

Specification for Line Pipe

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Note

This edition supersedes the 35th edition dated May 31, 1985 and Sup. 1 thereto dated May 31, 1985. It includes revisions adopted at the 1985 and 1986 meetings.

This specification was originally adopted as "tentative" in 1927 and as "standard" in 1928. Revised editions were issued in 1929, 1930, 1931, 1934, 1935, 1940, 1942, 1944, 1945, 1949, 1951, 1954, 1955, 1956, 1957, 1958, 1960, 1962, 1963, 1965, 1967, 1968, 1969, 1970, 1971, 1973, 1975, 1977, 1978, 1980, 1982, 1983, 1984, 1985 and 1986.

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SUGGESTIONS FOR ORDERING API LINE PIPE

In placing orders for line pipe to be manufactured in accordance with API Spec 5L, the purchaser should specify the following on the purchase order:

Specification	API Spec 5L
Quantity	
Grade or Class	Table 3.1 and 4.1
Process of Manufacture:	
Pipe.....	Par. 2.1
Pipe Material.....	Par. 2.3
Size	
Nominal Diameter:	
Standard-Weight Threaded Pipe.....	Table 6.1
Standard-Weight Plain-End Pipe	Table 6.2
Extra-Strong Plain-End Pipe.....	Table 6.2
Extra-Strong Threaded Pipe	Table 6.1.a
Double-Extra-Strong Plain-End Pipe	Table 6.2
Outside Diameter:	
Regular-Weight Plain-End Pipe	Table 6.2
Special Plain-End Pipe.....	Table 6.2
Weight Per Foot or Wall Thickness	Par. 6.1
Length	Par. 6.5
Inspection by Purchaser	Par. 10.2
End Finish	Sect. 7
Delivery Date and Shipping Instructions	

The purchaser should also state on the purchase order his requirements concerning the following stipulations, which are optional with the purchaser:

Heat Analysis	Par. 3.2
Product Analysis	Par. 3.3, 3.5
Yield-to-Tensile Ratio	Par. 4.1
Acceptance of Jointers	Par. 6.7
Jointers for Threaded Pipe	Par. 6.7
Threaded Ends, Extra-Strong Pipe	Par. 7.1
Alternative Bevel, Plain-End Pipe in Sizes	
2½ in. and larger	Par. 7.3
Special Coupling Pipe Ends	Par. 7.5
Power-Tight Make-up	Par. 7.2
Bare Pipe — Special Coatings	Par. 11.9
Repairing Defects.....	Par. 10.8, 10.9
Markings in Metric Units	Par. 11 (d)
Method of Welding Jointers	Appendix A

Attention is called to the following stipulations which are subject to agreement between the purchaser and the manufacturer:

Intermediate Grades	Par. 1.1, 3.1, 4.1, Table B.1
Intermediate Diameters	Par. 6.2
Intermediate Wall Thickness	Par. 6.3
Supplementary Requirements	Appendix E
Supplementary Hydrostatic Test.....	Par. 5.4
Hydrostatic Test Pressure	Par. 5.3
Average Length	Par. 6.5
Welded Couplings.....	Par. 8.1
Thread Protectors	Par. 7.6
Marking Requirements	Par. 11.1, 11.4, 11.6

SPECIAL NOTE:

NOTHING IN THIS SPECIFICATION SHOULD BE INTERPRETED AS INDICATING A PREFERENCE BY THE COMMITTEE FOR ANY MATERIAL OR PROCESS OR AS INDICATING EQUALITY BETWEEN THE VARIOUS MATERIALS OR PROCESSES. IN THE SELECTION OF MATERIALS AND PROCESSES, THE PURCHASER MUST BE GUIDED BY HIS EXPERIENCE AND BY THE SERVICE FOR WHICH THE PIPE IS INTENDED.

Foreword

a. This specification is under the jurisdiction of the Committee on Standardization of Tubular Goods of the American Petroleum Institute. Spec 5LS and 5LX have been incorporated into this edition of Spec 5L. Spec 5LS and 5LX, the last editions of which were published in March 1982, have been withdrawn.

b. The purpose of this specification is to provide standards for pipe suitable for use in conveying gas, water, and oil in both the oil and natural gas industries.

c. Although the plain-end line pipe meeting this specification is primarily intended for field make-up by circumferential welding, the manufacturer will not assume responsibility for field welding.

d. For regular-weight and special plain-end pipe (special weight), and for standard-weight threaded pipe larger than 12 in. nominal, the size designations used herein are outside-diameter sizes. For all other pipe, the size designations are nominal pipe sizes. In the text paragraphs herein, where pipe size limits (or size ranges) are given, these are outside-diameter sizes except where stated to be nominal. These outside-diameter size limits and ranges apply also to the corresponding nominal sizes.

e. Class II steel is rephosphorized and probably has better threading properties than Class I. Because Class II has higher chemical properties than Class I, it may be somewhat more difficult to bend.

f. Metric units in this specification are shown in italic type in parenthesis in the text and in many tables. Outside diameters and wall thicknesses are converted from inch dimensions. The converted diameters are rounded to the nearest 0.1 mm for diameters less than 18 in. and to the nearest 1.0 mm for diameters 18 in. and larger. Wall thicknesses are rounded to the nearest 0.1 mm.

Metric inside diameters are calculated from the metric outside diameters and wall thicknesses and rounded to the nearest 0.1 mm.

Metric plain-end weights are calculated from the metric outside diameters and wall thicknesses by the following formula and rounded to the nearest 0.01 kg/m.

$$w_{pe} = .02466 (D-t)t$$

Metric hydrostatic pressures are calculated from the metric outside diameters and wall thicknesses and metric fiber stresses shown in Sect. 5.

The factors used where conversions are appropriate are as follows:

1 inch (in.)	= 25.4 millimeters (mm) exactly
1 square inch (sq. in.)	= 645.16 square millimeters (mm ²) exactly
1 foot (ft.)	= 0.3048 meters (m) exactly
1 pound (lb.)	= 0.45359 kilograms (kg)
1 pound per foot (lb/ft)	= 1.4882 kilograms per meter (kg/m)
1 pound per square inch (psi)	= 6.895 kilopascals (kPa) for pressure = .006895 megapascals (MPa) for stress
1 foot-pound (ft-lb)	= 1.3558 Joules (J) for impact energy

The following formula was used to convert degrees Fahrenheit (°F) to degrees Celsius (°C):

$$^{\circ}\text{C} = \frac{5}{9} (\text{°F} - 32)$$

Attention Users: Portions of this publication have been changed from the previous edition. The location of changes have been marked with a bar in the margin, as shown to the left of this paragraph. In some cases the changes are significant, while in other cases the changes reflect minor editorial adjustments. The bar notations in the margins are provided as an aid to users as to those parts of this publication that have been changed from the previous edition, but API makes no warranty as to the accuracy of such bar notations.

SECTION 1

SCOPE

NOTE: The grade designations used herein for Grades A and B do not include reference to the specified minimum yield strength. Other grade designations used herein comprise the Letter A or X followed by the first two digits of the specified minimum yield strength.

1.1 Coverage. This specification covers seamless and welded steel line pipe. It includes standard-weight and extra-strong threaded line pipe; and standard-weight plain-end, regular-weight plain-end, special plain-end, extra-strong plain-end, and double-extra-strong plain-end pipe; as well as bell and spigot and through-the-flowline (TFL) pipe.

Dimensional requirements on threads and thread gages, stipulations on gaging practice, gage specifications and certification, as well as instruments and methods for inspection of threads are given in API Std 5B and are applicable to products covered by this specification.

Grades covered by this specification are A25, A, B, X42, X46, X52, X56, X60, X65, X70 and X80 and grades intermediate to the Grades X42 and higher listed. The chemical composition and mechanical properties of intermediate grades which are subject to agreement between purchaser and manufacturer must be consistent with the corresponding requirements for the grades to which the material is intermediate.

Pipe manufactured as Grade X60 or higher shall not be substituted for pipe ordered for Grade X52 or lower without purchaser approval.

1.2 Policy. American Petroleum Institute (API) Specifications are published as aids to the procurement of standardized equipment and materials, as well as instructions to API Licensees. These Specifications are not intended to obviate the need for sound engineering, nor to inhibit in any way anyone from purchasing or producing products to other specifications.

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SECTION 2

PROCESS OF MANUFACTURE AND MATERIAL

2.1 Process of Manufacture. Pipe furnished to this specification shall be either seamless or welded as defined below and limited to the combinations of grade and process shown in Table 2.1.

a. Seamless

Seamless pipe is defined as a wrought steel tubular product made without a welded seam. It is manufactured by hot working steel or, if necessary, by subsequently cold finishing the hot-worked tubular product to produce the desired shape, dimensions, and properties.

b. Electric-Weld

Electric-welded pipe is defined as pipe having one longitudinal seam formed by electric-resistance welding, or electric-induction welding without the addition of extraneous metal. The weld seam of electric-resistance welded pipe and induction welded pipe in grades higher than X42 shall be heat treated after welding to a minimum temperature of 1000°F (538°C). For grades X42 and lower, the weld seam shall be similarly heat treated, or the pipe shall be processed in such a manner that no untempered martensite remains.

c. Submerged-Arc Weld

Submerged-arc welded pipe is defined as pipe having one longitudinal seam formed by automatic submerged-arc welding. At least one pass shall be made on the inside and at least one pass on the outside.

d. Gas Metal-Arc Weld (MIG)

Gas metal-arc welded pipe is defined as pipe having one longitudinal seam formed by continuous gas metal-arc welding. At least one pass shall be made on the inside and at least one pass from the outside of the pipe. Gas metal-arc welding is an arc welding process wherein coalescence is produced by heating with an arc between continuous filler metal (consumable) electrode and the work. Shielding is obtained entirely from an externally supplied gas or gas mixture. The shielding gas protects the fluid weld metal from oxidation or contamination by the surrounding atmosphere.

e. Combination Gas Metal-Arc Weld (MIG) and Submerged-Arc Weld

Combination gas metal-arc weld and submerged-arc weld pipe is defined as pipe having one longitudinal seam formed by the combination of continuous gas metal-arc welding and automatic submerged-arc welding. The gas metal-arc welding process shall be first and followed by the submerged-arc welding process. The provisions of

2.1(c) and 2.1(d) shall apply for each respective process in the combination weld. All other provisions of this specification for the longitudinal seam shall apply as if the weld were accomplished by the gas metal-arc welding process.

f. Double Seam Welded Pipe

Double seam pipe is defined as pipe having two longitudinal seams formed by the submerged-arc welding process defined in Par. 2.1(c) or the gas metal-arc welding process defined in Par. 2.1(d), or the combination welding process defined in Par. 2.1(e). The location of the seams shall be approximately 180° apart. All requirements specified herein for submerged-arc, gas metal-arc, and combination weld pipe shall be applicable to double-seam welded pipe. All weld tests shall be performed after forming and welding.

g. Spiral Weld Pipe

Spiral weld pipe is defined as pipe having a helical seam produced by automatic submerged-arc welding. At least one pass shall be made on the inside and at least one pass on the outside.

h. Butt-Weld (applicable to Grade A25 only)

Butt-welded pipe (including continuous-weld process) is defined as pipe having one longitudinal seam formed by mechanical pressure to make the welded junction, the edges being furnace heated to the welding temperature prior to welding.

2.2 Cold Expansion. Pipe furnished to this specification, except butt-weld, shall be either non-expanded or cold expanded at the option of the manufacturer unless otherwise specified on the purchase order. Suitable provision shall be incorporated to protect the weld from contact with the internal expander during mechanical expansion.

2.3 Material. Pipe furnished to this specification shall be made from open-hearth, electric-furnace, or basic-oxygen steel. Spiral weld skelp widths shall not be less than 0.8 or more than 3.0 times the pipe OD.

2.4 Heat Treatment. Pipe furnished to this specification may be as rolled, normalized, normalized and tempered, subcritically stress relieved, or subcritically age hardened; and X Grades may be quenched and tempered. See Sect. 11 for applicable marking requirements.

2.5 Skelp End Welds. Skelp end welds in finished spiral weld pipe are permitted only at distances greater than 12 in. from the ends of the pipe. Such welds shall be made by one of the processes specified in Par. 2.1 for the spiral weld, or by the electric-flash welding process. Skelp ends shall be properly prepared for welding.

TABLE 2.1
PROCESS OF MANUFACTURE

1	2	3	4
Process	Grades		
	A-25	A and B	X42 Through X80
Seamless	X	X	X
Butt-Welded	X		
Straight Seam Electric-Weld	X	X	X
Straight Seam Submerged-Arc		X	X
Straight Seam Gas Metal-Arc		X	X
Straight Seam Combination Gas Metal-Arc, SAW			X
Spiral Weld ¹ Submerged-Arc		X	X
Double Seam ²		X	X

¹Spiral weld pipe is limited to 4½ in. OD and larger.

²Double seam pipe is limited to 36 in. OD and larger.

SECTION 3 CHEMICAL PROPERTIES AND TESTS

3.1 Composition. The composition of pipe furnished to this specification, as determined by heat analyses, shall conform to the chemical requirements specified in Table 3.1. The composition of intermediate grades (at strength levels greater than X42) shall conform to chemical requirements agreed upon between the purchaser and the manufacturer, which requirements shall be consistent with the requirements specified in Table 3.1 for pipe made by the same process of manufacture. In addition to, or in lieu of, the elements and their

respective percentages specified in Table 3.1, Columns 7, 8 and 9, other elements may be added in any of the categories (Process of Manufacture) listed, in any Grade X42 or higher, by agreement between purchaser and manufacturer. The addition of such otherwise desirable elements may alter the weldability of the pipe and caution (care) should be exercised in the determination of the quantity which may be added for any particular size and thickness of pipe.

TABLE 3.1
CHEMICAL REQUIREMENTS FOR HEAT ANALYSES, percent

1 Process of Manufacture	2 Grade	3 Carbon Max. ²	4		5 Manganese Min. Max. ³	6 Phosphorus Min. Max.	7 Sulfur Max.	8 Cb Min.	9 V Min.	Ti Min.
			Min.	Max.						
Seamless										
Non-expanded or cold expanded	A25, Cl I	.21	.30	.60	—	.045	.080	.06	—	—
"	A25 Cl II ¹	.21	.30	.60	.045	—	.04	.05	—	—
"	A	.22	—	.90	—	—	.04	.05	—	—
"	B	.27	—	1.15	—	—	.04	.05	—	—
Non-expanded	X42 ⁹	.29	—	1.25	—	—	.04	.05	—	—
"	X46 ⁹ , X52 ⁹	.31	—	1.35	—	—	.04	.05	—	—
Cold expanded	X42 ⁹ , X46 ⁹ , X52 ⁹	.29 ³	—	1.25	—	—	.04	.05	—	—
Non-expanded or cold expanded	X42 ⁹ , X46 ⁹ , X52 ⁹	.29 ³	—	1.35	—	—	.04	.05	.005 ⁵	.02 ⁵
"	X56 ⁴ , X60 ⁴	.26	—	1.35	—	—	.04	.05	—	.03 ⁵
	X65, X70 X-80									
(By Agreement)										
Welded	A25 Cl I	.21	.30	.60	—	.045	.080	.06	—	—
		.21	.30	.60	.045	—	.04	.05	—	—
Electric-weld or Butt-weld only	A25 Cl II	.21	—	.90	—	—	.04	.05	—	—
		.21	—	1.15	—	—	.04	.05	—	—
Non-expanded or cold expanded	A	.26	—	1.25	—	—	.04	.05	—	—
		.28	—	1.35	—	—	.04	.05	—	—
Non-expanded	X42 ⁹	.28	—	1.35	—	—	.04	.05	—	—
		.30	—	1.25	—	—	.04	.05	—	—
Cold expanded	X46 ⁹ , X52 ⁹	.28	—	1.25	—	—	.04	.05	—	—
		.26	—	1.35	—	—	.04	.05	.005 ⁵	.02 ⁵
Non-expanded or cold expanded	X46 ⁹ , X52 ⁹	.28	—	1.25	—	—	.04	.05	—	—
		.26	—	1.35	—	—	.04	.05	—	.03 ⁵
" "	X56 ⁴ , X60 ⁴	.26	—	1.35	—	—	.04	.05	—	—
		.26	—	1.40	—	—	.04	.05	.005 ⁷	.02 ⁷
Non-expanded or Cold expanded	X65 ⁸	.26	—	1.60 ⁸	—	—	.04	.05	—	—
		.23 ⁸	—	1.60 ⁸	—	—	.04	.05	—	—
	X70 ⁴									
	X-80 ⁴									
		0.18 ^{10,11}		1.80 ^{10,11}		0.030 ¹¹	0.018 ¹¹			

¹Class II Steel is rephosphorized (see Par. e of the Foreword for note on bending and threading properties).
²In Grades X42 through X65, for each reduction of 0.01 percent below the maximum carbon content, an increase of 0.05 percent manganese above the specified maximum is permissible, up to a maximum of 1.45 percent for Grades X52 and lower and up to a maximum of 1.60 percent for grades higher than X52.

³For cold expanded seamless pipe in Sizes 20 in. and larger, the maximum carbon content shall be .28 percent.
⁴Other chemical analyses may be furnished by agreement between purchaser and manufacturer.

⁵Either columbium, vanadium or titanium, or a combination thereof, shall be used at the discretion of the manufacturer.
⁶For Grades X65 in Sizes 16 in. and larger with wall thicknesses .500 in. (12.7 mm) and less, the chemical composition shall be shown or as agreed upon between the purchaser and manufacturer. For other sizes and wall thicknesses, the chemical composition shall be as agreed upon between the purchaser and manufacturer.

⁷Either columbium or vanadium or a combination thereof, may be used at the discretion of the manufacturer.

⁸For each reduction of 0.01 percent below the specified maximum carbon content, an increase of 0.05 percent manganese above the specified maximum is permissible.
⁹Columbium, titanium, vanadium, or a combination thereof, may be used by agreement between purchaser and manufacturer.

¹⁰Manganese level may be increased by 0.05% for each 0.01% decrease in carbon up to a max manganese level of 2.00%.

¹¹Levels are product analysis limits eliminating the need for check tolerances in Par. 3.3.

3.2 Heat Analyses. When requested by the purchaser, the manufacturer shall furnish a report giving the heat analysis of each heat of steel used in the manufacture of pipe furnished on the purchase order. The analysis so determined shall conform to the requirements specified in Par. 3.1. For Grade A25, the manufacturer may certify that the material furnished has been analyzed and meets the chemical requirements of API Spec 5L. If alloys other than those specified in Table 3.1 for a particular grade are added for other than deoxidation purposes, the heat analyses, including the alloy additions, shall be reported for each heat applied to the purchaser's order. If a heat analysis is requested for X-80 steel by the purchaser, it shall be supplied by the manufacturer and shall include those alloys added for other than deoxidation purposes. No heat analysis limits have been defined for Grade X-80, only product analysis limits have been defined.

3.3 Product Analyses. One test from each of two lengths of pipe or plate or skelp from each lot size as indicated below shall be analyzed for product analyses by the manufacturer. The results of the analyses shall be available to the purchaser on request.

Grade	Size, in.	Lot Size
A25	$\leq 1\frac{1}{2}$ nom.	25 tons or fraction thereof
A25	≥ 2 nom.	50 tons or fraction thereof
A and B	2 $\frac{1}{2}$ through 5 $\frac{9}{16}$	400 lengths or less
A and B	6 $\frac{1}{2}$ through 12 $\frac{1}{4}$	200 lengths or less
X42 and higher	2 $\frac{1}{2}$ through 12 $\frac{1}{4}$	200 lengths or less
All Grades	14 and over	100 lengths or less

For multiple length seamless pipe, a length shall be considered as all of the sections cut from a particular multiple length. The samples shall be taken as follows:

a. Seamless Pipe

At the option of the manufacturer, samples used for product analyses shall be taken either from tensile test specimens or from the finished pipe.

b. Welded Pipe

At the option of the manufacturer, samples used for product analyses shall be taken from either finished pipe, plate, skelp, tensile test specimens or flattening test specimens. The location of the samples shall be a minimum of 90° from the weld, of longitudinally welded pipe. For spiral weld, the sample location shall be at a position of not less than one-quarter the distance between adjacent weld convolutions as measured from either edge of the weld. For pipe manufactured from plate or skelp, the product analyses may be made by the supplier of the plate or skelp providing the analyses are made in accordance with the frequency requirement stated above.

The composition so determined shall conform to the chemical requirements shown in Table 3.1, within the following permissible variations for product analyses except for X80 pipe where the requirements in Table 3.1 are for product analysis:

Carbon, percent:

Seamless pipe

All non-expanded and cold expanded smaller than 20 in..... +0.03

Cold expanded 20 in. and larger in Grades X42 and higher +0.04

Welded pipe..... +0.04

Manganese, percent:

All grades through B +0.05

Where minimum is specified -0.05

Grade X42 and higher +0.10

Phosphorus, percent:..... +0.01

Where minimum is specified -0.01

Sulfur, percent:..... +0.01

Columbium, percent:..... -0.000

Vanadium, percent:..... -0.01

Titanium, percent:..... -0.01

3.4 Recheck Analyses. If the product analyses of both lengths of pipe representing the lot fail to conform to the specified requirements, at the manufacturer's option, either the lot shall stand rejected or all the remaining lengths in the lot shall be tested individually for conformance to the specified requirements. If only one of the two samples fails, at the manufacturer's option, either the lot shall stand rejected or two recheck analyses shall be made on two additional lengths from the same lot. If both recheck analyses conform to the requirements, the lot shall be accepted except for the length represented by the initial analyses which failed. If one or both of the recheck analyses fail, at the manufacturer's option, the entire lot shall be rejected or each of the remaining lengths shall be tested individually. In the individual testing of the remaining lengths in any lot, analyses for only the rejecting element or elements need be determined. Samples for recheck analyses shall be taken in the same location as specified for product analysis samples.

3.5 Control Analyses. A product analysis shall be made by the manufacturer, as a control, of each heat of steel used for the production of pipe under this specification. A record of such analyses shall be available to the purchaser.

3.6 Chemical Analyses Procedures. Chemical analyses shall be determined by any of the procedures commonly used for determining chemical compositions such as emission spectroscopy, X-ray emission, atomic absorption, combustion techniques or wet analytical procedures. The calibration methods used shall be traceable to established standards. In case of dispute, samples used in making chemical analyses shall be prepared in accordance with ASTM E-59 and chemical determinations shall be made in accordance with ASTM E-350 or other procedures agreed upon between purchaser and manufacturer.

SECTION 4 MECHANICAL PROPERTIES AND TESTS

4.1 Mechanical Properties. Grades A25, A, B, X42, X46, X52, X56, X60, X65, X70 and X80 shall conform to the tensile requirements specified in Table 4.1. Other grades intermediate to the listed grades between X42 and X80 shall conform to tensile requirements agreed upon between purchaser and manufacturer, which requirements shall be consistent with those specified in Table 4.1. For cold expanded pipe, the ratio of yield strength to ultimate tensile strength of each test pipe on which yield strength and body ultimate strength are determined shall not exceed .85, except that for Grade X65 pipe with wall thicknesses over .375 and for grades higher than X65 in all wall thicknesses the ratio shall not exceed .90 except X80 which shall not exceed 0.93. The yield strength shall be the tensile stress required to

produce a total elongation of 0.5 percent of the gage length, as determined by an extensometer or by multiplying dividers. When a fracture toughness requirement is specified for Grades X70 and lower, the yield-to-tensile ratio shall not apply if agreed upon between purchaser and manufacturer. When elongation is recorded or reported, the record or report shall show the nominal width of the test specimen when strip specimens are used, the diameter and gage length when round bar specimens are used, or state when full section specimens are used. For Grade A25 pipe, the manufacturer may certify that the material furnished has been tested and meets the mechanical requirements of A25.

**TABLE 4.1
TENSILE REQUIREMENTS**

Grade	2		3	4	5
	Yield Strength, Min. PSI	MPa			
A25	25,000	(172)	45,000	(310)	
A	30,000	(207)	48,000	(331)	
B	35,000	(241)	60,000	(413)	
X42	42,000	(289)	60,000	(413)	
X46	46,000	(317)	63,000	(434)	
X52	52,000	(358)	66,000 ¹ 72,000 ²	(455 ¹) (496 ²)	
X56	56,000	(386)	71,000 ¹ 75,000 ²	(489 ¹) (517 ²)	
X60*	60,000	(413)	75,000 ¹ 78,000 ²	(517 ¹) (537 ²)	
X65	65,000	(448)	77,000 ¹ 80,000 ²	(530 ¹) (551 ²)	
X70	70,000	(482)	82,000	(565)	
X80	80,000	(551)	90,000	(620)	120,000 (827)

*The minimum ultimate tensile strength for Grade X60 Electric-Resistance Welded Pipe in all sizes and wall thicknesses shall be 75,000 psi (517 MPa).

¹For pipe less than 20 in. OD with any wall thickness and for pipe 20 in. OD and larger with wall thickness greater than .375 in. (9.5 mm).

²For pipe 20 in. OD and larger with wall thickness .375 in. (9.5 mm) and less.

³The minimum elongation in 2 in. (50.80 mm) shall be that determined by the following formula:

$$\text{English Formula}$$

$$e = 625,000 \frac{A^{0.2}}{U^{0.9}}$$

$$\text{Metric Formula}$$

$$e = 1942.57 \frac{A^{0.2}}{U^{0.9}}$$

Where:

e = minimum elongation in 2 in. (50.80 mm) in percent to nearest $\frac{1}{2}$ percent.

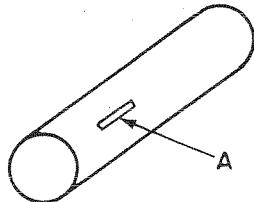
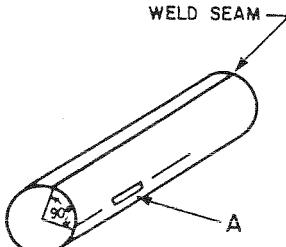
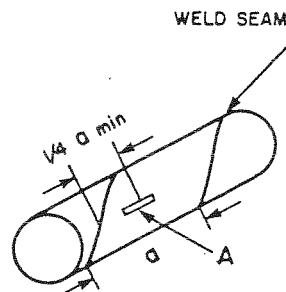
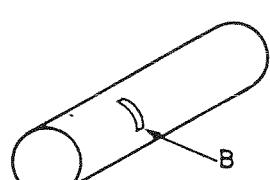
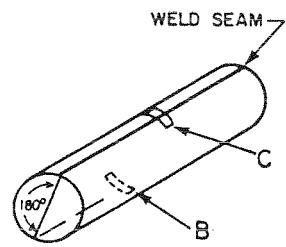
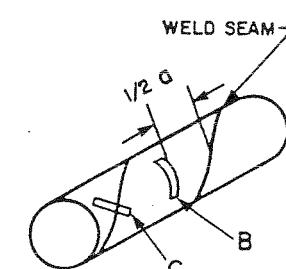
A = cross-sectional area of the tensile test specimen in sq. in. (mm) based on specified outside diameter or nominal specimen width and specified wall thickness rounded to the nearest 0.01 sq. in. (6.5 mm^2) or .75 sq. in. (4.84 cm^2) whichever is smaller.

U = specified minimum ultimate tensile strength, psi, (MPa).

See Appendix C for minimum elongation values for various size tensile specimens and grades. The minimum elongations for round bar tensile specimens (0.350 in. diameter with 1.4 in. gage length, and the 0.500 in. diameter with 2.00 in. gage length) shown in the Area A line of .20 sq. in. in the Elongation Table of Appendix C.

4.2 Tensile Tests. Tensile test orientation shall be as shown in Fig. 4.1. At the option of the manufacturer for straight seam welded pipe, the longitudinal specimens may be taken from the skelp parallel to the rolling direction and approximately midway between edge and center. Testing procedure shall conform to the requirements of ASTM A-370: *Mechanical Testing of Steel Products, Annex II, Steel Tubular Products*. All tensile tests, except transverse weld and ring tests, shall include yield strength, ultimate tensile strength and elongation determinations and shall be performed with the specimens at room temperature. The strain rate shall be in accordance with the requirements of ASTM A-370. At the option of the manufacturer, the specimen may be

either full section, strip specimen, or round bar specimens per Par. 4.4, 4.5 and Fig. 4.2. The type, size and orientation of the specimens shall be reported. Strip specimens shall be approximately $1\frac{1}{2}$ in. (38.1 mm) wide in gage length if suitable curved face testing grips are used or if the ends of the specimens are machined to reduce the curvatures in the grip area, otherwise they shall be approximately $\frac{3}{4}$ in. (19.0 mm) wide for pipe $3\frac{1}{2}$ in. and smaller, approximately 1 in. (25.4 mm) wide for pipe 4 in. through $6\frac{1}{2}$ in., and approximately $1\frac{1}{2}$ in. (38.1 mm) wide for pipe $8\frac{1}{2}$ in. and larger. Alternately, when grips with curved faces are not available, the ends of the specimens may be flattened without heating.

O.D.	SEAMLESS PIPE, HOT ROLLED* AND COLD WORKED	WELDED PIPE	
		STRAIGHT SEAM	SPIRAL WELD
$\leq 6\frac{5}{8}$			
$\geq 8\frac{5}{8}$			

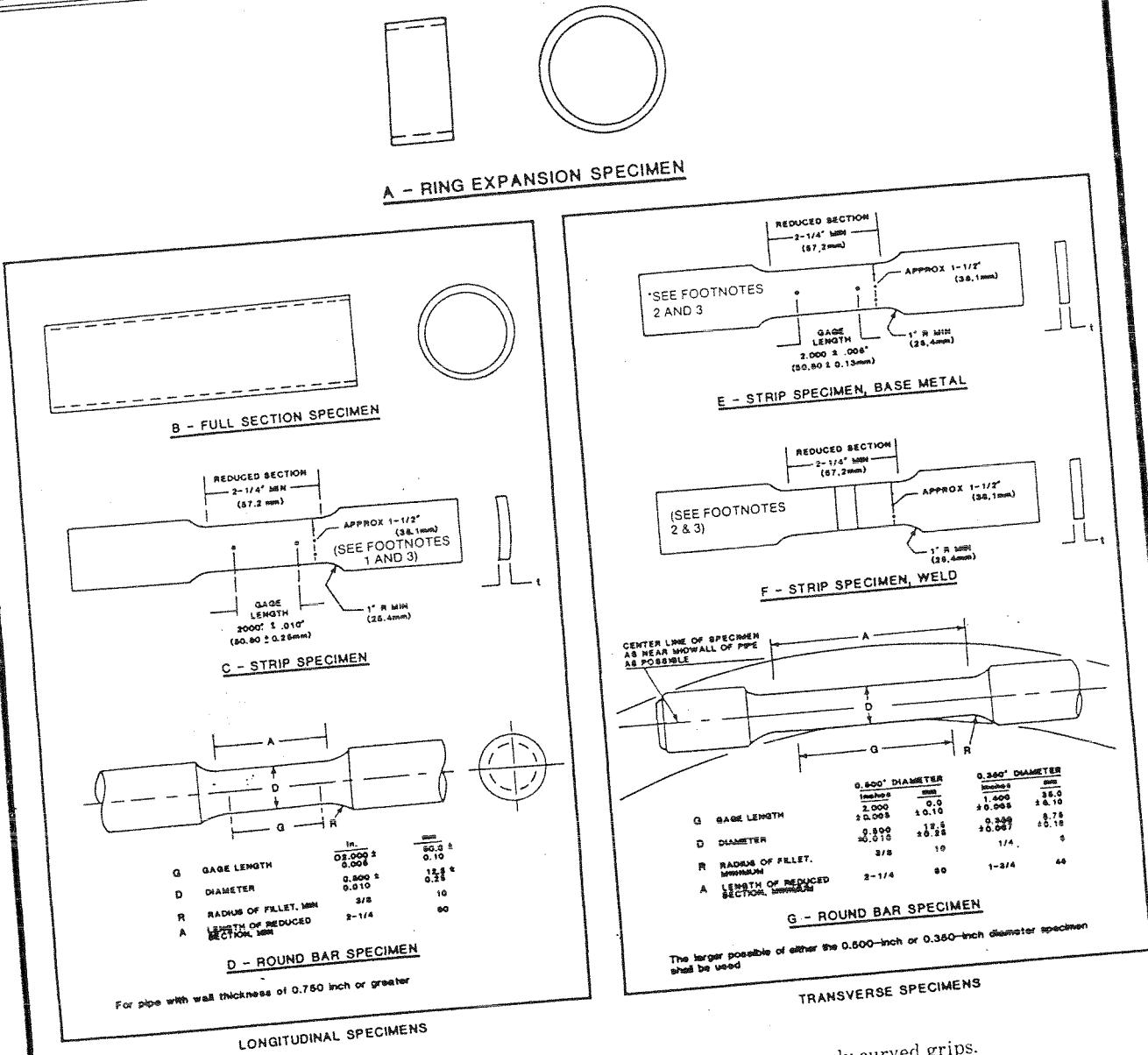
A = Strip Specimen (any circumferential location for seamless)

B = Transverse Specimen (any circumferential location for seamless). For two seam pipe the specimen shall be taken from a location midway between the welds.

C = Transverse Weld Specimen

* For hot-rolled seamless all tensile tests shall be in the longitudinal direction, except when agreed upon between purchaser and manufacturer transverse tests may be specified for $8\frac{1}{2}$ in. and larger.

FIG. 4.1
ORIENTATION OF TENSILE TEST SPECIMENS



NOTE 1: See Par. 4.2 for gage width if testing is not done with properly curved grips.

NOTE 2: Flattening of transverse and weld specimens shall be performed at room temperature.

NOTE 3: Hot flattening, artificial aging, or heat treatment of tensile specimens is not permitted.

FIG. 4.2
TENSILE TEST SPECIMENS
See Par. 4.2

TABLE 4.2
FREQUENCY OF TENSILE TESTING

1 Size, in.	2 Tensile Tests	3 Weld Tensile Tests	4 Control Tensile Tests
≤ 1½ nom. A25 Welded	1 per 25 tons or fraction thereof		
≥ 2 nom. A25 Welded	1 per 50 tons or fraction thereof		
≤ 5 ½ OD except A25 Welded	1 per 400 lengths		
≥ 6% OD thru 12 ¼ OD	1 per 200 lengths		One per heat on all sizes except for Grade A25
> 12 ¼ OD	1 per 100 lengths		
8% OD thru 12 ¼ OD		1 per 200 lengths	
> 12 ¼ OD		1 per 100 lengths*	

*Each weld for two-seam pipe.

4.3 Testing Frequency. Tensile tests shall be made at the frequency shown in Table 4.2.

4.4 Longitudinal Tensile Tests. At the option of the manufacturer longitudinal tests may utilize a full section specimen (Fig. 4.2-B), a strip specimen (Fig. 4.2-C) or for pipe with wall thickness greater than 0.750 inch (19.1 mm) a 0.500-inch (12.7 mm) diameter round bar specimen (Fig. 4.2-D). The strip specimen shall be tested without flattening.

4.5 Transverse Tensile Tests. The transverse tensile properties shall be determined, at the option of the manufacturer, by one of the following methods:

- a. The yield strength, ultimate strength and elongation values shall be determined on either a flattened rectangular specimen (Fig. 4.2E) or a 0.500-inch (12.7 mm) or 0.350-inch (8.9 mm) round bar specimen (Fig. 4.2G).
- b. The yield strength shall be determined by the ring expansion method (Fig. 4.2A) with the ultimate strength and elongation values determined from a flattened rectangular specimen.

The same method of testing must be employed for all lots in an order item. All transverse tensile specimens shall be as shown in Fig. 4.2. All specimens shall represent the full wall thickness of the pipe from which the specimen was cut, except for round bar tensile specimens. Transverse round bar specimens are to be secured from non-flattened pipe sections and the largest possible round bar diameter shall be used.

Transverse round bar specimens are to be secured from non-flattened pipe sections. The 0.500-inch (12.7 mm) diameter round bar specimens shall be used when the pipe size allows, and the 0.350-inch (8.9 mm) diameter round bar specimen shall be used for other sizes. For pipe sizes too small to allow a 0.350-inch (8.9 mm) specimen, round bar tensile specimens are not permitted.

4.6 Weld Tensile Tests. Weld tensile test specimens shall be taken at 90° to the weld with the weld at the center as shown in Fig. 4.1 and 4.2 and shall represent the full wall thickness of the pipe from which the spec-

imen was cut. Weld reinforcement may be removed at the manufacturer's option. Weld tensile tests need not include determination of yield strength and elongation.

4.7 Control Tensile Tests. One tensile test shall be made as a control for each heat of steel used by the manufacturer for production of pipe except for Grade A25. A record of such tests shall be available to the purchaser. For welded pipe, except spiral weld, these tensile tests shall be made on either the skelp or the finished pipe at the option of the manufacturer.

4.8 Retests. If the tensile test specimen representing a lot of pipe fails to conform to the specified requirements, the manufacturer may elect to make retests on two additional lengths from the same lot. If both retest specimens conform to the requirements, all the lengths in the lot shall be accepted, except the length from which the initial specimen was taken. If one or both of the retest specimens fail to conform to the specified requirements, the manufacturer may elect to test individually the remaining lengths in the lot, in which case determinations are required only for the particular requirements with which the specimens failed to comply in the preceding tests. Specimens for retest shall be taken in the same manner as the specimen which failed to meet the minimum requirements.

4.9 Defective Specimens. If any tensile test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted. When the elongation of any tensile test specimen is less than that specified and if any part of the fracture is outside the middle third of the gage length as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

4.10 Flattening Tests. Flattening tests shall be performed for electric-weld and butt-welded pipe. Frequency of testing, sample location, and test orientation are shown in Fig. 4.3. When a weld stop condition occurs during production of a multiple length, flattening tests with the weld at 90 degrees shall be made from the crop ends resulting from each side of the weld stop, and may be substituted for the intermediate flattening tests.

4.11 Acceptable criteria for flattening tests shall be as follows:

Electric-Weld in grades higher than A25

A25 (Welded)

Flatten to $\frac{2}{3}$ original OD without weld opening. Continue flattening to $\frac{1}{3}$ original OD without cracks or breaks other than in weld. Continue flattening until opposite walls of the pipe meet. No evidence of lamination of burnt metal may develop during entire test.

Flatten to $\frac{3}{4}$ original OD without weld fracture. Continue flattening to 60 percent of original OD without cracks or breaks other than in weld.

4.12 Retests. Flattening retest provisions are as follows:

Non-expanded Electric-Weld produced in single lengths — higher than Grade A25

Manufacturer may elect to retest any failed end until the requirements are met providing

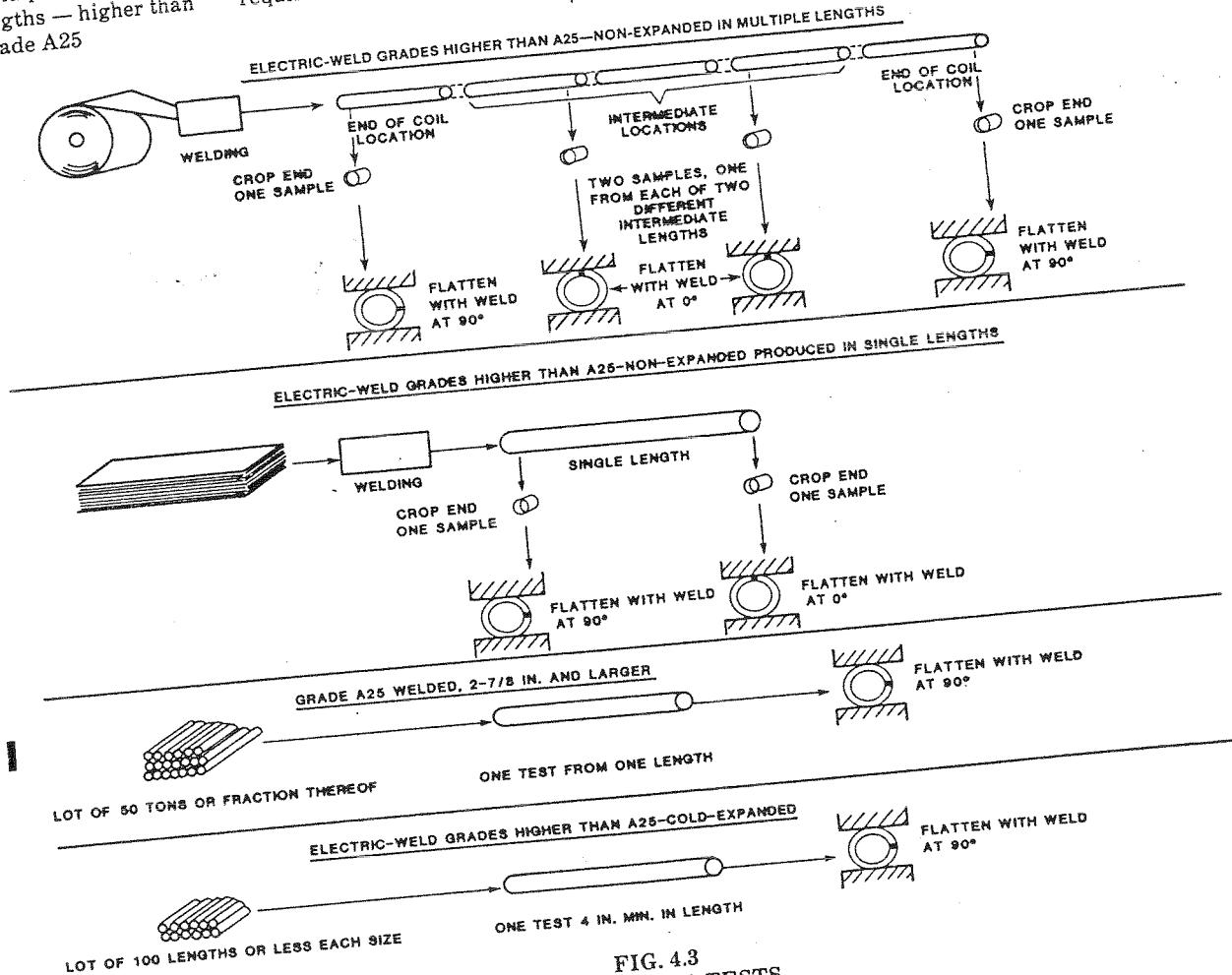
ing the finished pipe is not less than 80 percent of its length after initial cropping.

Non-expanded Electric Weld produced in multiple lengths — higher than Grade A25

Cold-expanded Electric Weld — higher than Grade A25 and all welded A25 $2\frac{1}{8}$ in. and larger

Manufacturer may elect to retest each end of each individual length if any test fails. The retests for each end of each individual length shall be made with the weld alternately at 0° and 90° .

Manufacturer may elect to retest one end from each of two additional lengths of the same lot. If both retests are acceptable, all lengths in the lot shall be accepted, except the original failed length. If one or both retests fail, the manufacturer may elect to repeat the test on specimens cut from one end of each of the remaining individual lengths in the lot.



**FIG. 4.3
FLATTENING TESTS
See Par. 4.10**

4.13 Bend Tests. For welded Grade A25 pipe, 2 in. nom. and smaller, one full-section specimen of appropriate length, cut from a length of pipe from each lot of 25 tons, or fraction thereof, of pipe 1½ in. nom. and smaller, and from each lot of 50 tons, or fraction thereof, of 2 in. nom. pipe, shall be bent cold through 90°, around a mandrel having a diameter not greater than twelve times the outside diameter of the pipe being tested, with the weld located approximately 45° from the point of contact of the specimen with the mandrel. No cracks shall occur in any portion of the pipe, and no opening shall occur in the weld. If the specimen fails to conform to these requirements, the manufacturer may elect to make retests on specimens cut from two additional lengths from the same lot. If all retest specimens conform to the specified requirements, all lengths in the lot shall be accepted, except the length from which the initial specimen was taken. If one or more of the retest specimens fail to conform to the specified requirements, the manufacturer may elect to repeat the test on specimens cut from the individual lengths remaining in the lot.

NOTE: For the purpose of mechanical testing the weld of electric-welded pipe of 2 in. nom. and larger, "the weld" extends to a distance of ½ in. (12.7 mm) on either side of the fusion line. For pipe smaller than 2 in. nom., "the weld" extends to a distance of ¼ in. (6.35 mm) on either side of the fusion line.

4.14 Submerged-Arc and Gas Metal-Arc Welded Manipulation Tests. Submerged-arc and gas metal-arc welded pipe shall be tested by the guided-bend or tensile-elongation test as shown below.

Outside Diam. in.	Spiral Weld	Straight Seam
Less than 12½	Tensile-Elongation through X65*	Guided-Bend through X65*
12½ and larger	Guided-Bend through X65*	Guided-Bend through X65*

*For Grade X70 and X80 either tensile-elongation or guided-bend may be used at the manufacturer's option.

The specimens shall be taken from each weld in a length of pipe from each lot of 50 lengths or less of each size. The specimens shall not contain any repair welding made by the manual metallic-arc procedure. For each lot of 50 lengths or less of each size, wall thickness, or grade of spiral welded pipe containing skelp end welds, one skelp end weld shall be tested by the tensile-elongation test or by the guided-bend test at the option of the manufacturer.

4.15 Tensile-Elongation Test. One specimen conforming to Fig. 4.4 shall be tested in tension, and shall conform to the elongation requirements specified in

Par. 4.1. At the option of the manufacturer, specimens for spiral weld pipe may be flattened before testing.

4.16 Guided-Bend Test. One face-bend and one root-bend specimen, both conforming to Fig. 4.5, shall be bent approximately 180° in a jig substantially in accordance with Fig. 4.6. For any combination of diameter, wall thickness and grade, the maximum value for jig Dimension "A" may be calculated by the formula. The manufacturer shall use a jig based on this dimension, or a smaller dimension at his option; however, to minimize the number of jigs required, standard values for Dimension "A" have been selected for pipe sizes 12½ in. (323.9 mm) and larger. These values are listed for each diameter, wall thickness and grade in Appendix F. For intermediate grades or wall thicknesses, the next smaller standard value for Dimension "A" shall be used. When Dimension "A" is greater than 9 in. (228.6 mm), the length of the specimen required to contact the male die need not exceed 9 in. (228.6 mm). For pipe with wall thickness over .750 in. (19.1 mm), a reduced wall specimen as shown in Fig. 4.5 may be used at the option of the manufacturer. Reduced wall specimens shall be tested in a jig with the "A" Dimension calculated for .750 in. (19.1 mm) wall pipe of the appropriate size and grade. The specimens (a) shall not fracture completely, (b) shall not reveal any cracks or ruptures in the weld metal greater than ¼ in. (3.18 mm) in length regardless of depth, and (c) shall not reveal any cracks or ruptures in the parent metal, the heat affected zone, or the fusion line longer than ¼ in. (3.18 mm) and deeper than 12½ percent of the specified wall thickness; except cracks which occur at the edges of the specimen and which are less than ¼ in. (6.35 mm) long shall not be cause for rejection in (b) or (c) regardless of depth. If the fracture or crack in the specimen is caused by a defect or flaw, that specimen may be discarded and a new specimen substituted.

