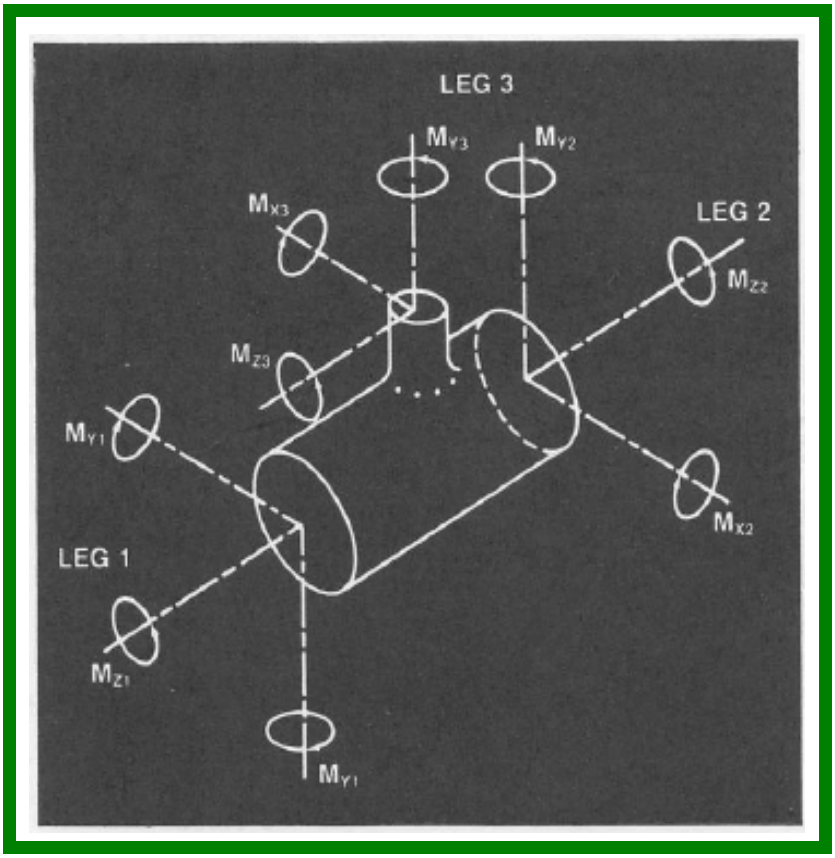
Piping Stress Handbook

Second Edition



Victor Helguero M.

Piping Stress Handbook

Second Edition

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Dedicated to my mother, Blanca Maceda; my father, Victor Helguero B.; my brother, Guillermo Helguero; my wife, Maria Elena; and my children, who provide the essential inspiration for all my efforts.

Piping Stress Handbook

Second Edition

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Contents

Preface

Determining piping stresses for the design of petrochemical and power plant piping systems involves many complex mathematical calculations. These calculations can be solved with the aid of any one of several computer programs available provided they have the required capacity and an acceptable input/output format. The most formidable task facing the engineer is compiling the extensive amount of data needed to run the program. These data include physical properties, allowable stresses, valve weights and dimensions, stress intensification factors, thermal expansion coefficients, spring hangers and expansion joint selection, and piping wind loads.

This reference book provides formulas, technical data, and other pertinent design information not readily available in a single source for the piping stress analyst in the petrochemical industry who often has difficulty collecting the required data and solutions to complete a piping stress analysis. Depending on the magnitude and complexity of the job, the data needed to complete a given task may be scattered throughout a host of sources. The author's aim is to bring together in a single reference all the above material and present it in a convenient form.

Much of the information included in this book was obtained from the work of others; some was used in its original form, while some was rearranged for this application.

The author wishes to acknowledge his indebtedness to Mr. Robert Kingshill, Virender Shukla, and Timothy W. Calk for their assistance in preparing this handbook; and the American Society of Mechanical Engineers which generously permitted the author to use several equations to develop tabulations contained in this handbook.

Suggestions and criticism concerning errors that may remain in spite of all precautions will be greatly appreciated. They will contribute to the further improvement of this reference handbook.

Victor Helguero M., P.E.

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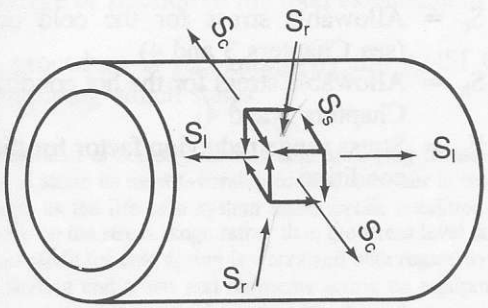
Basic Theory of Pipe Stress and ANSI/ASME Codes B31.1, B31.3, B31.4, and B31.8 Pipe Stress Compliances

Pipe Stress Theory

To understand the basic criteria of the ANSI* pressure piping code, it will be useful to explain the way different stresses develop when a piping element is subjected to a number of loading conditions. There are four main stresses that affect a piping element, as shown in Figure 1-1. The following gives the intensity of these stresses and the manner in which they may be combined:

* For reasons of space these codes will be designated ANSI codes throughout the text of the book. Some readers may be more familiar with the designation ANSI/ASME as indicated in the headings.



S_l = Longitudinal stress and the sum of three component parts (see Equation 1-1).
S_c = Circumferential stress
S_r = Radial stress
S_s = Shear stress

Figure 1-1. Stress-free-body diagram.

The bending stress due to temperature, weight of pipe, contents, insulation, snow and ice, wind or earthquake is calculated by the following equation:

$$S_b = \frac{\sqrt{(M_i I_i)^2 + (M_o I_o)^2}}{Z}$$

where S_b = Bending stress
I_i = In-plane stress intensification factor
I_o = Out-of-plane stress intensification factor
M_i = In-plane moment, lb-in.
M_o = Out-of-plane moment, lb-in.
Z = Section modulus of pipe, in.^{3}

The direct longitudinal stress due to temperature and weight is calculated as follows:

$$S_{dl} = \frac{F_a}{A}$$

where A = Metal pipe cross-sectional area, in.^{2}
F_a = Direct force, lb

The longitudinal stress due to internal pressure is calculated as follows:

$$S_p = \frac{PD}{4t}$$

where P = Internal pressure
D = Outside diameter of pipe (see Chapter 10)
t = Pipe wall thickness (see Chapter 10)

$S_3 = 0$ (shear)

Both significant stresses act in the same direction; therefore the stresses are "additive," i.e.

$$S_l = S_b + S_p + S_{dl} \quad (1\text{-}1)$$

Note: Longitudinal stresses due to temperature are excluded from the combination when doing code calculations.

Circumferential stress, S_c, is primarily due to internal pressure:

$$S_c = \frac{PD}{2t}$$

Radial stress, S_r, is primarily due to internal pressure, which is equal to P.

$$S_r = P$$

Shear stress, S_s, is the sum of two component parts: tortional stress and direct shear stress (the second stress is usually negligible). (This condition occurs in three-dimensional piping systems.)

$$S_s = \frac{T}{2Z} + 2.0\,\frac{F_s}{A}$$

where S_s = Shear stress
T = Torque, lb-in.
F_s = Resultant shear force
A = Cross-sectional area of pipe
Z = Section modulus of pipe
S_t = T/2Z, tortional stress

While the ANSI pressure piping code considers stresses due to thermal expansion separately from primary stresses due to pressure, weight, and external loadings, it is obvious that when combined stresses formulas and a specific yield criterion exist, stresses from all loadings should be included to determine the principal stresses before confirming them. Resultant principal stresses at the outside fiber are as follows:

$$S_1 = 1/2\,[S_l + S_c + \sqrt{4S_t^2 + (S_l - S_c)^2}]$$

$$S_2 = 1/2\,[S_l + S_c - \sqrt{4S_t^2 + (S_l - S_c)^2}]$$

To calculate the principal stresses use S_1 or S_2, whichever is greater, or the following equation:

$$\sqrt{4S_t^2 + (S_l - S_c)^2} \quad (1\text{-}2)$$

The preceding method is known as the maximum shear theory (Tresca) and is the preferred method of the ANSI Code. A second method, known as the distortion-energy theory (Von Mises), also provides good results but is not used by the Code:

$$\sqrt{3S_t^2 + S_l^2 + S_c^2 + S_lS_c}$$

Expansion Stresses

The ANSI pressure piping code recognizes that stress due to thermal expansion tends to diminish with time as a result of local yielding or creep. This reduction of stress will appear as a stress of opposite sign in the cold condition. This phenomenon is known as *self springing*. Cold springing is similar, and although the hot stresses tend to diminish with time, the sum of the hot and cold stresses for any one cycle will remain practically constant. This sum is called the *stress range*, and the code for pressure piping defines this allowable expansion stress range established for thermal expansion in terms of hot and cold tabular S values as:

$$S_a = F\,(1.25\,S_c + 0.25\,S_h)$$

where S_a = Allowable expansion stress range (see Chapters 3 and 4)
S_c = Allowable stress for the cold condition (see Chapters 3 and 4)
S_h = Allowable stress for the hot condition (see Chapters 3 and 4)
F = Stress range reduction factor for the cyclic condition

Total No. of Cycles Over Expected Life	F
7,000 and less	1.0
14,000 and less	0.9
22,000 and less	0.8
45,000 and less	0.7
100,000 and less	0.6
250,000 and less	0.5

The stress due to thermal expansion, which must not exceed the allowable expansion range, is called *expansion stress* and is defined by the piping code as:

$$S_e = \sqrt{(S_b)^2 + 4(S_t)^2}$$

See Equation 1-2, where $S_p = 0$ and $S_l = S_b$

The piping code further states that the sum of the longitudinal stresses due to pressure, weight, and other sustained external loadings shall not exceed S_h. If the longitudinal stress due to sustained loadings is less than S_h, the code permits the unused portion to be applied to extend the stress range available for expansion effects. Therefore, the code, in effect, permits a total equal to 1.25 $(S_c + S_h)$, for thermal expansion stress combined with stresses from other sustained loadings.

Cold Springing

A piping system may be *cold sprung*, or *prestressed*, to reduce anchor forces and moments caused by thermal expansion or contraction. This is accomplished by shortening or lengthening the overall length of pipe by any desired amount not in excess of the calculated expansion. The amount of cold spring (C. S.) is usually expressed as a percentage or fraction of the total expansion or contraction.

This procedure is recognized by the ANSI Code for pressure piping which states:

> The beneficial effect of judicious cold springing in assisting the system to attain its most favorable condition sooner is recognized. Inasmuch as the life of a system under cyclic condition depends primarily on the stress range rather than the stress level at any one time, no credit for cold spring is warranted with regard to stresses. In calculating end trusts and moments acting on equipment containing moving or removable parts with close clearances, the actual reactions at any one time rather than their range are significant, and credit accordingly is allowed for cold spring in the calculations of thrusts and moments.

The reactions (forces and moments) R_h and R_c in the hot and cold conditions, respectively, obtained as follows from the reactions, R, are derived from the flexibility calculations based on the modulus of elasticity at room temperature, E_c:

$$R_h = (1 - 2/3C)\left(\frac{E_h}{E_c}\right) R$$

$$R_c = CR$$

or

$$R_c = \left[1 - \frac{S_h}{S_e} \times \frac{E_c}{E_h}\right] R$$

These relationships apply only to two-anchor piping systems with no intermediate restraints (use whichever equation is greater) and with the further condition that

$$\frac{S_h}{S_e} \times \frac{E_c}{E_h} < 1$$

where C = Cold-spring factor varying from zero for no cold spring to one for 100% cold spring
S_e = Maximum computed expansion stress
E_c = Modulus of elasticity in the cold condition
E_h = Modulus of elasticity in the hot condition
R = Range of reactions corresponding to the full expansion range based on E_c

R_c and R_h represent the maximum reactions estimated to occur in the cold and hot conditions, respectively.

Thus, the ANSI piping code does not allow any credit for cold springing in the computation of stress. For reactions in the hot condition credit may be taken for two-thirds of the actual cold spring applied; however, the full amount of cold sping must be taken into account in computing reactions for the cold condition.

To understand the effects of stress range, self springing, and cold springing, see Figure 1-2.

ANSI B31.1 Power Piping Code Stress Compliances (1983)

The standard terms, used in the equations set forth in the ANSI code, are defined as follows:

i = Stress intensification factor. The term (0.75i) shall never be taken as less than 1.0
Z = Section modulus, in., $Z = r_m^2 t_n \pi$
r_m = Mean radius, in.
D_o = Outside diameter, in.
t_n = Nominal wall thickness, in.

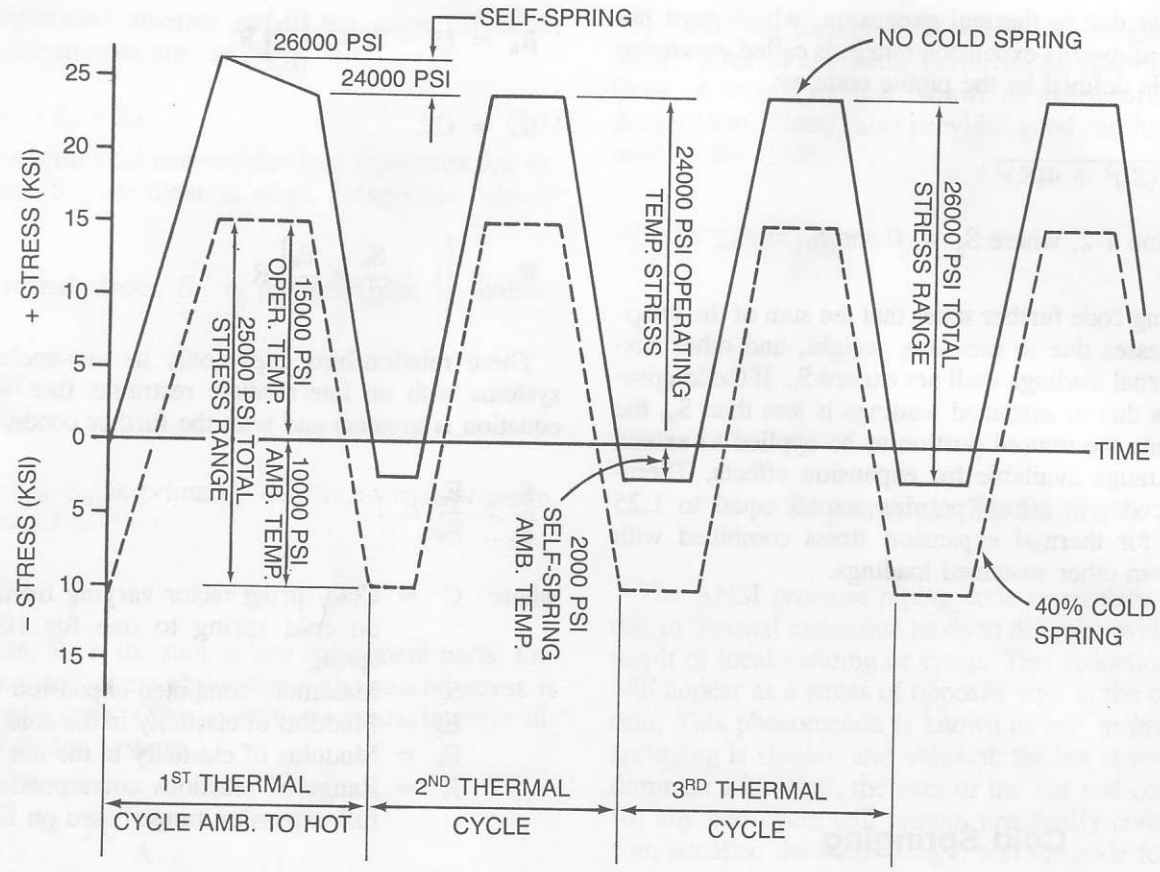


Figure 1-2. Stress-range curve with and without cold spring.

