	8 3/4	14	253
10	13	6 1/2	16	1 3/16	35 3/8	45 3/4	12 7/8	18	427
12	14	7	19	1 1/4	40 5/8	53 1/8	12 7/8	18	581

ALL FLANGE VALVES TAPPED & PLUGGED @ POSITION "A"

LISTED UL 888H · F M APPROVED · NSF

A.W.W.A Standard C509

8561AN WITH 2" SQUARE NUT
8561A WITH HANDWHEEL
8701A WITH POST PLATE (3"–12")



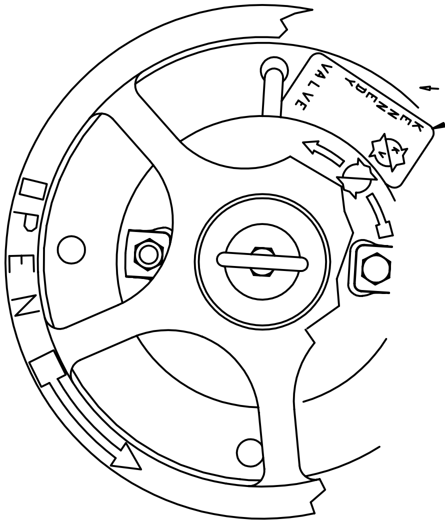
VALVE SIZE	A	B	C	D	E	F	G	H	WEIGHT 2" NUT
**2	7	3 1/2	6	5/8	10 7/8	4 5/8	7 1/4	2	41
**2 1/2	7 1/2	3 3/4	7	11/16	11 3/8	4 5/8	7 1/4	2 1/2	51
3	8	4	7 1/2	3/4	12 3/8	4 5/8	10	3	62
4	9	4 1/2	9	15/16	14 3/4	8 5/8	10	4 1/4	87
6	10 1/2	5 1/4	11	1	19	8 3/4	12	6 1/4	134
8	11 1/2	5 3/4	13 1/2	1 1/8	22 1/2	8 3/4	14	8 1/4	205
10	13	6 1/2	16	1 3/16	26 1/2	12 7/8	18	10 1/4	331
12	14	7	19	1 1/4	30	12 7/8	18	12 1/4	515

*HANDWHEEL--ADD 1# (2" – 2 1/2"), 6.5# (3"–4"), 7#(6"), 10#(8"), 16#(10" & 12")
*INDICATOR POST PLATE ADD 16# (3"–12") ONLY
*PALLET QUANTITIES 2" NUT: 46(2 1/2"), 30(3"), 40(4"), 21(6"), 8(8)", 6(10"), 4(12")
*PALLET QUANTITIES HANDWHEEL: 36(2" & 2 1/2"), 30(3"), 40(4"), 21(6"), 8(8"), 6(10"), 4(12")
*TURNS TO OPEN: 7 3/4(2"), 8(2 1/2"), 10(3"), 13 1/2(4"), 19 1/2(6"),
25 1/2(8"), 31 1/2(10"), 37 3/4(12")
**2" and 2 1/2" not included in AWWA C509

KENNEDY VALVE
ELMIRA, NEW YORK
A DIVISION OF MCWANE INC.

DWN: TRIJ
DATE: 7/1/05
DWG. NO. SD-9

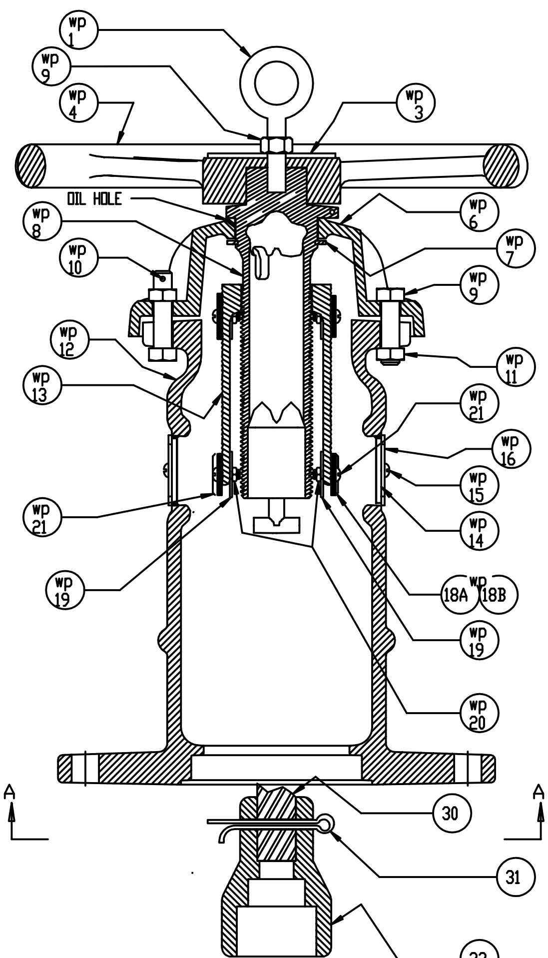
3" THRU 12"
RESILIENT SEAT GATE VALVE
C509-STYLE 8561AN
FLANGED ENDS

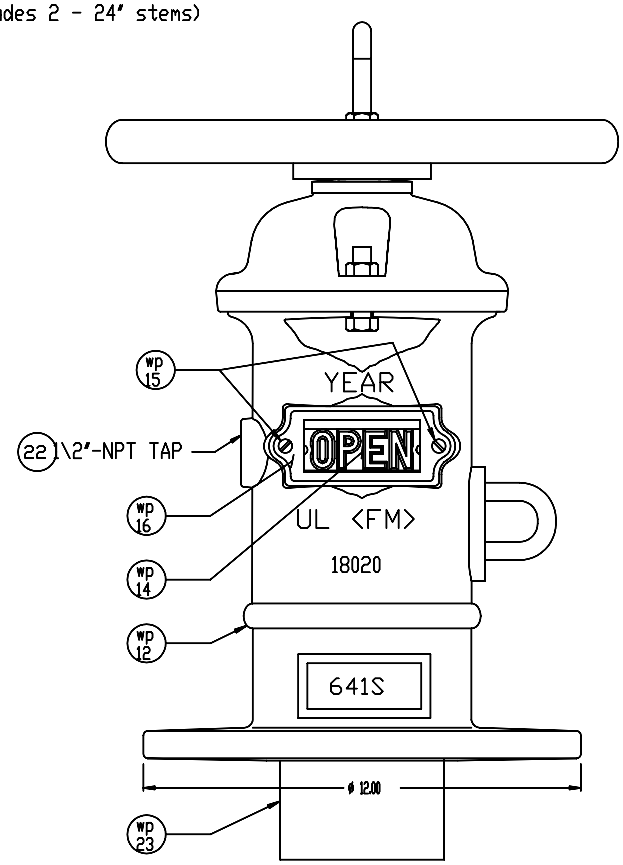


TOP VIEW

NO	ITEM	MATERIAL	QTY	SPEC	PART NUMBER
WP-1	EYE BOLT 1/2-UNC 2" LG	STL	1		440253P
WP-2	NUT 1/2-UNC PLATED	STL	1		477495P
WP-3	WASHER 5.8 0 PLATED	STL	1		445834P
WP-4	HANDWHEEL-14"DIA	CI	1		446015P
WP-5	COVER	CI	1	A126-B	3180282
WP-6	RETAINER RING #5100-225	STL	1		443599P
WP-7	OPER STEM NUT	BR	1	AWWA'A'	3180165
WP-8	NUTS 1\2-UNC PLATED	RP STL	2		442482P
WP-9	BOLT 1\2-UNC x 2"	RP STL	1	A304	444419P
WP-10	BOLT 1\2-UNC x 1.75"	RP STL	1	A304	444348P
WP-11	TOP SECT.-WALL POST	CI	1	A126-B	3180203
WP-12	TARGET NUT	BR	1	AWWA'A'	3180172
WP-13	WINDOWS - FLAT	PLAST	2		441982P
WP-14	SCREWS-SELF TAP		4		444435P
WP-15	FERRULE	STL	2		441587P
WP-16	PROTECTIVE STEEL PLATES	STL	2		443344P
WP-17A	TARGET PLATE (OPEN)	ALUM	2		443348P
WP-17B	TARGET PLATE (SHUT)	ALUM	2		443350P
WP-18	CLAMPS -PLATED	STL	4		440734P
WP-19	NUTS-SQUARE	STL	8		442576P
WP-20	MACH SCREW-RD HEAD	BR	8		444432P
WP-21	PIPE PLUG-1\2 NPT	IRON	1		443476P
WP-22/23/24	PIPE-4" NPT 13" LG		1 EA.		2180912
WP-22	STEM -(ORD. BY LG)	STL	1		445312L
WP-23	COTTER PIN	BR	1		442190P
WP-24	CRANE COUPLING	CI	1		318035&
WP-25	ADJUSTMENT CARD		1		440443P
WP-26	MARKING TAG	MYLAR	1		

Figure 551 - Angle Wall Post Kit, use with 641-13 wall post
(Style "A" includes 2 - 18" stems)
(Style "B" includes 2 - 24" stems)





KENNEDY VALVE ELMIRA, NEW YORK A DIVISION OF MCWANE INC.	DWN: TRIJ DATE: 6/2/03 DWG. NO. PV–A1	WALL TYPE INDICATOR POST FIG 641 ASSEMBLY & PARTS LIST

BERMAD PRESSURE RELIEF VALVES

Operations & Maintenance Manual
December 2015

Pressure Relief Valve

Model: FP 430-UF

1½" - 4"

6" - 12"

~~FM APPROVED~~ ~~UL LISTED~~

Description

The BERMAD Model FP 430-UF pilot operated valve prevents over pressure, maintaining a constant preset system pressure regardless of fluctuating demands.

~~UL Listed (up to 175 psi) and FM Approved according to NFPA 20.~~

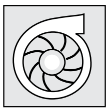
The valve offers reliable performance in:

Refineries, petrochemical complexes, tank farms,

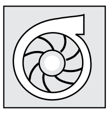
high-rise buildings, aviation, marine and on-shore installations.

THE RELIEF VALVE WILL BE FACTORY SET TO OPEN AT 265 PSI

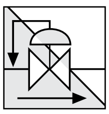
Typical Applications



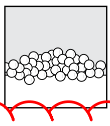
Pressure relief for individual diesel fire pump



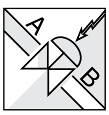
Pump station pressure relief



Centralized thermal pressure relief



Foam recirculation; maintains required foam pressure



Zone safety relief

Features and Benefits

- **Advanced Elastomeric Globe type –** Low pressure loss
- **One-piece molded elastomeric moving part –** No maintenance required
- **Simple design –** Cost effective
- **In-line serviceable –** Minimal down time

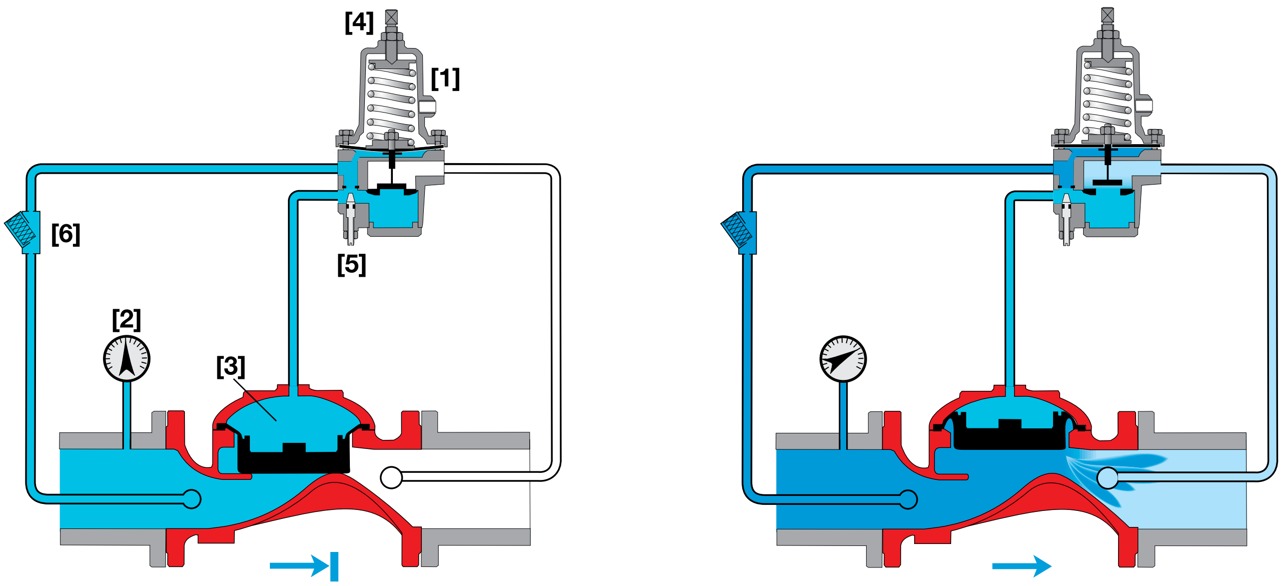
Optional Features

- **Large control filter** (code: F)
- **Seawater service construction**
- **Valve Position Single/Double Limit Switches**

Note: Optional features can be mixed and matched.
Consult your local BERMAD representative for full details

Operation

The BERMAD Model FP 430-UF remains closed as long as the sensed upstream pressure is lower than the adjustable set point. When the Pressure Relief Pilot **[1]** senses upstream pressure **[2]** that is higher than the pilot setting, it acts upon the control chamber **[3]** causing the main valve to modulate open, relieving excess pressure to either a reservoir or sump, thus preventing system over pressure. The Pressure Relief Pilot is equipped with an adjusting screw **[4]** to preset the desired upstream pressure, and an integral adjustable needle valve **[5]** to control the main valve closing speed. The valve's unique design provides quick reaction to system demand and keeps pressure loss at a minimum. The control system is equipped with a control strainer **[6]**.



Valve Closed **Valve Open** (pressure-relief)

Engineer Specifications

The Pressure Relief Valve shall be UL-Listed, FM-Approved, and hydraulic pilot controlled. The main valve shall be an elastomeric type globe valve with a rolling-diaphragm.
Valve actuation shall be accomplished by a fully peripherally supported, one-piece balanced rolling-diaphragm, vulcanized with a rugged radial seal disk. The diaphragm assembly shall be the only moving part.
The valve shall have an **unobstructed flow path**, with no stem guide or **supporting ribs**.
The valve shall have a removable cover for quick in-line service enabling all necessary inspection and servicing.
The pilot system shall be field adjustable, with adjustable valve closing speed integrated into the main valve, hydraulically tested and supplied as an assembly consisting of:

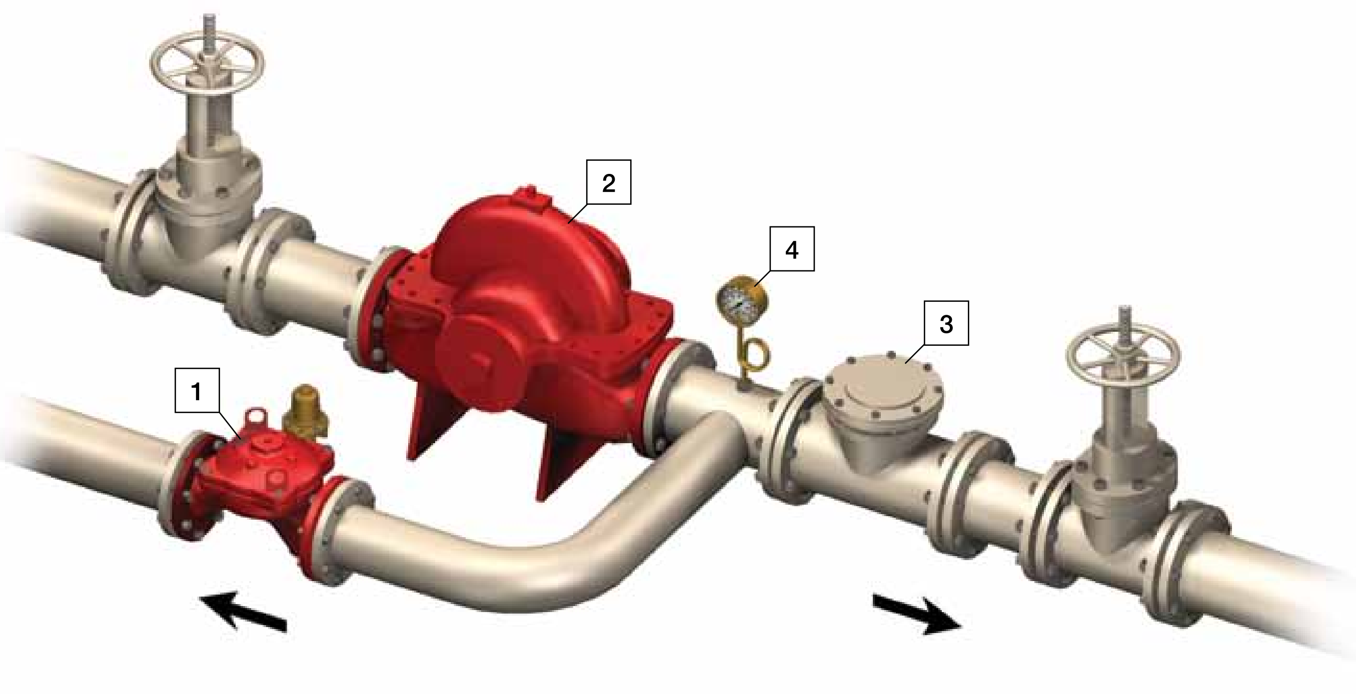
- Relief pilot valve UL-Listed and FM-Approved as part of the assembly with built-in, internal needle valve
- "Y" strainer

The control trim shall be supplied as an assembly, pre-assembled and hydraulically tested at an ISO 9000 and 9001 certified factory.

Typical Installations

System Components

1 - BERMAD Model FP 430-UF
2 - Fire Pump
3 - Check Valve
4 - Pressure Gauge



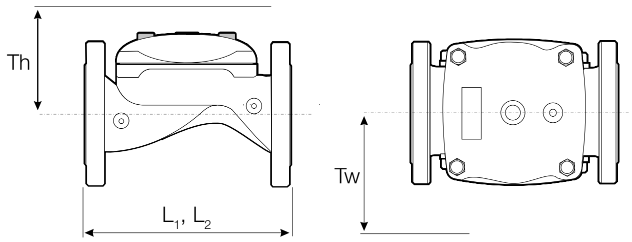
Installation Considerations

- Valve size should be no less than NFPA-20 requirements.
- Provide adequate clearance around valve for maintenance, ensuring that the actuator can be easily removed.
- Design installation with the valve cover up for best performance.
- Ensure that before the valve is installed, instructions are given to flush the pipeline at full flow.

Approvals

The BERMAD Model FP 430-UF is UL-Listed and FM-Approved when installed as a unit.

Technical Data



Size		2"		2½"		3"		4"		6"		8"		10"		12"	
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
Dimensions	L_1 (1)	205	8½	205	8½	257	10⅛	320	12 9/16	415	16 5/16	500	19 11/16	605	23 13/16	725	28½
	L_2 (2)	180	7 1/16	210	8¼	255	10 1/16	N/A	N/A	N/A	N/A	500	19 11/16	N/A	N/A	N/A	N/A
	Tw	284	11 3/16	284	11 3/16	300	11 3/16	313	12 5/16	341	13 7/16	415	16 5/16	443	17 7/16	481	18 15/16
	Th	210	8¼	210	8¼	215	8 7/16	243	9 9/16	315	12⅜	350	13¾	382	15	430	6 15/16

Notes:
1. L_1 is for flanged valves.
2. L_2 is for threaded NPT or ISO-7-Rp.
3. Tw & Th are max. for pilot system.
4. Data is for envelope dimensions, component positioning may vary.
5. Provide space around valve for maintenance.

Connection Standard
- Flanged: ANSI B16.42 (Ductile Iron), B16.5 (Steel & Stainless Steel), B16.24 (Bronze)
- ISO PN16
- Threaded: NPT or ISO-7-Rp for 2, 2½ & 3"
- Grooved: ANSI/AWWA C606 for 2, 3, 4, 6 & 8"

Water Temperature
- 0.5 – 50°C (33 – 122°F)

Available Sizes
- Globe: 2, 2½, 3, 4, 6, 8, 10 & 12"
- UL Listed and FM approved: 2, 2½, 3, 4 & 6"

~~**UL Listed / FM Pressure Rating**~~
- ~~Max. inlet: 175 psi (12 bar)~~
- ~~Set: 30 - 175 psi (2 - 12 bar)~~
- ~~Test: 365 psi (25 bar)~~

THE RELIEF VALVE WILL BE FACTORY SET TO OPEN AT 265 PSI

Manufacturers Standard Materials

Main valve body and cover
- Ductile Iron ASTM A-536

Main valve internals
- Stainless Steel & Elastomer

Control Trim System
- Brass control components/accessories
- Stainless Steel 316 tubing & fittings

Elastomers
- Polyamide fabric reinforced Polyisoprene, NR

Coating
- Electrostatic Powder Coating Polyester, Red (RAL 3002)

Optional Materials

Main valve body
- Carbon Steel ASTM A-216 WCB
- Stainless Steel 316
- Ni-Al-Bronze ASTM B-148

Control Trim
- Stainless Steel 316
- Monel® and Al-Bronze
- Hastelloy C-276

Elastomers
- NBR
- EPDM

Coating
- High Build Epoxy Fusion-Bonded with UV Protection, Anti-Corrosion

Approvals
- UL Listed - Fire Pump Relief Valve (QXZQ)
- FM Approved - Water Relief Valve and Fire Pump Relief Valve
- ISO 9001 QA certified
- ABS approval 2-12"
- Lloyd's Registered 2-12"

PATTERSON PUMP COMPANY
A Gorman-Rupp Company

TELEPHONE:
706-886-2101
FAX 706-886-0023

Post Office Box 790
Toccoa, Georgia 30577

INSTALLATION, OPERATION AND MAINTENANCE MANUAL SUMMARY SHEET

WESTERN STATES FIRE PROTECTION CO. 7026 S. TUCSON WAY CENTENNIAL CO 80112 USA	DATE:	MAY 29, 2015	
	PROJECT:	WSFP-EJMT	
	SERIAL NO:	FP-C0136866	

ATTN:
WE ARE SENDING YOU (1) CD MANUAL

DRAWINGS			**DRIVER**	
Order Copy		XX	Manual	XX
Outline Dimension	AC-11500-1	XX		
Assembly Drawing	C02-101391	XX	**DRIVER CONTROLLER**	
Rotational View		XX	Manual	XX
Certified Curve		XX		
L1		XX	**JOCKEY PUMP**	
C02-99430 Air Release Valve		XX	Manual	
C02-99432 Suction and Discharge Gauges				
C02-99433 Hose Valves			**JP CONTROLLER**	
C02-99439 Enclosed Waste Cone			Manual	
C02-99448 CDI				
C02-99441 ESR			**MISCELLANEOUS**	
C02-102005 Outside Hose Valve Header			Pressure Relief Valve	XX
C02-99668 MRV			Air Release Valve	XX
L6			Wika Gauges	XX
Engine Silencer			Coupling	XX
Heat Exchange By-Pass			GVI Flow Meter	
Fuel Tank			Cla-Val MRV	
Layout / Piping Connection		XX	Cash Acme	
PUMP			Asco	
Patterson IOM		XX	Ameridrive Shaft	
Spare Parts List			Emergency Vent Valve	
Inspection and Maintenance Schedule		XX	Leak Sensing Float Switch Assembly	

Warranty

Patterson Pump Company and Divisions of Patterson Pump Company ("Patterson") warrants, to the extent hereinafter set forth, each new piece of Patterson equipment to be free from defects in material and workmanship under the normal use and service for which it was intended if, and only if, it has been properly installed and operated.

Patterson's obligation under the warranty is limited to replacing or repairing, free of charge, F.O.B. point of manufacture, any defective part or parts of the equipment that were manufactured by Patterson and which are returned to Patterson at Toccoa, Georgia, provided that such part or parts are received at the Patterson factory not later than twelve (12) months after installation or eighteen (18) months after shipment whichever occurs first.

As to a part or parts such as engines, motors and accessories which are furnished by Patterson, but not manufactured by it, same will carry only the warranty of the manufacturer of such part or parts, and this shall be the limit of Patterson's liability with respect to such part or parts. Mechanical seals provided on commercial products (HVAC & Plumbing) are not covered by this warranty.

Purchaser must notify Patterson by registered or certified mail, return receipt requested, of a claimed breach of warranty within thirty (30) days after discovery thereof, but not later than the termination of the guarantee period hereinabove provided; otherwise, such claim shall be deemed waived.

Purchaser assumes all risk and liability whatsoever resulting from the use thereof, whether used singly or in combination with other equipment or machinery.

This warranty shall not apply to any Patterson Equipment, or parts thereof, which have been repaired or altered without Patterson's written consent, outside Patterson's factory, or which have been altered in any way so as in the judgement of Patterson, to affect adversely the performance or reliability of the Patterson equipment, or which have been subject to misuse, negligence or accident, or which have been operated under conditions more severe than, or otherwise exceeding, those set forth in the specifications for such equipment.

THIS WARRANTY IS FURNISHED EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE NOT OTHERWISE SET FORTH IN A WRITING SIGNED BY AN AUTHORIZED REPRESENTATIVE OF PATTERSON.

Patterson shall not be liable for any loss or damage resulting, directly or indirectly, from the use or loss of use of the equipment. Without limiting the generality of the foregoing, this exclusion from liability embraces the Purchaser's expenses for downtime or for making up downtime, and/or damage for which the purchaser may be liable to other persons, and/or damages to property, and/or injury to or death of any persons. Patterson neither assumes nor authorizes any person to assume for it any other liability in connection with the sale or use of the Patterson Equipment.

PATTERSON PUMP COMPANY / A Subsidiary of Gorman-Rupp
2129 Ayersville Road
Box 790 / Toccoa, Georgia 30577 (706) 886-2101 / FAX (706) 886-0023
www.pattersonpumps.com

PATTERSON MOTOR DRIVEN PUMP

Operations & Maintenance Manual
December 2015

Order Verification

A Gorman-Rupp Company

PATTERSON PUMP COMPANY

2129 AYERSVILLE RD
P.O. BOX 790
TOCCOA, GEORGIA 30577
PHONE 706/886-2101

INVOICE TO: 58433 **ROUTE TO:** 13

INVOICE TO	ROUTE TO
WESTERN STATES FIRE PROTECTION CO. 7026 S. TUCSON WAY CENTENNIAL CO 80112 USA	RELIABLE 2256 N Pagosa St Aurora CO 80011-8128 USA

Tag For: WSFP-EJMT **Shipping Terms:** FOB FACTORY PREPAY & DEDUCT

ORDER	CUST PO	SHIP VIA	TERMS	ORDER DATE	VERIFICATION
C000136866	4201-636322	BEST WAY	NET 30 DAYS	2/19/2015	5/29/2015

LINE/REL	DUE DATE	QTY ORDERED		ITEM	UNIT PRICE	NET AMOUNT
1 0	5/14/2015	EA	1.000	FP-C000136866-1	0.00000	0.00
JOB: 301857				PATTERSON MOTOR DRIVEN PUMP		

1 8" X 6" TYPE MABSH
UL-FM APPROVED
POSITIVE PRESSURE FIRE PUMP
DESIGN: 1250 GPM 115 PSI
266.00 TDH 1780 RPM
COUNTER-CLOCKWISE ROTATION
SUCTION-125# FLG DISCHARGE-250# FLG
MATCH CURVE C049863 W/MINIMUM HP.
DOMESTIC CASTINGS REQUIRED

1 BASE-PLATE, STANDARD

1 COUPLING, SPECIAL LISTED COUPLING

1 COUPLING GUARD

1 NIDEC, 150.0 H/P, 1780 RPM,
3 PHASE, 60 CYCLE, 460 VOLT
OPEN DRIPPROOF MOTOR, FRAME-444TS
SOFT START
UL LABELED 1.15SF
HIGH ELEVATION MOTOR
PER QUOTE

1 MASTER MODEL-MCSTZ225-150-46
COMBINED MANUAL AND AUTOMATIC
FIRE PUMP CONTROLLER
SOFT START
FREE STANDING
RATED FOR 3 PHASE, 60 CYCLE,
460 VOLT, 150.0 H/P OPERATION,
WITH 100000 AIC
TRANSFER SWITCH

Order Verification

PATTERSON PUMP COMPANY

A Gorman-Rupp Company

2129 AYERSVILLE RD
P.O. BOX 790
TOCCOA, GEORGIA 30577
PHONE 706/886-2101

INVOICE TO: 58433

ROUTE TO: 13

WESTERN STATES FIRE PROTECTION CO.
7026 S. TUCSON WAY
CENTENNIAL CO 80112
USA

RELIABLE
2256 N Pagosa St
Aurora CO 80011-8128
USA

Tag For: WSFP-EJMT

Shipping Terms: FOB FACTORY PREPAY & DEDUCT

ORDER	CUST PO	SHIP VIA	TERMS	ORDER DATE	VERIFICATION
C000136866	4201-636322	BEST WAY	NET 30 DAYS	2/19/2015	5/29/2015

LINE/REL	DUE DATE	QTY ORDERED	ITEM	UNIT PRICE	NET AMOUNT

1 CD MANUAL
UP TO 8 FIELD PROGRAMMABLE CONTACTS (6 ON MCV)
L PUMP ROOM TEMP SWITCH
REMOTE START ONLY FIRE PUMP

PUMP ACCESSORIES
1 1/2" 175# AUTOMATIC AIR RELEASE VALVE
1 GLYCERIN 4 PRESSURE GAUGES -
300 LBS W/ GAUGE COCKS
PCA # F
1 3/4" CASING RELIEF VALVE, 300#

ONE LOT SHIPMENT:
1 CD MANUALS
.

CONTACT FRED ZACHREL AT 303-591-5226 AND ANDREW BOLEI AT 303-792-0022 ONE WEEK PRIOR TO SHIPMENT

Trucker to Call John 720-284-2472 24 Hours before Delivery

SHIPPING TERMS: FOB FACTORY PREPAY & DEDUCT

THIS IS AN ORDER ACKNOWLEDGEMENT, NOT AN INVOICE. DO NOT PAY FROM THIS DOCUMENT. AN INVOICE WILL BE SENT TO YOU FOLLOWING SHIPMENT OF THE EQUIPMENT.

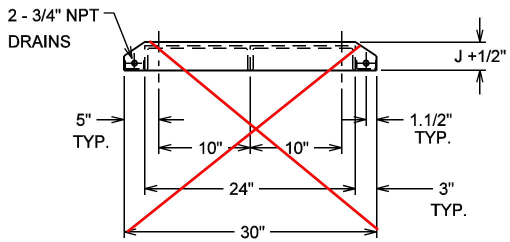
Sales Amount:		0.00
Sales Tax:		0.00
Freight:		0.00
Misc:		0.00
Prepaid:		0.00
Total (USD):	$	0.00

MOTOR	A	B	C	D	E	F	G	H	J
405 TS	72.7/32"	17.3/4"	13.3/32"	20"	12"	33"	70"	3/8"	3"
444 TS	75.1/8"	19.1/2"	14.1/4"	20"	12"	36"	76"	3/8"	3"
445 TS	77.1/8"	20.1/2"	15.1/4"	20"	12"	36"	76"	3/8"	3"
447 TS	80.7/8"	22.1/4"	17.1/4"	20"	12"	40"	84"	3/8"	3"

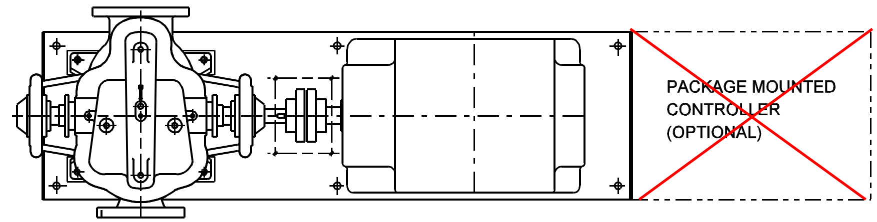
NOTE: 1) CLOCKWISE ROTATION SHOWN WHEN VIEWED FROM DRIVER END, SUCTION ON RIGHT, DISCHARGE ON LEFT.
FOR COUNTERCLOCKWISE ROTATION, SUCTION IS ON LEFT, DISCHARGE IS ON RIGHT. WHEN VIEWED FROM DRIVER END.

2) 5" GROUT HOLES ARE PROVIDED

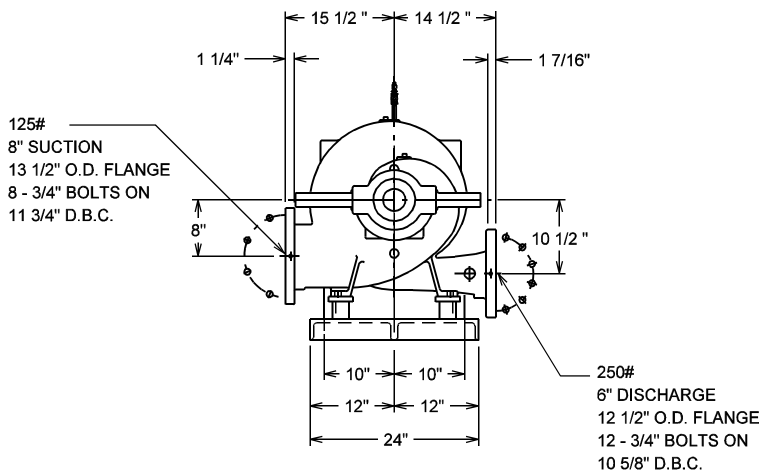
CONTROLLER	AA	BB	CC
FIRETROL FTA 1000A	26"	67.5/8"	34"



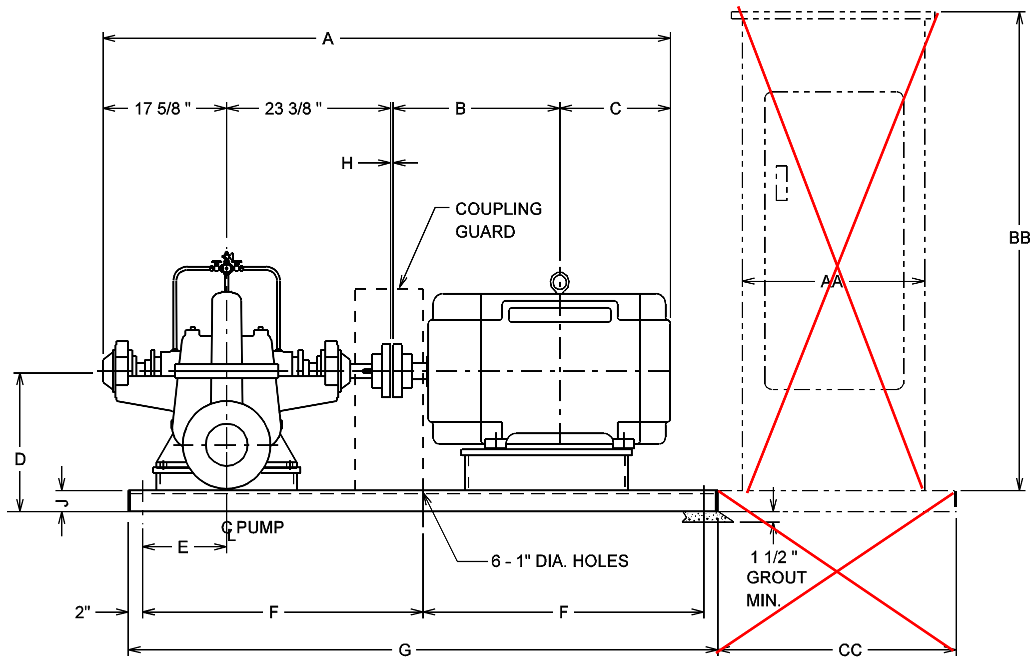
DRIP RIM BASE (OPTIONAL)



TOP VIEW



D.B.C. 'S STRADDLE ℄



UNIT UL-FM APPROVED OUR ORDER No. FP-C0136866

JOB WSFP-EJMT CUSTOMER ORDER No. 4201-636322

PUMP 8X6MABSH CAPACITY 1250 G.P.M. @ 266 FT. HD.

MOTOR ODP MAKE NIDEC FRAME 444TS

150 H.P. 3 PHASE 60 CYCLE 460 VOLT 1780 R.P.M.

CONTROLLER MASTER MCST

CERTIFIED BY: AMY ALLEN DATE 5-29-15

REV. 1 ECN# 10040 4-11-00 VC

PATTERSON PUMP COMPANY
A SUBSIDIARY OF THE GORMAN-RUPP COMPANY

OUTLINE DIMENSIONS
for
8 X 6 MABSH

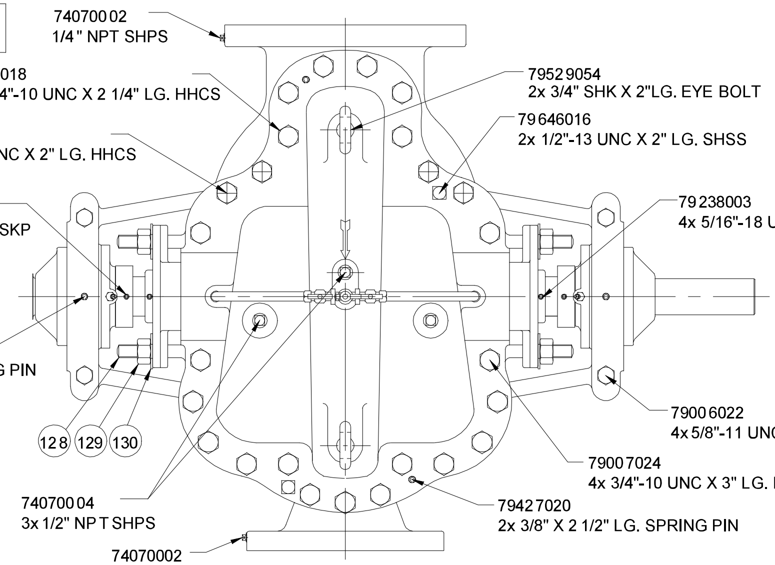
DWG. NO.	
AC - 11500-1	
DRAWN ADAMS	DATE 12-9-91
SCALE NONE	APPR. A.P.

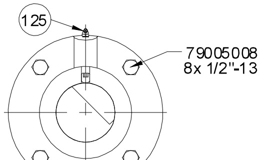
FP - 68

ITEM	DESCRIPTION	PART NO.
1A	LOWER HALF CASING	
1B	UPPER HALF CASING	
2	IMPELLER	
6	SHAFT	23000072
7	CASING RING	23011488
8	IMPELLER RING (OPTIONAL)	23000167
13	PACKING	73040008
13A	O-RING	74080229
14	SHAFT SLEEVE	23000161
16	INBOARD BEARING (RADIAL)	74010010
17	PACKING GLAND	23030201
18	OUTBOARD BEARING (THRUST)	74010043
20	SLEEVE NUT	23000127
22	BEARING LOCKNUT (RADIAL)	74010104
22A	BEARING LOCKNUT (THRUST)	74010102
29	LANTERN RING	23000125
31	INBOARD BEARING HOUSING	23000268
32	IMPELLER KEY	23139184
33	OUTBOARD BEARING HOUSING	23000268
35	INBOARD BEARING COVER	23000284
37	OUTBOARD BEARING COVER	23000284
40	DEFLECTOR	23000136
41	INBOARD BEARING CAP	23001274
41A	OUTBOARD BEARING CAP	23001274
46	COUPLING KEY	23103112
63	STUFFING BOX BUSHING	23000128
68	SHOULDER RING	23000129
69	BEARING LOCKWASHER (RADIAL)	74010075
69A	BEARING LOCKWASHER (THRUST)	74010073
123	END CAP	23000185
125	GREASE FITTING	76000006
127	SEAL WATER PIPING	——
128	GLAND BOLT	23001242
129	GLAND BOLT NUT	79526078
130	GLAND BOLT WASHER	79527019

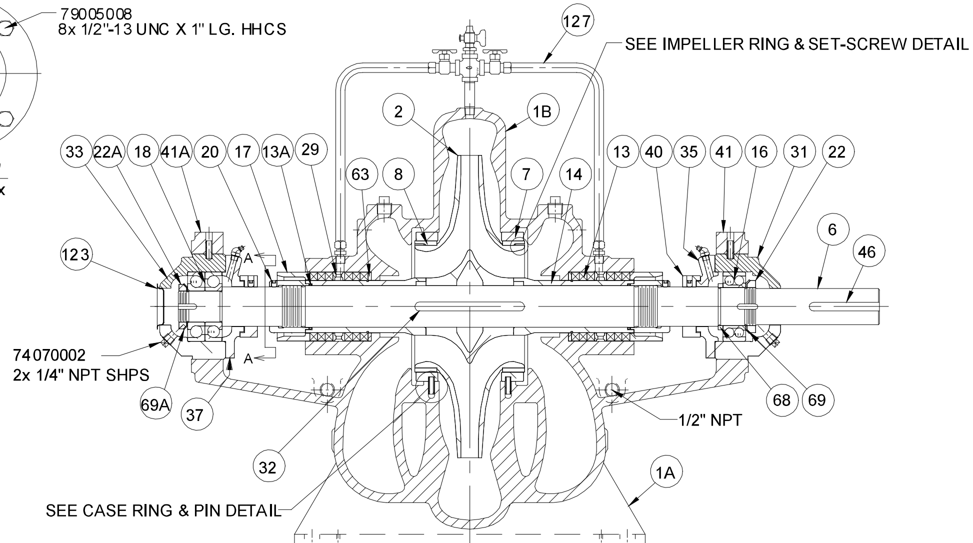
NOTE: THRUST / OUTBOARD BEARING MUST BE MOUNTED IN THE BACK TO BACK POSITION.

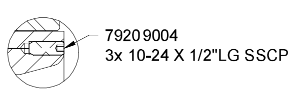
SUCTION & DISCHARGE DRAINS ARE 1/2" NPT (NOT SHOWN)



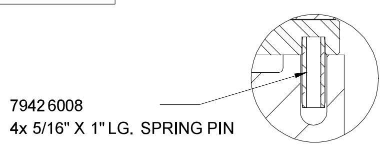


VIEW "A-A"
SCALE: 1.5x





IMPELLER RING &
SET-SCREW DETAIL



CASE RING & PIN DETAIL

SOME FEATURES ARE SHOWN ROTATED FOR CLARITY.

PATTERSON PUMP COMPANY
A SUBSIDIARY OF THE GORMAN-RUPP COMPANY

ASSEMBLY SECTION
FOR
8 X 6 MABS

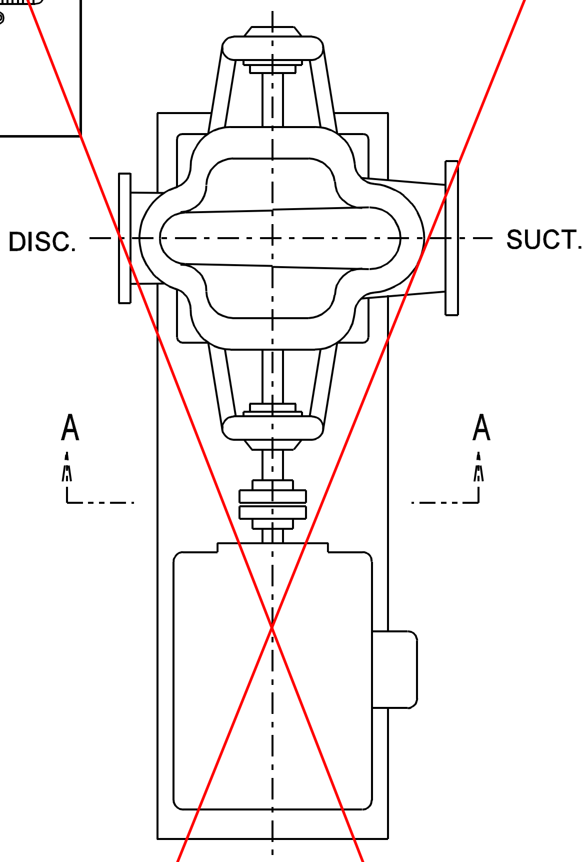
DWG. NO.		REV.
C02-101391		
DRAWN	DATE	
MATT C.	1/18/2006	
SCALE	APPRVD.	
NONE	A.P.	

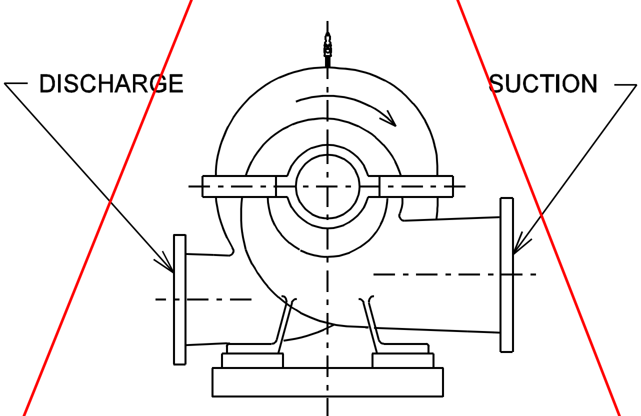
ROTATIONAL VIEWS

PATTERSON PUMP COMPANY
GORMAN-RUPP COMPANY

-1 REV. ECR#16314, 7/24/03, MC

CLOCKWISE ROTATION

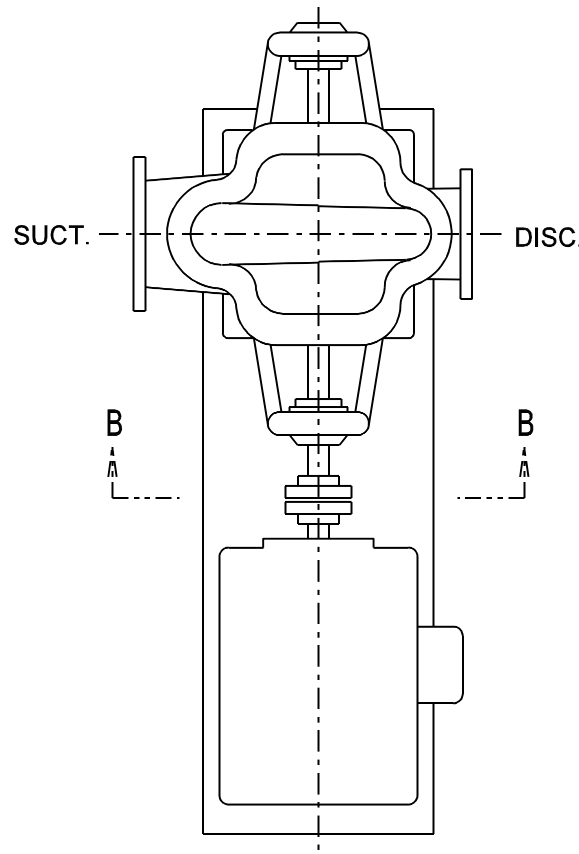


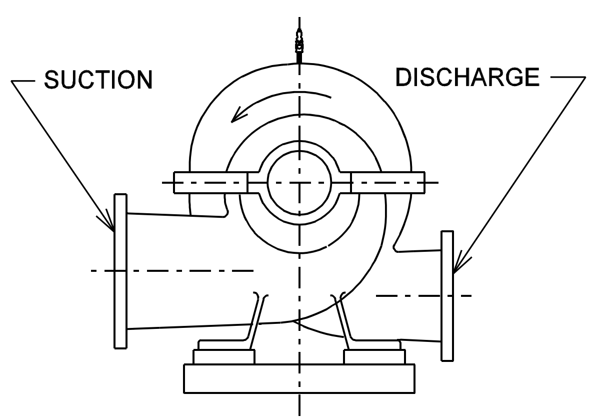


VIEW A-A

CW ______ PRINT ______ SIGN

COUNTERCLOCKWISE ROTATION





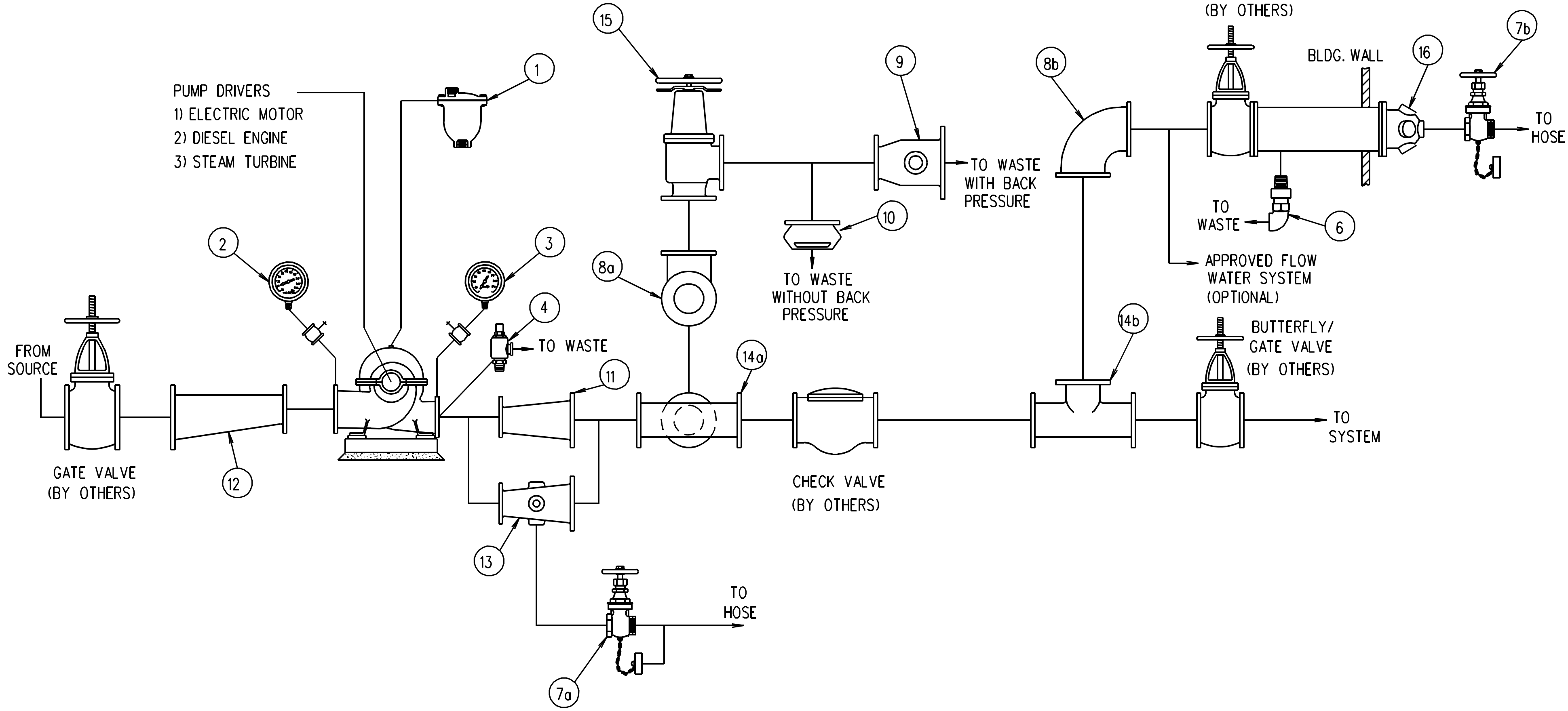
VIEW B-B

CCW ______ PRINT ______ SIGN

ROTATION MUST BE VERIFIED BY END USER / CONSULTANT PRIOR TO MANUFACTURING.

AE-15100-1

FOR DETAIL DRAWING OF NUMBERED PIECES
SEE CORRESPONDING NUMBER ON DRAWINGS



1) AUTOMATIC AIR RELEASE VALVE	10) OPEN WASTE CONE
2) SUCTION GAUGE	11) CONCENTRIC DISCHARGE INCREASER
3) DISCHARGE GAUGE	12) ECCENTRIC SUCTION REDUCER
4) CASING RELIEF VALVE	13) INSIDE HOSE VALVE HEADER
6) BALL DRIP VALVE	14) TEE
7) HOSE VALVE	15) MAIN RELIEF VALVE
8) 90° ELBOW	16) OUTSIDE HOSE VALVE HEADER
9) ENCLOSED WASTE CONE	

NOTE:

1) ITEM 5 REPLACES ITEM 1 FOR MANUAL SYSTEM.
2) ITEMS 8a, 9, 10, 14a, & 15, ARE USED FOR VARIABLE SPEED DRIVES & PUMP PRESSURES ABOVE THE RATED SYSTEM PRESSURE.
3) ITEM 4 IS USED WITH ELECTRIC & STEAM TURBINE DRIVES ONLY.
4) ITEM 7a & 13 ARE USED WITH INSIDE HOSE VALVE HEADER ONLY.

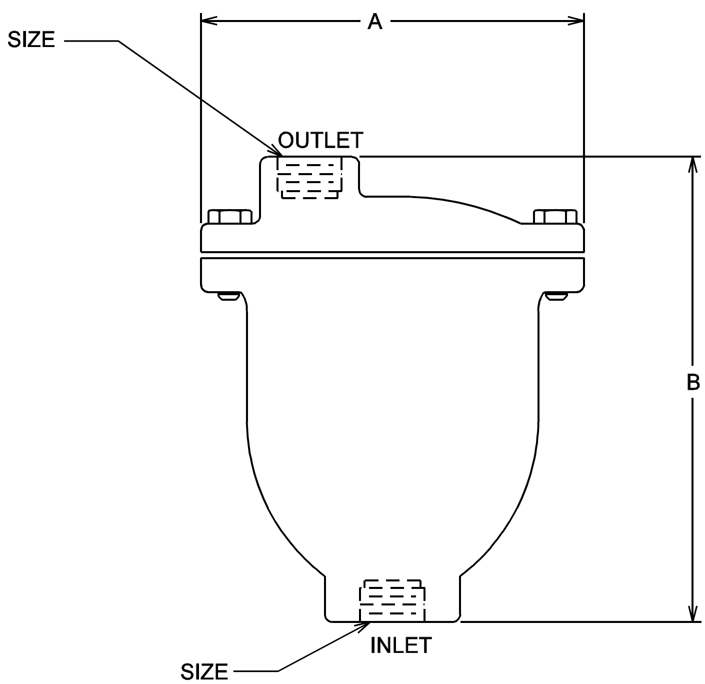
-2 REV. ECN#13448, 4/04/02, MC

PATTERSON PUMP COMPANY
A SUBSIDIARY OF THE GORMAN-RUPP COMPANY
TOCCOA, GEORGIA

GENERAL FIRE PUMP
OPERATING LAYOUT

DRAWN	DATE	DRAWING NO.
SAP	12-21-79	L1-2
SCALE: NONE	APPRVD: YR	

	HORIZONTAL (SPLITCASE)	VERTICAL
SIZE N.P.T.	1/2"	2"
A	5.1/8"	9.1/2"
A IN METRIC	(130.1)	(241.3)
B	6.3/8"	12"
B IN METRIC	(161.9)	(304.8)
MAT'L	BRASS	C.I.



PRIMARY DIMENSIONS ARE IN INCHES
SECONDARY DIMENSIONS ARE METRIC.

PATTERSON PUMP COMPANY
A SUBSIDIARY OF THE GORMAN-RUPP COMPANY

AUTOMATIC AIR RELEASE VALVE

DWG. NO.	REV.
C02-99430	

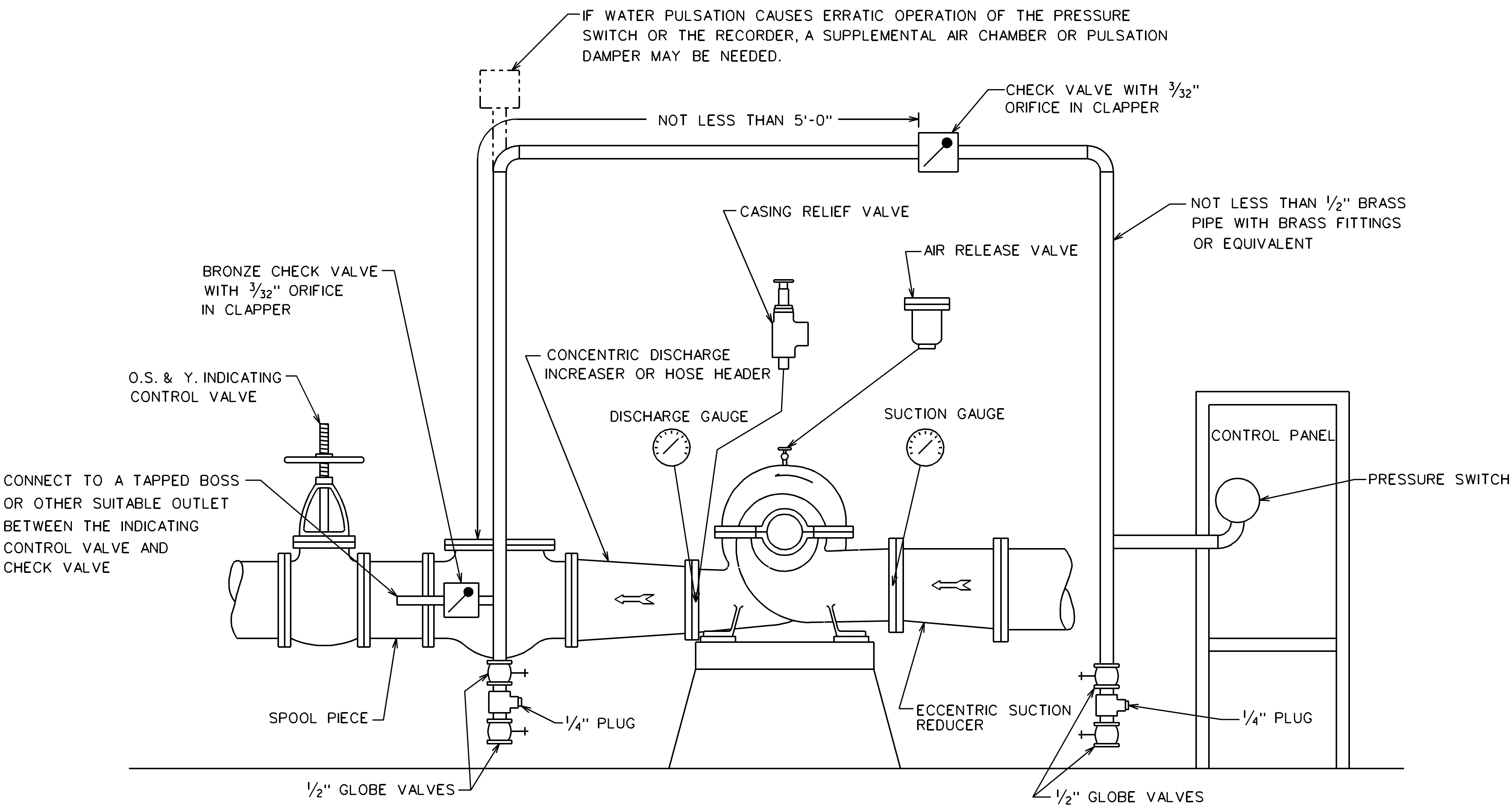
DRAWN	DATE
MEALOR	8/25/05
SCALE	APPRVD.
NONE	AP

NOTE: DIAGRAM IS IN CONFORMITY WITH N.P.H.A. PAMPHLET 20

PATTERSON PUMP COMPANY
A SUBSIDIARY OF THE GORMAN-RUPP COMPANY

PIPING CONNECTION FOR AUTOMATIC PRESSURE SWITCH

DWG. NO.	
L00-1011-2	
DRAWN: PURCELL	DATE: 5-14-90
SCALE: NONE	APPRVD.: A.P.



OPERATION & MAINTENANCE MANUAL

for

DOUBLE SUCTION SPLIT CASE PUMPS

PATTERSON PUMP COMPANY
A SUBSIDIARY OF THE GORMAN-RUPP COMPANY
PO Box 790
9201 Ayersville Road
Toccoa, Georgia 30577
Telephone: 706-886-2101
Fax: 706-886-0023

SAFETY PRECAUTIONS

WARNING

Do not operate this equipment in excess of its rated speed or other than in accordance with the instructions contained in this manual.

The equipment has been found satisfactory of the conditions for which it was sold, but its operation in excess of these conditions may subject it to stresses and strains which it was not designed to withstand.

For equipment covered by this instruction book, it is important to observe safety precautions to protect personnel from possible injury. Among the many considerations, personnel should be instructed to:

- avoid contact with rotating parts
- avoid bypassing or rendering inoperative any safeguards or protective devices
- avoid extended exposure in close proximity to machinery with high noise levels
- use proper care and procedures in handling, lifting, installing, operating and maintaining the equipment
- do not modify this equipment – consult factory if modification is deemed necessary
- do not substitute for repair parts which can be provided by the equipment manufacturer.

Safe maintenance practices with qualified personnel are imperative.

Failure to heed this warning may result in an accident causing personal injury.

TABLE OF CONTENTS

SECTION I

GENERAL INFORMATION

This manual covers the installation, operation and maintenance of Patterson Pump horizontal split case pumps. The pump is a centrifugal, single stage, double suction type. When properly installed and when given reasonable care and maintenance, centrifugal pumps should operate satisfactorily for a long period of time. Centrifugal pumps use the centrifugal force principal of accelerating the liquid within a rotating impeller, and then collecting it and converting it to pressure head in a stationary volute.

The pump consists of two assemblies:

1. Casing assembly or stationary part

2. Rotating element or moving part

This casing is split along the horizontal centerline of the pump shaft, suction and discharge nozzles both being located in the lower half. With this arrangement, it is not necessary to disconnect suction or discharge piping to make repairs to, or replace the rotating element. Upper and lower half casings are bolted together and doweled to maintain a smooth volute contour inside the pump. Supporting feet are integrally cast in the lower half casing and are drilled for bolting and doweling to base plate. Bearing brackets form a drip pocket for collecting stuffing box leakage and are provided with drilled and tapped connections for draining. The brackets also contain an overflow hole to release the water before it reaches the shaft, in case drain piping should become clogged. Suction and discharge flanges are drilled and tapped for gauge connections. Pump suction and discharge nozzles are drilled and tapped on the underneath side for complete pump drain. Wear rings are provided to minimize internal bypassing of the liquid being pumped, and to better efficiency, as well as to reduce the replacement of major components (such as casing and impeller).

SECTION II

STORAGE & PROTECTION

All pumps are shop serviced and ready for operation when delivered, but there is occasions when considerable time elapses between the delivery date and the time the pump is put into operation. Equipment, which is not in service, should be kept in a clean, dry area. If equipment is to be stored for long periods of time (six months or more), the following precautions should be taken to insure that the equipment remains in good condition.

1. Be sure that the bearings are fully lubricated.

2. Unpainted-machined surfaces, which are subject to corrosion, should be protected by some corrosive resistant coating.

3. The shaft should be rotated 10 to 15 revolutions by hand periodically in order to spread the lubricant over all the bearing surfaces. Suitable intervals are from one to three months, depending on atmospheric conditions, etc. In order to insure that the pump shaft does not begin to sag, do not leave the shaft in the same position each time.

Section II – Storage & Protection Continued

4. Space heaters on motors and controllers should be connected and fully operable if atmospheric conditions approach those experienced in operation. Consult instruction manuals for other precautions concerning storage of individual components of pumping unit.

5. Fresh lubricant must be applied to bearings upon removal of equipment form storage.

SECTION III

INSTALLATION

3-1 Location:

Several factors should be considered when selecting a location for the pumping unit (pump, base, drive, and coupling). The unit should be accessible for both inspection and maintenance. Headroom should be provided for the use of crane, hoist or other necessary lifting devices. The pump should be located as close as possible to the liquid supply so that the suction line is short and direct. Location should require a minimum of elbows and fittings in the discharge line to minimize friction losses. The unit should be protected against flooding.

3-2 Foundation:

The foundation should be sufficiently substantial to absorb vibration and to form a permanent rigid support for the base plate. Concrete is most widely used for foundation. Before pouring the foundation, locate anchor bolts per outline drawing. Allow for 3/4 inch to 1 1/2 inch of grout between foundation and base plate. The top surface of the foundation should be roughened to provide a good bond for the grout.

3-3 Mounting:

WARNING!!! Do not attempt to lift entire unit using lugs provided on either pump or motor only. Such action may lead to failure of the lugs and possible damage to the unit or injury to personnel. Lift unit with slings around the base plate, or by attaching cables to the lifting lugs on both the pump and the motor.

Coupling halves should be disconnected when mounting the pumping unit on the foundation. Wedges should be used to support the unit at the time of grouting. Wedges should be located adjacent to anchor bolts (one on each side of bolt) and midway between bolts. Adjust the wedges to raise or lower the unit as required to align suction and discharge flanges to piping and to level the base plate. Leveling bolts made of cap screws and nuts are useful when leveling large base plate, but should not replace shims or blocks for supporting the load. After unit has been in operation for about a week, check alignment. After making any required adjustments, dowel pump and motor to base.

Section III – Installation Continued

3-4 Alignment:

The pump unit has been manufactured to allow field alignment. The unit must be properly aligned at the time of installation. Reliable trouble-free and efficient operation of a unit depends upon correct alignment. Misalignment may be the cause of noisy pump operation, vibration, premature bearing failure, or excessive coupling wear. Factors that may change the alignment of the pumping unit are settling of the foundation, springing of the base plate, piping strains, a shift of the pump or drive on the foundation. When checking coupling alignment, remember flexible couplings are not intended to be used as universal joints. The purpose of a flexible coupling is to compensate for temperature changes and to permit end movement of the shafts without interference with each other.

Two types of misalignment may exist: parallel misalignment and angular misalignment. Limits of misalignments are stated in the coupling manufacturer's instructions, but should be kept to a minimum for maximum life of equipment components.

To check coupling alignment, the following procedure should be followed:

1. Set the coupling gap to the dimension shown on the outline drawing.

2. Check for parallel misalignment by placing a straight edge across both coupling halves at four points 90° apart. Correct alignment occurs when the straight edge is level across the coupling halves at all points.

3. Check angular misalignment with a feeler gauge at four points 90° apart. Correct alignment occurs when the same gauge just enters between the halves at all four points.

Angular and parallel misalignment are corrected by shifting the motor and adding or removing shims from under the motor feet. After each change, it is necessary to recheck the alignment of the coupling halves. Adjustment in one direction may disturb adjustment already made in another direction.

An alternative method for checking coupling alignment is by use of a dial indicator. Proceed as follows:

1. Scribe index lines on coupling halves or mark where the indicator point rests.

2. Set indicator dial to zero.

3. Slowly turn both coupling halves so that the index lines match, or the indicator point is always on the mark.

4. Observe dial reading to determine whether adjustments are needed. Acceptable alignment occurs when total indicator reading does not exceed 0.004 inches for both parallel and angular alignment.

The importance of correct alignment cannot be overemphasized. Alignment should be checked and corrected as required after:

1. Mounting
2. Grouting has hardened
3. Foundation bolts are tightened
4. Piping is connected
5. Pump, driver, or base plate is moved for any reason.

WARNING!!!

The importance of correct alignment cannot be overemphasized. The following procedure should be used for initial installation.

1. Place complete pump assembly on anchor bolts allowing room under the base plate for leveling wedges or shims. Make sure the base plate is level by using the leveling wedges adjacent to the foundation bolts and midway between the bolts.

2. Put nuts on the anchor bolts and tighten evenly, but not too tight.

3. At this point check alignment of the coupling. This should not be more than that recommended by the coupling manufacturer.

4. If misalignment is evident, determine which direction the coupling needs to be moved.

5. Loosen all nuts and add the shims underneath the base plate at the opposite corners. Use the anchor bolts to flex the base plate to bring the coupling into alignment.

6. After the alignment has been made with all anchor bolt nuts tight, the grouting can take place.

7. After grouting is completed, final alignment should be checked to be sure it is within allowable tolerances. Use of shims under the driver can be used to obtain final alignment.

Alignment should be checked and corrected as required after:

- Mounting
- Foundation bolts are tightened
- Grouting has hardened
- Piping is connected
- Pump, driver, or base plate is moved for any reason

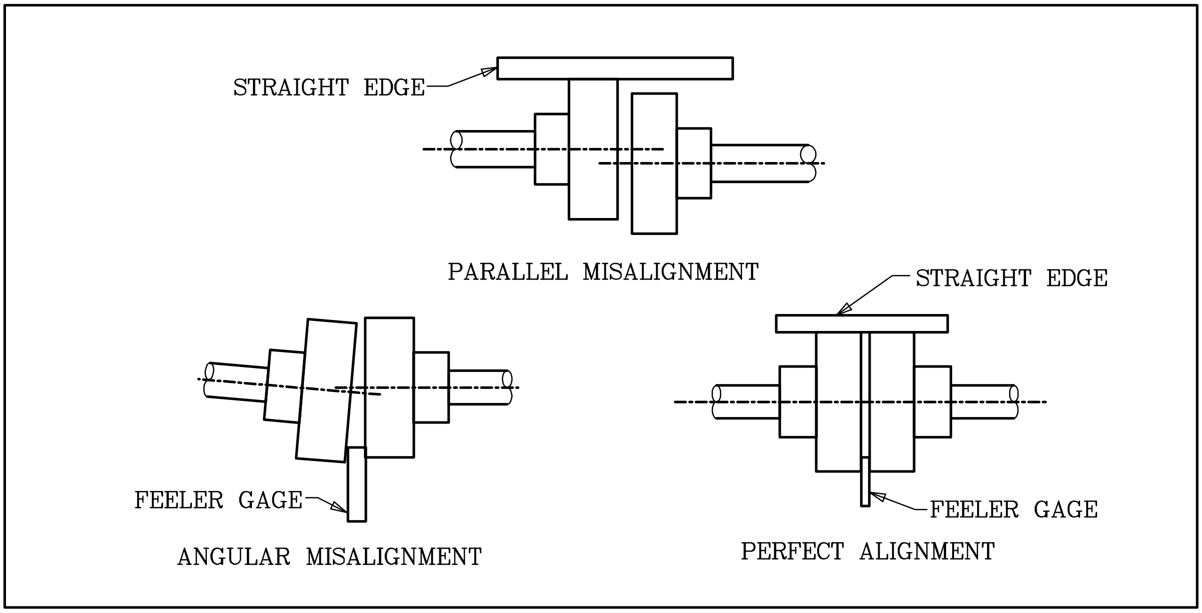


FIG. 1 TESTING ALIGNMENT, STRAIGHTEDGE

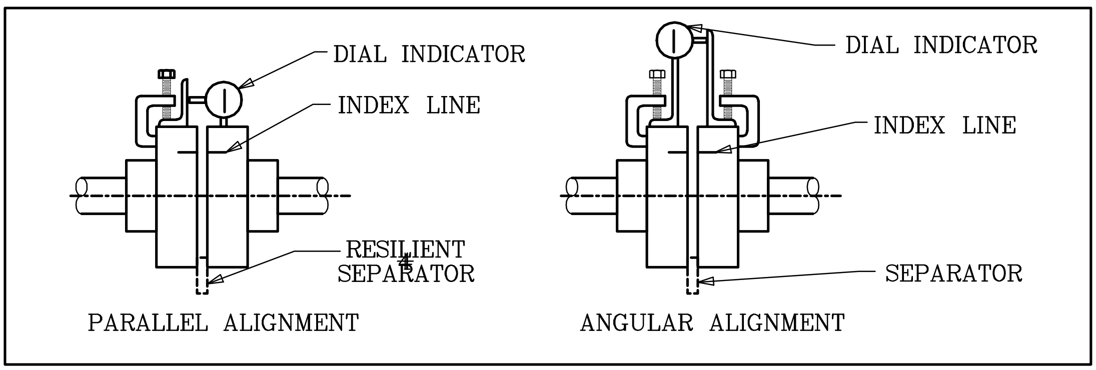


FIG. 2 TESTING ALIGNMENT, DIAL INDICATOR

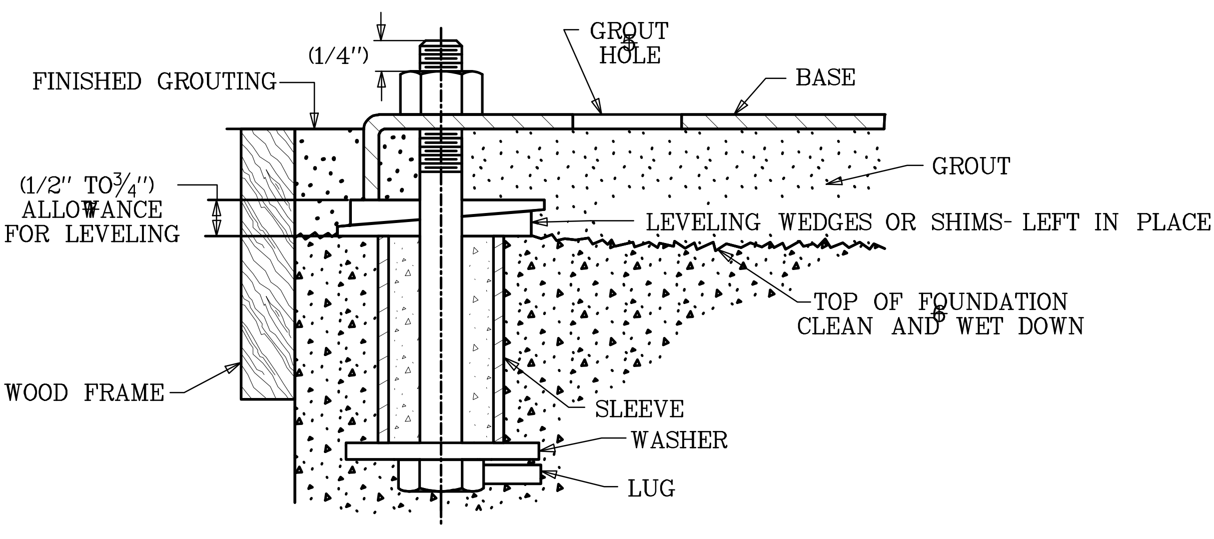


FIG. 3 TYPICAL FOUNDATION BOLT DESIGN

3-5 Grouting:

Grout compensates for unevenness in the foundation and distributes the weight of the unit uniformly on the foundation. It also prevents lateral shifting of the base plate and reduces vibration. Use a non-shrinking grout. Foundation bolts should be tightened evenly, but not too firmly. Grout the unit as follows:

1. Build a strong form around the base plate to contain the grout.

2. Soak the foundation top thoroughly, and then remove surface water.

3. Pour grout. Tamp liberally while pouring in order to fill all cavities and prevent air pockets. The space between the foundation and base plate should be completely filled with grout. In order to prevent the base plate from shifting, fill under the base plate at least four inches in from all four edges. Wedges may be left in place.

4. After the grout has hardened (usually about 48 hours), thoroughly tighten foundation bolts and check alignment.

5. Approximately 14 days after the grout has been poured or when it is thoroughly dry, apply an oil base paint to exposed edges of the grout to prevent air and moisture form coming in contact with the grout.

3-6 Piping:

Connect pipelines after the grout has thoroughly hardened. The suction and discharge piping should be installed with the shortest and most direct runs. Elbows should preferably be of the long radius type. Pipes must line up naturally. The piping must never be pulled into position by the flange bolts. Such action may draw the pump out of alignment. Pipes should be support independently of the pump so as not to put any strain on the pump casing. Suction piping, if not properly installed, is a potential source of faulty operation. Suction lines should be free of air leaks, and arranged so there are no loops or high spots in which air can be trapped. Generally, the suction line is larger than the pump suction nozzle, and eccentric reducers should be used. Eccentric reducers are not necessary for bottom suction pumps. If the liquid supply is located below the pump centerline, the reducer should be installed with the straight side up.

Most often air enters the suction pipe entrained in the liquid. Installations with a static suction lift preferably should have the inlet of the vertical suction piping submerged in the liquid to four times the piping diameter. A large suction pipe will usually prevent the formation of vortexes or whirlpools, especially if the entrance is flared (Figure 5). A floating vortex breaker (raft) around the suction piping may be provided if a tendency appears for a vortex to form at the liquid surface. A stream of liquid falling into the sump near the intake pipe will churn air into the liquid (Figure 6). The supply line should extend down into the sump. Liquid supply entering a well perpendicular to the intake line tends to rotate the liquid, which interferes with the flow into the suction line (Figure 7). A baffle placed in front of the supply pipe will remedy this situation. A short elbow should never to bolted directly to the pumps suction nozzle. The disturbance in the flow caused by the sharp bend so near the pump inlet may result in noisy operation, loss in efficiency, and capacity, and heavy end thrust.

A long sweep or long radius elbow placed as far away from the pump as practicable should be used if a bend is necessary in the suction line. If separate suction lines cannot be used for each pump, then a tapering header with Y-branches should be used (Figure 8A). A straight branch header should never be used. Prior to installing the pump, suction piping and pump should be inspected internally, cleaned and flushed. If a strainer is installed in the suction line, the openings in the screen must be checked and cleaned periodically. The opening must be smaller than the sphere size allowed by the impeller.

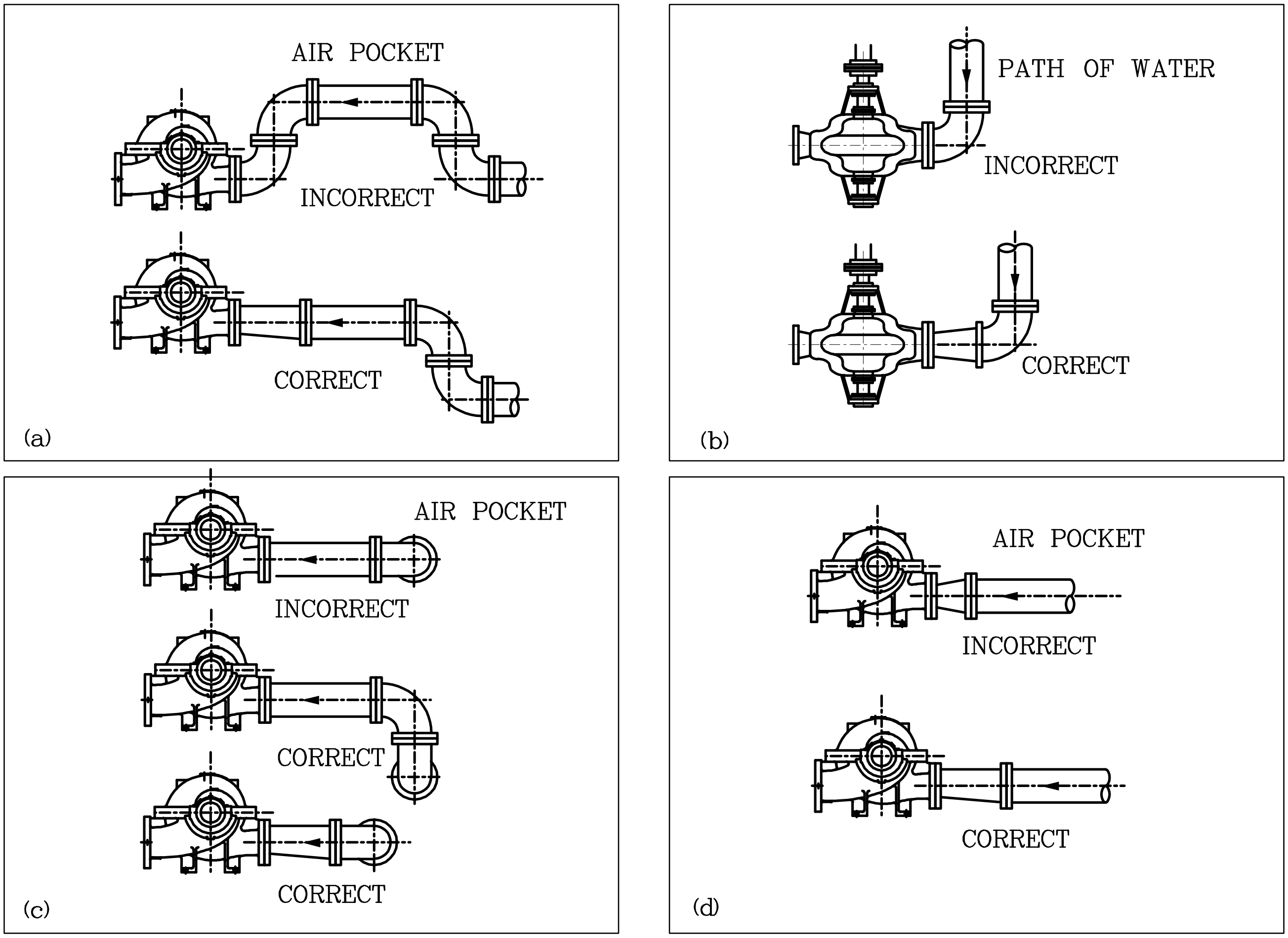


FIG. 4. SUCTION PIPING ARRANGEMENTS

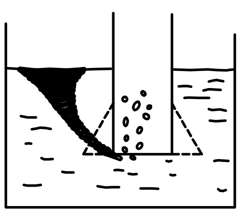


Fig. 5 Enlarging the suction pipe usually prevents whirlpools and the resultant entrance of air into the pipes

FIG. 5

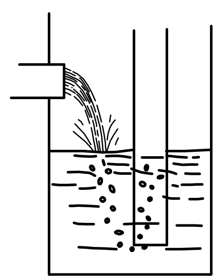


Fig. 6(a) Water falling into sump churns air into the sump liquid and causes trouble in the suction line

Fig. 6(a)

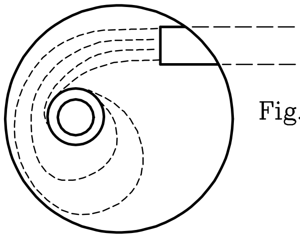


Fig. 7

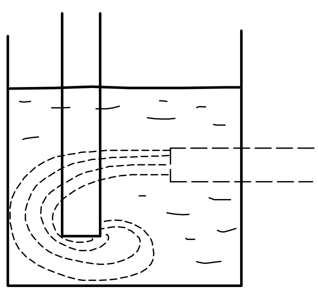


Fig. 7 Rotation of water in the well, as illustrated, can be prevented with a baffle.

Fig. 6(b) Supply line should extend down into the sump to prevent the churning of air into the water.

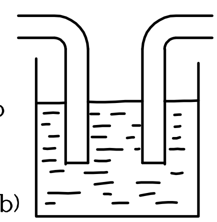


Fig. 6(b)

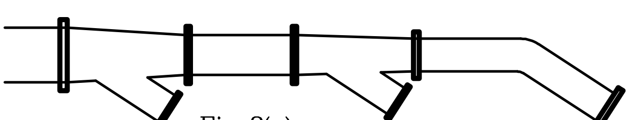


Fig. 8(a)

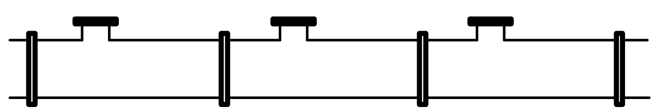


Fig. 8(b)

Fig. 8(a) Shows the tapering header which should be used if two or more pumps are served with one intake line. the pipe shown in FIG. 8(b) should never be used.

Section III – 3-6 Piping Continued

Discharge piping should be installed with check valve and gate valve, with the check valve being between the pump and the gate valve. The check valve prevents reverse flow and protects the pump from excessive backpressure. The gate valve is used to isolate the pump for maintenance, priming and starting. If a diffuser is used, it should be placed between the pump and check valve.

Stuffing box seal connections are usually made form the top of the pump casing. If the liquid being pumped is unsuitable for sealing, then it is preferable to bring fresh, cool water to seal connections from an outside source. Centrifugal separators or other filters may be used to remove abrasive particles from the liquid being pumped if an outside source is not available. After all piping connections have been made, the alignment should be checked again.

SECTION IV

OPERATION

Before bolting the coupling halves together, check the drive rotation to see that it matches the pump rotation. Pump rotation is indicated by an arrow attached to the casing assembly. For a three-phase motor, rotation may be reversed, if necessary, by interchanging any two of the three power leads. Rotation of single-phase motors is fixed by internal wiring.

WARNING!!! Prior to startup, check the coupling alignment as covered in the **Installation Section**. Operation of the pump with the unit misaligned will cause damage to the shaft, bearings, and the coupling.

4-1 Starting:

- When possible, turn the pump shaft by hand to insure that the parts do not bind
- Check the bearing lubricant
- Open the valve in the pump suction line, if fitted
- Close discharge valve
- Prime the pump in one of the following ways:

    1. If the pump operates under positive pressure, open vent valve on top of the pump casing. After all entrained air has escaped, close the vent valves. Rotate the shaft, if possible, to allow any air trapped in the impeller passages to escape.
    2. If the pump operates on a suction lift and a foot valve is included in the system, fill the pump and the suction line with liquid from an outside source. Trapped air should be allowed to escape through the vent valve while filling.
    3. If the pump operates on a suction lift and no foot valve is provided, use a vacuum pump or ejector operated by air, steam, water, etc. to evacuate air from the pump case and suction line by connecting the ejector to the priming connection on top of the pump case.

Open valves in stuffing box seal lines, if fitted. Start driver. Open discharge valve slowly when the pump is up to speed.

CAUTION: Overheating and/or loss of prime will result if the pump is operated against a closed valve for more than a few minutes.

WARNING !!! The coupling guard should be in place when the unit is started. Stay clear of any exposed rotating parts while the pump is operating. Contact with rotating parts may result in injury to personnel.

Adjust the packing gland until there is a slight leakage from the stuffing box. **(See Maintenance on Adjustment of Packing)**. Mechanical seals need no adjustment. There should be no leakage.

NOTE: Should the pump fail to build up pressure or discharge water when the discharge valve is opened, stop the pump and read **Section Locating Operating Difficulties**.

4-2 Shutdown

The pump may be stopped with the discharge valve open without causing damage. However, in order to prevent water hammer effects, the discharge valve should be closed first.

1. Close discharge valve.
2. Stop driver.
3. Close water seal valves.
4. Close valve in the pump suction line, if fitted. If danger of freezing exists, drain the pump completely.

4-3 Minimum Flow Limitation

All centrifugal pumps have limitations on the minimum flow at which they should be operated. The most common limitation is to avoid excessive temperature buildup in the pump because of absorption of the input power into the pumped fluid. Other less understood reasons for restrictions are:

1. Increased radial reaction at low flows in single volute casings.
2. Increased NPSHR at low flows.
3. Noisy, rough operation and possible physical damage due to internal recirculation.
4. Increased suction and discharge pulsation levels.

The size of the pump, the energy absorbed, and the liquid pumped are among the considerations in determining these minimum flow limitations. For example, most small pumps such as domestic home circulators, service water pumps, and chemical pumps have no limitations, except for temperature buildup considerations while many large, high horsepower pumps have limitations as high as 40-50% of the best efficiency point capacity. The minimum safe flow for this pump is given under **Pump Specifications**.

SECTION V

MAINTENANCE

5-1 Lubrication:

Couplings: Couplings with rubber drive elements do not require lubrication. Most other couplings require some form of lubrication. Consult manufacturer's instructions for recommendations.

Bearings: Frequency of lubrication depends upon operating conditions and environment, therefore, lubrication intervals must be determined by experience. Table I may be used as a general guide for grease relubrication. Lubricants need replacing only because of contamination by dirt or dust, metal particles, moisture or high temperature breakdown. A small amount of grease may be added about every 400 hours of operation. The bearing housing should be about 1/3 full of grease. Oil lubricated units are provided with constant level oilers. Bottles should be kept filled at all times so that there is a visible supply of oil. All lubricants have a tendency to deteriorate in the course of time, therefore, sooner or later it will be necessary to replace the old lubricant with new. Bearings, which are dismantled, are, of course, much more easily cleaned than bearings, which stay in assembled equipment. Solvents may be used more freely and effectively. For cleaning bearings without dismounting, hot light oil at 180° - 200° F may be flushed through the housing while the shaft is slowly rotated. Light transformer oils, spindle oils, or automotive flushing oils are suitable for cleaning bearings, but anything heavier than light motor oil (SAE 10) is not recommended. The use of chlorinated solvents of any kind is not recommended in bearing cleaning.

Grease Relubrication: (pumps are shipped with grease in bearing housings)

1. Thoroughly clean grease fitting and outside of bearing housing.
2. Remove drain plug.
3. Inject clean, new grease forcing out the old.
4. Start and run the pump for a short time to eject any excess grease.
5. Wipe off all excess grease and replace drain plug.

Oil Relubrication: (pumps are shipped without oil in bearing housing)

1. Remove drain plug and allow any residue oil to completely drain.
2. Remove constant level oiler bottle and clean thoroughly.
3. Replace drain plug.
4. Fill bottle, screw it to the lower reservoir of oiler and allow oil to flow into bearing housing reservoir. Repeat this procedure until a supply of oil remains in the bottle.

For ball bearings, the oil level should be at about the middle of the lower most ball. For ring oiled sleeve bearings, the oil level should be about 1/8 inch over the lowest point of the oil ring.

WARNING !!! Proper lubrication is essential to the pump operation. Do not operate the pump if sufficient lubricant is not present in the bearing housing of if lubricant is contaminated with excessive dirt or moisture. Operation of the unit under these conditions will lead to impaired pump performance, and possible bearing failure. Do not operate the pump with excessive amount of lubricant. Such action will cause bearings to overheat.

5-2 Stuffing Box:

The purpose of a stuffing box is to limit or eliminate leakage of the pump fluid and to prevent air from entering the suction spaces along the pump shaft. Pumps are equipped with packing (limited leakage) or mechanical seals (no leakage). Normally, the pumped liquid is used to lubricate the stuffing box seal. If the liquid is dirty, gritty, or contains material that would gum or jam the seal, use a sealing liquid from an external source. If suction pressure is above atmospheric pressure, seal piping may not be required. For pumps equipped with packing, there must always be a slight leakage from the glands. The amount of leakage is hard to define, but we recommend a steady dripping of liquid through the gland. Stuffing box glands should be adjusted after the pump is started. When leakage is excessive, tighten gland bolts evenly a little at a time. Allow an interval for packing to adjust to new position. Never tighten gland to be leakproof, as this will cause overheating and undue wear on shaft sleeves.

Replace stuffing box packing as follows:

1. Shutdown the pump.
2. Take precautions to prevent the driver from being inadvertently started.
3. Remove the gland bolt nuts and gland.
4. Remove and discard old packing rings – note location of lantern ring. When repacking stuffing box, lantern ring must be positioned such that the water seal connection is opposite lantern ring.
5. Clean out the stuffing box.
6. Inspect shaft sleeve for wear – if it is scored or grooved, it should be replaced.
7. Make sure the stuffing box bushing (if furnished) is set at the bottom of the box.
8. Insert rings of packing and tap lightly to seat against bushing. Be sure rings are of the proper size and length and installed with cuts staggered. Lantern ring **must** be installed opposite sealing water connection.
9. Install gland and tighten, finger tight. With the pump running, adjust gland as described previously. Care should be taken during the first hour of operation to take up on the packing gradually just enough to maintain the required amount of leakage.

If the pump is operated daily, the stuffing box packing should be renewed about every two to three months before it gets hard and scores the shaft sleeves.

Mechanical seals should be removed, assembled, and/or adjusted according to the seal manufacturer's instructions. There should be no leakage from the gland if mechanical seals are used, except for a brief run in period.

5-3 Wear Ring Clearance:

Running fits between wear rings is given under the pump specifications. When these clearances are doubled, or the capacity of the pump is reduced by 5 to 10%, the rings should be renewed. The purpose of these rings is to keep internal bypassing of the liquid being pumped to a minimum. Clearances should be checked periodically and whenever the pump casing is opened. Check with feeler gauge or by direct measurement. Measure ID of case ring and OD of impeller ring, then compute clearance (ID minus OD).

TABLE 1
SUGGESTED RE-LUBRICATION INTERVALS FOR VARIOUS ENVIRONMENTAL, OPERATING AND TEMPERATURE CONDTIONS (GREASE LUBRICATED BEARINGS)

AMBIENT CONDITIONS		OPERATING CONDITIONS		BEARING OPERATING TEMPERATURE		SUGGESTED GREASING INTERVALS**	USE THESE GREASES
Dirt	Moisture	Load	Speed	Low	High		
Clean	Dry	Light to medium	Slow to medium	0°F (-18°C)	120°F (49°C)	2 to 6 months	High quality NGLI No. 1 or 2 multipurpose bearing greases are generally satisfactory. Consultation with a reputable lubricant supplier is recommended.
				120°F (49°C)	200°F (93°C)	1 to 2 months	
Moderate to dirty	Dry	Light to medium	Slow to medium	0°F (-18°C)	120°F (49°C)	1 to 4 weeks	
				120°F (49°C)	200°F (93°C)	1 to 7 days	
Extreme dirt	Dry	Light to medium	Slow to medium	0°F (-18°C)	200°F (93°C)	Daily flushing out dirt	
	High humidity Direct water Splash	Light to heavy	Slow to medium	32°F (0°C)	200°F (93°C)	1 to 4 weeks grease at shutdowns	Lithium or other corrosion control grease
		Heavy to very heavy	Slow	0°F (-18°C)	200°F (93°C)	1 to 8 weeks	High viscosity lubrication
				-20°F (-29°C)	120°F (49°C)	1 to 8 weeks	
		Light	High speed	100°F (38°C)	200°F (93°C)	1 to 8 weeks	Channeling (high speed) type grease
	Possible frost	Light to heavy	Slow to medium	-65°F (-54°C)	+250°F (121°C)	1 to 4 weeks grease at shutdown	Wide temperature range Diester-type greases (Silicone-Diester-Polyester lubricants)
Clean to moderate	Dry	Light to medium	Slow to medium	80°F (27°C)	250°F (121°C)	1 to 8 weeks	Good quality high temperature type greases
Clean to dirty	Dry	Light	Slow	80°F (27°C)	300°F (149°C)	1 to 4 weeks	Synthetic type greases

**Suggested starting interval for maintenance program. Check grease conditions for oiliness and dirt and adjust greasing frequency accordingly. Watch operating temperatures as sudden rises may show need for grease or indicate over lubrication on higher speed applications.

TABLE II

RECOMMENDED GREASES

Use NLGI Grade 2 grease

Such As:

COMPANY	GREASE
Chevron	SRI
CITGO	Premium Lithium EP2
Exxon	Lidok EP2
Keystone	81EP2
Pennzoil	PennLith 712
Shell	Alvania EP2
Texaco	Multifak EP2

WARNING!!! Use of lubricants other than those listed or their equivalent will cause reduced pump performance and reduce bearing life.

TABLE III

RECOMMENDED OILS

	SPEED RANGE (RPM)	
	1800 and Over	1500 and Below
	VISCOSITY RANGE	
MANUFACTURER	145 SSU TO 175 SSU @100°	270 SSU TO 375 SSU @100°
MOBILE OIL COMPANY	MOBILE DTE 797	DTE OIL HEAVY MEDIUM
SHEEL OIL COMPANY	TELLUS 927	TELLUS 933
TEXACO, INC.	REGAL A (R & O)	REGAL PC (R & O)
STANDARD OIL COMPANY	CHEVRON OC TURBINE 9	CHEVRON OC TURBINE 15
HUMBLE OIL & REFINING COMPANY	TERESSTIC OR TERESSO 43	TERESSTIC OR TERESSO 52
GULF OIL CORPORATION	HARMONY 44	HARMONY 53
UNION OIL OF CALIFORNIA	RED LINE TURBINE 150	RED LINE TURBINE 300
RICHFIELD DIVISION	EAGLE R & O NO. 10	EAGLE R & O LIGHT
ATLANTIC DIVISION ATL. RICH.	HYTHERM C	HYTHERM F
AMERICAN OIL COMPANY	AMER INDUSTRIAL OIL NO. 15	AMER INDUSTRIAL OIL NO. 31
CITIES SERVICE OIL COMPANY	CITGO PACEMAKER T-15	CITGO PACEMAKER T-30
CONTINENTAL OIL COMPANY	CONOCO DECTOL NO. 15 R & O	
E.F. HOUGHTON & COMPANY	HYDRO-DRIVE MIH LIGHT	HYDRO-DRIVE MIH-20
KEYSTONE LUBRICATING COMPANY	KLC-6	KLC-4A
PENNZOIL COMPANY	PENNBELL NO. 1	PENNBELL NO. 3
PHILLIPS PETROLEUM COMPANY	MAGNUS OIL 150	
PURE OIL COMPANY		PUROPALE RX HEAVY MEDIUM
SINCLAIR REFINING COMPANY	DURO 150	DURO 300
SUN OIL COMPANY	SUNVIS 916	SUNVIS 931

WARNING!!! Use of lubricants other than those listed or their equivalent will cause reduced pump performance and reduce bearing life.

SECTION VI

REPAIRS AND REPLACEMENT

WARNING!!! Whenever any disassembly work is to be done on the pump, disconnect the power source to the driver to eliminate any possibility of starting unit.

6-1 To Remove Rotor:

Reference: Pump Assembly Section

1. Remove the coupling guard and disconnect coupling halves.

2. Disconnect any piping from the upper half casing (1B) that will interfere with its removal.

3. Remove bolting from the casing flanges and the bearing caps (41). **NOTE:** Some units are not provided with bearing caps. Remove bolting from the bearing bracket (31 & 33) and the lower case (1A).

4. Drain oil from the reservoirs (oil lubricated ball bearing units only).

5. Remove bolting through oil reservoirs (oil lubricated ball bearing units only). **NOTE:** On some units the oil reservoir is independent of the bearing housing. Remove the outboard oil reservoir with bolting (check Assembly Section).

6. Screw jackscrews down to separate upper and lower case. Turn jackscrews back after separation to prevent interference at reassembly.

7. Lift upper casing (1B) straight up until clear of the impeller.

8. Remove the bearing caps (41).

9. Remove the glands (17) and the gland bolts (170).

10. Place slings around the shaft near the bearing housings and lift rotating element from lower casing (1A).

11. Place rotating element in a clean, dry work area for necessary disassembly. Case wear rings (7) will be loose on assembly.

6-2 Disassembly of Rotating Element:

If the bearing assemblies do not require attention, but just the impeller or rings, then work just one side of the unit (impeller may be removed from either end).

1. Remove the pump half coupling.

2. Loosen setscrews in deflectors (40) and slide toward center of the pump.

3. Remove cap screws from the bearing covers (35 & 37) and separate covers from the bearing housings (31 & 33).

4. Remove bearing housings (31 & 33).

Section VI – Disassembly of Rotating Element Continued

5. Straighten locking tip on lockwashers (69) and remove locknuts (22) and washers.

6. Remove oil flings (172) and oil rings (60) – (oil lubricated ball bearings only).

7. Remove bearings (16 & 18). Remove with bearing puller pressing on the inside race. **Never** pull a bearing on the outside race unless the bearing is to be discarded.

NOTE: Items 8-10 refer to the sleeve bearing units only.

8. Remove thrust bearing cartridge (74), if applicable.

9. Remove oil rings (60).

10. Remove bolting from sleeve bearing halves (135 & 137) and remove bearings.

11. Remove bearing covers (35) and deflectors (40).

12. Remove packing (13), lantern ring (29), and stuffing box bushing (63), if applicable. Note the number of packing rings on either side of the lantern ring. The lantern ring (29) must be installed opposite seal water inlet. **NOTE:** Follow the seal manufacturer's instructions for repair and removal of mechanical seals.

13. Loosen setscrews in sleeve nut (20) and unscrew the nut from the shaft.

14. Remove o-ring packing (13A) and shaft sleeves (14).

15. Remove casing wear rings (7). On most pumps, casing rings may be removed before disassembling rotating element.

16. Impeller (2) with impeller rings (8) can now be removed from either end of the shaft.

CAUTION: When removing the impeller, note the direction of the vanes. The impeller must be installed with the vanes in the same direction.

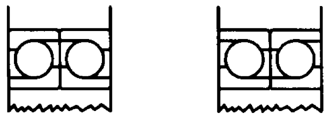
6-3 To Remove Impeller Rings:

It is not necessary to remove the impeller from the shaft to replace the impeller rings. First remove the rotating element. Remove the locking set screws from the rings. The rings may now be pulled form the impeller, cut off with a chisel, or turned off, if a suitable lathe is available, using original shaft centers. **DO NOT CUT INTO THE BODY OF THE IMPELLER!** When new rings are installed, drill and tap new holes for the locking set screws – do not attempt to use old half holes in the impeller hub.

6-4 Inspection:

Visually inspect parts for damage affecting serviceability. Check o-rings and gaskets for cracks, nicks, or tears; packing rings for excessive compression, fraying or shredding, and embedded particles. Replace if defective in any way. Mount the shaft between lathe centers and check eccentricity throughout the entire length. Eccentricity should not exceed .002 inches. Bearing surfaces should be smooth and shoulders square and free of nicks.

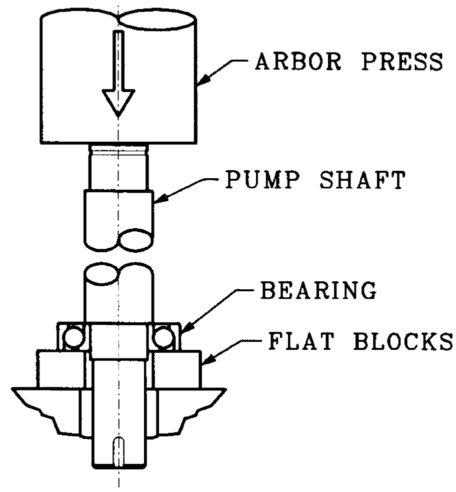
Measure OD of impeller hub or impeller wear rings and ID of casing wear ring. Compute diametral clearance (ID minus OD) and compare with clearance given under the **Pump Specifications**. Surfaces must be smooth and concentric. Examine impeller passages for cracks, dents or embedded material. Examine shaft sleeves for wear.



(Face to Face) (Back to Back)

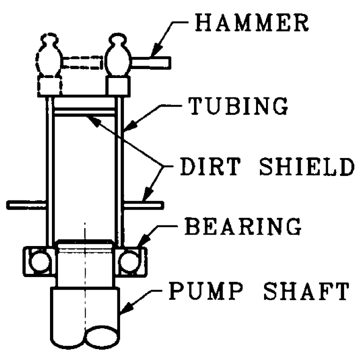
USING AN ARBOR PRESS

1. PLACE THE BEARING ON TWO FLAT BLOCKS SO THAT THEY CONTACT THE INNER RING OR BOTH RINGS OF THE BEARING
2. HOLD SHAFT STRAIGHT-FORCE THE SHAFT BY A STEADY PRESSURE, UNTIL THE BEARING IS SEATED AGAINST THE SHAFT SHOULDER.



USING TUBING

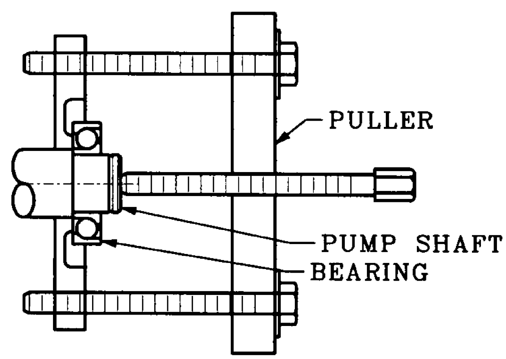
1. PLACE THE BEARING ON SHAFT.
2. PLACE TUBING OVER SHAFT IN CONTACT WITH THE INNER RING OF THE BEARING.
3. APPLY HAMMER ALTERNATELY AT OPPOSITE POINTS-AVOID COCKING.



BEARING MOUNTING

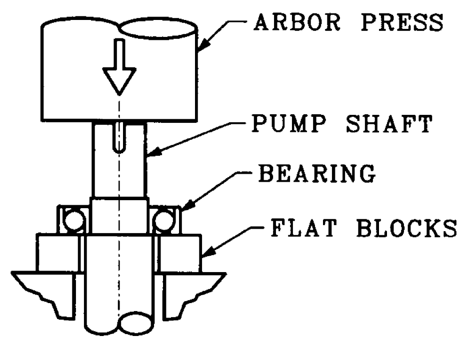
USING A BEARING PULLER

1. PLACE BEARING PULLER BEHIND BEARING INNER RING. SET PULLER JAWS SO THAT THEY WILL NOT SLIP OVER THE INNER RING AND DAMAGE SEPARATOR OR SHILD WHEN PRESSURE IS APPLIED.
2. FORCE BEARING OFF SHAFT BY A STRAIGHT PULL. BO NOT COCK BEARINGS.



USING AN ARBOR PRESS

1. REST THE BEARING INNER RING OR BOTH RINGS (NEVER THE OUTER RING ONLY) AGAINST A PAIR OF FLAT BLOCKS.
2. FORCE THE SHAFT OUT BY A STEADY PRESSURE- KEEP SHAFT STRAIGHT- DO NOT ALLOW SHAFT TO COCK OR DROP.



BEARING REMOVAL

FIGURE 9. BEARING REMOVAL AND MOUNTING

TABLE IV

BEARING DEFECTS

(Failures – Replace if found)

DEFECT (failure)	APPEARANCE	PROBABLE CAUSE
Flaking and cracking	In the early stages the surface of the inner and outer races develop small cracks, which flake. The cracks and flaking ultimately spread over the entire race surface.	1. Normal fatigue failure. 2. Bearing loads in excess of bearing capacity caused by misalignment.
Indentations	Indentations or cavities in the inner and outer races.	1. Dirt in the bearings. 2. Excessive impact loading of the bearings such as improper mounting or removal.
Broken separator (cage)	Cracked separator or separator in pieces.	1. Poor lubrication. 2. Misalignment of shaft. 3. Excessive shaft deflection.
Wear	Bore and OD of outer ring of bearing galled or braided.	1. Fit on shaft or in housing too loose. 2. Bearing locked by dirt and turning on shaft or in housing.
Fractured ring	Hairline cracks or complete ring fracture.	1. Forcing a cocked bearing on or off a shaft. 2. Too heavy a press fit.
Discoloration	Balls and races darker than normal appearances of bearing metal. (Moderate discoloration of balls and races not a reason for discard).	1. Inadequate lubrication.
Corrosion	Balls and raceways rusted.	1. Water entering the housing. 2. Condensation inside the housing. 3. Lubricant breaks down into acid (wrong lubricant).

6-5 Assembly:

Assembly is the reverse of the disassembly procedure. The following should prove helpful in reassembling the pump:

1. All parts, inside and out, should be clean. Dirt and grit will cause excessive wear, plus needless shutdown.

2. Make certain that the keys are in their proper position.

3. Reinstall impeller with vanes in the right direction. Pump rotation is defined by viewing from the driver end. Impeller vanes slope must be opposite the pump rotation.

4. Do not lock sleeve nut (20) to the shaft until the impeller has been positioned in the center of the volute. This may be accomplished by loosening or tightening sleeve nuts against sleeves (14) as required, thereby working the impeller into position.

5. Make certain that the case rings (7) are in proper position. The half-raised ring should be on the outside and completely in the lower half casing (1A). Be sure the ring is fully seated.

6. Insure that the packing does not block seal water inlet.

7. Rotate by hand to insure that the parts do not bind before replacing upper half-case (1B).

8. Bearing mounting is simplified by heating the whole bearing, thereby expanding it enough to be slipped on the shaft. This heating is best done by submerging the bearing in a bath consisting of 10 – 15% soluble oil in water and heated to boiling. This mixture cannot be overheated, is non-flammable, drains off easily permitting convenient handling, and yet leaves an oil film sufficient for rust protection of the bearing surfaces.

LOCATING OPERATING DIFFICULTIES

In the majority of cases, operating difficulties are external to the pump and the following causes should be carefully investigated before undertaking repairs:

No Water Delivered

- Pump not primed – indicated by no pressure on discharge.
- Speed too low – indicated by low pressure on discharge.
- Valve closed – indicated by high discharge head.
- Impeller completely plugged up – indicated by low discharge pressure.

Abnormally Small Quantities Delivered

- Air leaks in suction pipe or stuffing boxes.
- Speed too low.
- Discharge head higher than anticipated.
- Impeller partially plugged up.
- Obstruction in suction line.
- Mechanical defects: casing rings worn, impeller damaged, casing or seal defective.

Insufficient Pressure

- Speed too low. Might be caused by low voltage or current characteristics different from nameplate reading on the motor.
- Air in water will cause the pump to make a cracking noise.
- Mechanical defects: worn casing rings, damaged impeller, defective casing or seal.

Intermittent Operation

- Leaky suction line.
- Water seal plugged (hence, a leaky stuffing box).
- Suction lift too high.
- Air, gas or vapor in liquid.

Pump Overloads Driver

- Speed too high.
- Head lower than rated, hence, pumping too much water. (This is valid for low specific speed pumps).
- Mechanical defects: stuffing boxes too tight, shaft bent, rotating element binds.
- Rubbing due to foreign matter in the pump between the case rings and the impeller.

Pump Vibrates

- Misalignment.
- Foundation not sufficiently rigid.
- Impeller partially clogged.
- Mechanical defects: bent shaft, rotating element binds, bearings worn, coupling defective.
- Suction and discharge pipes not anchored.
- Pump cavitating from too high a suction lift.
- Air entrainment in the pump suction due to low submergence.

RECOMMENDED SPARE PARTS FOR DOUBLE SUCTION PUMPS

Reference: Assembly Section

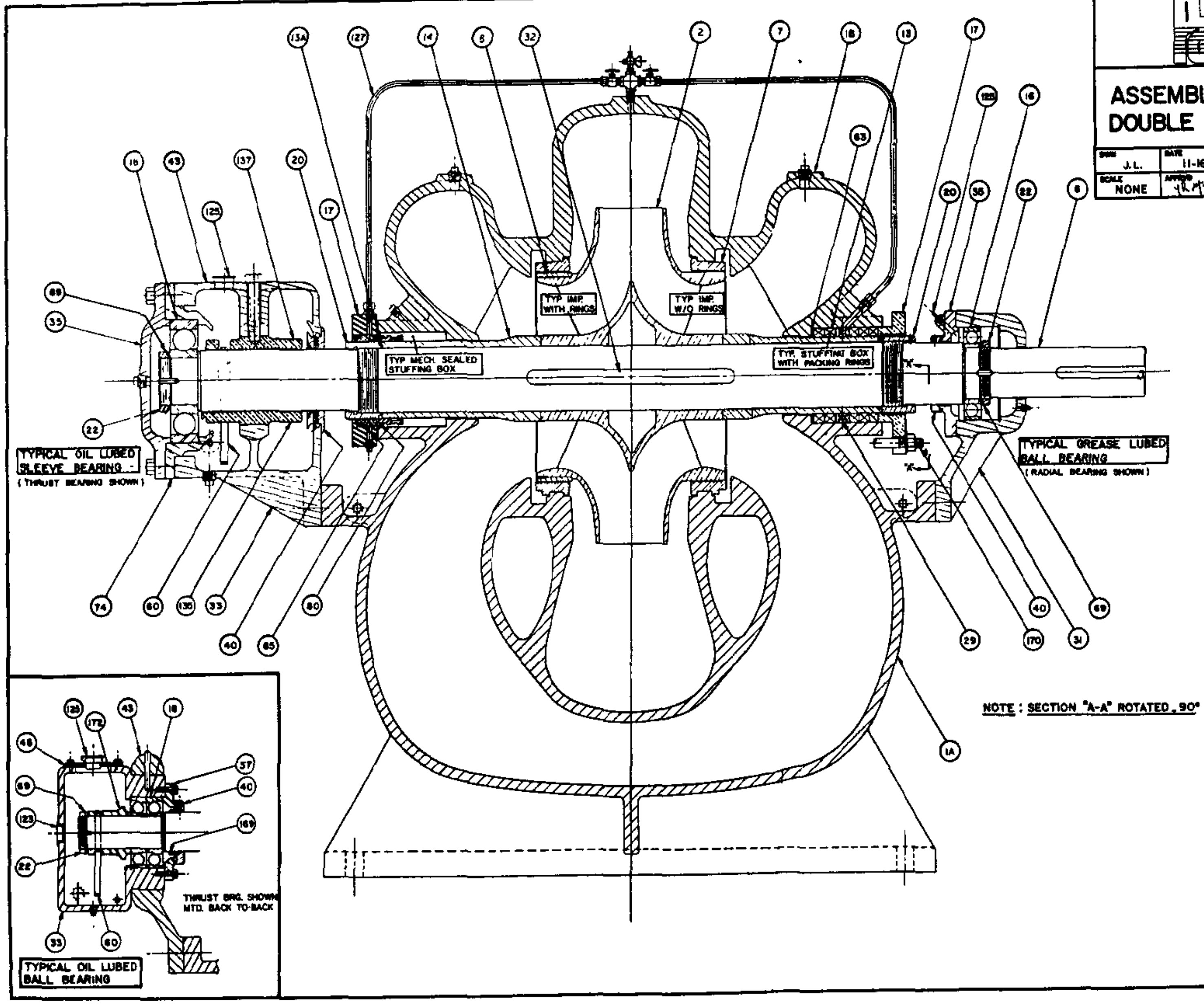
INTERMITTENT DUTY

Number		Description
7		Casing Ring
8	*	Impeller Ring
13	*	Packing (stuffing box)
13A		Packing O-Ring (shaft sleeve)
14	*	Shaft Sleeve
65	+*	Mechanical Seal (stationary element)
80	+*	Mechanical Seal (rotating element)
		Coupling and its accessories (not shown)
		Gasket (not shown)
		Gland Bolts (not shown)

CONTINUOUS DUTY

Number		Description
2		Impeller
6	*	Shaft
7		Casing Ring
8	*	Impeller Ring
13	*	Packing (stuffing box)
13A		Packing O-Ring (shaft sleeve)
14	*	Shaft Sleeve
16		Bearing (inboard)
18		Bearing (outboard)
20		Shaft Sleeve Nut
20A	*	Impeller Locknut
22		Bearing Locknut
32		Impeller Key
40		Deflector
46		Coupling Key
65	+*	Mechanical Seal – Stationary Element
68		Shaft Collar
80	+*	Mechanical Seal – Rotating Element
		Coupling and its accessories (not shown)
		All Hardware (not shown)
		Gasket (not shown)
		Gland Bolts (not shown)

* Determined by Pump Construction
\+ Complete Consists of 65 & 80



ASSEMBLY SECTION FOR DOUBLE SUCTION PUMPS

DRN J.L.	DATE 11-16-79	DWG NO. AD-4712
SCALE NONE	APPRD	

ITEM	DESCRIPTION
1A	CASING (LOWER HALF)
1B	CASING (UPPER HALF)
2	IMPELLER
6	SHAFT
7	CASING RING
8	IMPELLER RING
13	PACKING (STUFFING BOX)
13A	PACKING (SHAFT SLEEVE)
14	SHAFT SLEEVE
16	BEARING (INBOARD)
17	GLAND
18	BEARING (OUTBOARD)
20	NUT (SHAFT SLEEVE)
22	LOCKNUT
29	LANTERN RING
31	BEARING HOUSING (INBOARD)
32	IMPELLER KEY
33	BEARING HOUSING (OUTBOARD)
35	BEARING COVER (INBOARD)
37	BEARING COVER (OUTBOARD)
40	DEFLECTOR
41	BEARING CAP (INBOARD)
43	BEARING CAP (OUTBOARD)
45	OIL RESERVOIR COVER
60	OIL RING
63	STUFFING BOX BUSHING
65	MECH SEAL (STATIONARY ELEMENT)
69	LOCKWASHER
74	JOURNAL (THRUST BEARING)
80	MECH. SEAL (ROTATING ELEMENT)
123	BEARING END COVER
125	OILVENT (GREASE FITTING)
127	SEAL PIPING
135	BEARING SHELL (LOWER HALF)
137	BEARING SHELL (UPPER HALF)
169	BEARING HOUSING SEAL
170	GLAND SWING BOLT
172	OIL SLINGER

AD-4712

(TYPICAL ONLY)

General Pump Inspection and Maintenance Schedule

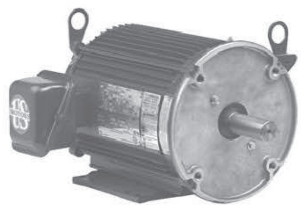
Horizontal Split Case Pumps

Excludes motors, engines, gear drives, VFD's, and controls.

Actions required only for specific pump types are so noted.
The symbol (■) used in the table below indicates that the action indicated may not be applicable to a specific pump of a particular type.
For more information regarding inspection and maintenance requirements refer to the Patterson O & M manual supplied with the pump.
Contact Patterson Pump Company if assistance is needed to determine the inspection and service requirements for a specific pump.

Inspect (✔) or service (•) at the indicated calendar time or run time interval – whichever comes first	4 hours	Routinely	Monthly	2000 hours or 3 months	4000 hours or 6 months	8000 hours or 12 months
Unusual noise		✔				
Unusual vibration		✔				
Unusual temperature		✔				
Leaks in pump or piping		✔				
Pressure gauge readings		✔				
Visual inspection of equipment general condition		✔				
Anytime a pump is opened, inspect the running clearances and restore them to original specifications if the running clearances have doubled (adjust ring clearances if so supplied or install new wear rings)		✔ •				
Anytime a pump is opened, inspect the impeller for corrosion or excessive wear.		✔ •				
Packing box – verify slight leakage (if excessive, adjust gland or seal water valve; replace packing if required) ■		✔ •				
Mechanical seal (should be no leakage) ■		✔				
Drain lines are working properly ■		✔				
Coupling integrity ■		✔				
Operate the pump			✔			
Tightness of foundation and hold-down bolts				✔		
Check coupling alignment and integrity (maintain records) ■				✔		
Add grease to pump anti-friction bearings (maintain records) ■				•		
Add grease to coupling (maintain records) ■				•		
Change anti-friction bearing oil (maintain records) ■				•		
Replace packing (all packing; not just the outermost ring) ■					•	
Clean and oil gland bolts (packed pumps) ■					•	
Verify free movement of packing glands (packed pumps) ■					✔	
Clean packing box						•
Check and flush seal water and drain piping						•
Perform a comparative field test (flow, pressures, and power) with calibrated instruments. Restore internal running clearances if results are unsatisfactory (install new wear rings).						✔ •
Perform a comparative vibration test						✔
Remove packing and inspect sleeve(s). Replace if worn. (packed pumps) ■						✔ •
Realign coupled pumps (maintain records) ■						•

Installation, Operation & Maintenance Instructions



HORIZONTAL MOTORS

TITAN MOTORS

VERTICAL MOTORS

For your safety, read and retain this manual.

NIDEC MOTOR CORPORATION

8050 W. Florissant Avenue | PO Box 36912
St. Louis, MO 63136
www.usmotors.com

E N G L I S H

SAFETY FIRST

⚠ DANGER ***High voltage and rotating parts can cause serious or fatal injury. Safe installation, operation and maintenance must be performed by qualified personnel. Familiarization with, and adherence to, NEMA MG2, the National Electrical Code (NEC), and local codes is required. It is important to observe safety precautions to protect personnel from possible injury.***

PERSONNEL SHOULD BE INSTRUCTED TO:

1. Be familiar with the equipment and read all instructions thoroughly before installing or working on equipment.
2. Avoid contact with energized circuits or rotating parts.
3. Disconnect all power sources before initiating any maintenance or repair.
4. Act with care in accordance with prescribed procedures in handling and lifting this equipment.
5. Be sure unit is electrically grounded in accordance with code requirements.
6. Be sure equipment is properly enclosed or protected to prevent access by children or other unauthorized personnel to prevent possible accidents.
7. Be sure shaft key is fully captive before unit is energized.
8. Avoid contact with capacitors until safe discharge procedures have been completed.
9. Provide proper guarding for personnel against rotating parts and applications involving high inertia loads which can cause overspeed.
10. Avoid extended exposure to equipment with high noise levels.

INSPECTION AND HANDLING

Inspect unit to make sure no damage has occurred during shipment. Check nameplate for correct speed, horsepower, voltage, hertz and phase for conformance with power supply and equipment.

⚠WARNING ***Units should be lifted using all eyebolts or lugs if provided. These eyebolts or lugs are provided for lifting this unit only and must not be used to lift any additional weight. Lifting angle, from shank of eyebolt, must not exceed 30 degrees for machines with single and 45 degrees for machines with multiple lifting means. Replacement eyebolts must be per ASTM A489 or equivalent. All eyebolts must be securely tightened. Be careful not to touch overhead power lines with lifting equipment. Failure to observe this warning may result in serious personal injury.***

STORAGE

Units should be stored indoors, in a clean, dry location & winding should be protected from excessive moisture absorption. NOTE: If motors are to be stored for over one year, refer to Nidec Motor Corporation (NMC). If motors are to be stored for over one year and if gear and belt transmission units are to be stored for over six months, refer to Nidec Motor Corporation.

LOCATION

⚠WARNING ***Use only UL Listed Hazardous Location Motors for service in Hazardous Locations as defined in Article 500 of the NEC. Units should be located in a clean, well-ventilated area. Units should be located in a suitable enclosure or protected to prevent access by children or other unauthorized personnel to prevent possible accidents.***

INSTALLATION / MOUNTING

Mount unit on a firm, flat surface sufficiently rigid to prevent vibration. Drive belts and chains should be tensioned in accordance with supplier recommendations. Couplings should be properly aligned and balanced. For belt, chain and gear drive selection refer to the drive or equipment manufacturer. For application of drive equipment refer to applicable information in NEMA MG1.

Motors have been dynamically balanced using a half key the same length as the full key shipped with the motor. If pulley length keyway is less than this length, rework long key by removing one-half of excess length between pulley and end of key to maintain balance.

Do not restrict motor ventilation. Unless otherwise specified on nameplate, motor is designed for operation in accordance with NEMA MG1 "Usual Service Conditions" which states an ambient temperature range of -15º C to 40º C (5º F to 104º F). Standard grease lubricated units are suitable for operation within this temperature range. Special lubricants may be required for ambient temperatures outside of this range. Note: Motors operating under rated load and allowable ambient conditions may feel hot when touched; this is normal and should not be cause for concern. When in doubt, measure frame surface temperature and confer with nearest office. Enclosed motors normally have condensation drain openings. Insure that drain openings are properly located and open (plugs removed) for the motor mounting position. Drain openings should be at lowest point of end brackets, frame housing and terminal housing when the motor is installed. This may require modification of motor to accomplish. If unit appears wet, and/or has been stored in a damp location, dry out thoroughly and check for adequate insulation resistance to ground before operating.

⚠WARNING ***Guards should be provided for all exposed rotating parts to prevent possible personal injury. Keep fingers and foreign objects away from ventilation and other openings. Applications involving high inertia loads may damage this equipment due to motor overspeed during coast shutdown. Such applications should be referred to Nidec Motor Corporation.***

⚠ CAUTION ***Do not force drive coupling or other equipment onto shaft, as bearing damage may result.***

POWER SUPPLY AND CONNECTIONS

The power supply must agree with values on nameplate. Terminal voltage should not vary more than ±10% of nameplate voltage at rated frequency. Unbalanced line voltage, greater than one percent, can cause overheating. Do not exceed the rated load amperes on the nameplate. Starting controls and overload protection should be properly sized in accordance with the NEC and the control manufacturer's recommendations.

Motor connections should be made by following instructions on connection diagram. Determine direction of rotation before connecting driven equipment. If direction of rotation label is supplied, operate only in specified direction. Rotation may be reversed on three phase motors by interchanging any two line connections. On single phase motors interchange leads per connection diagram on motor. Wiring of units, controls and grounding shall be in accordance with local and NEC requirements.

