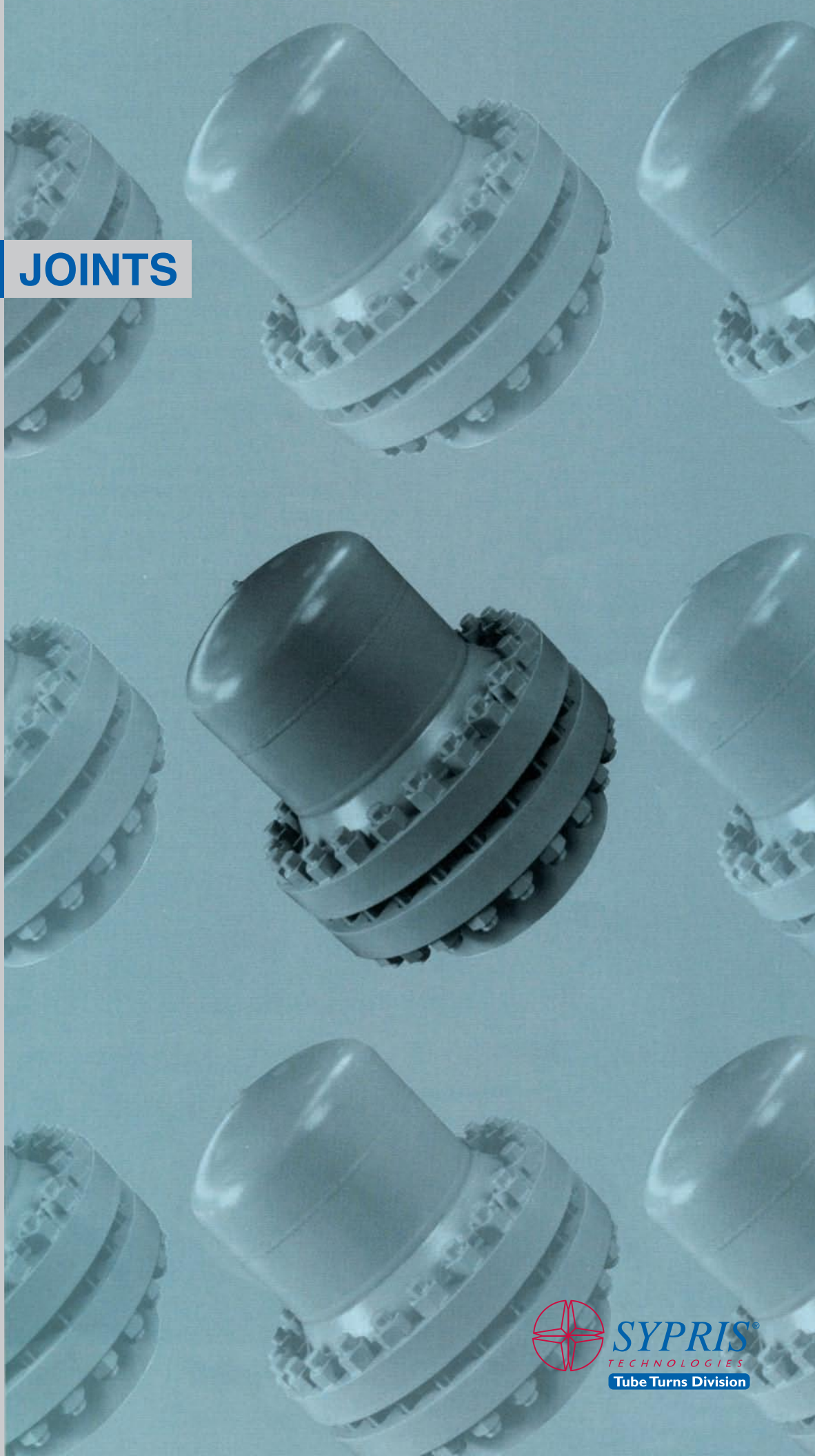
TRANSITION JOINTS



Transition Joints
for Aluminum-to-
Stainless Steel
Cryogenic Piping

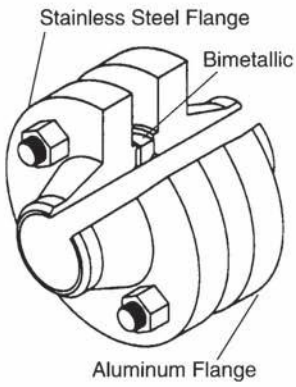
SYPRIS® TECHNOLOGIES
Tube Turns Division

TRANSITION JOINTS

The TRANSITION JOINT is a pre-fabricated, non-separable, metallurgically bonded joint used for field butt welding of dissimilar metal piping components which are not weldable to each other. Typical metals include aluminum to stainless steel for cryogenic applications.