P = Internal design pressure

M_a = Resultant moment loading due to weight and other sustained loads, in.-lbs

M_b = Resultant moment loading due to occasional loads, including earthquake loads, trusts from relief/safety valve loads, in.-lbs

M_c = Range of resultant moments due to thermal expansion/contraction, in.-lbs

K = 1.15 for occasional loads acting less than 10% of the operation period

K = 1.20 for occasional loads acting less than 1% of the operation period

S_{lp} = Longitudinal stress due to pressure, psi

S_{ls} = Longitudinal stress due to sustained loads, psi

S_{lo} = Longitudinal stress due to occasional loads, psi

S_e = Thermal expansion stress due to thermal expansion and anchor displacements, psi

$S_{ls} + S_e$ = Longitudinal stress due to sustained loads plus the thermal expansion stress, psi

S_a = Allowable stress range for expansion stresses.
$S_a = f(1.25\ S_c + 0.25\ S_h)$
(see Chapter 4)

S_c = Basic material allowable stress at minimum temperature from allowable stress tables, psi

S_h = Basic material allowable stress at maximum temperature from allowable stress tables, psi

f = Stress range reduction factor for cyclic conditions for total number N of full-temperature cycles over total number of years of system operation (see "Expansion Stresses")

t_n = Wall thickness, in.

y = Coefficient having values as given in the ANSI Code B31.1, Table 104.1.2(A)

SE = Maximum allowable stress in material due to internal pressure and joint efficiency at the design temperature

Pressure Design

The minimum wall thickness for straight pipe under internal pressure and temperatures not exceeding those for various materials listed in the allowable stress tables, including allowances for mechanical strength, should not be less than that determined by this equation (Section 104.1.2, Equation 3):

$$t_m = \left[\frac{PD_o}{2(SE + PY)} + A\right] \qquad \text{(see Chapter 7)}$$

The design pressure should not exceed:

$$P = \frac{2SE\,(t_m - A)}{D_o - 2Y\,(t_m - A)} \qquad \text{(see Chapter 7)}$$

where t_m = minimum required wall thickness, in. (mm)

If pipe is ordered by its nominal thickness, the manufacturing tolerances must be taken into account. This minimum thickness must be increased to provide the increase of manufactured tolerance allowed by the applicable specification or required by the process. The next heavier commercial thickness should be selected.

External Pressure

To determine wall thickness and stiffening requirements for straight pipe under external pressure, the procedures outlined in paragraphs UG-28, UG-29, and UG-30 of Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code should be followed.

Longitudinal Stress

The internal pressure stress, S_{lp}, should be determined by the following equation:

$$S_{lp} = \frac{PD_o}{4t_n}$$

Thermal Expansion Stress

The thermal expansion stress is calculated using the following Code equation:

$$S_e = (iM_c/Z)$$

where M_c is combined in the following manner:

$$M_c = (M_x^2 + M_y^2 + M_z^2)^{1/2}$$

For full size outlet connections the equation is:

$$Z = \pi\, r_h^2 t_h$$

where t_h = Nominal wall thickness of the run pipe

For reduced outlet branch connections the equation is (see Figure 1-3):

$$Z = \pi\, r_b^2 t_s$$

where r_b = Branch mean cross sectional radius, in.
t_s = Effective branch wall thickness, in. = lesser of t_h or (i) t_b
t_b = Nominal branch wall thickness, in.
t_h = Nominal thickness of run pipe, in.

Sustained Longitudinal Stress

The sustained longitudinal stress, S_{ls}, is the algebraic summation of the longitudinal pressure stress and longitudinal sustained weight stress. S_{ls} is calculated using the following Code equation (Section 104.8.1, Equation 11):

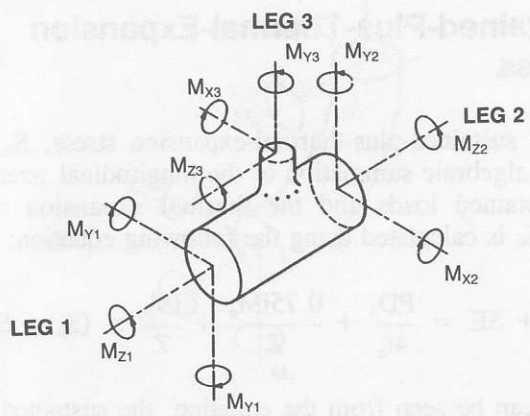


Figure 1-3. Header and branch connections.

$$S_{ls} = \frac{PD_o}{4t_n} + \frac{0.75iM_A}{Z} \leq 1.0Sh$$

(see Chapter 3 for S_h)

As can be seen from the equation, the longitudinal stress due to pressure, weight, and other sustained loads should be less than or equal to the S_h for the material.

Occasional Longitudinal Stress

The occasional longitudinal stress, S_{lo}, is the algebraic summation of the longitudinal sustained weight stress, the longitudinal pressure stress, and occasional stress. S_{lo} is calculated using the following Code equation (Section 104.8.2, Equation 12):

$$S_{lo} = \frac{PD_o}{4t_n} + \frac{0.75iM_a}{Z} + \frac{0.75iM_b}{Z} \leq K\,S_h$$

As can be seen from the equation, the longitudinal stress due to occasional loads should be less than or equal to k S_h.

Allowable Thermal Expansion Stress

The thermal expansion stress is calculated using the following Code equation (Section 104.8.3 (A), Equation 13):

$$S_e = iM_c/Z \leq S_a + f(S_h - S_l) \text{(see Chapter 3 for } S_a\text{)}$$

As can be seen from the equation, the thermal expansion stress should be less than or equal to S_a.

Sustained-Plus-Thermal-Expansion Stress

The sustained-plus-thermal-expansion stress, $S_{ls} + S_e$, is the algebraic summation of the longitudinal stress due to sustained loads and the thermal expansion stress. $S_{ls} + S_e$ is calculated using the following equation:

$$S_{ls} + SE = \frac{PD_o}{4t_n} + \frac{0.75iM_a}{Z} + \frac{iM_c}{Z} \leq (S_h + S_a)$$

As can be seen from the equation, the sustained-plus-thermal-expansion stress should be less than or equal to the sum of S_h and S_a.

ANSI B31.3 Chemical Plant and Petroleum Refinery Piping Code Stress Compliances (1984)

Pressure Stress

The minimum allowed wall thickness is calculated by using the design pressure in the following equation:

$$t_m = \frac{(P)\ (O.\ D.)}{2\ (SE + yP)} + A \qquad \text{(see Chapter 6)}$$

where
- P = Design pressure, psig
- O. D. = Actual pipe outside diameter, in.
- SE = Maximum allowable stress in material due to internal pressure and joint efficiency
- y = A coefficient having values as given in the ANSI Code, Table 304.1.1, A; normally 0.4
- .875 = A factor used to account to the industry's 12.5% mill tolerance on finished-wall thicknesses
- A = Allowance for corrosion, erosion, etc., in.

The allowed pressure is calculated by using:

$$P_{allow} = \frac{2\ (SE)\ (t_m - A)}{O.\ D. - 2y\ (t_m - A)} \qquad \text{(see Chapter 6)}$$

where
- t_m = .875 × wall thickness, in.
- SE = Maximum allowable stress of the material for internal pressure considering the joint efficiency

Expansion Stress

The expansion stress is calculated using the Code equation (Section 319.4.4, Equation 17).

$$S_e = (S_b^2 + 4S_t^2)^{1/2}$$

where
- S_e = Computed expansion stress, psi
- S_b = Resultant bending stress, psi
- S_b = $[(i_iM_i)^2 + (i_oM_o)^2]^{1/2}/Z$
- S_t = Torsional stress, psi, = $M_t/2Z$
- M_i = In-plane bending moment, in.-lb
- M_o = Out-of-plane bending moment, in.-lb

M_t = Torsional moment on cross section, in.-lb
Z = Section modulus of pipe, in.^{3}
i = Stress intensification factor (see Chapter 5)

For branch connections, the resultant bending stress (S_b) is calculated using the Code equations (Section 319.4.4, Equations 19 and 20):

For the header (Legs 1 and 2 in Figure 1-3):

$$S_b = \frac{[(i_i M_i)^2 + (i_o M_o)^2]^{1/2}}{Z}$$

For the branch (Leg 3):

$$S_b = \frac{[(i_i M_i)^2 + (i_o M_o)^2]^{1/2}}{Z_e}$$

where S_b = Resultant bending stress, psi
Z_e = Effective section modulus for the branch, in.^{3}, $= r_m^2 t_s \pi$
r_m = Mean branch cross-sectional radius, in.
t_s = Effective branch wall thickness, in., = lesser of t_h and $(i_o)(t_b)$
t_h = Thickness of pipe matching run of tee or header exclusive of reinforcing pad or saddle, in.
t_b = Thickness of pipe matching branch, in.
i_o = Out-of-plane stress intensification factor
i_i = In-plane stress intensification factor

For elbows and miter bends, the resultant bending stresses (S_b) calculated using the Code equation (Section 319.4.4, Equation 18):

S_b = Resultant bending stress, psi

$$S_b = \frac{[(i_i M_i)^2 + (i_o M_o)^2]^{1/2}}{Z}$$

where i_i = In-plane stress intensification factor
i_o = Out-of-plane stress intensification factor
M_i = In-plane bending bending moment, in.-lb (see Figure 1-4)
M_o = Out-of-plane bending moment, in.-lb (see Figure 1-4)
Z = Section modulus of pipe, in.^{3}

A conservative equation generally utilized for the calculation of the allowable expansion stress range is given in the ANSI Code B31.3 Section 302.3.58d, Equation 1:

$$S_a = f\,(1.25\,S_c + .25\,S_h)$$ (see Chapter 4)

ANSI B31.4 Liquid Petroleum Transportation Piping Code Stress Compliances

Pressure Stress

The minimum allowed wall-thickness pressure stress is calculated by using the internal pressure in the equation:

$$t_{allow} = \frac{P\,D_o}{2\,S} + A$$

where P = Pressure, psig
D_o = Actual pipe outside diameter, in.
A = Allowance for corrosion, erosion, etc., in.
S = (0.72) (E) (SMYS), psi
SMYS = Specified minimum yield strength, psi, Table 1-1
E = Weld joint factor, Table 1-2

Longitudinal Stress

The longitudinal pressure stress is computed in accordance with the Code using the equation:

$$S_{lp} = \frac{P\,D_o}{4t}$$

where S_{lp} = Longitudinal pressure stress, psi
P = Internal pressure, psig
t = Actual pipe wall thickness, in.
D_o = Nominal outside diameter of the pipe, in.

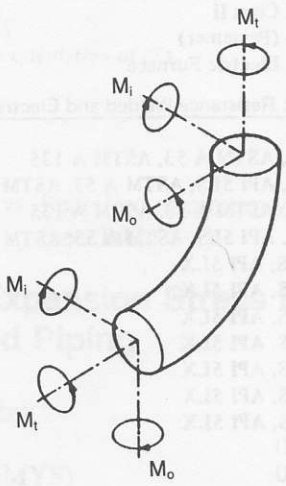


Figure 1-4. In-plane and out-of-plane bending moments.

Table 1-1
Tabulation of Examples of Allowable Stresses for Reference Use in Liquid Petroleum Transportation Piping Systems

Allowable stress values (S) shown in this Table are equal to 0.72 × E (weld joint factor) × specified minimum yield strength of the pipe.

Allowable stress values shown are for new pipe of known specification. Allowable stress values for new pipe of unknown specification, ASTM A 120 specification or used (reclaimed) pipe shall be determined in accordance with 402.3.1.

For some Code computations, particularly with regard to branch connections [see 404.3.1 (d) (3)] and expansion, flexibility, structural attachments, supports, and restraints (Chapter II, Part 5), the weld joint factor E need not be considered.

For specified minimum yield strength of other grades in approved specifications, refer to that particular specification.

Allowable stress value for cold worked pipe subsequently heated to 600 F or higher (welding excepted) shall be 75 percent of value listed in Table.

Definitions for the various types of pipe are given in 400.2.

Specification	Grade	Specified Min Yield Strength psi	Notes	(E) Weld Joint Factor	(S) Allowable Stress Value −20 F to 250 F psi
Seamless					
API 5L	A25	25,000	(1)	1.00	18,000
API 5L, ASTM A 53, ASTM A 106	A	30,000	(1) (2)	1.00	21,600
API 5L, ASTM A 53, ASTM A 106	B	35,000	(1) (2)	1.00	25,200
ASTM A 106	C	40,000	(1) (2)	1.00	28,800
ASTM A 524	I	35,000	(1)	1.00	25,200
ASTM A 524	II	30,000	(1)	1.00	21,600
API 5LU	U80	80,000	(1) (4)	1.00	57,600
API 5LU	U100	100,000	(1) (4)	1.00	72,000
API 5LX	X42	42,000	(1) (2) (4)	1.00	30,250
API 5LX	X46	46,000	(1) (2) (4)	1.00	33,100
API 5LX	X52	52,000	(1) (2) (4)	1.00	37,450
API 5LX	X56	56,000	(1) (4)	1.00	40,300
API 5LX	X60	60,000	(1) (4)	1.00	43,200
API 5LX	X65	65,000	(1) (4)	1.00	46,800
API 5LX	X70	70,000	(1) (4)	1.00	50,400
Furnace Welded-Butt Welded					
ASTM A 53		25,000	(1) (2)	0.60	10,800
API 5L Class I & Class II	A25	25,000	(1) (2) (3)	0.60	10,800
API 5L (Bessemer), ASTM A 53 (Bessemer)		30,000	(1) (2) (5)	0.60	12,950
Furnace Welded-Lap Welded					
API 5L Class I		25,000	(1) (2) (6)	0.80	14,400
API 5L Class II		28,000	(1) (2) (6)	0.80	16,150
API 5L (Bessemer)		30,000	(1) (2) (6)	0.80	17,300
API 5L Electric Furnace		25,000	(1) (2) (6)	0.80	14,400
Electric Resistance Welded and Electric Flash Welded					
API 5L	A25	25,000	(1) (7)	1.00	18,000
API 5L, ASTM A 53, ASTM A 135	A	30,000	(2)	0.85	18,360
API 5L, API 5LS, ASTM A 53, ASTM A 135	A	30,000	(1)	1.00	21,600
API 5L, ASTM A 53, ASTM A 135	B	35,000	(2)	0.85	21,420
API 5L, API 5LS, ASTM A 53, ASTM A 135	B	35,000	(1)	1.00	25,200
API 5LS, API 5LX	X42	42,000	(1) (2) (4)	1.00	30,250
API 5LS, API 5LX	X46	46,000	(1) (2) (4)	1.00	33,100
API 5LS, API 5LX	X52	52,000	(1) (2) (4)	1.00	37,450
API 5LS, API 5LX	X56	56,000	(1) (4)	1.00	40,300
API 5LS, API 5LX	X60	60,000	(1) (4)	1.00	43,200
API 5LS, API 5LX	X65	65,000	(1) (4)	1.00	46,800
API 5LS, API 5LX	X70	70,000	(1) (4)	1.00	50,400
API 5LU	U80	80,000	(1) (4)	1.00	57,600
API 5LU	U100	100,000	(1) (4)	1.00	72,000

Reproduced from ANSI/ASME Code B31.4-1979, Table 402.3.1. Reprinted courtesy of The American Society of Mechanical Engineers.