⚠WARNING ***Failure to properly ground unit may cause serious injury to personnel. Where unexpected starting could be hazardous to personnel, do not use automatic reset starting devices.***

USE OF VARIABLE FREQUENCY DRIVES

Electric motors can be detrimentally affected when applied with variable frequency drives (VFD's). The non-sinusoidal waveforms of VFD's have harmonic content which causes additional motor heating; and high voltage peaks.

Other effects of VFD's on motor performance include reduced efficiency, increased load current, vibration and noise. Standard motors utilized with VFD's must be limited to those application considerations defined in NEMA MG-1 Part 30. For most current guidelines on installing and applying a US Motors product refer to http://www.usmotors.com/guidelines. This information takes precedence over previous published information.

E N G L I S H

NEMA MG-1 Part 31 defines performance and application considerations for Definite-Purpose Inverter Fed Motors. To insure satisfactory performance and reliability, Nidec Motor Corporation offers and recommends nameplated inverter duty motor products which meet the requirements of NEMA MG-1 Part 31. The use of non-inverter duty motors may result in unsatisfactory performance or premature failure, which may not be warrantable under the Terms and Conditions of Sale. Contact your Nidec Motor Corporation Field Sales Engineer for technical assistance for motor selection, application and warranty details.

OIL LUBRICATION

Most oil lubricated units are shipped without oil. Refer to Instruction Manual with unit for specific type and grade of oil to be used, change interval and level. If lubrication instructions specify synthetic oil, do not substitute.

⚠WARNING ***For applications in the food and drug industry (including animal food), consult the petroleum supplier for lubricants that are acceptable to the Food and Drug Administration and other governing bodies.***

MAINTENANCE

Inspect units at regular intervals. Keep units clean and ventilation openings clear of dust, dirt or other debris. Lubricate units per this operating instruction folder and instruction plate on unit. Excessive lubrication may damage the unit. Do not over grease.

⚠WARNING ***Disconnect all power sources to the unit and discharge all parts which may retain an electrical charge before attempting any maintenance or repair. Screen and covers must be maintained in place when unit is in operation. Failure to observe this warning may result in personal injury.***

U.L. Listed Motors for use in Hazardous Locations: Repair of these motors must be made by the manufacturer or manufacturer's authorized service station approved to repair U.L. Listed Motors. The U.L. listing applies to the electric motor only and not the belt or gear transmissions or other devices that may be connected to the motor.

COOLING TOWER DUTY MOTORS

During installation, insure drain plugs are removed from lower drain holes in bracket and outlet box. All upper drain holes must be plugged at all times. External umbrella seal must be in place for shaft up applications. Motors with Bearing numbers “XXXX-2RS” are double sealed and not to be relubricated.

GREASE LUBRICATION INSTRUCTIONS

Units are prelubricated at the factory and do not require initial lubrication. Relubricating interval depends upon speed, type of bearing and service. Refer to Table 1 for suggested regreasing intervals. Operating conditions may dictate more frequent lubrication. Motor must be at rest and electrical controls should be locked open to prevent energizing while motor is being serviced (refer to section on Safety). If motor is being taken out of storage, refer to storage procedures.

To relubricate bearings, remove the drain plug. Inspect grease drain and remove any blockage with a mechanical probe taking care not to damage bearing.

⚠ CAUTION ***Under no circumstances should a mechanical probe be used while the motor is in operation. Add new grease at the grease inlet, refer to Table 1 for replenishment quantities. New grease must be compatible with grease in the motor (See Caution Note). Run the motor for 15 to 30 minutes with the drain plug removed to allow purging of any excess grease. Shut off unit and replace the drain plug. Return motor to service. Some motors have sealed bearings and are not regreasable.***

Over greasing can cause excessive bearing temperatures, premature lubricant breakdown and bearing failure. Care should be exercised against over greasing.

Table 1

Recommended Grease Replenishment Quantities & Intervals
(For lubrication of units in service)

Bearing Number				Bearing Type	Grease FL Oz.	Lubrication Interval		
Common		AFBMA						
62XX	63XX	XXBC02	XXBC03			1801-3600 RPM	1201-1800 RPM	0-1200 RPM
6203-6207	6303-6306	17-35	17-30	Ball	0.2	2 Years	3 Years	3 Years
6208-6212	6307-6309	40-60	35-45		0.4	1 Year	2 Years	2 Years
6213-6215	6310-6311	65-75	50-55		0.6	1 Year	2 Years	2 Years
6216-6219	6312-6315	80-95	60-75		1.0	6 Mos.	1 Year	2 Years
6220-6228	6316-6320	100-140	80-100		1.8	3 Mos.	1 Year	1 Year
NU307		35RU03		Roller	0.3	N/A	6 Mos.	1 Year
NU309		45RU03			0.4			
NU311		55RU03			0.6			
NU215		75RU02			0.6			
NU315		75RU03			1.0			
NU220		100RU02			1.1	N/A	3 Mos.	6 Mos.
NU222		110RU02			1.4			
NU226		130RU02			1.6			
NU228		140RU02			1.9			
C2211 CARB		N/A			0.4	N/A	6 Mos.	1 Year
C2213 CARB		N/A			0.6			
C2316 CARB		N/A			1.8			
C2220 CARB		N/A			1.4	N/A	3 Mos.	6 Mos.
C2222 CARB		N/A			1.8			
C2226 CARB		N/A			2.5			

For motors mounted vertically or in hostile environments, reduce intervals shown by 50 percent.

Refer to motor nameplate for bearings provided on a specific motor.

For bearings not listed in table above, the amount of grease required may be calculated by the formula:

$$G=0.11 \times D \times B$$

Where;

G = Quantity of grease in fluid ounces.

D = Outside diameter of bearing in inches.

B = Width of bearing in inches.

ENGLISH

Table 2
RECOMMENDED GREASES

THE FOLLOWING GREASES ARE INTERCHANGEABLE WITH THE GREASE AS PROVIDED IN UNITS SUPPLIED FROM FACTORY (UNLESS STATED OTHERWISE ON A LUBRICATION NAMEPLATE PROVIDED ON MOTOR).

MANUFACTURER	GREASE (NLGI No. 2)
MOBIL CORP.	POLYREX - EM
CHEVRON U.S.A. INC.	SRI NO. 2

⚠ CAUTION ***Greases of different bases (lithium, polyurea, clay, etc.) may not be compatible when mixed. Mixing such greases can result in reduced lubricant life and premature bearing failure. When necessary, prevent such intermixing by disassembling the motor, removing all old grease from bearings and housings (including all grease fill and drain holes). Inspect and replace damaged bearings. Fill bearing housings and bearing approximately 30% full of new grease. Remove any excess grease extending beyond the edges of the bearing races and retainers. Refer to Table 2 for recommended greases.***

WARRANTY

LIMITED WARRANTY

All Nidec Motor Corporation products are warranted against defects in workmanship and materials for 12 months from date of installation, not to exceed 18 months from date of shipment from NMC. Some of Nidec Motor Corporation products carry a warranty period longer than 12 months. Please refer to the current price catalog or to NMC for details on specific products. This limited warranty does not apply to any product which has been subject to misuse, misapplication, neglect (including without limitation, inadequate maintenance), accident, improper installation, modification, adjustment, or repair. This constitutes NMC's only warranty in connection with this sale and is in lieu of all other warranties, expressed or implied, written or oral. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE THAT APPLY TO THIS SALE. No employee, agent, dealer or other person is authorized to give any warranties on behalf of NMC nor to assume for NMC any other liability in connection with any of its products.

EXCLUSIVE REMEDY

NMC's liability shall be limited exclusively to repairing or replacing any product found by NMC to be defective, or at NMC's option, to refund the purchase price of its product. Such product shall be returned, freight prepaid, to the nearest Nidec Motor Corporation authorized service station or NMC factory. It is agreed that such replacement, repair, or refund be the sole and exclusive remedies available from NMC. NMC shall not be liable for damages of any sort whatsoever beyond these exclusive remedies including incidental and consequential damages regardless of whether any claim is based upon contract, negligence, strict liability, tort, warranty, or other basis. The repair or replacement of the product, or the refund of the purchase price, at NMC's option, constitutes fulfillment of all liabilities of NMC to the buyer for defective products.

RENEWAL PARTS AND WARRANTY SERVICE

When inquiring for renewal parts, call the nearest Nidec Motor Corporation Parts Stocking Distributor. For warranty service, call the nearest Nidec Motor Corporation Authorized Service Station. Give them complete Nameplate data, including identification number, etc.

Request installation and maintenance manuals by product name.

FOR SERVICE CALL:

NEAREST NIDEC MOTOR CORPORATION AUTHORIZED SERVICE STATION OR NIDEC MOTOR CORPORATION PRODUCT SERVICE ST. LOUIS, MO 1-800-566-1418

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ENGLISH

Notes

Notes

ENGLISH

MASTER

TRANSFER SWITCH
FIRE PUMP CONTROLLER

Models – MCAT, MCPT, MCRT, MCOT, MCYT, MCST, MCTT

Innovation – G4

INSTRUCTION MANUAL

TABLE OF CONTENTS

IMPORTANT SAFETY INFORMATION

WARNING - DANGER OF LETHAL ELECTRICAL SHOCK AND ARC FLASH HAZARD - USE APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT (PPE) IN ACCORDANCE WITH NFPA 70E.

WARNING - TO PREVENT THE POSSIBILITY OF SERIOUS INJURY OR DEATH DUE TO AN ELECTRICAL FAULT, BE SURE THE DOOR(S) IS CLOSED AND LATCHED BEFORE CLOSING ANY OF THE ISOLATING SWITCHES AND CIRCUIT BREAKERS OR OPERATING THE CONTROLLER.

WARNING - THIS EQUIPMENT MUST ONLY BE SERVICED BY QUALIFIED ELECTRICAL PERSONNEL.

WARNING - DO NOT DEFEAT ANY INTERLOCKS OR SAFETY FEATURES OR EQUIPMENT OR CIRCUITRY.

WARNING - FOREIGN VOLTAGE MAY BE PRESENT. CONTROLLERS EQUIPPED WITH MODIFICATION "SP1" OR "SP2" UTILIZE AUXILIARY BRANCH CIRCUIT POWER WHICH IS NOT SWITCHED OR CONTROLLED BY THE ISOLATING SWITCH (IS) OR CIRCUIT BREAKER (CB). ALWAYS TURN OFF OR DISCONNECT THE EXTERNAL SOURCE OF POWER BEFORE ATTEMPTING TO SERVICE THE CONTROLLER.

WARNING - BEFORE ATTEMPTING TO MAINTENANCE OR SERVICE THIS EQUIPMENT, BE SURE TO FOLLOW THE PLACARD INSTRUCTIONS TO DE-ENERGIZE BOTH THE TRANSFER SWITCH AND FIRE PUMP CONTROLLER.

CAUTION - OPENING ONLY THE NORMAL SOURCE CIRCUIT BREAKER (CB-N) WILL CAUSE THE GENERATOR TO START AND THE CONTROLLER TO TRANSFER TO THE EMERGENCY SOURCE AFTER A 10 SECOND DELAY.

GENERAL DESCRIPTION and APPLICATION

Master combined Manual and Automatic Electric Fire Pump Controllers meet all of the requirements of NFPA-20, *Standard for the Installation of Stationary Fire Pumps for Fire Protection*. They are designed to automatically start an electric motor driven fire pump in the event of a fire.

-Model MCATZ transfer switch fire pump controller combination units provide across-the-line (direct-on-line) full voltage starting for three phase motor driven fire pumps. These controllers are used where local power limitations do not restrict the motor starting in-rush (locked rotor) current.

-Model MCPTZ transfer switch fire pump controller combination units provide part winding reduced inrush starting for three phase motor driven fire pumps. These controllers are used where local power limitations restrict the motor starting in-rush (locked rotor) current.

-Model MCRTZ transfer switch fire pump controller combination units provide primary reactor reduced voltage starting for three phase motor driven fire pumps. These controllers are used where local power limitations restrict the motor starting in-rush (locked rotor) current.

-Model MCOTZ transfer switch fire pump controller combination units provide wye-delta (star-delta) open transition reduced inrush starting for three phase motor driven fire pumps. These controllers are used where local power limitations restrict the motor starting in-rush (locked rotor) current.

-Model MCYTZ transfer switch fire pump controller combination units provide wye-delta (star-delta) closed transition reduced inrush (reduced voltage) starting for three phase motor driven fire pumps. These controllers are used where local power limitations restrict the motor starting in-rush (locked rotor) current.

-Model MCSTZ transfer switch fire pump controller combination units provide reduced voltage soft starting and soft stopping for three phase motor driven fire pumps. These controllers are used where local power limitations restrict the motor starting in-rush (locked rotor) current, and/or where hydraulic conditions warrant. They utilize a solid state motor starter for soft start and stop functions.

-Model MCTTZ transfer switch fire pump controller combination units provide autotransformer reduced voltage starting for three phase motor driven fire pumps. These controllers are used where local power limitations restrict the motor starting in-rush (locked rotor) current.

MODEL NUMBER CONSTRUCTION

Model	-	Horsepower	-	Voltage Code	-	Modifications
MCAT		3, 5, 7.5, 10		20 – 200v, 60hz		XG4
MCPT		15, 20, 25, 30		21 – 208v, 60hz		(See table below)
MCRT		40, 50, 60, 75		22 – 220v, 50hz		
MCOT		100, 125, 150		23 – 230v, 60hz		
MCYT		200, 250, 300		24 – 240v, 60hz		
MCST		350, 400		38 – 380v, 50hz		
MCTT				39 – 380v, 60hz		
				40 – 400v, 50hz		
				41 – 415v, 50hz		
				42 – 415v, 60hz		
				46 – 460v, 60hz		
				57 – 575v, 60hz		

G4 Innovation - Modification Code Table

FC - Foam Controller
LPM - Leading Phase Monitor
POC - Programmable Option Chassis – 8 input signals and 8 output relays

Relays can be programmed for:

AC Volts Low
AC Failure
CB Trip (requires SP1 or SP2 to maintain signal)
Failure to Start
Load Shed
Lockout
Low Discharge Pressure
Low Suction Pressure
Low Zone Start or On Demand
Motor Overload
Overpressure
PhaseSmart
Phase Reversal
Pump House Trouble inputs 1-8
Pump Running
Single Phase Running
Transducer Failure
Transfer Switch Normal
Transfer Switch Normal Power Available
Transfer Switch Emergency
Transfer Switch Emergency Power Available
Transfer Switch Emergency CB Open
Transfer Switch Generator Start

SP1 - Supervisory Power input for 120 vac, 50/60 hz
SP2 - Supervisory Power input for 240 vac, 50/60 hz

12 - NEMA type 12, dust tight enclosure
3R - NEMA type 3R, rain tight enclosure
4 - NEMA type 4, water tight enclosure
4XB - NEMA type 4X, 304 stainless steel water tight enclosure
4XC - NEMA type 4X, 316 stainless steel water tight enclosure
8E - CE declaration for European Community
15 - 300 PSI, 316 SS pressure transducer, test valve, and wet parts
15A - 300 PSI, 300 series SS pressure transducer, test valve, and wet parts
16A - 500 PSI, pressure transducer, test valve, and wet parts
19 - Space heater
20 - Space heater with thermostat
20A - Space heater with humidistat
27 - 200,000 amp short circuit current rating – Emergency source
32 - Low pump room temperature switch
33 - Auxiliary 1 amp, 115 vac fused output
83LT - Low suction transducer and wet parts externally mounted
200 - 200,000 amp short circuit current rating – Normal source

G4 Standard Functions

- Pressure Start
- Remote Start
- Deluge Start
- Manual, Non-automatic Operation (Remote, Deluge, or Manual Start only)
- Sequence Delay
- High Zone Delay
- Minimum Run Timer
- 3 second restart delay
- Auto Weekly or Monthly Testing
- Pressure Drop Start button
- Audible Alarm with silence.
- Transducer Testing
- Remote Alarm Contact Testing
- Single phase starting lockout (PhaseSmart)
- Single phase running alarm
- Failure to Start alarm
- Low Discharge Pressure alarm
- Overpressure alarm
- AC Volts Low alarm
- Motor Overload alarm
- Pump Demand/On Demand contacts
- Conversion between PSI and BAR
- Motor run audible alarm
- Lockout (when authorized by AHJ)

STANDARD PRODUCT SPECIFICATIONS

Fire Protection Approvals – UL listed to ANSI/UL 218, FM approved to standard 1321/1323.

Fire Protection Standards – Complies with NFPA 20, IEC62091.

Voltage Rating – Controllers are designed for or it's rated voltage, -15% and +10%.

Normal Short Circuit Current Rating – Standard controllers are rated for 100,000 symmetrical RMS amps at 200 vac to 480 vac. Higher ratings are available.

Emergency Short Circuit Current Rating – Standard controllers are rated for 100,000 symmetrical RMS amps at 200 vac to 480 vac. Higher ratings are available.

Horsepower Rating – Controller are designed to control the specific nameplated motor horsepower rating.

Service Factor – Controllers are designed for use with motors having a maximum Service Factor of 1.15.

Locked Rotor Code – Controllers are designed for use with motors having a locked rotor KVA/HP code of G for motors rated 200/208 vac, 60 hz, 230 vac, 60 hz, 460 vac, 60 hz, 575, 60 hz. They are designed for code H motors rated 380/415 vac, 50 hz.

Remote Contacts – On the CU, control unit, the voltage free contacts are rated for 2 amps (resistive) at 30 vdc, or 1 amp (resistive) at 125 vac.

Remote Contacts – On the POC, Programmable Option Chassis, the voltage free contacts are rated for 6 amps (resistive) at 30 vdc, 6 amps (resistive) at 250 vac. They also carry UL pilot duty ratings R300 and B300.

Pressure Rating – Standard controllers are rated for 300 PSI (20.7 BAR). Higher ratings are available.

Plumbing – Standard controllers are provided with brass fittings. Other materials are available.

Enclosure – Standard controllers are rated for NEMA type 2 or IP-31. Other enclosures are available.

Ambient Temperature – Rated for operation in a 50C ambient provided the input and output cable has a temperature rating of 105C. For a 40C ambient, the temperature rating of the cable can be reduced to 90C. No direct sunlight is allowed on the enclousure.

Electromagnetic Compatibility – Tested to comply with EN 61000-6-2 for immunity and EN 61000-6-4 for emissions.

ANNOTATED CONTROLLER ILLUSTRATION

MC*TZ Series Controller

Emergency Isolating Switch

Normal Isolating Switch

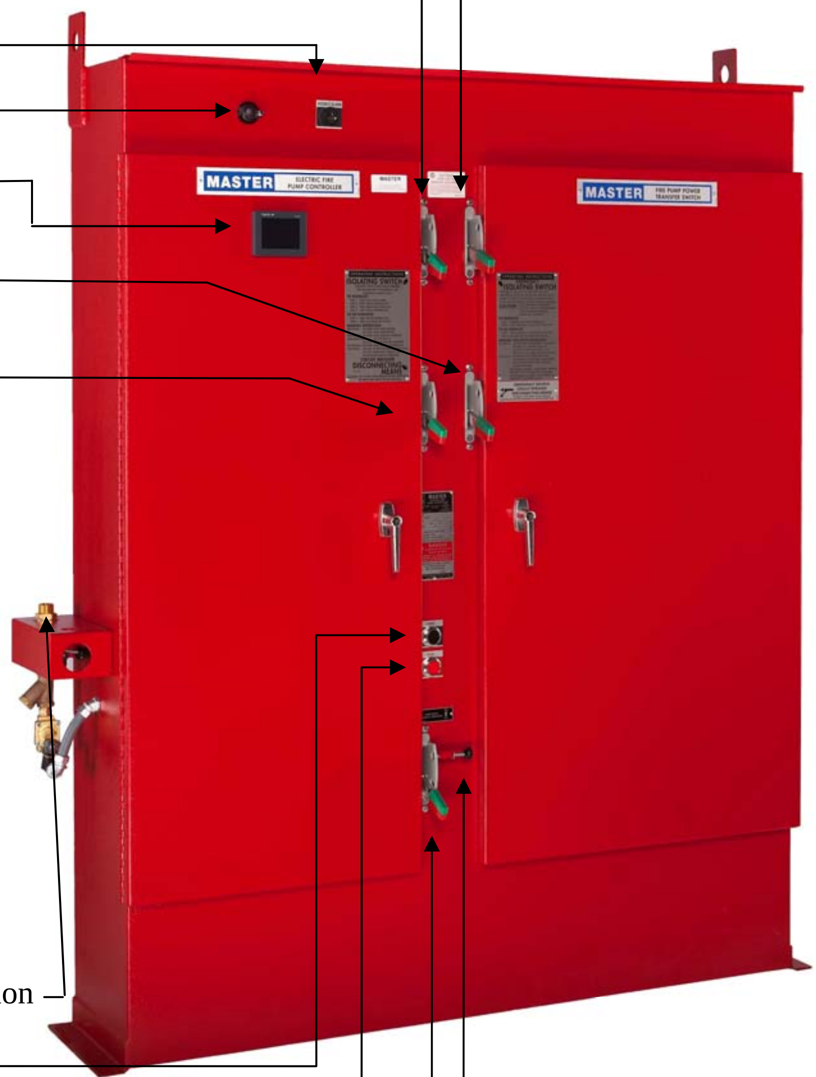
Audible Alarm

USB Waterproof Adapter

Color Display

Emergency Circuit Breaker
(Disconnecting Means)

Normal Circuit Breaker
(Disconnecting Means)



Pressure Sense Line Connection

Start (Pushbutton)

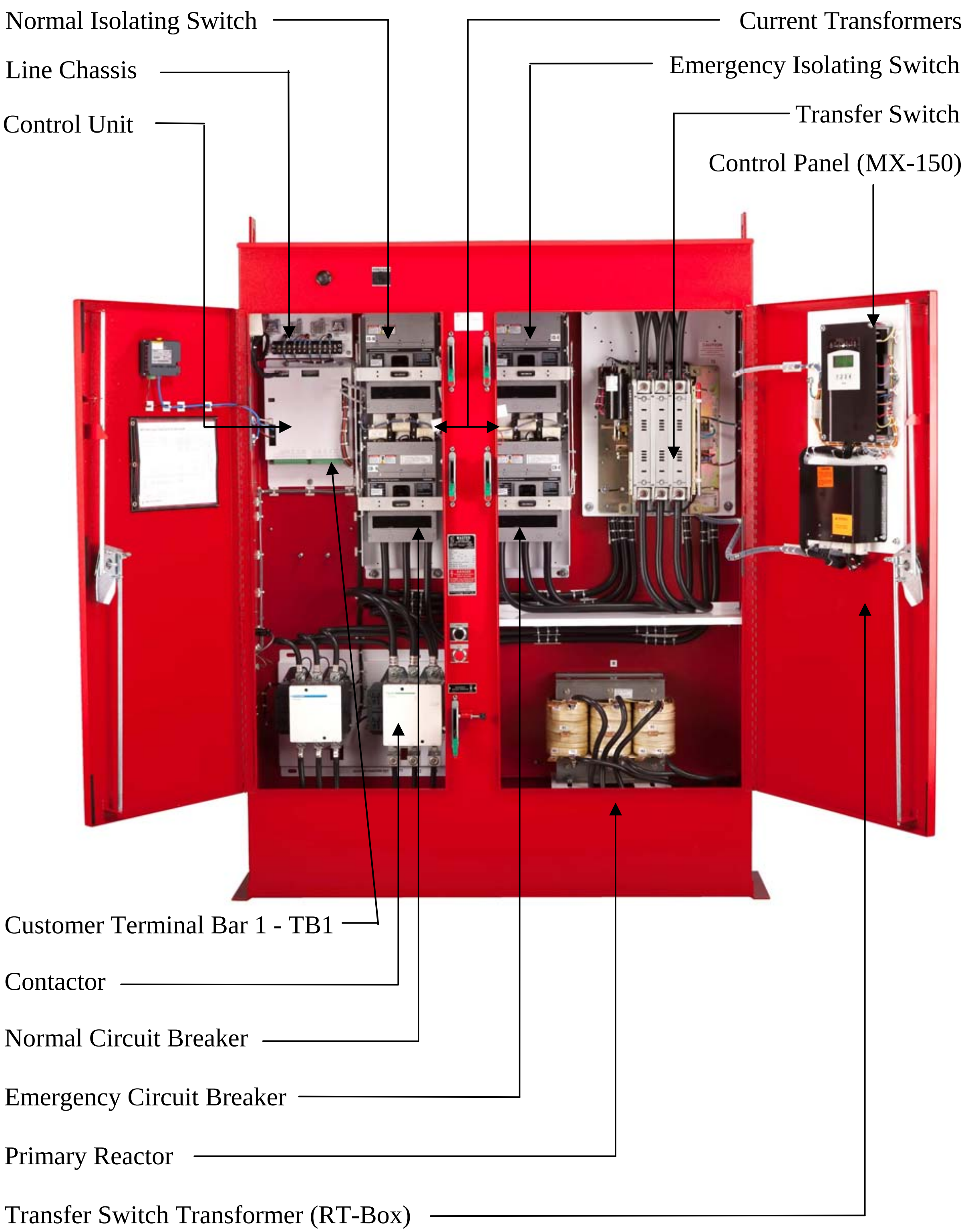
Stop (Pushbutton)

Emergency Manual Operator

Emergency Manual Operator Latch

ANNOTATED CONTROLLER ILLUSTRATION

MC*TZ Series Controller



INSTALLATION

The fire pump controller and all of its wiring and plumbing should be installed in accordance with the requirements given below and the external wiring diagram(s) near the end of this manual. It should also be installed in accordance with the requirements of NFPA-20, *Standard for the Installation of Stationary Fire Pumps for Fire Protection*, and the requirements of NFPA-70, article 695, the *National Electric Code,* as well as any local requirements.

LOCATION - Controllers should be located as close as practical to the motors they control. It should also be located within sight of the motor and in an area free from dripping and spraying water.

RATINGS - Check that the system voltage and the motor nameplate voltage and horsepower ratings agree with the controller nameplate voltages and horsepower ratings before beginning installation.

MOUNTING - Controllers should be securely mounted and bolted to noncombustible surface or structure. The use of a (3 inch) housekeeping pad is recommended when needed to keep the bottom of the controller dry.

CONDUIT ENTRANCE - Conduit entrance can be made either through the top or bottom of the enclosure.

CAUTION - FOREIGN METALLIC DEBRIS, SUCH AS DRILLING CHIPS, CAN CAUSE A DANGEROUS AND/OR DAMAGING ELECTRICAL FAULT WHEN THE EQUIPMENT IS ENERGIZED. BE SURE TO PROTECT ALL ELECTRICAL PARTS FROM METALLIC DEBRIS DURING INSTALLATION.

Use appropriate conduit hub that matches the "Enclosure Type" as shown on the controller nameplate. When controllers suitable for outside installation are used, be sure the appropriate weatherproof conduit hub is used and provide a sun roof to prevent direct sunlight on the controller.

NOTE: If entering from the top, waterproof hubs are required for all installations to match the minimum “Enclosure Type”.

CONNECTIONS

PIPING CONNECTIONS - A 1/2 inch nominal pressure sense line, typically made of brass, rigid copper or 300 series stainless steel, shall be connected to the incoming bulkhead connector located on the controller. The pressure sense line shall have two 3/32" orifices installed between the fire protection system and the bulkhead fitting. Secure this sense line as needed to prevent vibration or damage. For further installation details, consult NFPA-20 or refer to the Piping Diagram drawing located in the drawing section of this manual.

POWER CONNECTIONS –

MCATZ - The normal power source input conductors are connected to the Normal Isolating Switch (IS-N) at points labeled NL1, NL2, and NL3. The emergency power source input conductors are connected to the Emergency Isolating Switch (IS-E) at points labeled EL1, EL2, and EL3. Power supply phase sequence for Normal and Emergency MUST be the same, preferably A-B-C. The output motor wiring is connected to the bottom of the Main Contactor M at points labeled T1, T2, and T3. Refer to the External Wiring diagram for details.

MCPTZ – The normal power source input conductors are connected to the Normal Isolating Switch (IS-N) at points labeled NL1, NL2, and NL3. The emergency power source input conductors are connected to the Emergency Isloating Switch (IS-E) at points labeled EL1, EL2, and EL3. Power supply phase sequence for Normal and Emergency MUST be the same, preferably A-B-C. The output motor wiring is connected to the bottom of the Main Contactors M1 and M2 load side lugs T1-T2-T3 and to T7-T8-T9. Refer to the External Wiring diagram for details.

MCRTZ – The normal power source input conductors are connected to the Normal Isolating Switch (IS-N) at points labeled NL1, NL2, and NL3. The emergency power source input conductors are connected to the Emergency Isolating Switch (IS-E) at points labeled EL1, EL2, and EL3. Power supply phase sequence for Normal and Emergency MUST be the same, preferably A-B-C. The output motor wiring is connected to the bottom of the Main Contactor M load side terminal lugs T1, T2 and T3. Refer to the External Wiring diagram for details.

MCOTZ - The normal power source input conductors are connected to the Normal Isolating Switch (IS-N) at points labeled NL1, NL2, and NL3. The emergency power source input conductors are connected to the Emergency Isolating Switch (IS-E) at points labeled EL1, EL2, and EL3. Power supply phase sequence for Normal and Emergency MUST be the same, preferably A-B-C. The output motor wiring is connected to the bottom of the Main Contactors M1 and M2 load side terminal lugs T1-T2-T3 and to T6-T4-T5 **or** T12-T10-T11. Refer to the External Wiring diagram for details.

MCYTZ - The normal power source input conductors are connected to the Normal Isolating Switch (IS-N) at points labeled NL1, NL2, and NL3. The emergency power source input conductors are connected to the Emergency Isolating Switch (IS-E) at points labeled EL1, EL2, and EL3. Power supply phase sequence for Normal and Emergency MUST be the same, preferably A-B-C. The output motor wiring is connected to the bottom of the Main Contactors M1 and M2 load side terminal lugs T1-T2-T3 and to T6-T4-T5 **or** T12-T10-T11. Refer to the External Wiring diagram for details.

MCSTZ – The normal power source input conductors are connected to the Normal Isolating Switch (IS-N) at points labeled NL1, NL2, and NL3. The emergency power source input conductors are connected to the Emergency Isolating Switch (IS-E) at points labeled EL1, EL2, and EL3. Power supply phase sequence for Normal and Emergency MUST be the same, preferably A-B-C. The output motor wiring is connected to the bottom of the Main Contactor M load side terminal lugs T1, T2, and T3. Refer to the External Wiring diagram for details.

MCTTZ - The normal power source input conductors are connected to the Normal Isolating Switch (IS-N) at points labeled NL1, NL2, and NL3. The emergency power source input conductors are connected to the Emergency Isolating Switch (IS-E) at points labeled EL1, EL2, and EL3. Power supply phase sequence for Normal and Emergency MUST be the same, preferably A-B-C. The output motor wiring is connected to the bottom of the Main Contactor M load side terminal lugs T1, T2 and T3. Refer to the External Wiring diagram for details.

MOTOR CIRCUIT CONDUCTORS - All motor circuit conductors must be sized according to the National Electric Code (NFPA-70) on a continuous duty basis. Insulation for these conductors should be chosen so it will not be affected by the surrounding environment and have an insulation temperature rating at least 90 degrees C for an ambient of 40C or at least 105C for an ambient of 50C.

The ampacity of the wire is based on 125% of the motor full load current (FLA) using the 60C column for 100 amps or less and the 75C column in field wiring table 310.15(B)(16) of the 2011 edition of the NFPA 70 for higher currents. Also, apply the appropriate correction factors in accordance with 310.15(B)(1) through 310.15(B)(7).

The outgoing motor wiring is reduced to:

-58% of this value for wye-delta (MCOT or MCYT) controllers.

-50% of this value for part winding (MCPT) controllers.

CAUTION - BE SURE TO SECURE CONDUCTORS IN SUCH A MANNER SO THEY WILL NOT MOVE OR INTERFERE OR RUB AGAINST ANY COMPONENTS OR MECHANISMS IN THE CONTROLLER. PROTECT AGAINST CONTACT WITH SHARP EDGES OR CORNERS.

NOTE: The controller is Service Entrance Rated so a dual grounding lug is provided for the grounding electrode conductor and the grounded service conductor. No neutral connection is provided or needed. The controller is suitable for use on either three wire or four wire systems without the use of a neutral.

REMOTE ALARM CONNECTIONS - See the contact rating limitations on the wiring diagram.

1. Pump Running Signal - Terminals numbered 5, 6, and 7 provide a form "C" set of contacts which transfer when the motor current is detected. Contacts on terminals 5 and 6 close in the alarm state, while contacts on terminals 6 and 7 open in the alarm state.

2. Pump Running Signal (2nd set) - Terminals numbered 8, 9, and 10 provide a form "C" set of contacts which transfer when the motor current is detected. Contacts on terminals 8 and 9 close in the alarm state, while contacts on terminals 9 and 10 open in the alarm state. This relay can also be programmed for other alarms if required. See the Advanced menu section for information on programming this signal for other alarms.

3. A.C. Power Failure Signal - Terminals numbered 11, 12, and 13 provide a form "C" set of contacts which transfer when any phase of the incoming normal power fails. Contacts on terminals 11 and 12 close in the alarm state, while contacts on terminals 12 and 13 open in the alarm state.

4. Phase Reversal Signal - Terminals numbered 14, 15, and 16 provide a form "C" set of contacts which transfer when any two phases of the incoming power are reversed. Contacts on terminals 14 and 15 close in the alarm state, while contacts on terminals 15 and 16 open in the alarm state.

5. System Trouble Signal – Terminals numbered 17, 18, and 19 provide a form “C” set of contacts which transfer when internal controller trouble exists. Contacts on terminals 17 and 18 close in the alarm state, while contacts on terminals 18 and 19 open in the alarm state. See the Advanced menu section for information on programming this signal for other alarms.

6. Low Zone Remote Start (On Demand) – Terminals numbered 20, 21, and 22 provide a form “C” set of contacts which transfer immediately when the High Zone function is enabled and a start demand is received. Contacts on terminals 20 and 21 close in the alarm state, while contacts on terminals 21 and 22 open in the alarm state.

7. Transfer Switch Normal - Terminals numbered 23, 24, and 25 provide a form “C” set of contacts which transfer when the transfer switch is in the Normal position. Contacts on terminals 23 and 24 close in the alarm state, while contacts on terminals 24 and 25 open in the alarm state.

8. Transfer Switch Emergency - Terminals numbered 26, 27, and 28 provide a form “C” set of contacts which transfer when the transfer switch is in the Emergency position. Contacts on terminals 26 and 27 close in the alarm state, while contacts on terminals 27 and 28 open in the alarm state.

9. Emergency Circuit Breaker Open - Terminals numbered 29, 30 and 31 provide a form "C" set of contacts which transfer when the Emergency Circuit Breaker is operated. Contacts on terminals 29 and 30 close in the alarm state, while contacts on terminals 30 and 31 open in the alarm state.

10. Generator Start Circuit - Terminals numbered 32, 33, and 34 provide a form "C" set of contacts which transfer to start the Emergency Standby Generator Set. Contacts on terminals 32 and 33 close to start the generator, while contacts on terminals 33 and 34 open to start the generator.

REMOTE INPUTS -

1. Deluge Valve Start – Wire a normally closed remote contact between terminals 1 and 2 on TB1A of the Control Unit. Contacts open to start. See Circuit Wiring Table below.

2. Remote Start – Wire a normally closed remote contact between terminals 1 and 3 on TB1A of the Control Unit. Contacts open to start. See Circuit Wiring Table below.

3. Lockout – Wire a normally open remote contact between terminals 1 and 4 on TB1A of the Control Unit. Contacts close to lockout. See Circuit Wiring Table below.

Remote/Deluge Start or Lockout Circuit Wiring Table

Wire Size	Wire Resistance Ohm/1,000 Ft.	12 vdc (50 Ohms)	24 vdc (250 Ohm)
#12 AWG	1.588	15,700 Ft.	78,500 Ft.
#14	2.525	9,900	49,000
#16	4.016	6,200	31,000
#18	6.385	3,900	19,500
#20	10.15	2,500	12,500
#22	16.14	1,500	7,500
#24	25.67	940	4,700
#26	40.18	620	3,100

NOTE: Resistance and number of splices and contacts in circuit must be taken into consideration. A single splice may exceed the total resistance of 1,000 Ft. or more of wire.

SUPERVISORY POWER CONNECTION -

If Modification Codes SP1 or SP2 is provided, the control power circuit is also powered from a separate branch circuit. This keeps the control circuit powered so alarms can be provided when the Circuit Breaker is off or tripped. On the SP1 or SP2 auxiliary chassis, terminals numbered 1 and 2 are provided for connection of Supervisory Power. SP1 is for 120 vac, 50/60 hz and SP2 is for 240 vac, 50/60 hz.

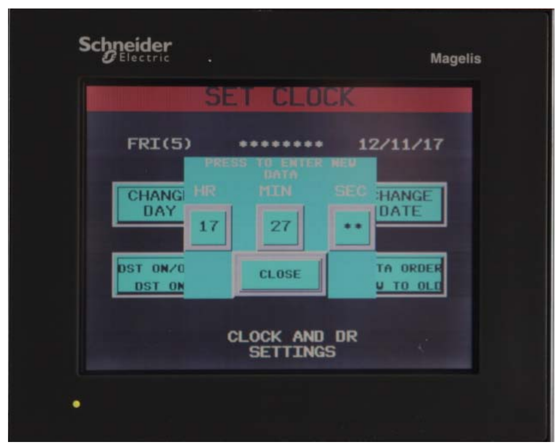
INITIAL POWER UP

When turning on your controller for the first time, your G4 touch screen will automatically turn on. You will immediately be prompted to set the current date and time as follows:

1. Press CHANGE DAY to correspond with today's date, with 1 representing Monday.
2. Press CHANGE TIME to access options to set the hour, minute and second. From here, change the hour to match a 24-hour clock, and the minute and second accordingly.
3. Press CLOSE when you are satisfied with the time.

NOTE: In some cases, a password is required to begin. If the Login screen appears, the Service Level password is required to continue. Contact the factory for further information.

NOTE: If the Phase Reversal alarm is active, Page 2 of the SETUP ASSISTANT will appear before the date and time prompting. The PHASE ROTATION button will be red to indicate the setting must be changed. Press the button to reverse the alarm sensing and clear the alarm. Then press BACK to return to the CLOCK AND SETTINGS screen.



After the time and date are set, press BACK to proceed to page 1 of the SETUP ASSISTANT.

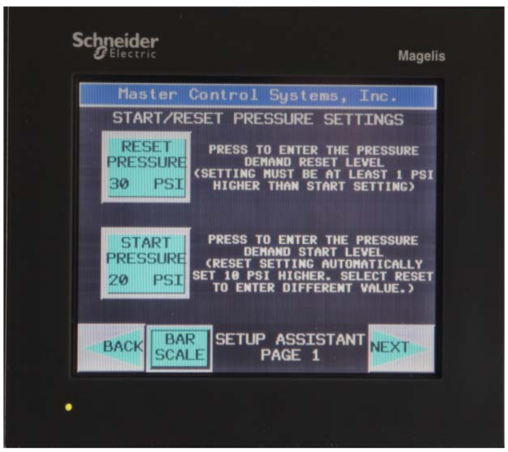
SETUP ASSISTANT

The Setup Assistance helps you to setup all the basic settings on the controller. It allows you to set the Start/Reset pressures, set the display for PSI or BAR, set the Phase Rotation for ABC or CBA, enable Deluge/Remote Start, enable the Minimum Run Timer, set the Sequence staring delay, set the accelerate time, and enable the Auto Test Timer.

Note: After the Initial Power Up, you will need to Login to access the Setup Assistant. See Logging In for further information.

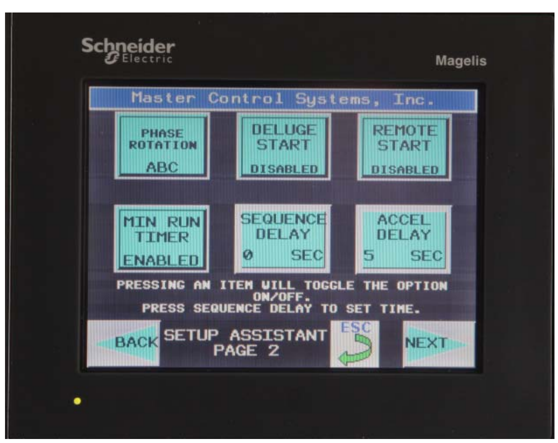
Note: All settings are automatically updated once entered.

Page 1 allows you to setup the Start Pressure. Simply press the START PRESSURE button and enter the value desired. The Reset pressure will automatically set itself to 10 PSI (0.69 BAR).



If you need to adjust your RESET Pressure Setting, simply push the RESET PRESSURE button, and set it accordingly.

Press NEXT to continue to page 2 of the Setup Assistant, where you will find all your options and settings, including PHASE ROTATION, DELUGE START, REMOTE START, MIN RUN TIMER, SEQUENCE DELAY, and ACCEL DELAY.



Phase Rotation

When the motor is rotating in the correct direction, the alarm should be off. If the alarm is sounding, you can toggle the phase rotation setting.

To toggle the Phase Rotation from the sequence shown on the screen, press the PHASE ROTATION button. Each time the button is pressed, the sequence will change from ABC to CBA and visa versa.

Deluge Start

The Deluge Start function will allow a maintained contact from a Deluge Valve to call for a start, if enabled. To use this function, you must wire a normally closed contact to the controller that opens when the Deluge Valve trips. The start function is delayed by Sequence Start delay setting.

To enable the Deluge Start from the screen, simply toggle the DELUGE START button to enable or disable as dictated by your needs.

Remote Start

The Remote Start function will allow a remote manual pushbutton to call for a start, if enabled. To use this function, you must wire a normally closed contact to the controller that opens when the Remote Start button is pressed. The start function is immediately and will not be delayed by the Sequence Start delay setting.

To enable the Remote Start from the screen, simply toggle the REMOTE START button to enable or disable as dictated by your needs.

Minimum Run

When enabled, the Minimum Run option will run the motor for at least 600 seconds. If there is no demand after that time, the pump will shut off immediately – however if there is a demand, the pump will continue running until the demand is reset. Typically, this occurs when the pressure recovers to a point above the Reset Pressure setting.

To enable the Minimum Run Timer, toggle the MIN RUN TIMER button to enable or disable as dictated by your needs.

Sequence Start

This function is used to start multiple pumps in sequence. For example, if you have 3 pumps, and you want a 5 second delay between each one starting, you would set the controllers as follows:

Controller 1: 0 seconds
Controller 2: 5 seconds
Controller 3: 10 seconds

To enable the sequence start time delay, press the SEQUENCE DELAY button and enter the appropriate time delay. Press ENTER and your entry will automatically be updated.

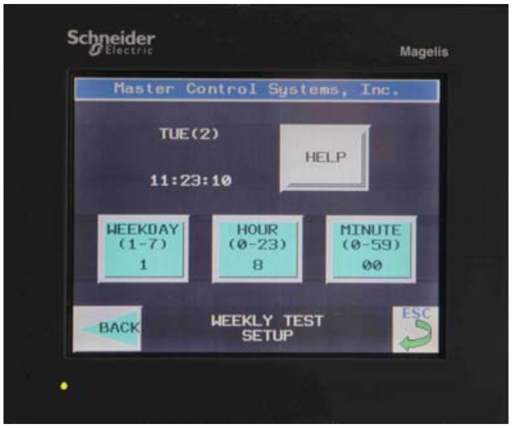
Accelerate Time Delay

On reduced voltage controllers, the Accelerate Time Delay determines how much time the controller allows for the motor to accelerate to full speed. The maximum setting is 10 seconds.

To set the Accelerate Time Delay from the screen, press the ACCEL DELAY button and input the time delay that fits your needs. Press ENTER and your entry will automatically be updated.

Press NEXT to continue to page 3 of the Setup Assistant, where you may set the weekly or monthly test time.

How to Set the Weekly or Monthly Test



To enable, press the AUTO TEST ENABLE button. Then select either the monthly or weekly test, and enter the time you would like the test to automatically occur.

To set the WEEKLY TEST, enter the following:

1. The day, 1-7 with 1 representing Monday
2. The hour, in accordance with a 24 hour clock.
3. The minute, 0-59

For example, if you would like to set the weekly test to **Monday at 8:00 am**, you would enter the following:

Day: 1 **Hour: 8** **Minute: 00**

To set the MONTHLY TEST you must enter the following:

1. A week 1-4, with 1 representing the first week of the month
2. A day, 1-7 with 1 representing Monday
3. The hour, in accordance with a 24 hour clock.
4. The minute 0-59.

Alternatively, if you would like to set the monthly test to the **2nd Tuesday of each month at 2:15pm**, you would enter the following:

Week: 2 **Day: 2** **Hour: 14** **Minute: 15**

NOTE: All adjustments are automatically updated as soon as they are entered.

LOGGING IN

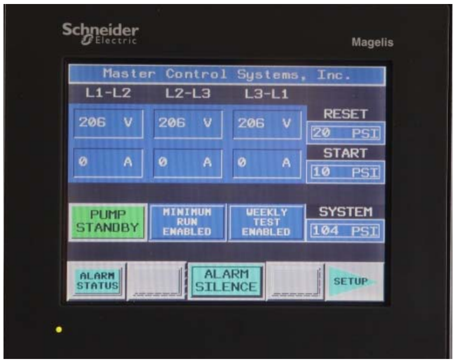
To change settings on your G4 interface, you must first login with the associated username and password. Unless changed, the factory default username and password is as follows:

Login Factory Defaults:
Username: USER
Password: USER

Or

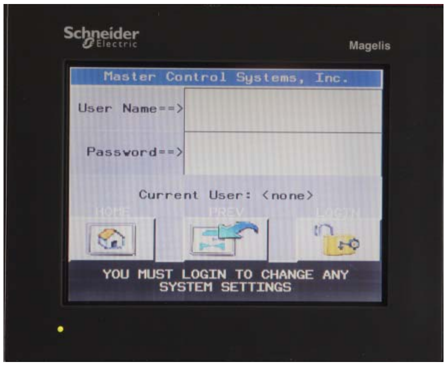
Username: SERVICE
Password: SERVICE

To login from the Main Menu, press SETUP to access the Setting screen. Press LOGIN and then the blank space next to User Name and Password and enter the appropriate information. Once entered, press LOGIN (shown as the lock and key icon). Then press PREV (shown as the reverse arrow icon) to go back to the Setting screen. Now press SETUP ASSISTANT, ADVANCED SETUP, or SERVICE INFORMATION. You are now logged in until any screen is idle for more than 10 minutes.



Main Menu

Setup



Login

Entering Information

MENU FUNCTIONS

Functions on Main Menu

ALARM STATUS: When an alarm occurs, the screen will jump to the appropriate alarm screen to display the active alarm. Once the Audible Alarm is silenced, the BACK button can be used to return to the main screen, but if the alarm is still active, the button will change to ACTIVE ALARM and be flashing red. Press the button to go back to the alarm screen. If a Pump House Trouble alarm exists, this button will be flashing. Press to see theses alarms.

ALARM SILENCE: This button silences the Audible Alarm for the active alarm.

TRANSFER SWITCH STATUS: When a transfer switch alarm occurs, the screen will jump to the appropriate alarm screen to display the active alarm. Once the Audible Alarm is silenced, the BACK button can be used to return to the main screen, but if the alarm is still active, the button will change to XFERSW ALARM and be flashing red. Press the button to go back to the alarm screen.

STOP Button: When the motor is running, the STOP button on the main screen will stop the motor under all conditions.

NOTE: The STOP button also silences the Audible Alarm.

SETUP Button: This button takes you to the SETTINGS screen. From here you can access the Setup Assistant, Advanced Setup, Service Information, Pressure Drop Test button, Alarm Test button, and Setting Summary button.

Functions on Alarm Status Menu

PUMP RUNNING Alarm: When the pump is running, the Pump Running light illuminates and the Pump Running alarm contacts transfers.

NOTE: The alarm is activated when the motor current is greater that 20% of the motor FLA.

AC FAILURE Alarm: When one or all phases are lost, the AC Failure alarm will illuminate and the AC Failure alarm contacts will transfer.

NOTE: If only one phase is lost, the controller implements PhaseSmart lockout which prevents the motor from starting until the phase is restored.

PHASE SEQUENCE Alarm: When the Phase Sequence on the incoming 3-phase source from the last set sequence, the Phase Sequence alarm light will illuminate, the Audible Alarm will sound, and the remote Phase Sequence contacts will transfer.

NOTE: See the Setup Assistant section of this manual for more information on how to initially setup this alarm.

PUMP TROUBLE STATUS Button: This button takes you to the Pump House Trouble alarm screen. When a Pump House Trouble alarm contact closes, the appropriate indicating light illuminates, the Audible Alarm sounds, and the Pump House Trouble alarm contacts transfer.

Functions on Transfer Switch Status Menu

TRANSFER SWITCH – NORMAL: Anytime the transfer switch is in the Normal position, the Transfer Switch Normal light will illuminate.

TRANSFER SWITCH – EMERGENCY: Anytime the transfer switch is in the Emergency position, the Transfer Switch Emergency light will illuminate, the Audible Alarm will sound, and the Transfer Switch Emergency alarm contacts will transfer.

EMERGENCY CB OPEN: Anytime the Emergency Circuit Breaker is opened, the Emergency CB Open light will illuminate, the audible alarm will sound, and the Emergency CB alarm contacts will transfer.

NORMAL POWER OK: Anytime the power to the Normal side of the transfer switch is present, the Normal Power Ok light will illuminate.

EMERGENCY POWER OK: Anytime the power to the Emergency side of the transfer switch is present, the Emergency Power Ok light will illuminate.

XFERSW TEST: Press and hold button until transfer to Emergency occurs.

XFERSW BYPASS: Press to transfer back from Emergency to Normal.

Note: Normal power must be present for Bypass function to operate.

Functions on Settings Menu

SETUP ASSISTANT: See the Initial Setup Section in this manual. This requires User Level password. See the Logging In section in this manual for further details.

ADVANCED SETUP: This button takes you to the Advanced Setup screen where you can setup all controller functions. This requires User/Service Level password. See the Advance Setup section in this manual for further details.

SERVICE INFO: This button takes you to the Service Information screen where you may find your local service contact information, pump information, change password, and Annual Notification banner settings

PUMP INFO (HMI v3.7 and higher)
DATA SCREENS - 0%, 25%, 50%, 75%, 100%, 125%, 150% data point buttons.

SAVE DATA - When any of the flow buttons are pressed, a new screen will appear. Press SAVE DATA, enter service password, press SAVE DATA again to automatically enter all voltages, currents, the discharge pressure, and the suction pressure (when Mod. 83LT is provided). Press ENTER FLOW and ENTER SPEED buttons to manually enter GPM and RPM. Press BACK for the next flow point.

COMPARE DATA – Press to compare Present to Previous or Present to Acceptance.

TOGGLE GRAPH – Switches between Present, Previous, and Acceptance net pump curves.

NEXT

SAVE TO HISTORY AND CLEAR ALL DATA – Saves Present data to Previous data and clears Present data. Press before entering new data from the next test. Must first press HISTORY PROTECTION OFF (Advanced Setup/Service Menu).

SECURE PRESENT DATA – Press to prevent changes in present data.

CHART FULL SCALE – Set maximum pressure on graph.

SAVE ACCEPTANCE TEST – Press to Present data as also initial Acceptance Test data.

ENTER PW – Enter the Service Level password and press RESET SERV MESSAGE to change or reset the Annual Test Due banner. Enter the number of days until the next test. This is reset by again pressing RESET SERV MESSAGE and entering a new day count or 999.

Note: If the Annual Test Banner is set for 999, it will disable the banner.

<u>PRESSURE DROP TEST Button</u>: Pressing the PRESSURE DROP TEST button opens the drain valve solenoid to initiate the motor starting sequence by a pressure drop. This button should be used for routine starting.

<u>ALARM TEST Button:</u> This button takes you to the Alarm Test screen where every remote alarm contact can be tested by function. Contacts automatically transfer back to normal when the screen is exited or when the screen times out and returns to the main menu.

<u>SETTING SUMMARY:</u> See the Setting Summary section in this manual for further details.

ADVANCED SETUP

The Advance Setting Screen allows setting and enabling a multitude of advanced features. Below is a listing of all the features available through this screen:

Advanced Setup Screen (login under USER/USER)

- System Settings Screen
  - Start Pressure – enter pressure
  - Reset Pressure – enter pressure
  - PSI or BAR scale – press to toggle
  - Phase Rotation – press to toggle ABC or CBA
  - Minimum Run Timer – press to enable or disable
  - Auto Test Button – See Setup Assistant for further details
  - Transducer Test – press to enable or disable

- Timer Settings Screen
    - Sequence Delay – enter time
    - Accelerate Delay – enter time
    - High Zone Delay – enter time
    - Failure to Start Delay – enter time

- Option Settings Screen
  - Option Enables - Page 1
    - Auxiliary Alarm Relay Setup (Relays provided with Mod. Code POC)
      - Relay Number – press to set or change
        - Name - press to set or change
        - Select Function - press to continue
          - Functions desired – press to select (also see next screen)
          - Note: Multiple functions can be selected (except for AC Fail)
    - Pump Trouble Alarm Setup (Inputs provided with Mod. Code POC)
      - Input Number – press set or change
        - Name - press to set or change
    - Deluge Start – press to enable or disable
    - Remote Start – press to enable or disable
    - Pump Lockout – press to enable or disable (note: not allowed per NFPA 20)
    - Motor Run Audible – press to enable or disable

  - Option Enables - Page 2
    - Low Suction Pressure Setup (Suction transducer provided with Mod. Code 83LT)
      - Low Suction – press to enable or disable
      - Low Suction Trip Pressure – enter pressure
      - Low Suction Alarm Delay – enter time
      - Low Suction Reset Pressure – enter pressure
      - Low Suction Shutdown – press to enable or disable
        - Note: not allowed per NFPA 20
      - Low Suction Shutdown Delay – enter time

Low Suction Shutdown Delay Reset – enter time
Low Discharge Pressure Setup
Low Discharge – press to enable or disable
Low Discharge Alarm Pressure – enter pressure
Low Discharge Alarm Reset Pressure – enter pressure
Low Discharge Alarm Delay – enter time
System Overpressure Setup
System Overpressure Alarm – press to enable or disable
System Overpressure Alarm Pressure – enter pressure
System Overpressure Alarm Reset Pressure – enter pressure
System Overpressure Alarm Delay – enter pressure
Manual Start Only – press to enable or disable
On Demand Signal – press for immediate or delayed
Motor Overload – press to enable or disable

Option Enables - Page 3
AC Volts Low – press to enable or disable
Transfer Switch Remote Test – press to enable or disable
Note: Once enabled, use PT8 input to activate test
Load Shed – press to continue (Contacts provided with Mod. Code POC)
Load Shed – press to enable or disable
Load Shed Maintained or Momentary – press to toggle
Load Shed Start Delay – enter time
Supervisory Power Failure Alarm (Mod. Code SP1 or 2) – press to enable or disable
Supervisory Power Failure Start (Mod. Code SP1 or 2) – press to enable or disable

<u>DR/Clock Settings Screen</u>
Change Day – press to enter day of the week 1 through 7 (Monday is day 1)
Change Time – press to enter hour, minute, second
Change Date – press to enter Year, Month, Day
Daylight Savings Time On/Off – press to enable or disable
Hold to Clear Data Memory – press and hold to delete all history
Data Order New to Old or Old to New – press to toggle

<u>CB Test</u> – press to initiate locked rotor trip test

If logged in under SERVICE/SERVICE, the Advanced Setup Screen enables an additional Service button. Here the analog signals can be recalibrated.

<u>CAUTION</u> – IMPROPER CHANGES TO THE ANALOG SIGNAL CALIBRATION CAN CAUSE ERRONEOUS READINGS AND DISABLE THE FIRE PUMP FROM OPERATING AS INTENDED. CONTACT THE FACTORY FOR FURTHER INFORMATION.

SETTING SUMMARY

To check current system settings from the Main Menu, press SETUP, then SETTING SUMMARY. Log-in is not required to view the following system settings:

Setting Summary Screen

Summary Page 1

Reset Pressure	Deluge Start	Pump Lockout
Start Pressure	Remote Start	Minimum Run
Runtime Hours	Start Count	Phase Sequence

Summary Page 2

Auto Test Week		Sequence Time
Auto Test Day		High Zone Time
Auto Test Time		Accelerate Time

Summary Page 3 – Low Suction Alarm and Shutdown

Trip Pressure	Trip Delay	Shutdown Delay
Reset Pressure		Shutdown Reset Delay

Summary Page 4 – Low Discharge Pressure Alarm

Trip Pressure	Alarm Delay	Reset Pressure

Summary Page 5

Load Shed	Over Pressure Trip	Over Pressure Delay
Load Shed Start Delay		Over Pressure Reset

Summary Page 6

System Voltage		System FLA
Serial Number	Start Mode	Manufactured Date
DR version		VI version
HMI version		CTL version

START-UP PROCEDURE

Preliminary Checks

WARNING - PERFORM THESE PRELIMINARY CHECKS BEFORE ENERGIZING ANY INPUT CONNECTION TO THE CONTROLLER.

___1. Make absolutely sure that the system (power supply) voltage, motor nameplate voltage and horsepower ratings correspond to the controller nameplate voltages and horsepower ratings.

___2. Inspect for and remove any metal chips which may have fallen in the controller during installation.

___3. Remove all shipping ties and packing material that may not yet have been removed. In particular, check the contactor or contactors for full movement with the Emergency Manual Operator.

___4. Check all control wires for tightness.

___5. Check that all connectors are seated and latched.

___6. Check all connections in the power path of the motor and any Ground or Grounded conductors for tightness. Re-torque any loose connections to the component manufacturer's specifications. Contact Master Control Systems for additional information.

___7. Check that the limit switch, mounted on the Emergency Manual Operator, trips before the power contacts touch.

Start-up Checklist

The following checklist is designed to verify basic operation and all field input and output connections. It is recommended for each new installation and the annual fire pump test

WARNING - TO PREVENT THE POSSIBILITY OF SERIOUS INJURY OR DEATH DUE TO AN ELECTRICAL FAULT, BE SURE THE DOOR(S) IS CLOSED AND LATCHED BEFORE CLOSING THE ISOLATING SWITCH AND CIRCUIT BREAKER OR OPERATING THE CONTROLLER.

CAUTION - BE SURE THE DISCHARGE VALVE IS CLOSED AND THE FIRE PUMP AND FIRE SPRINKLER SYSTEM ARE READY OPERATION.

I. ENERGIZING CONTROLLER

___A. Close and Latch the controller doors.

___B. With both controller doors closed, first close the Normal Isolating Switch (IS-N), next close the Normal Circuit Breaker (CB-N), pause for 2 seconds and then close the Emergency Isolating Switch (IS-E), and finally, close the Emergency Circuit Breaker (CB-E).

___C. Check that the display begins powering up but don't begin the setup yet.

___D. Check the Pump Rotation by jogging (bumping) the motor. Do this by simultaneously pressing and holding both the Start and Stop pushbuttons. Then momentarily release the Stop pushbutton. If the pump runs backwards, open the Circuit Breaker (CB), the Isolating Switch (IS), and have a qualified electrician change rotation by swapping two of the three motor leads on the (M) contactor output terminals. For Part Winding and Wye-Delta controllers, swap the same two of three motor leads on the M1 and M2 output terminals. Re-close the door(s) and re-energize the controller and transfer switch.

___E. Now begin the setup by setting the clock.

___F. Press "BACK" and continue with the setup by following the Setup Assistant section.

___G. Verify all three voltages shown on the display are present and adequate.

___H. Press the Start pushbutton to run the motor.

___I. Verify all three currents on the display are adequate and balanced.

II. OPERATING THE TRANSFER SWITCH

___A. Open the Normal Circuit Breaker (CB-N).

___B. After 10 seconds, verify the Transfer Switch transfers to Emergency.

___C. Press the Start pushbutton to start and run the motor.

___D. Verify all three voltages shown on the display are adequate.

___E. Verify all three currents on the display are adequate and balanced.

___F. Press the Stop pushbutton to stop the motor.

___G. Close the Normal Circuit Breaker (CB-N).

___H. Press the Transfer Switch Bypass pushbutton.

___I. Verify the Transfer Switch transfers back to Normal.

III. <u>EMERGENCY MANUAL OPERATOR START</u>

___A. Pull all the way up on the Emergency Manual Operator handle. Check that the Main contactor(s) actuates and that the motor starts.

___B. Slide the latch <u>under</u> the Emergency Manual Operator handle and not through it. The entire Emergency Manual Operator lever should be resting on the latch. Check that the motor remains running.

___C. Lift up on the Emergency Manual Operator handle to unlatch and then release it. Check that the contactor drops out and the motor stops.

IV. <u>ENERGIZING THE CONTROLLER FOR STAND-BY OPERATION</u>

___A. Pressurize the system using the Jockey Pump.

___B. Verify the Start setting of the jockey pump is higher than the Start setting of the fire pump. This is to avoid starting the fire pump while in standby.

___C. Open the pump discharge valve and any other valves required for proper operation.

___D. Verify the fire pump does not start.

___E. Operate the Pressure Drop Test button to drop system pressure and start the motor. Also, verify Deluge Valve Start and Remote Start, if used.

___F. Check for a pressure start.

___G. Use the Stop pushbutton to stop the fire pump and leave it in service.

OPERATING INSTRUCTIONS

WARNING - TO PREVENT THE POSSIBILITY OF SERIOUS INJURY OR DEATH DUE TO AN ELECTRICAL FAULT, BE SURE THE DOOR(S) IS CLOSED AND LATCHED BEFORE CLOSING THE ISOLATING SWITCH AND CIRCUIT BREAKER OR OPERATING THE CONTROLLER.

EMERGENCY STOPPING - PULL THE CIRCUIT BREAKER (CB) HANDLE DOWN TO OPEN THE CIRCUIT BREAKER AND STOP THE MOTOR.

Energizing Controller: When energizing the controller for the first time after installation or after any service to the controller, motor, or motor wiring, follow the "Start-up Procedure" found earlier in this manual. For other cases, follow the Operating Instructions on the controller door.

Stand-by Operation: The normal stand-by configuration for the controller is for the Normal Isolating Switch (IS-N), the Normal Circuit Breaker (CB-N), the Emergency Isolating Switch (IS-E), and the Emergency Circuit Breaker (CB-E) all to be in the closed position, the color display to be energized, the motor to be off, and the Audible Alarm to be silent.

De-energizing Controller: To de-energize the controller, open the Circuit Breaker and then the Isolating Switch. If the controller is equipped with modification SP1 or SP2, the supervisory power source branch circuit breaker must also be opened.

WARNING - FOREIGN VOLTAGE MAY BE PRESENT. CONTROLLERS EQUIPPED WITH MODIFICATION “SP1” OR “SP2” UTILIZE AUXILIARY BRANCH CIRCUIT POWER WHICH IS NOT SWITCHED OR CONTROLLED BY THE ISOLATING SWITCH (IS) OR CIRCUIT BREAKER (CB). ALWAYS TURN OFF OR DISCONNECT THE EXTERNAL SOURCE OF POWER BEFORE ATTEMPTING TO SERVICE THE CONTROLLER.

Manual Electric Starting: Momentarily press the START pushbutton.

Manual Electric Stopping: Momentarily press the STOP pushbutton. If a start demand exists, the motor will restart after the STOP pushbutton is released and the restart time delay times out.

Emergency Manual Mechanical Starting: Pull up on the EMERGENCY MANUAL OPERATOR handle and slide the latch under the operator handle lever. To stop the fire pump motor, pull up on EMERGENCY MANUAL OPERATOR to release the latch and then release the operator handle quickly.

NOTE: The Stop pushbutton will not stop the motor while the EMERGENY MANUAL OPERATOR is engaged.

Automatic Transfer Switch Operation to Emergency Power: To transfer the Transfer Switch (TS) from the normal source to the emergency source automatically, open the Normal Circuit Breaker (CB-N). After a 3 second delay, the Generator Start contacts will transfer to start the Standby Emergency Generator. Approximately 7 seconds later, emergency power will be available at the line side of the Emergency Isolating Switch (IS-E) and the transfer switch will transfer.

Automatic Transfer Switch Operation to Normal Power: To transfer the Transfer Switch (TS) from the emergency source to the normal source automatically, first following the instructions above to transfer to the emergency power source. Now close the Normal Circuit Breaker (CB-N) and open the Emergency Circuit Breaker (CB-E), the transfer switch will immediately transfer back to the normal source. Close the Emergency Circuit Breaker (CB-E).

Manual Electrical Transfer: To transfer the Transfer Switch (TS) from the normal source to the emergency source, push and hold the Test pushbutton until the transfer occurs within 10 seconds. To transfer the Transfer Switch (TS) from the emergency source to the normal source, push and hold the Bypass pushbutton until the transfer occurs. Be sure that all Isolating Switches and Circuit Breakers are closed (both normal and emergency).

To transfer the Transfer Switch (TS) back from the emergency source to the normal source, press the Bypass pushbutton.

Manual Mechanical Transfer:

De-energize the Transfer Switch and Fire Pump Controller as described on the controller placards. Open the control (left) bay door then the transfer switch (right) bay door. Install the manual operator provided with the transfer switch and operate the switch. (See transfer switch instructions supplied with the controller). After transferring the switch, close and latch both doors. Now energize the Fire Pump Controller and Transfer Switch as described on the placards.

DOWNLOADING HISTORY

To download data from the data recorder, open the waterproof cap and slide a USB memory stick into the socket. A banner on the main screen will show "USB Active". When complete, the banner will show "USB Ok". When Ok, simply remove the memory stick.

To read the data from the USB, simply plug in the USB into any computer and open the CSV file with any spreadsheet program.

The file name for the captured data has the following format:

YYMDDHMM

YY – Last 2 digits of the year
M - A through L = January through December
DD - 1 through 31 = date
H - A through X = Hour in 24 hour format
MM - 0 through 59 = Minute

MAINTENANCE

WARNING - DANGER OF LETHAL ELECTRICAL SHOCK AND ARC FLASH HAZARD - USE APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT (PPE) IN ACCORDANCE WITH NFPA 70E.

WARNING - THIS EQUIPMENT MUST ONLY BE SERVICED BY QUALIFIED ELECTRICAL PERSONNEL.

WARNING - BEFORE ATTEMPTING TO MAINTENANCE OR SERVICE THIS EQUIPMENT, BE SURE TO FOLLOW THE PLACARD INSTRUCTIONS TO DE-ENERGIZE BOTH THE TRANSFER SWITCH AND FIRE PUMP CONTROLLER.

CAUTION - OPENING ONLY THE NORMAL SOURCE CIRCUIT BREAKER (CB-N) WILL CAUSE THE GENERATOR TO START AND THE CONTROLLER TO TRANSFER TO THE EMERGENCY SOURCE AFTER A 10 SECOND DELAY.

On a weekly or monthly basis with the door(s) closed and latched, perform a test of the controller by pressing the Pressure Drop Test button on the Setup menu and verify proper operation. In addition to the pressure drop test, remote starting or deluge valve starting should also be tested if used.

On an annual basis, perform Startup Procedure previously outlined in this manual should be performed.

During the annual testing, qualified electrical personnel should inspect the inside of the controller and check:

- All control wires for tightness
- That all connectors are seated and latched
- All connections in the power path for tightness. Re-torque any loose connections to the component manufactures' specifications. Contact Master Control Systems, Inc. for further information.
- For any indication of water marks on any of the components. Replace every component that has water marks on it.
- For any indication that the wire insulation is cracking.

If any operation of the controller does not function correctly, or the inspection reveals any of the above problems, contact Master Control Systems, Inc. for factory authorized service agent recommendations.

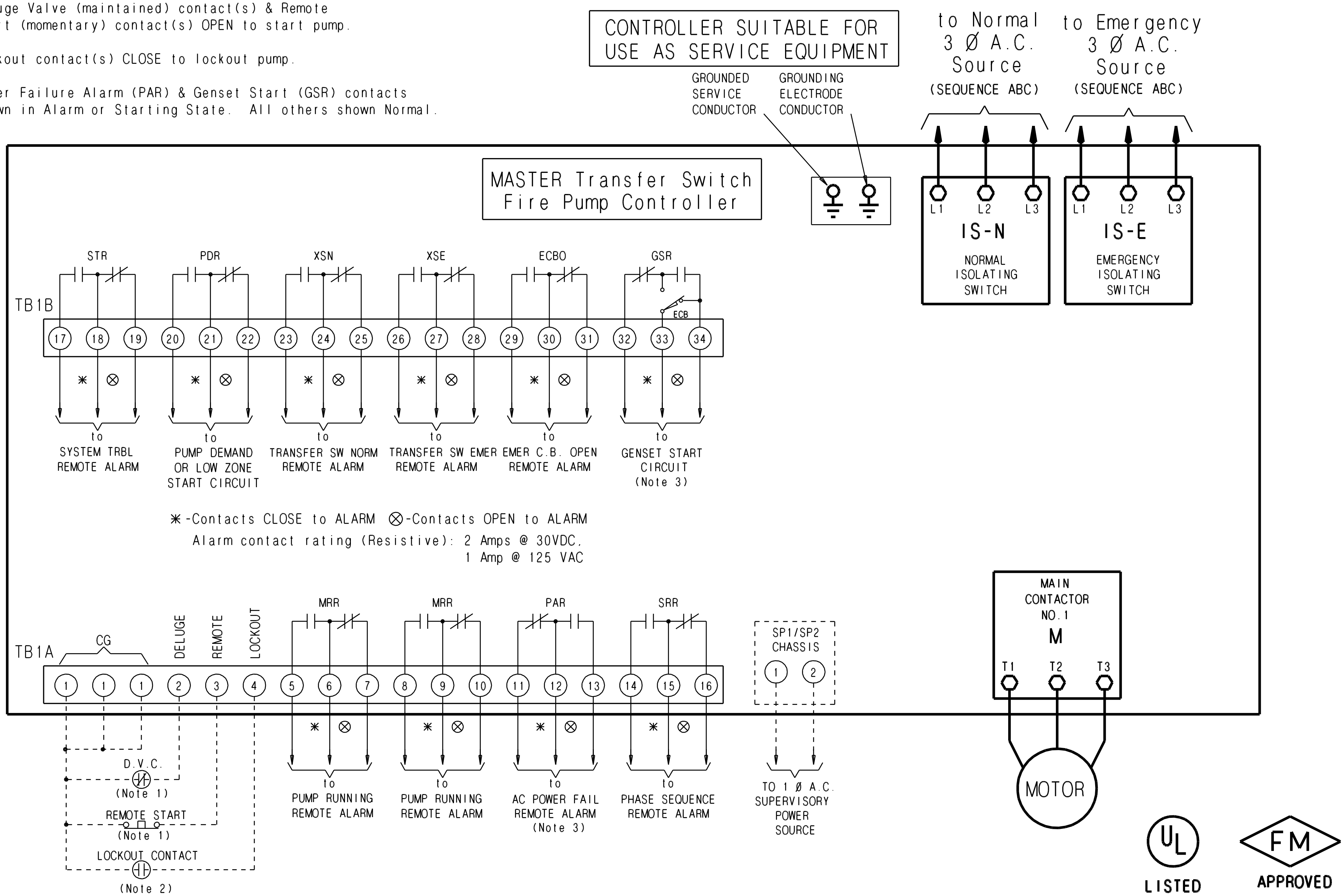
MCAT Across the Line Transfer Switch Fire Pump Controller

MASTER

Notes:
1) Deluge Valve (maintained) contact(s) & Remote Start (momentary) contact(s) OPEN to start pump.

2) Lockout contact(s) CLOSE to lockout pump.

3) Power Failure Alarm (PAR) & Genset Start (GSR) contacts shown in Alarm or Starting State. All others shown Normal.



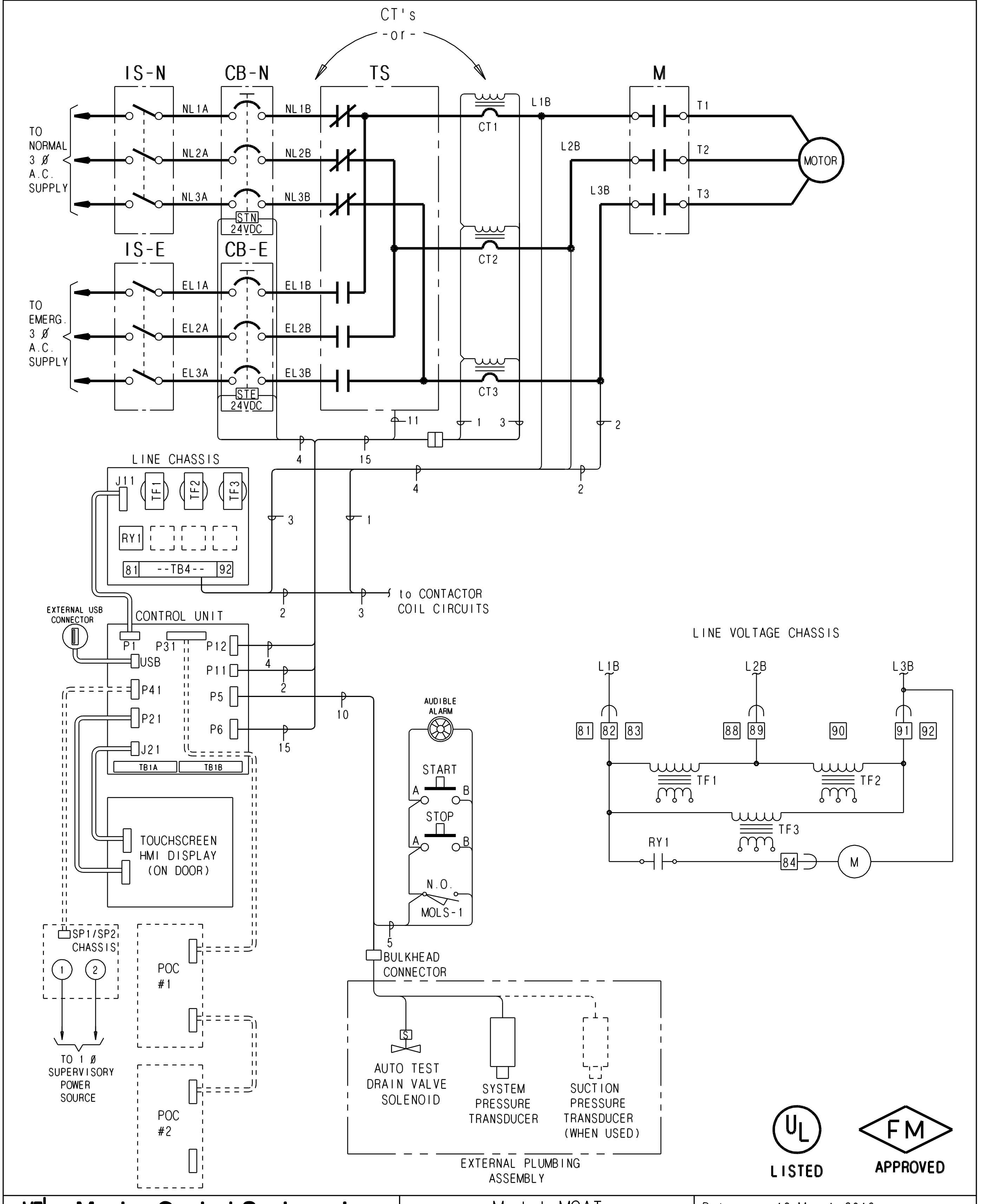
Master Control Systems Inc.
LAKE BLUFF, ILLINOIS U.S.A.

MODEL MCAT EXTERNAL WIRING DIAGRAM - G4

Date	10 Jan 2014
Drawing	20111 Issue 2

MCAT Transfer Switch Fire Pump Controller

MASTER



Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	Model MCAT Schematic Diagram - G4	Date 19 March 2013 Drawing 20211 Issue 1

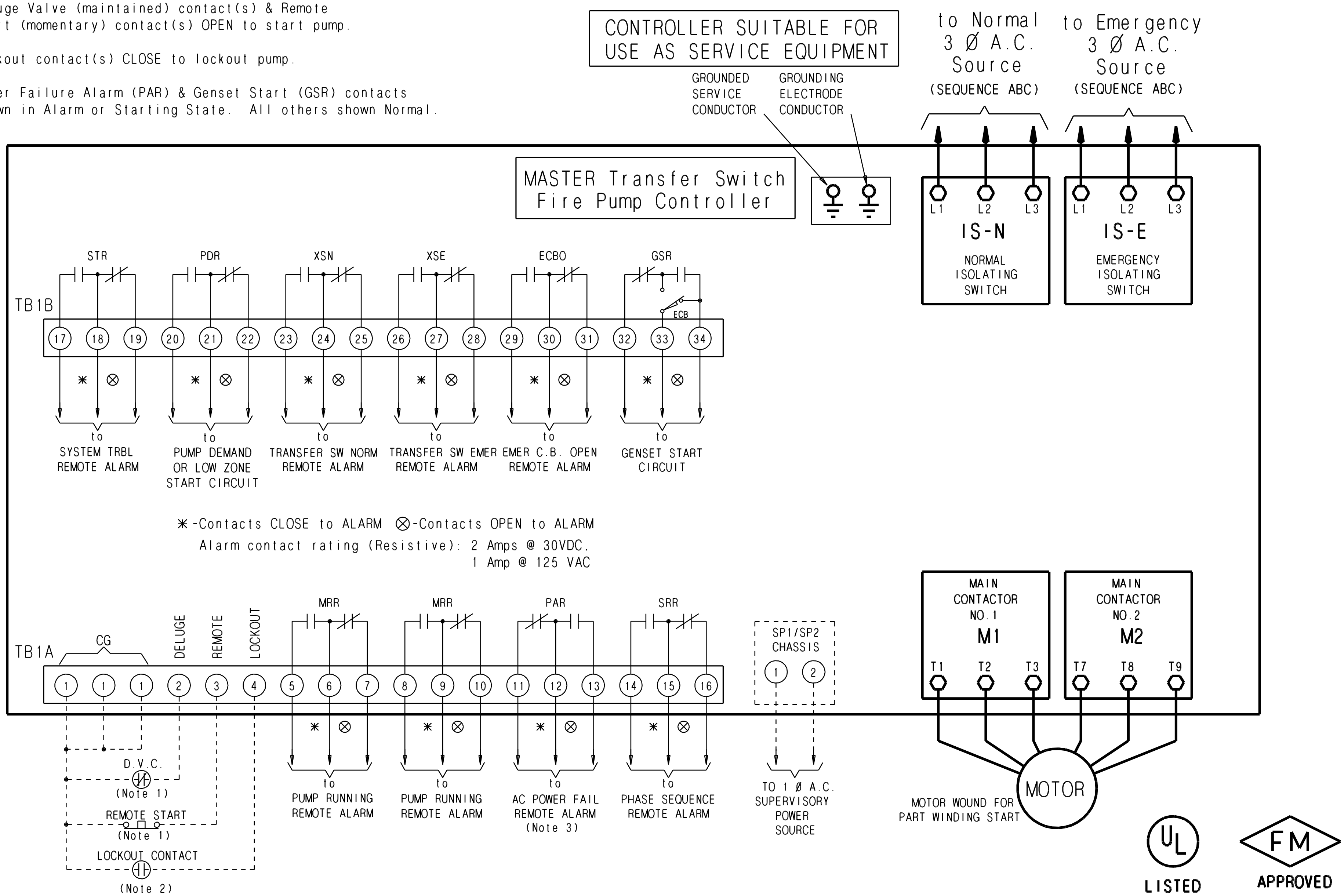
MCPT Part Winding Transfer Switch Fire Pump Controller

MASTER

Notes:
1) Deluge Valve (maintained) contact(s) & Remote Start (momentary) contact(s) OPEN to start pump.

2) Lockout contact(s) CLOSE to lockout pump.

3) Power Failure Alarm (PAR) & Genset Start (GSR) contacts shown in Alarm or Starting State. All others shown Normal.



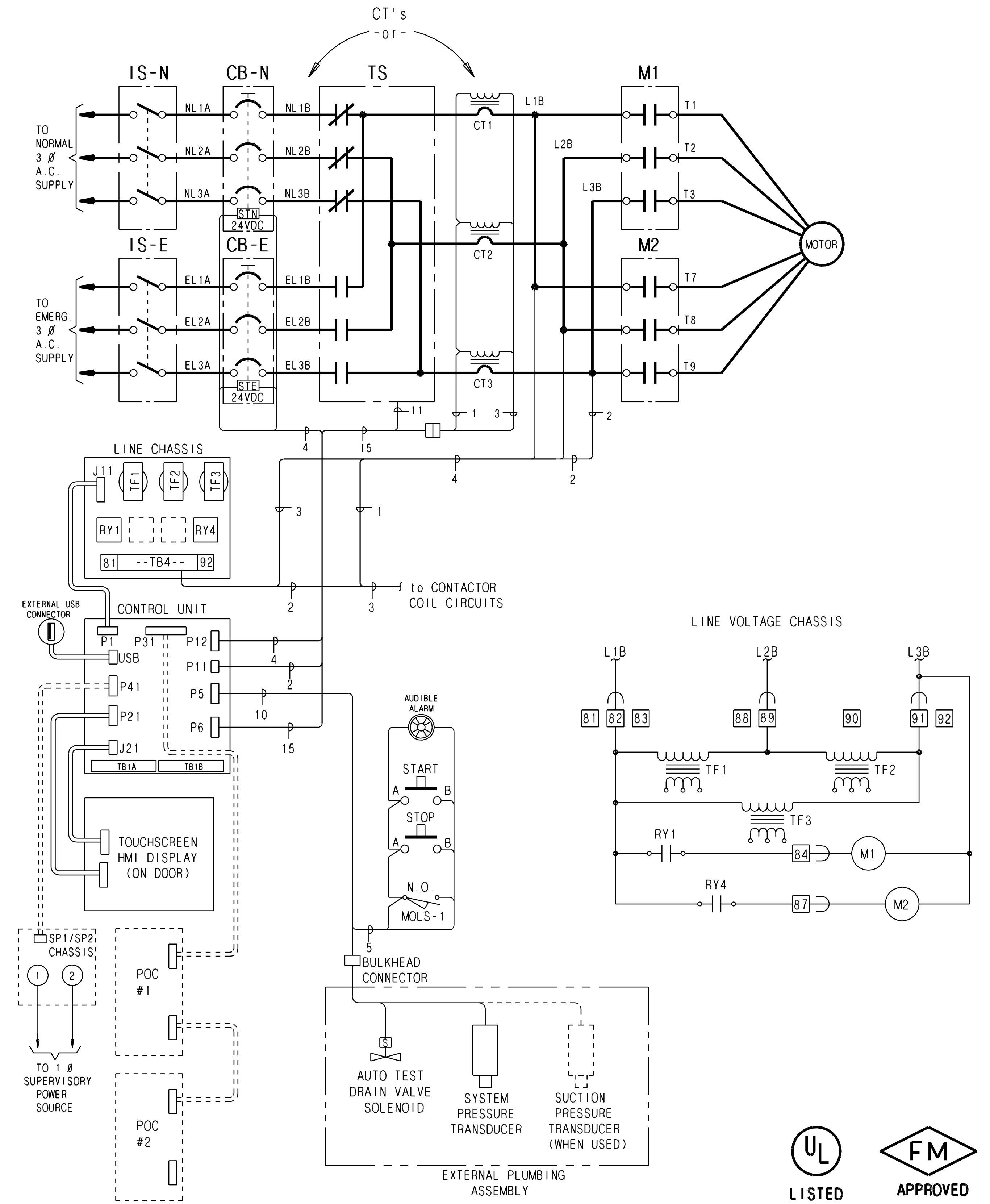
Master Control Systems Inc.
LAKE BLUFF, ILLINOIS U.S.A.

MODEL MCPT EXTERNAL WIRING DIAGRAM - G4

Date	10 Jan 2014	
Drawing	20112	Issue 2

MCPT Transfer Switch Fire Pump Controller

MASTER



Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	Model MCPT Schematic Diagram - G4	Date 19 March 2013
		Drawing 20212 Issue 1

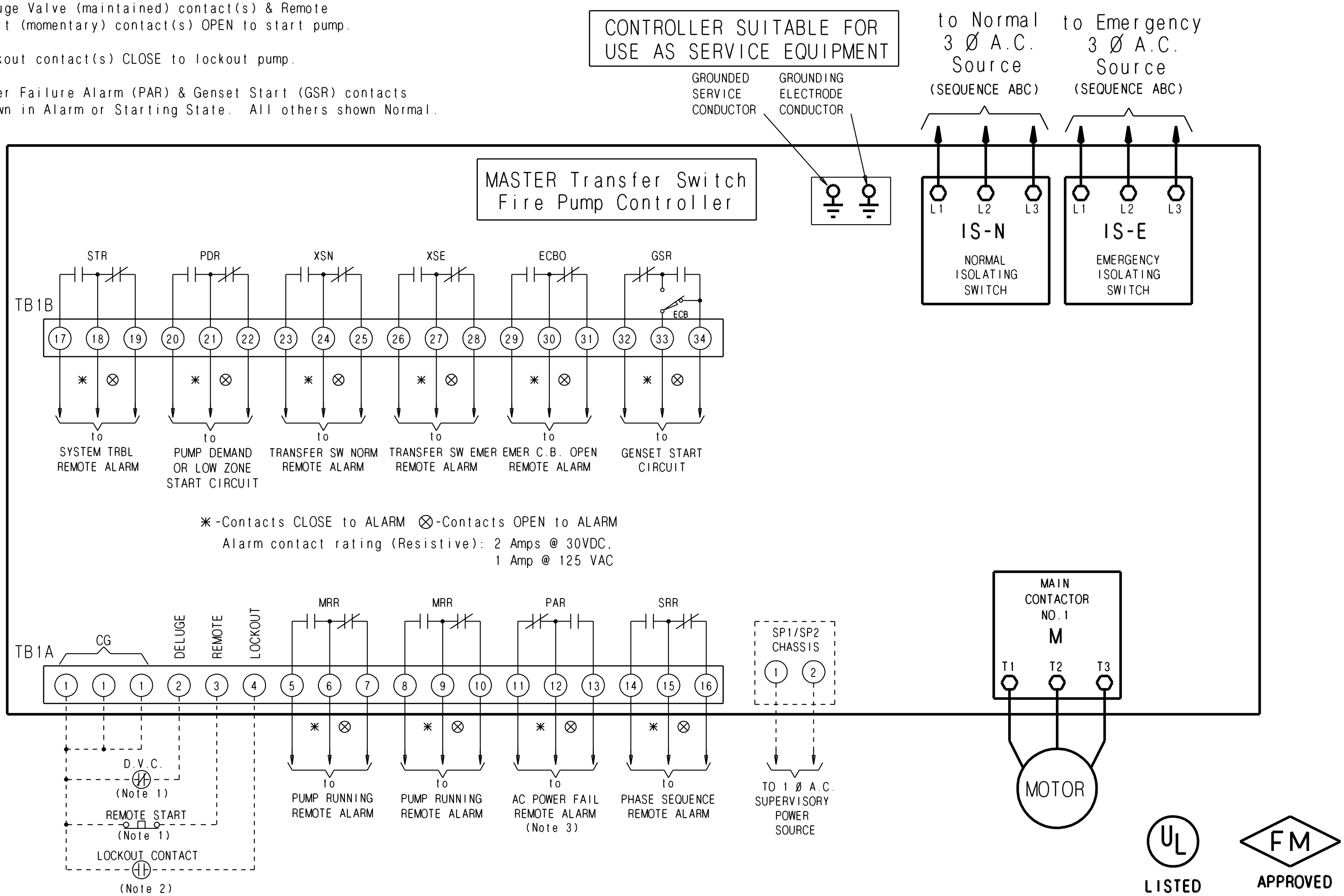
MCRT Primary Reactor Transfer Switch Fire Pump Controller

MASTER

Notes:
1) Deluge Valve (maintained) contact(s) & Remote Start (momentary) contact(s) OPEN to start pump.

2) Lockout contact(s) CLOSE to lockout pump.

3) Power Failure Alarm (PAR) & Genset Start (GSR) contacts shown in Alarm or Starting State. All others shown Normal.



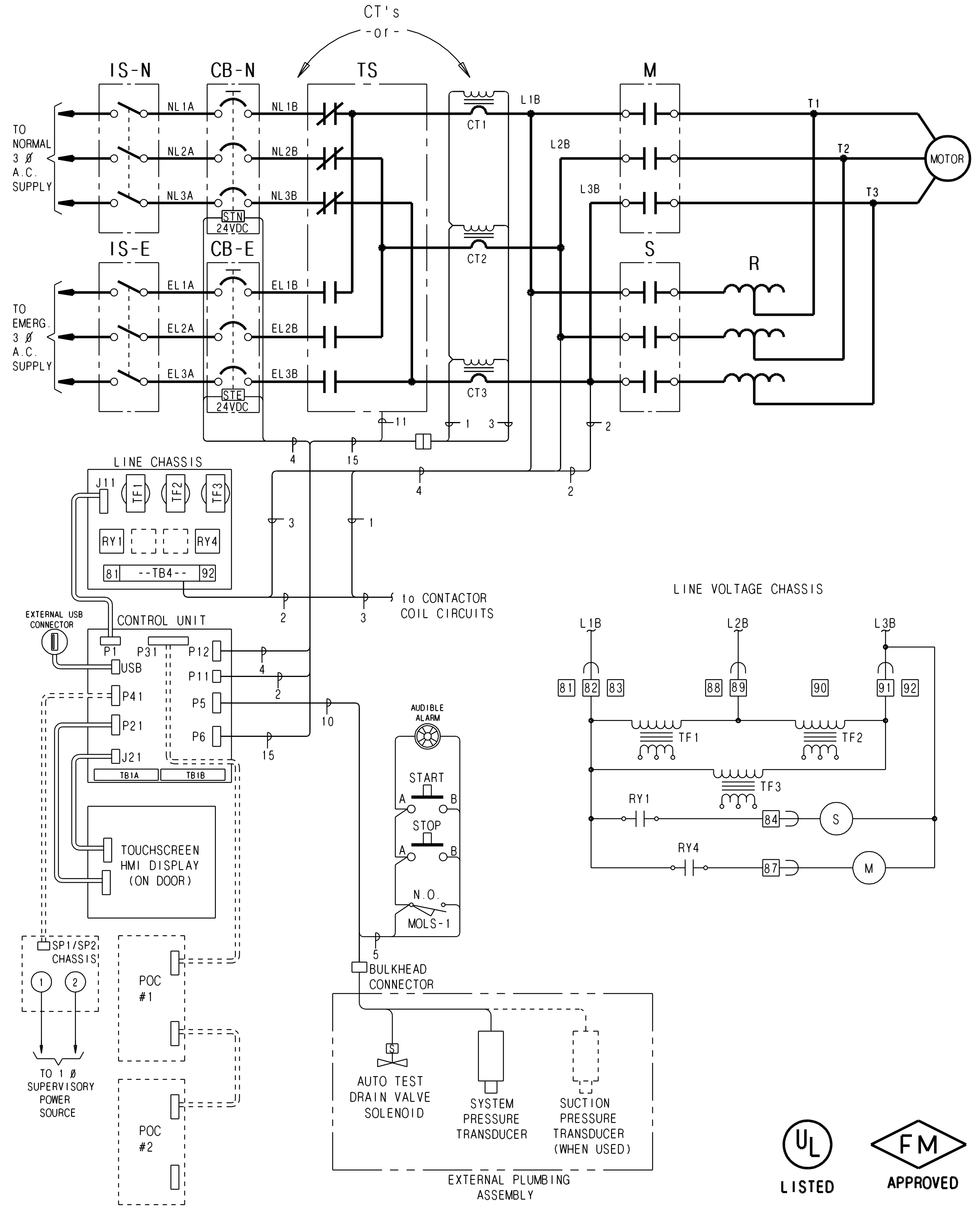
Master Control Systems Inc.
LAKE BLUFF, ILLINOIS U.S.A.

MODEL MCRT EXTERNAL WIRING DIAGRAM - G4

Date	10 Jan 2014
Drawing	20113 Issue 2

MCRT Transfer Switch Fire Pump Controller

MASTER



Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	Model MCRT Schematic Diagram - G4	Date 19 March 2013
		Drawing 20213 Issue 1

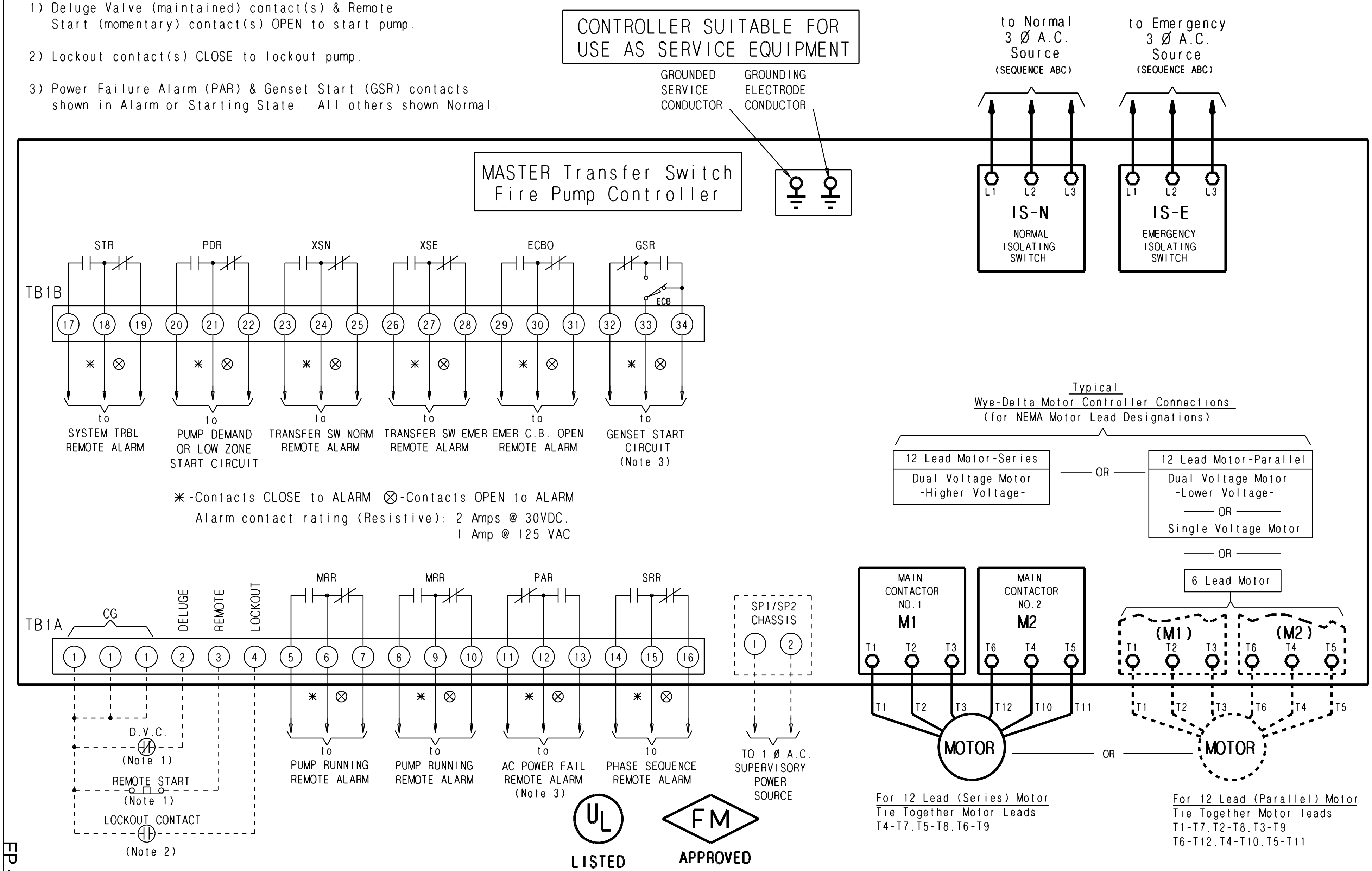
MCOT Wye Delta (Open) Transfer Switch Fire Pump Controller

MASTER

Notes:
1) Deluge Valve (maintained) contact(s) & Remote Start (momentary) contact(s) OPEN to start pump.

2) Lockout contact(s) CLOSE to lockout pump.

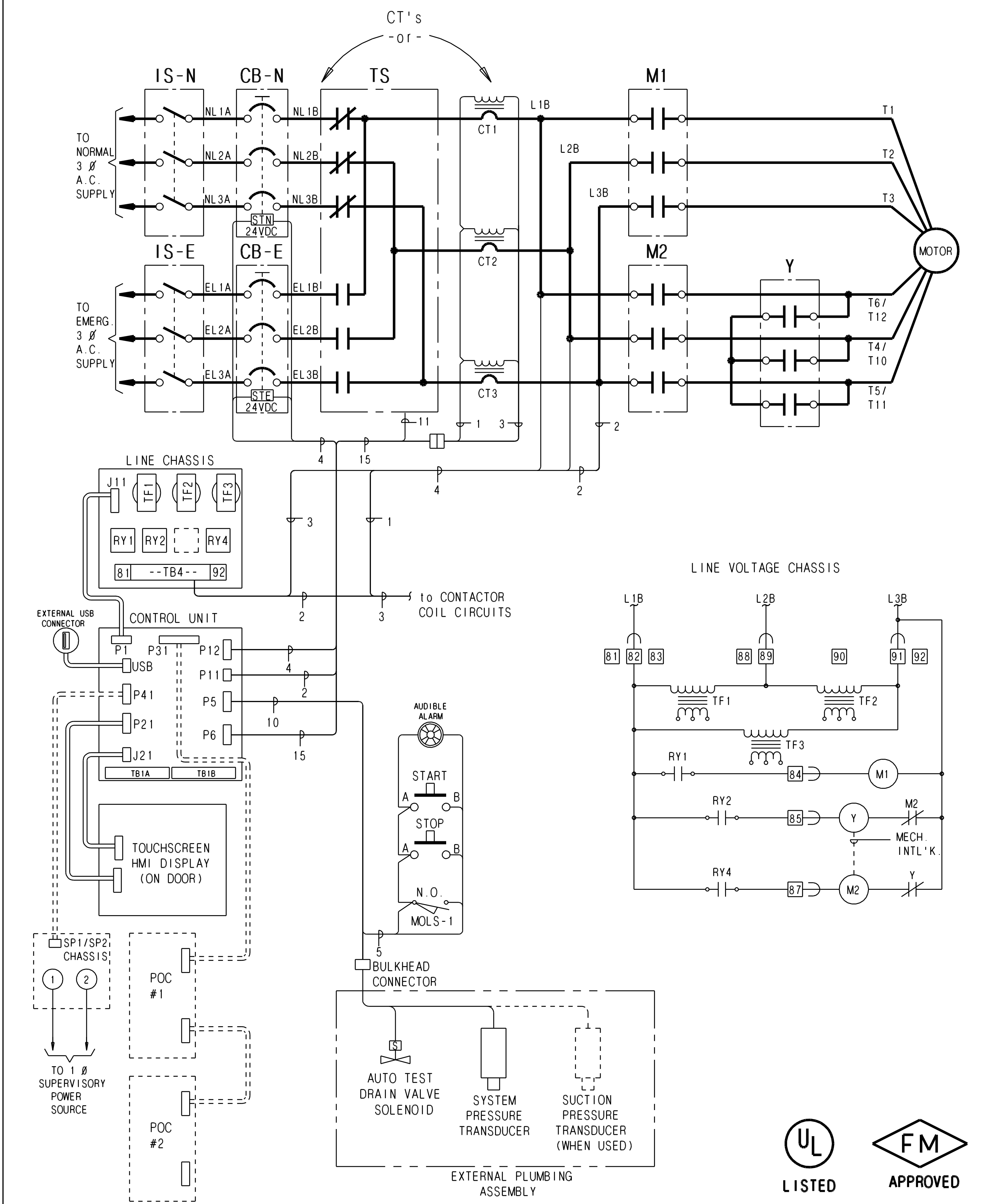
3) Power Failure Alarm (PAR) & Genset Start (GSR) contacts shown in Alarm or Starting State. All others shown Normal.



Master Control Systems Inc.
LAKE BLUFF, ILLINOIS U.S.A.

MODEL MCOT EXTERNAL WIRING DIAGRAM - G4

Date	10 Jan 2014
Drawing	20115 Issue 2



Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	Model MCOT Schematic Diagram - G4	Date 19 March 2013
		Drawing 20215 Issue 1

MCYT Wye Delta (Closed) Transfer Switch Line Fire Pump Controller

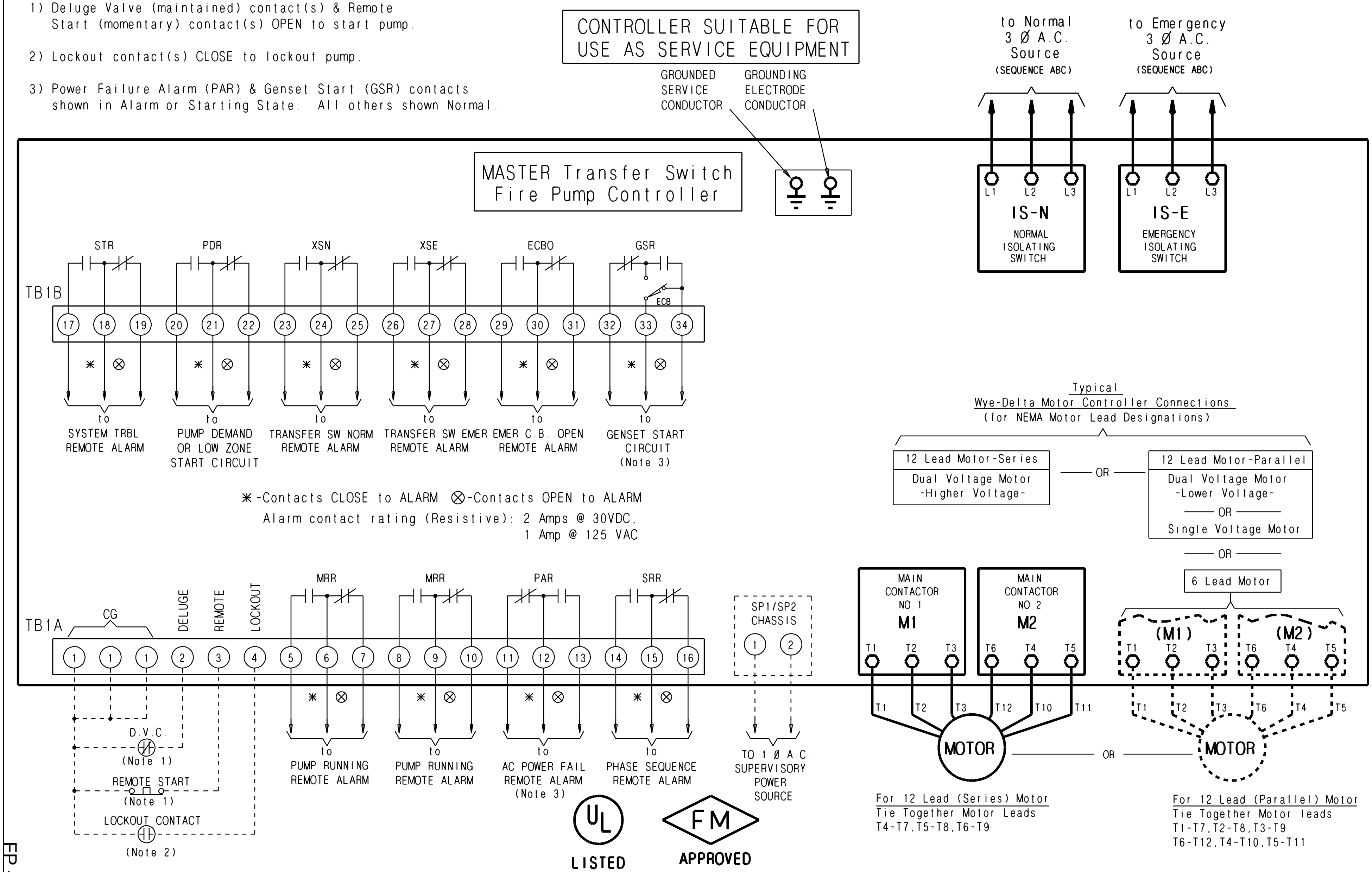
MASTER

Notes:
1) Deluge Valve (maintained) contact(s) & Remote Start (momentary) contact(s) OPEN to start pump.

2) Lockout contact(s) CLOSE to lockout pump.

3) Power Failure Alarm (PAR) & Genset Start (GSR) contacts shown in Alarm or Starting State. All others shown Normal.

CONTROLLER SUITABLE FOR USE AS SERVICE EQUIPMENT



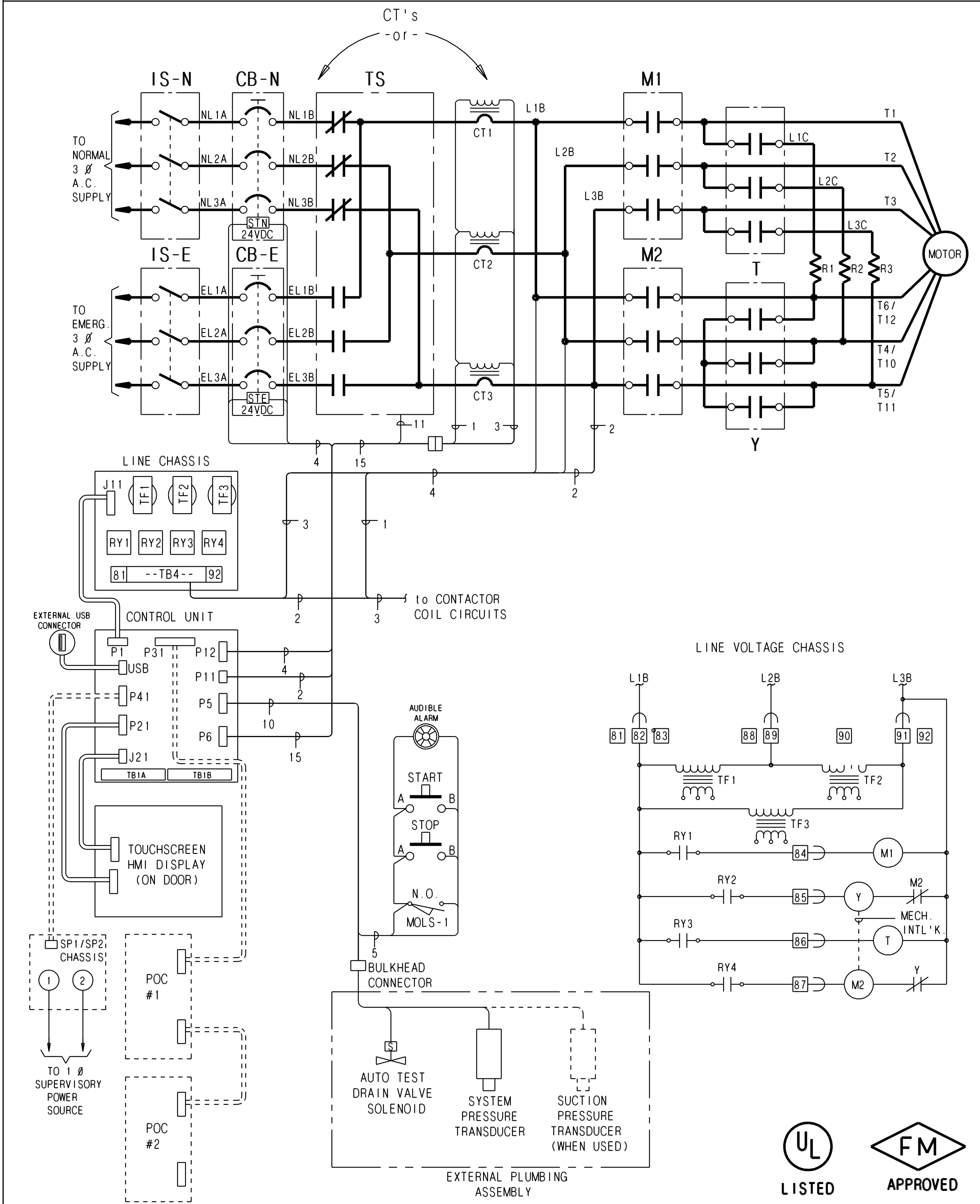
Master Control Systems Inc.
LAKE BLUFF, ILLINOIS U.S.A.

MODEL MCYT EXTERNAL WIRING DIAGRAM - G4

Date	10 Jan 2014
Drawing	20116
Issue	2

MCYT Transfer Switch Fire Pump Controller

MASTER



Master Control Systems Inc.
LAKE BLUFF, ILLINOIS U.S.A.

Model MCYT
Schematic Diagram - G4

Date	19 March 2013
Drawing	20216
Issue	1

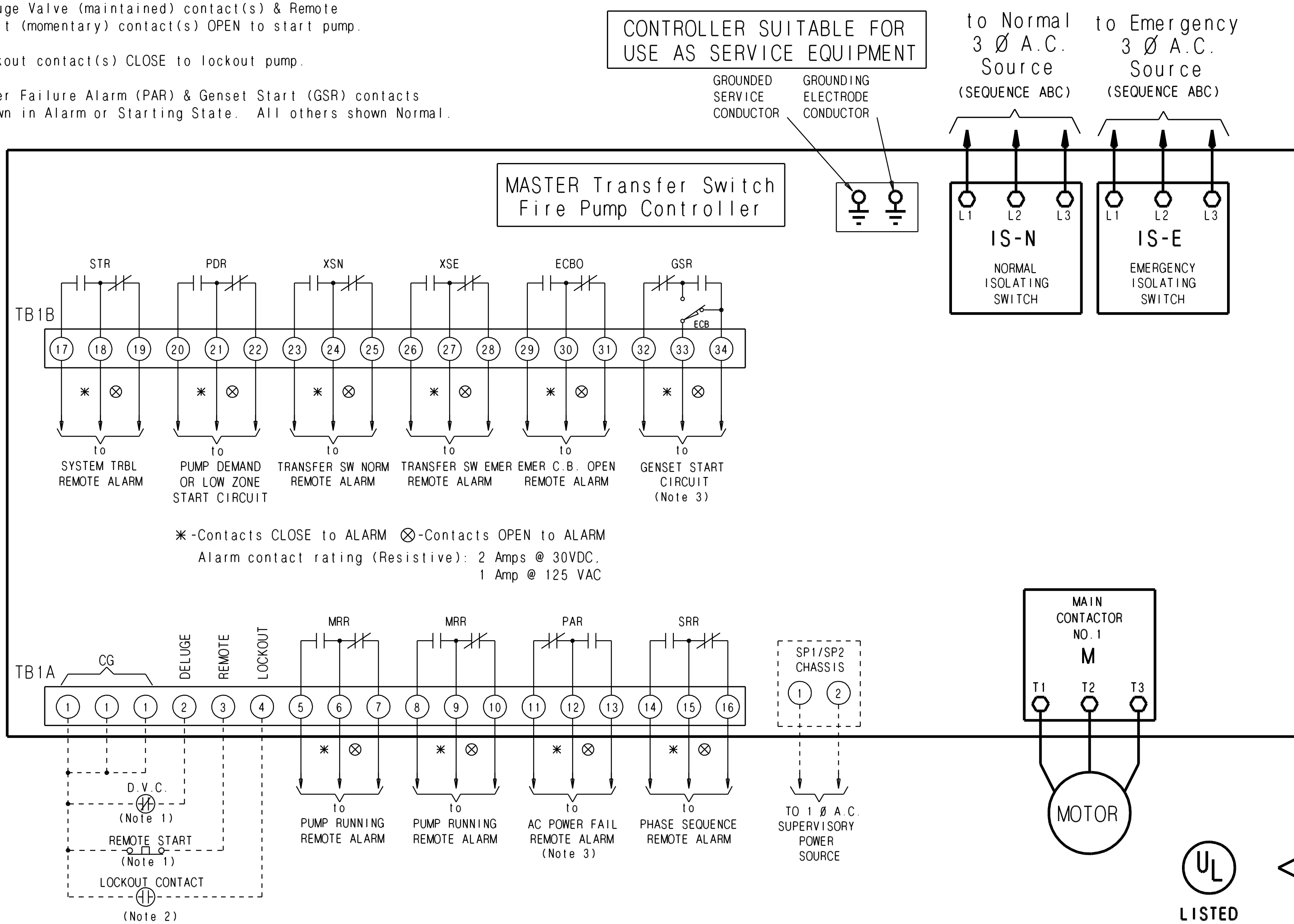
MCST Soft Start Transfer Switch Fire Pump Controller

MASTER

Notes:
1) Deluge Valve (maintained) contact(s) & Remote Start (momentary) contact(s) OPEN to start pump.

2) Lockout contact(s) CLOSE to lockout pump.

3) Power Failure Alarm (PAR) & Genset Start (GSR) contacts shown in Alarm or Starting State. All others shown Normal.



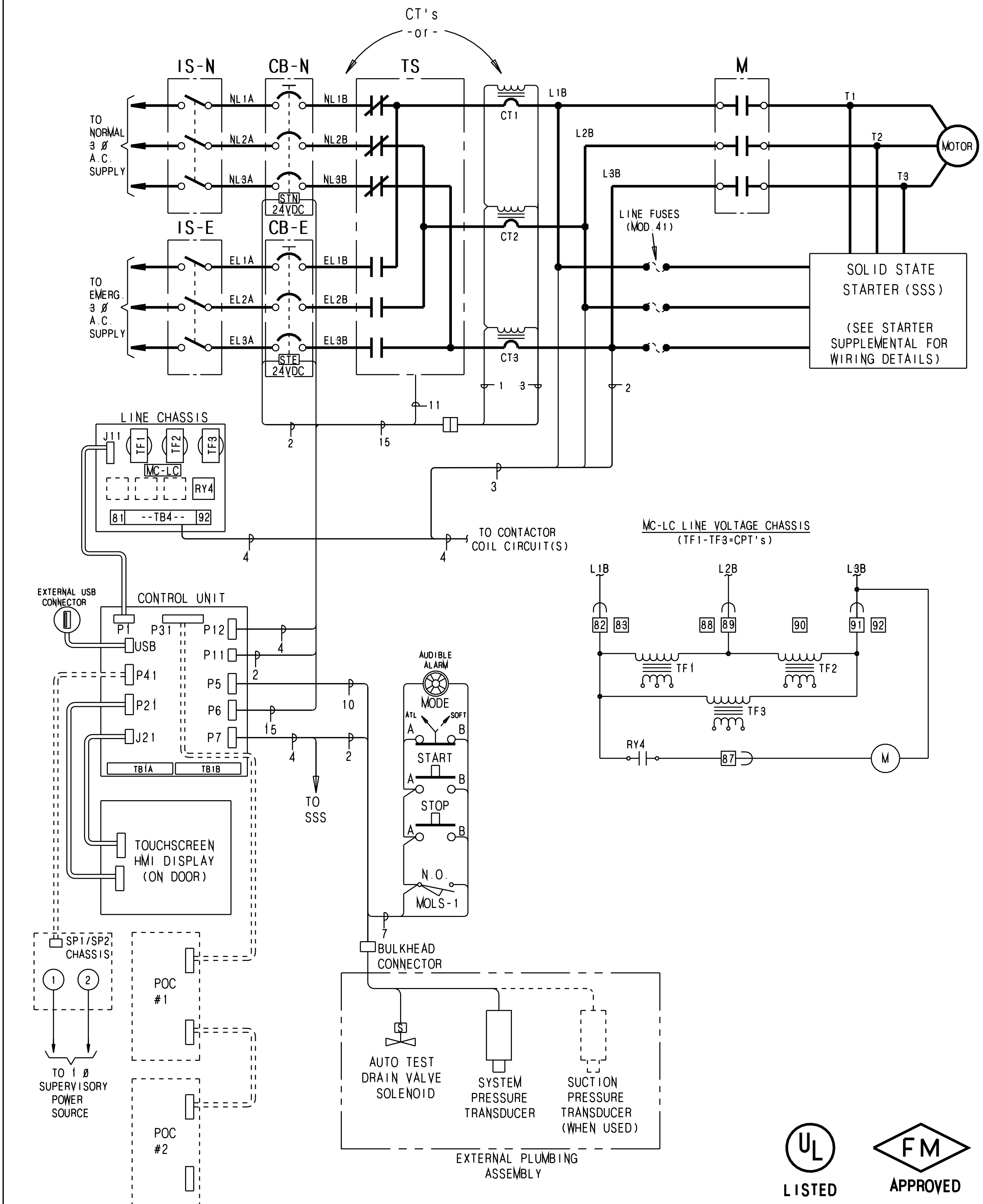
LISTED

APPROVED

Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	MODEL MCST EXTERNAL WIRING DIAGRAM - G4	Date 10 Jan 2014
		Drawing 20117 Issue 2

MCST Transfer Switch Fire Pump Controller

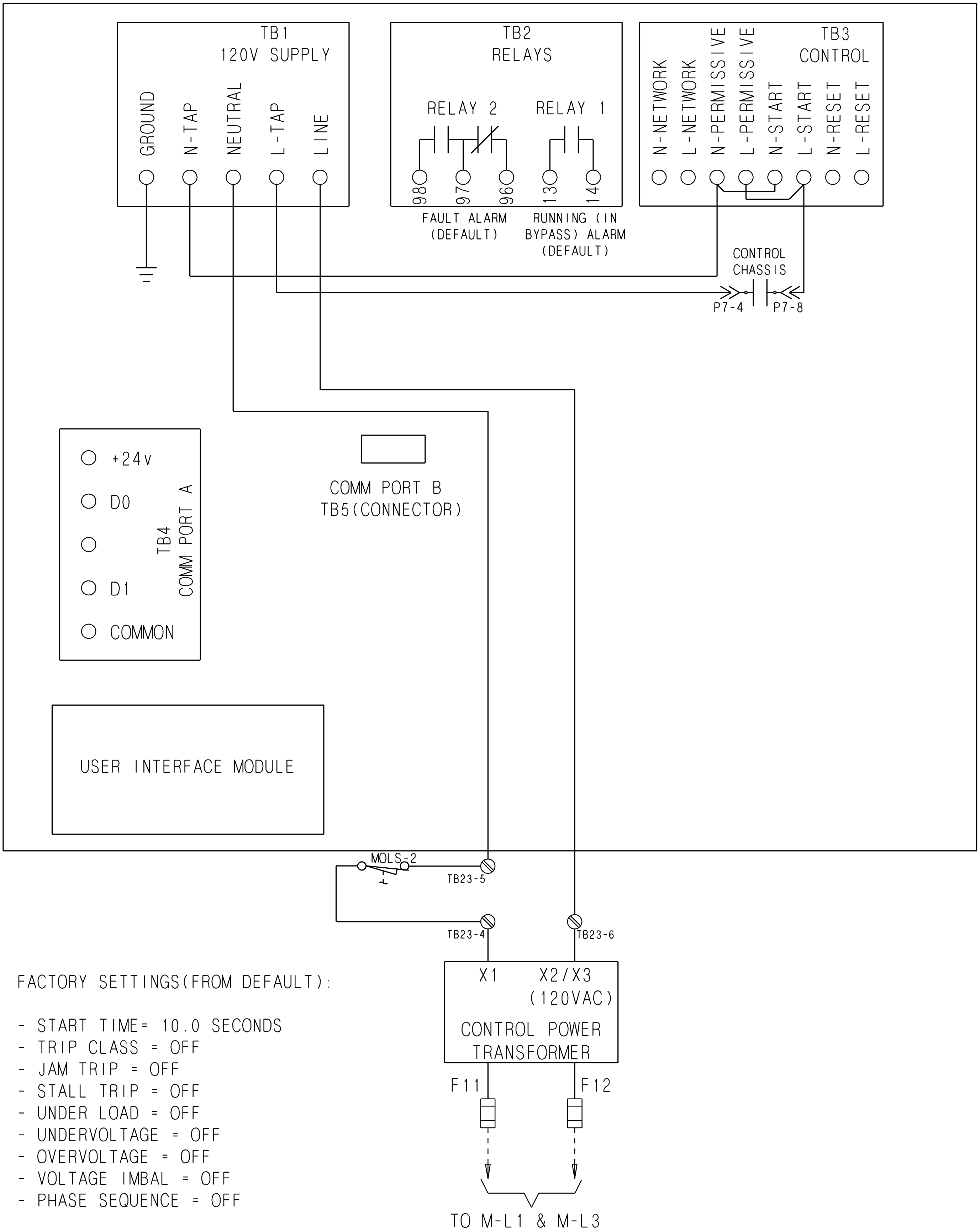
MASTER



Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	Model MCST Schematic Diagram - G4	Date 6 May 2014 Drawing 20217 Issue 3

MC** Eaton Solid State Starter Wiring

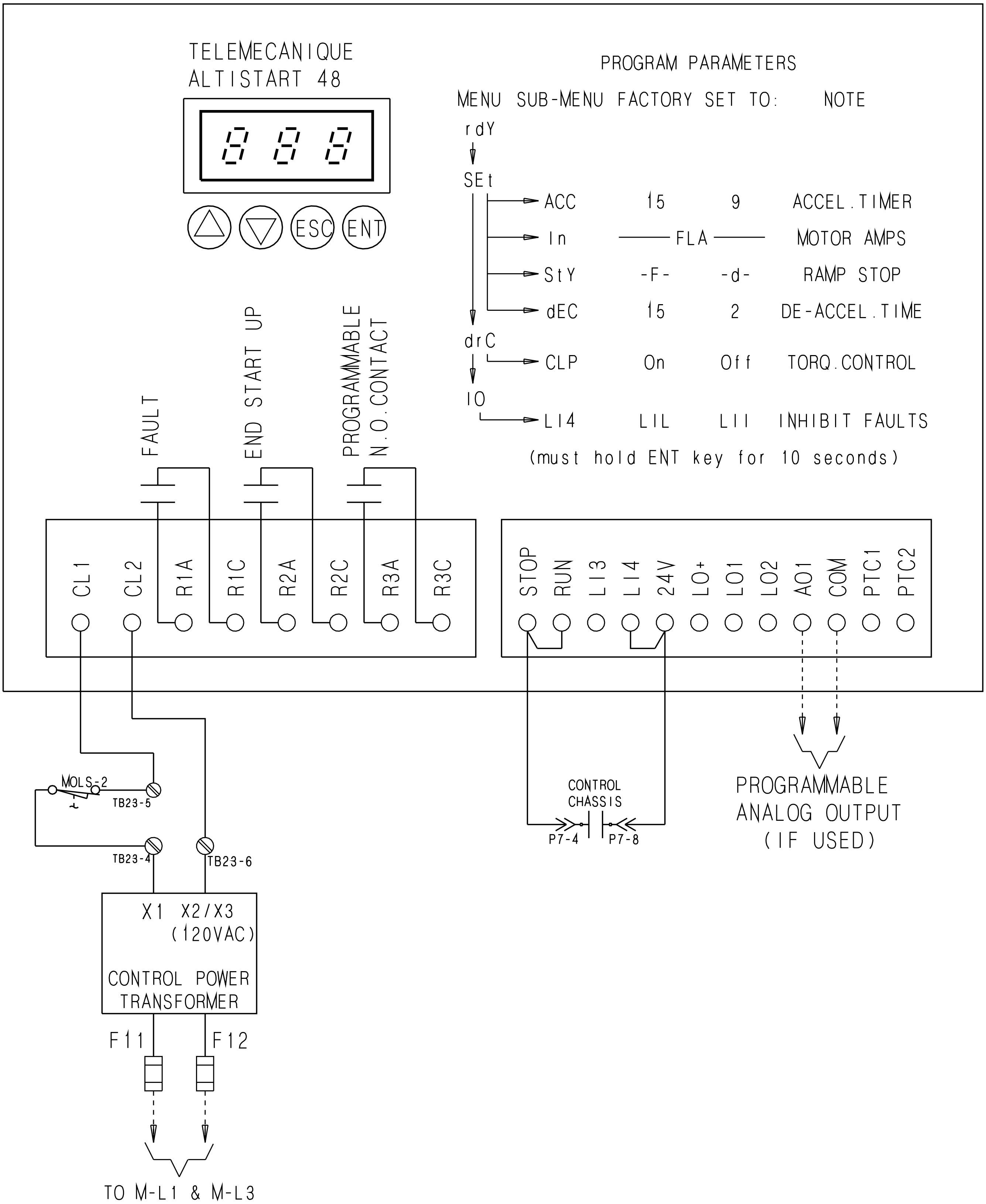
MASTER



FACTORY SETTINGS(FROM DEFAULT):

- START TIME= 10.0 SECONDS
- TRIP CLASS = OFF
- JAM TRIP = OFF
- STALL TRIP = OFF
- UNDER LOAD = OFF
- UNDERVOLTAGE = OFF
- OVERVOLTAGE = OFF
- VOLTAGE IMBAL = OFF
- PHASE SEQUENCE = OFF

Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	MC** Eaton Solid State Wiring Diagram - G4	Date 21 May 2014
		Drawing 20300 Issue 3



Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	MC** Square D Solid State Wiring Diagram - G4	Date 30 August 2013
		Drawing 20301 Issue 2

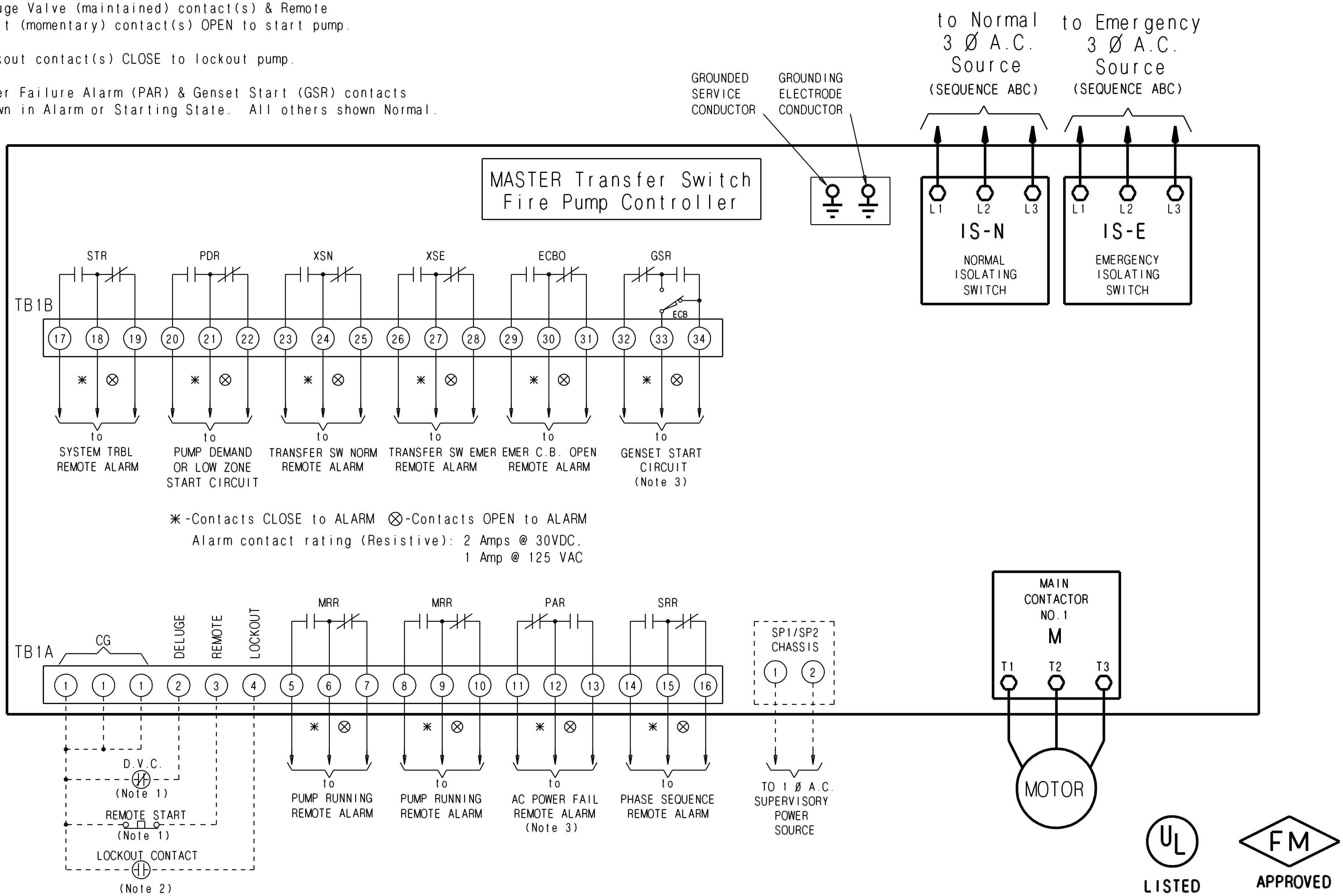
MCTT Autotransformer Transfer Switch Fire Pump Controller

MASTER

Notes:
1) Deluge Valve (maintained) contact(s) & Remote Start (momentary) contact(s) OPEN to start pump.