4.17 Retests. If the tensile-elongation specimen or one or both of the guided-bend specimens fail to conform to the specified requirements, the manufacturer may elect to repeat the tests on specimens cut from two additional lengths of pipe from the same lot. If such specimens conform to the specified requirements, all lengths in the lot shall be accepted, except the length initially selected for test. If any of the retest specimens fail to pass the specified requirements, the manufacturer may elect to test specimens cut from the individual lengths remaining in the lot. The manufacturer may also elect to retest any length which has failed to pass the test by cropping back and cutting two additional specimens from the same end. If the requirements of the original test are met by both of these additional tests, that length shall be acceptable. No further cropping and retesting is permitted. Specimens for retests shall be taken in the same manner as specified in Par. 4.15 and 4.16.

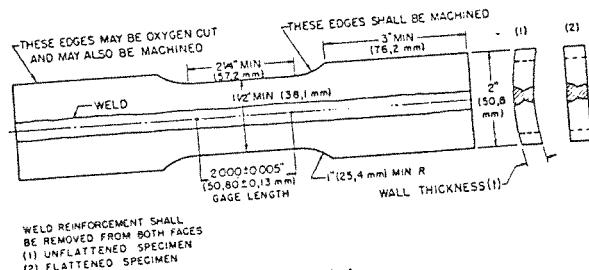


FIG. 4.4
TENSILE-ELONGATION TEST SPECIMEN
See Par. 4.15

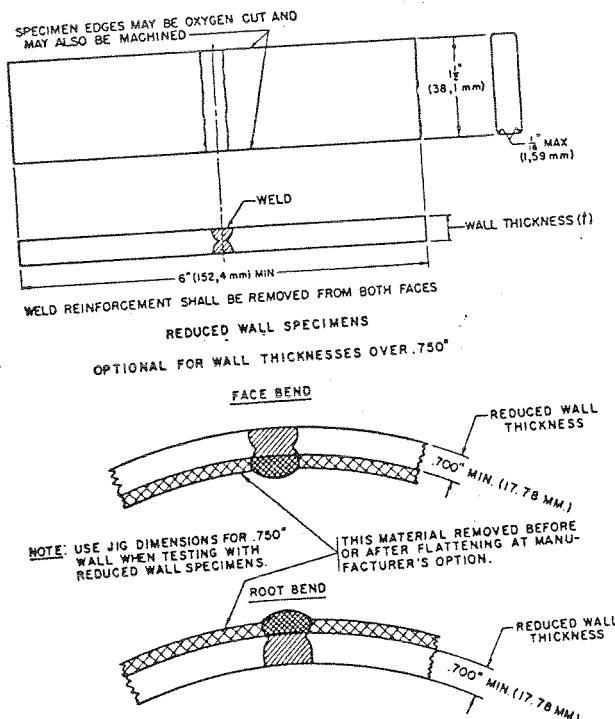
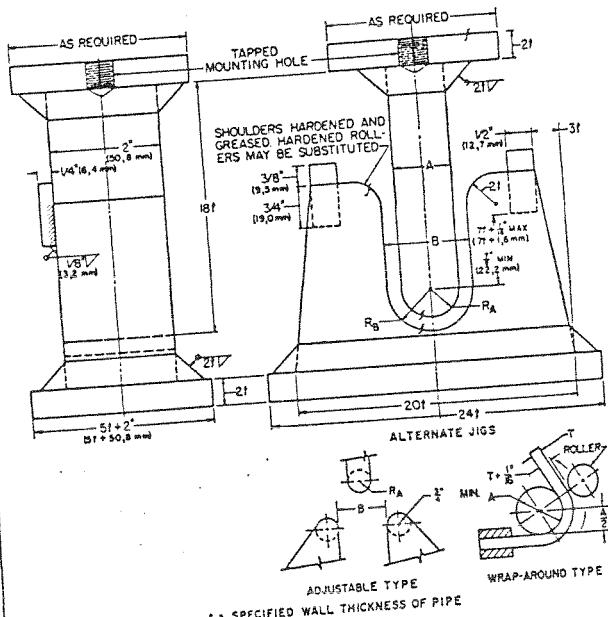


FIG. 4.5
GUIDED-BEND TEST SPECIMEN
See Par. 4.16



where:
 $1.15 = \text{peaking factor}$
 $D = \text{specified OD, in. (mm)}$
 $t = \text{specified wall thickness, in (mm)}$
 $e = \text{strain}$
 in./in. mm/m

for Grade A = 0.1675 (167.5)

for Grade B = 0.1375 (137.5)

for Grade X42 = 0.1375 (137.5)

for Grade X46 = 0.1325 (132.5)

for Grade X52 = 0.1250 (125.0)

for Grade X56 = 0.1175 (117.5)

for Grade X60 = 0.1125 (112.5)

for Grade X65 = 0.1100 (110.0)

for Grade X70 = 0.1025 (102.5)

for Grade X80 = 0.0900 (90.0)

$$R_A = \frac{1}{2} A$$

$$B = A + 2t + \frac{1}{8} \text{ in.}$$

$$(A + 2t + 3.2 \text{ mm})$$

$$R_B = \frac{1}{2} B$$

FIG. 4.6
JIG FOR GUIDED-BEND TEST
See Par. 4.16

4.18 Weld Ductility Test. For electric-welded pipe, the weld ductility shall be determined by tests on full-section specimens of 2 in. (50.8 mm) minimum length. The specimens shall be flattened cold between parallel plates. The weld shall be placed 90° from the direction of applied force (point of maximum bending). No crack or breaks exceeding $\frac{1}{8}$ in. (3.18 mm) in any direction in the weld or the parent metal shall occur on the outside surface until the distance between the plate is less than the value of "S" calculated by the formulas (a) and (b) below:

(a) *Grades less than X52*

$$S = \frac{3.07 t}{.07 + 3 t/D}$$

(b) *Grades X52 or higher*

$$S = \frac{3.05 t}{.05 + 3 t/D}$$

where:

S = distance between flattening plates, in. (mm)

t = specified wall thickness of the pipe, in. (mm)

D = specified outside diameter of the pipe, in. (mm)

Cracks which originate at the edge of the specimen and which are less than $\frac{1}{4}$ in. (6.35 mm) long shall not be cause for rejection. One test shall be made on a length of pipe from each lot size as indicated below.

Grade	Outside Diameter in.	Lot Size, No. of Lengths
A25, A and B	2 $\frac{1}{8}$ through 5 $\frac{1}{16}$	400 or less
A25, A and B	6 $\frac{1}{8}$ through 12 $\frac{1}{4}$	200 or less
X42 and higher	2 $\frac{1}{8}$ through 12 $\frac{1}{4}$	200 or less
All Grades	14 and over	100 or less

For multiple-length pipe, a length shall be considered as each section cut from a particular multiple length. The weld ductility test may also serve as one of the flattening tests of Par. 4.10 by compliance with appropriate amounts of flattening.

4.19 Retests. If the weld ductility test specimen representing a lot of pipe fails to conform to the requirements of Par. 4.18, the manufacturer may elect to make retests on two additional lengths from the same lot. If both retest specimens conform to the requirements, all the lengths in the lot shall be accepted, except the length from which the initial specimen was taken. If one or both of the retest specimens fail to conform to the specified requirements, the manufacturer may elect to test specimens cut from one end of the individual lengths remaining in the lot. Precaution shall be taken so that the specimens can be identified with respect to the length of pipe from which they were cut. The manufacturer may also elect to retest any length which has failed to pass the above test procedure

by cropping back and cutting two additional specimens from the same end. If the weld ductility test requirements are met by both of these additional tests, that length shall be acceptable. No further cropping and retesting is permitted.

4.20 Fracture Toughness Tests. When so specified on the purchase order, the manufacturer shall conduct fracture toughness tests in accordance with Supplementary Requirement SR-5 or SR-6 or SR-8 (see Appendix E) or any combination of these, as specified by the purchaser, and shall furnish a report of results showing compliance with the supplementary requirement specified. The testing temperature for SR-5 and SR-6 shall be selected by the purchaser and shall be shown on the purchase order. Both testing temperature and the Charpy V-notch energy value for SR-8 shall be selected by the purchaser and shown on the purchase order. For Grade X80, the following fracture toughness requirements are mandatory for all diameters. The fracture toughness tests shall be conducted in accordance with SR8 and SR5, except that SR6 may be substituted for SR5 by agreement between manufacturer and user.

SR8 and SR5 Mandatory Toughness Requirements

Min. Energy at 32F. Ft. Lbs (a)(b)	Min. Percent Shear Area at 32F (c)
Avg. of 3 Specimens	
All Heat Avg. From One Heat	Avg. of 3 Specimens
50	70
20	40

Optional SR8 and SR6 Mandatory Toughness Requirements Based on Charpy and Drop Weight Tear Tests

Min. Charpy Energy at 32F. Ft. Lbs (a)(b)	Min. DWTT Percent Shear Area at 32F (c)
Avg. of 3 Specimens	
All Heat Avg. From One Heat	Avg. of 3 Specimens
50	60
20	40

- (a) Three 10 mm x 10 mm Charpy V-Notch specimens shall be used if obtainable from the pipe diameter and wall thickness. Otherwise appropriate specimen thicknesses shall be used with the required energy levels reduced in proportion to the thickness. For pipe diameters 6 $\frac{1}{8}$ -inch and smaller, longitudinal specimens shall be used.
- (b) If the all heat average of the order does not meet 50 ft. lbs., the manufacturer shall be responsible for the replacement of heats as may be necessary to bring the average up to 50 ft. lbs.
- (c) If the all heat average of the order does not meet the required percent shear area, the manufacturer shall be responsible for replacement of such heats as may be necessary to bring the average to the required value.

SECTION 5

HYDROSTATIC TESTS

5.1 Inspection Hydrostatic Test. Each length of pipe shall withstand, without leakage, an inspection hydrostatic test to at least the pressure specified in Par. 5.3. Test pressures for all sizes of seamless pipe and for welded pipe in sizes 18 in. and smaller, shall be held for not less than 5 sec. Test pressures for welded pipe in sizes 20 in. and larger shall be held for not less than 10 sec. For threaded-and-coupled pipe, the test shall be applied with the couplings made up power-tight if power-tight make-up is specified on the purchase order, except sizes greater than 12½ in. OD may be tested in the plain-end condition. For threaded pipe furnished with couplings made up handling tight, the hydrostatic test shall be made on the pipe in the plain-end or threads-only condition or with couplings applied, unless otherwise agreed upon by the purchaser and the manufacturer.

5.2 Verification of Test. In order to insure that every length of pipe is tested to the required test pressure, each tester, except those on which butt-welded pipe is tested, shall be equipped with a recording gage that will record the test pressure and duration of time applied to each length of pipe, or equipped with some positive and automatic or interlocking device to prevent pipe from being classified as tested until the test requirements (pressure and time) have been complied with. Such records or charts shall be available for examination at the manufacturer's facility by the purchaser's inspectors when the purchaser is so represented at the manufacturer's facility.

5.3 Test Pressures. The minimum test pressure shall be the standard test pressure or alternate test pressure as listed in Table 6.1, 6.1a and 6.2 or an intermediate or higher pressure at the discretion of the manufacturer unless specifically limited by the purchaser, or a higher pressure as agreed upon between the purchaser and manufacturer. The minimum test pressures for grades, diameters, and wall thicknesses not listed shall be computed by the formula given below. For all sizes Grade A25 smaller than 5½", and those of Grade A and B smaller than 2¾", the test pressure has been arbitrarily assigned. Where the unlisted wall is intermediate to walls whose test pressure has been arbitrarily assigned, the test pressure for the intermediate wall shall be equal to the next heaviest wall. When computed pressures are not an exact multiple of 10 psi (100 kPa), they shall be rounded to the nearest 10 psi (100 kPa).

NOTE 1: The hydrostatic test pressures given herein are inspection test pressures, are not intended as a basis for design, and do not necessarily have any direct relationship to working pressures.

NOTE 2: The test pressures given in Table 6.1, 6.1a and 6.2 were computed by the following formula and rounded to the nearest 10 psi (100 kPa):

English Formula

$$P = \frac{2 St}{D}$$

Metric Formula

$$P = \frac{2000 St}{D}$$

where:

P = hydrostatic test pressure in pounds per sq. in. (kPa)

S = fiber stress in pounds per sq. in. (MPa), equal to a percentage of the specified minimum yield strength for the various sizes as shown below.

t = specified wall thickness in in. (mm)

D = specified outside diameter in in. (mm)

Grade	Size	Percent of Specified Minimum Yield Strength	
		Standard Test Pressure	Alternate Test Pressure
A25	5 9/16"	60	—
	2 1/2" and larger**	60	75
	2 1/2" and larger**	60	75
X42 thru X80†	5 9/16" and smaller	60	75
	6 1/2" and 8 1/2"	75	—
	10 1/2" to 18 incl.	85	—
	20 and larger	90	—

*Test pressures for other sizes established arbitrarily.

**Test pressures were limited to 2500 psi (17200 kPa) for 3 1/2 in. and smaller, and to 2800 psi (19300 kPa) for sizes larger than 3 1/2 in. Test pressures for other sizes established arbitrarily.

†Test pressures for grades X42 thru X70 were limited to 3000 psi (20700 kPa) to accommodate hydrostatic tester limitations.

When the purchase order specifies a hydrostatic test that will produce a hoop stress greater than 90% of the specified minimum yield strength, and when the Supplementary Requirement (SR) is specified on the purchase order, the test pressure shall be determined in accordance with SR 14.

NOTE 3: When hydrostatic testing in excess of 90 percent of specified minimum yield strength, using the above formula, the applied forces for end sealing produce a compressive longitudinal stress which should be considered.

5.4 Supplementary Hydrostatic Tests. By agreement between the purchaser and the manufacturer, for Grade X42 and higher, the manufacturer shall make additional internal pressure tests, which may involve one or more of the following methods. In all supplementary hydrostatic tests, the formula shown in Par. 5.3 shall be used for stress calculations. The conditions of test shall be as agreed upon.

- Hydrostatic destructive tests in which the minimum length of the specimen is ten times the outside diameter of the pipe, but need not exceed 40 ft.
- Full-length destructive tests made by the "hydrostatic pressure water column" method.
- Hydrostatic transverse yield strength tests using accurate strain gages.¹

¹Acceptable gages are the roller-chain ring-expansion gage (J&L Steel, Youngstown, Ohio), the SR-4 strain gage (Baldwin-Lima-Hamilton Corp., Philadelphia, Pennsylvania), or other suitable gages of similar accuracy.

SECTION 6

DIMENSIONS, WEIGHTS, AND LENGTHS

6.1 Dimensions and Weights. Line pipe shall be furnished in the sizes, wall thicknesses, and weights provided in Tables 6.1, 6.1a and 6.2 and Par. 6.2 and 6.3 as specified on the purchase order.

NOTE: The plain-end weight, w_{pe} , shall be calculated using the following formula:

$$\begin{array}{ll} \text{English Formula} & \text{Metric Formula} \\ w_{pe} = 10.68 (D-t)t & w_{pe} = 0.02466 (D-t)t \end{array}$$

where:

w_{pe} = plain-end weight, rounded to the nearest 0.01 lb/ft (0.01 kg/m)

D = outside diameter, rounded to the nearest 0.001 in. (0.1 mm for sizes less than 457 mm, and 1 mm for sizes 457 mm and larger)

t = specified wall thickness, rounded to the nearest 0.001 in. (0.1 mm)

6.2 Diameter. The outside diameter shall be within the tolerances specified in Table 6.3. (Inside diameters are governed by the outside diameter and weight tolerances.) Pipe in Grades X42 and higher with outside diameters intermediate to those listed in Table 6.2 is available in sizes 20 in. and larger by agreement between the purchaser and the manufacturer. Such pipe shall be consistent with all requirements of this specification and shall be marked in accordance with Sect. 11. For threaded pipe, the outside diameter at the threaded ends shall be such that the thread length L_4 and the number of full-crest threads in that length are within the dimensions and tolerances specified in API Std 5B. (Inside diameters are governed by the outside diameter and weight tolerances.)

6.3 Wall Thickness. Each length of pipe shall be measured for conformance to wall-thickness requirements. The wall thickness at any place shall be within the tolerances specified in Table 6.3, except that the weld area shall not be limited by the plus tolerance. Wall-thickness measurements shall be made with a mechanical caliper or with a properly calibrated non-destructive inspection device of appropriate accuracy. In case of dispute, the measurement determined by use of the mechanical caliper shall govern. The mechanical caliper shall be fitted with contact pins having circular cross sections of $\frac{1}{4}$ in. (6.35 mm) diameter. The end of the pin contacting the inside surface of the pipe shall be rounded to a maximum radius of $1\frac{1}{2}$ in. (38.10 mm) for pipe $6\frac{1}{2}$ in. and larger, a maximum radius of $d/4$ for pipe less than $6\frac{1}{2}$ in., with a minimum radius of $\frac{1}{8}$ in. The end of the pin contacting the outside surface of the pipe shall be either flat or rounded to a radius of not less than $1\frac{1}{2}$ in. (38.10 mm). Pipe with wall thicknesses intermediate to those listed in Table 6.2 is available by agreement between purchaser and manufacturer. Such pipe shall be consistent with all requirements of this specification and shall be marked in accordance with Sect. 11.

6.4 Weight. Each length of pipe $5\frac{1}{16}$ in. and larger, shall be weighed separately, and the carload weights determined. Lengths of pipe $4\frac{1}{2}$ in. and smaller shall be weighed either individually or in convenient lots, at the option of the manufacturer and the carload weights determined. A carload is considered to be a minimum of 40,000 lb. (18144 kg). Threaded-and-coupled pipe shall be weighed with the couplings screwed on, but without thread protectors except for carload weighings, for which proper allowance shall be made for the weight of thread protectors. Threaded-and-coupled pipe may be weighed without the couplings screwed on providing proper allowance is made for weight of the couplings.

The weights determined as described above shall conform to the specified weights or calculated weights for plain-end pipe, or to the specified calculated weights (or adjusted calculated weights) for threaded-and-coupled pipe, within the tolerances specified in Table 6.3.

NOTE: Calculated weights shall be determined in accordance with the following formula:

$$W_L = (w_{pe} \times L) + e_w$$

where:

W_L = calculated weight of a piece of pipe of length L , lb (kg)

w_{pe} = plain-end weight, lb/ft (kg/m)

L = length of pipe, including end finish, as defined in Par. 6.5, ft (m)

e_w = weight gain or loss due to end finishing, lb (kg). For plain-end pipe, e_w equals zero.

6.5 Length. Unless otherwise agreed upon between the purchaser and the manufacturer, pipe shall be furnished in the lengths shown in Table 6.4 as specified on the purchase order. The lengths shall be within the tolerances specified in Table 6.4. When pipe is furnished with threads and couplings, the length shall be measured to the outer face of the coupling. The length of threaded-and-coupled pipe may be determined without the couplings screwed on providing proper allowance is made for the length of the couplings.

6.6 Straightness. Pipe less than $4\frac{1}{2}$ in. OD in Grades A25, A and B shall be reasonably straight. All other pipe shall be random checked for straightness and deviation from a straight line shall not exceed 0.2 percent of the length. Measurements may be made using a taut string or wire from end to end along the side of the pipe measuring the greatest deviation.

6.7 Jointers. Unless otherwise specified on the purchase order, jointers (two pieces of pipe coupled or welded together to make a standard length) may be furnished to a maximum of 5 percent of the order, but no lengths used in making a jointer shall be less than 5 ft. (1.5 m). Skelp end welds (for spiral weld pipe) shall be at least 12 in. from the jointer weld. Welded jointers shall be supplied on plain-end pipe; either welded or coupled jointers may be supplied on threaded pipe unless otherwise specified. (Welded jointers shall comply with the requirements of Appendix A.)

TABLE 6.1
STANDARD-WEIGHT THREADED LINE PIPE
DIMENSIONS, WEIGHTS, AND TEST PRESSURES
See Fig. 6.1

Nominal Size	Outside Diameter D	'Nominal Weight: Threads and Coupling	Calculated Weight,						Test Pressure									
			in.	lb/ft	in.	mm	Wall Thickness t	in.	mm	Plain End W _{pe}	lb/ft	kg/m	lb	kg	psi	100 kPa	psi	100 kPa
1/8	0.405 (10.3)	0.25	0.068	(1.7)	0.269	(6.9)	0.24	(0.36)	0.20	(0.09)	700	(48)	700	(48)	700	(48)	700	(48)
1/4	0.540 (13.7)	0.43	0.088	(2.2)	0.364	(9.3)	0.42	(0.62)	0.20	(0.09)	700	(48)	700	(48)	700	(48)	700	(48)
3/8	0.675 (17.1)	0.57	0.091	(2.3)	0.493	(12.5)	0.57	(0.84)	0.00	(0.00)	700	(48)	700	(48)	700	(48)	700	(48)
1/2	0.840 (21.3)	0.86	0.109	(2.8)	0.622	(15.7)	0.85	(1.28)	0.20	(0.09)	700	(48)	700	(48)	700	(48)	700	(48)
5/8	1.050 (26.7)	1.14	0.113	(2.9)	0.824	(20.9)	1.13	(1.70)	0.20	(0.09)	700	(48)	700	(48)	700	(48)	700	(48)
1	1.315 (33.4)	1.70	0.133	(3.4)	1.049	(26.6)	1.68	(2.52)	0.20	(0.09)	700	(48)	700	(48)	700	(48)	700	(48)
1 1/4	1.660 (42.2)	2.30	0.140	(3.6)	1.380	(35.0)	2.27	(3.43)	0.60	(0.27)	1000	(69)	1000	(69)	1100	(76)	1100	(76)
1 1/2	1.900 (48.3)	2.75	0.145	(3.7)	1.610	(40.9)	2.72	(4.07)	0.40	(0.18)	1000	(69)	1000	(69)	1100	(76)	1100	(76)
2	2.375 (60.3)	3.75	0.154	(3.9)	2.067	(52.5)	3.65	(5.42)	1.20	(0.54)	1000	(69)	1000	(69)	1100	(76)	1100	(76)
2 1/2	2.875 (73.0)	5.90	0.203	(5.2)	2.469	(62.6)	5.79	(8.69)	1.80	(0.82)	1000	(69)	1000	(69)	1100	(76)	1100	(76)
3	3.500 (88.9)	7.70	0.216	(5.5)	3.068	(77.9)	7.58	(11.31)	1.80	(0.82)	1000	(69)	1000	(69)	1100	(76)	1100	(76)
3 1/2	4.000 (101.6)	9.25	0.226	(5.7)	3.548	(90.2)	9.11	(13.48)	3.20	(1.45)	1200	(83)	1200	(83)	1300	(90)	1300	(90)
4	4.500 (114.3)	11.00	0.237	(6.0)	4.026	(102.3)	10.79	(16.02)	4.40	(2.00)	1200	(83)	1200	(83)	1300	(90)	1300	(90)
5	5.563 (141.3)	15.00	0.258	(6.6)	5.047	(128.1)	14.62	(21.92)	5.60	(2.54)	1200	(83)	1200	(83)	1300	(90)	1300	(90)
6	6.625 (168.3)	19.45	0.280	(7.1)	6.065	(154.1)	18.97	(28.22)	7.20	(3.27)	---	---	1200	(83)	1200	(83)	1300	(90)
8	8.625 (219.1)	25.55	0.277	(7.0)	8.071	(205.1)	24.70	(36.61)	14.80	(6.72)	---	---	1160	(80)	1350	(93)	1570	(108)
8	8.625 (219.1)	29.35	0.322	(8.2)	7.981	(202.7)	28.55	(42.65)	14.00	(6.36)	---	---	1340	(92)	1570	(108)	1570	(108)
10	10.750 (273.0)	32.75	0.279	(7.1)	10.192	(258.9)	31.20	(46.57)	20.00	(9.08)	---	---	930	(64)	1090	(75)	1120	(77)
10	10.750 (273.0)	35.75	0.307	(7.8)	10.136	(257.5)	34.24	(51.03)	19.20	(8.72)	---	---	1030	(71)	1200	(83)	1430	(99)
10	10.750 (273.0)	41.85	0.365	(9.3)	10.020	(254.5)	40.48	(60.50)	17.40	(7.90)	---	---	1220	(84)	1430	(99)	1430	(99)
12	12.750 (323.8)	45.45	0.330	(8.4)	12.090	(307.1)	43.77	(65.35)	32.60	(14.80)	---	---	960	(64)	1090	(75)	1240	(85)
12	12.750 (323.8)	51.15	0.375	(9.5)	12.000	(304.9)	49.56	(73.65)	30.80	(13.98)	---	---	1060	(73)	1120	(77)	1240	(85)
14D	14.000 (355.6)	57.00	0.375	(9.5)	13.250	(336.6)	54.57	(81.08)	24.60	(11.17)	---	---	960	(66)	840	(58)	980	(68)
16D	16.000 (406.4)	65.30	0.375	(9.5)	15.250	(387.4)	62.58	(92.98)	30.00	(13.62)	---	---	750	(52)	880	(61)	880	(61)
18D	18.000 (457.0)	73.00	0.375	(9.5)	17.250	(438.0)	70.59	(104.84)	35.60	(16.16)	---	---	680	(47)	790	(54)	790	(54)
20D	20.000 (508.0)	81.00	0.375	(9.5)	19.250	(489.0)	78.60	(116.78)	42.00	(19.07)	---	---	---	---	---	---	---	---

¹Nominal weights, threads and coupling (Col. 3) are shown for the purpose of identification in ordering.

²Weight gain due to end finishing. See Par. 6.4.

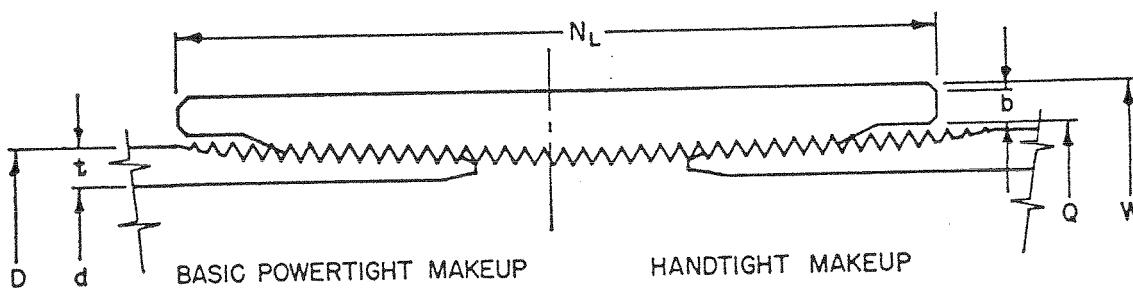


FIG. 6.1
LINE PIPE AND COUPLING
See Table 6.1 for pipe dimensions
See Table 8.1 for coupling dimensions
See Std 5B for thread details

TABLE 6.1a
EXTRA-STRONG THREADED LINE PIPE
DIMENSIONS, WEIGHTS, AND TEST PRESSURES

Nominal Size	Outside Diameter D		'Nominal Weight Threads and Coupling	Wall Thickness t		Test Pressure					
						Grade A25		Grade A		Grade B	
	in.	in.	mm	lb/ft	in.	mm	psi	kPa	psi	kPa	psi
1/8	.405	(10.3)	.31	.095	(2.4)	850	(59)	850	(59)	850	(59)
1/4	.540	(13.7)	.54	.119	(3.0)	850	(59)	850	(59)	850	(59)
5/16	.675	(17.1)	.74	.126	(3.2)	850	(59)	850	(59)	850	(59)
1/2	.840	(21.3)	1.09	.147	(3.7)	850	(59)	850	(59)	850	(59)
5/8	1.050	(26.7)	1.48	.154	(3.9)	850	(59)	850	(59)	850	(59)
1	1.315	(33.4)	2.18	.179	(4.5)	850	(59)	850	(59)	850	(59)
1 1/4	1.660	(42.2)	3.02	.191	(4.9)	1300	(90)	1500	(103)	1600	(110)
1 1/2	1.900	(48.3)	3.66	.200	(5.1)	1300	(90)	1500	(103)	1600	(110)
2	2.375	(60.3)	5.07	.218	(5.5)	1300	(90)	2500	(172)	2500	(172)
2 1/2	2.875	(73.0)	7.73	.276	(7.0)	1300	(90)	2500	(172)	2500	(172)
3	3.500	(88.9)	10.33	.300	(7.6)	1300	(90)	2500	(172)	2500	(172)
3 1/2	4.000	(101.6)	12.63	.318	(8.1)	1700	(117)	2800	(193)	2800	(193)
4	4.500	(114.3)	15.17	.337	(8.6)	1700	(117)	2700	(186)	2800	(193)
5	5.563	(141.3)	21.09	.375	(9.5)	1700	(117)	2400	(165)	2800	(193)
6	6.625	(168.3)	28.89	.432	(11.0)	---	---	2300	(159)	2700	(186)
8	8.625	(219.1)	43.90	.500	(12.7)	---	---	2100	(145)	2400	(165)
10	10.75	(273.0)	55.82	.500	(12.7)	---	---	1700	(117)	2000	(138)
12	12.75	(323.8)	66.71	.500	(12.7)	---	---	1400	(97)	1600	(110)

¹Nominal weights, threads and coupling (Col. 3) are shown for the purpose of identification in ordering

TABLE 6.2
PLAIN-END LINE PIPE
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²
 See Appendix D for Metric Tables

Nom. in.	Design- nation	Outside Diameter, in. <i>D</i>	Plain- End Weight, lb. per ft. <i>W_{pe}</i>	Wall Thickness, in. <i>t</i>	Inside Diameter, in. <i>d</i>	Test Pressure, psi, min.					
						Grade A		Grade B		Grade A25	
						Std.	Alt.	Std.	Alt.		
1/8	Std	0.405	0.24	0.068	0.269	700	---	700	---	700	
1/8	XS	0.405	0.31	0.095	0.215	850	---	850	---	850	
1/4	Std	0.540	0.42	0.088	0.364	700	---	700	---	700	
1/4	XS	0.540	0.54	0.119	0.302	850	---	850	---	850	
3/8	Std	0.675	0.57	0.091	0.493	700	---	700	---	700	
3/8	XS	0.675	0.74	0.126	0.423	850	---	850	---	850	
1/2	Std	0.840	0.85	0.109	0.622	700	---	700	---	700	
1/2	XS	0.840	1.09	0.147	0.546	850	---	850	---	850	
1/2	XXS	0.840	1.71	0.294	0.252	1000	---	1000	---	1000	
5/8	Std	1.050	1.13	0.113	0.824	700	---	700	---	700	
5/8	XS	1.050	1.47	0.154	0.742	850	---	850	---	850	
5/8	XXS	1.050	2.44	0.308	0.434	1000	---	1000	---	1000	
1	Std	1.315	1.68	0.133	1.049	700	---	700	---	700	
1	XS	1.315	2.17	0.179	0.957	850	---	850	---	850	
1	XXS	1.315	3.66	0.358	0.599	1000	---	1000	---	1000	
1 1/4	Std	1.660	2.27	0.140	1.380	1200	---	1300	---	1000	
1 1/4	XS	1.660	3.00	0.191	1.278	1800	---	1900	---	1300	
1 1/4	XXS	1.660	5.21	0.382	0.896	2200	---	2300	---	1400	
1 1/2	Std	1.900	2.72	0.145	1.610	1200	---	1300	---	1000	
1 1/2	XS	1.900	3.63	0.200	1.500	1800	---	1900	---	1300	
1 1/2	XXS	1.900	6.41	0.400	1.100	2200	---	2300	---	1400	

TABLE 6.2 (Continued)
PLAIN-END LINE PIPE
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²
 See Appendix D for Metric Tables

TABLE 6.2 (Continued)
PLAIN-END LINE PIPE
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²
 See Appendix D for Metric Tables

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Size: Outside Diameter in. <i>D</i>				Test Pressure, psi, min.										
in. <i>D</i>	Weight, lb. per ft. <i>w_{pe}</i>	Wall Thickness, in. <i>t</i>	Inside Diameter, in. <i>d</i>	Grade A25	Grade A	Grade B	Grade X42	Grade X46	Grade X52	Grade X56	Grade X60	Grade X65	Grade X70	Grade X80
*4	3.47	0.083	3.834	STD	---	750	870	1050	1150	1290	1390	1490	1620	1740
				ALT	---	---	---	1310	1430	1620	1740	1870	2020	2180
*4	4.53	0.109	3.782	STD	600	980	1140	1370	1500	1700	1830	1960	2130	2290
				ALT	---	---	---	1720	1880	2130	2290	2450	2660	2860
*4	5.17	0.125	3.750	STD	---	1120	1310	1580	1730	1950	2100	2250	2440	2630
				ALT	---	---	---	1970	2160	2440	2630	2810	3000	3000
*4	5.81	0.141	3.718	STD	800	1270	1480	1780	1950	2200	2370	2540	2750	2960
				ALT	---	---	2220	2430	2750	2960	3000	3000	3000	3000
*4	6.40	0.156	3.688	STD	---	1400	1640	1970	2150	2430	2620	2810	3000	3000
				ALT	---	---	2460	2690	3000	3000	3000	3000	3000	3000
4	7.03	0.172	3.656	STD	1000	1550	1810	2170	2370	2680	2890	3000	3000	3000
				ALT	---	---	2710	2970	3000	3000	3000	3000	3000	3000
4	7.65	0.188	3.624	STD	1200	1690	1970	2370	2590	2930	3000	3000	3000	3000
				ALT	---	---	2960	3000	3000	3000	3000	3000	3000	3000
4	9.11	0.226	3.548	STD	1200	2030	2370	2850	3000	3000	3000	3000	3000	3000
				ALT	---	---	3000	3000	3000	3000	3000	3000	3000	3000
4	10.01	0.250	3.500	STD	---	2250	2620	3000	3000	3000	3000	3000	3000	3000
				ALT	---	---	3000	3000	3000	3000	3000	3000	3000	3000
4	11.16	0.281	3.438	STD	---	2530	2800	3000	3000	3000	3000	3000	3000	3000
				ALT	---	---	3000	3000	3000	3000	3000	3000	3000	3000
4	12.50	0.318	3.364	STD	1700	2800	2800	3000	3000	3000	3000	3000	3000	3000
				ALT	---	---	3000	3000	3000	3000	3000	3000	3000	3000
*4½	3.92	0.083	4.334	STD	---	660	770	930	1020	1150	1240	1330	1440	1550
				ALT	---	---	1160	1270	1440	1550	1660	1800	1940	1940
*4½	5.84	0.125	4.250	STD	800	1000	1170	1400	1530	1730	1870	2000	2170	2330
				ALT	---	---	1750	1920	2170	2330	2500	2710	2920	2920
*4½	6.56	0.141	4.218	STD	---	1130	1320	1580	1730	1960	2110	2260	2440	2630
				ALT	---	---	1970	2160	2440	2630	2820	3000	3000	3000
*4½	7.24	0.156	4.188	STD	1000	1250	1460	1750	1910	2160	2330	2500	2700	2910
				ALT	---	---	2180	2390	2700	2910	3000	3000	3000	3000
4½	7.95	0.172	4.156	STD	---	1380	1610	1930	2110	2390	2570	2750	2980	3000
				ALT	---	---	2410	2640	2960	3000	3000	3000	3000	3000
4½	8.66	0.188	4.124	STD	1200	1500	1750	2110	2310	2610	2810	3000	3000	3000
				ALT	---	---	2630	2880	3000	3000	3000	3000	3000	3000
4½	9.32	0.203	4.094	STD	---	1620	1890	2270	2490	2810	3000	3000	3000	3000
				ALT	---	---	2840	3000	3000	3000	3000	3000	3000	3000
4½	10.01	0.219	4.062	STD	1200	1750	2040	2450	2690	3000	3000	3000	3000	3000
				ALT	---	---	3000	3000	3000	3000	3000	3000	3000	3000
4½	10.79	0.237	4.026	STD	1200	1900	2210	2650	2910	3000	3000	3000	3000	3000
				ALT	---	---	3000	3000	3000	3000	3000	3000	3000	3000
4½	11.35	0.250	4.000	STD	---	2000	2330	2800	3000	3000	3000	3000	3000	3000
				ALT	---	---	3000	3000	3000	3000	3000	3000	3000	3000
4½	12.66	0.281	3.938	STD	---	2250	2620	3000	3000	3000	3000	3000	3000	3000
				ALT	---	---	3000	3000	3000	3000	3000	3000	3000	3000
4½	13.96	0.312	3.876	STD	---	2500	2800	3000	3000	3000	3000	3000	3000	3000
				ALT	---	---	3000	3000	3000	3000	3000	3000	3000	3000
4½	14.98	0.337	3.826	STD	1700	2700	2800	3000	3000	3000	3000	3000	3000	3000
				ALT	---	---	3000	3000	3000	3000	3000	3000	3000	3000
4½	19.00	0.438	3.624	STD	---	2800	2800	3000	3000	3000	3000	3000	3000	3000
				ALT	---	---	3000	3000	3000	3000	3000	3000	3000	3000
4½	22.51	0.531	3.438	STD	---	2800	2800	3000	3000	3000	3000	3000	3000	3000
				ALT	---	---	3000	3000	3000	3000	3000	3000	3000	3000
4½	27.54	0.674	3.152	STD	---	2800	2800	3000	3000	3000	3000	3000	3000	3000
				ALT	---	---	3000	3000	3000	3000	3000	3000	3000	3000
*5½ ₁₆	4.86	0.083	5.397	STD	---	540	630	750	820	930	1000	1040	1160	1250
*5½ ₁₆	7.26	0.125	5.312	STD	670	810	940	1130	1240	1400	1500	1630	1750	1890
*5½ ₁₆	9.01	0.156	5.251	STD	840	1010	1180	1410	1550	1750	1910	2020	2120	2360
5½ ₁₆	10.79	0.188	5.187	STD	1010	1220	1420	1700	1870	2110	2270	2430	2640	2840
5½ ₁₆	12.50	0.219	5.125	STD	1180	1420	1650	1990	2170	2460	2550	2830	3000	3000
5½ ₁₆	14.62	0.258	5.047	STD	1200	1670	1950	2340	2560	2890	3000	3000	3000	3000
5½ ₁₆	15.85	0.281	5.001	STD	1520	1820	2120	2550	2790	3000	3000	3000	3000	3000
5½ ₁₆	17.50	0.312	4.939	STD	1680	2020	2360	3000	3000	3000	3000	3000	3000	3000
5½ ₁₆	19.17	0.344	4.875	STD	1860	2230	2600	3000	3000	3000	3000	3000	3000	3000
5½ ₁₆	20.78	0.375	4.813	STD	2020	2430	2800	3000	3000	3000	3000	3000	3000	3000
5½ ₁₆	27.04	0.500	4.563	STD	2700	2800	2800	3000	3000	3000	3000	3000	3000	3000
5½ ₁₆	32.96	0.625	4.313	STD	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000
5½ ₁₆	38.55	0.750	4.063	STD	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000

The decimal equivalent to 5½₁₆ shall be taken as 5.563.

TABLE 6.2 (Continued)
PLAIN-END LINE PIPE
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²
 See Appendix D for Metric Tables

Size: Outside Diameter, in. <i>D</i>	Weight, lb. per ft. <i>w_{ps}</i>	Wall Thickness, in. <i>t</i>	Inside Diameter, in. <i>d</i>	Test Pressure, psi, min.											
				Grade A		Grade B		Grade X42	Grade X46	Grade X52	Grade X56	Grade X60	Grade X65	Grade X70	Grade X80
				Std.	Alt.	Std.	Alt.								
*6%	5.80	0.083	6.459	450	560	530	660	790	860	980	1050	1130	1220	1320	..
*6%	7.59	0.109	6.407	590	740	690	860	1040	1140	1280	1380	1480	1600	1730	..
*6%	8.68	0.125	6.375	680	850	790	990	1190	1300	1470	1580	1700	1840	1980	..
*6%	9.76	0.141	6.343	770	960	890	1120	1340	1470	1660	1790	1920	2080	2230	..
*6%	10.78	0.156	6.313	850	1060	990	1240	1480	1620	1840	1980	2120	2300	2470	..
6%	11.85	0.172	6.281	930	1170	1090	1360	1640	1790	2030	2180	2340	2530	2730	..
6%	12.92	0.188	6.249	1020	1280	1190	1490	1790	1960	2210	2380	2550	2770	2980	..
6%	13.92	0.203	6.219	1100	1380	1290	1610	1930	2110	2390	2570	2760	2990	3000	..
6%	14.98	0.219	6.187	1190	1490	1390	1740	2080	2280	2580	2780	2980	3000	3000	..
6%	17.02	0.250	6.125	1360	1700	1580	1980	2380	2600	2940	3000	3000	3000	3000	..
6%	18.97	0.280	6.065	1520	1900	1780	2220	2660	2920	3000	3000	3000	3000	3000	..
6%	21.04	0.312	6.001	1700	2120	1980	2470	2970	3000	3000	3000	3000	3000	3000	..
6%	23.08	0.344	5.937	1870	2340	2180	2500	3000	3000	3000	3000	3000	3000	3000	..
6%	25.03	0.375	5.875	2040	2550	2380	2730	3000	3000	3000	3000	3000	3000	3000	..
6%	28.57	0.432	5.761	---	---	---	---	3000	3000	3000	3000	3000	3000	3000	..
6%	32.71	0.500	5.625	2720	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
6%	36.39	0.562	5.501	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
6%	40.05	0.625	5.375	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
6%	45.35	0.719	5.187	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
6%	47.06	0.750	5.125	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
6%	53.73	0.875	4.875	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
*8%	11.35	0.125	8.375	520	650	610	760	910	1000	1130	1220	1300	1410	1520	..
*8%	14.11	0.156	8.313	650	810	760	950	1140	1250	1410	1520	1630	1760	1900	..
8%	16.94	0.188	8.249	780	890	920	1140	1370	1500	1700	1830	1960	2130	2290	..
8%	18.26	0.203	8.219	---	---	---	---	1480	1520	1840	2000	2120	2290	2470	..
8%	19.66	0.219	8.187	910	1140	1070	1330	1600	1750	1980	2130	2290	2480	2670	..
8%	22.36	0.250	8.125	1040	1300	1220	1520	1830	2000	2260	2430	2610	2830	3000	..
8%	24.70	0.277	8.071	1160	1450	1350	1690	2020	2220	2510	2700	2890	3000	3000	..
8%	27.70	0.312	8.001	1300	1630	1520	1900	2280	2500	2820	3000	3000	3000	3000	..
8%	28.55	0.322	7.981	1340	1680	1570	1960	2350	2580	2910	3000	3000	3000	3000	..
8%	30.42	0.344	7.937	1440	1790	1680	2090	2510	2750	3000	3000	3000	3000	3000	..
8%	33.04	0.375	7.875	1570	1960	1830	2280	2740	3000	3000	3000	3000	3000	3000	..
8%	38.30	0.438	7.749	1830	2290	2130	2670	3000	3000	3000	3000	3000	3000	3000	..
8%	43.39	0.500	7.625	2090	2610	2430	2800	3000	3000	3000	3000	3000	3000	3000	..
8%	48.40	0.562	7.501	2350	2800	2740	2800	3000	3000	3000	3000	3000	3000	3000	..
8%	53.40	0.625	7.375	2610	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
8%	60.71	0.719	7.187	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
8%	63.08	0.750	7.125	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
8%	67.76	0.812	7.001	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
8%	72.42	0.875	6.875	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
8%	81.44	1.000	6.625	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
*10%	17.65	0.156	10.438	520	650	610	760	1040	1130	1280	1380	1480	1600	1730	..
*10%	21.21	0.188	10.374	630	790	730	920	1250	1370	1550	1660	1780	1930	2080	..
*10%	22.87	0.203	10.344	---	---	---	---	1350	1480	1670	1800	1930	2090	2250	..
10%	24.63	0.219	10.312	730	920	860	1070	1450	1590	1800	1940	2080	2250	2420	..
10%	28.04	0.250	10.250	840	1050	980	1220	1660	1820	2060	2210	2370	2570	2770	..
10%	31.20	0.279	10.192	930	1170	1090	1360	1850	2030	2290	2470	2650	2870	3000	..
10%	34.24	0.307	10.136	1030	1290	1200	1500	2040	2230	2520	2720	2910	3000	3000	..
10%	38.23	0.344	10.062	1150	1440	1340	1680	2280	2500	2830	3000	3000	3000	3000	..
10%	40.48	0.365	10.020	1220	1530	1430	1780	2420	2660	3000	3000	3000	3000	3000	..
10%	48.24	0.438	9.874	1470	1830	1710	2140	2910	3000	3000	3000	3000	3000	3000	..
10%	54.74	0.500	9.750	---	---	---	---	3000	3000	3000	3000	3000	3000	3000	..
10%	61.15	0.562	9.626	1880	2350	2200	2740	3000	3000	3000	3000	3000	3000	3000	..
10%	67.58	0.625	9.500	2090	2620	2440	2800	3000	3000	3000	3000	3000	3000	3000	..
10%	77.03	0.719	9.312	2410	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
10%	86.18	0.812	9.126	2720	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
10%	92.28	0.875	9.000	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
10%	98.30	0.938	8.874	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
10%	104.13	1.000	8.750	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
10%	126.83	1.250	8.250	2800	2800	2800	2800	3000	3000	3000	3000	3000	3000	3000	..
*12%	23.11	0.172	12.406	490	610	570	710	960	1050	1150	1300	1400	1500	1630	1750
*12%	25.22	0.188	12.374	530	660	620	770	1050	1140	1250	1410	1520	1620	1760	1890
*12%	27.20	0.203	12.344	---	---	---	---	1140	1250	1410	1520	1640	1750	1900	2040
*12%	29.31	0.219	12.312	620	770	720	900	1230	1340	1520	1640	1750	1900	2040	..
*12%	33.38	0.250	12.250	710	880	820	1030	1400	1530	1730	1870	2000	2170	2330	..
12%	37.42	0.281	12.188	790	990	930	1160	1570	1720	1950	2100	2250	2440	2620	..