Table 1-1
Continued

Specification	Grade	Specified Min Yield Strength psi	Notes	(*E*) Weld Joint Factor	(*S*) Allowable Stress Value −20 F to 250 F psi
Electric Fusion Welded					
ASTM A 134	–	–		0.80	–
ASTM A 139	A	30,000	(1) (2)	0.80	17,300
ASTM A 139	B	35,000	(1) (2)	0.80	20,150
ASTM A 155	–	–	(2) (8)	0.90	–
ASTM A 155	–	–	(1) (8)	1.00	–
Submerged Arc Welded					
API 5L, API 5LS	A	30,000	(1)	1.00	21,600
API 5L, API 5LS	B	35,000	(1)	1.00	25,200
API 5LS, API 5LX	X42	42,000	(1) (2) (4)	1.00	30,250
API 5LS, API 5LX	X46	46,000	(1) (2) (4)	1.00	33,100
API 5LS, API 5LX	X52	52,000	(1) (2) (4)	1.00	37,450
API 5LS, API 5LX	X56	56,000	(1) (4)	1.00	40,300
API 5LS, API 5LX	X60	60,000	(1) (4)	1.00	43,200
API 5LS, API 5LX	X65	65,000	(1) (4)	1.00	46,800
API 5LS, API 5LX	X70	70,000	(1) (4)	1.00	50,400
API 5LU	U80	80,000	(1) (4)	1.00	57,600
API 5LU	U100	100,000	(1) (4)	1.00	72,000
ASTM A 381	Y35	35,000	(1) (2)	1.00	25,200
ASTM A 381	Y42	42,000	(1) (2)	1.00	30,250
ASTM A 381	Y46	46,000	(1) (2)	1.00	33,100
ASTM A 381	Y48	48,000	(1) (2)	1.00	34,550
ASTM A 381	Y50	50,000	(1)	1.00	36,000
ASTM A 381	Y52	52,000	(1)	1.00	37,450
ASTM A 381	Y60	60,000	(1)	1.00	43,200
ASTM A 381	Y65	65,000	(1)	1.00	46,800

NOTES (1) Weld joint factor *E* (see Table 402.4.3) and allowable stress value are applicable to pipe manufactured after 1958.
(2) Weld joint factor *E* (see Table 402.4.3) and allowable stress value are applicable to pipe manufactured before 1959.
(3) Class II produced under API 5L 23rd Edition, 1968, or earlier has a specified minimum yield strength of 28,000 psi.
(4) Other grades provided for in API 5LS, API 5LU, and API 5LX not precluded.
(5) Manufacture was discontinued and process deleted from API 5L in 1969.
(6) Manufacture was discontinued and process deleted from API 5L in 1962.
(7) A25 is not produced in electric flash weld.
(8) See applicable plate specification for yield point and refer to 402.3.1 for calculation of (*S*).

Allowable Longitudinal Stress

The allowable stress value for additive longitudinal stresses is given by the Code in Section 419.6.4(c):

$$S_l \text{ (allow)} = 0.75\ S_a$$

where S_a = The allowable expansion stress range, psi
= 0.72 SMYS

where SMYS = Specified minimum yield strength, psi (see Table 1-1)

Allowable Expansion Stress Range for Unrestrained Piping

This is given by:

$$S_a = 0.72\ (\text{SMYS})$$

where SMYS = Specified minimum yield strength, psi (see Table 1-1)

Table 1-2
Weld Joint Factor *E*

Specification Number	Pipe Type (1)	Weld Joint Factor *E*	
		Pipe Mfrd. Before 1959	Pipe Mfrd. After 1958
ASTM A 53	Seamless	1.00	1.00
	Electric-Resistance-Welded	0.85 (2)	1.00
	Furnace Lap-Welded	0.80	0.80
	Furnace Butt-Welded	0.60	0.60
ASTM A 106	Seamless	1.00	1.00
ASTM A 134	Electric-Fusion (Arc)-Welded single or double pass	0.80	0.80
ASTM A 135	Electric-Resistance-Welded	0.85 (2)	1.00
ASTM A 139	Electric-Fusion-Welded single or double pass	0.80	0.80
ASTM A 155	Electric-Fusion-Welded	0.90	1.00
ASTM A 381	Electric-Fusion-Welded, Double Submerged Arc-Welded	–	1.00
API 5L	Seamless	1.00	1.00
	Electric-Resistance-Welded	0.85 (2)	1.00
	Electric-Flash-Welded	0.85 (2)	1.00
	Electric-Induction-Welded	–	1.00
	Submerged Arc-Welded	–	1.00
	Furnace Lap-Welded	0.80	0.80 (3)
	Furnace Butt-Welded	0.60	0.60
API 5LS	Electric-Resistance-Welded	–	1.00
	Submerged Arc-Welded	–	1.00
API 5LX	Seamless	1.00	1.00
	Electric-Resistance-Welded	1.00	1.00
	Electric-Flash-Welded	1.00	1.00
	Electric-Induction-Welded	–	1.00
	Submerged Arc-Welded	1.00	1.00
API 5LU	Seamless	–	1.00
	Electric-Resistance-Welded	–	1.00
	Electric-Flash-Welded	–	1.00
	Electric-Induction-Welded	–	1.00
	Submerged Arc-Welded	–	1.00
Known	Known	(4)	(5)
Unknown	Seamless	1.00 (6)	1.00 (6)
Unknown	Electric-Resistance or Flash-Welded	0.85 (6)	1.00 (6)
Unknown	Electric-Fusion-Welded	0.80 (6)	0.80 (6)
Unknown	Furnace Lap-Welded or over 4½" OD	0.80 (7)	0.80 (7)
Unknown	Furnace Butt-Welded or 4½" OD and smaller	0.60 (8)	0.60 (8)

NOTES: (1) Definitions for the various pipe types (weld joints) are given in 400.2.
(2) A weld joint factor of 1.0 may be used for electric-resistance-welded or electric-flash-welded pipe manufactured prior to 1959 where (a) pipe furnished under this classification has been subjected to supplemental tests and/or heat treatments as agreed to by the supplier and the purchaser, and such supplemental tests and/or heat treatment demonstrate the strength characteristics of the weld to be equal to the minimum tensile strength specified for the pipe, or (b) pipe has been tested as required for a new pipeline in accordance with 437.4.1.
(3) Manufacture was discontinued and process deleted from API 5L in 1962.
(4) Factors shown above for pipe manufactured before 1959 apply for new or used (reclaimed) pipe if pipe specification and pipe type are known and it is known that pipe was manufactured before 1959 or not known whether manufactured after 1958.
(5) Factors shown above for pipe manufactured after 1958 apply for new or used (reclaimed) pipe if pipe specification and pipe type are known and it is known that pipe was manufactured after 1958.
(6) Factor applies for new or used pipe of unknown specification and ASTM A 120 if type of weld joint is known.
(7) Factor applies for new or used pipe of unknown specification and ASTM A 120 if type of weld joint is known to be furnace lap-welded, or for pipe over 4½ in. OD if type of joint is unknown.
(8) Factor applies for new or used pipe of unknown specification and ASTM A 120 if type of weld joint is known to be furnace butt-welded, or for pipe 4½ in. OD and smaller if type of joint is unknown.

Reproduced from ANSI Code B31.4-1979, Table 402.4.3. Reprinted courtesy of The American Society of Mechanical Engineers.

Longitudinal Expansion Stress for Restrained Piping

For restrained piping, use the longitudinal expansion stress from the equation given in ANSI Code B31.4, Section 419.6.4 (b):

$$S_l = E\,(a)\,(T_2 - T_1) - v(S_h)$$

where S_l = Longitudinal compressive stress, psi
E = Modulus of elasticity of steel, psi
S_h = Hoop stress due to fluid pressure, psi
T_1 = Temperature at time of installation, °F
T_2 = Maximum or minimum operating temperature, °F
a = Linear coefficient of thermal expansion, in./in./°F
v = Poisson's ratio = 0.3 for steel

Allowable Expansion Stress Range for Restrained Piping

This is calculated by using:

$$S_a = 0.90\,(SMYS)$$

where SMYS = Specified minimum yield strength of the pipe, psi (see Table 1-1)

The expansion stress for unrestrained piping is calculated by using:

$$S_e = [S_b^2 + 4S_t^2]^{1/2}$$

where S_e = Computed expansion stress, psi

$$S_b = \frac{[(i_i M_i)^2 + (i_o M_o)^2]^{1/2}}{Z}$$

= equivalent bending stress, psi
$S_t = M_t/2Z$ = torsional stress, psi
M_i = Bending moment in plane of member (for members having significant orientation, such as elbows or tees; for the latter the moments in the header and branch portions are to be considered separately), in.-lbs
M_o = Bending moment out of, or transverse to, plane of member, in.-lbs
M_t = Torsional moment, in.-lbs
i_i = Stress intensification factor under bending in plane

Allowable Shear Stress

The allowable stress value in shear is computed in accordance with the ANSI Code B31.4, Section 402.3.1 (e):

$$S_{sh}\,(allow) = (.45)\,(SMYS)$$

Allowable Internal Pressure Stress

The allowed internal pressure stress is S, where S = (0.72) (E) (SMYS), psi

DOT/B31.8 Gas Transmission and Distribution Piping Systems Stress Compliances (1982)

Pressure Stress

The design pressure for steel gas piping systems or the nominal wall thickness for a given pressure is determined by:

$$P = \frac{2S_t}{D}\,(F)\,(E)\,(T)$$

(For limitations see Section 841.121)

where P = Design pressure, psig
S = Specified minimum yield strength, psi (see Table 1-3). For special limitations on S see Section 841.121 (e) and (f).
D = Nominal outside diameter of pipe, in.
t = Nominal wall thickness, in.
F = Construction-type design factor obtained from Table 1-4
E = Longitudinal joint factor obtained from Table 1-5 (see also Section 811.253 (d))
T = Temperature derating factor obtained from Table 1-6

Table 1-3
Specified Minimum Yield Strength for Steel and Iron Pipe Commonly Used in Piping Systems*

Specification	Grade	Type (1)	SMYS (psi)
API 5L	A25	BW, ERW, S	25,000
API 5L	A	ERW, FW, S, DSA	30,000
API 5L	B	ERW, FW, S, DSA	35,000
API 5LS (2)	A	ERW, DSA	30,000
API 5LS	B	ERW, DSA	35,000
API 5LS	X42	ERW, DSA	42,000
API 5LS	X46	ERW, DSA	46,000
API 5LS	X52	ERW, DSA	52,000
API 5LS	X56	ERW, DSA	56,000
API 5LS	X60	ERW, DSA	60,000
API 5LS	X65	ERW, DSA	65,000
API 5LS	X70 (Tentative)	ERW, DSA	70,000
API 5LX (2)	X42	ERW, FW, S, DSA	42,000
API 5LX	X46	ERW, FW, S, DSA	46,000
API 5LX	X52	ERW, FW, S, DSA	52,000
API 5LX	X56	ERW, FW, S, DSA	56,000
API 5LX	X60	ERW, FW, S, DSA	60,000
API 5LX	X65	ERW, FW, S, DSA	65,000
API 5LX	X70 (Tentative)	ERW, FW, S, DSA	70,000
ASTM A53	Open Hearth, Basic Oxygen, Elect. Furnace	BW	25,000
ASTM A53	Bessemer	BW	30,000
ASTM A53	A	ERW, S	30,000
ASTM A53	B	ERW, S	35,000
ASTM A106	A	S	30,000
ASTM A106	B	S	35,000
ASTM A106	C	S	40,000
ASTM A135	A	ERW	30,000
ASTM A135	B	ERW	35,000
ASTM A139	A	EFW	30,000
ASTM A139	B	EFW	35,000
ASTM A381	Class Y-35	DSA	35,000
ASTM A381	Class Y-42	DSA	42,000
ASTM A381	Class Y-46	DSA	46,000
ASTM A381	Class Y-48	DSA	48,000
ASTM A381	Class Y-50	DSA	50,000
ASTM A381	Class Y-52	DSA	52,000
ASTM A381	Class Y-56	DSA	56,000
ASTM A381	Class Y-60	DSA	60,000
ASTM A381	Class Y-65	DSA	65,000
ASTM A134	–	EFW	(3)
ASTM A155	–	EFW	(3)
ASTM A333	1	S, ERW	30,000
ASTM A333	3	S, ERW	35,000
ASTM A333	4	S	35,000
ASTM A333	6	S, ERW	35,000
ASTM A333	7	S, ERW	35,000
ASTM A333	8	S, ERW	75,000
ASTM A333	9	S, ERW	46,000
ASTM A559	–	ERW	35,000

(1) Abbreviations: BW – Furnace butt-welded; ERW – Electric resistance welded; S – Seamless; FW – Flash welded; EFW – Electric fusion welded; DSA – Double submerged-arc welded.

(2) Intermediate grades are available in API 5LS and 5LX.

(3) See applicable plate specification for SMYS.

Note: *This table is not complete. For minimum specified yield strength of other grades and grades in approved specifications, refer to the particular specification.*

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Table 1-4
Values of Design Factor *F*

Construction Type (See 841.151)	Design Factor *F*
Type – A	0.72
Type – B	0.60
Type – C	0.50
Type – D	0.40

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Table 1-5
Longitudinal Joint Factor *E*

Spec. Number	Pipe Class	*E* Factor
ASTM A53	Seamless	1.00
	Electric Resistance Welded	1.00
	Furnace Butt Welded	.60
ASTM A106	Seamless	1.00
ASTM A134	Electric Fusion Arc Welded	.80
ASTM A135	Electric Resistance Welded	1.00
ASTM A139	Electric Fusion Welded	.80
ASTM A155	Electric Fusion Arc Welded	1.00
ASTM A211	Spiral Welded Steel Pipe	.80
ASTM A381	Double Submerged-Arc-Welded	1.00
API 5L	Seamless	1.00
	Electric Resistance Welded	1.00
	Electric Flash Welded	1.00
	Furnace Butt Welded	.60
	*Furnace Lap-Welded	.80
API 5LX	Seamless	1.00
	Electric Resistance Welded	1.00
	Electric Flash Welded	1.00
	Submerged Arc Welded	1.00
API 5LS	Electric Resistance Welded	1.00
	Submerged Arc Welded	1.00

Note: Definitions for the various classes of welded pipe are given in 804.243.

*Manufacture was discontinued and process deleted from API 5L in 1962.

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Table 1-6
Temperature Derating Factor *T* for Steel Pipe

Temperature Degrees Fahrenheit	Temperature Derating Factor *T*
250 F or less	1.000
300 F	0.967
350 F	0.933
400 F	0.900
450 F	0.867

Note: For intermediate temperatures interpolate for derating factor.

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Expansion Stress

This is calculated by using the Code equation:

$$S_e = (S_b^2 + 4S_t^2)^{1/2}$$

where S_e = Computed expansion stress, psi
S_b = Resultant bending stress, psi = iM/Z
S_t = Torsional stress, psi = M_t/2Z
M = Resultant bending moment on cross section, in.-lbs
M_t = Torsional moment on cross section, in.-lbs
Z = Section modulus of pipe, $in.^3$
i = Stress intensification factor (see ANSI Code B31.8, Appendix E)

Allowable Expansion Stress Range

This is calculated by using:

$$S_a = 0.72 \text{ (SMYS)}$$

where SMYS = Specified minimum yield strength, psi (see Table 1-3)

Longitudinal Pressure Stress

This is computed by using:

$$S_{lp} = \frac{P\ D_o}{4t}$$

where P = Design pressure, psig
D_o = Outside diameter of pipe, in.
t = Pipe wall thickness, in.