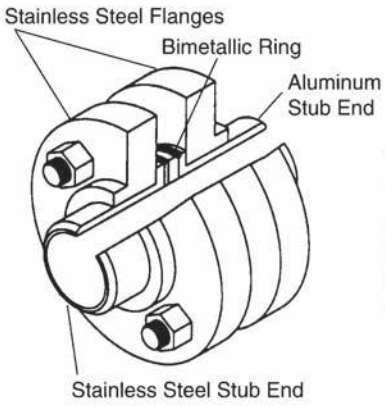
TYPE "T"

SIZES 2-1/2" TO 36"

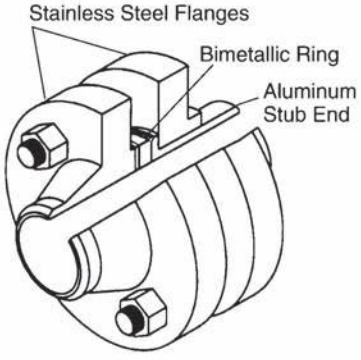


TYPE "K"

SIZES 1/2" TO 2"



2-1/2" TO 36"



ADVANTAGES OF TUBE TURNS TECHNOLOGY DESIGN:

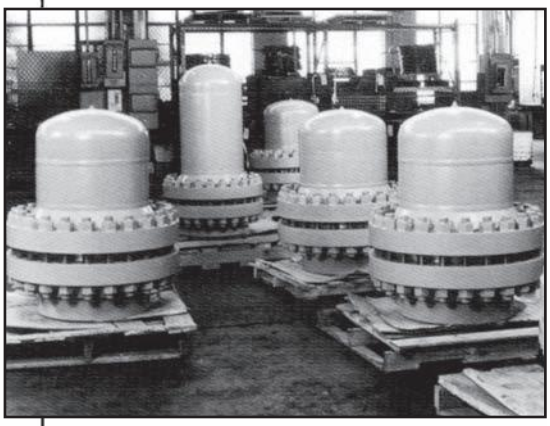
Reliable

Tube Turns Technologies Transition Joints have been manufactured for over 30 years in pipe sizes ranging from 1/2" to 36" diameter and have been produced from a variety of stainless steels (304, 304L, 316, 316L, 321, 347) and aluminum alloys (3003, 5082, 5083, 6061). They are used to join stainless steel piping to aluminum piping for cryogenic services down to minus 320°F (minus 196°C) and are installed in heat exchangers, liquefied gas storage tanks, transfer lines and similar cryogenic applications for pressures ranging from full vacuum to in excess of 6,000 psi. No field failures in over 30 years of successful service have proven the reliability of these joints.

CONSTRUCTION MATERIAL

COMPONENT	ASTM SPECIFICATIONS
Stainless Steel Flanges	A 182 (Type as Specified)
Stainless Steel Stub Ends	A 182 (Type as Specified)
Aluminum Flanges	B 247 (Type as Specified)
Aluminum Stub Ends	B 247 (Type as Specified)
Bimetallic Ring (Alloy 1100 & Type 304 S.S.)	B 209/ A 240
Stainless Steel Stud Bolts	A 320 Grade B8
Stainless Steel Heavy Hex Nuts	A 194 Grade 8

The materials normally specified for the matching piping systems are Type 304 or 304L for the stainless steel and Type 6061 or 5083 for the aluminum side. However other commercially available materials can be used in the construction of these joints.