TABLE 6.2 (Continued)
PLAIN-END LINE PIPE
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²
 See Appendix D for Metric Tables

TABLE 6.2 (Continued)
PLAIN-END LINE PIPE
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²
 See Appendix D for Metric Tables

See Appendix D for Metric Tables

TABLE 6.2 (Continued)
PLAIN-END LINE PIPE
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²
See Appendix D for Metric Tables

Size: Outside Diameter, in. <i>D</i>	Weight, lb. per ft. <i>W_{pe}</i>	Wall Thickness, in. <i>t</i>	Inside Diameter, in. <i>d</i>	Test Pressure, psi. min.																
				Grade A				Grade B				Grade X42	Grade X46	Grade X52	Grade X56	Grade X60	Grade X65	Grade X70	Grade X80	
				Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.									
22	237.48	1.062	19.876	1740	2170	2030	2500	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	
22	250.81	1.125	19.750	1840	2300	2150	2500	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	
22	264.06	1.188	19.626	1940	2430	2270	2500	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	
22	277.01	1.25	19.500	2050	2500	2390	2500	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	
22	289.88	1.312	19.376	2150	2500	2500	2500	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	
22	302.88	1.375	19.250	2250	2500	2500	2500	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	
22	315.79	1.438	19.126	2350	2500	2500	2500	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	
22	328.41	1.5	19.000	2450	2500	2500	2500	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	
*24	63.41	0.25	23.500	380	470	440	550	790	860	980	1050	1130	1220	1310	1410	1510	1610	1710	1810	
*24	71.18	0.281	23.438	420	530	490	610	890	970	1100	1180	1260	1370	1480	1580	1680	1780	1880	1980	
24	78.93	0.312	23.376	470	580	550	680	980	1080	1190	1340	1440	1550	1680	1810	1970	2130	2290	2460	
24	86.91	0.344	23.312	520	640	600	750	1080	1190	1290	1460	1580	1690	1830	1970	2130	2290	2460	2630	
24	94.62	0.375	23.250	560	700	660	820	1180	1280	1400	1580	1710	1830	1980	2130	2290	2460	2630	2950	
24	102.31	0.406	23.188	---	---	---	---	1280	1400	1580	1710	1840	1970	2140	2300	2460	2630	2950	3000	
24	110.22	0.438	23.124	660	820	770	960	1380	1510	1710	1830	1970	2110	2290	2440	2630	2950	3000	3000	
24	117.86	0.469	23.062	---	---	---	---	1480	1620	1830	1970	2110	2250	2440	2630	2950	3000	3000	3000	
24	125.49	0.5	23.000	750	940	880	1090	1580	1730	1950	2100	2360	2530	2740	2950	3000	3000	3000	3000	3000
24	140.68	0.562	22.876	840	1050	980	1230	1770	1940	2190	2440	2630	2810	3000	3000	3000	3000	3000	3000	3000
24	156.03	0.625	22.750	940	1170	1090	1370	1970	2160	2440	2680	2890	3000	3000	3000	3000	3000	3000	3000	3000
24	171.29	0.688	22.624	1030	1290	1200	1500	2170	2370	2590	2930	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	186.23	0.75	22.500	1120	1410	1310	1640	2360	2590	2930	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	201.90	0.812	22.376	1220	1520	1420	1780	2760	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	216.10	0.875	22.250	1310	1640	1530	1910	2950	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	231.03	0.938	22.124	1410	1760	1640	2050	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	245.64	1	22.000	1500	1880	1750	2190	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	260.17	1.062	21.876	1590	1990	1860	2300	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	274.84	1.125	21.750	1690	2110	1970	2300	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	289.44	1.188	21.626	1780	2230	2080	2300	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	303.71	1.25	21.500	1880	2300	2190	2300	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	317.91	1.312	21.376	1970	2300	2300	2300	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	332.25	1.375	21.250	2060	2300	2300	2300	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	346.50	1.438	21.126	2160	2300	2300	2300	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	360.45	1.5	21.000	2250	2300	2300	2300	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
24	374.31	1.562	20.876	2300	2300	2300	2300	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
*26	68.75	0.25	25.500	350	430	400	500	730	800	900	970	1040	1130	1210	1360	1510	1670	1820	1970	2120
*26	77.18	0.281	25.438	390	490	450	570	820	890	1010	1090	1170	1260	1400	1510	1670	1820	1970	2120	2270
26	85.60	0.312	25.376	430	540	500	630	910	990	1120	1210	1300	1430	1550	1670	1820	1970	2120	2270	2420
26	94.26	0.344	25.312	480	600	560	690	1000	1100	1240	1330	1450	1560	1690	1820	1970	2120	2270	2420	2570
26	102.63	0.375	25.250	520	650	610	760	1090	1190	1350	1460	1570	1690	1830	1970	2120	2270	2420	2570	2720
26	110.98	0.406	25.188	---	---	---	---	1180	1270	1390	1580	1700	1820	1950	2110	2270	2420	2570	2720	2870
26	119.57	0.438	25.124	610	760	710	880	1270	1390	1490	1690	1820	1950	2080	2250	2420	2570	2720	2870	3000
26	127.88	0.469	25.062	---	---	---	---	1360	1450	1590	1800	1940	2080	2250	2420	2570	2720	2870	3000	3000
26	136.17	0.5	25.000	690	870	810	1010	1450	1590	1800	1940	2080	2250	2420	2570	2720	2870	3000	3000	3000
26	152.68	0.562	24.876	780	970	910	1130	1630	1790	2020	2180	2250	2420	2600	2810	3000	3000	3000	3000	3000
26	169.38	0.625	24.750	870	1080	1010	1260	1820	1990	2250	2480	2670	2860	3000	3000	3000	3000	3000	3000	3000
26	185.99	0.688	24.624	950	1190	1110	1390	2000	2190	2480	2700	2910	3000	3000	3000	3000	3000	3000	3000	3000
26	202.25	0.75	24.500	1040	1300	1210	1510	2180	2390	2590	2920	3000	3000	3000	3000	3000	3000	3000	3000	3000
26	218.43	0.812	24.376	1120	1410	1310	1640	2360	2590	2790	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
26	234.79	0.875	24.250	1210	1510	1410	1770	2540	2790	2990	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
26	251.07	0.938	24.124	1300	1620	1520	1890	2730	2990	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
26	267.00	1	24.000	1380	1730	1620	2000	2910	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
*28	74.09	0.250	27.500	320	400	370	470	680	740	840	900	96								

TABLE 6.2 (Continued)
PLAIN-END LINE PIPE
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²
 See Appendix D for Metric Tables

Size: Outside Diameter, in. <i>D</i>	Weight, lb. per ft. <i>w_{pe}</i>	Wall Thickness, in. <i>t</i>	Inside Diameter, in. <i>d</i>	Test Pressure, psi, min.																																	
				Grade A		Grade B		Grade X42		Grade X46		Grade X52		Grade X56		Grade X60		Grade X65		Grade X70		Grade X80															
				Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.																		
28	253.48	0.875	26.250	1120	1410	1310	1640	2360	2590	2920	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000															
28	271.10	0.938	26.124	1210	1510	1410	1760	2530	2770	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000															
28	288.36	1.000	26.000	1290	1610	1500	1880	2700	2960	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000															
30	79.43	0.250	29.500	300	370	350	440	630	690	780	840	900	980	1050	1120	1180	1220	1310	1340	1440	1580	1710	1780														
30	89.19	0.281	29.438	340	420	390	490	710	780	880	940	1010	1100	1180	1220	1310	1340	1440	1580	1710	1780	1840	1970	2000													
30	98.93	0.312	29.376	370	470	440	550	790	860	970	1050	1120	1220	1310	1340	1440	1580	1710	1780	1840	1970	2000	2050	2100													
30	108.95	0.344	29.312	---	---	---	---	870	950	1070	1160	1240	1340	1440	1580	1710	1780	1840	1970	2000	2050	2100	2150	2280													
30	118.65	0.375	29.250	450	560	520	660	940	1040	1170	1260	1350	1460	1580	1710	1780	1840	1970	2000	2050	2100	2150	2280	2360													
30	128.32	0.406	29.188	---	---	---	---	1020	1120	1270	1360	1460	1580	1710	1840	1970	2000	2050	2100	2150	2280	2360	2440	2630	2750												
30	138.29	0.438	29.124	530	660	610	770	1100	1210	1370	1470	1580	1710	1840	1970	2000	2050	2100	2150	2280	2360	2440	2630	2750	2890												
30	147.92	0.469	29.062	---	---	---	---	1180	1290	1460	1580	1690	1830	1970	2000	2050	2100	2150	2280	2360	2440	2630	2750	2890	2920	3000											
30	157.53	0.500	29.000	600	750	700	880	1260	1380	1560	1680	1800	1950	2100	2200	2300	2420	2540	2660	2780	2900	3000	3000	3000	3000	3000											
30	176.69	0.562	28.876	670	840	790	980	1420	1550	1750	1900	2100	2250	2440	2630	2800	2990	3100	3200	3300	3400	3500	3600	3700	3800	3900											
30	196.08	0.625	28.750	750	940	880	1090	1580	1720	1950	2100	2250	2440	2630	2800	2990	3100	3200	3300	3400	3500	3600	3700	3800	3900	3900											
30	215.38	0.688	28.624	830	1030	960	1200	1730	1900	2150	2310	2480	2680	2890	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000										
30	234.29	0.750	28.500	900	1120	1050	1310	1890	2070	2340	2520	2700	2920	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000											
30	253.12	0.812	28.376	970	1220	1140	1420	2050	2240	2530	2730	2920	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000											
30	272.17	0.875	28.250	1050	1310	1220	1530	2200	2420	2730	2940	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000											
30	291.14	0.938	28.124	1130	1410	1310	1640	2360	2590	2930	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000											
30	309.72	1.000	28.000	1200	1500	1400	1750	2520	2760	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000											
30	328.22	1.062	27.876	1270	1590	1490	1860	2680	2930	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000											
30	346.93	1.125	27.750	1350	1690	1580	1970	2840	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000											
30	365.56	1.188	27.624	1430	1780	1660	2080	2990	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000											
30	383.81	1.250	27.500	1500	1880	1750	2190	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000											
32	84.77	0.250	31.500	280	350	330	410	590	650	730	790	840	910	980	1050	1110	1180	1230	1280	1350	1420	1480	1550	1620	1680	1750											
32	95.19	0.281	31.438	320	400	370	460	660	730	820	890	950	1030	1110	1180	1230	1300	1360	1420	1480	1550	1620	1680	1750	1820	1900	1970										
32	105.59	0.312	31.376	350	440	410	510	740	810	890	970	1050	1120	1200	1280	1350	1420	1480	1550	1620	1680	1750	1820	1900	1970	2050	2100										
32	116.30	0.344	31.312	---	---	---	---	810	890	1010	1080	1160	1230	1300	1350	1420	1480	1550	1620	1680	1750	1820	1900	1970	2050	2100	2150										
32	126.66	0.375	31.250	420	530	490	620	890	970	1100	1180	1260	1340	1420	1500	1580	1660	1740	1820	1900	1980	2060	2140	2220	2300	2380	2460	2540									
32	136.99	0.406	31.188	---	---	---	---	960	1050	1190	1280	1370	1460	1550	1640	1730	1820	1910	2000	2090	2180	2270	2360	2450	2540	2630	2720	2810	2900								
32	147.64	0.438	31.124	490	620	570	720	1030	1130	1280	1380	1480	1580	1680	1780	1880	1980	2080	2180	2280	2380	2480	2580	2680	2780	2880	2980	3080	3180								
32	157.94	0.469	31.062	---	---	---	---	1110	1210	1370	1480	1580	1680	1780	1880	1980	2080	2180	2280	2380	2480	2580	2680	2780	2880	2980	3080	3180	3280	3380	3480						
32	168.21	0.500	31.000	560	700	660	820	1180	1290	1460	1580	1680	1780	1880	1980	2080	2180	2280	2380	2480	2580	2680	2780	2880	2980	3080	3180	3280	3380	3480	3580						
32	188.70	0.562	30.876	630	790	740	920	1330	1450	1640	1770	1900	2050	2210	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200	3300	3400	3500	3600	3700	3800	3900	4000					
32	209.43	0.625	30.750	700	880	820	1030	1480	1620	1830	1970	2110	2290	2460	2640	2820	2970	3050	3130	3220	3320	3420	3520	3620	3720	3820	3920	4020	4120	4220	4320	4420	4520				
32	230.08	0.688	30.624	770	970	900	1130	1530	1630	1780	1910	2010	2170	2320	2470	2620	2770	2920	3070	3220	3370	3520	3670	3820	3970	4120	4270	4420	4570	4720	4870	4970	5070				
32	250.31	0.750	30.500	840	1050	980	1230	1770	1940	2120	2300	2480	2660	2840	3020	3200	3380	3560	3740	3920	4100	4280	4460	4640	4820	4970	5120	5270	5420	5570	5720	5870	5970	6070			
32	270.47	0.812	30.376	910	1140	1070	1330	1920	2100	2380	2560	2750	2940	3130	3320	3510	3700	3890	4080	4270	4460	4650	4840	5030	5220	5410	5600	5790	5980	6170	6360	6550	6740	6930	7120	7310	7500
32	290.86	0.875	30.250	980	1230	1150	1440	2070	2260	2560	2750	2950																									

TABLE 6.2 (Continued)
PLAIN-END LINE PIPE
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²
See Appendix D for Metric Tables

3	Weight, lb per ft of pipe	Wall Thickness, in. t	Inside Diameter, in. d	Test Pressure, psi, min.											
				Grade A		Grade B		Grade X42	Grade X46	Grade X52	Grade X56	Grade X60	Grade X65	Grade X70	Grade X80
				Std.	Alt.	Std.	Alt.								
38	95.45	0.250	35.500	250	310	290	360	520	580	650	700	750	810	880	**
38	107.20	0.281	35.438	280	350	330	410	590	650	730	790	840	910	980	**
38	118.92	0.312	35.376	310	390	360	450	660	720	810	870	940	1010	1090	**
38	131.00	0.344	35.312	---	---	---	---	720	790	890	960	1030	1120	1200	**
38	142.68	0.375	35.250	380	470	440	550	790	860	980	1050	1120	1220	1310	**
38	154.34	0.406	35.188	---	---	---	---	850	930	1060	1140	1220	1320	1420	**
38	166.35	0.438	35.124	440	550	510	640	920	1010	1140	1230	1310	1420	1530	**
38	177.97	0.469	35.062	---	---	---	---	980	1080	1220	1310	1410	1520	1640	**
38	189.57	0.500	35.000	500	620	580	730	1050	1150	1300	1400	1500	1620	1750	**
38	212.70	0.562	34.876	560	700	660	820	1180	1290	1460	1570	1690	1820	1970	**
38	236.13	0.625	34.750	620	780	730	910	1310	1440	1620	1750	1880	2030	2190	**
38	259.47	0.688	34.624	690	860	800	1000	1440	1580	1790	1930	2060	2240	2410	**
38	282.35	0.750	34.500	750	940	880	1090	1580	1720	1950	2100	2250	2440	2630	**
38	305.16	0.812	34.376	810	1020	950	1180	1710	1870	2110	2270	2440	2640	2840	**
38	328.24	0.875	34.250	880	1090	1020	1280	1840	2010	2280	2450	2620	2840	3000	**
38	351.25	0.938	34.124	940	1170	1090	1370	1970	2160	2440	2630	2810	3000	3000	**
38	373.80	1.000	34.000	1000	1250	1170	1460	2100	2300	2600	2800	3000	3000	3000	**
38	396.27	1.062	33.876	1060	1330	1240	1550	2230	2440	2760	2970	3000	3000	3000	**
38	419.02	1.125	33.750	1130	1410	1310	1640	2360	2590	2930	3000	3000	3000	3000	**
38	441.69	1.188	33.624	1190	1480	1390	1730	2490	2730	3000	3000	3000	3000	3000	**
38	463.91	1.250	33.500	1250	1560	1460	1820	2830	2870	3000	3000	3000	3000	3000	**
38	125.58	0.312	37.376	300	370	340	430	620	680	770	830	890	960	1030	**
38	138.35	0.344	37.312	330	410	380	480	680	750	850	910	980	1060	1140	**
38	150.69	0.375	37.250	360	440	410	520	750	820	920	990	1070	1150	1240	**
38	163.01	0.406	37.188	380	480	450	560	810	880	1000	1080	1150	1250	1350	**
38	175.71	0.438	37.124	410	520	480	610	870	950	1080	1160	1240	1350	1450	**
38	187.99	0.469	37.062	440	560	520	650	930	1020	1160	1240	1330	1440	1560	**
38	200.25	0.500	37.000	470	590	550	690	990	1090	1230	1330	1420	1540	1660	**
38	224.71	0.562	36.876	530	670	620	780	1120	1220	1380	1490	1600	1730	1860	**
38	243.48	0.625	36.750	590	740	690	860	1240	1360	1540	1560	1780	1920	2070	**
38	274.16	0.688	36.624	650	810	760	950	1370	1500	1690	1830	1960	2120	2280	**
38	298.37	0.750	36.500	710	890	830	1040	1490	1630	1850	1990	2130	2310	2490	**
38	322.50	0.812	36.376	770	960	900	1120	1620	1770	2000	2150	2310	2500	2690	**
38	346.93	0.875	36.250	830	1040	970	1210	1740	1910	2160	2320	2490	2690	2900	**
38	371.28	0.938	36.124	890	1110	1040	1300	1870	2040	2310	2490	2670	2890	3000	**
38	395.16	1.000	36.000	950	1180	1110	1380	1990	2180	2460	2650	2840	3000	3000	**
38	418.96	1.062	35.876	1010	1260	1170	1470	2110	2310	2620	2820	3000	3000	3000	**
38	443.05	1.125	35.750	1070	1330	1240	1550	2240	2450	2770	2980	3000	3000	3000	**
38	467.06	1.188	35.624	1130	1410	1310	1640	2960	2590	2930	3000	3000	3000	3000	**
38	490.61	1.250	35.500	1180	1480	1380	1730	2490	2720	3000	3000	3000	3000	3000	**
40	132.25	0.312	39.376	280	350	330	410	590	650	730	790	840	910	980	**
40	145.69	0.344	39.312	310	390	360	450	650	710	800	870	930	1010	1080	**
40	158.70	0.375	39.250	340	420	390	490	710	780	880	940	1010	1100	1180	**
40	171.68	0.406	39.188	370	460	430	530	770	840	950	1020	1100	1190	1280	**
40	185.06	0.438	39.124	390	490	460	570	830	910	1020	1100	1180	1280	1380	**
40	198.01	0.469	39.062	420	530	490	620	890	970	1100	1180	1270	1370	1480	**
40	210.93	0.500	39.000	450	560	520	660	940	1040	1170	1260	1350	1460	1580	**
40	236.71	0.562	38.876	510	630	590	740	1060	1160	1320	1420	1520	1640	1770	**
40	262.83	0.625	38.750	560	700	660	820	1180	1290	1460	1580	1690	1830	1970	**
40	288.86	0.688	38.624	620	770	720	900	1300	1420	1610	1730	1860	2010	2170	**
40	314.39	0.750	38.500	680	840	790	980	1420	1550	1760	1890	2020	2190	2360	**
40	339.84	0.812	38.376	730	910	850	1070	1530	1680	1900	2050	2190	2380	2560	**
40	365.62	0.875	38.250	790	980	920	1150	1650	1810	2050	2200	2360	2560	2760	**
40	391.32	0.938	38.124	840	1060	980	1230	1770	1940	2190	2360	2530	2740	2950	**
40	416.52	1.000	38.000	900	1120	1050	1310	1890	2070	2340	2520	2700	2920	3000	**
40	441.64	1.062	37.876	960	1190	1120	1390	2010	2200	2490	2680	2870	3000	3000	**
40	467.08	1.125	37.750	1010	1270	1180	1480	2130	2330	2630	2830	3000	3000	3000	**
40	492.44	1.188	37.624	1070	1340	1250	1560	2250	2460	2780	2990	3000	3000	3000	**
40	517.31	1.250	37.500	1130	1410	1310	1640	2360	2590	2930	3000	3000	3000	3000	**
42	153.04	0.344	41.312	290	370	340	430	620	680	770	830	880	960	1030	**
42	166.71	0.375	41.250	320	400	380	470	680	740	840	900	960	1040	1130	**
42	180.35	0.406	41.188	350	430	410	510	730	800	900	970	1040	1130	1220	**
42	194.42	0.438	41.124	380	470	440	550	790	860	980	1050	1130	1220	1310	**
42	208.03	0.469	41.062	400	500	470	590	840	920	1050	1130	1210	1310	1410	**
42	221.61	0.500	41.000	430	540	500	620	900	990	1110	1200	1290	1390	1500	**
42	248.72	0.562	40.876	480	600	560	700	1010	1110	1250	1350	1450	1570	1690	**

TABLE 6.2 (Continued)
PLAIN-END LINE PIPE
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²
See Appendix D for Metric Tables

Size: Outside Diameter, in. <i>D</i>	Weight, lb. per ft. <i>w_{pe}</i>	Wall Thickness, in. <i>t</i>	Inside Diameter, in. <i>d</i>	Test Pressure, psi, min.											
				Grade A		Grade B		Grade X42	Grade X46	Grade X52	Grade X56	Grade X60	Grade X65	Grade X70	Grade X80
				Std.	Alt.	Std.	Alt.								
42	276.18	0.625	40.750	540	670	620	780	1120	1230	1390	1500	1610	1740	1880	..
42	303.55	0.688	40.624	590	740	690	860	1240	1360	1530	1650	1770	1920	2060	..
42	330.41	0.750	40.500	640	800	750	940	1350	1480	1670	1800	1930	2090	2250	..
42	357.19	0.812	40.376	700	870	810	1020	1460	1600	1810	1950	2090	2260	2440	..
42	384.31	0.875	40.250	750	940	880	1090	1580	1720	1950	2100	2250	2440	2630	..
42	411.35	0.938	40.124	800	1000	940	1170	1690	1850	2090	2250	2410	2610	2810	..
42	437.88	1.000	40.000	860	1070	1000	1250	1800	1970	2230	2400	2570	2790	3000	..
42	464.32	1.062	39.876	910	1140	1060	1330	1910	2090	2370	2550	2730	2960	3000	..
42	491.11	1.125	39.750	960	1210	1130	1410	2030	2200	2510	2700	2890	3000	3000	..
42	517.82	1.188	39.624	1020	1270	1190	1480	2140	2340	2650	2850	3000	3000	3000	..
42	544.01	1.250	39.500	1070	1340	1250	1560	2250	2460	2790	3000	3000	3000	3000	..
44	160.39	0.344	43.312	280	350	330	410	590	650	730	790	840	910	990	..
44	174.72	0.375	43.250	310	380	360	450	640	710	800	860	920	1000	1070	..
44	189.03	0.406	43.188	330	420	390	480	700	760	860	930	1000	1080	1160	..
44	203.78	0.438	43.124	360	450	420	520	750	820	930	1000	1080	1160	1250	..
44	218.04	0.469	43.062	380	480	450	560	810	880	1000	1070	1150	1250	1340	..
44	232.29	0.500	43.000	410	510	480	600	860	940	1060	1150	1230	1330	1430	..
44	260.72	0.562	42.876	460	570	540	670	970	1060	1200	1290	1380	1490	1610	..
44	289.53	0.625	42.750	510	640	600	750	1070	1180	1330	1430	1530	1650	1790	..
44	318.25	0.688	42.624	560	700	660	820	1180	1290	1460	1580	1690	1830	1970	..
44	346.43	0.750	42.500	610	770	720	890	1290	1410	1600	1720	1840	1990	2150	..
44	374.53	0.812	42.376	660	830	780	970	1400	1530	1730	1860	1990	2160	2330	..
44	403.00	0.875	42.250	720	890	840	1040	1500	1650	1860	2000	2150	2330	2510	..
44	431.39	0.938	42.124	770	960	900	1120	1610	1770	2000	2150	2300	2490	2690	..
44	459.24	1.000	42.000	820	1020	950	1190	1720	1880	2130	2290	2450	2660	2860	..
44	487.01	1.062	41.876	870	1090	1010	1270	1820	2000	2260	2430	2610	2820	3000	..
44	515.14	1.125	41.750	920	1150	1070	1340	1930	2120	2390	2580	2760	2990	3000	..
44	543.19	1.188	41.624	970	1210	1130	1420	2040	2240	2530	2720	2920	3000	3000	..
44	570.71	1.250	41.500	1020	1280	1190	1490	2150	2350	2660	2860	3000	3000	3000	..
46	167.74	0.344	45.312	270	340	310	390	570	620	700	750	810	870	940	..
46	182.73	0.375	45.250	290	370	340	430	620	680	760	820	880	950	1030	..
46	197.70	0.406	45.188	320	400	370	460	670	730	830	890	950	1030	1110	..
46	213.13	0.438	45.124	340	430	400	500	720	790	890	960	1030	1110	1200	..
46	228.06	0.469	45.062	370	460	430	540	770	840	950	1030	1100	1190	1280	..
46	242.97	0.500	45.000	390	490	460	570	820	900	1020	1100	1170	1270	1370	..
46	272.73	0.562	44.876	440	550	510	640	920	1010	1140	1230	1320	1430	1540	..
46	302.86	0.625	44.750	490	610	570	710	1030	1120	1270	1370	1470	1590	1710	..
46	332.95	0.688	44.624	540	670	630	790	1130	1240	1400	1510	1620	1750	1880	..
46	362.45	0.750	44.500	590	730	680	860	1230	1350	1530	1640	1760	1910	2050	..
46	391.88	0.812	44.376	640	790	740	930	1330	1460	1650	1780	1910	2070	2220	..
46	421.69	0.875	44.250	680	860	800	1000	1440	1580	1780	1920	2050	2230	2400	..
46	451.42	0.938	44.124	730	920	860	1070	1540	1690	1910	2060	2200	2390	2570	..
46	480.60	1.000	44.000	780	980	910	1140	1640	1800	2030	2190	2350	2540	2740	..
46	509.69	1.062	43.876	830	1040	970	1210	1750	1910	2160	2330	2490	2700	2910	..
46	539.17	1.125	43.750	880	1100	1030	1280	1850	2020	2290	2470	2640	2860	3000	..
46	568.57	1.188	43.624	930	1160	1080	1360	1950	2140	2420	2600	2790	3000	3000	..
46	597.41	1.250	43.500	980	1220	1140	1430	2050	2250	2540	2740	2930	3000	3000	..
48	175.08	0.344	47.312	260	320	300	380	540	590	670	720	770	840	900	..
48	190.74	0.375	47.250	280	350	330	410	590	650	730	790	840	910	980	..
48	206.37	0.406	47.188	300	380	360	440	640	700	790	850	910	990	1070	..
48	222.49	0.438	47.124	330	410	380	480	690	760	850	920	990	1070	1150	..
48	238.08	0.469	47.062	350	440	410	510	740	810	910	980	1060	1140	1230	..
48	253.65	0.500	47.000	380	470	440	550	790	860	980	1050	1120	1220	1310	..
48	284.73	0.562	46.876	420	530	490	610	890	970	1100	1180	1260	1370	1480	..
48	316.23	0.625	46.750	470	590	550	680	980	1080	1220	1310	1410	1520	1640	..
48	347.64	0.688	46.624	520	640	600	750	1080	1190	1340	1440	1550	1680	1810	..
48	378.47	0.750	46.500	560	700	660	820	1180	1290	1460	1580	1690	1830	1970	..
48	409.22	0.812	46.376	610	760	710	890	1280	1400	1580	1710	1830	1980	2130	..
48	440.38	0.875	46.250	660	820	770	960	1380	1510	1710	1840	1970	2130	2300	..
48	471.46	0.938	46.124	700	880	820	1030	1480	1620	1830	1970	2110	2290	2460	..
48	501.96	1.000	46.000	750	940	880	1090	1580	1720	1950	2100	2250	2440	2630	..
48	532.38	1.062	45.876	800	1000	930	1160	1670	1830	2070	2230	2390	2590	2790	..
48	563.20	1.125	45.750	840	1050	980	1230	1770	1940	2190	2360	2530	2740	2950	..
48	593.94	1.188	45.624	890	1110	1040	1300	1870	2050	2320	2490	2670	2900	3000	..
48	624.11	1.250	45.500	940	1170	1090	1370	1970	2160	2440	2620	2810	3000	3000	..

TABLE 6.2 (Continued)
PLAIN-END LINE PIPE
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²
See Appendix D for Metric Tables

Size: Outside Diameter, in. D	Weight, lb. per ft. w/p	Wall Thickness, in. t	Inside Diameter, in. d	Grade A		Grade B		Test Pressure, psi. min.		Grade X52	Grade X56	Grade X60	Grade X65	Grade X70	Grade X80
				Std.	Alt.	Std.	Alt.	9	10						
				3	4	5	6	7	8						
52	206.76	0.375	51.250	260	320	300	380	300	380	680	730	780	840	910	980
52	223.72	0.406	51.188	280	350	330	410	590	650	730	790	840	910	990	1060
52	241.20	0.438	51.124	300	380	350	440	640	700	790	850	910	970	1040	1140
52	258.11	0.469	51.062	320	430	400	450	560	630	1000	1100	1240	1330	1430	1550
52	275.01	0.500	51.000	350	490	500	540	560	690	1090	1190	1350	1450	1560	1690
52	308.74	0.562	50.876	390	540	500	560	690	760	1090	1190	1460	1570	1690	1820
52	342.93	0.625	50.750	430	600	560	610	760	820	1180	1290	1580	1700	1820	1970
52	377.03	0.688	50.624	480	650	660	710	880	950	1360	1490	1690	1940	2080	2250
52	410.51	0.750	50.500	520	700	660	710	880	950	1450	1590	1800	1940	2060	2110
52	443.91	0.812	50.376	560	810	760	810	1010	1070	1540	1690	1910	2030	2180	2340
52	477.76	0.875	50.250	610	870	810	860	1070	1140	1640	1790	1890	2140	2300	2670
52	511.53	0.938	50.124	650	920	910	960	1200	1730	1890	2250	2420	2600	2810	3000
52	544.68	1.000	50.000	690	970	910	960	1260	1820	1990	2250	2420	2600	2810	2880
52	577.75	1.062	49.750	780	1030	1010	1080	1260	1820	1990	2250	2420	2600	2810	2880
52	611.26	1.125	49.624	820	1080	1010	1260	1820	1990	2250	2420	2600	2810	2880	2880
52	644.69	1.188	49.500	870	1080	1010	1260	1820	1990	2250	2420	2600	2810	2880	2880
52	677.51	1.250	55.250	240	300	280	350	510	550	630	670	720	780	840	840
56	222.78	0.375	55.188	260	330	300	380	550	600	680	730	780	840	910	990
56	241.06	0.406	55.124	280	350	330	410	590	650	730	790	840	900	980	1060
56	259.91	0.438	55.062	300	380	350	440	680	760	830	920	1040	1120	1260	1330
56	278.15	0.469	55.000	320	400	380	420	530	590	840	920	1020	1150	1240	1350
56	298.37	0.500	54.876	360	450	470	500	650	930	1020	1110	1250	1350	1450	1570
56	332.75	0.562	54.750	400	500	550	520	700	1010	1110	1200	1360	1460	1570	1690
56	369.63	0.625	54.624	440	600	560	610	760	1180	1290	1390	1570	1690	1810	1930
56	406.42	0.688	54.500	480	650	660	700	820	1270	1350	1480	1670	1780	1910	2050
56	442.55	0.750	54.376	520	700	660	700	880	940	1350	1430	1570	1700	1830	1970
56	478.60	0.812	54.250	560	800	750	750	940	1000	1430	1570	1780	1920	2050	2290
56	515.14	0.875	54.124	600	800	850	800	1050	1520	1660	1880	2020	2170	2350	2530
56	551.60	0.938	54.000	640	900	840	1110	1600	1760	1990	2140	2290	2410	2610	2810
56	587.40	1.000	53.876	680	900	890	1110	1690	1850	2090	2250	2410	2600	2810	2880
56	623.12	1.062	53.750	720	950	940	1170	1690	1850	2090	2250	2410	2600	2810	2880
56	659.32	1.125	53.624	760	950	1000	940	1330	1470	1760	1900	1990	2140	2350	2530
56	695.45	1.188	53.500	800	1000	940	1170	1690	1850	2090	2250	2410	2600	2810	2880
56	730.91	1.250	59.250	230	280	260	330	470	520	590	630	680	730	790	850
60	238.80	0.375	59.188	240	300	280	350	510	560	630	680	730	790	850	920
60	258.40	0.406	59.124	260	330	300	380	550	600	680	740	840	910	980	1050
60	278.62	0.438	59.062	280	350	350	440	630	710	780	860	950	1070	1160	1220
60	298.19	0.469	59.000	300	420	390	420	550	600	870	950	1030	1170	1260	1310
60	317.73	0.500	58.876	340	470	440	480	600	660	950	1030	1120	1270	1360	1440
60	356.76	0.562	58.750	380	520	530	560	710	1020	1120	1210	1370	1470	1580	1710
60	396.33	0.625	58.624	410	520	530	560	770	1100	1290	1380	1560	1660	1780	1970
60	435.81	0.688	58.500	450	610	570	610	820	1180	1290	1380	1560	1660	1780	1970
60	474.59	0.750	58.376	490	660	660	700	880	1260	1340	1470	1660	1760	1860	2040
60	513.29	0.812	58.250	530	700	700	750	930	1340	1420	1550	1760	1850	1950	2100
60	552.52	0.875	58.124	560	750	740	790	980	1420	1500	1640	1850	1950	2070	2230
60	591.67	0.938	58.000	600	800	790	830	1040	1580	1720	1950	2100	2250	2440	2630
60	630.12	1.000	57.876	640	840	830	880	1090	1580	1720	1950	2100	2250	2440	2630
60	668.48	1.062	57.750	680	890	830	880	1090	1580	1720	1950	2100	2250	2440	2630
60	707.38	1.125	57.624	710	940	880	1040	1580	1720	1950	2100	2250	2440	2630	2820
60	746.20	1.188	57.500	750	940	880	1070	1580	1720	1950	2100	2250	2440	2630	2820
60	784.31	1.250	57.500	210	260	250	310	440	490	550	590	640	690	740	800
64	254.82	0.375	63.250	230	290	270	330	480	530	640	690	740	800	860	920
64	275.75	0.406	63.188	250	310	290	360	520	570	640	690	740	790	860	920
64	297.33	0.438	63.124	260	330	310	380	550	610	690	740	790	840	910	980
64	318.22	0.469	63.062	280	350	370	410	640	740	810	890	1010	1080	1150	1230
64	339.09	0.500	63.000	320	400	440	480	560	620	890	970	1100	1280	1370	1480
64	380.76	0.562	62.876	350	440	410	450	560	620	960	1050	1190	1280	1370	1480
64	423.03	0.625	62.750	390	480	450	490	530	670	1030	1130	1280	1380	1480	1600
64	465.21	0.688	62.624	420	530	500	530	670	720	1030	1110	1210	1370	1480	1720
64	506.63	0.750	62.500	460	570	520	570	670	720	1030	1110	1210	1370	1480	1720
64	547.98	0.812	62.376	490	620	560	660	760	820	1180	1290	1460	1570	1670	1790
64	589.90	0.875	62.250	530	660	620	700	760	870	1250	1370	1460	1570	1670	1790
64	631.74	0.938	62.124	560	660	700	750	800	870	1250	1370	1460	1570	1670	1790
64	672.84	1.000	62.000	61.876	600	750	700	870	1250	1370	1460	1570	1670	1790	1940
64	713.85	1.062	62.000	61.876	600	750	700	870	1250	1370	1460	1570	1670	1790	1940

TABLE 6.2 (Continued)
PLAIN-END LINE PIPE
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²
See Appendix D for Metric Tables

Size, Outside Diameter, in. <i>D</i>	Weight, lb. per ft. <i>w_{pc}</i>	Wall Thickness, in. <i>t</i>	Inside Diameter, in. <i>d</i>	Test Pressure, psi, min.											
				Grade A		Grade B		Grade X42	Grade X46	Grade X52	Grade X56	Grade X60	Grade X65	Grade X70	Grade X80
				Std.	Alt.	Std.	Alt.								
64	755.44	1.125	61.750	630	790	740	920	1330	1460	1650	1770	1900	2060	2210	**
64	796.95	1.188	61.624	670	840	780	970	1400	1540	1740	1870	2000	2170	2340	**
64	837.71	1.250	61.500	700	880	820	1030	1480	1620	1830	1970	2110	2290	2460	**
68	338.26	0.469	67.062	250	310	290	360	520	570	650	700	740	810	870	**
68	360.45	0.500	67.000	260	330	310	390	560	610	690	740	790	860	930	**
68	404.77	0.562	66.876	300	370	350	430	620	680	770	830	890	970	1040	**
68	449.73	0.625	66.750	330	410	390	480	690	760	860	930	990	1080	1160	**
68	494.60	0.688	66.624	360	460	420	530	760	840	950	1020	1090	1180	1270	**
68	538.67	0.750	66.500	400	500	460	580	830	910	1030	1110	1190	1290	1390	**
68	582.66	0.812	66.375	430	540	500	630	900	990	1120	1200	1290	1400	1500	**
68	627.28	0.875	66.250	460	580	540	680	970	1070	1200	1300	1390	1510	1620	**
68	671.82	0.938	66.124	500	620	580	720	1040	1140	1290	1390	1490	1610	1740	**
68	715.56	1.000	66.000	530	660	620	770	1110	1220	1380	1480	1590	1720	1850	**
68	759.22	1.062	65.875	560	700	660	820	1180	1290	1460	1570	1690	1830	1970	**
68	803.50	1.125	65.750	600	740	690	870	1250	1370	1550	1670	1790	1940	2080	**
68	847.70	1.188	65.624	630	790	730	920	1320	1450	1640	1760	1890	2040	2200	**
68	891.11	1.250	65.500	660	830	770	970	1390	1520	1720	1850	1990	2150	2320	**
72	381.81	0.500	71.000	250	310	290	360	530	570	650	700	750	810	880	**
72	428.78	0.562	70.876	280	350	330	410	590	650	730	790	840	910	980	**
72	476.43	0.625	70.750	310	390	360	460	660	720	810	870	940	1020	1090	**
72	523.99	0.688	70.624	340	430	400	500	720	790	890	960	1030	1120	1200	**
72	570.71	0.750	70.500	380	470	440	550	790	860	980	1050	1130	1220	1310	**
72	617.35	0.812	70.375	410	510	470	590	850	930	1060	1140	1220	1320	1420	**
72	664.66	0.875	70.250	440	550	510	640	920	1010	1140	1220	1310	1420	1530	**
72	711.89	0.938	70.124	470	590	550	680	980	1080	1220	1310	1410	1520	1640	**
72	758.28	1.000	70.000	500	630	580	730	1050	1150	1300	1400	1500	1630	1750	**
72	804.59	1.062	69.875	530	660	620	770	1120	1220	1380	1490	1590	1730	1860	**
72	851.56	1.125	69.750	560	700	660	820	1180	1290	1460	1570	1690	1830	1970	**
72	898.45	1.188	69.624	590	740	690	870	1250	1370	1540	1660	1780	1930	2080	**
72	944.51	1.250	69.500	630	780	730	910	1310	1440	1630	1750	1880	2030	2190	**
76	403.17	0.500	75.000	240	300	280	350	500	540	620	660	710	770	830	**
76	452.79	0.562	74.876	270	330	310	390	560	610	690	750	800	870	930	**
76	503.13	0.625	74.750	300	370	350	430	620	680	770	830	890	960	1040	**
76	553.38	0.688	74.624	330	410	380	480	680	750	850	910	980	1060	1140	**
76	602.75	0.750	74.500	360	440	410	520	750	820	920	990	1070	1150	1240	**
76	652.04	0.812	74.375	380	480	450	560	810	880	1000	1080	1150	1250	1350	**
76	702.04	0.875	74.250	410	520	480	600	870	950	1080	1160	1240	1350	1450	**
76	751.96	0.938	74.124	440	560	520	650	930	1020	1160	1240	1330	1440	1560	**
76	801.00	1.000	74.000	470	590	550	690	990	1090	1230	1330	1420	1540	1660	**
76	849.96	1.062	73.875	500	630	590	730	1060	1160	1310	1410	1510	1630	1760	**
76	899.62	1.125	73.750	530	670	620	780	1120	1230	1390	1490	1600	1730	1870	**
76	949.20	1.188	73.624	560	700	660	820	1180	1290	1460	1580	1690	1830	1970	**
76	997.91	1.250	73.500	590	740	690	860	1240	1360	1540	1660	1780	1920	2070	**
80	476.80	0.562	78.876	250	320	300	370	530	580	660	710	760	820	890	**
80	529.83	0.625	78.750	280	350	330	410	590	650	730	790	840	910	980	**
80	582.77	0.688	78.624	310	390	360	450	650	710	800	870	930	1010	1080	**
80	634.79	0.750	78.500	340	420	390	490	710	780	880	940	1010	1100	1180	**
80	686.73	0.812	78.375	370	460	430	530	770	840	950	1020	1100	1190	1280	**
80	739.42	0.875	78.250	390	490	460	570	830	910	1020	1100	1180	1280	1380	**
80	792.03	0.938	78.124	420	530	490	620	890	970	1100	1180	1270	1370	1480	**
80	843.72	1.000	78.000	450	560	530	660	950	1030	1170	1260	1350	1460	1580	**
80	895.33	1.062	77.875	480	600	560	700	1000	1100	1240	1340	1430	1550	1670	**
80	947.68	1.125	77.750	510	630	590	740	1060	1160	1320	1420	1520	1650	1770	**
80	999.95	1.188	77.624	530	670	620	780	1120	1230	1390	1500	1600	1740	1870	**
80	1051.31	1.250	77.500	560	700	660	820	1180	1290	1460	1570	1690	1830	1970	**

¹Outside diameter and wall-thickness dimensions shown are subject to tolerances as given in Table 6.3. Inside diameters are nominal, and are given here for information (see Par. 6.2).

²The test pressures given in Table 6.2 apply to grades A25, A, B, X42, X46, X52, X56, X60, X65, and X70 only. See Par. 5.3 for pressures applicable to other grades.

*These sizes are special plain-end weights. All other sizes are regular weight. See Table 6.3 for applicable weight tolerances. For grades X42 and higher, weights intermediate to regular-weights shall be considered regular-weight, weights intermediate to special-plain-end weights shall be considered special-plain-end weights, and weights intermediate between the heaviest tabulated special-plain-end weight and the lightest regular-weight shall be considered special-plain-end weights.

**Use equation shown in Par. 5.3 to calculate required test pressures. Tabular test pressures will be available in the thirty-seventh edition of Spec 5L.

TABLE 6.3
TOLERANCES ON DIMENSIONS AND WEIGHTS

Outside Diameter D**Pipe Body**

1.900 in. and smaller	+0.016 in. (+0.41 mm)
2 $\frac{1}{2}$ in. through 4 $\frac{1}{2}$ in. Grade A25	-0.031 in. (-0.79 mm) ± 1.00 percent butt-weld only
2 $\frac{1}{2}$ in. through 18 in.	$\pm .75$ percent
20 in. through 36 in.	± 1.00 percent
Non-expanded	± 0.75 percent
Cold expanded	-0.25 percent
Larger than 36 in.	± 1.00 percent
Non-expanded	± 0.75 percent
*Cold expanded	+ $\frac{1}{4}$ in. (+6.35 mm) - $\frac{1}{8}$ in. (-3.20 mm)

*In the case of pipe hydrostatically tested to pressures in excess of standard test pressures, other tolerances may be agreed upon between the manufacturer and purchaser.

For pipe 4 $\frac{1}{2}$ in. OD and larger, the outside diameter measurements on the body of the pipe shall be made at the mill with a diameter tape on a random basis, but not less than three measurements per 8 hour working turn.

Pipe Ends

Pipe 10 $\frac{1}{2}$ in. and smaller, shall not be more than $\frac{1}{64}$ in. (0.40 mm) smaller than the specified outside diameter for a distance of 4 in. (101.6 mm), from the end of the pipe and shall permit the passage over the ends, for a distance of 4 in. (101.6 mm) of a ring gage which has a bore $\frac{1}{16}$ in. (1.59 mm) larger than the specified outside diameter of the pipe. Pipe 12 $\frac{1}{2}$ in. to 20 in., inclusive, shall not be more than $\frac{1}{32}$ in. (0.79 mm) smaller than the specified outside diameter for a distance of 4 in. (101.6 mm) from the end of the pipe and shall permit the passage over the ends, for a distance of 4 in. (101.6 mm), of a ring gage which has a bore $\frac{3}{32}$ in. (2.38 mm) larger than the specified outside diameter of the pipe. For SAW line pipe it is permissible to notch or slot the ring gage to permit passage of the gage over the weld bead. At the option of the manufacturer, the minimum outside diameter of pipe in sizes 20 in. and smaller may be measured with a diameter tape. Pipe larger than 20 in. shall not be more than $\frac{1}{32}$ in. (0.79 mm) smaller nor more than $\frac{3}{32}$ in. (2.38 mm) larger than the specified outside diameter for a distance of 4 in. (101.6 mm) from the end of the pipe, as measured with a diameter tape.

By agreement between the purchaser and the manufacturer, the tolerance on outside diameter at the ends may be applied instead to the inside diameter at the ends.

On welded expanded pipe larger than 20 in. OD, the diameter, measured with a diameter tape, at one end of

the pipe shall not differ by more than $\frac{3}{32}$ in. (2.38 mm) from that of the other end. These measurements may be made on the ID at the manufacturer's option.

Out-of-Roundness

For pipe larger than 20 in., and for a distance of 4 in. (101.6 mm) from the ends of the pipe, the maximum outside diameter shall not be more than 1 percent larger than specified, and the minimum outside diameter shall not be more than 1 percent smaller than specified, measured with a bar gage, caliper, or other device capable of measuring the actual minimum and maximum diameters.

Wall Thickness

Size (OD in.) and Process	Tolerance, Percent	
	Grade A, B, A25	X42 through X80
2.875 and smaller, seamless & welded	+20.0 -12.5	+15.0 -12.5
3.50 seamless & welded	+18.0 -12.5	+15.0 -12.5
4.00 through 18, seamless & welded	+15.0 -12.5	+15.0 -12.5
20 and larger, welded	+17.5 -10.0	+19.5 -8.0
20 and larger, seamless	+15.0 -12.5	+17.5 -10.0

Weight**Single lengths**

Standard-weight, regular-weight
extra-strong and double-extra-strong
pipe. Except Grade A25

+10.0 percent
- 3.5 percent

Special plain-end pipe or A25 pipe

+10.0 percent
- 5.0 percent

Carload lots

All grades except A25

-1.75 percent
- 2.5 percent

Grade A25

A carload is considered to be a minimum of 40,000 lb.
(18144 kg).

When a wall thickness minus tolerance less than that shown above is agreed upon between the purchaser and the manufacturer, the plus tolerance shall be increased by an amount (percentage) equal to the decrease in minus tolerance, and the plus weight tolerance shall be increased to 22.5 percent less the wall thickness minus tolerance.

Weight tolerances apply to the calculated weights for threaded-and-coupled pipe and to the tabulated weights for plain-end pipe.