2) Lockout contact(s) CLOSE to lockout pump.

3) Power Failure Alarm (PAR) & Genset Start (GSR) contacts shown in Alarm or Starting State. All others shown Normal.



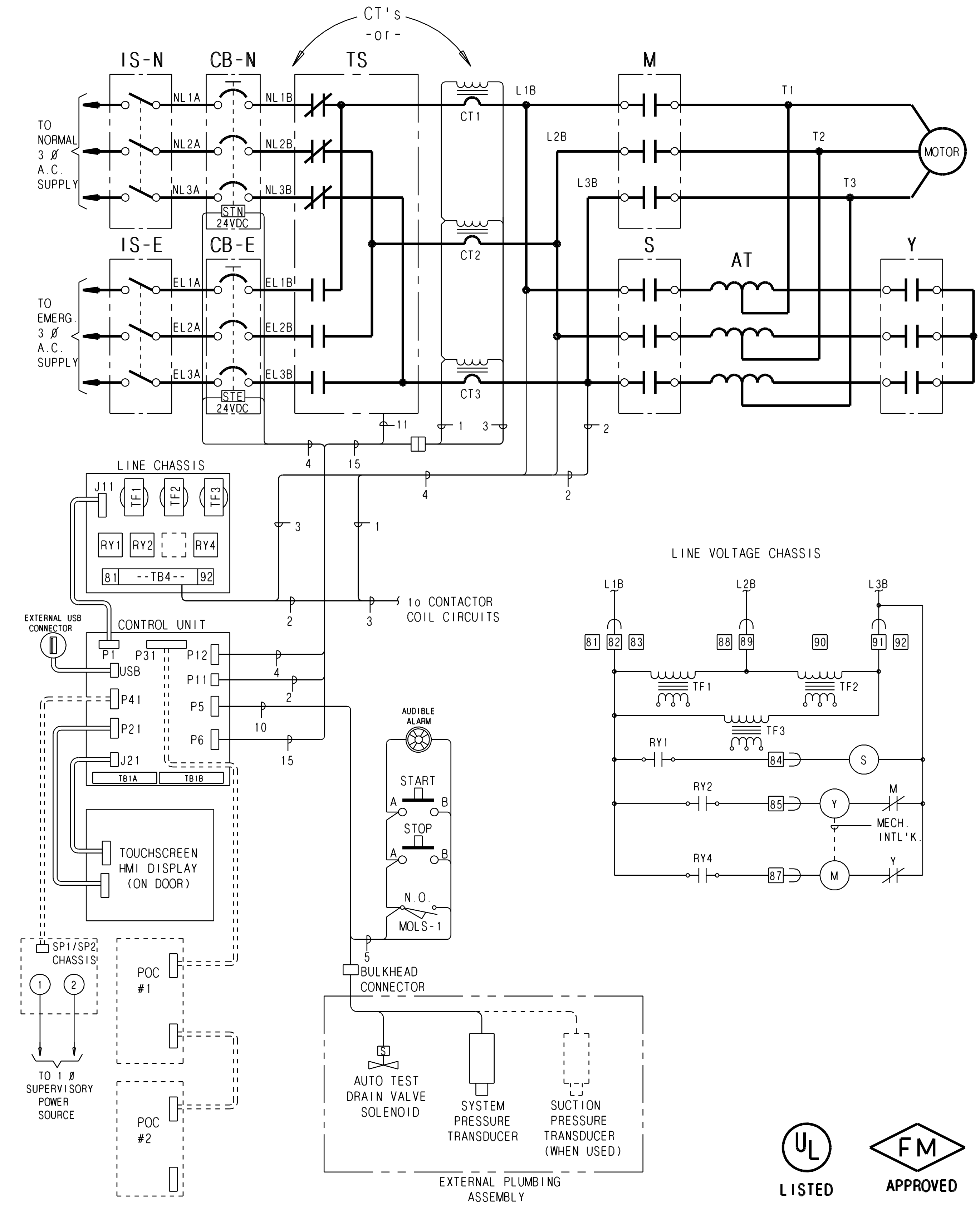
Master Control Systems Inc.
LAKE BLUFF, ILLINOIS U.S.A.

MODEL MCTT EXTERNAL WIRING DIAGRAM - G4

Date	10 Jan 2014
Drawing	20118 Issue 2

MCTT Transfer Switch Fire Pump Controller

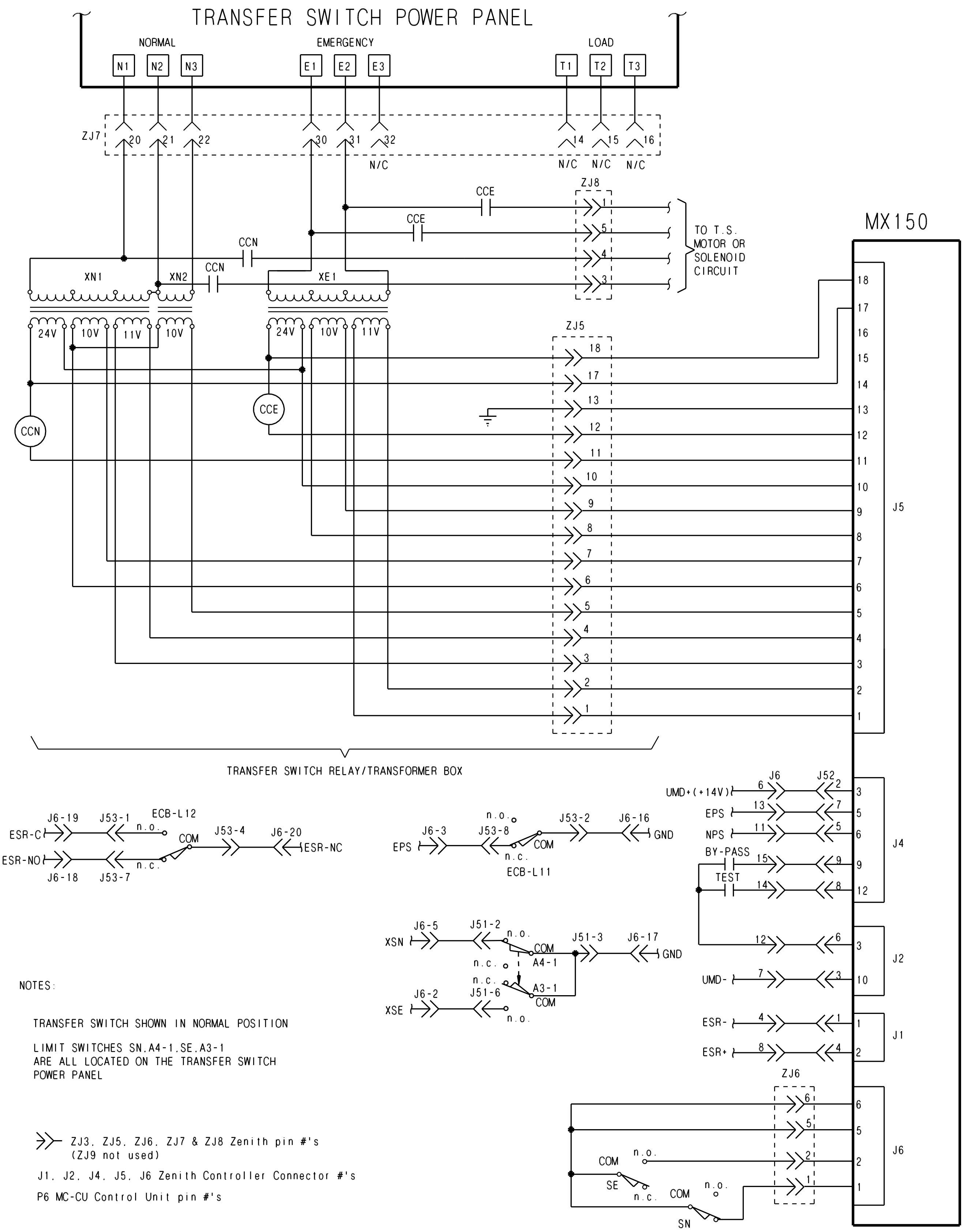
MASTER



Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	Model MCTT Schematic Diagram - G4	Date 19 March 2013
		Drawing 20218 Issue 1

MC Transfer Switch Control Circuit

MASTER



NOTES:

TRANSFER SWITCH SHOWN IN NORMAL POSITION

LIMIT SWITCHES SN,A4-1,SE,A3-1 ARE ALL LOCATED ON THE TRANSFER SWITCH POWER PANEL

>>— ZJ3, ZJ5, ZJ6, ZJ7 & ZJ8 Zenith pin #'s (ZJ9 not used)

J1, J2, J4, J5, J6 Zenith Controller Connector #'s

P6 MC-CU Control Unit pin #'s

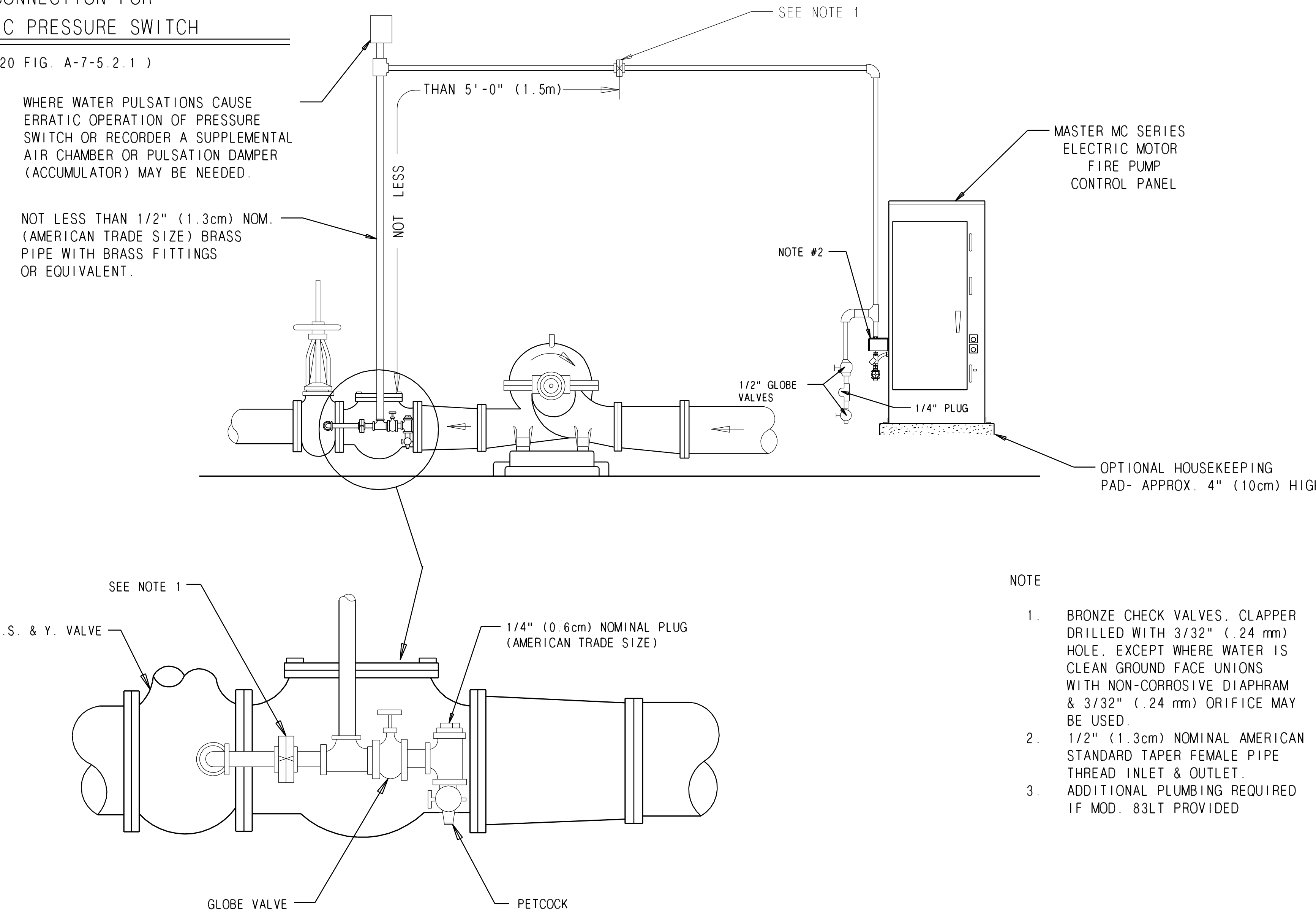
Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	Zenith Transfer Switch	Date 4 June 2013
	Schematic Diagram - G4	Drawing 20320 Issue 1

PIPING CONNECTIONS FOR ELECTRIC FIRE PUMP CONTROLLERS

MASTER

PIPING CONNECTION FOR
AUTOMATIC PRESSURE SWITCH

(PER NFPA 20 FIG. A-7-5.2.1)



NOTE

1. BRONZE CHECK VALVES, CLAPPER DRILLED WITH 3/32" (.24 mm) HOLE, EXCEPT WHERE WATER IS CLEAN GROUND FACE UNIONS WITH NON-CORROSIVE DIAPHRAM & 3/32" (.24 mm) ORIFICE MAY BE USED.
2. 1/2" (1.3cm) NOMINAL AMERICAN STANDARD TAPER FEMALE PIPE THREAD INLET & OUTLET.
3. ADDITIONAL PLUMBING REQUIRED IF MOD. 83LT PROVIDED

Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	Piping Connections for Electric Controllers	Date 14 January 2014 Drawing 20400 Issue 2

OPTION AND MODIFICATION DRAWINGS

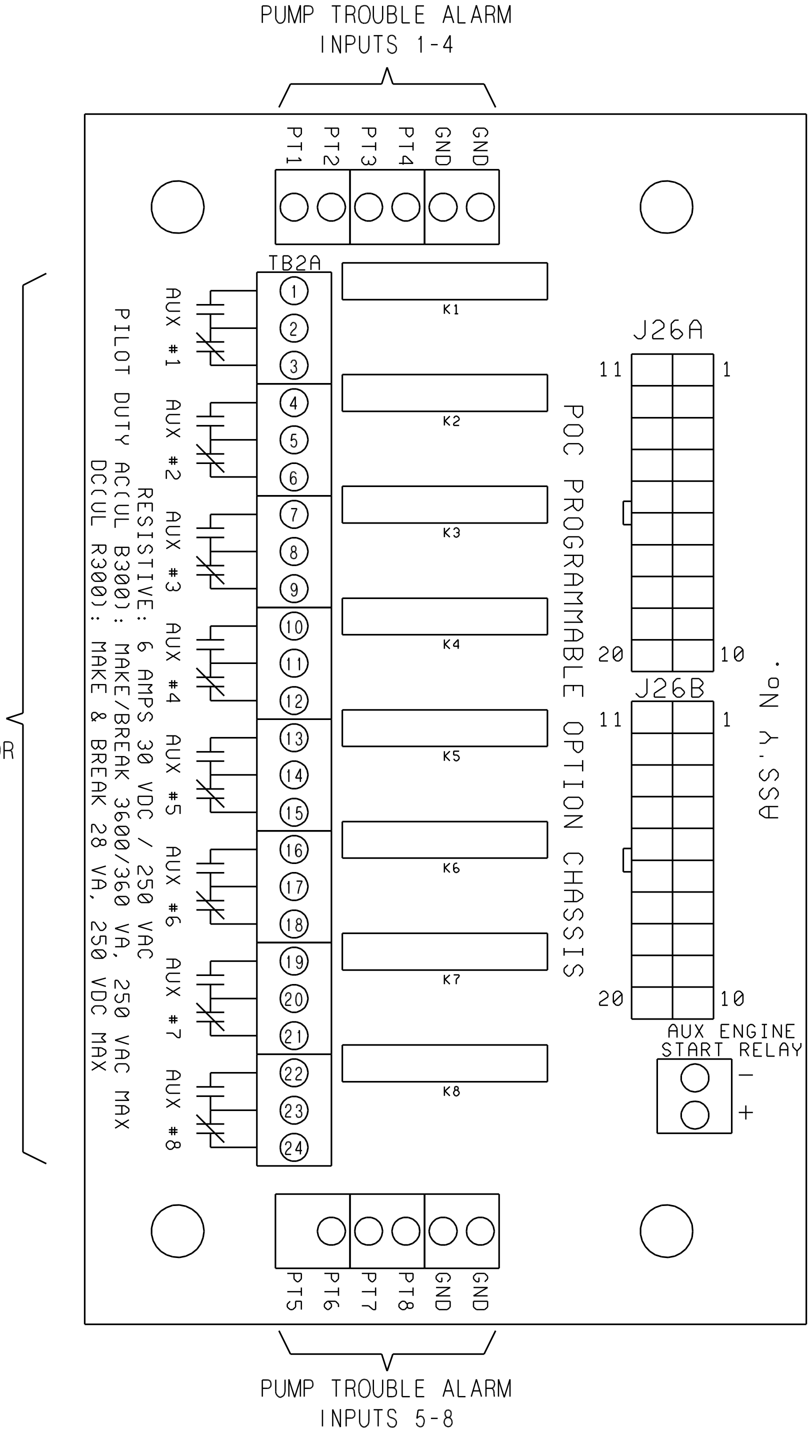
***NOTE**: The following drawings are applicable to controllers with model numbers which indicate that they are equipped with the following. See controller nameplate for complete model number.*

MODIFICATION	DESCRIPTION	DRAWING
X (FOLLOWED BY)		
POC	Programmable Option Chassis	20310
SP1	120 vac Supervisory Power Input For Built-in Alarm Systems	20331
19	Strip Heater	20339
20	Strip Heater w/Thermostat	20339
20A	Strip Heater w/Humidistat	20339
33	Auxiliary 115 VAC Output	20338
LPM	Leading Phase Monitor	20399

MC-POC Programmable Option Chassis

MASTER

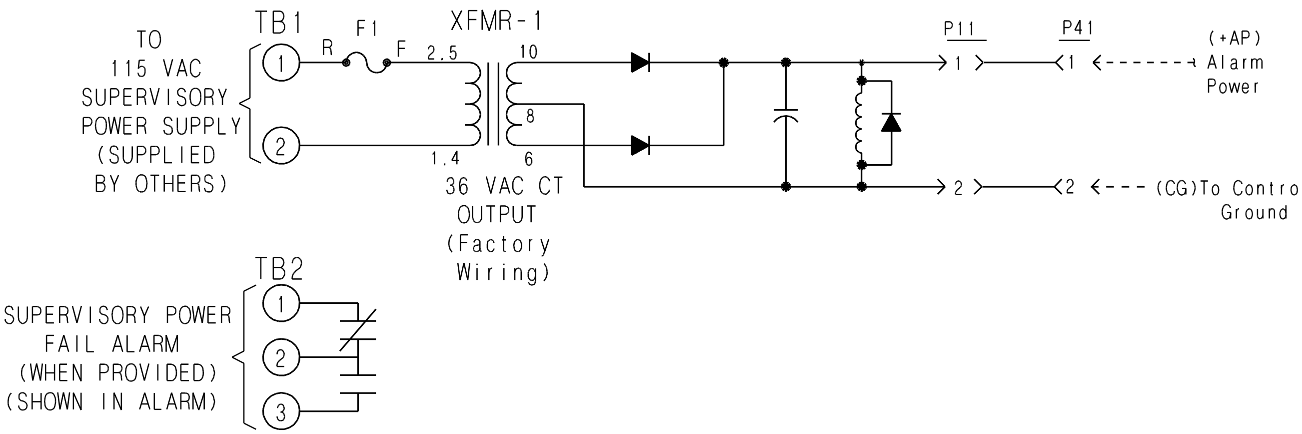
PUMP TROUBLE ALARM FIELD INPUT DEFINITIONS
PT 1
PT 2
PT 3
PT 4
PT 5
PT 6
PT 7
PT 8



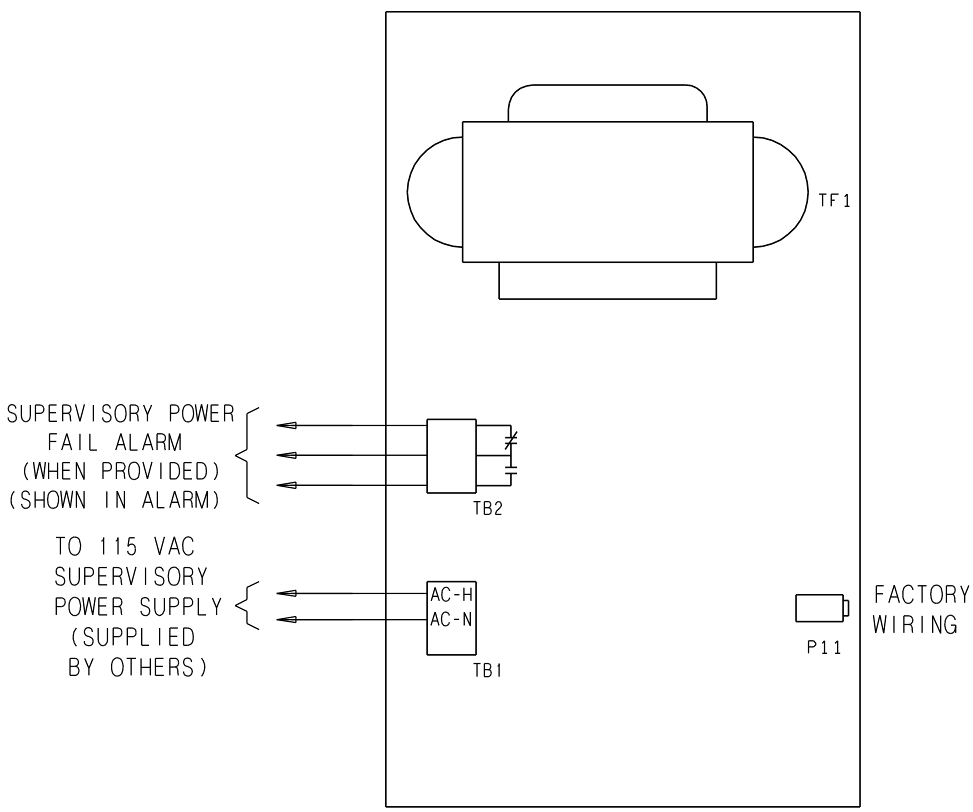
FIELD ALARM RELAY DEFINITIONS
AUX 1
AUX 2
AUX 3
AUX 4
AUX 5
AUX 6
AUX 7
AUX 8

Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	EXTERNAL DIAGRAM FOR PROGRAMMABLE OPTION CHASSIS - POC	Date 1 April 2013 Drawing 20310 Issue 1

SCHEMATIC DIAGRAM



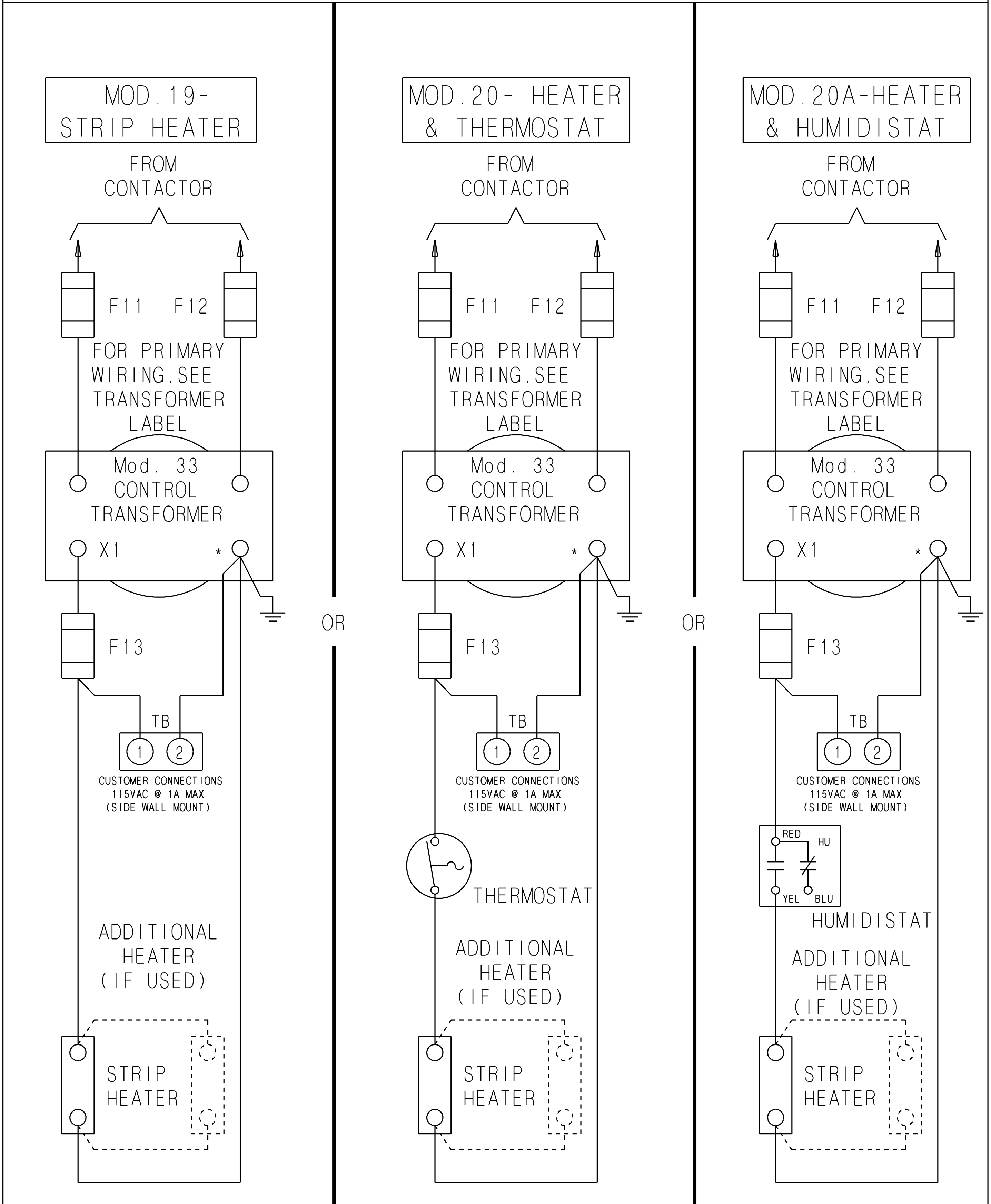
EXTERNAL DIAGRAM



Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	Opt.SP1 Supervisory Power Wiring Diagram - G4	Date 28 August 2014
		Drawing 20331 Issue 4

Fire Pump Controller Mod. 19, 20 or 20A W/Mod. 33

MASTER

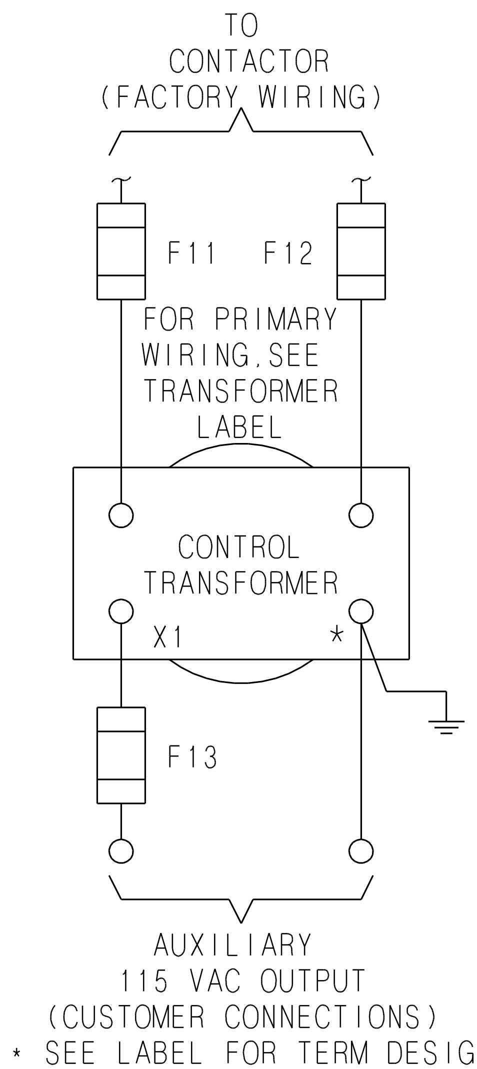


Master Control Systems Inc.
LAKE BLUFF, ILLINOIS U.S.A.

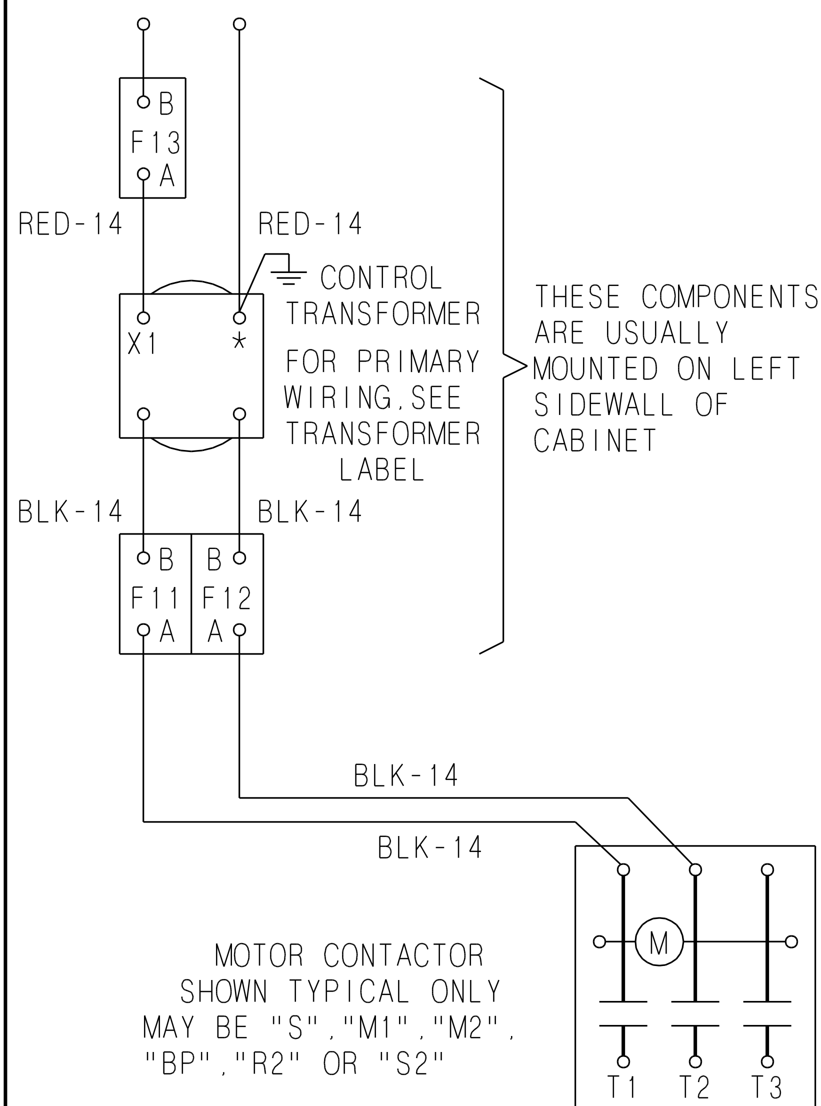
WIRING DIAGRAM-MOD.19,20 OR 20A WITH MOD 33 IN MC SERIES CONTROLLERS - G4

Date	26 August 2014
Drawing	20339
Issue	1

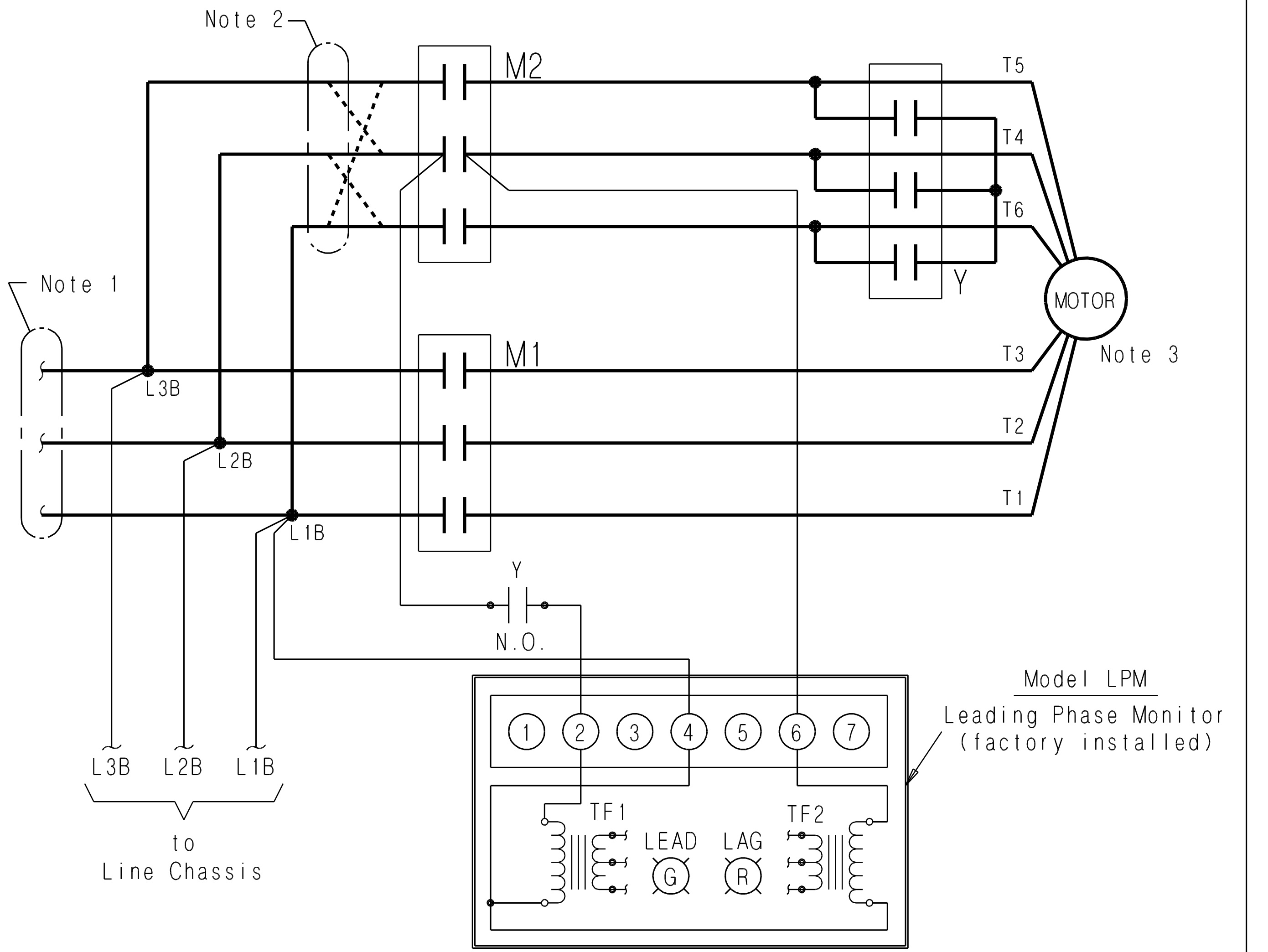
SCHEMATIC DIAGRAM



INTERNAL WIRING



Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	WIRING DIAGRAM MOD.33 IN MC* CONTROLLER (AUX.115 VAC POWER SUPPLY) - G4	Date 26 August 2014	
		Drawing 20338	Issue 1



NOTES:

1) First check the motor rotation. If the motor is starting backwards, swap any two sets of power wires at the load side of the Circuit Breaker or Transfer Switch. The motor coils should remain connected between T1 and T4, T2 and T5, T3 and T6. This can be verified with an ohmmeter.

2) Now check the status of the LPM during the Wye start. If the LED is green, it indicates that the Wye starting voltage is leading the Delta running voltage so the open transition "spike" is subtatntially reduced. If it is red, rotate all 3 power wire connections on the top of M2 to the left to change the connection to Leading without changing the motor rotation.

3) It is not recommended, but if the motor rotation is changed at the bottom of M1 and M2, all three power wires on top of M2 must be rotated to the right instead. Both LEDs will be off, but the connections will be Leading. See Notes 1 and 2 above for the recommended procedure.

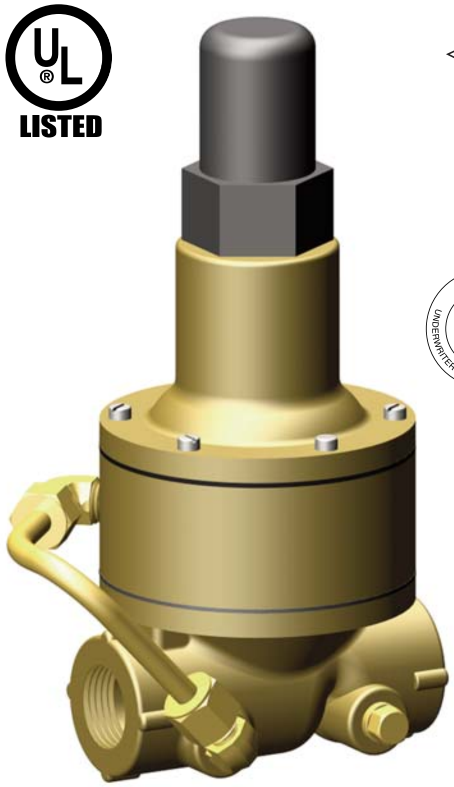
A3-060

MASTER CONTROL SYSTEMS, Inc.

CLA-VAL™

MODEL 55L

Pressure Relief Valve



- UL Listed
- Factory Mutual Approved
- Direct Acting - Precise Pressure Control
- Positive Dependable Opening
- Drip Tight Closure
- No Packing Glands or Stuffing Boxes
- Sensitive to Small Pressure Variations

The Cla-Val Model 55L **(UL Listed FM approved)** Pressure Relief Valve is a direct-acting, spring loaded, diaphragm type relief valve. The valve may be installed in any position and will open and close within very close pressure limits.

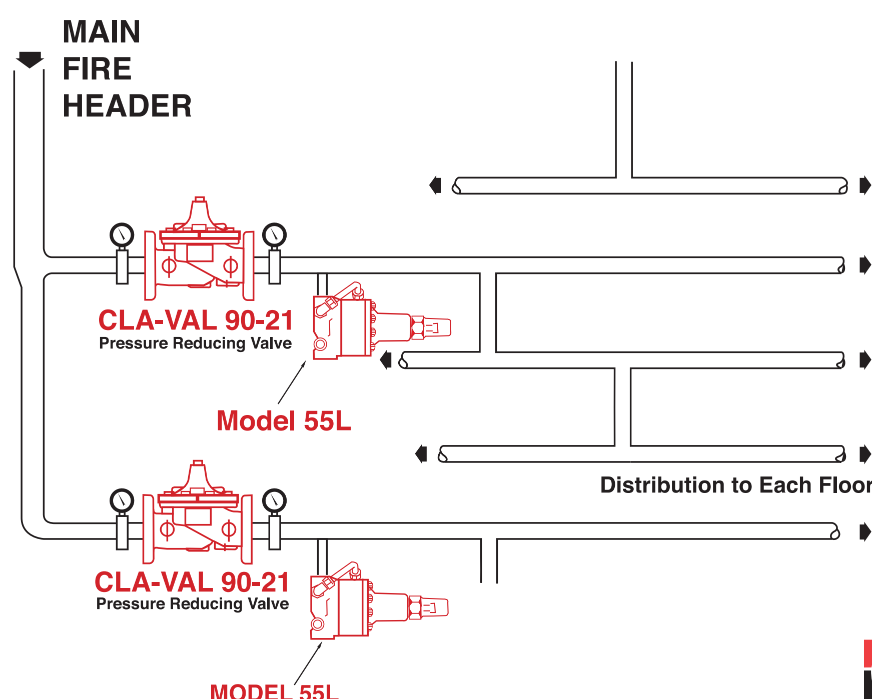
The Model 55L is normally held closed by the force of the compression spring above the diaphragm. When the controlling pressure applied under the diaphragm exceeds the spring setting, the disc is lifted off its seat, permitting flow through the control. When control pressure drops below the spring setting, the spring forces the control back to its normally closed position. The controlling pressure is applied to the chamber beneath the diaphragm through an external tube on the 55L.

Pressure adjustment is simply a matter of turning the adjusting screw to vary the spring load on the diaphragm. The 55L is available in three pressure ranges; 0 to 75 psi, 20 to 175 psi, 100 to 300 psi. To prevent tampering, the adjustment cap can be wire sealed by using the lock wire holes provided in the cap and cover.

Note: Also Available in Seawater Service Material

Typical Applications

Fire Protection System Service
Using the **Model 55L** in a fire protection system or other closed type system, prevents pressure build-up whenever line pressure exceeds the setting of the spring. The valve will relieve excess pressure to atmosphere preventing damage to the distribution network.



Specifications

Size 1/2" & 3/4" Threaded

Temperature Range Water, Air: to 180°F Max.

Materials

Body & Cover: Cast Bronze ASTM B62
Stainless Steel ASTM A743-CF-16Fa

Trim: Brass & Stainless Steel 303

Rubber: Buna-N® Synthetic Rubber

UL Listed 55L Range psi	Approximate Increase for Each Clockwise Turn of Adjusting Screw
20 to 175	28.0 psi

FM Approved 55L Range psi	Approximate Increase for Each Clockwise Turn of Adjusting Screw
0 to 75	8.5 psi
20 to 200	28.0 psi
100 to 300	18.0 psi

Pressure Ratings Cast Bronze 400 psi Max.
Stainless Steel 400 psi Max.

Other Materials Available on special order

Adjustment Ranges 0 to 75 psi
20 to 200 psi
100 to 300 psi

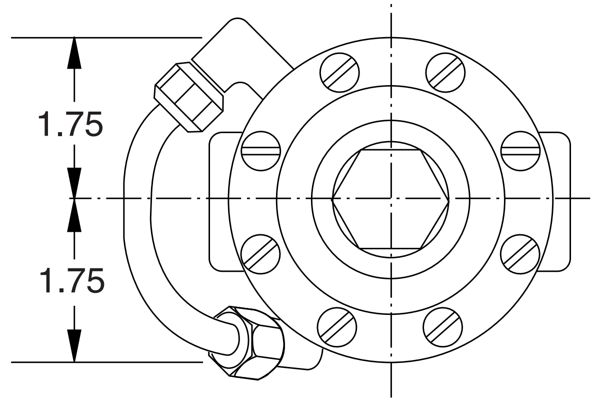
Flow Loss Chart (Full Open Valve)

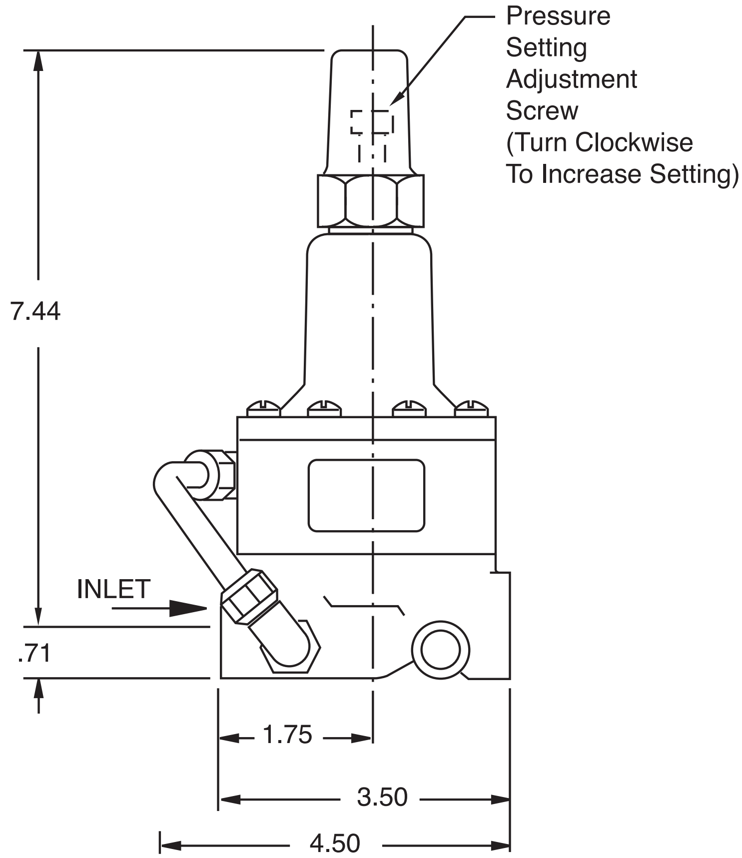
Valve Size	C_V Factor	Flow of Water - Gallons Per Minute				
		5	10	16	20	30
1/2"	6	0.7	2.7	6	11	--
3/4"	8.5	0.3	1.4	3.1	5.5	12.2

When Ordering, Please Specify

1. Catalog No. 55L
2. Valve Size
3. Adjustment Range Desired
4. Optional Materials

55L Basic Valve Dimensions (In Inches)





0 to 75 and 20 to175 psi design

CLA-VAL
PO Box 1325 Newport Beach CA 92659-0325
800-942-6326 • Fax: 949-548-5441 • Web Site: cla-val.com • E-mail: claval@cla-val.com

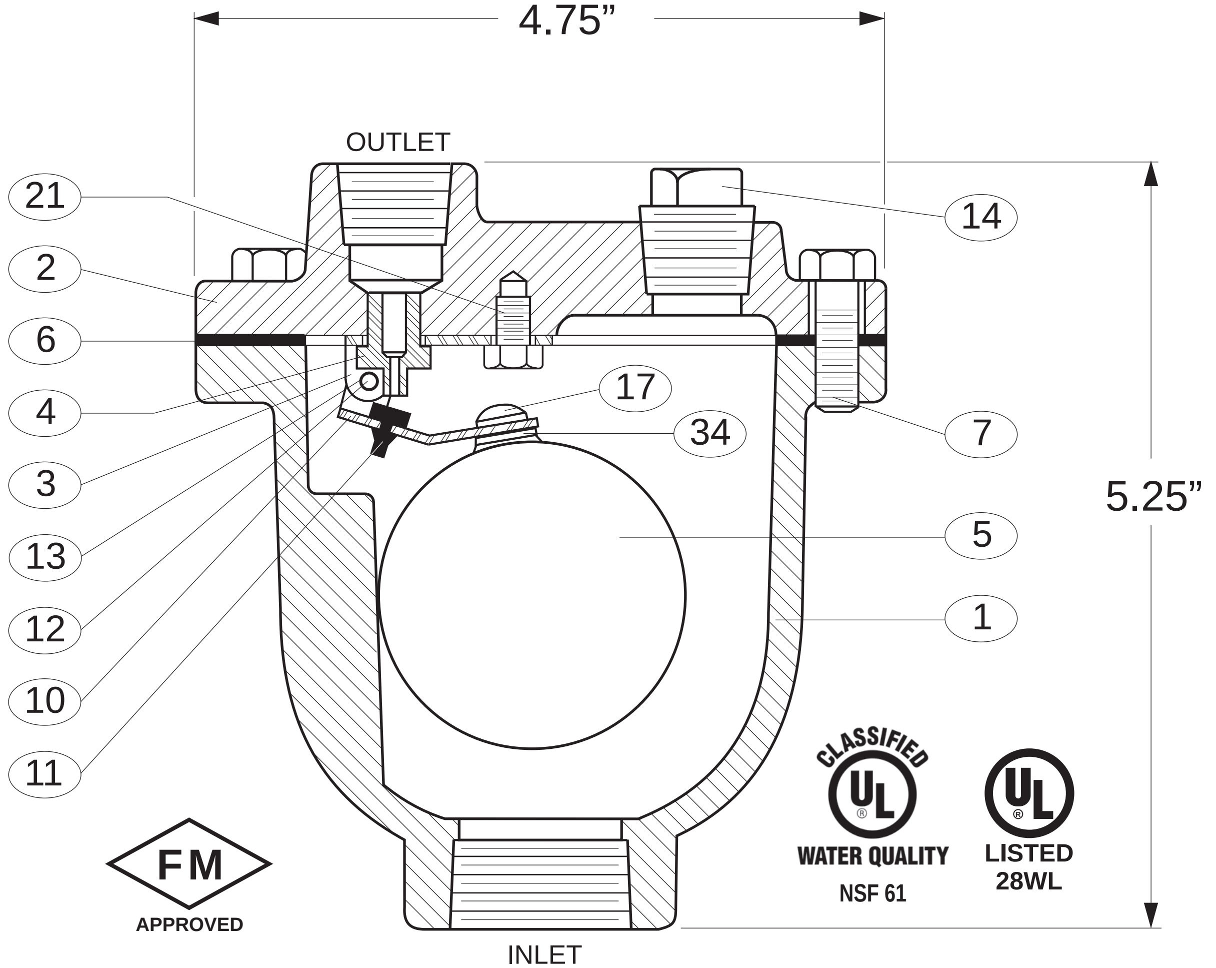
CLA-VAL CANADA
4687 Christie Drive
Beamsville, Ontario
Canada L0R 1B4
Phone: 905-563-4963
Fax: 905-563-4040
E-mail sales@cla-val.ca

CLA-VAL EUROPE
Chemin des Mésanges 1
CH-1032 Romanel/
Lausanne, Switzerland
Phone: 41-21-643-15-55
Fax: 41-21-643-15-50
E-mail: cla-val@cla-val.ch

CLA-VAL UK
Dainton House, Goods Station Road
Tunbridge Wells
Kent TN1 2 DH England
Phone: 44-1892-514-400
Fax: 44-1892-543-423
E-mail: info@cla-val.co.uk

CLA-VAL FRANCE
Porte du Grand Lyon 1
ZAC du Champ du Périer
France - 01700 Neyron
Phone: 33-4-72-25-92-93
Fax: 33-4-72-25-04-17
E-mail: cla-val@cla-val.fr

CLA-VAL PACIFIC
306 Port Hills Road (Level Two)
Woolston, Christchurh, 8042
NewZealand
Phone: 64-39644860
Fax: 64-39644786
E-mail: gnuthall@cla-val.com



TEST PRESSURE
1.5 TIMES COLD WORKING PRESSURE-CWP

SEE DRAWING NO. VM-15A-M FOR STANDARD MATERIAL OF CONSTRUCTION.

VALVE SIZE	MODEL NO.	INLET SIZE	OUTLET SIZE	CWP P.S.I.	ORIFICE SIZE
1/2"	1/2"-15A	1/2" N.P.T.	1/2" N.P.T.	175	1/16"
3/4"	3/4"-15A.2	3/4" N.P.T.	1/2" N.P.T.	175	1/16"
1"	1" -15A.3	1" N.P.T.	1/2" N.P.T.	175	1/16"

1	BODY	11	ORIFICE BUTTON
2	COVER	12	PIVOT PIN
3	LEVER FRAME	13	PIN RETAINER (NOT SHOWN)
4	SEAT	14	PIPE PLUG
5	FLOAT	17	FLOAT RETAINER
6	GASKET	21	LOCATOR
7	COVER BOLT	34	LOCK WASHER
10	FLOAT ARM		

Revision 2-24-09

AIR RELEASE VALVE	DATE 2-23-87
VAL-MATIC® VALVE AND MANUFACTURING CORP.	DRWG. NO. VM-15A

Industrial Gauges

Type 23X.53

- Stainless Steel Case & Crimp Ring
- Welded Case-to-Socket Connection
- Field Liquid-Fillable

Liquid Fillable

Type 232.53 - Dry case
Type 233.53 - Liquid filled case

The rugged construction of WIKA Type 23X.53 stainless steel gauges provides resistance to the most corrosive media and environments. These gauges feature 316 stainless steel wetted parts and 304 stainless steel case and crimped ring, and can be liquid-filled in the field.

Standard Features

- **Nominal Case Size:** 2" (53 mm) 2½" (68 mm), 4" (100 mm)
- **Case Material:** 304 stainless steel
- **Wetted Parts:** 316 SS
- **Window Type & Material:** 2½" Polycarbonate; 4" Acrylic
- **Removable Window:** No
- **Dial Material:** White aluminum
- **Bezel Ring Type & Material:** Crimp on SS polished
- **Liquid Fillable Gauge:** Yes
- **Case-to-Socket O-ring Material:** Welded
- **"Other" Gaskets/O-ring Types & Materials:** Window gasket, BUNA-N
- **Pointer Material/Type:** Black aluminum
- **Adjustable Pointer:** No
- **Accuracy:** ±1.5% of span (2" & 2½"); (4") ± 1.0% of span-ASME B40.100 Grade 1A
- **Connection locations:** LM (Lower Mount), CBM (Center Back Mount) & LBM (Lower Back Mount) (4" only)
- **Media Operating Temperature:** 212°F
- **Ambient Operating Temperature:** -40°F to 140°F dry; -4°F to 140°F glycerine case fill; -40°F to 140°F silicone case fill

Available Options

"Dampened Movement" Option: Yes, (N/A on 2½" CBM or 2" LM/CBM) & LBM
U-Clamp Bracket: Yes (CBM only)
Front Flange: Yes (CBM & LBM only)
Rear Flange: Yes (LM, CBM & LBM)
Restrictor: Yes
Safety Glass Window: No
Instrument Glass Window (flat glass): No
Drag Pointer (maximum reading indicator): Yes
Cleaned for Use in Oxygen Service: Yes
Panel Mount Kit: Yes (see front flange or u-clamp option)
Magnetic or Inductive Contact Switches: No
Receiver Gauge Scales: Yes
Special Connection: Limited to wrench flat area

Type	232.53				
Connection	LM	CBM			
Conn. Size	1/4" NPT				
Size	2½"				
Pressure Scale[1]	PSI	PSI	PSI/BAR	PSI/KPA	PSI/KG/CM²
30" Hg	9768777	9768394			
30"-0-15 PSI					
30"-0-30 PSI	9768769	9768386			
30"-0-60 PSI	9768750	9768378			
30"-0-100 PSI					
30"-0-160 PSI	9768742	9768360			
30"-0-200 PSI					
15 PSI	9768734	9768351			
30 PSI	9768726	9768343			
60 PSI	9768718	9768335	8992848	8993089	8992962
100 PSI	9768700	9768327	8992856	8993097	8992970
160 PSI	9768696	9768319	8992865	8993101	8992988
200 PSI	9768688	9768300	8992873	8993119	8992996
300 PSI	9768670	9768297	8992881	8993127	8993004
400 PSI	9768661	9768289			
600 PSI	9768653	9768270	9779685	9779693	
800 PSI					
1,000 PSI	9768645	9768262	8992899	8993135	8993012
1,500 PSI	9768637	9768254	8992903	8993144	8993020
2,000 PSI	9768629	9768246	8992911	8993152	8993038
3,000 PSI	9768610	9768238	8992929	8993160	8993046
5,000 PSI	9768602	9768220	8992937	8993178	8993055
6,000 PSI		8993208	8992945	8993186	8993063
10,000 PSI	9768599	9768211	8992954	8993195	8993071
15,000 PSI		9779715	9776715		9779731

[1]"PSI/BAR" denotes dual scale; PSI outside in black, BAR inside in red; "PSI/KPA" denotes dual scale; PSI outside in black, KPA inside in red; "PSI/KG/CM²" denotes dual scale; PSI outside in black, KG/CM² inside in red. Note: Vacuum scale: 30" Hg outside in black; 760 mm Hg inside in red. [2]

Note: For options not shown - consult your WIKA Distributor or the Factory.

Data sheet: 23X.53

For liquid filled gauges, add "-829" to part numbers above for 2½" size or "-834" for 4" size.

Items shown with part numbers indicate readily available standard WIKA products. Items shown without part numbers are available on special order.

FP - 171

Type	232.53- liquid fillable		
Connection	LM	LM	LBM
Conn. Size	1/4" NPT	1/2" NPT	
Size	4"		
Pressure Scale	PSI	PSI	PSI
30" Hg	9767576	9768459	9737057
30"-0-15 PSI	9737910	9768467	9737065
30"-0-30 PSI	9767398	9768475	9737073
30"-0-60 PSI	9767401	9768483	9737081
30"-0-100 PSI	9737898	9737880	9737090
30"-0-160 PSI	9767410	9768491	9737103
30"-0-200 PSI	9737901	9768505	9737111
30"-0-300 PSI	4260147		
30"-0-400 PSI	4260155		
15 PSI	9767428	9768513	9737120
30 PSI	9767436	9768521	9737138
60 PSI	9767444	9768530	9737146
100 PSI	9767452	9768548	9737154
160 PSI	9767460	9768556	9737162
200 PSI	9767479	9768564	9737170
300 PSI	9767487	9768572	9737189
400 PSI	9767495	9768580	9737197
600 PSI	9767509	9768963	9737200
800 PSI			9737219
1,000 PSI	9767517	9768858	9737227
1,500 PSI		9768866	9737235
2,000 PSI		9768807	9737243
3,000 PSI		9768874	9737251
5,000 PSI		9768823	9737260
10,000 PSI		9768831	9737278
15,000 PSI		9768840	9737286

Type	233.53- glycerine filled				
Connection	LM		LM	LBM	CBM
Conn. Size	1/4" NPT		1/2" NPT		1/4" NPT
Size	2½"	4"	4"		2½"
Pressure Scale	PSI	PSI	PSI	PSI	PSI
30" Hg	9833646	9833124	9833328	9831504	9833310
30"-0-15 PSI		9831775	9833336	9831512	
30"-0-30 PSI	9833638	9832993	9833345	9831520	9833302
30"-0-60 PSI	9833620	9833000	9833353	9831538	9833298
30"-0-100 PSI		9831759	9831741	9831546	
30"-0-160 PSI	9833612	9833018	9833361	9831555	9833280
30"-0-200 PSI		9831767	9833379	9831563	
30"-0-300 PSI					
30"-0-400 PSI					
15 PSI	9833604	9833026	9833387	9831571	9833272
30 PSI	9833590	9833035	9833395	9831589	9833264
60 PSI	9833582	9833043	9833409	9831597	9833255
100 PSI	9833574	9833051	9833417	9831601	9833247
160 PSI	9833565	9833069	9833425	9831619	9833239
200 PSI	9833557	9833077	9833434	9831627	9833221
300 PSI	9833549	9833085	9833442	9831635	9833213
400 PSI	9833531	9833094	9833450	9831644	9833205
600 PSI	9833523	9833107	9833727	9831652	9833191
800 PSI					
1,000 PSI	9833515	9833115	9833697	9831678	9833183
1,500 PSI	9833506		9833701	9831686	9833175
2,000 PSI	9833493		9833655	9831695	9833166
3,000 PSI	9833485		9833719	9831708	9833158
5,000 PSI	9833476		9833663	9831716	9833140
10,000 PSI	9833468		9833671	9831725	9833132
15,000 PSI			9833689	9831733	

Type	232.53- Stock Gauges with Ammonia Scales	
Size	2 ½"	4"
Connection	LM	
Conn. Size	1/4" NPT	
30"-0-150 PSI / 84°F	9797144	9797127
30"-0-300 PSI / 126°F	9797152	9797135

FP - 172

A Gorman-Rupp Company

GRID COUPLING <FM> CERTIFIED RATINGS & INSTALLATION INSTRUCTIONS

Patterson Pump Company
A GORMAN-RUPP COMPANY
PO Box 790
2129 Ayersville Road
Toccoa, GA 30577
(706) 886-2101
www.pattersonpumps.com

FP - 173

FM CERTIFIED RATINGS BHP AT RPM

PATTERSON ELECTRIC DRIVER
COUPLING RATINGS

	1450	1750	1800	3000	3600	TORQUE (IN-LBS)
P1040	50.7	61.2	62.9	105	125.9	2204
P1050	88.6	106.9	110	183.3	219.9	3850
P1060	139.3	168	172.9	288.2	345.8	6054
P1070	202.4	244.3	252	418.8	502.6	8798
P1080	417.4	503.8	518.2	863.6		18144
P1090	759.5	916.7	942.8			33013

PATTERSON DIESEL DRIVEN
COUPLING RATINGS

	1470	1760	2100	2350	2400	2600	2800	3000
P1040	51.4	61.5	73.4	82.2	83.9	90.9	97.9	104.9
P1050	89.8	107.5	128.3	143.6	146.6	158.8	171	183.3
P1060	141.2	169.1	201.7	225.7	230.5	249.7	269	288.2
P1070	205.2	245.7	293.2	328	335	362.9	390.9	418.8
P1080	423.2	506.7	604.6	676.6	690.9	748.5	806.1	863.7
P1090	770	921.9						

SERIES P1000 HORIZONTALLY SPLIT COVER COUPLINGS

COUPLING DATA

SIZE	COUPLING RATING (IN-LBS)	MAX SPEED	MIN BORE (IN)	MAX BORE (IN)	COUPLING WEIGHT(LBS)	WR^2 (LBS/FT^2
P1040	2204	3600	0.5	1.63	7.1	11.3
P1050	3850	3600	0.5	1.88	11.5	23.9
P1060	6054	3600	0.75	2.13	15.7	41
P1070	8798	3600	0.75	2.5	22.3	61.5
P1080	18144	3000	1.06	3	39	153.8
P1090	33013	1800	1.06	3.5	54	268.9

Coupling weight and WR^2 are with no bore
Max bore is with square key
Standard couplings are designed for clearance fit with one set screw over key way.

APPLICATION GUIDE

Certified couplings for rated BHP's and speeds given above can be used for fixed speed Centrifugal Fire Pumps with service factor 1.0.

The calculated driver torque, and adjusted by the motor service factor and above service factor, shall not exceed the maximum torque rating of the flexible coupling.

For Diesel Driven fire Pumps service factor is 2.0.

For Variable speed Fire Pumps service factor is 1.25.

BHP = torque (ft – lb.) X RPM / 5252

MATERIAL OF CONSTRUCTION

Part	Material uses Grid Coupling	Produce method
Hub	**Steel** **SM45C** **(Equivalent to AISI 1045)**	**Machining**
Grid	**Spring Steel** **HSWR82B** **(Equivalent to SAE 9254)**	**Forming - Heat Treatment - Peening** **and Powder Coating (or Phosphate Coating)**
Cover **H-type**	**Aluminum alloy** **ALDCS/8** **(Equivalent to ASTM 380)**	**Die-Casting**
Gasket	**Fiber**	
Oil seal	**NBR**	

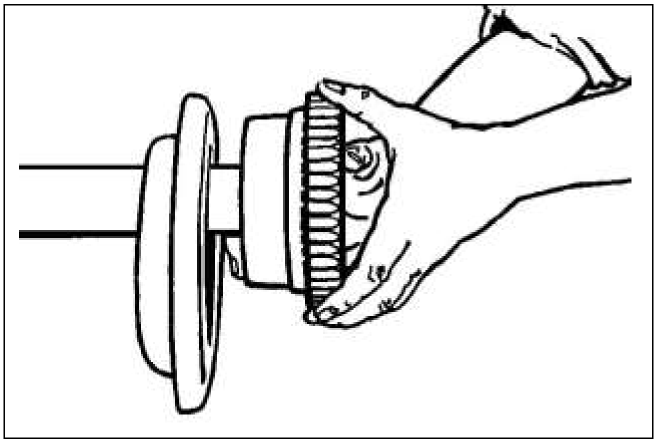
Recommended Grease:

SKF – LMC or 1/0.035

Technical data

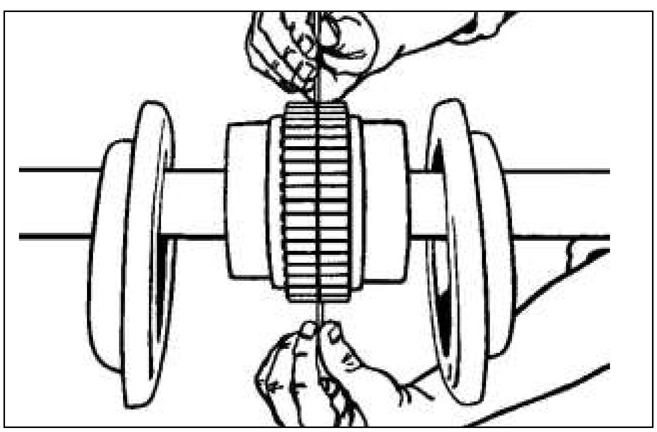
Designation	LMCG 1/(pack size)	
DIN 51825 code	G0G1G-0	**Corrosion protection**
NLGI consistency class	1	SKF Emcor:
Soap Type	Polyethylene	-standard ISO 11007
Colour	Brown	-salt water test(100%)
Base oil type	Mineral	**Copper corrosion ASTM**
Operating temperature range	0 to 120°C	24 hrs at 100°C
	(32 to 248°C)	**EP performance**
Dropping point DIN ISO 2176	210°C (410°F)	Wear scar DIN 51350
Base oil viscosity		4-ball test, welding
40°C, mm^2/s	670	**Koppers Method ASTM**
100°C, mm^2/s	34	K36, 24h
Penetration DIN ISO 2137		**Approximate density**
60 strokes, 10^{-1} mm	310-340	At 20 C, IPPM-CS/03

General Guidance for the installation of Patterson grid couplings

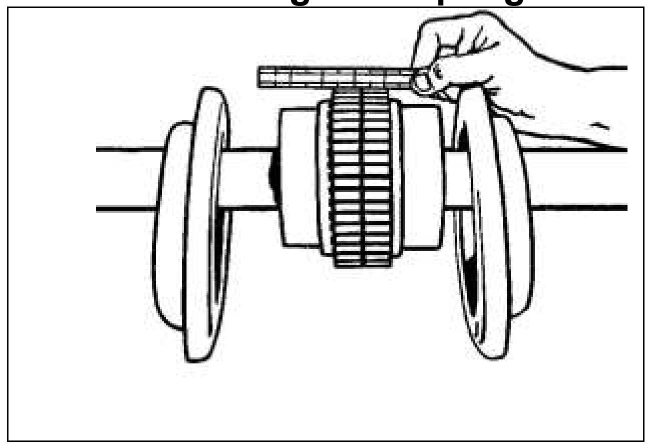


1. Mount Seals and Hubs
P1000 Series (horizontal split cover). Lightly smear seals with grease and place on shafts before mounting hubs.

2. Alignment
Satisfactory alignment can be achieved with the use of a straight edge and feeler gauge, although a dial indicator would generally improve accuracy.

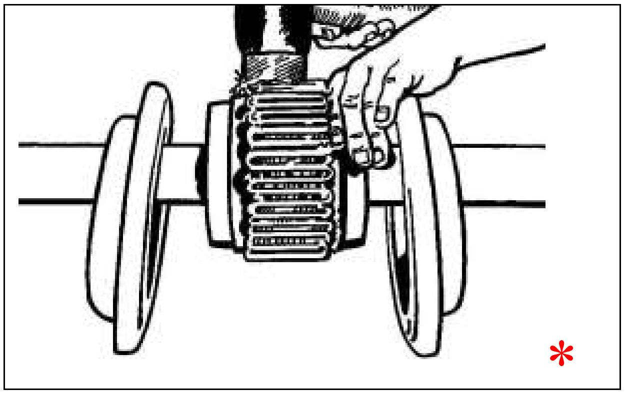


3. Gap and Angular Alignment
Set gap using a spacer bar equal in thickness to the nominal gap specified in the table on back page. With the spacer bar inserted to the same depth, measure clearance between bar and hub face at 90° intervals using feelers.



4. Parallel Offset Alignment
Use a straight edge and feelers, or dial indicator, over the tops of the coupling teeth, taking measurements at 90° intervals. Error should not exceed offset limit specified in the table on back page. (page 4)

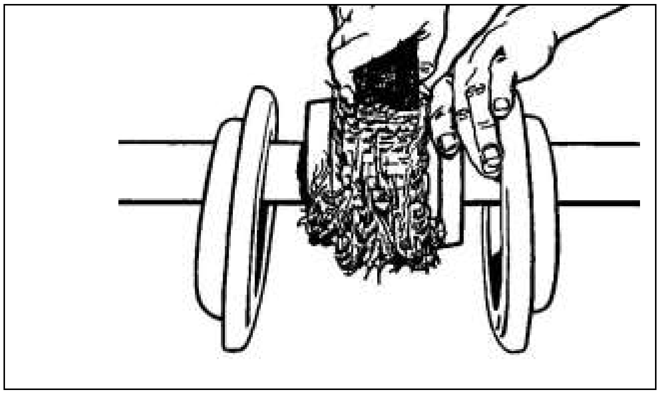
5. Be sure to tighten & torque all Set screw & final alignment
Tighten all equipment based plate bolts. Repeat step 3 & 4 and if necessary re-align.



6. Grid Assembly

*Before inserting the grid segments, thoroughly pack the grooves with NGLI #2 lubricant. A list of recommended lubricants can be found on the back page. Lubricant packages are included with sizes P1040 through P1090.

When grids are supplied in two or more segments assemble so the cut ends at a segment joint extend in the same direction. Spread the grid slightly so that it will pass over the coupling teeth, and tap all the rungs into the respective slots with a soft mallet.



7. Cover Assembly

Pack the spaces around the grid with lubricant and wipe off the excess flush with top of grid.

P1000 (horizontally split cover): Position seals on hubs so that they line up with grooves on cover. Position gaskets on lower cover half and assemble covers so that match marks are on the same side. If using the coupling in any position other than horizontal, assemble cover halves with the lug and match mark up, or on the high side. Fasten the cover halves to the torque specified in the table on back page.

Maintenance

Check coupling misalignment every year and adjust if required. Excessive misalignment, high ambient temperatures and/or frequent rapid reversing may necessitate more frequent inspections.

If quantity of lubricant appears low, check for leaks and change seals. If necessary, replenish lubricant.

Clean coupling of all old lubricant and replace annually.

Table 1 – Misalignment & End Float

Size	Installation Alignment Limits						Operation Alignment Limits				Cover Bolt Tightening Torques		
	Parallel Offset		Angular		Hub Gap 10%		Parallel Offset		Angular		P1000		
	Max Inch	Max mm	Max Inch	Max mm	Max Inch	Max mm	Max Inch	Max mm	Max Inch	Max mm	Nm	(in-lb)	Size
P1040	0.006	0.15	0.003	0.08	0.125	3.2	0.012	0.30	0.013	0.33	11	100	M6
P1050	0.008	0.20	0.004	0.10	0.125	3.2	0.016	0.40	0.016	0.40	22	200	M8
P1060	0.008	0.20	0.005	0.12	0.125	3.2	0.016	0.40	0.018	0.45	22	200	M8
P1070	0.008	0.20	0.005	0.12	0.125	3.2	0.016	0.40	0.020	0.50	22	200	M8
P1080	0.008	0.20	0.006	0.15	0.125	3.2	0.016	0.40	0.024	0.60	22	200	M8
P1090	0.008	0.20	0.007	0.18	0.125	3.2	0.016	0.40	0.028	0.70	22	200	M8

Table 1 – Misalignment & End Float

Size	Max RPM		Lube Wt	
	P1000		lb	kg
P1040	3600		0.12	0.05
P1050	3600		0.15	0.05
P1060	3600		0.19	0.09
P1070	3600		0.25	0.11
P1080	3000		0.38	0.17
P1090	1800		0.56	0.25

Table 2 – Lubricants

Manufacturer	Product
American Lubricants Co. (Dayton, OH)	Alubco Bison 1650
Brooks Technology (Cleveland, OH) (Fuchs Lubricants)	Superplex EP #1 or Benalene 350 EP #2
Chevron Lubricants	Coupling Grease or Duralith EP2
Citgo Petroleum Corp.	Premium Lithium EP2
Exxon / Mobil Corp.	Mobilux EP111
Fiske Bros. Refining Co.	Lubriplate 630AA
Anderol Inc. (Houghton, Canada)	Anderol 786
Kendall Motor Oil	L-424
Lyondell Lubricants (Houston, TX)	Litholene H EP 2
Maryn International/ Power Up Lubricants (Calgary, Canada	Thixogrease EP #2
Pennzoil / Quaker State	Pennlith EP711 or Pennlith EP712
Syn-Tech Ltd. (Addison, IL)	NS-2913-G1
Texaco Inc.	Mulifax EP2 or Texaco Coupling Grease
UNOCAL 76 (TOSCO Corporation)	UNOBA EP2

Patterson Pump Company
PO Box 709 2129 Ayersville Rd. Toccoa, GA 30577
706-886-2101
www.pattersonpumps.com
A Gorman-Rupp Company

NIDEC MOTOR CORPORATION

8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136

DATE: 10/27/2014

P.O. NO.: FIRE PUMP- RFQ
Order/Line NO.: 1038396 IN 100

TO: Patterson Pump Co
Subsidiary Gorman-Rupp Co
Attn: Accts Payable
PO Box 790
Toccoa, GA, 30577
ATTN: CUSTOMER

Model Number: NA
Catalog Number: FF150E1CS-P
Horiz. ODP Fed. Eff. Config.
CONF,MOTOR,HORIZ ODP FED EFF

REVISIONS:

ALL DOCUMENTS HEREIN ARE CONSIDERED TYPICAL BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR INQUIRY AND THE OPPORTUNITY TO SERVE YOU.

Features:

```
Temporary - DO NOT COPY
Horsepower ............. 00150.00 ~ KW: 111.9
Enclosure .............. ODP
Poles .................. 02 ~ RPM: 3600
Frame Size ............. 444~TS
Phase/Frequency/Voltage.. 3~060~460 ~ Random Wound
Service Factor ......... 1.15
Insulation Class ........ Class "F" ~ Insulife 1000
Altitude In Feet (Max) .. 12000 Ft.
Ambient In Degree C (Max) +40 C
Assembly Position ....... "F-1" Assembly Position
Efficiency Class ........ Energy Efficient
Application ............ UL Listed Fire Pump Motor
Customer Part Number ....
"AK" Dimension (Inches).. NA
Temperature Rise (Sine Wave): "B" Rise @ 1.0 SF (Resist)
NEMA Design ............ B
KVA Code Letter ......... "G"
Starting Method ......... Soft Start
Duty Cycle ............. Continuous Duty
Efficiency Value ........ 95.0 % ~ Typical
Load Inertia (lb-ft2): NEMA ~ NEMA Inertia: 133.00 ~ 1.00
Number Of Starts Per Hour: NEMA
Motor Type Code ......... FR
Rotor Inertia (LB-FT²)      13.7 LB-FT²
Qty. of Bearings PE (Shaft)  1
Qty. of Bearings SE (OPP)    1
Bearing Number PE (Shaft)    6313-J
Bearing Number SE (OPP)      6313-J
```

NIDEC MOTOR CORPORATION

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REVISIONS:

ALL DOCUMENTS HEREIN ARE CONSIDERED TYPICAL BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR INQUIRY AND THE OPPORTUNITY TO SERVE YOU.

Accessories:
Direct Connected To Load
.
Special Features Plate Info:
0 FL EFF @
12000 FASL

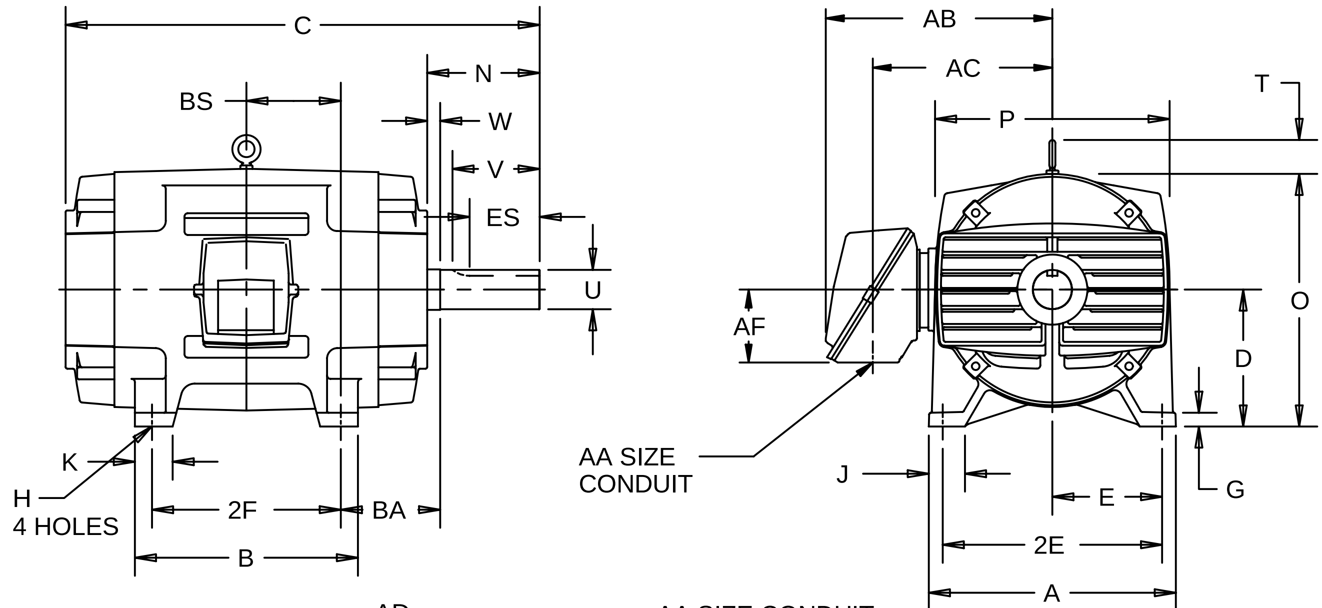
USE THE DATA PROVIDED BELOW TO SELECT THE APPROPRIATE DIMENSION PRINT

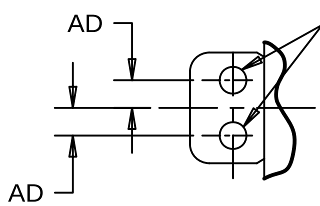
Horsepower	150
Pole(s)	02
Voltage(s)	460
Frame Size	444TS
Shaft U Diameter	2.375
Outlet Box AF	4.72
Outlet Box AA	3.00

US MOTORS HORIZONTAL MOTORS OPEN DRIP PROOF

Operations & Maintenance Manual
December 2015

EFFECTIVE: 05-MAR-12	HORIZONTAL MOTORS	PRINT: 07-1988
SUPERSEDES: 05-AUG-11	OPEN DRIP PROOF FRAME: 444T THRU 447TS BASIC TYPE: R	SHEET: 1 OF 1





ALL DIMENSIONS ARE IN INCHES AND MILLIMETERS

UNITS	A	D -.06	E	2E ±.03	G	H +.05	J	O	P [2]	T	W	BA
IN	22.00	11.00	9.00	18.00	1.38	.81	4.00	22.06	22.94	3.25	.25	7.50
MM	559	279	229	457	35	21	102	560	583	83	6	191

FRAME	UNITS	B	C	K	N	2F ±.03	U -.001	V MIN	BS	ES MIN	SQ KEY
444T	IN	17.75	37.75	3.25	8.75	14.50	3.375	8.25	7.25	6.91	.875
	MM	451	959	83	222	368	85.73	210	184	176	22.23
444TS	IN	17.75	34.00	3.25	4.97	14.50	2.375	4.50	7.25	3.03	.625
	MM	451	864	83	126	368	60.33	114	184	77	15.88
445T	IN	19.75	39.75	3.25	8.75	16.50	3.375	8.25	8.25	6.91	.875
	MM	502	1010	83	222	419	85.73	210	210	176	22.23
445TS	IN	19.75	36.00	3.25	5.00	16.50	2.375	4.50	8.25	3.03	.625
	MM	502	914	83	127	419	60.33	114	210	77	15.88
447T	IN	23.25	43.25	3.25	8.75	20.00	3.375	8.25	10.00	6.91	.875
	MM	591	1099	83	222	508	85.73	210	254	176	22.23
447TS	IN	23.25	39.50	3.25	5.00	20.00	2.375	4.50	10.00	3.03	.625
	MM	591	1003	83	127	508	60.33	114	254	77	15.88

FULL LOAD AMPS	HP	UNITS	AA	AB	AC	AD	AF
UP TO 250	---	IN	3.00	19.81	15.31	---	4.72
		MM		503	389	---	120
251 AND UP	≤250	IN	3 1/2 NPT	22.44	16.81	---	8.06
		MM		570	427	---	205
	≥300	IN	3 NPT	22.44	16.81	2.75	8.06
		MM		570	427	70	205

1: ALL ROUGH CASTING DIMENSIONS MAY VARY BY .25" DUE TO CASTING AND/OR FABRICATION VARIATIONS.
2: LARGEST MOTOR WIDTH.

3: CONDUIT BOX MAY BE LOCATED ON EITHER SIDE OF MOTOR. CONDUIT OPENINGS MAY BE LOCATED IN STEPS OF 90 DEGREES REGARDLESS OF LOCATION. STANDARD AS SHOWN WITH CONDUIT OPENING DOWN.

07-1988/E

Nidec Motor Corporation
St. Louis, Missouri

US MOTORS

ISSUED BY R. KING
APPROVED BY J. HAGENE

IHP_DP_NMCA (MAR-2011) SOLIDEDGE

NAMEPLATE DATA

CATALOG NUMBER:	FF150E1CS-P			NAMEPLATE PART #:	422696-002		
MODEL		FR	444TS	TYPE	FR	ENCL	ODP
SHAFT END BRG	6313-J - QTY 1			OPP END BRG	6313-J - QTY 1		
PH	3	MAX AMB	40 C	ID#	(ref: Order#: 1038396, Type: IN, Line#: 100)		
INSUL CLASS	F	Asm. Pos.	F1	DUTY	CONT		

HP	150	RPM	3565			HP		RPM			
VOLTS	460					VOLTS					
FL AMPS	169.0					FL AMPS					
SF AMPS	195.0					SF AMPS					
SF	1.15	DESIGN	B	CODE	G	SF		DESIGN		CODE	
NEMA NOM EFFICIENCY	95.0	NOM PF	87.3	KiloWatt	111.9	NEMA NOM EFFICIENCY		NOM PF			
GUARANTEED EFFICIENCY	94.1	MAX KVAR	29.7	HZ	60	GUARANTEED EFFICIENCY		MAX KVAR		HZ	

HAZARDOUS LOCATION DATA (IF APPLICABLE):

DIVISION		CLASS I		GROUP I	
TEMP CODE		CLASS II		GROUP II	

VFD DATA (IF APPLICABLE):

VOLTS			
AMPS			
TORQUE 1		TORQUE 2	
VFD LOAD TYPE 1		VFD LOAD TYPE 2	
VFD HERTZ RANGE 1		VFD HERTZ RANGE 2	
VFD SPEED RANGE 1		VFD SPEED RANGE 2	
SERVICE FACTOR		FL SLIP	
NO. POLES	2	MAGNETIZING AMPS	43.8
VECTOR MAX RPM		Encoder PPR	
Radians / Seconds		Encoder Volts	

TEAO DATA (IF APPLICABLE):

HP (AIR OVER)		HP (AIR OVER M/S)		RPM (AIR OVER)		RPM (AIR OVER M/S)	
FPM AIR VELOCITY		FPM AIR VELOCITY M/S		FPM AIR VELOCITY SEC			

ADDITIONAL NAMEPLATE DATA:

Decal / Plate	WD=011658	Customer PN	
Notes		Non Rev Ratchet	
Max Temp Rise	80C RISE/RES@1.00SF	OPP/Upper Oil Cap	GREASE
Thermal (WDG)		SHAFT/Lower Oil Cap	GREASE
Altitude	12000 FASL		
Regulatory Notes		Regulatory Compliance	CC 030A
COS		Marine Duty	
Balance		Arctic Duty	
3/4 Load Eff.	95.7	Inrush Limit	
Motor Weight (LBS)	1100	Direction of Rotation	
Sound Level		Special Note 1	0 FL EFF @
Vertical Thrust (LBS)		Special Note 2	12000 FASL
Thrust Percentage		Special Note 3	
Bearing Life		Special Note 4	
Starting Method		Special Note 5	
Number of Starts		Special Note 6	
200/208V 60Hz Max Amps		SH Max. Temp.	
190V 50 hz Max Amps		SH Voltage	
380V 50 Hz Max Amps		SH Watts	
NEMA Inertia		Load Inertia	
Sumpheater Voltage		Sumpheater Wattage	
Special Accessory Note 1		Special Accessory Note 16	
Special Accessory Note 2		Special Accessory Note 17	
Special Accessory Note 3		Special Accessory Note 18	
Special Accessory Note 4		Special Accessory Note 19	
Special Accessory Note 5		Special Accessory Note 20	
Special Accessory Note 6		Special Accessory Note 21	
Special Accessory Note 7		Special Accessory Note 22	
Special Accessory Note 8		Special Accessory Note 23	
Special Accessory Note 9		Special Accessory Note 24	
Special Accessory Note 10		Special Accessory Note 25	
Special Accessory Note 11		Special Accessory Note 26	
Special Accessory Note 12		Special Accessory Note 27	
Special Accessory Note 13		Special Accessory Note 28	
Special Accessory Note 14		Special Accessory Note 29	
Special Accessory Note 15		Special Accessory Note 30	

NIDEC MOTOR CORPORATION

ST. LOUIS, MO

TYPICAL NAMEPLATE DATA
ACTUAL MOTOR NAMEPLATE LAYOUT MAY VARY
SOME FIELDS MAY BE OMITTED

<u>PATTERSON PUMP CO. PUMP 8X6MABS</u>

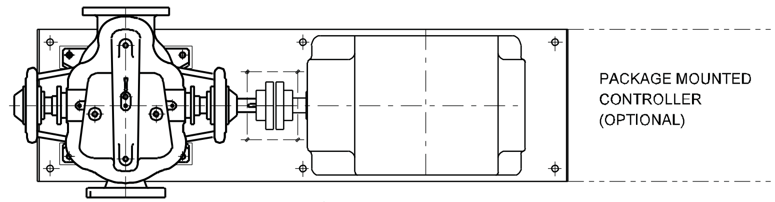
Operations & Maintenance Manual
December 2015

MOTOR	A	B	C	D	E	F	G	H	J
405 TS	72.7/32"	17.3/4"	13.3/32"	20"	12"	33"	70"	3/8"	3"
444 TS	75.1/8"	19.1/2"	14.1/4"	20"	12"	36"	76"	3/8"	3"
445 TS	77.1/8"	20.1/2"	15.1/4"	20"	12"	36"	76"	3/8"	3"
447 TS	80.7/8"	22.1/4"	17.1/4"	20"	12"	40"	84"	3/8"	3"

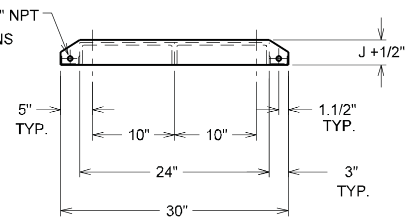
CONTROLLER	AA	BB	CC
~~FIRETROL FTA 1000A~~	~~26"~~	~~67.5/8"~~	~~34"~~

NOTE: 1) CLOCKWISE ROTATION SHOWN WHEN VIEWED FROM DRIVER END, SUCTION ON RIGHT, DISCHARGE ON LEFT.
FOR COUNTERCLOCKWISE ROTATION, SUCTION IS ON LEFT, DISCHARGE IS ON RIGHT. WHEN VIEWED FROM DRIVER END.

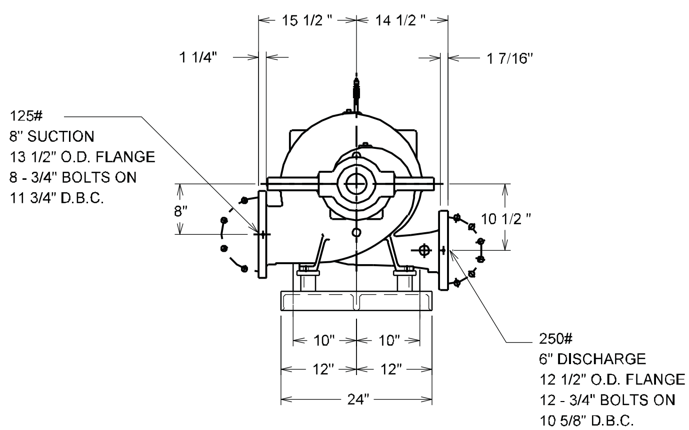
2) 5" GROUT HOLES ARE PROVIDED



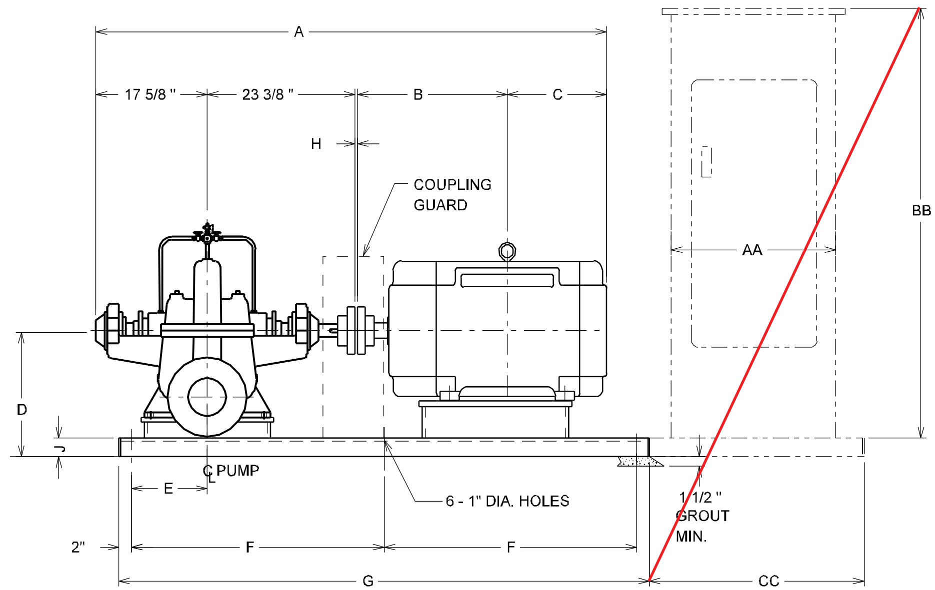
TOP VIEW



DRIP RIM BASE (OPTIONAL) NOT INCLUDED



D.B.C. 'S STRADDLE ℄



UNIT ______ OUR ORDER No. ______

JOB ______ CUSTOMER ORDER No. ______

PUMP 8x6 MABS CAPACITY 1250 G.P.M. @ ______ FT. HD.

MOTOR UL Listed MAKE Idec - US Motors FRAME 444TS

150 H.P. 3 PHASE 60 CYCLE 480 VOLT 1780 R.P.M.

CONTROLLER ______

CERTIFIED BY: ______ DATE ______

REV. 1 ECN# 10040 4-11-00 VC

PATTERSON PUMP COMPANY
A SUBSIDIARY OF THE GORMAN-RUPP COMPANY

OUTLINE DIMENSIONS
for
8 X 6 MABSH

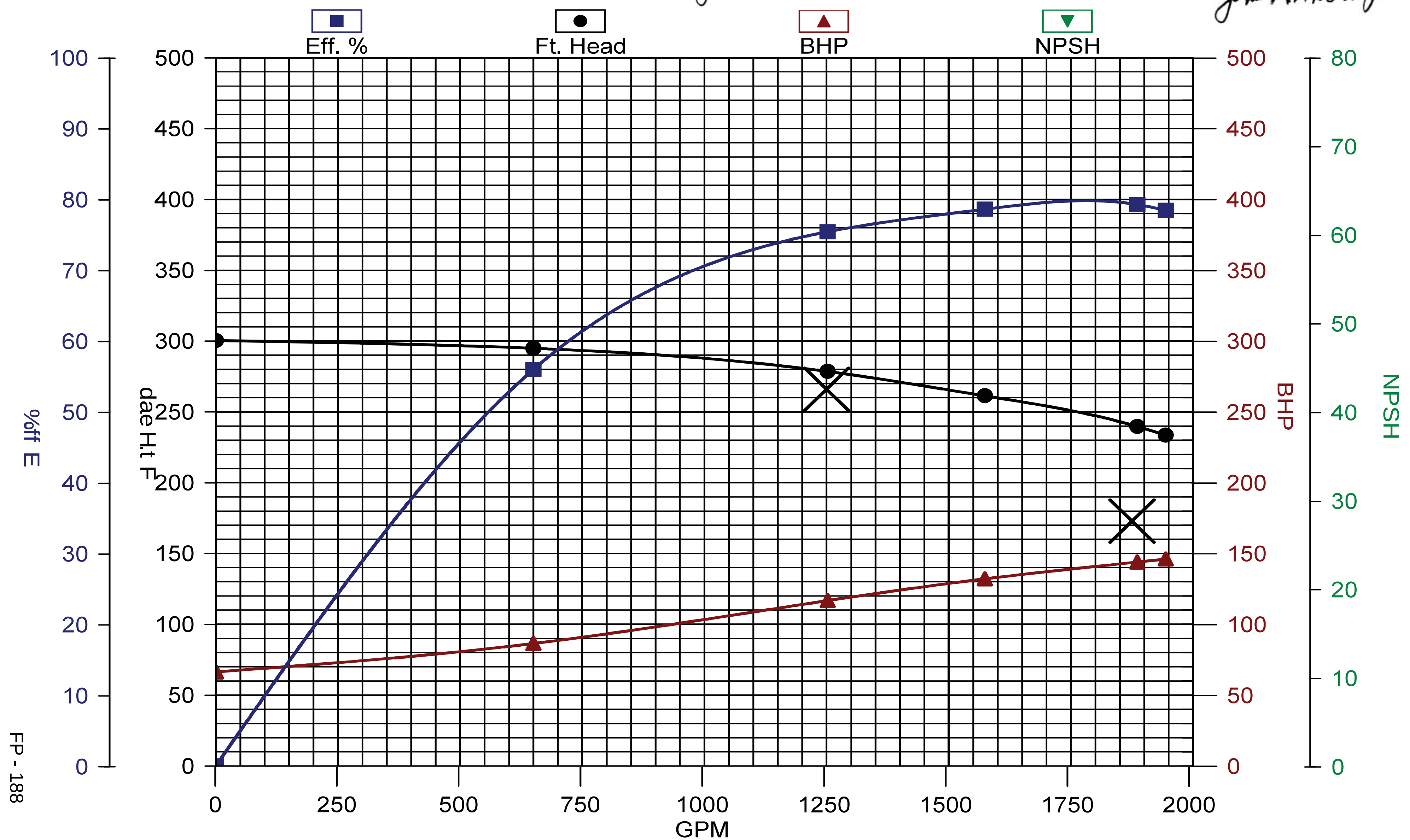
DWG. NO. AC - 11500-1	
DRAWN ADAMS	DATE 12-9-91
SCALE NONE	APPRVD. A.P.

Patterson Pump Company

Serial No: FP-C049863-001
Pump Type:8X6MABS
Imp Pattern:B-15396
Imp Dia:16.5
Vane Tips:.875
No. Stages:1
Certified By:____AL____________

Sold To:
Test Driver:WESTINGHOUSE
HP:150
Eff%:0.924
Test RPM:1780
Test Type:Performance Test
Approved By:_ John H McCullough _____

Job: 154123
GPM:1250
Ft. Head:266
Rated RPM:1780
Test Num:1
Date:Apr-19-2005
Witnessed By:_ John H McCullough _



PATTERSON PUMP COMPANY

ORDER INFORMATION
Customer:
Serial No: FP-C049863-001
Job: 154123

PUMP DATA
Pump Size & Type: 8X6MABS
Impeller Pattern: B-15396
Impeller Diameter: 16.500
Vane Tips: .875
Stages: 1

RATING (Design)
GPM: 1250
FT HD: 266
RPM (N2): 1780

TEST INFORMATION
Positive Pressure Test
Venturi Meter: 8"
Venturi Constant: 192.78
Discharge Dia: 6.00
Suction Dia: 8.00
Discharge Guage Elev.(Zd): 0.00
Suction Guage Elev. (Zs): 0.00
Pressure Ga: 300PSI
Panel No.: 1-S6
WaterTemp

TEST DRIVER INFORMATION
HP: 150
RPM: 1780
Manufacturer: WESTINGHOUSE
Serial No.: 474B859G09
Volts: 460
Amps: 177
S.F.: 1.15
Eff.(.00): 0.924

SECONDARY RATINGS
GPM: 1,875.00, 0.00
FT HD: 172.90, 0.00

Data Collected by : AL
Test Date : Apr-19-2005
Test No.: 1

Test Data						Calculated Data						Calculated Data at Rated Speed		
No	Pd (PSI)	Ps (PSI)	kW	N1	h (" H2O)	Q1 (GPM)	H1 (FT)	whp	ehp	bhp1	npump	Q2 (GPM)	H2 (FT)	bhp2
1	135.50	3.40	54.90	1,794.00	0.00	0.00	305.15	0.00	73.59	68.00	0.00	0.00	300.41	66.42
2	132.00	3.00	71.10	1,791.00	11.50	653.75	298.58	49.29	95.31	88.06	55.97	649.73	294.92	86.45
3	124.00	3.40	95.37	1,787.00	42.50	1,256.77	280.75	89.10	127.84	118.13	75.43	1,251.85	278.56	116.74
4	115.50	3.20	107.56	1,785.00	67.00	1,577.97	262.83	104.73	144.18	133.22	78.61	1,573.55	261.36	132.11
5	105.00	3.00	116.83	1,783.00	96.00	1,888.85	240.51	114.72	156.61	144.71	79.28	1,885.67	239.70	143.98
6	102.00	2.80	118.54	1,783.00	102.00	1,946.98	234.35	115.22	158.90	146.82	78.47	1,943.71	233.56	146.08

Comments:
UL/FM RATING HP 150

CLARKE FLEXIBLE COUPLINGS

Operations & Maintenance Manual
December 2015

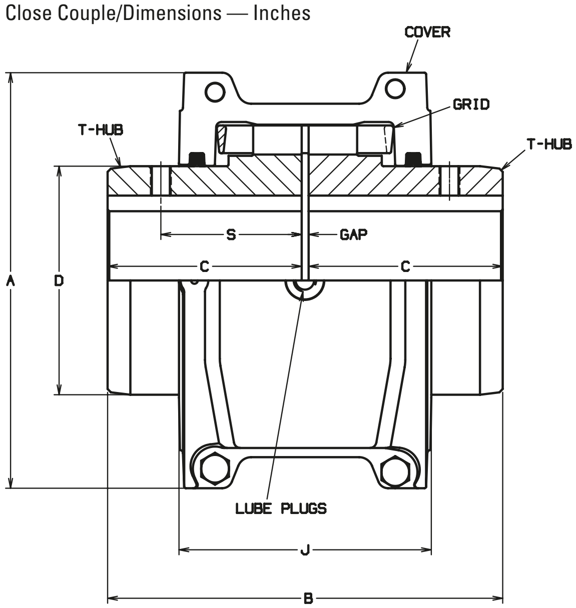
MOTOR DRIVEN CERTIFIED ALL METAL FLEXIBLE COUPLINGS
UL CERTIFIED RATINGS BHP/*KW* AT RPM

MODEL	OPERATING SPEED									
	1450		1750		1800		3000		3600	
C1040T	**50.8**	*37.9*	**61.3**	*45.7*	**63.1**	*47.1*	**105**	*78.3*	**126**	*94*
C1050T	**89**	*66.4*	**107**	*79.8*	**110**	*82.0*	**183**	*136.5*	**220**	*164.1*
C1060T	**139**	*103.7*	**168**	*125.3*	**173**	*129.0*	**288**	*214.8*	**346**	*258.0*
C1070T	**202**	*150.6*	**244**	*182*	**251**	*187.2*				
C1080T	**417**	*311.8*	**503**	*375.1*	**518**	*386.3*				

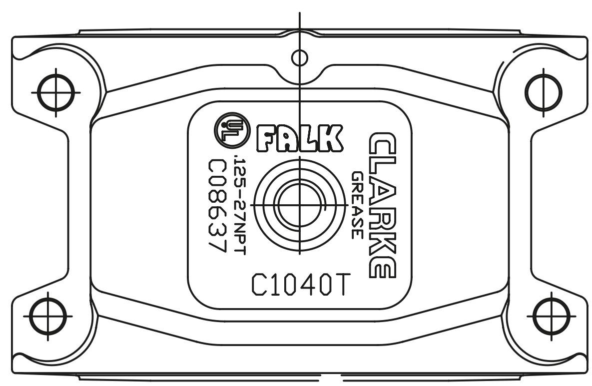
Couplings are not listed for service with diesel engines.
Motor certified couplings can only be used with fixed speed centrifugal fire pumps, contact factory for application guidelines for positive displacement pumps and variable speed fire pumps.

TYPE C10

Close Couple/Dimensions — Inches



Cover Profile — Horizontal Split



Covers are cast aluminum alloy

MODEL	Max Speed rpm	Max Bore*	Min Bore	Cplg Wt With No Bore-(lb)	Lube Wt (lb)	Dimensions — Inches						
						A	B	C	D	J	S	Max Gap
C1040T	3,600	1.625	.500	7.4	.12	4.50	4.12	2.00	2.25	2.75	1.58	.25
C1050T	3,600	1.875	.500	12.0	.15	5.32	4.88	2.38	2.62	3.19	1.76	.25
C1060T	3,600	2.125	.750	16.0	.19	5.82	5.12	2.50	3.00	3.68	2.06	.25
C1070T	1,800	2.500	.750	23.0	.25	6.25	6.12	3.00	3.44	3.81	2.12	.25
C1080T	1,800	3.000	1.062	39.0	.38	7.50	7.12	3.50	4.12	4.55	2.54	.25

*T-hub max bore with square key. For larger bores with rectangular key, consult factory. For max bores for shaft-hubs consult factory.
*Standard couplings are designed for clearance fit with one set screw over keyway.

Meets NFPA 20 Requirements

CLARKE

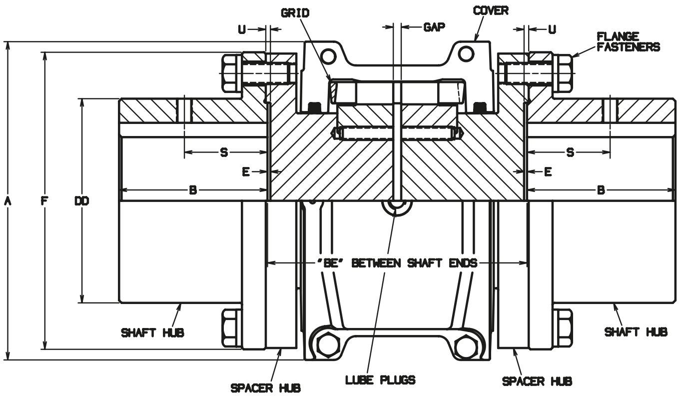
FIRE PUMP COUPLINGS FOR ELECTRIC MOTORS

MODELS

C1040T C1050T C1060T C1070T C1080T

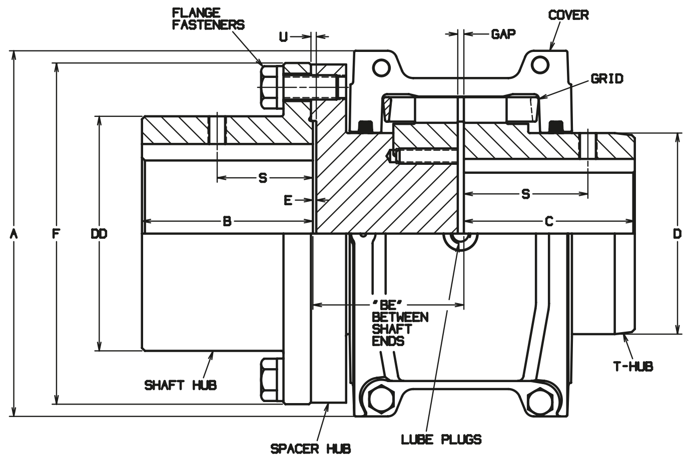
TYPE C31

Full Spacer



TYPE C35

Half Spacer



For dimensions, consult factory
Full Spacer or Half Spacer are required for end suction fire pumps

TABLE 1 — TYPE C31 STOCK SPACER HUB LENGTHS (BE=DISTANCE BETWEEN SHAFT ENDS)

"BE" Between Shaft Ends	ANSI B73.1 Pump Std	Coupling Model				
		1040T	1050T	1060T	1070T	1080T
3.50	X	X				
4.38	X	X	X			
5.00	X	X	X	X	X	
7.25	X	X	X	X	X	X

Other "BE" dimensions are available, consult factory

TABLE 2 — TYPE C35 STOCK SPACER HUB LENGTHS (BE=DISTANCE BETWEEN SHAFT ENDS)

"BE" Between Shaft Ends	ANSI B73.1 Pump Std	Coupling Model				
		1040T	1050T	1060T	1070T	1080T
3.50	X	X	X	X		
5.00	X					X

Caution: To permit removal of T35 shaft hub without moving connected equipment, select a half spacer with dimension BE (in table 2) greater than the dimension B.

CERTIFIED POWER AT ANY SPEED

- Although UL Certified BHP ratings are shown at specific speeds, Clarke couplings can be applied at any intermediate speed. Contact Clarke or your Pump OEM representative to obtain details.

CLARKE

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3133 E. Kemper Rd., Cincinnati, Ohio 45241
United States of America
Tel +1-513-771-2200 Fax +1-513-771-0726
www.clarkefire.com

CLARKE UK, Ltd.
Grange Works, Lomond Rd., Coatbridge, ML5-2NN
United Kingdom
Tel +44-1236-429946 Fax +44-1236-427274
www.clarkefire.com

MASTER TRANSFER SWITCH FIRE PUMP CONTROLLERS

Operations & Maintenance Manual
December 2015

MASTER

Transfer Switch Fire Pump Controllers
Model MCST Controllers

UL LISTED FM APPROVED

Master Model MCST soft start controller combines a transfer switch and soft start controller into one unit in accordance with the latest edition of NFPA 20. Soft Start controllers smoothly ramp up the voltage to the motor during starting and down during stopping. The advantage of this type of starting is its smooth acceleration and deceleration of the pump, which helps to eliminate water hammer.

G4 Innovation

MCST-250-46-XG4

HMI Special Features

- Simultaneous display of 3 phase voltages and currents, System Pressure, Start/Reset, Manual/Auto, and Weekly/Monthly Testing
- Starting sequence displayed
- Setup assistant and summary screen
- Start setting with auto 10 PSI increment for reset
- Automatic weekly/monthly testing
- Transducer testing during weekly/monthly testing
- Remote alarm contact testing
- Annual testing reminder
- Service contact information displayed
- Alarm silence with auto re-sound
- Instant conversion from PSI to BAR
- Multiple password levels

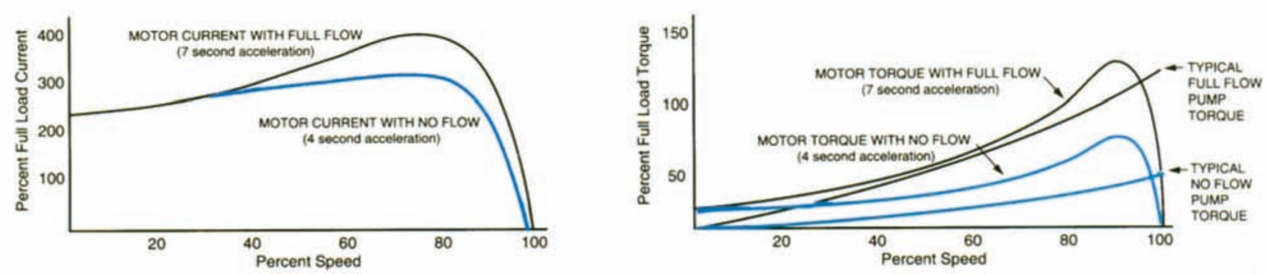
Controller Special Features

- 3.5 inch color touch screen HMI display
- Data Recorder with CSV file to USB adapter
- Waterproof USB adapter
- PhaseSmart single phase protection per NFPA 20
- 3 second restart time delay
- HMI not needed not needed for operation
- No water connections inside enclosure
- Protective bracket for external transducer
- Y-strainer to protect test valve solenoid
- 50 C ambient temperature rating

Standard Features

- NEMA type 2 enclosure
- 100,000 SCCR at 200-480 vac
- Sequence start
- Remote/Deluge start - normally closed
- Automatic stop
- Auto test valve solenoid
- High zone delayed start
- Manual, Non-automatic operation
- Lockout when approved by AHJ
- 22mm mechanical Start/Stop pushbuttons
- Manual test valve start
- Motherboard in steel chassis with latched plug-in cables
- DC circuit breaker shunt trip
- Vertically mounted IS and CB for safe separation
- Visual and audible alarms for Pump Running, AC Failure, Phase Reversal, Failure to Start, Motor Overload, Overpressure, Low Voltage, On Demand
- Voltage free remote contacts for Pump Running (2), AC Failure, Phase Reversal, System Failure, Low Zone start

Current and Torque vs. Speed for 100 HP, 3600 RPM Motor With a Soft Start Controller and 10 Second Ramp Time

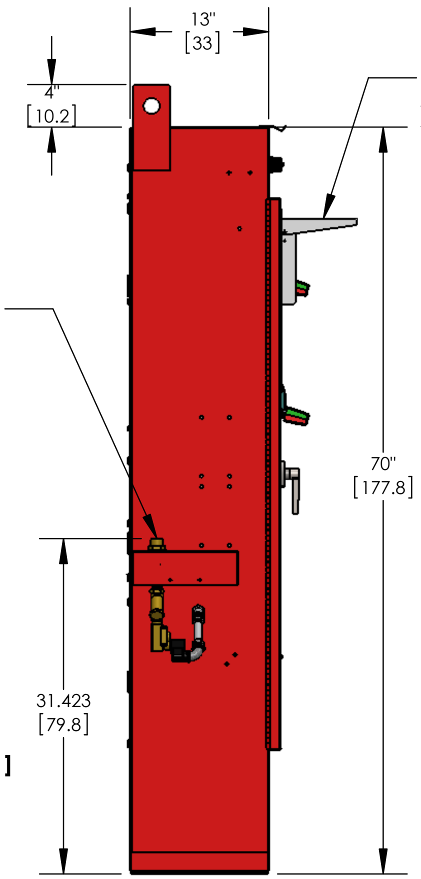


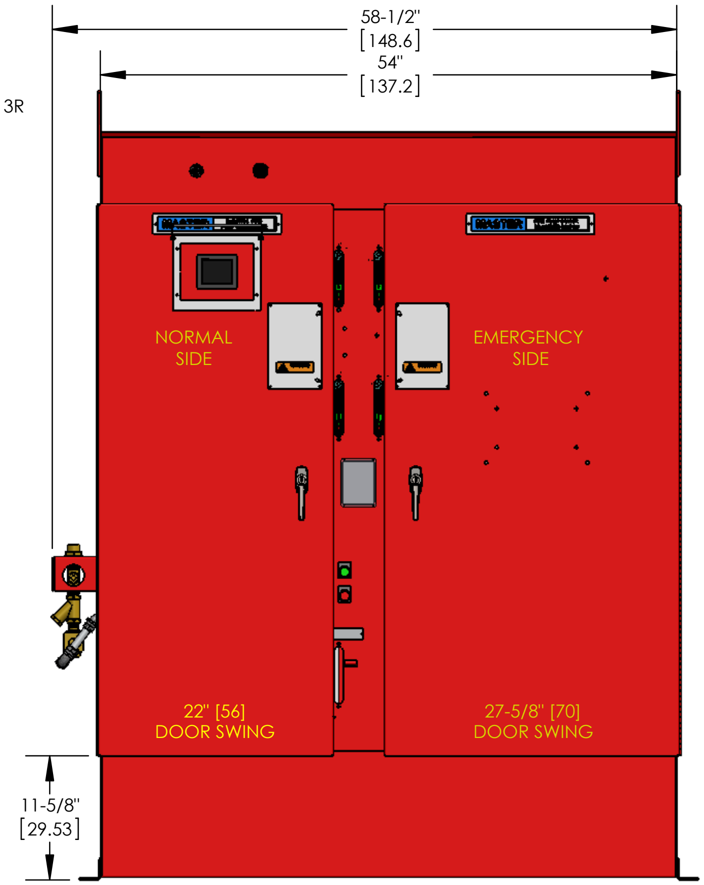
MC Transfer Switch Fire Pump Controller

MASTER

Short Circuit Current Rating	Maximum Horsepower				
	200/208	220-240	380/415	440-480	550-600
100,000A	100/125	125	200/250	250	350

FM APPROVED UL LISTED

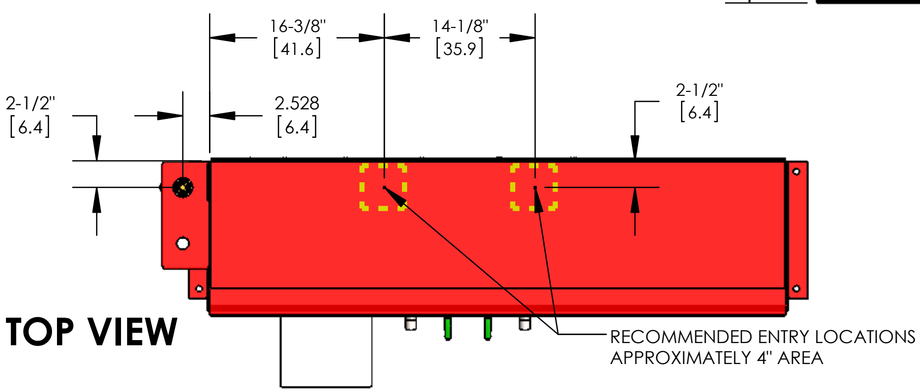




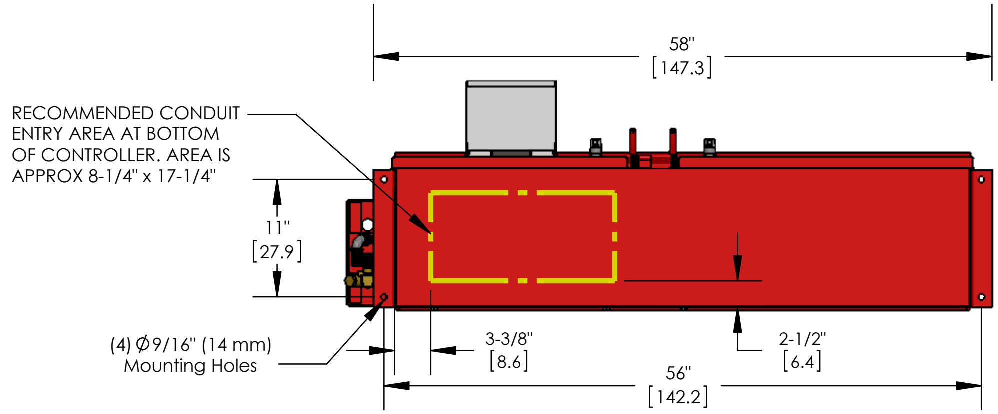
Notes:

Construction:	**NEMA Type 2, 12, 3R and 4**
Finish:	**Fire Pump Red**
Conduit Entrance:	**Conduit Entry on Top or Bottom.**
	Protect Equipment from Drilling Chips
Conduit Hubs:	**Waterproof Hubs Required for Top Entry**
Access:	**Front**
Mounting:	**Floor Mount**
Shipping Weight:	**1300 Lbs. (589.7 kg) Max.**

Dimensions In Inches and [Centimeters]



TOP VIEW



MASTER CONTROL SYSTEMS INC. **LAKE BLUFF, ILLINOIS U.S.A.**	TITLE: MODEL MC*T 70" DIMENSIONAL DRAWING - G4 - TYPE 2, 12, 3R and 4	DATE 12-2-2013 DWG. NO. 20021 REV. 5

MCST Soft Start Transfer Switch Fire Pump Controller

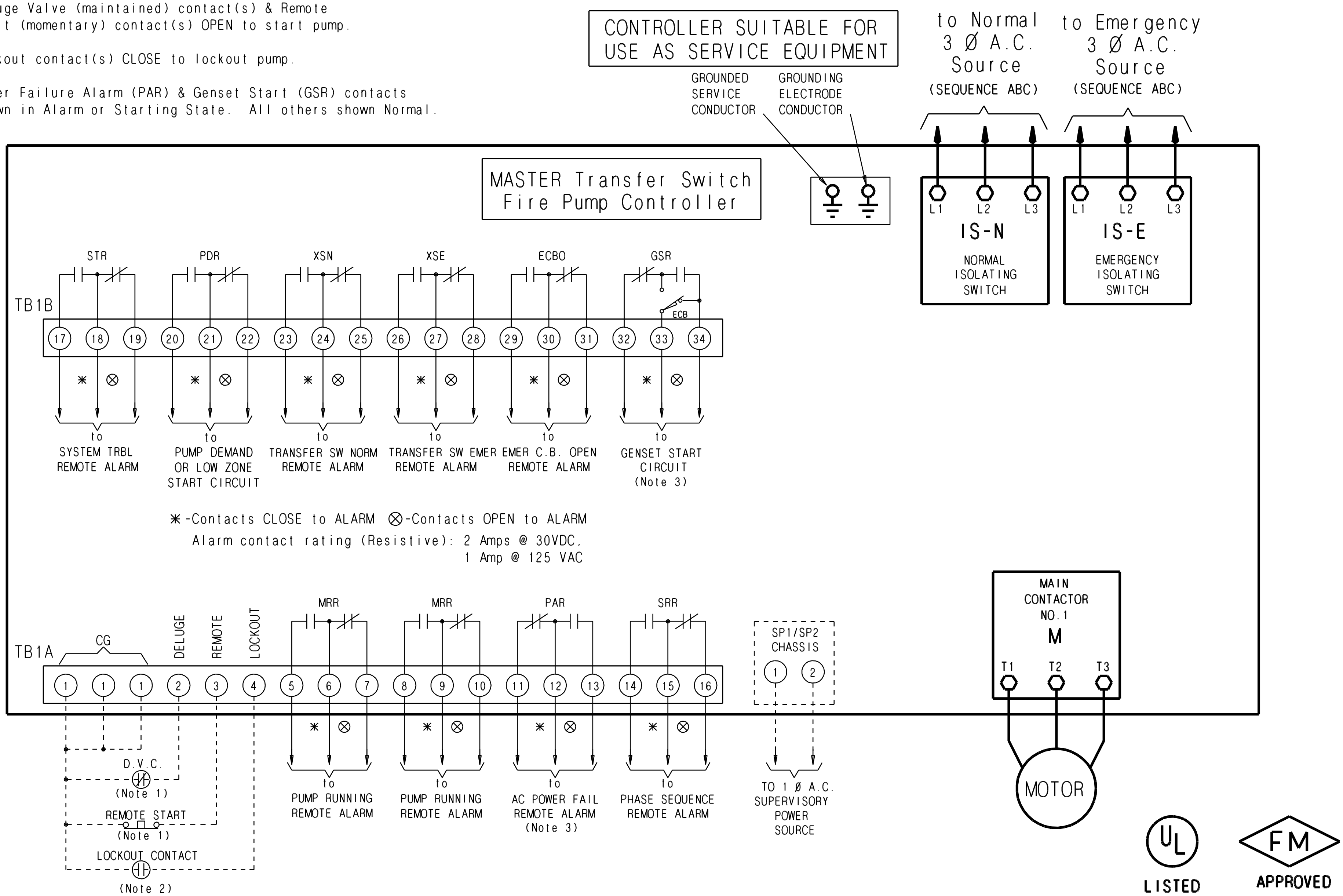
MASTER

Notes:

1) Deluge Valve (maintained) contact(s) & Remote Start (momentary) contact(s) OPEN to start pump.