The sum of the longitudinal pressure and longitudinal bending stresses due to external loads such as weight of pipe and contents, wind, etc., should not exceed 75% of the allowable stress in the hot condition. The allowable for the sum of the longitudinal stresses is given by:

$$S_l = \text{(allow)} = 0.75 \text{ (S) (F) (T)}$$

where S = Specified minimum yield strength, psi
F = Design factor obtained from Table 1-4
T = Temperature derating factor, Table 1-6

Standard Outline for ANSI B31 Codes

ANSI Code B31.1: Power Piping

Includes

1. Power and auxiliary service piping systems for electric generating plants.
2. Industrial and institutional plants (also see ANSI Code B31.9).
3. Central and district heating plants (also see ANSI Code B31.9).
4. All piping and component parts within or part of plants as previously specified, unless specifically excluded.
5. Boiler external piping which is covered under the ASME Code, Section I, stamping requirements.
6. Geothermal steam and hot water piping.
7. Oil or gas piping, downstream of meter, within plant identified in 1, 2, or 3, above.
8. Air and hydraulic distribution systems.

Excludes

1. Piping specifically covered by other ANSI/ASME sections.
2. Components covered by ASME B and PV Code.
3. Fuel gas in industrial and institutional plants.
4. Building heating and distribution steam piping for 15 psi (100 kPa) gauge or less or hot water systems for 30 psi (200 kPa) gauge or less.
5. Roof drains, floor drains, plumbing, sewer or fire protection systems.
6. Piping for hydraulic or pneumatic tools.
7. Piping for nuclear power plants.

ANSI Code B31.2: Fuel Gas Piping

Includes

1. Natural gas.
2. Manufactured gas.
3. LPG—air mixtures above the combustible limit.
4. LPG—in the gaseous state.

Excludes

1. Fuel gas piping where the metal temperature is above 450°F (232°C) or below −20°F (−29°C).
2. Fuel gas piping covered by the ANSI Codes B31.1, B31.3, B31.8, Z21.30, or Z106.1
3. Pressure vessels covered by the ASME B and PV Code.
4. Gas gathering, transmission, and distribution systems covered by ANSI Code B31.8.
5. LPG in the liquid state.
6. Fuel gas—air mixtures in the combustible or flammable range.

Note: This Code will be withdrawn when the new issue of ANSI Code Z223.1 (which does not reference ANSI Code B31.2) is released. This service will be covered by ANSI Codes B31.9 and Z223.1.

ANSI Code B31.3: Chemical Plant and Petroleum Refinery Piping

Includes

1. All piping within the property limits of facilities engaged in the processing or handling of chemical or petroleum or related products.

Excludes

1. Nonhazardous fluid piping with pressures between 0 and 15 psi (100 kPa) and temperatures ranging from −20°F (−29°C) to 366°F (186°C).
2. Piping covered by the ASME B and PV Code, Section I or ANSI Code B31.1, which requires Section I, Inspection and Stamping (B.E.P. Piping).
3. Pressure vessels, heat exchangers, pumps, etc., including internal piping and connections for external piping.
4. Piping within the property limits which has been designated for design according to the ANSI Code B31.4 or B31.8 or to government regulation (pipeline rights-of-way).
5. Plumbing or sewers.
6. Piping for fire protection systems (covered by insurance underwriter's requirements).

ANSI Code B31.4: Liquid Petroleum Transportation Piping Systems

Includes

1. Piping transporting liquid petroleum and petroleum products between the producer's facilities and delivery and receiving points.

Excludes

1. Water, air, steam, lube oil, gas, and fuel piping.
2. Pressure vessels, heat exchangers, pumps, meters, etc., including internal piping and connections to external piping.
3. Piping systems designed for internal pressures less than 15 psi (100 kPa).
4. Piping systems designed for internal pressures greater than 15 psi (100 kPa) where the design temperature is below −20°F (−29°C) or above 250°F (120°C).
5. Casing, tubing, or pipe used in oil wells, wellhead assemblies, and piping connecting those assemblies.
6. Piping covered by the ANSI Code B31.3 or B31.8.
7. Ammonia refrigeration piping systems.

ANSI Code B31.5: Refrigeration Piping

Includes

1. Refrigeration and brine piping systems down to −350°F (−196°C) either erected on the premises or factory assembled, unless specifically excluded.

Excludes

1. Self-contained refrigeration systems covered by requirements of Underwriter's Laboratories or other nationally recognized testing laboratories.
2. Water piping systems.
3. Piping systems with internal or external pressure of 15 psi (100 kPa) or less.

ANSI Code B31.8: Gas Transmission and Distribution Piping

Includes

1. Gas transmission pipelines.
2. Gas compressor stations.
3. Gas metering and regulation stations.
4. Gas mains.
5. Service lines to outlet of customer's meter set.
6. Gas storage lines and storage equipment of the closed-pipe type.

Excludes

1. Pressure vessels and piping covered by the ASME B and PV Code.
2. Piping systems with metal temperatures above 450°F (232°C) or below −20°F (−29°C).
3. Piping in chemical plant or refinery property limits, natural gasoline extraction plants, etc., covered by ANSI Code B31.3.
4. Atmospheric vent piping for waste gases.
5. Low pressure gas which is covered by ANSI Code B31.4.
6. Wellhead assemblies.
7. Proprietary items of equipment.

ANSI Code B31.9: Building Services Piping

Includes*

1. Piping systems for building services for industrial, commercial, public, institutional, and multi-unit residential buildings.

Examples:

A. Dual-temperature water for heating and cooling.
B. Chilled water.
C. Condensing water.
D. Hot water.
E. Steam and condensate return.
F. Compressed air and other nonflammable gases.
G. Fuel gas over 60 psi (415 kPa) (fuel gas under 60 psi is covered by the new ANSI Code Z223.1)

Excludes

1. *Pressure limit exclusions:*

   A. Steam: 125 psi (860 kPa) Gauge
   B. Nonfuel gas: 125 (860 kPa) Gauge
   C. Liquids: 300 (2,070 kPa) Gauge
   D. Full vacuum for all fluids

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* (as per latest draft.)

2. *Other exclusions:*

   A. Piping systems covered by ANSI Code B31.1
   B. Sanitary, potable water, and storm drain piping
   C. Fire protection systems
   D. Acetylene, hydrogen, oxygen and medical gas piping
   E. Fuel oil piping

ANSI Code B31.10: Cryogenic Piping*

Includes†

1. Liquid-solid mixtures (or slush), operating at temperatures ranging from 120K (−244°F, −153°C) to 0K (−459°F, −273°C), either erected on the premises or factory assembled.

Excludes

1. Vessels, heat exchangers, condensers, pumps, compressors, expanders, scrubbers, and other equipment.
2. Vacuum piping systems which supply insulating vacuum to vacuum jackets of cryogenic piping systems.
3. Piping systems specifically covered by ANSI Codes B31.5 or B31.3 (wording of draft).

ANSI Code B31.11: Slurry Piping Systems

Includes

1. Initial coverage will be coal transported in water.
2. Future coverages will include slurries of other solids transported in nonhazardous liquids.

* (To be included in future ANSI Code B31.3)
† (as per latest draft.)

2

Coefficients of Thermal Expansion

This chapter contains tables of the coefficients of thermal expansion (Table 2-1) and other tables relating to the physical properties of piping materials (Tables 2-2 through 2-4).

Table 2-1
Coefficients of Thermal Expansion
(in./100 ft)

Temp. (F)	Carbon Steel Carbon-moly Low-chrome (Thru 3 Cr Mo)	5 CR MO Thru 9 Cr Mo	Austenitic Stainless Steels 18 Cr 8 Ni	12 Cr 17 Cr 27 Cr	25 Cr 20 Ni	Monel 67 Ni 30 Cu	3½ Nickel
-325	-2.370	-2.220	-3.85	-2.040		-2.620	-2.250
-320	-2.344	-2.196	-3.806	-2.016		-2.596	-2.234
-315	-2.318	-2.172	-3.762	-1.992		-2.572	-2.218
-310	-2.292	-2.148	-3.718	-1.968		-2.548	-2.202
-305	-2.266	-2.124	-3.674	-1.944		-2.524	-2.186
-300	-2.240	-2.100	-3.630	-1.920		-2.500	-2.170
-295	-2.214	-2.076	-3.586	-1.896		-2.476	-2.150
-290	2.118	-2.052	-3.542	-1.872		-2.452	-2.130
-285	2.162	-2.028	-3.498	-1.848		-2.428	-2.110
-280	2.136	-2.004	-3.454	-1.824		-2.404	-2.090
-275	-2.110	-1.980	-3.410	-1.80		-2.380	-2.070
-270	-2.084	-1.956	-3.366	-1.776		-2.356	-2.048
-265	-2.058	-1.932	-3.322	-1.752		-2.332	-2.026
-260	-2.032	-1.908	-3.278	-1.728		-2.308	-2.004
-255	-2.006	-1.884	-3.234	-1.704		-2.284	-1.982
-250	-1.980	-1.860	-3.19	-1.68		-2.260	-1.960
-245	-1.954	-1.836	-3.146	-1.658		-2.236	-1.940
-240	-1.928	-1.812	-3.102	-1.636		-2.212	-1.920
-235	-1.902	-1.788	-3.058	-1.614		-2.188	-1.900
-230	-1.876	-1.764	-3.014	-1.592		-2.164	-1.880
-225	-1.850	-1.740	-2.960	-1.570		-2.140	-1.860
-220	-1.822	-1.716	-2.914	-1.548		-2.116	-1.840
-215	-1.794	-1.692	-2.870	-1.526		-2.092	-1.820
-210	-1.766	-1.668	-2.824	-1.504		-2.068	-1.800
-205	-1.738	-1.644	-2.778	-1.482		-2.044	-1.780
-200	-1.710	-1.620	-2.730	-1.46		-2.020	-1.760
-195	-1.689	-1.596	-2.685	-1.438		-1.996	-1.732
-190	-1.658	-1.572	-2.640	-1.416		-1.972	-1.704
-185	-1.632	-1.548	-2.595	-1.394		-1.948	-1.676
-180	-1.606	-1.524	-2.550	-1.372		-1.924	-1.648
-175	-1.580	-1.50	-2.500	-1.350		-1.90	-1.620
-170	-1.554	-1.474	-2.454	-1.328		-1.878	-1.592
-165	-1.528	-1.448	-2.408	-1.306		-1.856	-1.564
-160	-1.500	-1.422	-2.362	-1.284		-1.834	-1.536
-155	-1.474	-1.396	-2.316	-1.262		-1.812	-1.508
-150	-1.450	-1.370	-2.27	-1.240		-1.790	-1.480
-145	-1.420	-1.342	-2.218	-1.214		-1.750	-1.450
-140	-1.390	-1.314	-2.166	-1.188		-1.710	-1.420
-135	-1.360	-1.286	-2.114	-1.162		-1.670	-1.390
-130	-1.330	-1.258	-2.062	-1.136		-1.630	-1.360
-125	-1.300	-1.230	-2.01	-1.110		-1.590	-1.330
-120	-1.270	-1.200	-1.958	-1.084		-1.548	-1.298
-115	-1.240	-1.170	-1.906	-1.058		-1.506	-1.266
-110	-1.210	-1.140	-1.854	-1.032		-1.464	-1.234
-105	-1.180	-1.110	-1.802	-1.006		-1.422	-1.202
-100	-1.150	-1.080	-1.75	-0.98		-1.380	-1.170
- 95	-1.120	-1.052	-1.700	-0.954		-1.34	-1.138
- 90	-1.090	-1.024	-1.650	-0.928		-1.30	-1.106
- 85	-1.060	- .996	-1.600	-0.902		-1.26	-1.074
- 80	-1.030	- .968	-1.550	-0.876		-1.22	-1.042

Table 2-1
Continued

Temp. (F)	Carbon Steel Carbon-moly Low-chrome (Thru 3 Cr Mo)	5 CR MO Thru 9 Cr Mo	Austenitic Stainless Steels 18 Cr 8 Ni	12 Cr 17 Cr 27 Cr	25 Cr 20 Ni	Monel 67 Ni 30 Cu	3½ Nickel
- 75	-1.000	-0.940	-1.500	-0.85		-1.18	-1.010
- 70	-0.97	-0.910	-1.448	-0.824		-1.14	- .976
- 65	-0.94	-0.880	-1.396	-0.798		-1.10	- .942
- 60	-0.91	-0.850	-1.344	-0.772		-1.06	- .908
- 55	-0.88	-0.820	-1.292	-0.746		-1.02	- .874
- 50	-0.84	-0.790	-1.240	-0.72		-0.98	-0.840
- 45	-0.808	-0.758	-1.188	-0.690		-0.938	-0.806
- 40	-0.776	-0.726	-1.136	-0.630		-0.896	-0.772
- 35	-0.744	-0.694	-1.084	-0.600		-0.812	-0.704
- 30	-0.712	-0.662	-1.032				
- 25	-0.680	-0.630	-0.980	-0.57		-0.77	-0.670
- 20	-0.642	-.0596	-0.928	-0.54		-0.73	-0.636
- 15	-0.604	-0.562	-0.876	-0.51		-0.69	-0.602
- 10	-0.566	-0.528	-0.824	-0.48		-0.65	-0.568
- 5	-0.528	-0.494	-0.772	-0.45		-0.61	-0.534
- 0	-0.49	-0.460	-0.720	-0.42		-0.57	-0.50
5	-0.456	-0.428	-0.668	-0.39		-0.53	-0.464
10	-0.422	-0.396	-0.616	-0.36		-0.49	-0.428
15	-0.388	-0.364	-0.564	-0.33		-0.45	-0.392
20	-0.354	-0.332	-0.512	-0.30		-0.41	-0.356
25	-0.320	-0.300	-0.460	-0.27		-0.370	-0.320
30	-0.284	-0.266	-0.410	-0.24		-0.336	-0.286
35	-0.248	-0.232	-0.360	-0.21		-0.302	-0.252
40	-0.212	-0.198	-0.310	-0.18		-0.268	-0.218
45	-0.176	-0.164	-0.260	-0.15		-0.234	-0.184
50	-0.140	-0.13	-0.210	-0.12		-0.200	-0.15
55	-0.105	-0.098	-0.158	-0.09		-0.150	-0.113
60	-0.070	-0.066	-0.106	-0.06		-0.100	-0.076
65	-0.035	-0.034	-0.054	-0.03		-0.050	-0.038
70	0	0	0	0	0	0	0
75	0.038	0.037	0.056	0.033	0.053	0.047	0.038
80	0.076	0.074	0.112	0.066	0.106	0.094	0.076
85	0.114	0.111	0.168	0.099	0.159	0.140	0.114
90	0.152	0.148	0.225	0.137	0.212	0.186	0.152
95	0.190	0.185	0.282	0.166	0.265	0.233	0.190
100	0.230	0.22	0.340	0.200	0.320	0.28	0.23
105	0.268	0.258	0.396	0.232	0.372	0.328	0.268
110	0.306	0.294	0.452	0.264	0.424	0.376	0.306
115	0.344	0.332	0.508	0.296	0.476	0.424	0.344
120	0.382	0.370	0.564	0.328	0.528	0.472	0.382
125	0.420	0.40	0.620	0.360	0.58	0.52	0.42
130	0.458	0.436	0.876	0.394	0.632	0.568	0.458
135	0.496	0.472	0.732	0.428	0.684	0.616	0.496
140	0.534	0.508	0.788	0.462	0.736	0.664	0.534
145	0.572	0.544	0.844	0.496	0.783	0.712	0.572
150	0.610	0.580	0.90	0.530	0.84	0.75	0.61
155	0.648	0.616	0.956	0.562	0.892	0.798	0.648
160	0.686	0.652	1.012	0.594	0.944	0.846	0.686
165	0.724	0.688	1.068	0.626	0.996	0.894	0.724
170	0.762	0.724	1.124	0.658	1.048	0.942	0.762