TABLE 6.4
TOLERANCES ON LENGTHS*

1	2	3	4	5
	Shortest Length in Entire Shipment	Shortest Length in 95% of Entire Shipment	Shortest Length in 90% of Entire Shipment	Minimum Average Length Entire Shipment
Threaded-and-Coupled Pipe				
Single random lengths	16.0 ft (4.88m)	18.0 ft (5.49m)	---	---
Double random lengths	22.0 ft (6.71m)	---	---	35.0 ft (10.67m)
Plain-End Pipe				
Single random lengths	9.0 ft (2.74m)	---	---	17.5 ft (5.33m)
Double random lengths	14.0 ft (4.27m)	---	26.3 ft (8.00m)	35.0 ft (10.67m)
As agreed upon lengths in excess of 20 ft. (6.10m)	40% of average agreed upon	---	75% of average agreed upon	---

*By agreement between the purchaser and the manufacturer, these tolerances shall apply to each carload.

SECTION 7

PIPE ENDS AND THREAD PROTECTORS

7.1 Pipe Ends. Pipe shall be furnished threaded or plain-end as set forth in Tables 6.1, 6.1a and 6.2, or with bell and spigot ends in accordance with Par. 7.4. Extra-strong line pipe shall be furnished with plain ends, except that the ends shall be threaded-and-coupled if so specified on the purchase order. Spiral weld may not be threaded. The inside and outside edges of the ends of all pipe shall be free of burrs.

7.2 Threaded Ends. Threaded ends shall conform to the threading, thread inspection, and gaging requirements specified in API Std 5B. One end of each length of threaded pipe shall be provided with a coupling conforming to the requirements of Sect. 8, and the other end with thread protection conforming to the requirements of Par. 7.6. Couplings shall be screwed onto the pipe handling-tight¹, except that they shall be applied power-tight if so specified on the purchase order. A high-grade thread compound shall be applied to cover the full surface of either the coupling or pipe engaged thread before making up the joint. All exposed threads shall be coated with a high-grade thread compound, unless otherwise specified on the purchase order. A storage compound of distinct color may be substituted for high grade thread compound on all exposed threads. Whichever compound is used shall be applied to a surface that is clean and reasonably free of moisture and cutting fluids.

NOTE: The purpose of making up couplings handling-tight is to facilitate removal of the couplings for cleaning and inspecting threads and applying fresh thread compound before laying the pipe. This procedure has been found necessary to prevent thread leakage, especially in gas lines, because manufacturer applied couplings made up power-tight, although leak-proof at the time of make-up, may not always remain so after transportation, handling, and laying.

7.3 Plain Ends. Unless otherwise ordered, plain-end pipe (other than double-extra-strong pipe) in sizes 2½ in. and larger shall be furnished with ends beveled to an angle of 30°, +5°, -0°, measured from a line drawn perpendicular to the axis of the pipe, and with a root face of $\frac{1}{16}$ in. $\pm \frac{1}{32}$ in. (1.59 \pm 0.79 mm). For seamless pipe where internal machining is required to maintain the root face tolerance, the angle of the internal taper, measured from the longitudinal axis, shall be no larger than that listed below.

Specified Wall Thickness (in.)	Maximum Angle of Taper (Deg.)
Less than 0.418 (10.6 mm)	7
0.418 thru 0.555 (10.6 thru 14.1 mm)	9½
0.556 thru 0.666 (14.1 thru 16.9 mm)	11
Over 0.666 (16.9 mm)	14

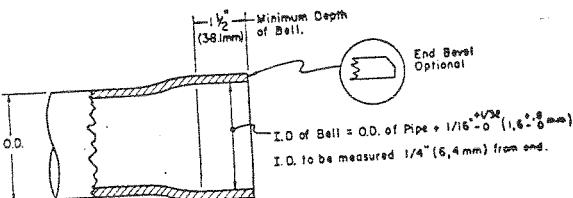
For the removal of an internal burr on welded pipe larger than 4½ in. OD, the internal taper, measured from the longitudinal axis, shall be no larger than 7°.

¹Handling-tight shall be defined as sufficiently tight that the coupling cannot be removed except by use of a wrench.

Double-extra-strong plain-end pipe in sizes 2½ in. and larger shall be furnished with square-cut ends, unless beveled ends (as above) are specified on the purchase order. For pipe sizes 10¼ in. and larger, the ends shall be cut square within $\frac{1}{16}$ in. (1.59 mm), measured not less than three times per 8 hour working shift. The end finish for pipe in sizes smaller than 2½ in. shall be as specified on the purchase order. Both ends of submerged-arc and gas metal-arc welded pipe shall have the inside weld reinforcement removed for a distance of approximately 4 in. (101.6 mm) from the end of the pipe.

NOTE: The purchaser is directed to the applicable code for the recommended angle of pipe bevel.

7.4 Bellied Ends. When so specified on the purchase order, pipe with wall thickness 0.141 in. (3.58 mm) and less shall be furnished with one end belled for bell and spigot joints in accordance with Fig. 7.1. The belled end shall be visually inspected for workmanship and injurious defects.



**FIG. 7.1
BELLED END FOR BELL AND SPIGOT JOINT**

7.5 Plain Ends for Special Couplings. When so specified on the purchase order, pipe shall be furnished with ends suitable for use with Dresser, Victaulic, or other special couplings. Such pipe shall be sufficiently free from indentations, projections, or roll marks for a distance of 8 in. (203 mm) from the end of the pipe, to permit proper make-up of coupling.

7.6 Thread Protectors. On pipe sizes smaller than 2 in. nominal, the thread protectors shall be suitable fabric wrappings, or suitable metal, fiber, or plastic protectors. On pipe sizes 2 in. nominal and larger, the thread protectors shall be of such design, material, and mechanical strength to protect the thread and end of the pipe from damage under normal handling and transportation. The thread protectors shall cover the full length of the thread on the pipe and exclude water and dirt from the thread during transportation and normal storage period. Normal storage period shall be considered as approximately one year. The thread forms in protectors shall be such that the pipe threads are not damaged by the protectors. Protector material shall contain no compounds capable of causing corrosion or promoting adherence of the protectors to the threads and shall be suitable for service temperatures of -50° to +150°F (-46° to +66°C).

SECTION 8 COUPLINGS

8.1 Material. Couplings for Grades A and B pipe shall be seamless and shall be made of a grade of material at least equal in mechanical properties to that of the pipe. Couplings for Grade A25 pipe shall be seamless or welded, and shall be made of steel. By agreement between the purchaser and the manufacturer, welded couplings may be supplied on pipe 14 in. and larger, if the couplings are properly marked.

8.2 Tensile Tests. A tensile test shall be made on each heat of steel from which couplings are produced, and the coupling manufacturer shall maintain a record of such tests. This record shall be open to inspection by the purchaser. If such test is made on finished couplings, either round specimens proportioned as specified in ASTM E8: *Tensile Testing of Metallic Materials*, or strip specimens shall be used, at the option of the manufacturer.

8.3 Dimensions. Couplings shall conform to the dimensions and tolerances shown in Table 8.1 and Fig. 6.1.

NOTE: *Couplings covered by Table 8.1 are applicable to either standard-weight or extra-strong pipe.*

8.4 Threading. Coupling threads, gaging practice and thread inspection shall conform to the requirements of API Std 5B. Couplings shall not be expanded to provide the required taper for threads.

8.5 Inspection. Couplings shall be free from blisters, pits, cinder marks and other defects which would impair the efficiency of the coupling or break the continuity of the thread.

TABLE 8.1
COUPLING DIMENSIONS, WEIGHTS,
AND TOLERANCES

See Fig. 6.1

Size: Nominal	2		3		4		5		6	
	Outside Diameter of Coupling <i>W</i>		Minimum Length, <i>N_L</i>		Diameter of Recess <i>Q</i>		Width of Bearing Face <i>b</i>		Calculated Coupling Weight	
	in.	mm	in.	mm	in.	mm	in.	mm	lb.	kg
1/8	0.563	(14.3)	1 1/16	(27.0)	0.468	(11.9)	1/32	(0.8)	0.04	(0.02)
1/4	0.719	(18.3)	1 1/8	(41.3)	0.603	(15.3)	1/32	(0.8)	0.09	(0.04)
5/16	0.875	(22.2)	1 1/8	(41.3)	0.738	(18.8)	1/32	(0.8)	0.13	(0.06)
1/2	1.063	(27.0)	2 1/8	(54.0)	0.903	(22.9)	1/16	(1.6)	0.24	(0.11)
5/8	1.313	(33.4)	2 1/8	(54.0)	1.113	(28.3)	1/16	(1.6)	0.34	(0.15)
1	1.576	(40.0)	2 1/8	(66.7)	1.378	(35.0)	3/32	(2.4)	0.54	(0.25)
1 1/4	2.054	(52.2)	2 1/4	(69.8)	1.723	(43.8)	3/32	(2.4)	1.03	(0.47)
1 1/2	2.200	(55.9)	2 1/4	(69.8)	1.963	(49.9)	3/32	(2.4)	0.90	(0.41)
2	2.875	(73.0)	2 1/8	(73.0)	2.469	(62.7)	1/8	(3.2)	1.86	(0.84)
2 1/2	3.375	(85.7)	4 1/8	(104.8)	2.969	(75.4)	3/16	(4.8)	3.27	(1.48)
3	4.000	(101.6)	4 1/4	(108.0)	3.594	(91.3)	3/16	(4.8)	4.09	(1.86)
3 1/2	4.625	(117.5)	4 1/8	(111.1)	4.094	(104.0)	3/16	(4.8)	5.92	(2.69)
4	5.200	(132.1)	4 1/2	(114.3)	4.594	(116.7)	1/4	(6.4)	7.59	(3.45)
5	6.296	(159.9)	4 1/8	(117.5)	5.657	(143.7)	1/4	(6.4)	9.98	(4.53)
6	7.390	(187.7)	4 1/8	(123.8)	6.719	(170.7)	1/4	(6.4)	12.92	(5.87)
8	9.625	(244.5)	5 1/4	(133.4)	8.719	(221.5)	1/4	(6.4)	23.18	(10.52)
10	11.750	(298.4)	5 1/4	(146.0)	10.844	(275.4)	3/8	(9.5)	31.55	(14.32)
12	14.000	(355.6)	6 1/8	(155.6)	12.844	(326.2)	3/8	(9.5)	49.27	(22.37)
14D	15.000	(381.0)	6 1/8	(161.9)	14.094	(358.0)	3/8	(9.5)	45.83	(20.81)
16D	17.000	(431.8)	6 1/8	(171.4)	16.094	(408.8)	3/8	(9.5)	55.83	(23.35)
18D	19.000	(482.6)	7 1/8	(181.0)	18.094	(459.6)	3/8	(9.5)	66.53	(30.20)
20D	21.000	(533.4)	7 1/8	(193.7)	20.094	(510.4)	3/8	(9.5)	79.37	(36.03)

Tolerance on outside diameter *W*, ± 1 per cent

SECTION 9

NON-DESTRUCTIVE INSPECTION

9.1 Methods of Inspection. The weld seam of welded pipe furnished to this specification in sizes 2 in. nom. and larger, except Grade A25, shall be inspected full length (100 percent) in accordance with methods specified below. In addition, the skelp end weld of spiral-weld pipe shall be so inspected. The location of equipment in the manufacturer's facility shall be at the discretion of the manufacturer.

- a. Submerged-arc welded pipe shall be inspected by radiological methods in accordance with Par. 9.2 through 9.13 full length, or for a distance of 8 in. (203 mm), 4 in. (102 mm) for spiral weld, from each end if the balance of the length is inspected by ultrasonic methods in accordance with Par. 9.14 through 9.17.
- b. Electric-welded pipe shall be inspected by ultrasonic or electromagnetic methods in accordance with Par. 9.14 through 9.17. If necessary to meet the full length (100 percent) inspection requirement of Par. 9.1, pipe ends shall be inspected by using hand-held ultrasonic shear wave equipment, or other NDT method agreed to by the manufacturer and the purchaser.
- c. Gas metal-arc welded pipe shall be inspected full length by ultrasonic methods in accordance with Par. 9.14 through 9.17. In addition, the ends of each length of pipe shall be inspected for a distance of 8 in. (203 mm) by radiological methods in accordance with Par. 9.2 through 9.13.
- d. Skelp end welds for spiral weld pipe shall be inspected in accordance with an appropriate method as specified above. In addition, the junction of the skelp end weld with the spiral seam shall be inspected radiologically if either of the welds is made by the submerged-arc process. When pipe is cold expanded, the radiological inspection of the junction shall be performed after the expansion process.

By agreement between the purchaser and the manufacturer and when specified on the purchase order, seamless pipe shall be non-destructively inspected in accordance with Supplementary Requirement SR4, Appendix E.

RADIOLOGICAL INSPECTION

9.2 Equipment. The homogeneity of weld seams examined by radiological methods shall be determined by means of x-rays directed through the weld material onto a suitable radiographic film or fluorescent screen, or a television screen provided adequate sensitivity can be obtained.

9.3 Fluoroscopic Operator Qualification. Operators of fluoroscopic equipment shall be trained, tested and certified by the pipe manufacturer.

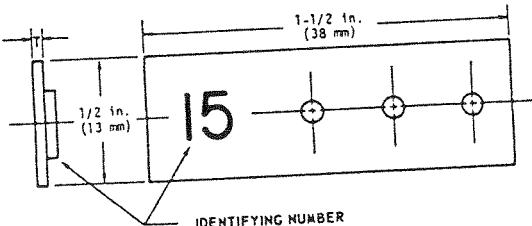
Details of such training, testing, and certification programs shall be available to the purchaser. Included in this program shall be:

- a. Classroom instructions in the fundamentals of radiological inspection techniques.
- b. On the job training designed to familiarize the operator with specific installations including the appearance and interpretation of weld imperfections and defects. The length of time for such training shall be of sufficient duration to assure adequate assimilation of the knowledge required for conducting the inspection.
- c. Knowledge of appropriate requirements of this specification.
- d. A physical examination at least once per year to determine the operator's optical capability to perform the required inspection.
- e. Upon completion of (a) and (b) above, an examination shall be given by the manufacturer to determine if the operator is qualified to properly perform fluoroscopic examinations.

9.4 Certified operators whose work has not included fluoroscopic inspection for a period of one year or more shall be recertified by successfully completing the examination of (e) above and also passing the physical examination of (d) above. Substantial changes in procedure or equipment shall require recertification of the operators.

9.5 Reference Standards. Unless otherwise specified, the reference standard shall be the API standard penetrometer described in Par. 9.6, or at the option of the manufacturer the ISO wire penetrometer described in Par. 9.7. By agreement between purchaser and manufacturer, other standard penetrometers may be used.

9.6 API Standard Penetrometer. The API standard penetrometer shall be as shown in Fig. 9.1 and made of a material with the same radiological characteristics as the pipe. The thickness of the penetrometer



THE DIAMETER OF EACH HOLE SHALL BE 1/16 in.
(1.6mm).

HOLES SHALL BE ROUND AND DRILLED PERPENDICULAR TO THE SURFACE.

HOLES SHALL BE FREE OF BURRS, BUT EDGES SHALL NOT BE CHAMFERED.

EACH PENETROMETER SHALL CARRY A LEAD IDENTIFICATION NUMBER AS GIVEN IN TABLE 9.1.

FIG. 9.1
API STANDARD PENETROMETER

shall be a maximum of 4 percent of the nominal wall thickness. Either 2 percent or 4 percent penetrameters may be used at the option of the manufacturer. Standard 4 percent penetrameter sizes are shown in Table 9.1.

TABLE 9.1
API STANDARD 4% PENETRAMETERS

	1	2	3	
Wire No.	Wall Thickness		Identifying Number	Wire Diameter mm
	Over in.	Through mm		
1/4 (6.4)	5/16 (7.9)	(7.9) 0.0125 (0.32)	12	
5/16 (7.9)	3/8 (9.5)	0.015 (0.38)	15	
3/8 (9.5)	7/16 (11.1)	0.0175 (0.44)	17	
7/16 (11.1)	1/2 (12.7)	0.020 (0.51)	20	
1/2 (12.7)	5/8 (15.9)	0.025 (0.64)	25	
5/8 (15.9)	3/4 (19.1)	0.030 (0.76)	30	
3/4 (19.1)	1 (25.4)	0.035 (0.89)	35	
1 (25.4)	1 1/4 (31.8)	0.040 (1.02)	40	

9.7 ISO Wire Penetrometer. The ISO wire penetrometer shall be Fe 1/7, Fe 6/12, or Fe 10/16 in accordance with Table 9.2 for the appropriate wall thickness.

9.8 Frequency. The penetrometer shall be used to check the sensitivity and adequacy of the radiographic technique on one pipe in every lot of 50 pipe, but not less than twice per 8 hour working shift, when the fluoroscopic method is used full length, and on each film when film is used. When film is used full length, one penetrometer shall be used for each length of pipe. The pipe shall be held in a stationary position during the adjustment of the radiographic technique by use of the penetrometer. Proper definition and sensitivity is attained when all three holes of the API standard penetrometer or individual wires of the ISO penetrometer are clearly discernible.

9.9 Procedure for Evaluating In-Motion Operation of the Fluoroscope. To evaluate the definition of defects at operational speeds, a pipe section having a minimum wall of 0.375 in. (9.5 mm) shall be used. Series of $1/32$ in. (0.79 mm) holes, as shown in Example 6, Fig. 9.3 shall be drilled into the center of the weld to a depth of 100 percent of the total thickness. At least four such series shall be used, spaced one foot apart. As an alternate to the use of the pipe section described above, a penetrometer as described in Par. 9.5, 9.6 and 9.7 may be used at the option of the manufacturer. The speed of operation shall be adjusted so that the holes in

TABLE 9.2
ISO WIRE PENETRAMETER
(Sensitivity 4%)

	1	2	3	4
Wire No.	Wire Diameter		Wall Thickness	
	mm	in.	in.	mm
Fe 1/7				
1	(3.20)	.13	3.25	(82.6)
2	(2.50)	.10	2.50	(63.5)
3	(2.00)	.08	2.00	(50.8)
4	(1.60)	.065	1.62	(41.1)
5	(1.25)	.050	1.25	(31.8)
6	(1.00)	.040	1.00	(25.4)
7	(0.80)	.032	0.80	(20.3)
Fe 6/12				
6	(1.00)	.040	1.000	(25.4)
7	(0.80)	.032	0.800	(20.3)
8	(0.63)	.025	.625	(15.9)
9	(0.50)	.020	.500	(12.7)
10	(0.40)	.016	.400	(10.2)
11	(0.32)	.013	.325	(8.3)
12	(0.25)	.010	.250	(6.4)
Fe 10/16				
10	(0.40)	.016	.400	(10.2)
11	(0.32)	.013	.325	(8.3)
12	(0.25)	.010	.250	(6.4)
13	(0.20)	.008	.200	(5.1)
14	(0.16)	.006	.162	(4.1)
15	(0.13)	.005	.125	(3.2)
16	(0.10)	.004	.100	(2.5)

To determine correct wall thickness for:

4% sensitivity — divide wire diameter by .04

2% sensitivity — divide wire diameter by .02

Always use penetrometer with wall equivalent wire near center.

the pipe section or API penetrometer, or individual wires in the ISO penetrometer, are clearly visible to the operator.

9.10 Acceptance Limits. Radiological examination shall be capable of detecting weld imperfections* and defects** as described in Par. 9.11 and 9.12.

*Imperfection. An imperfection is a discontinuity or irregularity in the product detected by methods outlined in this specification.

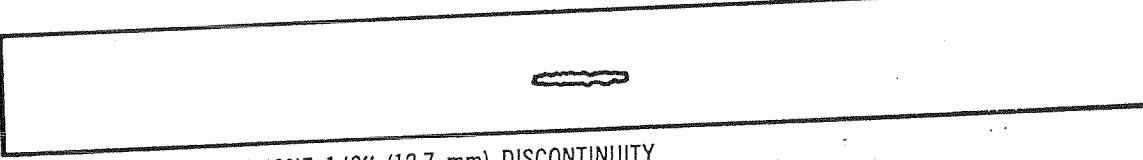
**Defect. A defect is an imperfection of sufficient magnitude to preclude acceptance of the product in accordance with this specification.

TABLE 9.3
ELONGATED SLAG-INCLUSION-TYPE DISCONTINUITIES*
(See Fig. 9.2)

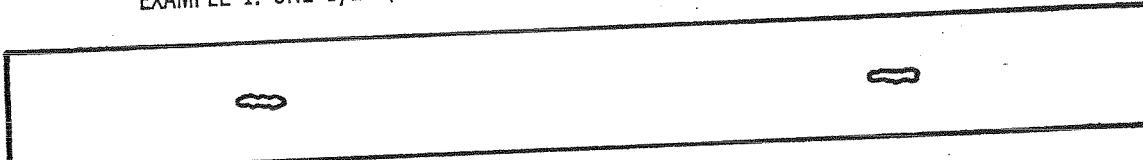
1	2	3
Maximum Dimensions, in.	Minimum Separation, in.	Maximum Number in any 6 in. (152.4 mm)
	mm	mm
$\frac{1}{16} \times \frac{1}{2}$ (1.6×12.7)	6 (152.4)	1
$\frac{1}{16} \times \frac{1}{4}$ (1.6×6.4)	3 (76.2)	2
$\frac{1}{16} \times \frac{1}{8}$ (1.6×3.2)	2 (50.8)	3

*Maximum accumulated length of discontinuities in any 6 in. (152.4 mm) shall not exceed $\frac{1}{2}$ in. (12.7 mm).

EXAMPLE 1: ONE $\frac{1}{2}$ " (12.7 mm) DISCONTINUITY



EXAMPLE 2: TWO $\frac{1}{4}$ " (6.4 mm) DISCONTINUITIES



EXAMPLE 3: THREE $\frac{1}{8}$ " (3.2 mm) DISCONTINUITIES

FIG. 9.2
EXAMPLES OF MAXIMUM DISTRIBUTION PATTERNS OF INDICATED
ELONGATED SLAG-INCLUSION-TYPE DISCONTINUITIES

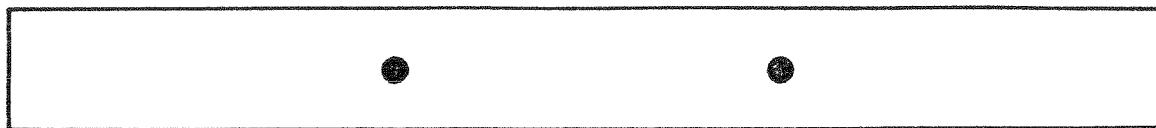
TABLE 9.4
CIRCULAR SLAG-INCLUSION AND GAS-POCKET-TYPE DISCONTINUITIES*
(See Fig. 9.3)

1	2	3	4
Size, in.	Adjacent Size, in.	Minimum Separation, in.	Maximum Number in any 6 in. (152.4 mm)
	mm	mm	mm
$**\frac{1}{8}$ (3.2)	$**\frac{1}{16}$ (3.2)	(3.2) (1.6)	2 (50.8) (25.4)
$**\frac{1}{8}$ (3.2)	$\frac{1}{16}$ $\frac{1}{32}$	(1.6) (0.8)	1 $\frac{1}{2}$ (12.7)
$**\frac{1}{8}$ (3.2)	$\frac{1}{64}$	(0.4)	$\frac{3}{8}$ (9.5)
$**\frac{1}{8}$ (3.2)	$\frac{1}{64}$	(1.6)	$\frac{1}{2}$ (12.7)
$\frac{1}{16}$ (1.6)	$\frac{1}{16}$	(0.8)	$\frac{3}{8}$ (9.5)
$\frac{1}{16}$ (1.6)	$\frac{1}{32}$	(0.8)	$\frac{1}{4}$ (6.4)
$\frac{1}{16}$ (1.6)	$\frac{1}{64}$	(0.4)	$***\frac{1}{4}$ (6.4)
$\frac{1}{32}$ (0.8)	$\frac{1}{32}$	(0.8)	$\frac{3}{16}$ (4.8)
$\frac{1}{32}$ (0.8)	$\frac{1}{64}$	(0.4)	$\frac{1}{8}$ (3.2)
$\frac{1}{64}$ (0.4)	$\frac{1}{64}$	(0.4)	Varies

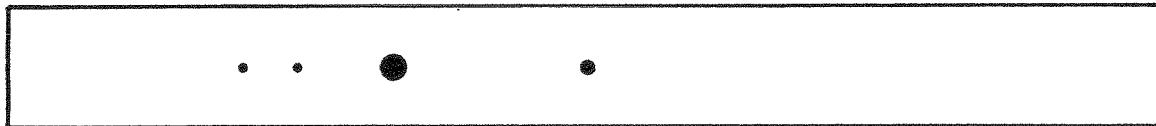
*The sum of the diameters of all discontinuities in any 6 in. (152.4 mm) not to exceed $\frac{1}{4}$ in. (6.4 mm).

**Maximum size discontinuity for 0.250 in. (6.4 mm) wall and lighter shall be $\frac{3}{32}$ in. (2.4 mm).

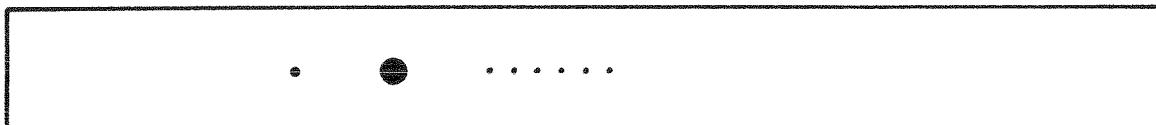
***Two discontinuities, $\frac{1}{32}$ in. (0.8 mm) or smaller, may be as close as one diameter apart provided they are separated from any other discontinuity by at least $\frac{1}{2}$ in. (12.7 mm).



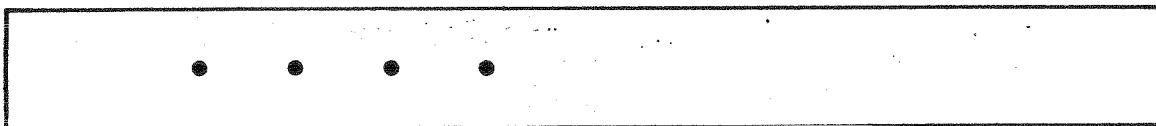
EXAMPLE 1: TWO 1/8" (3.2 mm) DISCONTINUITIES



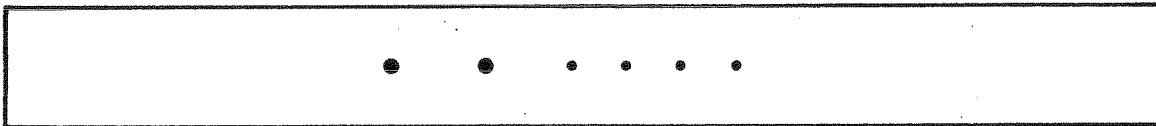
EXAMPLE 2: ONE 1/8" (3.2 mm), ONE 1/16" (1.6 mm), TWO 1/32" (0.8 mm) DISCONTINUITIES



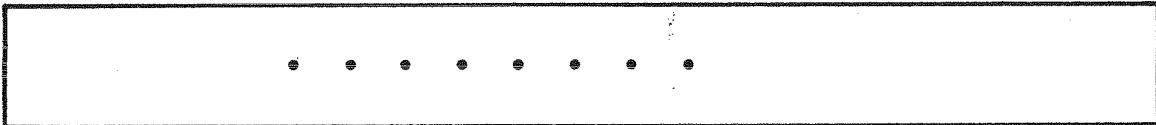
EXAMPLE 3: ONE 1/8" (3.2 mm), ONE 1/32" (0.8 mm), SIX 1/64" (0.4 mm) DISCONTINUITIES



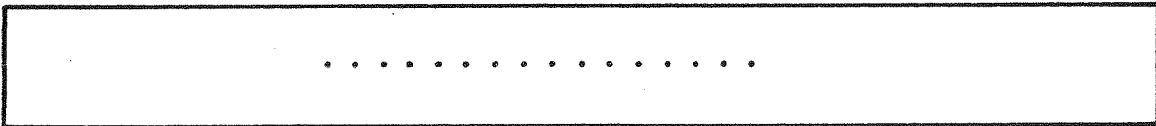
EXAMPLE 4: FOUR 1/16" (1.6 mm) DISCONTINUITIES



EXAMPLE 5: TWO 1/16" (1.6 mm), FOUR 1/32" (0.8 mm) DISCONTINUITIES



EXAMPLE 6: EIGHT 1/32" (0.8 mm) DISCONTINUITIES



EXAMPLE 7: SIXTEEN 1/64" (0.4 mm) DISCONTINUITIES



EXAMPLE 8: SCATTERED, THREE 1/32" (0.8 mm), TEN 1/64" (0.4 mm) DISCONTINUITIES

FIG. 9.3
EXAMPLES OF MAXIMUM DISTRIBUTION PATTERNS OF
INDICATED CIRCULAR SLAG-INCLUSION AND GAS-POCKET TYPE DISCONTINUITIES



9.11 Imperfections. The maximum acceptable size and distribution of slag inclusion and/or gas pocket discontinuities are shown in Tables 9.3 and 9.4 and Fig. 9.2 and 9.3.

NOTE: Unless the discontinuities are elongated, it cannot be determined with assurance whether the radiological indications represent slag inclusions or gas pockets. Therefore, the same limits apply to all circular-type discontinuities.

The important factors to be considered in determining rejection or acceptance limits are size and spacing of discontinuities and the sum of the diameters in an established distance. For simplicity, the distance is established as any 6 in. (152.4 mm) length. Discontinuities of this type usually occur in an aligned pattern, but no distinction is made between aligned or scattered patterns. Also, the distribution pattern may be of assorted sizes.

9.12 Defects. Cracks, lack of complete penetration, or lack of complete fusion, and discontinuities greater in size and/or distribution than shown in Tables 9.3 and 9.4 and Fig. 9.2 and 9.3, as indicated by radiological examination shall be considered defects. See Par. 10.6 for disposition of pipe containing defects.

9.13 Disposition. Any weld defect detected as a result of radiological examination shall be rejected. Disposition of the pipe containing the defect shall be in accordance with Par. 10.6.

ULTRASONIC AND ELECTROMAGNETIC INSPECTION

9.14 Equipment. Any equipment utilizing the ultrasonic or electromagnetic principles and capable of continuous and uninterrupted inspection of the weld seam shall be used. The equipment shall be checked with an applicable reference standard as described in Par. 9.15 at least once every working turn to demonstrate its effectiveness and the inspection procedures. The equipment shall be adjusted to produce well defined indications when the reference standard used by the manufacturer is scanned by the inspection unit in a manner simulating the inspection of the product, and shall be capable of inspecting $\frac{1}{16}$ in. (1.6 mm) on either side of the weld line for the entire wall thickness.

9.15 Reference Standards. Reference standards shall have the same specified diameter and thickness as the product being inspected and may be of any convenient length as determined by the manufacturer. Reference standards shall contain machined notches, one on the inside surface and one on the outside surface, or a drilled hole as shown in Fig. 9.4, at the option of the manufacturer. The notches shall be parallel to the weld seam, and shall be separated by a distance sufficient to produce two separate and distinguishable signals. The $\frac{1}{16}$ in. (1.6 mm) or $\frac{1}{8}$ in. (3.2 mm) hole shall be drilled through the wall and perpendicular to the surface of the reference standard as shown in Fig. 9.4.

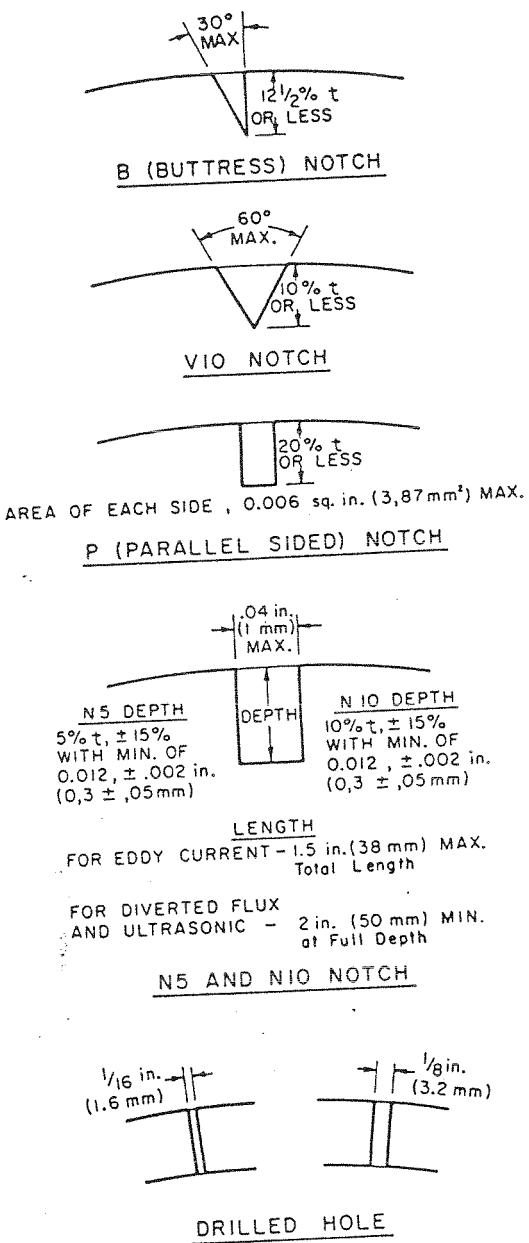


FIG. 9.4
REFERENCE STANDARDS
(See Par. 9.15)

NOTE: The reference standards defined above are convenient standards for calibration of non-destructive testing equipment. The dimensions of these standards should not be construed as the minimum size imperfection detectable by such equipment.

9.16 Acceptance Limits. Table 9.5 gives the height of acceptance limit signals in percent of the height of signals produced by reference standards. An imperfection that produces a signal greater than the acceptance limit signal given in Table 9.5 shall be considered a defect unless it can be demonstrated by the manufacturer that the imperfection does not exceed the provisions of Par. 10.5. Alternatively, indicated imperfections in submerged-arc welded pipe may be reinspected by radiological methods in accordance with Par. 9.2 through 9.13. In addition, for gas metal-arc welded pipe, continuous flaw signals greater than one inch in length regardless of height, but greater than the background signal (noise), shall be reinspected by radiological methods in accordance with Par. 9.2 through 9.13 or by other techniques as agreed upon between purchaser and manufacturer.

TABLE 9.5
ACCEPTANCE LIMITS

1	2	3	4	Acceptance Limit
Weld Type	Notch Type	Size Hole, in.	Signal, mm	percent
Submerged-arc, Gas-Metal arc and Repair Welds	N5	$\frac{1}{16}$	(1.6)	100
	All other	$\frac{1}{8}$	(3.2)	33 $\frac{1}{2}$
Electric- Weld	N10, V10	$\frac{1}{8}$	(3.2)	100
	B, P	---	---	80

9.17 Weld Repair. Defects in the weld, found by ultrasonic or electromagnetic methods of inspection, may be repaired by welding and non-destructively re-examined in accordance with Par. 10.7.

REINSPECTION OF PIPE ENDS

9.18 For cold expanded welded pipe non-destructively inspected prior to cold expansion, the weld at each end of each length shall be non-destructively reinspected subsequent to cold expansion for a distance of at least 6 in. (152.4 mm) by any of the methods specified in Par. 9.1, or by the magnetic particle method in accordance with Par. 9.19 through 9.21.

MAGNETIC PARTICLE INSPECTION (For repair welds and pipe ends only)

9.19 Equipment. The equipment used for magnetic particle inspection shall produce a magnetic field, transverse to the weld, and of sufficient intensity to indicate weld area defects in the external surface of the pipe of the following character: open welds, partial or incomplete welds, intermittent welds, cracks, seams, and slivers.

9.20 Reference Standard. If requested by the purchaser, arrangements shall be made by the manufacturer to perform a demonstration for the purchaser or his representative during production of his order. Such demonstration shall be on the basis of pipe in process or sample lengths of similar pipe retained by the manufacturer for that purpose and which exhibit natural or artificially produced defects of the character stated in Par. 9.19.

9.21 Acceptance Limits. The manufacturer shall mark each magnetic particle indication and subsequently explore each indication with respect to depth of the imperfection. Imperfections which require grinding or chipping to determine their depth shall be completely removed by grinding, or by cutting off, or may be repaired by welding in accordance with Par. 10.7 through 10.9 and re-examined non-destructively.

SECTION 10

WORKMANSHIP, VISUAL INSPECTION, AND REPAIR OF DEFECTS

10.1 Visual Inspection. All pipe shall be visually examined and shall be free of defects in the finished condition.

10.2 Purchaser Inspection.

a. **Inspection Notice.** Where the inspector representing the purchaser desires to inspect this pipe or witness these tests, reasonable notice shall be given of the time at which the run is to be made.

b. **Plant Access.** The inspector representing the purchaser shall have free entry at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which will concern the manufacture of the pipe ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the pipe is being manufactured in accordance with this specification. All inspections should be made at the place of manufacture prior to shipment, unless otherwise specified on the purchase order, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

10.3 Compliance. The manufacturer is responsible for complying with all of the provisions of this specification. The purchaser may make any investigation necessary to satisfy himself of compliance by the manufacturer and may reject any material that does not comply with this specification.

10.4 Rejection. Material which shows defects on inspection or subsequent to acceptance at the manufacturer's works, or which proves defective when properly applied in service, may be rejected, and the manufacturer so notified. If tests that require the destruction of material are made, the purchaser shall pay for that material which meets the specification but shall not pay for any material which fails to meet the specification.

10.5 Workmanship and Defects. Imperfections of the following types exceeding the specified criteria shall be considered defects. The manufacturer shall take all reasonable precautions to minimize recurring imperfections, damage and defects.

a. Dents.

The pipe shall contain no dents greater than $\frac{1}{4}$ in. (6.35 mm), measured as the gap between the lowest point of the dent and a prolongation of the original contour of the pipe. The length of the dent in any direction shall not exceed one-half the pipe diameter. All cold-formed dents deeper than $\frac{1}{8}$ in. (3.18 mm) with a sharp bottom gouge shall be considered a defect. The gouge may be removed by grinding.

b. Offset of Plate Edges.

For submerged-arc and gas metal-arc welded pipe with wall thicknesses 0.500 in. (12.7 mm) and less,

the radial offset (misalignment) of plate edges in the weld seams shall not be greater than $\frac{1}{16}$ in. (1.59 mm). For submerged-arc and gas metal-arc welded pipe with wall thicknesses over 0.500 in. (12.7 mm) the radial offset shall not be greater than 0.125 or $\frac{1}{8}$ in. (3.18 mm) whichever is smaller. For electric-welded pipe, the radial offset of plate edges plus flash trim shall be no greater than 0.060 in. (1.52 mm).

c. Out-of-Line Weld Bead in Submerged-Arc and Gas Metal-Arc Welded Pipe.

Out-of-line weld bead (off-seam weld) shall not be cause for rejection provided complete penetration and complete fusion have been achieved as indicated by non-destructive examination. When the electric-resistance welding process is used for tack welding, the subsequent submerged-arc or gas metal-arc weld must eliminate all evidence of the tack weld.

d. Height of Outside and Inside Weld Beads — Submerged-Arc Welds.

The weld bead shall not extend above the prolongation of the original surface of the pipe more than the amount listed below:

Wall Thickness	Maximum Height of Weld Bead
$\frac{1}{2}$ in. (12.70 mm) and under	$\frac{1}{8}$ in. (3.18 mm)
Over $\frac{1}{2}$ in. (12.70 mm)	$\frac{3}{16}$ in. (4.76 mm)

Weld beads higher than permitted by the requirements of this paragraph may be ground to acceptable limits at the option of the manufacturer.

The height of the weld bead shall in no case come below a prolongation of the surface of the pipe (outside or inside the weld bead), except that contouring by grinding, otherwise covered in Spec 5L, shall be permitted.

e. Height of Flash of Electric-Welded Pipe.

The outside flash of electric-welded pipe shall be trimmed to an essentially flush condition.

The inside flash of electric-welded pipe shall not extend above the prolongation of the original inside surface of the pipe more than 0.060 in. (1.52 mm).

f. Trim of Inside Flash of Electric-Welded Pipe.

The depth of groove resulting from removal of the internal flash of electric-welded pipe shall not be greater than the amount listed below for the various wall thicknesses. Depth of groove is defined as the difference between the wall thickness measured approximately 1 in. from the weld line and the remaining wall under the groove.

Wall Thickness	Maximum Depth of Trim
0.150 in. (3.8 mm) and less	0.10 t
0.151 in. (3.8 mm) to 0.301 in. (7.6 mm)	0.015 in. (0.38 mm)
0.301 in. (7.6 mm) and greater	0.05 t

g. Hard Spots.

Any hard spot having a minimum dimension greater than 2 inches (50.8 mm) in any direction and a hardness greater than or equal to 35 HRC (BHN 327) is rejectable. The section of pipe containing the hard spot shall be removed as a cylinder.

The surface of cold formed welded pipe shall be examined visually to detect irregularities in the curvature of the pipe. When this examination fails to disclose mechanical damage as the cause of the irregular surface, but instead indicates that the irregular surface may be attributed to a hard spot, the hardness and dimensions of the area shall be determined. If hardness and dimensions exceed the aforementioned rejection criteria, the hard spot shall be removed.

h. Cracks and Leaks.

All cracks, sweats, and leaks shall be considered defects.

i. Laminations.

Any lamination or inclusion extending into the face or bevel of the pipe and having a visually determined transverse dimension exceeding $\frac{1}{4}$ in. (6.35 mm) are considered defects. Pipe containing such defects shall be cut back until no lamination or inclusion is greater than $\frac{1}{4}$ in. (6.35 mm).

j. Arc Burns.

Arc burns, defined as localized points of surface melting caused by arcing between electrode or ground and pipe surface, shall be considered defects.

NOTE: Contact marks, defined as intermittent marks adjacent to the weld line, resulting from the electrical contact between the electrodes supplying the welding current and the pipe surface, are not defects.

Disposition of pipe containing arc burns shall be in accordance with Par. 10.6, except that removal of defects by grinding shall be subject to the following additional conditions.

1. Arc burns may be removed by grinding, chipping or machining. The resulting cavity shall be thoroughly cleaned and checked for complete removal of damaged material by etching with a 10% solution of ammonium persulfate or a 5% solution of nital. If removal of damaged material is complete the cavity may be merged

smoothly into the original contour of the pipe by grinding, provided the remaining wall thickness is within specified limits.

k. Undercuts.

Undercutting on submerged-arc or gas metal-arc welded pipe is the reduction in thickness of the pipe wall adjacent to the weld where it is fused to the surface of the pipe. Undercutting can best be located and measured visually.

Minor undercutting on either the inside or the outside of the pipe is defined in 1. and 2. below and is acceptable without repair or grinding.

1. Maximum depth of $\frac{1}{32}$ in. (0.79 mm) and not exceeding 12½% of the wall thickness with a maximum length of one-half the wall thickness and not more than two such undercuts in any 1 ft. (0.30 m) of the weld length.
2. Maximum depth of $\frac{1}{64}$ in. (0.40 mm), any length.
3. Undercutting in excess of Par. 10.5.k.1 shall be considered a defect. Disposition shall be as follows:
 - a. Undercut defects not exceeding $\frac{1}{32}$ in. in depth and not exceeding 12½% of the specified wall thickness shall be removed by grinding in accordance with Par. 10.6.a.
 - b. Disposition of undercuts greater in depth than $\frac{1}{32}$ in. or 12½% of the specified wall thickness shall be in accordance with Par. 10.6.b, c or d.

l. Other Defects.

Any imperfection having a depth greater than 12½ percent of the specified wall thickness, measured from the surface of the pipe, shall be considered a defect.

10.6 Disposition of Defects.

Pipe containing a defect must be given one of the following dispositions:

- a. The defect shall be removed by grinding provided the remaining wall thickness is within specified limits. Grinding shall be done in a workmanlike manner.
- b. The defect shall be repaired in accordance with Par. 10.7 through 10.11.
- c. The section of pipe containing the defect shall be cut off within the limits of requirements on length.
- d. The entire pipe shall be rejected.

10.7 Repair of Defects.

a. Seamless Pipe and Parent Metal of Welded Pipe.

The repair of defects in seamless pipe and parent metal of welded pipe is permissible except when the depth of defect exceeds 33½ percent of the

specified wall thickness of the pipe and the length of that portion of the defect in which the depth exceeds 12½ percent is greater than 25 percent of the specified outside diameter of the pipe, or when more than one repair is required in any length equivalent to 10 times the specified outside diameter of the pipe. Repairs shall be made in accordance with Par. 10.9. Repair welds shall be inspected by the magnetic particle method in accordance with Par. 9.19 through 9.21 or by liquid penetrant or, by agreement between purchaser and manufacturer, other NDT methods may be used.

b. Weld Seam of Welded Pipe.

Defects in the weld seam of submerged-arc and gas metal-arc welded pipe may be repaired at the discretion of the manufacturer. Submerged-arc and gas metal-arc weld seam repairs shall be in accordance with Par. 10.10. The weld seam of electric-resistance welded pipe and induction welded pipe may be repaired only by agreement between the purchaser and manufacturer. Electric-resistance weld and induction weld seam repairs shall be in accordance with Par. 10.11. Repair welds shall be nondestructively examined ultrasonically in accordance with Par. 9.14 through 9.16, except that the equipment need not be capable of continuous and uninterrupted operation. At the manufacturer's option, repairs made by submerged-arc welding or by shielded metal-arc welding may alternatively be examined radiographically in accordance with Par. 9.2 through 9.12.

c. Heat Treated Pipe.

When heat treated pipe has been repaired by welding, the need for and type of reheat treatment shall be, by agreement between the manufacturer and the purchaser, based on the effect of the repair on the structure and properties of the heat treated pipe.

10.8 Procedure for Repair of Seamless Pipe and Parent Metal of Welded Pipe.

The repair of defects in seamless pipe and parent metal of welded pipe shall conform to the following requirements. Conformance to the repair procedure is subject to approval of the purchaser's inspector.

1. The defect shall be removed completely by chipping and/or grinding and the resultant cavity shall be thoroughly cleaned and, before welding, shall be inspected by magnetic particle methods to insure complete removal of the defect.
2. The minimum length of repair weld shall be 2 in. (50.8 mm). Where the orientation of the defect permits, the repair weld shall be placed in the circumferential direction.
3. The repair weld shall be made either by submerged-arc welding, gas metal-arc welding, or shielded manual metal-arc welding using low hydrogen electrodes. The metal temperature in the area to be repaired shall be a minimum of 50°F (10°C). The welding procedure and performance

- shall be qualified in accordance with Appendix B.
4. The repair weld shall be ground to merge smoothly into the original contour of the pipe.
5. Repaired pipe shall be hydrostatically tested after repairing in accordance with Section 5.

10.9 Procedure for Repair of Weld Seams of Submerged-Arc Welded and Gas Metal-Arc Welded Pipe.

The repair of defects in the weld seam of submerged-arc welded pipe shall conform to the following requirements. Conformance is subject to approval of purchaser's inspector.