2) Lockout contact(s) CLOSE to lockout pump.

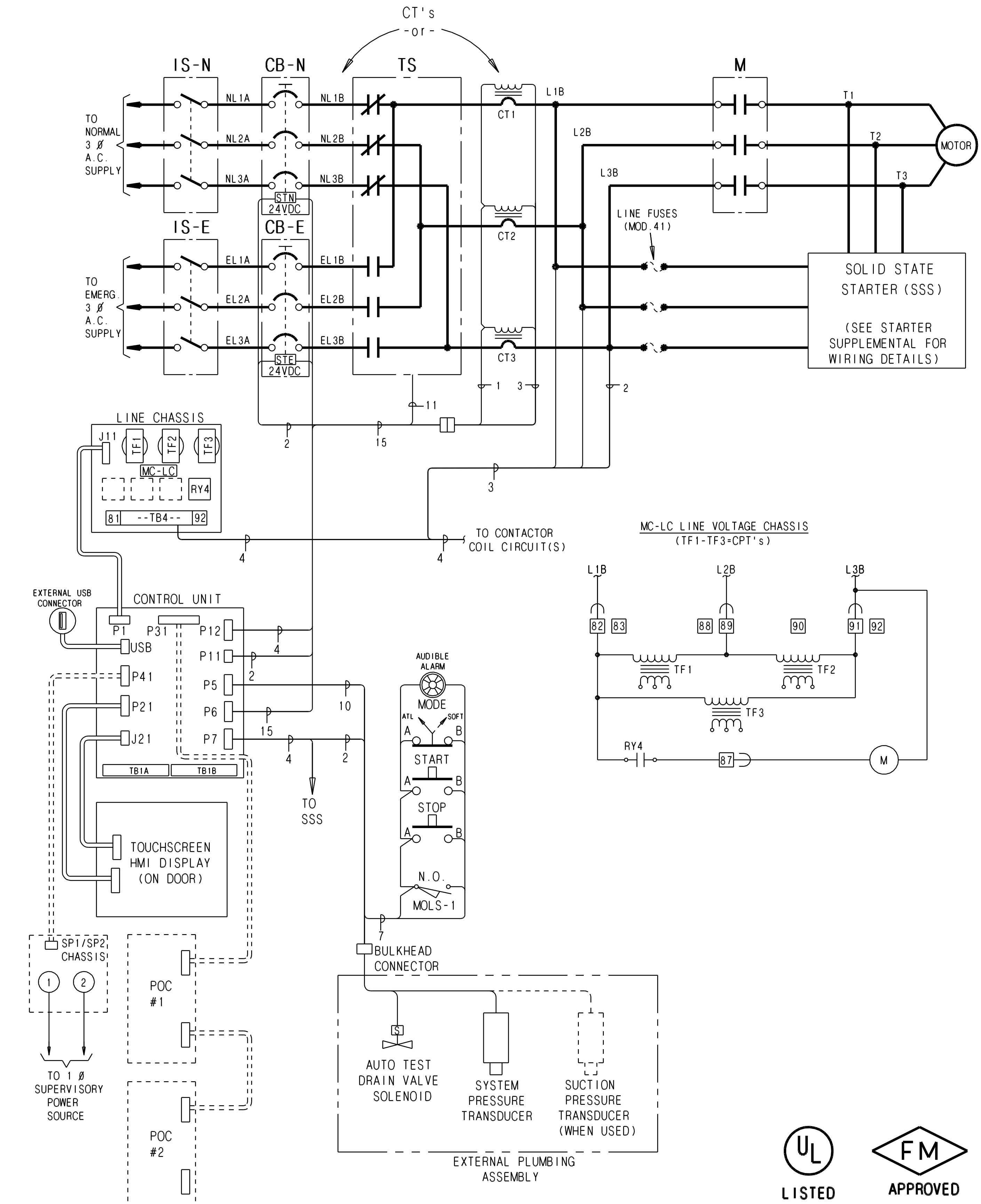
3) Power Failure Alarm (PAR) & Genset Start (GSR) contacts shown in Alarm or Starting State. All others shown Normal.



Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	MODEL MCST EXTERNAL WIRING DIAGRAM - G4	Date 10 Jan 2014
		Drawing 20117 Issue 2

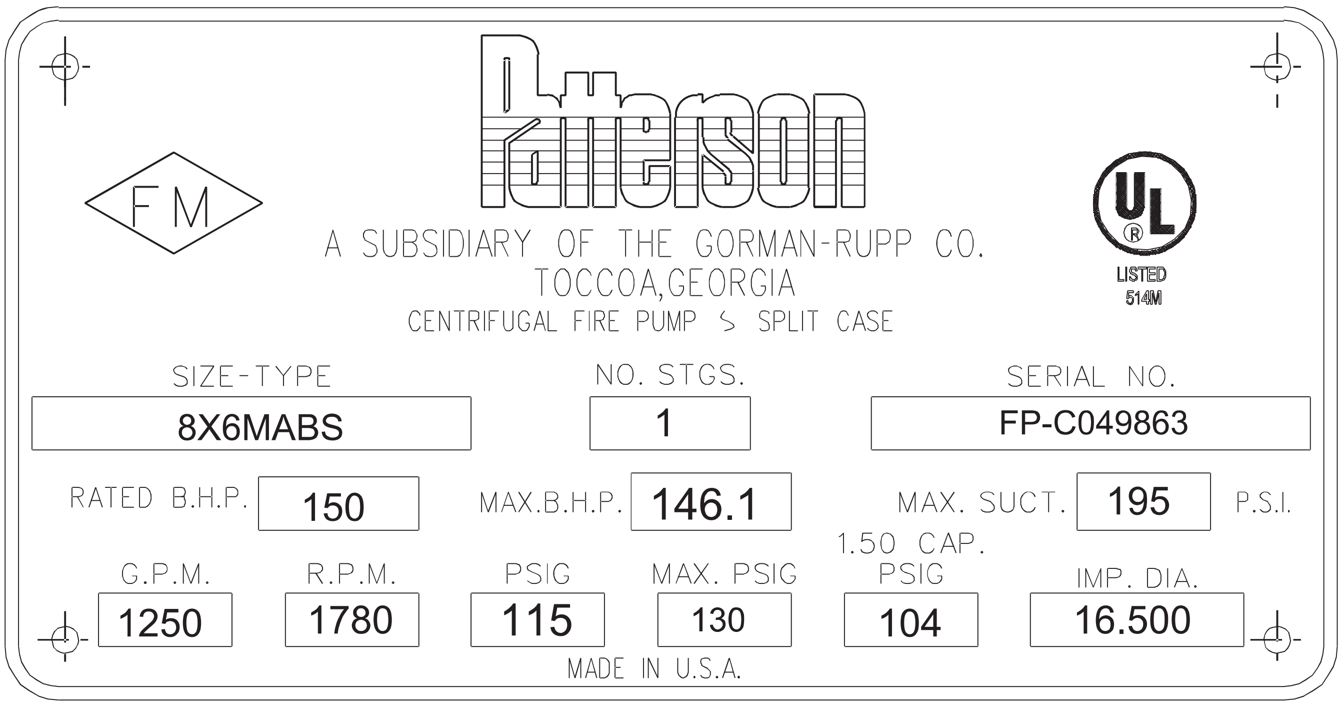
MCST Transfer Switch Fire Pump Controller

MASTER



Master Control Systems Inc. LAKE BLUFF, ILLINOIS U.S.A.	Model MCST Schematic Diagram - G4	Date 6 May 2014 Drawing 20217 Issue 3

TOLERANCES (EXCEPT AS NOTED)	REVISIONS				PATTERSON PUMP COMPANY TOCCOA, GEORGIA	CHKD. A.L.B. 7/19/78	SCALE FULL	DRWG. NO. E-11354-8
	NO.	ECN	DATE	BY		APPRVD. A.P.	DATE 6-28-78	
DECIMAL + -	8	3893	9-21-95	VC	UL/FM NAMEPLATE			
FRACTIONAL + -						MAT.	DRAWN PURCELL	PATT. NO.
ANGULAR + -						PART NO. 23001014	REF.	JOB NO.



VICTAULIC FIRELOCK FITTINGS

Operations & Maintenance Manual
December 2015

FireLock® Fittings

See Victaulic publication 10.01 for details

FireLock® products comprise a unique system specifically designed for fire protection services. FireLock full-flow elbows and tees feature CAD-developed, hydrodynamic design, affording a shorter center-to-end dimension than standard fittings. A noticeable bulge allows the water to make a smoother turn to maintain similar flow characteristics as standard full flow fittings.

FireLock fittings are designed for use exclusively with Victaulic IPS-sized couplings that have been Listed or Approved for Fire Protection Services. Use of other couplings or flange adapters may result in bolt pad interference.

Victaulic FireLock fittings pressure ratings conform to the ratings of Victaulic FireLock EZ® Style 009N/Style 009H couplings.

MATERIAL SPECIFICATIONS

Fitting: Ductile iron conforming to ASTM A-536, grade 65-45-12.

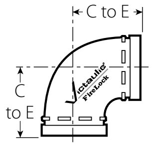
Fitting Coating:

- Orange enamel.
- Red Enamel in EMEA-I.
- **Optional:** Hot dipped galvanized.

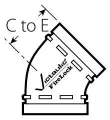
JOB/OWNER	CONTRACTOR	ENGINEER
System No. ____________	Submitted By ____________	Spec Sect ______ Para ______
Location ____________	Date ____________	Approved ____________
		Date ____________

FireLock® Fittings

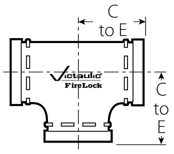
DIMENSIONS



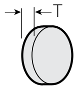
NO. 001



NO. 003



NO. 002



NO. 006

Size		No. 001 90° Elbow		No. 003 45° Elbow		No. 002 Straight Tee		No. 006 Cap	
Nominal Size Inches mm	Actual Outside Diameter Inches mm	C to E Inches mm	Approx. Weight Each Lbs. kg	C to E Inches mm	Approx. Weight Each Lbs. kg	C to E Inches mm	Approx. Weight Each Lbs. kg	Thickness "T" Inches mm	Approx. Weight Each Lbs. kg
1 ¼ 32	1.660 42.4	—	—	—	—	—	—	0.8 21	0.3 0.1
1 ½ 40	1.900 48.3	— —	— —	— —	— —	— —	— —	0.82 21	0.4 0.2
2 50	2.375 60.3	2.75 70	1.7 0.8	2.00 51	1.8 0.8	2.75 70	2.4 1.1	0.88 22	0.6 0.3
2 ½ 65	2.875 73.0	3.00 76	3.1 1.4	2.25 57	2.2 1.0	3.00 76	3.6 1.6	0.88 22	1.0 0.5
76.1 mm	3.000 76.1	3.00 76	3.30 1.5	2.25 57	2.4 1.1	—	—	—	—
3 80	3.500 88.9	3.38 86	4.0 1.8	2.50 64	3.1 1.4	3.38 86	5.3 2.4	0.88 22	1.2 0.5
108 mm	4.250 108.0	4.00 102	5.7 2.6	3.00 76	5.1 2.3	4.00 102	7.5 3.4	—	—
4 100	4.500 114.3	4.00 102	6.7 3.0	3.00 76	5.6 2.5	4.00 102	8.7 3.9	1.00 25	2.4 1.1
5 125	5.563 141.3	4.88 124	12.6 5.7	3.25 83	8.3 3.8	4.88 124	15.7 7.1	1.00 25	4.1 1.9
159 mm	6.250 158.8	5.50 140	12.6 5.7	3.50 89	9.2 4.2	5.50 140	17.9 8.0	—	—
6 150	6.625 168.3	5.50 140	18.3 8.3	3.50 89	11.7 5.3	5.50 140	22.7 10.3	1.00 25	5.9 2.7
8 200	8.625 219.1	6.81 173	25.5 11.6	4.25 108	20.4 9.3	6.94 176	38.7 17.6	1.13 29	12.7 5.8

FireLock® Fittings

FLOW DATA

Size		Frictional Resistance Equivalent Feet/meters of Straight Pipe †			
		Elbows		No. 002 Straight Tee	
Nominal Size Inches mm	Actual Outside Diameter Inches mm	No. 001 90° Elbow	No. 003 45° Elbow	Branch	Run
1 ¼ 32	1.660 42.4	— —	— —	— —	— —
1 ½ 40	1.900 48.3	— —	— —	— —	— —
2 50	2.375 60.3	3.5 1.1	1.8 0.5	8.5 2.6	3.5 1.1
2 ½ 65	2.875 73.0	4.3 1.3	2.2 0.7	10.8 3.3	4.3 1.3
76.1 mm	3.000 76.1	4.5 1.4	2.3 0.7	11.0 3.4	4.5 1.4
3 80	3.500 88.9	5.0 1.5	2.6 0.8	13.0 4.0	5.0 1.5
108 mm	4.250 108.0	6.4 2.0	3.2 0.9	15.3 4.7	6.4 2.0
4 100	4.500 114.3	6.8 2.1	3.4 1.0	16.0 4.9	6.8 2.1
5 125	5.563 141.3	8.5 2.6	4.2 1.3	21.0 6.4	8.5 2.6
159 mm	6.250 158.8	9.4 2.9	4.9 1.5	25.0 7.6	9.6 2.9
6 150	6.625 168.3	10.0 3.0	5.0 1.5	25.0 7.6	10.0 3.0
8 200	8.625 219.1	13.0 4.0	5.0 1.5	33.0 10.1	13.0 4.0

† The flow data listed is based upon the pressure drop of Schedule 40 pipe.

FireLock® Fittings

GENERAL NOTES

NOTE: When assembling FireLock EZ couplings onto end caps, take additional care to make certain the end cap is fully seated against the gasket end stop. For FireLock EZ Style 009N/009H couplings, use FireLock No. 006 end caps containing the "EZ" marking on the inside face or No. 60 end caps containing the "QV EZ" marking on the inside face. Non-Victaulic end cap products shall not be used with Style 009/009V/009H couplings.

WARRANTY

Refer to the Warranty section of the current Price List or contact Victaulic for details.

NOTE

This product shall be manufactured by Victaulic or to Victaulic specifications. All products to be installed in accordance with current Victaulic installation/assembly instructions. Victaulic reserves the right to change product specifications, designs and standard equipment without notice and without incurring obligations.

VICTAULIC GROOVED END FITTINGS

Operations & Maintenance Manual
December 2015

Grooved End Fittings

SEE VICTAULIC PUBLICATION 10.01 FOR DETAILS

Victaulic offers a broad line of fittings in sizes through 60"/1500 mm in a variety of straight and reducing styles. Most standard fittings are cast of durable ductile iron to precise tolerances. Victaulic standard fittings pressure ratings conform to the ratings of Victaulic Style 77 couplings.

All fittings are supplied with grooves to permit fast installation without field preparation. The grooved design permits flexibility for easy alignment. *These fittings are not intended for use with Victaulic couplings for plain end pipe (refer to Section 14.04 for fittings available for plain end applications).*

Fittings are provided in various materials including ductile iron, steel or segmentally welded steel depending on styles and size. Fittings are painted orange enamel with a galvanized finish available as an option, contact Victaulic for details.

Victaulic fittings are designed specifically for use in grooved piping systems. Fittings are provided grooved conforming to standard steel pipe outside diameters. When connecting wafer or lug-type butterfly valves directly to Victaulic fittings with 741 or 743 Vic-Flange® adapters, check disc clearance dimensions with I.D. dimension of fitting.

Note: The following Victaulic fittings are VdS approved: No.10 90° Elbow, No.11 45° Elbow, No.20 Tee and No.60 Cap.

Note: The following Victaulic fittings are LPCB approved: No.10 90° Elbow, No.11 45° Elbow, No.12 22 ½° Elbow, No.13 11 ¼° Elbow, No.30 45° Lateral, No.30-R Reducing Lateral, No.100 Long Radius Elbow, No.110 Long Radius Elbow, No.20 Tee, No.35 Cross, No.60 Cap, No.25 Reducing Tee, No.33 True Wye, No.50 Concentric Reducer, No.51 Eccentric Reducer and No.29M Tee with Threaded Branch.

NO. 20 TEE

NO. 10 ELBOW

AGS – ADVANCED GROOVE SYSTEM

Advanced Groove System – For 14 – 60"/350 – 1500 mm piping systems, Victaulic now offers the Advanced Groove System (AGS). Refer to Section 20.05 for AGS fitting details.

Stainless Steel – Grooved end fittings are available in Schedule 10 Type 316 stainless steel (Schedule 5, 40 and Type 304 available as an option) in various sizes. Fitting center-to-end dimensions will vary depending upon type and schedule. Refer to Section 17.04 and 17.16 for details.

Aluminum – Grooved end fittings are available in aluminum alloy 356 T6, in sizes from 1 – 8"/25 – 200 mm. Refer to Section 21.03 or contact Victaulic for details.

Fabricated Steel – A full range of fabricated segemtnally welded steel or full flow grooved end fittings are available refer to section 07.04.

Fabricated Steel with AGS Vic-Rings – A full range of full flow fabricated fittings with Vic-Rings are also available.

ALTERNATE STYLES

Extra Heavy EndSeal® "ES" Fittings – EndSeal fittings are available in 2 – 12"/50 – 300 mm for use with "ES" grooved pipe and HP-70ES EndSeal couplings. "ES" fittings are painted black for easy identification. EndSeal (and standard) fittings may be easily internally coated (by others) for severe service requirements. Always specify "ES EndSeal fittings" when ordering. See Section 07.03 for information on EndSeal fittings.

Fittings Machined for Rubber or Urethane Lining (MRL) – For severe abrasive services, Victaulic fittings may be rubber or urethane lined (by others). Lining may be inside diameter/end (abrasion resistance) or wrap-around (corrosion and/or abrasion) machined. Refer to Section 25.03 or contact Victaulic for specific details.

Note: Fittings are available with a variety of coatings upon request such as hot dip galvanized, epoxy, glass lined and others.

JOB/OWNER	CONTRACTOR	ENGINEER
System No. ______	Submitted By ______	Spec Sect ______ Para ______
Location ______	Date ______	Approved ______
		Date ______

www.victaulic.com

Grooved End Fittings

MATERIAL SPECIFICATIONS

Fitting: Ductile iron conforming to ASTM A-536, grade 65-45-12. Ductile iron conforming to ASTM A-395, grade 65-45-15, is available upon special request.

- **Or**: Segmentally welded steel as shown under nipples

Nipples: (adapter, swaged & hose)

- ¾ – 4"/20 – 100 mm: Carbon steel, Schedule 40, conforming to ASTM A-53, Type F
- 5 – 6"/125 – 150 mm: Carbon steel, Schedule 40, conforming to ASTM A-53, Type E or S, Gr. B
- 8 – 12"/200 – 300 mm: Carbon steel, Schedule 30 or 40, conforming to ASTM A-53, Type E or S, Gr. B

Flanged Adapter Nipples: (Nipple – see above)

- Class 125 Flange: Cast iron conforming to ANSI B-16.1
- Class 150 Flange: Carbon steel conforming to ANSI B-16.5, raised or flat face
- Class 300 Flange: Carbon steel conforming to ANSI B-16.5, raised or flat face

Fitting Coatings: Orange enamel

- **Optional**: Hot dip galvanized and others. Some fittings supplied electroplated as standard – see product specifications.

Flanged Adapter Nipple Coating: None (Unfinished)

- **Optional**: Orange enamel, hot dip galvanized and others.

Grooved End Fittings

FLOW DATA

(Frictional Resistance)

The chart expresses the frictional resistance of various Victaulic fittings as equivalent feet of straight pipe. Fittings not listed can be estimated from the data given, for example, a 22½° elbow is approximately one-half the resistance of a 45° elbow. Values of mid-sizes can be interpolated.

Size		Dimension – Feet/meters					
		Elbows				Tees	
		90° Elbows		45° Elbows			
Nominal Size In./mm	Actual Outside Dia. In./mm	No. 10 Std. Radius	No. 100 1 ½ D Long Radius	No. 11 Std. Radius	No. 110 1 ½ D Long Radius	Branch	Run
1 25	1.315 33.7	1.7 0.5	—	0.8 0.2	—	4.2 1.3	1.7 0.5
2 50	2.375 60.3	3.5 1.1	2.5 0.8	1.8 0.5	1.1 0.3	8.5 2.6	3.5 1.1
76.1 mm	3.000 76.1	4.3 1.3	—	2.1 0.7	—	10.8 3.3	4.3 1.3
3 80	3.500 88.9	5.0 1.5	3.8 1.2	2.6 0.8	1.6 0.5	13.0 4.0	5.0 1.5
108.0 mm	4.250 108.0	6.4 2.0	—	3.2 0.9	—	15.3 4.7	6.4 2.0
4 100	4.500 114.3	6.8 2.1	5.0 1.5	3.4 1.0	2.1 0.6	16.0 4.9	6.8 2.1
133.0 mm	5.250 133.0	8.1 2.5	—	4.1 1.2	—	20.0 6.2	8.1 2.5
139.7 mm	5.500 139.7	8.5 2.6	—	4.2 1.3	—	21.0 6.4	8.5 2.6
5 125	5.563 141.3	8.5 2.6	—	4.2 1.3	—	21.0 6.4	8.5 2.6
159.0 mm	6.250 159.0	9.4 2.9	—	4.9 1.5	—	25.0 7.6	9.6 2.9
165.1 mm	6.500 165.1	9.6 2.9	—	5.0 1.5	—	25.0 7.6	10.0 3.0
6 150	6.625 168.3	10.0 3.0	7.5 2.3	5.0 1.5	3.0 0.9	25.0 7.6	10.0 3.0
8 200	8.625 219.1	13.0 4.0	9.8 3.0	6.5 2.0	4.0 1.2	33.0 10.1	13.0 4.0
10 250	10.750 273.0	17.0 5.2	12.0 3.7	8.3 2.5	5.0 1.5	41.0 12.5	17.0 5.2
12 300	12.750 323.9	20.0 6.1	14.5 4.4	10.0 3.0	6.0 1.8	50.0 15.2	20.0 6.1
14 350	14.000 355.6	24.5 § 7.5	15.8 4.8	18.5 § 5.6	11.0 3.4	70.0 21.3	23.0 7.0
16 400	16.000 406.4	28.0 § 8.5	18.0 5.5	21.0 § 6.4	13.0 4.0	80.0 24.4	27.0 8.2
18 450	18.000 457.0	31.0 § 9.5	20.0 6.1	23.5 § 7.2	14.0 4.3	90.0 27.4	30.0 9.1
20 800	20.000 508.0	34.0 § 10.4	22.5 6.9	25.5 § 7.8	16.0 4.9	100.0 30.5	33.0 10.1
24 600	24.000 610.0	42.0 § 12.8	27.0 8.2	29.5 § 9.0	19.0 5.8	120.0 36.6	40.0 12.2
Fittings available up to 60"/1500 mm. Contact Victaulic for details.							

Contact Victaulic for details.

For roll grooved systems, Victaulic offers the Advanced Groove System (AGS). For pricing and availability of cut groove fittings in this size, contact your nearest Victaulic sales office.

§ Fitting flow data for 14-24"/350-600 mm size No. 10 and No. 11 Elbows is based on fittings for Style 07 and 77 couplings. For flow data on AGS fittings (No. W10 and No. W11 Elbows), refer to submittal 20.05.

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".

S= Carbon Steel Direct Roll Groove (OGS)

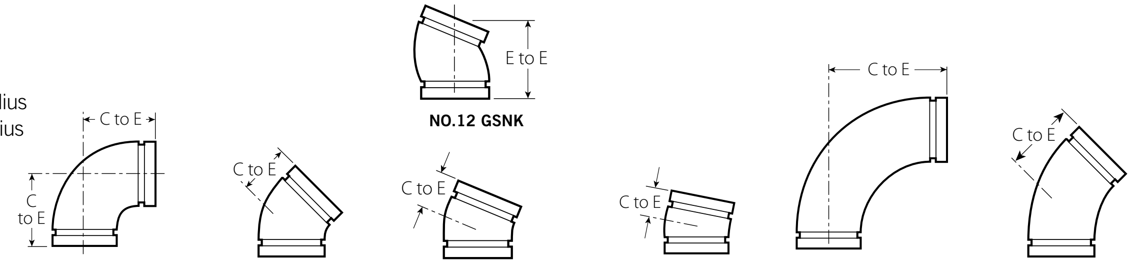
SW= Carbon Steel Segmentally Welded

Grooved End Fittings

DIMENSIONS

Elbows

NO. 10 90° Elbow
NO. 11 45° Elbow
NO. 12 22½° Elbow
NO. 13 11¼° Elbow
NO. 100 90° Long Radius
NO. 110 45° Long Radius



NO. 10 | NO. 11 | NO. 12 | NO. 13 | NO. 100 | NO. 110

Size		No. 10 90° Elbow		No. 11 45° Elbow		No. 12 22½° Elbow		No. 13 11¼° Elbow		No. 100† 90° Long Radius Elbow (S)		No. 110† 45° Long Radius Elbow (S)	
Nominal Size Inches mm	Actual Outside Dia. Inches mm	C to E Inches mm	Approx. Wgt. Each Lbs. kg	C to E Inches mm	Approx. Wgt. Each Lbs. kg	C to E Inches mm	Approx. Wgt. Each Lbs. kg	C to E Inches mm	Approx. Wgt. Each Lbs. kg	C to E Inches mm	Approx. Wgt. Each Lbs. kg	C to E Inches mm	Approx. Wgt. Each Lbs. kg
¾ 20	1.050 26.9	2.25 57	0.5 0.2	1.50 38	0.5 0.2	1.63 sw 41	—	1.38sw 35	—	2.50 sw 64	0.4 0.2	1.81 sw 46	0.3 0.1
1 25	1.315 33.7	2.25 57	0.6 0.3	1.75 44	0.6 0.3	3.25 83	0.6 0.3	1.38sw 35	0.3 0.1	2.88 sw 73	0.6 0.3	2.25 sw 57	0.5 0.2
1 ¼ 32	1.660 42.4	2.75 70	1.0 0.5	1.75 44	0.9 0.4	1.75 44	0.8 0.4	1.38sw 35	0.5 0.2	3.25 sw 83	1.1 0.5	2.38 sw 60	0.7 0.3
1 ½ 40	1.900 48.3	2.75 70	1.2 0.5	1.75 44	0.9 0.4	1.75 44	0.8 0.4	1.38sw 35	0.5 0.2	3.63 sw 92	2.2 1.0	2.50 sw 64	1.3 0.6
2 50	2.375 60.3	3.25 83	1.8 0.8	2.00 51	1.3 0.6	3.75 @ 95	1.4 0.6	1.38 35	1.0 0.5	4.38 111	2.5 1.1	2.75 70	1.8 0.8
2 ½ 65	2.875 73.0	3.75 95	3.2 1.5	2.25 57	2.2 1.0	4.00 @ 102	2.3 1.0	1.50 38	1.1 0.5	5.13 130	3.4 1.5	3.00 76	2.8 1.3
76.1 mm	3.000 76.1	3.75 95	3.7 1.7	2.25 57	3.4 1.5	2.24 57	—	1.50 38	—	—	—	—	—
3 80	3.500 88.9	4.25 108	4.5 2.0	2.50 64	3.1 1.4	4.50 @ 114	3.1 1.4	1.50 38	2.1 1.0	5.88 149	6.0 2.7	3.38 86	4.9 2.2
3 ½ 90	4.000 101.6	4.50 114	5.6 2.5	2.75 70	4.3 2.0	2.50 sw 64	4.0 1.8	1.75sw 44	2.7 1.2	—	—	—	—
4 100	4.500 114.3	5.00 127	7.1 3.2	3.00 76	5.6 2.5	2.88 73	5.6 2.5	1.75 44	3.6 1.6	7.50 191	12.3 5.6	4.00 102	7.3 3.3
108.0 mm	4.250 108.0	5.00 127	11.0 5.0	3.00 76	5.6 2.5	—	—	—	—	—	—	—	—
4 ½ 120	5.000 127.0	5.25 sw 133	10.0 4.5	3.13 sw 79	6.0 2.7	3.50 sw 89	6.6 3.0	1.88sw 48	4.2 1.9	—	—	—	—
5 125	5.563 141.3	5.50 140	11.7 5.3	3.25 83	8.3 3.8	2.88sw 73	7.8 3.5	2.00sw 51	5.0 2.2	9.25 sw 235	18.2 8.3	4.88 sw 124	14.8 6.7
133.0 mm	5.250 133.0	5.50 140	11.7 5.3	3.25 83	8.3 3.8	—	—	—	—	—	—	—	—
139.7 mm	5.500 139.7	5.50 140	11.7 5.3	3.25 83	8.3 3.8	2.87 73	—	2.00 51	—	—	—	—	—
6 150	6.625 168.3	6.50 165	17.2 7.8	3.50 89	10.8 4.9	6.25 @ 159	12.2 5.5	2.00 51	7.0 3.2	10.75 273	30.4 13.8	5.50 140	17.4 7.9
159.0 mm	6.250 159.0	6.50 165	18.6 8.4	3.50 89	10.8 4.9	—	—	—	—	—	—	—	—
165.1 mm	6.500 165.1	6.50 165	15.5 7.0	3.50 89	9.8 4.4	3.13 79	11.4 5.2	2.00 51	7.4 3.4	10.75sw 273	29.0 13.2	5.50sw 140	19.0 8.6

@ Gooseneck design, end-to-end dimension fittings in this size, contact your nearest Victaulic sales office.

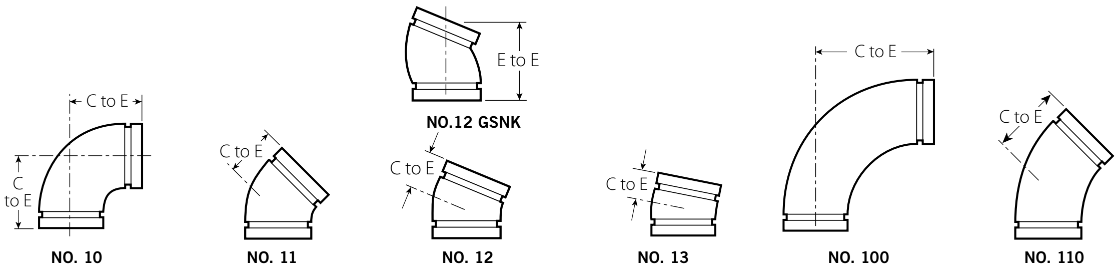
† Chinese standard sizes

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".

S= Carbon Steel Direct Roll Groove (OGS)

SW= Carbon Steel Segmentally Welded

Grooved End Fittings



Size		No. 10 90° Elbow		No. 11 45° Elbow		No. 12 22½° Elbow		No. 13 11¼° Elbow		No. 100† 90° Long Radius Elbow (S)		No. 110† 45° Long Radius Elbow (S)	
Nominal Size Inches mm	Actual Outside Dia. Inches mm	C to E Inches mm	Approx. Wgt. Each Lbs. kg	C to E Inches mm	Approx. Wgt. Each Lbs. kg	C to E Inches mm	Approx. Wgt. Each Lbs. kg	C to E Inches mm	Approx. Wgt. Each Lbs. kg	C to E Inches mm	Approx. Wgt. Each Lbs. kg	C to E Inches mm	Approx. Wgt. Each Lbs. kg
8 200	8.625 219.1	7.75 197	29.9 13.6	4.25 108	20.4 9.3	7.75 @ 197	20.0 9.1	2.00 51	10.1 4.6	14.25 362	66.0 30.0	7.25 184	36.0 16.3
10 250	10.750 273.0	9.00 229	63.3 28.7	4.75 121	37.5 17.0	4.38sw 111	30.0 13.6	2.13 54	11.8 5.3	15.00 381	107.0 48.5	6.25 159	57.0 25.9
12 300	12.750 323.9	10.00 254	74.0 33.6	5.25 133	66.7 30.3	4.88sw 124	40.0 18.1	2.25 57	29.3 13.3	18.00 457	156.0 70.8	7.50 191	90.0 40.8
14 # 350	14.000 355.6	14.00 355.6	136.0 61.7	5.75 146	65.0 29.5	5.00sw 127	46.0 20.9	3.50sw 89	32.0 14.5	21.00 s 533	164.0 74.4	8.75 s 222	82.0 37.2
377.0 mm †	14.843 377.0	14.84 376.9	149.3 67.7	6.15 156.2	82.0 37.2	—	—	—	—	—	—	—	—
16 # 400	16.000 406.4	16.00 406.4	171.0 77.6	6.63 168	88.0 39.9	5.00sw 127	58.0 26.3	4.00sw 102	42.0 19.1	24.00 s 610	210.0 95.3	10.00 s 254	100.0 45.4
426.0 mm †	16.772 426.0	16.77 426.0	198.6 90.1	6.95 176.5	101.3 45.9	—	—	—	—	—	—	—	—
18 # 450	18.000 457.0	18.00 457.2	228.0 103.4	7.46 189	108.0 50.0	5.50sw 140	65.0 29.5	4.50sw 114	53.2 24.1	27.00 s 686	273.0 123.8	11.25 s 286	135.0 61.2
480.0 mm †	18.898 480.0	18.90 480.0	291.0 132.0	7.83 198.8	141.7 64.3	—	—	—	—	—	—	—	—
20 # 500	20.000 508.0	20.00 508.0	298.0 135.2	8.28 210	138.0 62.6	6.00sw 152	78.6 36.0	5.00sw 127	65.0 29.5	30.00 s 762	343.0 155.6	12.50 s 318	174.0 78.9
530.0 mm †	20.866 530.0	20.87 530.0	355.0 161.0	8.64 219.4	179.0 81.2	—	—	—	—	—	—	—	—
24 # 600	24.000 610.0	24.00 609.6	438.0 198.7	9.94 252	221.0 100.2	7.00sw 178	140.0 63.5	6.00sw 152	60.0 27.2	36.00 s 914	516.0 234.1	15.00 s 381	251.0 113.9
630.0 mm †	24.803 630.0	24.80 630.0	545.0 247.2	10.27 261.0	255.2 115.7	—	—	—	—	—	—	—	—
14 – 60" 350 – 1500 mm	AGS™ For AGS fitting information, see publication 20.05												

@ Gooseneck design (GSNK), end-to-end dimension fittings in this size, contact your nearest Victaulic sales office.

For roll grooved systems, Victaulic offers the Advanced Groove System (AGS). For pricing and availability of cut groove fittings in this size, contact your nearest Victaulic sales office.

† Chinese standard sizes

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".

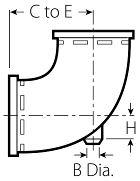
S= Carbon Steel Direct Roll Groove (OGS)

SW= Carbon Steel Segmentally Welded

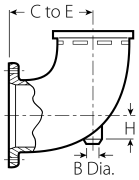
Grooved End Fittings

Reducing Base Support Elbow

NO. R-10G Grv. × Grv.
NO. R-10F Grv. × Flange



NO. R-10G



NO. R-10F

Size		No. R-10 Reducing Base Support Elbow			Approx. Weight Each	
Nominal Size Inches mm		C to E Inches mm	H Inches mm	B Diameter Inches mm	Grv. × Grv. Lbs. kg	Grv. × Flange Lbs. kg
6 150 ×	4 100	9.00 229	1.25 32	1.50 38	19.0 8.6	33.0 15.0
	5 125	9.00 229	1.50 38	1.50 38	23.0 10.4	38.0 17.2
8 200 ×	6 150	10.50 267	2.13 54	1.50 38	33.0 15.0	52.0 23.6
10 250 ×	8 200	12.00 305	2.40 61	1.50 38	61.0 27.7	88.0 39.9

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".
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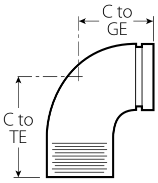
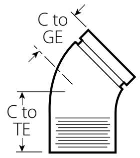
Grooved End Fittings

Adapter Elbow

NO. 18 90° Adapter Elbow
NO. 19 45° Adapter Elbow



NO. 18



NO. 19

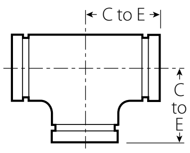
Size		No. 18 90° Adapter Elbow @			No. 19 45° Adapter Elbow @		
Nominal Size Inches mm	Actual Outside Diameter Inches mm	C to GE Inches mm	C to TE Inches mm	Approx. Weight Each Lbs. kg	C to GE Inches mm	C to TE Inches mm	Approx. Weight Each Lbs. kg
¾ 20	1.050 26.9	2.25 57	2.25 57	0.5 0.2	1.50 38	1.50 38	0.5 0.2
1 25	1.315 33.7	2.25 57	2.25 57	0.5 0.2	—	—	—
1 ¼ 32	1.660 42.4	2.75 70	2.75 70	0.9 0.4	—	—	—
1 ½ 40	1.900 48.3	2.75 70	2.75 70	1.1 0.5	1.75 44	1.75 44	0.9 0.4
2 50	2.375 60.3	3.25 83	4.25 108	2.5 1.1	—	—	—
2 ½ 65	2.875 73.0	3.75 95	3.75 95	3.0 1.4	2.25 57	2.25 57	2.3 1.0
3 80	3.500 88.9	4.25 108	6.00 152	5.8 2.6	2.50 64	4.25 108	5.0 2.3
3 ½ 90	4.000 101.6	4.50 114	6.25 159	8.0 3.6	5.25 133	5.25 133	8.8 4.0
6 150	6.625 168.3	6.50 165	6.50 165	17.6 8.0	3.50 89	3.50 89	12.7 5.8

@ Available with British Standard Pipe Threads· specify "BSP" clearly on order·
Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s"·
S= Carbon Steel Direct Roll Groove (OGS)
SW= Carbon Steel Segmentally Welded

Grooved End Fittings

Tees, Crosses and True Wyes

NO. 20 Tee
NO. 35 Cross
NO. 33 True Wye
NO. 29M Tee with Threaded Branch



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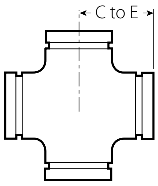

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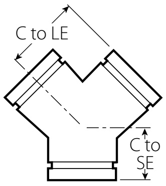

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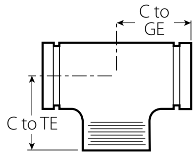


NO. 29M

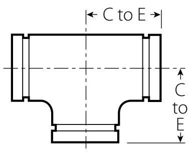
Size		No. 20 Tee		No. 35 Cross (sw)		No. 33 True Wye (sw)			No. 29M Tee with Threaded Branch		
Nominal Size Inches mm	Actual Outside Dia. Inches mm	C to E Inches mm	Approx. Weight Each Lbs. kg	C to E Inches mm	Approx. Weight Each Lbs. kg	C to LE Inches mm	C to SE Inches mm	Approx. Weight Each Lbs. kg	C to GE Inches mm	C to TE Inches mm	Approx. Weight Each Lbs. kg
¾ 20	1.050 26.9	2.25 57	0.6 0.3	2.25 57	0.9 0.4	2.25 57	2.00 51	0.7 0.3	2.25 57	2.25 sw 57	0.6 0.3
1 25	1.315 33.7	2.25 57	1.0 0.5	2.25 57	1.3 0.6	2.25 57	2.25 57	1.1 0.5	2.25 57	2.25 57	1.0 0.5
1¼ 32	1.660 42.4	2.75 70	1.5 0.7	2.75 70	2.1 1.0	2.75 70	2.50 64	1.5 0.7	2.75 70	2.75 70	1.5 0.7
1½ 40	1.900 48.3	2.75 70	2.0 0.9	2.75 70	2.5 1.1	2.75 70	2.75 70	1.8 0.8	2.75 70	2.75 70	2.0 0.9
2 50	2.375 60.3	3.25 83	3.0 1.4	3.25 83	3.8 1.7	3.25 83	2.75 70	2.5 1.1	3.25 83	4.25 108	3.00 1.4
2½ 65	2.875 73.0	3.75 95	4.3 2.0	3.75 95	6.1 2.8	3.75 95	3.00 76	4.3 2.0	3.75 95	3.75 95	4.3 2.0
76.1 mm	3.000 76.1	3.75 95	5.2 2.4	—	—	—	—	—	3.75 95	3.75 sw 95	5.2 2.4
3 80	3.500 88.9	4.25 108	6.8 3.0	4.25 108	10.5 4.8	4.25 108	3.25 83	6.1 2.8	4.25 108	6.00 152	6.8 3.1
3½ 90	4.000 101.6	4.50 sw 114	7.9 3.6	4.50 114	11.5 5.2	4.50 114	3.50 89	9.6 4.4	4.50 114	4.50 sw 114	7.9 73.6
108.0 mm	4.250 108.0	5.00 127	15.5 7.0	—	—	—	—	—	5.00 127	5.00 sw 127	15.5 7.0
4 100	4.500 114.3	5.00 127	11.9 5.4	5.00 127	15.8 7.2	5.00 127	3.75 95	10.0 4.5	5.00 127	7.25 184	11.9 5.4
4½ 120	5.000 127.0	5.25 sw 133	15.0 6.8	5.25 133	18.5 8.4	—	—	—	5.25 133	5.25 sw 133	15.0 6.8
133.0 mm	5.250 133.0	5.50 140	17.8 8.1	—	—	—	—	—	5.50 140	5.50 sw 140	17.8 8.1
139.7 mm	5.500 139.7	5.50 140	17.8 8.1	—	—	—	—	—	5.50 140	5.50 sw 140	17.8 8.1
5 125	5.563 141.3	5.50 140	17.8 8.1	5.50 140	20.0 9.1	5.50 140	4.00 102	15.0 6.8	5.50 140	5.50 sw 140	17.8 8.1
159.0 mm	6.250 159.0	6.50 165	27.1 12.3	—	—	—	—	—	6.50 165	6.50 sw 165	27.1 12.3
165.1 mm	6.500 165.1	6.50 165	22.0 10.0	6.50 165	28.0 12.7	—	—	—	6.50 165	6.50 sw 165	22.0 10.0
6 150	6.625 168.3	6.50 165	25.7 11.7	6.50 165	28.0 12.7	6.50 165	4.50 114	22.3 10.1	6.50 165	6.50 sw 165	25.7 11.7
8 200	8.625 219.1	7.75 197	47.6 21.6	7.75 197	48.0 21.8	7.75 197	6.00 152	36.0 16.3	7.75 197	7.75 sw 197	47.6 21.6
10 250	10.750 273.0	9.00 229	99.0 44.9	9.00 229	121.5 55.1	9.00 229	6.50 155	69.9 31.7	9.00 229	9.00 sw 229	73.0 33.1
12 300	12.750 323.9	10.00 254	133.0 60.3	10.00 254	110.0 49.9	10.00 254	7.00 178	80.0 36.3	10.00 254	10.00 sw 254	99.0 44.9

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".
S= Carbon Steel Direct Roll Groove (OGS)
SW= Carbon Steel Segmentally Welded

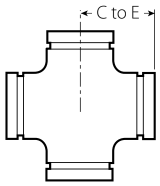
Grooved End Fittings

Tees, Crosses and True Wyes

NO. 20 Tee
NO. 35 Cross
NO. 33 True Wye
NO. 29M Tee with Threaded Branch



NO. 20



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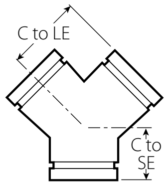

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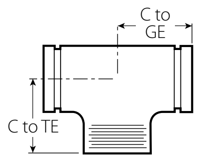


NO. 29M

Size		No. 20 Tee		No. 35 Cross (sw)		No. 33 True Wye (sw)			No. 29M Tee with Threaded Branch (sw)		
Nominal Size Inches mm	Actual Outside Dia. Inches mm	C to E Inches mm	Approx. Weight Each Lbs. kg	C to E Inches mm	Approx. Weight Each Lbs. kg	C to LE Inches mm	C to SE Inches mm	Approx. Weight Each Lbs. kg	C to GE Inches mm	C to TE Inches mm	Approx. Weight Each Lbs. kg
14 # 350	14.000 355.6	11.00 sw 279	145.0 65.8	11.00 279	198.0 89.8	11.00 279	7.50 191	134.2 60.8	11.00 sw 279	11.00 279	145.0 65.8
377.0 mm	14.000 355.6	11.50 292	145.0 65.8	—	—	—	—	—	—	—	—
16 # 400	16.000 406.4	12.00 sw 305	186.0 84.4	12.00 305	250.0 113.4	12.00 305	8.00 203	167.0 75.7	12.00 sw 305	12.00 305	186.0 84.4
426.0 mm †	16.000 406.4	13.00 300	186.0 84.4	—	—	—	—	—	—	—	—
18 # 450	18.000 457.0	15.50 sw 394	260.0 117.9	15.50 394	350.0 158.8	15.50 394	8.50 216	234.0 106.1	15.50 sw 394	15.50 394	117.9
480.0 mm†	18.000 457.0	14.57 370	256.0 116.1	—	—	—	—	—	—	—	—
20 # 500	20.000 508.0	17.25 sw 438	336.0 152.4	17.25 438	452.0 205.0	17.25 438	9.00 229	281.0 127.5	17.25 sw 438	17.25 438	336.0 152.4
530.0 mm †	20.000 508.0	15.39 sw 391	339.0 153.8	—	—	—	—	—	—	—	—
24 # 600	24.000 610.0	20.00 sw 508	592.0 268.5	20.00 508	795.0 360.6	20.00 508	10.00 254	523.0 237.2	20.00 sw 508	20.00 508	592.0 268.5
630.0 mm †	24.000 610.0	17.37 sw 441	473.0 214.5	—	—	—	—	—	—	—	—
14 – 60" 350 – 1500 mm	AGS™ For AGS fitting information, see publication 20.05										

For roll grooved systems, Victaulic offers the Advanced Groove System (AGS). For pricing and availability of cut groove fittings in this size, contact your nearest Victaulic sales office.

† Chinese standard sizes

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".

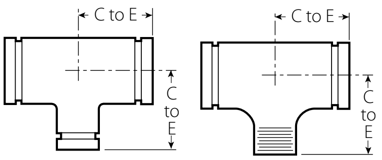
S= Carbon Steel Direct Roll Groove (OGS)

SW= Carbon Steel Segmentally Welded

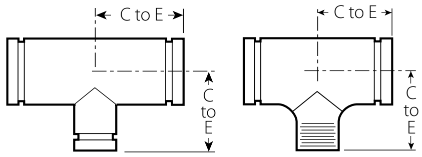
Grooved End Fittings

Reducing Tee

NO. 25 Grooved Branch
NO. 29T Threaded Branch



NO. 25 NO. 29T



NO. 25-SW NO. 29T-SW

Size Nominal Size Inches mm	No. 25 Std. C to E Inches mm	No. 29T w/ Thd. Branch C to E Inches mm	Approx. Weight Each Lbs. kg
1 × 1 × ¾ 25 × 25 × 20	2.25 sw 57	2.24 sw 57	1.0 0.5
1 ¼ × 1 ¼ × 1 32 × 32 × 25	2.75 sw 70	2.75 sw 70	1.3 0.6
1 ½ × 1 ½ × ¾ 40 × 40 × 20	2.75 sw 70	2.75 sw 70	1.5 0.7
1 25	2.75 sw 70	2.75 sw 70	1.5 0.7
1 ¼ 32	2.75 sw 70	2.75 sw 70	1.7 0.8
2 × 2 × ¾ 50 × 50 × 20	3.25 83	3.25 83	2.5 1.1
1 25	3.25 83	3.25 83	2.7 1.2
1 ¼ 32	3.25 sw 83	3.25 sw 83	1.8 0.8
1 ½ 40	3.25 83	3.25 sw 83	3.0 1.4
2 ½ × 2 ½ × ¾ 65 × 65 × 20	3.75 sw 95	3.75 sw 95	3.9 1.8
1 25	3.75 95	3.75 sw 95	3.8 1.7
1 ¼ 32	3.75 sw 95	3.75 sw 95	4.2 1.7
1 ½ 40	3.75 95	3.75 95	3.9 1.8
2 50	3.75 95	3.75 sw 95	4.5 2.0
3 × 3 × ¾ 80 × 80 × 20	4.25 sw 108	4.25 sw 108	5.7 2.6
1 25	4.25 108	4.25 108	6.1 2.8
1 ¼ 32	4.25 sw 108	4.25 sw 108	8.0 3.6
1 ½ 40	4.25 108	4.25 sw 108	6.5 2.9
2 50	4.25 108	4.25 sw 108	6.2 2.8
2 ½ 65	4.25 108	4.25 sw 108	6.4 2.9
4 × 4 × ¾ 100 × 100 × 20	5.00 sw 127	5.00 sw 127	8.0 3.6
1 25	5.00 127	5.00 127	7.8 3.5

Size Nominal Size Inches mm	No. 25 Std. C to E Inches mm	No. 29T w/ Thd. Branch C to E Inches mm	Approx. Weight Each Lbs. kg
4 × 4 × 1 ¼ 100 × 100 × 32	5.00 sw 127	5.00 sw 127	9.6 4.4
1 ½ 40	5.00 127	5.00 127	10.2 4.6
2 50	5.00 127	5.00 127	11.2 5.1
2 ½ 65	5.00 127	5.00 127	11.4 5.2
3 80	5.00 127	5.00 127	11.6 5.3
5 × 5 × 1 125 × 125 × 25	5.50 sw 140	5.50 sw 140	14.0 6.4
1 ½ 40	5.50 sw 140	5.50 sw 140	14.3 6.5
2 50	5.50 sw 140	5.50 sw 140	14.5 6.6
2 ½ 65	5.50 140	5.50 sw 140	15.2 6.9
3 80	5.50 140	5.50 sw 140	16.6 7.5
4 100	5.50 140	5.50 sw 140	16.7 7.6
6 × 6 × 1 150 × 150 × 25	6.50 sw 165	6.50 sw 165	23.0 10.4
1 ½ 40	6.50 sw 165	6.50 sw 165	24.0 10.9
2 50	6.50 165	6.50 165	21.6 9.8
2 ½ 65	6.50 165	6.50 165	21.4 11.7
14 – 60" 350 – 1500 mm	AGS™ For AGS fitting information, see publication 20.05		

+ Contact Victaulic for details.

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s"

S= Carbon Steel Direct Roll Groove (OGS)

SW= Carbon Steel Segmentally Welded

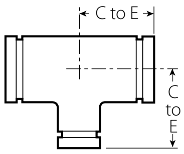
IMPORTANT NOTE:

No. 29T Threaded Outlet Reducing Tees are supplied NPT and are available with British Standard threads. For British Standard specify "BSP" clearly on order.

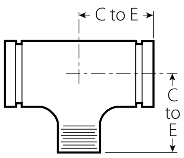
Grooved End Fittings

Reducing Tee

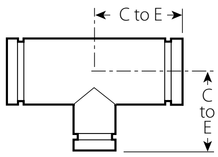
NO. 25 Grooved Branch
NO. 29T Threaded Branch



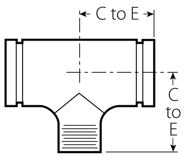
NO. 25



NO. 29T



NO. 25-SW



NO. 29T-SW

Size	No. 25 Std.	No. 29T w/ Thd. Branch	Approx. Weight Each
Nominal Size Inches mm	C to E Inches mm	C to E Inches mm	Lbs. kg
6 × 6 × 3 150 × 150 × 80	6.50 165	6.50 165	26.5 12.0
4 100	6.50 165	6.50 165	25.0 11.3
5 125	6.50 165	6.50 165	23.2 10.5
6½ × 6½ × 3 165.1 × 165.1 × 80	6.50 165	6.50 sw 165	24.0 10.9
4 100	6.50 165	6.50 sw 165	25.0 11.3
8 × 8 × 1½ 200 × 200 × 40	7.75 sw 197	7.75 sw 197	33.0 15.0
2 50	7.75 sw 197	7.75 sw 197	33.5 15.2
2½ 65	7.75 sw 197	7.75 sw 197	39.0 17.7
3 80	7.75 sw 197	7.75 sw 197	33.6 15.2
4 100	7.75 197	7.75 197	41.8 19.0
5 125	7.75 sw 197	7.75 sw 197	34.0 15.4
6 150	7.75 197	7.75 197	42.3 19.2
165.1	7.75 sw 197	7.75 sw 197	48.0 21.8
10 × 10 × 1½ 250 × 250 × 40	9.00 229	9.00 229	62.0 28.1
2 50	9.00 sw 229	9.00 sw 229	62.0 28.1
2½ 65	9.00 sw 229	9.00 sw 229	62.4 28.3
3 80	9.00 sw 229	9.00 sw 229	60.0 27.2
4 100	9.00 sw 229	9.00 sw 229	61.0 27.7
5 125	9.00 sw 229	9.00 sw 229	52.0 23.6
6 150	9.00 sw 229	9.00 sw 229	59.0 26.8
8 200	9.00 sw 229	9.00 sw 229	64.7 29.3

Size	No. 25 Std.	No. 29T w/ Thd. Branch	Approx. Weight Each
Nominal Size Inches mm	C to E Inches mm	C to E Inches mm	Lbs. kg
12 × 12 × 1 300 × 300 × 25	10.00 sw 254	10.00 sw 254	77.0 34.9
2 50	10.00 sw 254	10.00 sw 254	80.0 36.3
2½ 65	10.00 sw 254	10.00 sw 254	78.0 35.4
3 80	10.00 sw 254	10.00 sw 254	82.0 37.2
4 100	10.00 sw 254	10.00 sw 254	80.0 36.3
5 125	10.00 sw 254	10.00 sw 254	75.0 34.0
6 150	10.00 sw 254	10.00 sw 254	75.0 34.0
8 200	10.00 sw 254	10.00 sw 254	80.0 36.3
10 250	10.00 sw 254	10.00 sw 254	84.0 38.1
# 14 × 14 × 4 350 × 350 × 100	11.00 sw 279	11.00 sw 279	102.0 46.3
6 150	11.00 sw 279	11.00 sw 279	108.2 49.1
8 200	11.00 279	11.00 279	112.0 50.8
10 300	11.00 279	11.00 279	120.0 54.4
12 300	11.00 279	11.00 279	129.1 58.6
# 16 × 16 × 4 400 × 400 × 100	+	+	130.0 59.0
14 – 60" 350 – 1500 mm	AGS™ For AGS fitting information, see publication 20.05		

+ Contact Victaulic for details.

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s"

S= Carbon Steel Direct Roll Groove (OGS)

SW= Carbon Steel Segmentally Welded

IMPORTANT NOTE:

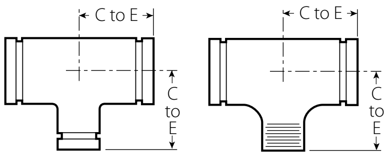
No. 29T Threaded Outlet Reducing Tees are supplied NPT and are available with British Standard threads. For British Standard specify "BSP" clearly on order.

For roll grooved systems, Victaulic offers the Advanced Groove System (AGS). For pricing and availability of cut groove fittings in this size, contact your nearest Victaulic sales office.

Grooved End Fittings

Reducing Tee

NO. 25 Grooved Branch
NO. 29T Threaded Branch



Size			No. 25 Std.	No. 29T w/ Thd. Branch	Approx. Weight Each
Nominal Size Inches mm			C to E Inches mm	C to E Inches mm	Lbs. kg
# 16 400	16 400	6 150	12.00 sw 305	12.00 sw 305	133.5 60.6
		8 200	12.00 305	12.00 305	145.0 65.8
		10 250	12.00 305	12.00 305	149.5 67.8
		12 300	12.00 305	12.00 305	154.0 69.9
		14 350	12.00 sw 305	—	167.0 75.8
# 18 450	18 450	4 100	15.50 sw 394	15.50 sw 394	194.0 88.0
		6 150	15.50 sw 394	15.50 sw 394	200.0 90.7
		8 200	15.50 sw 394	15.50 sw 394	202.0 91.6
		10 250	15.50 394	15.50 394	212.0 96.2
		12 300	15.50 394	15.50 394	222.6 101.0
		14 350	15.50 394	—	230.1 104.4
		16 400	15.50 394	—	247.6 112.3
# 20 500	20 500	6 150	17.25 438	17.25 438	240.0 108.9
		8 200	17.25 438	17.25 438	244.0 110.7
		10 250	17.25 438	17.25 438	256.0 116.1
		12 300	17.25 438	17.25 438	264.0 119.8
		14 350	17.25 438	—	275.0 124.7

Size			No. 25 Std.	No. 29T w/ Thd. Branch	Approx. Weight Each
Nominal Size Inches mm			C to E Inches mm	C to E Inches mm	Lbs. kg
# 20 500	20 500	16 400	17.25 438	—	288.6 130.9
		18 450	17.25 438	—	297.0 134.7
# 24 600	24 600	8 200	20.00 508	20.00 508	340.0 154.2
		10 250	20.00 508	20.00 508	343.9 156.0
		12 300	20.00 508	20.00 508	352.8 160.0
		14 § 350	20.00 508	—	360.0 163.3
		16 400	20.00 508	—	378.0 171.5
		18 § 450	20.00 508	—	380.0 172.4
		20 500	20.00 508	—	373.0 169.2
14 – 60" 350 – 1500 mm			AGS™ For AGS fitting information, see publication 20.05		

+ Contact Victaulic for details.

Note: All fittings are ductile iron unless otherwise noted with an “sw” or “s”

S= Carbon Steel Direct Roll Groove (OGS)

SW= Carbon Steel Segmentally Welded

IMPORTANT NOTE:

No. 29T Threaded Outlet Reducing Tees are supplied NPT and are available with British Standard threads. For British Standard specify "BSP" clearly on order.

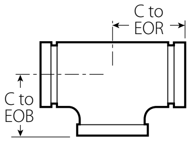
For roll grooved systems, Victaulic offers the Advanced Groove System (AGS). For pricing and availability of cut groove fittings in this size, contact your nearest Victaulic sales office.

§ Cast fitting available. Contact Victaulic for details.

Grooved End Fittings

Bullhead Tee

NO. 21



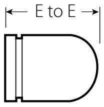
NO. 21

Size			No. 21 Bullhead Tee		
Nominal Size Inches mm			C to EOR Inches mm	C to EOB Inches mm	Approx. Weight Each Lbs. kg
5 125	× 5 125	× 8 200	7.75 197	5.50 140	28.7 13.0
6 150	× 6 150	× 8 200	7.75 197	6.50 165	37.5 17.0

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".
S= Carbon Steel Direct Roll Groove (OGS)
SW= Carbon Steel Segmentally Welded

Bull Plug

NO. 61



NO. 61

Size		No. 61 Bull Plug (S)	
Nominal Size Inches mm	Actual Outside Diameter Inches mm	E to E Inches mm	Approx. Weight Each Lbs. kg
2 50	2.375 60.3	4.00 102	2.5 1.1
2½ 65	2.875 73.0	5.00 127	3.0 1.4
3 80	3.500 88.9	6.00 152	4.5 2.0
4 100	4.500 114.3	7.00 178	7.5 3.4
5 125	5.563 141.3	8.00 203	12.0 5.4
6 150	6.625 168.3	10.00 254	17.0 7.7

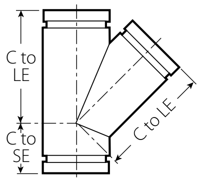
IMPORTANT NOTES:

Steel dish caps available through 24"/600 mm, contact Victaulic.
No. 61 Bull Plugs should be used in vacuum service with Style 72 or 750 couplings
Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s"
S= Carbon Steel Direct Roll Groove (OGS)
SW= Carbon Steel Segmentally Welded

Grooved End Fittings

45° Lateral

NO. 30



NO. 30

Size		No. 30 45° Lateral (SW)		
Nominal Size Inches mm	Actual Outside Diameter Inches mm	C to LE Inches mm	C to SE Inches mm	Approx. Weight Each Lbs. kg
¾ 20	1.050 26.9	4.50 114	2.00 51	1.0 0.5
1 25	1.315 33.7	5.00 127	2.25 57	1.7 0.8
1 ¼ 32	1.660 42.4	5.75 146	2.50 64	2.5 (d) 1.1
1 ½ 40	1.900 48.3	6.25 159	2.75 70	3.5 1.6
2 50	2.375 60.3	7.00 178	2.75 70	4.6 (d) 2.1
2 ½ 65	2.875 73.0	7.75 197	3.00 76	9.0 94.1
76.1 mm	3.000 76.1	8.50 216	3.25 83	11.0 5.0
3 80	3.500 88.9	8.50 216	3.25 83	11.7 (d) 5.4
3 ½ 90	4.000 101.6	10.00 254	3.50 89	17.8 8.1
4 100	4.500 114.3	10.50 267	3.75 95	22.2 (d) 10.1
5 125	5.563 141.3	12.50 318	4.00 102	21.8 9.9
165.1 mm	6.500 165.1	14.00 356	4.50 114	43.6 19.8

Size		No. 30 45° Lateral (SW)		
Nominal Size Inches mm	Actual Outside Diameter Inches mm	C to LE Inches mm	C to SE Inches mm	Approx. Weight Each Lbs. kg
6 150	6.625 168.3	14.00 356	4.50 114	43.6 19.8
8 200	8.625 219.1	18.00 457	6.00 152	72.0 32.7
10 250	10.750 273.0	20.50 521	6.50 165	105.0 47.6
12 300	12.750 323.9	23.00 584	7.00 178	165.0 74.8
14 # 350	14.000 355.6	26.50 673	7.50 191	276.0 125.2
16 # 400	16.000 406.4	29.00 737	8.00 203	344.2 156.1
18 # 450	18.000 457.0	32.00 813	8.50 216	429.0 194.6
20 # 500	20.000 508.0	35.00 889	9.00 229	500.0 226.8
24 # 600	24.000 610.0	40.00 1016	10.00 254	715.0 324.3
14 – 60" 350 – 1500 mm	AGS™ For AGS fitting information, see publication 20.05			

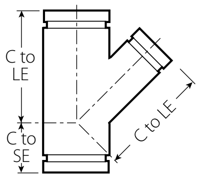
For roll grooved systems, Victaulic offers the Advanced Groove System (AGS). For pricing and availability of cut groove fittings in this size, contact your nearest Victaulic sales office.

Note: All fittings are segmentally welded steel unless otherwise noted with a (d) for ductile iron.

Grooved End Fittings

45° Reducing Lateral

NO. 30-R



NO. 30-R

Size			No. 30-R 45° Reducing Lateral (SW)		
Nominal Size Inches mm			C to LE Inches mm	C to SE Inches mm	Approx. Weight Each Lbs. kg
3 80	x 3 80	x 2 50	8.50 216	3.25 83	9.8 4.4
		2½ 65	8.50 216	3.25 83	9.8 4.4
4 100	x 4 100	x 2 50	10.50 267	3.75 95	10.0 4.5
		2½ 65	10.50 267	3.75 95	10.0 4.5
		3 80	10.50 267	3.75 95	18.3 8.3
5 125	x 5 125	x 2 50	12.50 318	4.00 102	24.0 10.9
		3 80	12.50 318	4.00 102	27.0 212.2
		4 100	12.50 318	4.00 102	26.5 12.0
6 150	x 6 150	x 3 80	14.00 356	4.50 114	37.0 16.8
		4 100	14.00 356	4.50 114	36.0 16.3
		5 125	14.00 356	4.50 114	44.7 20.3
8 200	x 8 200	x 4 100	18.00 457	6.00 152	62.0 28.1
		5 125	18.00 457	6.00 152	75.5 34.2
		6 150	18.00 457	6.00 152	82.0 37.2
10 250	x 10 250	x 4 100	20.50 521	6.50 165	104.8 147.5
		5 125	20.50 521	6.50 165	99.0 44.9
		6 150	20.50 521	6.50 165	105.8 48.0
		8 200	20.50 521	6.50 165	118.0 53.5
12 300	x 12 300	x 5 125	23.00 584	7.00 178	122.0 55.3
		6 150	23.00 584	7.00 178	137.0 62.1
		8 200	23.00 584	7.00 178	147.0 66.7
		10 250	23.00 584	7.00 178	167.0 75.8

Size			No. 30-R 45° Reducing Lateral (SW)		
Nominal Size Inches mm			C to LE Inches mm	C to SE Inches mm	Approx. Weight Each Lbs. kg
# 14 350	x 14 350	x 4 100	26.50 673	7.50 191	172.0 78.0
		6 150	26.50 673	7.50 191	187.0 84.8
		8 200	26.50 673	7.50 191	205.8 93.4
		10 250	26.50 673	7.50 191	235.0 106.6
		12 300	26.50 673	7.50 191	250.0 113.4
# 16 400	x 16 400	x 6 150	29.00 737	8.00 203	215.0 97.5
		8 200	29.00 737	8.00 203	252.5 114.5
		10 250	29.00 737	8.00 203	265.0 120.2
		12 300	29.00 737	8.00 203	295.0 133.8
		14 350	29.00 737	8.00 203	305.0 138.3
# 18 450	x 18 450	x 6 150	32.00 813	8.50 216	274.0 124.3
		8 200	32.00 813	8.50 216	275.0 124.7
		12 300	32.00 813	8.50 216	347.0 157.4
		14 350	32.00 813	8.50 216	350.0 158.8
		16 400	32.00 813	8.50 216	362.0 164.2
# 20 500	x 20 500	x 12 300	35.00 889	9.00 229	415.0 188.2
		14 350	35.00 889	9.00 229	420.0 190.5
		16 400	35.00 889	9.00 229	425.0 192.8
# 24 600	x 24 600	x 16 400	40.00 1016	10.00 254	425.0 192.8
		20 600	40.00 1016	10.00 254	570.0 258.6
14 – 60" 350 – 1500 mm			AGS For AGS fitting information, see publication 20.05		

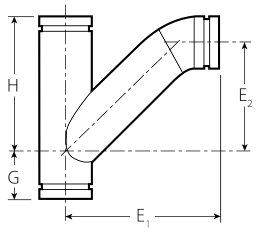
For roll grooved systems, Victaulic offers the Advanced Groove System (AGS). For pricing and availability of cut groove fittings in this size, contact your nearest Victaulic sales office.

Note: All fittings are segmentally welded steel unless otherwise noted a (d) for ductile iron.

Grooved End Fittings

Tee Wye

NO. 32



NO. 32

Size					No. 32 Tee Wye (SW)				
Nominal Size Inches mm					G Inches mm	H Inches mm	E1 Inches mm	E2 Inches mm	Approx. Wgt. Each Lbs. kg
2 50	×	2 50	×	2 50	2.75 70	7.00 178	9.00 229	4.63 118	6.4 2.9
2½ 65	×	2½ 65	×	2½ 65	3.00 76	7.75 197	10.50 267	5.75 146	11.5 5.2
3 80	×	3 80	×	3 80	3.25 83	8.50 216	11.50 292	6.50 165	14.3 6.5
3½ 90	×	3½ 90	×	3½ 90	3.25 89	10.00 254	13.00 330	7.75 197	22.9 10.4
4 100	×	4 100	×	4 100	3.75 95	10.50 267	13.63 346	8.13 207	26.0 11.8

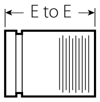
Size					No. 32 Tee Wye (SW)				
Nominal Size Inches mm					G Inches mm	H Inches mm	E1 Inches mm	E2 Inches mm	Approx. Wgt. Each Lbs. kg
5 125	×	5 125	×	5 125	4.00 102	12.50 318	16.13 410	10.00 254	48.0 21.8
6 150	×	6 150	×	6 150	4.50 114	14.00 356	18.25 464	11.50 292	60.5 27.4
8 200	×	8 200	×	8 200	6.00 152	18.00 457	23.25 591	15.25 387	127.1 57.7
10 250	×	10 250	×	10 250	6.50 165	20.50 521	27.25 692	18.00 457	190.0 186.2
12 300	×	12 300	×	12 300	7.00 178	23.00 584	31.00 787	20.50 521	240.0 108.9

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s"
S= Carbon Steel Direct Roll Groove (OGS)
SW= Carbon Steel Segmentally Welded

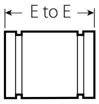
Grooved End Fittings

Adapter Nipple

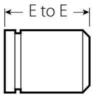
NO. 40 Grv. × Thd.
NO. 42 Grv. × Bev.
NO. 43 Grv. × Grv.



NO. 40 *



NO. 43



NO. 42

Size		No. 40, 42, 43 Adapter Nipple (s)	
Nominal Size Inches mm	Actual Outside Diameter Inches mm	E to E Inches mm	Approx. Weight Each Lbs. kg
¾ 20	1.050 26.9	3.00 76	0.3 0.1
1 25	1.315 33.7	3.00 76	0.4 0.2
1¼ 32	1.660 42.4	4.00 102	0.8 0.4
1½ 40	1.900 48.3	4.00 102	0.9 0.4
2 50	2.375 60.3	4.00 102	1.2 0.5
2½ 65	2.875 73.0	4.00 102	1.9 0.9
3 80	3.500 88.9	4.00 102	2.5 1.1
3½ 90	4.000 101.6	4.00 102	2.1 0.9
4 100	4.500 114.3	6.00 152	5.5 2.5
5 125	5.563 141.3	6.00 152	7.4 3.4
6 150	6.625 168.3	6.00 152	9.5 4.3
8 200	8.625 219.1	6.00 152	14.2 6.4
10 250	10.750 273.0	8.00 203	27.0 12.2
12 300	12.750 323.9	8.00 203	33.0 15.0

* Available with British Standard Pipe Threads, specify "BSP" clearly on order.

IMPORTANT NOTES:

For pump package nipples with 1½"/40 mm hole cut to receive Style 923 Vic-Let or Style 924 Vic-O-Well request special No. 40, 42 or 43 nipples and specify No. 40-H, 42-H or 43-H on order. NOTE: 4 – 12"/100 – 300 mm diameter – 8"/200 mm minimum length required.

For roll grooved systems, Victaulic offers the Advanced Groove System (AGS). For pricing and availability of cut groove fittings in this size, contact your nearest Victaulic sales office.

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s"

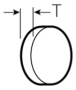
S= Carbon Steel Direct Roll Groove (OGS)

SW= Carbon Steel Segmentally Welded

Grooved End Fittings

Cap

NO. 60



NO. 60

Size		No. 60 Cap	
Nominal Size Inches mm	**Actual Outside Diameter Inches mm**	**T Thickness Inches mm**	**Approx. Weight Each Lbs. kg**
¾ 20	1.050 26.9	0.88 22	0.2 0.1
1 25	1.315 33.7	0.88 22	0.3 0.1
1 ¼ 32	1.660 42.4	0.88 22	0.3 0.1
1 ½ 40	1.900 48.3	0.88 22	0.5 0.2
2 50	2.375 60.3	0.88 22	0.6 0.3
2 ½ 65	2.875 73.0	0.88 22	1.0 0.5
76.1 mm	3.000 76.1	0.88 22	1.2 0.5
3 80	3.500 88.9	0.88 22	1.2 0.5
3 ½ 90	4.000 101.6	0.88 22	2.5 1.1
108.0 mm	4.250 108.0	1.00 25	2.3 1.0
4 100	4.500 114.3	1.00 25	2.5 1.1
133.0 mm	5.250 133.0	1.00 25	4.5 2.0
139.7 mm	5.500 139.7	1.00 25	4.5 2.0
5 125	5.563 141.3	1.00 25	4.6 2.1
159.0 mm	6.250 159.0	1.00 25	6.8 3.1
165.1 mm	6.500 165.1	1.00 25	7.3 3.3

Size		No. 60 Cap	
Nominal Size Inches mm	**Actual Outside Diameter Inches mm**	**T Thickness Inches mm**	**Approx. Weight Each Lbs. kg**
6 150	6.625 168.3	1.00 25	6.1 2.8
8 200	8.625 219.1	1.19 30	13.1 5.9
10 250	10.750 273.0	1.25 32	21.0 9.5
12 300	12.750 323.9	1.25 32	35.6 16.2
14 # (s) 350	14.000 355.6	9.50 241	*
16 # (s) 400	16.000 406.4	10.00 254	*
18 # (s) 450	18.000 457.0	11.00 279	*
20 # (s) 500	20.000 508.0	12.00 305	*
24 # (s) 600	24.000 610.0	13.50 343	*
14 – 60" 350 – 1500 mm	AGS™ For AGS fitting information, see publication 20.05		

IMPORTANT NOTES:

* Steel dish caps available through 24"/600 mm, contact Victaulic.

No. 60 cap is not suitable for use in vacuum service with Style 72 or 750 couplings. No. 61 bull plugs should be used, see pg. 35.

For roll grooved systems, Victaulic offers the Advanced Groove System (AGS). For pricing and availability of cut groove fittings in this size, contact your nearest Victaulic sales office.

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".

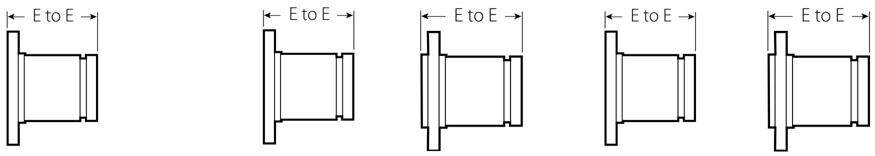
S= Carbon Steel Direct Roll Groove (OGS)

SW= Carbon Steel Segmentally Welded

Grooved End Fittings

Flanged Adapter Nipple

NO. 41 ANSI Class 125 (Cast Iron)
NO. 45F ANSI Class 150 Flat Face
NO. 45R ANSI Class 150 Raised Face
NO. 46F ANSI Class 300 Flat Face
NO. 46R ANSI Class 300 Raised Face



NO. 41 **NO. 45F** NO. 45R NO. 46F NO. 46R

Size		No. 41 ANSI 125 Flange Adapter Nipple		No. 45F and No. 45R ANSI 150 Flange Adapter Nipple (S)		No. 46F and No. 46R ANSI 300 Flange Adapter Nipple (S)	
Nominal Size Inches mm	Actual Outside Diameter Inches mm	E to E Inches mm	Approx. Weight Each Lbs. kg	E to E Inches mm	Approx. Weight Each Lbs. kg	E to E Inches mm	Approx. Weight Each Lbs. kg
¾ 20	1.050 26.9	3 76	—	3 76	2.3 1.0	3 76	3.3 1.5
1 25	1.315 33.7	3 76	2.5 1.1	3 76	2.7 1.2	3 76	3.9 1.8
1¼ 32	1.660 42.4	4 102	3.0 1.4	4 102	3.3 1.5	4 102	4.8 2.2
1½ 40	1.900 48.3	4 102	3.5 1.6	4 102	3.9 1.8	4 102	6.9 3.1
2 50	2.375 60.3	4 102	5.5 2.5	4 102	6.2 2.8	4 102	8.2 3.7
2½ 65	2.875 73.0	4 102	8.0 3.6	4 102	9.9 4.5	4 102	11.9 5.4
3 80	3.500 88.9	4 102	9.5 4.3	4 102	11.4 5.2	4 102	16.5 7.5
3½ 90	4.00 101.6	4 102	12.0 5.4	4 102	15.1 6.8	4 102	20.1 9.1
4 100	4.500 114.3	6 152	16.7 7.6	6 152	18.4 8.3	6 152	27.4 12.4
5 125	5.563 141.3	6 152	21.5 9.8	6 152	21.3 9.7	6 152	35.3 16.0
6 150	6.625 168.3	6 152	26.5 12.0	6 152	27.5 12.5	6 152	47.5 21.5
8 200	8.625 219.1	6 152	39.0 17.7	6 152	41.3 18.8	6 152	70.3 31.9
10 250	10.750 273.0	8 203	57.0 25.9	8 203	59.8 27.1	8 203	100.8 45.7
12 300	12.750 323.9	8 203	41.0 18.6	8 203	88.2 40.0	8 203	146.2 66.3
14 # 350	14.000 355.6	8 203	—	8 203	+	8 203	+
16 # 400	16.000 406.4	8 203	—	8 203	+	8 203	+
18 # 450	18.000 457.0	8 203	—	8 203	+	8 203	+
20 # 500	20.000 508.0	8 203	—	8 203	+	8 203	+
24 # 600	24.000 610.0	8 203	—	8 203	+	8 203	+
14 – 60" 350 – 1500 mm	AGS™ **For AGS fitting information, see publication 20.05**						

IMPORTANT NOTES:

+ Contact Victaulic for details.

Flanged adapter nipples are supplied with standard rolled grooves.
Standard cut grooves or machining for rubber lining are optionally available. Contact Victaulic for details.

For roll grooved systems, Victaulic offers the Advanced Groove System (AGS). For pricing and availability of cut groove fittings in this size, contact your nearest Victaulic sales office.

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".

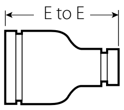
S= Carbon Steel Direct Roll Groove (OGS)

SW= Carbon Steel Segmentally Welded

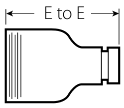
Grooved End Fittings

Swaged Nipple

NO. 53 Grv. × Grv.
NO. 54 Grv. × Thd.
NO. 55 Thd. × Grv.



NO. 53



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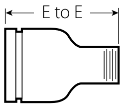


NO. 54

Size			No. 53, 54 and 55 Swaged Nipples (S)	
Nominal Size Inches mm			E to E Inches mm	Approx. Weight Each Lbs. kg
2 50	×	1 25	6.50 165	2.0 0.9
		1 ¼ 32	6.50 165	2.0 0.9
		1 ½ 40	6.50 165	2.0 0.9
2½ 65	×	1 25	7.00 178	3.0 1.4
		1 ¼ 32	7.00 178	3.0 1.4
		1 ½ 40	7.00 178	3.0 1.4
		2 50	7.00 178	3.0 1.4
3 80	×	1 25	8.00 203	4.5 2.0
		1 ¼ 32	8.00 203	4.5 2.0
		1 ½ 40	8.00 203	4.4 2.0
		2 50	8.00 203	4.5 2.0
		2½ 65	8.00 203	4.5 2.0
3½ 90	×	3 80	8.00 203	6.8 3.1
4 100	×	1 25	9.00 229	7.5 3.4
		1 ¼ 32	9.00 229	7.5 3.4
		1 ½ 40	9.00 229	7.5 3.4
		2 50	9.00 229	7.5 3.4
4 100	×	2½ 65	9.00 229	7.5 3.4

Size			No. 53, 54 and 55 Swaged Nipples (S)	
Nominal Size Inches mm			E to E Inches mm	Approx. Weight Each Lbs. kg
4 100	×	3 80	9.00 229	7.5 3.4
		3½ 90	9.00 229	7.5 3.4
5 125	×	2 50	11.00 279	11.5 5.2
		3 80	11.00 279	11.3 5.1
		4 100	11.00 279	11.5 5.2
6 150	×	1 25	12.00 305	17.0 7.7
		1 ¼ 32	12.00 305	17.0 7.7
		1 ½ 40	12.00 305	17.2 7.8
		2 50	12.00 305	17.4 7.9
		2½ 65	12.00 305	17.4 7.9
		3 80	12.00 305	17.4 7.9
		3½ 90	12.00 305	17.4 7.9
		4 100	12.00 305	17.5 7.9
		4 ½ 120	12.00 305	17.5 7.9
		5 125	12.00 305	17.5 7.9
8 200	×	6 150	+	20.0 9.1

+ Contact Victaulic for details.

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".

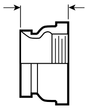
S= Carbon Steel Direct Roll Groove (OGS)

SW= Carbon Steel Segmentally Welded

Grooved End Fittings

Female Threaded Adapter

NO. 80



NO. 80

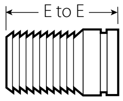
Size		No. 80 Female Threaded Adapter	
Nominal Size Inches mm	Actual Outside Diameter Inches mm	E to E Inches mm	Approx. Weight Each Lbs. kg
¾ 20	1.050 26.9	2.00 51	1.0 0.5
1 25	1.315 33.7	2.06 52	1.0 0.5
1 ¼ 32	1.660 42.4	2.31 (sw) 59	1.5 0.7
1 ½ 40	1.900 48.3	2.31 (sw) 59	1.5 0.7
2 50	2.375 60.3	2.50 64	1.4 0.6
2½ 65	2.875 73.0	2.75 70	1.5 0.7
3 80	3.500 88.9	2.75 70	2.9 1.3
4 100	4.500 114.3	3.25 83	4.5 2.0

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".
S= Carbon Steel Direct Roll Groove (OGS)
SW= Carbon Steel Segmentally Welded

IMPORTANT NOTE:
Available with British Standard Pipe threads, specify "BSP" clearly on order.

Hose Nipple

NO. 48



NO. 48

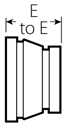
Size		No. 48 Hose Nipple (s)	
Nominal Size Inches mm	Actual Outside Diameter Inches mm	E to E Inches mm	Approx. Weight Each Lbs. kg
¾ 20	1.050 26.9	3.12 79	0.3 0.1
1 25	1.315 33.7	3.38 86	0.4 0.2
1 ¼ 32	1.660 42.4	3.88 98	0.6 0.3
1 ½ 40	1.900 48.3	3.88 98	0.8 0.4
2 50	2.375 60.3	4.50 114	1.1 0.5
2½ 65	2.875 73.0	5.38 137	2.0 0.9
3 80	3.500 88.9	5.75 146	3.2 1.5
4 100	4.500 114.3	7.00 178	4.9 2.2
5 125	5.563 141.3	8.75 222	8.0 3.6
6 150	6.625 168.3	10.12 257	14.3 6.5
8 200	8.625 219.1	11.88 302	24.7 11.2
10 250	10.750 273.0	12.50 318	40.1 18.2
12 300	12.750 323.9	14.50 368	62.0 28.1

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".
S= Carbon Steel Direct Roll Groove (OGS)
SW= Carbon Steel Segmentally Welded

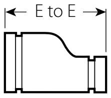
Grooved End Fittings

Concentric/Eccentric Reducer

NO. 50 Concentric
NO. 51 Eccentric



NO. 50



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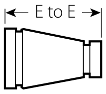
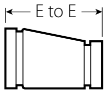


Fabricated Steel
No.50



Fabricated Steel
No.51

Size		No. 50 Concentric Reducer		No. 51 Eccentric Reducer	
Nominal Size Inches mm		E to E Inches mm	Approx. Weight Each Lbs. kg	E to E Inches mm	Approx. Weight Each Lbs. kg
1 ¼ 32 ×	¾ 20	+	1.9 0.9	—	—
	1 25	+	1.9 0.9	—	—
1 ½ 40 ×	¾ 20	+	1.4 0.6	—	—
	1 25	2.50 64	0.8 0.4	8.50 sw 216	4.5 2.0
	1 ¼ 32	2.50 64	1.0 0.5	—	—
2 50 ×	¾ 20	2.50 64	0.9 0.3	9.00 sw 229	2.0 0.9
	1 25	2.50 64	0.7 0.3	9.00 sw 229	2.3 1.0
	1 ¼ 32	2.50 64	1.2 0.5	9.00 sw 229	4.6 2.1
	1 ½ 40	3.50 89	1.0 0.5	3.50 89	1.1 0.5
2 ½ 65 ×	¾ 20	+	1.3 0.6	+	3.3 1.5
	1 25	2.50 64	1.1 0.5	9.50 241	3.5 1.6
	1 ¼ 32	3.50 89	3.3 1.5	3.50 89	1.4 0.6
	1 ½ 40	2.50 64	3.6 1.6	9.50 sw 241	3.7 1.7
	2 50	2.50 64	3.9 1.8	3.50 89	4.3 2.0
3 80 ×	¾ 20	+	1.5 0.7	+	4.5 2.0
	1 25	2.50 241	1.3 0.6	9.50 sw 241	4.8 2.2
	1 ¼ 32	2.50 64	1.4 0.6	+	4.8 2.2
	1 ½ 40	2.50 64	5.1 2.3	9.50 sw 241	5.1 2.3
	2 50	2.50 64	1.6 0.7	3.50 89	6.0 2.7
	2 ½ 65	2.50 64	1.8 0.8	3.50 89	7.0 3.2
	76.1	2.50 64	2.1 1.0	—	—

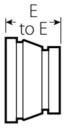
Size		No. 50 Concentric Reducer		No. 51 Eccentric Reducer	
Nominal Size Inches mm		E to E Inches mm	Approx. Weight Each Lbs. kg	E to E Inches mm	Approx. Weight Each Lbs. kg
3 ½ 90 ×	3 80	2.50 64	2.0 0.9	9.50 sw 241	7.0 3.2
4 100 ×	1 25	3.00 76	3.0 1.4	13.00 sw 330	6.5 2.9
	1 ¼ 32	+	4.6 2.1	—	—
	1 ½ 40	3.00 sw 76	2.6 1.2	10.00 sw 254	8.1 3.7
	2 50	3.00 76	2.4 1.1	4.00 102	3.3 1.5
	2 ½ 65	3.00 76	2.7 1.2	4.00 102	3.4 1.5
	3 80	3.00 76	3.2 1.4	4.00 102	3.5 1.6
	3 ½ 90	3.00 76	2.9 1.3	10.00 sw 254	8.0 3.6
5 125 ×	2 50	11.00 sw 279	9.0 4.1	11.00 sw 279	5.2 2.4
	2 ½ 65	4.00 102	4.3 2.0	11.00 sw 279	10.8 4.9
	3 80	4.00 102	55 2.5	11.00 sw 279	11.1 5.0
	4 100	3.50 89	4.3 1.9	5.00 127	12.0 5.4
6 150 ×	1 25	4.00 102	5.0 2.3	11.50 sw 292	14.5 6.6
	1 ½ 40	+	5.5 2.5	+	+
	2 50	4.00 102	6.6 3.0	11.50 sw 292	14.5 6.6
	2 ½ 65	4.00 102	6.4 2.9	11.50 sw 292	14.2 6.4
	3 80	4.00 102	6.4 2.9	5.50 140	15.0 6.8
	4 100	4.00 102	6.5 2.9	5.50 140	17.0 7.7
	5 125	4.00 102	6.4 2.9	5.50 140	17.0 7.7
8 200 ×	2 ½ 65	16.00 406	7.9 3.6	12.00 sw 305	26.1 11.8
	3 80	5.00 127	9.3 4.2	12.00 sw 305	22.0 10.0

Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".
S= Carbon Steel Direct Roll Groove (OGS)
SW= Carbon Steel Segmentally Welded

Grooved End Fittings

Concentric/Eccentric Reducer

NO. 50 Concentric
NO. 51 Eccentric



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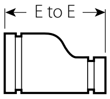

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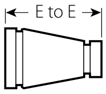
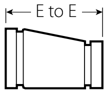


Fabricated Steel
No.50



Fabricated Steel
No.51

Size			No. 50 Concentric Reducer		No. 51 Eccentric Reducer	
Nominal Size Inches mm			E to E Inches mm	Approx. Weight Each Lbs. kg	E to E Inches mm	Approx. Weight Each Lbs. kg
8 200	×	4 100	5.00 127	10.4 4.8	12.00 sw 305	23.0 10.4
		5 125	5.00 127	11.6 5.2	12.00 sw 305	23.0 10.4
		6 150	5.00 127	11.9 5.4	6.00 152	24.0 10.9
10 250	×	4 100	6.00 152	19.7 8.9	13.00 sw 330	32.0 14.5
		5 125	+	34.3 15.6	+	34.6 15.7
		6 150	6.00 152	20.0 9.1	13.00 sw 330	36.9 16.7
		8 200	6.00 152	22.0 10.0	7.00 178	21.6 9.8
12 300	×	4 100	+	44.0 20.0	14.00 sw 356	48.0 21.8
		6 150	7.00 178	24.6 11.2	14.00 sw 356	50.0 22.7
		8 200	7.00 178	52.0 23.6	14.00 sw 356	53.5 24.3
		10 250	7.00 178	39.0 17.7	14.00 sw 356	57.0 25.9
# 14 350	×	6 150	13.00 330	65.0 29.5	13.00 330	60.0 27.2
		8 200	13.00 330	65.0 29.5	13.00 330	60.0 27.2
		10 250	13.00 330	66.0 29.9	13.00 330	65.0 29.5
		12 300	13.00 330	68.0 30.8	13.00 330	66.0 29.9
# 16 400	×	8 200	14.00 356	73.0 33.1	14.00 355	73.0 33.1
		10 § 250	14.00 356	73.0 33.1	14.00 355	73.0 33.1
		12 300	14.00 356	73.0 33.1	14.00 355	73.0 33.1
		14 350	14.00 356	73.0 33.1	14.00 355	73.0 33.1
# 18 450	×	10 250	15.00 381	91.0 41.3	15.00 381	91.0 41.3

Size			No. 50 Concentric Reducer		No. 51 Eccentric Reducer	
Nominal Size Inches mm			E to E Inches mm	Approx. Weight Each Lbs. kg	E to E Inches mm	Approx. Weight Each Lbs. kg
# 18 450	x	12 300	15.00 381	91.0 41.3	15.00 381	91.0 41.3
		14 350	15.00 381	91.0 41.3	15.00 381	91.0 41.3
		16 400	15.00 381	91.0 41.3	15.00 381	91.0 41.3
# 20 500	×	10 250	20.00 508	110.0 49.9	20.00 508	177.0 80.3
		12 300	20.00 508	120.0 54.4	20.00 508	120.0 54.4
		14 350	20.00 508	149.0 67.9	20.00 508	149.0 67.9
		16 400	20.00 508	120.0 54.4	20.00 508	120.0 54.4
		18 450	20.00 508	136.0 61.7	20.00 508	136.0 61.7
# 24 600	×	10 250	20.00 508	142.0 64.4	20.00 508	142.0 64.4
		12 300	20.00 508	150.0 68.0	20.00 508	150.0 68.0
		14 350	20.00 508	162.0 73.5	20.00 508	162.0 73.5
		16 400	20.00 508	162.0 73.5	20.00 508	162.0 73.5
		18 450	20.00 508	162.0 73.5	20.00 508	162.0 73.5
		20 500	20.00 508	151.0 68.5	20.00 508	190.0 86.2
14 – 60" 350 – 1500 mm			AGS™ For AGS fitting information, see publication 20.05			

\+ Contact Victaulic for details.
* Available with male threaded small end No. 52.
Note: All fittings are ductile iron unless otherwise noted with an "sw" or "s".
S= Carbon Steel Direct Roll Groove (OGS)
SW= Carbon Steel Segmentally Welded

IMPORTANT NOTE:

Steel eccentric reducers available through 30"/750 mm, contact Victaulic for dimensions.

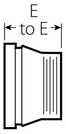
\# For roll grooved systems, Victaulic offers the Advanced Groove System (AGS). For pricing and availability of cut groove fittings in this size, contact your nearest Victaulic sales office.

§ Cast fitting available for JIS size. Contact Victaulic for details.

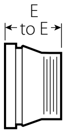
Grooved End Fittings

Small Threaded Reducer

NO. 52



NO. 52



NO. 52F

Size			No. 52 Small Threaded Reducer		No. 52F Concentric Reducer with BSPT Female Threaded End	
Nominal Size Inches mm			E to E Inches mm	Approx. Weight Each Lbs. kg	E to E Inches mm	Approx. Weight Each Lbs. kg
1½ 40	×	1 25	2.50 64	0.8 0.4	—	—
		1¼ 32	2.50 64	0.9 0.4	—	—
2 50	×	¾ 20	2.50 64	0.9 0.4	—	—
		1 25	2.50 64	0.7 0.3	—	—
		1¼ 32	2.50 64	1.2 0.5	—	—
		1½ 40	2.50 64	1.0 0.5	—	—
2½ 65	×	1 25	2.50 64	1.1 0.5	—	—
		1¼ 32	2.50 (sw) 64	1.2 0.5	—	—
		1½ 40	2.50 (sw) 64	1.3 0.6	—	—
		2 50	3.00 76	1.4 0.6	—	—
76.1	×	48.3	63.5	0.8	63.5	0.77
		60	—	—	63.5	0.85
3 80	×	¾ 20	+ (sw)	1.5 0.7	—	—
		1 25	2.50 64	1.3 0.6	—	—
		1¼ 32	2.50 64	1.5 0.7	—	—
		1½ 40	2.50 (sw) 64	1.5 0.7	—	—
		2 50	2.50 64	1.5 0.7	—	—
		2½ 65	2.50 64	2.4 1.1	—	—
88.9	×	42.4	63.5	0.9	63.5	0.82
		48.3	63.5	0.9	63.5	0.85
		60	—	—	63.5	0.89
4 100	×	1 25	3.00 76	2.3 1.0	—	—
		1½ 40	3.00 76	2.7 1.2	—	—
		2 50	3.00 76	2.6 1.2	—	—

Size			No. 52 Small Threaded Reducer		No. 52F Concentric Reducer with BSPT Female Threaded End	
Nominal Size Inches mm			E to E Inches mm	Approx. Weight Each Lbs. kg	E to E Inches mm	Approx. Weight Each Lbs. kg
4 100	×	2½ 65	3.00 76	2.6 1.2	—	—
		3 80	3.00 76	2.5 1.1	—	—
108	×	42.4	76.2	1.3	76.2	1.32
		48.3	76.2	1.3	76.2	1.35
		60	—	—	76.2	1.39
114.3	×	42.4	76.2	1.3	76.2	1.30
		48.3	76.2	1.3	76.2	1.34
		60	—	—	76.2	1.40
5 125	×	4 100	+	4.5 2.0	—	—
133	×	60	—	—	114.3	2.17
139	×	60	—	—	114.3	2.26
6 150	×	1 25	4.00 102	5.5 2.5	—	—
		2 50	4.00 102	5.7 2.6	—	—
		2½ 65	4.00 102	5.8 2.6	—	—
		3 80	4.00 102	5.8 2.6	—	—
		4 100	+ (sw)	6.5 2.9	—	—
		5 125	+ (sw)	2.0 0.9	—	—
159	x	42.4	114.3	2.2	114.3	2.45
		48.3	114.3	2.2	114.3	2.51
		60	—	—	114.3	2.60
165.1	x	42.4	101.6	2.4	101.6	2.90
		48.3	101.6	2.6	101.6	2.95
		60	—	—	101.6	3.00
8 200	×	2 50	16.00 406	1.5 0.7	—	—
		2½ 65	16.00 406	1.7 0.8	—	—

\+ Contact Victaulic for details.

Note: All fittings are ductile iron unless otherwise noted with an “sw” or “s”

S= Carbon Steel Direct Roll Groove (OGS)

SW= Carbon Steel Segmentally Welded

IMPORTANT NOTE:

Available with British Standard Pipe Threads, specify "BSP" clearly on order

VICTAULIC FIRELOCK RIGID COUPLINGS

Operations & Maintenance Manual
December 2015

FireLock® Rigid Coupling

§ LPC and VdS Approved, see notes on page 4

SEE VICTAULIC PUBLICATION 10.01 FOR DETAILS

STYLE 005

WITH VIC-PLUS™ GASKET SYSTEM (NORTH AMERICA ONLY)

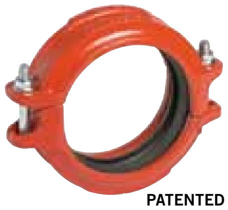
FireLock Style 005 rigid coupling has a unique, patented angle-pad design which allows the housings to offset while clamping the grooves. By permitting the housings to slide on the angled bolt pads, rigidity is obtained.

Support and hanging requirements correspond to NFPA 13 Sprinkler Systems. Angle-pad design permits assembly by removing one nut/bolt and swinging the housing over the gasket. This reduces components to handle during assembly.

Style 005 FireLock coupling are designed and recommended for use ONLY on fire protection systems.

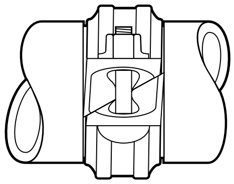
Vic-Plus™ Gasket System:

In North America, Victaulic offers a gasket system which requires no field lubrication on wet pipe systems that are hydrostatically tested. The Vic-Plus System (patented) is dry, clean, and non-toxic. It reduces assembly time substantially and eliminates the mess and chance of over-lubrication. Please refer to the latest copy of the Victaulic Field Installation Handbook (I-100) for supplemental lubrication requirements and dry pipe fire protection system notes.



PATENTED

VicPlus™ Gasket System PATENTED



Exaggerated for clarity

LISTING/APPROVALS

The information provided below is based on the latest listing and approval data at the time of publication. Listings/Approvals are subject to change and/or additions by the approvals agencies. Contact Victaulic for performance on other pipe and the latest listings and approvals.

Related Working Pressure – psi					Related Working Pressure – psi					Related Working Pressure – psi				
Pipe Sch.	Size Inches	UL	ULC	FM	Pipe Sch.	Size Inches	UL	ULC	FM	Pipe Sch.	Size Inches	UL	ULC	FM
5	1 ¼ – 3	175	175	175	EL	1 ¼ – 2	300	N/A	N/A	MT	1 ¼ – 2	300	N/A	N/A
10, 40	1 ¼ – 4	350	350	350	ET	1 ¼ – 2	300	N/A	N/A	STF	1 ¼ – 4	N/A	N/A	300
	5 – 8	300	300	300	EZ	4 – 6	300#	N/A	300	Steady Thd.	1 ¼ – 2	N/A	N/A	300
BLT	1 ¼ – 2	300	300	N/A	FF	1 ¼ – 4	N/A	N/A	300	TF	3 – 8	N/A	N/A	300
DF	1 ¼ – 4	300	300	300	GAL - 7	1 ¼ – 2	300	N/A	N/A	WLS	1 ¼ – 2	300	300	N/A
DT	1 ¼ – 2	300	300	N/A	MLT	1 ¼ – 2	300	N/A	N/A	XL	1 ¼ – 3	300	300	300
EF	1 1⁄ – 4	175@	N/A	175	MF	1 ¼ – 4	300	N/A	300*					

* FM approved for service in 1 ½ – 4" pipe.

UL Listed for service up to 4" pipe only.

@ UL Listed for service up to 3" only.

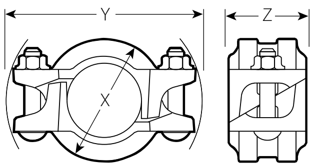
JOB/OWNER	CONTRACTOR	ENGINEER
System No. ____________	Submitted By ____________	Spec Sect ________ Para ________
Location ____________	Date ____________	Approved ____________
		Date ____________

FireLock® Rigid Coupling

STYLE 005

WITH VIC-PLUS™ GASKET SYSTEM (NORTH AMERICA ONLY)

DIMENSIONS



Rated for wet and dry sprinkler systems at 350 psi/2413 kPa for 1¼ – 4"/32 – 100 mm sizes and 300 psi /2068 kPa for 4¼ – 8"/108 – 200 mm sizes; Schedule 10 roll grooved or Schedule 40 cut or roll grooved steel pipe. Style 005 is rigid and does not accommodate expansion, contraction or angular deflection.

Size		Max. Work Pressure § *	Max. End Load *	Allow. Pipe End Sep. †	Bolt/Nut@ No – Size	Dimensions – Inches/mm			Approx. Wgt. Each
Nominal Size Inches/mm	Actual Outside Diameter Inches/mm	PSI kPa	Lbs. N	Inches mm	Inches mm	X	Y	Z	Lbs. kg
1 ¼ 32	1.660 42.4	350 2413	755 3370	0.05 1.2	2 – ⅜ x 2¼	2.75 70	4.50 114	1.88 48	1.2 0.5
1 ½ 40	1.900 48.3	350 2413	990 4415	0.05 1.2	2 – ⅜ x 2¼	3.00 76	4.75 121	1.88 48	1.2 0.5
2 50	2.375 60.3	350 2413	1550 6900	0.07 1.7	2 – ⅜ x 2½	3.50 89	5.25 133	1.88 48	1.6 0.7
2½ 65	2.875 73.0	350 2413	2270 10110	0.07 1.7	2 – ⅜ x 2½	4.00 102	5.75 146	1.88 48	1.9 .09
76.1 mm	3.000 76.1	350 2413	2475 11010	0.07 1.7	2 – ⅜ x 2½	4.13 105	5.75 146	1.88 48	1.9 0.9
3 80	3.500 88.9	350 2413	3365 14985	0.07 1.7	2 – ⅜ x 2½	4.63 118	6.13 156	1.88 48	2.1 1.0
4 100	4.500 114.3	350 2413	5565 24770	0.16 4.1	2 – ⅜ x 2½	5.75 146	7.25 184	2.13 54	3.1 1.4
108.0 mm	4.250 108.0	300 2068	4255 18940	0.16 4.1	2 – ⅜ x 2½	5.63 143	7.25 184	2.13 54	3.1 1.4
5 125	5.563 141.3	300 2068	7290 32445	0.16 4.1	2 – ½ x 3	6.88 175	9.00 229	2.13 54	4.5 2.0
133.0 mm	5.250 133.0	300 2068	6495 28900	0.16 4.1	2 – ½ x 2¾	6.63 168	9.00 229	2.13 54	4.5 2.0
139.7 mm	5.500 139.7	300 2068	7125 31715	0.16 4.1	2 – ½ x 2¾	6.88 175	9.00 229	2.13 54	4.8 2.2
6 150	6.625 168.3	300 2068	10340 46020	0.16 4.1	2 – ½ x 3	8.00 203	10.00 254	2.13 53	5.0 2.3
159.0 mm	6.250 159.0	300 2068	9200 40955	0.16 4.1	2 – ½ x 2¾	7.63 194	10.00 254	2.13 54	5.5 2.5
165.1 mm	6.500 165.1	300 2068	9955 44295	0.16 4.1	2 – ½ x 3	8.15 207	10.00 254	2.13 54	5.5 2.5
8 200	8.625 219.1	300 2068	17525 78000	0.19 4.8	2 – ⅝ x 4¼	10.50 267	13.14 334	2.63 67	11.3 5.1

* Working Pressure and End Load are total, from all internal and external loads, based on standard weight (ANSI) steel pipe, standard roll or cut grooved in accordance with Victaulic specifications. Contact Victaulic for performance on other pipe.

WARNING: FOR ONE TIME FIELD TEST ONLY, the Maximum Joint Working Pressure may be increased to 1 1/2 times the figures shown.

† The allowable pipe separation dimension shown is for system layout purposes only. Style 005 couplings are considered rigid connections and will not accommodate expansion or contraction of the piping system.

@ Number of bolts required equals number of housing segments. Metric thread size bolts are available (color coded gold) for all coupling sizes upon request. Contact Victaulic for details.

§ Style 005 couplings are VdS and LPC Approved to 12 Bar/175 psi.

FireLock® Rigid Coupling

STYLE 005

WITH VIC-PLUS™ GASKET SYSTEM (NORTH AMERICA ONLY)

MATERIAL SPECIFICATIONS

Housing: Ductile iron conforming to ASTM A-536, grade 65-45-12. Ductile iron conforming to ASTM A-395, grade 65-45-15, is available upon special request.

Housing Coating: Orange enamel (North America); red enamel (Europe)
- **Optional:** Hot dipped galvanized

Gasket:

- **Grade "E" EPDM – Type A Vic-Plus™ Gasket System Δ**
  (Violet color code). FireLock products have been Listed by Underwriters Laboratories Inc. and Approved by Factory Mutual Research for wet and dry (oil free air) sprinkler services up to the rated working pressure using the Grade "E" Type A Vic-Plus™ Gasket System, requiring no field lubrication for most installation conditions.

- **Grade "L" Silicone**
  Recommended for dry heat, air without hydrocarbons to +350°F and certain chemical services.

For dry services, Victaulic continues to recommend the use of Grade "E" Type A FlushSeal® Gasket. Contact Victaulic for details.

Bolts/Nuts: Heat-treated plated carbon steel, trackhead meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183.

Δ Standard gasket and FlushSeal gasket approved for dry pipe systems to –40°F/–40°C. Based on "typical" pipe surface conditions, supplemental lubricant is recommended for services installed below 0°F/–18°C and for all dry pipe systems or systems to be subjected to air tests prior to being filled with water. Supplemental lubrication may also be required on pipe with raised or undercut weld seams or pipe that has voids and/or cracks at the weld seams. Victaulic continues to recommend the use of FlushSeal gaskets for dry services.

VICTAULIC FLEXIBLE COUPLING

Operations & Maintenance Manual
December 2015

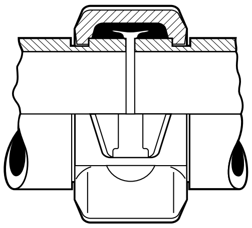
SEE VICTAULIC PUBLICATION 10.01 FOR DETAILS

Flexible Coupling

STYLE 75

Style 75 is available where moderate pressures are expected or weight considerations are a factor. Up to 50% lighter in weight than the Style 77, the Style 75 coupling is recommended for service up to 500 psi/3450 kPa depending on size. Housings are cast in two identical pieces in all sizes. Hot-dip galvanized and special coatings are available for all sizes.

The Victaulic standard flexible coupling offering for grade "EHP" or "T" gaskets is the Style 177 installation-ready flexible coupling. For all available sizes, the Style 177 is the standard flexible coupling Victaulic supplies in North America for piping systems using Grade "EHP" or "T" gaskets. Contact Victaulic for further details.



Exaggerated for clarity

MATERIAL SPECIFICATIONS

Housing: Ductile iron conforming to ASTM A-536, grade 65-45-12. Ductile iron conforming to ASTM A-395, grade 65-45-15, is available upon special request.

Housing Coating: Orange enamel.
- **Optional:** Hot dipped galvanized and others.

Gasket: (specify choice*)

- **Grade "E" EPDM**
  EPDM (Green color code). Temperature range –30°F to +230°F/–34°C to +110°C. Recommended for hot water service within the specified temperature range plus a variety of dilute acids, oil-free air and many chemical services. UL classified in accordance with ANSI/NSF 61 for cold +86°F/+30°C and hot +180°F/+82°C potable water service. NOT RECOMMENDED FOR PETROLEUM SERVICES.

- **Grade "T" nitrile**
  Nitrile (Orange color code). Temperature range –20°F to +180°F/–29°C to +82°C. Recommended for petroleum products, air with oil vapors, vegetable and mineral oils within the specified temperature range; except hot, dry air over +140°F/+60°C and water over +150°F/+66°C. NOT RECOMMENDED FOR HOT WATER SERVICES.

* Services listed are General Service Recommendations only. It should be noted that there are services for which these gaskets are not recommended. Reference should always be made to the latest Victaulic Gasket Selection Guide for specific gasket service recommendations and for a listing of services which are not recommended.

NOTE: Additional gasket styles are available. Contact Victaulic for details.

Bolts/Nuts: Heat-treated plated carbon steel, trackhead meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183.

JOB/OWNER	CONTRACTOR	ENGINEER
System No. ____________	Submitted By ____________	Spec Sect ________ Para ________
Location ____________	Date ____________	Approved ____________
		Date ____________

www.victaulic.com

Flexible Coupling

STYLE 75

DIMENSIONS

Size		Max. Work Pressure *	Max. End Load *	Allow. Pipe End Sep. †	Deflect. Fr. C_L†		Bolt/Nut@ No – Size	Dimensions – Inches/mm			Approx. Wgt. Each
Nominal Size Inches mm	Actual Outside Diameter Inches mm	psi kPa	Lbs. N	Inches mm	Per Cplg. Deg.	Pipe In./Ft. mm/m	Inches	X	Y	Z	Lbs. kg
1 25	1.315 33.4	500 3450	680 3025	0 – 0.06 0 – 1.6	2° – 43′	0.57 48	2 – ⅜ x 2	2.38 61	4.27 108	1.77 45	1.3 0.6
1 ¼ 32	1.660 42.2	500 3450	1080 4805	0 – 0.06 0 – 1.6	2° – 10′	0.45 38	2 – ⅜ x 2	2.68 68	4.61 117	1.77 45	1.4 0.6
1 ½ 40	1.900 48.3	500 3450	1420 6320	0 – 0.06 0 – 1.6	1° – 56′	0.40 33	2 – ⅜ x 2	2.91 74	4.82 122	1.77 45	1.5 0.6
2 50	2.375 60.3	500 3450	2215 9860	0 – 0.06 0 – 1.6	1° – 31′	0.32 26	2 – ⅜ x 2	3.43 87	5.22 133	1.88 48	1.7 0.8
2 ½ 65	2.875 73.0	500 3450	3245 14440	0 – 0.06 0 – 1.6	1° – 15′	0.26 22	2 – ⅜ x 2	3.88 98	5.68 144	1.88 48	1.9 0.9
76.1 mm	3.000 76.1	500 3450	3535 15730	0 – 0.06 0 – 1.6	1° – 12′	0.26 22	2 – ⅜ x 2	4.00 102	5.90 150	1.88 48	1.9 0.9
3 80	3.500 88.9	500 3450	4800 21360	0 – 0.06 0 – 1.6	1° – 2′	0.22 18	2 – ½ x 2 ¾	4.50 114	7.00 178	1.88 48	2.9 1.3
3 ½ 90	4.000 101.6	500 3450	6300 28035	0 – 0.06 0 – 1.6	0° – 54′	0.19 16	2 – ½ x 2 ¾	5.00 127	7.50 191	1.88 48	2.9 1.3
4 100	4.500 114.3	500 3450	7950 35380	0 – 0.13 0 – 3.2	1° – 36′	0.34 28	2 – ½ x 2 ¾	5.80 147	8.03 204	2.13 54	4.1 1.9
108.0 mm	4.250 108.0	450 3100	6380 28395	0 – 0.13 0 – 3.2	1° – 41′	0.35 29	2 – 12 x 70.0	5.55 141	7.79 198	2.13 54	3.7 1.7
4 ½ 120	5.000 127.0	450 3100	8820 39250	0 – 0.13 0 – 3.2	1° – 26′	0.25 21	2 – ⅝ x 3 ¼	6.13 156	9.43 240	2.13 54	5.5 2.5
5 125	5.563 141.3	450 3100	10935 48660	0 – 0.13 0 – 3.2	1° – 18′	0.27 23	2 – ⅝ x 3 ¼	6.88 175	10.07 256	2.13 54	5.8 2.6
133.0 mm	5.250 133.0	450 3100	9735 43325	0 – 0.13 0 – 3.2	1° – 21′	0.28 24	2 – 16 x 82.5	6.55 166	9.37 238	2.13 54	6.0 2.7
139.7 mm	5.500 139.7	450 3100	10665 47460	0 – 0.13 0 – 3.2	1° – 18′	0.28 24	2 – ⅝ x 3 ¼	6.80 173	9.59 244	2.13 54	6.3 2.9
152.4 mm	6.000 152.4	450 3100	12735 56670	0 – 0.13 0 – 3.2	1° – 12′	0.21 18	2 – ⅝ x 3 ¼	7.38 187	10.48 266	1.88 48	6.2 2.8
6 150	6.625 168.3	450 3100	15525 69085	0 – 0.13 0 – 3.2	1° – 5′	0.23 18	2 – ⅝ x 3 ¼	8.00 203	11.07 281	2.13 54	7.0 3.2
159.0 mm	6.250 159.0	450 3100	13800 61405	0 – 0.13 0 – 3.2	1° – 9′	0.24 20	2 – 16 x 82.5	7.63 194	10.49 266	2.13 54	6.8 3.1
8 200	8.625 219.1	450 3100	26280 116945	0 – 0.13 0 – 3.2	0° – 50′	0.18 14	2 – ¾ x 4 ¼	10.34 263	13.97 355	2.32 59	12.4 5.6

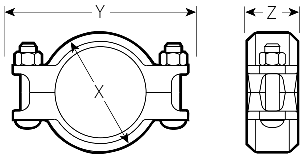
* Working Pressure and End Load are total, from all internal and external loads, based on standard weight (ANSI) steel pipe, standard roll or cut grooved in accordance with Victaulic specifications. Contact Victaulic for performance on other pipe.

WARNING: FOR ONE TIME FIELD TEST ONLY, the Maximum Joint Working Pressure may be increased to 1 1/2 times the figures shown.

† Allowable Pipe End Separation and Deflection figures show the maximum nominal range of movement available at each joint for standard roll grooved pipe. Figures for standard cut grooved pipe may be doubled. These figures are maximums; for design and installation purposes these figures should be reduced by: 50% for ¾ – 3 1/2"/20 – 90 mm; 25% for 4"/100 mm and larger.

@ Number of bolts required equals number of housing segments.

Metric thread size bolts are available (color coded gold) for all coupling sizes upon request. Contact Victaulic for details.



Flexible Coupling

STYLE 75

WARRANTY

Refer to the Warranty section of the current Price List or contact Victaulic for details.

NOTE

This product shall be manufactured by Victaulic or to Victaulic specifications. All products to be installed in accordance with current Victaulic installation/assembly instructions. Victaulic reserves the right to change product specifications, designs and standard equipment without notice and without incurring obligations.

INSTALLATION

Reference should always be made to the I-100 Victaulic Field Installation Handbook for the product you are installing. Handbooks are included with each shipment of Victaulic products for complete installation and assembly data, and are available in PDF format on our website at www.victaulic.com.

For complete contact information, visit www.victaulic.com

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VICTAULIC REDUCING COUPLINGS

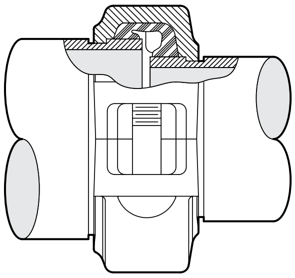
Operations & Maintenance Manual
December 2015

Reducing Coupling

SEE VICTAULIC PUBLICATION 10.01 FOR DETAILS

STYLE 750

The Style 750 Reducing Coupling permits direct reduction on the piping run. Designed to replace two couplings and a reducing fitting, the Style 750 features a special reducing gasket for pressure responsive sealing. A steel washer which prevents telescoping of the smaller pipe inside the larger pipe during vertical systems assembly is available upon request.



Exaggerated for clarity

MATERIAL SPECIFICATIONS

Housing: Ductile iron conforming to ASTM A-536, grade 65-45-12. Ductile iron conforming to ASTM A-395, grade 65-45-15, is available upon special request.

Housing Coating: Orange enamel
- **Optional:** Hot dipped galvanized and others

Gasket: (Specify choice*):

- **Grade "E" EPDM (All other sizes)**
  EPDM (Green color code). Temperature range –30°F to +230°F/–34°C to +110°C. Recommended for cold and hot water service within the specified temperature range plus a variety of dilute acids, oil-free air and many chemical services. UL classified in accordance with ANSI/NSF 61 for cold +86°F/+30°C and hot +180°F/+82°C potable water service. NOT RECOMMENDED FOR PETROLEUM SERVICES.

- **Grade "T" nitrile**
  Nitrile (Orange color code). Temperature range –20°F to +180°F/–29°C to +82°C. Recommended for petroleum products, air with oil vapors, vegetable and mineral oils within the specified temperature range. Not recommended for hot water services over +150°F/+66°C or for hot dry air over +140°F/+60°C.

* Services listed are General Service Recommendations only. It should be noted that there are services for which these gaskets are not recommended. Reference should always be made to the latest Victaulic Gasket Selection Guide for specific gasket service recommendations and for a listing of services which are not recommended.

- **Optional:** Assembly Washer: Galvanized, carbon steel

Bolts/Nuts: Heat-treated plated carbon steel, trackhead meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183.

JOB/OWNER	CONTRACTOR	ENGINEER
System No. ________	Submitted By ________	Spec Sect ______ Para ______
Location ________	Date ________	Approved ________
		Date ________

Reducing Coupling

STYLE 750

DIMENSIONS

Size			Max. Work Pressure *	Max. End Load *	Allow. Pipe End Sep. †	Deflect. Fr. C_L†		Bolt/Nut@ No - Size	Dimensions – Inches/mm			Approx. Wgt. Each
Nominal Size Inches/mm			psi kPa	Lbs. N	Inches/ mm	Per Cplg. Deg.	Pipe In./Ft. mm/m	Inches	X	Y	Z	Lbs. kg
2 50	×	1 25	350 2410	500 2225	0 – 0.07 0 – 1.8	0° – 57'	0.20 17	2 – ⅜ x 2	3.38 85	5.28 134	1.88 48	2.7 1.2
		1½ 40	350 2410	1000 4450	0 – 0.07 0 – 1.8	0° – 57'	0.20 17	2 – ⅜ x 2	3.38 85	5.28 134	1.88 48	2.0 1.0
2½ 65	×	2 50	500 3450	2215 9850	0 – 0.07 0 – 1.8	0° – 47'	0.16 14	2 – ⅜ x 2	4.00 102	5.93 151	1.88 48	3.1 1.4
76.1 mm	×	2 50	350 2410	1550 6900	0 – 0.07 0 – 1.8	0° – 47'	0.16 14	2 – ½ x 2¾	4.38 111	6.63 168	1.88 48	4.6 2.1
3 80	×	2 50	350 2410	1550 6900	0 – 0.07 0 – 1.8	0° – 39'	0.13 11	2 – ½ x 2¾	4.75 121	7.13 181	1.88 48	4.9 2.2
		2½ 65	500 3450	3250 14460	0 – 0.07 0 – 1.8	0° – 39'	0.13 11	2 – ½ x 2¾	4.75 121	7.13 181	1.88 48	4.3 2.0
88.9 mm	×	76.1 mm	350 2410	2475 11010	0 – 0.07 0 – 1.8	0° – 39'	0.13 11	2 – ½ x 2¾	4.75 121	7.13 181	1.88 48	4.2 1.9
4 100	×	2 50	350 2410	1550 6900	0 – 0.13 0 – 3.2	1° – 19'	0.28 25	2 – ⅝ x 3¼	6.25 159	8.90 226	2.25 57	8.1 3.7
		2½ 65	350 2410	2275 10125	0 – 0.13 0 – 3.2	1° – 19'	0.28 25	2 – ⅝ x 3¼	6.25 159	8.90 226	2.25 57	8.6 3.9
		3 80	500 3450	4810 21400	0 – 0.13 0 – 3.2	1° – 19'	0.28 25	2 – ⅝ x 3¼	6.00 152	8.90 226	2.25 57	6.7 3.0
114.3 mm	×	76.1 mm	350 2410	2475 11014	0 – 0.13 0 – 3.2	1° – 19'	0.28 25	2 – ⅝ x 3¼	6.25 159	8.90 226	2.25 57	6.9 3.1
5 125	×	4 100	350 2410	5565 24765	0 – 0.13 0 – 3.2	1° – 3'	0.22 19	2 – ¾ x 4¼	7.18 182	10.70 272	2.13 54	11.2 5.1
6 150	×	4 100	350 2410	5565 24765	0 – 0.13 0 – 3.2	0° – 52'	0.18 15	2 – ¾ x 4¼	8.63 181	11.90 302	2.25 57	16.7 7.6
		5 125	350 2410	8500 37825	0 – 0.13 0 – 3.2	0° – 52'	0.18 15	2 – ¾ x 4¼	8.31 211	11.90 302	2.25 57	12.9 5.9
165.1 mm	×	4 100	350 2410	5565 24765	0 – 0.13 0 – 3.2	0° – 55'	0.19 16	2 – ¾ x 4¼	8.63 219	11.90 302	2.25 57	15.2 6.9
8 200	×	6 150	350 2410	12060 53645	0 – 0.13 0 – 3.2	0° – 38'	0.13 11	2 – ⅞ x 5	10.81 275	14.88 378	2.50 64	22.4 10.2
219.1 mm	×	165.1 mm	350 2410	11610 51645	0 – 0.13 0 – 3.2	0° – 38'	0.13 11	2 – ⅞ x 5	10.75 273	14.88 378	2.50 64	23.2 10.5
10 273	×	8 219.1	350 2410	20450 90970	0 – 0.13 0 – 3.2	0° – 25'	0.9 8	2 – 1 x 5½	13.12 333	17.26 438	2.62 67	31.4 14.2

Style 750 Reducing couplings should not be used with end caps (#60) in systems where a vacuum may be developed. Contact Victaulic for details.

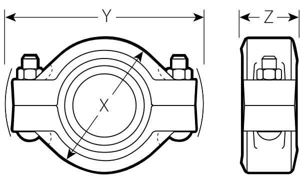
* Working Pressure and End Load are total, from all internal and external loads, based on standard weight (ANSI) steel pipe, standard **roll** or **cut** grooved in accordance with Victaulic specifications. Contact Victaulic for performance on other pipe. Maximum working pressure rating based on larger pipe size. Maximum End Load rating based on smaller pipe size. WARNING: FOR ONE TIME FIELD TEST ONLY, the Maximum Joint Working Pressure may be increased to 1½ times the figures shown.

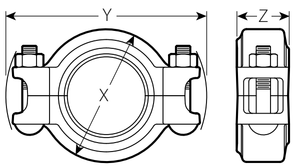
† Allowable Pipe End Separation and Deflection figures show the maximum nominal range of movement available at each joint for standard **roll** grooved pipe. Figures for standard **cut** grooved pipe may be doubled. These figures are maximums; for design and installation purposes these figures should be reduced by: 50% for ¾ – 3½"/20 – 90 mm; 25% for 4"/100 mm and larger.

@ Number of bolts required equals number of housing segments.

Metric thread size bolts are available (color coded gold) for all coupling sizes upon request. Contact Victaulic for details.

WARNING: Depressurize and drain the piping system before attempting to install, remove, or adjust any Victaulic piping products.





Reducing Coupling

STYLE 750

FLOW DATA

HEAD LOSS

The head loss across Style 750 Reducing coupling is very small and is essentially the same as for standard short body reducing pipe fittings.

Equivalent lengths of standard weight steel pipe are shown in the tables. All data is based on water flowing at ambient temperature.