Rugged Construction

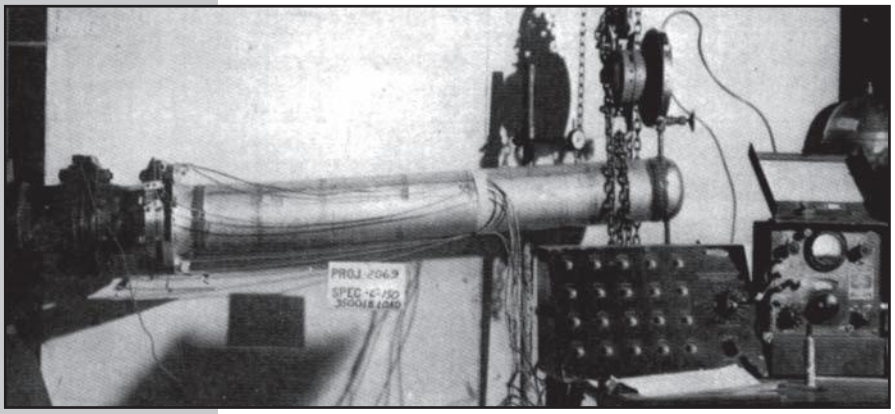
The construction of these Transition joints utilizes flanges and lap joint stub ends in accordance with ASME/ANSI dimensions which have proven reliable for all types of service conditions. These components are continuously seal welded to a bimetallic ring to provide a leakproof joint. This bimetallic ring consists of a layer of type 304 stainless steel and a layer of 1100 aluminum joined together by pressure welding to produce a strong, ductile solid-phase bond. The flanges are then bolted together and the bolts tightened to a predetermined torque. The bolts and nuts are then tack welded to provide a non-separable unit. These joints are constructed in accordance with ASME B31.3 Chemical Plant and Petroleum Refinery Piping and ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

Two Designs Available

To meet the varied requirements of the cryogenic industry, Tube Turns Technologies offers two types of aluminum/stainless steel Transition Joints. The Type "T" uses aluminum and stainless steel flanges and the Type "K" uses all stainless steel flanges and an aluminum stub end. The Type "T" design is generally a more economical design for systems using high strength aluminum alloys such as 6061-T6 whereas the Type "K" design is usually more economical for higher pressure systems utilizing the lower strength aluminum alloys such as 3003 and 5083.

PROTOTYPE PROGRAM

Tube Turns Technologies is fully qualified to provide all nondestructive examinations along with the required NDE Reports to meet customer requirements. Since reliability in service is of prime importance, Tube Turns Technologies conducted an extensive prototype qualification program which included a series of systematic critical tests.



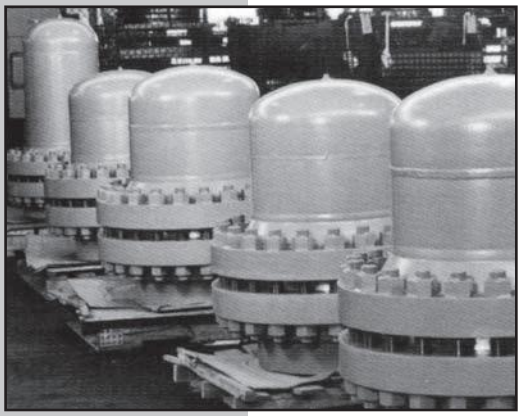
Full Size 6" Transition Joint Assembly being subjected to simultaneous internal pressure and external bending load.

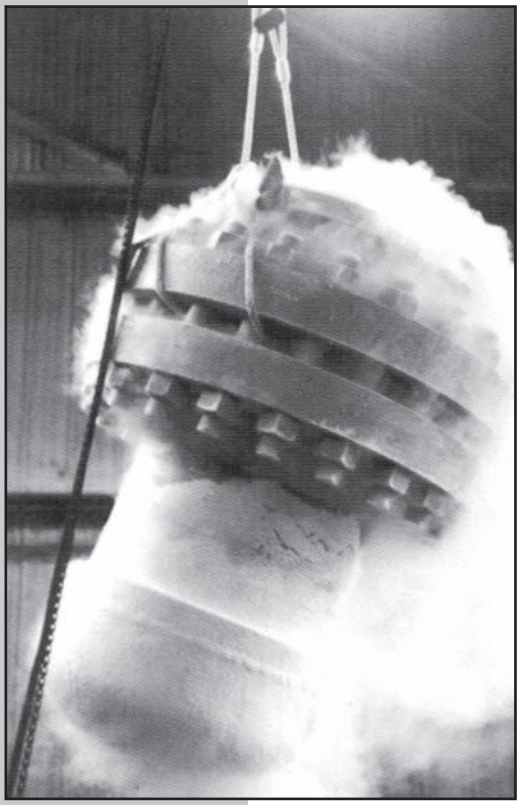
THE SERIES OF TESTS INCLUDE:

1. 100 psi air and helium leak tests (1×10^{-9} atm cc/sec).
2. Thermal cycle tests (boiling water at 212°F to liquid nitrogen at -320°F).
3. Hydrostatic testing to 4 times maximum rating.
4. Pressure pulsation testing of a Class 150 Transition Joint for more than 150,000 cycles at pressures to 1250 psi (4 times greater than the flange ratings).
5. Simultaneous pressure and bending tests producing bending stresses in the center of the Transition Joint greater than the yield strength of the attached 6061-T6 standard weight aluminum pipe.
6. Torsion tests of the Transition Joint generating loads sufficient to shear the attached aluminum pipe.
7. Tensile testing of bimetallic transition plate at high (to 1000°F), room, and cryogenic (to -320°F) temperatures to evaluate bond strength and integrity and the effect of thermal cycles.

The thoroughness and completeness of this testing program amply demonstrates the suitability of Tube Turns Transition Joints for cryogenic applications.

QUALITY CONTROL





Thermal Cycle Test of 16" Class 600 Transition Joint

Each joint manufactured by Tube Turns Technologies is completely factory assembled and helium leak tested to 1 x 10^{-7} atm. cc/sec. before shipment. In addition, the seal welds are liquid penetrant examined and the bimetallic ring material is ultrasonically examined to assure bond integrity.

QUALITY ASSURANCE

When specified, the following can be furnished for each joint:

- Certified Material Test Reports
- Helium Leak Test Certification
- Liquid Penetrant Test Certification

When specified, thermal shock and hydrostatic testing can be performed at additional cost. Tube Turns Technologies Quality Control System is in accordance with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section VIII, Division 1, Appendix 10 and is audited by an Authorized Inspection Agency.

The system covers Order Analysis, Drawing Control, Procurement Control, Receiving of Materials, Process Control, Welding, Nondestructive Examination and Inspection.

Raw materials are inspected for dimensional acceptability and proper heat code identification. Mill test reports are checked to insure proper physical and chemical properties.

A serial number is assigned to each Transition Joint and is permanently stamped on the joint. The actual heats of material used for the individual joint are permanently recorded for this serial number and this provides traceability to the material test reports for every joint.

THERMAL CYCLE TEST

Tube Turns Technologies has performed numerous thermal cycle tests (immerse joint in boiling water, 212°F, then transfer joint to liquid nitrogen, -320°F) and hydrostatic tests at 1-1/2 times design pressure as shown in the chart below.

SIZE In.	SIZE mm	CLASS
3/4	(20)	300
1	(25)	300
1-1/2	(40)	150
1-1/2	(40)	300
1-1/2	(40)	600
2	(50)	150
2	(50)	300
2	(50)	600
2-1/2	(65)	150
2-1/2	(65)	600
3	(80)	150
3	(80)	300
3	(80)	600
3-1/2	(90)	150
3-1/2	(90)	600
4	(100)	150
4	(100)	300
4	(100)	600
5	(125)	600
6	(150)	150
6	(150)	300
6	(150)	600
8	(200)	150
8	(200)	300
8	(200)	600
10	(250)	150
10	(250)	300
10	(250)	600
12	(300)	150
12	(300)	300
12	(300)	600
14	(350)	150
14	(350)	600
16	(400)	150
16	(400)	300
16	(400)	600
18	(450)	150
18	(450)	600
20	(500)	150
20	(500)	300
20	(500)	600
24	(600)	150
24	(600)	600
26	(650)	600
28	(700)	150
30	(750)	150
36	(900)	150

JOINT RATINGS

Tube Turns Technologies Transition Joints utilize flanges with ASME B 16.5 dimensions for sizes up through 24" and ASME B 16.47 Series "B" dimensions for sizes 26" through 36". Ratings are based on stainless steel flange ratings published in B 16.5, B 16.47 and aluminum ratings published in ASME B 31.3.

PRESSURE RATINGS

The ratings are shown in the following tables for each type of Transition Joint construction and assume that the user has specified the matching pipe wall thickness required by the appropriate construction code.