1. The defect shall be completely removed and the cavity thoroughly cleaned. Where multiple pass repairs are used, the size of the cavity must be sufficiently large (at least 2 in. [50.8 mm] in length) to avoid coincidence of starts and stops of individual passes.
2. The minimum length of each repair weld shall be 2 in. [50.8 mm]. The repair weld shall be made either by manual or semi-automatic submerged-arc welding, metal-arc welding, or manual shielded metal-arc welding using low hydrogen electrodes, and the welding procedure and performance shall be qualified in accordance with Appendix B; or the repair weld shall be made by automatic submerged-arc welding.
3. Each length of repaired pipe shall be tested hydrostatically in accordance with Sect. 5.

10.10 Procedure for Repair of Weld Seams of ERW and Induction Welded Pipe.

Repair welding of the weld seam of electric-resistance welded pipe and induction welded pipe shall conform to the following requirements and shall include the weld zone which is defined for the purposes of repair as $\frac{1}{2}$ in. (12.7 mm) on either side of the fusion line. Conformance to the repair procedure is subject to approval of the purchaser's inspector.

1. The weld zone defect shall be removed completely by chipping and/or grinding and the resultant cavity shall be thoroughly cleaned.
2. The minimum length of repair weld shall be 2 in. (50.8 mm), and individual weld repairs must be separated by at least 10 ft. (3 m).
3. The repair weld shall be made either by manual or semi-automatic submerged-arc welding, gas metal-arc welding, or manual shielded metal-arc welding using low hydrogen electrodes. The metal temperature in the area to be repaired shall be a minimum of 50°F (10°C). The welding procedure and performance shall be qualified in accordance with Appendix B.
4. When a repair weld is made through the full wall thickness, it shall include weld passes made from both the ID and the OD of the pipe. Starts and stops of the ID and OD repair welds shall not coincide.
5. The repair shall be ground to merge smoothly into the original contour of the pipe and shall have a maximum crown of 0.06 in. (1.52 mm).
6. Repaired pipe shall be hydrostatically tested after repair in accordance with Sect. 5.

SECTION 11

MARKING AND COATING

11.1 Pipe and pipe couplings, manufactured in conformance with this specification, shall be marked by the manufacturer as specified hereinafter.

- a. The required marking on pipe shall be as stipulated in Par. 11.2.
- b. The required marking on couplings shall be die stamped unless otherwise agreed upon between the purchaser and the manufacturer, in which case they shall be paint stenciled.
- c. Size, weight per foot, length, and hydrostatic test pressure markings shall be in English units except that for pipe intended for use in countries utilizing the metric system; these markings shall be in metric units or both English and metric units, if so specified on the purchase order. If not so specified, for pipe made and intended for use in countries utilizing the metric system, these markings may be given in metric units only, at the option of the manufacturer.

11.2 The location and sequence of identification markings shall be as follows:

Location of Markings

1.900 in. OD and smaller — Die stamped on a metal tag fixed to the bundle, or may be printed on the straps or banding clips used to tie the bundle.

Seamless pipe in all other sizes and welded up to 16 in. OD — Paint stencil on the outside surface starting at a point between 18 and 30 inches from the end of the pipe, and in the sequence shown below, except when agreed between the purchaser and the manufacturer some or all of the markings may be placed on the inside surface in a sequence convenient to the manufacturer.

Welded pipe 16 in. OD and larger — Paint stencil on the inside surface starting at a point no less than 6 in. from the end of the pipe in a sequence convenient to the manufacturer, unless otherwise specified by the purchaser.

Sequence of Markings

a. Manufacturer's Name or Mark.

b. Spec 5L*

"Spec 5L" should be paint stenciled when the product is in complete compliance with this specification.

c. Size.

The size in inches.

*Users of this specification should note that there is no longer a requirement for marking a product with the API monogram. The American Petroleum Institute continues to license use of the monogram on products covered by this specification but it is administered by the staff of the Institution separately from the specification. The policy describing licensing and use of the monogram is contained in Appendix H, herein. No other use of the monogram is permitted. Non-licensees may mark products in conformance with Section 11 and Licensees may mark products in conformance with Appendix H, Section H.9.

d. Weight per Foot.

For sizes 4½ in. and larger, the nominal weight in pounds per foot for threaded-and-coupled pipe (Col. 3, Table 6.1), and the tabulated weight in pounds per foot for plain-end pipe (Table 6.2), shall be paint stenciled.

e. Grade.

The symbols to be used are as follows:

Grade A25	A25
Grade A	A
Grade B	B
Grade X42	X42
Grade X46	X46
Grade X52	X52
Grade X56	X56
Grade X60	X60
Grade X65	X65
Grade X70	X70
Grade X80	X80

For grades intermediate to X42 and X56, the symbol shall be X followed by the first two digits of the specified minimum yield strength.

For all Grades X42 and higher, including intermediate grades, containing columbium, vanadium, and/or titanium, the grade symbol shall be followed by the letter(s) C, V, T, or combination thereof.

By agreement between purchaser and manufacturer and when so specified on the purchase order, the grade shall be identified by color in accordance with Supplementary Requirement SR-3.

NOTE: See Par. 1.1 for limitations on downgrading.

f. Process of Manufacture.

The symbols to be used are as follows:

Seamless pipe	S
Welded pipe, except butt-weld	E
Butt-welded pipe	F
Spiral weld pipe	SW

g. Type of Steel.

The symbols to be used are as follows:

Electric-furnace steel	E
Rephosphorized Steel (Class II)	R

NOTE: No type marking is required for open-hearth or basic-oxygen steel.

h. Heat Treatment.

The symbols to be used are as follows:

Normalized or normalized and tempered	HN
Subcritical stress relieved	HS
Subcritical age hardened	HA
Quench and Tempered	HQ

i. Test Pressure.

When the specified hydrostatic test pressure is higher than the tabulated pressure (Tables 6.1 and 6.2), the test pressure in pounds per square inch, preceded by the word TESTED, shall be paint stenciled.

j. Supplementary Requirements.

See Appendix E.

Examples:

1. 14 in., 54.57 lb., Grade B, seamless, open-hearth, regular-weight, plain-end pipe shall be paint stenciled as follows:
AB CO Spec 5L* 14.00 54.57 B S
2. 6½ in., 18.97 lb., Grade B, electric-welded, open-hearth, regular-weight, plain-end pipe shall be paint stenciled as follows:
AB CO Spec 5L* 6½ 18.97 B E
3. 4 in., nominal size, Grade A25 butt-welded, Class I open-hearth, standard-weight, threaded line pipe shall be paint stenciled as follows:
AB CO Spec 5L* 4 11.00 A25 F
4. 14 in., 54.57 lb., Grade X42, seamless, open-hearth steel pipe shall be paint stenciled as follows:
AB CO Spec 5L* 14.00 54.57 X42 S
5. 12¾ in., 43.77 lb., Grade X42, seamless, open-hearth steel pipe shall be paint stenciled as follows:
AB CO Spec 5L* 12¾ 43.77 X42 S
6. 6½ in., 14.97 lb., Grade X42, electric-welded, electric-furnace steel pipe shall be paint stenciled as follows:
AB CO Spec 5L* 6½ 14.97 X42 E E
7. 12¾ in., 43.77 lb., Grade X42, submerged-arc, spiral weld, basic oxygen steel pipe shall be paint stenciled as follows:
AB CO Spec 5L* 12¾ 43.77 X42 SW

11.3 For pipe in sizes 1.900 in. OD and smaller, the identification markings specified in Par. 11.2 shall be placed on the tag, strap, or clip used to tie the bundle.

11.4 Length. In addition to the identification markings stipulated in Par. 11.2 and 11.3, the length shall be marked as follows:

- a. For pipe in sizes larger than 1.900 in. OD, the length in feet and tenths of a foot, unless otherwise specified on the purchase order, as measured on the finished pipe shall be paint stenciled on the outside surface at a place convenient to the manufacturer, except by agreement between the purchaser and the manufacturer, the length marking may be placed inside the pipe at a convenient location.

*Users of the specification should note that there is no longer a requirement for marking a product with the API monogram. The American Petroleum Institute continues to license use of the monogram on products covered by this specification but it is administered by the staff of the Institution separately from the specification. The policy describing licensing and use of the monogram is contained in Appendix H, herein. No other use of the monogram is permitted. Non-licensees may mark products in conformance with Section 11 and Licensees may mark products in conformance with Appendix H, Section H.9.

b. For sizes 1.900 in. OD and smaller, the total length of pipe in the bundle in feet and tenths of a foot, unless otherwise specified on the purchase order, shall be marked on the tag, band, or clip.

11.5 Couplings. All couplings in nominal size 2 in. and larger shall be identified with the manufacturer's name or mark and the API monogram.

11.6 Die Stamping. Cold die stamping of grades higher than A25 plate or pipe not subsequently heat treated, and all pipe with wall thickness of 0.156 in. and less is prohibited, except that by agreement between the purchaser and the manufacturer and when so specified on the purchase order, pipe or plate may be cold die stamped. The manufacturer at his option may hot die stamp (200°F, 93°C, or higher) plate or pipe, cold die stamp plate or pipe if it is subsequently heat treated, and cold die stamp couplings. Cold die stamping shall be done with rounded or blunt dies. All die stamping shall be at least 1 in. (25 mm) from the weld for all grades except Grade A25.

11.7 Thread Identification. At the manufacturer's option, any pipe threads which conform to the threading and gaging stipulations given in API Std 5B may be identified by stamping or stenciling the product adjacent to such thread, with the manufacturer's name or mark, the size, and the letters LP to indicate the type of thread. The thread marking may be applied to products which do or do not bear the API monogram. For example, 6 in. API line pipe thread may be marked:

AB CO 6 "SPEC 5L" LP

If the product is clearly marked elsewhere with the manufacturer's identification, his name or mark, as above, may be omitted.

11.8 The use of the letters "Spec 5B" as provided in Par. 11.7 shall constitute a certification by the manufacturer that the threads so marked comply with the requirements stipulated in API Std 5B, but should not be construed by the purchaser as a representation that the product so marked is, in its entirety, in accordance with any API specification. Manufacturers who use the letters "Spec 5B" for thread identification must have in their possession properly certified API reference master pipe gages.

11.9 Coatings. Unless otherwise ordered, pipe shall be given an external coating to protect it from rusting in transit. An attempt should be made to make these coatings smooth, hard to the touch, and with minimum sags.

NOTE: If bare pipe or specially coated pipe is desired, the purchase order should so state. For special coatings, the purchase order should state further whether the coating is to be applied to the full length or whether a certain specified distance from the end is to be left uncoated. Unless otherwise specified, such bare ends are commonly given a coating with oil for protection in transit.

11.10 Pipe Processor Markings. Pipe heat treated by a processor other than the original pipe manufacturer shall be marked as stipulated in Par. 11.1, 11.2, 11.3, 11.4, 11.5 and 11.6. The processor shall remove any identity which is not indicative of the new condition of the product as a result of heat treating (i.e., prior grade identity, original pipe manufacturer's name or logo).

APPENDIX A

SPECIFICATION FOR WELDED JOINTERS

(See Par. 6.7 for length requirements on jointers)

A-1. Method. Welding of any type generally recognized as sound practice shall be permitted except when a particular method is specified by the purchaser.

A-2. Workmanship. The ends of the pipe to be welded together shall be prepared in accordance with the requirements of the process used. The completed jointers shall be straight within limits recognized by this specification.

A-3. All jointers shall be marked so as to identify the welders. Each weld shall have a substantially uniform cross section around the entire circumference of the pipe. At no point shall its crowned surface be below the outside surface of the parent metal nor shall it rise above the latter more than $\frac{1}{16}$ in. (1.59 mm).

A-4. Hydrostatic Test. Hydrostatic tests shall be made in accordance with provisions of Sect. 5, except that hammer blows shall be struck near the jointer weld instead of near ends of jointers. Minor sweats or leaks which develop in welds during the hydrostatic test may be repaired by welding after complete removal of the defective weld area by chipping. Such jointers shall again be subjected to hydrostatic tests.

A-5. Nondestructive Test. The girth weld of jointers in sizes 20 in. and larger shall be 100 percent radiographed in accordance with standards of acceptability in API Std 1104. Such jointers need not be rehydrostatically tested.

A-6. Tensile Test. Longitudinal tensile tests of jointer welds shall be made with procedure similar to that specified in Sect. 4, except that, whenever possible, the test specimen shall be a full cross-section sample with the weld at the center; otherwise a strip specimen of the required size shall be taken at right angles to the weld between jointers with the finished weld at the center of the specimen. Test specimens shall not be taken nearer than 90° to the longitudinal or the spiral weld.

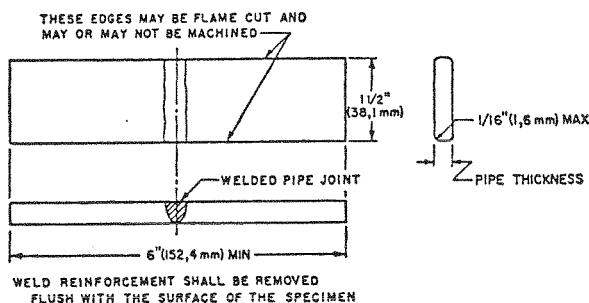


FIG. A1
GUIDED-BEND SPECIMEN

The number of such tensile tests shall be one out of each lot of 50 jointers or less, but not less than one for each welder. All tensile specimens shall be tested with the pipe and weld at room temperature. Each weld tested shall develop the full minimum tensile strength specified for the pipe.

A-7. Bend Tests. Two guided-bend tests, one face and one root, shall be made on specimens cut from the jointer weld of one length of pipe from each lot of 50 jointers or less of each size. Specimens shall be prepared in accordance with Fig. A1 and shall be bent approximately 180° in a jig substantially in accordance with Fig. A2 for grade A and B, and with Fig. B4 and Table B1 for grade X42 and higher.

The bend test shall be acceptable if no cracks or other defects exceeding $\frac{1}{8}$ in. (3.18 mm) in any direction are present in the weld metal or between the weld and the pipe metal after bending. Cracks which originate along the edges of the specimen during testing and that are less than $\frac{1}{4}$ in. (6.35 mm) measured in any direction, shall not be considered. Test specimens shall not include manual metallic-arc repair welds.

A-8. Retests. If any test specimen fails to conform to the requirements specified, the manufacturer may elect to make the specified tests on two additional jointers from the same lot by the same welder. Retests are required only for the test with which the specimen did not comply originally. If any specimen on retest fails to conform to the specified requirements, all jointers welded by said welder, in the lot under test, shall be rejected.

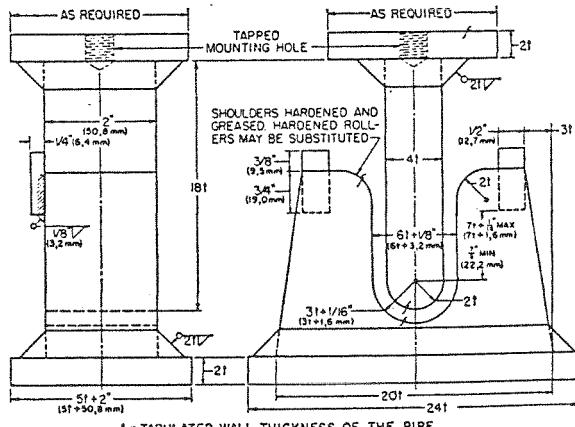


FIG. A2
JIG FOR GUIDED-BEND TEST

APPENDIX B

REPAIR-WELDING PROCEDURE AND WELDER PERFORMANCE TESTS

B-1. All manual and semi-automatic submerged-arc and gas metal-arc repair welds, and manual shielded metal-arc repair welds using low hydrogen electrodes shall be made according to a tested procedure and by a repair welder tested in a flat position as specified in Par. B-2 and B-3. The manufacturer shall maintain a record of the procedure and performance-test results. At the option of the manufacturer, the tests specified in the latest issue of the *ASME Boiler and Pressure Vessel Code*, Section IX, may be substituted for the test specified herein. Further, test welds may be made either on plate stock or pipe stock at the option of the manufacturer.

B-2. Repair-Welding Procedure Tests. Repair-welding procedure tests are required on two specimens from each test of every grade and on material which is on the high side of the chemistry specification and which is at least as thick as the pipe on which welds are to be made. The repair welding procedure test shall be made at a temperature at or below the lowest temperature at which repair welds are made.

1. Transverse Tensile Test. The transverse tensile test specimen shall be approximately $1\frac{1}{2}$ in. (38.1 mm) wide and shall have the transverse metallic-arc butt weld perpendicular to the longitudinal axis at the center of the test specimen. The

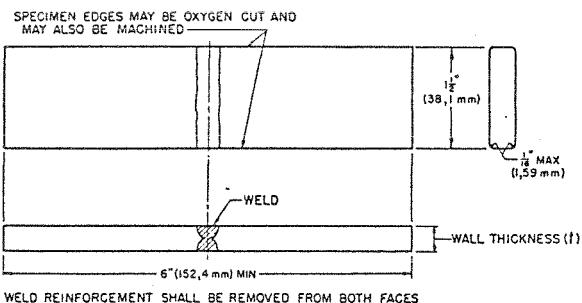


FIG. B1
TRANSVERSE TENSILE TEST SPECIMEN

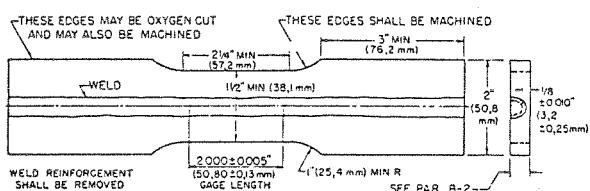


FIG. B2
TENSILE-ELONGATION TEST SPECIMEN

weld reinforcement shall be removed from both faces. The ultimate tensile strength shall be at least equal to the minimum specified for the grade.

2. Longitudinal Tensile-Elongation Test. The longitudinal tensile-elongation test specimen shall conform to Fig. B2. The weld shall be made in a groove as shown. The elongation after complete rupture of the test specimen in tension shall be at least equal to the minimum elongation specified for the grade.

3. Transverse Guided Bend Test. The transverse guided bend test specimen shall conform to Fig. B3. The weld shall be made in a groove as shown. The specimen shall be placed on the die with the weld at mid-span, and shall be bent approximately 180° in a jig substantially in accordance with Fig. B4 and Table B1, with the exposed surface of the weld in tension. The bend test shall be considered acceptable if:

a. No crack or other defect exceeding $\frac{1}{16}$ in. (3.18 mm) in any direction is present in the weld metal or between the weld and the pipe metal after bending. Cracks which originate along the edges of the specimen during testing and which are less than $\frac{1}{16}$ in. (6.35 mm) measured in any direction shall not be considered.

Or

b. The specimen cracks or fractures during bending and the exposed surface shows: complete penetration and fusion throughout the entire thickness of the weld specimen; no more than 6 gas pockets per square inch with the greatest dimension not to exceed $\frac{1}{16}$ in. (1.59 mm); and no slag inclusions greater than $\frac{1}{32}$ in. (0.79 mm) in depth or $\frac{1}{8}$ in. (3.18 mm) in width and separated by at least $\frac{1}{2}$ in. (12.7 mm) of sound metal. (If necessary the specimen shall be broken apart to permit examination of the fracture.)

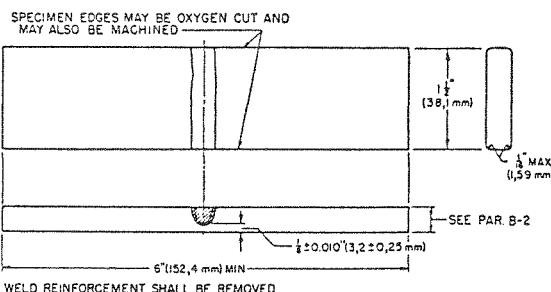


FIG. B3
GUIDED-BEND TEST SPECIMEN

TABLE B1
GUIDED-BEND TEST JIG DIMENSIONS
See Fig. B4

	1	2	3	4	5	6
	Pipe Grade					
	A, B & X42	X46	X52 & X56	X60 & X65	X70 & X80	
Radius of male member, R_A	3t	3½t	4t	4½t	5t	
Radius of female member, R_B	4t + 1/16"	4½t + 1/16"	5t + 1/16"	5½t + 1/16"	6t + 1/16"	
	4t + 1.6 mm	4½t + 1.6 mm	5t + 1.6 mm	5½t + 1.6 mm	6t + 1.6 mm	
Width of male member, A	6t	7t	8t	9t	10t	
Width of groove in female member, B	8t + 1/8"	9t + 1/8"	10t + 1/8"	11t + 1/8"	12t + 1/8"	
	8t + 3.2 mm	9t + 3.2 mm	10t + 3.2 mm	11t + 3.2 mm	12t + 3.2 mm	

t = specified wall thickness of the pipe

For intermediate grades of pipe, the above dimensions of the bending jig shall conform to those shown for the next lower grade or shall be proportional thereto.

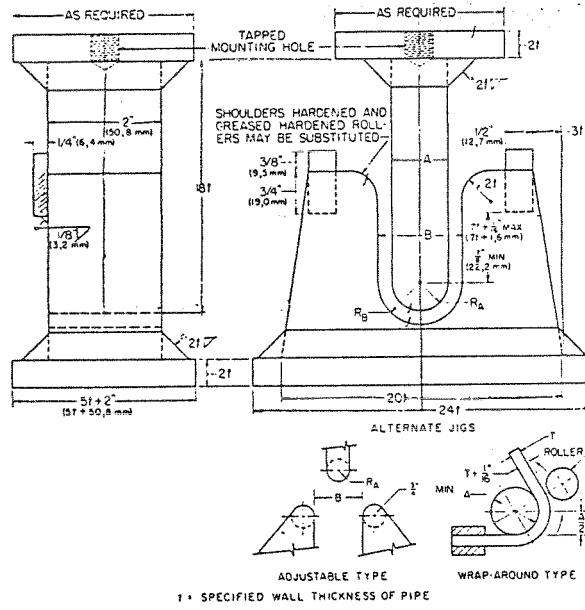


FIG. B4
JIG FOR GUIDED-BEND TEST
See Table B1

4. Nick-Break Test. The nick-break specimen shall conform to Fig. B5. The weld shall be made in a groove as shown. The specimen shall be hacksaw-notched from both edges at the center of the weld and shall be broken by pulling or hammer blows at the center or one end. The exposed surface of the specimen shall be considered acceptable if it shows no more than:

- a. One gas pocket for nominal wall thicknesses of 0.250 in. (6.35 mm) and less.
- b. Two gas pockets for nominal wall thicknesses of 0.500 in. (12.70 mm) or less, but greater than 0.250 in. (6.35 mm).
- c. Three gas pockets for nominal wall thicknesses greater than 0.500 in. (12.70 mm).

The greatest dimension of a gas pocket shall not exceed 1/16 in. (1.59 mm). Slag inclusion shall be separated by at least 1/2 in. (12.7 mm) of sound metal and shall be no greater than 1/32 in. (0.79 mm) in depth or 1/8 in. (3.18 mm) in width.

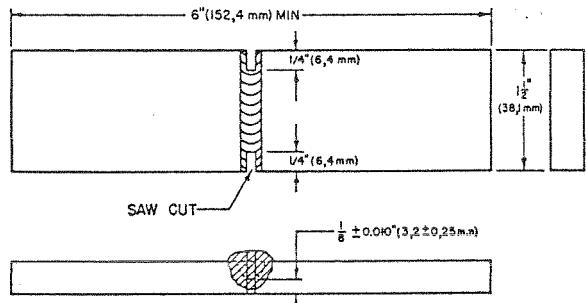


FIG. B5
NICK-BREAK TEST SPECIMEN

B-3. Repair-Welders Performance Tests. Repair-welders performance tests are required on two specimens from each test of every grade, except that a welder qualified on one grade is also qualified for any lower grade. If either of the two specimens fails to conform to the requirements specified, four retests shall be required if made immediately, or two retests shall be required if the welder takes further instructions in the practice before making a retest. All retests shall conform to the requirements specified. Further performance tests are required at a minimum of 1-year intervals, and also if the repair welder is not engaged in the tested repair-welding procedure for a period of three months or more, or if there is some specific reason to question his ability. Both of the following tests shall be made:

- a. Transverse guided bend test as stipulated under welding-procedure test item B-2, Subpar. 3.
- b. Nick-break test as stipulated under welding-procedure test item B-2, Subpar. 4.

APPENDIX C ELONGATION TABLE

Tabulated below are the minimum elongation values calculated by the formula given in Table 4.1.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Tensile Test Specimen				Elongation in 2 inches, minimum, percent												
Area, sq. in.	Specified Wall Thickness, in.			A25 45,000	A 48,000	B X42 60,000	X46 63,000	X52 66,000	X56 71,000	X52 72,000	X56 75,000	X65 77,000	X60 78,000	X65 80,000	X70 82,000	X80 90,000
	1/4 in. Specimen	1 in. Specimen	1 1/4 in. Specimen													
0.75 and greater	.994 and greater	.746 and greater	.497 and greater	38.5	36.0	29.5	28.5	27.0	25.5	25.0	24.0	23.5	23.5	23.0	22.5	*
0.74	.980-.993	.735-.745	.490-.496	38.0	36.0	29.5	28.0	27.0	25.5	25.0	24.0	23.5	23.5	22.5	22.0	*
0.73	.987-.979	.725-.734	.484-.489	38.0	36.0	29.5	28.0	27.0	25.5	25.0	24.0	23.5	23.0	22.5	22.0	*
0.72	.954-.966	.715-.725	.477-.483	38.0	36.0	29.5	28.0	27.0	25.0	25.0	24.0	23.5	23.0	22.5	22.0	*
0.71	.941-.953	.705-.714	.471-.476	38.0	35.5	29.0	28.0	27.0	25.0	25.0	24.0	23.5	23.0	22.5	22.0	*
0.70	.927-.940	.695-.705	.464-.470	38.0	35.5	29.0	28.0	26.5	25.0	24.5	24.0	23.5	23.0	22.5	22.0	*
0.69	.914-.926	.686-.694	.457-.463	37.5	35.5	29.0	28.0	26.5	25.0	24.5	24.0	23.0	23.0	22.5	22.0	*
0.68	.900-.913	.675-.685	.450-.456	37.5	35.5	29.0	27.5	25.5	25.0	24.5	23.5	23.0	23.0	22.5	22.0	*
0.67	.887-.899	.666-.674	.444-.449	37.5	35.5	29.0	27.5	26.5	25.0	24.5	23.5	23.0	23.0	22.5	22.0	*
0.66	.874-.886	.655-.665	.437-.443	37.5	35.0	29.0	27.5	26.5	25.0	24.5	23.5	23.0	22.5	22.0	21.5	*
0.65	.861-.873	.646-.654	.431-.436	37.0	35.0	28.5	27.5	26.5	24.5	24.5	23.5	23.0	22.5	22.0	21.5	*
0.64	.847-.860	.635-.645	.424-.430	37.0	35.0	28.5	27.5	26.5	24.5	24.5	23.5	23.0	22.5	22.0	21.5	*
0.63	.834-.846	.626-.634	.417-.423	37.0	35.0	28.5	27.5	26.0	24.5	24.0	23.5	23.0	22.5	22.0	21.5	*
0.62	.820-.833	.615-.625	.410-.416	37.0	35.0	28.5	27.0	26.0	24.5	24.0	23.5	23.0	22.5	22.0	21.5	*
0.61	.807-.819	.606-.614	.404-.409	36.5	34.5	28.5	27.0	26.0	24.5	24.0	23.0	22.5	22.0	21.5	*	*
0.60	.794-.806	.595-.605	.397-.403	36.5	34.5	28.5	27.0	26.0	24.5	24.0	23.0	22.5	22.0	21.5	*	*
0.59	.781-.793	.586-.594	.391-.396	36.5	34.5	28.0	27.0	26.0	24.0	24.0	23.0	22.5	22.0	21.5	21.5	*
0.58	.767-.780	.575-.585	.384-.390	36.5	34.5	28.0	27.0	26.0	24.0	24.0	23.0	22.5	22.0	21.5	21.0	*
0.57	.754-.766	.566-.574	.377-.383	36.0	34.0	28.0	27.0	25.5	24.0	23.5	23.0	22.5	22.0	21.5	21.0	*
0.56	.740-.753	.555-.565	.370-.376	36.0	34.0	28.0	26.5	25.5	24.0	23.5	23.0	22.5	22.0	21.5	21.0	*
0.55	.727-.739	.546-.554	.364-.369	36.0	34.0	28.0	26.5	25.5	24.0	23.5	22.5	22.0	22.0	21.5	21.0	*
0.54	.714-.726	.535-.545	.357-.363	36.0	34.0	27.5	26.5	25.5	24.0	23.5	22.5	22.0	22.0	21.5	21.0	*
0.53	.701-.713	.526-.534	.351-.356	35.5	33.5	27.5	26.5	25.5	23.5	23.5	22.5	22.0	22.0	21.5	21.0	*
0.52	.687-.700	.515-.525	.344-.350	35.5	33.5	27.5	26.5	25.0	23.5	23.5	22.5	22.0	21.5	21.0	20.5	*
0.51	.674-.686	.506-.514	.337-.343	35.5	33.5	27.5	26.0	25.0	23.5	23.0	22.5	22.0	21.5	21.0	20.5	*
0.50	.660-.673	.495-.505	.330-.336	35.5	33.5	27.0	26.0	25.0	23.5	23.0	22.5	22.0	21.5	21.0	20.5	*
0.49	.647-.659	.486-.494	.324-.329	35.0	33.0	27.0	26.0	25.0	23.5	23.0	22.0	21.5	21.5	21.0	20.5	*
0.48	.634-.646	.475-.485	.317-.323	35.0	33.0	27.0	26.0	25.0	23.0	23.0	22.0	21.5	21.5	21.0	20.5	*
0.47	.621-.633	.466-.474	.311-.316	35.0	33.0	27.0	26.0	24.5	23.0	23.0	22.0	21.5	21.5	21.0	20.5	*
0.46	.607-.620	.455-.465	.304-.310	34.5	33.0	27.0	25.5	24.5	23.0	22.5	22.0	21.5	21.0	20.5	20.0	*
0.45	.594-.606	.446-.454	.297-.303	34.5	32.5	26.5	25.5	24.5	23.0	22.5	22.0	21.5	21.0	20.5	20.0	*
0.44	.580-.593	.435-.445	.290-.296	34.5	32.5	26.5	25.5	24.5	23.0	22.5	21.5	21.0	21.0	20.5	20.0	*
0.43	.557-.579	.425-.434	.284-.289	34.5	32.5	26.5	25.5	24.5	22.5	22.5	21.5	21.0	21.0	20.5	20.0	*
0.42	.554-.566	.415-.425	.277-.283	34.0	32.0	26.5	25.0	24.0	22.5	22.5	21.5	21.0	21.0	20.5	20.0	*
0.41	.541-.553	.406-.414	.271-.276	34.0	32.0	26.0	25.0	24.0	22.5	22.0	21.5	21.0	20.5	20.0	19.5	*
0.40	.527-.540	.395-.405	.264-.270	34.0	32.0	26.0	25.0	24.0	22.5	22.0	21.5	21.0	20.5	20.0	19.5	*
0.39	.514-.526	.386-.394	.257-.263	33.5	31.5	26.0	25.0	24.0	22.5	22.0	21.0	20.5	20.5	20.0	19.5	*
0.38	.500-.513	.375-.385	.250-.256	33.5	31.5	26.0	24.5	23.5	22.0	22.0	21.0	20.5	20.5	20.0	19.5	*
0.37	.487-.499	.366-.374	.244-.249	33.0	31.5	25.5	24.5	23.5	22.0	22.0	21.0	20.5	20.5	20.0	19.5	*
0.36	.474-.486	.355-.365	.237-.243	33.0	31.0	25.5	24.5	23.5	22.0	21.5	21.0	20.5	20.5	20.0	19.5	*
0.35	.461-.473	.346-.354	.231-.236	33.0	31.0	25.5	24.5	23.5	22.0	21.5	21.0	20.5	20.5	20.0	19.5	*
0.34	.447-.460	.335-.345	.224-.230	32.5	31.0	25.0	24.0	23.0	21.5	21.5	20.5	20.0	20.0	19.5	19.0	*
0.33	.434-.446	.326-.334	.217-.223	32.5	30.5	25.0	24.0	23.0	21.5	21.5	20.5	20.0	19.5	19.0	19.0	*
0.32	.420-.433	.315-.325	.210-.216	32.5	30.5	25.0	24.0	23.0	21.5	21.0	20.5	20.0	19.5	19.0	18.5	*
0.31	.407-.419	.306-.314	.204-.209	32.0	30.5	25.0	23.5	22.5	21.5	21.0	20.5	20.0	19.5	19.0	18.5	*
0.30	.394-.406	.295-.305	.197-.203	32.0	30.0	24.5	23.5	22.5	21.0	21.0	20.0	19.5	19.5	19.0	18.5	*
0.29	.381-.393	.286-.294	.191-.196	31.5	30.0	24.5	23.5	22.5	21.0	20.5	20.0	19.5	19.5	19.0	18.5	*
0.28	.367-.380	.275-.285	.184-.190	31.5	29.5	24.5	23.0	22.5	21.0	20.5	20.0	19.5	19.0	18.5	18.5	*
0.27	.354-.366	.266-.274	.177-.183	31.0	29.5	24.0	23.0	22.0	20.5	20.5	19.5	19.0	18.5	18.0	18.0	*
0.26	.340-.353	.255-.265	.170-.176	31.0	29.0	24.0	23.0	22.0	20.5	20.5	19.5	19.0	18.5	18.0	17.5	*
0.25	.327-.339	.246-.254	.164-.169	30.5	29.0	23.5	22.5	22.0	20.5	20.0	19.5	19.0	18.5	18.0	17.5	*
0.24	.314-.326	.235-.245	.157-.163	30.5	29.0	23.5	22.5	21.5	20.0	20.0	19.0	19.0	18.5	18.0	18.0	*
0.23	.301-.313	.226-.234	.151-.156	30.0	28.5	23.5	22.5	21.5	20.0	20.0	19.0	18.5	18.0	17.5	17.5	*
0.22	.287-.300	.215-.225	.144-.150	30.0	28.5	23.0	22.0	21.0	20.0	19.5	19.0	18.5	18.0	17.5	17.5	*
0.21	.274-.286	.206-.214	.137-.143	29.5	28.0	23.0	22.0	21.0	20.0	18.5	18.5	17.5	17.0	16.5	16.5	*
0.20	.260-.273	.195-.205	.130-.136	29.5	27.5	22.5	21.5	21.0	19.5	19.5	18.5	18.0	18.0	17.5	17.0	*
0.19	.247-.259	.186-.194	.124-.129	29.0	27.5	22.5	21.5	20.5	19.5	19.0	18.5	18.0	17.5	17.5	17.0	*
0.18	.234-.246	.175-.185	.117-.123	29.0	27.0	22.0	21.5	20.5	19.0	18.0	17.5	17.0	16.5	16.0	15.5	*
0.17	.221-.233	.166-.174	.111-.116	28.5	27.0	22.0	21.0	20.0	19.0	18.5	18.0	17.5	17.0	16.5	16.0	*

APPENDIX D METRIC TABLES

The following tables provide the metric equivalents of English values for dimensions, weights, and test pressures.

METRIC TABLE 6.2
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²

1		2		3		4		5		6		7		8		9	
Size		Plain-End Weight, w_{pe}		Wall Thickness t		Inside Diameter, d		Grade A		Grade B		Test Pressure, 100 kPa min.		Grade A25			
Nom. in.	Design- nation	Outside Diameter, D	lb/ft	kg/m	in.	mm	in.	mm	Std	Alt.	Std	Alt.	Std	Alt.	Std	Alt.	
1/8	Std	0.405	10.3	0.24	0.36	0.068	1.7	0.269	6.9	48	---	48	---	48	---	48	
1/8	XS	0.405	10.3	0.31	0.47	0.095	2.4	0.215	5.5	59	---	59	---	59	---	59	
1/4	Std	0.540	13.7	0.42	0.62	0.088	2.2	0.364	9.3	48	---	48	---	48	---	48	
1/4	XS	0.540	13.7	0.54	0.79	0.119	3.0	0.302	7.7	59	---	59	---	59	---	59	
5/16	Std	0.675	17.1	0.57	0.84	0.091	2.3	0.493	12.5	48	---	48	---	48	---	48	
5/16	XS	0.675	17.1	0.74	1.10	0.126	3.2	0.423	10.7	59	---	59	---	59	---	59	
1/2	Std	0.840	21.3	0.85	1.28	0.109	2.8	0.622	15.7	48	---	48	---	48	---	48	
1/2	XS	0.840	21.3	1.09	1.61	0.147	3.7	0.546	13.9	59	---	59	---	59	---	59	
1/2	XXS	0.840	21.3	1.71	2.55	0.294	7.5	0.252	6.3	69	---	69	---	69	---	69	
5/8	Std	1.050	26.7	1.13	1.70	0.113	2.9	0.824	20.9	48	---	48	---	48	---	48	
5/8	XS	1.050	26.7	1.47	2.19	0.154	3.9	0.742	18.9	59	---	59	---	59	---	59	
5/8	XXS	1.050	26.7	2.44	3.64	0.308	7.8	0.434	11.1	69	---	69	---	69	---	69	
1	Std	1.315	33.4	1.68	2.52	0.133	3.4	1.049	26.6	48	---	48	---	48	---	48	
1	XS	1.315	33.4	2.17	3.21	0.179	4.5	0.957	24.4	59	---	59	---	59	---	59	
1	XXS	1.315	33.4	3.66	5.45	0.358	9.1	0.599	15.2	69	---	69	---	69	---	69	
1 1/4	Std	1.660	42.2	2.27	3.43	0.140	3.6	1.380	35.0	83	---	90	---	69	---	69	
1 1/4	XS	1.660	42.2	3.00	4.51	0.191	4.9	1.278	32.4	124	---	131	---	90	---	90	
1 1/4	XXS	1.660	42.2	5.21	7.77	0.382	9.7	0.896	22.8	152	---	158	---	96	---	96	
1 1/2	Std	1.900	48.3	2.72	4.07	0.145	3.7	1.610	40.9	83	---	90	---	69	---	69	
1 1/2	XS	1.900	48.3	3.63	5.43	0.200	5.1	1.500	38.1	124	---	131	---	90	---	90	
1 1/2	XXS	1.900	48.3	6.41	9.58	0.400	10.2	1.100	27.9	152	---	158	---	96	---	96	

METRIC TABLE 6.2 (Continued)
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²

METRIC TABLE 6.2 (Continued)
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²

METRIC TABLE 6.2 (Continued)
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²

METRIC TABLE 6.2 (Continued)
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Size: Outside Diameter, <i>D</i>	Plain End Weight, <i>w_{pe}</i>	Wall Thickness, <i>t</i>	Inside Diameter, <i>d</i>	Grade A		Grade B		Grade X42	Grade X46	Grade X52	Grade X56	Grade X60	Grade X65	Grade X70	Grade X80
in.	mm	lb/ft	kg/m	in.	mm	mm	Std.	Alt.	Std.	Alt.					
*12 ^{1/4}	323.9	23.11	34.67	0.172	4.4	315.1	34	42	39	49	66	72	82	88	95
*12 ^{1/4}	323.9	25.22	37.77	0.188	4.8	314.3	37	45	43	53	72	79	90	96	103
*12 ^{1/4}	323.9	27.20	40.87	0.203	5.2	313.5	---	---	---	---	79	86	97	105	112
*12 ^{1/4}	323.9	29.31	43.96	0.219	5.6	312.7	43	53	50	62	85	92	105	113	121
12 ^{1/4}	323.9	33.38	50.11	0.250	6.4	311.1	49	61	56	71	96	105	119	129	138
12 ^{1/4}	323.9	37.42	55.47	0.281	7.1	309.7	54	68	64	80	108	119	134	145	155
12 ^{1/4}	323.9	41.45	61.56	0.312	7.9	308.1	61	76	71	88	121	132	149	161	172
12 ^{1/4}	323.9	43.77	65.35	0.330	8.4	307.1	64	80	75	94	127	139	158	169	182
12 ^{1/4}	323.9	45.58	67.62	0.344	8.7	306.5	67	83	78	98	133	145	165	177	189
12 ^{1/4}	323.9	49.56	73.65	0.375	9.5	304.9	73	91	85	106	145	158	179	193	207
12 ^{1/4}	323.9	53.52	79.65	0.406	10.3	303.3	---	---	---	---	156	172	194	207	207
12 ^{1/4}	323.9	57.59	85.62	0.438	11.1	301.7	85	107	99	124	169	185	207	207	207
12 ^{1/4}	323.9	65.42	97.46	0.500	12.7	298.5	---	---	---	193	207	207	207	207	207
12 ^{1/4}	323.9	73.15	109.18	0.562	14.3	295.3	110	136	127	159	207	207	207	207	207
12 ^{1/4}	323.9	80.93	120.76	0.625	15.9	292.1	121	152	142	177	207	207	207	207	207
12 ^{1/4}	323.9	88.63	132.23	0.688	17.5	288.9	134	167	156	193	207	207	207	207	207
12 ^{1/4}	323.9	96.12	143.56	0.750	19.1	285.7	146	183	170	193	207	207	207	207	207
12 ^{1/4}	323.9	103.53	154.08	0.812	20.6	282.7	158	193	184	193	207	207	207	207	207
12 ^{1/4}	323.9	110.97	165.17	0.875	22.2	279.5	170	193	193	207	207	207	207	207	207
12 ^{1/4}	323.9	118.33	176.13	0.938	23.8	276.3	183	193	193	207	207	207	207	207	207
12 ^{1/4}	323.9	125.49	186.97	1.000	25.4	273.1	193	193	193	207	207	207	207	207	207
12 ^{1/4}	323.9	132.57	197.68	1.062	27.0	269.9	193	193	193	207	207	207	207	207	207
12 ^{1/4}	323.9	139.67	208.27	1.125	28.6	266.7	193	193	193	207	207	207	207	207	207
12 ^{1/4}	323.9	153.53	229.06	1.250	31.8	260.3	193	193	193	207	207	207	207	207	207
*14	355.6	27.73	41.52	0.188	4.8	346.0	33	41	39	48	66	72	82	88	94
*14	355.6	29.91	44.93	0.203	5.2	345.2	36	45	42	52	---	---	---	---	---
*14	355.6	30.93	45.78	0.210	5.3	345.0	---	---	---	74	81	92	99	105	114
*14	355.6	32.23	48.33	0.219	5.6	344.4	---	---	---	77	84	95	103	110	119
*14	355.6	36.71	55.11	0.250	6.4	342.8	44	55	52	65	88	96	109	117	125
*14	355.6	41.17	61.02	0.281	7.1	341.4	50	62	58	72	99	108	122	132	141
14	355.6	45.61	67.74	0.312	7.9	339.8	55	69	65	81	110	120	136	146	156
14	355.6	50.17	74.42	0.344	8.7	338.2	61	76	71	89	121	132	150	161	173
14	355.6	54.57	81.08	0.375	9.5	336.6	66	83	77	97	132	144	163	176	188
14	355.6	58.94	87.71	0.406	10.3	335.0	---	---	---	143	156	176	190	204	207
14	355.6	63.44	94.30	0.438	11.1	333.4	78	97	90	113	154	169	191	205	207
14	355.6	67.78	100.86	0.469	11.9	331.8	---	---	---	165	181	204	207	207	207
14	355.6	72.09	107.39	0.500	12.7	330.2	89	111	103	130	176	192	207	207	207
14	355.6	80.66	120.36	0.562	14.3	327.0	100	125	116	145	198	207	207	207	207
14	355.6	89.28	133.19	0.625	15.9	323.8	111	138	130	161	207	207	207	207	207
14	355.6	97.81	145.91	0.688	17.5	320.6	122	152	142	178	207	207	207	207	207
14	355.6	106.13	158.49	0.750	19.1	317.4	133	166	155	193	207	207	207	207	207
14	355.6	114.37	170.18	0.812	20.6	314.4	144	180	168	193	207	207	207	207	207
14	355.6	122.65	182.52	0.875	22.2	311.2	155	193	181	193	207	207	207	207	207
14	355.6	130.85	194.74	0.938	23.8	308.0	166	193	193	207	207	207	207	207	207
14	355.6	138.84	206.83	1.000	25.4	304.8	177	193	193	207	207	207	207	207	207
14	355.6	146.74	218.79	1.062	27.0	301.6	189	193	193	207	207	207	207	207	207
14	355.6	154.69	230.63	1.125	28.6	298.4	193	193	193	207	207	207	207	207	207
14	355.6	170.21	253.31	1.250	31.8	292.1	193	193	193	207	207	207	207	207	207
*16	406.4	31.75	47.54	0.188	4.8	396.8	29	37	34	43	58	63	72	77	83
*16	406.4	34.25	51.45	0.203	5.2	396.0	32	39	37	46	63	68	77	83	96
*16	406.4	36.91	55.35	0.219	5.6	395.2	34	43	39	50	68	74	83	90	104
*16	406.4	42.05	63.13	0.250	6.4	393.6	39	48	45	56	77	84	95	103	119
*16	406.4	47.17	69.91	0.281	7.1	392.2	43	54	51	63	86	94	107	115	134
16	406.4	52.27	77.63	0.312	7.9	390.6	48	61	56	70	96	105	119	128	144
16	406.4	57.52	85.32	0.344	8.7	389.0	53	67	62	78	106	116	131	141	164
16	406.4	62.58	92.98	0.375	9.5	387.4	58	72	68	85	115	126	143	154	178
16	406.4	67.62	100.61	0.406	10.3	385.8	---	---	---	125	136	154	167	178	193
16	406.4	72.80	108.20	0.438	11.1	384.2	68	85	79	99	134	147	167	180	192
16	406.4	77.79	115.77	0.469	11.9	382.6	---	---	---	144	158	178	192	206	207
16	406.4	82.77	123.30	0.500	12.7	381.0	77	97	90	113	154	168	190	205	207
16	406.4	92.66	138.27	0.562	14.3	377.8	87	109	102	127	173	189	207	207	207
16	406.4	102.63	153.11	0.625	15.9	374.6	97	121	113	141	192	207	207	207	207
16	406.4	112.51	167.83	0.688	17.5	371.4	107	134	125	156	207	207	207	207	207
16	406.4	122.15	182.42	0.750	19.1	368.2	116	145	136	169	207	207	207	207	207
16	406.4	131.71	195.98	0.812	20.6	365.2	126	157	147	183	207	207	207	207	207
16	406.4	141.34	210.33	0.875	22.2	362.0	136	169	158	193	207	207	207	207	207
16	406.4	150.89	224.55	0.938	23.8	358.8	145	182	169	193	207	207	207	207	207

METRIC TABLE 6.2 (Continued)
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²