FLOW REDUCING

Size			Equiv. Pipe Length
Nominal Size Inches/mm			Sm. Dia. Feet/m
2 50	×	1 25	5.9 1.8
		1½ 40	2.0 0.6
2½ 65	×	2 50	1.9 0.6
76.1 mm	×	2 50	1.9 0.6
3 80	×	2 50	5.5 1.7
		2½ 65	3.8 1.2
88.9 mm	×	76.1 mm	3.8 1.2
4 100	×	2 50	6.0 1.8
		2½ 65	6.0 1.8
		3 80	6.0 1.8
114.3 mm	×	76.1 mm	6.0 1.8
5 125	×	4 100	3.0 0.9
6 150	×	4 100	6.0 1.8
		5 125	4.5 1.4
165.1 mm	×	4 100	6.0 1.8
8 200	×	6 150	7.3 2.2
219.1 mm	×	165.1 mm	7.3 2.23
10 273	×	8 219.1	8.7 2.65

FLOW EXPANDING

Size			Equiv. Pipe Length
Nominal Size Inches/mm			Sm. Dia. Feet/m
1 25	×	2 50	2.7 0.8
1½ 40	×	2 50	1.9 0.6
2 50	×	2½ 65	1.0 0.3
		76.1 mm	1.0 0.3
		3 80	3.5 1.1
		4 100	3.0 0.9
2½ 65	×	3 80	2.5 0.8
		4 100	3.0 0.9
76.1 mm	×	88.9 mm	2.5 0.8
		114.3 mm	3.0 0.9
3 80	×	4 100	2.5 0.8
4 100	×	5 125	3.3 1.0
		6 150	4.6 1.4
		165.1 mm	4.6 1.4
5 125	×	6 150	2.3 0.7
6 150	×	8 200	6.0 1.8
165.1 mm	×	219.1 mm	5.4 1.65
8 219.1	×	10 273	6.3 19.2

VICTAULIC STYLE 744 FIRELOCK FLANGE ADAPTER

Operations & Maintenance Manual
December 2015

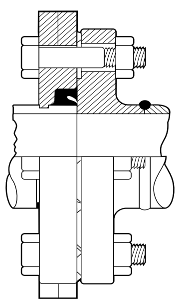
VICTAULIC® IS AN ISO 9001 CERTIFIED COMPANY

Style 744 FireLock® Flange Adapter

with Vic-Plus™ Gasket System

PRODUCT DESCRIPTION

2 - 8" Sizes



(Exaggerated for clarity)

Style 744 FireLock Flange adapter is designed for directly incorporating flanged components with ANSI CL. 125 or CL. 150 bolt hole patterns into a grooved pipe system. Sizes 2 - 8" (50 - 200 mm) are hinged for easy handling with integral end tabs which facilitate assembly.

The design incorporates small teeth inside the key shoulder I.D. to prevent rotation.

Because of the outside flange dimension, FireLock Flange adapters should not be used on FireLock fittings. When wafer or lug-type valves are used adjoining a Victaulic fitting, check disc dimensions to assure proper clearance.

FireLock Flange adapters should not be used as anchor points for tie-rods across nonrestrained joints. Mating rubber faced flanges, valves, etc., require the use of a FireLock Flange washer.

FireLock Flange adapters with Vic-Plus gaskets do not require lubrication. The gasket must always be assembled with the color coded lip on the pipe and the other lip facing the mating flange.

Style 744 FireLock Flange Adapters with the Vic-Plus™ Gasket System are designed and recommended for use ONLY on fire protection systems.

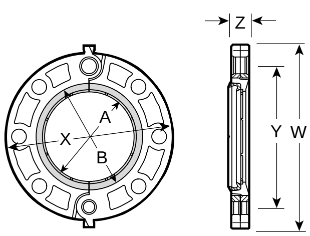
Vic-Plus Gasket System:
Victaulic® now offers a gasket system which requires no field lubrication on wet pipe systems. The Vic-Plus™ System (patented) is dry, clean, and non-toxic. It reduces assembly time substantially and eliminates the mess and chance of over-lubrication. Please refer to the latest copy of the Victaulic Field Installation Handbook (I-100) for supplemental lubrication requirements.

See Victaulic publication 10.01 for details.

DIMENSIONS

Style 744

Sizes 2 - 8" (50 - 200 mm)
ANSI Class 125 and 150 Flange



Note: Gray area of mating face must be free from gouges, undulations or deformities of any type for effective sealing.

Pipe Size		Max. Work Press.*	Max. End Load*	No. Bolts †	Bolt Size †	Sealing Surface Inches/mm		Dimensions Inches/millimeters				Aprx. Wgt. Each
Nominal Diameter In./mm	Actual Outside Diameter In./mm	PSI kPa	Lbs. N	Req'd.	Inches	"A" Max.	"B" Min.	W	X	Y	Z	Lbs. kg
2 50	2.375 60,3	175 1200	775 3450	4	5/8 X 2 3/4	2.38 60	3.41 87	6.75 172	6.00 152	4.75 121	0.75 19	2.7 1,2
2 1/2 65	2.875 73,0	175 1200	1135 5050	4	5/8 X 3	2.88 73	3.91 99	7.88 200	7.00 178	5.50 140	0.88 22	4.2 1,9
3 80	3.500 88,9	175 1200	1685 7500	4	5/8 X 3	3.50 89	4.53 115	8.44 214	7.50 191	6.00 152	0.94 24	4.8 2,2
4 100	4.500 114,3	175 1200	2780 11045	8	5/8 X 3	4.50 114	5.53 141	9.94 252	9.00 229	7.50 191	0.94 24	7.1 3,2
5 125	5.563 141,3	175 1200	4250 18920	8	3/4 X 3 1/2	5.56 141	6.71 171	11.00 279	10.00 254	8.50 216	1.00 25	8.3 3,8
6# 150	6.625 168,3	175 1200	6030 26840	8	3/4 X 3 1/2	6.63 168	7.78 198	12.00 305	11.00 279	9.50 241	1.00 25	9.3 4,2
8# 200	8.625 219,1	175 1200	10219 45475	8	3/4 X 3 1/2	8.63 219	9.94 252	14.63 372	13.50 343	11.75 298	1.13 29	13.9 6,3

*Refer to notes below.

†Total bolts required to be supplied by installer. Bolt sizes for conventional flange-to-flange connection. Larger bolts are required when Vic-Flange adapter is utilized with wafer-type valves.

Not available with Vic-Plus gasket system. Lubrication is required.

NOTES

* Working Pressure and End Load are total, from all internal and external loads, based on standard weight steel pipe, standard roll or cut grooved in accordance with Victaulic specifications. Contact Victaulic for performance on other pipe.

WARNING: FOR ONE TIME FIELD TEST ONLY, the Maximum Joint Working Pressure may be increased to 1½ times the figures shown.

Style 744 FireLock Flange adapters provide rigid joints when used on pipe with standard roll or cut groove dimensions and consequently allow no linear or angular movement at the joint.

WARNING: Depressurize and drain the piping system before attempting to install, remove, or adjust any Victaulic piping products.

1477 REV D

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VIC-FLANGE ADAPTER NOTES

1 The Style 744 (2 - 8"/50 - 200 mm) design incorporates small teeth inside the key shoulder I.D. to prevent rotation.

2 FireLock Flange adapter should not be used on FireLock fittings. When wafer or lug-type valves are used adjoining a Victaulic fitting, check disc dimensions to assure proper clearance.

3 FireLock Flange adapters should not be used as anchor points for tie-rods across nonrestrained joints. Mating rubber faced flanges, valves, etc. require the use of a FireLock Flange washer.

4 Area A-B noted in the above drawing must be free from gouges, undulations or deformities of any type for effective sealing.

5 FireLock Flange adapter gaskets must always be assembled with the color coded lip on the pipe and the other lip facing the mating flange.

6 Flange Washers: FireLock Flange adapters require a smooth hard surface at the mating flange face for effective sealing. Some applications for which the Vic-Flange adapter is otherwise well suited do not provide an adequate mating surface. In such cases, it is recommended that a metal Flange Washer be inserted between the FireLock Flange adapter and the mating flange to provide the necessary sealing surface.

Typical applications where a Flange Washer should be used are:

A When mating to a serrated flange: a standard flat flange gasket should be used adjacent to the serrated flange and then the Flange Washer is inserted between the FireLock Flange adapter and the flange gasket.

B When mating to a wafer valve: where typical valves are rubber lined and partially rubber faced (smooth or not), the Flange Washer is placed between the valve and the FireLock Flange adapter.

C When mating a rubber faced flange: the Flange Washer is placed between the FireLock Flange adapters and the rubber faced flange.

D When mating AWWA cast flanges to IPS flanges: the Flange Washer is placed between two FireLock Flanges. The hinge points must be oriented approximately 90° to each other. If one flange is not a FireLock Flange adapter (e.g. flanged valve), then a standard flat flange gasket must be placed adjacent to that flange and the Flange Washer inserted between the flange gasket and the FireLock Flange adapter.

E When mating to components (valves, strainers, etc.) where the component flange face has an insert: follow the same arrangement as in Application 1.

F When mating to a Series 705-W Butterfly valve, Style 744 may only be used on one side of the connection.

When ordering Flange Washers, always specify product style (Style 744) and size to assure proper Flange Washer is supplied.

MATERIAL SPECIFICATIONS

Flange Housing: Ductile iron conforming to ASTM A-536, grade 65-45-12. Ductile iron conforming to ASTM A-395, grade 65-45-15, is available upon special request.

Coating: Black enamel

- **Optional:** Hot dipped galvanized

Bolts/Nuts: Supplied by installer

Gasket:

- **Grade “E” EPDM - Type A Vic-Plus Gasket System Δ**
  (Violet color code). FireLock products have been Listed by Underwriters Laboratories Inc. and Approved by Factory Mutual Research for wet and dry (oil free air) sprinkler services up to the rated working pressure using the Grade “E” Type A Vic-Plus Gasket System, requiring no field lubrication for most installation conditions.

Δ Standard gasket approved for dry pipe systems to –40°F (–40°C). Based on “typical” pipe surface conditions, supplemental lubricant is recommended for services installed below 0°F (-18°C) and for all dry pipe systems or systems to be subjected to air tests prior to being filled with water. Supplemental lubrication may also be rquired on pipe with raised or undercut weld seams or pipe that has voids and/or cracks at the weld seams.

<u>VICTAULIC FIRELOCK OUTLET-T</u>

Operations & Maintenance Manual
December 2015

FireLock® Outlet-T

SEE VICTAULIC PUBLICATION 10.01 FOR DETAILS

STYLE 922

The Style 922 Outlet-T provides a convenient method of incorporating ½, ¾, and 1"/15, 20 and 25 mm outlets for directly connecting sprinklers, drop nipples, sprigs, gauges, drains and other outlet products. Available for 1¼ through 76.1 mm/32 to 76.1 mm piping systems, Style 922 outlets are UL/ULC Listed, LPCB and FM Approved for branch connections and VdS Approved for direct sprinkler connection only on wet and dry systems.

The locating collar engages into the hole prepared in the pipe. When tightened, the assembly compresses the gasket onto the OD of the pipe. The Style 922 Outlet-T is UL/FM rated up to 300 psi/2068 kPa and VdS rated up to 16 bar at the ambient temperatures typical for fire protection systems.

Style 922 is suitable for use on standard, lightwall, Schedule 5 and other specialty pipes.* Contact Victaulic for other optional coatings.

*Consult Section 10.01 for specific listings/approvals.

MATERIAL SPECIFICATIONS

Housing: Ductile iron conforming to ASTM A-536, grade 65-45-12. Ductile iron conforming to ASTM A-395, grade 65-45-15, is available upon special request.

Gasket:
- **Grade "E" EPDM - Type A**
  (Violet color code). FireLock products have been Listed by Underwriters Laboratories Inc. and Approved by Factory Mutual Research for wet and dry (oil free air) sprinkler services up to the rated working pressure using the Grade "E" Type A Gasket System.

Bolts/Nuts: Heat-treated plated carbon steel, trackhead meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183.

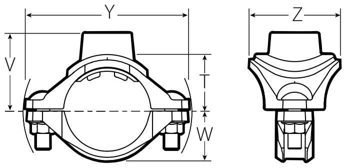
Housing Coating:
- Orange enamel (North America, Latin America, Asia Pacific)
- Red enamel (Europe)

JOB/OWNER	CONTRACTOR	ENGINEER
System No. ______	Submitted By ______	Spec Sect ______ Para ______
Location ______	Date ______	Approved ______
		Date ______

FireLock® Outlet-T

STYLE 922

DIMENSIONS



Nominal Size inches/mm			Hole Diameter	Dimensions – inches/millimeters					Approx. Weight Each
Run X Branch FPT†			+0.06/+1.5 -0.00/-0.0	T*	V	W	Y	Z	lbs/kg
1 ¼ 32	X	½ 15	1 3⁄16 30.2	1.30 33.0	1.83 46.5	1.10 27.9	3.87 98.3	2.56 65.0	1.0 0.45
		¾ 20	1 3⁄16 30.2	1.28 32.5	1.83 46.5	1.10 27.9	3.87 98.3	2.56 65.0	1.1 0.50
		1 25	1 3⁄16 30.2	1.52 38.6	2.18 55.4	1.10 27.9	3.87 98.3	2.56 65.0	1.2 0.54
1 ½ 40	X	½ 15	1 3⁄16 30.2	1.42 36.1	1.95 49.5	1.22 31.0	4.08 103.6	2.56 65.0	1.2 0.54
		¾ 20	1 3⁄16 30.2	1.40 35.6	1.95 49.5	1.22 31.0	4.08 103.6	2.56 65.0	1.2 0.54
		1 25	1 3⁄16 30.2	1.64 41.7	2.30 58.4	1.22 31.0	4.08 103.6	2.56 65.0	1.3 0.59
2 50	X	½ 15	1 3⁄16 30.2	1.66 42.2	2.19 55.6	1.46 37.1	4.60 116.8	2.56 65.0	1.3 0.59
		¾ 20	1 3⁄16 30.2	1.64 41.7	2.19 55.6	1.46 37.1	4.60 116.8	2.56 65.0	1.4 0.64
		1 25	1 3⁄16 30.2	1.88 47.8	2.54 64.5	1.46 37.1	4.60 116.8	2.56 65.0	1.5 0.68
2 ½ 65	X	½ 15	1 3⁄16 30.2	1.91 48.5	2.44 62.0	1.71 43.4	5.40 137.2	2.56 65.0	1.6 0.73
		¾ 20	1 3⁄16 30.2	1.89 48.0	2.44 62.0	1.71 43.4	5.40 137.2	2.56 65.0	1.6 0.73
		1 25	1 3⁄16 30.2	2.13 54.1	2.79 70.9	1.71 43.4	5.40 137.2	2.56 65.0	1.6 0.73
76.1 mm	X	½ 15	1 3⁄16 30.2	1.91 48.5	2.44 62.0	1.71 43.4	5.50 139.7	2.56 65.0	1.6 0.73
		¾ 20	1 3⁄16 30.2	1.89 48.0	2.44 62.0	1.71 43.4	5.50 139.7	2.56 65.0	1.6 0.73
		1 25	1 3⁄16 30.2	2.13 54.1	2.79 70.9	1.71 43.4	5.50 139.7	2.56 65.0	1.7 0.80

† Victaulic female threaded products are designed to accommodate standard NPT or BSPT (optional) male pipe threads only. Use of male threaded products with special features, such as probes, dry pendent sprinklers, etc., should be verified as suitable for use with this Victaulic product. Failure to verify suitability in advance may result in assembly problems or leakage.

*Center of run to engaged pipe end for NPT threads (dimensions are approximate).

FireLock® Outlet-T

STYLE 922

PERFORMANCE

Run Size x Outlet Size			Equivalent Length of 1 inch Schedule 40 Steel Pipe (per UL 213, Section 16) (C=120)*, FT
Inches/mm			Feet/meters
1 ¼ 32	X	1 25	8.5 2.6
1 ½ 40	X	1 25	8.5 2.6
2 50	X	1 25	8.5 2.6
2 ½ 65	X	1 25	8.5 2.6
76.1 mm	X	1 25	8.5 2.6

* Hazen-Williams coefficient of friction is 120

VICTAULIC MECHANICAL-T BOLTED BRANCH OUTLETS

Operations & Maintenance Manual
December 2015

Mechanical-T® Bolted Branch Outlets

SEE VICTAULIC PUBLICATION 10.01 FOR DETAILS

STYLES 920 AND 920N

Victaulic Mechanical-T® Outlet provides a direct branch connection at any location a hole can be cut in pipe. The hole is cut oversize to receive a “holefinder” locating collar which secures the outlet in position permanently. A pressure responsive gasket seals on the pipe O.D.

Cross-type connections can be achieved by utilizing two upper housings of the same style and size, with the same or differing branch size connections. NOTE: Style 920 and Style 920N housings cannot be mated to each other to achieve a cross connection.

Style 920 and Style 920N Mechanical-T outlets are available with grooved or female threaded outlet. Specify choice on order. Units are supplied painted with plated bolts. Galvanized housings are available, supplied with plated bolts.

All sizes of Style 920 and 920N are rated at 500 psi/3450 kPa working pressure on Schedule 10 and 40 carbon steel pipe. They may also be used on high density polyethylene or polybutylene (HDPE) pipe. Pressure ratings on HDPE are dependent on the pipe rating. Contact Victaulic for ratings on other pipe. **Style 920 and 920N are not recommended for use on PVC plastic pipe.**

Standard piping practices dictate that the Mechanical-T Styles 920 and 920N must be installed so that the main and branch connections are a true 90° angle when permanently attached to the pipeline surface.

Additionally, the Vic-Tap II® hole cutting tool, which allows for hole cutting capabilities on pressurized systems, utilizes the Style 920 Mechanical-T in conjunction with the Series 726 Vic-Ball Valve to create the Style 931 Vic-Tap II Mechanical-T unit. See page 8 for further information.

STYLES 920 AND 920N

STYLE 920 CROSS

PATENTED

MATERIAL SPECIFICATIONS

Housing/Coating: Ductile iron conforming to ASTM A-536, grade 65-45-12, with orange enamel coating. Ductile iron conforming to ASTM A-395, grade 65-45-15, is available upon special request.

- **Optional:** Hot dipped galvanized

Gasket: (Specify choice*)

- **Grade “E” EPDM**
  EPDM (Green color code). Temperature range –30°F to +230°F/–34°C to +110°C. Recommended for cold and hot water service within the specified temperature range plus a variety of dilute acids, oil-free air and many chemical services. UL Classified in accordance with ANSI/NSF 61 for cold +86°F/+30°C and hot +180°F/+82°C. NOT RECOMMENDED FOR PETROLEUM SERVICES.

- **Grade “T” nitrile**
  Nitrile (Orange color code). Temperature range –20°F to +180°F/–29°C to +82°C. Recommended for petroleum products, air with oil vapors, vegetable and mineral oils within the specified temperature range. Not recommended for hot water services over +150°F/+66°C or for hot dry air over +140°F/+60°C.

*Services listed are General Service Recommendations only. It should be noted that there are services for which these gaskets are not recommended. Reference should always be made to the latest Victaulic Gasket Selection Guide for specific gasket service recommendations and for a listing of services which are not recommended.

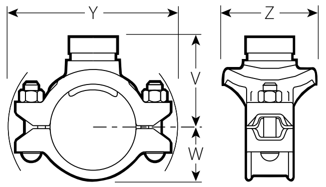
Bolts/Nuts: Heat-treated plated carbon steel, trackhead meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183.

JOB/OWNER	CONTRACTOR	ENGINEER
System No. ______	Submitted By ______	Spec Sect ______ Para ______
Location ______	Date ______	Approved ______
		Date ______

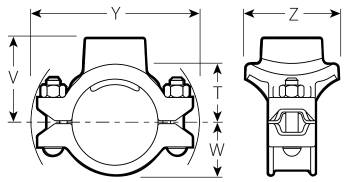
Mechanical-T® Bolted Branch Outlets

STYLES 920 AND 920N

DIMENSIONS



GROOVED OUTLET



FEMALE THREADED OUTLET

- Provides a direct branch connection at any location where a hole can be cut in the pipe
- A pressure responsive gasket provides the seal
- Request Publication 11.03 for Mechanical-T cross assemblies
- Pressure rated up to 500 psi/3450 kPa on steel pipe; also available for use with HDPE pipe
- Sizes from 2 × ½"/50 × 15 mm through 8 × 4"/200 × 100 mm

Size			Style No.	Max. Work Pressure@	Dimensions							Approx. Weight Each	
Run × Branch Nominal Size Inches mm			920 or 920N	psi kPa	Hole Diameter +0.13 -0.00	T** Inches mm	V ‡ # Thd. Inches mm	V ‡ Grv. Inches mm	W Inches mm	Y Inches mm	Z Inches mm	Female Thd. Lbs. kg	Grv. Lbs. kg
2 50	×	½ (a) ¤ 15	920N	500 3450	1.50 38.1	2.00 51	2.53 64	—	1.61 41	5.35 136	2.75 70	3.1 1.5	—
		¾ (a) ¤ 20	920N	500 3450	1.50 38.1	1.97 50	2.53 64	—	1.61 41	5.35 136	2.75 70	3.1 1.5	—
		1 (a) ¤ 25	920N	500 3450	1.50 38.1	1.85 47	2.53 64	—	1.61 41	5.35 136	2.75 70	3.0 1.4	—
		1 ¼ (a) †¤ 32	920N	500 3450	1.75 44.5	2.05 52	2.75 70	3.00 76	1.61 41	5.35 136	3.00 76	3.5 1.7	3.2 1.5
		1 ½ (a) †¤ 40	920N	500 3450	1.75 44.5	2.03 52	2.75 70	3.12 79	1.61 41	5.35 136	3.25 83	3.6 1.7	3.2 1.5
2 ½ 65	×	½ (a) §¤ 15	920N	500 3450	1.50 38.1	2.21 56	2.74 70	—	1.82 46	5.64 143	2.75 70	3.0 1.4	—
		¾ (a) §¤ 20	920N	500 3450	1.50 38.1	2.18 55	2.74 70	—	1.82 46	5.64 143	2.75 70	3.0 1.4	—
		1 (a) §¤ 25	920N	500 3450	1.50 38.1	2.06 52	2.74 70	—	1.82 46	5.64 143	2.75 70	2.9 1.4	—
		1 ¼ † (a) ¤ 32	920N	500 3450	1.75 44.5	2.30 58	3.00 76	3.25 83	1.82 46	6.29 160	3.00 76	3.5 1.7	3.2 1.5
		1 ½ † (a) ¤ 40	920N	500 3450	2.00 50.8	2.28 58	3.00 76	3.25 83	1.82 46	6.26 159	3.25 83	3.6 1.7	3.3 1.6
76.1	×	½ (a) 15	920N	300 2065	1.50 38.1	2.22 56	2.75 70	—	2.25 57	6.46 164	3.18 81	3.9 1.8	—
		¾ (a) 20	920N	300 2065	1.50 38.1	2.19 56	2.75 70	—	2.25 57	6.46 164	3.18 81	3.9 1.8	—
		1 (a) 25	920N	300 2065	1.50 38.1	2.07 53	2.75 70	—	2.25 57	6.46 164	3.18 81	3.8 1.7	—
		1 ¼ (a) ¤ 32	920N	500 3450	1.75 44.5	2.30 58	3.00 76	3.31 84	1.92 49	6.29 160	3.00 76	3.5 1.6	3.2 1.5
		1 ½ (a) ¤ 40	920N	500 3450	2.00 50.8	2.28 58	3.00 76	3.31 84	1.92 49	6.29 160	3.25 83	3.5 1.6	3.3 1.5
3 80	×	½ (a) ¤ 15	920N	500 3450	1.50 38.1	2.52 64	3.05 78	—	2.28 58	6.15 156	2.75 70	3.4 1.6	—
		¾ (a) ¤ 20	920N	500 3450	1.50 38.1	2.49 63	3.05 78	—	2.28 58	6.15 156	2.75 70	3.4 1.6	—
		1 (a) 25	920N	500 3450	1.50 38.1	2.38 61	3.06 78	—	2.28 58	6.15 156	2.75 70	3.3 1.6	—
		1 ¼ (a) †¤ 32 (b)	920N	500 3450	1.75 44.5	2.55 65	3.25 83	3.56 90	2.28 58	6.15 156	3.00 76	3.8 1.8	3.7 1.8
		1 ½ (a) †¤ 40 (b)	920N	500 3450	2.00 50.8	2.78 71	3.50 89	3.56 90	2.28 58	6.15 156	3.25 83	4.1 1.9	3.8 1.8
		2 (a) ¤ 50	920N	500 3450	2.50 63.5	2.75 70	3.50 89	3.56 90	2.28 58	6.75 172	3.88 99	4.9 2.3	4.6 2.1
3 ½ 90	×	2 50	920N	500 3450	2.50 63.5	3.00 76	—	3.75 95	2.44 62	6.72 171	3.88 99	—	3.8 1.8

TABLE CONTINUED ON PG. 3

** Center of run to engaged pipe end, female threaded outlet only (dimensions approximate).

† Available with grooved or female threaded outlet. Specify choice on order.

‡ Center of run to end of fitting.

\# Female threaded outlets are available to NPT and BSPT specifications.

@ See page 7 for Fire Protection approvals and pressure ratings.

(a) British Standard female pipe threaded outlet is available as listed. Specify "BSPT" clearly on order.

(b)For 76.1 mm threaded outlet, specify 2½" BSPT clearly on order.

§ Vds approved for fire protection services

¤ LPCB approved for fire protection services

Ø Approved for use in China by Tianjin Approvals Company.

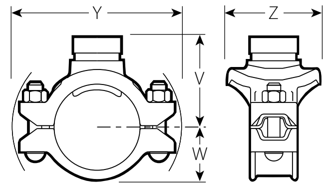
IMPORTANT NOTES:

Style 920 and Style 920N housings cannot be mated to one another
to achieve cross connections.

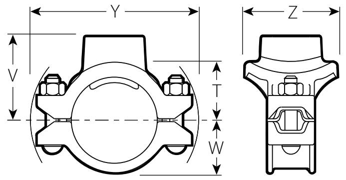
Mechanical-T® Bolted Branch Outlets

STYLES 920 AND 920N

DIMENSIONS



GROOVED OUTLET



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Size Run × Branch Nominal Size Inches mm		Style No. 920 or 920N	Max. Work Pressure@ psi kPa	Dimensions Hole Diameter +0.13 -0.00	Dimensions T** Inches mm	Dimensions V ‡ # Thd. Inches mm	Dimensions V ‡ Grv. Inches mm	Dimensions W Inches mm	Dimensions Y Inches mm	Dimensions Z Inches mm	Approx. Weight Each Female Thd. Lbs. kg	Approx. Weight Each Grv. Lbs. kg
TABLE CONTINUED FROM PAGE 2												
4 100 ×	½ (a) ¤ 15	920N	500 3450	1.50 38.1	3.03 77	3.56 90	—	2.69 68	7.01 178	2.75 70	3.7 1.8	—
	¾ (a) ¤ 20	920N	500 3450	1.50 38.1	3.00 76	3.56 90	—	2.69 68	7.01 178	2.75 70	3.7 1.8	—
	1 (a) ¤ 25	920N	500 3450	1.50 38.1	2.88 73	3.56 90	—	2.69 68	7.01 178	2.75 70	3.6 1.8	—
	1 ¼ (a) †¤ 32 (b)	920N	500 3450	1.75 44.5	3.08 78	3.78 96	4.00 102	2.69 68	7.01 178	3.00 76	4.0 1.9	3.6 1.8
	1 ½ (a) †¤ 40 (b)	920N	500 3450	2.00 50.8	3.28 83	4.00 102	4.00 102	2.69 68	7.01 178	3.25 83	4.2 2.0	3.9 1.9
	2 (a) †¤ 50	920N	500 3450	2.50 63.5	3.25 83	4.00 102	4.00 102	2.69 68	7.01 178	3.88 99	5.0 2.3	4.6 2.1
	2½ (a) † 65	920	500 3450	2.75 69.9	2.88 73	4.00 102	4.00 102	2.69 68	7.34 186	4.63 118	5.8 2.6	5.0 2.3
	76.1 mm	920	500 3450	2.75 69.9	2.88 73	—	4.00 102	2.69 68	7.34 186	4.63 118	—	6.4 2.9
	3 (a) † 80	920	500 3450	3.50 88.9	3.31 84	4.50 114	4.12 105	2.69 68	7.73 196	5.12 130	8.4 3.8	6.4 2.9
108.0 ×	1 ¼ (a)¤ 32	920N	500 3450	1.75 44.5	3.08 78	3.78 96	—	2.63 67	7.64 194	3.05 78	5.0 2.3	—
	1 ½ (a)¤ 40	920N	500 3450	2.00 50.8	3.28 83	4.00 102	—	2.63 67	7.64 194	3.25 83	5.0 2.3	—
	2 (a) 50	920N	500 3450	2.50 63.5	3.25 83	4.00 102	—	2.63 67	7.64 194	4.00 102	4.0 1.9	—
	76.1 mm	920	500 3450	2.75 69.9	2.88 73	4.00 102	4.00 102	2.63 67	7.64 194	4.29 109	8.0 3.6	7.8 3.5
	3 (a) 80	920	500 3450	3.50 88.9	3.31 84	4.50 114	4.50 114	2.63 67	7.63 194	4.88 124	6.8 3.1	6.5 3.0
5 125 ×	1 ½ (a) † 40	920	500 3450	2.00 50.8	4.03 102	4.75 121	4.75 121	3.16 80	9.70 246	3.69 94	7.4 3.4	7.6 3.4
	2 (a) † 50	920	500 3450	2.50 63.5	4.00 102	4.75 121	4.75 121	3.16 80	9.70 246	4.38 111	8.2 3.7	8.0 3.6
	2½ (a) † 65	920	500 3450	2.75 69.9	3.63 92	4.75 121	4.75 121	3.16 80	9.70 246	4.63 118	8.3 3.8	7.9 3.6
	76.1 mm ¤	920	500 3450	2.75 69.9	3.75 95	—	4.75 121	3.16 80	9.70 246	4.63 118	—	8.0 3.6
	3 (a) † 80	920	500 3450	3.50 88.9	3.81 97	5.00 127	4.63 118	3.16 80	9.70 246	5.31 135	8.4 3.8	8.8 4.0
133.0 ×	2 50	920N	500 3450	2.50 63.5	3.75 95	4.50 114	—	3.17 81	8.00 203	3.88 99	8.0 3.6	—
	3 80	920	500 3450	3.50 88.9	3.81 97	5.00 127	—	3.00 76	9.46 240	5.31 135	8.0 3.6	—
TABLE CONTINUED ON PG. 4												

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Female threaded outlets are available to NPT and BSPT specifications.

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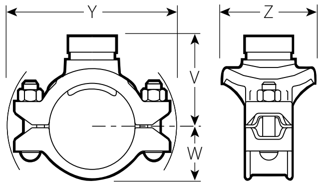
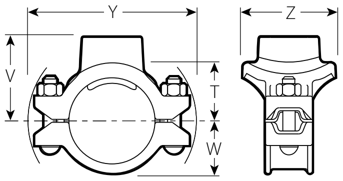
Mechanical-T® Bolted Branch Outlets

STYLES 920 AND 920N

DIMENSIONS



GROOVED OUTLET



FEMALE THREADED OUTLET

- Provides a direct branch connection at any location where a hole can be cut in the pipe
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- Sizes from 2 × ½"/50 × 15 mm through 8 × 4"/200 × 100 mm

Size		Style No.	Max. Work Pressure@	Dimensions							Approx. Weight Each	
Run × Branch Nominal Size Inches mm		920 or 920N	psi kPa	Hole Diameter +0.13 -0.00	T** Inches mm	V ‡ # Thd. Inches mm	V ‡ Grv. Inches mm	W Inches mm	Y Inches mm	Z Inches mm	Female Thd. Lbs. kg	Grv. Lbs. kg
TABLE CONTINUED FROM PAGE 3												
139.7 ×	1 ½ † 40	920N	500 3450	2.00 50.8	3.78 96	4.50 114	—	3.30 84	8.23 209	3.25 83	7.0 3.2	—
	2 † 50	920N	500 3450	2.50 63.5	3.75 95	4.50 114	—	3.30 84	8.23 209	3.88 99	9.0 4.1	—
6 150 ×	1 ¼ (a) 32 (b)	920N	500 3450	1.75 44.5	4.43 112	5.13 130	5.13 130	3.79 96	9.15 232	3.25 83	5.1 2.3	4.8 2.2
	1 ½ (a) †¤ 40 (b)	920N	500 3450	2.00 50.8	4.40 112	5.13 130	5.13 130	3.79 96	9.15 232	3.25 83	5.4 2.4	5.1 2.3
	2 (a) †¤ 50	920N	500 3450	2.50 63.5	4.38 111	5.13 130	5.13 130	3.79 96	9.15 232	3.88 99	6.0 2.7	5.6 2.5
	2 ½ 65	920	500 3450	2.75 69.9	4.01 110	5.13 130	5.12 130	3.69 94	10.51 267	4.63 118	8.3 3.8	7.6 3.4
	76.1 mm ¤	920	500 3450	2.75 69.9	4.15 105	—	5.21 132	3.69 94	10.51 267	4.63 118	—	8.4 3.8
	3 (a) † 80	920	500 3450	3.50 88.9	4.31 110	5.50 140	5.13 130	3.69 94	10.51 267	5.31 135	9.9 4.5	8.4 3.8
	4 (a) †¤ 100	920	500 3450	4.50 114.3	3.81 97	5.75 146	5.38 137	3.69 94	10.51 267	6.25 159	10.1 4.6	10.1 4.6
159.0 ×	1 ½ (a) 40	920N	500 3450	2.00 50.8	4.41 112	5.13 130	—	3.63 92	9.40 239	3.25 83	7.8 3.5	—
	2 (a) 50	920N	500 3450	2.50 63.5	4.38 111	5.13 130	—	3.63 92	9.40 239	3.88 99	8.0 3.6	—
	76.1 mm	920	500 3450	2.75 69.9	4.38 111	5.50 140	5.13 130	3.63 92	9.40 239	4.63 118	9.5 4.3	9.5 4.3
	3 80	920	500 3450	3.50 88.9	4.31 110	5.50 140	5.13 130	3.63 92	9.40 239	5.31 135	8.1 3.7	14.0 6.4
	108.0mm	920	500 3450	4.50 114.3	4.45 113	—	5.38 137	3.63 92	9.40 239	6.12 155	—	10.0 4.5
	4 100	920	500 3450	4.50 114.3	3.81 96.80	5.75 146	—	3.63 92	9.40 239	6.25 159	18.0 8.2	—
TABLE CONTINUED ON PG. 5												

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‡ Center of run to end of fitting.

Female threaded outlets are available to NPT and BSPT specifications.

@ See page 7 for Fire Protection approvals and pressure ratings.

(a) British Standard female pipe threaded outlet is available as listed. Specify "BSPT" clearly on order.

(b) For 76.1 mm threaded outlet, specify 2½" BSPT clearly on order.

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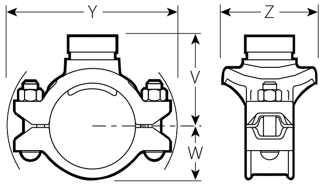
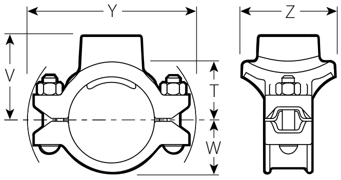
STYLES 920 AND 920N

DIMENSIONS



GROOVED OUTLET



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Size Run × Branch Nominal Size Inches mm		Style No. 920 or 920N	Max. Work Pressure@ psi kPa	Dimensions Hole Diameter +0.13 -0.00	T** Inches mm	V ‡ # Thd. Inches mm	V ‡ Grv. Inches mm	W Inches mm	Y Inches mm	Z Inches mm	Approx. Weight Each Female Thd. Lbs. kg	Grv. Lbs. kg
TABLE CONTINUED FROM PAGE 4												
165.1 ×	1 25	920N	500 3450	1.50 38.1	3.88 99	4.56 116	—	3.79 96	9.34 237	2.75 70	8.0 3.6	—
	1 ¼ ¤ 32	920N	500 3450	1.75 44.5	4.43 113	5.13 130	—	3.79 96	9.34 237	3.25 83	8.4 3.8	—
	1 ½ (a) †¤ 40	920N	500 3450	2.00 50.8	4.41 112	5.13 130	5.13 130	3.79 96	9.34 237	3.25 83	8.4 3.8	5.4 2.4
	2 (a) † 50	920N	500 3450	2.50 63.5	4.38 111	5.13 130	5.13 130	3.79 96	9.34 237	3.88 99	8.5 3.9	6.0 2.7
	76.1 mm	920	500 3450	2.75 69.9	4.01 110	5.13 130	5.21 132	3.63 92	10.51 267	4.63 118	8.6 3.9	7.6 3.4
	3 (a) † ø 80	920	500 3450	3.50 88.9	4.31 110	5.50 140	5.13 130	3.63 92	10.51 267	5.31 135	10.2 4.6	8.4 3.8
	4 (a) †¤ 100	920	500 3450	4.50 114.3	3.81 97	5.75 146	5.38 137	3.63 92	10.51 267	6.25 159	10.5 4.8	8.4 3.8
8 200 ×	2 (a) † 50	920	500 3450	2.75 69.9	5.44 138	6.19 157	6.25 159	4.81 122	12.42 316	4.50 114	11.6 5.3	11.6 5.3
	2½ (a) † 65	920	500 3450	2.75 69.9	5.07 129	6.19 157	6.19 157	4.81 122	12.42 316	4.50 114	11.6 5.3	11.6 5.3
	76.1 mm ¤	920	500 3450	2.75 69.9	5.25 133	—	6.25 159	4.81 122	12.42 316	4.56 116	—	11.6 5.3
	3 (a) †¤ 80	920	500 3450	3.50 88.9	5.31 135	6.50 165	6.50 165	4.81 122	12.42 316	5.31 135	12.6 5.7	11.6 5.3
	4 (a) †¤ 100	920	500 3450	4.50 114.3	4.81 122	6.75 171	6.38 162	4.81 122	12.42 316	6.25 159	15.3 6.9	12.5 5.7

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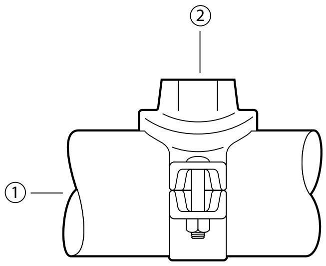
Mechanical-T® Bolted Branch Outlets

STYLES 920 AND 920N

FLOW DATA

Flow test data has shown that the total head loss between point (1) and (2) for the Style 920, 920N and 929 Mechanical-T® fittings can best be expressed in terms of the pressure difference across the inlet and branch. The pressure difference can be obtained from the relationship below.



Exaggerated for clarity

C_V and Kv Values

Values for flow of water at +60°F/+16°C are shown in the table below.

Formulas for C_V /K_v Values:

$\Delta P = \frac{Q^2}{C_v^2}$

$Q = C_v \times \sqrt{\Delta P}$

Where:
Q = Flow (GPM)
ΔP = Pressure Drop (psi)
C_v = Flow Coefficient

$\Delta P = \frac{Q^2}{K_v}$

$Q = K_v \times \sqrt{\Delta P}$

Where:
Q = Flow (m³/h)
ΔP = Pressure Drop (bar)
K_v = Flow Coefficient

OUTLET SIZE		Equivalent Length of Outlet Size Schedule 40 Carbon Steel Pipe (per UL 213, Sec. 16) (C = 120)ŧ FT		C_V/K_V Values	
NOMINAL DIAMETER In/mm	ACTUAL O.D. In/mm	GROOVED	THREADED	GROOVED	THREADED
½ 15	0.840 21.3	-	2	-	11 9.4
¾ 20	1.050 26.7	-	4	-	16 13.7
1 25	1.315 33.7	-	8	-	21 1.8
1 ¼ 32	1.660 42.7	5 ½	6	50 42.9	48 41.1
1 ½ 40	1.900 98.3	11	11	53 45.4	53 45.4
2 50	2.375 60.3	9	10 ½	112 96	104 89.1
2 ½ 65	2.875 73.0	20	12 ½	119 102	150 128.5
76.1 mm	3.000 76.1	16*	-	161 138.1	-
3 80	3.500 88.9	14	15 ½	249 213.4	237 203.1
4 100	4.500 114.3	20	22	421 360.8	401 343.6

ŧ Hazen-Williams coefficient of friction is 120.
* Pipe with a wall thickness of 0.165in./4.2mm.

Mechanical-T® Bolted Branch Outlets

STYLES 920 AND 920N

FIRE PROTECTION APPROVALS AND PRESSURE RATINGS

The information provided below is based on the latest listing and approval data at the time of publication. Listings/Approvals are subject to change and/or additions by the approvals agencies. Contact Victaulic for performance on other pipe and the latest listings and approvals.

Run Size		Outlet Size	Pipe	Approval Agency Rated Working Pressures – psi/kPa					
								Vds	
Nominal Size Inches/mm	Actual Outside Diameter Inches/mm	Inches/mm	Schedule	UL	ULC	FM	LPCB	(Style 920)	(Style 920N)
21/2 - 6 65 - 150	2.875 - 6.625 73.0 - 168.3	All	10, 40	400 2755	400 2755	400 2755	290 1999	232 1599	362 2496
21/2 - 4 65 - 100	2.875 - 4.500 73.0 - 114.3	All	DF	300 2065	300 2065	300 2065	290 1999	232 1599	362 2496
21/2 - 4 65 - 100	2.875 - 4.500 73.0 - 114.3	All	SF	300 2065	300 2065	300 2065	290 1999	232 1599	362 2496
6 150	6.625 168.3	3, 4	10	300 2065	300 2065	250 1724	290 1999	232 1599	362 2496
6 150	6.625 168.3	3,4	30, 40	300 2065	300 2065	300 2065	290 1999	232 1599	362 2496
8 200	8.625 219.1	21/2	10, 40	400 2755	—	—	—	145 1000	—
8 200	8.625 219.1	3,4	10	300 2065	—	250 1724	—	145 1000	—
8 200	8.625 219.1	3,4	30, 40	300 2065	—	300 2065	—	145 1000	—

NOTES:
- 10 refers to Listed/Approved Schedule 10 steel sprinkler pipe.
- 40 refers to Listed/Approved Schedule 40 steel sprinkler pipe.
- DF refers to Listed/Approved Dyna-Flow steel sprinkler pipe manufactured by American Tube Company.
- SF refers to Listed/Approved Super-Flo steel sprinkler pipe manufactured by Allied Tube and Conduit Corporation.

VIC-TAP II HOLE CUTTING TOOL FOR 4 - 8"/100 - 200 MM CARBON STEEL PIPE

The Vic-Tap II hole cutting tool is designed for use with the Style 931 Vic-Tap II Mechanical-T unit, which is a combination of the Style 920 Mechanical-T and Series 726 Vic-Ball Valve. The Vic-Tap II is capable of tapping into carbon steel pipe systems under pressures up to 500 psi/3450 kPa.

The Style 931 Vic-Tap II Mechanical-T unit is a full port ball valve which can be mounted on 4"/100 mm, 5"/125 mm, 6"/150 mm and 8"/200 mm diameter pipe. The Style 931 comes with a 2 ½"/65 mm grooved outlet.

The drill motor is an electric motor with ground fault circuit interrupter (GFCI) in accordance with safety codes.

For more information, refer to publication 24.01.

VICTAULIC VIC-STRAINER

Operations & Maintenance Manual
December 2015

Vic-Strainer®

SERIES 730

Series 730 Vic-Strainer is lighter than flanged "Y" type strainers and provides straight-through flow for lower pressure drop. It installs with two Victaulic couplings, and is rated up to 750 psi/5175 kPa depending upon the installed coupling's pressure rating and size. A durable 304 stainless screen is provided. The standard mesh sizes are 12 mesh for sizes 1½ – 3"/40 – 80 mm and 6 mesh for sizes 4 – 12"/100 – 300 mm; other mesh sizes are available. Access cap and integral rails permit easy basket removal for cleaning. Basket must be cleaned prior to obtaining 10 psi/69 kPa pressure differential across the basket. Contact Victaulic for details.

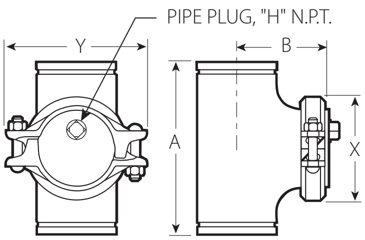
For 14 – 24"/350 – 600 mm sizes, Victaulic offers the Advanced Groove System (AGS) line of products. Request publication 20.11 for information on the Series W730 AGS Vic-Strainer.

WARNING

- **Always depressurize and drain the piping system before attempting to install, remove, or adjust any Victaulic piping products.**

Failure to do so could result in serious personal injury, property damage, joint leakage or joint separation.

DIMENSIONS



1½ – 12"/40 – 300 MM (TYPICAL)

Pipe		Maximum Working Pressure	Diameter – Inches/mm					Approx. Weight Each
Nominal Size Inches/mm	Actual Outside Diameter Inches/mm	psi/ kPa †	A	B	X	Y	H	Lbs./ kg
1½ 40	1.900 48.3	750 5175	5.50 140	3.75 95	2.94 75	5.81 148	0.25 6	7.0 3.2
2 50	2.375 60.3	750 5175	6.50 165	4.25 108	3.35 85	5.78 147	0.50 13	5.8 2.6
2½ 65	2.875 73.0	750 5175	7.50 191	4.75 121	3.88 98	6.38 162	0.50 13	8.9 4.0
3 80	3.500 88.9	750 5175	8.50 216	5.25 133	4.54 115	6.81 173	0.75 19	21.0 9.5
4 100	4.500 114.3	750 5175	10.00 254	6.00 152	5.83 148	8.21 209	1.00 25	19.6 8.9
5 125	5.563 141.3	750 5175	11.00 279	6.50 165	7.03 179	9.89 251	1.25 32	31.3 14.2
6 150	6.625 168.3	700 4825	13.00 330	7.50 191	8.26 210	10.83 275	1.25 32	43.3 19.6
8 200	8.625 219.1	600 4130	15.50 394	9.00 229	10.54 268	13.74 349	2.00 51	75.0 34.0
10 250	10.750 273.0	500 3450	18.00 457	10.25 260	12.86 327	16.98 431	2.00 51	136.0 61.7
12 300	12.750 323.9	400 2750	20.00 508	11.25 286	14.86 377	18.88 480	2.00 51	197.2 89.4

† Working pressure is maximum based on Style 07 access coupling and will be governed by couplings used for installation and related system components. Maximum differential pressure from inlet to outlet must not exceed 10 psi (69 kPa).

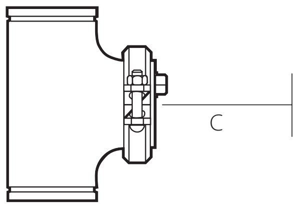
+Working Pressure is dependent upon the style of Victaulic coupling used to join Series 730 to the piping system.

JOB OWNER	CONTRACTOR	ENGINEER
System No. ______________	Submitted By ______________	Spec Sect ________ Para ________
Location ______________	Date ______________	Approved ______________
		Date ______________

Vic-Strainer®

SERIES 730

ASSEMBLY CLEARANCE



Typical 1½ – 12"/40 – 300 mm
Series 730 Vic-Strainers

Recommended Minimum Clearance Required to Remove Strainer Basket

Size		"C"	Size		"C"
Nominal Size inches/mm	Actual Outside Diameter inches/mm	Strainer Basket Clearance * inches/mm	Nominal Size inches/mm	Actual Outside Diameter inches/mm	Strainer Basket Clearance * inches/mm
1½ 40	1.900 48.3	4.00 102	5 125	5.563 141.3	8.00 203
2 50	2.375 60.3	5.00 127	6 150	6.625 168.3	10.00 254
2½ 65	2.875 73.0	5.00 127	8 200	8.625 219.1	12.00 305
3 80	3.500 88.9	6.00 152	10 250	10.750 273.0	14.00 356
4 100	4.500 114.3	7.00 178	12 300	12.750 323.9	16.00 406

*Measurement is from the centerline to the top of the basket during removal.

Vic-Strainer®

SERIES 730

PERFORMANCE

C_V values for flow of water at +60°F/+16°C with various disc positions are shown in the table below.

Formulas for C_V Values:

$$\Delta P = \frac{Q^2}{C_v^2}$$

$$Q = C_v \times \sqrt{\Delta P}$$

Where:
Q = Flow (GPM)
ΔP = Pressure Drop (psi)
C_v = Flow Coefficient

Size		C_V	Size		C_V
Nominal Size inches/mm	Actual Outside Diameter inches/mm	Values	Nominal Size inches/mm	Actual Outside Diameter inches/mm	Values
1½ 40	1.900 48.3	61	5 125	5.563 141.3	685
2 50	2.375 60.3	190	6 150	6.625 168.3	950
2½ 65	2.875 73.0	230	8 200	8.625 219.1	2108
3 80	3.500 88.9	290	10 250	10.750 273.0	2683
4 100	4.500 114.3	425	12 300	12.750 323.9	3872

For 20 – 30"/500 – 750 mm sizes contact Victaulic.

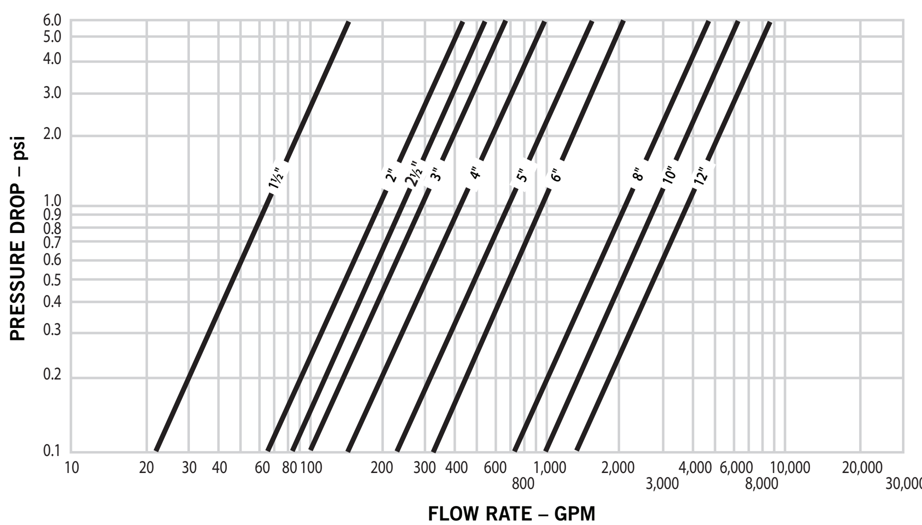
FLOW CHARACTERISTICS

Flow characteristics are charted below and are based on standard 12 mesh for sizes 1½ – 3/40 – 80 mm) and 6 mesh for sizes 4 – 12"/100 – 300 mm.

Flow may vary from these figures.

For 20 – 30"/500 – 750 mm performance contact Victaulic.

The chart below expresses the flow of water at 65°F/18°C.



Vic-Strainer®

SERIES 730

MATERIAL SPECIFICATIONS

Body and Coupling:
2 – 12"/50 – 300 mm: Ductile iron conforming to ASTM A-536, grade 65-45-12, with enamel coating. Ductile iron conforming to ASTM A-395, grade 65-45-15, is available upon special request.

Optional: Zinc electroplated

End Cap:
2 – 12"/50 – 300 mm: Ductile iron conforming to ASTM A-536, grade 65-45-12, with enamel coating. Ductile iron conforming to ASTM A-395, grade 65-45-15, is available upon special request.

Optional: Zinc electroplated

Basket: Stainless Steel, Type 304, frame and mesh.
1½ – 3"/40 – 80 mm: 12 x 12 mesh (0.020" wire) with 0.063" opening.
4 – 12"/100 – 300 mm: 6 x 6 mesh (0.041" wire) with 0.126" opening.

Optional: Other mesh sizes and materials available, contact Victaulic for details.

Coupling Gasket: (specify choice*)

Grade "E" EPDM
EPDM (Green color code). Temperature range –30°F to +230°F/–34°C to +110°C. Recommended for cold and hot water service within the specified temperature range plus a variety of dilute acids, oil-free air and many chemical services. UL classified in accordance with ANSI/NSF 61 for cold +86°F/+30°C and hot +180°F/+82°C potable water service. NOT RECOMMENDED FOR PETROLEUM SERVICES.

Grade "T" nitrile
Nitrile (Orange color code).Temperature range –20°F to +180°F/–29°C to +82°C. Recommended for petroleum products, air with oil vapors, vegetable and mineral oils within the specified temperature range. Not recommended for hot water services over +150°F/+66°C or for hot dry air over +140°F/+60°C.

*Services listed are General Service Recommendations only. It should be noted that there are services for which these gaskets are not recommended. Reference should always be made to the latest Victaulic Gasket Selection Guide for specific gasket service recommendations and for a listing of services which are not recommended.

Bolts/Nuts: Heat-treated plated carbon steel, trackhead meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183.

Magnets: Magnets, particularly for lubricating oil service applications and others can be added at the factory. Contact Victaulic for details.

Couplings: Vic-Strainer Series 730 is normally supplied with a Style 07 Zero-Flex coupling for cleaning access. All appropriately sized Victaulic standard grooved pipe couplings will fit (such as Style 78 Snap-Joint quick disconnect coupling) for cleaning access. Pressure ratings will vary according to access coupling (and installing couplings) used. Contact Victaulic for sizes, pressures and pricing for other access couplings.

Other: Special requirements can often be met. Contact Victaulic with specific requirements for recommendations, availability and delivery.

Vic-Strainer®

SERIES 730

WARRANTY

Refer to the Warranty section of the current Price List or contact Victaulic for details.

NOTE

This product shall be manufactured by Victaulic or to Victaulic specifications. All products to be installed in accordance with current Victaulic installation/assembly instructions. Victaulic reserves the right to change product specifications, designs and standard equipment without notice and without incurring obligations.

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www.victaulic.com

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UPDATED 2/06
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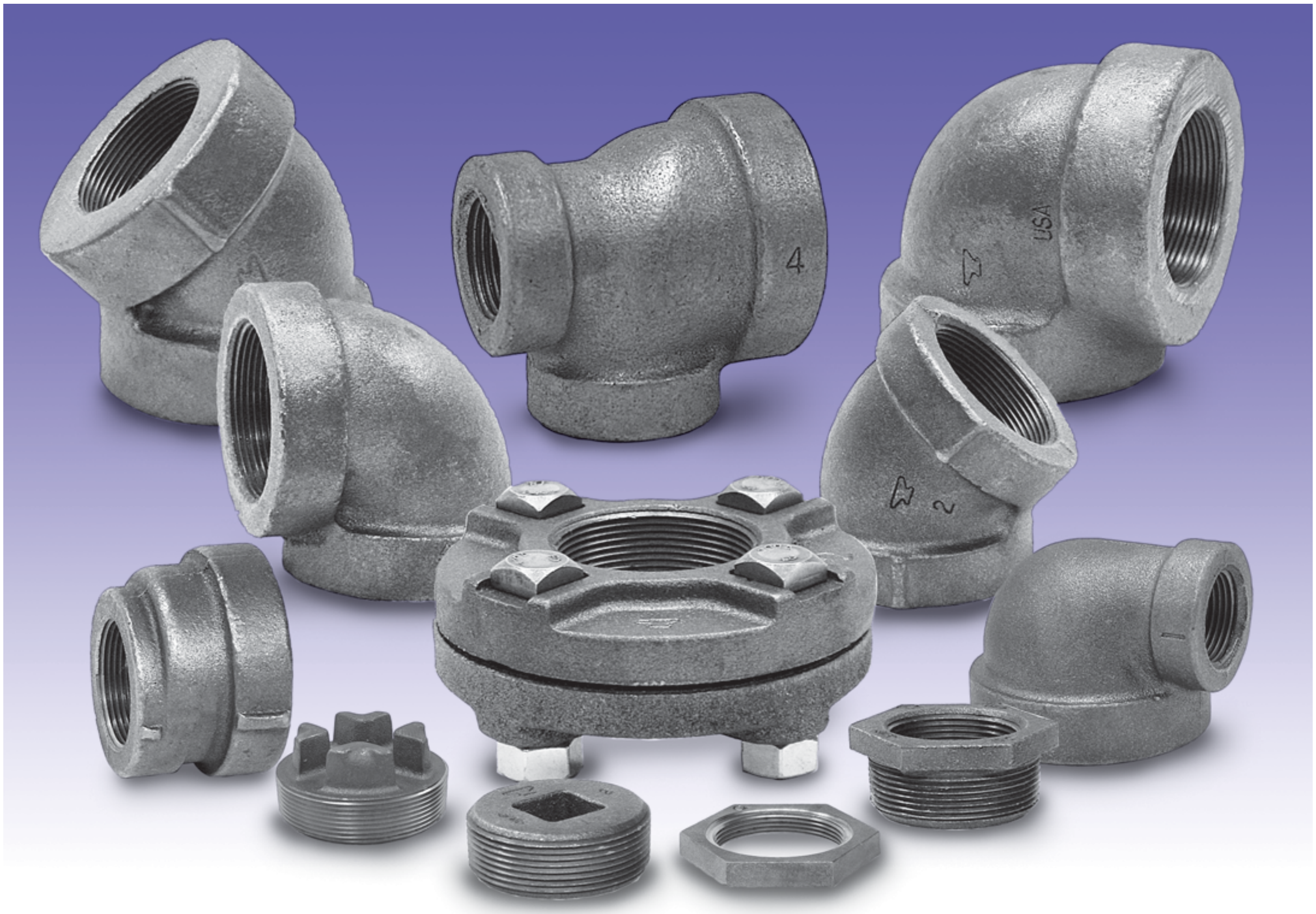
ANVIL CAST IRON THREADED FITTINGS

Operations & Maintenance Manual
December 2015



Anvil standard and extra heavy cast iron threaded fittings are manufactured in accordance with ASME-B16.4 (except plugs and bushings, ASME B16.14). Dimensions also conform to Federal Specifications, WW-P-501 (except plugs and bushings WW-P-471).

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

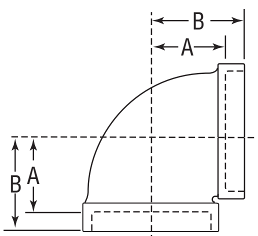
	Dimensions	Material	Galvanizing****	Thread	Pressure Rating	Federal/Other
CAST IRON THREADED FITTINGS						
Class 125	ASME B16.4•	ASTM A-126 (A)	ASTM A-153	ASME B1.20.1+	ASME B16.4•	ASME B16.4■
Class 250	ASME B16.4•	ASTM A-126 (A)	ASTM A-153	ASME B1.20.1+	ASME B16.4•	ASME B16.4■
CAST IRON PLUGS AND BUSHINGS						
	ASME B16.14•	ASTM A- 126 (A)	ASTM A-153	ASME B1.20.1+	ASME B16.14•	WW-P-471

• an American National standard (ANSI), + ASME B1.20.1 was ANSI B2.1, ■ Formerly WW-P-501

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

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

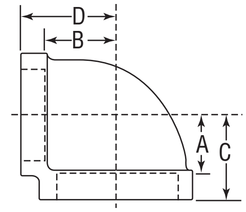
Note: See following page for pressure-temperature ratings.

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

CAST IRON THREADED FITTINGS

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:	

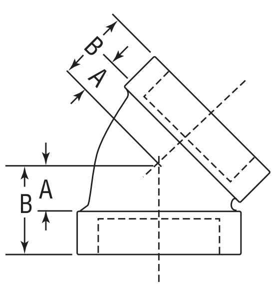
CAST IRON THREADED FITTINGS

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

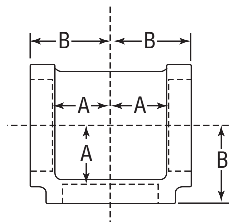
Size		A		B		C		D		Unit Weight Black	
NPS	DN	in	mm	in	mm	in	mm	in	mm	lbs	kg
1 x ½	25 x 15	1/2	15	7/8	22	1 1/16	27	1 5/16	33	0.95	0.43

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:	

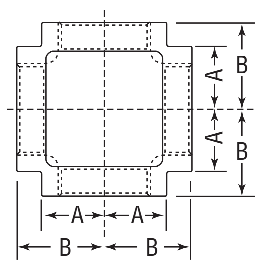
Class 125 (Standard)

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



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
6	150	3 7/8	98	5 1/8	130	47.67	21.62

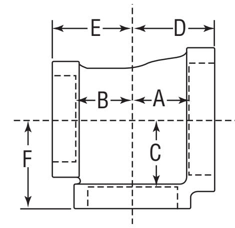
Note: See following page for pressure-temperature ratings.

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

CAST IRON THREADED FITTINGS

Class 125 (Standard)

☐ **FIGURE 359**
Tee Reducing



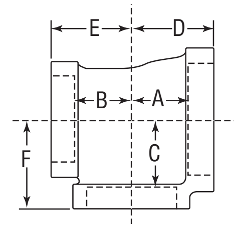
Size						A		B		C		D		E		F		Unit Weight Black	
NPS	DN	NPS	DN	NPS	DN	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lbs	kg
1/2	15	1/2	15	1/4	8	1 1/16	17	11/16	17	13/16	22	1 1/8	29	1 1/8	29	1 1/8	29	0.57	0.26
				3/8	10	1 1/16	17	11/16	17	3/4	19	1 1/8	29	1 1/8	29	1 1/8	29	0.57	0.26
				3/4	20	1 3/16	22	13/16	22	11/16	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	1/4	8	3/4	20	1 3/16	22	15/16	24	13/16	22	15/16	24	1 1/4	32	15/16	24	0.79	0.36
		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

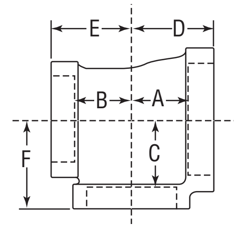


Size						A		B		C		D		E		F		Unit Weight Black	
NPS	DN	NPS	DN	NPS	DN	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lbs	kg
1 1/4	32	1/2	15	1/2	15	1 3/16	22	13/16	22	1 1/8	29	1 7/16	37	15/16	24	1 5/8	41	1.00	0.45
				1	25	1 5/16	24	15/16	24	1 1/8	29	1 9/16	40	1 3/8	35	1 11/16	43	1.38	0.63
				1 1/4	32	1 1/8	29	1 1/8	29	1 1/8	29	1 3/4	44	1 9/16	40	1 3/4	44	1.64	0.74
		3/4	20	3/4	20	1 3/16	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
				1 1/4	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	1/2	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
				3/4	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
				1 1/4	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
				1 1/2	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
		1 1/4	32	1/2	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
				3/4	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
				1 1/2	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
1 1/2	40	1/2	15	1 1/4	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
				1 1/2	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
		3/4	20	1 1/2	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	1/2	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
				3/4	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
				1 1/4	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
				1 1/2	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
		1 1/4	32	1/2	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
				3/4	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
				1 1/4	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
				1 1/2	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
		1 1/2	40	1/2	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
				3/4	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
				1 1/4	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
				2 1/2	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

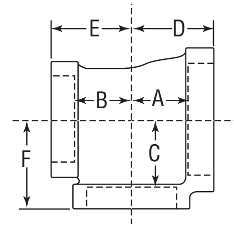


Size						A		B		C		D		E		F		Unit Weight Black	
NPS	DN	NPS	DN	NPS	DN	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lbs	kg
2	50	1/2	15	1 1/2	40	15/16	24	1 3/8	35	1 1/2	38	2	51	1 13/16	47	2 1/8	54	2.95	1.34
				2	50	1 9/16	40	1 7/16	37	1 9/16	40	2 1/4	57	1 7/8	48	2 1/4	57	3.30	1.50
		3/4	20	1 1/4	32	1 3/16	22	1 1/8	29	1 7/16	37	1 7/8	48	1 3/4	44	2 1/16	52	2.50	1.13
				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	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 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 1/4	32	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	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	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 1/2	40	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 1/4	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
		2	50	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
				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

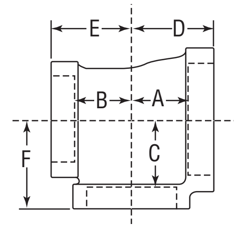


Size						A		B		C		D		E		F		Unit Weight Black	
NPS	DN	NPS	DN	NPS	DN	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lbs	kg
2 1/2	65	1/2	15	2 1/2	65	1 13/16	47	1 13/16	47	1 13/16	47	2 11/16	68	2 1/4	57	2 11/16	68	5.20	2.36
		3/4	20	2 1/2	65	1 13/16	47	1 3/4	44	1 13/16	47	2 11/16	68	2 1/4	57	2 11/16	68	5.10	2.31
		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

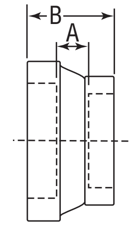


Size						A		B		C		D		E		F		Unit Weight Black	
NPS	DN	NPS	DN	NPS	DN	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lbs	kg
3 1/2	90	3 1/2	90	1 1/2	40	1 3/8	35	1 3/8	35	2 7/16	62	2 3/8	60	2 3/8	60	3 1/16	78	8.87	4.02
				2	50	1 5/8	41	1 5/8	41	2 7/16	62	2 5/8	67	2 5/8	67	3 3/16	81	9.94	4.51
4	100	1	25	4	100	2 3/4	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	50	1 11/16	43	1 9/16	40	2 3/4	70	2 11/16	68	2 9/16	65	3 1/2	89	10.21	4.63
				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 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

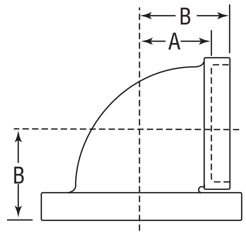
Note: See following page for pressure-temperature ratings.

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

ANVIL INTERNATIONAL

Class 125 (Standard)

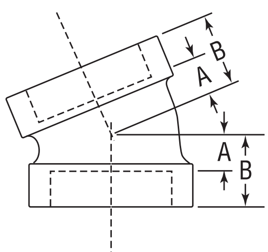
FIGURE 371
90° Elbow, Flange & Screw



Size NPS	Size DN	A in	A mm	B in	B mm	Unit Weight Black lbs	Unit Weight Black kg
2 1/2	65	1 13/16	47	2 11/16	68	10.22	4.63
3	80	2 3/16	56	3 1/8	79	13.25	6.01
4	100	2 11/16	68	3 13/16	98	21.56	9.78
6	150	3 7/8	98	5 1/8	130	40.50	18.37

†Nominal Pipe Sizes of 4" *(100 DN)* and larger have two holes tapped for stud or tap bolts.

FIGURE 356A
22 1/2° Elbow



Size NPS	Size DN	A in	A mm	B in	B mm	Unit Weight Black lbs	Unit Weight Black kg
3/4	20	3/8	10	7/8	22	0.52	0.24
1	25	7/16	11	1	25	0.80	0.36
1 1/4	32	1/2	13	1 1/8	29	1.40	0.63
1 1/2	40	5/8	16	1 1/4	32	1.64	0.74
2	50	3/4	19	1 7/16	37	2.50	1.13
2 1/2	65	3/4	19	1 5/8	41	3.95	1.79

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:	

CAST IRON THREADED FITTINGS

Class 125 (Standard)

FIGURE 387 Square Head Plugs, Cored

Size NPS	Size DN	Black lbs	Black kg	Galv. lbs	Galv. 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

FIGURE 388 Square Head Plugs, Solid

Size NPS	Size DN	Black lbs	Black kg	Galv. lbs	Galv. 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

Size NPS	Size DN	Black lbs	Black kg	Galv. lbs	Galv. 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

Size NPS	Size DN	Black lbs	Black 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:	

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.

ANVIL STEEL PIPE NIPPLES & MALLEABLE FITTINGS

Operations & Maintenance Manual
December 2015

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July 2012

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SPF/ANVIL™

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Standard Welded

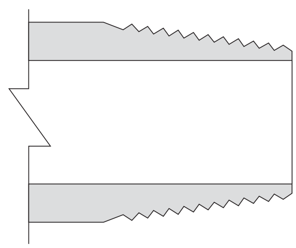
Anvil International is the only manufacturer where you can combine your import and U.S. Manufactured product requirements.

STANDARDS & SPECIFICATIONS

SPF Imported Steel Pipe Nipples (Standard Welded)

Dimensional:	ASTM A733
Material:	ASTM A53 Type F or Type E
Galvanizing:	Hot Dip Galvanizing*
Threading:**	ASME B 1.20.1

Standard End Finish
Tapered Pipe Thread (NPT)



*Galvanized nipples are manufactured from pipe coated on the inside and outside by hot dip process.

**British Standard threading per BS 21 available upon request.

- Ends are cut square to the central axis. All burrs on the inside are removed. The ends of the pipe nipples are chamfered on the outside at an angle of 35° +/- 10° to the central axis.
- Pipe nipples are threaded on both ends with standard NPT tapered threads. Threads are right hand on both ends.

Also available:

- Ready Cut Pipe, Standard - Schd. 40 (black and galvanized)
  Pipe Size: 1/2", 3/4", 1", 1 1/4", 1 1/2", 2"
  Pipe Length: 8", 24", 30", 48", 60", 72"
- "66" Packs, Standard – Schd. 40 (black and galvanized)
  Nipple Size: 1/2", 3/4", 1", 1 1/4", 1 1/2", 2"
- Single Run Nipple Packs (black and galvanized)
  Pipe Size: 1/2", 3/4", 1, 1 1/4", 1 1/2", 2"

Pipe Size	Pipe O.D.	Length Close	Pipe Nipple Lengths (Black and galvanized)															
(in.)	(in.)	(in.)																
1/8	.405	3/4	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	7	8	9	10	11	12
1/4	.540	7/8	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	7	8	9	10	11	12
3/8	.675	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	7	8	9	10	11	12
1/2	.840	1 1/8	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	7	8	9	10	11	12
3/4	1.050	1 3/8	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	7	8	9	10	11	12
1	1.315	1 1/2		2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	7	8	9	10	11	12
1 1/4	1.660	1 5/8		2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	7	8	9	10	11	12
1 1/2	1.900	1 3/4		2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	7	8	9	10	11	12
2	2.375	2			2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	7	8	9	10	11	12
2 1/2	2.875	2 1/2				3	3 1/2	4	4 1/2	5	5 1/2	6	7	8	9	10	11	12
3	3.500	2 5/8				3	3 1/2	4	4 1/2	5	5 1/2	6	7	8	9	10	11	12
4	4.500	2 7/8						4	4 1/2	5	5 1/2	6	7	8	9	10	11	12
6	6.625	3 1/8						4	4 1/2	5	5 1/2	6	7	8	9	10	11	12

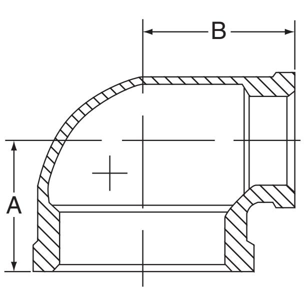
Class 150 (Standard)

STANDARDS & SPECIFICATIONS

Import Malleable Iron Screwed Fittings (Class 150)		
Dimensional:	Fittings:	ASME B16.3
	Unions:	ASME B 16.39
	Bushings/Plugs:	ASME B 16.14
Material:	ASTM A-197	
Galvanizing:	ASTM A-153	(Hot Dip Galvanizing)
Threading:*	ASME B 1.20.1	
Pressure Rating:	Fittings:	ASME B 16.3
	Unions:	ASME B 16.39
	Bushings/Plugs:	ASME B 16.14
Pressure Testing:	All malleable iron fittings are tested for through wall porosity using an air under water process.	
Agency Approvals:	All malleable iron fittings and unions are UL Listed and FM Approved.	

*British Standard threading per BS 21 available upon request.

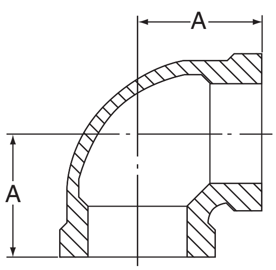
90˚ REDUCING ELBOW



Size	A	B	Weight
in	in	in	lbs
¼ x ⅛	0.74	0.76	0.08
⅜ x ⅛	0.81	0.85	0.11
⅜ x ¼	0.88	0.90	0.13
½ x ¼	0.97	0.98	0.16
½ x ⅜	1.04	1.03	0.19
¾ x ⅜	1.12	1.13	0.26
¾ x ½	1.20	1.22	0.29
1 x ⅜	1.18	1.26	0.35
1 x ½	1.26	1.36	0.42
1 x ¾	1.37	1.45	0.47
1 ¼ x ½	1.34	1.53	0.54
1 ¼ x ¾	1.45	1.62	0.62
1 ¼ x 1	1.58	1.67	0.73
1 ½ x ½	1.38	1.65	0.65
1 ½ x ¾	1.52	1.75	0.74
1 ½ x 1	1.65	1.80	0.88
1 ½ x 1 ¼	1.82	1.88	1.03
2 x ½	1.50	1.89	0.93
2 x ¾	1.60	1.97	1.04
2 x 1	1.73	2.02	1.28
2 x 1 ¼	1.90	2.10	1.36
2 x 1 ½	2.02	2.16	1.51
2 ½ x 1 ½	2.16	2.51	2.20
2 ½ x 2	2.39	2.60	2.55
3 x 2	2.52	2.89	3.35
3 x 2 ½	2.83	2.99	4.12
4 x 2	2.72	3.43	5.01
4 x 3	3.30	3.60	6.65

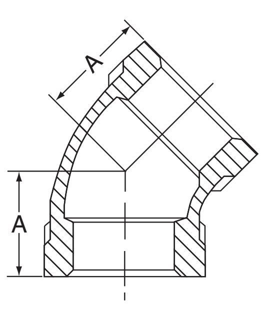
Class 150 (Standard)

90° ELBOW



Size	A	Weight
in	*in*	*lbs*
⅛	0.69	0.06
¼	0.81	0.10
⅜	0.95	0.15
½	1.12	0.22
¾	1.31	0.36
1	1.50	0.57
1 ¼	1.75	0.87
1 ½	1.94	1.16
2	2.25	1.81
2 ½	2.70	3.23
3	3.08	4.82
4	3.79	8.41
6	5.13	19.96

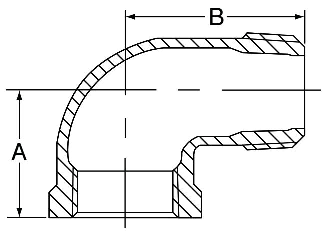
45° ELBOW



Size	A	Weight
in	*in*	*lbs*
⅛	0.63	0.06
¼	0.73	0.11
⅜	0.80	0.14
½	0.88	0.20
¾	0.98	0.32
1	1.12	0.50
1 ¼	1.29	0.76
1 ½	1.43	1.00
2	1.68	1.61
2 ½	1.95	2.77
3	2.17	4.03
4	2.61	6.92
6	3.46	16.31

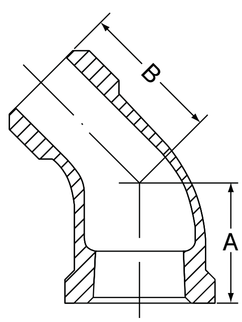
Class 150 (Standard)

90° STREET ELBOW



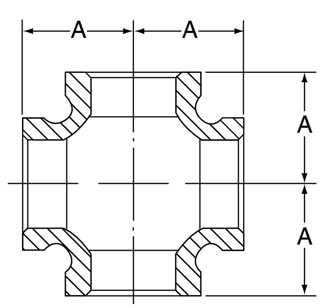
Size	A	B	Weight
in	*in*	*in*	*lbs*
⅛	0.69	1.00	0.05
¼	0.81	1.19	0.09
⅜	0.95	1.44	0.15
½	1.12	1.63	0.20
¾	1.31	1.89	0.34
1	1.50	2.14	0.58
1 ¼	1.75	2.45	0.84
1 ½	1.94	2.69	1.12
2	2.25	3.26	1.85
2 ½	2.70	3.86	3.28
3	3.08	4.51	5.00
4	3.79	5.69	9.18

45° STREET ELBOW



Size	A	B	Weight
in	*in*	*in*	*lbs*
⅛	0.63	0.83	0.05
¼	0.73	0.94	0.08
⅜	0.80	1.03	0.12
½	0.88	1.15	0.18
¾	0.98	1.29	0.27
1	1.12	1.47	0.44
1 ¼	1.29	1.71	0.70
1 ½	1.43	1.88	0.92
2	1.68	2.22	1.50

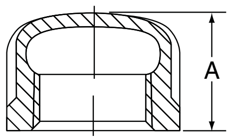
CROSS



Size	A	Weight
in	*in*	*lbs*
¼	0.81	0.17
⅜	0.95	0.26
½	1.12	0.38
¾	1.31	0.61
1	1.50	0.95
1 ¼	1.75	1.42
1 ½	1.94	1.86
2	2.25	2.83

Class 150 (Standard)

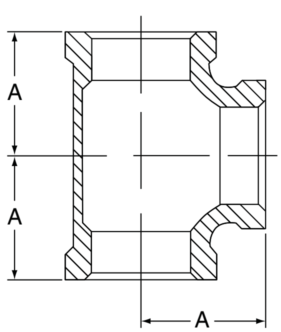
CAP



Size	A	Weight
in	*in*	*lbs*
⅛ ▲	0.53	0.03
¼ ▲	0.63	0.05
⅜ ▲	0.74	0.07
½	0.87	0.11
¾	0.97	0.18
1	1.16	0.30
1 ¼	1.28	0.44
1 ½	1.33	0.55
2	1.45	0.85
2 ½	1.70	1.49
3	1.80	2.20
3 ½	1.90	3.02
4	2.08	3.79
6	2.55	8.77

▲ Supplied in Steel only (Black and Galvanized).

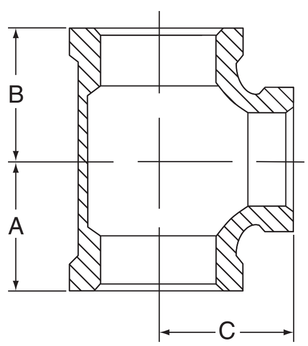
TEE



Size	A	Weight
in	*in*	*lbs*
⅛	0.69	0.09
¼	0.81	0.14
⅜	0.95	0.21
½	1.12	0.31
¾	1.31	0.50
1	1.50	0.79
1 ¼	1.75	1.19
1 ½	1.94	1.57
2	2.25	2.43
2 ½	2.70	4.33
3	3.08	6.37
4	3.79	11.03
6	5.13	25.98

Class 150 (Standard)

REDUCING TEE

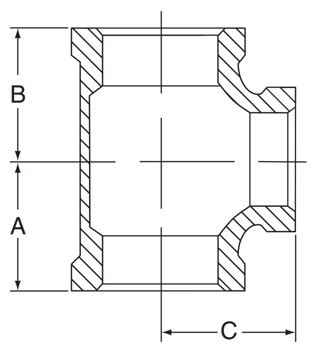


Size			A	B	C	Weight
in			in	in	in	lbs
½	½	¼	0.97	0.97	0.98	0.24
		⅜	1.04	1.04	1.03	0.27
		¾	1.22	1.22	1.20	0.37
		1	1.36	1.36	1.26	0.49
¾	½	½	1.20	1.12	1.22	0.38
		¾	1.31	1.22	1.31	0.45
	¾	¼	1.05	1.05	1.08	0.36
		⅜	1.12	1.12	1.13	0.39
		½	1.20	1.20	1.22	0.43
		1	1.45	1.45	1.37	0.62
1	¼	1	1.50	1.18	1.50	0.63
	½	½	1.26	1.12	1.36	0.48
		¾	1.37	1.22	1.45	0.56
		1	1.50	1.36	1.50	0.67
	¾	½	1.26	1.20	1.36	0.53
		¾	1.37	1.31	1.45	0.61
		1	1.50	1.45	1.50	0.71
	1	⅜	1.18	1.18	1.27	0.57
		½	1.26	1.26	1.36	0.62
		¾	1.37	1.37	1.45	0.69
		1 ¼	1.67	1.67	1.58	0.94
		1 ½	1.80	1.80	1.65	1.07
		2	2.02	2.02	1.73	1.45
1 ¼	½	1	1.58	1.36	1.67	0.82
		1 ¼	1.75	1.53	1.75	0.95
	¾	¾	1.45	1.31	1.62	0.75
		1	1.58	1.45	1.67	0.87
		1 ¼	1.75	1.62	1.75	1.00
	1	½	1.34	1.26	1.53	0.74
		¾	1.45	1.37	1.62	0.82
		1	1.58	1.50	1.67	0.94
		1 ¼	1.75	1.67	1.75	1.08
	1 ¼	⅜	1.26	1.26	1.44	0.78
		½	1.34	1.34	1.53	0.84
		¾	1.45	1.45	1.62	0.92
		1	1.58	1.58	1.67	1.04
		1 ½	1.88	1.88	1.82	1.34
		2	2.10	2.10	1.90	1.65

CONTINUED
ON NEXT PAGE.

Class 150 (Standard)

REDUCING TEE



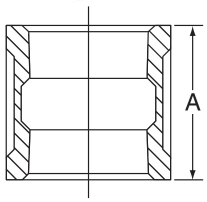
Size			A	B	C	Weight
in			in	in	in	lbs
1 ½	½	1 ½	1.94	1.66	1.94	1.24
	¾	¾	1.50	1.26	1.69	0.86
		1 ½	1.94	1.75	1.94	1.29
	1	1	1.65	1.50	1.80	1.08
		1 ¼	1.82	1.67	1.88	1.23
		1 ½	1.94	1.80	1.94	1.35
	1 ¼	¾	1.52	1.45	1.75	1.04
		1	1.65	1.58	1.80	1.17
		1 ¼	1.82	1.75	1.88	1.32
		1 ½	1.94	1.88	1.94	1.45
		2	2.10	2.10	1.90	1.82
	1 ½	½	1.41	1.41	1.66	1.04
		¾	1.52	1.52	1.75	1.14
		1	1.65	1.65	1.80	1.27
		1 ¼	1.82	1.82	1.88	1.43
		2	2.16	2.16	2.02	1.89
2	½	2	2.25	1.88	2.25	1.89
	¾	2	2.25	1.97	2.25	1.93
	1	1	1.81	1.75	1.87	1.39
		2	2.25	2.02	2.25	2.00
	1 ¼	1 ¼	1.90	1.75	2.10	1.64
		1 ½	2.02	1.88	2.16	1.80
		2	2.25	2.10	2.25	2.09
	1 ½	1	1.73	1.65	2.02	1.57
		1 ¼	1.90	1.82	2.10	1.71
		1 ½	2.02	1.94	2.16	1.88
		2	2.25	2.16	2.25	2.21
	2	½	1.49	1.49	1.88	1.53
		¾	1.60	1.60	1.97	1.63
		1	1.73	1.73	2.02	1.78
		1 ¼	1.90	1.90	2.10	1.97
		1 ½	2.02	2.02	2.16	2.12
		2 ½	2.60	2.60	2.39	3.15
2 ½	2 ½	¾	1.74	1.74	2.32	2.67
		1	1.87	1.87	2.37	2.84
		1 ¼	2.04	2.04	2.45	3.09
		1 ½	2.16	2.16	2.51	3.29
		2	2.39	2.39	2.60	3.65
3	2	2	2.52	2.25	2.89	3.88
	3	¾	1.87	1.87	2.61	3.72
		1	2.00	2.00	2.66	3.96
		1 ¼	2.17	2.17	2.74	4.23
		1 ½	2.29	2.29	2.80	4.45
		2	2.52	2.52	2.89	4.90
		2 ½	2.83	2.83	2.99	5.69
4	4	2	2.74	2.74	3.41	7.52
		2 ½	3.05	3.05	3.51	8.51
		3	3.30	3.30	3.60	9.25

Class 150 (Standard)

FLOOR FLANGE

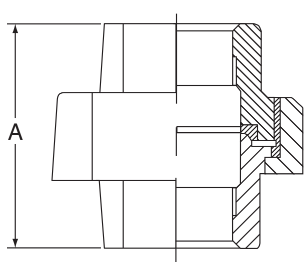
Size	Dia. Flange	Dia. of Bolt Circle	Dia. of Bolt Holes	Weight
in	in	in	in	lbs
¾	3.37	2.36	.28	0.49
1	3.78	2.80	.28	0.63
1 ¼	4.19	3.17	.28	0.87
1 ½	4.59	3.50	.31	1.10
2	5.18	4.01	.31	1.57

COUPLING



Size	A	Weight
in	in	lbs
⅛	0.96	0.05
¼	1.06	0.08
⅜	1.16	0.12
½	1.34	0.17
¾	1.52	0.27
1	1.67	0.43
1 ¼	1.93	0.65
1 ½	2.15	0.86
2	2.53	1.35
2 ½	2.88	2.33
3	3.18	3.36
4	3.69	5.59

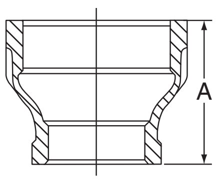
UNIONS (BRASS SEAT)



Size	A	Weight
in	in	lbs
⅛	1.26	0.16
¼	1.46	0.23
⅜	1.61	0.33
½	1.73	0.41
¾	1.95	0.60
1	2.07	0.89
1 ¼	2.26	1.25
1 ½	2.42	1.76
2	2.75	2.44
2 ½	3.23	3.52
3	3.50	4.34

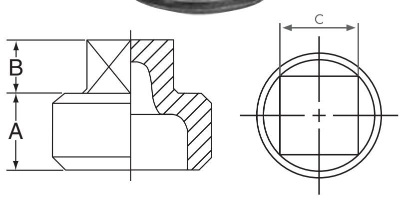
Class 150 (Standard)

REDUCING COUPLINGS



Size	A	Weight
in	*in*	*lbs*
¼ x ⅛	1.00	0.07
⅜ x ⅛	1.13	0.09
⅜ x ¼	1.13	0.10
½ x ⅛	1.25	0.13
½ x ¼	1.25	0.13
½ x ⅜	1.25	0.14
¾ x ⅛	1.44	0.18
¾ x ¼	1.44	0.20
¾ x ⅜	1.44	0.21
¾ x ½	1.44	0.22
1 x ½	1.69	0.34
1 x ¾	1.69	0.36
1 ¼ x ½	2.06	0.47
1 ¼ x ¾	2.06	0.51
1 ¼ x 1	2.06	0.57
1 ½ x ½	2.31	0.62
1 ½ x ¾	2.31	0.66
1 ½ x 1	2.31	0.73
1 ½ x 1 ¼	2.31	0.80
2 x ½	2.81	0.94
2 x ¾	2.81	0.99
2 x 1	2.81	1.03
2 x 1 ¼	2.81	1.17
2 x 1 ½	2.81	1.25
2 ½ x 1 ¼	3.25	1.81
2 ½ x 1 ½	3.25	1.90
2 ½ x 2	3.25	2.04
3 x 1	3.69	2.48
3 x 1 ¼	3.69	2.55
3 x 1 ½	3.69	2.67
3 x 2	3.69	2.78
3 x 2 ½	3.69	3.23
4 x 2	4.38	4.43
4 x 2 ½	4.38	4.87
4 x 3	4.38	5.29

PLUGS



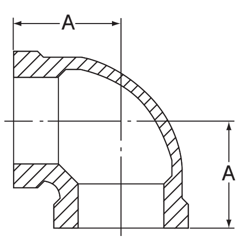
	Size	A	B	C	Weight
	in	*in*	*in*	*in*	*lbs*
Solid	¼	0.44	0.28	0.38	0.04
Solid	⅜	0.48	0.31	0.44	0.06
Cored	½	0.56	0.38	0.56	0.08
Cored	¾	0.63	0.44	0.63	0.13
Cored	1	0.75	0.50	0.81	0.20
Cored	1 ¼	0.80	0.56	0.94	0.32
Cored	1 ½	0.83	0.62	1.13	0.43
Cored	2	0.88	0.68	1.31	0.67
Cored	2 ½	1.07	0.74	1.50	1.11
Cored	3	1.13	0.80	1.69	1.53
Bar Plug	4	1.22	1.00	–	2.71
Bar Plug	6	1.40	1.25	–	4.00

Class 300 (Extra Heavy)

STANDARDS & SPECIFICATIONS

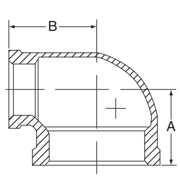
Malleable Iron Screwed Fittings (Class 300)		
Dimensional:	Fittings:	ASME B16.3
	Unions:	ASME B 16.39
	Bushings/Plugs:	ASME B 16.14
Material:	ASTM A-197	
Galvanizing:	ASTM A-153	(Hot Dip Galvanizing)
Threading:	ASME B 1.20.1	
Pressure Rating:	Fittings:	ASME B 16.3
	Unions:	ASME B 16.39
	Bushings/Plugs:	ASME B 16.14
Pressure Testing:	All malleable iron fittings are tested for through wall porosity using an air under water process.	
Agency Approvals:	All malleable iron fittings and unions are UL Listed and FM Approved.	

90° ELBOW



Size	A	Weight
in	*in*	*lbs*
¼	0.94	0.20
⅜	1.06	0.29
½	1.25	0.47
¾	1.44	0.66
1	1.63	1.20
1 ¼	1.94	1.90
1 ½	2.13	2.50
2	2.50	4.20
2 ½	2.94	5.30
3	3.38	9.70
4	4.50	16.00

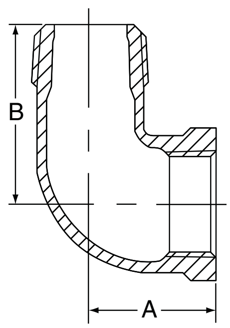
90° REDUCING ELBOW



Size	A	B	Weight
in	*in*	*in*	*lbs*
½ x ⅜	1.19	1.19	0.41
1 x ¾	1.50	1.56	1.00

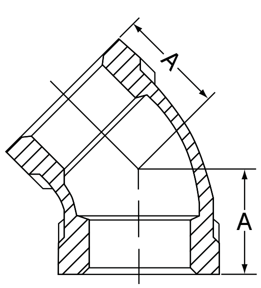
Class 300 (Extra Heavy)

90˚ STREET ELBOW



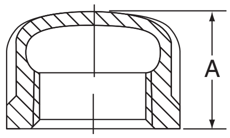
Size	A	B	Weight
in	in	in	lbs
¼	0.94	1.44	0.17
⅜	1.06	1.63	0.26
½	1.25	2.00	0.40
¾	1.44	2.19	0.68
1	1.63	2.56	1.10
1 ¼	1.94	2.88	1.60
1 ½	2.13	3.13	2.20
2	2.50	3.69	3.60
3	3.38	5.13	9.60

45˚ ELBOW

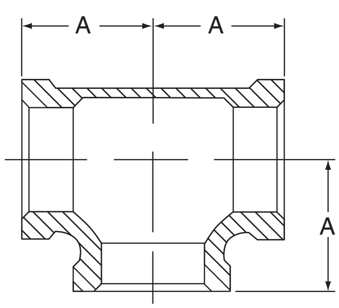


Size	A	Weight
in	in	lbs
¼	0.81	0.19
⅜	0.88	0.28
½	1.00	0.43
¾	1.13	0.66
1	1.31	1.00
1 ¼	1.50	1.70
1 ½	1.69	2.10
2	2.00	3.40
2 ½	2.25	5.50
3	2.50	8.10
4	2.81	13.00

Class 300 (Extra Heavy)



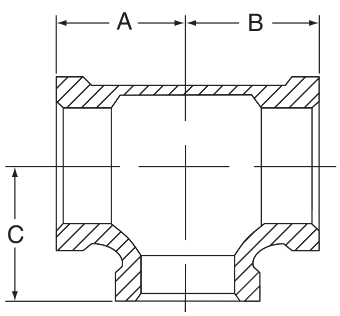
CAP	Size	A	Weight
	in	in	lbs
	¼	0.78	0.10
	⅜	0.81	0.15
	½	1.00	0.23
	¾	1.06	0.35
	1	1.25	0.58
	1 ¼	1.38	0.94
	1 ½	1.44	1.20
	2	1.69	1.90
	2 ½	2.06	3.30
	3	2.19	4.70



TEE	Size	A	Weight
	in	in	lbs
	¼	1.31	0.27
	⅜	1.06	0.42
	½	1.25	0.65
	¾	1.44	1.10
	1	1.63	1.60
	1 ¼	1.94	2.50
	1 ½	2.13	3.40
	2	2.50	5.20
	2 ½	2.94	8.00
	3	3.38	13.00
	4	4.50	24.00

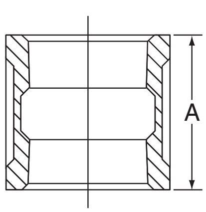
Class 300 (Extra Heavy)

REDUCING TEE



Size			A	B	C	Weight
in			in	in	in	lbs
¾	¾	½	1.31	1.31	1.38	0.90
1	1	½	1.44	1.44	1.50	1.30
		¾	1.50	1.50	1.56	1.30
1 ¼	1 ¼	½	1.50	1.50	1.69	1.70
		¾	1.63	1.63	1.75	1.90
		1	1.75	1.75	1.81	2.10
1 ½	1 ½	½	1.63	1.63	1.81	2.30
		¾	1.69	1.69	1.88	2.50
		1	1.81	1.81	2.00	2.60
		1 ¼	2.00	2.00	2.06	3.00
2	2	½	1.75	1.75	2.06	3.40
		¾	1.81	1.81	2.13	3.60
		1	2.00	2.00	2.25	4.00
		1 ¼	2.13	2.13	2.31	4.20
		1 ½	2.25	2.25	2.38	4.60
2 ½	2 ½	2	2.69	2.69	2.75	7.60
3	3	2	2.81	2.81	3.13	9.60

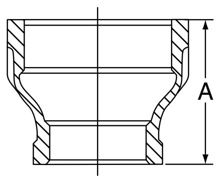
COUPLING



Size	A	Weight
in	in	lbs
¼	1.38	0.17
⅜	1.63	0.26
½	1.88	0.42
¾	2.13	0.65
1	2.38	0.99
1 ¼	2.88	1.60
1 ½	2.88	2.00
2	3.63	3.20
2 ½	4.13	5.50
3	4.13	7.30

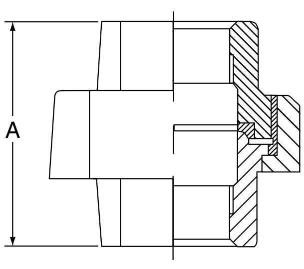
Class 300 (Extra Heavy)

REDUCING COUPLINGS



Size	A	Weight
in	*in*	*lbs*
⅜ x ¼	1.44	0.21
½ x ¼	1.69	0.31
½ x ⅜	1.69	0.34
¾ x ⅜	1.75	0.47
¾ x ½	1.75	0.50
1 x ½	2.00	0.71
1 x ¾	2.00	0.79
1 ¼ x ½	2.38	1.10
1 ¼ x ¾	2.38	1.20
1 ¼ x 1	2.38	1.30
1 ½ x ½	2.69	1.50
1 ½ x ¾	2.69	1.60
1 ½ x 1	2.69	1.60
1 ½ x 1 ¼	2.69	1.80
2 x ½	3.19	2.40
2 x ¾	3.19	2.40
2 x 1	3.19	2.50
2 x 1 ¼	3.19	2.70
2 x 1 ½	3.19	2.70
2 ½ x 1 ½	3.69	4.10
2 ½ x 2	3.69	4.30
3 x 2	4.06	5.80
3 x 2 ½	4.06	6.50
4 x 3	4.38	10.00

UNIONS (BRASS SEAT)



Size	A	Weight
in	*in*	*lbs*
⅛	1.31	0.14
¼	1.81	0.47
⅜	1.81	0.43
½	2.06	0.53
¾	2.25	0.80
1	2.56	1.30
1 ¼	2.75	1.60
1 ½	3.00	2.10
2	3.38	3.50
2 ½	3.88	5.00
3	4.25	7.70
4	4.88	18.00

Building Connections That Last

CORPORATE OFFICES

2 Holland Way
Exeter, NH 03833
Tel: 603-422-8000 • Fax: 603-422-8033
E-mail: sales@anvilintl.com

CUSTOMER SERVICE CENTERS

UNITED STATES

University Park, IL
Tel: 708-885-3000 • Fax: 708-534-5441
Toll Free: 1-800-301-2701

Irving, TX
Tel: 972-871-1206 • Fax: 972-641-8946
Toll Free: 1-800-451-4414

CANADA

Simcoe, Ontario
Tel: 519-426-4551 • Fax: 519-426-5509

EUROPE AND MIDDLE EAST

Tel: +31-53-5725570 • Fax: +31-53-5725579

International Customer Service
Tel: +1-708-885-3000 • Fax: +1-708-534-5441

MEXICO, PUERTO RICO AND LATIN AMERICA

International Customer Service
Tel: +1-708-885-3000 • Fax: +1-708-534-5441

U.S. REGIONAL DISTRIBUTION CENTERS

UNIVERSITY PARK

750 Central Avenue
University Park, IL 60484

IRVING

1401 Valley View Lane, Suite 150
Irving, TX 75061

COLUMBIA

800 Malleable Road
Columbia, PA 17512

ONTARIO

1470 S. Vintage Avenue
Ontario, CA 91761

ANVIL EPS

Engineered Pipe Supports
Customer Service Center

160 Frenchtown Road
North Kingstown, RI 02852

Tel: 401-886-3000
Fax: 401-886-3010
Toll Free: 1-877-406-3108

additional INVENTORY LOCATIONS*

UNITED STATES: Arizona, Colorado, Georgia, Indiana, Massachusetts, Minnesota, Missouri, New York, Tennessee, Texas, Washington and Wisconsin

INTERNATIONAL: Ontario, Canada and Waalwijk, Netherlands

*Inventory varies at locations

B U I L D I N G   C O N N E C T I O N S   T H A T   L A S T

www.anvilintl.com

MERIT

MERIT MFG DIVISION OF ANVIL INT'L
319 Circle of Progress
Pottstown, PA 19464-3811 USA

Ph: 610-327-4000 Fx: 610-970-9282
www.meritmfg.com

CERTIFICATE OF COMPLIANCE
TEE-LET WELDED OUTLET FITTINGS
ADJUSTABLE DROP NIPPLES

This is to certify that the fittings listed above are manufactured by Merit Manufacturing, a division of Anvil International, Inc., located in Pottstown, PA and supplied to the Anvil Distribution Centers are made in the U.S.A. and comply with the following specifications:

Material	Components may be manufactured from one of the following materials: ASTM 1008-1010, A53, A795, A135 or A513
Threads	ANSI/ASME B.1 20.1 or ISO 7-1
Optional Plating	ASTM B-633 Type 3 SC1
Approvals	Underwriters Laboratories Factory Mutual VdS

Certified for and on behalf of Merit Manufacturing, Division of Anvil International, Inc.

Ted Jensen
Plant Manager

May 15, 2006

WARD MANUFACTURING
Make it simple. Make it Ward.

P.O. Box 9
Blossburg, PA 16912-0009
570-638-2131 Ext. 000

For 85 years, Ward Manufacturing has remained committed to producing products here in the United States. Our reputation for performance, quality and service would not be possible without a well-entrenched domestic manufacturing facility operated by generations of dedicated American workers.

Implementation of the American Recovery and Reinvestment Act of 2009 means that US Made is more important today than ever. Provisions of Section 1605 of the Recovery Act. Buy American include:

Use of American Iron, Steel, and Manufactured Goods.

a. None of the funds appropriated or otherwise made available by this Act may be used for a project for the construction, alteration, maintenance, or repair of a public building or public work unless all of the iron, steel, and manufactured goods used in the project are produced in the United States.

b. Subsection (a) shall not apply in any case or category of cases in which the head of the Federal department or agency involved finds that -

    1. applying subsection (a) would be inconsistent with the public interest;
    2. iron, steel, and the relevant manufactured goods are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or
    3. inclusion of iron, steel, and manufactured goods produced in the United States will increase the cost of the overall project by more than 25 percent.

c. If the head of a Federal department or agency determines that it is necessary to waive the application of subsection (a) based on a finding under subsection (b), the head of the department or agency shall publish in the Federal Register a detailed written justification as to why the provision is being waived.

d. This section shall be applied in a manner consistent with United States obligations under international agreements.

WARD MANUFACTURING

117 Gulick St.
Blossburg PA 16912
(800) 248 1027
Fax (570) 241 0100

CERTIFICATION OF COMPLIANCE WITH AMERICAN RECOVERY AND REINVESTMENT ACT SECTION 1605

1. Identification of American-made Iron, Steel, and manufactured good: Consistent with the terms of OWNER'S bid solicitation and the provisions of ARRA Section 1605, the Bidder certifies that this Bid reflects the Bidder's best, good faith effort to identify domestic sources of iron., steel, and manufactured goods for every component contained in the bid solicitation where such American-made components are available on the schedule and consistent with the deadlines prescribed in or required by the bid solicitation

2. Verification of U.S. Production: Bidder certifies that all components contained in the bid solicitation that are American-made have been so identified, and if this bid is accepted, the bidder agrees that it will provide reasonable, sufficient, and timely verification to OWNER of the U.S. production of each component so identified.

3. Documentation regarding Non-American-made Iron, Steel, and Manufactured Goods: The Bidder certifies that for any component or components that are not American-made and are so identified in this bid, the Bidder has included in or attached to the bid one of both of the following, as applicable.

   a. Identification of and citation to a categorical waiver published by the U.S. Environmental Protection Agency in the Federal register that is applicable to such component or components, and an analysis that supports it applicability to the component or components
   b. Verifiable documentation sufficient to OWNER, as required in the bid solicitation or otherwise, that the Bidder has sought to secure American-made components but has determined that such components are not available on the schedule and consistent with the deadlines prescribed in the bid application, with assurance adequate for the Bidder under the applicable conditions stated in the bid solicitation or otherwise.

4. Information and Detailed Justification regarding Non-American Iron, Steel or Manufactured Goods. The Bidder certifies that for any such component or components that are not so available, the Bidder has also provided in or attached to this bid information, included but not limited to the verifiable documentation and a full description of the Bidder's efforts to secure such American-made component or components, that the bidder believes are sufficient to provide and, as far as possible, constitute the detailed justification required for a waiver under Section 1605 with respect to such component or components. The Bidder further agrees that, if this bid is accepted, it will assist OWNER in amending, supplementing, or further supporting such information as required by OWNER to request and, as applicable, implement the terms of a waiver with respect to any such component or components.

AP Guidi Jr 5/11/11
Signature Date

Arthur P. Guidi President
Name & Title of Signee

WARD MANUFACTURING
P.O. Box 9
117 Gulick Street
Blossburg, PA 16912-0009 (570) 638-2131

January 3, 2011

To whom it may concern:

I hereby certify that our products listed below comply with the current specification. The products listed below are made with pride in Blossburg, Pennsylvania, USA.

CL 150 Malleable Iron Threaded Fittings

Fed. Spec. WW - P - 521

ASME	B16.3	(Dimensions)
ASTM	A-197	(Chemical & Physical Properties)
ASTM	A-153	(For Galvanized Product)
ANSI/ASME	B1.20.1	(Tapered Pipe Threads)

CL 300 Malleable Iron Threaded Fittings

ASME	B16.3	(Dimensions)
ASTM	A-197	(Chemical & Physical Properties)
ASTM	A-153	(For Galvanized Product)
ANSI/ASME	B1.20.1	(Tapered Pipe Threads)

Unions, Union Fittings, Flange Unions & Companion Flanges

CL 150 Malleable Iron to Brass Seat, Iron to Iron Unions
Fed. Spec. WW - U - 531 ASME B16.39
CL 250 Malleable Iron to Brass Seat, Unions
Fed. Spec. WW - U - 531 ASME B16.39
CL 300 Malleable Iron to Brass Seat, Iron to Iron Unions
MIL - U - 18250 ASME B16.39
CL 125 - CL 250 Cast Iron Flanges ASME B16.1

ASTM	A-126	(Chemical & Physical Properties)
ASTM	A-153	(For Galvanized Product)
ANSI/ASME	B1.20.1	(Tapered Pipe Threads)

Bushings and Plugs

Fed. Spec. WW - P - 471

ASME	B16.14	(Dimensions)
ANSI/ASME	B1.20.1	(Tapered Pipe Threads) Supersedes B-2-1
ASTM	A-197 or A-126	(Chemical & Physical Properties)
ASTM	A-153	(For Galvanized Product)

CL 125 Cast Iron Threaded Fittings

Fed. Spec. WW - P - 501

ASME	B16.4	(Dimensions)
ASTM	A-126	(Chemical & Physical Properties)
ASTM	A-153	(For Galvanized Product)
ANSI/ASME	B1.20.1	(Tapered Pipe Threads)

Sincerely

Jim Belawski
Manager of Quality Assurance

WARD SPEC/DATA

CAST IRON THREADED FITTINGS

Standard Class 125 Specifications:

ANSI B1. 20.1, Threads, B16.4, Dimensions, Pressure Rating.
ASTM A126, Material A153, Galvanizing.

Pressure Ratings: 125 psig - Saturated Stream
175 psig - At 150 Degrees W.O.G.

Federal Spec: WW P-501
U.L.C. and U.L. Listed Where Applicable
FM Approved Where Applicable

Plug and Bushing Specifications:

ANSI B1. 20.1, Threads, B16.4, Dimensions, Pressure Rating.
ASTM A197 (Malleable), A126 (Cast), A153, Galvanizing.

Pressure Ratings (Mall.): 150 psig - Saturated Stream
300 psig - At 150 Degrees W.O.G.

Pressure Ratings (Cast): 125 psig - Saturated Stream
175 psig - At 150 Degrees W.O.G.

Federal Spec: WW-P-471
U.L.C. and U.L. Listed Where Applicable
FM Approved Where Applicable

Drainage Fitting Specifications:

ANSI B1. 20.1, Threads, B16.12, Dimensions.
ASTM A126, Material. A153, Galvanizing.

Federal Spec: WW-F-941

Cast-Iron Flange Specifications:

ANSI B1. 20.1, Threads, B16.1, Dimensions, Pressure Rating.
ASTM A126, Material. A153, Galvanizing.

Pressure Ratings: 125 psig - Saturated Stream
175 psig - At 150 Degrees W.O.G.

Federal Spec: WW-F-406
U.L.C. and U.L. Listed Where Applicable
FM Approved Where Applicable

Cast-Iron Flange Fitting Specifications:

ANSI B16.1 Dimensions, Pressure Rating.
ASTM A126, Material.

Pressure Ratings: 125 psig - Saturated Stream
175 psig - At 150 Degrees W.O.G.

Federal Spec: WW-F-406
U.L.C. and U.L. Listed Where Applicable
FM Approved Where Applicable

Top Beam & C-Clamp Specifications:

Malleable Iron
ASTM A197, Material, A153, Galvanizing.
3/8", 1/2" rod size.
Supplied with set screw and lock nut.

Clamp Range: Small mouth Beam Clamp & C-Clamp - 3/4"
Large mouth Beam Clamp & C-clamp - 1 1/4"

U.L. Listed Where Applicable

P.O. Box 9
Blossburg, Pennsylvania 16912-0009

WARD MANUFACTURING

717-638-2131
Fax 717-638-3410

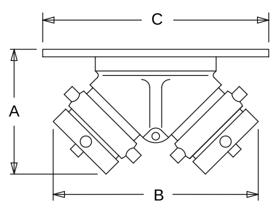
<u>GUARDIAN PROJECTING FIRE DEPARTMENT INLET CONNECTIONS</u>

Operations & Maintenance Manual
December 2015

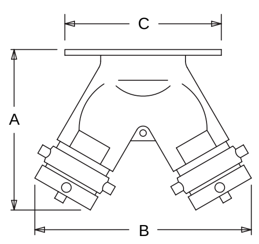
6100 Series
Projecting Fire Dept. Inlet Connections

GUARDIAN
FIRE EQUIPMENT, INC.

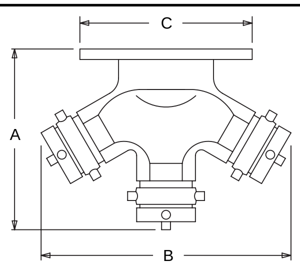
6114



6124/6126



6136



Function

- Used as auxiliary connections through which the fire department can pump water to supplement existing water supplies
- Provides 250 GPM flow (minimum), per $2^{1}/_{2}$” inlet

Features/Components

- **Two and three-way** inlet connections feature clappered brass bodies (straight pattern), with female hose thread swivel inlets and female NPT outlets
- **Standard components, all connections:** Plugs with chains and identification plate
- Cast brass construction*, standard

*Optional brass finishes, add suffix to model no.
-B Polished; **-C** Rough Chrome Plated; **-D** Polished Chrome Plated

Two and Three-Way Connections

Model No.	Size	Clappers	A	B	C
6114	4” x $2^{1}/_{2}$” x $2^{1}/_{2}$”	1	$5^{7}/_{8}$”	$8^{1}/_{8}$”	10”
6124	4” x $2^{1}/_{2}$” x $2^{1}/_{2}$”	2	$7^{5}/_{8}$”	$10^{1}/_{2}$”	10”
6126	6” x $2^{1}/_{2}$” x $2^{1}/_{2}$”	2	8”	$10^{1}/_{2}$”	$11^{1}/_{4}$”
6136	6” x $2^{1}/_{2}$” x $2^{1}/_{2}$” x $2^{1}/_{2}$”	3	$11^{1}/_{4}$”	$13^{3}/_{4}$”	$11^{1}/_{4}$”

Identification Plate Lettering:

- **AUTO SPKR**
- **STANDPIPE**
- **AUTO SPKR & STANDPIPE**
- **DRY STANDPIPE**

Notes

- Always specify hose threads and identification plate lettering
- Contact factory for current UL listing/FM approvals and special requirements

Gate Valves (Non-Rising Stem)

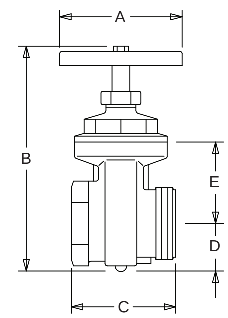
Female x Male

- Used on dry systems as fire hose outlet connections and on pump test manifolds
- Female NPT inlet x Male hose thread outlet, solid wedge disc with tapered seats, 300 PSI, cast brass*

Model No.	Size	A	B	C	D	E
5110	2½" x 2½"	5⅛"	9¾"	4¾"	1⅛"	3½"
5115	3" X 2½"	5⅛"	9¾"	4⅝"	1⅞"	3½"

*Optional brass finishes add suffix to model no.
-B Polished; **-C** Rough Chrome Plated; **-D** Polished Chrome Plated

5110-5115

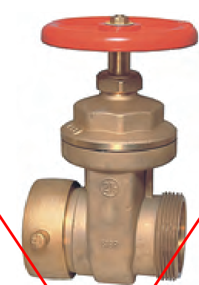


Female x Male

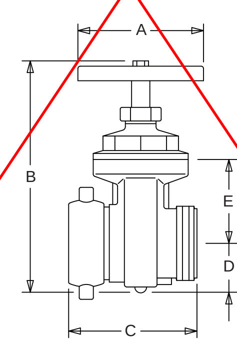
- Used on dry systems as fire hose outlet connections and on pump test manifolds
- Female hose thread swivel inlet x Male hose thread outlet, solid wedge disc with tapered seats, 300 PSI, cast brass*

Model No.	Size	A	B	C	D	E
5120	2½" X 2½"	5⅛"	9¾"	5¼"	1⅞"	3½"

*Optional brass finishes add suffix to model no.
-B Polished; **-C** Rough Chrome Plated; **-D** Polished Chrome Plated



5120

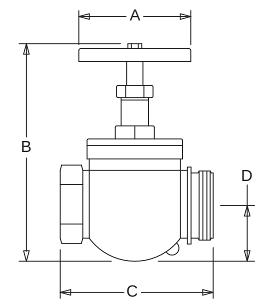


Contact factory for current UL listing/FM approvals and special requirements

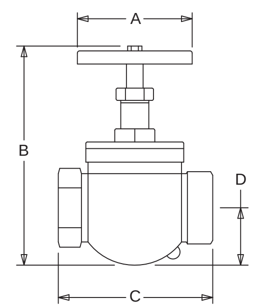
****Important: Specify hose threads*****

GUARDIAN
FIRE EQUIPMENT, INC.

5310



5325



Globe Valves

Female x Male

- Used as fire hose outlet connections
- Female NPT inlet x male hose thread outlet, cast brass*

Model No.	Size	A	B	C	D
5310	2½" X 2½"	5⅛"	10⅞"	7"	2⅝"

Female x Female

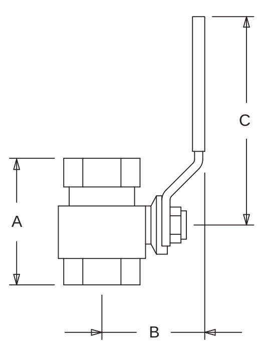
- Used with hose rack assemblies and as drain outlets
- Female NPT inlet and outlet, cast brass*

Model No.	Size	A	B	C	D
5315	½" x ½"	2⅛"	3⅜"	1⅞"	⅝"
5320	1½" x 1½"	3⅝"	5¾"	3⅜"	1¼"
5325	2½" X 2½"	5⅛"	10⅞"	7"	2⅝"

Variaton: ½" and 1½" globe valves available with extended stems (up to 36"), add suffix **-EXT** to model no. and specify length

*Optional brass finishes add suffix to model no.
-B Polished; **-C** Rough Chrome Plated; **-D** Polished Chrome Plated

5405-5445



Ball Valves - Full Port

Female x Female

- Used where rapid "on/off" control of flow is required
- Suitable for water, oil, gas, or steam
- Forged brass body, chrome plated ball, teflon seals, vinyl covered handle
- Female NPT inlet/outlet, positive closure in either flow direction

Model No.	Size	Port	A	B	C	Pressure (psi) WOG
5404	½"	½"	2⅛"	1⁵⁄₁₆"	3⅛"	600
5410	¾"	¾"	2⁷⁄₁₆"	1¹³⁄₁₆"	3¹³⁄₁₆"	600
5415	1"	1"	3"	1¹⁵⁄₁₆"	3¹³⁄₁₆"	600
5420	1¼"	1¼"	3⁵⁄₁₆"	2⅛"	3¹³⁄₁₆"	600
5425	1½"	1½"	3¹¹⁄₁₆"	2¹¹⁄₁₆"	5⁷⁄₁₆"	600
5430	2"	2"	4¹⁵⁄₁₆"	2¹⁵⁄₁₆"	5⁷⁄₁₆"	400
5435	2½"	2⅜"	5¹¹⁄₁₆"	4"	6¹³⁄₁₆"	400
5440	3"	2¹⁵⁄₁₆"	6⁵⁄₁₆"	4⁵⁄₁₆"	6¹³⁄₁₆"	400
5440	4"	3¾"	8"	5⁵⁄₁₆"	7⁵⁄₁₆"	400

Contact Guardian for Current Approvals

5505-5540

5515P/5525P

Caps With Chains

Female Threads

- Used to protect hose thread outlets on valves and hydrants
- Cast brass*, pin lugs or red plastic with rocker lugs

Size	¾"	1"	1½"	2"	2½"	3"	4"	4½"
Brass Model No.	5505	5510	5515	5520	5525	5530	5535	5540
Plastic Model No.	---	---	5515P	---	5525P	---	---	---

Variaton: brass caps available with rocker lugs, add suffix **-RL** to model no. to specify

*Optional brass finishes add suffix to model no.
-B Polished; **-C** Rough Chrome Plated; **-D** Polished Chrome Plated

Contact factory for current UL listing/FM approvals and special requirements

*****Important: Specify Hose Threads*****

GUARDIAN
FIRE EQUIPMENT, INC.

3300 Series Brass Adapters and Snoots

Adapters

Model 3305
Type: Rigid Hexagon, Male x Male threads

Model 3310
Type: Rigid Hexagon, Female x Male threads

Model 3315
Type: Rigid Pin Lug Reducer, Female x Male threads

Model 3320
Type: Rigid Hexagon, Female x Female threads

Model 3325
Type: Rigid Hexagon, Male x Female threads

Model 3330
Type: Double Swivel Pin Lug, Female x Female threads


3305


3310


3315


3320


3325


3330

Snoots

Model 3335
Type: Rigid Hex., Female NPT x Male (Hose or NPT Threads)

Model 3340
Type: Swivel Pin Lug, Male NPT x Female Hose Threads

Model 3345
Type: Swivel Pin Lug, Female NPT x Female Hose Threads


3335


3340


3345

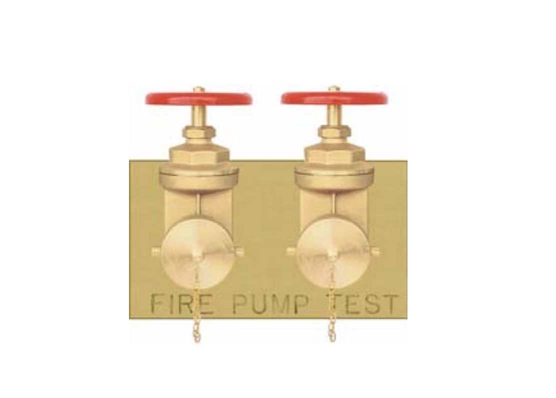
Function
- Used to change threads, configuration and/or size - refer to chart for model availability

Options
- Brass Finish (add suffix to model no. to specify)
  - **B** Polished
  - **C** Rough Chrome Plated
  - **D** Polished Chrome plated
- Models **3315** and **3330** with rocker lug, (add suffix **-RL** to model no. to specify)

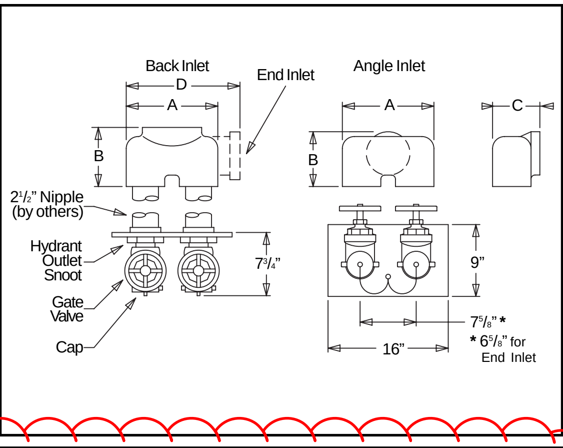
Adapters						
Model No.	**3305**	**3310**	**3315**	**3320**	**3325**	**3330**
Config.	M x M	F x M	F x M	F x F	M x F	F x F
1” x 1”	✔	✔		✔		
1 1/2” x 3/4”	✔		✔		✔	
1 1/2” x 1”	✔	✔	✔	✔	✔	
1 1/2” x 1 1/2”	✔	✔		✔		✔
2” x 3/4”	✔	✔	✔	✔	✔	
2” x 1 1/2”	✔	✔	✔		✔	
2” x 2”	✔	✔		✔		
2 1/2” x 3/4”			✔			
2 1/2” x 1”			✔		✔	
2 1/2” x 1 1/2”	✔	✔	✔		✔	
2 1/2” x 2”	✔	✔	✔		✔	
2 1/2” x 2 1/2”	✔	✔		✔		✔
3” x 1 1/2”			✔		✔	
3” x 2”					✔	
3” x 2 1/2”	✔	✔	✔	✔	✔	
3” x 3”	✔	✔				
4” x 4”	✔	✔				
4 1/2” x 4”	✔	✔		✔	✔	

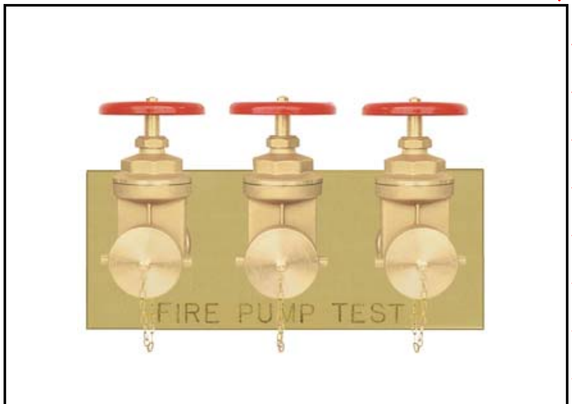
Snoots			
Model No.	**3335**	**3340**	**3345**
Config.	F x M	M x F	F x F
--			
--			
--			
1 1/2” x 1 1/2”		✔	✔
--			
--			
--			
--			
--			
1 1/2” x 2 1/2”		✔	✔
2” x 2 1/2”		✔	✔
2 1/2” x 2 1/2”	✔	✔	✔
--			
--			
3” x 2 1/2”	✔	✔	✔
3” x 3”	✔	✔	✔
--			
--			

Important: Specify Hose Threads

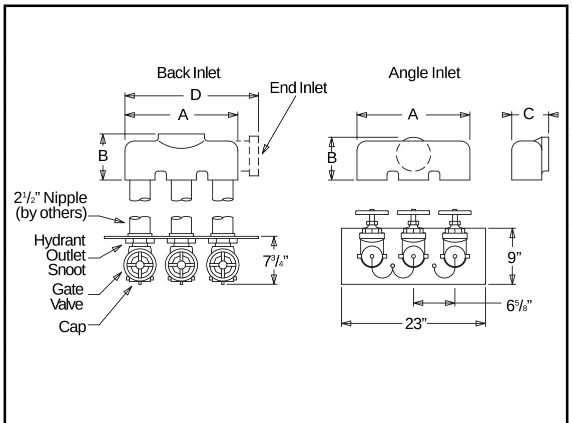


6724-6729





6734-6736



Function

- Used to conduct flow tests on fire pumps

Features/Components

- **Two & three-way** test connections feature brass bodies (straight, angle or end pattern) with female NPT inlets and outlets
- **Standard components, all connections:**
  Hydrant outlet snoots ($2\frac{1}{2}$" female NPT x $2\frac{1}{2}$" male NPT), N.R.S. loose bonnet gate valves ($2\frac{1}{2}$" female NPT x $2\frac{1}{2}$" male hose thread), caps with chains and identification plate lettered "**FIRE PUMP TEST**"
- Cast brass construction*, standard

*Optional brass finishes on exposed surfaces, add suffix to model no. **-B** Polished; **-C** Rough Chrome Plated; **-D** Polished Chrome Plated

Two and Three-Way Connections

Model No.	Inlet	Size	Pump Size (gpm)	A	B	C	D
6724	Back	4" x $2\frac{1}{2}$" x $2\frac{1}{2}$"	500	11	$6\frac{1}{8}$"	---	---
6725	Angle	4" x $2\frac{1}{2}$" x $2\frac{1}{2}$"	500	11	$6\frac{1}{8}$"	$4\frac{1}{8}$"	---
6726*	End	4" x $2\frac{1}{2}$" x $2\frac{1}{2}$"	500	---	---	---	16"
6727	Back	6" x $2\frac{1}{2}$" x $2\frac{1}{2}$"	500	$11\frac{1}{2}$"	8"	---	---
6728	Angle	6" x $2\frac{1}{2}$" x $2\frac{1}{2}$"	500	$11\frac{1}{2}$"	$7\frac{3}{4}$"	$4\frac{1}{8}$"	---
6729*	End	6" x $2\frac{1}{2}$" x $2\frac{1}{2}$"	500	---	---	---	16"
6734	Back	6" x $2\frac{1}{2}$" x $2\frac{1}{2}$" x $2\frac{1}{2}$"	750	$17\frac{3}{8}$"	$6\frac{1}{8}$"	---	---
6735	Angle	6" x $2\frac{1}{2}$" x $2\frac{1}{2}$" x $2\frac{1}{2}$"	750	$17\frac{3}{8}$"	9"	6"	---
6736*	End	6" x $2\frac{1}{2}$" x $2\frac{1}{2}$" x $2\frac{1}{2}$"	750	---	---	---	$20\frac{1}{2}$"

*Available with steel body (**-ST**) only

Component Variations

Suffix

-ST Bodies fabricated of schedule 40 steel (straight, angle or end pattern) with female NPT inlets and outlets
All steel bodies furnished with $2\frac{1}{2}$" female NPT outlets and 7" center lines

- 1 Standard components, except hydrant outlet snoots ($2\frac{1}{2}$" female NPT x $2\frac{1}{2}$" male hose thread), and less valves

- 2 Standard components, except hydrant outlet snoots ($2\frac{1}{2}$" female NPT x $2\frac{1}{2}$" male hose thread), and N.R.S. swivel inlet gate valves ($2\frac{1}{2}$" female hose thread x $2\frac{1}{2}$" male hose thread)
Swivel inlet gate valves always furnished cast brass

To specify variations, add suffix(es) to model no.