Table 2-1
Continued

Temp. (F)	Carbon Steel Carbon-moly Low-chrome (Thru 3 Cr Mo)	5 CR MO Thru 9 Cr Mo	Austenitic Stainless Steels 18 Cr 8 Ni	12 Cr 17 Cr 27 Cr	25 Cr 20 Ni	Monel 67 Ni 30 Cu	3½ Nickel
175	0.80	0.76	1.180	0.69	1.10	0.99	0.81
180	0.838	0.796	1.236	0.724	1.152	1.038	0.85
185	0.876	0.832	1.292	0.758	1.204	1.086	0.89
190	0.914	0.868	1.348	0.792	1.256	1.134	0.93
195	0.952	0.904	1.404	0.826	1.308	1.182	0.97
200	0.990	.940	1.46	0.86	1.37	1.22	1.01
205	1.034	.978	1.518	0.894	1.424	1.268	1.05
210	1.078	1.016	1.576	0.928	1.478	1.316	1.09
215	1.122	1.054	1.634	0.962	1.532	1.364	1.13
220	1.166	1.092	1.692	0.996	1.586	1.412	1.17
225	1.210	1.130	1.750	1.03	1.64	1.460	1.210
230	1.248	1.170	1.806	1.066	1.694	1.508	1.252
235	1.286	1.210	1.862	1.102	1.748	1.556	1.294
240	1.324	1.250	1.918	1.138	1.802	1.604	1.336
245	1.362	1.290	1.974	1.174	1.866	1.652	1.378
250	1.400	1.330	2.030	1.210	1.910	1.710	1.420
255	1.442	1.368	2.088	1.244	1.964	1.760	1.462
260	1.484	1.406	2.146	1.278	2.018	1.810	1.504
265	1.526	1.444	2.204	1.312	2.072	1.860	1.546
270	1.568	1.482	2.262	1.346	2.126	1.910	1.588
275	1.610	1.520	2.320	1.380	2.180	1.960	1.630
280	1.652	1.558	2.378	1.416	2.234	2.010	1.672
285	1.694	1.596	2.436	1.454	2.288	2.060	1.714
290	1.736	1.634	2.444	1.490	2.342	2.110	1.756
295	1.778	1.672	2.552	1.526	2.396	2.160	1.798
300	1.82	1.710	2.610	1.56	2.450	2.210	1.84
305	1.864	1.748	2.668	1.596	2.504	2.256	1.882
310	1.908	1.786	2.726	1.632	2.558	2.302	1.924
315	1.952	1.824	2.784	1.668	2.612	2.348	1.966
320	1.996	1.862	2.842	1.704	2.666	2.394	
325	2.040	1.900	2.900	1.74	2.72	2.44	2.050
330	2.084	1.940	2.960	1.778	2.774	2.488	2.092
335	2.128	1.980	3.020	1.816	2.828	2.532	2.134
340	2.172	2.020	3.080	1.854	2.882	2.576	2.176
345	2.216	2.060	3.140	1.892	2.936	2.620	2.218
350	2.26	2.100	3.200	1.93	2.99	2.680	2.26
355	2.304	2.140	3.260	1.966	3.044	2.728	2.302
360	2.348	2.180	3.320	2.002	3.098	2.776	2.344
365	2.392	2.220	3.380	2.038	3.152	2.824	2.386
370	2.436	2.260	3.440	2.074	3.206	2.872	2.428
375	2.480	2.30	3.500	2.11	3.26	2.910	2.470
380	2.524	2.340	3.560	2.148	3.314	2.978	2.512
385	2.568	2.380	3.620	2.186	3.368	3.046	2.554
390	2.612	2.420	3.680	2.224	3.422	3.084	2.596
395	2.656	2.460	3.740	2.262	3.476	3.152	2.638
400	2.700	2.500	3.800	2.30	3.530	3.250	2.690
405	2.746	2.544	3.860	2.340	3.584	3.304	2.732
410	2.792	2.588	3.920	2.380	3.638	3.358	2.774
415	2.838	2.632	3.980	2.420	3.692	3.412	2.816
420	2.884	2.676	4.040	2.940	3.746	3.466	2.858

Table 2-1
Continued

Temp. (F)	Carbon Steel Carbon-moly Low-chrome (Thru 3 Cr Mo)	5 CR MO Thru 9 Cr Mo	Austenitic Stainless Steels 18 Cr 8 Ni	12 Cr 17 Cr 27 Cr	25 Cr 20 Ni	Monel 67 Ni 30 Cu	3½ Nickel
425	2.930	2.72	4.100	2.500	3.800	3.520	2.910
430	2.976	2.762	4.162	2.538	3.854	3.574	2.954
435	3.022	2.804	4.224	2.576	3.908	3.628	2.998
440	3.068	2.846	4.286	2.614	3.962	3.682	3.042
445	3.114	2.888	4.348	2.652	4.016	3.736	3.086
450	3.160	2.930	4.410	2.690	4.070	3.790	3.130
455	3.206	2.972	4.470	2.730	4.124	3.844	3.174
460	3.252	3.014	4.530	2.770	4.178	3.898	3.218
465	3.298	3.056	4.590	2.810	4.232	3.952	3.262
470	3.344	3.098	4.650	2.850	4.286	4.006	3.306
475	3.390	3.140	4.710	2.890	4.340	4.060	3.350
480	3.436	3.182	4.770	2.923	4.394	4.114	3.396
485	3.432	3.224	4.830	2.966	4.448	4.168	3.442
490	3.528	3.266	4.860	3.004	4.502	4.222	3.988
495	3.574	3.308	4.920	3.042	4.556	4.276	3.534
500	3.620	3.350	5.010	3.080	4.610	4.330	3.580
505	3.668	3.396	5.010	3.120	4.664	4.386	3.626
510	3.716	3.442	5.130	3.160	4.718	4.442	3.672
515	3.764	3.488	5.190	3.200	4.772	4.498	3.718
520	3.812	3.534	5.250	3.240	4.826	4.554	3.764
525	3.860	3.580	5.310	3.280	4.880	4.610	3.810
530	3.910	3.524	5.372	3.322	4.934	4.668	3.856
535	3.960	3.668	5.434	3.364	4.988	4.726	3.902
540	4.010	3.712	5.496	3.406	5.042	4.784	3.948
545	4.060	3.756	5.558	3.448	5.096	4.842	3.994
550	4.110	3.800	5.620	3.490	5.150	4.900	4.040
555	4.158	3.844	5.682	3.530	5.204	4.958	4.086
560	4.206	3.888	5.744	3.570	5.258	5.016	4.132
565	4.254	3.932	5.806	3.610	5.312	5.074	4.178
570	4.302	3.976	5.868	3.650	5.366	5.132	4.224
575	4.350	4.020	5.930	3.690	5.420	5.180	4.270
580	4.400	4.064	5.992	3.732	5.474	5.236	4.316
585	4.450	4.108	6.058	3.774	5.528	5.292	4.362
590	4.500	4.152	6.120	3.816	5.582	5.348	4.408
595	4.550	4.196	6.182	3.858	5.636	5.404	4.454
600	4.600	4.240	6.240	3.900	5.690	5.460	4.500
505	4.652	4.286	6.302	3.940	5.144	5.518	4.458
610	4.704	4.332	6.364	3.980	5.798	5.576	4.596
615	4.756	4.378	6.426	4.020	5.852	5.634	4.644
620	4.808	4.424	6.488	4.060	5.906	5.692	4.692
625	4.360	4.470	6.550	4.100	5.960	5.750	4.740
630	4.910	4.514	6.614	4.142	6.014	5.810	4.788
635	4.960	4.558	6.678	4.184	6.068	5.870	4.836
640	5.010	4.602	6.742	4.226	6.122	5.930	4.884
645	5.060	4.646	6.806	4.268	6.176	5.990	4.932
650	5.110	4.690	6.870	4.310	6.230	6.050	4.980
655	5.162	4.736	6.932	4.352	6.284	6.108	5.028
660	5.214	4.782	6.995	4.394	6.338	6.166	5.076
665	5.266	4.828	7.057	4.436	6.392	6.224	5.124
670	5.318	4.374	7.119	4.478	6.446	6.282	5.172

Table 2-1
Continued

Temp. (F)	Carbon Steel Carbon-moly Low-chrome (Thru 3 Cr Mo)	5 CR MO Thru 9 Cr Mo	Austenitic Stainless Steels 18 Cr 8 Ni	12 Cr 17 Cr 27 Cr	25 Cr 20 Ni	Monel 67 Ni 30 Cu	3½ Nickel
675	5.370	4.920	7.180	4.520	6.500	6.340	5.220
680	5.422	4.964	7.244	4.562	6.554	6.400	5.268
685	5.474	5.008	7.308	4.604	6.608	6.460	5.316
690	4.536	5.052	7.372	4.646	6.662	6.520	5.364
695	4.588	5.096	7.436	4.688	6.716	6.580	5.412
700	5.630	5.140	7.500	4.730	6.770	6.640	5.460
705	5.684	5.188	7.564	4.776	6.824	6.700	5.508
710	5.738	5.236	7.628	4.814	6.878	6.760	5.556
715	5.792	5.284	7.692	4.856	6.932	6.820	5.604
720	5.846	5.332	7.756	4.898	6.986	6.880	5.652
725	5.900	5.380	7.820	4.940	7.040	6.940	5.700
730	5.952	5.428	7.886	4.984	7.094	7.002	5.748
735	6.004	5.476	7.952	5.028	7.148	7.064	5.796
740	6.056	5.524	8.018	5.072	7.702	7.126	5.844
745	6.108	5.572	8.084	5.116	7.256	7.188	5.892
750	6.160	5.620	8.150	5.160	7.310	7.250	5.940
755	6.214	5.668	8.214	5.204	7.364	7.310	5.988
760	6.268	5.716	8.278	5.248	7.418	7.370	6.036
765	6.322	5.764	8.342	5.292	7.472	7.430	6.084
770	6.376	5.812	8.406	5.336	7.526	7.490	6.132
775	6.430	5.860	8.470	5.380	7.580	7.550	6.180
780	6.484	5.908	8.536	5.424	7.634	7.610	6.230
785	6.533	5.956	8.602	5.468	7.688	7.670	6.280
790	6.592	6.004	8.668	5.512	7.742	7.730	6.330
795	6.646	6.052	8.734	5.556	7.796	7.790	6.380
800	6.700	6.100	8.80	5.600	7.850	7.850	6.430
805	6.754	6.148	8.866	5.644	7.910	7.912	6.480
810	6.808	6.196	8.932	5.688	7.970	7.974	6.530
815	6.862	6.244	8.998	5.732	8.030	8.036	6.580
820	6.916	6.292	9.064	5.776	8.090	8.098	6.630
825	6.970	6.340	9.130	5.820	8.150	8.160	6.680
830	7.026	6.390	9.196	5.866	8.210	8.224	6.730
835	7.082	6.440	9.262	5.912	8.270	8.288	6.780
840	7.138	6.490	9.328	5.958	8.330	8.352	6.830
845	7.194	6.590	9.394	6.004	8.390	8.416	6.850
850	7.250	6.590	9.460	6.050	8.450	8.480	6.930
855	7.306	6.638	9.526	6.094	8.510	8.544	6.980
860	7.362	6.686	9.542	6.138	8.570	8.608	7.030
865	7.413	6.734	9.658	6.182	8.630	8.672	7.080
870	7.474	6.782	9.724	6.226	8.690	8.736	7.130
875	7.530	6.830	9.790	6.270	8.750	8.800	7.180
880	7.586	6.878	9.856	6.314	8.810	8.864	7.230
885	7.642	6.926	9.922	6.358	8.870	8.928	7.280
890	7.698	6.974	9.988	6.402	8.930	8.992	7.330
895	7.754	7.022	10.054	6.446	8.990	9.056	7.380
900	7.810	7.070	10.120	6.490	9.050	9.120	7.430
905	7.866	7.118	10.188	6.534	9.110	9.184	7.480
910	7.922	7.166	10.256	6.578	9.170	9.248	7.530
915	7.978	7.214	10.324	6.622	9.230	9.312	7.580
920	8.034	7.762	10.392	6.666	9.290	9.376	7.630

Table 2-1
Continued

Temp. (F)	Carbon Steel Carbon-moly Low-chrome (Thru 3 Cr Mo)	5 CR MO Thru 9 Cr Mo	Austenitic Stainless Steels 18 Cr 8 Ni	12 Cr 17 Cr 27 Cr	25 Cr 20 Ni	Monel 67 Ni 30 Cu	3½ Nickel
925	8.080	7.310	10.460	6.710	9.350	9.440	7.680
930	8.134	7.360	10.528	6.756	9.410	9.506	7.730
935	8.188	7.410	10.596	6.802	9.470	9.572	7.780
940	8.242	7.460	10.664	6.848	9.530	9.638	7.830
945	8.296	7.510	10.732	6.894	9.590	9.704	7.880
950	8.350	7.560	10.800	6.940	9.650	9.770	7.930
955	8.404	7.610	10.868	6.986	9.710	9.834	7.978
960	8.458	7.660	10.936	7.032	9.770	9.898	3.026
965	8.512	7.710	11.004	7.078	9.830	9.962	8.074
970	8.566	7.760	11.072	7.124	9.890	10.026	8.122
975	8.620	7.810	11.140	7.170	9.950	10.090	8.170
980	8.674	7.860	11.208	7.216	10.010	10.156	8.218
985	8.728	7.910	11.276	7.262	10.070	10.222	8.266
990	8.782	7.960	11.344	7.308	10.130	10.288	8.314
995	8.836	8.010	11.412	7.354	10.190	10.354	8.362
1000	8.890	8.060	11.480	7.400	10.250	10.420	8.410
1005	8.946	8.110	11.548	7.444	10.310	10.486	
1010	9.002	8.160	11.616	7.488	10.370	10.552	
1015	9.058	8.210	11.684	7.532	10.430	10.618	
1020	9.114	8.260	11.752	7.576	10.490	10.686	
1025	9.170	8.300	11.820	7.620	10.550	10.750	
1030	9.228	8.350	11.888	7.686	10.610	10.818	
1035	9.286	8.400	11.956	7.752	10.670	10.886	
1040	9.344	8.450	12.024	7.818	10.730	10.959	
1045	9.402	8.500	12.094	7.884	10.790	11.022	
1050	9.460	8.550	12.160	7.950	10.850	11.090	
1055	9.518	8.600	12.228	7.996	10.910	11.158	
1060	9.576	8.650	12.296	8.042	10.970	11.226	
1065	9.634	8.700	12.364	8.088	11.030	11.294	
1070	9.692	8.750	12.432	8.134	11.090	11.362	
1075	9.750	8.800	12.500	8.180	11.150	11.430	
1080	9.808	8.850	12.568	8.206	11.210	11.498	
1085	9.866	8.900	12.636	8.232	11.270	11.566	
1090	9.929	8.950	12.704	8.258	11.330	11.634	
1095	9.982	9.000	12.772	8.284	11.390	11.702	
1100	10.040	9.050	12.840	8.310	11.450	11.770	
1105	10.094	9.096	12.908	8.354	11.516	11.838	
1110	10.148	9.142	12.976	8.398	11.582	11.906	
1115	10.202	9.188	13.044	8.442	11.648	11.974	
1120	10.256	9.234	13.112	8.486	11.714	12.042	
1125	10.310	9.280	13.180	8.530	11.780	12.110	
1130	10.362	9.330	13.248	8.576	11.846	12.182	
1135	10.414	9.380	13.316	8.622	11.912	12.254	
1140	10.466	9.430	13.384	8.668	11.978	12.326	
1145	10.518	9.480	13.452	8.714	12.044	12.398	
1150	10.570	9.520	13.520	8.760	12.110	12.470	
1155	10.622	9.568	13.588	8.804	12.176	12.538	
1160	10.674	9.616	13.656	8.848	12.292	12.606	
1165	10.726	9.664	13.724	8.892	12.308	12.674	
1170	10.778	9.712	13.792	8.936	12.374	12.742	