Size: Outside Diameter, <i>D</i> in. mm	Plain End Weight, <i>w_{pe}</i> lb/ft kg/m	Wall Thickness, <i>t</i> in. mm	Inside Diameter, <i>d</i> mm	†Minimum Test Pressure, kPa × 100															
				Grade A		Grade B		Grade X42		Grade X46		Grade X52		Grade X56		Grade X60		Grade X65	
				Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.
16	406.4	160.20	238.64	1.000	25.4	355.6	155	193	181	193	207	207	207	207	207	207	207	207	207
16	406.4	169.43	252.61	1.062	27.0	352.4	165	193	192	193	207	207	207	207	207	207	207	207	207
16	406.4	178.22	266.45	1.125	28.6	349.2	174	193	193	193	207	207	207	207	207	207	207	207	207
16	406.4	187.93	280.17	1.188	30.2	346.0	185	193	193	193	207	207	207	207	207	207	207	207	207
16	406.4	196.91	293.76	1.250	31.8	342.8	193	193	193	193	207	207	207	207	207	207	207	207	207
*18	457.0	35.76	53.53	0.188	4.8	447.4	26	32	30	38	52	56	63	68	74	79	85	85	**
*18	457.0	41.59	62.34	0.219	5.6	445.8	30	38	35	44	60	65	74	80	85	92	100	100	**
*18	457.0	47.39	71.12	0.250	6.4	444.2	34	43	40	50	68	75	85	91	98	105	114	114	**
*18	457.0	53.18	78.77	0.281	7.1	442.8	39	48	45	56	76	84	95	103	110	119	128	128	**
18	457.0	58.94	87.49	0.312	7.9	441.2	43	54	50	63	85	94	105	114	122	132	142	142	**
18	457.0	64.87	96.18	0.344	8.7	439.6	48	59	55	69	94	103	116	125	134	145	156	156	**
18	457.0	70.59	104.84	0.375	9.5	438.0	52	65	61	75	103	112	127	136	146	158	171	185	**
18	457.0	76.29	113.46	0.406	10.3	436.4	-----	-----	-----	111	121	137	148	158	172	185	200	200	**
18	457.0	82.15	122.05	0.438	11.1	434.8	61	76	70	88	120	131	148	160	171	185	207	207	**
18	457.0	87.81	130.62	0.469	11.9	433.2	-----	-----	-----	128	141	158	171	183	198	207	207	207	**
18	457.0	93.45	139.15	0.500	12.7	431.6	69	86	81	101	136	150	169	182	195	207	207	207	**
18	457.0	104.67	156.11	0.562	14.3	428.4	77	96	90	113	154	168	190	205	207	207	207	207	**
18	457.0	115.98	172.95	0.625	15.9	425.2	86	107	101	125	171	187	207	207	207	207	207	207	**
18	457.0	127.21	189.67	0.688	17.5	422.0	95	119	111	138	188	206	207	207	207	207	207	207	**
18	457.0	138.17	206.25	0.750	19.1	418.8	103	130	121	151	205	207	207	207	207	207	207	207	**
18	457.0	149.06	221.69	0.812	20.6	415.8	112	140	130	163	207	207	207	207	207	207	207	207	**
18	457.0	160.03	238.03	0.875	22.2	412.6	121	151	141	176	207	207	207	207	207	207	207	207	**
18	457.0	170.92	254.25	0.938	23.8	409.4	130	161	151	189	207	207	207	207	207	207	207	207	**
18	457.0	181.56	270.34	1.000	25.4	406.2	138	172	161	193	207	207	207	207	207	207	207	207	**
18	457.0	192.11	286.30	1.062	27.0	403.0	146	183	171	193	207	207	207	207	207	207	207	207	**
18	457.0	202.75	302.14	1.125	28.6	399.8	155	193	181	207	207	207	207	207	207	207	207	207	**
18	457.0	213.31	317.85	1.188	30.2	396.6	163	193	191	193	207	207	207	207	207	207	207	207	**
18	457.0	223.61	333.44	1.250	31.8	393.4	172	193	193	207	207	207	207	207	207	207	207	207	**
*20	508.0	46.27	69.38	0.219	5.6	496.8	27	34	32	39	57	63	71	77	82	89	96	109	**
*20	508.0	52.73	79.16	0.250	6.4	495.2	31	39	36	45	66	72	81	88	94	102	121	121	**
*20	508.0	59.18	87.70	0.281	7.1	493.8	35	43	41	51	73	80	90	97	104	113	135	135	**
20	508.0	65.60	97.43	0.312	7.9	492.2	39	48	45	56	81	89	100	108	116	125	149	149	**
20	508.0	72.21	107.12	0.344	8.7	490.6	43	53	50	62	89	98	111	119	128	138	162	162	**
20	508.0	78.60	116.78	0.375	9.5	489.0	47	58	54	68	97	107	121	130	139	151	164	176	**
20	508.0	84.96	126.41	0.406	10.3	487.4	-----	-----	-----	106	116	131	141	151	163	176	190	190	**
20	508.0	91.51	136.01	0.438	11.1	485.8	54	68	63	79	114	125	141	152	163	174	189	204	**
20	508.0	97.83	145.58	0.469	11.9	484.2	-----	-----	-----	122	134	151	161	174	186	202	207	207	**
20	508.0	104.13	155.12	0.500	12.7	482.6	62	77	72	90	130	143	161	174	186	202	207	207	**
20	508.0	116.67	174.10	0.562	14.3	479.4	70	87	81	102	147	161	182	196	207	207	207	207	**
20	508.0	129.33	192.95	0.625	15.9	476.2	77	97	90	113	163	179	202	202	207	207	207	207	**
20	508.0	141.90	211.68	0.688	17.5	473.0	85	107	99	125	180	197	207	207	207	207	207	207	**
20	508.0	154.19	230.27	0.750	19.1	469.8	93	116	109	136	196	207	207	207	207	207	207	207	**
20	508.0	166.40	247.60	0.812	20.6	466.8	101	126	118	147	207	207	207	207	207	207	207	207	**
20	508.0	178.72	265.95	0.875	22.2	463.6	109	136	127	158	207	207	207	207	207	207	207	207	**
20	508.0	190.96	284.18	0.938	23.8	460.4	116	145	136	169	207	207	207	207	207	207	207	207	**
20	508.0	202.92	302.28	1.000	25.4	457.2	124	155	145	181	207	207	207	207	207	207	207	207	**
20	508.0	214.80	320.26	1.062	27.0	454.0	132	165	154	189	207	207	207	207	207	207	207	207	**
20	508.0	226.78	338.11	1.125	28.6	450.8	139	174	162	189	207	207	207	207	207	207	207	207	**
20	508.0	238.68	355.83	1.188	30.2	447.6	147	184	172	189	207	207	207	207	207	207	207	207	**
20	508.0	250.31	373.43	1.250	31.8	444.4	155	189	181	189	207	207	207	207	207	207	207	207	**
20	508.0	261.86	389.81	1.312	33.3	441.4	162	189	189	207	207	207	207	207	207	207	207	207	**
20	508.0	273.51	407.17	1.375	34.9	438.2	171	189	189	207	207	207	207	207	207	207	207	207	**
*22	559.0	50.94	76.42	0.219	5.6	547.8	25	31	29	36	52	57	65	70	75	81	87	99	**
*22	559.0	58.07	87.21	0.250	6.4	546.2	28	35	33	41	60	65	74	80	85	92	99	110	**
*22	559.0	65.18	96.63	0.281	7.1	544.8	32	39	37	46	66	73	82	88	95	102	114	123	**
22	559.0	72.27	107.36	0.312	7.9	543.2	35	44	41	51	74	81	91	98	105	114	126	135	**
22	559.0	79.56	118.06	0.344	8.7	541.6	39	48	45	56	81	89	97	110	118	127	137	148	**
22	559.0	86.61	128.73	0.375	9.5	540.0													

METRIC TABLE 6.2 (Continued)
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
+Minimum Test Pressure, kPa × 100															
Size: Outside Diameter, <i>D</i>	Plain End Weight, <i>w_p</i>	Wall Thickness, <i>t</i>	Inside Diameter, <i>d</i>	Grade A	Grade B	Grade X42	Grade X46	Grade X52	Grade X56	Grade X60	Grade X65	Grade X70	Grade X80	Grade X70	Grade X80
in.	mm	lb/ft	kg/m	in.	mm	mm	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.
22	559.0	197.41	293.87	0.875	22.2	514.6	99	123	115	144	207	207	207	207	207
22	559.0	211.00	314.11	0.938	23.8	511.4	105	132	123	154	207	207	207	207	207
22	559.0	224.28	334.23	1.000	25.4	508.2	113	141	132	165	207	207	207	207	207
22	559.0	237.48	354.22	1.062	27.0	505.0	120	150	140	172	207	207	207	207	207
22	559.0	250.81	374.08	1.125	28.6	501.8	127	158	148	172	207	207	207	207	207
22	559.0	264.06	393.81	1.188	30.2	498.6	134	167	156	172	207	207	207	207	207
22	559.0	277.01	413.42	1.250	31.8	495.4	141	172	165	172	207	207	207	207	207
22	559.0	289.88	431.69	1.312	33.3	492.4	148	172	172	172	207	207	207	207	207
22	559.0	302.88	451.06	1.375	34.9	489.2	155	172	172	172	207	207	207	207	207
22	559.0	315.79	470.30	1.438	36.5	486.0	162	172	172	172	207	207	207	207	207
22	559.0	328.41	489.41	1.500	38.1	482.8	169	172	172	172	207	207	207	207	207
*24	610.0	63.41	95.26	0.250	6.4	597.2	26	32	30	38	55	60	68	73	78
*24	610.0	71.18	105.56	0.281	7.1	595.8	29	37	34	42	61	66	75	81	87
24	610.0	78.93	117.30	0.312	7.9	594.2	32	40	38	47	68	74	84	90	96
24	610.0	86.91	129.00	0.344	8.7	592.6	36	44	41	52	74	81	92	99	106
24	610.0	94.62	140.68	0.375	9.5	591.0	39	48	45	56	81	89	101	108	116
24	610.0	102.31	152.32	0.406	10.3	589.4	-	-	-	-	88	96	109	117	126
24	610.0	110.22	163.93	0.438	11.1	587.8	45	56	53	66	95	104	117	126	136
24	610.0	117.86	175.51	0.469	11.9	586.2	-	-	-	-	102	111	126	136	147
24	610.0	125.49	187.06	0.500	12.7	584.6	52	65	61	75	109	119	134	145	155
24	610.0	140.68	210.07	0.562	14.3	581.4	58	72	68	85	122	134	151	163	175
24	610.0	156.03	232.94	0.625	15.9	578.2	65	81	75	94	136	149	168	181	194
24	610.0	171.29	255.69	0.688	17.5	575.0	71	89	83	103	150	164	185	199	207
24	610.0	186.23	278.32	0.750	19.1	571.8	77	97	90	113	163	179	202	207	207
24	610.0	201.09	299.41	0.812	20.6	568.8	84	105	98	123	176	193	207	207	207
24	610.0	216.10	321.79	0.875	22.2	565.6	90	113	105	132	190	207	207	207	207
24	610.0	231.03	344.05	0.938	23.8	562.4	97	121	113	141	203	207	207	207	207
24	610.0	245.64	366.17	1.000	25.4	559.2	103	130	121	151	207	207	207	207	207
24	610.0	260.17	388.17	1.062	27.0	556.0	110	137	128	158	207	207	207	207	207
24	610.0	274.84	410.05	1.125	28.6	552.8	116	145	136	158	207	207	207	207	207
24	610.0	289.44	431.80	1.188	30.2	549.6	123	154	143	158	207	207	207	207	207
24	610.0	303.71	453.42	1.250	31.8	546.4	130	158	151	158	207	207	207	207	207
24	610.0	317.91	473.57	1.312	33.3	543.4	136	158	158	207	207	207	207	207	207
24	610.0	332.25	494.95	1.375	34.9	540.2	142	158	158	207	207	207	207	207	207
24	610.0	346.50	516.20	1.438	36.5	537.0	149	158	158	207	207	207	207	207	207
24	610.0	360.45	537.33	1.500	38.1	533.8	155	158	158	207	207	207	207	207	207
24	610.0	374.31	558.32	1.562	39.7	530.6	158	158	158	207	207	207	207	207	207
*26	660.0	68.75	103.15	0.250	6.4	647.2	24	30	28	34	51	55	63	67	72
*26	660.0	77.18	114.31	0.281	7.1	645.8	27	34	31	39	56	61	69	75	80
26	660.0	85.60	127.04	0.312	7.9	644.2	30	37	34	43	62	68	77	83	89
26	660.0	94.26	139.73	0.344	8.7	642.6	33	41	39	48	69	75	85	92	98
26	660.0	102.63	152.39	0.375	9.5	641.0	36	45	42	52	75	82	93	100	107
26	660.0	110.98	165.02	0.406	10.3	639.4	-	-	-	-	81	89	101	108	116
26	660.0	119.57	177.62	0.438	11.1	637.8	42	52	49	61	88	96	109	117	125
26	660.0	127.88	190.19	0.469	11.9	636.2	-	-	-	-	94	103	116	125	134
26	660.0	136.17	202.72	0.500	12.7	634.6	48	60	56	70	100	110	124	134	143
26	660.0	152.68	227.70	0.562	14.3	631.4	54	67	63	78	113	124	140	151	161
26	660.0	169.38	252.55	0.625	15.9	628.2	60	74	70	87	126	138	155	167	179
26	660.0	185.99	277.27	0.688	17.5	625.0	65	82	76	96	138	151	171	184	197
26	660.0	202.25	301.87	0.750	19.1	621.8	72	90	83	104	151	165	187	201	207
26	660.0	218.43	324.81	0.812	20.6	618.8	77	97	90	113	163	178	201	207	207
26	660.0	234.79	349.16	0.875	22.2	615.6	83	104	97	122	175	192	207	207	207
26	660.0	251.07	373.39	0.938	23.8	612.4	90	112	105	130	188	206	207	207	207
26	660.0	267.00	397.49	1.000	25.4	609.2	95	119	112	138	201	207	207	207	207
*28	711.0	74.09	111.20	0.250	6.4	698.2	22	28	25	32	47	51	58	62	66
*28	711.0	83.19	123.24	0.281	7.1	696.8	25	31	29	37	52	57	65	70	74
28	711.0	92.26	136.97	0.312	7.9	695.2	28	34	32	40	58	63	72	77	83
28	711.0	101.61	150.67	0.344	8.7	693.6	-	-	-	-	64	70	79	85	92
28	711.0	110.64	164.34	0.375	9.5	692.0	33	41	39	48	76	83	94	101	108
28	711.0	119.65	177.98	0.406	10.3	690.4	-	-	-	-	81	90	101	109	116
28	711.0	128.93	191.58	0.438	11.1	688.8	39	48	45	56	81	90	101	109	116
28	711.0	137.90	205.15	0.469	11.9	687.2	-	-	-	-	88	96	108	116	125
28	711.0	146.85	218.69	0.500	12.7	685.6	44	55	52	65	93	102	115	124	133
28	711.0	164.69	245.68	0.562	14.3	682.4	50	62	58	72	105	114	130	139	150
28	711.0	182.73	272.54	0.625	15.9	679.2	55	69	65	81	116	127	144	155	166
28	711.0	200.68	299.28	0.688	17.5	676.0	61	76	71	89	128	140	158	171	183
28	711.0	218.27	325.89	0.750	19.1	672.8	66	83	77	97	139	153	173	186	199

METRIC TABLE 6.2 (Continued)
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²

METRIC TABLE 6.2 (Continued)
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²

Size: Outside Diameter, <i>D</i> in	Plain End Weight, <i>w_{pe}</i>		Wall Thickness, <i>t</i> mm	Inside Diameter, <i>d</i> mm	†Minimum Test Pressure, kPa × 100																	
					Grade A		Grade B		Grade X42		Grade X46		Grade X52		Grade X56		Grade X60		Grade X65		Grade X70	
	in	mm	lb/ft	kg/m	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.
.36	914.0	95.45	143.24	0.250	6.4	901.2	17	21	20	25	36	40	45	48	52	56	61	66	
.36	914.0	107.20	158.79	0.281	7.1	899.8	19	24	23	28	41	45	50	54	58	63	68	72	
36	914.0	118.92	176.52	0.312	7.9	898.2	21	27	25	31	45	50	56	60	65	70	75	
36	914.0	131.00	194.22	0.344	8.7	896.6	50	54	61	66	71	77	83	
36	914.0	142.68	211.90	0.375	9.5	895.0	26	32	30	38	54	59	68	72	77	84	90	
36	914.0	154.34	229.54	0.406	10.3	893.4	59	64	73	79	85	90	98	105	
36	914.0	166.35	247.15	0.438	11.1	891.8	30	38	35	44	63	70	79	
36	914.0	177.97	264.72	0.469	11.9	890.2	68	74	84	90	97	105	113	
36	914.0	189.57	282.27	0.500	12.7	888.6	34	43	40	50	72	79	
36	914.0	212.70	317.27	0.562	14.3	885.4	39	48	45	56	81	89	101	108	116	125	136	
36	914.0	236.13	352.14	0.625	15.9	882.2	43	54	50	63	90	99	112	121	130	140	151	
36	914.0	259.47	386.88	0.688	17.5	879.0	48	59	55	69	99	109	123	133	142	154	166	
36	914.0	282.35	421.50	0.750	19.1	875.8	52	65	61	75	109	119	134	145	155	168	181	
36	914.0	305.16	453.84	0.812	20.6	872.8	56	70	65	81	118	129	145	156	168	182	196	
36	914.0	328.24	488.22	0.875	22.2	869.6	61	75	70	88	127	138	157	169	181	196	
36	914.0	351.25	522.47	0.938	23.8	866.4	65	81	75	94	136	149	168	181	194	207	207	
36	914.0	373.80	556.59	1.000	25.4	863.2	69	86	81	101	145	158	179	193	207	207	
36	914.0	396.27	590.58	1.062	27.0	860.0	73	92	85	107	154	168	190	205	207	207	
36	914.0	419.02	624.45	1.125	28.6	856.8	78	97	90	113	163	178	202	207	207	207	
36	914.0	441.69	658.19	1.188	30.2	853.6	82	102	96	119	172	188	207	207	207	207	
36	914.0	463.91	691.81	1.250	31.8	850.4	86	107	101	125	181	198	207	207	207	207	
38	965.0	125.58	186.46	0.312	7.9	949.2	21	25	23	30	43	47	53	57	61	66	71	
38	965.0	138.35	205.17	0.344	8.7	947.6	23	28	26	33	47	52	59	63	68	73	79	
38	965.0	150.69	223.84	0.375	9.5	946.0	25	30	28	36	52	56	63	68	74	79	85	
38	965.0	163.01	242.49	0.406	10.3	944.4	26	33	31	39	56	61	69	74	79	86	93	
38	965.0	175.71	261.11	0.438	11.1	942.8	28	36	33	42	60	65	70	80	85	93	100	
38	965.0	187.99	279.69	0.469	11.9	941.2	30	39	36	45	64	70	80	85	92	99	107	
38	965.0	200.25	298.24	0.500	12.7	939.6	32	41	38	48	68	75	85	92	98	106	114	
38	965.0	224.71	335.25	0.562	14.3	936.4	37	46	43	54	77	84	95	103	110	119	128	
38	965.0	249.48	372.14	0.625	15.9	933.2	41	51	48	59	85	94	106	107	123	132	143	
38	965.0	274.16	408.89	0.688	17.5	930.0	45	56	52	65	94	103	116	126	135	146	157	
38	965.0	298.37	445.52	0.750	19.1	926.8	49	61	57	72	103	112	127	137	147	159	172	
38	965.0	322.50	479.75	0.812	20.6	923.8	53	66	62	77	112	122	138	148	159	172	185	
38	965.0	346.93	516.14	0.875	22.2	920.6	57	72	67	83	120	132	149	160	172	185	200	
38	965.0	371.28	552.40	0.938	23.8	917.4	61	76	72	90	129	141	159	172	184	199	207	
38	965.0	395.16	588.53	1.000	25.4	914.2	65	81	76	95	137	150	169	183	196	207	207	
38	965.0	418.96	624.54	1.062	27.0	911.0	70	87	81	101	145	159	181	194	207	207	207	
38	965.0	443.05	660.42	1.125	28.6	907.8	74	92	85	107	154	169	191	205	207	207	207	
38	965.0	467.08	696.18	1.188	30.2	904.6	78	97	90	113	163	178	202	207	207	207	207	
38	965.0	490.61	731.80	1.250	31.8	901.4	81	102	95	119	172	187	207	207	207	207	207	
40	1016.0	132.25	196.39	0.312	7.9	1000.2	19	24	23	28	41	45	50	54	58	63	68	
40	1016.0	145.69	216.11	0.344	8.7	998.6	21	27	25	31	45	49	55	60	64	70	81	
40	1016.0	158.70	235.79	0.375	9.5	997.0	23	29	27	34	49	54	61	65	70	76	74	
40	1016.0	171.68	255.45	0.406	10.3	995.4	25	32	30	37	53	58	65	70	76	82	88	
40	1016.0	185.06	275.07	0.438	11.1	993.8	27	34	32	39	57	63	70	76	81	88	95	
40	1016.0	198.01	294.66	0.469	11.9	992.2	29	37	34	43	61	67	76	81	88	94	102	
40	1016.0	210.93	314.22	0.500	12.7	990.6	31	39	36	45	65	72	81	87	93	101	109	
40	1016.0	236.71	353.24	0.562	14.3	987.4	35	43	41	51	73	80	91	98	105	113	122	
40	1016.0	262.83	392.13	0.625	15.9	984.2	39	48	45	56	81	89	101	109	116	126	136	
40	1016.0	288.86	430.90	0.688	17.5	981.0	43	53	50	62	90	98	111	119	128	138	150	
40	1016.0	314.39	469.55	0.750	19.1	977.8	47	58	54	68	98	107	121	130	139	151	163	
40	1016.0	339.84	505.66	0.812	20.6	974.8	50	63	59	74	105	116	131	141	151	164	176	
40	1016.0	365.62	544.06	0.875	22.2	971.6	54	68	63	79	114	125	141	152	163	176	190	
40	1016.0	391.32	582.33	0.938	23.8	968.4	58	73	68	85	122	134	151	163	174	189	203	
40	1016.0	416.52	620.48	1.000	25.4	965.2	62	77	72	90	130	143	161	174	186	201	207</					

METRIC TABLE 6.2 (Continued)
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			
Size: Outside Diameter, D in. mm	Plain End Weight, w_{pe} lb/ft kg/m	Wall Thickness, t in. mm	Inside Diameter, d in. mm	Grade A		Grade B		Grade X42	Grade X46	Grade X52	Grade X56	Grade X60	Grade X65	Grade X70	Grade X80			
				Std.	Alt.	Std.	Alt.											
42	1067.0	303.55	452.91	0.688	17.5	1032.0	41	51	48	59	85	94	105	114	122	132	142	..
42	1067.0	330.41	493.57	0.750	19.1	1028.8	44	55	52	65	93	102	115	124	133	144	155	..
42	1067.0	357.19	531.57	0.812	20.6	1025.8	48	60	56	70	101	110	125	134	144	156	168	..
42	1067.0	384.31	571.98	0.875	22.2	1022.6	52	65	61	75	109	119	134	145	155	168	181	..
42	1067.0	411.35	612.26	0.938	23.8	1019.4	55	69	65	81	116	127	144	155	166	180	194	..
42	1067.0	437.88	652.42	1.000	25.4	1016.2	59	74	69	86	124	136	154	165	177	192	207	..
42	1067.0	464.33	692.45	1.062	27.0	1013.0	63	79	73	92	132	144	163	176	188	204	207	..
42	1067.0	491.11	732.36	1.125	28.6	1009.8	66	83	78	97	140	153	173	186	199	207	207	..
42	1067.0	517.82	772.14	1.188	30.2	1006.6	70	88	82	102	147	161	183	196	207	207	207	..
42	1067.0	544.01	811.79	1.250	31.8	1003.4	74	92	86	107	155	169	192	207	207	207	207	..
44	1118.0	160.39	237.99	0.344	8.7	1100.6	19	24	23	28	41	45	50	54	63	68	..	
44	1118.0	174.72	259.69	0.375	9.5	1099.0	21	26	25	31	44	49	55	59	63	69	74	..
44	1118.0	189.03	281.35	0.406	10.3	1097.4	23	29	27	33	48	52	59	64	69	74	80	..
44	1118.0	203.78	302.99	0.438	11.1	1095.8	25	31	29	36	52	56	64	69	74	80	86	..
44	1118.0	218.04	324.59	0.469	11.9	1094.2	26	33	31	39	56	61	69	74	79	86	92	..
44	1118.0	232.29	346.16	0.500	12.7	1092.6	28	35	33	41	59	65	73	79	85	92	99	..
44	1118.0	260.72	389.21	0.562	14.3	1089.4	32	39	37	46	67	73	83	89	95	103	111	..
44	1118.0	289.53	432.13	0.625	15.9	1086.2	35	44	41	52	74	81	92	99	105	114	123	..
44	1118.0	318.25	474.92	0.688	17.5	1083.0	39	48	45	56	81	89	101	109	116	126	136	..
44	1118.0	346.43	517.59	0.750	19.1	1079.8	42	53	50	61	89	97	110	119	127	137	148	..
44	1118.0	374.53	557.47	0.812	20.6	1076.8	45	57	54	67	96	105	119	128	137	149	161	..
44	1118.0	403.00	599.90	0.875	22.2	1073.6	50	61	58	72	103	114	128	138	148	161	173	..
44	1118.0	431.39	642.19	0.938	23.8	1070.4	53	66	62	77	111	122	138	148	158	172	185	..
44	1118.0	459.24	684.37	1.000	25.4	1067.2	56	70	65	82	119	130	147	158	169	183	197	..
44	1118.0	487.01	726.41	1.062	27.0	1064.0	60	75	70	88	125	138	156	167	180	194	207	..
44	1118.0	515.14	768.33	1.125	28.6	1060.8	63	79	74	92	133	146	165	178	190	206	207	..
44	1118.0	543.19	810.12	1.188	30.2	1057.6	67	83	78	98	141	154	174	187	201	207	207	..
44	1118.0	570.71	851.79	1.250	31.8	1054.4	70	88	82	103	148	162	183	197	207	207	207	..
46	1168.0	167.74	248.72	0.344	8.7	1150.6	19	23	21	27	39	43	48	52	56	60	65	..
46	1168.0	182.73	271.40	0.375	9.5	1149.0	20	25	23	30	43	47	52	56	61	65	71	..
46	1168.0	197.70	294.05	0.406	10.3	1147.4	22	28	25	32	46	50	57	61	65	71	76	..
46	1168.0	213.13	316.67	0.438	11.1	1145.8	23	30	28	34	50	54	61	66	71	76	83	..
46	1168.0	228.06	339.26	0.469	11.9	1144.2	25	32	30	37	53	58	65	71	76	82	88	..
46	1168.0	242.97	361.82	0.500	12.7	1142.6	27	34	32	39	56	62	70	76	81	88	94	..
46	1168.0	272.73	406.84	0.562	14.3	1139.4	30	38	35	44	63	70	79	85	91	99	106	..
46	1168.0	302.88	451.73	0.625	15.9	1136.2	34	42	39	49	71	77	88	94	101	110	118	..
46	1168.0	332.95	496.50	0.688	17.5	1133.0	37	46	43	54	78	85	96	104	112	121	130	..
46	1168.0	362.45	541.14	0.750	19.1	1129.8	41	50	47	59	85	93	105	113	121	132	141	..
46	1168.0	391.88	582.87	0.812	20.6	1126.8	44	54	51	64	92	101	114	123	132	143	153	..
46	1168.0	421.69	627.27	0.875	22.2	1123.6	47	59	55	69	99	109	123	132	141	154	165	..
46	1168.0	451.42	671.54	0.938	23.8	1120.4	50	63	59	74	106	116	132	142	152	165	177	..
46	1168.0	480.60	715.68	1.000	25.4	1117.2	54	68	79	113	124	140	151	162	175	189	..	
46	1168.0	509.69	759.70	1.062	27.0	1114.0	57	72	67	83	121	132	149	161	172	186	200	..
46	1168.0	539.17	803.59	1.125	28.6	1110.8	61	76	71	88	127	139	158	170	182	197	207	..
46	1168.0	568.57	847.36	1.188	30.2	1107.6	64	80	74	94	134	147	167	179	192	207	207	..
46	1168.0	597.41	890.99	1.250	31.8	1104.4	68	84	79	99	141	155	175	189	202	207	207	..
48	1219.0	175.08	259.66	0.344	8.7	1201.6	18	22	21	26	37	41	46	50	53	58	62	..
48	1219.0	190.74	283.35	0.375	9.5	1200.0	19	24	23	28	41	45	50	54	58	63	68	..
48	1219.0	206.37	307.01	0.406	10.3	1198.4	21	26	25	30	44	48	54	59	63	68	74	..
48	1219.0	222.49	330.63	0.438	11.1	1196.8	23	28	26	33	48	52	59	63	68	74	79	..
48	1219.0	238.08	354.23	0.469	11.9	1195.2	24	30	28	35	51	56	63	68	73	79	85	..
48	1219.0	253.65	377.79	0.500	12.7	1193.6	26	32	30	38	54	59	68	72	77	84	90	..
48	1219.0	284.73	424.82	0.562	14.3	1190.4	29	37	34	42	61	67	76	81	87	94	102	..
48	1219.0	316.23	471.73	0.625	15.9	1187.2	32	41	38	47	68	74	84	90	97	105	113	..
48	1219.0	347.64	518.51	0.688	17.5	1184.0	36	44	41	52	74	82	92	99	107	116	125	..
48	1219.0	378.47	565.16	0.750	19.1	1180.8	39	48	45	56	81	89	101	109	116	126	136	..
48	1219.0	409.22	608.78	0.812	20.6	1177.8	42	52	49	61	88	96	109	118	126	136	147	..
48	1219.0	440.38	655.19	0.875	22.2	1174.6	45	56	53	66	95	104	118	127	136	147	158	..
48	1219.0	471.46	701.47	0.938	23.8	1171.4	48	61	56	71	102	112	126	136	145	158	169	..
48	1219.0	501.96	747.63	1.000	25.4	1168.2	52	65	61	75	109	119	134	145	155	168	181	..
48	1219.0	532.38	793.56	1.062	27.0	1165.0	55	69	64	80	115	126	143	154	165	178	192	..
48	1219.0																	

METRIC TABLE 6.2 (Continued)
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²

†Minimum Test Pressure, kPa × 100																					
Size: Outside Diameter, <i>D</i>	Plain End Weight, <i>w_{pe}</i>	Wall Thickness, <i>t</i>	Inside Diameter, <i>d</i>	Grade A		Grade B		Grade X42		Grade X46		Grade X52		Grade X56		Grade X60		Grade X65		Grade X70	
				Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.		
	in.	mm	lb/ft	kg/m	in.	mm	mm	Std.	Alt.												
52	1321.0	241.20	358.55	0.438	11.1	1298.8	21	26	24	30	44	48	54	59	63	68	73	73	73	73	73
52	1321.0	258.11	384.16	0.469	11.9	1297.2	22	28	26	32	47	52	58	63	67	73	79	79	80	80	80
52	1321.0	275.01	409.74	0.500	12.7	1295.6	24	30	28	34	50	55	62	67	72	78	83	83	83	83	83
52	1321.0	308.74	460.79	0.562	14.3	1292.4	27	34	31	39	56	61	70	75	81	87	94	94	94	94	94
52	1321.0	342.93	511.72	0.625	15.9	1289.2	30	37	34	43	63	69	78	83	90	97	104	104	104	104	104
52	1321.0	377.03	562.53	0.688	17.5	1286.0	33	41	39	48	69	76	85	92	99	107	115	115	115	115	115
52	1321.0	410.51	613.20	0.750	19.1	1282.8	36	45	42	52	75	82	93	100	107	116	125	125	125	125	125
52	1321.0	443.91	660.60	0.812	20.6	1279.8	39	48	45	56	81	89	101	108	116	126	136	136	136	136	136
52	1321.0	477.76	711.03	0.875	22.2	1276.6	42	52	49	61	88	96	109	117	125	136	146	146	146	146	146
52	1321.0	511.53	761.34	0.938	23.8	1273.4	45	56	52	65	94	103	116	125	134	145	156	156	156	156	156
52	1321.0	544.68	811.52	1.000	25.4	1270.2	48	60	56	70	100	110	124	134	143	155	167	167	167	167	167
52	1321.0	577.75	861.57	1.062	27.0	1267.0	51	63	59	74	106	116	132	142	152	165	177	177	177	177	177
52	1321.0	611.26	911.50	1.125	28.6	1263.8	54	67	63	79	113	123	140	150	161	174	188	188	188	188	188
52	1321.0	644.69	961.30	1.188	30.2	1260.6	56	71	66	83	119	130	147	158	170	184	198	198	198	198	198
52	1321.0	677.51	1010.98	1.250	31.8	1257.4	60	74	70	87	125	137	155	167	179	194	207	207	207	207	207
56	1422.0	222.78	330.91	0.375	9.5	1403.0	17	21	19	24	35	38	43	46	50	54	58	58	58	58	58
56	1422.0	241.06	358.57	0.406	10.3	1401.4	18	23	21	26	38	41	47	50	54	59	63	63	63	63	63
56	1422.0	259.91	386.20	0.438	11.1	1399.8	19	24	23	28	41	45	50	54	58	63	68	68	68	68	68
56	1422.0	278.15	413.80	0.469	11.9	1398.2	21	26	24	30	43	48	54	58	62	68	73	73	73	73	73
56	1422.0	296.37	441.37	0.500	12.7	1396.6	22	28	26	32	47	51	58	62	66	72	78	78	78	78	78
56	1422.0	332.75	496.41	0.562	14.3	1393.4	25	31	29	37	52	57	65	70	74	81	87	87	87	87	87
56	1422.0	369.63	551.32	0.625	15.9	1390.2	28	34	32	41	58	63	72	77	83	90	97	97	97	97	97
56	1422.0	406.42	606.11	0.688	17.5	1387.0	30	38	36	45	64	70	79	85	92	99	107	107	107	107	107
56	1422.0	442.55	660.77	0.750	19.1	1383.8	33	41	39	48	70	76	86	93	100	108	116	116	116	116	116
56	1422.0	478.60	711.9	0.812	20.6	1380.8	36	45	42	52	76	83	94	101	108	117	126	126	126	126	126
56	1422.0	515.14	766.32	0.875	22.2	1377.6	39	48	55	66	81	89	101	108	116	126	136	136	136	136	136
56	1422.0	551.60	820.61	0.938	23.8	1374.4	41	52	48	61	88	96	108	116	125	135	145	145	145	145	145
56	1422.0	587.40	874.78	1.000	25.4	1371.2	44	55	52	65	93	102	115	124	133	144	155	155	155	155	155
56	1422.0	623.12	928.82	1.062	27.0	1368.0	47	24	55	69	99	108	123	132	141	153	165	165	165	165	165
56	1422.0	659.32	982.73	1.125	28.6	1364.8	50	62	58	72	105	114	130	139	150	162	174	174	174	174	174
56	1422.0	695.45	1036.52	1.188	30.2	1361.6	52	65	61	76	110	121	137	147	158	171	184	184	184	184	184
56	1422.0	730.91	1090.18	1.250	31.8	1358.4	55	69	65	81	116	127	144	155	166	180	194	194	194	194	194
60	1524.0	238.80	355.69	0.375	9.5	1505.0	16	19	18	23	32	36	41	43	47	50	54	54	54	54	54
60	1524.0	258.40	384.89	0.406	10.3	1503.4	17	21	19	25	35	39	43	47	50	54	59	59	59	59	59
60	1524.0	278.62	415.00	0.438	11.1	1501.8	18	23	21	26	38	41	47	51	54	59	63	63	63	63	63
60	1524.0	298.19	444.15	0.469	11.9	1500.2	19	24	23	28	41	45	50	54	58	63	68	68	68	68	68
60	1524.0	317.73	473.31	0.500	12.7	1498.6	21	26	24	30	43	48	54	58	62	68	72	72	72	72	72
60	1524.0	356.76	532.38	0.562	14.3	1495.4	23	29	27	34	49	54	61	65	70	76	81	81	81	81	81
60	1524.0	396.33	591.32	0.625	15.9	1492.2	26	32	30	38	54	59	68	72	78	84	90	90	90	90	90
60	1524.0	435.82	650.13	0.688	17.5	1489.0	28	36	33	41	60	65	74	80	85	92	99	99	99	99	99
60	1524.0	474.59	708.82	0.750	19.1	1485.8	31	39	37	45	65	71	81	87	93	101	109	118	118	118	118
60	1524.0	513.29	763.72	0.812	20.6	1482.8	34	42	39	49	70	77	88	94	101	109	118	127	127	127	127
60	1524.0	552.52	822.16	0.875	22.2	1479.6	37	45	42	53	76	83	94	101	109	118	127	136	136	136	136
60	1524.0	591.67	880.48	0.938	23.8	1476.4	39	48	45	56	81	89	101	106	116	126	136	145	145	145	145
60	1524.0	630.12	938.67	1.000	25.4	1473.2	41	52	48	61	87	95	107	116	124	134	143	154	154	154	154
60	1524.0	668.48	995.73	1.062	27.0	1470.0	44	55	51	64	92	101	114	123	132	143	151	163	163	163	163
60	1524.0	707.38	1054.67	1.125	28.6	1466.8	47	58	54	68	98	107	121	130	140	151	163	172	172	172	172
60	1524.0	746.20	1112.48	1.188	30.2	1463.6	49	61	57	72	103	113	127	138	147	160	172	172	172	172	172
60	1524.0	784.31	1170.17	1.250	31.8	1460.4	52	65	61	75	109	119	134	145	155	168	181	181	181	181	181
64	1626.0	254.82	378.70	0.375	9.5	1607.0	14	18	17	21	30	34	38	41	43	48	51	51	51	51	51
64	1626.0	275.75	410.38	0.406	10.3	1605.4	16	20	19	23	33	37	41	44	48	51	55	55	55	55	55
64	1626.0	297.33	442.04	0.438	11.1	1603.8	17	21	20	25	36	39	44	48	51	55	59	59	59	59	59
64	1626.0	318.22	473.66	0.469	11.9	1602.2	18														

METRIC TABLE 6.2 (Continued)
DIMENSIONS¹, WEIGHTS, AND TEST PRESSURES²

Size: Outside Diameter, <i>D</i> in. mm	Plain End Weight, <i>w_{pe}</i> lb/ft kg/m		Wall Thickness, <i>t</i> in. mm	Inside Diameter, <i>d</i> mm	†Minimum Test Pressure, kPa × 100														
					Grade A		Grade B		Grade X42	Grade X46	Grade X52	Grade X56	Grade X60	Grade X65	Grade X70	Grade X80			
	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.	Std.	Alt.			
68 1727.0 338.26 503.30 5.469 11.9 1703.2 17 21 20 25 36 39 45 48 51 56 60 **																			
68 1727.0 360.45 536.89 0.500 12.7 1701.6 18 23 21 27 39 42 48 51 54 59 64 **																			
68 1727.0 404.77 603.96 0.562 14.3 1698.4 21 25 24 27 30 43 47 53 57 61 67 **																			
68 1727.0 449.73 670.91 0.625 15.9 1695.2 23 28 27 33 48 52 59 64 68 74 80 **																			
68 1727.0 494.60 737.73 0.688 17.5 1692.0 25 32 29 37 52 58 65 70 75 81 88 **																			
68 1727.0 538.67 804.43 0.750 19.1 1688.8 28 34 32 40 57 63 71 76 82 89 96 **																			
68 1727.0 582.66 865.84 0.812 20.6 1685.8 30 37 34 43 62 68 77 83 89 96 103 **																			
68 1727.0 627.28 933.30 0.875 22.2 1682.6 32 40 37 47 67 74 83 90 96 104 112 **																			
68 1727.0 671.82 999.62 0.938 23.8 1679.4 34 43 40 50 72 79 89 96 103 111 120 **																			
68 1727.0 715.56 1065.82 1.000 25.4 1676.2 37 45 43 53 76 84 95 102 110 119 127 **																			
68 1727.0 759.22 1131.89 1.062 27.0 1673.0 39 48 45 56 81 89 101 108 116 126 136 **																			
68 1727.0 803.50 1197.84 1.125 28.6 1669.8 41 51 48 60 86 94 107 115 123 134 143 **																			
68 1727.0 847.70 1263.66 1.188 30.2 1666.6 43 54 50 63 91 100 100 113 121 130 141 152 **																			
68 1727.0 891.11 1329.36 1.250 31.8 1663.4 45 57 53 67 96 105 119 127 137 148 160 **																			
72 1829.0 381.81 568.83 0.500 12.7 1803.6 17 21 20 25 37 39 45 48 52 56 61 **																			
72 1829.0 428.78 639.93 0.562 14.3 1800.4 19 24 23 28 41 45 50 54 58 63 68 **																			
72 1829.0 476.43 710.91 0.625 15.9 1797.2 21 27 25 32 45 53 56 60 65 70 75 **																			
72 1829.0 523.99 781.75 0.688 17.5 1794.0 23 30 28 34 50 54 61 66 71 77 83 **																			
72 1829.0 570.71 852.47 0.750 19.1 1790.8 26 32 30 39 54 59 64 73 79 84 **																			
72 1829.0 617.35 918.66 0.812 20.6 1787.8 28 35 33 41 63 68 74 80 90 98 105 **																			
72 1829.0 664.66 989.14 0.875 22.2 1784.6 30 38 35 44 68 74 84 90 97 105 113 **																			
72 1829.0 711.89 1059.49 0.938 23.8 1781.4 32 41 38 47 72 79 90 96 103 112 121 **																			
72 1829.0 758.28 1129.69 1.000 25.4 1778.2 34 43 40 50 77 84 95 103 110 119 128 **																			
72 1829.0 804.59 1199.81 1.062 27.0 1775.0 37 45 43 53 81 89 101 108 116 126 136 **																			
72 1829.0 851.56 1269.78 1.125 28.6 1771.8 39 48 45 56 86 94 106 114 123 133 143 **																			
72 1829.0 898.45 1339.62 1.188 30.2 1768.6 41 51 48 60 90 99 112 121 130 140 151 **																			
72 1829.0 944.51 1409.34 1.250 31.8 1765.4 43 54 50 63 99 112 121 130 140 151 **																			
76 1930.0 403.17 600.46 0.500 12.7 1904.6 17 21 19 24 34 37 43 45 49 53 57 **																			
76 1930.4 452.79 675.55 0.562 14.3 1901.4 19 23 21 27 39 42 48 52 55 60 64 **																			
76 1930.0 503.13 750.51 0.625 15.9 1898.2 21 25 24 30 43 47 53 57 61 66 72 79 **																			
76 1930.0 553.38 825.34 0.688 17.5 1895.0 23 28 26 33 47 52 56 63 68 74 79 85 **																			
76 1930.0 602.75 900.05 0.750 19.1 1891.8 25 30 28 39 56 61 69 74 79 86 93 **																			
76 1930.0 652.04 969.97 0.812 20.6 1888.8 26 36 33 41 60 65 74 80 85 92 99 107 **																			
76 1930.0 702.04 1044.43 0.875 22.2 1885.6 28 36 33 45 64 70 80 85 92 98 106 114 **																			
76 1930.0 751.96 1118.76 0.938 23.8 1882.4 30 39 36 45 68 75 85 92 98 106 112 121 **																			
76 1930.0 801.00 1192.97 1.000 25.4 1879.2 32 41 38 48 73 80 90 97 104 112 129 **																			
76 1930.0 849.96 1267.06 1.062 27.0 1876.0 34 43 41 50 77 85 96 103 110 119 126 136 **																			
76 1930.0 899.62 1341.02 1.125 28.6 1872.8 37 46 43 54 77 84 91 101 109 116 126 136 **																			
76 1930.0 949.20 1414.84 1.188 30.2 1869.6 39 48 45 56 81 89 106 114 123 132 143 **																			
76 1930.0 997.91 1488.55 1.250 31.8 1866.4 41 51 48 59 85 94 106 114 123 132 143 **																			
80 2032.0 476.80 711.52 0.562 14.3 2003.4 17 22 21 25 37 40 45 49 52 56 61 **																			
80 2032.0 529.83 790.50 0.625 15.9 2000.2 19 24 23 28 41 45 49 55 60 64 70 74 **																			
80 2032.0 582.77 869.36 0.688 17.5 1997.0 21 27 25 31 49 54 61 65 70 76 81 **																			
80 2032.0 634.79 948.09 0.750 19.1 1993.8 23 29 27 34 49 53 58 65 70 76 82 88 **																			
80 2032.0 686.73 1021.78 0.812 20.6 1990.8 25 32 30 37 53 63 70 76 81 88 94 102 **																			
80 2032.0 739.42 1100.27 0.875 22.2 1987.6 27 34 32 39 57 63 70 76 81 88 94 101 109 **																			
80 2032.0 792.03 1178.63 0.938 23.8 1984.4 29 37 34 43 61 67 76 81 87 93 101 109 **																			
80 2032.0 843.72 1256.86 1.000 25.4 1981.2 31 39 37 45 65 71 81 85 92 99 107 115 **																			
80 2032.0 895.33 1334.97 1.062 27.0 1978.0 33 41 39 48 69 76 80 91 98 105 114 122 **																			
80 2032.0 947.68 1412.95 1.125 28.6 1974.8 35 43 41 51 73 80 91 98 105 110 120 129 **																			
80 2032.0 999.95 1490.80 1.188 30.2 1971.6 37 46 43 54 77 85 96 103 110 116 126 136 **																			
80 2032.0 1051.31 1568.53 1.250 31.8 1968.4 39 48 45 56 81 89 101 108 116 126 136 **																			

Outside diameter and wall-thickness dimensions shown are subject to tolerances as given in Table 6.3. Inside diameters are nominal and are given here for information (see Par. 6.2).

¹The test pressures given in Table 6.2 apply to grades A25, A, B, X42, X46, X52, X60, X65 and X70 only. See Par. 5.3 for pressures applicable to other grades.

²These sizes are special plain-end weight sizes. All other sizes are regular weight. See Table 6.3 for applicable weight tolerances. For grades X42 and higher, weights intermediate to regular-weights shall be considered regular-weight. Weights intermediate to special-plain-end weights shall be considered special-plain-end weight, and weights intermediate between the heaviest tabulated special-plain-end weights and the lightest regular-weights shall be considered special-plain-end weight.

†100 kPa = 1 Bar

**Use equation shown in Par. 5.3 to calculate required test pressures. Tabular test pressures will be available in the Thirty-sixth edition of Spec 5L.

APPENDIX E SUPPLEMENTARY REQUIREMENTS

By agreement between the purchaser and manufacturer and when specified on the purchase order the following supplementary requirements shall apply.

SUPPLEMENTARY REQUIREMENT SR3 COLOR IDENTIFICATION

SR3.1 Grade X46 and higher pipe in sizes 4½ in. OD and larger shall be identified by color in accordance with the color code given in Par. SR3.3.