Notes

- Always specify hose threads
- Pipe nipples for connecting bodies to hydrant snoots by others
- Contact factory for current UL listing/FM approvals and special requirements

BULL MOOSE TUBE COMPANY
1819 Clarkson Road, Suite 100 • Chesterfield, Missouri 63017
(636) 537-2600 • www.bullmoosetube.com

August 23, 2012

Viking Supplynet

All sprinkler pipe 1-1/4" - 4" sch 10, 1"- 4" sch 40, 1" – 2" Eddythread and 1-1/4" – 4" Eddyflow supplied by Bull Moose Tube Company is manufactured in the United States at one of the following locations, Gerald, Missouri, Masury, Ohio, or Casa Grande, AZ.

If you require any further information, feel free to give me a call.

Sincerely

David Weinrich
General Sales Manager-Sprinkler Pipe

<u>BULL MOOSE TUBE CO.</u>
<u>SCH10 & SCH40 PIPE</u>

Operations & Maintenance Manual
December 2015

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
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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

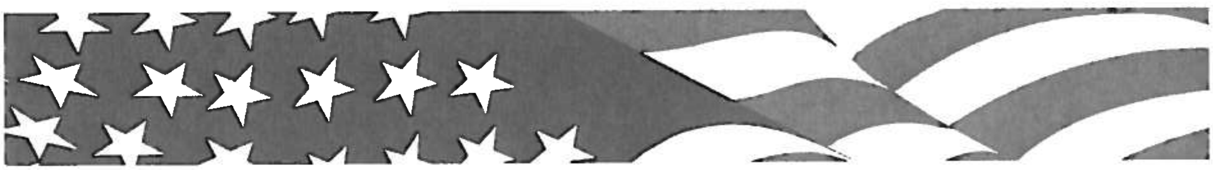
c UL us LISTED

FM APPROVED

WHEATLAND TUBE CO.
SCH10 & SCH40 PIPE

Operations & Maintenance Manual
December 2015

If You're Going to "Buy American", Make Sure it Was Made in America.



Wheatland *Tube*

JMC STEEL GROUP

100% manufactured in the USA and produced from steel that was made and melted in the USA

The Buy American Provision Of The American Recovery And Reinvestment Act Of 1990 ("ARRA")

Welded steel pipe and tube must be both manufactured in the United States and produced from steel that is made and melted in the United States in order to satisfy the requirement of the Buy American Provision contained in the ARRA.

The *Buy American Provision* of the ARRA, which was signed into law on February 17, 2009, states that:

> *"[n]one of the funds appropriated or otherwise made available by the [ARRA] may be used for a project for the construction, alteration, maintenance, or repair of a public building or public work unless all of the iron, steel and manufactured goods used in the project are produced in the United States."*

On August 30, 2010, the Federal Acquisition Councils, in order to further implement the Buy American Provision of ARRA, issued a Final Rule amending the Federal Acquisition Regulations (FAR). The Final Rule is effective October 1, 2010 and applies to solicitations issued and contracts awarded on or after October 1, 2010.

Prior to the issuance of the Final Rule some confusion existed as to whether there was a requirement that welded tube and pipe be manufactured from steel that was melted domestically. **The Final Rule makes it clear that in order to satisfy the requirement of the Buy American Provision of ARRA, welded tube and pipe must be manufactured in the United States. Which means rolled in the United States from steel that is made and melted in the United States. Welded steel pipe and tube manufactured in the United States but made from steel that was <u>PRODUCED USING FOREIGN SLABS DOES NOT QUALIFY</u> under the Buy American Provision of ARRA.**

Wheatland Tube products are manufactured in the United States, and are produced from steel that is made and melted in the United States.

Wheatland Tube has the strength to deliver support to customers who supply products for projects that are funded by the ARRA.

When you purchase Wheatland Tube's products you can purchase with the confidence that Wheatland Tube satisfies the strictest of standards to be considered American Made, Made in America, or Buy American.

For more information about the "Buy America — Recovery Act" provision, Section 1605 in Division A, and the interim rule amending the Federal Aquisition Regulation (FAR), please go to www.gpcaccess.gov/fr/.

Wheatland Tube Products

Electrical Conduit and Fittings

We supply a full range of steel conduit (RMC, IMC and EMT) that offers superior physical protection for electrical conductors, is recognized as an equipment grounding conductor by the NEC® and acts as an effective shield against electrical magnetic interference (EMI). All three products are available in 10-foot lengths. Many trade sizes of RMC and EMT are also available in 5-ft and 20-ft. lengths, which helps speed installation, and reduce costs.

Wheatland also supplies Rigid Aluminum Conduit (RAC), which provides: extra protection in most corrosive and industrial atmospheres, ease of installation, reduced maintenance costs and a bright, attractive appearance.

To complement our conduit, we carry a full line of fittings – nipples, elbows, couplings and running thread pipe.

Applications: Protection of electrical wiring and conductors

DOM Mechanical Tubing
A-513 ERW and A-512 CW

We manufacture cold-drawn mechanical tubing for customers who need the precision of mechanical tubing that can be drawn to very specific sizes and requirements.

Our A-513 ERW is extremely precise. Produced from an ERW hollow that's been normalized, it can be drawn to virtually any size.

Applications: flattened or fled parts, hydraulic cylinders, machine parts, and applications which require a superior surface finish and precise dimensions.

Fence Framework

We furnish fence framework for high security, commercial, light industrial and residential applications. Our WT-40 and hot-dip, galvanized F1083 pipe in regular, intermediate and high-strength grades are designed for high security applications, like government installations or correctional facilities.

Our WT-30, WT-20 and WT-15 tubing is used in light industrial and commercial fencing.

We also produce tubing in round and square shapes for residential fence framework. It combines security with sophisticated good looks.

Applications: government facilities, correctional institutions, highway fencing, sports facilities, industrial and commercial perimeter security, parking lots, playgrounds, residential security.

Oil and Gas Industry Tubular Goods & Line Pipe

We make two types of tubular products for the oil country:

- Oil Country Tubular Goods. We manufacture oil well casing and tubing to both API specifications and proprietary specs, in size ranges from 1.900 through 5.500 O.D.
- Line pipe. We produce to API 5L specifications in grades A25 through X52, in size ranges from ½" through 6" NPS.

Wheatland facilities that produce energy products are licensed with API – 5CT and API 5L designations and are ISO 9001:2008 certified.

Applications: Use in the production and transportation of crude oil and oil products.

Standard Pipe

Wheatland produces A53 continuous weld and ERW pipe, lance pipe and seamless pressure pipe. We set the industry standard for hot-dip galvanized pipe, supply lance pipe with superior weld integrity and longer burn times, and offer over 350 different combinations of finish, end treatments and length on our standard pipe. We've been doing it for 133 years!

A53 CW and ERW Pipe Applications: *ordinary use in steam, water, gas and air lines*

Lance Pipe Applications: *lancing operations in steel mills, foundries and smelters*

Fire Sprinkler Pipe

We make the most complete line of sprinkler pipe in the industry, and offer a number of proprietary products and unique benefits:

- Our coatings set us apart
  - state-of-the-art, in-house hot-dip galvanizing that meets FM requirements for dry systems
  - black sprinkler pipe coatings that set the standard for corrosion resistance, and appearance and also serve as an excellent paint primer
  - MIC Shield™ the only FM Global approved factory applied, anti-microbial coating for use with CPVC fire sprinkler systems
- Wheatland's Schedule 10 and Schedule 40 Sprinkler Pipe come with a proprietary mill coating that's corrosive and heat resistant. And our Mega-Flow high-strength, lightwall sprinkler pipe offers a larger inside diameter that saves money by letting you downsize your system, without affecting quality or safety.
- Mega-Thread — offers a larger inside diameter than schedule 40 pipe which provides improved hydraulics, down-sizing opportunities, stronger, lighterweight systems and significant cost savings. Mega-Thread threads smoothly and easily, has a proprietary mill coating that extends shelf life, is approved for standard hanger spacing and can be used for earthquake sway bracing.
- Wheatland's GL, galvanized lightwall threadable sprinkler pipe, is ideal for branch line use in wet, dry, preaction and deluge systems and provides exceptional hydrolics.

Applications: use in fire protection systems

ALL PRODUCTS MADE IN AMERICA

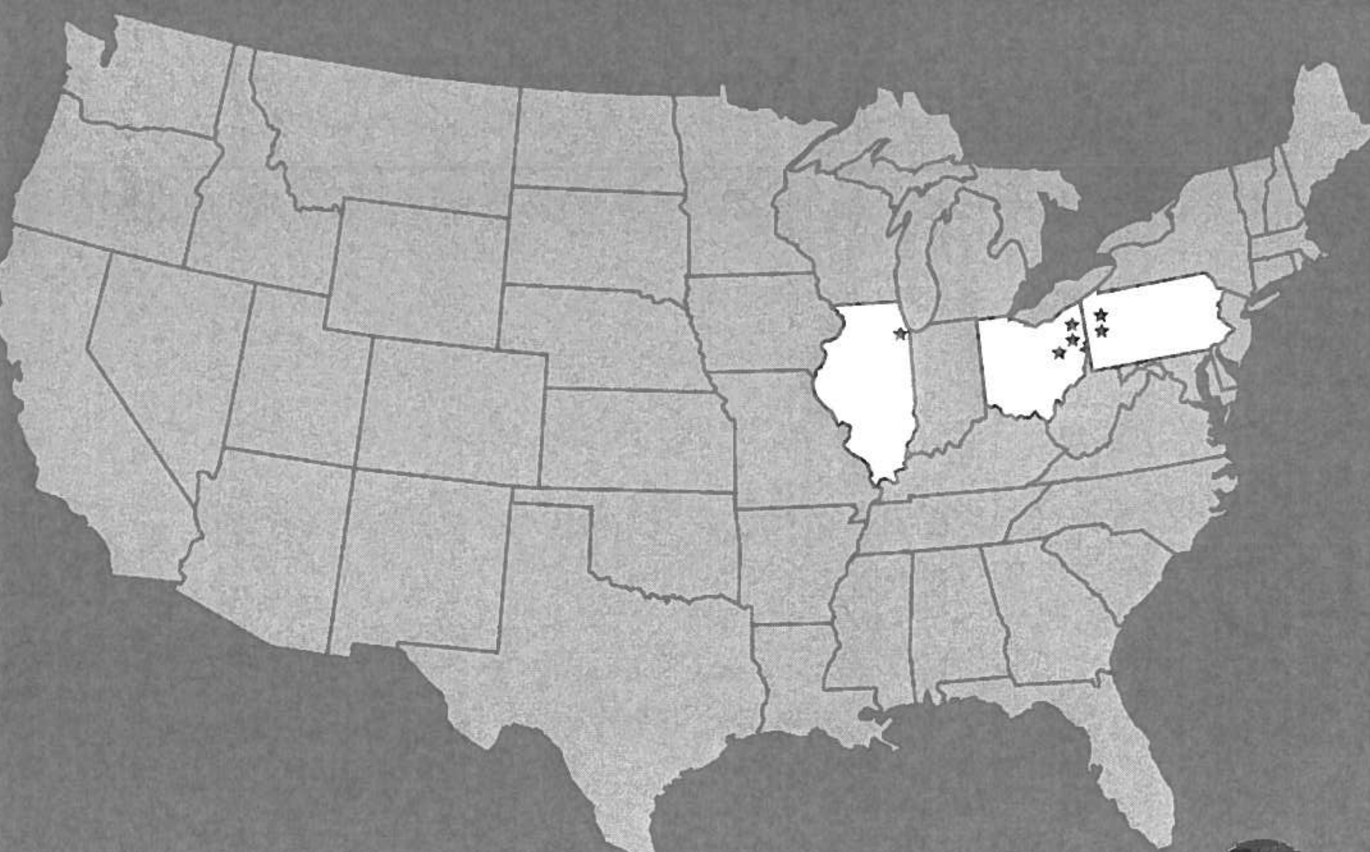
JMC Steel Group
Pipe and Tube Solutions

Corporate Office
3201 Enterprise Pkwy., Ste. 150,
Beachwood, OH 44122-7329
Ph: (216) 910-3700

Wheatland Tube
JMC STEEL GROUP

Wheatland Tube
700 South Dock Street,
Sharon, PA 16146
Ph: (800) 257-8182
Fax: (724) 346-7260
info@wheatland.com

Wheatland produces a wide variety of steel tubular products, including: standard pipe, DOM mechanical tubing, fence framework, fire sprinkler pipe, electrical conduit and fittings, oil country tubular goods (well casing and tubing) and line pipe produced to API specifications.



For more information contact Wheatland Tube at 800-257-8782, email: info@wheatland.com or visit our website@www.wheatland.com

Made in U.S.A.

Wheatland Tube Company

700South Dock Street Sharon, PA 16146 Ph: (800) 257-8182

GUIDELINE FOR DETERMINING THE MAXIMUM WORKING PRESSURE IN PSI, CALCULATIONS ARE BASED ON ASME B31.1 POWER PIPING CODE

CONTINUOUS WELD PIPE ASTM A 53 TYPE F GRADE A, APL5L GRADE A25 PSL				
	SCHEDULE 40		SCHEDULE 80	
NPS	PLAIN END	THREADED	PLAIN END	THREADED
½	1750	750	2500	1400
¾	1450	650	2050	1150
1	1350	550	1900	1050
1 ¼	1100	500	1550	[illegible]
1 ½	1000	450	1400	850
2	850	400	1200	[illegible]
2 ½	900	400	1250	750
3	800	400	1150	700
3 ½	700	350	1050	650
4	650	350	950	650

ELECTRIC RESISTANCE WELD PIPE ASTM A 53 GRADE B & API5L GRADE B PSL 1				
	SCHEDULE 40		SCHEDULE 80	
NPS	PLAIN END	THREADED	PLAIN END	THREADED
1	2400	1000	3350	1900
1 1/4	2000	900	2800	1650
1 1/2	1800	850	2500	1550
2	1500	750	2200	1400
2 1/2	1650	750	2300	1350
3	1400	700	2000	1250
3 1/2	1300	650	1850	1200
4	1200	650	1750	1150
5	1050	600	1550	1100
6	950	600	1500	1100
8	850	550	1350	1050

A SAFETY FACTOR SHOULD ALWAYS BE INCULDED WHEN USING THE ABOVE PRESSURES. WORKING PRESSURES ARE THEORETICAL; THE ACTUAL WORKING PRESSURE MAY VARY BASED ON DESIGN CALCULATIONS.

Safety Factor	Multiplier
5	0.80
6	0.67
7	0.57
8	0.50
9	0.44
10	0.40

A safety factor of 8 would be suitable for the majority of applications, local codes or specific applications may require a higher safety factor. A piping design engineer should be consulted for specific applications. To determine a safe working pressure using a safety factor, multiply the values found in the tables by one of the above multipliers.

Note:

1. The pressures listed are based on ASME B31.1 Power Piping Code.
2. No provision is made for abnormal or unusual conditions
3. No allowance for the coupling design or limitations
4. No allowance for the thinning of the pipe wall due to corrosion, bending etc.
5. Temperature rating: -20 degrees to 400 degrees Fahrenheit.
6. ERW or CW pipe may not be suitable for specific applications, consult a piping design engineer for specific applications.

LIGHT WALL SPRINKLER PIPE MAXIMUM WORKING PRESSURE

Type	Maximum Pressure in PSI
WST, Wheatland Super Tube	175
WLS, MEGA-FLOW, MLT, GL, MEGA-THREAD & SCH. 10	300

Fire Sprinkler Pipe

Schedule 10 and Schedule 40

Submittal Data Sheet

FM Approved and Fully Listed Sprinkler Pipe
Wheatland's Schedule 10 and Schedule 40 steel fire sprinkler pipe is FM Approved and UL, C-UL and FM Listed.

Approvals and Specifications
Both products meet or exceed the following standards:

- ASTM A135, Type E, Grade A (Schedule 10)
- ASTM A795, Type E, Grade A (Schedule 40)
- NFPA 13

Manufacturing Protocols
Schedule 10 and Schedule 40 are subjected to the toughest possible testing protocols to ensure the highest quality and long-lasting performance.

Finishes and Coatings
All Wheatland black steel fire sprinkler pipe up to 6" receives a proprietary mill coating to ensure a clean, corrosion-resistant surface that outperforms and outlasts standard lacquer coatings. This coating allows the pipe to be easily painted, without special preparation. Schedule 10 and Schedule 40 can be ordered in black, or with hot-dip galvanizing, to meet FM/UL requirements for dry systems that meet the zinc coating specifications of ASTM A795 or A53. All Wheatland galvanized material is also UL Listed.

Product Marking
Each length of Wheatland fire sprinkler pipe is continuously stenciled to show the manufacturer, type of pipe, grade, size and length. Barcoding is acceptable as a supplementary identification method.

SCHEDULE 10 SPECIFICATIONS

NPS	NOM OD		NOM ID		NOMINAL WALL		NOMINAL WEIGHT		UL	PIECES
	in.	mm	in.	mm	in.	mm	lbs./ft.	kg/m	CRR*	Lift
1¼	1.660	42.2	1.442	36.6	.109	2.77	1.81	2.69	7.3	61
1½	1.900	48.3	1.682	42.7	.109	2.77	2.09	3.11	5.8	61
2	2.375	60.3	2.157	54.8	.109	2.77	2.64	3.93	4.7	37
2½	2.875	73.0	2.635	66.9	.120	3.05	3.53	5.26	3.5	30
3	3.500	88.9	3.260	82.8	.120	3.05	4.34	6.46	2.6	19
4	4.500	114.3	4.260	108.2	.120	3.05	5.62	8.37	1.6	19
5	5.563	141.3	5.295	134.5	.134	3.40	7.78	11.58	1.5	13
6	6.625	168.3	6.357	161.5	.134	3.40	9.30	13.85	1.0	10
8	8.625	219.1	8.249	209.5	.188	4.78	16.96	25.26	2.1	7

** Calculated using Standard UL CRR formula, UL Fire Protection Directory, Category VIZY.*
** The CRR is a ratio value used to measure the ability of a pipe to withstand corrosion. Threaded Schedule 40 steel pipe is used as the benchmark (value of 1.0).*

SCHEDULE 40 SPECIFICATIONS

NPS	NOM OD		NOM ID		NOMINAL WALL		NOMINAL WEIGHT		UL	PIECES
	in.	mm	in.	mm	in.	mm	lbs./ft.	kg/m	CRR*	Lift
1	1.315	33.4	1.049	26.6	.133	3.38	1.68	2.50	1.00	70
1¼	1.660	42.2	1.380	35.1	.140	3.56	2.27	3.39	1.00	51
1½	1.900	48.3	1.610	40.9	.145	3.68	2.72	4.05	1.00	44
2	2.375	60.3	2.067	52.5	.154	3.91	3.66	5.45	1.00	30

** Calculated using Standard UL CRR formula, UL Fire Protection Directory, Category VIZY.*
** The CRR is a ratio value used to measure the ability of a pipe to withstand corrosion. Threaded Schedule 40 steel pipe is used as the benchmark (value of 1.0).*

c

APPROVED

SUBMITTAL INFORMATION

PROJECT: ______ CONTRACTOR: ______ DATE: ______

ENGINEER: ______ SPECIFICATION REFERENCE: ______ SYSTEM TYPE: ______

LOCATIONS: ______ COMMENTS: ______

☐ BLACK ☐ HOT-DIP GALVANIZED

Wheatland Tube 700 South Dock Street Sharon, PA 16146
P 800.257.8182 | **F** 724.346.7260 | info@wheatland.com | wheatland.com

SIGMA WELDED FITTINGS

Operations & Maintenance Manual
December 2015

Σ SIGMA.

Piping Products – Fire, Plumbing, Industrial

Quality – Service – Commitment – Delivered

Welded

SIGMA Corporation

700 Goldman Drive
Cream Ridge, NJ 08514

281-987-1200
800-999-0109
spp-sales@sigmaco.com

www.sigmaco.com

Welded

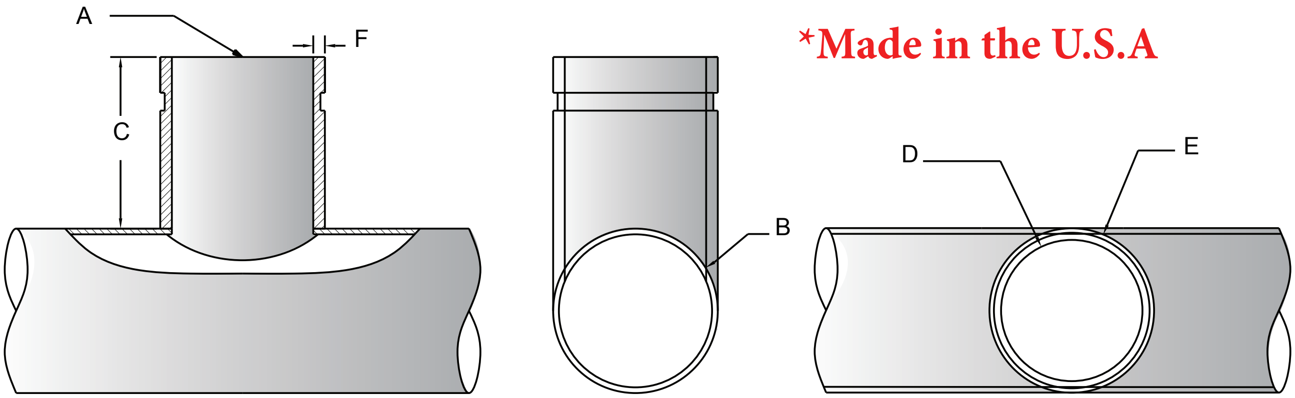
Grooved Welding Outlet

Description

Roll Groove

- **MATERIALS:** Highly Weldable grade black carbon steel equal to or exceeding the requirements of the American Society for Testing and Materials Specifications A - 135,A-795,A-53.

- **U.L. / U.L.C. / F.M. WORKING PRESSURE:** Schedule 40 Cut Groove / up to 500 CWP in PSI Schedule 40 Roll Groove up to 300 CWP in PSI Pressures have been established using listed and/or approved couplings and fittings of equal or higher ratings. Hydrostatic test of 2:1 for maximum working pressure and 5:1 for strength of body. (4:1 for 8”).
- **QUALITY ASSURANCE AND INSPECTION:** Dimensional integrity is assured with accurate machining, stringent quality control procedures, and sound fabrication techniques. Grooves, threads and bevels are constantly checked for proper alignment and concentricity, uniform depth, taper and degree, as applicable,conforming to established industry standards.
- **MARKING:** For identification, each fitting bears the name “ISLAND” or registered trademark, along with appropriate figure number and end preparation designation. In addition, the nominal outlet and header size in inches, and ◄FM► indicating listing and approval with recognized testing laboratories.
- **DESIGN:** Welded outlets are designed to provide unobstructed full flow. This is accomplished by making the inside diameter of the low weld volume machine coWntour precisely fit the outside diameter of the adjoining pipe/header to be welded. The full penetration weld is made forming a smooth passageway to prevent catching or clogging of foreign matter. Therefore, no special allowances are necessary when utilizing computer hydraulic flow calculations. Type 40 & 10 weld outlets are manufactured in a wide range of header sizes. Each fitting is manufactured “size on size”. This means the outlet fits exactly on the header to which it is welded, so it is ideal for use with automatic welding machines.
- **FINISH:** Fittings are cleaned to bare metal internally and externally and protected with a smokeless rust inhibitor giving a lasting finish to extend shelf life.
- **PACKAGING:** For convenience in warehouse handling, storage, and inventory control, Schedule 40 and 10 fittings



*Made in the U.S.A

**SUPPLIER: ISLAND FITTING

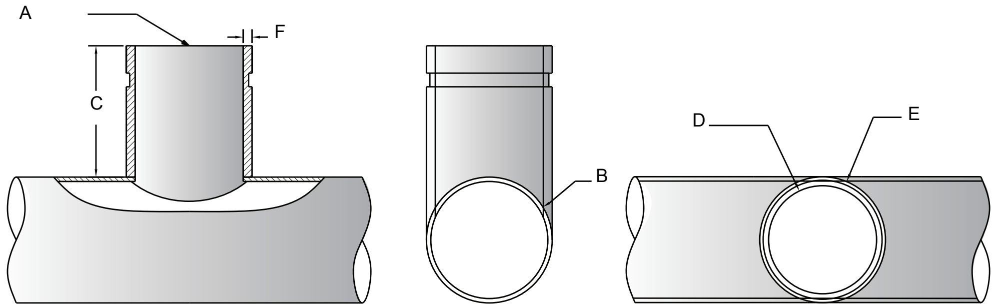
UL LISTED FM APPROVED

NOM SIZE A X B	ITEM CODE	STANDARD LENGTH C	INSIDE DIAMETER D	OUTSIDE DIAMETER E	WALL THICKNESS F	ITEM WT.
2.5” X 2.5”	UL0117	3	2.635	2.875	0.120	1.00
2.5” X 3”	UL0118	3	2.635	2.875	0.120	1.00
2.5” X 4”	UL0119	3	2.635	2.875	0.120	1.00
2.5” X 6”	UL0120	3	2.635	2.875	0.120	1.00
2.5” X 8”	UL0121	3	2.635	2.875	0.120	1.00
3” X 3”	UL0122	4	3.260	3.500	0.120	1.20
3” X 4”	UL0123	4	3.260	3.500	0.120	1.20
3” X 6”	UL0124	4	3.260	3.500	0.120	1.20
3” X 8”	UL0125	4	3.260	3.500	0.120	1.20
4” X 4”	UL0126	4	4.260	4.500	0.120	2.10
4” X 6”	UL0127	4	4.260	4.500	0.120	2.10
4” X 8”	UL0128	4	4.260	4.500	0.120	2.10
6” X 6”	UL0129	4	6.357	6.625	0.134	3.80
6” X 8”	UL0130	4	6.357	6.625	0.134	3.80
6” X 8”	UL0131	4	8.329	8.625	0.188	6.20

Groove Welding Outlet

Description

Cut Groove



NOM SIZE A X B	ITEM CODE	STANDARD LENGTH C	INSIDE DIAMETER D	OUTSIDE DIAMETER E	WALL THICKNESS F	ITEM WT.
1.25” X 1.25”	UL0201	3	1.368	1.660	0.140	0.56
1.25” X 1.5”	UL0202	3	1.368	1.660	0.140	0.56
1.25” X 2”	UL0203	3	1.368	1.660	0.140	0.56
1.25” X 2.5”	UL0203A	3	1.368	1.660	0.140	0.56
1.25” X 3”	UL0204	3	1.368	1.660	0.140	0.56
1.25” X 4”	UL0204A	3	1.368	1.900	0.145	0.70
1.25” X 5”	UL0205	3	1.368	1.900	0.145	0.70
1.25” X 6”	UL0205A	3	1.368	1.900	0.145	0.70
1.25” X 8”	UL0205C	3	1.368	1.900	0.145	0.70
1.5” X 1.5”	UL0206	3	1.610	1.900	0.145	0.70
1.5” X 2”	UL0207	3	1.610	2.375	0.154	0.90
1.5” X 2.5”	UL0208	3	1.610	2.375	0.154	0.90
1.5” X 3”	UL0209	3	1.610	2.375	0.154	0.90
1.5” X 4”	UL0209A	3	1.610	2.375	0.154	0.90
1.5” X 5”	UL0210	3	1.610	2.375	0.154	0.90
1.5” X 6”	UL0210A	3	1.610	2.375	0.154	0.90
2” X 2”	UL0211	3	2.067	2.375	0.154	0.90
2” X 2.5”	UL0212	3	2.067	2.375	0.154	0.90
2” X 3”	UL0213	3	2.067	2.875	0.203	1.40
2” X 4”	UL0214	3	2.067	2.875	0.203	1.40
2” X 6”	UL0215	3	2.067	2.875	0.203	1.40
2” X 8”	UL0216	3	2.067	2.875	0.203	1.40
2.5” X 2.5”	UL0217	3	2.469	2.875	0.203	1.40
2.5” X 3”	UL0218	3	2.469	3.500	0.216	2.10
2.5” X 4”	UL0219	3	2.469	3.500	0.216	2.10
2.5” X 6”	UL0220	3	2.469	3.500	0.216	2.10
2.5” X 8”	UL0221	3	2.469	3.500	0.216	2.10
3” X 3”	UL0222	3	3.068	4.500	0.237	3.40
3” X 4”	UL0223	3	3.068	4.500	0.237	3.40
3” X 6”	UL0224	3	3.068	4.500	0.237	3.40
3” X 8”	UL0225	3	3.068	6.625	0.280	7.00
4” X 4”	UL0226	4	4.026	6.625	0.280	7.00
4” X 6”	UL0227	4	4.026	8.625	0.277	10.40
4” X 8”	UL0228	4	4.026			
6” X 6”	UL0229	4	6.065			
6” X 8”	UL0230	4	6.065			
6” X 8”	UL0231	4	7.981			

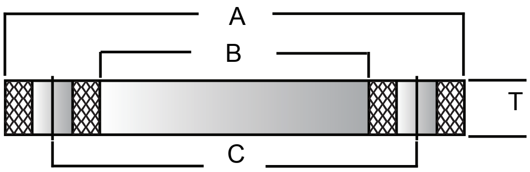
Welded

Steel Plate Flanges

- Bolts shall be smaller in diameter than the normal bolt hole diameter.
- Pressure rating at atmospheric temperature for sizes 2” - 12” is 175 psi.
- These flanges have the same diameter and drilling as class 125 Cast Iron flanges (ANSI B16.1) .
- Minimum bolt lengths shall be the sum of the mating flange maximum thicknesses, the gasket, and the depth of the nut plus 1/8” (3.2mm) minimum before torquing. If threaded rods are used, they shall be the same length as the bolts determined previously, plus the depth of the nuts. Flanges conform to AWWA C207.

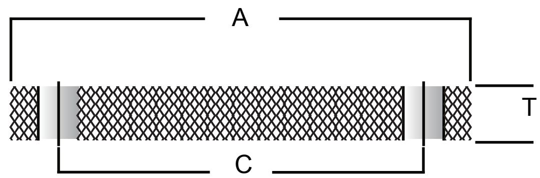
Description

Slip-on & Reducing



Description

Blind



NOM SIZE	ITEM CODE	OUTSIDE DIAMETER A	INSIDE DIAMETER B	BOLT CIRCLE C	THICKNESS T	NUMBER OF BOLTS REQUIRED	BOLT HOLE DIAMETER	ITEM WT.
SLIP-ON								
2”	1FLS0909	6	3	4.75	0.5	4	0.75	4.2
2 1/2”	1FLS1010	7	3	5.5	0.5	4	0.75	5.6
3”	1FLS1111	7.5	3.6	6	0.5	4	0.75	6.3
4”	1FLS1212	9	4.6	7.5	0.625	8	0.75	8.5
6”	1FLS1414	11	6.7	9.5	0.688	8	0.875	10.9
8”	1FLS1515	13.5	8.7	11.75	0.688	8	0.875	15.6
10”	1FLS1616	16	11	14.25	0.812	12	1	20
12”	1FLS1717	19	13	17	0.938	12	1	33.1
REDUCING								
2 1/2 X 2	1FLR1009	7	2.4	5.5	0.5	4	0.75	5.6
3 X 2	1FLR1109	7.5	2.4	6	0.5	4	0.75	6.3
3 X 2 1/2	1FLR1110	7.5	3.0	6	0.5	4	0.75	6.3
4 X 2	1FLR1209	9	2.4	7.5	0.625	8	0.75	8.5
4 X 2 1/2	1FLR1210	9	3.0	7.5	0.625	8	0.75	8.5
4 X 3	1FLR1211	9	3.6	7.5	0.625	8	0.75	8.5
6 X 2	1FLR1409	11	2.4	9.5	0.688	8	0.875	10.9
6 X 2 1/2	1FLR1410	11	3.0	9.5	0.688	8	0.875	10.9
6 X 3	1FLR1411	11	3.6	9.5	0.688	8	0.875	10.9
6 X 4	1FLR1412	11	4.6	9.5	0.688	8	0.875	10.9
8 X 3	1FLR1511	13.5	3.0	11.75	0.688	8	0.875	15.6
8 X 4	1FLR1512	13.5	4.6	11.75	0.688	8	0.875	15.6
8 X 6	1FLR1514	13.5	6.7	11.75	0.688	8	0.875	15.6
10 X 6	1FLR1614	16	6.7	14.25	0.812	12	1	20.0
10 X 8	1FLR1615	16	8.7	14.25	0.812	12	1	20.0
BLIND								
2”	1FLB0909	6	3	4.75	0.5	4	0.75	4.2
2 1/2”	1FLB1010	7	3	5.5	0.5	4	0.75	5.6
3”	1FLB1111	7.5	3.6	6	0.5	4	0.75	6.3
4”	1FLB1212	9	4.6	7.5	0.625	8	0.75	8.5
6”	1FLB1414	11	6.7	9.5	0.688	8	0.875	10.9
8”	1FLB1515	13.5	8.7	11.75	0.688	8	0.875	15.6
10”	1FLB1616	16	11	14.25	0.812	12	1	20
12”	1FLB1717	19	13	17	0.938	12	1	33.1

UniLet

Threaded Welded Outlet - Import

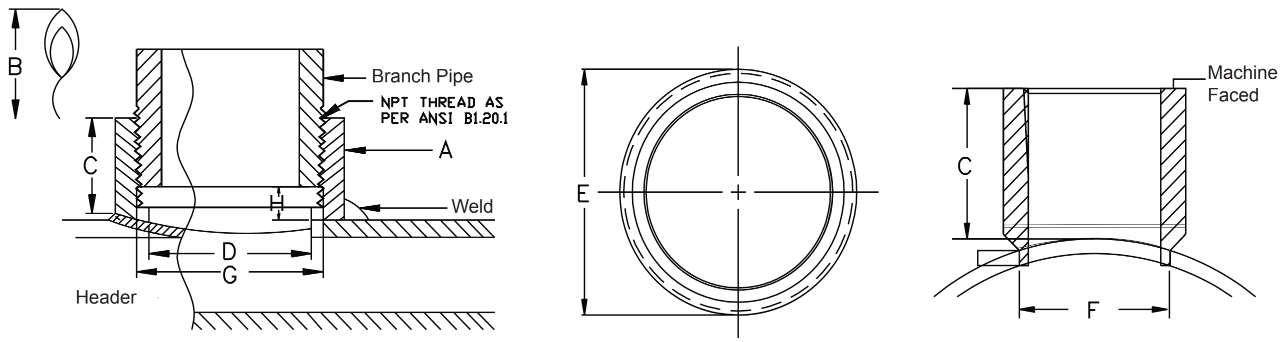
UniLet welding oulets are manufactured by Sigma Piping Products from highly weldable steel which conforms to ASTM A 576/A 29. UniLets are designed specifically for use with automatic welding equipment. Threads are cut in accordance with ANSI B1.20.1 national standard for tapered threads.

FOR FIRE PROTECTION & OTHER LOW PRESSURE PIPING SYSTEMS: UnLets offer the user a high strength-low cost, forged threaded outlet specifically designed and manufactured to be installed on proprietary thin wall “FLOW PIPE”,Schedule 10 and standard wall pipe.

- Only three 1” outlets are required to fit header sizes up to 8”.
- Reduces stock numbers in inventory by reducing inventory
- Chill ring ensures proper positioning, speeds automatic welding, and helps prevent burn or weld through.
- Simplifies and reduces cost of inventory
- Only one ½“ or ¾“ outlet is required to fit header sizes up to 8”

Description

UniLet



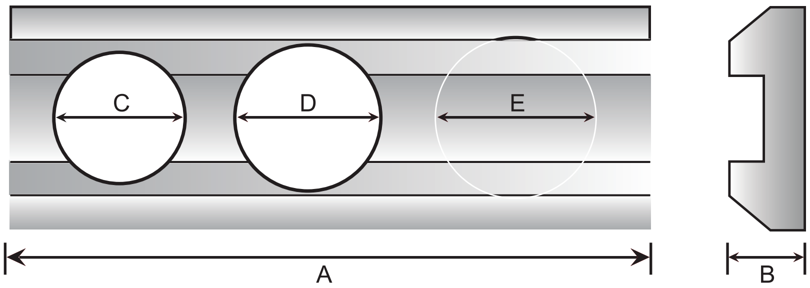
NOM OUTLET SIZE A	NOM HEADER SIZE B	ITEM CODE	TAKE OUT LENGTH C	INSIDE DIAMTER D	OUTSIDE DIAMETER E	BOTTOM DIAMETER F	HOLE SIZE G	MAKE UP H	ITEM WT.
1/2	1 1/4 - 8	UL0001N	1.063	0.700	1.063	0.858	0.875	0.531	0.1
3/4	1 1/4 - 8	UL0002N	1.125	0.900	1.315	1.055	1.063	0.562	0.15
1	1 1/4	D-SL031	1.25		1.57	1.156	1.186		
1	1/ 1/2 - 2 1/2	UL0003N	1.25	1.145	1.57	1.30	1.313	0.593	0.2
1	3 - 8	UL0004N	1.25	1.145	1.57	1.30	1.313	0.593	0.2
1 1/4	1 1/2 - 2	UL0005	1.375	1.480	1.90	1.605	1.625	0.687	0.4
1 1/4	2 1/2 - 8	UL0006	1.375	1.480	1.90	1.605	1.625	0.687	0.4
1 1/2	2 - 3	UL0007	1.625	1.610	2.105	1.735	1.75	0.937	0.5
1 1/2	4 - 8	UL0008	1.625	1.610	2.105	1.735	1.75	0.937	0.5
2	2 1/2 - 3	UL0009	1.75	2.067	2.620	2.192	2.25	1.062	0.8
2	4 - 8	UL0010	1.75	2.067	2.620	2.192	2.25	1.062	0.8

UniLet Template

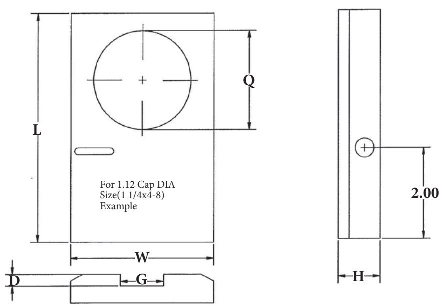
Description

UniLet Template

1/2, 3/4, 1



1 1/4, 1 1/2, 2



SIZE	ITEM CODE	DESCRIPTION	A/L	B/H	C/Q	D/G	E/W
THERMAL DYNAMICS							
1.000	ULTEMP1	1/2, 3/4, 1	9.25	1.00	1.81	2.02	2.24
1.000	ULTEMP4	1 1/4 X 4 - 8	6.25	0.87	2.63	2.12	3.5
1.000	ULTEMP5	1 1/4 X 2 1/2 - 4	6.25	0.87	2.63	1.435	3.5
1.000	ULTEMP6	1 1/2 X 4 - 8	7.00	0.87	2.69	2.12	3.875
1.000	ULTEMP7	1 1/2 X 3 - 4	7.00	0.87	2.69	1.50	3.875
1.000	ULTEMP8	1 1/2 X 2 - 2 1/2	7.00	0.87	2.69	1.50	3.875
1.000	ULTEMP9	2 X 4 - 8	7.00	0.99	3.19	2.12	4.25
1.000	ULTEMP10	2 X 2 1/2 - 3	7.00	0.99	3.19	1.56	4.25
MILLER							
1.080	ULTEMP3	1/2, 3/4, 1	9.25	1.00	1.88	2.11	2.33
HYPERTHERM							
1.125	ULTEMP2	1/2, 3/4, 1	9.25	1.00	1.94	2.15	2.40
1.125	ULTEMP11	1 1/4 X 4 - 8	6.25	0.87	2.75	2.12	3.5
1.125	ULTEMP12	1 1/4 X 2 1/2 - 4	6.25	0.87	2.75	1.435	3.5
1.125	ULTEMP13	1 1/2 X 4 - 8	7.00	0.87	2.815	2.12	3.875
1.125	ULTEMP14	1 1/2 X 3 - 4	7.00	0.87	2.815	1.50	3.875
1.125	ULTEMP15	1 1/2 X 2 - 2 1/2	7.00	0.87	2.815	1.50	3.875
1.125	ULTEMP16	2 X 4 - 8	7.00	0.99	3.315	2.12	4.25
1.125	ULTEMP17	2 X 2 1/2 - 3	7.00	0.99	3.315	1.56	4.25

SigLet

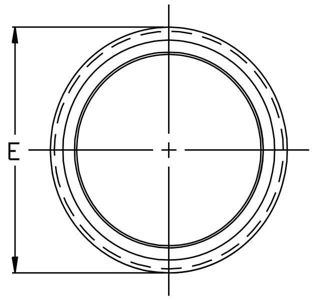
Threaded Welded Outlet *Made in the U.S.A

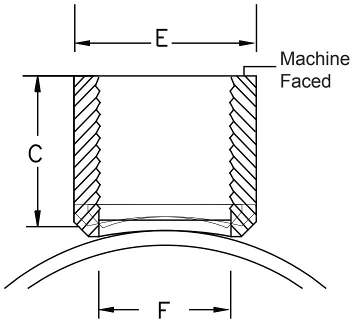
SigLet welding oulets are manufactured by Sigma Piping Products from highly weldable steel which conforms to ASTM A 576/A 29. SigLets are designed specifically for use with automatic welding equipment. Threads are cut in accordance with ANSI B1.20.1 national standard for tapered threads.

FOR FIRE PROTECTION & OTHER LOW PRESSURE PIPING SYSTEMS: SigLets offer the user a high strength-low cost, forged threaded outlet specifically designed and manufactured to be installed on proprietary thin wall "FLOW PIPE",Schedule 10 and standard wall pipe.

Description

SigLet





OUTLET SIZE	RUN SIZE	ITEM CODE	Dimension C	Dimension E	Dimension F	HOLE SIZE
1/2"	1 1/4" - 1 1/2"	D-SL011	1.059"	1.063"	0.71"	0.74"
1/2"	2" - 2 1/2"	D-SL012	1.059"	1.063"	0.71"	0.74"
1/2"	2 1/2" - 8"	D-SL013	1.059"	1.063"	0.71"	0.74"
3/4"	1 1/4" - 1 1/2"	D-SL021	1.125"	1.313"	0.917"	0.95"
3/4"	2" - 2 1/2"	D-SL022	1.125"	1.313"	0.917"	0.95"
3/4"	2 1/2" - 8"	D-SL023	1.125"	1.313"	0.917"	0.95"
1"	1 1/4"	D-SL031	1.25"	1.57"	1.156"	1.186"
1"	1 1/2"	D-SL032	1.25"	1.57"	1.156"	1.186"
1"	2" - 2 1/2"	D-SL033	1.25"	1.57"	1.156"	1.186"
1"	3" - 4"	D-SL034	1.25"	1.57"	1.156"	1.186"
1 1/4"	1 1/2"	D-SL042	1.351"	1.90"	1.48"	1.51"
1 1/4"	2" - 2 1/2"	D-SL044	1.359"	1.90"	1.48"	1.51"
1 1/4"	3" - 4"	D-SL045	1.362"	1.90"	1.48"	1.51"
1 1/2"	2"	D-SL052	1.426"	2.105"	1.635"	1.66"
1 1/2"	2 1/2"	D-SL053	1.511"	2.105"	1.635"	1.66"
1 1/2"	3"	D-SL054	1.573"	2.105"	1.635"	1.66"
1 1/2"	4"	D-SL055	1.619"	2.105"	1.635"	1.66"
1 1/2"	6" - 8"	D-SL056	1.619"	2.105"	1.635"	1.66"
2"	2 1/2"	D-SL062	1.283"	2.62"	2.113"	2.143"
2"	3"	D-SL063	1.408"	2.62"	2.113"	2.143"
2"	4"	D-SL064	1.513"	2.62"	2.113"	2.143"
2"	6"	D-SL066	1.615"	2.62"	2.113"	2.143"
2"	8"	D-SL067	1.662"	2.62"	2.113"	2.143"

*We reserve the right to substitute for another manufacturers domestic threaded outlet.

SIGMA.

Piping Products – Fire, Plumbing, Industrial

Quality – Service – Commitment – Delivered

Products

LOCATIONS

Corporate Head Quarters
Cream Ridge, NJ
Phone (800) 999-0109
Fax (281) 987-0200
spp-sales@sigmaco.com

Southeast & Eastern Regions
Alexander City, AL
Phone (800) 999-0109
Fax (281) 987-0200
spp-sales@sigmaco.com

Western Region
Ontario, CA
Phone (800) 999-0109
Fax (281) 987-0200
spp-sales@sigmaco.com

Auburn, WA
Phone (800) 999-0109
Fax (281) 987-0200
spp-sales@sigmaco.com

Southwest & Midwest Regions
Houston, TX
Phone (800) 999-0109
Fax (281) 987-0200
spp-sales@sigmaco.com

Threaded Fittings

- Black Malleable Iron (3/8” - 4”) - 300psi, CL150
- Galvanized Malleable Iron (3/8” - 4”) - 300psi CL150
- Cast Iron (1” - 2-1/2”) - 300psi, CL150
- Ductile Iron (1” - 2”) - 500psi, CL150
- UL Listed
- FM Approved

Steel Pipe Nipples Domestic and Import

- Schedule 40 Carbon Steel, Welded
- 66- Nipple Pack (1/2’” and 3/4”)
- Black Steel (1/4” - 6”)
- Galvanized Steel (1/4” - 6”)
- Conforms to ASTM A53
- Conforms to ANSI/ASME B.120.1

Welded Products Domestic and Import

- UniLet Import Threaded Weld Outlet (1/2” - 2”)
- SigLet Domestic Threaded Weld Outlet (1/2” - 2”)
- Grooved Welding Outlet (1-1/2” - 8”)
- Welding Templates for Uni-Let
- Plate Flanges
- ULListed
- FM Approved

Indicator Posts

- Vertical Indicator Posts
- Wall Mounted Indicator Posts
- UL Listed
- FM Approved

Gate Valves

- Mechanical Joint, non rising stem (4” - 12”)
- Flanged Joint, non rising stem (4” - 12”)
- Flanged Joint, OS&Y .PIV (4” - 12”)
- 300psi working pressure
- UL Listed
- FM Approved

Fire Valves

- Butterfly - Grooved or Wafer (2-1/2” - 8”)
- Threaded Brass ball valves (1/2” - 2”)
- Double door check valves (4” - 12”)
- UL Listed
- FM Approved

Cast Iron Flanged Fittings

- Cast Iron / Ductile Iron Flanged (2” - 12”)
- ANSI/AWWA C110/A21.10
- Bare, Cement Lined, Special coatings and Linings
- 250psi
- UL/FM

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Terms and Conditions of Sales available at our website.

4.3.6 HDI & HDI-L

4.3.6.1 Product Description

The Hilti HDI/HDI-L Drop-In anchor is an internally threaded, flush mounted expansion anchor for use in concrete.

Product Features

HDI

- Anchor, setting tool and Hilti drill bit form a matched tolerance system to provide reliable fastenings
- Below surface setting for easy patchwork
- Allows shallow embedment without sacrificing performance

HDI-L

- Lip provides flush installation, consistent anchor depth, and easy rod alignment
- Lip allows accurate flush surface setting, independent of hole depth
- Ideal for repetitive fastenings with threaded rods of equal length
- Intelligent expansion section adapts to the base material and reduces number of hammer blows up to 50%
- Easy to read brand and size identification (red paint)

Guide Specifications

Expansion Anchor Expansion anchors shall be flush or shell type and zinc plated in accordance with ASTM B 633, SC 1, Type III. Anchors shall be Hilti HDI/HDI-L anchors as supplied by Hilti.

Installation Install shell or flush type anchors in holes drilled with Hilti carbide tipped drill bits. Install anchors as per manufacturer's recommendations.

4.3.6.2 Material Specifications

HDI/HDI-L, 1/4", 3/8", 1/2", and HDI 5/8" and 3/4" are manufactured from mild carbon steel which is plated with a zinc finish for corrosion protection in accordance with ASTM B 633, SC 1, Type III

HDI Stainless Steel material meets the requirements of AISI 303

4.3.6.3 Technical Data

HDI/HDI-L Specification Table

Details	Anchor Size	in. (mm)	HDI/HDI-L			HDI	
			1/4 (6.4)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)
d_{bit}	Bit diameter[1]	in.	3/8	1/2	5/8	27/32	1
h_{nom} ℓ h_1	Std. depth of embed. Anchor length Hole depth	in. (mm)	1 (25)	1-9/16 (40)	2 (51)	2-9/16 (65)	3-3/16 (81)
ℓ_{th}	Useable thread length	in. (mm)	7/16 (11)	5/8 (15)	11/16 (17)	7/8 (22)	1-3/8 (34)
	Threads per inch		20	16	13	11	10
h	min. base material thickness	in. (mm)	3 (76)	3-1/8 (79)	4 (102)	5-1/8 (130)	6-3/8 (162)
T_{max}	max. tightening torque	ft-lb (Nm)	4 (5.4)	11 (14.9)	22 (29.8)	37 (50.2)	80 (108.5)

1 For Hilti matched tolerance carbide tipped drill bits, see section 8.4.1.

Combined Shear and Tension Loading

$$\left(\frac{N_d}{N_{rec}}\right)^{5/3} + \left(\frac{V_d}{V_{rec}}\right)^{5/3} \leq 1.0$$ *(Ref. Section 4.1.2.7)*

Listings/Approvals

ICC-ES (International Code Council)
Evaluation Report No. 2895 (HDI Only)

COLA (City of Los Angeles)
Research Report No. 23709 (HDI Only)

FM (Factory Mutual)
Serial No. 22765 "Sprinkler Hanger Components–Expansion Shields." (HDI and HDI-L)

UL (Underwriters Laboratory)
"Pipe Hangers" (3/8"–3/4" diameter) (HDI and HDI-L)

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US www.us.hilti.com
Canada www.hilti.ca

HILTI HDI-L & HDI-L DROP-IN ANCHORS

Operations & Maintenance Manual
December 2015

Carbon Steel HDI Ultimate Loads in Concrete

Anchor size in. (mm)	2000 psi (13.8 MPa)				4000 psi (27.6 MPa)				6000 psi (41.4 MPa)			
	Tension lb (kN)		Shear lb (kN)		Tension lb (kN)		Shear lb (kN)		Tension lb (kN)		Shear lb (kN)	
	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L
1/4 (6.4)	**1995** (8.9)	**1995** (8.9)	**1800** (8.0)	**1800** (8.0)	**2270** (10.1)	**2270** (10.1)	**2500** (11.1)	**2500** (11.1)	**3150** (14.0)	**3150** (14.0)	**2800** (12.5)	**2800** (12.5)
3/8 (9.5)	**3555** (15.8)	**3555** (15.8)	**3850** (17.1)	**3850** (17.1)	**4460** (19.8)	**4460** (19.8)	**5000** (22.2)	**5000** (22.2)	**5430** (24.2)	**5430** (24.2)	**6000** (26.7)	**6000** (26.7)
1/2 (12.7)	**4470** (19.9)	**4470** (19.9)	**6000** (26.7)	**6000** (26.7)	**7140** (31.8)	**7140** (31.8)	**8500** (37.8)	**7750** (34.4)	**9375** (41.7)	**9375** (41.7)	**10000** (44.5)	**10000** (44.5)
5/8 (15.9)	**7500** (33.4)	–	**10000** (44.5)	–	**11685** (52.0)	–	**13000** (57.8)	–	**14865** (66.1)	–	**15000** (66.7)	–
3/4 (19.1)	**10000** (44.5)	–	**15500** (69.0)	–	**16260** (72.3)	–	**20000** (89.0)	–	**22250** (99.0)	–	**22000** (97.9)	–

Carbon Steel HDI Allowable Loads in Concrete

Anchor size in. (mm)	2000 psi (13.8 MPa)				4000 psi (27.6 MPa)				6000 psi (41.4 MPa)			
	Tension lb (kN)		Shear lb (kN)		Tension lb (kN)		Shear lb (kN)		Tension lb (kN)		Shear lb (kN)	
	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L
1/4 (6.4)	**500** (2.2)	**500** (2.2)	**450** (8.0)	**450** (8.0)	**570** (2.5)	**570** (2.5)	**625** (2.8)	**625** (2.8)	**790** (3.5)	**790** (3.5)	**700** (3.1)	**700** (3.1)
3/8 (9.5)	**890** (4.0)	**890** (4.0)	**965** (4.3)	**965** (4.3)	**1115** (5.0)	**1115** (5.0)	**1250** (5.6)	**1250** (5.6)	**1360** (6.0)	**1360** (6.0)	**1500** (6.7)	**1500** (6.7)
1/2 (12.7)	**1120** (5.0)	**1120** (5.0)	**1500** (6.7)	**1500** (6.7)	**1785** (7.9)	**1785** (7.9)	**2125** (9.5)	**1940** (8.6)	**2345** (10.4)	**2345** (10.4)	**2500** (11.1)	**2500** (11.1)
5/8 (15.9)	**1875** (8.3)	–	**2500** (11.1)	–	**2920** (13.0)	–	**3250** (14.5)	–	**3715** (16.5)	–	**3750** (16.7)	–
3/4 (19.1)	**2500** (11.1)	–	**3875** (17.2)	–	**4065** (18.1)	–	**5000** (22.2)	–	**5565** (24.8)	–	**5500** (24.5)	–

Note: The ultimate shear and allowable shear values are based on the use of SAE Grade 5 bolts, (f_y = 85 ksi, F_{ult} = 120 ksi) with the exception of the 1/4" HDI/HDI-L in f'_c = 6000 psi concrete which is based upon the use of a SAE Grade 8 bolt (f_y = 120 ksi, F_{ult} = 150 ksi).

Carbon Steel HDI Allowable Loads in Lightweight Concrete and Lightweight Concrete over Metal Deck[1, 2]

Anchor Size in. (mm)	Anchor Installed in 3000 psi (20.7 MPa) Lt. Wt. Concrete[3]		Anchor Installed Through Steel Deck Upper Flute Into 3000 psi (20.7 MPa) Lt. Wt. Concrete[4]		Anchor Installed Through Steel Deck Lower Flute Into 3000 psi (20.7 MPa) Lt. Wt. Concrete[4]	
	Tension, lb (kN)	Shear, lb (kN)	Tension, lb (kN)	Shear, lb (kN)	Tension, lb (kN)	Shear, lb (kN)
1/4 (6.4)	**465** (2.1)	**340** (1.5)	**530** (2.4)	**335** (1.5)	**375** (1.7)	**250** (1.1)
3/8 (9.5)	**755** (3.4)	**940** (4.2)	**880** (3.9)	**1010** (4.5)	**500** (2.2)	**500** (2.2)
1/2 (12.7)	**1135** (5.0)	**1700** (7.6)	**1105** (4.9)	**1755** (7.8)	**625** (2.8)	**750** (3.3)
5/8 (15.9)	**1465** (6.5)	**2835** (12.6)	–	–	**875** (3.9)	**875** (3.9)
3/4 (19.1)	**2075** (9.2)	**3680** (16.4)	–	–	**1250** (5.5)	**1000** (4.4)

1 The allowable values are based on the use of SAE Grade 2 bolts installed in the anchors.

2 Based on using a safety factor of 4.0.

3 The tabulated shear and tensile values are for anchors installed in structural lightweight concrete having the designated ultimate compressive strength at the time of installation. The concrete must comply with ASTM C 330-77.

4 The tabulated shear and tensile values are for anchors installed through 20 gauge intermediate decking into structural lightweight concrete having the designated ultimate strength at the time of installation. The concrete must comply with ASTM C 330-77.

Stainless Steel HDI Ultimate Loads in Concrete

Anchor size in. (mm)	4000 psi (27.6 MPa)		6000 psi (41.4 MPa)	
	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
SS HDI – 1/4 (6.4)	**1930** (8.6)	**2400** (10.7)	**2950** (13.1)	**2400** (10.7)
SS HDI – 3/8 (9.5)	**4170** (18.5)	**4920** (21.9)	**5850** (26.0)	**4920** (21.9)
SS HDI – 1/2 (12.7)	**7350** (32.7)	**11040** (49.1)	**9630** (42.8)	**11040** (49.1)
SS HDI – 5/8 (15.9)	**10540** (46.9)	**18040** (80.2)	**15100** (67.2)	**18040** (80.2)
SS HDI – 3/4 (19.1)	**15340** (68.2)	**22320** (99.3)	**20130** (89.5)	**22320** (99.3)

Stainless Steel HDI Allowable Loads in Concrete

Anchor size in. (mm)	4000 psi (27.6 MPa)		6000 psi (41.4 MPa)	
	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
HDI – 1/4 (6.4)	**480** (2.1)	**600** (2.7)	**740** (3.3)	**600** (2.7)
HDI – 3/8 (9.5)	**1040** (4.6)	**1230** (5.5)	**1460** (6.5)	**1230** (5.5)
HDI – 1/2 (12.7)	**1840** (8.2)	**2760** (12.4)	**2410** (10.7)	**2760** (12.3)
HDI – 5/8 (15.9)	**2630** (11.7)	**4510** (20.1)	**3770** (16.8)	**4510** (20.1)
HDI – 3/4 (19.1)	**3830** (17.0)	**5580** (24.8)	**5030** (22.4)	**5580** (24.8)

Note: The ultimate and allowable shear values are based on the use of Type 18-8 bolts.

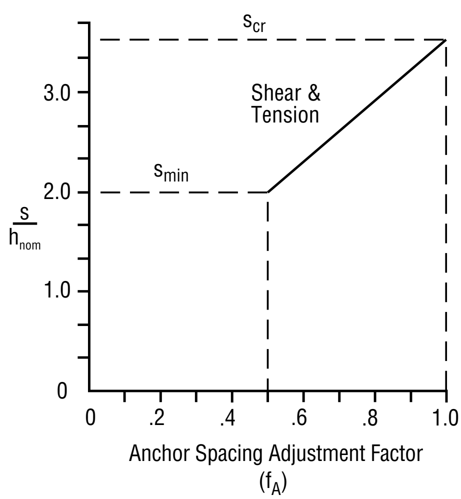
Anchor Spacing and Edge Distance Guidelines (See Anchoring Technology Section 4.1.3)

Anchor Spacing Adjustment Factors

s = Actual Spacing

$s_{min} = 2.0\ h_{nom}$

$s_{cr} = 3.5\ h_{nom}$

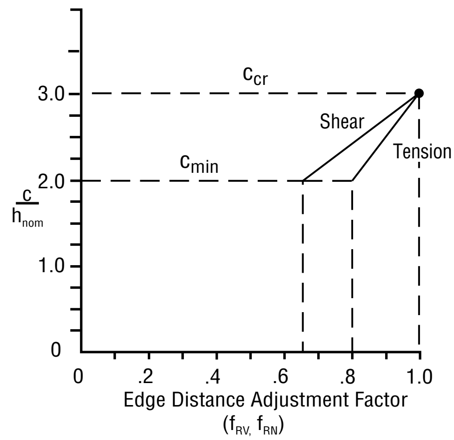


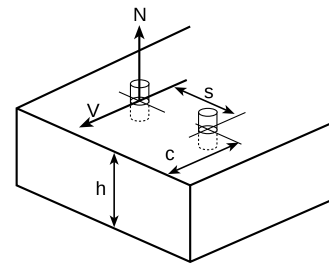
Edge Distance Adjustment Factors

c = Actual edge distance

$c_{min} = 2.0\ h_{nom}$

$c_{cr} = 3.0\ h_{nom}$





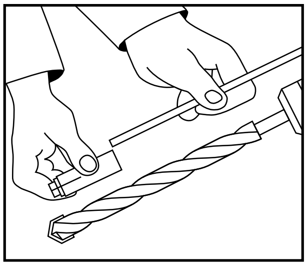
Influence of Anchor Spacing & Edge Distance f_A, f_R

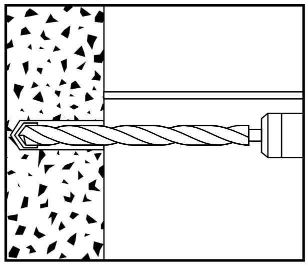
Anchor Size **in.** (mm)	h_{nom} **in.** (mm)
1/4 (6.4)	**1** (25)
3/8 (9.5)	**1-9/16** (40)
1/2 (12.7)	**2** (51)
5/8 (15.8)	**2-9/16** (65)
3/4 (19.1)	**3-3/16** (81)

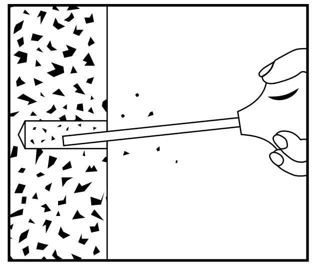
h_{nom} = standard embedment depth

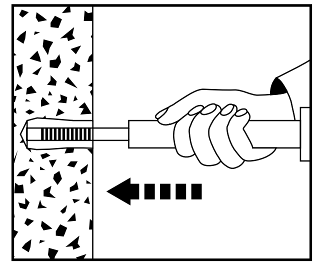
Load Adjustment Factors (Anchor Spacing) f_A						**Load Adjustment Factors (Edge Distance) f_R**										
Tension/Shear Loads						**Tension, f_{RN}**						**Shear, f_{RV}**				
Spacing s in. (mm)	**Anchor Diameter**					**Edge Distance c in.** (mm)	**Anchor Diameter**					**Anchor Diameter**				
	1/4	**3/8**	**1/2**	**5/8**	**3/4**		**1/4**	**3/8**	**1/2**	**5/8**	**3/4**	**1/4**	**3/8**	**1/2**	**5/8**	**3/4**
2 (51)	.50					**2** (51)	.80					.65				
2-1/2 (64)	.67					**2-1/2** (64)	.90					.83				
3 (76)	.83	.50				**3** (76)	1.0	.80				1.0	.65			
3-1/2 (89)	1.0	.58				**3-1/2** (89)		.85					.73			
4 (102)		.69	.50			**4** (102)		.91	.80				.85	.65		
4-1/2 (114)		.79	.58			**4-1/2** (114)		.98	.85				.96	.74		
5 (127)		.90	.67	.50		**5** (127)		1.0	.90	.80			1.0	.83	.65	
5-1/2 (140)		1.0	.75	.55		**5-1/2** (140)			.95	.83				.91	.70	
6 (152)			.83	.61	.50	**6** (152)			1.0	.87				1.0	.77	
7 (178)			1.0	.74	.57	**6-1/2** (165)				.91	.80				.84	.65
8 (203)				.87	.67	**7** (178)				.95	.84				.91	.72
9 (229)				1.0	.77	**8** (203)				1.0	.90				1.0	.83
10 (254)					.88	**9** (229)					.96					.94
11 (279)					.98	**10** (254)					1.0					1.0
12 (305)					1.0											
$s_{min} = 2.0\ h_{nom}$, $s_{cr} = 3.5\ h_{nom}$ $f_A = 0.33 \frac{s}{h_{nom}} - 0.17$ for $s_{cr} > s > s_{min}$						$c_{min} = 2.0\ h_{nom}$, $c_{cr} = 3.0\ h_{nom}$ $f_{RN} = 0.2 \frac{c}{h_{nom}} + 0.4$ for $c_{cr} > c > c_{min}$						$c_{min} = 2.0\ h_{nom}$, $c_{cr} = 3.0\ h_{nom}$ $f_{RV} = 0.35 \frac{c}{h_{nom}} - 0.05$ for $c_{cr} > c > c_{min}$				

4.3.6.4 Installation Instructions









1 Adjust depth gauge so that anchor will be flush with the concrete surface when installed.

2 Hammer drill hole.

3 Clean hole.

4 Install anchor using proper setting tool. Setting tool to be driven into anchor until setting tool shoulder meets top of anchor.

4.3.6.5 Ordering Information

HDI Anchors

Anchor Thread Size	Carbon Steel				Stainless Steel		Box Qty
	Description	Item No.	Description	Item No.	Description	Item No.	
1/4"	HDI 1/4	00336425	HDI-L 1/4	00283608	HDI (SS 303) 1/4	00336430	100
3/8"	HDI 3/8	00336426	HDI-L 3/8	00283609	HDI (SS 303) 3/8	00336431	50
1/2"	HDI 1/2	00336427	HDI-L 1/2	00283610	HDI (SS 303) 1/2	00336432	50
5/8"	HDI 5/8	00336428	–	–	HDI (SS 303) 5/8	00336433	25
3/4"	HDI 3/4	00336429	–	–	HDI (SS 303) 3/4	00336434	25

Setting Tools for HDI & HDI-L Anchors

Anchor Thread Size	Description – Manual Setting Tools	Item No.
1/4"	HST 1/4 Setting Tool	00032978
3/8"	HST 3/8 Setting Tool	00032979
1/2"	HST 1/2 Setting Tool	00032980
5/8"	HST 5/8 Setting Tool	00032981
3/4"	HST 3/4 Setting Tool	00032982
Anchor Thread Size	**Description – Automatic Setting Tools[1]**	**Item No.**
3/8"	HSD-MM 3/8" (TE-C-24SD10 3/8" Setting tool)	00243751
1/2"	HSD-MM 1/2" (TE-C-24SD12 1/2" Setting tool)	00243752

1 Use automatic setting tools with TE-5, TE-5A, TE-15, TE-18 and TE-25 rotary hammer drills.

Attached are page(s) from the 2014 Hilti North American Product Tech Guide. For complete details on this product, including data development, product specifications, general suitability, installation, corrosion, and spacing and edge distance guidelines, please refer to the Technical Guide, or contact Hilti.

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Tulsa, OK 74146

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<u>HILTI KWIK BOLT 3 EXPANSION ANCHORS</u>

Operations & Maintenance Manual
December 2015

3.3.8.1 Product description

The KWIK Bolt 3 (KB3) is a torque controlled expansion anchor, which provides consistent performance for a wide range of mechanical anchor applications. This anchor series is available in carbon steel with zinc electroplated coating, carbon steel with hot-dip galvanized coating, 304 stainless steel and 316 stainless steel versions.The threaded stud version of the anchor is available in a variety of diameters ranging from 1/4- to 1-in. depending on the steel and coating type. Applicable base materials include normal-weight concrete, structural lightweight concrete, lightweight concrete over metal deck, and grout-filled concrete masonry.

Product features

- Length identification code facilitates quality control and inspection after installation.
- Through fixture installation and variable thread lengths improve productivity and accommodate various base plate thicknesses.
- Raised impact section (Dog Point) prevents thread damage during installation.
- Anchor size is same as drill bit size for easy installation. For temporary applications anchors may be driven into drilled holes after usage.
- Mechanical expansion allows immediate load application.

Guide specifications

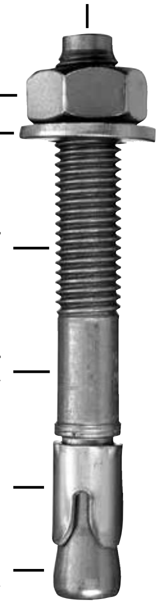
Torque-controlled expansion anchor shall be Hilti KWIK Bolt 3. KWIK Bolt 3 anchors meet the description of Federal Specification A-A 1923A, Type 4. The anchor bears a length identification mark embossed on the impact section (dog point) of the anchor identifying the anchor as a Hilti KWIK Bolt 3.

Carbon steel Kwik Bolt 3 anchors have a carbon steel anchor body, carbon steel nut and carbon steel washer. Anchor body, nut and washer have zinc plating conforming to ASTM B633 with a minimum thickness of 5 µm.

AISI Type 304 stainless steel Kwik Bolt 3 anchors have an anchor body, nut and washer That conform to AISI Type 304. The expansion wedges conform to either AISI Type 304 stainless steel or either AISI Type 316 stainless steel.

AISI Type 316 stainless steel Kwik Bolt 3 anchors have an anchor body, nut and washer That conform to AISI Type 316. The expansion wedges conform to AISI Type 316 stainless steel.

Hot-dip galvanized Kwik Bolt 3 anchors have a carbon steel anchor body, carbon steel nut and carbon steel washer. Anchor body, nut and washer have zinc plating conforming to ASTM A153 with an average thickness of 53 µm. The expansion wedges conform to either AISI Type 304 stainless steel or either AISI Type 316 stainless steel.



Listings/Approvals

ICC-ES (International Code Council)
ESR-2302

ICC-ES (International Code Council)
ESR-1385 Grout-filled concrete masonry

City of Los Angeles
Research Report No. 25577
Research Report No. 25577M
for masonry

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

UL LLC
UL 203 Pipe Hanger Equipment for Fire
Protection Services for 3/8 through 3/4

Qualified under an NQA-1 Nuclear
Quality Program

*Please refer to the reports to verify that the type and diameter specified is included

Independent code evaluation

IBC® / IRC® 2012
IBC® / IRC® 2009
IBC® / IRC® 2006
IBC® / IRC® 2003

3.3.8 KWIK Bolt 3 Expansion Anchor

3.3.8.2 Material specifications

Carbon steel with electroplated zinc

All carbon steel KWIK Bolt 3 and Rod Coupling Anchors, excluding the 3/4 x 12 and 1-inch diameter sizes, have the tensile bolt fracture loads shown in table 1.

All carbon steel 3/4 x 12 and 1 inch diameter sizes and carbon steel KWIK Bolt 3 Countersunk anchor bodies have mechanical properties as listed in table 1.

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 wedges are manufactured from carbon steel, except the following anchors have stainless steel wedges:

- All 1/4-inch diameter anchors
- 3/4x12
- All 1-inch diameter anchors
- All KWIK Bolt 3 Countersunk

Carbon steel with hot-dip galvanized plating

Anchor bodies manufactured from carbon steel have the tensile bolt fracture loads shown in table 1.

Carbon steel anchor components have an average zinc plating thickness greater than 53 µm according to ASTM A153, Class C.

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

Washers meet the requirements of ASTM F844.

Stainless steel expansion wedges are manufactured from either AISI Type 304 or Type 316.

Stainless steel

Anchor bodies smaller than 3/4-inch, excluding all KWIK Bolt 3 Countersunk, are produced from AISI Type 304 or Type 316 stainless steel having the bolt fracture loads shown in table 1.

Anchor bodies 3/4-inch and larger, and all stainless steel KWIK Bolt 3 Countersunk anchor bodies, are produced from AISI Type 304 or Type 316 stainless steel having the mechanical properties shown in table 1.

Nuts meet the dimensional requirements of ASTM F594.

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

Stainless steel expansion wedges for AISI Type 304 are made from either AISI Type 304 or Type 316. Stainless steel expansion wedges for AISI Type 316 anchors are made from type 316. All stainless steel nuts and washers for AISI Type 304 or Type 316 anchors are manufactured from AISI Type 304 or 316, respectively.

Table 1 - KWIK Bolt 3 Bolt fracture load (lb)[1]

Nominal anchor diameter	Carbon steel	Hot-dip galvanized	Stainless steel
1/4	2,900	no offering	2,900
3/8	7,200	no offering	7,200
1/2	12,400	12,400	12,400
5/8	19,600	19,600	21,900
3/4	28,700	28,700	$f_{uta} \geq 76$, $f_{ya} \geq 64$[2]
1	$f_{uta} \geq 88$, $f_{ya} \geq 75$[2]	no offering	$f_{uta} \geq 76$, $f_{ya} \geq 64$[2]

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 use. See tables 4 and 12 for the steel design strengths of carbon steel and stainless steel, respectively.

2 All 3/4-in. stainless steel, 3/4x12 carbon steel, all 1-in. carbon steel and all 1-in. stainless steel material strengths specified by the tensile and yield strengths expressed in (ksi). Bolt fracture loads not applicable for these models.

3.3.8.3.1 Technical data for concrete

The load values contained in this section are Hilti Simplified Design Tables. The load tables in this section were developed using the Strength Design parameters and variables of ESR-2302 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-2302 are not contained in this section, but can be found at www.icc-es.org or at www.us.hilti.com.

Allowable Stress Design or ASD technical information and data tables can be found at www.us.hilti.com.

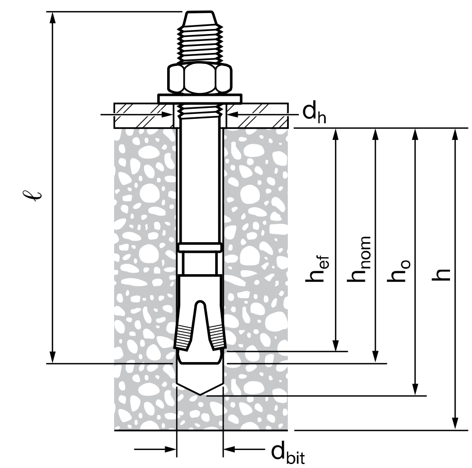


Figure 1 - KWIK Bolt 3 installation

Table 2 - Carbon Steel KWIK Bolt 3 specifications

Setting information	Symbol	Units	Nominal anchor diameter									
			1/4	3/8	1/2		5/8		3/4		1	
Drill bit dia.	d_{bit}		1/4	3/8	1/2		5/8		3/4		1	
Minimum nominal embedment	h_{nom}	in.	1-3/4	2-3/8	2-1/4	3-5/8	3-1/2	4-3/8	4-1/4	5-5/8	4-5/8	6-3/8
		(mm)	(44)	(60)	(57)	(92)	(89)	(111)	(108)	(143)	117	162
Minimum effective embedment	h_{ef}	in.	1-1/2	2	2	3-1/4	3-1/8	4	3-3/4	5	4	5-3/4
		(mm)	(38)	(51)	(51)	(83)	(79)	(102)	(95)	(127)	(102)	(146)
Minimum hole depth	h_o	in.	2	2-5/8	2-5/8	4	3-7/8	4-3/4	4-1/2	5-3/4	5	6-3/4
		(mm)	(51)	(67)	(67)	(102)	(98)	(121)	(114)	(146)	(127)	(171)
Fixture hole diameter	d_h	in.	5/16	7/16	9/16		11/16		13/16		1-1/8	
Anchor length	ℓ		See ordering information									
Installation torque	T_{inst}	ft-lb	4	20	40		60		110		150	
		(Nm)	(5)	(27)	(54)		(81)		(149)		(203)	
Wrench size		in.	7/16	9/16	3/4		15/16		1-1/8		1-1/2	

3.3.8 KWIK Bolt 3 Expansion Anchor

Table 3 - Hilti KWIK Bolt 3 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 f'_c = 2500 psi lb (kN)	Tension - ϕN_n f'_c = 3000 psi lb (kN)	Tension - ϕN_n f'_c = 4000 psi lb (kN)	Tension - ϕN_n f'_c = 6000 psi lb (kN)	Shear - ϕV_n f'_c = 2500 psi lb (kN)	Shear - ϕV_n f'_c = 3000 psi lb (kN)	Shear - ϕV_n f'_c = 4000 psi lb (kN)	Shear - ϕV_n f'_c = 6000 psi lb (kN)
1/4	1-1/2 (38)	1-3/4 (44)	1,025 (4.6)	1,080 (4.8)	1,180 (5.2)	1,330 (5.9)	1,545 (6.9)	1,690 (7.5)	1,950 (8.7)	2,390 (10.6)
3/8	2 (51)	2-3/8 (60)	2,205 (9.8)	2,415 (10.7)	2,790 (12.4)	3,420 (15.2)	2,375 (10.6)	2,605 (11.6)	3,005 (13.4)	3,680 (16.4)
1/2	2 (51)	2-1/4 (57)	2,205 (9.8)	2,415 (10.7)	2,790 (12.4)	3,420 (15.2)	2,375 (10.6)	2,605 (11.6)	3,005 (13.4)	3,680 (16.4)
	3-1/4 (83)	3-1/2 (89)	4,420 (19.7)	4,840 (21.5)	5,590 (24.9)	6,845 (30.4)	9,845 (43.8)	10,785 (48.0)	12,450 (55.4)	15,250 (67.8)
5/8	3-1/8 (79)	3-1/2 (89)	4,310 (19.2)	4,720 (21.0)	5,450 (24.2)	6,675 (29.7)	9,280 (41.3)	10,165 (45.2)	11,740 (52.2)	14,380 (64.0)
	4 (102)	4-3/8 (111)	6,240 (27.8)	6,835 (30.4)	7,895 (35.1)	9,665 (43.0)	13,440 (59.8)	14,725 (65.5)	17,000 (75.6)	20,820 (92.6)
3/4	3-3/4 (95)	4-1/4 (108)	5,665 (25.2)	6,205 (27.6)	7,165 (31.9)	8,775 (39.0)	12,200 (54.3)	13,365 (59.5)	15,430 (68.6)	18,900 (84.1)
	5 (127)	5-1/2 (140)	6,880 (30.6)	7,535 (33.5)	8,705 (38.7)	10,660 (47.4)	18,785 (83.6)	20,575 (91.5)	23,760 (105.7)	29,100 (129.4)

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 10 as necessary. Compare to 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

Table 4 - Steel design strength for Hilti KWIK Bolt 3 carbon steel anchors[1,2]

Nominal anchor diameter	Nominal embedment in. (mm)	Tensile[3] ϕN_{sa} lb (kN)	Shear[4] ϕV_{sa} lb (kN)
1/4	1-3/4 (44)	1,590 (7.1)	1,065 (4.7)
3/8	2-3/8 (60)	4,770 (21.2)	2,905 (12.9)
1/2	2-1/4 (57)	8,745 (38.9)	4,315 (19.2)
	3-1/2 (89)		4,390 (19.5)
5/8	3-1/2 (89)	13,515 (60.1)	7,950 (35.4)
	4-3/8 (111)		
3/4	4-1/4 (108)	19,080 (84.9)	10,180 (45.3)
	5-1/2 (140)		10,785 (48.0)

1 See section 3.1.7.3 to convert design strength value to ASD value.
2 KWIK Bolt 3 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.

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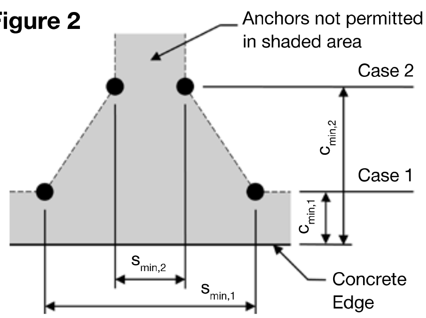
Figure 2



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

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

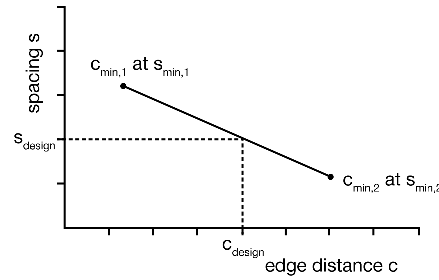


Table 5 - Carbon steel KWIK Bolt 3 installation parameters[1]

Setting information	Symbol	Units	Nominal anchor diameter d_o												
			1/4	3/8		1/2				5/8			3/4		
Effective minimum embedment	h_{ef}	in.	1-1/2	2		2		3-1/4		3-1/8	4		3-3/4		5
		(mm)	(38)	(51)		(51)		(83)		(79)	(102)		(95)		(127)
Minimum member thickness	h_{min}	in.	4	4	5	4	5	6	8	5	6	8	6	8	8
		(mm)	(102)	(102)	(127)	(102)	(127)	(152)	(203)	(127)	(152)	(203)	(152)	(203)	(203)
Case 1	$c_{min,1}$	in.	1-3/8	2	1-1/2	2-1/8	2	1-5/8	1-5/8	2-1/4	1-3/4	1-3/4	2-3/4	2-5/8	2-1/2
		(mm)	(35)	(51)	(38)	(54)	(51)	(41)	(41)	(57)	(44)	(44)	(70)	(67)	(64)
	for $s_{min,1}$ ≥	in.	1-3/4	2-7/8	3-1/2	4-7/8	4-3/4	4-1/4	4	5-1/4	4-3/4	4	6-7/8	6-1/2	6-3/8
		(mm)	(44)	(73)	(89)	(124)	(121)	(108)	(102)	(133)	(121)	(102)	(175)	(165)	(162)
Case 2	$c_{min,2}$	in.	1-5/8	2-3/8	2/3/8	2-5/8	2-3/8	2-1/4	2	3-1/8	2-3/8	2-1/4	3-3/4	3-3/8	3-3/8
		(mm)	(41)	(60)	(60)	(67)	(60)	(57)	(51)	(79)	(60)	(57)	(95)	(86)	(86)
	for $s_{min,2}$ ≥	in.	1-1/4	1-3/4	1-3/4	2-1/2	2-1/4	2	1-7/8	2-3/8	2-1/8	2-1/8	3-3/4	3-3/8	3-1/4
		(mm)	(32)	(44)	(44)	(64)	(57)	(51)	(48)	(60)	(54)	(54)	(95)	(86)	(83)

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.

Table 6 - Load adjustment factors for 1/4-in. diameter KWIK Bolt 3 carbon steel anchor in uncracked concrete[1,2]

1/4-in. KB3 carbon steel 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		Concrete thickness factor in shear[4] f_{HV}
						⊥ toward edge f_{RV}	II To edge f_{RV}	
Embedment h_{nom}			1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h) - in. (mm)	in.	(mm)	(44)	(44)	(44)	(44)	(44)	(44)
	1-1/4	(32)	0.64	n/a	0.56	n/a	n/a	n/a
	1-3/8	(35)	0.65	0.58	0.57	0.26	0.51	n/a
	1-1/2	(38)	0.67	0.61	0.57	0.29	0.58	n/a
	2	(51)	0.72	0.75	0.60	0.45	0.75	n/a
	3	(76)	0.83	1.00	0.65	0.83	1.00	n/a
	3-1/2	(89)	0.89		0.67	1.00		n/a
	4	(102)	0.94		0.70			0.88
	4-1/2	(114)	1.00		0.72			0.94
	5	(127)			0.74			0.99
	5-1/2	(140)			0.77			1.00
	6	(152)			0.79			
	7	(178)			0.84			
	8	(203)			0.89			
	9	(229)			0.94			
	10	(254)			0.99			
	11	(279)			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. Use of Hilti KWIK Bolt 3 anchors with edge distance and spacing dimensions smaller than what is noted in this table is permitted.

3.3.8

3.3.8 KWIK Bolt 3 Expansion Anchor

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

3/8-in. KB3 carbon steel 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: II To edge f_{RV}	Concrete thickness factor in shear[4] f_{HV}
Embedment h_{nom}		2-3/8	2-3/8	2-3/8	2-3/8	2-3/8	2-3/8
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): in.	(mm)	(60)	(60)	(60)	(60)	(60)	(60)
1-3/4	(44)	0.65	n/a	0.57	n/a	n/a	n/a
2	(51)	0.67	0.50	0.58	0.35	0.50	n/a
2-1/2	(64)	0.71	0.58	0.60	0.49	0.58	n/a
3	(76)	0.75	0.67	0.62	0.64	0.67	n/a
3-1/4	(83)	0.77	0.72	0.63	0.72	0.72	n/a
3-1/2	(89)	0.79	0.78	0.64	0.81	0.81	n/a
4	(102)	0.83	0.89	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
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 8 - Load adjustment factors for 1/2-in. diameter KWIK Bolt 3 carbon steel anchor in uncracked concrete[1,2]

1/2-in. KB3 carbon steel 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: II To edge f_{RV}		Concrete thickness factor in shear[4] f_{HV}	
Embedment h_{nom}		2-1/4	3-1/2	2-1/4	3-1/2	2-1/4	3-1/2	2-1/4	3-1/2	2-1/4	3-1/2	2-1/4	3-1/2
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): in.	(mm)	(57)	(89)	(57)	(89)	(57)	(89)	(57)	(89)	(57)	(89)	(57)	(89)
1-5/8	(41)	n/a	n/a	n/a	0.39	n/a	n/a	n/a	0.07	n/a	0.15	n/a	n/a
2	(51)	n/a	0.60	n/a	0.42	n/a	0.54	n/a	0.10	n/a	0.20	n/a	n/a
2-1/8	(54)	n/a	0.61	0.48	0.43	n/a	0.54	0.42	0.11	0.48	0.22	n/a	n/a
2-1/2	(64)	0.71	0.63	0.54	0.47	0.61	0.55	0.53	0.14	0.54	0.28	n/a	n/a
3	(76)	0.75	0.65	0.62	0.52	0.63	0.55	0.70	0.19	0.70	0.37	n/a	n/a
3-1/2	(89)	0.79	0.68	0.72	0.57	0.65	0.56	0.88	0.23	0.88	0.47	n/a	n/a
4	(102)	0.83	0.71	0.82	0.62	0.68	0.57	1.00	0.29	1.00	0.57	0.84	n/a
4-1/2	(114)	0.88	0.73	0.92	0.68	0.70	0.58		0.34		0.68	0.89	n/a
5	(127)	0.92	0.76	1.00	0.74	0.72	0.59		0.40		0.74	0.94	n/a
6	(152)	1.00	0.81		0.89	0.76	0.61		0.53		0.89	1.00	0.66
7	(178)		0.86		1.00	0.81	0.63		0.66		1.00		0.71
8	(203)		0.91			0.85	0.64		0.81				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						
> 24	(610)						0.93						

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. Use of Hilti KWIK Bolt 3 anchors with edge distance and spacing dimensions smaller than what is noted in this table is permitted.

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Table 9 - Load adjustment factors for 5/8-in. diameter KWIK Bolt 3 carbon steel anchor in uncracked concrete[1,2]

5/8-in. KB3 carbon steel 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 II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Embedment h_{nom}		3-1/2	4-3/8	3-1/2	4-3/8	3-1/2	4-3/8	3-1/2	4-3/8	3-1/2	4-3/8	3-1/2	4-3/8
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): in.	(mm)	(89)	(111)	(89)	(111)	(89)	(111)	(89)	(111)	(89)	(111)	(89)	(111)
1-3/4	(44)	n/a	n/a	n/a	0.32	n/a	n/a	n/a	0.07	n/a	0.14	n/a	n/a
2	(51)	n/a	n/a	n/a	0.34	n/a	n/a	n/a	0.08	n/a	0.17	n/a	n/a
2-1/8	(54)	n/a	0.59	n/a	0.34	n/a	0.53	n/a	0.09	n/a	0.18	n/a	n/a
2-1/4	(57)	n/a	0.59	0.39	0.35	n/a	0.54	0.14	0.10	0.27	0.20	n/a	n/a
2-3/8	(60)	0.63	0.60	0.40	0.36	0.55	0.54	0.15	0.11	0.30	0.21	n/a	n/a
2-1/2	(64)	0.63	0.60	0.41	0.37	0.55	0.54	0.16	0.12	0.32	0.23	n/a	n/a
3	(76)	0.66	0.63	0.46	0.40	0.56	0.55	0.21	0.15	0.42	0.30	n/a	n/a
4	(102)	0.71	0.67	0.55	0.47	0.58	0.56	0.32	0.23	0.55	0.47	n/a	n/a
5	(127)	0.77	0.71	0.67	0.55	0.60	0.58	0.45	0.33	0.67	0.55	0.63	n/a
6	(152)	0.82	0.75	0.80	0.63	0.62	0.59	0.59	0.43	0.80	0.63	0.69	0.62
7	(178)	0.87	0.79	0.93	0.74	0.64	0.61	0.75	0.54	0.93	0.74	0.74	0.67
8	(203)	0.93	0.83	1.00	0.84	0.66	0.63	0.91	0.66	1.00	0.84	0.79	0.71
9	(229)	0.98	0.88		0.95	0.68	0.64	1.00	0.79		0.95	0.84	0.75
10	(254)	1.00	0.92		1.00	0.70	0.66		0.92		1.00	0.89	0.80
11	(279)		0.96			0.72	0.67		1.00			0.93	0.83
12	(305)		1.00			0.74	0.69					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						
24	(610)					0.97	0.88						
> 30	(762)					1.00	0.97						

Table 10 - Load adjustment factors for 3/4-in. diameter KWIK Bolt 3 carbon steel anchor in uncracked concrete[1,2]

3/4-in. KB3 carbon steel 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 II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Embedment h_{nom}		4-1/4	5-1/2	4-1/4	5-1/2	4-1/4	5-1/2	4-1/4	5-1/2	4-1/4	5-1/2	4-1/4	5-1/2
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): in.	(mm)	(108)	(140)	(108)	(140)	(108)	(140)	(108)	(140)	(108)	(140)	(108)	(140)
2-1/2	(64)	n/a	n/a	n/a	0.42	n/a	n/a	n/a	0.09	n/a	0.18	n/a	n/a
2-3/4	(70)	n/a	n/a	0.36	0.44	n/a	n/a	0.15	0.11	0.31	0.21	n/a	n/a
3	(76)	n/a	n/a	0.38	0.45	n/a	n/a	0.17	0.12	0.35	0.24	n/a	n/a
3-1/4	(83)	n/a	0.61	0.40	0.47	n/a	0.54	0.20	0.14	0.39	0.27	n/a	n/a
3-1/2	(89)	n/a	0.62	0.41	0.49	n/a	0.55	0.22	0.15	0.41	0.30	n/a	n/a
3-3/4	(95)	0.67	0.63	0.43	0.50	0.57	0.55	0.24	0.17	0.43	0.34	n/a	n/a
4	(102)	0.68	0.63	0.45	0.52	0.57	0.55	0.27	0.18	0.45	0.37	n/a	n/a
4-1/2	(114)	0.70	0.65	0.49	0.56	0.58	0.56	0.32	0.22	0.49	0.44	n/a	n/a
5	(127)	0.72	0.67	0.53	0.59	0.59	0.57	0.38	0.26	0.53	0.52	n/a	n/a
6	(152)	0.77	0.70	0.62	0.67	0.60	0.58	0.49	0.34	0.62	0.67	0.65	n/a
7	(178)	0.81	0.73	0.72	0.75	0.62	0.59	0.62	0.43	0.72	0.75	0.70	n/a
8	(203)	0.86	0.77	0.82	0.84	0.64	0.61	0.76	0.52	0.82	0.84	0.75	0.66
9	(229)	0.90	0.80	0.92	0.95	0.66	0.62	0.91	0.62	0.92	0.95	0.79	0.70
10	(254)	0.94	0.83	1.00	1.00	0.67	0.64	1.00	0.73	1.00	1.00	0.83	0.74
11	(279)	0.99	0.87			0.69	0.65		0.84			0.87	0.77
12	(305)	1.00	0.90			0.71	0.66		0.96			0.91	0.81
14	(356)		0.97			0.74	0.69		1.00			0.99	0.87
16	(406)		1.00			0.78	0.72					1.00	0.93
18	(457)					0.81	0.74						0.99
20	(508)					0.85	0.77						1.00
24	(610)					0.92	0.82						
30	(762)					1.00	0.91						
> 36	(914)						0.99						

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. Use of Hilti KWIK Bolt 3 anchors with edge distance and spacing dimensions smaller than what is noted in this table is permitted.

3.3.8 KWIK Bolt 3 Expansion Anchor

Table 11 - Hilti KWIK Bolt 3 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)
1/4	1-1/2 (38)	1-3/4 (44)	730 (3.2)	770 (3.4)	840 (3.7)	950 (4.2)	1,545 (6.9)	1,690 (7.5)	1,950 (8.7)	2,390 (10.6)
3/8	2 (51)	2-3/8 (60)	1,925 (8.6)	2,110 (9.4)	2,440 (10.9)	2,985 (13.3)	2,375 (10.6)	2,605 (11.6)	3,005 (13.4)	3,680 (16.4)
1/2	2 (51)	2-1/4 (57)	2,150 (9.6)	2,355 (10.5)	2,720 (12.1)	3,335 (14.8)	2,375 (10.6)	2,605 (11.6)	3,005 (13.4)	3,680 (16.4)
	3-1/4 (83)	3-1/2 (89)	3,920 (17.4)	4,295 (19.1)	4,960 (22.1)	6,070 (27.0)	9,845 (43.8)	10,785 (48.0)	12,450 (55.4)	15,250 (67.8)
5/8	3-1/8 (79)	3-1/2 (89)	4,050 (18.0)	4,435 (19.7)	5,120 (22.8)	6,275 (27.9)	9,280 (41.3)	10,165 (45.2)	11,740 (52.2)	14,380 (64.0)
	4 (102)	4-3/8 (111)	5,090 (22.6)	5,575 (24.8)	6,440 (28.6)	7,885 (35.1)	13,440 (59.8)	14,725 (65.5)	17,000 (75.6)	20,820 (92.6)
3/4	3-3/4 (95)	4-1/4 (108)	5,560 (24.7)	6,090 (27.1)	7,035 (31.3)	8,615 (38.3)	12,200 (54.3)	13,365 (59.5)	15,430 (68.6)	18,900 (84.1)
	5 (127)	5-1/2 (140)	7,040 (31.3)	7,710 (34.3)	8,905 (39.6)	10,905 (48.5)	18,785 (83.6)	20,575 (91.5)	23,760 (105.7)	29,100 (129.4)
1	4 (102)	4-1/2 (114)	6,240 (27.8)	6,835 (30.4)	7,895 (35.1)	9,665 (43.0)	13,440 (59.8)	14,725 (65.5)	17,000 (75.6)	20,820 (92.6)
	5-3/4 (146)	6-1/4 (159)	10,110 (45.0)	11,070 (49.2)	12,785 (56.9)	15,660 (69.7)	23,165 (103.0)	25,375 (112.9)	29,300 (130.3)	35,885 (159.6)

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 14 to 19 as necessary. Compare to steel values in table 12. 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

Table 12 - Steel design strength for Hilti KWIK Bolt 3 stainless steel anchors[1,2]

Nominal anchor diameter	Nominal embedment in. (mm)	Tensile[3] ϕN_{sa} lb (kN)	Shear[4] ϕV_{sa} lb (kN)
1/4	1-3/4 (44)	1,725 (7.7)	1,090 (4.8)
3/8	2-3/8 (60)	5,175 (23.0)	3,235 (14.4)
1/2	2-1/4 (57)	9,490 (42.2)	2,725 (12.1)
	3-1/2 (89)		4,510 (20.1)
5/8	3-1/2 (89)	14,665 (65.2)	5,820 (25.9)
	4-3/8 (111)		9,295 (41.3)
3/4	4-1/4 (108)	16,200 (72.1)	7,735 (34.4)
	5-1/2 (140)		15,305 (68.1)
1	4-1/2 (114)	31,735 (141.2)	8,130 (36.2)
	6-1/4 (159)		17,775 (79.1)

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

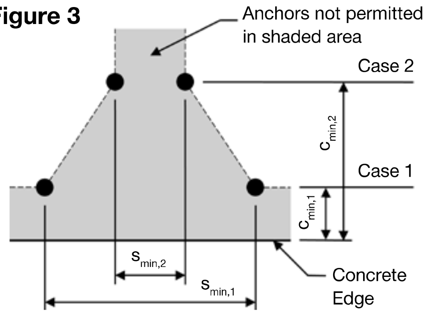
2 KWIK Bolt 3 stainless steel anchors are to be considered ductile steel elements.

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.

3.3.8 KWIK Bolt 3 Expansion Anchor

Figure 3



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

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

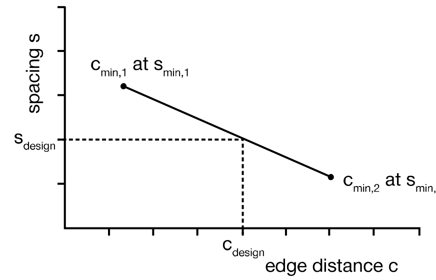


Table 13 - Stainless steel KWIK Bolt 3 installation parameters[1]

Setting information	Symbol	Units	Nominal anchor diameter d_o														
			1/4	3/8		1/2				5/8			3/4			1	
Effective minimum embedment	h_{ef}	in.	1-1/2	2		2		3-1/4		3-1/8	4		3-3/4		5	4	5-3/4
		(mm)	(38)	(51)		(51)		(83)		(79)	(102)		(95)		(127)	(102)	(146)
Minimum member thickness	h_{min}	in.	4	4	5	4	6	6	8	5	6	8	6	8	8	8	10
		(mm)	(102)	(102)	(127)	(102)	(152)	(152)	(203)	(127)	(152)	(203)	(152)	(203)	(203)	(203)	(254)
Case 1	$c_{min,1}$	in.	1-3/8	2	1-5/8	2-1/2	1-7/8	1-5/8	1-5/8	3-1/4	2-1/2	2-1/2	3-1/4	3	2-7/8	3/1/02	3
		(mm)	(35)	(51)	(41)	(68)	(48)	(41)	(41)	(83)	(64)	(64)	(83)	(76)	(73)	(89)	(76)
	for $s_{min,1} \geq$	in.	1-3/4	4	3-5/8	5	4-5/8	4-1/2	4-1/4	5-5/8	5-1/4	5	7	6-7/8	6-5/8	6-3/4	6-3/4
		(mm)	(44)	(102)	(92)	(127)	(117)	(114)	(108)	(143)	(133)	(127)	(178)	(175)	(168)	(172)	(172)
Case 2	$c_{min,2}$	in.	1-5/8	1-3/4	2-1/2	2-7/8	2-3/8	2-3/8	2-1/8	3-7/8	3	2-3/4	4-1/8	3-3/4	3-3/4	4-1/4	3-3/4
		(mm)	(41)	(83)	(64)	(73)	(60)	(60)	(54)	(98)	(76)	(70)	(105)	(95)	(95)	(108)	(95)
	for $s_{min,2} \geq$	in.	1-1/4	2	1-3/4	2-1/2	2-1/4	2-1/8	1-7/8	3-1/8	2-1/8	4	3-1/2	3-1/2	3-1/2	5	4-3/4
		(mm)	(32)	(51)	(44)	(64)	(57)	(54)	(48)	(79)	(54)	(54)	(102)	(89)	(89)	(127)	(121)

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.

Table 14 - Load adjustment factors for 1/4-in. diameter KWIK Bolt 3 stainless steel anchor in uncracked concrete[1,2]

1/4-in. KB3 stainless steel uncracked uoncrete			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 II to edge f_{RV}	Concrete thickness factor in shear[4] f_{HV}
Embedment h_{nom}			1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	in.	(mm)	(44)	(44)	(44)	(44)	(44)	(44)
	1-1/4	(32)	0.64	n/a	0.56	n/a	n/a	n/a
	1-3/8	(35)	0.65	0.53	0.57	0.26	0.51	n/a
	1-1/2	(38)	0.67	0.56	0.57	0.29	0.56	n/a
	2	(51)	0.72	0.68	0.60	0.45	0.68	n/a
	3	(76)	0.83	1.00	0.65	0.83	1.00	n/a
	3-1/2	(89)	0.89		0.67	1.00		n/a
	4	(102)	0.94		0.70			0.88
	4-1/2	(114)	1.00		0.72			0.94
	5	(127)			0.74			0.99
	5-1/2	(140)			0.77			1.00
	6	(152)			0.79			
	7	(178)			0.84			
	8	(203)			0.89			
	9	(229)			0.94			
	10	(254)			0.99			
	11	(279)			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 13 and figure 3 of this section to calculate permissable edge distance, spacing and concrete thickness combinations. Use of Hilti KWIK Bolt 3 anchors with edge distance and spacing dimensions smaller than what is noted in this table is permitted.

Table 15 - Load adjustment factors for 3/8-in. diameter KWIK Bolt 3 stainless steel anchor in uncracked concrete[1,2]

3/8-in. KB3 stainless steel 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: II to edge f_{RV}	Concrete thickness factor in shear[4] f_{HV}
Embedment h_{nom}		2-3/8	2-3/8	2-3/8	2-3/8	2-3/8	2-3/8
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): in.	(mm)	(60)	(60)	(60)	(60)	(60)	(60)
2	(51)	0.67	0.51	0.58	0.35	0.51	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
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			
14	(356)						

Table 16 - Load adjustment factors for 1/2-in. diameter KWIK Bolt 3 stainless steel anchor in uncracked concrete[1,2]

1/2-in. KB3 stainless steel 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: II to edge f_{RV}		Concrete thickness factor in shear[4] f_{HV}	
Embedment h_{nom}		2-1/4	3-1/2	2-1/4	3-1/2	2-1/4	3-1/2	2-1/4	3-1/2	2-1/4	3-1/2	2-1/4	3-1/2
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): in.	(mm)	(57)	(89)	(57)	(89)	(57)	(89)	(57)	(89)	(57)	(89)	(57)	(89)
1-5/8	(41)	n/a	n/a	n/a	0.39	n/a	n/a	n/a	0.07	n/a	0.15	n/a	n/a
2	(51)	n/a	n/a	n/a	0.42	n/a	n/a	n/a	0.10	n/a	0.20	n/a	n/a
2-1/8	(54)	n/a	0.61	n/a	0.43	n/a	0.54	n/a	0.11	n/a	0.22	n/a	n/a
2-1/2	(64)	0.71	0.63	0.54	0.47	0.61	0.55	0.53	0.14	0.54	0.28	n/a	n/a
3	(76)	0.75	0.65	0.62	0.52	0.63	0.55	0.70	0.19	0.70	0.37	n/a	n/a
3-1/2	(89)	0.79	0.68	0.72	0.57	0.65	0.56	0.88	0.23	0.88	0.47	n/a	n/a
4	(102)	0.83	0.71	0.82	0.62	0.68	0.57	1.00	0.29	1.00	0.57	0.84	n/a
4-1/2	(114)	0.88	0.73	0.92	0.68	0.70	0.58		0.34		0.68	0.89	n/a
5	(127)	0.92	0.76	1.00	0.74	0.72	0.59		0.40		0.74	0.94	n/a
6	(152)	1.00	0.81		0.89	0.76	0.61		0.53		0.89	1.00	0.66
7	(178)		0.86		1.00	0.81	0.63		0.66		1.00		0.71
8	(203)		0.91			0.85	0.64		0.81				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						
> 24	(610)						0.93						

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 13 and figure 3 of this section to calculate permissable edge distance, spacing and concrete thickness combinations. Use of Hilti KWIK Bolt 3 anchors with edge distance and spacing dimensions smaller than what is noted in this table is permitted.

3.3.8

3.3.8 KWIK Bolt 3 Expansion Anchor

Table 17 - Load adjustment factors for 5/8-in. diameter KWIK Bolt 3 stainless steel anchor in uncracked concrete[1,2]

5/8-in. KB3 stainless steel 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 II to edge f_{RV}		Concrete thickness factor in shear[4] f_{HV}	
Embedment h_{nom}		3-1/2	4-3/8	3-1/2	4-3/8	3-1/2	4-3/8	3-1/2	4-3/8	3-1/2	4-3/8	3-1/2	4-3/8
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm) in.	(mm)	(89)	(111)	(89)	(111)	(89)	(111)	(89)	(111)	(89)	(111)	(89)	(111)
2-1/8	(54)	n/a	0.59	n/a	n/a	n/a	0.53	n/a	n/a	n/a	n/a	n/a	n/a
2-1/2	(64)	n/a	0.60	n/a	0.37	n/a	0.54	n/a	0.12	n/a	0.23	n/a	n/a
3	(76)	n/a	0.63	n/a	0.40	n/a	0.55	n/a	0.15	n/a	0.30	n/a	n/a
3-1/8	(79)	0.67	0.63	n/a	0.41	0.56	0.55	n/a	0.16	n/a	0.32	n/a	n/a
3-1/4	(83)	0.67	0.64	0.49	0.42	0.56	0.55	0.24	0.17	0.47	0.34	n/a	n/a
3-1/2	(89)	0.69	0.65	0.51	0.44	0.57	0.56	0.26	0.19	0.51	0.38	n/a	n/a
4	(102)	0.71	0.67	0.56	0.47	0.58	0.56	0.32	0.23	0.56	0.47	n/a	n/a
5	(127)	0.77	0.71	0.68	0.55	0.60	0.58	0.45	0.33	0.68	0.55	0.63	n/a
6	(152)	0.82	0.75	0.81	0.63	0.62	0.59	0.59	0.43	0.81	0.63	0.69	0.62
7	(178)	0.87	0.79	0.95	0.74	0.64	0.61	0.75	0.54	0.95	0.74	0.74	0.67
8	(203)	0.93	0.83	1.00	0.84	0.66	0.63	0.91	0.66	1.00	0.84	0.79	0.71
9	(229)	0.98	0.88		0.95	0.68	0.64	1.00	0.79		0.95	0.84	0.75
10	(254)	1.00	0.92		1.00	0.70	0.66		0.92		1.00	0.89	0.80
11	(279)		0.96			0.72	0.67		1.00			0.93	0.83
12	(305)		1.00			0.74	0.69					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						
24	(610)					0.97	0.88						
> 30	(762)					1.00	0.97						

Table 18 - Load adjustment factors for 3/4-in. diameter KWIK Bolt 3 stainless steel anchor in uncracked concrete[1,2]

3/4-in. KB3 stainless steel 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 II to edge f_{RV}		Concrete thickness factor in shear[4] f_{HV}	
Embedment h_{nom}		4-1/4	5-1/2	4-1/4	5-1/2	4-1/4	5-1/2	4-1/4	5-1/2	4-1/4	5-1/2	4-1/4	5-1/2
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm) in.	(mm)	(108)	(140)	(108)	(140)	(108)	(140)	(108)	(140)	(108)	(140)	(108)	(140)
2-7/8	(73)	n/a	n/a	n/a	0.43	n/a	n/a	n/a	0.11	n/a	0.23	n/a	n/a
3	(76)	n/a	n/a	n/a	0.44	n/a	n/a	n/a	0.12	n/a	0.24	n/a	n/a
3-1/4	(83)	n/a	n/a	0.37	0.46	n/a	n/a	0.20	0.14	0.37	0.27	n/a	n/a
3-1/2	(89)	n/a	0.62	0.39	0.47	n/a	0.55	0.22	0.15	0.39	0.30	n/a	n/a
4	(102)	0.68	0.63	0.42	0.51	0.57	0.55	0.27	0.18	0.42	0.37	n/a	n/a
4-1/2	(114)	0.70	0.65	0.45	0.54	0.58	0.56	0.32	0.22	0.45	0.44	n/a	n/a
5	(127)	0.72	0.67	0.49	0.58	0.59	0.57	0.38	0.26	0.49	0.52	n/a	n/a
6	(152)	0.77	0.70	0.57	0.65	0.60	0.58	0.49	0.34	0.57	0.65	0.65	n/a
7	(178)	0.81	0.73	0.67	0.73	0.62	0.59	0.62	0.43	0.67	0.73	0.70	n/a
8	(203)	0.86	0.77	0.76	0.82	0.64	0.61	0.76	0.52	0.76	0.82	0.75	0.66
9	(229)	0.90	0.80	0.86	0.92	0.66	0.62	0.91	0.62	0.91	0.92	0.79	0.70
10	(254)	0.94	0.83	0.95	1.00	0.67	0.64	1.00	0.73	1.00	1.00	0.83	0.74
11	(279)	0.99	0.87	1.00		0.69	0.65		0.84			0.87	0.77
12	(305)	1.00	0.90			0.71	0.66		0.96			0.91	0.81
14	(356)		0.97			0.74	0.69		1.00			0.99	0.87
16	(406)		1.00			0.78	0.72					1.00	0.93
18	(457)					0.81	0.74						0.99
20	(508)					0.85	0.77						1.00
24	(610)					0.92	0.82						
30	(762)					1.00	0.91						
> 36	(914)						0.99						

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 13 and figure 3 of this section to calculate permissable edge distance, spacing and concrete thickness combinations. Use of Hilti KWIK Bolt 3 anchors with edge distance and spacing dimensions smaller than what is noted in this table is permitted.

Table 19 - Load adjustment factors for 1-in. diameter KWIK Bolt 3 stainless steel anchor in uncracked concrete[1,2]

1-in. KB3 stainless steel 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 II to edge f_{RV}		Concrete thickness factor in shear[4] f_{HV}	
Embedment h_{nom}			4-1/2	6-1/4	4-1/2	6-1/4	4-1/2	6-1/4	4-1/2	6-1/4	4-1/2	6-1/4	4-1/2	6-1/4
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	in.	(mm)	(114)	(159)	(114)	(159)	(114)	(159)	(114)	(159)	(114)	(159)	(114)	(159)
	3	(76)	n/a	n/a	n/a	0.43	n/a	n/a	n/a	0.10	n/a	0.20	n/a	n/a
	3-1/2	(89)	n/a	n/a	0.42	0.45	n/a	n/a	0.21	0.12	0.42	0.25	n/a	n/a
	4	(102)	n/a	n/a	0.45	0.48	n/a	n/a	0.26	0.15	0.45	0.30	n/a	n/a
	4-1/2	(114)	n/a	n/a	0.49	0.51	n/a	n/a	0.31	0.18	0.49	0.36	n/a	n/a
	4-3/4	(121)	n/a	0.64	0.50	0.53	n/a	0.56	0.34	0.20	0.50	0.39	n/a	n/a
	5	(127)	0.71	0.64	0.52	0.54	0.59	0.56	0.37	0.21	0.52	0.43	n/a	n/a
	6	(152)	0.75	0.67	0.60	0.60	0.60	0.57	0.48	0.28	0.60	0.56	n/a	n/a
	7	(178)	0.79	0.70	0.70	0.67	0.62	0.58	0.61	0.35	0.70	0.67	n/a	n/a
	8	(203)	0.83	0.73	0.80	0.74	0.64	0.60	0.74	0.43	0.80	0.74	0.74	n/a
	9	(229)	0.88	0.76	0.90	0.82	0.65	0.61	0.89	0.51	0.90	0.82	0.78	n/a
	10	(254)	0.92	0.79	1.00	0.91	0.67	0.62	1.00	0.60	1.00	0.91	0.83	0.69
	11	(279)	0.96	0.82		1.00	0.69	0.63		0.69		1.00	0.87	0.72
	12	(305)	1.00	0.85			0.70	0.64		0.79			0.91	0.76
	14	(356)		0.91			0.74	0.67		1.00			0.98	0.82
	16	(406)		0.96			0.77	0.69					1.00	0.87
	18	(457)		1.00			0.81	0.71						0.92
	20	(508)					0.84	0.74						0.98
	24	(610)					0.91	0.79						1.00
	30	(762)					1.00	0.86						
	> 36	(914)						0.93						

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 13 and figure 3 of this section to calculate permissable edge distance, spacing and concrete thickness combinations. Use of Hilti KWIK Bolt 3 anchors with edge distance and spacing dimensions smaller than what is noted in this table is permitted.

3.3.8 KWIK Bolt 3 Expansion Anchor

Table 20 - Hilti KWIK Bolt 3 hot-dip galvanized 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 f'_c = 2500 psi lb (kN)	f'_c = 3000 psi lb (kN)	f'_c = 4000 psi lb (kN)	f'_c = 6000 psi lb (kN)	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)
1/2	2 (51)	2-1/4 (57)	2,205 (9.8)	2,415 (10.7)	2,790 (12.4)	3,420 (15.2)	2,375 (10.6)	2,605 (11.6)	3,005 (13.4)	3,680 (16.4)
	3-1/4 (83)	3-1/2 (89)	4,250 (18.9)	4,655 (20.7)	5,375 (23.9)	6,585 (29.3)	9,845 (43.8)	10,785 (48.0)	12,450 (55.4)	15,250 (67.8)
5/8	3-1/8 (79)	3-1/2 (89)	4,200 (18.7)	4,605 (20.5)	5,315 (23.6)	6,510 (29.0)	9,280 (41.3)	10,165 (45.2)	11,740 (52.2)	14,380 (64.0)
	4 (102)	4-3/8 (111)	5,860 (26.1)	6,420 (28.6)	7,415 (33.0)	9,080 (40.4)	13,440 (59.8)	14,725 (65.5)	17,000 (75.6)	20,820 (92.6)
3/4	3-3/4 (95)	4-1/4 (108)	5,665 (25.2)	6,205 (27.6)	7,165 (31.9)	8,775 (39.0)	12,200 (54.3)	13,365 (59.5)	15,430 (68.6)	18,900 (84.1)
	5 (127)	5-1/2 (140)	6,615 (29.4)	7,245 (32.2)	8,365 (37.2)	10,245 (45.6)	18,785 (83.6)	20,575 (91.5)	23,760 (105.7)	29,100 (129.4)

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 23 to 25 as necessary. Compare to steel values in table 21. 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

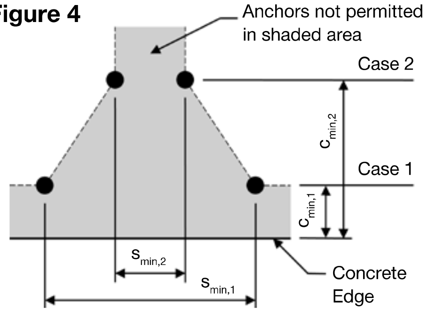
Table 21 - Steel design strength for Hilti KWIK Bolt 3 hot-dip galvanized anchors[1,2]

Nominal anchor diameter	Nominal embedment in. (mm)	Tensile[3] ϕN_{sa} lb (kN)	Shear[4] ϕV_{sa} lb (kN)
1/2	2-1/4 (57)	8,745 (38.9)	2,925 (13.0)
	3-1/2 (89)		3,815 (17.0)
5/8	3-1/2 (89)	13,515 (60.1)	7,565 (33.7)
	4-3/8 (111)		
3/4	4-1/4 (108)	19,080 (84.9)	11,050 (49.2)
	5-1/2 (140)		

1 See section 3.1.7.3 to convert design strength value to ASD value.
2 KWIK Bolt 3 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.

KWIK Bolt 3 Expansion Anchor 3.3.8

Figure 4



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

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

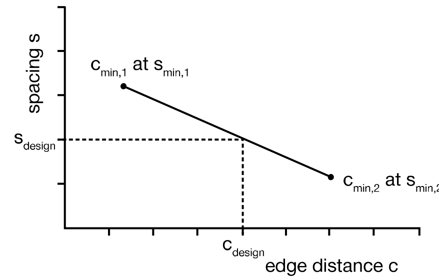


Table 22 - Hot-dip galvanized KWIK Bolt 3 installation parameters[1]

Setting information	Symbol	Units	Nominal anchor diameter d_o									
			1/2				5/8			3/4		
Effective minimum embedment	h_{ef}	in.	2		3-1/4		3-1/8	4		3-3/4		5
		(mm)	(51)		(83)		(79)	(102)		(95)		(127)
Minimum member thickness	h_{min}	in.	4	6	6	8	5	6	8	6	8	8
		(mm)	(102)	(152)	(152)	(203)	(127)	(152)	(203)	(152)	(203)	(203)
Case 1	$c_{min,1}$	in.	3-1/4	2-5/8	2		2-1/4	2	1-78	3-1/2		3-5/8
		(mm)	(83)	(67)	(51)		(57)	(51)	(48)	(89)		(92)
	for $s_{min,1}$ ≥	in.	6-1/4	5-1/2	4-7/8		5-1/4	5	4-3/4	7-1/2		7-3/8
		(mm)	(158)	(140)	(124)		(133)	(127)	(121)	(191)		(187)
Case 2	$c_{min,2}$	in.	3-3/4	2-3/4	2-5/8	2-1/4	3-1/2	2-1/2	2-1/4	6-1/2		4-3/4
		(mm)	(95)	(70)	(67)	(57)	(89)	(64)	(57)	(165)		(121)
	for $s_{min,2}$ ≥	in.	3-1/8	2-3/4	2-3/8	2-1/8	2-1/2	2-1/8	2-1/8	4		3-7/8
		(mm)	(79)	(70)	(60)	(54)	(64)	(54)	(54)	(102)		(98)

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.

3.3.8

3.3.8 KWIK Bolt 3 Expansion Anchor

Table 23 - Load adjustment factors for 1/2-in. diameter KWIK Bolt 3 hot-dip galvanized anchor in uncracked concrete[1,2]

1/2-in. KB3 hot-dip galvanized 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 II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Embedment h_{nom}		2-1/4	3-1/2	2-1/4	3-1/2	2-1/4	3-1/2	2-1/4	3-1/2	2-1/4	3-1/2	2-1/4	3-1/2
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): in.	(mm)	(57)	(89)	(57)	(89)	(57)	(89)	(57)	(89)	(57)	(89)	(57)	(89)
2	(51)	n/a	n/a	n/a	0.38	n/a	n/a	n/a	0.10	n/a	0.20	n/a	n/a
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
3	(76)	n/a	0.65	n/a	0.46	n/a	0.55	n/a	0.19	n/a	0.37	n/a	n/a
3-1/8	(79)	0.76	0.66	n/a	0.48	0.64	0.56	n/a	0.20	n/a	0.40	n/a	n/a
3-1/4	(83)	0.77	0.67	0.67	0.49	0.64	0.56	0.79	0.21	0.79	0.42	n/a	n/a
3-1/2	(89)	0.79	0.68	0.72	0.51	0.65	0.56	0.88	0.23	0.88	0.47	n/a	n/a
4	(102)	0.83	0.71	0.82	0.56	0.68	0.57	1.00	0.29	1.00	0.56	0.84	n/a
4-1/2	(114)	0.88	0.73	0.92	0.61	0.70	0.58		0.34		0.61	0.89	n/a
5	(127)	0.92	0.76	1.00	0.67	0.72	0.59		0.40		0.67	0.94	n/a
6	(152)	1.00	0.81		0.80	0.76	0.61		0.53		0.80	1.00	0.66
7	(178)	1.00	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						
> 24	(610)						0.93						

Table 24 - Load adjustment factors for 5/8-in. diameter KWIK Bolt 3 hot-dip galvanized anchor in uncracked concrete[1,2]

5/8-in. KB3 hot-dip galvanized 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 II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Embedment h_{nom}		3-1/2	4-3/8	3-1/2	4-3/8	3-1/2	4-3/8	3-1/2	4-3/8	3-1/2	4-3/8	3-1/2	4-3/8
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): in.	(mm)	(89)	(111)	(89)	(111)	(89)	(111)	(89)	(111)	(89)	(111)	(89)	(111)
2	(51)	n/a	n/a	n/a	0.34	n/a	n/a	n/a	0.08	n/a	0.17	n/a	n/a
2-1/8	(54)	n/a	0.59	n/a	0.34	n/a	0.53	n/a	0.09	n/a	0.18	n/a	n/a
2-1/4	(57)	n/a	0.59	0.38	0.35	n/a	0.54	0.14	0.10	0.27	0.20	n/a	n/a
2-1/2	(64)	0.63	0.60	0.41	0.37	0.55	0.54	0.16	0.12	0.32	0.23	n/a	n/a
3	(76)	0.66	0.63	0.45	0.40	0.56	0.55	0.21	0.15	0.42	0.30	n/a	n/a
3-1/2	(89)	0.69	0.65	0.50	0.44	0.57	0.56	0.26	0.19	0.50	0.38	n/a	n/a
4	(102)	0.71	0.67	0.54	0.47	0.58	0.56	0.32	0.23	0.54	0.47	n/a	n/a
4-1/2	(114)	0.74	0.69	0.60	0.51	0.59	0.57	0.38	0.28	0.60	0.51	n/a	n/a
5	(127)	0.77	0.71	0.66	0.55	0.60	0.58	0.45	0.33	0.66	0.55	0.63	n/a
6	(152)	0.82	0.75	0.79	0.63	0.62	0.59	0.59	0.43	0.79	0.63	0.69	0.62
7	(178)	0.87	0.79	0.92	0.74	0.64	0.61	0.75	0.54	0.92	0.74	0.74	0.67
8	(203)	0.93	0.83	1.00	0.84	0.66	0.63	0.91	0.66	1.00	0.84	0.79	0.71
9	(229)	0.98	0.88		0.95	0.68	0.64	1.00	0.79		0.95	0.84	0.75
10	(254)	1.00	0.92		1.00	0.70	0.66		0.92		1.00	0.89	0.80
11	(279)		0.96			0.72	0.67		1.00			0.93	0.83
12	(305)		1.00			0.74	0.69					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						
24	(610)					0.97	0.88						
> 30	(762)					1.00	0.97						

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.

(shaded) 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 22 and figure 4 of this section to calculate permissable edge distance, spacing and concrete thickness combinations. Use of Hilti KWIK Bolt 3 anchors with edge distance and spacing dimensions smaller than what is noted in this table is permitted.

Table 25 - Load adjustment factors for 3/4-in. diameter KWIK Bolt 3 hot-dip galvanized anchor in uncracked concrete[1,2]

3/4-in. KB3 hot-dip galvanized 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 II to edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Embedment h_{nom}		4-1/4	5-1/2	4-1/4	5-1/2	4-1/4	5-1/2	4-1/4	5-1/2	4-1/4	5-1/2	4-1/4	5-1/2
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm) in.	(mm)	(108)	(140)	(108)	(140)	(108)	(140)	(108)	(140)	(108)	(140)	(108)	(140)
3-1/2	(89)	n/a	n/a	0.41	n/a	n/a	n/a	0.22	n/a	0.41	n/a	n/a	n/a
3-5/8	(92)	n/a	n/a	0.42	0.49	n/a	n/a	0.23	0.16	0.42	0.32	n/a	n/a
3-7/8	(98)	n/a	0.63	0.44	0.51	n/a	0.55	0.26	0.18	0.44	0.35	n/a	n/a
4	(102)	0.68	0.63	0.45	0.52	0.57	0.55	0.27	0.18	0.45	0.37	n/a	n/a
4-1/2	(114)	0.70	0.65	0.49	0.56	0.58	0.56	0.32	0.22	0.49	0.44	n/a	n/a
5	(127)	0.72	0.67	0.53	0.59	0.59	0.57	0.38	0.26	0.53	0.52	n/a	n/a
5-1/2	(140)	0.74	0.68	0.57	0.63	0.60	0.57	0.43	0.30	0.57	0.60	n/a	n/a
6	(152)	0.77	0.70	0.62	0.67	0.60	0.58	0.49	0.34	0.62	0.67	0.65	n/a
7	(178)	0.81	0.73	0.72	0.75	0.62	0.59	0.62	0.43	0.72	0.75	0.70	n/a
8	(203)	0.86	0.77	0.82	0.84	0.64	0.61	0.76	0.52	0.82	0.84	0.75	0.66
9	(229)	0.90	0.80	0.92	0.95	0.66	0.62	0.91	0.62	0.92	0.95	0.79	0.70
10	(254)	0.94	0.83	1.00	1.00	0.67	0.64	1.00	0.73	1.00	1.00	0.83	0.74
11	(279)	0.99	0.87			0.69	0.65		0.84			0.87	0.77
12	(305)	1.00	0.90			0.71	0.66		0.96			0.91	0.81
14	(356)		0.97			0.74	0.69		1.00			0.99	0.87
16	(406)		1.00			0.78	0.72					1.00	0.93
18	(457)					0.81	0.74						0.99
20	(508)					0.85	0.77						1.00
24	(610)					0.92	0.82						
30	(762)					1.00	0.91						
> 36	(914)						0.99						

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 22 and figure 4 of this section to calculate permissable edge distance, spacing and concrete thickness combinations. Use of Hilti KWIK Bolt 3 anchors with edge distance and spacing dimensions smaller than what is noted in this table is permitted.

3.3.8 KWIK Bolt 3 Expansion Anchor

Table 26 - Hilti KWIK Bolt 3 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 5			
			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)
1/4	1-1/2 (38)	1-3/4 (44)	1,140 (5.1)	1,315 (5.8)	1,255 (5.6)	1,255 (5.6)
3/8	2 (51)	2-3/8 (60)	1,460 (6.5)	1,685 (7.5)	1,845 (8.2)	1,845 (8.2)
1/2	2 (51)	2-1/4 (57)	1,775 (7.9)	2,050 (9.1)	2,050 (9.1)	2,050 (9.1)
	3-1/4 (83)	3-1/2 (89)				
5/8	3-1/8 (79)	3-1/2 (89)	3,095 (13.8)	3,575 (15.9)	4,280 (19.0)	4,280 (19.0)
	4 (102)	4-3/8 (111)				

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

Nominal anchor diameter	Effective embed. in. (mm)	Nominal embed. in. (mm)	Loads according to figure 5			
			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)
1/4	1-1/2 (38)	1-3/4 (44)	1,175 (5.2)	1,355 (6.0)	1,315 (5.8)	1,315 (5.8)
3/8	2 (51)	2-3/8 (60)	1,675 (7.5)	1,935 (8.6)	1,675 (7.5)	1,675 (7.5)
1/2	2 (51)	2-1/4 (57)	1,265 (5.6)	1,460 (6.5)	1,135 (5.0)	1,135 (5.0)
	3-1/4 (83)	3-1/2 (89)				
5/8	3-1/8 (79)	3-1/2 (89)	2,880 (12.8)	3,325 (14.8)	3,700 (16.5)	3,700 (16.5)
	4 (102)	4-3/8 (111)				

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 control.
7 Comparison to steel values in table 12 is not required. Values in tables 27 control.