Installation, Operation And Maintenance

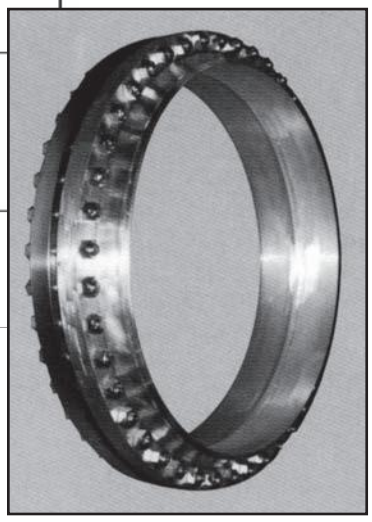
No special precautions are normally required for installation of Tube Turns Technologies flanged type transition joints and the same welding procedures that are used to join stainless or aluminum piping in the system are satisfactory for welding the transition joints. However heating of the aluminum flanges and the attached aluminum pipe may need to be limited to approximately 350°F to minimize the loss of strength of the tempered type of aluminum alloys.

TYPE "T" TRANSITION JOINT PRESSURE RATINGS (PSIG AT 100°F AND LOWER)

CLASS	STAINLESS STEEL (304, 316) ALUMINUM (6061-T6)	STAINLESS STEEL (304L, 316L) ALUMINUM (6061-T6)	STAINLESS STEEL (304, 304L, 316, 316L) ALUMINUM (3003)
150	275	230	40
300	720	600	105
600	1440	1200	205

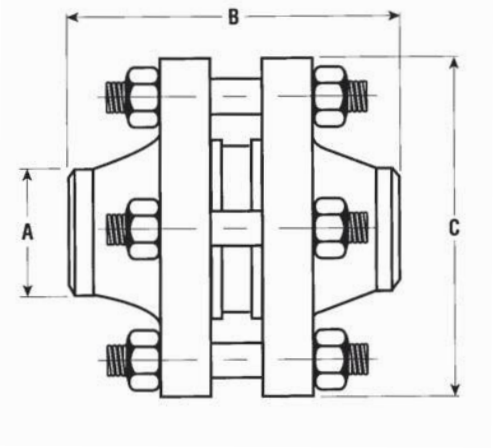
TYPE "K" TRANSITION JOINT PRESSURE RATINGS (PSIG AT 100°F AND LOWER)

CLASS	STAINLESS STEEL (304, 316) ALUMINUM (6061-T6, 3003, 5083-H112)	STAINLESS STEEL (304L, 316L) ALUMINUM (6061-T6, 3003, 5083-H112)
150	275	230
300	720	600
600	1440	1200