SR3.2 The manufacturer shall apply a 2 in. (50 mm) daub of paint of the appropriate color on the inside surface at one end of each length of pipe.

SR3.3 The grade identification colors are as follows:

Grade	Color	Grade	Color
X46	Black	X65	White
X52	Green	X70	Purple
X56	Blue	X80	Yellow
X60	Red		

SUPPLEMENTARY REQUIREMENT SR4 NONDESTRUCTIVE INSPECTION OF SEAMLESS LINE PIPE

SR4.1 Supplementary Nondestructive Inspection. Seamless pipe shall be inspected full length for longitudinal defects by either magnetic particle inspection or by ultrasonic or electromagnetic methods. The location of the equipment in the mill shall be at the discretion of the manufacturer; however, the nondestructive inspection must take place after all heat-treating and expansion operations, if performed, but may take place before cropping, bevelling, and end sizing.

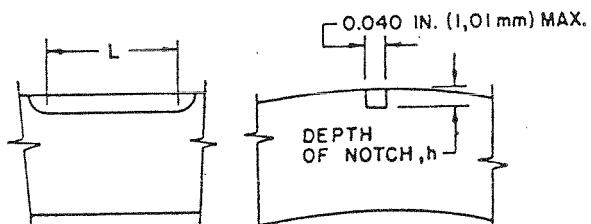
SR4.2 Magnetic Particle Inspection. When magnetic particle inspection is employed to inspect for longitudinal defects, the entire outside surface shall be inspected. The depth of all imperfections revealed by magnetic particle inspection shall be determined and when found to be greater than 12½% of the specified wall thickness the imperfection shall be considered a defect. Pipe containing defects shall be disposed of in accordance with Par. 10.7.

SR4.3 Ultrasonic or Electromagnetic Inspection

a. **Equipment.** Any equipment utilizing the ultrasonic or electromagnetic principles and capable of continuous and uninterrupted inspection of the entire outer surface of the pipe or tube may be used. The equipment shall be of sufficient sensitivity to indicate defects and shall be checked as prescribed in Par. SR4.3b.

b. **Reference Standards.** A reference standard having the same nominal diameter and thickness as the product being inspected shall be used to demonstrate the effectiveness of the inspection equipment and procedures at least once every working turn. The reference standard may be of any convenient length as determined by the manufacturer. It shall be scanned by the inspection unit in

a manner simulating the inspection of the product. For ultrasonic inspection, the reference standard shall contain a machined notch as specified in Fig. SR4.1. For electromagnetic inspection, the reference standard shall contain either a machined notch as specified in Fig. SR4.1 or a ¼ in. (3.2 mm)

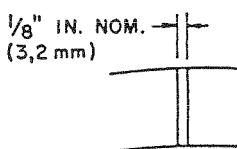


Depth of notch, *h*, shall be 12½ per cent of the nominal wall thickness of the pipe being inspected, but not less than 0.012 in. (0.30 mm).

For ultrasonic and eddy current the length of notch at full depth, *L*, shall be at least twice the width of the scanning head.

For diverted flux the length of notch shall be as required by the equipment design to provide a reproducible signal when the reference standard is passed through the equipment at the inspection line speed for the pipe being inspected. Three passes through the equipment shall be required to insure reproducibility.

NOTCH



DRILLED HOLE
FIG. SR4.1
REFERENCE STANDARDS

drilled hole. The notch shall be in the outer surface of the reference standard and parallel to the longitudinal axis of the pipe or, at the option of the manufacturer, may be oriented at such an angle as to optimize the detection of anticipated defects. The $\frac{1}{8}$ in. (3.2 mm) hole shall be drilled radially through the wall of the reference standard. The inspection equipment shall be adjusted to produce a well-defined indication when the reference standard is scanned by the inspection unit.

- c. Acceptance Limits. Any imperfection that produces a signal greater than the signal received from the reference standard shall be considered a defect unless it can be demonstrated by the manufacturer that the imperfection does not exceed the

provisions of Par. 10.7 in Spec 5L. Pipe containing defects shall be given one of the dispositions specified in Par. 10.7.

NOTE: The reference standards defined above are convenient standards for calibration of nondestructive testing equipment. The dimensions of these standards should not be construed as the minimum size imperfection detectable by such equipment.

NOTE: Reference standards other than the specific notch described above may be used by agreement between the purchaser and manufacturer.

SR4.4 Marking. Pipe nondestructively inspected in accordance with this supplementary requirement shall be marked SR4.

SUPPLEMENTARY REQUIREMENT SR5 CHARPY IMPACT TESTING ON WELDED PIPE 20 in. DIAMETER OR LARGER, GRADE X-52 OR HIGHER

SR5.1 The manufacturer shall make two-thirds size Charpy V-notch tests in accordance with ASTM A 370 as follows:

SR5.2 Three transverse specimens shall be taken from one length of pipe from each heat supplied on the order. The specimens shall be oriented circumferentially from a location 90° from the weld, with the axis of the notch oriented through the pipe wall thickness as shown in Fig. SR6.1. The specimens shall be tested at 50°F (10°C) or at a lower temperature as specified by the purchaser. The average shear value of the fracture appearance of the three specimens shall not be less than 35 percent and the all-heat average for each order per diameter size and grade shall not be less than 50 percent.

SR5.3 If the average of the three specimens from one heat does not meet the requirement of 35 percent shear, the manufacturer may elect to repeat the tests on specimens cut from two additional lengths of pipe from the same heat. If such specimens conform to the specified requirements, all the lengths in the heat shall be accepted except the length initially selected for test. If any of the re-test specimens fail to pass this specified re-test requirement, the manufacturer may elect to test specimens cut from the individual lengths remaining in the heat.

SR5.4 The average shear value for a heat shall be the average of the original three specimens if this is 35 percent or more; the combined average of the retest specimens, provided the average of each group of three specimens is 35 percent or more; or, in the event individual lengths are tested, the combined average of all

groups of three specimens that meet 35 percent. The all-heat average value is the combined average of the value established for each heat.

SR5.5 If the all-heat average of the order does not meet the requirement of 50 percent shear, the manufacturer shall be responsible for replacement of such heats as may be necessary to bring the average shear area up to 50 percent.

SR5.6 Alternatively, the manufacturer may elect to test two or more additional lengths from one or more of the heats. In determining the new heat average, the original test value may be discarded if the pipe length represented is rejected or the three or more individual values averaged. In any case, the new test values shall be incorporated into the value for the heat.

SR5.7 The Charpy impact test specimens shall be taken from the pipe wall away from the weld and without flattening and may be of lesser cross section if the pipe wall thickness and diameter will not permit two-third size specimens.

SR5.8 Specimens showing material defects or defective preparation, whether observed before or after breaking, may be discarded and replacements shall be considered as original specimens.

SR5.9 Marking. Pipe tested in accordance with this supplementary requirement shall be marked to indicate the type of test and the testing temperature.

Example:

SR5F32

SUPPLEMENTARY REQUIREMENT SR6
DROP WEIGHT TEAR TESTING ON WELDED PIPE
20 in. DIAMETER OR LARGER, GRADE X-52 OR HIGHER

SR6.1 Fracture toughness of pipe 20 in. diameter and larger, Grade X-52 and higher, shall be determined by the manufacturer using drop weight tear tests in accordance with the following requirements:

SR6.2 Two transverse specimens shall be taken from one length of pipe from each heat supplied on the order. The specimens shall be oriented circumferentially from a location 90° from the weld with the axis of the notch oriented through the pipe wall thickness as shown in Fig. SR6.1. The specimens shall be tested at 50°F (10°C) or at a lower temperature as specified by the purchaser.

SR6.3 The test specimens, testing procedure, and rating of the specimens shall be in accordance with API RP 5L3, *Recommended Practice for Conducting Drop-Weight Tear Tests on Line Pipe*.

SR6.4 At least 80 percent of the heats shall exhibit a fracture appearance shear area of 40 percent or more for the specified test temperature.

NOTE: Due to manufacturing difficulties encountered with thicker materials, pipe producers may not be able to offer materials in all grades that meet this requirement.

SR6.5 In the event the average value of the two specimens from the length selected to represent the heat is less than 40 percent, the manufacturer may elect to

establish the heat average by testing two specimens from each of two or more additional lengths of pipe in the heat. In establishing the new heat average, the manufacturer may elect to employ the combined average of the three or more tests; or to discard the result of the first test, reject the pipe from which it was taken, and employ the combined average of the two or more additional tests. Alternatively, the manufacturer may elect to test all the pipe in the heat, in which case 80 percent or more of the lengths tested and applied to the order must exhibit an average of 40 percent or more shear.

SR6.6 Specimens showing material defects or defective preparation, whether observed before or after breaking, may be discarded and replacements shall be considered as original specimens.

SR6.7 The manufacturer shall be responsible for replacement of such heats as may be necessary to meet the above requirements.

SR6.8 **Marking.** Pipe tested in accordance with this supplementary requirement shall be marked to indicate the type of test and the testing temperature.

Example:

SR6F32

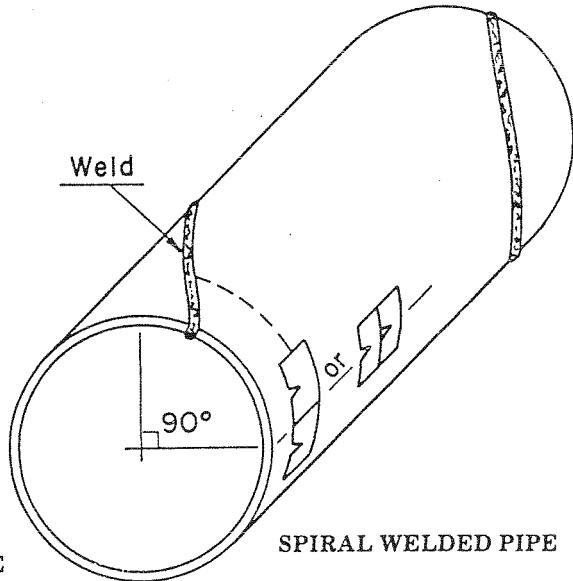
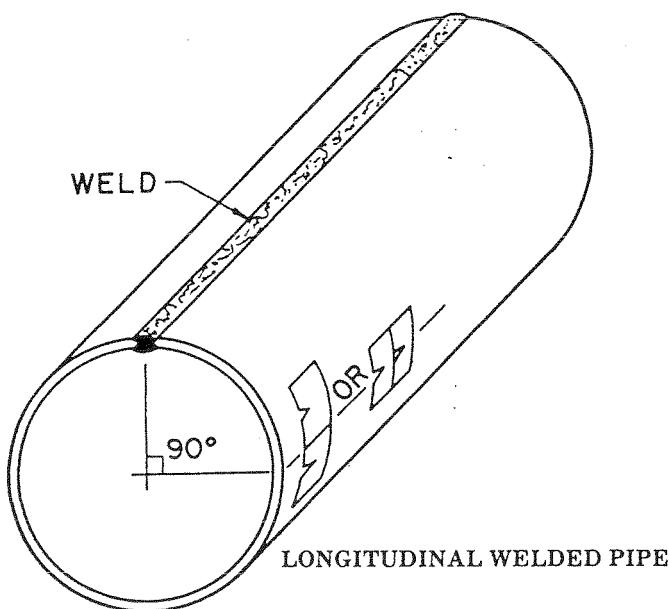


FIG. SR6.1
DROP WEIGHT TEAR TEST SPECIMEN

SUPPLEMENTARY REQUIREMENT SR7 THROUGH-THE-FLOWLINE (TFL) PIPE

SR7.1 General. TFL pipe shall comply with all requirements of this specification except as specified hereafter.

SR7.2 Dimension and Grades. TFL pipe shall be seamless or straight seam welded in the OD sizes, wall thicknesses and grades listed in Table SR7.1.

SR7.3 Length. Unless otherwise specified, TFL pipe shall be furnished only in double random lengths with no jointers (girth welds).

SR7.4 Drift Tests. Each length of TFL pipe shall be tested throughout its entire length with a cylindrical drift mandrel conforming to the requirements listed below. The leading edge of the drift mandrel shall be rounded to permit easy entry into the pipe. The drift mandrel shall pass freely through the pipe with a reasonable exerted force equivalent to the weight of the mandrel being used for the test. Pipe shall not be rejected until it has been drift tested when it is free of all foreign matter and properly supported to prevent sagging.

Product and Size, in.	Drift Mandrel Size,	
	Length in.	Diam., min. mm
2 $\frac{1}{2}$ and smaller	42 (1066)	d- $\frac{3}{32}$ (d-2.4)
3 $\frac{1}{2}$ and larger	42 (1066)	d- $\frac{1}{8}$ (d-3.2)

SR7.5 Hydrostatic Tests. TFL pipe shall be hydrostatically tested in accordance with the requirements of Sect. 5, except that the minimum test pressures shall be as shown in Table SR7.1. These values are computed by the formula given in Par. 5.3 using a fiber stress (S) equal to 80% of the specified minimum yield strength, or 10,000 psi (68.9 MPa) whichever is smaller.

SR7.6 Marking. TFL pipe manufactured in accordance with this Supplementary Requirement shall be marked with the letters TFL in addition to the marking required in Section 11.

TABLE SR7.1
TFL PIPE
DIMENSIONS, WEIGHTS AND TEST PRESSURES

1 Outside Diam., in. <i>D</i>	2 Grade	3 Wall Thickness, <i>t</i>		4 Weight <i>W_{pe}</i>		5 Inside Diameter, <i>d</i>		6 Hydrostatic Test Pressure	
		in.	mm	in.	mm	lb/ft	kg/m	in.	mm
*2 $\frac{1}{2}$ (60.3)	X56	.188	(4.8)	4.39	(6.54)	1.999	(50.7)	7100	(489)
2 $\frac{1}{2}$ (73.0)	X56	.438	(11.1)	11.40	(16.98)	1.999	(50.8)	10000	(689)
*2 $\frac{1}{2}$ (73.0)	X56	.216	(5.5)	6.13	(9.13)	2.443	(62.2)	6700	(462)
3 $\frac{1}{2}$ (88.9)	X56	.530	(13.5)	16.81	(25.04)	2.440	(61.9)	10000	(689)
4 (101.6)	X60	.750	(19.1)	26.03	(38.77)	2.500	(63.4)	10000	(689)
4 (101.6)	X42	.500	(12.7)	18.69	(27.84)	3.000	(76.2)	8400	(579)
4 (101.6)	X60	.500	(12.7)	18.69	(27.84)	3.000	(76.2)	10000	(689)
*4 (101.6)	X70	.250	(6.4)	10.01	(14.91)	3.500	(88.8)	7000	(482)
4 $\frac{1}{2}$ (114.3)	X52	.750	(19.1)	30.04	(44.74)	3.000	(76.1)	10000	(689)
*4 $\frac{1}{2}$ (114.3)	X70	.281	(7.1)	12.66	(18.86)	3.938	(100.1)	7000	(482)

*Standard size, weight and grade.

SUPPLEMENTARY REQUIREMENT SR8

FRACTURE TOUGHNESS TESTING OF LINE PIPE

SR8.1 The Fracture Toughness of pipe 16 inch diameter and larger in Grades X-42 and higher shall be determined by the manufacturer using Charpy V-notch impact test specimens at the temperature specified by the purchaser. The test shall be performed in accordance with ASTM A370.

SR8.2 Three transverse specimens representing one test shall be taken from one length of pipe from each lot. The specimens shall be oriented circumferentially and taken from a location 90° from any weld seam. Flattening is not permitted. The axis of the notch shall be oriented through the wall thickness, radially.

When the wall thickness of the pipe does not permit machining of full size (10 mm by 10 mm) specimens, the largest size possible of either $\frac{2}{3}$ size or $\frac{1}{2}$ size may be substituted. See Table SR 8.1.

Testing frequency shall be one test per lot and in no case shall a lot contain more than one heat. Lot size shall be determined on the basis of order size. For orders of 1000 or more lengths of pipe, a lot shall consist of 100 or fewer pipe. For orders of 100 to 999 pipe, a lot shall consist of 100 or fewer pipe, but sufficient lots of reasonable, uniform size shall be assigned to insure a minimum total of ten tests. For orders of fewer than 100 pipe, sufficient lots shall be assigned to insure a total number of tests, equivalent to one test per ten joints of pipe or fraction thereof ordered.

SR8.3 For acceptance, the average of the 3 individual specimens from a length shall not be less than the value specified by the purchaser. In addition, the lowest individual value of the three specimens shall not be less than 75% of the specified average value. In the case of subsize specimens, the specification values shall be reduced proportionally with the reduction in cross-sectional area.

SR8.4 Specimens showing material defects or defective preparations, whether observed before or after breaking, may be discarded and replacements shall be considered original specimens.

In the event a set of test specimens fail to meet the specified values, the manufacturer may elect to replace the lot of material involved or alternatively to test two more lengths from the same lot. If both of the new tests meet the specified values, then all pipe in that lot with the exception of the original selected length shall be considered to meet the requirement. Failure of either of the two additional tests shall require testing of each length in the lot for acceptance.

SR8.5 Pipe tested in accordance with this supplementary requirement shall be marked to indicate the type of test, the minimum average impact value specified and test temperature. Example: SR8-20-32F.

TABLE SR8.1
MINIMUM WALL FOR TRANSVERSE
CHARPY V-NOTCH SPECIMENS

Outside Diameter in.	Minimum Wall Thickness for					
	Full Size Specimen in. mm		$\frac{2}{3}$ Size Specimen in. mm		$\frac{1}{2}$ Size Specimen in. mm	
16	0.468	(11.89)	0.337	(8.56)	0.271	(6.88)
18	0.459	(11.66)	0.328	(8.33)	0.262	(6.65)
20	0.453	(11.51)	0.323	(8.20)	0.256	(6.50)
22	0.447	(11.35)	0.316	(8.03)	0.250	(6.35)
24	0.443	(11.25)	0.312	(7.92)	0.246	(6.25)
26	0.439	(11.15)	0.308	(7.82)	0.242	(6.15)
28	0.436	(11.07)	0.305	(7.75)	0.239	(6.07)
30	0.433	(11.00)	0.302	(7.67)	0.236	(5.99)
32	0.431	(10.95)	0.300	(7.62)	0.234	(5.94)
34	0.429	(10.90)	0.298	(7.57)	0.232	(5.89)
36	0.427	(10.85)	0.296	(7.52)	0.230	(5.84)
38	0.425	(10.80)	0.294	(7.47)	0.228	(5.79)
40	0.423	(10.74)	0.292	(7.42)	0.226	(5.74)
42	0.422	(10.72)	0.291	(7.39)	0.225	(5.72)
44	0.421	(10.70)	0.290	(7.37)	0.224	(5.69)
46	0.419	(10.64)	0.288	(7.32)	0.222	(5.64)
48	0.418	(10.62)	0.287	(7.30)	0.221	(5.61)
52	0.417	(10.59)	0.286	(7.26)	0.220	(5.59)
56	0.415	(10.54)	0.284	(7.21)	0.218	(5.54)
60	0.414	(10.52)	0.283	(7.19)	0.217	(5.51)
64	0.412	(10.46)	0.281	(7.14)	0.215	(5.46)

SUPPLEMENTARY REQUIREMENT 14
END LOAD COMPENSATION FOR HYDROSTATIC TEST PRESSURES IN EXCESS
OF 90% OF SPECIFIED MINIMUM YIELD STRENGTH

SR14.1 As a measure to prevent distortion when testing at pressures equivalent to stresses in excess of 90% of specified minimum yield strength, the manufacturer may apply a calculation to compensate for the forces applied to the pipe end which produce a compressive longitudinal stress. The calculation described below is based on Barlow's Formula (see Section 5) modified by a factor based on the Maximum Shear Theory¹. The calculation may be applied only when testing in excess of 90% of the specified minimum yield strength. In no case may the gage pressure for testing be less than that calculated using Barlow's Formula at 90% of specified minimum yield strength.

¹NOTE. The calculation is an approximation of the effective hoop stress (S_E) which is practical for application under mill pipe testing conditions. Other calculations provide closer approximations of effective hoop stress, but are complex and therefore impractical for application.

SR14.2 The test pressure calculated shall be rounded to the nearest 10 psi (100kPa).

SR14.3 The hydrostatic test pressure compensated for pipe end loading shall be calculated according to the following formula:

English Formula

$$P_I = \frac{S_E - \frac{P_R A_R}{A_P}}{\frac{D}{2t} - \frac{A_I}{A_P}}$$

Metric Formula

$$P_I = 1000 \frac{\frac{P_R A_R}{S_E - \frac{A_P}{A_I}}}{\frac{D}{2t} - \frac{A_I}{A_P}}$$

Where: A_I = internal cross-sectional area of pipe.
 A_P = cross-sectional area of pipe wall.
 A_R = cross-sectional area of ram.
 P_I = hydrostatic test pressure in pounds per sq. in. (kPa).
 P_R = internal pressure on end sealing ram.
 S_E = effective hoop stress in pounds per sq. in. (MPa) equal to a percentage of the specified minimum yield strength.
 D = specified outside diameter in in. (mm).
 t = specified wall thickness in in. (mm).

SR14.4 The above formula may be manipulated algebraically to provide calculation in other terms appropriate to the manufacturer's testing facility.

SR14.5 Appropriate techniques for the control of effective hoop stress based on measurements of internal pipe and ram pressures vary according to hydrotester system design. The manufacturer shall provide a control technique appropriate to his installation.

APPENDIX F
GUIDED BEND TEST JIG DIMENSIONS

1	2	3	4	5	6	7	8	9	10	11									
Dimension A																			
Outside Diam., in. <i>D</i>	Wall Thick., in. <i>t</i>	Grade A		Grade B & X-42		X-46		X-52		X-56		X-60		X-65		X-70		X-80	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
12 $\frac{1}{4}$.172	1.0	25.4	1.4	35.6	1.4	35.6	1.6	40.6	1.6	40.6	1.6	40.6	1.6	40.6	1.9	48.3	2.2	55.9
12 $\frac{1}{4}$.188	1.2	30.5	1.4	35.6	1.6	40.6	1.6	40.6	1.9	48.3	1.9	48.3	1.9	48.3	2.2	55.9	2.6	66.0
12 $\frac{1}{4}$.203	---	---	1.6	40.6	1.6	40.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.2	55.9	2.6	66.0
12 $\frac{1}{4}$.219	1.4	35.6	1.6	40.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.2	55.9	2.6	66.0	3.1	78.7
12 $\frac{1}{4}$.250	1.6	40.6	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	2.6	66.0	3.1	78.7	3.7	94.0	4.4	111.8
12 $\frac{1}{4}$.281	1.9	48.3	2.2	55.9	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
12 $\frac{1}{4}$.312	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
12 $\frac{1}{4}$.330	2.2	55.9	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1
12 $\frac{1}{4}$.344	2.2	55.9	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
12 $\frac{1}{4}$.375	2.6	66.0	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5	7.4	188.0
12 $\frac{1}{4}$.406	---	---	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	8.8	223.5
12 $\frac{1}{4}$.438	3.1	78.7	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0	8.8	223.5	10.5	266.7
12 $\frac{1}{4}$.500	---	---	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0	8.8	223.5	10.5	266.7	12.6	320.0	15.1	383.5
12 $\frac{1}{4}$.562	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7	12.6	320.0	15.1	383.5
12 $\frac{1}{4}$.625	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5	18.1	459.7
12 $\frac{1}{4}$.688	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	15.1	383.5	18.1	459.7	21.7	551.2	26.0	660.4
12 $\frac{1}{4}$.750	7.4	188.0	10.5	266.7	12.6	320.0	15.1	383.5	18.1	459.7	21.7	551.2	21.7	551.2	31.2	792.5	31.2	792.5
12 $\frac{1}{4}$.812	8.8	223.5	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7	21.7	551.2	21.7	551.2	31.2	792.5	31.2	792.5
12 $\frac{1}{4}$.875	10.5	266.7	15.1	383.5	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5
14	.188	1.2	30.5	1.4	35.6	1.6	40.6	1.6	40.6	1.9	48.3	1.9	48.3	2.2	55.9	2.6	66.0	2.6	66.0
14	.203	1.2	30.5	1.6	40.6	---	---	---	---	---	---	---	---	---	---	---	2.6	66.0	6.0
14	.210	---	---	1.6	40.6	1.6	40.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.6	66.0	3.1	78.7
14	.219	---	---	1.6	40.6	1.9	48.3	2.2	55.9	2.2	55.9	2.2	55.9	2.6	66.0	3.1	78.7	3.7	94.0
14	.250	1.6	40.6	1.9	48.3	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.7	94.0	4.4	111.8
14	.281	1.9	48.3	2.2	55.9	2.6	66.0	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	4.4	111.8	5.2	132.1
14	.312	1.9	48.3	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
14	.344	2.2	55.9	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
14	.375	2.6	66.0	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5	7.4	188.0
14	.406	---	---	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
14	.438	3.1	78.7	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
14	.469	---	---	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
14	.500	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	10.5	266.7	12.6	320.0
14	.562	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	15.1	383.5
14	.592	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	15.1	383.5
14	.625	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5	18.1	459.7
14	.688	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5	18.1	459.7	26.0	660.4
14	.750	7.4	188.0	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	31.2	792.5
14	.812	7.4	188.0	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7	21.7	551.2	31.2	792.5	31.2	792.5
14	.875	7.4	188.0	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7	21.7	551.2	31.2	792.5	31.2	792.5
16	.188	1.2	30.5	1.4	35.6	1.6	40.6	1.6	40.6	1.9	48.3	1.9	48.3	2.2	55.9	2.6	66.0	2.6	66.0
16	.203	1.2	30.5	1.6	40.6	1.6	40.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.6	66.0	3.1	78.7
16	.219	1.4	35.6	1.6	40.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7
16	.250	1.6	40.6	1.9	48.3	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.7	94.0	4.4	111.8
16	.281	1.6	40.6	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8
16	.312	1.9	48.3	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
16	.344	2.2	55.9	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	6.2	157.5
16	.375	2.6	66.0	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5
16	.406	---	---	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
16	.438	3.1	78.7	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0	8.8	223.5
16	.469	---	---	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
16	.500	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
16	.562	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
16	.625	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	15.1	383.5
16	.688	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5	21.7	551.2
16	.750	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5	18.1	459.7	26.0	660.4

GUIDED BEND TEST JIG DIMENSIONS (Continued)

1	2	3	4	5	6	7	8	9	10	11									
Dimension A																			
Outside Diam., in. <i>D</i>	Wall Thick., in. <i>t</i>	Grade A		Grade B & X-42		X-46		X-52		X-56		X-60		X-65		X-70		X-80	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
16	.938	8.8	223.5	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5
16	1.000	10.5	266.7	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	26.0	564.2	31.2	792.5	31.2	792.5	31.2	792.5
16	1.062	10.5	266.7	18.1	459.7	18.1	459.7	21.7	551.2	26.0	564.2	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
16	1.125	12.6	320.0	21.7	551.2	21.7	551.2	26.0	564.2	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
18	.188	1.0	25.4	1.4	35.6	1.4	35.6	1.6	40.6	1.6	40.6	1.9	48.3	1.9	48.3	1.9	48.3	1.9	48.3
18	.219	1.4	35.6	1.6	40.6	1.6	40.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.2	55.9	2.2	55.9
18	.250	1.6	40.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	2.6	66.0	2.6	66.0
18	.281	1.6	40.6	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.1	78.7	3.1	78.7
18	.312	1.9	48.3	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
18	.344	2.2	55.9	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1
18	.375	2.2	55.9	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
18	.406	---	---	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	7.4	188.0
18	.438	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
18	.469	---	---	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	8.8	223.5	10.5	266.7
18	.500	3.1	78.7	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	8.8	223.5	10.5	266.7
18	.562	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	7.4	188.0
18	.625	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	8.8	223.5	8.8	223.5
18	.688	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	10.5	266.7
18	.750	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	12.6	320.0
18	.812	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	15.1	383.5
18	.875	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	26.1	662.9
18	.938	8.8	223.5	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	18.1	459.7	21.7	551.2	31.2	792.5
18	1.000	8.8	223.5	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5
18	1.062	10.5	266.7	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5
18	1.125	10.5	266.7	18.1	459.7	18.1	459.7	21.7	551.2	26.0	660.4	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5
18	1.188	12.6	320.0	18.1	459.7	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
18	1.250	15.1	383.5	21.7	551.2	26.0	660.4	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
20	.219	1.2	30.5	1.6	40.6	1.6	40.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.2	55.9	2.6	66.0
20	.250	1.6	40.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	2.6	66.0	3.1	78.7
20	.281	1.6	40.6	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8
20	.312	1.9	48.3	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1
20	.344	2.2	55.9	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1
20	.375	2.2	55.9	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
20	.406	---	---	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5
20	.438	2.6	66.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5
20	.469	---	---	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0
20	.500	3.1	78.7	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0
20	.562	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5
20	.625	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
20	.688	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	15.1	383.5
20	.750	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	15.1	383.5	18.1	459.7
20	.812	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5
20	.875	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	21.7	551.2
20	.938	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	31.2	792.5
20	1.000	8.8	223.5	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4
20	1.062	8.8	223.5	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5
20	1.125	10.5	266.7	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5
20	1.188	10.5	266.7	18.1	459.7	18.1	459.7	21.7	551.2	26.0	660.4	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5
20	1.250	12.6	320.0	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
20	1.312	12.6	320.0	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
20	1.375	15.1	383.5	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
22	.219	1.2	30.5	1.6	40.6	1.6	40.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.2	55.9	2.6	66.0
22	.250	1.4	35.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	2.6	66.0	3.1	78.7
22	.281	1.6	40.6	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	2.6	66.0	2.6	66.0	3.1	78.7	3.7	94.0
22	.312	1.																	

GUIDED BEND TEST JIG DIMENSIONS (Continued)

1	2	3	4	5	6	7	8	9	10	11									
Dimension A																			
Outside Diam., in. D	Wall Thick., in. t	Grade A		Grade B & X-42		X-46		X-52		X-56		X-60		X-65		X-70		X-80	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
22	.375	2.2	55.9	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
22	.406	---	---	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	6.2	157.5
22	.438	2.6	66.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5
22	.469	---	---	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
22	.500	3.1	78.7	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
22	.562	3.7	94.0	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5	10.5	266.7
22	.625	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7	12.6	320.0
22	.688	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	15.1	383.5
22	.750	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
22	.812	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5	18.1	459.7
22	.875	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7	21.7	551.2
22	.938	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	26.0	660.4
22	1.000	7.4	188.0	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	31.2	792.5
22	1.062	8.8	223.5	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	26.0	660.4	31.2	792.5
22	1.125	10.5	266.7	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5
22	1.188	10.5	266.7	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5
22	1.250	12.6	320.0	18.1	459.7	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5
22	1.312	12.6	320.0	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
22	1.375	12.6	320.0	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
22	1.438	15.1	383.5	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
22	1.500	15.1	383.5	26.0	660.4	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
24	.250	1.4	35.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.7	94.0
24	.281	1.6	40.6	2.2	55.9	2.2	55.9	2.6	66.0	3.1	66.0	2.6	66.0	2.6	66.0	3.1	78.7	4.4	111.8
24	.312	1.9	48.3	2.2	55.9	2.6	66.0	2.6	66.0	3.1	66.0	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8
24	.344	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
24	.375	2.2	55.9	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
24	.406	---	---	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5
24	.438	2.6	66.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5
24	.469	---	---	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
24	.500	3.1	78.7	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
24	.562	3.7	94.0	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
24	.625	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	8.8	223.5	12.6	320.0
24	.688	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
24	.750	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
24	.812	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	18.1	459.7
24	.875	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	21.7	551.2	26.0	660.4
24	.938	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7	21.7	551.2
24	1.000	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	26.0	660.4
24	1.062	8.8	223.5	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7	18.1	459.7	21.7	551.2	26.0	660.4	31.2	792.5
24	1.125	8.8	223.5	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4
24	1.188	10.5	266.7	15.1	383.5	15.1	383.5	18.1	459.7	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	26.0	660.4
24	1.250	10.5	266.7	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5
24	1.312	12.6	320.0	18.1	459.7	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5
24	1.375	12.6	320.0	18.1	459.7	21.7	551.2	21.7	551.2	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
24	1.438	15.1	383.5	21.7	551.2	21.7	551.2	26.0	660.4	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
24	1.500	15.1	383.5	21.7	551.2	26.0	660.4	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
24	1.562	15.1	383.5	26.0	660.4	26.0	660.4	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5	31.2	792.5
26	.250	1.4	35.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.7	94.0
26	.281	1.6	40.6	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0
26	.312	1.9	48.3	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8
26	.344	2.2	55.9	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
26	.375	2.2	55.9	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
26	.406	---	---	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
26	.438	2.6	66.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5
26	.469	---	---	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132				

GUIDED BEND TEST JIG DIMENSIONS (Continued)

1	2	3	4	5	6	7	8	9	10	11									
Outside Diam., in. D	Wall Thick., in. t	Dimension A																	
		Grade A		Grade B & X-42		X-46		X-52		X-56		X-60		X-65		X-70		X-80	
26	.625	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	10.5	266.7
26	.688	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7
26	.750	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
26	.812	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
26	.875	6.2	157.5	8.8	223.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5
26	.938	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7
26	1.000	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	15.1	383.5	21.7	551.2
28	.250	1.4	35.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7
28	.281	1.6	40.6	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0
28	.312	1.9	48.3	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8
28	.344	---	---	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1
28	.375	2.2	55.9	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1
28	.406	---	---	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5
28	.438	2.6	66.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5
28	.469	---	---	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
28	.500	3.1	78.7	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	8.8	223.5	8.8	223.5
28	.562	3.7	132.1	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
28	.625	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
28	.688	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
28	.750	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0
28	.812	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
28	.875	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5
28	.938	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
28	1.000	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	18.1	459.7
30	.250	1.4	35.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.2	55.9	2.6	66.0	3.1	78.7	3.7	94.0
30	.281	1.6	40.6	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8
30	.312	1.9	48.3	2.2	55.9	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
30	.344	---	---	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1
30	.375	2.2	55.9	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1
30	.406	---	---	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
30	.438	2.6	66.0	3.1	78.7	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5
30	.469	---	---	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
30	.500	3.1	78.7	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0
30	.562	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5
30	.625	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
30	.688	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
30	.750	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0
30	.812	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
30	.875	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5
30	.938	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
30	1.000	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7
32	.250	1.4	35.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.2	55.9	2.6	66.0	3.1	78.7	3.7	94.0
32	.281	1.6	40.6	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8
32	.312	1.9	48.3	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8
32	.344	---	---	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1
32	.375	2.2	55.9	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1
32	.406	---	---	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5
32	.438	2.6	66.0	3.1	78.7	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5
32	.469	---	---	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
32	.500	3.1	78.7	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0
32	.562	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
32	.625	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
32	.688	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7
32	.750	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
32	.812	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
32	.875	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5
32	.938	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7								

GUIDED BEND TEST JIG DIMENSIONS (Continued)

1	2	3	4	5	6	7	8	9	10	11									
Dimension A																			
Outside Diam., in. D	Wall Thick., in. t	Grade A		Grade B & X-42		X-46		X-52		X-56		X-60		X-65		X-70		X-80	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
32	1.000	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
32	1.062	7.4	188.0	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7
32	1.125	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2
32	1.188	8.8	223.5	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	18.1	459.7	26.0	660.4
32	1.250	8.8	223.5	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	18.1	459.7	21.7	551.2	26.0	660.4
34	.250	1.4	35.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.2	55.9	2.2	55.9	2.6	66.0	3.1	78.7
34	.281	1.6	40.6	2.2	55.9	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.7	94.0		
34	.312	1.9	48.3	2.2	55.9	2.6	66.0	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0		
34	.344	--	--	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8		
34	.375	2.2	55.9	2.6	66.0	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8		
34	.406	--	--	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1		
34	.438	2.6	66.0	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1		
34	.469	--	--	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5		
34	.500	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5		
34	.562	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0		
34	.625	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5		
34	.688	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
34	.750	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	15.0	381.0
34	.812	5.2	132.1	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	15.0	381.0		
34	.875	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	15.1	383.5
34	.938	6.2	157.5	8.8	223.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
34	1.000	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
34	1.062	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2
34	1.125	7.4	188.0	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2
34	1.188	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2
34	1.250	8.8	223.5	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	18.1	459.7	21.7	551.2	26.0	660.4
36	.250	1.4	35.6	1.9	48.3	1.9	48.3	2.2	55.9	2.2	55.9	2.2	55.9	2.2	55.9	2.6	66.0	3.1	78.7
36	.281	1.6	40.6	2.2	55.9	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.7	94.0		
36	.312	1.9	48.3	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0		
36	.344	--	--	2.6	66.0	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8		
36	.375	2.2	55.9	2.6	66.0	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8		
36	.406	--	--	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
36	.438	2.6	66.0	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1
36	.469	--	--	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5		
36	.500	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5		
36	.562	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0		
36	.625	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5		
36	.688	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
36	.750	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
36	.812	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0		
36	.875	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0		
36	.938	6.2	157.5	8.8	223.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5
36	1.000	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
36	1.062	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
36	1.125	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2
36	1.188	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2
36	1.250	8.8	223.5	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	18.1	459.7	21.7	551.2	26.0	660.4
38	.312	1.9	48.3	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8
38	.344	1.9	48.3	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8		
38	.375	2.2	55.9	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8				
38	.406	2.2	55.9	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1		
38	.438	2.6	66.0	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1		
38	.469	2.6	66.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1		
38	.500	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
38	.562	3.1	78.7	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0		
38	.625	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5				

GUIDED BEND TEST JIG DIMENSIONS (Continued)

Outside Diam., in. D	Wall Thick., in. t	Grade A	Grade B & X-42		X-46		X-52		X-56		X-60		X-65		X-70		X-80		
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm		
38	.688	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7
38	.750	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
38	.812	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0
38	.875	5.2	132.1	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
38	.938	6.2	157.1	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5	15.1	383.5
38	1.000	6.2	157.1	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7		
38	1.062	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7		
38	1.125	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2
38	1.188	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2
38	1.250	8.8	223.5	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	15.1	383.5	18.1	459.7		
40	.312	1.9	48.3	2.2	55.9	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0
40	.344	1.9	48.3	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8		
40	.375	2.2	55.9	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1		
40	.406	2.2	55.9	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1		
40	.438	2.6	66.0	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5		
40	.469	2.6	66.0	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5		
40	.500	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0		
40	.562	3.1	78.7	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
40	.625	3.7	94.0	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
40	.688	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
40	.750	4.4	111.8	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0
40	.812	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0
40	.875	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5		
40	.938	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5		
40	1.000	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
40	1.062	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
40	1.125	7.4	188.0	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
40	1.188	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2
40	1.250	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	15.1	383.5	18.1	459.7		
42	.344	1.9	48.3	2.6	66.0	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8
42	.375	2.2	55.9	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1		
42	.406	2.2	55.9	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1		
42	.438	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5		
42	.469	2.6	66.0	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5		
42	.500	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
42	.562	3.1	78.7	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
42	.625	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5		
42	.688	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
42	.750	4.4	111.8	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7	12.6	320.0
42	.812	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0
42	.875	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
42	.938	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5		
42	1.000	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5
42	1.062	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5
42	1.125	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7		
42	1.188	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2
42	1.250	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	15.1	383.5	18.1	459.7		
44	.344	1.9	48.3	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8		
44	.375	2.2	55.9	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1		
44	.406	2.2	55.9	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1		
44	.438	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1		
44	.469	2.6	66.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5		
44	.500	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
44	.562	3.1	78.7	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
44	.625	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5		
44	.688	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
44	.750	4.4	111.8	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5		

GUIDED BEND TEST JIG DIMENSIONS (Continued)

1	2	3	4	5	6	7	8	9	10	11									
Dimension A																			
Outside Diam., in. <i>D</i>	Wall Thick., in. <i>t</i>	Grade A		Grade B & X-42		X-46		X-52		X-56		X-60		X-65		X-70		X-80	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
44	.812	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
44	.875	5.2	132.1	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0		
44	.938	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7				
44	1.000	6.2	157.5	8.8	223.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	15.1	408.9
44	1.062	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5		
44	1.125	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7		
44	1.188	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7		
44	1.250	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2		
46	.344	1.9	48.3	2.6	66.0	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8
46	.375	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8
46	.406	2.2	55.9	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
46	.438	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1
46	.469	2.6	66.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5		
46	.500	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5		
46	.562	3.1	78.7	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
46	.625	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
46	.688	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5
46	.750	4.4	111.8	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
46	.812	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7		
46	.875	5.2	132.1	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0		
46	.938	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0		
46	1.000	6.2	157.5	8.8	223.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5		
46	1.062	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5		
46	1.125	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
46	1.188	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7		
46	1.250	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2		
48	.344	1.9	48.3	2.6	66.0	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	4.4	111.8
48	.375	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8
48	.406	2.2	55.9	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
48	.438	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1
48	.469	2.6	66.0	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
48	.500	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.7	170.2
48	.562	3.1	78.7	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
48	.625	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
48	.688	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5
48	.750	4.4	111.8	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
48	.812	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	8.8	223.5	10.5	266.7
48	.875	5.2	132.1	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0		
48	.938	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0		
48	1.000	6.2	157.5	8.8	223.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5		
48	1.062	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5		
48	1.125	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
48	1.188	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7		
48	1.250	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7	21.7	551.2		
52	.375	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8
52	.406	2.2	55.9	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
52	.438	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1
52	.469	2.6	66.0	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
52	.500	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5	7.4	188.0
52	.562	3.1	78.7	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
52	.625	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0
52	.688	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
52	.750	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
52	.812	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
52	.875	5.2	132.1	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0		
52	.938	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0		

GUIDED BEND TEST JIG DIMENSIONS (Continued)

	1	2	3	4	5	6	7	8	9	10	11								
Outside Diam., in. <i>D</i>	Wall Thick., in. <i>t</i>	Dimension A																	
		Grade A		Grade B & X-42		X-46		X-52		X-56		X-60		X-65		X-70		X-80	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm		
52	1.000	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
52	1.062	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5		
52	1.125	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	18.1	459.7		
52	1.188	7.4	188.0	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	18.1	459.7		
52	1.250	8.8	223.6	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	15.1	383.5	18.1	459.7		
56	.375	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8
56	.406	2.2	55.9	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
56	.438	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
56	.469	2.6	66.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5	7.4	188.0
56	.500	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0	8.8	223.5
56	.562	3.1	78.7	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
56	.625	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5	10.5	266.7
56	.688	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
56	.750	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7
56	.812	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
56	.875	5.2	132.1	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	15.1	383.5
56	.938	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
56	1.000	6.2	157.5	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
56	1.062	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5
56	1.125	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	18.1	459.7
56	1.188	7.4	188.0	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7	12.6	320.0
56	1.250	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7	12.6	320.0	15.1	383.5
60	.375	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8
60	.406	2.2	55.9	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
60	.438	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
60	.469	2.6	66.0	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
60	.500	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
60	.562	3.1	78.7	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
60	.625	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5	10.5	266.7
60	.688	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5
60	.750	4.4	111.8	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7
60	.812	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
60	.875	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0
60	.938	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0
60	1.000	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
60	1.062	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5
60	1.125	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
60	1.188	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
60	1.250	7.4	188.0	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7	12.6	320.0
64	.375	2.2	55.9	2.6	66.0	2.6	66.0	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8
64	.406	2.2	55.9	3.1	78.7	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	5.2	132.1
64	.438	2.6	66.0	3.1	78.7	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
64	.469	2.6	66.0	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
64	.500	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
64	.562	3.1	78.7	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
64	.625	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5	10.5	266.7
64	.688	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5
64	.750	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7
64	.812	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
64	.875	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	12.6	320.0
64	.938	5.2	132.1	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0
64	1.000	6.2	157.5	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
64	1.062	6.2	157.5	8.8	223.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5
64	1.125	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
64	1.188	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1			

GUIDED BEND TEST JIG DIMENSIONS (Continued)

1	2	3	4	5	6	7	8	9	10	11									
Dimension A																			
Outside Diam., in. <i>D</i>	Wall Thick., in. <i>t</i>	Grade A		Grade B & X-42		X-46		X-52		X-56		X-60		X-65		X-70		X-80	
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
68	.469	2.6	66.0	3.1	78.7	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1
68	.500	2.6	66.0	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5
68	.562	3.1	78.7	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	7.4	188.0
68	.625	3.7	94.0	4.4	111.8	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0
68	.688	3.7	94.0	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5		
68	.750	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
68	.812	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7
68	.875	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7		
68	.938	5.2	132.1	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0		
68	1.000	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
68	1.062	6.2	157.5	8.8	223.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5
68	1.125	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5
68	1.188	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5
68	1.250	7.4	188.0	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
72	.500	2.6	66.0	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5		
72	.562	3.1	78.7	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5		
72	.625	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0		
72	.688	3.7	94.0	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5		
72	.750	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
72	.812	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7
72	.875	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0
72	.938	5.2	132.1	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	15.1	383.5
72	1.000	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	15.1	383.5
72	1.062	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5
72	1.125	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5
72	1.188	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5
72	1.250	7.4	188.0	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
76	.500	2.6	66.0	3.7	94.0	3.7	94.0	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	6.2	157.5		
76	.562	3.1	78.7	4.4	111.8	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5		
76	.625	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0		
76	.688	3.7	94.0	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5		
76	.750	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
76	.812	4.4	111.8	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7
76	.875	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0		
76	.938	5.2	132.1	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0	15.1	383.5
76	1.000	6.2	157.5	7.4	188.0	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0
76	1.062	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5
76	1.125	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5
76	1.188	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5
76	1.250	7.4	188.0	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7
80	.562	3.1	78.7	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0
80	.625	3.7	94.0	4.4	111.8	4.4	111.8	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5
80	.688	3.7	94.0	5.2	132.1	5.2	132.1	5.2	132.1	6.2	157.5	6.2	157.5	7.4	188.0	8.8	223.5		
80	.750	4.4	111.8	5.2	132.1	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7
80	.812	4.4	111.8	6.2	157.5	6.2	157.5	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7
80	.875	5.2	132.1	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	12.6	320.0		
80	1.000	6.2	157.5	7.4	188.0	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0
80	1.062	6.2	157.5	7.4	188.0	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5
80	1.125	6.2	157.5	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	15.1	383.5
80	1.188	7.4	188.0	8.8	223.5	8.8	223.5	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5
80	1.250	7.4	188.0	10.5	266.7	10.5	266.7	10.5	266.7	12.6	320.0	12.6	320.0	12.6	320.0	15.1	383.5	18.1	459.7

APPENDIX G

LIST OF AUTHORIZED MANUFACTURERS

Facilities authorized to use the API monogram on line pipe and line-pipe couplings (as of April 1987) in accordance with API Spec 5L are listed below.