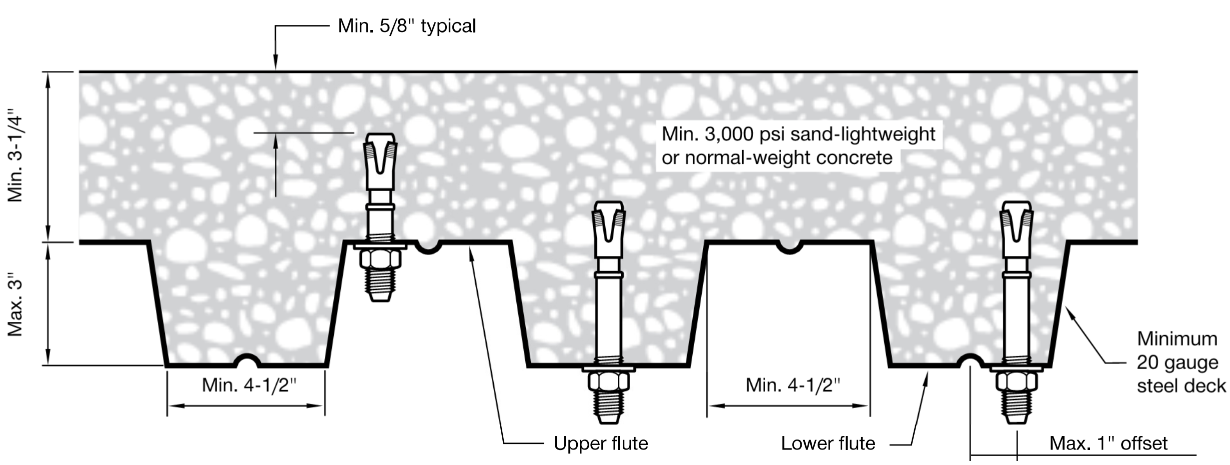


Figure 5 - Installation in concrete over metal deck

3.3.8.3.2 Technical data for masonry

Table 28 - KWIK Bolt 3 carbon steel allowable loads in grout-filled concrete masonry walls[1, 2, 3, 4, 5, 6]

Nominal anchor diameter	Nominal embedment in.	(mm)	Minimum distance from edge of block in.	(mm)	Tension lb	(kN)	Shear lb	(kN)
1/4	1-1/8	(29)	4	(102)	150	(0.7)	380	(1.7)
			12	(305)				
	2	(51)	4	(102)	540	(2.4)	445	(2.0)
			12	(305)				
3/8	1-5/8	(41)	4	(102)	320	(1.4)	735	(3.3)
			12	(305)	340	(1.5)	940	(4.2)
	2-1/2	(64)	4	(102)	780	(3.5)	1,010	(4.5)
			12	(305)			1,395	(6.2)
1/2	2-1/4	(57)	4	(102)	630	(2.8)	830	(3.7)
			12	(305)	665	(3.0)	1,465	(6.5)
	3-1/2	(89)	4	(102)	905	(4.0)	1,080	(4.8)
			12	(305)			2,375	(10.6)
5/8	2-3/4	(70)	4	(102)	815	(3.6)	890	(4.0)
			12	(305)	865	(3.8)	2,165	(9.6)
	4	(102)	4	(102)	1,240	(5.5)	970	(4.3)
			12	(305)	1,295	(5.8)	2,770	(12.3)
3/4	3-1/4	(83)	4	(102)	1,035	(4.6)	785	(3.5)
			12	(305)			3,135	(13.8)
	4-3/4	(121)	4	(102)	1,645	(7.3)	825	(3.7)
			12	(305)	1,710	(7.6)	3,305	(14.7)

Table 29 - KWIK Bolt 3 carbon steel allowable loads for anchors installed in top of grout-filled concrete masonry walls[1,6]

Nominal Anchor Diameter	Nominal Embedment in.	(mm)	Tension lb	(kN)	Shear V_1 lb	(kN)	Shear V_2 lb	(kN)
1/2	3	(76)	645	(2.9)	310	(1.4)	615	(2.7)
5/8	3-1/2	(89)	850	(3.8)	310	(1.4)	615	(2.7)

1 All values are for anchors installed in fully grouted concrete masonry with minimum masonry prism strength of 1,500 psi. Concrete masonry units may be lightweight, medium-weight or normal-weight conforming to ASTM C90. Allowable loads are calculated using safety factor of 4.

2 Anchors must be installed a minimum of 1-3/8 inch from any vertical mortar joint (see figure below).

3 Anchor locations are limited to one per masonry cell.

4 Embedment depth is measured from the outside face of the concrete masonry unit.

5 Linear interpolation to determine load values at intermediate edge distances is permitted.

6 All allowable loads based on safety factor of 4.

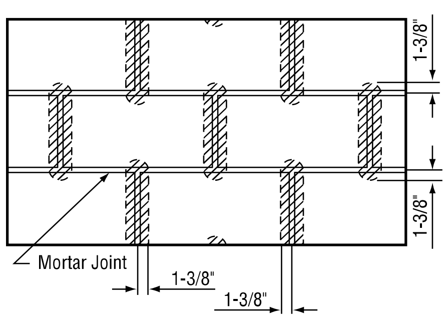


Figure 6 - Installation in grout-filled concrete masonry unit

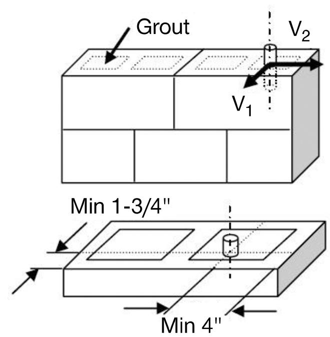


Figure 7 - KWIK Bolt 3 installed in the top of masonry walls

3.3.8.4 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.

3.3.8 KWIK Bolt 3 Expansion Anchor

3.3.8.5 Ordering Information

KWIK Bolt 3 anchor product line

Size	Length (ℓ) in.	(mm)	Thread length (ℓ_{th}) in.	(mm)	ID stamp	Box	Carbon steel	304 SS	316 SS	HDG
1/4 x 1-3/4	1-3/4	(44)	3/4	(18)	A	100	●	●		
1/4 x 2-1/4	2-1/4	(57)	7/8	(22)	B		●	●	●	
1/4 x 3-1/4	3-1/4	(83)	2	(51)	D		●	●		
			7/8	(22)					●	
1/4 x 4-1/2	4-1/2	(114)	2-7/8	(75)	G		●	●		
3/8 x 2-1/4	2-1/4	(57)	7/8	(22)	B	50	●	●		
3/8 x 3	3	(76)	1-1/4	(32)	D				●	
			1-1/2	(40)			●	●		
3/8 x 3-3/4	3-3/4	(95)	1-1/4	(32)	E				●	
			2-1/4	(59)			●	●		
3/8 x 5	5	(127)	3-1/2	(91)	H		●	●		
3/8 x 7	7	(178)	5-1/2	(142)	L		●	●		
1/2 x 2-3/4	2-3/4	(70)	1-1/4	(33)	C	25	●	●		
1/2 x 3-3/4	3-3/4	(95)	1-5/16	(35)	E				●	
			2-3/16	(56)			●	●		●
1/2 x 4-1/2	4-1/2	(114)	1-5/16	(35)	G				●	
			2-7/8	(75)			●	●		●
1/2 x 5-1/2	5-1/2	(140)	1-5/16	(35)	I				●	
			3-3/4	(96)			●	●		●
1/2 x 7	7	(178)	4-3/4	(121)	L		●	●		●
5/8 x 3-3/4	3-3/4	(95)	1-1/2	(41)	E	15	●	●	●	
5/8 x 4-3/4	4-3/4	(121)	1-1/2	(41)	G				●	
			2-3/4	(70)			●	●		●
5/8 x 6	6	(152)	1-1/2	(41)	J			●	●	
			4	(102)			●			●
5/8 x 7	7	(178)	4-3/4	(121)			●			
5/8 x 8-1/2	8-1/2	(216)	6-1/2	(166)	O		●	●		
5/8 x 10	10	(254)	7	(180)	R		●	●		
3/4 x 4-3/4	4-3/4	(121)	1-1/2	(41)	G	20		●	●	
			2-7/16	(62)		10	●			●
						20		●		
3/4 x 5-1/2	5-1/2	(140)	1-1/2	(41)	I	20		●		
			3-7/16	(85)		10	●			●
						20		●		
3/4 x 7	7	(178)	1-1/2	(41)	L	10		●		
			4-5/8	(119)			●			
3/4 x 8	8	(203)	5-3/4	(146)	N		●	●		●
3/4 x 10	10	(254)	5-7/8	(152)	R		●	●	●	
3/4 x 12	12	(305)	5-7/8	(152)	T		●	●		
1 x 6	6	(152)	2-1/4	(57)	J	5	●	●	●	
1 x 9	9	(114)	2-1/4	(57)	P		●	●		
1 x 12	12	(114)	6	(152)	T		●	●		

Countersunk KWIK Bolt anchor product line

Size	Length in.	(mm)	Box	Carbon steel	304 SS
C1/4 x 2	2	(51)	100	•	
C1/4 x 3	3	(76)	100	•	•
C1/4 x 5	5	(127)	100	•	
C3/8 x 2-1/4	2-1/4	(57)	100	•	
C3/8 x 3	3	(76)	100	•	
C3/8 x 4	4	(102)	50	•	•
C3/8 x 5	5	(127)	50	•	

Rod Coupling KWIK Bolt 3 anchor product line

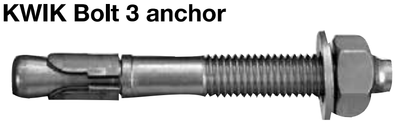
Size	Length in.	(mm)	Thread length in.	(mm)	ID stamp	Box quantity
3/8 x 2-1/4	2-1/4	(57)	7/8	(22)	B	100

HHDCA ceiling anchor product line

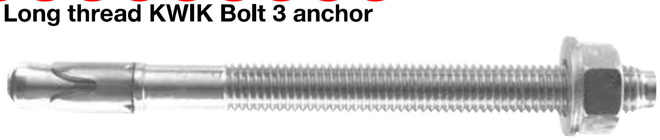
Size	Length in.	(mm)	Eyelet size in.	Box quantity
1/4 x 2	2-1/32	(52)	5/16	100

3.3.8

KWIK Bolt 3 anchor



Long thread KWIK Bolt 3 anchor



Countersunk KWIK Bolt 3 anchor

Rod coupling KWIK Bolt 3 anchor 3/8 x 2 1/4

HHDCA ceiling hanger 1/4 x 2

<u>EATON B-LINE STRUT SYSTEM</u>

Operations & Maintenance Manual
December 2015

Strut systems

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

B-Line
by EATON

Metal Framing Channels

Channel
Metal framing channel is cold formed on our modern rolling mills from 12 Ga. (2.6mm), 14 Ga. (1.9mm), and 16 Ga. (1.5mm) low carbon steel strips. A continuous slot with inturned lips provides the ability to make attachments at any point.

Lengths & Tolerances
All channels excluding 'SH' style
± 1/8" (3.2mm) on 10' (3.05m) and
± 3/16" (4.76mm) on 20' (6.09m)
All 'SH' channels only
± 1/4" (6.35mm) on 10' (3.05m) and
± 1/2" (12.70mm) on 20' (6.09m)
Custom lengths are available upon request.

Slots
Slotted series of channels offer full flexibility. A variety of pre-punched slot patterns eliminate the need for precise field measuring for hole locations. Slots offer wide adjustments in the alignment and bolt sizing.

Holes
A variety of pre-punched 9/16" (14.3 mm) diameter hole patterns are available in our channels. These hole patterns provide an economical alternative to costly field drilling required for many applications.

Knockouts
When used with series B217-20 Closure Strips, knockout channels can be used to provide an economical U.L. listed surface raceway. Channels are furnished with 7/8" (22.2 mm) knockouts on 6" (152 mm) centers, allowing for perfect fixture alignment on spans up to 20' (6.09 m).

Materials & Finishes (Unless otherwise noted)
Steel: Plain & Pre-galvanized
12 Ga. (2.6), 14 Ga. (1.9) and 16 Ga. (1.5)

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Finish Code	Finish	Specification
PLN	Plain	ASTM A1011, 33,000 PSI min. yield
GRN	DURA-GREEN™	
GLV	Pre-Galvanized	ASTM A653 33,000 PSI min. yield
HDG	Hot-Dipped Galvanized	ASTM A123
YZN	Yellow Zinc Chromate	ASTM B633 SC3 Type II
SS4	Stainless Steel Type 304	ASTM A240
SS6	Stainless Steel Type 316	ASTM A240
AL	Aluminum	Aluminum 6063-T6

Note: A minimum order may apply on special material and finishes.

Design Load (Steel & Stainless Steel)
The design loads given for strut beam loads are based on a simple beam condition using an allowable stress of 25,000 psi. This allowable stress results in a safety factor of 1.68. This is based upon virgin steel minimum yield strength of 33,000 psi cold worked during rolling to an average yield stress of 42,000 psi.
For aluminum channel loading multiply steel loading by a factor of 0.38.

Welding
Weld spacing is maintained between 2 1/2 inches (63.5 mm) and 4 inches (101.6 mm) on center. Through high quality control testing of welded channels and continuous monitoring of welding equipment, B-Line provides the most consistent combination channels available today.

Metric
Metric dimensions are shown in parentheses. Unless noted, all metric dimensions are in millimeters.

SELECTION CHART

for Channels, Materials and Hole Patterns

Channel Type	Channel Dimensions: Height		Channel Dimensions: Width		Material & Thickness *: Steel 1	Alum. 2	Stainless Steel Type 304 3	Stainless Steel Type 316 4	Channel Hole Pattern **: SH (9/16" x 1 1/8" slots on 2" centers)	S (13/32" x 3" slots)	H1 7/8 (9/16" diameter holes)	TH (9/16" diameter on 1 7/8" centers)	KO6 (7/8" diameter knockouts)
B11	3 1/4”	(82.5)	1 5/8”	(41.3)	12 Ga.	.105	–	–	1	1	1	–	1
B12	2 7/16”	(61.9)	1 5/8”	(41.3)	12 Ga.	.105	–	–	1 2	1	1 2	–	1 2
B22	1 5/8”	(41.3)	1 5/8”	(41.3)	12 Ga.	.105	12 Ga.	12 Ga.	1 2 3 4	1 3	1 2 3	1	1 2
B24	1 5/8”	(41.3)	1 5/8”	(41.3)	14 Ga.	.080	14 Ga.	14 Ga.	1 2 3 4	1	1 2 3	–	1 2
B26	1 5/8”	(41.3)	1 5/8”	(41.3)	16 Ga.	–	–	–	1	1	1	–	1
B32	1 3/8”	(34.9)	1 5/8”	(41.3)	12 Ga.	–	12 Ga.	–	1 3	1	1 3	–	1
B42	1”	(25.4)	1 5/8”	(41.3)	12 Ga.	–	12 Ga.	–	1 3	1	1 3	–	1
B52	13/16”	(20.6)	1 5/8”	(41.3)	12 Ga.	–	12 Ga.	12 Ga.	1 3 4	1	1	–	1
B54	13/16”	(20.6)	1 5/8”	(41.3)	14 Ga.	.080	14 Ga.	14 Ga.	1 2 3 4	1	1 2 3 4	–	1 2
B56	13/16”	(20.6)	1 5/8”	(41.3)	16 Ga.	–	–	–	1	1	1	–	1
B62	13/16”	(20.6)	13/16”	(20.6)	18 Ga.	–	–	–	–	–	–	–	–
B72	13/32”	(10.3)	13/16”	(20.6)	18 Ga.	–	–	–	–	–	–	–	–

The selection has been prepared to provide a reference for available channel, materials and hole patterns. Material types available for various hole patterns are defined by numbers 1 thru 4.
Some stainless steel channels with hole patterns are available on special order only.

*Metric equivalent for thicknesses shown in chart.
12 Ga. = 2.6 mm   18 Ga. = 1.2 mm
14 Ga. = 1.9 mm   .105 = 2.6 mm
16 Ga. = 1.5 mm   .080 = 2.0 mm

**1 - Steel
2 - Aluminum
3 - Type 304 Stainless Steel
4 - Type 316 Stainless Steel

Properties may vary due to commercial tolerances of the material.

Channel Part Numbering
Example:
B22 SH - 120 SS4

Channel Type	Hole Patterns	Length	Material/Finish
B11	SH (pg. 40)	120	GRN
B12	S (pg. 40)	240	GLV
B22 †	H178 (pg. 40)		HDG
B24 †	TH (pg. 41)		YZN
B26	K06 (pg. 41)		SS4
B32	SHA (pg. 41)		SS6
B42	S58 (pg. 42)		AL
B52 †	M (pg. 42)		
B54 †	H25 (pg. 43)		
B56	H112 † (pg. 42)		
B62	* Leave blank for no hole pattern		
B72			

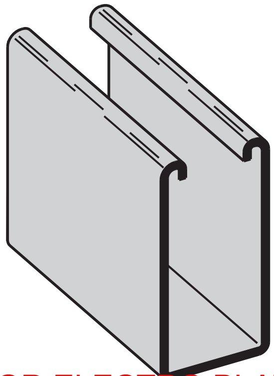
Channel & Combinations

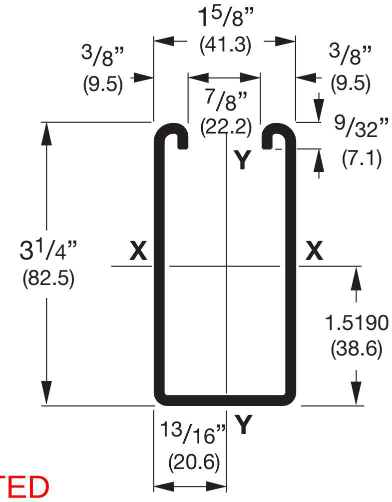
Reference page 14 for general fitting and standard finish specifications.

B11 Channel, Combinations & Load Data

B11

- Thickness: 12 Gauge (2.6 mm)
- Standard lengths: 10’ (3.05 m) & 20’ (6.09 m)
- Standard finishes: Plain, DURA-GREEN™, Pre-Galvanized, Hot-Dipped Galvanized, Aluminum
- Weight: 3.05 Lbs./Ft. (4.54 kg/m)





ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

SECTION PROPERTIES

					X - X Axis						Y - Y Axis					
Channel	Weight		Areas of Section		Moment of Inertia (I)		Section Modulus (S)		Radius of Gyration (r)		Moment of Inertia (I)		Section Modulus (S)		Radius of Gyration (r)	
	lbs./ft.	kg/m	sq. in.	cm^2	$in.^4$	cm^4	$in.^3$	cm^3	in.	cm	$in.^4$	cm^4	$in.^3$	cm^3	in.	cm
B11	3.059	(4.55)	.900	(5.81)	1.1203	(46.63)	.6472	(10.61)	1.116	(2.83)	.4357	(18.14)	.5362	(8.79)	.696	(1.77)
B11A	6.119	(9.11)	1.800	(11.61)	6.3931	(266.10)	1.9671	(32.24)	1.885	(4.79)	.8714	(36.27)	1.0725	(17.58)	.696	(1.77)

Calculations of section properties are based on metal thicknesses as determined by the AISI Cold-Formed Steel Design Manual.

BEAM LOADING

Beam Span		Channel	Uniform Load and Deflection				Uniform Load @ Deflection = 1/240 Span		1/360 Span	
In.	mm	Style	Lbs.	kN	In.	mm	Lbs.	kN	Lbs.	kN
24	(609)	B11	5130	(22.82)	.029	(.73)	5130	(22.82)	5130	(22.82)
		B11A	5130*	(22.82)	.005	(.13)	5130*	(22.82)	5130*	(22.82)
36	(914)	B11	3488	(15.51)	.065	(1.65)	3488	(15.51)	3488	(15.51)
		B11A	5130*	(22.82)	.017	(.43)	5130*	(22.82)	5130*	(22.82)
48	(1219)	B11	2616	(11.63)	.117	(2.97)	2616	(11.63)	2616	(11.63)
		B11A	5130*	(22.82)	.040	(1.01)	5130*	(22.82)	5130*	(22.82)
60	(1524)	B11	2093	(9.31)	.183	(4.65)	2093	(9.31)	1908	(8.49)
		B11A	5130*	(22.82)	.079	(2.00)	5130*	(22.82)	5130*	(22.82)
72	(1829)	B11	1744	(7.76)	.263	(6.68)	1744	(7.76)	1325	(5.89)
		B11A	5130*	(22.82)	.136	(3.45)	5130*	(22.82)	5130*	(22.82)
84	(2133)	B11	1495	(6.65)	.358	(9.09)	1460	(6.49)	974	(4.33)
		B11A	4552	(20.25)	.191	(4.85)	4552	(20.25)	4552	(20.25)
96	(2438)	B11	1308	(5.82)	.468	(11.89)	1118	(4.97)	745	(3.31)
		B11A	3983	(17.72)	.250	(6.35)	3983	(17.72)	3983	(17.72)
108	(2743)	B11	1163	(5.17)	.592	(15.03)	884	(3.93)	589	(2.62)
		B11A	3541	(15.75)	.317	(8.05)	3541	(15.75)	3353	(14.91)
120	(3048)	B11	1046	(4.65)	.731	(18.57)	716	(3.18)	477	(2.12)
		B11A	3187	(14.17)	.391	(9.93)	3187	(14.17)	2716	(12.08)
144	(3657)	B11	872	(3.88)	1.053	(26.74)	497	(2.21)	331	(1.47)
		B11A	2656	(11.81)	.563	(14.30)	2656	(11.81)	1886	(8.39)
168	(4267)	B11	747	(3.32)	1.433	(36.40)	365	(1.62)	243	(1.08)
		B11A	2276	(10.12)	.766	(19.45)	2078	(9.24)	1386	(6.16)
192	(4877)	B11	654	(2.91)	1.871	(47.52)	280	(1.24)	186	(0.83)
		B11A	1992	(8.86)	1.001	(25.42)	1591	(7.08)	1061	(4.72)
216	(5486)	B11	581	(2.58)	2.368	(60.15)	221	(0.98)	147	(0.65)
		B11A	1770	(7.87)	1.267	(32.18)	1257	(5.59)	838	(3.73)
240	(6096)	B11	523	(2.32)	2.924	(74.27)	179	(0.79)	119	(0.53)
		B11A	1593	(7.08)	1.564	(39.72)	1018	(4.53)	679	(3.02)

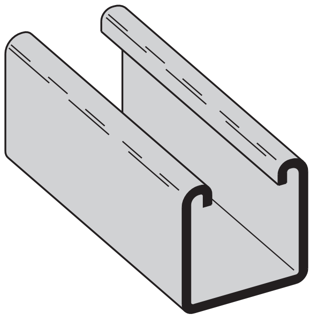
Based on simple beam condition using an allowable design stress of 25,000 psi (172 MPa) in accordance with MFMA, with adequate lateral bracing (see page 11 for further explanation). Actual yield point of cold rolled steel is 42,000 psi (289 MPa). To determine concentrated load capacity at mid span, multiply uniform load by 0.5 and corresponding deflection by 0.8. *Failure determined by weld shear.

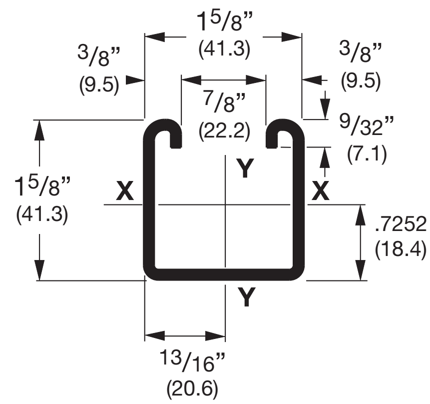
Reference page 14 for general fitting and standard finish specifications.

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

B22

- Thickness: 12 Gauge (2.6 mm)
- Standard lengths: 10’ (3.05 m) & 20’ (6.09 m)
- Standard finishes: Plain, DURA-GREEN™, Pre-Galvanized, Hot-Dipped Galvanized, Stainless Steel Type 304 or 316, Aluminum
- Weight: 1.90 Lbs./Ft. (2.83 kg/m)

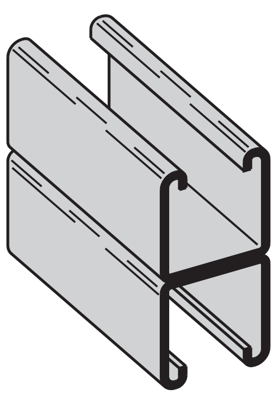




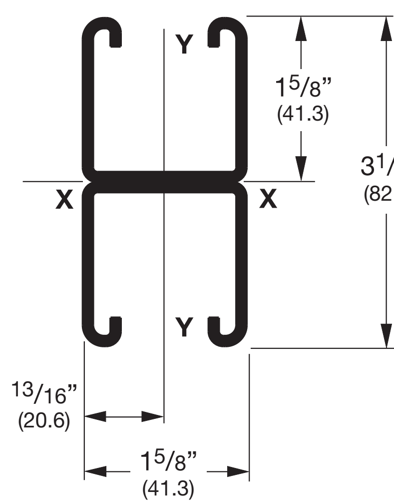
SECTION PROPERTIES

					X - X Axis						Y - Y Axis					
Channel	Weight		Areas of Section		Moment of Inertia (I)		Section Modulus (S)		Radius of Gyration (r)		Moment of Inertia (I)		Section Modulus (S)		Radius of Gyration (r)	
	lbs./ft.	kg/m	sq. in.	cm^2	$in.^4$	cm^4	$in.^3$	cm^3	in.	cm	$in.^4$	cm^4	$in.^3$	cm^3	in.	cm
B22	1.910	(2.84)	.562	(3.62)	.1912	(7.96)	.2125	(3.48)	.583	(1.48)	.2399	(9.99)	.2953	(4.84)	.653	(1.66)
B22A	3.820	(5.69)	1.124	(7.25)	.9732	(40.51)	.5989	(9.81)	.931	(2.36)	.4798	(19.97)	.5905	(9.68)	.653	(1.66)
B22X	6.649	(9.89)	1.956	(12.62)	4.1484	(172.67)	1.7019	(27.89)	1.456	(3.70)	1.1023	(45.88)	1.2027	(19.71)	.751	(1.91)

Calculations of section properties are based on metal thicknesses as determined by the AISI Cold-Formed Steel Design Manual.



B22A
Wt. 3.80 Lbs./Ft. (5.65 kg/m)



Reference page 14 for general fitting and standard finish specifications.

B22 Beam Loading Data

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Beam Span In.	Beam Span mm	Channel Style	Uniform Load and Deflection Lbs.	kN	In.	mm	Uniform Load @ Deflection = 1/240 Span Lbs.	kN	1/360 Span Lbs.	kN
12	(305)	B22	2610	(11.61)	.014	(.35)	2610	(11.61)	2610	(11.61)
		B22A	2610*	(11.61)	.002	(.05)	2610*	(11.61)	2610*	(11.61)
		B22X	5790*	(25.75)	.001	(.02)	5790*	(25.75)	5790*	(25.75)
18	(457)	B22	2269	(10.09)	.031	(.79)	2269	(10.09)	2269	(10.09)
		B22A	2610*	(11.61)	.007	(.18)	2610*	(11.61)	2610*	(11.61)
		B22X	5790*	(25.75)	.003	(.07)	5790*	(25.75)	5790*	(25.75)
24	(609)	B22	1702	(7.57)	.056	(1.42)	1702	(7.57)	1702	(7.57)
		B22A	2610*	(11.61)	.017	(.43)	2610*	(11.61)	2610*	(11.61)
		B22X	5790*	(25.75)	.008	(.20)	5790*	(25.75)	5790*	(25.75)
30	(762)	B22	1361	(6.05)	.087	(2.21)	1361	(6.05)	1294	(5.75)
		B22A	2610*	(11.61)	.033	(.84)	2610*	(11.61)	2610*	(11.61)
		B22X	5790*	(25.75)	.017	(.73)	5790*	(25.75)	5790*	(25.75)
36	(914)	B22	1135	(5.05)	.126	(3.20)	1135	(5.05)	899	(4.00)
		B22A	2610*	(11.61)	.057	(1.45)	2610*	(11.61)	2610*	(11.61)
		B22X	5790*	(25.75)	.029	(.73)	5790*	(25.75)	5790*	(25.75)
42	(1067)	B22	972	(4.32)	.172	(4.37)	972	(4.32)	660	(2.93)
		B22A	2610*	(11.61)	.091	(2.31)	2610*	(11.61)	2610*	(11.61)
		B22X	5790*	(25.75)	.046	(1.17)	5790*	(25.75)	5790*	(25.75)
48	(1219)	B22	851	(3.78)	.224	(5.69)	758	(3.37)	505	(2.24)
		B22A	2405	(10.70)	.125	(3.17)	2405	(10.70)	2405	(10.70)
		B22X	5790*	(25.75)	.068	(1.73)	5790*	(25.75)	5790*	(25.75)
54	(1371)	B22	756	(3.36)	.284	(7.21)	599	(2.66)	399	(1.77)
		B22A	2138	(9.51)	.158	(4.01)	2138	(9.51)	2024	(9.00)
		B22X	5790*	(25.75)	.097	(2.46)	5790*	(25.75)	5790*	(25.75)
60	(1524)	B22	681	(3.03)	.351	(8.91)	485	(2.16)	323	(1.44)
		B22A	1924	(8.56)	.195	(4.95)	1924	(8.56)	1640	(7.29)
		B22X	5645	(25.11)	.130	(3.30)	5645	(25.11)	5645	(25.11)
66	(1676)	B22	619	(2.75)	.424	(10.77)	401	(1.78)	267	(1.19)
		B22A	1749	(7.78)	.236	(5.99)	1749	(7.78)	1355	(6.03)
		B22X	5132	(22.83)	.158	(4.01)	5132	(22.83)	5132	(22.83)
72	(1829)	B22	567	(2.52)	.505	(12.83)	337	(1.50)	225	(1.00)
		B22A	1603	(7.13)	.281	(7.14)	1603	(7.13)	1139	(5.06)
		B22X	4704	(20.92)	.188	(4.77)	4704	(20.92)	4704	(20.92)
78	(1981)	B22	524	(2.33)	.593	(15.06)	287	(1.27)	191	(0.85)
		B22A	1480	(6.58)	.330	(8.38)	1455	(6.47)	970	(4.31)
		B22X	4342	(19.31)	.220	(5.59)	4342	(19.31)	4270	(18.99)
84	(2133)	B22	486	(2.16)	.687	(17.45)	248	(1.10)	165	(0.73)
		B22A	1374	(6.11)	.383	(9.73)	1255	(5.58)	837	(3.72)
		B22X	4032	(17.93)	.255	(6.48)	4032	(17.93)	3682	(16.38)
90	(2286)	B22	454	(2.02)	.789	(20.04)	216	(0.96)	144	(0.64)
		B22A	1283	(5.71)	.440	(11.17)	1093	(4.86)	729	(3.24)
		B22X	3763	(16.74)	.293	(7.44)	3763	(16.74)	3207	(14.26)
96	(2438)	B22	425	(1.89)	.898	(22.81)	190	(0.84)	126	(0.56)
		B22A	1202	(5.35)	.500	(12.70)	961	(4.27)	640	(2.85)
		B22X	3528	(15.69)	.334	(8.48)	3528	(15.69)	2819	(12.54)
102	(2591)	B22	400	(1.78)	1.013	(25.73)	168	(0.75)	112	(0.50)
		B22A	1132	(5.03)	.565	(14.35)	851	(3.78)	567	(2.52)
		B22X	3320	(14.77)	.377	(9.57)	3320	(14.77)	2497	(11.11)
108	(2743)	B22	378	(1.68)	1.136	(28.85)	150	(0.67)	100	(0.44)
		B22A	1069	(4.75)	.633	(16.08)	759	(3.37)	506	(2.25)
		B22X	3136	(13.95)	.422	(10.72)	3136	(13.95)	2227	(9.90)
114	(2895)	B22	358	(1.59)	1.266	(32.15)	134	(0.59)	90	(0.40)
		B22A	1013	(4.50)	.706	(17.93)	681	(3.03)	454	(2,02)
		B22X	2971	(13.21)	.471	(11.96)	2971	(13.21)	1999	(8,89)
120	(3048)	B22	340	(1.51)	1.403	(35.63)	121	(0.54)	81	(0.36)
		B22A	962	(4.28)	.782	(19.86)	615	(2.73)	410	(1.82)
		B22X	2822	(12.55)	.521	(13.23)	2706	(12.04)	1804	(8.02)

Based on simple beam condition using an allowable design stress of 25,000 psi (172 MPa) in accordance with MFMA, with adequate lateral bracing (see page 11 for further explanation). Actual yield point of cold rolled steel is 42,000 psi. To determine concentrated load capacity at mid span, multiply uniform load by 0.5 and corresponding deflection by 0.8. *Failure determined by weld shear.

Reference page 14 for general fitting and standard finish specifications.

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Unbraced Height		Channel Style	Max. Column Loading K = .80				Max. Column Loading (Loaded @ C.G.)					
			Loaded@ C.G.		Loaded@ Slot Face		K = .65		K = 1.0		K = 1.2	
In.	mm		Lbs.	kN	Lbs.	kN	Lbs.	kN	Lbs.	kN	Lbs.	kN
12	(305)	**B22**	10454	(46.50)	4276	(19.12)	10598	(47.14)	10222	(45.47)	9950	(44.26)
		B22A	21625	(96.19)	7002	(31.14)	21677	(96.42)	21539	(95.81)	21433	(95.34)
		B22X	46948	(208.83)	18975	(84.40)	47061	(209.34)	46761	(208.00)	46531	(206.98)
18	(457)	**B22**	9950	(44.26)	4153	(18.47)	10253	(45.62)	9481	(42.17)	8955	(39.83)
		B22A	21433	(95.34)	6959	(30.95)	21551	(95.86)	21239	(94.47)	21001	(93.42)
		B22X	46531	(206.98)	18859	(83.90)	46787	(208.12)	46110	(205.11)	45593	(202.81)
24	(609)	**B22**	9311	(41.42)	3993	(17.76)	9801	(43.60)	8582	(38.17)	7801	(3470)
		B22A	21164	(94.14)	6898	(30.68)	21373	(95.07)	20819	(92.61)	20397	(9073)
		B22X	45947	(204.38)	18693	(84.44)	46401	(206.40)	45198	(201.05)	44282	(196.97)
30	(762)	**B22**	8582	(38.17)	3802	(16.91)	9268	(41.22)	7601	(33.81)	6595	(29.33)
		B22A	20819	(92.61)	6821	(30.34)	21145	(94.06)	20279	(90.20)	19619	(87.27)
		B22X	45198	(201.05)	18485	(82.22)	45906	(204.20)	44026	(195.84)	42593	(189.46)
36	(914)	**B22**	7801	(34.70)	3589	(15.96)	8676	(38.59)	6595	(28.33)	5392	(23.98)
		B22A	20397	(90.73)	6728	(29.93)	20866	(92.81)	19619	(87.27)	18669	(83.04)
		B22X	44282	(196.97)	18233	(81.10)	45300	(201.50)	42593	(189.46)	40530	(180.28)
42	(1067)	**B22**	6998	(31.13)	3360	(14.94)	8048	(35.80)	5595	(24.89)	4444	(19.77)
		B22A	19898	(88.51)	6620	(29.45)	20537	(91.33)	18840	(83.80)	17546	(78.05)
		B22X	43198	(192.15)	17940	(79.80)	44586	(198.33)	40901	(181.94)	38092	(169.44)
48	(1219)	**B22**	6193	(27.55)	3118	(13.87)	7401	(32.92)	4718	(20.99)	3791	(16.86)
		B22A	19322	(85.95)	6496	(28.89)	20157	(89.66)	17940	(79.80)	16251	(72.29)
		B22X	41948	(186.59)	17604	(78.30)	43761	(194.57)	38948	(173.25)	35281	(156.94)
54	(1371)	**B22**	5392	(23.98)	2864	(12.74)	6746	(30.01)	4090	(18.19)	3310	(14.72)
		B22A	18669	(83.04)	6263	(27.86)	19276	(87.74)	16920	(75.26)	14782	(65.75)
		B22X	40530	(180.28)	16973	(75.50)	42825	(190.49)	36733	(163.39)	32092	(142.75)
60	(1524)	**B22**	4718	(20.99)	2631	(11.70)	6093	(27.10)	3616	(16.08)	2936	(13.06)
		B22A	17940	(79.80)	5340	(23.75)	19244	(85.60)	15781	(70.20)	13141	(58.45)
		B22X	38948	(173.25)	14471	(64.37)	41779	(185.84)	34260	(152.39)	28529	(126.90)
66	(1676)	**B22**	4202	(18.69)	2434	(10.83)	5441	(24.20)	3242	(14.42)	2634	(11.71)
		B22A	17134	(76.21)	4587	(20.40)	18712	(83.23)	14521	(64.59)	11328	(50.39)
		B22X	37198	(165.46)	12431	(55.29)	40624	(180.70)	31525	(140.23)	24593	(109.39)
72	(1829)	**B22**	3791	(16.86)	2264	(10.07)	4869	(21.66)	2936	(13.06)	2381	(10.59)
		B22A	16251	(72.29)	3968	(17.65)	18129	(80.64)	13141	(58.45)	9524	(42.36)
		B22X	35281	(156.94)	10753	(47.83)	39358	(175.07)	28529	(126.90)	20676	(91.97)
78	(1981)	**B22**	3456	(15.37)	2116	(9.41)	4412	(19.62)	2680	(11.92)	2166	(9.63)
		B22A	15291	(68.02)	3456	(15.37)	17496	(77.82)	11642	(51.78)	8115	(36.10)
		B22X	33197	(147.67)	9366	(41.66)	37984	(168.96)	25275	(112.43)	17617	(78.36)
84	(2133)	**B22**	3176	(14.13)	1984	(8.82)	4037	(17.96)	2461	(10.95)	1980	(8.81)
		B22A	14255	(63.41)	3028	(13.47)	16812	(74.78)	10076	(44.82)	6998	(31.13)
		B22X	30947	(137.66)	8206	(36.50)	36499	(162.35)	21875	(97.30)	15192	(67.58)
90	(2286)	**B22**	2936	(13.06)	1867	(8.30)	3724	(16.56)	2270	(10.10)	1816	(8.08)
		B22A	13141	(58.45)	2667	(11.86)	16077	(71.51)	8778	(39.04)	6096	(27.11)
		B22X	28529	(126.90)	7227	(32.15)	34903	(155.25)	19057	(84.77)	13234	(58.87)
96	(2438)	**B22**	2728	(16.58)	1761	(7.83)	3456	(15.37)	2101	(9.34)	1671	(7.43)
		B22A	11951	(53.16)	2359	(10.49)	15291	(68.02)	7715	(34.32)	5357	(23.83)
		B22X	25945	(115.41)	6393	(28.44)	33197	(147.67)	16749	(74.50)	11630	(51.73)
102	(2591)	**B22**	2545	(11.32)	1664	(7.40)	3225	(14.34)	1951	(8.68)	1542**	(6.34)
		B22A	10678	(47.50)	2093	(9.31)	14455	(64.30)	6834	(30.40)	4746	(21.11)
		B22X	23182	(103.12)	5672	(25.23)	31382	(139.59)	14836	(65.99)	10303	(45.83)
108	(2743)	**B22**	2381	(10.59)	1575	(7.00)	3022	(13.44)	1816	(8.08)	1426**	(68.60)
		B22A	9524	(42.36)	1867	(8.30)	13568	(60.35)	6096	(27.11)	4233	(18.83)
		B22X	20676	(91.97)	5059	(22.50)	29456	(131.03)	13234	(58.87)	9190	(40.88)
114	(2895)	**B22**	2234	(9.94)	1494	(6.64)	2842	(12.64)	1694	(7.53)	1322**	(5.88)
		B22A	8548	(38.02)	1675	(7.45)	12630	(56.18)	5471	(24.33)	3799**	(16.90)
		B22X	18558	(82.55)	4539	(20.19)	27420	(121.97)	11877	(52.83)	8247	(36.68)
120	(3048)	**B22**	2101	(9.34)	1418	(6.31)	2680	(11.92)	1583**	(7.04)	1228**	(5.46)
		B22A	7715	(34.32)	1512	(6.72)	11642	(51.78)	4937	(21.96)	3429**	(15.25)
		B22X	16749	(74.50)	4097	(18.22)	25275	(112.43)	10718	(47.67)	7444	(33.11)

**Where the slenderness ratio $\frac{KL}{r}$ exceeds 200, and K = end fixity factor, L = actual length and r = radius of gyration.

Channel & Combinations

Reference page 14 for general fitting and standard finish specifications.

Pipe/Conduit Clamps & Hangers

Our beam attachments and pipe supports offered in this section are designed to provide supports without drilling or welding. A complete selection of beam clamps, pipe clamps, rollers, supports and accessories are designed for use with our channels and offer many installation advantages.

Materials & Finishes*

Pipe clamps, pipe hangers, beam clamps, brackets, and rollers are made from low carbon steel strips, plates or rod unless noted.

Finish Code	Finish	Specification
PLN	Plain	ASTM A1011 33,000 PSI min. yield
ZN	Electro-Plated Zinc	ASTM B633 SC3 Type III or ASTM A653
GRN	DURA-GREEN™	
DCU	DURA-COPPER™	
HDG	Hot-Dipped Galvanized	ASTM A123
YZN	Yellow Zinc Chromate	ASTM B633 SC3 Type II
SS4	Stainless Steel Type 304	ASTM A240
SS6	Stainless Steel Type 316	ASTM A240
AL	Aluminum	ASTM B209

*Unless otherwise noted.

Load Data

The load data published includes a safety factor of 5.0 unless noted (safety factor = ratio of ultimate load to the design load).

Recommended Torque For Setscrews (unless noted)

Setscrew Size	1/4"-20	3/8"-16	1/2"-13
Foot/Lbs.	4	5	11
Nm	5	7	15

Setscrew Size	5/8"-11	3/4"-10
Foot/Lbs.	21	34
Nm	28	46

*See chart on page 72 for bolt torque.

Metric

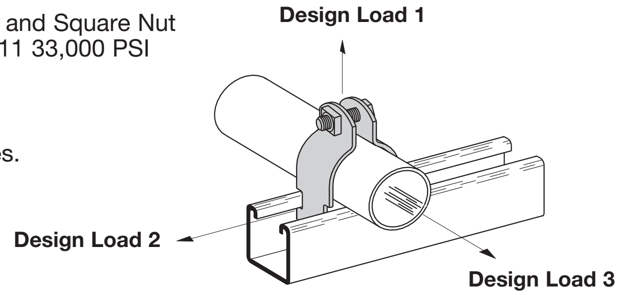
Metric dimensions are shown in parentheses. Unless noted, all metric dimensions are in millimeters.

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

B2000 SERIES
PIPE AND CONDUIT CLAMPS

- Safety Factor of 5
- Add PA to suffix for pre-assembled pipe clamps
- Includes Combination Recess Hex Head Machine Screw and Square Nut
- Material: 16 Ga. (1.5), 14 Ga. (1.9), 12 Ga. (2.6) ASTM A1011 33,000 PSI min. yield and 11 Ga. (3.0) ASTM A1011HSLA Gr. 50
- Standard finishes: ZN, HDG, SS4, SS6, AL

Note: For EMT sizes 2 1/2” and larger use rigid conduit sizes.



THINWALL CONDUIT (EMT) CLAMPS

Part No.	Conduit Size		Material Thickness		Design Load 1		Design Load 2		Design Load 3		Wt./C	
					Lbs.	kN	Lbs.	kg	Lbs.	kg	Lbs.	kg
B2000	3/8”	(10)	16 Ga.	(1.5)	400	(1.78)	50	(.22)	50	(.22)	10	(4.5)
B2001	1/2”	(15)	16 Ga.	(1.5)	400	(1.78)	50	(.22)	50	(.22)	10	(4.5)
B2002	3/4”	(20)	16 Ga.	(1.9)	400	(1.78)	50	(.22)	50	(.22)	11	(5.0)
B2003	1”	(25)	14 Ga.	(1.9)	600	(2.67)	75	(.33)	75	(.33)	16	(7.2)
B2004	1 1/4”	(32)	14 Ga.	(1.9)	600	(2.67)	75	(.33)	75	(.33)	19	(8.6)
B2005	1 1/2”	(40)	12 Ga.	(2.6)	800	(3.56)	125	(.56)	125	(.56)	28	(12.7)
B2006	2”	(50)	12 Ga.	(2.6)	800	(3.56)	125	(.56)	125	(.56)	33	(14.9)

RIGID CONDUIT OR PIPE CLAMPS

Part No.	Conduit Size		Material Thickness		Design Load 1		Design Load 2		Design Load 3		Wt./C	
					Lbs.	kN	Lbs.	kg	Lbs.	kg	Lbs.	kg
B2001	3/8”	(10)	16 Ga.	(1.5)	400	(1.78)	50	(.22)	50	(.22)	10	(4.5)
B2008	1/2”	(15)	16 Ga.	(1.5)	400	(1.78)	50	(.22)	50	(.22)	11	(5.0)
B2009	3/4”	(20)	14 Ga.	(1.9)	600	(2.67)	75	(.33)	75	(.33)	15	(6.8)
B2010	1”	(25)	14 Ga.	(1.9)	600	(2.67)	75	(.33)	75	(.33)	16	(7.2)
B2011	1 1/4”	(32)	14 Ga.	(1.9)	600	(2.67)	75	(.33)	75	(.33)	20	(9.1)
B2012	1 1/2”	(40)	12 Ga.	(2.6)	800	(3.56)	125	(.56)	125	(.56)	30	(13.6)
B2013	2”	(50)	12 Ga.	(2.6)	800	(3.56)	125	(.56)	125	(.56)	34	(15.4)
B2014	2 1/2”	(65)	12 Ga.	(2.6)	800	(3.56)	125	(.56)	125	(.56)	38	(17.2)
B2015	3”	(80)	12 Ga.	(2.6)	800	(3.56)	125	(.56)	125	(.56)	44	(19.9)
B2016	3 1/2”	(90)	11 Ga.	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	61	(27.6)
B2017	4”	(100)	11 Ga.	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	66	(29.9)
B2018	4 1/2”	(115)	11 Ga.	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	70	(31.7)
B2019	5”	(125)	11 Ga.	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	77	(34.9)
B2020	6”	(150)	11 Ga.	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	100	(45.3)
B2021	7”	(175)	11 Ga.	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	115	(52.1)
B2022	8”	(200)	11 Ga.	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	128	(58.0)
B2130	10	(254)	11 Ga.	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	160	(72.6)
B2132	12”	(305)	11 Ga.	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	185	(83.9)

Reference page 126 for general fitting and standard finish specifications.

Fig. 98 - Rod Stiffener

Size Range — Secures 3/8" thru 7/8" hanger rod
Material — Carbon Steel
Function — Secures channel to hanger rod for vertical seismic bracing.
Finish — Electro Galvanized
Note — Available in HDG finish or Stainless Steel materials.
Order By — Figure number

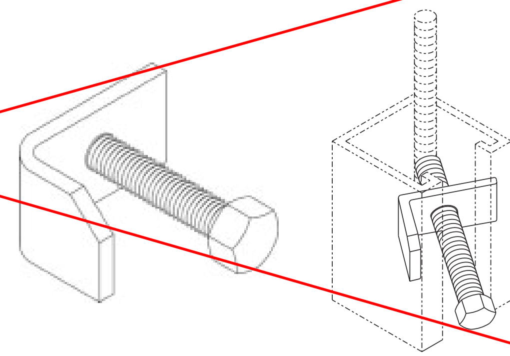
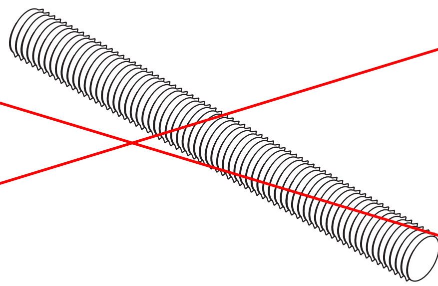


Fig. 99 - All Thread Rod Cut to Length

Size Range — Secures 3/8" thru 7/8" rod in 1" increments
Material — Carbon Steel
Maximum Temperature — 750°F
Finish — Plain
Note — Available in Electro-Galvanized and HDG finish or Stainless Steel materials.
Order By — Figure number, rod diameter, rod length and finish

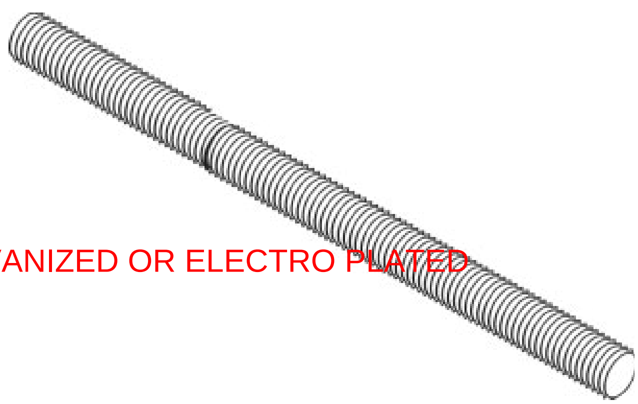


Dimensions • Weights

Rod Size	Max. Rec. Load Lbs. For Service Temps 650°F	750°F
3/8	610	540
1/2	1130	1010
5/8	1810	1610
3/4	2710	2420
7/8	3770	3360

Fig. 100 - All Thread Rod Full Lengths

Size Range — Secures 3/8" thru 7/8" rod in 10’ lengths
Material — Carbon Steel
Maximum Temperature — 750°F
Finish — Plain
Note — Available in Electro-Galvanized and HDG finish or Stainless Steel materials.
Order By — Figure number, rod diameter and finish



ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Dimensions • Weights

Rod Size	Max Rec. Load Lbs. For Service Temps 650°F	750°F	Approx. Wt./100
1/4	240	215	12
3/8	610	540	29
1/2	1130	1010	53
5/8	1810	1610	84
3/4	2710	2420	123
7/8	3770	3360	169
1	4960	4420	222
1 1/4	8000	7140	360
1 1/2	11630	10370	510

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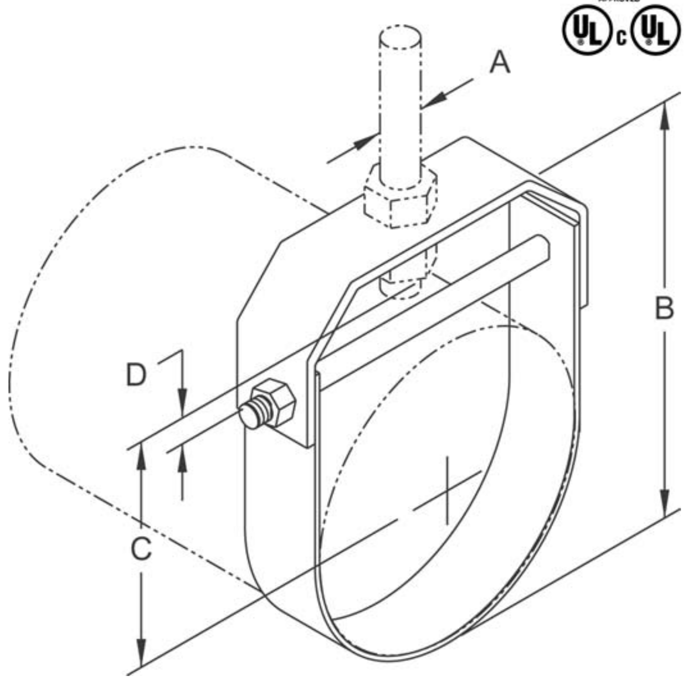
<u>TOLCO STANDARD CLEVIS HANGER</u>

Operations & Maintenance Manual
December 2015

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Fig. 1 - Standard Clevis Hanger



Size Range — Size 1/2" thru 36" pipe.

Material — Carbon Steel

Function — Recommended for the suspension of non-insulated pipe or insulated pipe with Fig. 220 shield.

Note — When an oversized clevis is used, a pipe spacer should be placed over the cross bolt to assure that the lower U-strap will not move in on the bolt. When attaching seismic bracing to clevis hangers, a Fig. 1 CBS (cross bolt spacer) must be installed. See TOLCO™ Seismic Restraint Approval Guidelines.

APPROVALS — Underwriters' Laboratories Listed in the USA (UL), Canada (cUL) 3/4" thru 8". FM Approved 3/4" - $1^{1}/_{2}$", 6" - 8".Conforms to Federal Specification WW-H-171E, Type 1, and Manufacturers Standardization Society SP-58, Type 1. Also available to accommodate rod schedule per National Fire Protection Association (NFPA) Pamphlet 13.

Maximum Temperature — 650°F

Finish — Plain

Note — Available in Electro-Galvanized and HDG finish or Stainless Steel.

Dimensions • Weights

Pipe Size	Rod Size A STD	Rod Size A NFPA	B	C	D	Max. Rec. Load Lbs.	Approx. Wt./100
1/2	3/8	3/8	$2^{1}/_{16}$	$1^{3}/_{16}$	1	610	36
3/4	3/8	3/8	$2^{7}/_{8}$	$1^{7}/_{8}$	1	610	38
1	3/8	3/8	$3^{1}/_{4}$	$2^{1}/_{16}$	1	610	42
$1^{1}/_{4}$	3/8	3/8	$3^{9}/_{16}$	$2^{1}/_{4}$	1	610	46
$1^{1}/_{2}$	3/8	3/8	$3^{7}/_{8}$	$2^{3}/_{8}$	1	610	49
2	3/8	3/8	$4^{7}/_{16}$	$2^{3}/_{4}$	1	610	55
$2^{1}/_{2}$	1/2	3/8	$5^{5}/_{16}$	$3^{1}/_{4}$	1	1130	124
3	1/2	3/8	$5^{15}/_{16}$	$3^{1}/_{2}$	$1^{1}/_{4}$	1130	140
$3^{1}/_{2}$	1/2	3/8	$6^{7}/_{16}$	$3^{3}/_{4}$	$1^{1}/_{4}$	1130	152
4	5/8	3/8	$7^{3}/_{8}$	$4^{1}/_{4}$	$1^{1}/_{2}$	1430	190
5	5/8	1/2	$8^{15}/_{16}$	$5^{1}/_{4}$	$1^{1}/_{2}$	1430	235
6	3/4	1/2	$9^{13}/_{16}$	$5^{1}/_{2}$	$1^{1}/_{2}$	1940	317
8	3/4	1/2	$12^{9}/_{16}$	$7^{1}/_{8}$	2	2000	428
10	7/8	5/8	$16^{1}/_{4}$	$9^{5}/_{8}$	$3^{1}/_{4}$	3600	918
12	7/8	5/8	$19^{1}/_{4}$	$11^{5}/_{8}$	$3^{1}/_{2}$	3800	1143
14	1	—	$20^{13}/_{16}$	$12^{5}/_{16}$	$3^{13}/_{16}$	4200	1543
16	1	—	$21^{15}/_{16}$	$12^{7}/_{16}$	$3^{5}/_{8}$	4600	1925
18	1	—	$24^{7}/_{16}$	$13^{15}/_{16}$	$3^{7}/_{8}$	4800	2243
20	$1^{1}/_{4}$	—	$26^{5}/_{16}$	$14^{7}/_{16}$	4	4800	4161
*24	$1^{1}/_{4}$	—	$31^{3}/_{8}$	$17^{1}/_{2}$	$4^{1}/_{4}$	4800	4835
*30	$1^{1}/_{4}$	—	$38^{7}/_{8}$	$21^{7}/_{8}$	5	6000	6940
*36	$1^{1}/_{2}$	—	48	$27^{3}/_{4}$	$5^{3}/_{4}$	9500	18103

*Furnished with pipe spacer to support maximum load rating

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Fig. 200 - “Trimline” Adjustable Band Hanger

Size Range — 1/2" thru 8" pipe

Material — Carbon Steel, Mil. Galvanized to G90 specifications

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

Features —

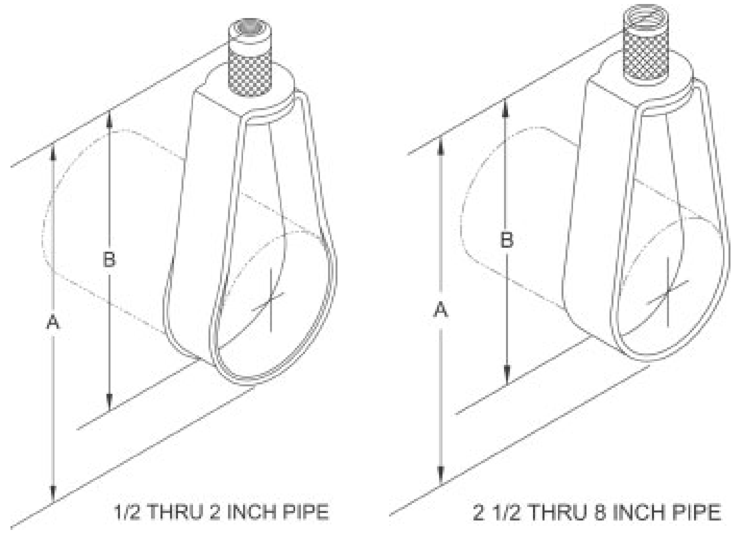
- (1/2" thru 2") Flared edges ease installation for all pipe types and protect CPVC plastic pipe from abrasion. Captured design keeps adjusting nut from separating with hanger. Hanger is easily installed around pipe.
- ($2\frac{1}{2}$" thru 8" Spring tension on nut holds it securely in hanger before installation. Adjusting nut is easily removed.

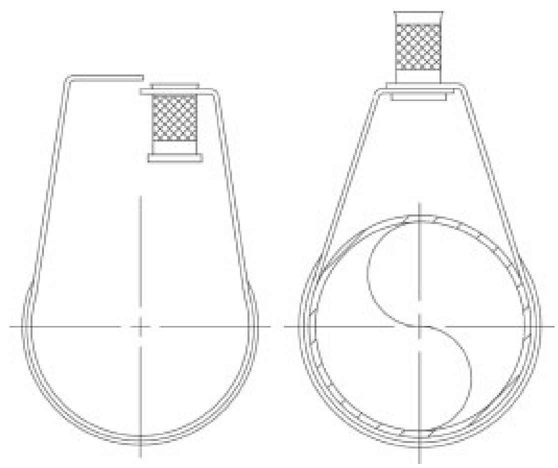
Approvals — Underwriters’ Laboratories listed (1/2" thru 8") in the USA **(UL)** and Canada **(cUL)** for steel and CPVC plastic pipe and Factory Mutual Engineering Approved (3/4" thru 8"). Conforms to Federal Specifications WW-H-171E, Type 10 and Manufacturers Standardization Society SP-69, Type 10.

Maximum Temperature — 650°F

Finish — Mil. Galvanized. For Stainless Steel materi-als, order TOLCO™ Fig. 200WON.

Order By — Figure number and pipe size





Dimensions • Weights

Pipe Size	Rod Size Inch	Rod Size Metric	A	B	Max. Rec. Load Lbs.	Approx. Length
1/2	3/8	8mm or 10mm	$3\frac{1}{8}$	$2\frac{5}{8}$	400	11
3/4	3/8	8mm or 10mm	$3\frac{1}{8}$	$2\frac{1}{2}$	400	11
1	3/8	8mm or 10mm	$3\frac{3}{8}$	$2\frac{5}{8}$	400	12
$1\frac{1}{4}$	3/8	8mm or 10mm	$3\frac{3}{4}$	$2\frac{7}{8}$	400	13
$1\frac{1}{2}$	3/8	8mm or 10mm	$3\frac{7}{8}$	$2\frac{7}{8}$	400	14
2	3/8	8mm or 10mm	$4\frac{1}{2}$	3	400	15
$2\frac{1}{2}$	3/8	10mm	$5\frac{5}{8}$	$4\frac{1}{8}$	600	27
3	3/8	10mm	$5\frac{7}{8}$	4	600	29
$3\frac{1}{2}$	3/8	10mm	$7\frac{3}{8}$	$5\frac{1}{4}$	600	34
4	3/8	10mm	$7\frac{3}{8}$	5	1000	35
5	1/2	12mm	$9\frac{1}{8}$	$6\frac{1}{4}$	1250	66
6	1/2	12mm	$10\frac{1}{8}$	$6\frac{3}{4}$	1250	73
8	1/2	12mm	$13\frac{1}{8}$	$8\frac{3}{4}$	1250	136

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Fig. 980 - Universal Swivel Sway Brace Attachment - $\frac{3}{8}$”-16 to $\frac{3}{4}$”-10 rods
Fig. 980H - Universal Swivel Sway Brace Attachment - $\frac{7}{8}$”-9 to $1\frac{1}{4}$”-7 rods

Component of State of California OSHPD Approved Seismic Restraints System

Size Range: One size fits bracing pipe 1" (25mm) thru 2" (50mm), Cooper B-Line 12 gauge (2.6mm) channel, and all structural steel up to $\frac{1}{4}$" (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 (2010) 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, 4L, 4A or 4B to form a complete bracing assembly. NFPA 13 and/or OSHPD guidelines should be followed.

To Install: Place the Fig. 980 onto the "bracing pipe". Tighten the set screw 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)**. Approved by Factory Mutual Engineering **(FM)**. Included in our Seismic Restraints Catalog 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 the TOLCO Seismic Restraint Systems Guidelines.

Note: Fig. 980 Swivel Attachment and Fig. 1001, Fig. 1000, Fig. 2002, Fig. 4A, Fig. 4B or Fig. 4L pipe clamps 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 B-Line for alternative finishes.

Order By: Figure number and finish.

US Patent Numbers
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

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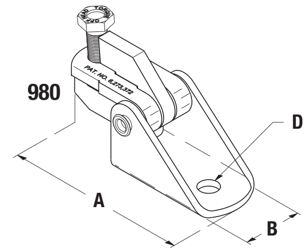
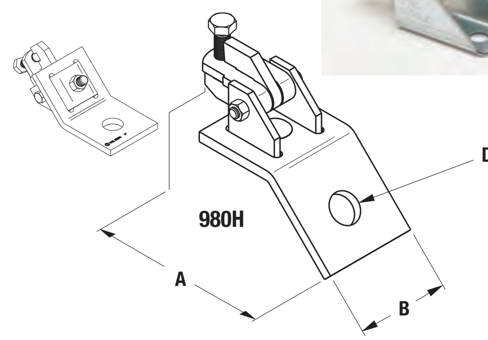
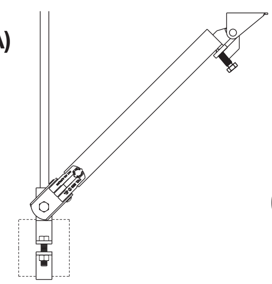
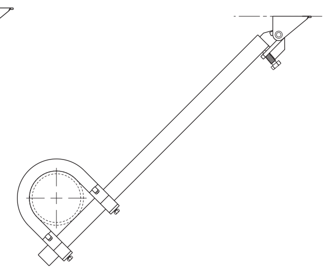


Set Screw Included

Mounting Hardware Is Not Included







Seismic Bracing

Part Number	A in.	A (mm)	B in.	B (mm)	D* in.	D* (mm)	Max. Design Load (cULus) lbs./(kN)	Max. Design Load** (FM) 30°-44° lbs./(kN)	45°-59° lbs./(kN)	60°-74° lbs./(kN)	75°-90° lbs./(kN)	Approx. Wt./100 lbs.	(kg)
980-$\frac{3}{8}$	$5\frac{1}{4}$”	(133.3)	$1\frac{7}{8}$”	(47.6)	$\frac{13}{32}$”	(10.3)	2015 (8.96)	1320 (5.87)	1970 (8.76)	2310 (10.27)	2550 (11.34)	149	(67.6)
980-$\frac{1}{2}$	$5\frac{1}{4}$”	(133.3)	$1\frac{7}{8}$”	(47.6)	$\frac{17}{32}$”	(13.5)						148	(67.1)
980-$\frac{5}{8}$	$5\frac{1}{4}$”	(133.3)	$1\frac{7}{8}$”	(47.6)	$\frac{11}{16}$”	(17.5)						147	(66.7)
980-$\frac{3}{4}$	$5\frac{1}{4}$”	(133.3)	$1\frac{7}{8}$”	(47.6)	$\frac{13}{16}$”	(20.5)						146	(66.2)
980H-$\frac{7}{8}$	$6\frac{3}{4}$”	(171.4)	$3\frac{1}{2}$”	(88.9)	$\frac{15}{16}$”	(23.8)						402	(182.3)
980H-1	$6\frac{3}{4}$”	(171.4)	$3\frac{1}{2}$”	(88.9)	$1\frac{1}{16}$”	(27.0)						400	(181.4)
980H-$1\frac{1}{8}$	$6\frac{3}{4}$”	(171.4)	$3\frac{1}{2}$”	(88.9)	$1\frac{3}{16}$”	(30.2)						397	(180.1)
980H-$1\frac{1}{4}$	$6\frac{3}{4}$”	(171.4)	$3\frac{1}{2}$”	(88.9)	$1\frac{5}{16}$”	(33.3)						390	(176.9)

* Mounting attachment hole size.
** Installed with 1” or $1\frac{1}{4}$” Schedule 40 brace pipe.

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

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

Strut systems

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

B-Line by EATON

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Powering business worldwide

As a global diversified power management company, we help customers worldwide manage the power needed for buildings, aircraft, trucks, cars, machinery and businesses.

Eaton's innovative technologies help customers manage electrical, hydraulic and mechanical power more reliably, efficiently, safely and sustainably.

EATON
Powering Business Worldwide

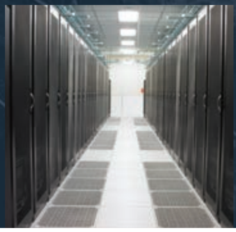


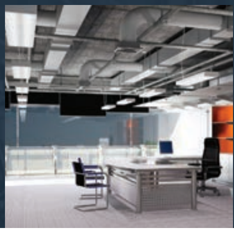
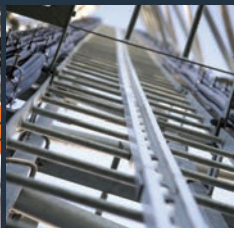

We deliver:

- **Electrical solutions** that use less energy, improve power reliability and make the places we live and work safer and more comfortable
- **Hydraulic and electrical solutions** that enable machines to deliver more productivity without wasting power
- **Aerospace solutions** that make aircraft lighter, safer and less costly to operate, and help airports operate more efficiently
- **Vehicle drivetrain and powertrain solutions** that deliver more power to cars, trucks and buses, while reducing fuel consumption and emissions

We provide integrated solutions that help make energy, in all its forms, more practical and accessible.

With 2012 sales of $16.3 billion, Eaton has approximately 103,000 employees around the world and sells products in more than 175 countries.

Eaton's electrical business

Eaton is a global leader with expertise in:

- Power distribution and circuit protection
- Backup power protection
- Solutions for harsh and hazardous environments
- Lighting and security
- Structural solutions and wiring devices
- Control and automation
- Engineering services

Eaton is positioned through its global solutions to answer today's most critical electrical power management challenges. With 100 years of electrical experience behind us, we're energized by the challenge of powering up a world that demands twice as much energy as today. We're anticipating needs, engineering products, and creating solutions to energize our markets today and in the future.

We are dedicated to ensuring that reliable, efficient and safe power is available when it's needed most.

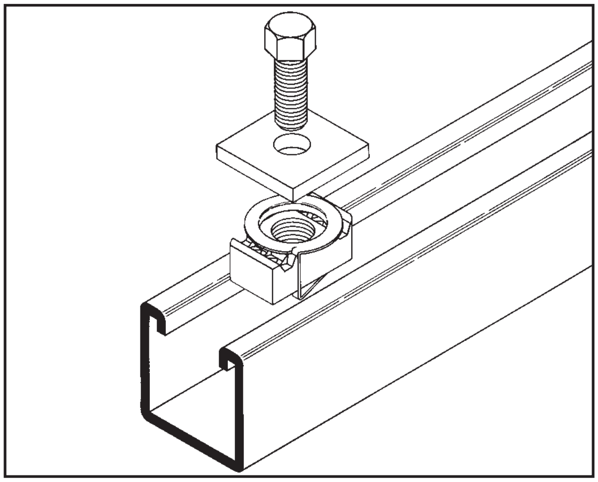
Eaton.com

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Introduction

Our strut support system is designed with many time-saving features. They are fully adjustable and reusable, with a complete line of channels, fittings and accessories for multi-purpose applications.

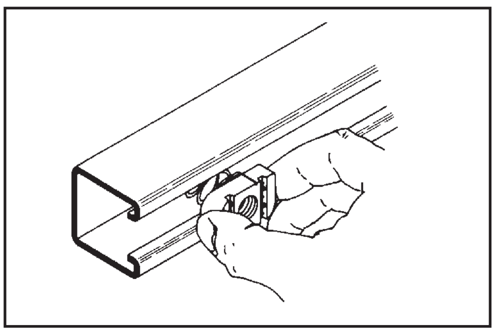
ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED



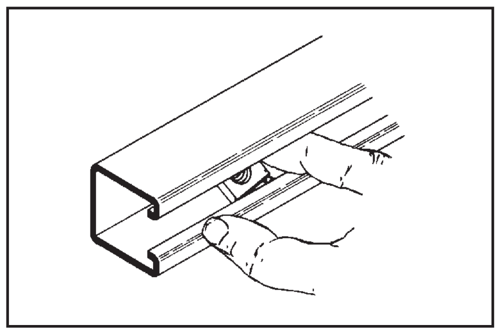
- **No Welding**
- **No Drilling**
- **Use Your Imagination**

The strut system installs quickly, with no need for special tools. All you need is a wrench and hacksaw.

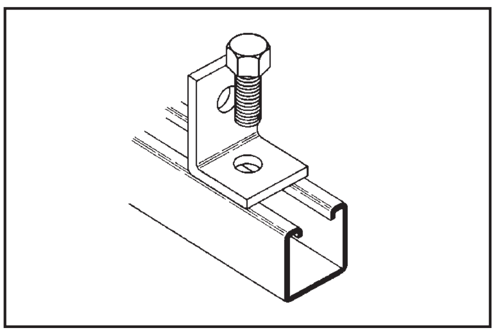
Channels and parts can be taken apart for reuse as quickly as they were assembled, yet help provide the strength of welded construction. This eliminates welding and drilling which can have substantial savings in time and labor.



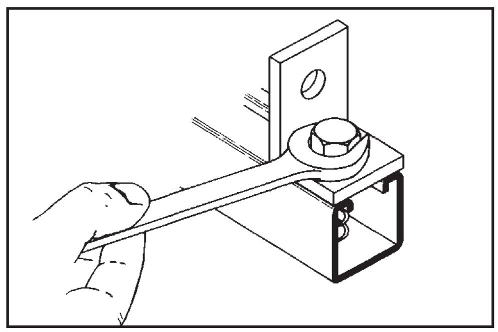
1. Channel nut may be inserted anywhere along continuous slot. Designed for easy insertion and self-alignment.



2. A 90° turn aligns channel nut grooves with inturned lips of the channel.



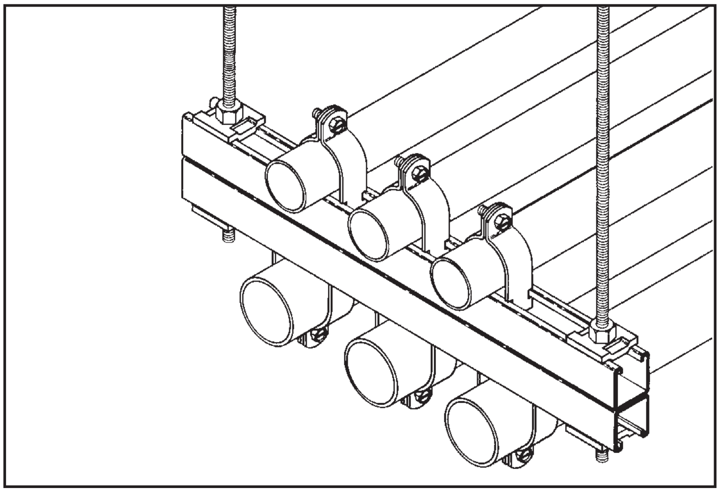
3. Position fitting over channel nut and insert bolt to start any connection.



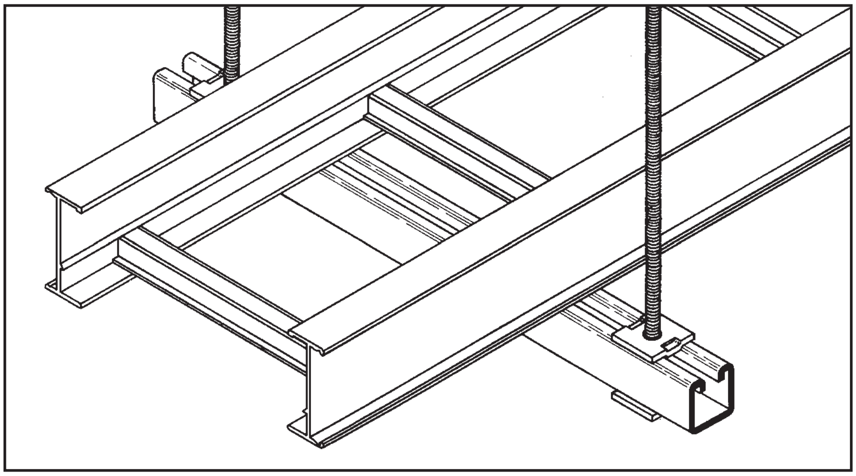
4. With the twist of a wrench, channel nut locks its teeth firmly against inturned lips.

Our strut system provides an economical solution for electrical, mechanical and industrial supports with an unlimited variety of applications in the construction industry.

Electrical Applications
- Lighting Fixture Supports
- Raceway Systems
- Trapeze Hangers
- Pipe & Conduit Supports
- Cable Tray Supports
- Beam Adjustments

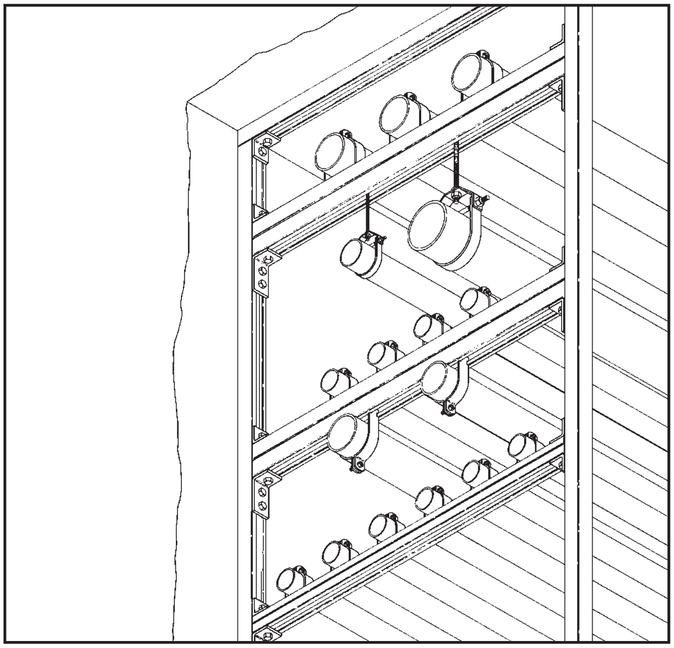


ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED



Mechanical Applications
- Piping Racks
- Tunnel Pipe Stanchions
- Concrete Inserts
- Beam Attachments
- Pipe Risers

Industrial Applications
- Racks and Shelving
- Partitions
- Production Line Supports
- Trolley Systems
- Wall Framing



MATERIALS

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Carbon Steel

Channels made from high-quality carbon steel are continuously roll formed to precise dimensions. By cold working the steel mechanical properties are increased, allowing lightweight structures to carry the required load. Corrosion resistance of carbon steel varies widely with coating and alloy. See “Finishes” for more detailed information.

Stainless Steel

Stainless steel channel is available in AISI Type 304 or 316 material. Both are non-magnetic and belong to the austenitic stainless steels group, based on alloy content and crystallographic structure. Like carbon steel, stainless steel exhibits increased strength when cold worked by roll-forming.

Several conditions make the use of stainless steel ideal. These include reducing long term maintenance costs, high ambient temperatures, appearance, and stable structural properties such as yield strength, and high creep strength.

Type 304 resists most organic chemicals, dyestuffs and a wide variety of inorganic chemicals at elevated or cryogenic temperatures. Type 316 contains slightly more nickel and adds molybdenum to give it better corrosion resistance in chloride and sulfuric acid environments. For more information concerning the differences between types 304 and 316, visit www.cooperbline.com/contactus.

Aluminum

Standard aluminum channel is extruded from aluminum alloy 6063-T6. Strut fittings are made from aluminum alloy 5052-H32.

The high strength to weight ratio of channel made of aluminum helps greatly reduce the overall cost of installation through ease of handling and field cutting.

Aluminum owes its excellent corrosion resistance to its ability to form an aluminum oxide film that immediately reforms when scratched or cut. In most outdoor applications, aluminum has excellent resistance to “weathering”. The resistance to chemicals, indoor or outdoor, can best be determined by tests conducted by the user with exposure to the specific conditions for which it is intended. The corrosion resistance of aluminum to some commonly known chemicals is shown in the Corrosion Chart. For further information, contact us or the Aluminum Association.

Fiberglass

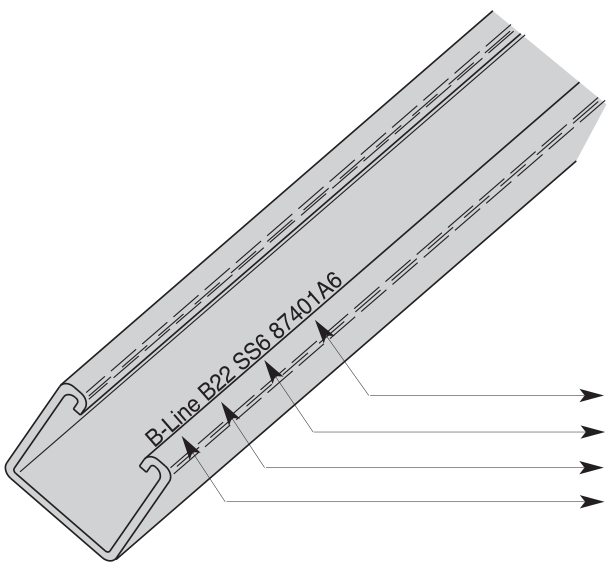
We offer two fire retardant (FR) resins for strut systems, polyester and vinyl ester. Both resins are ideal for corrosive environments or nonconductive applications with moderate strength requirements. Some common types of environments where Vinyl Ester Resins are recommended, that Poly Esters are not, are paper mills, most any metal plating operation and any condition with concentrated levels of Chlorine, [Cl^-]. Please consult our fiberglass corrosion resistance charts on pg. 183 for specific chemical recommendation data.

Unlike other base materials depicted in this catalog, fiberglass exhibits unique physical property changes when operating in elevated temperature conditions that are a fraction of increase compared to steel or aluminum. Thus, it is advised against using fiberglass in temperatures greater than 200° F.

Please refer to the "Corrosion Resistance Guide" below for specific applications.

The fiberglass strut systems are manufactured from glass fiber-reinforced plastic shapes that meet ASTM E-84, Class 1 Flame Rating and self-extinguishing requirements of ASTM D-635. A surface veil is applied during pultrusion to insure a resin-rich surface and ultraviolet resistance.

While polyester is sufficient for most uses, vinyl ester is suitable for a broader range of environments.



B-Line Steel Strut is stamped with:

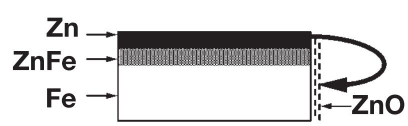
- Traceable to the steel’s origin
- Material/Finish
- B-Line part number designation
- Company Name

FINISHES

Zinc Coatings

Zinc protects steel in two ways. First it protects the steel as a coating and second as a sacrificial anode to repair bare areas such as cut edges, scratches, and gouges. The corrosion protection of zinc is directly related to its thickness and the environment. This means a .2 mil coating will last twice as long as a .1 mil coating in the same environment.

Galvanizing also protects cut and drilled edges.



Electrogalvanized Zinc

Electrogalvanized Zinc (also known as zinc plated or electroplated) is the process by which a coating of zinc is deposited on the steel by electrolysis from a bath of zinc salts.

A rating of SC3, our standard, provides a minimum zinc coating thickness of .5 mils (excluding hardware, which is SC1 = .2 mils).

When exposed to air and moisture, zinc forms a tough, adherent, protective film consisting of a mixture of zinc oxides, hydroxides, and carbonates. This film is in itself a barrier coating which slows subsequent corrosive attack on the zinc. This coating is usually recommended for indoor use in relatively dry areas, as it provides ninety-six hours protection in salt spray testing per ASTM B117.

Chromium/ Zinc

Chromium/ Zinc is a corrosion resistant composition, which was developed to protect fasteners and small bulk items for automotive use. The coating applications have since been extended to larger parts and other markets.

Chromium/Zinc composition is an aqueous coating dispersion containing chromium, proprietary organics, and zinc flake.

This finish provides 500 hours protection in salt spray testing per ASTM B117.

Pre-Galvanized Zinc

(Mill galvanized, hot dip mill galvanized or continuous hot dip galvanized) Pre-galvanized steel is produced by coating coils of sheet steel with zinc by continuously rolling the material through molten zinc at the mills. This is also known as mill galvanized or hot dip mill galvanized. These coils are then slit to size and fabricated by roll forming, shearing, punching, or forming to produce our pre-galvanized strut products.

The G90 specification calls for a coating of .90 ounces of zinc per square foot of steel. This results in a coating of .45 ounces per square foot on each side of the sheet. This is important when comparing this finish to hot dip galvanized after fabrication.

During fabrication, cut edges and welded areas are not normally zinc coated; however, the zinc near the uncoated metal becomes a sacrificial anode to protect the bare areas after a short period of time.

Hot Dip Galvanized After Fabrication (Hot dip galvanized or batch hot dip galvanized)

Hot dip galvanized strut products are fabricated from steel and then completely immersed in a bath of molten zinc. A metallic bond occurs resulting in a zinc coating that completely coats all sufaces, including edges and welds.

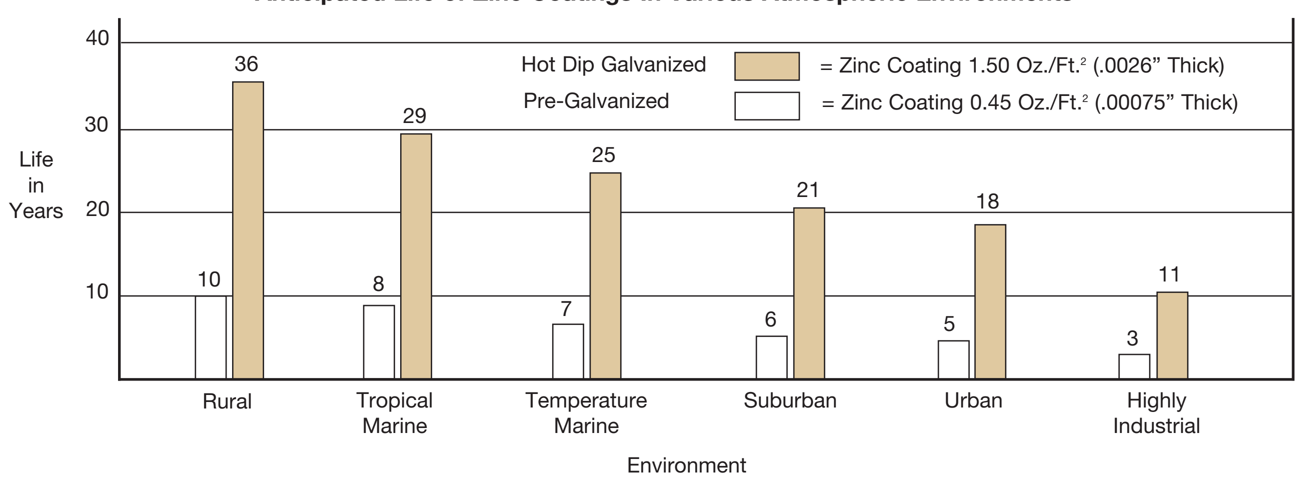
Another advantage of this method is coating thickness. Strut products that are hot dip galvanized after fabrication have a minimum thickness of 1.50 ounces per square foot on each side, or a total 3.0 ounces per square foot of steel, according to ASTM A123.

The zinc thickness is controlled by the amount of time each part is immersed in the molten zinc bath as well as the speed at which it is removed. The term "double dipping" refers to parts too large to fit into the galvanizing kettle and, therefore, must be dipped one end at a time. It does not refer to extra coating thickness.

The layer of zinc which bonds to steel provides a dual protection against corrosion. It protects first as an overall barrier coating. If this coating happens to be scratched or gouged, zinc's secondary defense is called upon to protect the steel by galvanic action.

Hot-Dip Galvanized After Fabrication is recommended for prolonged outdoor exposure and will usually protect steel for 20 years or more in most atmospheric environments and in many industrial environments. For best results, a zinc rich paint (available from B-Line) should be applied to field cuts. The zinc rich paint will provide immediate protection for these areas and eliminate the short time period for galvanic action to “heal” the damaged coating.

Anticipated Life of Zinc Coatings In Various Atmospheric Environments



ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

DURA-GREEN™ and DURA- COPPER™ Epoxy Coatings

DURA-GREEN and DURA-COPPER epoxy coatings are water borne epoxy coatings applied to B-Line products by a precisely controlled cathodic electro-deposition process. This process is accomplished using a conveyor to transport channel and fittings through several cleaning, phosphatizing and application stages prior to being baked (See diagram below).

This custom-designed paint system is used for painting all channels, channel combinations, slotted angle, and fittings.

Samples are selected on a routine basis for Salt Spray (fog) testing to verify the quality of the finish. These tests are performed in accordance with ASTM B117 and evaluated and related according to ASTM D1654 (Tables 1 & 2).

The DURA-GREEN and DURA-COPPER Epoxy coatings have been tested and listed by Underwriters Laboratories in accordance with “Standard for Surface Metal Raceway and Fittings, UL5” and “Standard for Pipe Hanger Equipment for Fire Protection Service, UL203”.

Due to DURA-GREEN’s organically based composition, it seats itself into porous surfaces more completely and efficiently than zinc coatings. As these porous caverns are filled along the material profile, the outer finished surface demonstrates an increased smooth uniform plane which produces considerably less off-gasing when tested.

DURA-GREEN channel meets or exceeds 100 level clean room standards. This was confirmed by testing the channel in accordance with Boeing (PCL) Standards, which are more stringent and complete than ASTM E595-93. DURA-GREEN was found to be a superior finish, due in part to its proven application process.

PVC Coating

Another of the corrosion resistant coatings offered by B-Line is PVC (polyvinyl chloride), applied over steel or aluminum channel and fittings. The PVC coating process begins by cleaning the product thoroughly. A bonding coat is applied to the part and then preheated to a temperature above the melting point of the coating powder. The product is then passed through a fluidized bed of vinyl plastic powder where the powder particles melt, adhere and flow out to form a smooth continuous coating. The thickness is controlled by the base metal temperature and the immersion time in the bed. It is then post-heated to complete the fusion of the outer surfaces.

The standard coating thickness of B-Line’s PVC coated products is 15 mils (.380 mm), plus or minus 5 mils (.125 mm). Since the chemistry, not the thickness of vinyl plastic PVC determines longevity, a coating of 10 to 20 mils (.250 to .500 mm) is more than adequate. If the corrosive conditions are such that the plasticizers are leeched out, a thicker coating will do little to extend the life of a coated product.

For certain environments, a plastisol dipped PVC coating is available on request.

PVC coating depends totally on the concept of encapsulation attached to the base metal by a bonding agent. If any hole or discontinuity occurs, the corrosive action can undercut the base metal to a point where all that remains is the PVC.

In the event of field cuts or any other damage to the coating, a liquid PVC patch, available from B-Line, must be applied to maintain the integrity of the coating. After the installation is complete, a thorough inspection should be performed to assure the absence of voids, pinholes, or cuts.

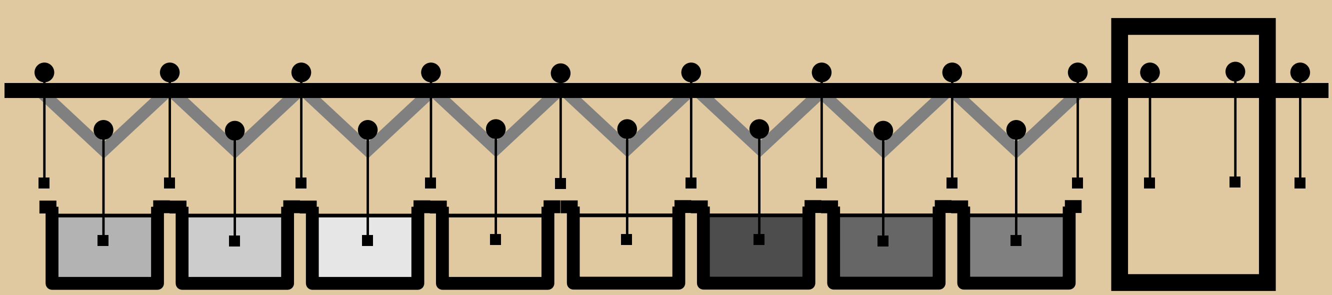
SALT SPRAY TEST RESULTS

Type of Finish	Unscribed 5% Failure (1)	Scribed 1/8” (3.2) Creepage from Scribe (1)
B-Line DURA-GREEN Epoxy	1000 Hours	312 Hours
Mill Galv. (Pre-Galv.) G90	192 Hours	288 Hours
Perma-Green	438 Hours	231 Hours
Zinc Chromate	36 Hours	96 Hours
Industry Green (Range)	10 to 36 Hours	4 to 30 Hours

(1) All salt spray (fog) tests conducted in accordance with ASTM B117 and evaluated and rated according to ASTM D1654 Tables 1 & 2. Tests are performed and certified by an independent testing laboratory.

DURA-GREEN™/DURA-COPPER™ EPOXY COATING PROCESS

TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TANK 6	TANK 7	TANK 8	BAKE OVEN
The channel and parts are thoroughly cleaned and phosphatized.	A rinse is applied to remove insoluble salts and unreacted phosphates.	A phosphatized sealer is applied to insure corrosion resistanceand paint adhesion.	The material moves through clear water rinse to remove excess phosphates.	A pre-deionized rinse prepares the metal for the cathodic electro-coating.	The electro-coating tank applies a uniform coat of epoxy paint to the entire surface.	The first post rinse removes any unelectrically attracted solids.	The final rinse insures a smooth, nonblemish surface.	The curing process takes 20 minutes at a baking temperature of 375° F (199° C).



WELDING

The welding procedures used in the fabrication of our steel products are in accordance with American Welding Society Standards. To achieve the highest quality in our manufacturing processes, our welders follow standards set by AWS Code.

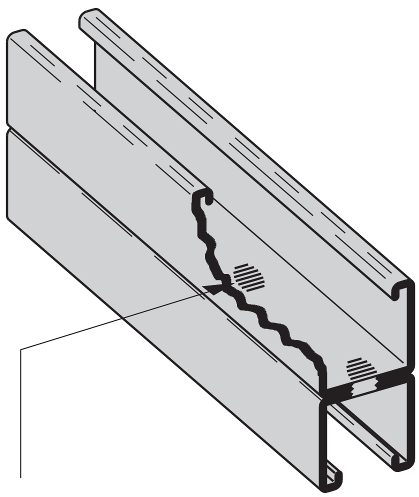
Spot Welding
Spot welded back-to-back channel is manufactured using a modern DC powered resistance welder controlled by a microprocessor. This produces a series of spot welds with speed and consistency. Consistency is one of the most important advantages in specifying back-to-back channel. Variables such as weld sequence, speed and duration are carefully controlled and monitored by a sophisticated electronic control system. A statistical quality control program, combining destructive and non-destructive testing, is used to ensure high quality welds.

MIG Welding
MIG welded, more properly called gas metal arc welded (GMAW) combination channels and fittings, are produced when physical dimensions or certain combinations require a weld process other than automatic spot welding. The same quality control requirements are imposed on MIG welded and spot-welded products.

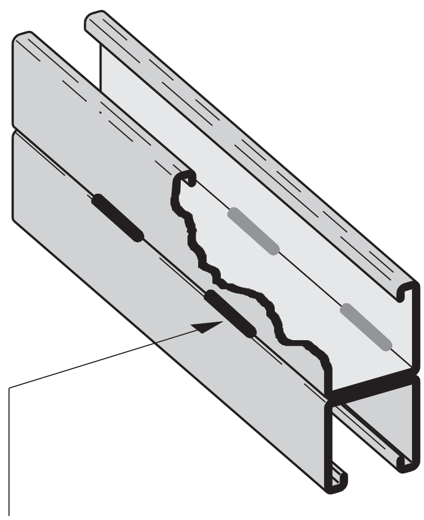
Quality Assurance
Our Quality Assurance Program has been developed and implemented for compliance with ISO9001:2008. We also complies with various industry standards and specifications. We have extensive experience in suppling metal framing components for the nuclear power generating industry, and upon request can provide products in compliance with 10CFR50 Appendix B, NQA-1 and 10CFR21. For more information on our quality capability please visit www.cooperbline.com/nuclear.

Technical Data

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED



Spot Weld



MIG Weld

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

CORROSION

All metal surfaces are affected by corrosion. Depending on the physical properties of the metal and the environment to which it is exposed, chemical or electromechanical corrosion may occur.

Atmospheric Corrosion

Atmospheric corrosion occurs when metal is exposed to airborne liquids, solids or gases. Some sources of atmospheric corrosion are moisture, salt, dirt and sulphuric acid. This form of corrosion is typically more severe outdoors, especially near marine environments.

Chemical Corrosion

Chemical corrosion takes place when metal comes in direct contact with a corrosive solution. Some factors which affect the severity of chemical corrosion include: chemical concentration level, duration of contact, frequency of washing, and operating temperature.

Storage Corrosion

Wet storage stain (white rust) is caused by the entrapment of moisture between surfaces of closely packed and poorly ventilated material for an extended period. Wet storage stain is usually superficial, having no affect on the properties of the metal.

Light staining normally disappears with weathering. Medium to heavy buildup should be removed in order to allow the formation of normal protective film. Proper handling and storage will help to assure stain-free material. If product arrives wet, it should be unpacked and dried before storage. Dry material should be stored in a well ventilated “low moisture” environment to avoid condensation formation. Outdoor storage is undesirable, and should be avoided whenever possible.

GALVANIC SERIES IN SEA WATER

Anodic End

More Anodic

- Magnesium
- Magnesium Alloys
- Zinc
- Beryllium
- Aluminum - Zinc Alloys (7000 series)
- Aluminum - Magnesium Alloys (5000 series)
- Aluminum (1000 series)
- Aluminum - Magnesium Alloys (3000 series)
- Aluminum - Magnesium - Silicon Alloys (6000 series)
- Cadmium
- Aluminum - Copper Alloys (2000 series)
- Cast Iron, Wrought Iron, Mild Steel
- Austenitic Nickel Cast Iron
- Type 410 Stainless Steel (active)
- Type 316 Stainless Steel (active)
- Type 304 Stainless Steel (active)
- Naval Brass, Yellow Brass, Red Brass
- Tin
- Copper
- Lead-Tin Solders
- Admiralty Brass, Aluminum Brass
- Manganese Bronze
- Silicon Bronze
- Tin Bronze
- Type 410 Stainless Steel (passive)
- Nickel - Silver
- Copper Nickel Alloys
- Lead
- Nickel - Aluminum Bronze
- Silver Solder
- Nickel 200
- Silver
- Type 316 Stainless Steel (passive)
- Type 304 Stainless Steel (passive)
- Incoloy 825
- Hastelloy B
- Titanium
- Hastelloy C
- Platinum
- Graphite

Cathodic End

Metals in descending order of activity in the presence of an electrolyte.

Galvanic Corrosion

Galvanic corrosion occurs when two or more dissimilar metals are in contact in the presence of an electrolyte (ie. moisture). An electrolytic cell is created and the metals form an anode or a cathode depending on their relative position on the Galvanic Series Table. The anodic material will be the one to corrode. Anodic or cathodic characteristics of two dissimilar metals will depend on the type of each material. For example: If zinc and steel are in contact, the zinc acts as the anode and will corrode; the steel acts as the cathode, and will be protected. If steel and copper are in contact, the steel is now the anode and will corrode.
The rate at which galvanic corrosion occurs depends on several factors:

1. The relative position on the Galvanic Series Table - the further apart materials are in the Galvanic Series Table, the greater the potential for corrosion of the anodic material.

2. The amount and concentration of electrolyte present - an indoor, dry environment will have little or no galvanic corrosion compared to a wet atmosphere.

3. The relative size of the materials - a small amount of anodic material in contact with a large cathodic material will result in greater corrosion. Likewise, a large anode in contact with a small cathode will decrease the rate of attack.

Chemical	Aluminum	Dura-Green	PVC	Type 304 Stainless	Type 316 Stainless	Zinc Coated Steel
Acetic Acid 10%	R	NR	R	R	R	NR
Acetic Acid 2%	R	F	R	R	R	NR
Acetone	R	R	NR	R	R	R
Ammonium Hydroxide-Conc.	R	R	R	R	R	–
Ammonium Hydroxide 10%	F	R	R	R	R	–
Ammonium Hydroxide 2%	R	R	R	R	R	–
Benzene	R	R	NR	R	R	–
Bromine Water	NR	R	R	NR	NR	–
Butanol (Butyl Alcohol)	R	R	R	R	R	R
Carbon Disulfide	R	R	NR	R	R	–
Carbon Tetrachloride	F	R	F	R	R	–
Chlorine Water	R	R	R	NR	F	R
Cutting Oil	–	R	–	–	–	–
Diethanolamine	R	R	NR	–	–	NR
Ethanol	R	R	R	R	R	R
Ethyl Acetate	R	R	NR	–	–	R
Ethylene Dichloride	F	R	NR	–	–	R
Formaldehyde 20%	R	R	R	R	R	R
Gasoline	R	R	R	R	R	R
Glycerine	R	R	R	R	R	R
Household Detergent 10%	F	R	R	R	R	–
Hydrochloric Acid 40%	NR	NR	R	NR	NR	NR
Hydrochloric Acid 10%	NR	F	–	NR	NR	NR
Hydrochloric Acid 2%	NR	F	–	NR	NR	NR
Hydrogen Peroxide 30%	R	NR	R	R	R	–
Hydrogen Peroxide 3%	R	R	–	R	R	–
Hydrogen Sulfide (Gas)	R	R	R	F	R	–
JP-4 Jet Fuel	R	R	R	R	R	–
Lactic Acid 85%	F	R	R	NR	–	–
Latex	R	R	–	R	R	NR
Linseed Oil Fatty Acid	R	F	R	R	R	–
Methanol	R	R	R	R	R	R
Methyl Ethyl Ketone	R	R	NR	–	–	R
Methyl Isobutyl Ketone	R	R	NR	–	–	R
Mineral Spirits	R	R	–	–	–	–
Motor Oil-10W	R	R	R	R	R	R
Naphtha, VM&P	R	R	R	R	R	R
Nitric Acid 2%	F	NR	R	R	R	–
Perchloroethylene	R	R	–	–	–	NR
Petroleum Ether	–	R	–	R	R	R
Phenol 10%	R	R	NR	R	R	R
Phosphoric Acid 2%	F	NR	R	R	R	NR
Potassium Hydroxide 50%	NR	R	R	R	R	–
Potassium Hydroxide 10%	NR	R	R	R	R	–
Potassium Hydroxide 2%	NR	R	R	R	R	–
Sodium Chloride 25%	F	R	R	R	R	F
Sodium Hydroxide 50%	NR	R	R	R	R	NR
Sodium Hydroxide 10%	NR	R	R	R	R	F
Sodium Hydroxide 2%	NR	R	R	–	–	–
Sodium Hypochlorite-C1. 10%	F	R	R	–	–	–
Sodium Hypochlorite-C1. 6%	F	R	R	NR	R	–
Sulfuric Acid 2%	F	NR	R	NR	R	NR
Tall Oil Fatty Acid (Syfate 94)	R	R	R	–	–	–
Tannic Acid 50%	F	R	R	R	R	–
Water-Deionized	R	R	R	R	R	F
Water-Sea	F	F	R	R	R	F
Water-Tap	R	R	R	F	F	R
Xyol	R	R	NR	–	–	–

Fiberglass corrosion chart on page 183.

The corrosion data given in this table is for general comparison only.
The presence of contaminates and the effect of temperature in chemical environments can greatly affect the corrosion of any material. B-Line strongly suggests that field service tests or simulated laboratory tests using actual environmental conditions be conducted in order to determine the proper materials and finishes to be selected.

R=Recommended
F=May be used under some conditions
NR=Not Recommended
–Information not available

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

DESIGN OF STRUT SYSTEMS

Beams

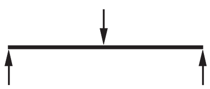
Beams are usually defined as horizontal members which are subjected to vertical loads such as shelves, platforms or supports for pipes, conduits or cable trays. The following is a brief overview of common beam configurations:

Simple Beam

An example of a simple beam is a length of channel placed across two cylinders. When a load is applied, the channel will support the load because of its stiffness. The cylinders serve to support the channel, but do not interfere with its natural tendency to flex or bend. Simple beam analysis is used almost universally for beam comparisons, even though it is seldom practical in field installations.

A cable tray or conduit trapeze hanger closely resembles a simple beam.

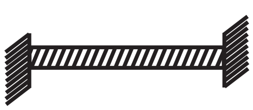
Point Load



Fixed Beam

This type of fixed support restricts the movement of the ends of the channel when a load is applied. Because of this, the stiffness of the channel at the ends and center is employed to resist the load. The result is a load capability which is greater than that of an identical simple beam.

The fixed beam can be approximated by bolting or welding a length of channel to rigid supports.



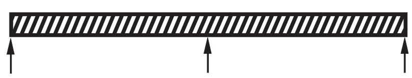
Cantilever Beam

Cantilever beams are often viewed as variations of a fixed beam, but they have special characteristics of their own. One end of the channel is firmly attached to a rigid support while the other end remains completely free.

A shelf bracket is an example of a cantilever beam.

Continuous Beam

This beam configuration is commonly used in lighting installations. The continuous beam possesses traits of both the simple and fixed beams. When equal loads are applied to all spans simultaneously, the counter-balancing effect of the loads on both sides of a support restricts the movement of the channel at the support, similar to that of the fixed beam. The end spans behave substantially like simple beams.



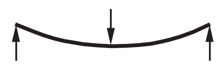
Continuous beam installations can typically support 20% more load than a simple beam of the same span with approximately half the deflection.

Therefore, simple beam data should be used for a general comparison only. An example of this configuration is found in a long run of channel when installed across several supports to form a number of spans.

Deflection

Deflection, commonly referred to as “sag”, is inherent in applying a load to a beam and cannot be avoided. Any and all beams will deflect when loaded. The amount of deflection will vary depending upon the material and the stiffness or moment of inertia. The deflection equations in this section show that increasing the stiffness can be increased by a variety of methods. Increasing the depth of the channel is the most direct method.

Point Load



The material used affects deflection in a manner which is significantly different from the way in which it affects load capacity. The deflection under load is inversely proportional to a material property known as the “modulus of elasticity” designated by “E”.

The modulus of elasticity is dependent upon the basic composition of the material and is not necessarily related to the material’s strength.

Safety Factor
The design loads given for strut beam loads are based on a simple beam condition using allowable stress of 25,000 psi. This allowable stress results in a safety factor of 1.68. This is based upon a virgin steel minimum yield strength of 33,000 psi cold worked during rolling to an average yield stress of 42,000 psi.

Aluminum typically has an elastic modulus which is 1/3 that of steel even though they may have identical strength. As a result, the deflection of aluminum channel will be three times that of steel channel under equal loading. In areas where structures will be subject to general viewing, deflection can produce a displeasing effect. To the untrained eye, a sagging channel may appear to be a result of poor design or excessive loading. This is not usually the case. Many properly designed channel installations will show a noticeable deflection at their designed loads. In areas where cosmetics are not important, deflection should not be a factor. Designing an entire installation based on minimal deflection could result in an over designed structure. This translates into increased material and installation cost. Where cosmetics are important, it may be necessary to limit the deflection to an aesthetically pleasing amount. This "acceptable deflection" amount is typically given as a fraction of the span. **1/240 span** deflection is typically the limit where the amount of deflection appears negligible. For example, a beam span of 240" would be allowed 1" (240/240) of deflection at the mid point. A 120" span would only be allowed 1/2" (120/240) of deflection. The maximum load for the channel must be limited in order to remain under these deflection requirements. The allowable load resulting in 1/240 span deflection is posted in the beam load chart for each channel size.

For even more stringent deflection requirements, an allowable load is listed in the beam load charts which results in **1/360** span deflection. This amount of deflection is sometimes used for beams in finished ceilings that are to be plastered.

Twisting & Lateral Bracing
Loading of strut on long spans can cause torsional stress, resulting in the tendency of the strut to twist or bend laterally. This phenomenon reduces the allowable beam loads as shown in the beam loading charts. It is recommended that long spans be supported in a manner to prevent twisting (fixed ends), and that the channel have adequate lateral bracing. Many typical strut applications provide this support and bracing inherently. Piping, tubing, cable trays, or conduits mounted to the strut with straps and clamps prevent twisting or lateral movement. If no such lateral support exists, contact the factory for loading recommendations.

Columns
Columns are vertical members which carry loads in compression. One common example of a channel column is the vertical members of a storage rack.

In theory, a column will carry a load equal to its cross sectional area multiplied by the ultimate compressive stress of the material of which the column is made. In reality, there are many factors affecting the load capacity of a column, such as the tendency to buckle or twist laterally (torsional-flexural buckling), the type of connection at the top or bottom, the eccentricity of the load application, and material imperfections. Several of these failure modes have been considered in the allowable column load tables shown in the "Channel" section of this catalog.

B-Line strongly recommends that the engineer perform a detailed study of the many variable conditions before the selection process begins.

Design Factors to be Considered
The loading capacity of channel depends primarily on the material, its cross-sectional design, and the beam or column loading configuration. It should be noted that if two lengths of channel have identical designs and configurations, the one made of the stronger base material will support a larger load. Therefore, any comparison of channel should begin by determining whether the materials are approximately equal in strength.

The column loading chart for each channel lists the allowable load for each channel in compression. This load varies depending on the support condition or "K-factor".

Several "K-factors" are listed, which correspond to the following support conditions:

K = .8 pinned top - fixed bottom
K = .65 fixed top - fixed bottom
K = 1.0 pinned top - pinned bottom
K = 1.2 free top - fixed bottom

There are a number of physical properties which are important to the complete design of a channel member; the "section modulus" designated as "Sx" or "Sy", "moment of inertia" designated by "Ix" or "Iy", and the "radius of gyration" which is given as "rx" or "ry".

Every structural material has its own maximum or ultimate stress, which is usually expressed in "pounds per square inch" (pascals). Any load which causes a member to fail is referred to as its "ultimate" load. In order to prevent channel from being accidentally loaded up to or beyond its ultimate load, a safety factor is included into the design. The ultimate load is divided by the safety factor to obtain the "recommended" or "allowable" working load.

When evaluating channel under various beam conditions, it is often more convenient to compare in terms of the ultimate or recommended "bending moment". Simple equations show the stress is directly proportional to the bending moment.

Therefore, comparing bending moments can save time in repeated calculations. The chart containing Formulas on Common Beam Loadings (following page) shows how to calculate the bending moment for various configurations and load conditions. It should be noted that the bending moment is usually not constant, but varies along the length of the span. However, the channel must be designed for a single point, which is the point of maximum bending moment.

For information regarding dynamic or seismic design, contact us at: www.cooperbline.com/contactus.

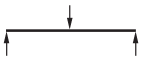
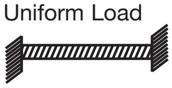
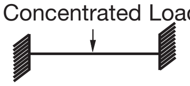
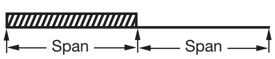
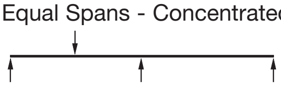
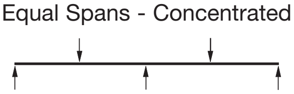
GENERAL INFORMATION

Torque
The torque values given throughout the catalog are to be used as a guide only. The relationship between the applied torque or torque wrench reading and the actual tension created in the bolt may be substantially different. For example, a dry non-lubricated bolt with a heavy plating may rate 50% as efficient as a bolt which is lubricated with a mixture of heavy oil and graphite. Other important factors affecting torque-tension relationships include friction under the bolt head or nut, hole tolerances, and torque wrench tolerances. Accuracy of many commercial torque wrenches may vary as much as plus or minus 25%.

Charts and Tables
Charts and tables in this section are compiled from information published by nationally recognized organizations and are intended for use as a guide only. We recommend that users of this information determine the validity of such information as applied to their own application.

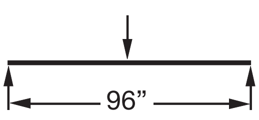
Technical Data

The data shown in the beam load charts for appropriate channels on page(s) 16 thru 37 is for simply supported, single span beams with a uniformly distributed load. For other loading and/or support conditions, use the appropriate factor from the chart below.

LOAD AND SUPPORT CONDITION	Load Factor	Deflection Factor
Simple Beam - Uniform Load 	1.00	1.00
Simple Beam - Concentrated Load at Center 	.50	.80
Simple Beam - Two Equal Concentrated Loads at 1/4 Points 	1.00	1.10
Beam Fixed at Both Ends - Uniform Load 	1.50	.30
Beam Fixed at Both Ends - Concentrated Load at Center 	1.00	.40
Cantilever Beam - Uniform Load 	.25	2.40
Cantilever Beam - Concentrated Load at End 	.12	3.20
Continuous Beam - Two Equal Spans - Uniform Load on One Span 	1.30	.92
Continuous Beam - Two Equal Spans - Concentrated Load on Both Spans 	1.00	.42
Continuous Beam - Two Equal Spans - Concentrated Load at Center of One Span 	.62	.71
Continuous Beam - Two Equal Spans - Concentrated Load at Center of Both Spans 	.67	.48

EXAMPLES:

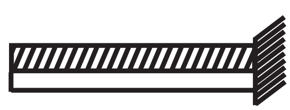
PROBLEM:
Calculate the maximum allowable load and corresponding deflection of a simply supported B22 beam with a concentrated load at midspan as shown.



SOLUTION:
From beam load chart for B22 (page 22), maximum allowable Load is A and the corresponding deflection is B.
Multiplying by the appropriate factors shown in the chart above.

LOAD = A x load factor = _______
DEFLECTION = B x deflection factor =

PROBLEM:
Calculate the maximum allowable load and corresponding deflection of a cantilever B52 beam with a uniformly distributed load.



SOLUTION:
From beam load chart for B52 (page 33), maximum allowable load is A and the corresponding deflection is B.
Multiplying by the appropriate factors shown in chart above.

LOAD = A x load factor = _______
DEFLECTION = B x deflection factor = _______

RECOMMENDED BOLTED METAL FRAMING SPECIFICATION

Brackets [ ] indicate alternative specifications which may be substituted by the project engineer.

PART 1 - GENERAL
1.01 WORK INCLUDED

A. Continuous slot, bolted framing channels and all associated fittings and hardware.

B. Trapeze type supports for cable tray, conduit, pipe and other similar systems.

C. Use of bolted metal framing as a surface metal raceway.

1.02 REFERENCES

A. ASTM A108 - Specification for Steel Bars, Carbon, Cold Finished, Structural Quality.

B. ASTM A123 - Specification for Zinc (hot-dip galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strips.

C. ASTM A1011, 33,000 PSI min. yield - Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

D. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

E. ASTM A653 33,000 PSI min. yield G90 - Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Structural Quality.

F. ASTM A1018 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled, Structural Quality.

G. MFMA - Metal Framing Standards Publication, MFMA-4.

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of bolted metal framing of the types required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. A material heat code number shall be stamped on all strut and fittings. This is required to maintain traceability of the product to the material test reports to the ASTM standard.

C. For stainless steel items, the part number shall contain a material designator (EXAMPLE: B-Line B22SS6 for type 316 or B22SS4 for type 304), or a separate stamp shall be included to reference the type of material used.

D. MFMA Compliance: comply with the latest revision of MFMA Standard Publication Number MFMA-4, “Metal Framing”.

E. NEC Compliance: Comply with the latest revision NFPA 70 - Article 352 “Surface Metal Raceways and Surface Nonmetallic Raceways”.

F. UL Compliance: Comply with UL “Standard for Surface Metal Raceway and Fittings”.

1.04 SUBMITTALS

A. Submit drawings of strut and accessories including clamps, brackets, hanger rods and fittings.

B. Submit manufacturer’s product data on strut channels including, but not limited to, types, materials, finishes, gauge thickness and hole patterns. For each different strut cross section, submit cross sectional properties including Section Modulus (S_x) and Moment of Inertia (I_x).

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver strut systems and components carefully to avoid breakage, denting, and scoring finishes. Do not install damaged equipment.

B. Store strut systems and components in original cartons and in clean dry space; protect from weather and construction traffic.

PART 2 - PRODUCTS
2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with these specifications, strut systems to be installed shall be as manufactured by B-Line Systems, Inc. [or engineer approved equal.]

2.02 STRUT CHANNELS AND COMPONENTS

A. General: Strut shall be 1$^5/_8$” wide in varying heights and welded combinations as required to meet load capacities and designs indicated on the drawings.

B. Material and Finish: Material and finish specifications for each strut type are as follows:

1. Aluminum: Strut shall be manufactured of extruded aluminum alloy 6063-T6. All fittings and hardware shall be zinc plated according to ASTM B633. For outdoor use, all fittings and hardware shall be stainless steel Type 316 [Type 304] or chromium zinc, ASTM F1136 Gr. 3.

2. Epoxy Painted: Strut shall be made from steel meeting the minimum mechanical properties of ASTM A1011 33,000 PSI min yield, then painted with water borne epoxy applied by a cathodic electro-deposition process. Fittings shall be manufactured from steel meeting the minimum requirements of ASTM A1018 33,000 PSI min. yield. The fittings shall have the same epoxy finish as the strut. Threaded hardware shall be zinc plated in accordance with ASTM B633 Service Class 1 (SC1). Service Class 1 is not an acceptable coating for fittings or components other than threaded hardware.

3. Pre-Galvanized Steel: Strut shall be made from structural quality steel meeting the minimum mechanical properties of ASTM A653 33,000 PSI min. yield, mill galvanized coating designation G90. Fittings shall be manufactured from steel meeting the minimum requirements of ASTM A1018 33,000 PSI min. yield and zinc plated in accordance with ASTM B633 service class 3 (SC3). Threaded hardware shall be zinc plated in accordance with ASTM B633 Service Class 1 (SC1). Service Class 1 is not an acceptable coating for fittings or components other than threaded hardware.

4. Hot-Dip Galvanized Steel: Strut shall be made from structural quality steel meeting the minimum mechanical properties of ASTM A1011 33,000 PSI min. yield and shall be hot-dip galvanized after fabrication in accordance with ASTM A123. Fittings shall be manufactured from steel meeting the minimum requirements of ASTM A1018 33,000 PSI min. yield, and hot-dip galvanized after fabrication in accordance with ASTM A123. All hardware shall be stainless steel Type 316 [Type 304] or chromium zinc ASTM F1136 Gr. 3. All hot-dip galvanized after fabrication products must be returned to point of manufacture after coating for inspection and removal of all sharp burrs.

5. Stainless Steel: All strut, fittings and hardware shall be made of AISI Type 316 [Type 304] stainless steel as indicated. Channels must be identified as required in previous section 1.03 Quality Assurance.

PART 3 - EXECUTION
3.01 INSTALLATION

A. Install strut as indicated; in accordance with equipment manufacturer’s recommendations, and with recognized industry practices.

B. All nuts and bolts shall be tightened to the following values.

Bolt Size	Torque (ft-lbs)
$^1/_4$-20	6
$^5/_{16}$-18	11
$^3/_8$-16	19
$^1/_2$-13	50

Technical Data

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Metal Framing Channels

Channel

Metal framing channel is cold formed on our modern rolling mills from 12 Ga. (2.6mm), 14 Ga. (1.9mm), and 16 Ga. (1.5mm) low carbon steel strips. A continuous slot with inturned lips provides the ability to make attachments at any point.

Lengths & Tolerances

All channels excluding 'SH' style
± 1/8" (3.2mm) on 10' (3.05m) and
± 3/16" (4.76mm) on 20' (6.09m)
All 'SH' channels only
± 1/4" (6.35mm) on 10' (3.05m) and
± 1/2" (12.70mm) on 20' (6.09m)
Custom lengths are available upon request.

Slots

Slotted series of channels offer full flexibility. A variety of pre-punched slot patterns eliminate the need for precise field measuring for hole locations. Slots offer wide adjustments in the alignment and bolt sizing.

Holes

A variety of pre-punched 9/16" (14.3 mm) diameter hole patterns are available in our channels. These hole patterns provide an economical alternative to costly field drilling required for many applications.

Knockouts

When used with series B217-20 Closure Strips, knockout channels can be used to provide an economical U.L. listed surface raceway. Channels are furnished with 7/8" (22.2 mm) knockouts on 6" (152 mm) centers, allowing for perfect fixture alignment on spans up to 20' (6.09 m).

Materials & Finishes (Unless otherwise noted)

Steel: Plain & Pre-galvanized

12 Ga. (2.6), 14 Ga. (1.9) and 16 Ga. (1.5)

Finish Code	Finish	Specification
PLN	Plain	ASTM A1011, 33,000 PSI min. yield
GRN	DURA-GREEN™	
GLV	Pre-Galvanized	ASTM A653 33,000 PSI min. yield
HDG	Hot-Dipped Galvanized	ASTM A123
YZN	Yellow Zinc Chromate	ASTM B633 SC3 Type II
SS4	Stainless Steel Type 304	ASTM A240
SS6	Stainless Steel Type 316	ASTM A240
AL	Aluminum	Aluminum 6063-T6

Note: A minimum order may apply on special material and finishes.

Design Load (Steel & Stainless Steel)

The design loads given for strut beam loads are based on a simple beam condition using an allowable stress of 25,000 psi. This allowable stress results in a safety factor of 1.68. This is based upon virgin steel minimum yield strength of 33,000 psi cold worked during rolling to an average yield stress of 42,000 psi.
For aluminum channel loading multiply steel loading by a factor of 0.38.

Welding

Weld spacing is maintained between 2 1/2 inches (63.5 mm) and 4 inches (101.6 mm) on center. Through high quality control testing of welded channels and continuous monitoring of welding equipment, B-Line provides the most consistent combination channels available today.

Metric

Metric dimensions are shown in parentheses. Unless noted, all metric dimensions are in millimeters.

SELECTION CHART

for Channels, Materials and Hole Patterns

Channel Type	Channel Dimensions: Height		Channel Dimensions: Width		Material & Thickness *: Steel	Alum.	Stainless Steel Type 304	Stainless Steel Type 316	Channel Hole Pattern **: SH ($^{9}/_{16}$” x $1\frac{1}{8}$” slots on 2” centers)	S ($^{13}/_{32}$” x 3” slots)	H$1\frac{7}{8}$ ($^{9}/_{16}$” diameter holes)	TH ($^{9}/_{16}$” diameter on $1\frac{7}{8}$” centers)	KO6 ($^{7}/_{8}$” diameter knockouts)
					1	2	3	4					
B11	$3\frac{1}{4}$”	(82.5)	$1\frac{5}{8}$”	(41.3)	12 Ga.	.105	–	–	1	1	1	–	1
B12	$2\frac{7}{16}$”	(61.9)	$1\frac{5}{8}$”	(41.3)	12 Ga.	.105	–	–	1 2	1	1 2	–	1 2
B22	$1\frac{5}{8}$”	(41.3)	$1\frac{5}{8}$”	(41.3)	12 Ga.	~~.105~~	~~12 Ga.~~	~~12 Ga.~~	1 2 3 4	1 3	1 2 3	1	1 2
B24	$1\frac{5}{8}$”	(41.3)	$1\frac{5}{8}$”	(41.3)	14 Ga.	.080	14 Ga.	14 Ga.	1 2 3 4	1	1 2 3	–	1 2
B26	$1\frac{5}{8}$”	(41.3)	$1\frac{5}{8}$”	(41.3)	16 Ga.	–	–	–	1	1	1	–	1
B32	$1\frac{3}{8}$”	(34.9)	$1\frac{5}{8}$”	(41.3)	12 Ga.	–	12 Ga.	–	1 3	1	1 3	–	1
B42	1”	(25.4)	$1\frac{5}{8}$”	(41.3)	12 Ga.	–	12 Ga.	–	1 3	1	1 3	–	1
B52	$^{13}/_{16}$”	(20.6)	$1\frac{5}{8}$”	(41.3)	12 Ga.	–	12 Ga.	12 Ga.	1 3 4	1	1	–	1
B54	$^{13}/_{16}$”	(20.6)	$1\frac{5}{8}$”	(41.3)	14 Ga.	.080	14 Ga.	14 Ga.	1 2 3 4	1	1 2 3 4	–	1 2
B56	$^{13}/_{16}$”	(20.6)	$1\frac{5}{8}$”	(41.3)	16 Ga.	–	–	–	1	1	1	–	1
B62	$^{13}/_{16}$”	(20.6)	$^{13}/_{16}$”	(20.6)	18 Ga.	–	–	–	–	–	–	–	–
B72	$^{13}/_{32}$”	(10.3)	$^{13}/_{16}$”	(20.6)	18 Ga.	–	–	–	–	–	–	–	–

The selection has been prepared to provide a reference for available channel, materials and hole patterns. Material types available for various hole patterns are defined by numbers 1 thru 4.
Some stainless steel channels with hole patterns are available on special order only.

*Metric equivalent for thicknesses shown in chart.

12 Ga. = 2.6 mm	18 Ga. = 1.2 mm
14 Ga. = 1.9 mm	.105 = 2.6 mm
16 Ga. = 1.5 mm	.080 = 2.0 mm

**1 - Steel
2 - Aluminum
3 - Type 304 Stainless Steel
4 - Type 316 Stainless Steel

Properties may vary due to commercial tolerances of the material.