Table 2-1
Continued

Temp. (F)	Carbon Steel Carbon-moly Low-chrome (Thru 3 Cr Mo)	5 CR MO Thru 9 Cr Mo	Austenitic Stainless Steels 18 Cr 8 Ni	12 Cr 17 Cr 27 Cr	25 Cr 20 Ni	Monel 67 Ni 30 Cu	3½ Nickel
1175	10.830	9.760	13.860	8.980	12.440	12.810	
1180	10.884	9.808	13.928	9.024	12.506	12.878	
1185	10.938	9.856	13.996	9.068	12.572	12.946	
1190	10.992	9.904	14.064	9.112	12.638	13.014	
1195	11.046	9.952	14.132	9.156	12.704	13.082	
1200	11.100	10.000	14.200	9.200	12.770	13.150	
1205	11.155	10.052	14.268	9.244	12.836	13.220	
1210	11.212	10.104	14.336	9.288	12.902	13.290	
1215	11.268	10.156	14.404	9.332	12.968	13.360	
1220	11.324	10.208	14.472	9.376	13.034	13.430	
1225	11.380	10.260	14.540	9.420	13.100	13.500	
1230	11.436	10 314	14.608	9.466	13.166	13.572	
1235	11.492	10.368	14.676	9.512	13.232	13.644	
1240	11.598	10.422	14.744	9.558	13.298	13.716	
1245	11.604	10.476	14.812	9.604	13.364	13.788	
1250	11.660	10.530	14.880	9.650	13.430	13.360	
1255	11.716	10.582	14.948	9.696	13.496	13.932	
1260	11.772	10.634	15.016	9.742	13.562	14.004	
1265	11.828	10.686	15.084	9.788	13.628	14.076	
1270	11.884	10.738	15.152	9.834	13.694	14.148	
1275	11.940	10.790	15.220	9.880	13.760	14.22	
1280	11.946	10.844	15.288	9.926	13.826	14.292	
1285	12.052	10.898	15.356	9.972	13.892	14.364	
1290	12.108	10.952	15.424	10.018	13.958	14.436	
1295	12.164	11.006	15.492	10.064	14.024	14.508	
1300	12.22	11.060	15.560	10.110	14.090	14.580	
1305	12.276	11.108	15.628	10.154	14.150	14.652	
1310	12.332	11.156	15.696	10.198	14.210	14.724	
1315	12.388	11.204	15.764	10.242	14.270	14.796	
1320	12.444	11.252	15.832	10.826	14.330	14.868	
1325	12.500	11.300	15.900	10.330	14.390	14.940	
1330	12.556	11.350	15.968	10.376	14.450	15.012	
1335	12.612	11.400	16.036	10.422	14.510	15.084	
1340	12.668	11.450	16.104	10.468	14.570	15.156	
1345	12.724	11.500	16.172	10.514	14.630	15.228	
1350	12.780	11.550	16.240	10.560	14.640	15.300	
1355	12.836	11.600	16.308	10.604	14.750	15.372	
1360	12.892	11.650	16.376	10.648	14.810	15.444	
1365	12.948	11.700	16.444	10.692	14.870	15.516	
1370	13.004	11.750	16.512	10.736	14.930	15.588	
1375	13.060	11.800	16.580	10.780	14.990	15.660	
1380	13.116	11.850	16.648	10.826	15.050	15.732	
1385	13.172	11.900	16.716	10.872	15.110	15.804	
1390	13.228	11.950	16.784	10.913	15.170	15.876	
1395	13.284	12.000	16.852	10.924	15.230	15.948	
1400	13.340	12.050	16.920	11.010	15.290	16.020	
1405			16.996				
1410			17.072				
1415			17.148				
1420			17.224				

Table 2-1
Continued

Temp. (F)	Carbon Steel Carbon-moly Low-chrome (Thru 3 Cr Mo)	5 CR MO Thru 9 Cr Mo	Austenitic Stainless Steels 18 Cr 8 Ni	12 Cr 17 Cr 27 Cr	25 Cr 20 Ni	Monel 67 Ni 30 Cu	3½ Nickel
1425			17.300				
1430			17.378				
1435			17.456				
1440			17.534				
1445			17.612				
1450			17.690				
1455			17.768				
1460			17.846				
1465			17.924				
1470			18.002				
1475			18.080				
1480			18.158				
1485			18.236				
1490			13.314				
1495			18.392				
1500			18.470				

Temp. (F)	Aluminum	Gray Cast Iron	Bronze	Brass	70 Cu 30 Ni	Ni-Fe-Cr	Ni-Cr-Fe	Ductile Iron
-325	-4.68		-3.98	-3.88	-3.15			
-320	-4.636		-3.932	-3.832	-3.094			
-315	-4.592		-3.884	-3.784	-3.038			
-310	-4.548		-3.836	-3.736	-2.982			
-305	-4.504		-3.788	-3.688	-2.926			
-300	-4.46		-3.74	-3.64	-2.87			
-295	-4.41		-3.692	-3.592	-2.836			
-290	-4.36		-3.644	-3.544	-2.802			
-285	-4.31		-3.596	-3.496	-2.768			
-280	-4.26		-3.548	-3.448	-2.734			
-275	-4.21		-3.5	-3.40	-2.70			
-270	-4.162		-3.452	-3.352	-2.666			
-265	-4.114		-3.404	-3.304	-2.632			
-260	-4.066		-3.356	-3.256	-2.598			
-255	-4.018		-3.308	-3.208	-2.564			
-250	-3.97		-3.26	-3.16	-2.53			
-245	-3.918		-3.212	-3.114	-2.496			
-240	-3.866		-3.164	-3.068	-2.462			
-235	-3.814		-3.116	-3.022	-2.428			
-230	-3.762		-3.068	-2.976	-2.394			
-225	-3.71		-3.02	-2.93	-2.36			
-220	-3.656		-2.972	-2.884	-2.326			
-215	-3.602		-2.924	-2.838	-2.292			
-210	-3.548		-2.876	-2.792	-2.258			
-205	-3.494		-2.828	-2.746	-2.224			

Table 2-1
Continued

Temp. (F)	Aluminum	Gray Cast Iron	Bronze	Brass	70 Cu 30 Ni	Ni-Fe-Cr	Ni-Cr-Fe	Ductile Iron
-200	-3.44		-2.78	-2.70	-2.19			-1.51
-195	-3.384		-2.732	-2.654	-2.176			-1.49
-190	-3.328		-2.684	-2.608	-2.162			-1.47
-185	-3.272		-2.636	-2.562	-2.148			-1.45
-180	-3.216		-2.588	-2.516	-2.134			-1.43
-175	-3.16		-2.54	-2.47	-2.12			-1.41
-170	-3.104		-2.494	-2.424	-2.086			-1.386
-165	-3.048		-2.448	-2.378	-2.052			-1.362
-160	-2.992		-2.402	-2.332	-2.018			-1.338
-155	-2.936		-2.356	-2.286	-1.984			-1.314
-150	-2.88		-2.31	-2.24	-1.95			-1.29
-145	-2.818		-2.26	-2.192	-1.908			-1.264
-140	-2.756		-2.21	-2.144	-1.866			-1.238
-135	-2.694		-2.16	-2.096	-1.824			-1.212
-130	-2.632		-2.11	-2.048	-1.782			-1.186
-125	-2.57		-2.06	-2.00	-1.74			-1.16
-120	-2.51		-2.01	-1.952	-1.698			-1.136
-115	-2.45		-1.96	-1.904	-1.656			-1.112
-110	-2.39		-1.91	-1.856	-1.614			-1.088
-105	-2.33		-1.86	-1.808	-1.572			-1.064
-100	-2.27		-1.81	-1.76	-1.53			-1.04
- 95	-2.21		-1.76	-1.712	-1.49			-1.014
- 90	-2.15		-1.71	-1.664	-1.45			-.988
- 85	-2.09		-1.66	-1.616	-1.41			-.962
- 80	-2.03		-1.61	-1.568	-1.37			-.936
- 75	-1.97		-1.56	-1.52	-1.33			-.91
- 70	-1.91		-1.512	-1.474	-1.29			-.882
- 65	-1.85		-1.464	-1.428	-1.25			-.854
- 60	-1.79		-1.416	-1.382	-1.21			-.826
- 55	-1.73		-1.368	-1.336	-1.17			-.798
- 50	-1.67		-1.32	-1.29	-1.13			-.77
- 45	-1.6		-1.306	-1.236	-1.082			-.74
- 40	-1.53		-1.292	-1.182	-1.034			-.71
- 35	-1.46		-1.278	-1.128	-0.986			-.68
- 30	-1.39		-1.264	-1.074	-0.938			-.65
- 25	-1.32		-1.25	-1.02	- .89			-.62
- 20	-1.25		-1.154	- .996	- .844			-.588
- 15	-1.18		-1.058	- .912	- .798			-.556
- 10	-1.11		- .962	- .858	- .752			-.524
- 5	-1.04		-0.866	- .804	- .706			-4.92
0	- .97		- .77	- .75	- .66			-.46
5	- .902		- .714	- .696	- .612			-.414
10	- .834		- .658	- .642	- .564			-.368
15	- .766		- .602	- .588	- .516			-.322
20	- .698		- .546	- .534	- .468			-.276
25	- .63		- .49	- .48	- .42			-.23
30	- .56		- .436	- .426	- .374			-.212
35	- .49		- .382	- .372	- .328			-.194
40	- .42		- .328	- .318	- .282			-.176
45	- .35		- .274	- .264	- .236			-.158

Table 2-1
Continued

Temp. (F)	Aluminum	Gray Cast Iron	Bronze	Brass	70 Cu 30 Ni	Ni-Fe-Cr	Ni-Cr-Fe	Ductile Iron
50	- .28		- .22	- .21				- .14
55	- .21		- .165	- .1575				- .105
60	- .14		- .11	- .105				- .07
65	- .07		- .055	- .525				- .035
70	0	0	0	0				0
75	.076	.035	.06	.0583	.0516	.0466	.0433	.035
80	.153	.07	.12	.1166	.1033	.0933	.0866	.07
85	.23	.105	.18	.175	.155	.14	.13	.105
90	.3066	.14	.24	.233	.206	.1866	.173	.14
95	.3833	.175	.3	.291	.258	.233	.216	.175
100	.46	.21	.36	.35	.31	.28	.26	.21
105	.538	.244	.42	.408	.36	.328	.304	.246
110	.616	.278	.48	.466	.41	.376	.348	.282
115	.694	.312	.54	.524	.46	.424	.392	.318
120	.772	.346	.6	.582	.51	.472	.436	.354
125	.85	.38	.66	.64	.56	.52	.48	.39
130	.926	.414	.72	.7	.612	.568	.524	.426
135	1.002	.448	.78	.76	.664	.616	.568	.462
140	1.078	.482	.84	.82	.716	.664	.612	.498
145	1.154	.516	.9	.88	.768	.712	.666	.534
150	1.23	.55	.96	.94	.82	.76	.7	.57
155	1.308	.586	1.02	.998	.87	.806	.744	.608
160	1.386	.622	1.08	1.056	.92	.852	.788	.646
165	1.464	.658	1.14	1.114	.97	.898	.832	.684
170	1.542	.694	1.2	1.172	1.02	.944	.876	.722
175	1.62	.73	1.26	1.23	1.07	.99	.92	.75
180	1.698	.764	1.32	1.288	1.122	1.038	.966	.788
185	1.776	.798	1.38	1.346	1.174	1.086	1.012	.826
190	1.854	.832	1.44	1.404	1.226	1.134	1.058	.864
195	1.932	.866	1.5	1.462	1.278	1.182	1.104	.902
200	2.00	.9	1.56	1.52	1.33	1.23	1.15	.94
205	2.082	.936	1.62	1.582	1.382	1.282	1.196	.976
210	2.164	.972	1.68	1.644	1.434	1.334	1.242	1.012
215	2.246	1.008	1.74	1.706	1.486	1.386	1.288	1.048
220	2.328	1.044	1.8	1.768	1.538	1.438	1.334	1.084
225	2.41	1.08	1.86	1.83	1.59	1.49	1.38	1.13
230	2.494	1.118	1.922	1.892	1.644	1.544	1.426	1.17
235	2.578	1.156	1.984	1.954	1.698	1.598	1.472	1.21
240	2.662	1.194	2.046	2.016	1.752	1.652	1.518	1.25
245	2.746	1.232	2.108	2.078	1.806	1.706	1.564	1.29
250	2.83	1.27	2.17	2.14	1.86	1.76	1.61	1.33
255	2.912	1.306	2.232	2.202	1.914	1.814	1.658	1.37
260	2.994	1.342	2.294	2.264	1.968	1.868	1.706	1.41
265	3.076	1.378	2.356	2.326	2.022	1.922	1.754	1.45
270	3.158	1.414	2.418	2.388	2.076	1.976	1.802	1.49
275	3.24	1.45	2.48	2.45	2.13	2.03	1.85	1.53
280	3.326	1.488	2.542	2.512	2.184	2.084	1.898	1.568
285	3.412	1.526	2.604	2.574	2.238	2.138	1.946	1.606
290	3.498	1.564	2.666	2.636	2.292	2.192	1.994	1.644
295	3.584	1.602	2.728	2.698	2.346	2.246	2.042	1.682