PIPE AND COUPLINGS

Acciaierie e Ferriere Lombarde FALCK S.p.A., Ancore, Italy Ancore, Italy Facility	Bethlehem Steel Corp., Bethlehem, PA Steelton, PA Facility
Acciaierie Tubifico Arvedi, Cremona, Italy Cremona, Italy Facility	Bharat Heavy Electricals, Ltd., Tiruchirapalli, India Tiruchirapalli, India Facility — plain end
Acciaierie e Tubificio Meridionali, S.p.A., Bari, Italy Bari, Italy Facility — plain end	Boon & Cheah Steel Pipes, Kuala Lumpur, Malaysia Kuala Lumpur, Malaysia Facility — plain end
Acindar S.A., Buenos Aires, Argentina Provincia de Sante Fe, Argentina Facility	Borusan Gemlik Boru Tesisleri A.S., Istanbul, Turkey Istanbul, Turkey Facility — plain end
Ajanta Tubes Ltd., Ghaziabad, India Ghaziabad, India Facility — plain end	British Steel Corp., Tubes Div., Corby, Northants, England Clydesdale Facility, Lanarkshire, Scotland Bromford Facility, West Midlands, England — plain end
Alessio Tubi S.p.A., La Loggia (Torino), Italy La Loggia (Torino), Italy Facility — plain end	Corby, England Facility Hartlepool, England Facility Stockton Facility, Cleveland, England
The Algoma Steel Corp., Ltd., Sault Ste. Marie, Ontario, Canada Sault Ste. Marie, Ontario, Canada Facility	BST, Ltd., New Delhi, India New Delhi, India Facility
Altos Hornos de Vizcaya, S.A., Navarro, Spain Navarro, Spain Facility — plain end	Byard Kenwest Engineering Ltd., Livingston, Scotland Livingston, Scotland Facility
American Steel Pipe, Birmingham, AL Birmingham, AL Facility	C. A. Conduven, Caracas, Venezuela La Victoria, Venezuela Facility
Arbed, S.A., Differdange, Luxembourg Differdange, Luxembourg Facility	Cameron Iron Works, Inc., Houston, TX Houston, TX Facility
ARFA Tube Mill Ltd., Basel, Switzerland Basel, Switzerland Facility — plain end	Central Steel Tube Co., Clinton, IA Clinton, IA Facility
Athens Pipe Works S.A., Athens, Greece Athens, Greece Facility	CF& I Steel Corp., Pueblo, CO Pueblo, CO Facility — plain end
Australian Tube Mills Pty. Ltd., Victoria, Australia Victoria, Australia Facility — plain end	CINOCA S.A., Montevideo, Uruguay Montevideo, Uruguay Facility — plain end
Awaji Sangyo KK, Hyogo-Ken, Japan Sumoto Hyogo-Ken, Japan Facility	Clayton, Son & Co., Ltd., Leeds, England Leeds, England Facility — plain end
Babcock & Wilcox Espanola, Bilbao, Spain Bilbao, Spain Facility — plain end	Comatter S.A. (Siat Div.), Buenos Aires, Argentina Siat Facility, Alsina, Argentina
Baoji Petroleum Steel Pipe & Tube Works, Baoji Shannix, China Baoji Shannix, China Facility	Confab Industrial S.A., Barueri, Brazil S.C. Sul, Brasil Facility Pinda, Brasil Facility
Berg Steel Pipe Corp., Panama City, FL Panama City, FL Facility — plain end	Copperweld Tubing Group, Ohio Steel Tube Co., Shelby, OH Ohio Steel Tube Facility, Shelby, OH — plain end Regal Tube Facility, Chicago, IL — plain end
Bergrohr GmbH Herne, Herne, West Germany Bochumer Facility, Herne W. Germany — plain end Diefflerstr Facility, Dillingen, W. Germany — plain end	Corinth Pipeworks, Athens, Greece Athens, Greece Facility — plain end
Bergrohr GmbH Siegen, Siegen, West Germany Siegen, W. Germany Facility — plain end	Csepel Works, c/o Pannonia Export Company, Budapest, Hungary Budapest, Hungary Facility

C.V.G. Siderurgica del Orinoco C.A., Caracas, Venezuela Puerto Ordaz, Venezuela Facility	GTS Industries, Dunkerque, France Belleville, France Facility — plain end Dunkerque, France Facility Maubeuge, France Facility
Cyclops Corp., Sawhill Tubular Div., Sharon, PA Sharon, PA Facility	Gujarat Steel Tubes Ltd., Ahmedabad, India Ahmedabad, India Facility — plain end
Dalmine S.p.A., Milano, Italy Massa, Italy Facility Dalmine, Italy Facility Torre Annunziata Facility — plain end Costa Volpino, Italy Facility — plain end	Hall Longmore & Co. (Pty) Ltd., Transvaal, South Africa Transvaal, South Africa Facility — plain end
Dongbu Steel Co., Ltd., Inchon, Korea Oryu, Korea Facility — plain end Inchon, Korea Facility — plain end	Hedpipe AB, Stockholm, Sweden Stockholm, Sweden Facility
Dunai Vasmu, c/o MERT Quality Control Co., Ltd., Budapest, Hungary Budapest, Hungary Facility	Helisold Iberica, S.A., Alava, Spain Alava, Spain Facility
Eisenbau Kramer M.B.H., Hilchenbach-Dahlbruch, West Germany Recklinghausen, W. Germany Facility Dahlbruch, W. Germany Facility	Helisold de Venezuela, S.A., Caracas, Venezuela Barcelona, Venezuela Facility
Eisen-und Metallwerke Ferndorf Gerb. Bender, Kreuztal-Ferndorf, West Germany Ferndorf, W. Germany Facility	Hindustan Pipe Udyog, Ltd., New Delhi, India New Delhi, India Facility — plain end
Eisenwerk GmbH, Sulzbach, West Germany Eschweiler, W. Germany Facility	Hoesch Rohr AG, Hamm, West Germany Hamm, W. Germany Facility Dortmund, W. Germany Facility
El Nasr Steel Pipes & Fittings Co., Cairo, Egypt Cairo, Egypt Facility	Huta Ferrum, Katowice, Poland Katowice, Poland Facility
Empresa Brazileira de Solda Eletrica S/A, Rio de Janeiro, Brazil Rio de Janeiro, Brazil Facility — plain end	Huta im. Boleslawa Bieruta, Katowice, Poland Katowice, Poland Facility — plain end
Ets Delcorte, Maubeuge, France Maubeuge, France Facility	HYLSA, S.A., Monterrey, Mexico Monterrey, Mexico Facility
Fabrika Za Zavareni Cevki I Profili, Kumanovo, Yugoslavia Kumanovo, Yugoslavia Facility — plain end	Hyundai Pipe Co. Ltd., Ulsan, Korea Ulsan, Korea Facility
The Far East Machinery Co., Ltd., Chia-Yi, Taiwan Chia-Yi, Taiwan Facility — plain end	IBS, United Tube Mills Corp., Athens, Greece Athens, Greece Facility
F.I.T. Ferrotubi Corbetta S.p.A., Milano, Italy Genova, Italy Facility — plain end	Indus Steel Pipes Ltd., Karachi, Pakistan Karachi, Pakistan Facility
Fornasa S.A., Sao Paulo, Brazil Sao Paulo, Brazil Facility — plain end	Industria Mecanica Orion, S.A., Caracas, Venezuela Caracas, Venezuela Facility
Fort Collins Pipe Co., Fort Collins, CO Fort Collins, CO Facility — plain end	Intreprinderea De Tevi Republica, Bucuresti, Romania Bucuresti, Romania
Fort Worth Pipe Co., Fort Worth, TX Conroe, TX Facility	Intreprinderea De Tevi Roman, Judetul Neamt, Romania Judetul Neamt, Romania Facility
General Sider Europa, Bologna, Italy Bologna, Italy Facility	IPSCO, Regina, Canada Calgary, Alberta, Canada Facility Red Deer, Canada Facility Port Moody, B.C., Canada Facility Regina, Canada Facility Edmonton, Alberta, Canada Facility
Geneva Tube, Inc., Deshler, NE Geneva, NE Facility — plain end	Jianghan Petroleum Machinery Mfg. Corp., Shashi Hubei, PRC Shashi Hubei, PRC Facility — plain end
Grupo Siderpro C.A. (Sideroca), Maracaibo, Venezuela Proacero Facility, Maracaibo, Venezuela Sideroca Facility, Puenta Gorda, Venezuela	Jindal Pipes Ltd., New Delhi, India New Delhi, India Facility — plain end

Kaiser Steel Corp., Fontana, CA Napa, CA Facility Fontana, CA Facility	Middle East Tube Co. Ltd., Haifa, Israel Haifa, Israel Facility — plain end Ramle, Israel Facility — plain end
Kao Hsing Chang Iron & Steel Corp., Kaohsiung, Taiwan Kaohsiung, Taiwan — plain end	Midwest Speciality, Tulsa, OK Tulsa, OK Facility
Karachi Pipe Mills Ltd., Karachi, Pakistan Karachi, Pakistan Facility — plain end	M. Royo S.A.C.I.I.F., Buenos Aires, Argentina Buenos Aires, Argentina Facility — plain end
Kawasaki Steel Corp., Tokyo, Japan Chita Facility Aichi, Japan Chiba, Japan Facility	NAPSCO, Bensalem, PA Bensalem, PA Facility — plain end
Korea Steel Pipe Co., Ltd., Seoul, Korea Inchon, Korea Facility — plain end	National Pipe Co. Ltd., Al-khobar, Saudi Arabia Al-khobar, Saudi Arabia Facility
Kosovska Metalna Industrija Urosevac, Maja, Yugoslavia Maja, Yugoslavia Facility — plain end	National Pipe & Tube, Liberty, TX Liberty, TX Facility
Krakatau Hoogovens International Pipe Industries, Ltd., P.T., Jakarta, Indonesia Cilegon Facility, West Java, Indonesia Cigading Facility, West Java, Indonesia	Newport Steel Corp., Newport, KY Newport, KY Facility — plain end
Kubota, Ltd., Tokyo, Japan Ichi Kawa Facility, Chiba Ken, Japan	Nippon Kokan Kabushiki Kaisha, Tokyo, Japan Keihin Facility, Kawasaki, Japan Fukuyama, Japan Facility — plain end Kanagawa Facility, Yokohama, Japan — plain end
Kuwait Metal Pipe Industries, Kuwait Kuwait Facility	Nippon Steel Corp., Tokyo, Japan Yawata Facility, Kita Kyushu, Japan Hikari City, Japan Facility Nagoya Facility, Tokai City, Japan Kimitsu City, Japan Facility — plain end Tokyo, Japan Facility — plain end
Laclede Steel Co., St. Louis, MO Alton, IL Facility	Nishimura Koki Co., Ltd., Amagasaki, Japan Amagasaki, Japan Facility — plain end
Lone Star Steel, Dallas, TX Lone Star, TX Facility	Northwest Pipe & Casing of Kansas, Atchison, KS Atchison, KS Facility — plain end
LTV Steel Corp., Youngstown, OH Cleveland, OH Facility Youngstown, OH Facility Campbell, OH Facility Counce, TN Facility	Nova Hut Klementa Gottwald, a.s., Kuncice, Czechoslovakia Kuncice, Czechoslovakia Facility
Mannesmannrohren-Werke AG, Dusseldorf, West Germany Muelheim, W. Germany Facility Dusseldorf, W. Germany Facility Remscheid, W. Germany Facility	Nuova Ital sider, Genova, Italy Savona Facility, Genova, Italy — plain end Taranto Facility, Genova, Italy — plain end
Mannesmann S/A, Belo Horizonte, Brazil Belo Horizonte, Brazil Facility	Osaka Tetsuen Kikai Co., Ltd., Osaka, Japan #1 Facility Osaka, Japan — plain end #2 Facility Osaka, Japan — plain end
Mannesmann-Sumerbank Boru Endustrisi, Izmn-Kocaeli, Turkey Izmn-Kocaeli, Turkey Facility	Osaka Tokushu Kokan Mfg., Shiga Ken, Japan Shiga Ken, Japan Facility
Marcegaglia SpA, Ravenna, Italy Cervigano, Italy Facility — plain end Ravenna, Italy Facility — plain end	Paderwerk Gebr. GmbH, Benteler, Paderborn, West Germany Dinslaken, W. Germany Facility
Maruichi American Corp., Santa Fe Springs, CA Santa Fe Springs, CA Facility — plain end	Paragon Industries, Inc., Sapulpa, OK Sapulpa, OK Facility — plain end
Maruichi Steel Tube Ltd., Osaka, Japan Osaka, Japan Facility — plain end	Persico-Pizzamiglio S.A., Sao Paulo, Brazil Sao Paulo, Brazil Facility — plain end
Maverick Tube Corp., Chesterfield, MO Union, MO Facility	Phoenix Steel Corp., Phoenixville, PA Phoenixville, PA Facility — plain end
	Pietra SpA, Brescia, Italy Brescia, Italy Facility — plain end

Pittsburgh Tube, Monaca, PA Darlington/Butler Facility, Monaca, PA	Steel Mains Pty. Ltd., Victoria, Australia Kwinan Facility, Perth, Australia — plain end
Productora Mexicana de Tuberia, Mexico, DF Lazaro Cardenas Michoacan, Mexico Facility — plain end	Steel Pipe Industries (Pty) Ltd., Elandsfontein, South Africa Elandsfontein, South Africa Facility
Productos Tubulares Monclova S.A., Coahuila, Mexico Coahuila, Mexico Facility	Stelco Pipe & Tube, Welland Ontario, Canada Camrose Alberta, Canada Facility Page Hersey Facility, Welland Ontario, Canada Welland Tube Facility, Welland Ontario, Canada
Prudential Steel Ltd., Calgary, Alberta, Canada Calgary, Alberta, Canada Facility — plain end	Structo Dom AB, Storfors, Sweden Storfors, Sweden Facility
P.T. Bakrie Bros., Jakarta, Indonesia Jakarta, Indonesia Facility	Stupp Corp., Baton Rouge, LA Baton Rouge, LA Facility — plain end
P.T. Bakrie Pipe Ind., Jakarta, Indonesia Jakarta, Indonesia Facility	Sumitomo Metal Industries, Ltd., Osaka, Japan Amagasaki, Japan Facility Kainan, Japan Facility Wakayama, Japan Facility Kashima Facility, Ibaraki, Japan — plain end Sumikin Daikei Koka, Sakai, Japan Facility Sumikin Daikei Kakan, Kashima Facility, Ibaraki, Japan
Pusan Steel Pipe Corp., Seoul, Korea Pohang, Korea Facility	Tata Iron & Steel, Jamshedpur, India Jamshedpur, India Facility
Quanex Corp., Houston, TX Bellevue, TX Facility Rosenberg, TX Facility Houston, TX Facility	Tex-Tube Div., Cyclops Corp., Houston, TX Houston, TX Facility
Rautaruukki OY, Pukkila, Finland Pukkila, Finland Facility — plain end Oulainen, Finland Facility — plain end	Theodor Grabener, Werthenbach, West Germany Werthenbach, W. Germany Facility — plain end
Rohrenwerke Bous/Saar GmbH, Bous, West Germany Bous, W. Germany Facility	Thompson Pipe & Steel Co., Denver, CO Denver, CO Facility — plain end
Rohrenwerk Gebr. Fuchs GmbH, Siegen-Kaan, West Germany Siegen-Kaan, W. Germany Facility — plain end	TI Desford Tubes, Ltd., Leicester, England Leicester, England Facility — plain end
Romag Pipes and Machines Ltd., Duding, Switzerland Duding, Switzerland Facility	TOSA, Ltd., Elsburg, South Africa Elsburg, South Africa Facility — plain end
SACILOR, Tube Spiral Division, Paris, France Paris, France Facility	Transformaciones Metalurgicas Especiales, S.A., Madrid, Spain Madrid, Spain Facility — plain end
Seamless Tubes Ltd., Wolverhampton, West Midlands, England Wednesfield, Wolverhampton, England Facility	Tubacero, S.A., Monterrey, Mexico Monterrey, Mexico Facility
S.E.T.A., S.p.A., Brescia, Italy Brescia, Italy Facility	Tubacex-C.E. de Tubos por Extrusion S.A., Llodio (Alava), Spain Llodio, Spain Facility — plain end Amurrio Alava, Spain Facility — plain end
Sider, Annaba, Algeria Annaba, Algeria Facility — plain end	Tubemakers of Australia, Ltd., Newcastle, Australia BTM Div., Facility — Kilburn, S.A. Kembla Grange, Australia Facility Mayfield, Australia Facility
Siderca S.A.I.C., Buenos Aires, Argentina Buenos Aires, Argentina Facility	TUBEMEUSE S.A., Flemalle, Belgium Flemalle, Belgium Facility
Sonco Steel Tube Ltd., Brampton, Ontario, Canada Brampton, Ontario, Canada Facility — plain end	Tuberia Laguna, S.A., Gomez Palacio, Mexico Gomez Palacio, Mexico Facility — plain end
Spiral Welded Pipes Ltd., Auckland, New Zealand Auckland, New Zealand Facility	TUBESA, S.A., Mexico Mexico Facility — plain end
Stahlwerke Peine-Salzgitter AG, Salzgitter, West Germany Salzgitter, W. Germany Facility	
Steel Authority of India Ltd., Rourkela, India Rourkela, India Facility — plain end	

Tubificio Dalmine Italsider S.p.A., Taranto, Italy
Taranto, Italy Facility — plain end

Tubimac Ancona SpA, Ancona, Italy
Ancona, Italy Facility — plain end

Tubos de Acero de Mexico, S.A., Cuauhtemoc, Mexico
Cuauhtemoc, Mexico Facility

Tubos Reunidos, S.A., Bilbao, Spain
Amurrio Facility Alava, Spain — plain end

Umran Spiral Kaynakli Boru Sanayii A.S.,
Istanbul, Turkey
Istanbul, Turkey Facility

Union Steel Mfg., Seoul, Korea
Seoul, Korea Facility — plain end

USS, Div. of USX Corp., Pittsburgh, PA
Fairfield, AL Facility
Geneva Facility Provo, UT
Lorain, OH Facility
Baytown, TX Facility
Fairless Hill, PA Facility

Valcovny, Chomutov, Czechoslovakia
Chomutov, Czechoslovakia Facility

VALEXY, Levallois, France
Levy, France Facility — plain end

Vallourec, Paris Cedex, France
Laigneville, France Facility
Saint Sauve, France Facility
Vitry Le Francois, France Facility
Anzin, France Facility
Aulnoye Aymeries, France Facility
Decazeville, France Facility
DeVille Les Rouen, France Facility

Valmont Industries, Valley, NE
Valley, NE Facility — plain end

Vitkovice Steel and Eng. Works of Klement
Gottwald, Ostrava, Czechoslovakia
Ostrava, Czechoslovakia Facility

Voest-Alpine AG, Kindberg-Aumuhl, Austria
Kindberg, Austria Facility

Westfalenwerk KG Grebe U. Co.,
Kreuztal-Littfeld, West Germany
Kreuztal-Littfeld, W. Germany Facility

Wheatland Tube Co., Wheatland, PA
Wheatland, PA Facility — (buttweld)

Wirsbo Bruks AB, Wirsbo, Sweden
Wirsbo, Sweden Facility

Zeljezara Sisak, Adije, Yugoslavia
Adije, Yugoslavia Facility

Zenith Limited, Maharashtra, India
Maharashtra, India Facility

THREADERS

American International Mfg. Corp., Fort Worth, TX
Fort Worth, TX Facility

Gensco Inc., Houston, TX
Uvalde, TX Facility

International Tool & Supply Co., Inc., Houston, TX
Houston, TX Facility
Channelview, TX Facility
Morgan City, LA Facility

L. B. Foster Co., Houston, TX
Houston, TX Facility
Long Beach, CA Facility

Nippon Kokan Tsugite Kabushiki Kaisha,
Osaka, Japan
Osaka, Japan Facility

Tamotsu Kogyo Kabushiki Kaisha, Tokyo, Japan
Yokohama, Japan Facility

TPS-Technitube GMBH, Daun, West Germany
Daun, W. Germany Facility

Tubos Reunidos, S.A., Bilboa, Spain
Galindo Facility, Vizcaya, Spain

Tubular Finishing Works, Inc., Navasota, TX
Navasota, TX Facility

COUPLINGS, PUP JOINTS, CONNECTORS

Algoma Steel Corp., Ltd., Sault Ste. Marie
Ontario, Canada
Sault Ste. Marie Ontario, Canada Facility

American Int'l. Mfg., Fort Worth, TX
Fort Worth, TX Facility

Arai Iron Works Co., Ltd., Tokyo, Japan
Edogawaku, Japan Facility

Beck Manufacturing, Inc., Waynesboro, PA
Waynesboro, PA Facility

Canvil, Ltd., Simeoe, Ontario, Canada
Edmonton Alberta, Canada Facility

Capitol Manufacturing Co., Columbus, OH
Crowley, LA Facility
Columbus, OH Facility

Conexiones Inoxidables, S.A., Monterrey, Mexico
Monterrey, Mexico Facility

Cronin Tubulars, Ltd., Corby, England
Corby, England Facility

Ets J. Delcorte, Maubeuge, France
Maubeuge, France Facility

Fukuda Kogyo Co., Ltd., Tokyo, Japan
Tokyo, Japan Facility

Gebr. Vetter Fittingsfabrik,
Dusseldorf, West Germany
Dusseldorf, W. Germany Facility

IBS, United Tube Mills Corp., Athens, Greece Athens, Greece Facility	Reinhold Industries, Ltd., Edmonton Alberta, Canada Edmonton Alberta, Canada Facility
Kashiwara Machine Mfg. Co., Ltd., Osaka, Japan Osaka, Japan Facility	Tamotsu Kogyo Co., Ltd., Tokyo, Japan Yokohama, Japan Facility
Kennedy Tubular Products Co., Inc., New Castle, PA New Castle, PA Facility	Tokyo Kinzoku Kogyo K.K., Yokohama, Japan Tokyo, Japan Facility
Lake Country Oil Products, Inc., Pittsburg, TX Pittsburg, TX Facility	Toshin Kogyo Co., Ltd., Tokyo, Japan Tokyo, Japan Facility
L. B. Foster Co., Houston, TX Houston, TX Facility Navasota, TX Facility	TPS-Technitube GMBH, Daun, West Germany Daun, W. Germany Facility
McKean Manufacturing Inc., Custer City, PA Custer City, PA Facility	Tubos Reunidos, S.A., Vizcaya, Spain Galindo Facility, Vizcaya, Spain
Nippon Kokan Tsugite Kabushiki Kaisha, Osaka, Japan Osaka, Japan Facility	Tubular Pipe Maintenance, Inc., Houston, TX Houston, TX Facility
Paderwerk Gebr. Benteler GmbH, Paderborn, West Germany Dinslaken, W. Germany Facility	Wheatland Tube Co., Wheatland, PA Wheatland, PA Facility
Picoma Industries, Inc., Texarkana, TX Texarkana, TX Facility	Wheeling Machine Fittings, Woodlake, CA Woodlake, CA Facility
Production Manufacturing Co., Tulsa, OK Tulsa, OK Facility	Wheeling Machine Products Co., South Pine Bluff, AR Pine Bluff, AR Facility
Pusan Steel Corp., Seoul, Korea Seoul, Korea Facility (couplings only)	

APPENDIX H USE OF API MONOGRAM

The original resolutions adopted by the Board of Directors of the American Petroleum Institute on Oct. 20, 1924, embodied the purpose and conditions under which such official monogram may be used.

The following restatement of the resolutions was adopted by the Board of Directors on November 14, 1977:

WHEREAS, The Board of Directors of the American Petroleum Institute has caused a review of the Institute's program for licensing the use of the API monogram and

WHEREAS, It now appears desirable to restate and clarify such licensing policy and to confirm and make explicitly clear that it is the licensees, not API, who make the representation and warranty that the equipment or material on which they have affixed the API monogram meets the applicable standards and specifications prescribed by the Institute;

NOW, THEREFORE, BE IT RESOLVED, That the purpose of the voluntary Standardization Program and the Monogram Program of the American Petroleum Institute is to establish a procedure by which purchasers of petroleum equipment and material may identify such equipment and materials as are represented and warranted by the manufacturers thereof to conform to applicable standards and specifications of the American Petroleum Institute; and be it further

RESOLVED, That the previous action under which the following monogram was adopted as the official monogram of the American Petroleum Institute is reaffirmed;



BE IT FURTHER RESOLVED, That the American Petroleum Institute's monogram and standardization programs have been beneficial to the general public as well as the petroleum industry and should be continued and the Secretary is hereby authorized to license the use of the monogram to anyone desiring to do so under such terms and conditions as may be authorized by the Board of Directors of the American Petroleum Institute, provided that the licensee shall agree that the use of the monogram by such licensee shall constitute the licensee's representation and warranty that equipment and materials bearing such monogram complies with the applicable standards and specifications of the American Petroleum Institute; and that licensee shall affix the monogram in the following manner;



BE IT FURTHER RESOLVED, That the words "Official Publication" shall be incorporated with said monogram on all such standards and specifications that may hereafter be adopted and published by the American Petroleum Institute, as follows:

OFFICIAL PUBLICATION



REG. U.S. PATENT OFFICE

PROCEDURE FOR OBTAINING AUTHORIZATION TO USE THE API MONOGRAM ON PIPE AND/OR COUPLINGS

H.1 API Monogram. The API monogram —  — is a registered trademark/servicemark of the American Petroleum Institute. Authorization to use the monogram is granted by the Institute to qualified licensees for use as a warranty that they have obtained a valid license to use the monogram and that each individual item which bears the monogram conformed, in every detail, with the API Specification applicable at the time of manufacture. However, the American Petroleum Institute does not represent, warrant or guarantee that products bearing the API monogram do in fact conform to the applicable API standard or specification. Such authorization does not include use of the monogram on letterheads or in advertising without the express statement of fact describing the scope of licensee's authorization and further does not include use of the monogram, the name AMERICAN PETROLEUM INSTITUTE or the description "API" in any advertising or otherwise to indicate API approval or endorsement of products.

The formulation and publication of API Specifications and the API monogram program is not intended in any way to inhibit the purchase of products from companies not licensed to use the API monogram.

H.2 Application for Authority to Use Monogram. Manufacturers desiring to warrant that products manufactured by them comply with the requirements of a given API specification may apply for a license to use the monogram with forms provided in an appendix to each specification. Exhibit B is a typical "Statement of Manufacturer's Qualifications" and Exhibit C is a "License Agreement."

The "Agreement" form must be submitted in duplicate for each specification under which monogram rights are desired. One "Statement of Manufacturer's Qualifications" is required for each facility.

A manufacturer desiring to apply the monogram at more than one facility (a facility is any manufacturing location) must submit a separate application for each facility.

Applicants when so directed by API shall have an approved functioning quality program in conformance with API Spec Q1 prior to being issued a license to use the API monogram.

H.3 Authorization to Use the Monogram. A decision to award or withhold monogram rights will be made by the staff of the Institute. A survey of the applicant's facilities will be made by an approved Institute surveyor prior to a decision to approve or withhold the license. The basis of the survey shall be the appropriate product specification and when determined, all applicable portions of API Spec Q1.

For a manufacturer having more than one facility (plant), each facility will be judged separately and if determined to be eligible for authorization to use the

monogram will be granted a separate license for each Specification, or part thereof, under which authorization is granted. The application of the monogram may not be subcontracted.

H.4 Fee for Use of Monogram.

Initial Authorization Fee. The applicant will be invoiced an initial authorization fee for the first Specification included in the application, and a separate fee for each additional Specification included in the application. The applicant will also be invoiced for the surveyor's fee.

Annual Renewal Fee. In addition to the initial authorization fee, licensees will be assessed an annual renewal fee for each specification under which he is authorized to use the monogram. Applicants issued monogram certificates dated November 1 through December 31 shall not be required to pay a renewal fee for the following year.

The fees assessed are to defray the cost of the Monogram Program.

H.5 Periodic Surveys. Existing licensees must be periodically surveyed by an approved Institute surveyor to determine whether or not they continue to qualify for authorization to use the monogram. The frequency of the periodic surveys will be at the discretion of the staff of the Institute. The surveyor's fee and expenses for making a periodic survey will be paid by the Institute.

H.6 Cancellation of Monogram Rights. The right to use the monogram is subject to cancellation for the following causes:

- a. Applying the monogram on any product that does not meet the Specification.
- b. Failure to maintain reference master gages in accordance with the Specifications.
- c. Failure to meet the requirements of any resurvey.
- d. Failure to pay the annual renewal fee for use of the monogram.
- e. For any other reason satisfactory to the Executive Committee on Standardization of Oilfield Equipment and Materials.

H.7 Reinstatement of Monogram Rights. Manufacturers whose authorization to use the monogram has been cancelled may request reinstatement at any time. If a request for reinstatement is made within sixty (60) days after cancellation, and if the reason for cancellation has been corrected, no new application is necessary. A resurvey of the manufacturer's facilities will be made by an approved Institute surveyor prior to a decision to reinstate monogram rights. The manufacturer will be invoiced for this resurvey regardless of the Institute's

decision on reinstatement. If the resurvey indicates that the manufacturer is qualified, the license will be reissued.

Request for reinstatement made more than sixty (60) days after cancellation shall be treated as a new application unless circumstances dictate an extension of this time period as agreed upon by the API staff.

H.8 Appeals.

An interested party may appeal a decision by the API staff to withhold monogram rights. Appeals shall be directed to the Director, API Production Department and handled by the General Committee of the Production Department with a further right of appeal to the API Management Committee. Competing suppliers or manufacturers of the product or service to which the standard applies or might apply may not be involved in appeals. The General Committee and the Management Committee may convene appeals boards to hear and act on appeals.

H.9 Marking. The following marking requirements apply to licensed manufacturers using the API monogram on products covered by this specification.

H.9.1 Pipe and pipe couplings, manufactured in conformance with this specification, shall be marked by the manufacturer as specified hereinafter.

- a. The required marking on pipe shall be as stipulated in H.9.2.
- b. The required marking on couplings shall be die stamped unless otherwise agreed upon between the purchaser and the manufacturer, in which case they shall be paint stenciled.
- c. Size, weight per foot, length, and hydrostatic test pressure markings shall be in English units except that for pipe intended for use in countries utilizing the metric system; these markings shall be in metric units or both English and metric units, if so specified on the purchase order. If not so specified, for pipe made and intended for use in countries utilizing the metric system, these markings may be given in metric units only, at the option of the manufacturer.

H.9.2 The location and sequence of identification markings shall be as follows:

Location of Markings

1.900 in. OD and smaller — Die stamped on a metal tag fixed to the bundle, or may be printed on the straps or banding clips used to tie the bundle.

Seamless pipe in all other sizes and welded up to 16 in. OD — Paint stencil on the outside surface starting at a point between 18 and 30 inches from the end of the pipe, and in the sequence shown below, except when agreed between the purchaser and the manufacturer some or all of the markings may be placed on the inside surface in a sequence convenient to the manufacturer.

Welded pipe 16 in. OD and larger — Paint stencil on the inside surface starting at a point no less than 6 in. from the end of the pipe in a sequence convenient to the manufacturer, unless otherwise specified by the purchaser.

Sequence of Markings

a. Manufacturer's Name or Mark.

b. API Monogram.

The upper and lower cross bars of the I in the monogram may be omitted. The API monogram shall be applied only to products complying with the requirements of the specification and only by authorized manufacturers. The monogram shall not be applied on any product for which any requirement is indicated to be tentative. (See Appendix H for regulations governing the use of the monogram.)

c. Size.

The size in inches.

d. Weight per Foot.

For sizes 4½ in. and larger, the nominal weight in pounds per foot for threaded-and-coupled pipe (Col. 3, Table 6.1), and the tabulated weight in pounds per foot for plain-end pipe (Table 6.2), shall be paint stenciled.

e. Grade.

The symbols to be used are as follows:

Grade A25	A25
Grade A	A
Grade B	B
Grade X42	X42
Grade X46	X46
Grade X52	X52
Grade X56	X56
Grade X60	X60
Grade X65	X65
Grade X70	X70
Grade X80	X80

For grades intermediate to X42 and X56, the symbol shall be X followed by the first two digits of the specified minimum yield strength.

For all Grades X42 and higher, including intermediate grades, containing columbium, vanadium, and/or titanium, the grade symbol shall be followed by the letter(s) C, V, T, or combination thereof.

By agreement between purchaser and manufacturer and when so specified on the purchase order, the grade shall be identified by color in accordance with Supplementary Requirement SR-3.

NOTE: See Par. 1.1 for limitations on downgrading.

f. Process of Manufacture.

The symbols to be used are as follows:

Seamless pipe	S
Welded pipe, except butt-weld.....	E
Butt-welded pipe	F
Spiral weld pipe	SW

g. Type of Steel.

The symbols to be used are as follows:

Electric-furnace steel	E
Rephosphorized Steel (Class II)	R

NOTE: No type marking is required for open-hearth or basic-oxygen steel.

h. Heat Treatment.

The symbols to be used are as follows:

Normalized or normalized and tempered	HN
Subcritical stress relieved	HS
Subcritical age hardened.....	HA
Quench and Tempered	HQ

i. Test Pressure.

When the specified hydrostatic test pressure is higher than the tabulated pressure (Tables 6.1 and 6.2), the test pressure in pounds per square inch, preceded by the word TESTED, shall be paint stenciled.

j. Supplementary Requirements.

See Appendix E.

Examples:

1. 14 in., 54.57 lb., Grade B, seamless, open-hearth, regular-weight, plain-end pipe shall be paint stenciled as follows:

AB CO ϕ 14.00 54.57 B S

2. 6½ in., 18.97 lb., Grade B, electric-welded, open-hearth, regular-weight, plain-end pipe shall be paint stenciled as follows:

AB CO ϕ 6½ 18.97 B E

3. 4 in., nominal size, Grade A25 butt-welded, Class I open-hearth, standard-weight, threaded line pipe shall be paint stenciled as follows:

AB CO ϕ 4 11.00 A25 F

4. 14 in., 54.57 lb., Grade X42, seamless, open-hearth steel pipe shall be paint stenciled as follows:

AB CO ϕ 14.00 54.57 X42 S

5. 12½ in., 43.77 lb., Grade X42, seamless, open-hearth steel pipe shall be paint stenciled as follows:

AB CO ϕ 12½ 43.77 X42 S

6. 6½ in., 14.97 lb., Grade X42, electric-welded, electric-furnace steel pipe shall be paint stenciled as follows:

AB CO ϕ 6½ 14.97 X42 E E

7. 12½ in., 43.77 lb., Grade X42, submerged-arc, spiral weld, basic oxygen steel pipe shall be paint stenciled as follows:

AB CO ϕ 12½ 43.77 X42 SW

H.9.3 For pipe in sizes 1.900 in. OD and smaller, the identification markings specified in Par. 11.2 shall be placed on the tag, strap, or clip used to tie the bundle.

H.9.4 Length. In addition to the identification markings stipulated in Par. E.9.2 and E.9.3, the length shall be marked as follows:

- a. For pipe in sizes larger than 1.900 in. OD, the length in feet and tenths of a foot, unless otherwise specified on the purchase order, as measured on the finished pipe shall be paint stenciled on the outside surface at a place convenient to the manufacturer, except by agreement between the purchaser and the manufacturer, the length marking may be placed inside the pipe at a convenient location.
- b. For sizes 1.900 in. OD and smaller, the total length of pipe in the bundle in feet and tenths of a foot, unless otherwise specified on the purchase order, shall be marked on the tag, band or clip.

H.9.5 Couplings. All couplings in nominal size 2 in. and larger shall be identified with the manufacturer's name or mark and the API monogram.

H.9.6 Die Stamping. Cold die stamping of grades higher than A25 plate or pipe not subsequently heat treated, and all pipe with wall thickness of 0.156 in. and less is prohibited, except that by agreement between the purchaser and the manufacturer and when so specified on the purchase order, pipe or plate may be cold die stamped. The manufacturer at his option may hot die stamp (200°F, 93°C, or higher) plate or pipe, cold die stamp plate or pipe if it is subsequently heat treated, and cold die stamp couplings. Cold die stamping shall be done with rounded or blunt dies. All die stamping shall be at least 1 in. (25 mm) from the weld for all grades except Grade A25.

H.9.7 Thread Identification. At the manufacturer's option, any pipe threads which conform to the threading and gaging stipulations given in API Std 5B may be identified by stamping or stenciling the product adjacent to such thread, with the manufacturer's name or mark, the size, and the API monogram (Φ) LP to indicate the type of thread. The thread marking may be applied to products which do or do not bear the API monogram. For example, 6 in. API line pipe thread may be marked:

AB CO 6 Φ LP

If the product is clearly marked elsewhere with the manufacturer's identification, his name or mark, as above, may be omitted.

H.11.8 The use of the letters "Spec 5B" as provided in Par. 11.7 shall constitute a certification by the manufacturer that the threads so marked comply with the requirements stipulated in API Std 5B, but should not be construed by the purchaser as a representation that the product so marked is, in its entirety, in accordance with any API specification. Manufacturers who use the letters API for thread identification must have in their possession properly certified API reference master pipe gages.

EXHIBIT C
LICENSE AGREEMENT

Use of the Official Monogram of the American Petroleum Institute

This Agreement between the AMERICAN PETROLEUM INSTITUTE (hereinafter "API"), a corporation of the District of Columbia, having an office at 1220 L — Street, N.W., Washington, D.C., and _____, (hereinafter "Licensee"), a corporation of _____, having its principal place of business at _____ provides that:

WHEREAS, API is the owner of federal trademark and servicemark registrations including registration nos. 677,359; 679,642 and 840,642, as well as the owner of common law rights to such trademarks and servicemarks and various other trademarks and servicemarks;

WHEREAS, API through licensing, publications and other programs seeks to establish and promote standards and specifications for goods and services in the petroleum industry;

WHEREAS, Licensee desires a non-exclusive license from API for the purpose of promoting the standards and specifications of API by use of API trademarks or servicemarks on or in connection with the marketing of goods made in accordance with API standards and specifications.

NOW THEREFORE, in consideration of the mutual covenants hereinafter stated, the parties agree as follows:

1. API grants to Licensee a non-exclusive license to use the trademark/service mark  (the "monogram") on _____ (List here the products on which the monogram is to be applied)

made at its facility located at _____ ("facility")

in accordance with the official publication of API entitled API Spec 5L: Specification for Line Pipe ("the products"), including any amendments, modifications or substitutions that may hereafter be adopted.

2. API grants to Licensee a non-exclusive license to use the monogram in connection with the marketing of the products; provided, however, that Licensee shall not use the monogram on letterheads or in any advertising without an express statement of fact describing the scope of Licensee's authorization, and further provided that Licensee shall not use the monogram or the name the AMERICAN PETROLEUM INSTITUTE or the description "API" in any advertising or otherwise to indicate API approval or endorsement of the products.

3. Licensee agrees that it will do all acts required of it by API to ensure that pertinent API standards and specifications are being met at all times in the manufacture of the products, including submitting when requested by API a statement of manufacturer's qualifications and samples of the products and permitting API, or a representative thereof, upon reasonable notice to inspect pertinent manufacturing facilities. API shall be the sole judge of whether Licensee meets the appropriate qualifications to become and remain a licensee and whether the products meet the appropriate qualifications.

4. Licensee agrees that use of the monogram on the products shall constitute a representation and warranty by Licensee to API and to the purchasers of the products that the products conform to the applicable standards and specifications of API; and Licensee agrees to hold harmless and indemnify API for any and all liability, loss, damage, cost and expense which API may suffer, incur, or be put to by reason of any claim, suit or proceeding, for personal injury, property damage or economic loss based on the failure or alleged failure of the Licensee's products to conform to such standards and specifications; and Licensee further agrees to defend API, at Licensee's expense, against any and all such suits, claims or proceedings.

5. This license solely for the products made by licensee at its facility designated above and shall not be assignable or transferable by Licensee in any manner nor shall Licensee have the right to grant sublicenses.

6. This Agreement may be terminated at any time and for any reason satisfactory to the API.

7. This license shall run for a term of three years unless sooner terminated.

8. Licensee agrees to pay an annual license fee when billed by API.

Date: _____

(Licensee Company Name)

Effective

Date: _____

By _____

Expiration

Date: _____

AMERICAN PETROLEUM INSTITUTE

By _____

AMERICAN PETROLEUM INSTITUTE
PRODUCTION DEPARTMENT
211 N. ERVAY, SUITE 1700
DALLAS TX 75201

EXHIBIT B

STATEMENT OF MANUFACTURER'S QUALIFICATIONS
TO USE API MONOGRAM ON TUBULAR GOODS

The information indicated below, when requested by the Institute, must accompany all applications to use the API monogram. All such information is subject to investigation and applications must be rejected if the information supplied so warrants.

Material: _____
(List here the equipment on which applicant desires to apply the monogram.)

API specification number and title: _____

1. Name of applicant: _____

2. Address: _____

3. Where will equipment be manufactured? _____

4. Class of ownership: _____
(Corporation, partnership, or individual)

5. Capital invested: _____ 6. Year organized: _____

7. Is the applicant thoroughly familiar with all stipulations given in the API specification covering this material? _____

8. Is the applicant actually manufacturing this material now? _____

a. State the length of time applicant has made the material and supplied it to the oil industry:

(Years and Months)

b. State the approximate percentage of production of this material to applicant's total production:

9. Give the names and addresses of five representative users in the oil industry to whom applicant has sold this material (give name of company, complete street address, and name of company representative to whom inquiries should be addressed):

10. List on separate sheet a brief description of major manufacturing facilities, giving size range and grade of tubular products being produced.
11. Does the applicant now possess the necessary equipment and personnel for conducting all tests required in the API specification covering this material? _____
12. Does the applicant now possess API reference master thread gages if required by the specification covering this material? _____
If applicant possesses such gages, attach copy of gage certificates.
13. If the applicant does not now possess such gages, have they been ordered? _____
If so, attach copy of purchase order.
14. Give names of five responsible business men as references regarding applicant's general character, integrity, and reputation. (Give complete mailing address and name of organization with which each is affiliated.)

15. Name and address of applicant's representative to whom API correspondence should be directed:

Name: _____

Mailing Address: _____

Date _____ (Signature and title of authorized officer)

(The above statement to be signed in the name of the applicant by an authorized officer)

PUBLICATIONS LIST

The following publications are under the jurisdiction of the API Committee on Standardization of Tubular Goods and are available from the American Petroleum Institute, Publications and Distribution Section, 1220 L Street, Northwest, Washington, DC 20005, (202) 682-8375.

SPECIFICATIONS

- Spec 5A:** Specification for Casing, Tubing, and Drill Pipe.
Covers seamless steel drill pipe, and seamless and welded steel casing and tubing in various grades. Processes of manufacture, chemical and physical requirements, methods of test, and dimensions are included.
- Spec 5AC:** Specification for Restricted Yield Strength Casing and Tubing.
Covers process of manufacture, chemical and physical requirements, methods of test, and dimensions.
- Spec 5AQ:** Specification for Q125 Casing.
Covers high strength Q125 casing, casing couplings, casing pup joints, connectors and coupling stock or blanks. Processes of manufacture, chemical and physical requirements including toughness requirements, methods of test and dimensions are included.
- Spec 5AX:** Specification for High-Strength Casing, Tubing, and Drill Pipe.
Covers high-strength seamless casing, tubing and drill pipe. Processes of manufacture, chemical and physical requirements, methods of test, and dimensions are included.
- Std 5B:** Specification for Threading, Gaging, and Thread Inspection of Casing, Tubing, and Line Pipe Threads.
Covers dimensional requirements on threads and thread gages, stipulations on gaging practice, gage specifications and certification, as well as instruments and methods for the inspection of threads of round-thread casing and tubing, buttress thread casing, and extreme-line casing, and drill pipe.
- Spec 5I:** Specification for Line Pipe.
Covers seamless and welded steel line pipe in various grades. It includes standard-weight threaded line pipe; and standard-weight, regular-weight, special, extra-strong, and double-extra-strong, plain-end line pipe. Processes of manufacture, chemical and physical requirements, methods of test, and dimensions are included, as well as requirements on coupling and thread protectors.

RECOMMENDED PRACTICES

- RP 5A5:** Recommended Practice for Field Inspection of New Casing, Tubing, and Plain End Drill Pipe; Section VI, Identification of Inspected New Tubular Goods and Couplings, March 1982.
Provides a uniform method for marking inspected tubular goods.
- RP 5B1:** Recommended Practice for Thread Inspection on Casing, Tubing and Line Pipe.
The purpose of this recommended practice is to provide guidance and instructions on the correct use of thread inspection techniques and equipment.

- RP 5C1:** Recommended Practice for Care and Use of Casing and Tubing.
Covers use, transportation, storage, handling, and reconditioning of casing and tubing.
- RP 5L1:** Recommended Practice for Railroad Transportation of Line Pipe.
Provides a recommended procedure for loading line pipe on railroad cars.
- RP 5L2:** Recommended Practice for Internal Coating of Line Pipe for Non-Corrosive Gas Transmission Services.
Covers coating materials, application practices and inspection of internal coatings on new pipe.
- RP 5L3:** Recommended Practice for Conducting Drop-Weight Tear Tests on Line Pipe.
Describes a recommended method for conducting drop-weight tear tests on line pipe 20 in. OD and larger with wall thicknesses 0.750 in. and less.
- RP 5L5:** Recommended Practice for Marine Transportation of Line Pipe.
Provides recommendations for transportation of line pipe in sizes 10 $\frac{3}{4}$ in. OD and larger by seagoing vessels.
- RP 5L6:** Recommended Practice for Transportation of Line Pipe on Inland Waterways, First Edition, March 1979.
Provides recommendations for transportation of line pipe in sizes 10 $\frac{3}{4}$ in. OD and larger on inland waterways.
- RP 5L7:** Recommended Practices for Unprimed Internal Fusion Bonded Epoxy Coating of Line Pipe.
Covers recommendations for coating materials, application, testing, and inspection of internal fusion bonded epoxy coatings on unused line pipe prior to installation.

BULLETINS

- Bul 5A2:** Bulletin on Thread Compounds.
Provides material requirements and performance tests for two grades of thread compound for use on oil-field tubular goods.
- Bul 5C2:** Bulletin on Performance Properties of Casing and Tubing.
Covers collapsing pressures, internal yield pressures, and joint strengths of casing and tubing and minimum yield load for drill pipe.
- Bul 5C3:** Bulletin on Formulas and Calculations for Casing, Tubing, Drill Pipe, and Line Pipe Properties.
Provides formulas used in the calculations of various pipe properties, also background information regarding their development and use.
- Bul 5C4:** Bulletin on Round Thread Casing Joint Strength with Combined Internal Pressure and Bending.
Provides joint strength of round thread casing when subject to combined bending and internal pressure.
- Bul 5T1:** Bulletin on Imperfection Terminology.
Provides definitions in English, French, German, Italian, Japanese, and Spanish for a number of imperfections which commonly occur in steel pipe.