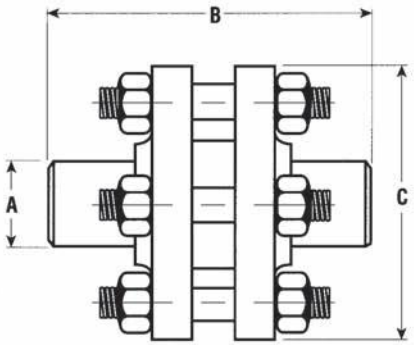
JOINT DIMENSIONS

TYPE "T" JOINT

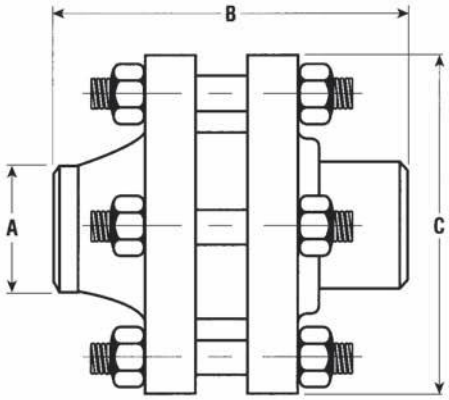


Nominal Pipe Size In (mm)	Diameter at Weld Bevel "A" In (mm)	CLASS 150 Overall Length "B" In (mm)	CLASS 150 Maximum Diameter "C" In (mm)	CLASS 150 Approximate Weight Lbs (Kg)	CLASS 300 Overall Length "B" In (mm)	CLASS 300 Maximum Diameter "C" In (mm)	CLASS 300 Approximate Weight Lbs (Kg)	CLASS 600 Overall Length "B" In (mm)	CLASS 600 Maximum Diameter "C" In (mm)	CLASS 600 Approximate Weight Lbs (Kg)
2-1/2 (65)	2.88 (73.0)	6.12 (155.4)	7.00 (177.8)	17 (7.7)	6.62 (168.1)	7.50 (190.5)	23 (10.4)	7.38 (187.5)	7.50 (190.5)	34 (15.4)
3 (80)	3.50 (88.9)	6.12 (155.4)	7.50 (190.5)	21 (9.5)	6.88 (174.8)	8.25 (209.6)	25 (11.3)	7.62 (193.5)	8.25 (209.6)	37 (16.8)
3-1/2 (90)	4.00 (101.6)	6.25 (158.8)	8.50 (215.9)	27 (12.2)	7.00 (177.8)	9.00 (228.6)	37 (16.8)	7.88 (200.2)	9.00 (228.6)	49 (22.2)
4 (100)	4.50 (114.3)	6.62 (168.1)	9.00 (228.6)	29 (13.2)	7.38 (187.5)	10.00 (254.0)	39 (17.7)	9.12 (231.6)	10.75 (273.1)	70 (31.8)
5 (125)	5.56 (141.3)	7.62 (193.5)	10.00 (254.0)	39 (17.7)	8.38 (212.9)	11.00 (279.4)	53 (24.0)	10.12 (257.0)	13.00 (330.2)	112 (50.8)
6 (150)	6.63 (168.3)	7.62 (193.5)	11.00 (279.4)	45 (20.4)	8.38 (212.9)	12.50 (317.5)	72 (32.7)	10.38 (263.7)	14.00 (355.6)	139 (63.0)
8 (200)	8.63 (219.1)	8.62 (218.9)	13.50 (342.9)	67 (30.4)	9.38 (238.3)	15.00 (381.0)	120 (54.4)	11.62 (295.1)	16.50 (419.1)	202 (91.6)
10 (250)	10.75 (273.1)	8.62 (218.9)	16.00 (406.4)	100 (45.4)	9.88 (251.0)	17.50 (444.5)	173 (78.5)	13.12 (333.2)	20.00 (508.0)	336 (152.4)
12 (300)	12.75 (323.9)	9.62 (244.3)	19.00 (482.6)	142 (64.4)	10.88 (276.4)	20.50 (520.7)	253 (114.8)	13.38 (339.9)	22.00 (558.8)	412 (186.9)
14 (350)	14.00 (355.6)	10.62 (269.7)	21.00 (533.4)	186 (84.4)	11.88 (301.8)	23.00 (584.2)	337 (152.9)	14.12 (358.6)	23.75 (603.3)	593 (269.0)
16 (400)	16.00 (406.4)	10.62 (269.7)	23.50 (596.9)	238 (108.0)	12.12 (307.8)	25.50 (647.7)	444 (201.4)	15.12 (384.0)	27.00 (685.8)	806 (365.6)
18 (450)	18.00 (457.2)	11.62 (295.1)	25.00 (635.0)	272 (123.4)	13.12 (333.2)	28.00 (711.2)	542 (245.8)	15.62 (396.7)	29.25 (743.0)	945 (428.6)
20 (500)	20.00 (508.0)	12.00 (304.8)	27.50 (698.5)	336 (152.4)	13.38 (339.9)	30.50 (774.7)	646 (293.0)	16.12 (409.4)	32.00 (812.8)	1195 (542.0)
22 (550)	22.00 (558.8)	12.38 (314.5)	29.50 (749.3)	409 (185.5)	13.62 (345.9)	33.00 (838.2)	788 (357.4)	16.62 (422.1)	34.25 (870.0)	1292 (586.0)
24 (600)	24.00 (609.6)	12.62 (320.5)	32.00 (812.8)	477 (216.4)	13.88 (352.6)	36.00 (914.4)	945 (428.6)	17.12 (434.8)	37.00 (939.8)	1723 (781.5)
26 (650)	26.00 (660.4)	7.62 (193.5)	30.94 (785.9)	247 (112.0)	12.00 (304.8)	34.12 (866.6)	767 (347.9)	15.38 (390.7)	35.00 (889.0)	1253 (568.3)
28 (700)	28.00 (711.2)	8.12 (206.2)	32.94 (836.7)	284 (128.8)	12.38 (314.5)	36.25 (920.8)	891 (404.1)	16.12 (409.4)	37.50 (952.5)	1482 (672.2)
30 (750)	30.00 (762.0)	8.50 (215.9)	34.94 (887.5)	312 (141.5)	13.12 (333.2)	39.00 (990.6)	1106 (501.7)	17.25 (438.2)	40.25 (1022.4)	1852 (840.0)
32 (800)	32.00 (812.8)	9.12 (231.6)	37.06 (941.3)	353 (160.1)	13.88 (352.6)	41.50 (1054.1)	1392 (631.4)	18.12 (460.2)	42.75 (1085.9)	2197 (996.5)
34 (850)	34.00 (863.6)	9.38 (238.3)	39.56 (1004.8)	454 (205.9)	14.25 (362.0)	43.62 (1107.9)	1514 (686.7)	19.50 (495.3)	45.75 (1162.1)	2693 (1221.5)
36 (900)	36.00 (914.4)	9.88 (251.0)	41.62 (1057.1)	513 (232.7)	14.88 (378.0)	46.12 (1171.4)	1680 (762.0)	20.25 (514.4)	47.75 (1212.9)	3088 (1400.7)