Channel Part Numbering
Example:
B22 SH - 120 SS4

Channel Type	Hole Patterns	Length	Material/Finish
B11	SH (pg. 40)	120	GRN
B12	S (pg. 40)	240	GLV
B22 †	H178 (pg. 40)		HDG
B24 †	TH (pg. 41)		YZN
B26	K06 (pg. 41)		SS4
B32	SHA (pg. 41)		SS6
B42	S58 (pg. 42)		AL
B52 †	M (pg. 42)		
B54 †	H25 (pg. 43)		
B56	H112 † (pg. 42)		
B62	* Leave blank for no hole pattern		
B72			

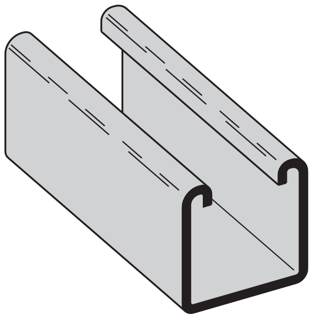
Channel & Combinations

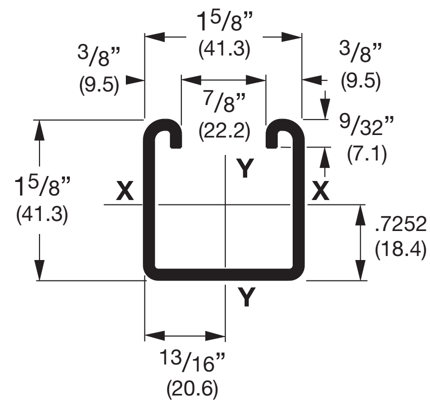
Reference page 14 for general fitting and standard finish specifications.

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

B22

- Thickness: 12 Gauge (2.6 mm)
- Standard lengths: 10’ (3.05 m) & 20’ (6.09 m)
- Standard finishes: Plain, DURA-GREEN™, Pre-Galvanized, Hot-Dipped Galvanized, Stainless Steel Type 304 or 316, Aluminum
- Weight: 1.90 Lbs./Ft. (2.83 kg/m)

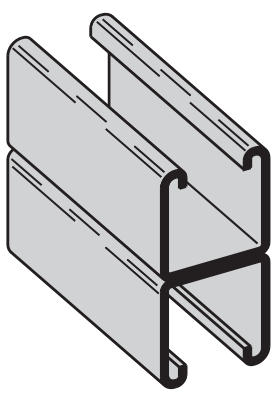




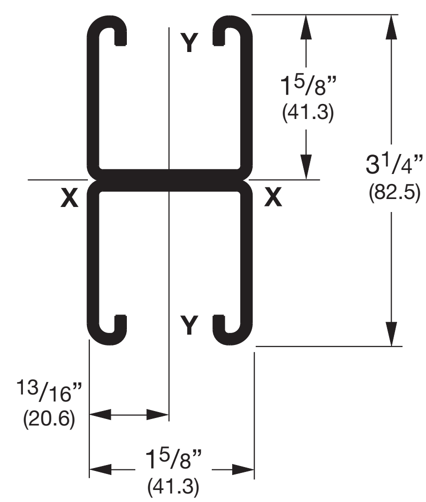
SECTION PROPERTIES

Channel	Weight		Areas of Section		X - X Axis Moment of Inertia (I)		X - X Axis Section Modulus (S)		X - X Axis Radius of Gyration (r)		Y - Y Axis Moment of Inertia (I)		Y - Y Axis Section Modulus (S)		Y - Y Axis Radius of Gyration (r)	
	lbs./ft.	kg/m	sq. in.	cm^2	in.^{4}	cm^4	in.^{3}	cm^3	in.	cm	in.^{4}	cm^4	in.^{3}	cm^3	in.	cm
B22	1.910	(2.84)	.562	(3.62)	.1912	(7.96)	.2125	(3.48)	.583	(1.48)	.2399	(9.99)	.2953	(4.84)	.653	(1.66)
B22A	3.820	(5.69)	1.124	(7.25)	.9732	(40.51)	.5989	(9.81)	.931	(2.36)	.4798	(19.97)	.5905	(9.68)	.653	(1.66)
B22X	6.649	(9.89)	1.956	(12.62)	4.1484	(172.67)	1.7019	(27.89)	1.456	(3.70)	1.1023	(45.88)	1.2027	(19.71)	.751	(1.91)

Calculations of section properties are based on metal thicknesses as determined by the AISI Cold-Formed Steel Design Manual.



B22A
Wt. 3.80 Lbs./Ft. (5.65 kg/m)



Reference page 14 for general fitting and standard finish specifications.

B22 Beam Loading Data

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Beam Span In.	Beam Span mm	Channel Style	Uniform Load and Deflection Lbs.	kN	In.	mm	Uniform Load @ Deflection = 1/240 Span Lbs.	kN	1/360 Span Lbs.	kN
12	(305)	B22	2610	(11.61)	.014	(.35)	2610	(11.61)	2610	(11.61)
		B22A	2610*	(11.61)	.002	(.05)	2610*	(11.61)	2610*	(11.61)
		B22X	5790*	(25.75)	.001	(.02)	5790*	(25.75)	5790*	(25.75)
18	(457)	B22	2269	(10.09)	.031	(.79)	2269	(10.09)	2269	(10.09)
		B22A	2610*	(11.61)	.007	(.18)	2610*	(11.61)	2610*	(11.61)
		B22X	5790*	(25.75)	.003	(.07)	5790*	(25.75)	5790*	(25.75)
24	(609)	B22	1702	(7.57)	.056	(1.42)	1702	(7.57)	1702	(7.57)
		B22A	2610*	(11.61)	.017	(.43)	2610*	(11.61)	2610*	(11.61)
		B22X	5790*	(25.75)	.008	(.20)	5790*	(25.75)	5790*	(25.75)
30	(762)	B22	1361	(6.05)	.087	(2.21)	1361	(6.05)	1294	(5.75)
		B22A	2610*	(11.61)	.033	(.84)	2610*	(11.61)	2610*	(11.61)
		B22X	5790*	(25.75)	.017	(.73)	5790*	(25.75)	5790*	(25.75)
36	(914)	B22	1135	(5.05)	.126	(3.20)	1135	(5.05)	899	(4.00)
		B22A	2610*	(11.61)	.057	(1.45)	2610*	(11.61)	2610*	(11.61)
		B22X	5790*	(25.75)	.029	(.73)	5790*	(25.75)	5790*	(25.75)
42	(1067)	B22	972	(4.32)	.172	(4.37)	972	(4.32)	660	(2.93)
		B22A	2610*	(11.61)	.091	(2.31)	2610*	(11.61)	2610*	(11.61)
		B22X	5790*	(25.75)	.046	(1.17)	5790*	(25.75)	5790*	(25.75)
48	(1219)	B22	851	(3.78)	.224	(5.69)	758	(3.37)	505	(2.24)
		B22A	2405	(10.70)	.125	(3.17)	2405	(10.70)	2405	(10.70)
		B22X	5790*	(25.75)	.068	(1.73)	5790*	(25.75)	5790*	(25.75)
54	(1371)	B22	756	(3.36)	.284	(7.21)	599	(2.66)	399	(1.77)
		B22A	2138	(9.51)	.158	(4.01)	2138	(9.51)	2024	(9.00)
		B22X	5790*	(25.75)	.097	(2.46)	5790*	(25.75)	5790*	(25.75)
60	(1524)	B22	681	(3.03)	.351	(8.91)	485	(2.16)	323	(1.44)
		B22A	1924	(8.56)	.195	(4.95)	1924	(8.56)	1640	(7.29)
		B22X	5645	(25.11)	.130	(3.30)	5645	(25.11)	5645	(25.11)
66	(1676)	B22	619	(2.75)	.424	(10.77)	401	(1.78)	267	(1.19)
		B22A	1749	(7.78)	.236	(5.99)	1749	(7.78)	1355	(6.03)
		B22X	5132	(22.83)	.158	(4.01)	5132	(22.83)	5132	(22.83)
72	(1829)	B22	567	(2.52)	.505	(12.83)	337	(1.50)	225	(1.00)
		B22A	1603	(7.13)	.281	(7.14)	1603	(7.13)	1139	(5.06)
		B22X	4704	(20.92)	.188	(4.77)	4704	(20.92)	4704	(20.92)
78	(1981)	B22	524	(2.33)	.593	(15.06)	287	(1.27)	191	(0.85)
		B22A	1480	(6.58)	.330	(8.38)	1455	(6.47)	970	(4.31)
		B22X	4342	(19.31)	.220	(5.59)	4342	(19.31)	4270	(18.99)
84	(2133)	B22	486	(2.16)	.687	(17.45)	248	(1.10)	165	(0.73)
		B22A	1374	(6.11)	.383	(9.73)	1255	(5.58)	837	(3.72)
		B22X	4032	(17.93)	.255	(6.48)	4032	(17.93)	3682	(16.38)
90	(2286)	B22	454	(2.02)	.789	(20.04)	216	(0.96)	144	(0.64)
		B22A	1283	(5.71)	.440	(11.17)	1093	(4.86)	729	(3.24)
		B22X	3763	(16.74)	.293	(7.44)	3763	(16.74)	3207	(14.26)
96	(2438)	B22	425	(1.89)	.898	(22.81)	190	(0.84)	126	(0.56)
		B22A	1202	(5.35)	.500	(12.70)	961	(4.27)	640	(2.85)
		B22X	3528	(15.69)	.334	(8.48)	3528	(15.69)	2819	(12.54)
102	(2591)	B22	400	(1.78)	1.013	(25.73)	168	(0.75)	112	(0.50)
		B22A	1132	(5.03)	.565	(14.35)	851	(3.78)	567	(2.52)
		B22X	3320	(14.77)	.377	(9.57)	3320	(14.77)	2497	(11.11)
108	(2743)	B22	378	(1.68)	1.136	(28.85)	150	(0.67)	100	(0.44)
		B22A	1069	(4.75)	.633	(16.08)	759	(3.37)	506	(2.25)
		B22X	3136	(13.95)	.422	(10.72)	3136	(13.95)	2227	(9.90)
114	(2895)	B22	358	(1.59)	1.266	(32.15)	134	(0.59)	90	(0.40)
		B22A	1013	(4.50)	.706	(17.93)	681	(3.03)	454	(2,02)
		B22X	2971	(13.21)	.471	(11.96)	2971	(13.21)	1999	(8,89)
120	(3048)	B22	340	(1.51)	1.403	(35.63)	121	(0.54)	81	(0.36)
		B22A	962	(4.28)	.782	(19.86)	615	(2.73)	410	(1.82)
		B22X	2822	(12.55)	.521	(13.23)	2706	(12.04)	1804	(8.02)

Based on simple beam condition using an allowable design stress of 25,000 psi (172 MPa) in accordance with MFMA, with adequate lateral bracing (see page 11 for further explanation). Actual yield point of cold rolled steel is 42,000 psi. To determine concentrated load capacity at mid span, multiply uniform load by 0.5 and corresponding deflection by 0.8. *Failure determined by weld shear.

Reference page 14 for general fitting and standard finish specifications.

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Unbraced Height In.	Unbraced Height mm	Channel Style	Max. Column Loading K = .80 Loaded@ C.G. Lbs.	Loaded@ C.G. kN	Loaded@ Slot Face Lbs.	Loaded@ Slot Face kN	Max. Column Loading (Loaded @ C.G.) K = .65 Lbs.	K = .65 kN	K = 1.0 Lbs.	K = 1.0 kN	K = 1.2 Lbs.	K = 1.2 kN
12	(305)	**B22**	10454	(46.50)	4276	(19.12)	10598	(47.14)	10222	(45.47)	9950	(44.26)
		B22A	21625	(96.19)	7002	(31.14)	21677	(96.42)	21539	(95.81)	21433	(95.34)
		B22X	46948	(208.83)	18975	(84.40)	47061	(209.34)	46761	(208.00)	46531	(206.98)
18	(457)	**B22**	9950	(44.26)	4153	(18.47)	10253	(45.62)	9481	(42.17)	8955	(39.83)
		B22A	21433	(95.34)	6959	(30.95)	21551	(95.86)	21239	(94.47)	21001	(93.42)
		B22X	46531	(206.98)	18859	(83.90)	46787	(208.12)	46110	(205.11)	45593	(202.81)
24	(609)	**B22**	9311	(41.42)	3993	(17.76)	9801	(43.60)	8582	(38.17)	7801	(3470)
		B22A	21164	(94.14)	6898	(30.68)	21373	(95.07)	20819	(92.61)	20397	(9073)
		B22X	45947	(204.38)	18693	(84.44)	46401	(206.40)	45198	(201.05)	44282	(196.97)
30	(762)	**B22**	8582	(38.17)	3802	(16.91)	9268	(41.22)	7601	(33.81)	6595	(29.33)
		B22A	20819	(92.61)	6821	(30.34)	21145	(94.06)	20279	(90.20)	19619	(87.27)
		B22X	45198	(201.05)	18485	(82.22)	45906	(204.20)	44026	(195.84)	42593	(189.46)
36	(914)	**B22**	7801	(34.70)	3589	(15.96)	8676	(38.59)	6595	(28.33)	5392	(23.98)
		B22A	20397	(90.73)	6728	(29.93)	20866	(92.81)	19619	(87.27)	18669	(83.04)
		B22X	44282	(196.97)	18233	(81.10)	45300	(201.50)	42593	(189.46)	40530	(180.28)
42	(1067)	**B22**	6998	(31.13)	3360	(14.94)	8048	(35.80)	5595	(24.89)	4444	(19.77)
		B22A	19898	(88.51)	6620	(29.45)	20537	(91.33)	18840	(83.80)	17546	(78.05)
		B22X	43198	(192.15)	17940	(79.80)	44586	(198.33)	40901	(181.94)	38092	(169.44)
48	(1219)	**B22**	6193	(27.55)	3118	(13.87)	7401	(32.92)	4718	(20.99)	3791	(16.86)
		B22A	19322	(85.95)	6496	(28.89)	20157	(89.66)	17940	(79.80)	16251	(72.29)
		B22X	41948	(186.59)	17604	(78.30)	43761	(194.57)	38948	(173.25)	35281	(156.94)
54	(1371)	**B22**	5392	(23.98)	2864	(12.74)	6746	(30.01)	4090	(18.19)	3310	(14.72)
		B22A	18669	(83.04)	6263	(27.86)	19276	(87.74)	16920	(75.26)	14782	(65.75)
		B22X	40530	(180.28)	16973	(75.50)	42825	(190.49)	36733	(163.39)	32092	(142.75)
60	(1524)	**B22**	4718	(20.99)	2631	(11.70)	6093	(27.10)	3616	(16.08)	2936	(13.06)
		B22A	17940	(79.80)	5340	(23.75)	19244	(85.60)	15781	(70.20)	13141	(58.45)
		B22X	38948	(173.25)	14471	(64.37)	41779	(185.84)	34260	(152.39)	28529	(126.90)
66	(1676)	**B22**	4202	(18.69)	2434	(10.83)	5441	(24.20)	3242	(14.42)	2634	(11.71)
		B22A	17134	(76.21)	4587	(20.40)	18712	(83.23)	14521	(64.59)	11328	(50.39)
		B22X	37198	(165.46)	12431	(55.29)	40624	(180.70)	31525	(140.23)	24593	(109.39)
72	(1829)	**B22**	3791	(16.86)	2264	(10.07)	4869	(21.66)	2936	(13.06)	2381	(10.59)
		B22A	16251	(72.29)	3968	(17.65)	18129	(80.64)	13141	(58.45)	9524	(42.36)
		B22X	35281	(156.94)	10753	(47.83)	39358	(175.07)	28529	(126.90)	20676	(91.97)
78	(1981)	**B22**	3456	(15.37)	2116	(9.41)	4412	(19.62)	2680	(11.92)	2166	(9.63)
		B22A	15291	(68.02)	3456	(15.37)	17496	(77.82)	11642	(51.78)	8115	(36.10)
		B22X	33197	(147.67)	9366	(41.66)	37984	(168.96)	25275	(112.43)	17617	(78.36)
84	(2133)	**B22**	3176	(14.13)	1984	(8.82)	4037	(17.96)	2461	(10.95)	1980	(8.81)
		B22A	14255	(63.41)	3028	(13.47)	16812	(74.78)	10076	(44.82)	6998	(31.13)
		B22X	30947	(137.66)	8206	(36.50)	36499	(162.35)	21875	(97.30)	15192	(67.58)
90	(2286)	**B22**	2936	(13.06)	1867	(8.30)	3724	(16.56)	2270	(10.10)	1816	(8.08)
		B22A	13141	(58.45)	2667	(11.86)	16077	(71.51)	8778	(39.04)	6096	(27.11)
		B22X	28529	(126.90)	7227	(32.15)	34903	(155.25)	19057	(84.77)	13234	(58.87)
96	(2438)	**B22**	2728	(16.58)	1761	(7.83)	3456	(15.37)	2101	(9.34)	1671	(7.43)
		B22A	11951	(53.16)	2359	(10.49)	15291	(68.02)	7715	(34.32)	5357	(23.83)
		B22X	25945	(115.41)	6393	(28.44)	33197	(147.67)	16749	(74.50)	11630	(51.73)
102	(2591)	**B22**	2545	(11.32)	1664	(7.40)	3225	(14.34)	1951	(8.68)	1542**	(6.34)
		B22A	10678	(47.50)	2093	(9.31)	14455	(64.30)	6834	(30.40)	4746	(21.11)
		B22X	23182	(103.12)	5672	(25.23)	31382	(139.59)	14836	(65.99)	10303	(45.83)
108	(2743)	**B22**	2381	(10.59)	1575	(7.00)	3022	(13.44)	1816	(8.08)	1426**	(68.60)
		B22A	9524	(42.36)	1867	(8.30)	13568	(60.35)	6096	(27.11)	4233	(18.83)
		B22X	20676	(91.97)	5059	(22.50)	29456	(131.03)	13234	(58.87)	9190	(40.88)
114	(2895)	**B22**	2234	(9.94)	1494	(6.64)	2842	(12.64)	1694	(7.53)	1322**	(5.88)
		B22A	8548	(38.02)	1675	(7.45)	12630	(56.18)	5471	(24.33)	3799**	(16.90)
		B22X	18558	(82.55)	4539	(20.19)	27420	(121.97)	11877	(52.83)	8247	(36.68)
120	(3048)	**B22**	2101	(9.34)	1418	(6.31)	2680	(11.92)	1583**	(7.04)	1228**	(5.46)
		B22A	7715	(34.32)	1512	(6.72)	11642	(51.78)	4937	(21.96)	3429**	(15.25)
		B22X	16749	(74.50)	4097	(18.22)	25275	(112.43)	10718	(47.67)	7444	(33.11)

**Where the slenderness ratio $\frac{KL}{r}$ exceeds 200, and K = end fixity factor, L = actual length and r = radius of gyration.

Channel & Combinations

Reference page 14 for general fitting and standard finish specifications.

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Channel Nuts & Hardware

Channel Nuts

Channel nuts are one of the main components of our metal framing system. It is designed to provide essential gripping power and ease during installation. Channel nuts are press formed, machined and hardened from steel which meets the requirements of ASTM A108 or ASTM A36 for our larger sizes.

Bolts, Screws, and Nuts

All bolts, screws and nuts meet the physical and chemical requirements of ASTM A307, SAE J429 or ASTM A563, and have unified inch screw threads (coarse, UNC). ISO metric threads are also available on special request.

Recommended Torque

Bolt Size	1/4"-20	5/16"-18	3/8"-16	1/2"-13
Foot/Lbs.	6	11	19	50
Nm	8	15	26	68

Bolt Size	M6x1	M8 x1.25	M10 x 1.5	M12x1.75
Nm	12	17	36	62
Foot/Lbs.	9	13	27	46

Materials & Finishes*

Finish Code	Finish	Specification
PLN	Plain	ASTM A108/A307 Gr. A, ASTM A563, SAE J429
ZN	Electro-Plated Zinc	ASTM B633 SC1 Type III
CZ	Chromium Zinc	ASTM F1136 Gr. 3
HDG	Hot-Dipped Galvanized	ASTM A153
SS6	Stainless Steel Type 316	MPIF 35/ASTM F593
AL	Aluminum	ASTM F468 S4

*Unless otherwise noted.

Note: Channel nuts are not available in HDG, Aluminum, or Stainless Steel Type 304

Metric

Metric dimensions are shown in parentheses. Unless noted, all metric dimensions are in millimeters.

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

STANDARD CHANNEL NUTS

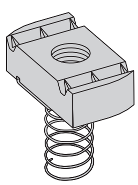
Numbering Example: **N 7 25 (*) WO**

Nut Type	**Channel Type**	**Thread Size**	**Stud Length**	**Suffix**
N = Standard Nut	7 = Tall Channels	21 = #8-32	* = Specify Length of stud below for Stud Nut or Twirl Stud Nuts	WO = Without Spring
TN = Twirl Nut	B11	22 = #10-24	3/4 = 3/4”	** = Twirl Nuts or nuts with springs have blank suffix
SN = Stud Nut	B12	27 = #10-32	1 = 1”	
STN = Stud Twirl Nut	2 = Medium Channels	24 = 1/4-20	1 1/4 = 1 1/4”	
NW = Combo Nut Washer	B22	23 = 5/16-18	1 1/2 = 1 1/2”	
	B24	28 = 3/8-16		
	B26	26 = 7/16-14		
	B32	25 = 1/2-13		
	5 = Short Channels	55 = 5/8-11		
	B42	75 = 3/4-10		
	B52	78 = 7/8-9		
	B54			
	B56			

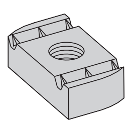
METRIC CHANNEL NUTS

Numbering Example: **BMS 6 M**

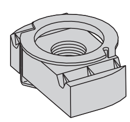
Nut Type	**Metric Thread Size**	**Suffix**
BMS = Spring Nut	3 = M3.5	S = Short Spring
BMS-D = Spring Nut (1/2” thick)	4 = M4	M = Medium Spring
BMT = Twirl Nut	5 = M5	L = Long Spring
BMT-D = Twirl Nut (1/2” thick)	6 = M6	* = Twirl Nuts and nuts without springs have blank suffix
BMM = Spring Nut (Mini channel)	8 = M8	
	10 = M10	
	12 = M12	



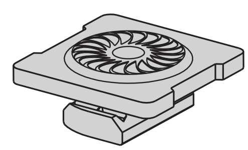
SPRING NUT



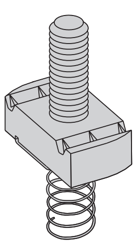
NUT WITHOUT SPRING



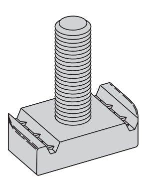
TWIRL-NUT™



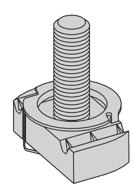
COMBO NUT WASHER



STUD NUT WITH SPRING



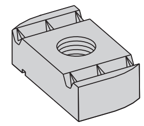
STUD NUT WITHOUT SPRING



TWIRL STUD NUT

Reference page 44 for general fitting and standard finish specifications.

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED



Note: See page 50 for resistance to slip & page 51 for pull-out strength.

NUT WITHOUT SPRING

Part No.	Thread Size	Fits Channel Sizes	Nut Thickness		Wt./C Lbs.	kg
N221WO	#8-32	All sizes except B62 & B72	1/4"	(6.3)	7.0	(3.17)
N227WO	#10-32	All sizes except B62 & B72	1/4"	(6.3)	7.0	(3.17)
N222WO	#10-24	All sizes except B62 & B72	1/4"	(6.3)	7.0	(3.17)
N224WO	1/4-20	All sizes except B62 & B72	1/4"	(6.3)	6.7	(3.04)
N223WO	5/16-18	All sizes except B62 & B72	1/4"	(6.3)	6.7	(3.04)
N228WO	3/8-16	All sizes except B62 & B72	3/8"	(9.5)	9.3	(4.22)
N226WO	7/16-14	All sizes except B62 & B72	3/8"	(9.5)	8.8	(3.99)
N225WO	1/2-13	B11, B12, B22, B24, B26, B32	1/2"	(12.7)	11.6	(5.26)
N525WO	1/2-13	B42, B52, B54, B56	3/8"	(9.5)	8.8	(3.99)
N255WO	5/8-11	B11, B12, B22, B24, B26, B32	1/2"	(12.7)	16.4	(7.44)
N555WO	5/8-11	B42, B52, B54, B56	3/8"	(9.5)	10.2	(4.62)
N275WO	3/4-10	B11, B12, B22, B24, B26, B32	1/2"	(12.7)	14.5	(6.58)
N575WO	3/4-10	B42, B52, B54, B56	3/8"	(9.5)	8.8	(3.99)
N278WO	7/8-9	B11, B12, B22, B24, B26, B32	1/2"	(12.7)	12.5	(5.67)
Metric Threads						
BMS-6	M6 x 1	All sizes except B62 & B72	1/4"	(6.3)	6.9	(3.13)
BMS-8	M8 x 1.25	All sizes except B62 & B72	1/4"	(6.3)	6.7	(3.04)
BMS-10	M10 x 1.5	All sizes except B62 & B72	3/8"	(9.5)	9.6	(4.35)
BMS-12	M12 x 1.75	All sizes except B62 & B72	3/8"	(9.5)	9.2	(4.17)
BMS-D-12	M12 x 1.75	B11, B12, B22, B24, B26, B32	1/2"	(12.7)	12.2	(5.53)

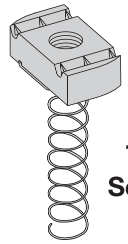
Note: For mini channel nut information see page 203.

Channel Nuts & Hardware

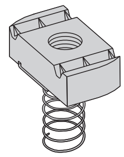
Reference page 44 for general fitting and standard finish specifications.

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

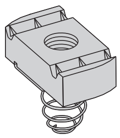
Note: See page 50 for resistance to slip & page 51 for pull-out strength.



700 Series



200 Series



500 Series

SPRING NUT

Part No.	Thread Size	Fits Channel Sizes	Nut Thickness		Wt./C Lbs.	kg
N721	#8-32	B11 & B12	1/4"	(6.3)	7.0	(3.17)
N221	#8-32	B22, B24, B26, B32	1/4"	(6.3)	7.0	(3.17)
N521	#8-32	B42, B52, B54, B56	1/4"	(6.3)	7.0	(3.17)
N727	#10-32	B11 & B12	1/4"	(6.3)	7.0	(3.17)
N227	#10-32	B22, B24, B26, B32	1/4"	(6.3)	7.0	(3.17)
N527	#10-32	B42, B52, B54, B56	1/4"	(6.3)	7.0	(3.17)
N722	#10-24	B11 & B12	1/4"	(6.3)	7.0	(3.17)
N222	#10-24	B22, B24, B26, B32	1/4"	(6.3)	7.0	(3.17)
N522	#10-24	B42, B52, B54, B56	1/4"	(6.3)	7.0	(3.17)
N724	1/4-20	B11 & B12	1/4"	(6.3)	6.7	(3.04)
N224	1/4-20	B22, B24, B26, B32	1/4"	(6.3)	6.7	(3.04)
N524	1/4-20	B42, B52, B54, B56	1/4"	(6.3)	6.7	(3.04)
N723	5/16-18	B11 & B12	1/4"	(6.3)	6.7	(3.04)
N223	5/16-18	B22, B24, B26, B32	1/4"	(6.3)	6.7	(3.04)
N523	5/16-18	B42, B52, B54, B56	1/4"	(6.3)	6.7	(3.04)
N728	3/8-16	B11 & B12	3/8"	(9.5)	9.3	(4.22)
N228	3/8-16	B22, B24, B26, B32	3/8"	(9.5)	9.3	(4.22)
N528	3/8-16	B42, B52, B54, B56	3/8"	(9.5)	9.3	(4.22)
N726	7/16-14	B11 & B12	3/8"	(9.5)	8.8	(3.99)
N226	7/16-14	B22, B24, B26, B32	3/8"	(9.5)	8.8	(3.99)
N526	7/16-14	B42, B52, B54, B56	3/8"	(9.5)	8.8	(3.99)
N725	1/2-13	B11 & B12	1/2"	(12.7)	11.6	(5.26)
N225	1/2-13	B22, B24, B26, B32	1/2"	(12.7)	11.6	(5.26)
N525	1/2-13	B42, B52, B54, B56	3/8"	(9.5)	8.8	(3.99)
N755	5/8-11	B11 & B12	1/2"	(12.7)	16.4	(7.44)
N255	5/8-11	B22, B24, B26, B32	1/2"	(12.7)	16.4	(7.44)
N555	5/8-11	B42, B52, B54, B56	3/8"	(9.5)	10.2	(4.62)
N775	3/4-10	B11 & B12	1/2"	(12.7)	14.5	(6.58)
N275	3/4-10	B22, B24, B26, B32	1/2"	(12.7)	14.5	(6.58)
N575	3/4-10	B42, B52, B54, B56	3/8"	(9.5)	8.8	(3.99)
N778	7/8-9	B11 & B12	1/2"	(12.7)	12.5	(5.67)
N278	7/8-9	B22, B24, B26, B32	1/2"	(12.7)	12.5	(5.67)
Metric Threads						
BMS-6L	M6 x 1	B11 & B12	1/4"	(6.3)	6.9	(3.13)
BMS-6M	M6 x 1	B22, B24, B26, B32	1/4"	(6.3)	6.9	(3.13)
BMS-6S	M6 x 1	B42, B52, B54, B56	1/4"	(6.3)	6.9	(3.13)
BMS-8L	M8 x 1.25	B11 & B12	1/4"	(6.3)	6.7	(3.04)
BMS-8M	M8 x 1.25	B22, B24, B26, B32	1/4"	(6.3)	6.7	(3.04)
BMS-8S	M8 x 1.25	B42, B52, B54, B56	1/4"	(6.3)	6.7	(3.04)
BMS-10L	M10 x 1.5	B11 & B12	3/8"	(9.5)	9.6	(4.35)
BMS-10M	M10 x 1.5	B22, B24, B26, B32	3/8"	(9.5)	9.6	(4.35)
BMS-10S	M10 x 1.5	B42, B52, B54, B56	3/8"	(9.5)	9.6	(4.35)
BMS-12M	M12 x 1.75	B22, B24, B26, B32	3/8"	(9.5)	9.2	(4.17)
BMS-12S	M12 x 1.75	B42, B52, B54, B56	3/8"	(9.5)	9.2	(4.17)
BMS-D-12L	M12 x 1.75	B11 & B12	1/2"	(12.7)	12.2	(5.53)
BMS-D-12M	M12 x 1.75	B22, B24, B26, B32	1/2"	(12.7)	12.2	(5.53)

Note: For mini channel nut information see page 203.

Reference page 44 for general fitting and standard finish specifications.

Pipe/Conduit Clamps & Hangers

Our beam attachments and pipe supports offered in this section are designed to provide supports without drilling or welding. A complete selection of beam clamps, pipe clamps, rollers, supports and accessories are designed for use with our channels and offer many installation advantages.

Materials & Finishes*

Pipe clamps, pipe hangers, beam clamps, brackets, and rollers are made from low carbon steel strips, plates or rod unless noted.

Finish Code	Finish	Specification
PLN	Plain	ASTM A1011 33,000 PSI min. yield
ZN	Electro-Plated Zinc	ASTM B633 SC3 Type III or ASTM A653
GRN	DURA-GREEN™	
DCU	DURA-COPPER™	
HDG	Hot-Dipped Galvanized	ASTM A123
YZN	Yellow Zinc Chromate	ASTM B633 SC3 Type II
SS4	Stainless Steel Type 304	ASTM A240
SS6	Stainless Steel Type 316	ASTM A240
AL	Aluminum	ASTM B209

*Unless otherwise noted.

Load Data

The load data published includes a safety factor of 5.0 unless noted (safety factor = ratio of ultimate load to the design load).

Recommended Torque For Setscrews (unless noted)

Setscrew Size	1/4"-20	3/8"-16	1/2"-13
Foot/Lbs.	4	5	11
Nm	5	7	15

Setscrew Size	5/8"-11	3/4"-10
Foot/Lbs.	21	34
Nm	28	46

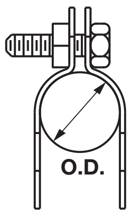
*See chart on page 72 for bolt torque.

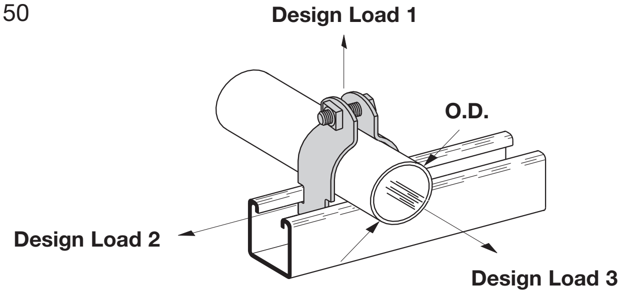
Metric

Metric dimensions are shown in parentheses. Unless noted, all metric dimensions are in millimeters.

B2000 SERIES
O.D. PIPE AND CONDUIT CLAMPS

- Safety Factor of 5
- Add PA to suffix for pre-assembled pipe clamps
- Other sizes available upon request
- Includes Combination Recess Hex Head Machine Screw and Square Nut.
- Material: 16 Ga. (1.5), 14 Ga. (1.9), 12 Ga. (2.6) ASTM A1011 33,000 PSI min. yield and 11 Ga. (3.0) ASTM A1011HSLA Gr. 50
- Standard finishes: ZN, HDG, SS4





O.D. CLAMPS

Part No.	O.D. Size (in.)		Hardware Size	Material Gauge Thickness		Design Load 1 Lbs.	kN	Design Load 2 Lbs.	kN	Design Load 3 Lbs.	kN	Wt./C Lbs.	kg
B2059	4 3/4”	(120.6)	5/16”-18	11	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	68	(30.8)
B2060	4 7/8”	(123.8)	5/16”-18	11	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	69	(31.3)
B2018	5	(127.0)	5/16”-18	11	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	70	(31.8)
B2062	5 1/8”	(130.2)	5/16”-18	11	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	70	(31.8)
B2063	5 1/4”	(133.3)	5/16”-18	11	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	70	(31.8)
B2064	5 3/8”	(136.5)	5/16”-18	11	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	77	(34.9)
B2019	5 1/2”	(139.7)	5/16”-18	11	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	78	(35.4)
B2066	5 5/8”	(142.9)	5/16”-18	11	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	83	(37.6)
B2067	5 3/4”	(146.0)	5/16”-18	11	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	84	(38.1)
B2068	5 7/8”	(149.2)	5/16”-18	11	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	85	(38.6)
B2069	6”	(152.4)	5/16”-18	11	(3.0)	1000	(4.45)	200	(.89)	150	(.67)	87	(39.5)
B2110	6 1/8”	(155.6)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	94	(42.6)
B2111	6 1/4”	(158.7)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	96	(43.5)
B2112	6 3/8”	(161.9)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	98	(44.4)
B2113	6 1/2”	(165.1)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	99	(44.9)
B2020	6 5/8”	(168.3)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	100	(45.4)
B2115	6 3/4”	(171.4)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	102	(46.3)
B2116	6 7/8”	(174.6)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	104	(47.2)
B2117	7”	(177.8)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	106	(48.1)
B2118	7 1/8”	(181.0)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	108	(49.0)
B2119	7 1/4”	(184.1)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	110	(49.9)
B2120	7 3/8”	(187.3)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	112	(50.8)
B2121	7 1/2”	(190.5)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	114	(51.7)
B2021	7 5/8”	(193.7)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	115	(52.2)
B2123	7 3/4”	(196.8)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	117	(53.1)
B2124	7 7/8”	(200.0)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	119	(54.0)
B2125	8”	(203.2)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	121	(54.9)
B2126	8 1/8”	(206.4)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	123	(55.8)
B2127	8 1/4”	(209.5)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	125	(56.7)
B2128	8 3/8”	(212.7)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	126	(57.2)
B2129	8 1/2”	(215.9)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	128	(58.1)
B2022	8 5/8”	(219.1)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	128	(58.1)
B2130	10 3/4”	(273.0)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	160	(72.6)
B2132	12 3/4”	(323.8)	3/8”-16	11	(3.0)	1000	(4.45)	250	(1.11)	200	(.89)	185	(83.9)

Reference page 126 for general fitting and standard finish specifications.

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Attached are page(s) from the 2014 Hilti North American Product Tech Guide. For complete details on this product, including data development, product specifications, general suitability, installation, corrosion, and spacing and edge distance guidelines, please refer to the Technical Guide, or contact Hilti.

NO STAINLESS STEEL BOLTS ARE REQUIRED

Hilti, Inc.
5400 South 122nd East Avenue
Tulsa, OK 74146

1-800-879-8000
www.hilti.com

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

FM APPROVED c UL us LISTED

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.

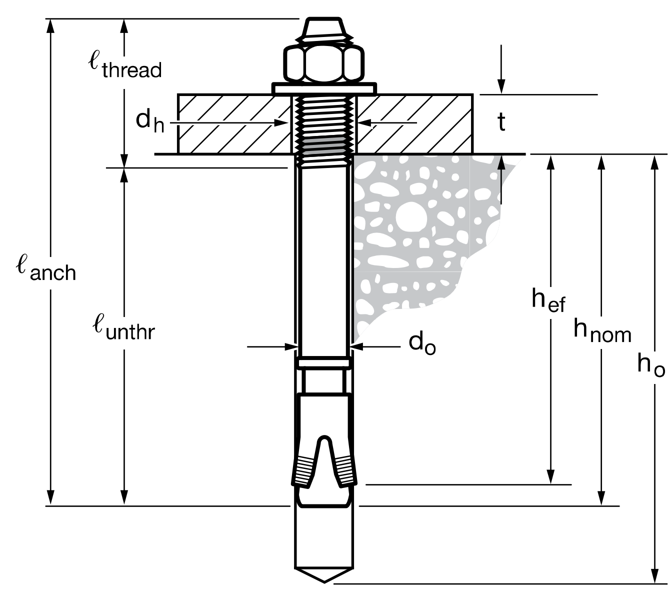
KWIK Bolt TZ Expansion Anchor 3.3.5

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 f'_c = 2500 psi lb (kN)	Tension - ϕN_n f'_c = 3000 psi lb (kN)	Tension - ϕN_n f'_c = 4000 psi lb (kN)	Tension - ϕN_n f'_c = 6000 psi lb (kN)	Shear - ϕV_n f'_c = 2500 psi lb (kN)	Shear - ϕV_n f'_c = 3000 psi lb (kN)	Shear - ϕV_n f'_c = 4000 psi lb (kN)	Shear - ϕV_n f'_c = 6000 psi lb (kN)
3/8	2 (51)	2-5/16 (59)	1,635 (7.3)	1,790 (8.0)	2,070 (9.2)	2,535 (11.3)	2,375 (10.6)	2,605 (11.6)	3,005 (13.4)	3,680 (16.4)
1/2	2 (51)	2-3/8 (60)	2,205 (9.8)	2,415 (10.7)	2,790 (12.4)	3,420 (15.2)	2,375 (10.6)	2,605 (11.6)	3,005 (13.4)	3,680 (16.4)
	3-1/4 (83)	3-5/8 (91)	3,585 (15.9)	3,925 (17.5)	4,535 (20.2)	5,555 (24.7)	9,845 (43.8)	10,785 (48.0)	12,450 (55.4)	15,250 (67.8)
5/8	3-1/8 (79)	3-9/16 (91)	4,310 (19.2)	4,720 (21.0)	5,450 (24.2)	6,675 (29.7)	9,280 (41.3)	10,165 (45.2)	11,740 (52.2)	14,380 (64.0)
	4 (102)	4-7/16 (113)	5,945 (26.4)	6,510 (29.0)	7,520 (33.5)	9,210 (41.0)	13,440 (59.8)	14,725 (65.5)	17,000 (75.6)	20,820 (92.6)
3/4	3-3/4 (95)	4-5/16 (110)	5,380 (23.9)	5,895 (26.2)	6,810 (30.3)	8,340 (37.1)	12,200 (54.3)	13,365 (59.5)	15,430 (68.6)	18,900 (84.1)
	4-3/4 (121)	5-9/16 (142)	6,940 (30.9)	7,605 (33.8)	8,780 (39.1)	10,755 (47.8)	17,390 (77.4)	19,050 (84.7)	22,000 (97.9)	26,945 (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 f'_c = 2500 psi lb (kN)	Tension - ϕN_n f'_c = 3000 psi lb (kN)	Tension - ϕN_n f'_c = 4000 psi lb (kN)	Tension - ϕN_n f'_c = 6000 psi lb (kN)	Shear - ϕV_n f'_c = 2500 psi lb (kN)	Shear - ϕV_n f'_c = 3000 psi lb (kN)	Shear - ϕV_n f'_c = 4000 psi lb (kN)	Shear - ϕV_n f'_c = 6000 psi lb (kN)
3/8	2 (51)	2-5/16 (59)	1,475 (6.6)	1,615 (7.2)	1,865 (8.3)	2,285 (10.2)	1,685 (7.5)	1,845 (8.2)	2,130 (9.5)	2,605 (11.6)
1/2	2 (51)	2-3/8 (60)	1,565 (7.0)	1,710 (7.6)	1,975 (8.8)	2,420 (10.8)	1,685 (7.5)	1,845 (8.2)	2,130 (9.5)	2,605 (11.6)
	3-1/4 (83)	3-5/8 (91)	3,195 (14.2)	3,500 (15.6)	4,040 (18.0)	4,950 (22.0)	6,970 (31.0)	7,640 (34.0)	8,820 (39.2)	10,800 (48.0)
5/8	3-1/8 (79)	3-9/16 (91)	3,050 (13.6)	3,345 (14.9)	3,860 (17.2)	4,730 (21.0)	6,575 (29.2)	7,200 (32.0)	8,315 (37.0)	10,185 (45.3)
	4 (102)	4-7/16 (113)	4,420 (19.7)	4,840 (21.5)	5,590 (24.9)	6,845 (30.4)	9,520 (42.3)	10,430 (46.4)	12,040 (53.6)	14,750 (65.6)
3/4	3-3/4 (95)	4-5/16 (110)	4,010 (17.8)	4,395 (19.5)	5,075 (22.6)	6,215 (27.6)	8,640 (38.4)	9,465 (42.1)	10,930 (48.6)	13,390 (59.6)
	4-3/4 (121)	5-9/16 (142)	5,720 (25.4)	6,265 (27.9)	7,235 (32.2)	8,860 (39.4)	12,320 (54.8)	13,495 (60.0)	15,585 (69.3)	19,085 (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.

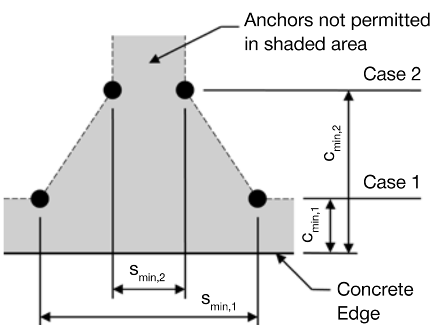
KWIK Bolt TZ Expansion Anchor 3.3.5

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:

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

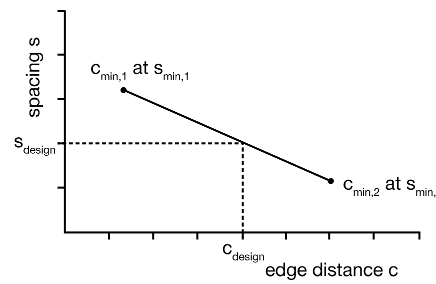


Table 5 - KWIK Bolt TZ carbon steel installation parameters[1]

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

KWIK Bolt TZ Expansion Anchor 3.3.5

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 II 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						

3.3.5

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 II 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 II 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 II 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 II 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						

3.3.5

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 II 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 (51)	2-5/16 (59)	1,710 (7.6)	1,875 (8.3)	2,160 (9.6)	2,650 (11.8)	2,375 (10.6)	2,605 (11.6)	3,005 (13.4)	3,680 (16.4)
1/2	2 (51)	2-3/8 (60)	1,865 (8.3)	2,045 (9.1)	2,360 (10.5)	2,890 (12.9)	2,375 (10.6)	2,605 (11.6)	3,005 (13.4)	3,680 (16.4)
	3-1/4 (83)	3-5/8 (91)	3,745 (16.7)	4,100 (18.2)	4,735 (21.1)	5,800 (25.8)	9,845 (43.8)	10,785 (48.0)	12,450 (55.4)	15,250 (67.8)
5/8	3-1/8 (79)	3-9/16 (91)	4,310 (19.2)	4,720 (21.0)	5,450 (24.2)	6,675 (29.7)	9,280 (41.3)	10,165 (45.2)	11,740 (52.2)	14,380 (64.0)
	4 (102)	4-7/16 (113)	6,240 (27.8)	6,835 (30.4)	7,895 (35.1)	9,665 (43.0)	13,440 (59.8)	14,725 (65.5)	17,000 (75.6)	20,820 (92.6)
3/4	3-3/4 (95)	4-5/16 (110)	5,665 (25.2)	6,205 (27.6)	7,165 (31.9)	8,775 (39.0)	12,200 (54.3)	13,365 (59.5)	15,430 (68.6)	18,900 (84.1)
	4-3/4 (121)	5-9/16 (142)	7,825 (34.8)	8,575 (38.1)	9,900 (44.0)	12,125 (53.9)	17,390 (77.4)	19,050 (84.7)	22,000 (97.9)	26,945 (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 (51)	2-5/16 (59)	1,520 (6.8)	1,665 (7.4)	1,925 (8.6)	2,355 (10.5)	1,685 (7.5)	1,845 (8.2)	2,130 (9.5)	2,605 (11.6)
1/2	2 (51)	2-3/8 (60)	1,750 (7.8)	1,915 (8.5)	2,210 (9.8)	2,710 (12.1)	2,375 (10.6)	2,605 (11.6)	3,005 (13.4)	3,680 (16.4)
	3-1/4 (83)	3-5/8 (91)	3,235 (14.4)	3,545 (15.8)	4,095 (18.2)	5,015 (22.3)	6,970 (31.0)	7,640 (34.0)	8,820 (39.2)	10,800 (48.0)
5/8	3-1/8 (79)	3-9/16 (91)	3,050 (13.6)	3,345 (14.9)	3,860 (17.2)	4,730 (21.0)	6,575 (29.2)	7,200 (32.0)	8,315 (37.0)	10,185 (45.3)
	4 (102)	4-7/16 (113)	3,795 (16.9)	4,160 (18.5)	4,800 (21.4)	5,880 (26.2)	9,520 (42.3)	10,430 (46.4)	12,040 (53.6)	14,750 (65.6)
3/4	3-3/4 (95)	4-5/16 (110)	5,270 (23.4)	5,775 (25.7)	6,670 (29.7)	8,165 (36.3)	12,200 (54.3)	13,365 (59.5)	15,430 (68.6)	18,900 (84.1)
	4-3/4 (121)	5-9/16 (142)	5,720 (25.4)	6,265 (27.9)	7,235 (32.2)	8,860 (39.4)	12,320 (54.8)	13,495 (60.0)	15,585 (69.3)	19,085 (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

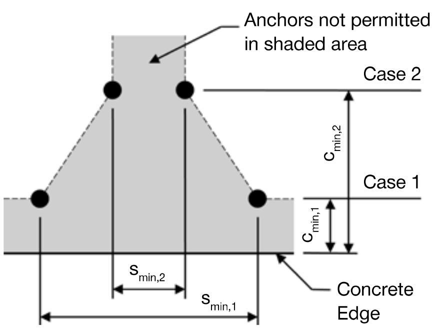
5 Tabular values are for static loads only. For seismic loads, multiply cracked concrete tabular values by α_{seis} = 0.75. See section 3.1.7.4 for additional information on seismic applications.

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:

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

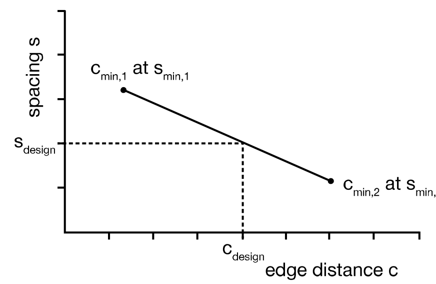


Table 17 - Stainless steel KWIK Bolt TZ installation parameters[1]

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

KWIK Bolt TZ Expansion Anchor 3.3.5

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 II 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 II 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 II 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 II 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.

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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 II 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						

3.3.5

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 II 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

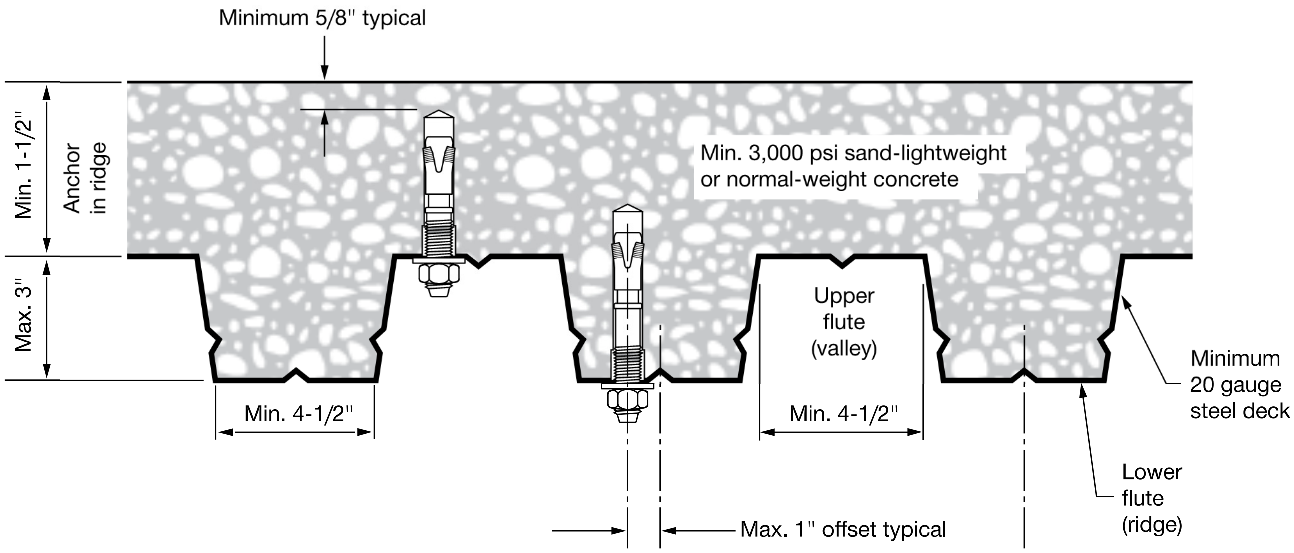

Figure 4 - Installation of KWIK Bolt TZ in the soffit of concrete over metal deck floor and roof assemblies - W Deck

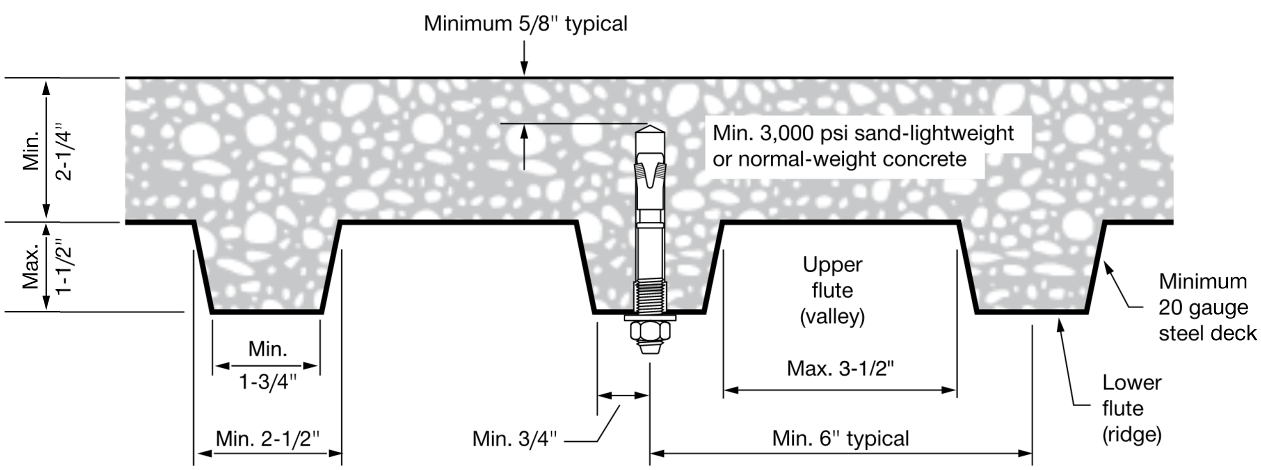

Figure 5 - Installation of KWIK Bolt TZ in the soffit of concrete over metal deck floor and roof assemblies - B Deck

KWIK Bolt TZ Expansion Anchor 3.3.5

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]

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

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]

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

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 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

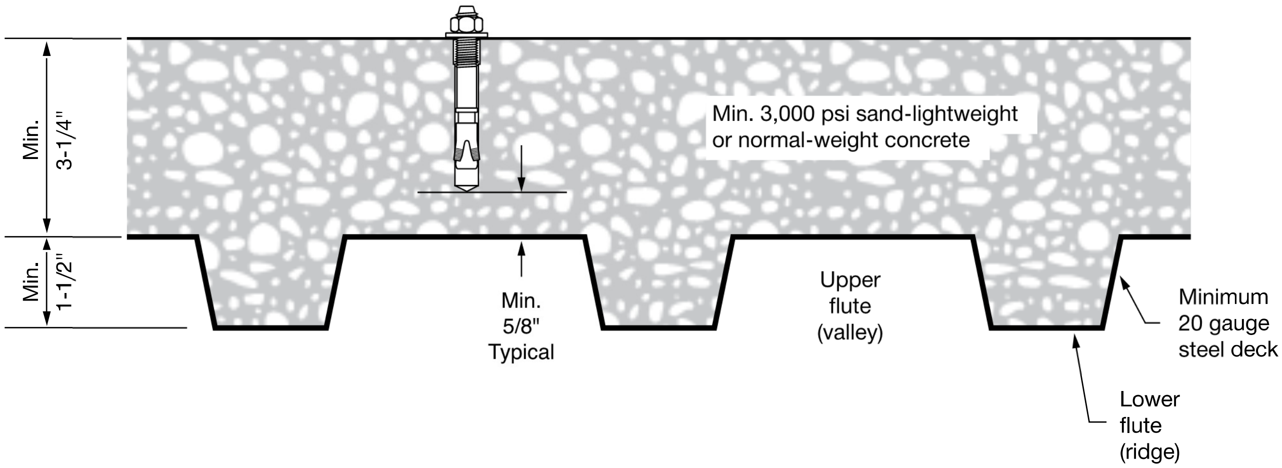

Figure 6 - Installation of the KWIK Bolt TZ on the top of sand-lightweight concrete over metal deck floor and roof assemblies

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 II 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						

3.3.5

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 II 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 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

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

AFCON

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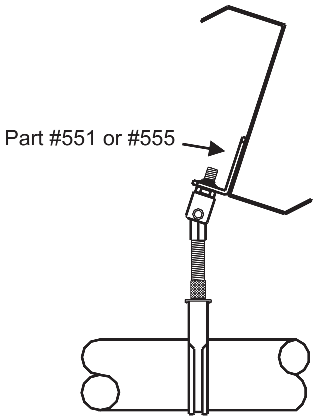
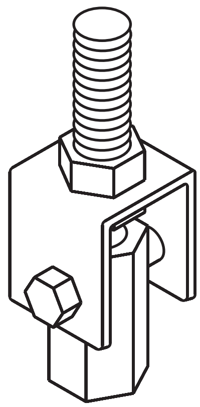
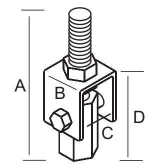
615

SWIVEL







Dimensions					
Size	A	B	C	D	Rod Make-up
3/8"	2.96	0.75	1.19	1.54	0.78
1/2"	3.62	0.76	0.97	1.75	0.72

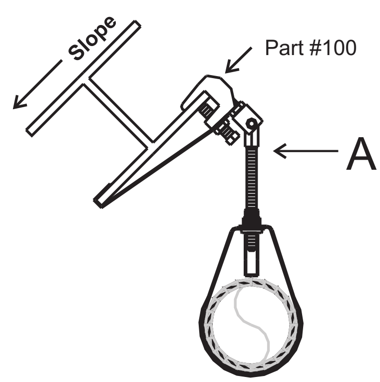
SIZE - ROD: 3/8" **SIZE - SYSTEM PIPE:** 4" max.
SIZE - ROD: 1/2" **SIZE - SYSTEM PIPE:** 8" max.

MATERIAL - Carbon Steel.
FINISH - Mil. Galvanized and E.G.
LISTING/APPROVAL -

c UL us LISTED **203-EX 2551**

FUNCTION - Pivot component of an ***AFCON*** hanger.
Used to provide angularity of the hanger assembly.
To support horizontal piping.
INSTALLATION - Per NFPA 13 and these instructions.
FEATURES
* Deep rod bore.
* Improved hanger adjustment.
* More pivot clearance at T.B.C. - See detail A.

ORDERING - Part #.



CAD

Fig. 98 - Rod Stiffener

Size Range — Secures 3/8" thru 7/8" hanger rod
Material — Carbon Steel
Function — Secures channel to hanger rod for vertical seismic bracing.
Finish — Electro Galvanized
Note — Available in HDG finish or Stainless Steel materials.
Order By — Figure number

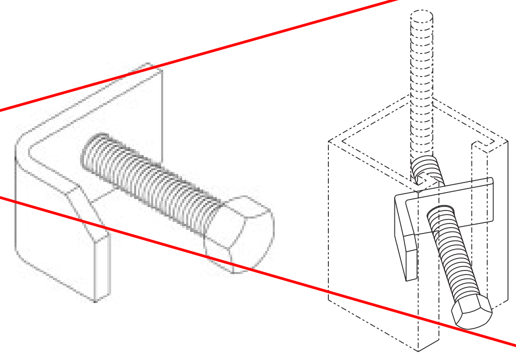
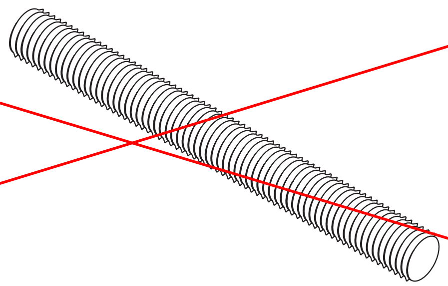


Fig. 99 - All Thread Rod Cut to Length

Size Range — Secures 3/8" thru 7/8" rod in 1" increments
Material — Carbon Steel
Maximum Temperature — 750°F
Finish — Plain
Note — Available in Electro-Galvanized and HDG finish or Stainless Steel materials.
Order By — Figure number, rod diameter, rod length and finish



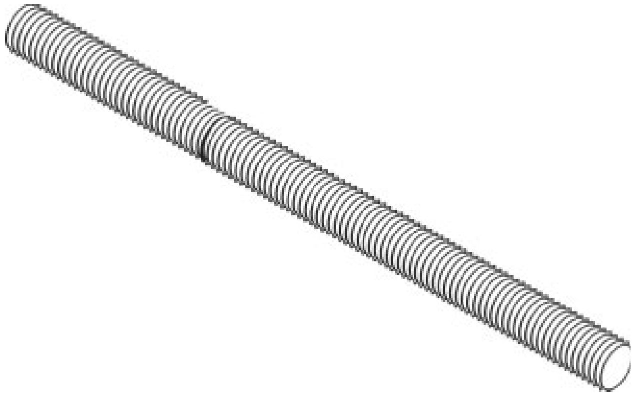
Dimensions • Weights

Rod Size	Max. Rec. Load Lbs. For Service Temps 650°F	750°F
3/8	610	540
1/2	1130	1010
5/8	1810	1610
3/4	2710	2420
7/8	3770	3360

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Fig. 100 - All Thread Rod Full Lengths

Size Range — Secures 3/8" thru 7/8" rod in 10' lengths
Material — Carbon Steel
Maximum Temperature — 750°F
Finish — Plain
Note — Available in Electro-Galvanized and HDG finish or Stainless Steel materials.
Order By — Figure number, rod diameter and finish



Dimensions • Weights

Rod Size	Max Rec. Load Lbs. For Service Temps 650°F	750°F	Approx. Wt./100
1/4	240	215	12
3/8	610	540	29
1/2	1130	1010	53
5/8	1810	1610	84
3/4	2710	2420	123
7/8	3770	3360	169
1	4960	4420	222
$1^1/_4$	8000	7140	360
$1^1/_2$	11630	10370	510

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Fig. 70 - Steel Rod Coupling
Fig. 70R - Steel Reducing Rod Coupling
Fig. 70S - Short Pattern Steel Rod Coupling
Fig. 71 - Steel Window Rod Coupling

Size Range — 1/4" thru $1\frac{1}{2}$" rod

Material — Carbon Steel

Function — Used for coupling two threaded rods together of equal or reduced rod sizes, with or without inspection hole.

Finish — Electro-Galvanized

Note — Available in HDG finish or Stainless Steel materials.

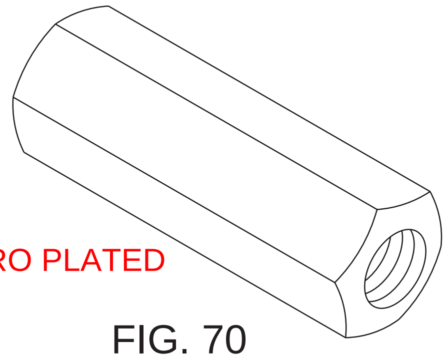


FIG. 70

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Fig. 70

Dimensions • Weights			
Rod Size	**Length**	**Max Rec. Load Lbs.**	**Approx. Wt./100**
1/4	7/8	240	2
5/16	$1\frac{3}{4}$	300	13
3/8	$1\frac{3}{4}$	610	11
1/2	$1\frac{3}{4}$	1130	11
5/8	$2\frac{1}{8}$	1810	16
3/4	$2\frac{1}{4}$	2710	27
7/8	$2\frac{1}{2}$	3770	57
1	$2\frac{3}{4}$	4960	70

$1\frac{1}{8}$" - $1\frac{1}{2}$" — Consult factory for specifications

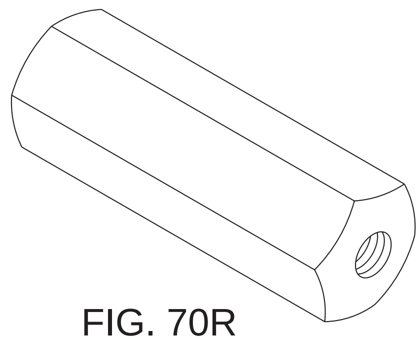


FIG. 70R

Fig. 70R

Dimensions • Weights			
Rod Size	**Length**	**Max Rec. Load Lbs.**	**Approx. Wt./100**
3/8 x 1/4	7/8	240	4
1/2 x 3/8	$1\frac{3}{4}$	610	7
5/8 x 1/2	$2\frac{1}{8}$	1130	14
3/4 x 5/8	$2\frac{1}{4}$	1810	21
7/8 x 3/4	$2\frac{1}{2}$	2710	40

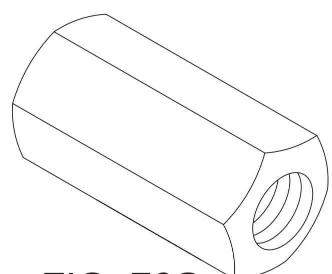


FIG. 70S

Fig. 70S/Fig. 71

Dimensions • Weights			
Rod Size	**Length**	**Max Rec. Load Lbs.**	**Approx. Wt./100**
3/8	$1\frac{1}{8}$	610	4
1/2	$1\frac{1}{4}$	1130	6

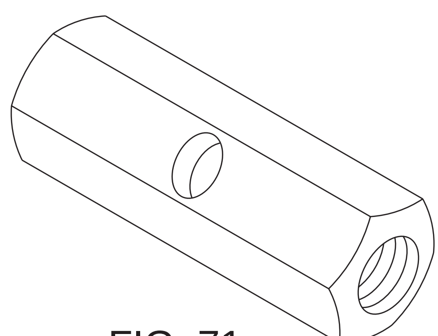


FIG. 71

Fig. 4A - Pipe Clamp for Sway Bracing

Component of State of California OSHPD Approved Seismic Restraints System

Size Range — 4" thru 8" pipe. For sizes smaller than 4" use TOLCO™ Fig. 4.

Material — Carbon Steel

Function — For bracing pipe against sway and seismic disturbance.

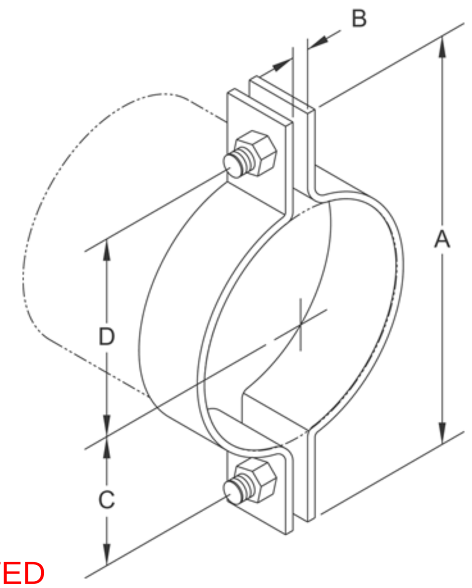
Approvals — Underwriters' Laboratories Listed in the USA **(UL)** and Canada **(cUL)** 4" thru 8". Included in our Seismic Restraints Catalog approved by the State of California Office of Statewide Health Planning and Development (OSHPD). For additional load, spacing and placement information relating to OSHPD projects, please refer to the TOLCO Seismic Restraint Systems Guidelines.

Installation Instructions — Install Fig. 4A Pipe Clamp on pipe to be braced. Attach Sway-Brace Fitting to 1/2" Clamp bolt (Sway-Brace Fitting to be on outside ears of clamp). Tighten securely. (min. torque requirement — 50 ft. lbs.) Sway Brace Assemblies are intended to be installed in accordance with NFPA 13 and the Manufacturers Installation Instructions.

Finish — Plain

Note — Available in Electro-Galvanized and HDG finish or Stainless Steel materials.

Order By — Figure number, pipe size and finish



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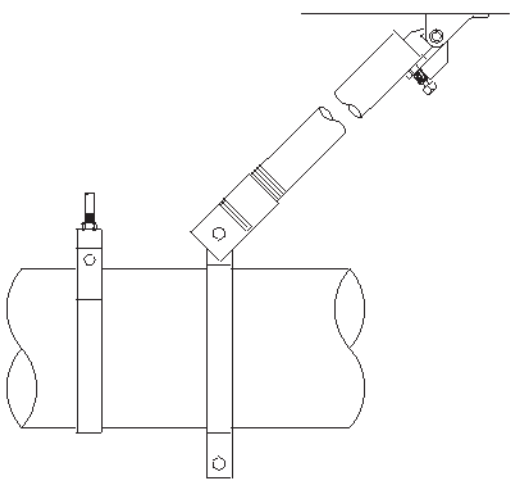


Fig. 4A - Longitudinal Brace

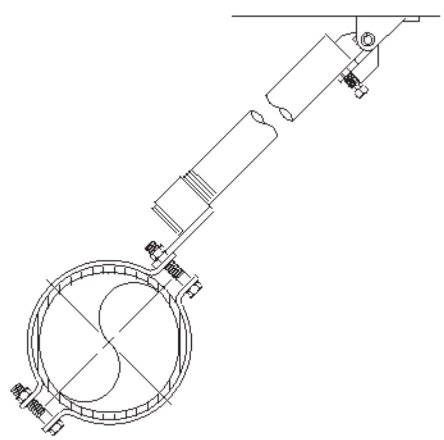
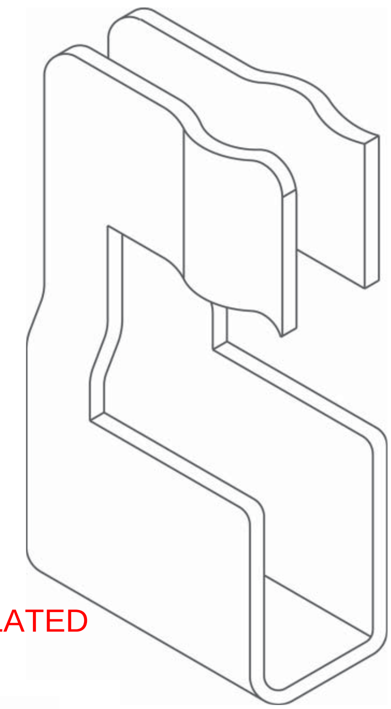


Fig. 4A - Brace

Dimensions • Weights

Pipe Sizes	A	B	C	D	Bolt Size	Max. Horizontal Design Load	Approx. Wt./100
4	$8\frac{1}{2}$	9/16	$3\frac{3}{8}$	$3\frac{11}{16}$	1/2	2015	221
5	$9\frac{3}{4}$	9/16	$3\frac{7}{8}$	$4\frac{3}{8}$	1/2	2015	253
6	$11\frac{1}{2}$	5/8	5	$5\frac{1}{8}$	1/2	2015	513
8	$13\frac{1}{4}$	3/4	$6\frac{11}{16}$	$6\frac{1}{8}$	1/2	2015	601

Fig. 25 - Surge Restrainer



Size Range — One size fits 3/4" thru 2" pipe.

Material — Steel

Function — Designed to be used in conjunction with TOLCO™ Band Hangers to restrict the upward movement of piping as it occurs during sprinkler head activation or earthquake type activity. The surge restrainer is easily and efficiently installed by snapping into a locking position on the bank hanger. This product is intended to satisfy the requirements as indicated in the National Fire Protection Association (NFPA 13, 1999 Edition), 6-2.3.3, 6-2.3.4 and A-6i-2.3.3 Can be used to restrain either steel pipe or CPVC plastic Pipe.

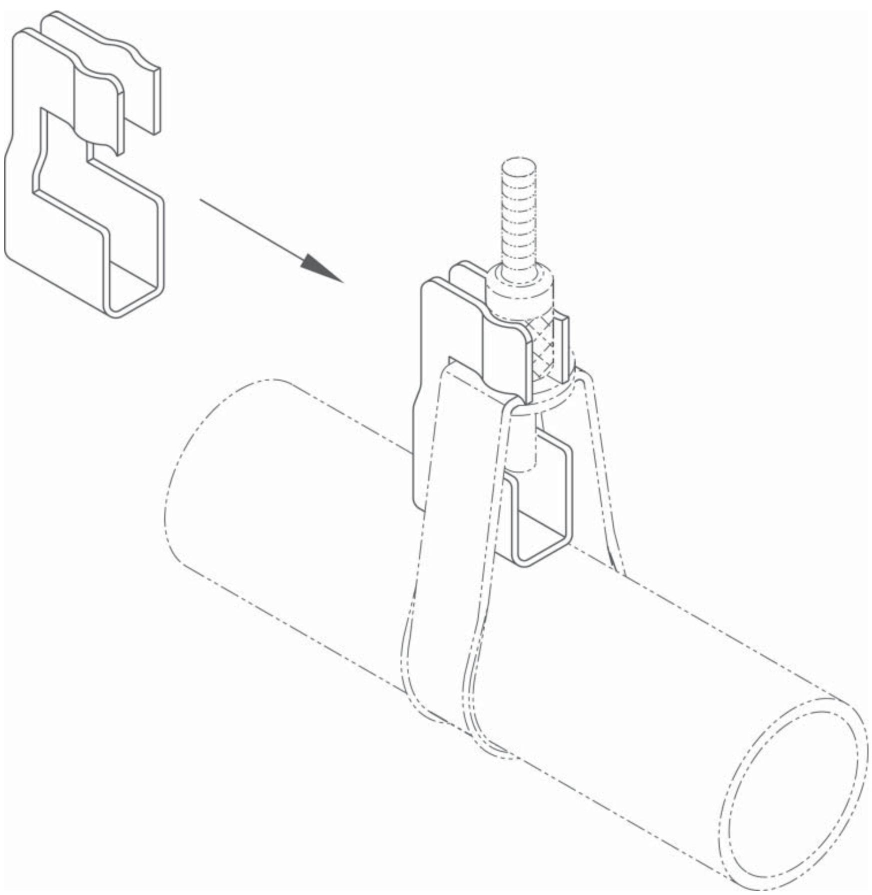
Approvals — Underwriters' Laboratories Listed only when used with TOLCO band hangers Fig. 2, 2NFPA and 200, in the USA **(UL)** and Canada **(cUL)**.

Finish — Pre-Galvanized

Order By — Figure number and TOLCO band hanger, size from 3/4" thru 2".

Patent #5,344,108

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED



ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Fig. 980 - Universal Swivel Sway Brace Attachment - 3/8"-16 to 3/4"-10 rods
Fig. 980H - Universal Swivel Sway Brace Attachment - 7/8"-9 to 1 1/4"-7 rods

Component of State of California OSHPD Approved Seismic Restraints System

Size Range: One size fits bracing pipe 1" (25mm) thru 2" (50mm), Cooper B-Line 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 (2010) 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, 4L, 4A or 4B to form a complete bracing assembly. NFPA 13 and/or OSHPD guidelines should be followed.

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

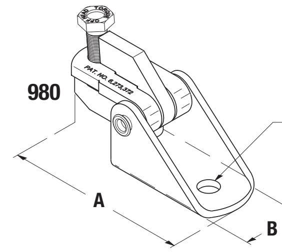
Approvals: —Underwriters Laboratories Listed in the USA **(UL)** and Canada **(cUL)**. Approved by Factory Mutual Engineering **(FM)**. Included in our Seismic Restraints Catalog approved by the State of California Office of Statewide Health Planning and Development **(OSHPD)**. For additional load, spacing and placement information relating to OSHPD projects, please refer to the TOLCO Seismic Restraint Systems Guidelines.

Note: Fig. 980 Swivel Attachment and Fig. 1001, Fig. 1000, Fig. 2002, Fig. 4A, Fig. 4B or Fig. 4L pipe clamps 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 B-Line for alternative finishes.

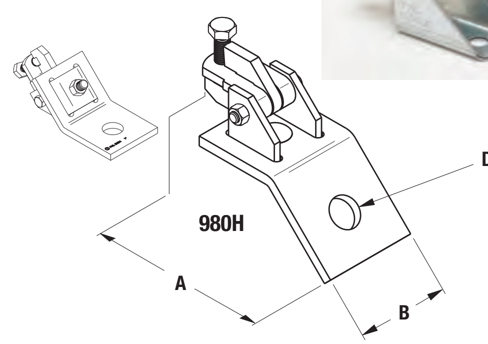
Order By: Figure number and finish.

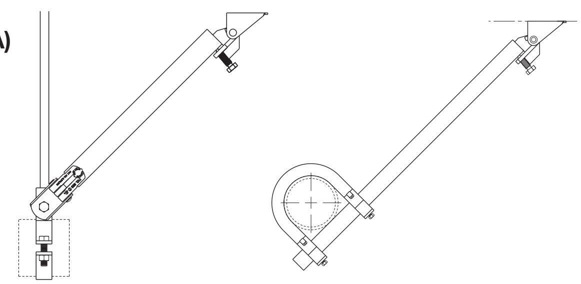
US Patent Numbers
Pat. #6,273,372, Pat. #6,517,030, Pat. #6,953,174,
Pat. #6,708,930, Pat. #7,191,987, Pat. #7,441,730, Pat. #7,669,806



Set Screw Included

Mounting Hardware Is Not Included





Part Number	A in.	A (mm)	B in.	B (mm)	D* in.	D* (mm)	Max. Design Load (cULus) lbs./(kN)	Max. Design Load** (FM) 30°-44° lbs./(kN)	45°-59° lbs./(kN)	60°-74° lbs./(kN)	75°-90° lbs./(kN)	Approx. Wt./100 lbs.	(kg)
980-3/8	5 1/4"	(133.3)	1 7/8"	(47.6)	13/32"	(10.3)	2015 (8.96)	1320 (5.87)	1970 (8.76)	2310 (10.27)	2550 (11.34)	149	(67.6)
980-1/2	5 1/4"	(133.3)	1 7/8"	(47.6)	17/32"	(13.5)						148	(67.1)
980-5/8	5 1/4"	(133.3)	1 7/8"	(47.6)	11/16"	(17.5)						147	(66.7)
980-3/4	5 1/4"	(133.3)	1 7/8"	(47.6)	13/16"	(20.5)						146	(66.2)
980H-7/8	6 3/4"	(171.4)	3 1/2"	(88.9)	15/16"	(23.8)						402	(182.3)
980H-1	6 3/4"	(171.4)	3 1/2"	(88.9)	1 1/16"	(27.0)						400	(181.4)
980H-1 1/8	6 3/4"	(171.4)	3 1/2"	(88.9)	1 3/16"	(30.2)						397	(180.1)
980H-1 1/4	6 3/4"	(171.4)	3 1/2"	(88.9)	1 5/16"	(33.3)						390	(176.9)

* Mounting attachment hole size.
** Installed with 1" or 1 1/4" Schedule 40 brace pipe.

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

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

ALL HANGER MATERIALS TO BE GALVANIZED OR ELECTRO PLATED

Fig. 1001 - Sway Brace Attachment

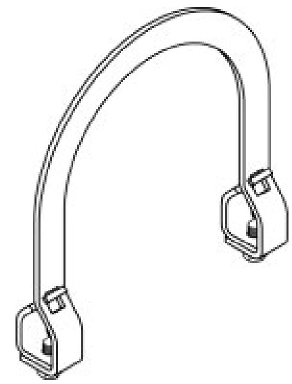
Component of State of California OSHPD Approved Seismic Restraints System

Size Range — Pipe size to be braced: $2\frac{1}{2}$" thru 8" IPS.* Pipe size used for bracing: 1" and $1\frac{1}{4}$" Schedule 40 IPS.

Material — Carbon Steel

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

Features — *Can be used to brace schedules 7 through 40 IPS. Field adjustable, making critical pre-engineering of bracing pipe length unnecessary. Unique design requires no threading of bracing pipe. Can be used as a component of a four-way riser brace. 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" pipe extension is recommended.

Maximum Design Load
Sch 7 - 1600 lbs.
Sch 10 & 40 w/1" Brace Pipe - 2015 lbs.
Sch 10 & 40 w/$1\frac{1}{4}$" Brace Pipe - 2765 lbs.

Approvals — Underwriters Laboratories Listed in the USA **(UL)** and Canada **(cUL)**. Included in our Seismic Restraints Catalog 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 the TOLCO Seismic Restraint Systems Guidelines.

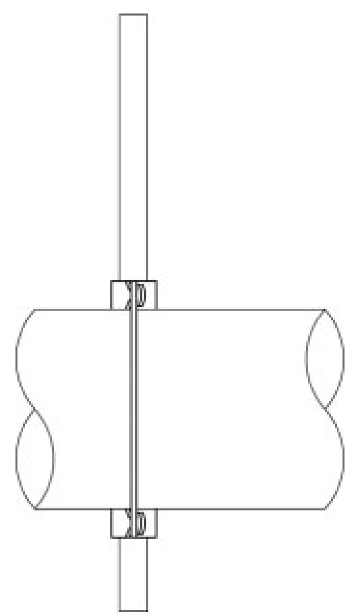
Finish — Plain

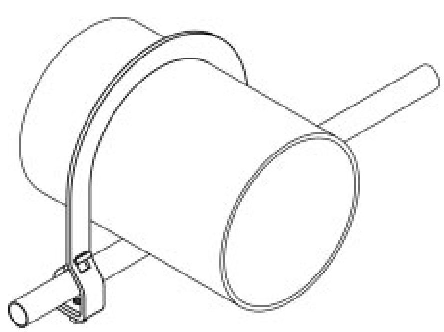
Note — Available in Electro-Galvanized and HDG finish.

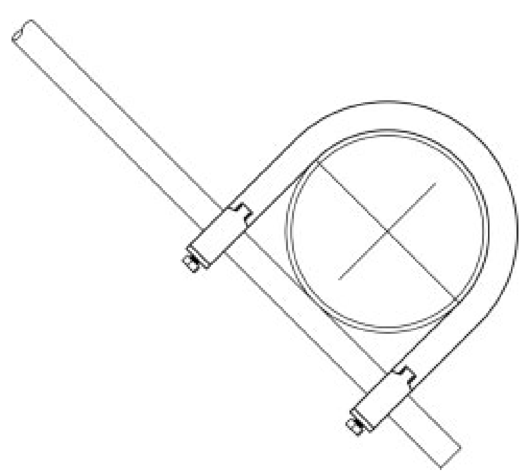
Order By — Indicate pipe size to be braced followed by pipe size used for bracing, figure number and finish.

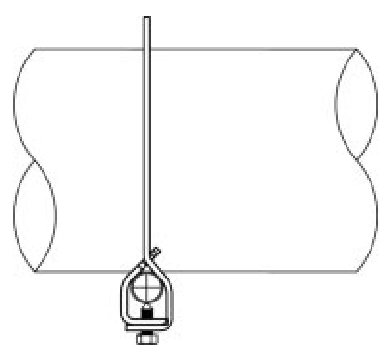
Important Note — The Fig. 1001 is precision manufactured to perform its function as a critical component of a complete bracing assembly. **To ensure performance, the UL Listing requires that the Fig. 1001 must be used only with other TOLCO bracing products**. **The Fig 1001 is not intended for use with the Fig. 907 4-Way Longitudinal Brace Attachment**.

NATIONAL AND INTERNATIONAL PATENT APPLICATION IN PROCESS









POTTER
The Symbol of Protection

PS10 SERIES
PRESSURE SWITCH

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.

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

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

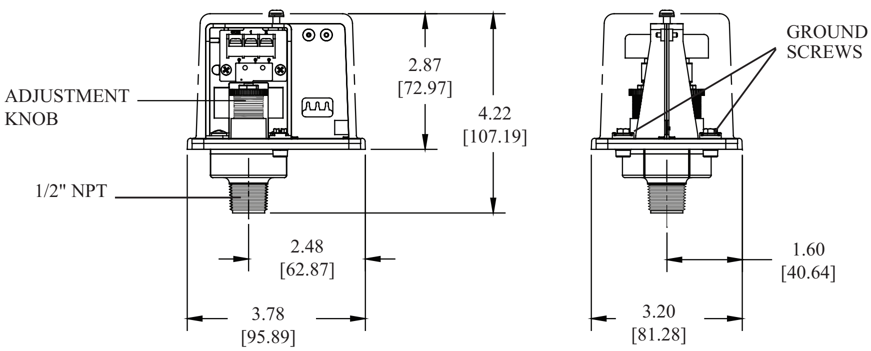
Connect PS10 into alarm port piping that extends from the intermediate chamber of the alarm check valve. Install on the outlet side of the in-line check valve of the alarm port piping. Insure that no unsupervised shut-off valves are present between the alarm check valve and the PS10.

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

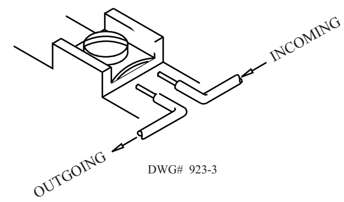


NOTE: To prevent leakage, apply Teflon tape sealant to male threads only.

DWG# 930-1

Switch Clamping Plate Terminal

Fig. 2

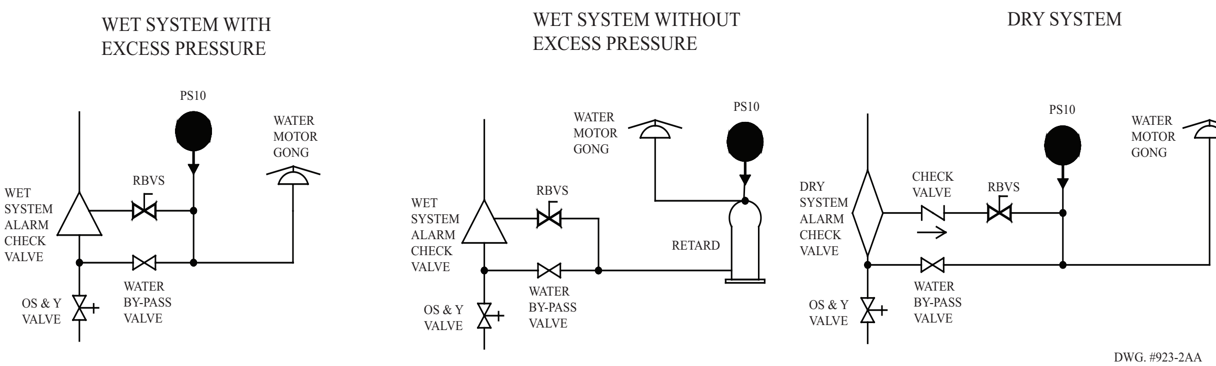


⚠ WARNING

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

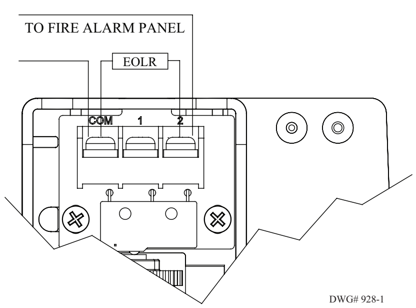


⚠ CAUTION

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.

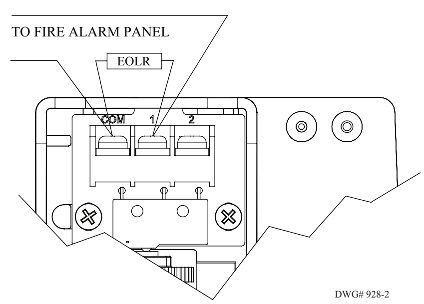
Low Pressure Signal Connection

Fig. 4



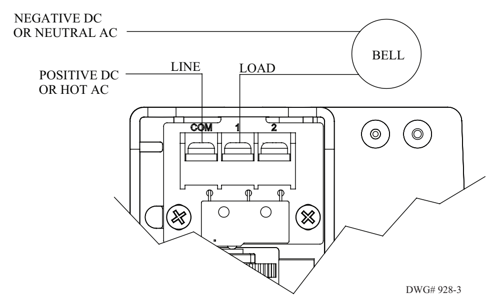
Waterflow Signal Connection

Fig. 5



Local Bell For Waterflow Connection

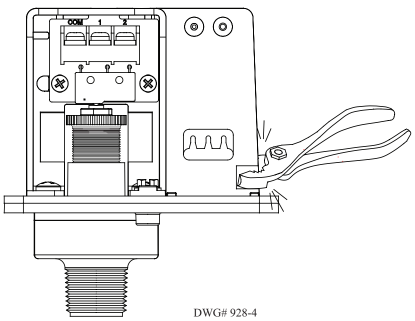
Fig. 6



One Conduit Wiring

Fig. 7

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

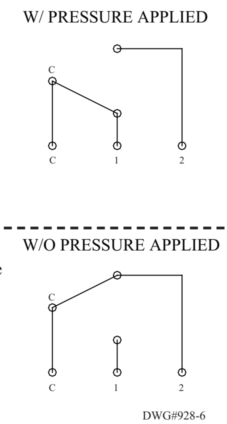


Switch Operation

Fig. 8

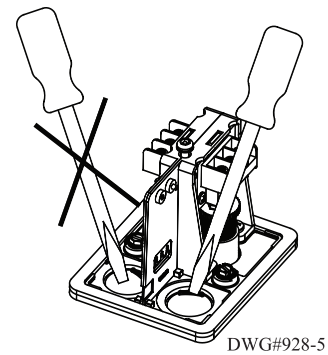
Terminal
C: Common
1: Closed when installed under normal system pressure.
2: Open when installed under normal system pressure. Closes on pressure drop. Use for low pressure supervision.

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



Removing Knockouts

Fig. 9



⚠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.

<u>POTTER VALVE SUPERVISORY SWITCH</u>

Operations & Maintenance Manual
December 2015

POTTER
The Symbol of Protection

OSYSU-1,-2
OUTSIDE SCREW AND YOKE VALVE SUPERVISORY SWITCH

UL, ULC and CSFM Listed, FM Approved, NYMEA Accepted, CE Marked

Dimensions: 6.19"L X 2.25"W X 5.88"H
15,7cm L X 5,7cm W X 14,6cm H

Weight: 2 lbs (0,9 kg)

Enclosure: Cover - Die-Cast
Finish - Red Spatter Enamel
Base - Die Cast Zinc
All parts have corrosion resistant finishes

Cover Tamper: Tamper Resistant Screws
Optional Cover Tamper Switch Available

Contact Ratings:
OSYSU-1: One set of SPDT (Form C)
OSYSU-2: Two sets of SPDT (Form C)
15 Amps at 125/250VAC
2.5 Amps at 30VDC resistive

Environmental Limitations:
-40°F to 140°F (-40°C to 60°C)
NEMA 4 and NEMA 6P Enclosure (IP67)
Indoor or outdoor use (Not for use in hazardous locations. See Bulletin No. 5400705 OSYS-U-EX for hazardous locations).

Conduit Entrances:
2 knockouts for 1/2" conduit provided

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

General Information
The OSYSU is used to monitor the open position of an OS&Y (outside screw and yoke) type gate valve. This device is available in two models; the OSYSU-1, containing one set of SPDT (Form C) contacts and the OSYSU-2, containing two sets of SPDT (Form C) contacts. These switches mount conveniently to most OS&Y valves ranging in size from 2" to 12" (50mm to 300mm). They will mount on some valves as small as ½" (12,5mm).
The cover is held in place by two tamper resistant screws that require a special tool to remove. The tool is furnished with each device and should be left with the building owner or responsible party. Replacement or additional cover screws and hex keys are available. See Ordering Information.

Optional Cover Tamper Switch
A field installable cover tamper switch is available as an option which may be used to indicate removal of the cover. See Ordering Information.

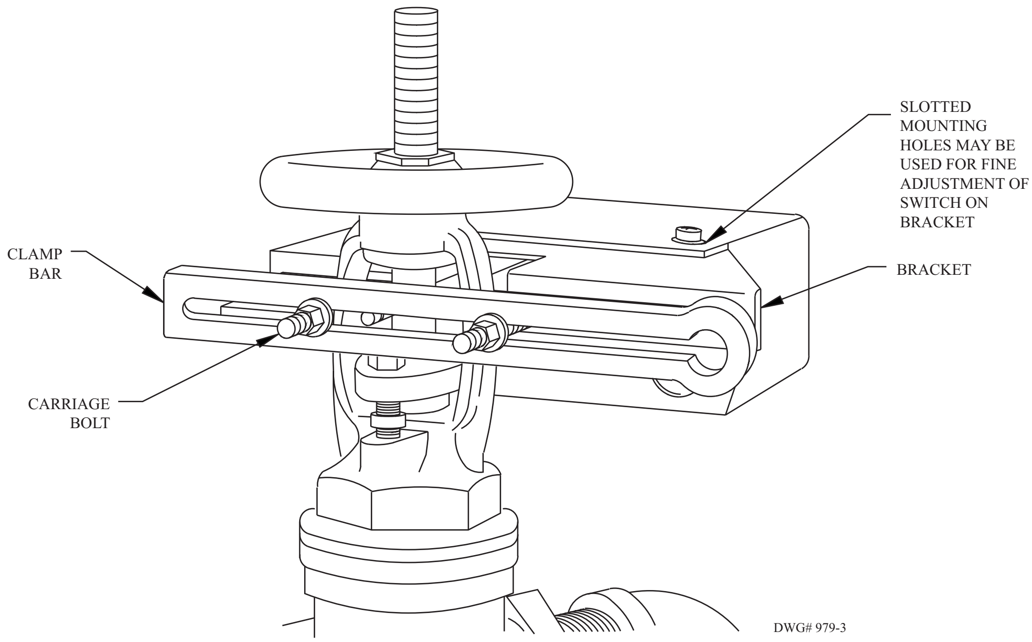
Testing
The OSYSU and its associated protective monitoring system should be inspected and tested in accordance with applicable NFPA codes and standards and/or the authority having jurisdiction (manufacturer recommends quarterly or more frequently).

Ordering Information

Model	Description	Stock No.
OSYSU-1	Outside Screw & Yoke Supervisory Switch (Single switch)	1010106
OSYSU-2	Outside Screw & Yoke Supervisory Switch (Double switch)	1010206
	Cover Screw	5490424
	Hex Key for Cover Screws and Installation Adjustments	5250062
	Optional Cover Tamper Switch Kit	0090131

FIG. 1 **SMALL VALVE INSTALLATION - 1/2" THRU 2 1/2" SIZES**

These switches mount conveniently to most 2" to 12" OS&Y valves. They will mount on some valves as small as 1/2". J-hooks may be required on valves with limited clearance.



SMALL VALVE INSTALLATION

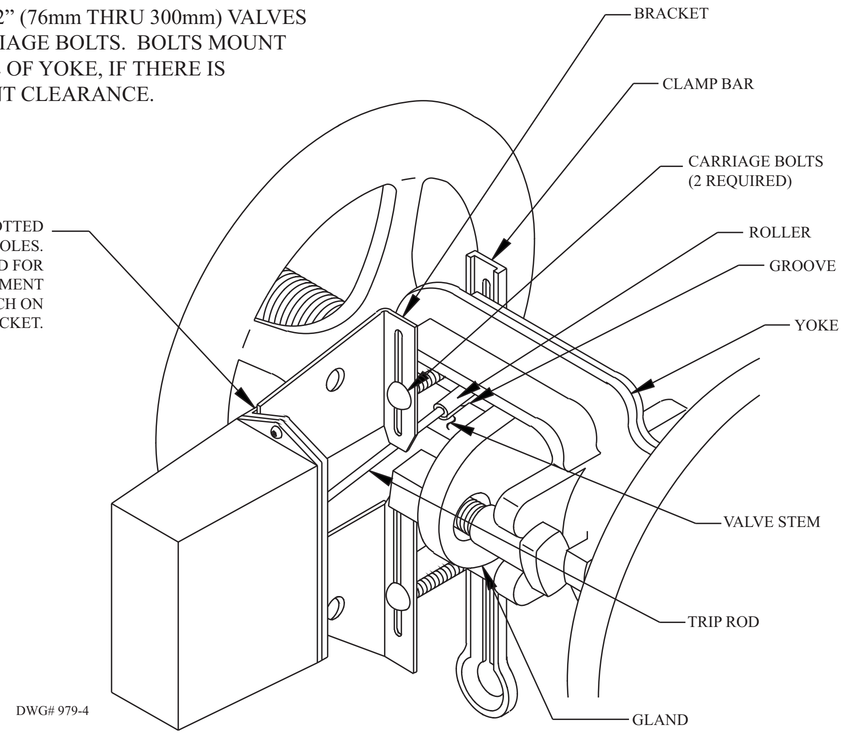
1. Remove and discard "C" washer and roller from the trip rod.
2. With the valve in the FULL OPEN position, locate the OSYSU across the valve yoke as far as possible from the valve gland, so that the trip rod lays against the non-threaded portion of the valve stem.
3. Loosen the locking screw that holds the trip rod in place and adjust the rod length (see Fig. 4). When adjusted properly, the rod should extend past the valve screw, but not so far that it contacts the clamp bar. Tighten the locking screw to hold the trip rod in place.

   NOTE: If trip rod length is excessive, loosen the locking screw and remove the trip rod from the trip lever. Using pliers, break off the one (1) inch long notched section (see Fig. 5). Reinstall trip rod and repeat Step 3 procedure.
4. Mount the OSYSU loosely with the carriage bolts and clamp bar supplied. On valves with limited clearance use J-hooks supplied instead of the carriage bolts and clamp bar to mount the OSYSU.
5. Mark the valve stem at the center of the trip rod.
6. Remove the OSYSU. File a 1/8" deep groove centered on the mark on the valve stem utilizing a 3/16" diameter straight file. Round and smooth the edges of the groove to prevent damage to the valve packing and to allow the trip rod to move easily in and out of the groove as the valve is operated.
7. Mount the OSYSU with the trip rod centered in groove.
8. Final adjustment is made by loosening 2 screws (see Fig. 1) and sliding the OSYSU on the bracket. Adjustment is correct when switches are not activated with the trip rod seated in the valve stem groove and that the switches activate when the trip rod moves out of the groove.
9. Tighten the adjustment screws and all mounting hardware. Check to insure that the rod moves out of the groove easily and that the switches activate within one turn when the valve is operated from the FULL OPEN towards the CLOSED position.

NOTE: CLOSE THE VALVE FULLY TO DETERMINE THAT THE STEM THREADS DO NOT ACTIVATE THE SWITCH. THE SWITCH BEING ACTIVATED BY THE STEM THREADS COULD RESULT IN A ***FALSE VALVE OPEN*** INDICATION.

FIG. 2 LARGE VALVE INSTALLATION - 3" THRU 12" SIZES

3” THRU 12” (76mm THRU 300mm) VALVES USE CARRIAGE BOLTS. BOLTS MOUNT ON INSIDE OF YOKE, IF THERE IS SUFFICIENT CLEARANCE.



LARGE VALVE INSTALLATION

1. With the valve in the FULL OPEN position, locate the OSYSU across the valve yoke as far as possible from the valve gland, so that the trip rod lays against the non-threaded portion of the valve stem.
2. Mount the OSYSU loosely with the carriage bolts and clamp bar supplied.
3. Loosen the locking screw that holds the trip rod in place and adjust the rod length (see Fig. 4). When adjusted properly, the rod should extend past the valve screw, but not so far that it contacts the clamp bar. Tighten the locking screw to hold the trip rod in place.

   NOTE: If trip rod length is excessive, loosen the locking screw and remove the trip rod from the trip lever. Using pliers, break off the one (1) inch long notched section (see Fig. 5). Reinstall trip rod and repeat Step 3 procedure.
4. Mark the valve stem at the center of the trip rod.
5. Remove the OSYSU. File a 1/8" deep groove centered on the mark of the valve stem utilizing a 3/8" diameter straight file. Round and smooth the edges of the groove to prevent damage to the valve packing and to allow the trip rod to move easily in and out of the groove as the valve is operated.
6. Mount the OSYSU loosely with the trip rod centered in groove.
7. Final adjustment is made by loosening 2 screws (see Fig. 2) and sliding the OSYSU on the bracket. Adjustment is correct when switches are not activated with the trip rod seated in the valve stem groove and that the switches activate within one turn when the valve is operated from the FULL OPEN towards the CLOSED position.
8. Tighten the adjustment screws and mounting hardware. Check to insure that the rod moves out of the groove easily and that the switches activate within one turn when the valve is operated from the FULL OPEN towards the CLOSED position.

NOTE: CLOSE THE VALVE FULLY TO DETERMINE THAT THE STEM THREADS DO NOT ACTIVATE THE SWITCH. THE SWITCH BEING ACTIVATED BY THE STEM THREADS COULD RESULT IN A ***FALSE VALVE OPEN*** INDICATION.

OSYSU-1,-2

OUTSIDE SCREW AND YOKE VALVE SUPERVISORY SWITCH

FIG. 3 **DIMENSIONS**

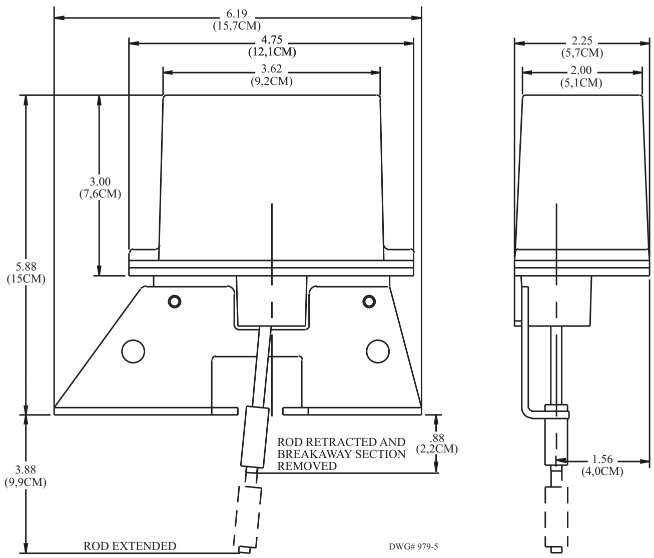
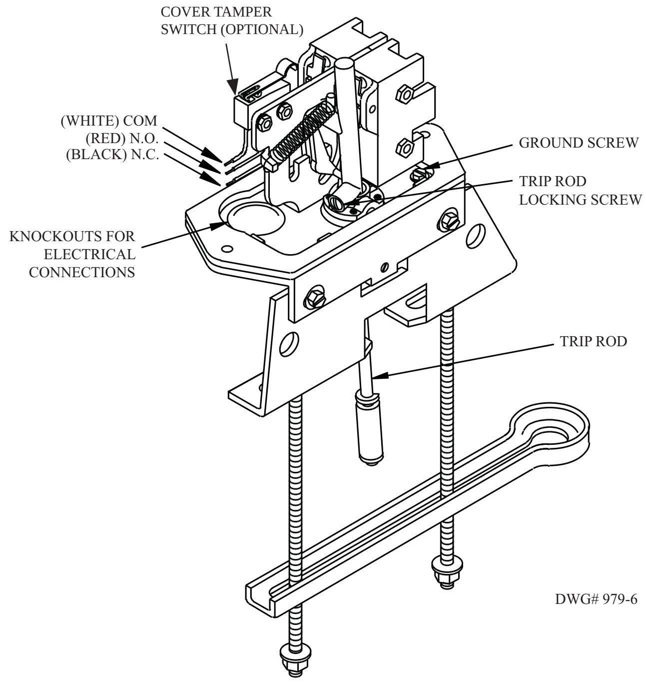
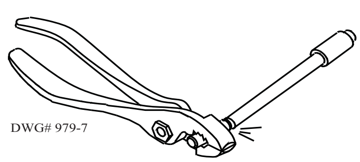


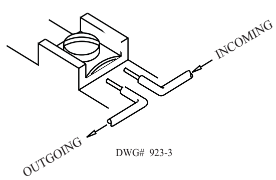
FIG. 4 **PARTS**



BREAKING EXCESSIVE ROD LENGTH

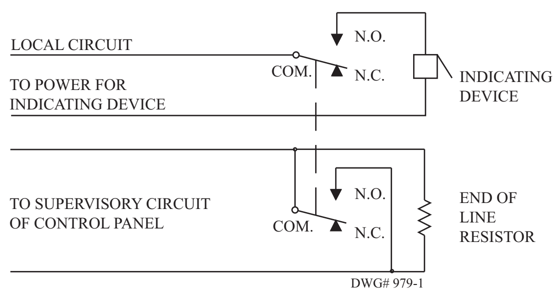


SWITCH TERMINAL CONNECTIONS CLAMPING PLATE TERMINAL



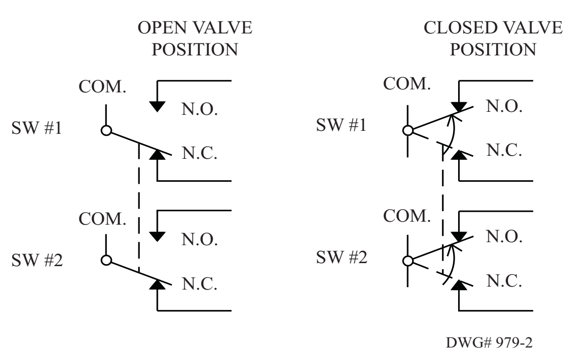
CAUTION:
An uninsulated section of a single conductor should not be looped around the terminal and serve as two separate connections. The wire must be severed, thereby providing supervision of the connection in the event that the wire becomes dislodged from under the terminal.

TYPICAL ELECTRICAL CONNECTIONS



Contacts shown in normal (valve open) condition.

TYPICAL SWITCH ACTION



GERARD ENGINEERING CO. MODEL-K FIRE PUMP TEST METER

Operations & Maintenance Manual
December 2015

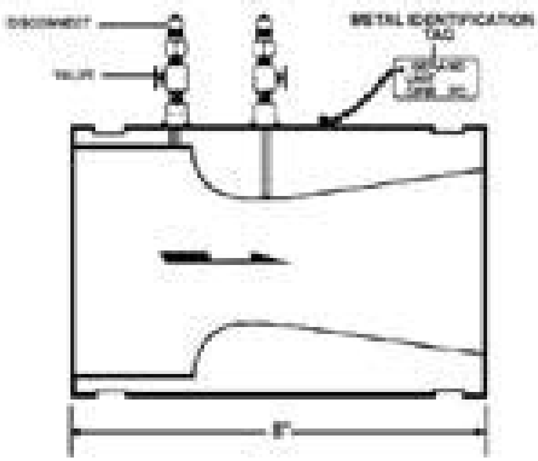
MODEL-K FIRE PUMP TEST METER

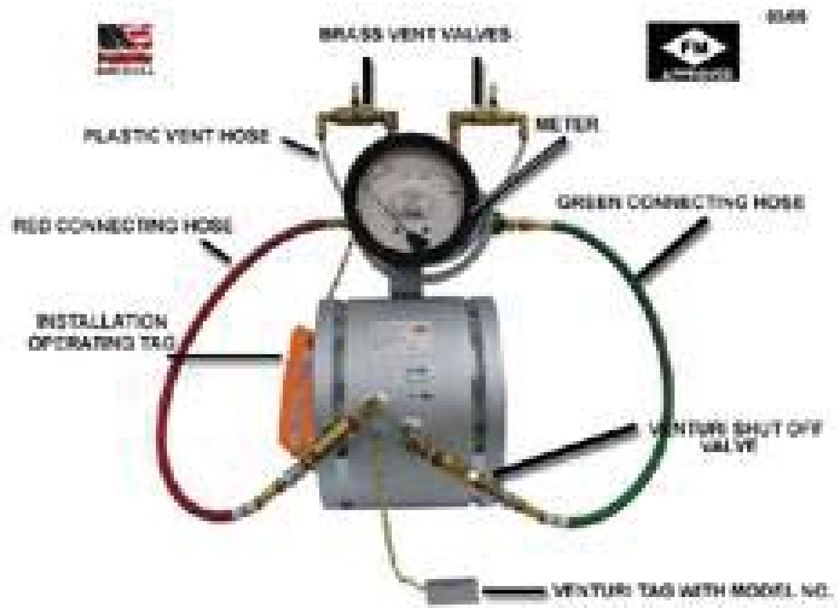
FM APPROVED 726-9-1-90 FM APPROVED

RATING 500 PSI

PUMP GPM	VENTURI SYSTEM MODEL NO.	PIPE SIZE	METER RANGE MIN. & MAX. GPM
1500	K-1500-8 (750)	8 INCH	750-3000

GROOVED ENDS





GERAND ENGINEERING CO.

11504 K-TEL DRIVE - MINNETONKA, MN - 55343 U.S.A. PHONE: (952) 374-1320 FAX: (952) 374-1758

Suppliers Contact Information

Pipe and Fabrication

Reliable Fabrication
2256 N Pagosa St #100, Aurora, CO 80011
Contact = Bo Ryan Boeckner
(720) 262-4816 Mobile (303) 656-6908
Email = RBoeckner@reliablesprinkler.com/
http://www.reliablesprinkler.com/

Brackets, Hangers and Fabrication

Viking Supply Net
12360 E 46th Ave, Denver, CO 8023
Contact = Shannon Lamb
(303) 576-0665 Mobile (303) 434-7617
Email = SLAMB@supplynet.com
http://www.vikinggroupinc.com/en/about/supplynet

Grvooved Fittings and Valves

Victaulic
3600 NE Kimball Drive, Kansas City, Missouri 64161
Contact = Steve Fritch
(800) 742-5842 Mobile (303) 641-0247
Email = SFritsch@victaulic.com
http://www.victaulic.com/en/

Fire Pump Assembly

Fire Pump Sales and Service
PO Box 44362, Denver, CO 80201
Contact = Fred Zacherl
(303) 460-8734 Mobile (303) 641-0247
Email = fred@firepumpsalesandservices.com
http://www.pattersonpumps.com/
http://www.mastercontrols.com/

Full Service Contractor

Western States Fire Protection Co.
7026 South Tucson Wat, Centennial, CO 80112
Contact = Fred Zacherl
(303) 792-0022 Mobile (720) 284-2472
Email = john.hulett@wsfp.us
http://www.wsfp.com/

PROVIDED SPARE PARTS

Operations & Maintenance Manual
December 2015

WSFP

System	Part Description	Part #	Manufacturer	Supplier	QTY	Location
Deluge	4" Eisenhower Flow Control Valve	FP-400-UF	Bermad	Victaulic	4	West Fan Deck
Deluge	4" Johnson Flow Control Valve	FP-400-UF	Bermad	Victaulic	4	West Fan Deck
Deluge	4" Flow Control Valve Trim Kit Only	Assembly	Bermad	Victaulic	8	West Fan Deck
Deluge	Eisenhower Insulated Valve Enclosure	Custom	Grunau	WSFP	2	West Fan Deck
Deluge	Johnson Insulated Valve Enclosure	Custom	Grunau	WSFP	2	West Fan Deck
Deluge	4" Grv. Butterfly Valve with Tamper	705W	Victaulic	WSFP	1	West Fan Deck
Portal	3/4" EC Horizontal Sidewall Sprinkler	VK630	Viking	Supply Net	12	Boiler Room Cabinet
Bete	1" Brass Full Cone Nozzle	N6 120 degree	Bete	WSFP	31	Boiler Room Cabinet
Bete	1 1/2" Brass Full Cone Nozzle	TF72 150 degree	Bete	WSFP	10	Boiler Room Cabinet
Pump Room	8" Grv. BF Valve w/ Tamper Switch	#705W	Victaulic	Victaulic	1	West Fan Deck
High Point	1/2" Air Relief Valve				2	West Fan Deck
Gauges	1/4" SOG Valve for Gauge				2	West Fan Deck
Gauges	1/4" 300 psi Gauge for IVE				19	West Fan Deck
Gauges	1/4" 300 psi Gauge for Pump Room				2	West Fan Deck
Relief	4" Pressure Relief Valve		Bermad	Victaulic	1	West Fan Deck
IVE	Bolts and nuts for IVE				1/2 Box	West Fan Deck
IVE	1/2 Box Versa Cleat				1/2 Box	West Fan Deck
IVE	IVE Insulation Strip				3 Rolls	West Fan Deck
IVE	Insulation Sleeves				8	West Fan Deck
Johnson	1 1/2" Grv. Cap	#006	Victaulic	WSFP	4	West Fan Deck
Johnson	1 1/2" Grv. Coup.	#009	Victaulic	WSFP	8	West Fan Deck
Eisenhower	2" Grv. Tee	#002	Victaulic	WSFP	1	West Fan Deck
Eisenhower	2" Grv. Cap	#006	Victaulic	WSFP	2	West Fan Deck
Eisenhower	2" Grv. 45	#003	Victaulic	WSFP	2	West Fan Deck
Eisenhower	2" Grv. 90	#001	Victaulic	WSFP	2	West Fan Deck
Portal	2" Galv. Flex. Coup.	#005	Victaulic	WSFP	3	West Fan Deck
Portal	2" Galv. Flex. Coup.	#005	Victaulic	WSFP	1	West Fan Deck
Eisenhower	2" Grv. Rigid Coup.	#009	Victaulic	WSFP	6	West Fan Deck
Eisenhower	2 1/2" Grv. Cap	#006	Victaulic	WSFP	5	West Fan Deck
IVE	4" Grv. Coup.	#005	Victaulic	WSFP	16	West Fan Deck
IVE	4" Grv. Flex. Coup	#75	Victaulic	WSFP	5	West Fan Deck
Pump Room	8" Grv. 90	#001	Victaulic	WSFP	1	West Fan Deck
Pump Room	8" Grv. Cap	#006	Victaulic	WSFP	2	West Fan Deck
Loop	6" Grv. Coup.	#009	Victaulic	WSFP	3	West Fan Deck
Loop	6" Grv. Flex. Coup.	#75	Victaulic	WSFP	1	West Fan Deck
Loop	6" Grv. Cap	#006	Victaulic	WSFP	1	West Fan Deck
Deluge	4" Grv. 90	#001	Victaulic	WSFP	9	West Fan Deck
Deluge	4" Grv. Drain 90	#10dr	Victaulic	WSFP	3	West Fan Deck
Deluge	4" Grv. Tee	#002	Victaulic	WSFP	2	West Fan Deck
Deluge	6" Grv. 45	#003	Victaulic	WSFP	1	West Fan Deck
Deluge	4" Grv. Cap	#006	Victaulic	WSFP	4	West Fan Deck
Deluge	4" Drain Cap		Victaulic	WSFP	1	West Fan Deck
IVE	Pressure Switch	PS10-1	Potter Electric	WSFP	3	West Fan Deck
IVE	10' Cable for IVE			WSFP	16	West Fan Deck
	Ball Drips and Nipple			WSFP	3	West Fan Deck
	Pro Shield Calcium Support			WSFP	Box	West Fan Deck
	Pro Shield Calcium Support - Heavy			WSFP	Box	West Fan Deck
	4" Unistrut Clamp			WSFP	5	West Fan Deck
	2 1/2" Unistrut Clamp			WSFP	6	West Fan Deck
	2" Unistrut Clamp			WSFP	3	West Fan Deck
	1 1/2" Unistrut Clamp			WSFP	9	West Fan Deck
IVE	1/2" Union		Victaulic	Victaulic	9	West Fan Deck
Loop	6" Grv. 90		Victaulic	Victaulic	1	West Fan Deck
Loop	8" Pipe			WSFP	10 LF	West Fan Deck on Pipe Rack
Loop	6" Pipe			WSFP	10 LF	West Fan Deck on Pipe Rack
Loop	4" Pipe			WSFP	20 LF	West Fan Deck on Pipe Rack

RECOMENDED SPARE PARTS

Operations & Maintenance Manual
December 2015

REPLACEMENT PARTS LIST

MC Series Electric Fire Pump Controllers

DESIGNATION	***DESCRIPTION***	***MCS PART NUMBER***
	Complete Chassis Assemblies	
Line Chassis	Line Voltage Transformer and Relay Chassis	586811-850
MC-CU	Control Unit Chassis	650256
POC	Programmable Option Chassis	650276
	Door Mounted Color Display	
HMI	3.5" Color Display (Human Machine Interface)	653275
	Cabinet Mounted Control Components	
USB	USB Waterproof Adapter with Cap	402785 / 402749
TRANSDUCER	Transducer, 1-6 vdc, 300 PSI	306772
DVS	Drain Valve Solenoid, 24 Vdc	306401
ALARM	Audible Alarm – Buzzer	402618
START, STOP	"START", "STOP" Pushbutton Operator	401993
	"START", "STOP" Pushbutton NO Contact	401992
IS	Isolating Sw. Operating Handle w/Door Interlock	402882 (NEMA 2,12) 400922 (NEMA 3R,4)
CB	Circuit Breaker Operating Handle	800686 (NEMA 2,12) 800685 (NEMA 3R,4)
MC-MO	Manual Mechanical Emergency Operator Handle	800686 (NEMA 2,12) 800685 (NEMA 3R,4)
MOLS	Manual Operator Limit Switch	801110
	Surge Arrester 208 thru 480 Vac Controllers	303481
	Surge Arrester 600 Vac Controllers	303482
	Fuse, Surge Arrester, 480 Vac, 100kA - Standard	204219
	Fuse, Surge Arrester, 600 Vac, 200kA	204319
	Plug-In Relays	
RY1 – RY4	DPDT 24 VDC Contactor Control Relay	617022

NOTE: When ordering replacement parts, you must supply the Serial Number and Model Number of the Controller in which parts are to be used.

RECOMMENDED SPARE PARTS FOR DOUBLE SUCTION PUMPS

Reference: Assembly Section

INTERMITTENT DUTY

Number		Description
7		Casing Ring
8	*	Impeller Ring
13	*	Packing (stuffing box)
13A		Packing O-Ring (shaft sleeve)
14	*	Shaft Sleeve
65	+*	Mechanical Seal (stationary element)
80	+*	Mechanical Seal (rotating element)
		Coupling and its accessories (not shown)
		Gasket (not shown)
		Gland Bolts (not shown)

CONTINUOUS DUTY

Number		Description
2		Impeller
6	*	Shaft
7		Casing Ring
8	*	Impeller Ring
13	*	Packing (stuffing box)
13A		Packing O-Ring (shaft sleeve)
14	*	Shaft Sleeve
16		Bearing (inboard)
18		Bearing (outboard)
20		Shaft Sleeve Nut
20A	*	Impeller Locknut
22		Bearing Locknut
32		Impeller Key
40		Deflector
46		Coupling Key
65	+*	Mechanical Seal – Stationary Element
68		Shaft Collar
80	+*	Mechanical Seal – Rotating Element
		Coupling and its accessories (not shown)
		All Hardware (not shown)
		Gasket (not shown)
		Gland Bolts (not shown)

* Determined by Pump Construction
\+ Complete Consists of 65 & 80

Eisenhower/Johnson Memorial Tunnel - EJMT
Fixed Fire Suppression System Project
Parts List

System	Part Description	Part #	Manufacturer	Supplier
Fire Pump Room	115 PSI @ 1250 GPM Fire Pump	MABSH	Patterson	Fire Pump Sales
Fire Pump Room	Fire Pump Controller & Transfer Switch	MCST	Master	Fire Pump Sales
Fire Pump Room	8" Grv. Strainer	#730	Victaulic	Victaulic
Fire Pump Room	8" Grv. BF Valve w/ Tamper Switch	#705W	Victaulic	Victaulic
Fire Pump Room	6" Grv. BF Valve w/ Tamper Switch	#705	Victaulic	Victaulic
Fire Pump Room	4" Grv. BF Valve w/ Tamper Switch	#705	Victaulic	Victaulic
Fire Pump Room	8" Grv. Check Valve	#717	Victaulic	Victaulic
Fire Pump Room	6" Grv. Check Valve	#717	Victaulic	Victaulic
Fire Pump Room	8" Flow Meter	K-1500-8	Gerand	Gerand
Fire Pump Room	4" Grv. Pressure Relief Valve	FP 430-UF	Bermad	Victaulic
Fire Pump Room	8" Flg. OS&Y Gate Valve	KS-FW	Kennedy	Viking
Fire Pump Room	6" Flg. NRS Gate Valve	C509	Kennedy	Viking
Fire Pump Room	4" Grv. Flow Control Valve	FP 400E-3DC	Bermad	Victaulic
	Grooved Fittings			
Pump Room Area	8" Grv. FL Flange Adapter	#744	Victaulic	Victaulic
Pump Room Area	8" Grv. FL Elbow	#001	Victaulic	Victaulic
Pump Room Area	8" Grv. FL 45 's	#003	Victaulic	Victaulic
Pump Room Area	8" Grv. FL Cap	#006	Victaulic	Victaulic
Pump Room Area	8" Grv. FL Tee	#002	Victaulic	Victaulic
Pump Room Area	8" Grv. FL Rigid Coupling	#005	Victaulic	Victaulic
Pump Room Area	8" Grv. Flexible Coupling	#004	Victaulic	Victaulic
Pump Room Area	8" Grv. STD Elbow	#010	Victaulic	Victaulic
Pump Room Area	8" Grv. STD 22 1/2 deg	#012	Victaulic	Victaulic
Pump Room Area	8" Grv. STD 11 1/4 deg	#013	Victaulic	Victaulic
Pump Room Area	8" Grv. STD Tee	#020	Victaulic	Victaulic
Pump Room Area	6" Grv. FL Flange Adapter	#744	Victaulic	Victaulic
Pump Room Area	6" Grv. FL Elbow	#001	Victaulic	Victaulic
Pump Room Area	6" Grv. FL Cap	#006	Victaulic	Victaulic
Pump Room Area	6" Grv. FL Tee	#002	Victaulic	Victaulic
Pump Room Area	6" Grv. FL Rigid Coupling	#005	Victaulic	Victaulic
Pump Room Area	6" Grv. Flexible Coupling	#004	Victaulic	Victaulic
Pump Room Area	6" Grv. STD FL Elbow	#010	Victaulic	Victaulic
Pump Room Area	6" Grv. STD FL Tee	#020	Victaulic	Victaulic
Deluge Systems	4" Grv. FL Elbow	#001	Victaulic	Victaulic
Deluge Systems	4" Grv. FL Tee	#002	Victaulic	Victaulic
Deluge Systems	4" Grv. FL Flexible Coupling	#004	Victaulic	Victaulic
Deluge Systems	4" Grv. FL Rigid Coupling	#005	Victaulic	Victaulic
Deluge Systems	4" Grv. FL End Cap	#006	Victaulic	Victaulic
Deluge Systems	3" Grv. FL Elbow	#001	Victaulic	Victaulic
Deluge Systems	3" Grv. FL Tee	#002	Victaulic	Victaulic
Deluge Systems	3" Grv. FL Flexible Coupling	#004	Victaulic	Victaulic
Deluge Systems	3" Grv. FL Rigid Coupling	#005	Victaulic	Victaulic
Deluge Systems	3" Grv. FL End Cap	#006	Victaulic	Victaulic
Deluge Systems	2 1/2" Grv. FL Elbow	#001	Victaulic	Victaulic
Deluge Systems	2 1/2" Grv. FL Tee	#002	Victaulic	Victaulic
Deluge Systems	2 1/2" Grv. FL Flexible Coupling	#004	Victaulic	Victaulic
Deluge Systems	2 1/2" Grv. FL Rigid Coupling	#005	Victaulic	Victaulic
Deluge Systems	2 1/2" Grv. FL End Cap	#006	Victaulic	Victaulic
Deluge Systems	2" Grv. FL Elbow	#001	Victaulic	Victaulic
Deluge Systems	2" Grv. FL Tee	#002	Victaulic	Victaulic
Deluge Systems	2" Grv. FL Flexible Coupling	#004	Victaulic	Victaulic
Deluge Systems	2" Grv. FL Rigid Coupling	#005	Victaulic	Victaulic
Deluge Systems	2" Grv. FL End Cap	#006	Victaulic	Victaulic
Deluge Systems	1 1/2" Grv. STD Elbow	#010	Victaulic	Victaulic
Deluge Systems	1 1/2" Grv. STD Tee	#020	Victaulic	Victaulic
Deluge Systems	1 1/2" Grv. STD Flexible Coupling	#004	Victaulic	Victaulic
Deluge Systems	1 1/2" Grv. STD Rigid Coupling	#005	Victaulic	Victaulic
Deluge Systems	1 1/2" Grv. FL Cap	#006	Victaulic	Victaulic
Deluge Systems	8" x 6" Reducing Coupling	#750	Victaulic	Victaulic
Deluge Systems	6" x 4" Reducing Coupling	#750	Victaulic	Victaulic
Deluge Systems	4" x 3" Reducing Coupling	#750	Victaulic	Victaulic
Deluge Systems	3" x 2 1/2" Reducing Coupling	#750	Victaulic	Victaulic
Deluge Systems	2 1/2" x 2" Reducing Coupling	#750	Victaulic	Victaulic
	Brass			
All	4" x 2 1/2" x 2 1/2" FDC	#6114	Gaurdian	Gaurdian
All	3" x 2 1/2" Hose Valves	#5115	Gaurdian	Gaurdian
All	2 1/2" Caps	#5525	Gaurdian	Gaurdian
All	2 1/2" x 2 1/2" Adapters	#3310	Gaurdian	Gaurdian
	Nozzles			
Johnson Deluge Systems	1" Brass Full Cone	N6 120 deg	Bete	Bete
Eisenhower Deluge Systems	1 1/2" Brass Full Cone	TF72 150 deg	Bete	Bete
Portal Deluge Systems	3/4" Extended Coverage HSW	VK630	Viking	Viking
	Devices			
Deluge Systems	Pressure Switch	PS10-2	Potter	Viking
Deluge Systems	Solenoid Valve for Flow Control	HT8210G207	ASCO	Victaulic
Pump Room Area	OS&Y Tamper Switch	OSYSU-2	Potter	Viking

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Eisenhower/Johnson Memorial Tunnel
Fixed Fire Suppression System
Design Build Project, NO. C 0703-360

Fire Protection System Consumables

The Fire Protection System and all associated components have no required consumables for normal operation, nor for any ongoing testing and maintenance operations.