Table 2-1
Continued

Temp. (F)	Aluminum	Gray Cast Iron	Bronze	Brass	70 Cu 30 Ni	Ni-Fe-Cr	Ni-Cr-Fe	Ductile Iron
300	3.67	1.64	2.79	2.76	2.40	2.30	2.09	1.72
305	3.754	1.678	2.854	2.824	2.456	2.358	2.136	1.762
310	3.838	1.716	2.918	2.888	2.512	2.416	2.182	1.804
315	3.922	1.754	2.982	2.952	2.568	2.474	2.228	1.846
320	4.006	1.792	2.046	3.016	2.624	2.532	2.274	1.888
325	4.09	1.83	3.11	3.08	2.68	2.59	2.32	1.93
330	4.176	1.87	3.172	3.146	2.736	2.648	2.368	1.97
335	4.262	1.91	3.234	3.212	2.792	2.706	2.416	2.01
340	4.348	1.95	3.296	3.278	2.848	2.764	2.464	2.05
345	4.434	1.99	3.358	3.344	2.904	2.822	2.512	2.09
350	4.52	2.03	3.42	3.41	2.96	2.88	2.56	2.13
355	4.606	2.068	3.484	3.474	3.016	2.94	2.608	2.176
360	4.692	2.106	3.548	3.538	3.072	3.00	2.656	2.222
365	4.778	2.144	3.612	3.602	3.128	3.06	2.704	2.268
370	4.864	2.182	3.676	3.666	3.184	3.12	2.752	2.314
375	4.95	2.22	3.74	3.73	3.24	3.18	2.80	2.36
380	5.038	2.26	3.802	3.794	3.296	3.24	2.85	2.4
385	5.126	2.3	3.864	3.858	3.352	3.30	2.9	2.44
390	5.214	2.34	3.926	3.922	3.408	3.36	2.95	2.48
395	5.302	2.38	3.988	3.986	3.464	3.42	3.0	2.52
400	5.39	2.42	4.05	4.05	3.52	3.48	3.05	2.56
405	5.478	2.46	4.114	4.116		3.536	3.098	2.606
410	5.566	2.5	4.178	4.182		3.592	3.146	2.652
415	5.654	2.54	4.242	4.248		3.648	3.194	2.698
420	5.742	2.58	4.306	4.314		3.704	3.242	2.744
425	5.83	2.62	4.37	4.38		3.76	3.29	2.79
430	5.92	2.662	4.434	4.448		3.816	3.338	2.836
435	6.01	2.704	4.498	4.516		3.872	3.386	2.882
440	6.1	2.746	4.562	4.584		3,928	3.434	2.928
445	6.19	2.788	4.626	4.652		3.984	3.482	2.974
450	6.28	2.83	4.69	4.72		4.04	3.53	3.04
455	6.368	2.87	4.754	4.788		4.094	3.58	3.088
460	6.456	2.91	4.818	4.856		4.148	3.63	3.136
465	6.544	2.95	4.882	4.924		4.202	3.68	3.184
470	6.632	2.99	4.946	4.992		4.256	3.73	3.232
475	6.72	3.03	5.01	5.06		4.31	3.78	3.28
480	6.81	3.072	5.074	5.128		4.366	3.828	3.332
485	6.9	3.114	5.138	5.196		4.422	3.876	3.384
490	6.99	3.156	5.202	5.264		4.472	3.924	3.436
495	7.08	3.198	5.266	5.332		4.534	3.972	3.488
500	7.17	3.24	5.33	5.40		4.59	4.02	3.54
505	7.262	3.284	5.394	5.47		4.646	4.07	3.584
510	7.354	3.328	5.458	5.54		4.702	4.12	3.628
515	7.446	3.372	5.522	5.61		4.758	4.17	3.672
520	7.538	3.416	5.586	5.68		4.814	4.22	3.716
525	7.63	3.46	5.65	5.75		4.87	4.27	3.76
530	7.724	3.502	5.716	5.82		4.928	4.32	3.806
535	7.818	3.544	5.782	5.89		4.986	4.37	3.852
540	7.912	3.586	5.848	5.96		5.044	4.42	3.898
545	8.006	3.628	5.914	6.03		5.102	4.47	3.944

Table 2-1
Continued

Temp. (F)	Aluminum	Gray Cast Iron	Bronze	Brass	70 Cu 30 Ni	Ni-Fe-Cr	Ni-Cr-Fe	Ductile Iron
550	8.1	3.67	5.98	6.10		5.16	4.52	3.99
555	8.192	3.714	6.046	6.17		5.218	4.57	4.036
560	8.284	3.758	6.112	6.24		5.276	4.62	4.082
565	8.376	3.802	6.178	6.31		5.334	4.67	4.128
570	8.468	3.846	6.244	6.38		5.392	4.72	4.174
575	8.56	3.89	6.31	6.45		5.45	4.77	4.22
580	8.654	3.934	6.376	6.52		5.496	4.82	4.264
585	8.748	3.978	6.442	6.59		5.552	4.87	4.308
590	8.842	4.022	6.508	6.66		5.608	4.92	4.352
595	8.936	4.066	6.574	6.73		5.664	4.97	3.396
600	9.03	4.11	6.64	6.80		5.72	5.02	4.44
605		4.156	6.704	6.872		5.778	5.07	4.484
610		4.202	6.768	6.944		5.836	5.12	4.528
615		4.428	6.832	7.016		5.894	5.17	4.572
620		4.294	6.896	7.088		5.952	5.22	4.616
625		4.34	6.96	7.16		6.01	5.27	4.66
630		4.386	7.026	7.234		6.068	5.322	4.708
635		4.432	7.092	7.308		6.126	5.374	4.756
640		4.478	7.158	7.382		6.184	5.426	4.804
645		4.524	7.224	7.456		6.242	5.478	4.852
650		4.57	7.29	7.53		6.30	5.53	4.9
655		4.616	7.356	7.602		6.356	5.582	4.948
660		4.662	7.422	7.674		6.412	5.634	4.996
665		4.708	7.488	7.746		6.468	5.686	5.044
670		4.754	7.554	7.818		6.524	5.738	5.092
675		4.8	7.62	7.89		6.58	5.79	5.14
680		4.846	7.686	7.964		6.64	5.842	5.19
685		4.892	7.752	8.038		6.70	5.894	5.24
690		4.938	7.818	8.112		6.76	5.946	5.29
695		4.984	7.884	8.186		6.82	5.998	5.34
700		5.03	7.95	8.26		6.88	6.05	5.39
705		5.076	8.016	8.336		6.938	6.102	5.432
710		5.122	8.082	8.412		6.996	6.154	5.474
715		5.168	8.148	8.488		7.054	6.206	5.516
720		5.214	8.214	8.564		7.112	6.258	5.558
725		5.26	8.28	8.64		7.17	6.31	5.60
730		5.308	8.348	8.716		7.23	6.362	5.65
735		5.356	8.416	8.792		7.29	6.414	5.70
740		5.404	8.484	8.868		7.35	6.466	5.75
745		5.452	8.552	8.944		7.41	6.518	5.80
750		5.5	8.62	9.02		7.47	6.57	5.85
755		5.548	8.688	9.096		7.528	6.624	5.90
760		5.596	8.756	9.172		7.586	6.678	5.95
765		5.644	8.824	9.248		7.644	6.732	6.00
770		5.692	8.892	9.324		7.702	6.786	6.05
775		5.74	8.96	9.40		7.76	6.84	6.10
780		5.788	9.028	9.476		7.82	6.894	6.15
785		5.836	9.096	9.552		7.88	6.948	6.20
790		5.884	9.164	9.628		7.94	7.002	6.25
795		5.932	9.232	9.704		8.00	7.056	6.30

Table 2-1
Continued

Temp. (F)	Aluminum	Gray Cast Iron	Bronze	Brass	70 Cu 30 Ni	Ni-Fe-Cr	Ni-Cr-Fe	Ductile Iron
800		5.98	9.30	9.78		8.06	7.10	6.35
805		6.028	9.368	9.858		8.118		6.398
810		6.076	9.436	9.936		8.176		6.446
815		6.124	9.504	10.014		8.234		6.494
820		6.172	9.572	10.092		8.292		6.542
825		6.22	9.64	10.17		8.35		6.59
830		6.27	9.71	10.25		8.412		6.642
835		6.32	9.78	10.33		8.474		6.694
840		6.37	9.85	10.41		8.536		6.746
845		6.42	9.92	10.49		8.598		6.798
850		6.47	9.99	10.57		8.66		6.85
855		6.52	10.06	10.648		8.722		6.898
860		6.57	10.13	10.726		8.784		6.946
865		6.62	10.2	10.804		8.846		6.994
870		6.67	10.27	10.882		8.908		7.042
875		6.72	10.33	10.96		8.95		7.09
880		6.77	10.4	11.038		9.012		7.138
885		6.82	10.47	11.116		9.074		7.186
890		6.87	10.54	11.194		9.136		7.234
895		6.92	10.61	11.272		9.198		7.282
900		6.97	10.68	11.35		9.26		7.35
905		7.022	10.748	11.43		9.32		7.408
910		7.074	10.816	11.51		9.38		7.466
915		7.216	10.884	11.59		9.44		7.524
920		7.178	10.952	11.67		9.5		7.582
925		7.23	11.02	11.75		9.56		7.64
930		7.284	11.09	11.832		9.622		7.684
935		7.338	11.16	11.914		9.684		7.728
940		7.392	11.23	11.996		9.746		7.772
945		7.446	11.3	12.078		9.808		7.816
950		7.5	11.37	12.16		9.87		7.86
955		7.552	11.438	12.242		9.932		7.91
960		7.604	11.506	12.324		9.994		7.96
965		7.656	11.574	12.402		10.056		8.01
970		7.708	11.642	12.488		10.118		8.06
975		7.76	11.71	12.57		10.18		8.11
980		7.812	11.778	12.652		10.242		8.158
985		7.864	11.846	12.734		10.304		8.206
990		7.916	11.914	12.816		10.366		8.254
995		7.968	11.982	12.898		10.428		8.302
1000		8.02	12.05	12.98		10.49		8.35
1005			12.12	13.062		10.552		
1010			12.19	13.144		10.614		
1015			12.26	13.226		10.676		
1020			12.33	13.308		10.738		
1025			12.4	13.39		10.80		
1030			12.472	13.474		10.862		
1035			12.544	13.558		10.924		
1040			12.616	13.642		10.986		
1045			16.688	13.726		11.048		

Table 2-1
Continued

Temp. (F)	Aluminum	Gray Cast Iron	Bronze	Brass	70 Cu 30 Ni	Ni-Fe-Cr	Ni-Cr-Fe	Ductile Iron
1050			12.76	13.81		11.11		
1055			12.83	13.894		11.172		
1060			12.90	13.978		11.234		
1065			12.97	14.062		11.296		
1070			13.04	14.146		11.358		
1075			13.11	14.23		11.42		
1080			13.182	14.314		11.484		
1085			13.254	14.398		11.548		
1090			13.32	14.482		11.612		
1095			13.39	14.566		11.676		
			13.47	14.65				
1100						11.74		
1105						11.802		
1110						11.864		
1115						11.926		
1120						11.988		
1125						12.05		
1130						12.116		
1135						12.182		
1140						12.248		
1145						12.314		
1150						12.38		
1155						12.442		
1160						12.504		
1165						12.566		
1170						12.628		
1175						12.69		
1180						12.756		
1185						12.822		
1190						12.888		
1195						12.954		
1200						13.02		
1205						13.088		
1210						13.156		
1215						13.224		
1220						13.292		
1225						13.36		
1230						13.43		
1235						13.5		
1240						13.57		
1245						13.64		
1250						13.71		
1255						13.776		
1260						13.842		
1265						13.908		
1270						13.974		
1275						14.04		
1280						14.11		
1285						14.18		
1290						14.25		
1295						14.32		

Table 2-1
Continued

Temp. (F)	Aluminum	Gray Cast Iron	Bronze	Brass	70 Cu 30 Ni	Ni-Fe-Cr	Ni-Cr-Fe	Ductile Iron
1300						14.39		
1305						14.46		
1310						14.53		
1315						14.60		
1320						14.67		
1325						14.74		
1330						14.812		
1335						14.884		
1340						14.956		
1345						15.028		
1350						15.10		
1355						15.168		
1360						15.236		
1365						15.304		
1370						15.372		
1375						15.44		
1380						15.512		
1385						15.584		
1390						15.656		
1395						15.278		
1400						15.80		
1405						15.872		
1410						15.944		
1415						15.016		
1420						16.088		
1425						16.16		
1430						16.234		
1435						16.308		
1440						16.382		
1445						16.456		
1450						16.53		
1455						16.60		
1460						16.67		
1465						16.74		
1470						16.81		
1475						76.88		
1480						16.954		
1485						17.028		
1490						17.102		
1495						17.176		
1500						17.25		

Table 2-2
Modulus of Elasticity-Ferrous Material

E = Modulus of Elasticity, psi (Multiply Tabulated Values by 10^6)

Material	Temperature, °F																	
	−325	−200	−100	70	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
Carbon steels with carbon content 0.3% or less, 3½ NI	30.0	29.5	29.0	27.9	27.7	27.4	27.0	26.4	25.7	24.8	23.4	18.5	15.4	13.0				
Carbon steels with carbon content above 0.30%	31.0	30.6	30.4	29.9	29.5	29.0	28.3	27.4	26.7	25.4	23.8	21.5	18.8	15.0	11.2			
Carbon-moly steels, low chrome steels through 3 Cr Mo	31.0	30.6	30.4	29.9	29.5	29.0	28.6	28.0	27.4	26.6	25.7	24.5	23.0	20.4	15.6			
Intermediate chrome steels (5 Cr Mo through 9 Cr Mo)	29.4	28.5	28.1	27.4	27.1	26.8	26.4	26.0	25.4	24.9	24.2	23.5	22.8	21.9	20.8	19.5	18.1	
Austenitic steels (Tp304, 310, 316, 321, 347)	30.4	29.9	29.4	28.3	27.7	27.1	26.6	26.1	25.4	24.8	24.1	23.4	22.7	22.0	21.3	20.7	19.3	17.9
Straight chromium steels (12 Cr, 17 Cr, 27 Cr)	30.8	30.3	29.8	29.2	28.7	28.3	27.7	27.0	26.0	24.8	23.1	21.1	18.6	15.6	12.2			
Gray cast iron				13.4	13.2	12.9	12.6	12.2	11.7	11.0	10.2							

These data are for information, and it is not implied that materials are suitable for all the temperatures shown.

Table 2-3
Modulus of Elasticity-Nonferrous Materials

E = Modulus of Elasticity, psi (Multiply Tabulated Values by 10^6)

Material	Temperature, °F															
	−325	−200	−100	70	100	200	300	400	500	600	700	800	900	1000	1100	1200
Monel (67 Ni-30 Cu) and (66 Ni-29 Cu-Al)	26.8	26.6	26.4	26.0	26.0	26.0	25.8	25.6	25.4	24.7	2.31	21.0	18.6	16.0	14.3	13.0
Copper-Nickel (70 Cu-30 Ni)				21.6	21.5	21.2	20.9	20.6	20.3	20.0	19.7	19.4				
Aluminum alloys	11.3	10.9	10.6	10.1	10.0	9.8	9.5	8.7	7.7							
Copper (99.98% Cu)	17.0	16.7	16.5	16.0	15.8	15.6	15.4	15.1	14.7	14.2	13.7					
Commercial brass (66 Cu-34 Zn)	15.0	14.7	14.5	14.0	13.9	13.7	13.5	13.0	12.7	12.2	11.8					
Leaded tin bronze (88 Cu-6 Sn-1.5 Pb-4.5 Zn)	14.2	13.8	13.5	13.0	12.9	12.7	12.4	12.0	11.7	11.3	10.9					

These data are for information, and it is not implied that materials are suitable for all the temperatures shown.