TYPE "K" JOINTS



1/2" to 2"



2-1/2" to 36"

ORDERING INFORMATION

When ordering, please specify the wall thickness of the matching pipes. Tube Turns transition joints are normally thru bored to the same ID as the aluminum matching pipe and taper bored at the stainless steel end to match the stainless steel pipe.

		CLASS 150			CLASS 300			CLASS 600		
Nominal Pipe Size In (mm)	Diameter at Weld Bevel "A" In (mm)	Overall Length "B" In (mm)	Maximum Diameter "C" In (mm)	Approximate Weight Lbs (Kg)	Overall Length "B" In (mm)	Maximum Diameter "C" In (mm)	Approximate Weight Lbs (Kg)	Overall Length "B" In (mm)	Maximum Diameter "C" In (mm)	Approximate Weight Lbs (Kg)
1/2 (15)	0.84 (21.3)	6.69 (169.9)	3.50 (88.9)	6 (2.7)	6.69 (169.9)	3.75 (95.3)	6 (2.7)	6.69 (169.9)	3.75 (95.3)	6 (2.7)
3/4 (20)	1.05 (26.7)	6.69 (169.9)	3.88 (98.6)	6 (2.7)	6.69 (169.9)	4.62 (117.3)	9 (4.1)	6.69 (169.9)	4.62 (117.3)	9 (4.1)
1 (25)	1.32 (33.4)	8.69 (220.7)	4.25 (108.0)	7 (3.2)	8.69 (220.7)	4.88 (124.0)	11 (5.0)	8.69 (220.7)	4.88 (124.0)	11 (5.0)
1-1/4 (32)	1.66 (42.2)	8.69 (220.7)	4.62 (117.3)	8 (3.6)	8.69 (220.7)	5.25 (133.4)	13 (5.9)	8.69 (220.7)	5.25 (133.4)	14 (6.4)
1-1/2 (40)	1.90 (48.3)	8.69 (220.7)	5.00 (127.0)	10 (4.5)	8.69 (220.7)	6.12 (155.4)	18 (8.2)	8.69 (220.7)	6.12 (155.4)	20 (9.1)
2 (50)	2.38 (60.3)	12.69 (322.3)	6.00 (152.4)	17 (7.7)	12.69 (322.3)	6.50 (165.1)	24 (10.9)	12.69 (322.3)	6.50 (165.1)	26 (11.8)
2-1/2 (65)	2.88 (73.0)	9.44 (239.8)	7.00 (177.8)	23 (10.4)	9.69 (246.1)	7.50 (190.5)	32 (14.5)	10.06 (255.5)	7.50 (190.5)	41 (18.6)
3 (80)	3.50 (88.9)	9.44 (239.8)	7.50 (190.5)	27 (12.2)	9.81 (249.2)	8.25 (209.6)	36 (16.3)	10.19 (258.8)	8.25 (209.6)	47 (21.3)
3-1/2 (90)	4.00 (101.6)	9.50 (241.3)	8.50 (215.9)	36 (16.3)	9.88 (251.0)	9.00 (228.6)	49 (22.2)	10.31 (261.9)	9.00 (228.6)	64 (29.0)
4 (100)	4.50 (114.3)	9.69 (246.1)	9.00 (228.6)	38 (17.2)	10.06 (255.5)	10.00 (254.0)	56 (25.4)	10.94 (277.9)	10.75 (273.1)	93 (42.2)
5 (125)	5.56 (141.3)	12.19 (309.6)	10.00 (254.0)	49 (22.2)	12.56 (319.0)	11.00 (279.4)	74 (33.6)	13.44 (341.4)	13.00 (330.2)	151 (68.5)
6 (150)	6.63 (168.3)	12.19 (309.6)	11.00 (279.4)	59 (26.8)	12.56 (319.0)	12.50 (317.5)	102 (46.3)	13.56 (344.4)	14.00 (355.6)	186 (84.4)
8 (200)	8.63 (219.1)	12.69 (322.3)	13.50 (342.9)	87 (39.5)	13.06 (331.7)	15.00 (381.0)	161 (73.0)	14.19 (360.4)	16.50 (419.1)	273 (123.8)
10 (250)	10.75 (273.1)	14.69 (373.1)	16.00 (406.4)	131 (59.4)	15.31 (388.9)	17.50 (444.5)	240 (108.9)	16.94 (430.3)	20.00 (508.0)	460 (208.7)
12 (300)	12.75 (323.9)	15.19 (385.8)	19.00 (482.6)	189 (85.7)	15.81 (401.6)	20.50 (520.7)	355 (161.0)	17.06 (433.3)	22.00 (558.8)	561 (254.5)
14 (350)	14.00 (355.6)	17.69 (449.3)	21.00 (533.4)	261 (118.4)	18.31 (465.1)	23.00 (584.2)	487 (220.9)	19.44 (493.8)	23.75 (603.3)	764 (346.5)
16 (400)	16.00 (406.4)	17.69 (449.3)	23.50 (596.9)	332 (150.6)	18.44 (468.4)	25.50 (647.7)	628 (284.9)	19.94 (506.5)	27.00 (685.8)	1047 (474.9)
18 (450)	18.00 (457.2)	18.19 (462.0)	25.00 (635.0)	376 (170.5)	18.94 (481.1)	28.00 (711.2)	766 (347.4)	20.19 (512.8)	29.25 (743.0)	1246 (565.2)
20 (500)	20.00 (508.0)	18.38 (466.9)	27.50 (698.5)	472 (214.1)	19.06 (484.1)	30.50 (774.7)	918 (416.4)	20.44 (519.2)	32.00 (812.8)	1569 (711.7)
22 (550)	22.00 (558.8)	18.56 (471.4)	29.50 (749.3)	538 (244.0)	19.19 (487.4)	33.00 (838.2)	1053 (477.6)	20.69 (525.5)	34.25 (870.0)	1710 (775.6)
24 (600)	24.00 (609.6)	18.69 (474.7)	32.00 (812.8)	655 (297.1)	19.31 (490.5)	36.00 (914.4)	1337 (606.4)	20.94 (531.9)	37.00 (939.8)	2290 (1038.7)
26 (650)	26.00 (660.4)	16.19 (411.2)	30.94 (785.9)	400 (181.4)	18.38 (466.9)	34.12 (866.6)	1115 (505.8)	20.06 (509.5)	35.00 (889.0)	1723 (781.5)
28 (700)	28.00 (711.2)	16.44 (417.6)	32.94 (836.7)	450 (204.1)	18.56 (471.4)	36.25 (920.8)	1298 (588.8)	20.44 (519.2)	37.50 (952.5)	2034 (922.6)
30 (750)	30.00 (762.0)	16.62 (422.1)	34.94 (887.5)	495 (224.5)	18.91 (480.3)	39.00 (990.6)	1584 (718.5)	21.00 (533.4)	40.25 (1022.4)	2543 (1153.5)
32 (800)	32.00 (812.8)	16.94 (430.3)	37.06 (941.3)	559 (253.6)	19.31 (490.5)	41.50 (1054.1)	1942 (880.9)	21.44 (544.6)	42.75 (1085.9)	2998 (1359.9)
34 (850)	34.00 (863.6)	17.00 (431.8)	39.56 (1004.8)	699 (317.1)	19.50 (495.3)	43.62 (1107.9)	2134 (968.0)	22.12 (561.8)	45.75 (1162.1)	3681 (1669.7)
36 (900)	36.00 (914.4)	17.31 (439.7)	41.62 (1057.1)	790 (358.3)	19.81 (503.2)	46.12 (1171.4)	2366 (1073.2)	22.50 (571.5)	47.75 (1212.9)	4160 (1886.9)

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