Table 2-4
Properties of Saturated Steam

Absolute Pressure		Vacuum	Temperature	Heat of	Latent Heat	Total Heat	Specific
Lbs. per Sq. In. P'	Inches of Hg	Inches of Hg	t Degrees F	the Liquid Btu/lb.	of Evaporation Btu/lb.	of Steam h_g Btu/lb.	Volume $\overline{V}$ Cu. ft. per lb.
0.20	0.41	29.51	53.14	21.21	1063.8	1085.0	1526.0
0.25	0.51	29.41	59.30	27.36	1060.3	1087.7	1235.3
0.30	0.61	29.31	64.47	32.52	1057.4	1090.0	1039.5
0.35	0.71	29.21	68.93	36.97	1054.9	1091.9	898.5
0.40	0.81	29.11	72.86	40.89	1052.7	1093.6	791.9
0.45	0.92	29.00	76.38	44.41	1050.7	1095.1	708.5
0.50	1.02	28.90	79.58	47.60	1048.8	1096.4	641.4
0.60	1.22	28.70	85.21	53.21	1045.7	1098.9	540.0
0.70	1.43	28.49	90.08	58.07	1042.9	1101.0	466.9
0.80	1.63	28.29	94.38	62.36	1040.4	1102.8	411.7
0.90	1.83	28.09	98.24	66.21	1038.3	1104.5	368.4
1.0	2.04	27.88	101.74	69.70	1036.3	1106.0	333.6
1.2	2.44	27.48	107.92	75.87	1032.7	1108.6	280.9
1.4	2.85	27.07	113.26	81.20	1029.6	1110.8	243.0
1.6	3.26	26.66	117.99	85.91	1026.9	1112.8	214.3
1.8	3.66	26.26	122.23	90.14	1024.5	1114.6	191.8
2.0	4.07	25.85	126.08	93.99	1022.2	1116.2	173.73
2.2	4.48	25.44	129.62	97.52	1020.2	1117.7	158.85
2.4	4.89	25.03	132.89	100.79	1018.3	1119.1	146.38
2.6	5.29	24.63	135.94	103.83	1016.5	1120.3	135.78
2.8	5.70	24.22	138.79	106.68	1014.8	1121.5	126.65
3.0	6.11	23.81	141.48	109.37	1013.2	1122.6	118.71
3.5	7.13	22.79	147.57	115.46	1009.6	1125.1	102.72
4.0	8.14	21.78	152.97	120.86	1006.4	1127.3	90.63
4.5	9.16	20.76	157.83	125.71	1003.6	1129.3	81.16
5.0	10.18	19.74	162.24	130.13	1001.0	1131.1	73.52
5.5	11.20	18.72	166.30	134.19	998.5	1132.7	67.24
6.0	12.22	17.70	170.06	137.96	996.2	1134.2	61.98
6.5	13.23	16.69	173.56	141.47	994.1	1135.6	57.50
7.0	14.25	15.67	176.85	144.76	992.1	1136.9	53.64
7.5	15.27	14.65	179.94	147.86	990.2	1138.1	50.29
8.0	16.29	13.63	182.86	150.79	988.5	1139.3	47.34
8.5	17.31	12.61	185.64	153.57	986.8	1140.4	44.73
9.0	18.32	11.60	188.28	156.22	985.2	1141.4	42.40
9.5	19.34	10.58	190.80	158.75	983.6	1142.3	40.31
10.0	20.36	9.56	193.21	161.17	982.1	1143.3	38.42
11.0	22.40	7.52	197.75	165.73	979.3	1145.0	35.14
12.0	24.43	5.49	201.96	169.96	976.6	1146.6	32.40
13.0	26.47	3.45	205.88	173.91	974.2	1148.1	30.06
14.0	28.50	1.42	209.56	177.61	971.9	1149.5	28.04

Pressure Lbs. per Sq. In.		Temperature	Heat of	Latent Heat	Total Heat	Specific
Absolute P'	Gage P	t Degrees F	the Liquid Btu/lb.	of Evaporation Btu/lb.	of Steam h_g Btu/lb.	Volume $\overline{V}$ Cu. ft. per lb.
14.696	0.0	212.00	180.07	970.3	1150.4	26.80
15.0	0.3	213.03	181.11	969.7	1150.8	26.29
16.0	1.3	216.32	184.42	967.6	1152.0	24.75
17.0	2.3	219.44	187.56	965.5	1153.1	23.39
18.0	3.3	222.41	190.56	963.6	1154.2	22.17
19.0	4.3	225.24	193.42	961.9	1155.3	21.08
20.0	5.3	227.96	196.16	960.1	1156.3	20.089
21.0	6.3	230.57	198.79	958.4	1157.2	19.192
22.0	7.3	233.07	201.33	956.8	1158.1	18.375
23.0	8.3	235.49	203.78	955.2	1159.0	17.627
24.0	9.3	237.82	206.14	953.7	1159.8	16.938
25.0	10.3	240.07	208.42	952.1	1160.6	16.303
26.0	11.3	242.25	210.62	950.7	1161.3	15.715
27.0	12.3	244.36	212.75	949.3	1162.0	15.170
28.0	13.3	246.41	214.83	947.9	1162.7	14.663
29.0	14.3	248.40	216.86	946.5	1163.4	14.189
30.0	15.3	250.33	218.82	945.3	1164.1	13.746
31.0	16.3	252.22	220.73	944.0	1164.7	13.330
32.0	17.3	254.05	222.59	942.8	1165.4	12.940
33.0	18.3	255.84	224.41	941.6	1166.0	12.572
34.0	19.3	257.58	226.18	940.3	1166.5	12.226
35.0	20.3	259.28	227.91	939.2	1167.1	11.898
36.0	21.3	260.95	229.60	938.0	1167.6	11.588
37.0	22.3	262.57	231.26	936.9	1168.2	11.294
38.0	23.3	264.16	232.89	935.8	1168.7	11.015
39.0	24.3	265.72	234.48	934.7	1169.2	10.750
40.0	25.3	267.25	236.03	933.7	1169.7	10.498
41.0	26.3	268.74	237.55	932.6	1170.2	10.258
42.0	27.3	270.21	239.04	931.6	1170.7	10.029
43.0	28.3	271.64	240.51	930.6	1171.1	9.810
44.0	29.3	273.05	241.95	929.6	1171.6	9.601
45.0	30.3	274.44	243.36	928.6	1172.0	9.401
46.0	31.3	275.80	244.75	927.7	1172.4	9.209
47.0	32.3	277.13	246.12	926.7	1172.9	9.025
48.0	33.3	278.45	247.47	925.8	1173.3	8.848
49.0	34.3	279.74	248.79	924.9	1173.7	8.678
50.0	35.3	281.01	250.09	924.0	1174.1	8.515
51.0	36.3	282.26	251.37	923.0	1174.4	8.359
52.0	37.3	283.49	252.63	922.2	1174.8	8.208
53.0	38.3	284.70	253.87	921.3	1175.2	8.062
54.0	39.3	285.90	255.09	920.5	1175.6	7.922
55.0	40.3	287.07	256.30	919.6	1175.9	7.787
56.0	41.3	288.23	257.50	918.8	1176.3	7.656
57.0	42.3	289.37	258.67	917.9	1176.6	7.529
58.0	43.3	290.50	259.82	917.1	1176.9	7.407
59.0	44.3	291.61	260.96	916.3	1177.3	7.289

Table 2-4
Continued

Pressure Lbs. per Sq. In. Absolute P'	Pressure Lbs. per Sq. In. Gage P	Temperature t Degrees F	Heat of the Liquid Btu/lb.	Latent Heat of Evaporation Btu/lb.	Total Heat of Steam h_g Btu/lb.	Specific Volume $\overline{V}$ Cu. ft. per lb.
60.0	45.3	292.71	262.09	915.5	1177.6	7.175
61.0	46.3	293.79	263.20	914.7	1177.9	7.064
62.0	47.3	294.85	264.30	913.9	1178.2	6.957
63.0	48.3	295.90	265.38	913.1	1178.5	6.853
64.0	49.3	296.94	266.45	912.3	1178.8	6.752
65.0	50.3	297.97	267.50	911.6	1179.1	6.655
66.0	51.3	298.99	268.55	910.8	1179.4	6.560
67.0	52.3	299.99	269.58	910.1	1179.7	6.468
68.0	53.3	300.98	270.60	909.4	1180.0	6.378
69.0	54.3	301.96	271.61	908.7	1180.3	6.291
70.0	55.3	302.92	272.61	907.9	1180.6	6.206
71.0	56.3	303.88	273.60	907.2	1180.8	6.124
72.0	57.3	304.83	274.57	906.5	1181.1	6.044
73.0	58.3	305.76	275.54	905.8	1181.3	5.966
74.0	59.3	306.68	276.49	905.1	1181.6	5.890
75.0	60.3	307.60	277.43	904.5	1181.9	5.816
76.0	61.3	308.50	278.37	903.7	1182.1	5.743
77.0	62.3	309.40	279.30	903.1	1182.4	5.673
78.0	63.3	310.29	280.21	902.4	1182.6	5.604
79.0	64.3	311.16	281.12	901.7	1182.8	5.537
80.0	65.3	312.03	282.02	901.1	1183.1	5.472
81.0	66.3	312.89	282.91	900.4	1183.3	5.408
82.0	67.3	313.74	283.79	899.7	1183.5	5.346
83.0	68.3	314.59	284.66	899.1	1183.8	5.285
84.0	69.3	315.42	285.53	898.5	1184.0	5.226
85.0	70.3	316.25	286.39	897.8	1184.2	5.168
86.0	71.3	317.07	287.24	897.2	1184.4	5.111
87.0	72.3	317.88	288.08	896.5	1184.6	5.055
88.0	73.3	318.68	288.91	895.9	1184.8	5.001
89.0	74.3	319.48	289.74	895.3	1185.1	4.948
90.0	75.3	320.27	290.56	894.7	1185.3	4.896
91.0	76.3	321.06	291.38	894.1	1185.5	4.845
92.0	77.3	321.83	292.18	893.5	1185.7	4.796
93.0	78.3	322.60	292.98	892.9	1185.9	4.747
94.0	79.3	323.36	293.78	892.3	1186.1	4.699
95.0	80.3	324.12	294.56	891.7	1186.2	4.652
96.0	81.3	324.87	295.34	891.1	1186.4	4.606
97.0	82.3	325.61	296.12	890.5	1186.6	4.561
98.0	83.3	326.35	296.89	889.9	1186.8	4.517
99.0	84.3	327.08	297.65	889.4	1187.0	4.474
100.0	85.3	327.81	298.40	888.8	1187.2	4.432
101.0	86.3	328.53	299.15	888.2	1187.4	4.391
102.0	87.3	329.25	299.90	887.6	1187.5	4.350
103.0	88.3	329.96	300.64	887.1	1187.7	4.310
104.0	89.3	330.66	301.37	886.5	1187.9	4.271
105.0	90.3	331.36	302.10	886.0	1188.1	4.232
106.0	91.3	332.05	302.82	885.4	1188.2	4.194
107.0	92.3	332.74	303.54	884.9	1188.4	4.157
108.0	93.3	333.42	304.26	884.3	1188.6	4.120
109.0	94.3	334.10	304.97	883.7	1188.7	4.084
110.0	95.3	334.77	305.66	883.2	1188.9	4.049
111.0	96.3	335.44	306.37	882.6	1189.0	4.015
112.0	97.3	336.11	307.06	882.1	1189.2	3.981
113.0	98.3	336.77	307.75	881.6	1189.4	3.947
114.0	99.3	337.42	308.43	881.1	1189.5	3.914
115.0	100.3	338.07	309.11	880.6	1189.7	3.882
116.0	101.3	338.72	309.79	880.0	1189.8	3.850
117.0	102.3	339.36	310.46	879.5	1190.0	3.819
118.0	103.3	339.99	311.12	879.0	1190.1	3.788
119.0	104.3	340.62	311.78	878.4	1190.2	3.758
120.0	105.3	341.25	312.44	877.9	1190.4	3.728
121.0	106.3	341.88	313.10	877.4	1190.5	3.699
122.0	107.3	342.50	313.75	876.9	1190.7	3.670
123.0	108.3	343.11	314.40	876.4	1190.8	3.642
124.0	109.3	343.72	315.04	875.9	1190.9	3.614
125.0	110.3	344.33	315.68	875.4	1191.1	3.587
126.0	111.3	344.94	316.31	874.9	1191.2	3.560
127.0	112.3	345.54	316.94	874.4	1191.3	3.533
128.0	113.3	346.13	317.57	873.9	1191.5	3.507
129.0	114.3	346.73	318.19	873.4	1191.6	3.481
130.0	115.3	347.32	318.81	872.9	1191.7	3.455
131.0	116.3	347.90	319.43	872.5	1191.9	3.430
132.0	117.3	348.48	320.04	872.0	1192.0	3.405
133.0	118.3	349.06	320.65	871.5	1192.1	3.381
134.0	119.3	349.64	321.25	871.0	1192.2	3.357
135.0	120.3	350.21	321.85	870.6	1192.4	3.333
136.0	121.3	350.78	322.45	870.1	1192.5	3.310
137.0	122.3	351.35	323.05	869.6	1192.6	3.287
138.0	123.3	351.91	323.64	869.1	1192.7	3.264
139.0	124.3	352.47	324.23	868.7	1192.9	3.242
140.0	125.3	353.02	324.82	868.2	1193.0	3.220
141.0	126.3	353.57	325.40	867.7	1193.1	3.198
142.0	127.3	354.12	325.98	867.2	1193.2	3.177
143.0	128.3	354.67	326.56	866.7	1193.3	3.155
144.0	129.3	355.21	327.13	866.3	1193.4	3.134
145.0	130.3	355.76	327.70	865.8	1193.5	3.114
146.0	131.3	356.29	328.27	865.3	1193.6	3.094
147.0	132.3	356.83	328.83	864.9	1193.8	3.074
148.0	133.3	357.36	329.39	864.5	1193.9	3.054
149.0	134.3	357.89	329.95	864.0	1194.0	3.034
150.0	135.3	358.42	330.51	863.6	1194.1	3.015
152.0	137.3	359.46	331.61	862.7	1194.3	2.977
154.0	139.3	360.49	332.70	861.8	1194.5	2.940
156.0	141.3	361.52	333.79	860.9	1194.7	2.904
158.0	143.3	362.53	334.86	860.0	1194.9	2.869
160.0	145.3	363.53	335.93	859.2	1195.1	2.834
162.0	147.3	364.53	336.98	858.3	1195.3	2.801
164.0	149.3	365.51	338.02	857.5	1195.5	2.768
166.0	151.3	366.48	339.05	856.6	1195.7	2.736
168.0	153.3	367.45	340.07	855.7	1195.8	2.705

Table 2-4
Continued

Pressure Lbs. Per Sq. In. Absolute P'	Pressure Lbs. Per Sq. In. Gage P	Temperature t Degrees F	Heat of the Liquid Btu/lb.	Latent Heat of Evaporation Btu/lb.	Total Heat of Steam h_g Btu/lb.	Specific Volume $\overline{V}$ Cu. ft. per lb.
170.0	155.3	368.41	341.09	854.9	1196.0	2.675
172.0	157.3	369.35	342.10	854.1	1196.2	2.645
174.0	159.3	370.29	343.10	853.3	1196.4	2.616
176.0	161.3	371.22	344.09	852.4	1196.5	2.587
178.0	163.3	372.14	345.06	851.6	1196.7	2.559
180.0	165.3	373.06	346.03	850.8	1196.9	2.532
182.0	167.3	373.96	347.00	850.0	1197.0	2.505
184.0	169.3	374.86	347.96	849.2	1197.2	2.479
186.0	171.3	375.75	348.92	848.4	1197.3	2.454
188.0	173.3	376.64	349.86	847.6	1197.5	2.429
190.0	175.3	377.51	350.79	846.8	1197.6	2.404
192.0	177.3	378.38	351.72	846.1	1197.8	2.380
194.0	179.3	379.24	352.64	845.3	1197.9	2.356
196.0	181.3	380.10	353.55	844.5	1198.1	2.333
198.0	183.3	380.95	354.46	843.7	1198.2	2.310
200.0	185.3	381.79	355.36	843.0	1198.4	2.288
205.0	190.3	383.86	357.58	841.1	1198.7	2.234
210.0	195.3	385.90	359.77	839.2	1199.0	2.183
215.0	200.3	387.89	361.91	837.4	1199.3	2.134
220.0	205.3	389.86	364.02	835.6	1199.6	2.087
225.0	210.3	391.79	366.09	833.8	1199.9	2.0422
230.0	215.3	393.68	368.13	832.0	1200.1	1.9992
235.0	220.3	395.54	370.14	830.3	1200.4	1.9579
240.0	225.3	397.37	372.12	828.5	1200.6	1.9183
245.0	230.3	399.18	374.08	826.8	1200.9	1.8803
250.0	235.3	400.95	376.00	825.1	1201.1	1.8438
255.0	240.3	402.70	377.89	823.4	1201.3	1.8086
260.0	245.3	404.42	379.76	821.8	1201.5	1.7748
265.0	250.3	406.11	381.60	820.1	1201.7	1.7422
270.0	255.3	407.78	383.42	818.5	1201.9	1.7107
275.0	260.3	409.43	385.21	816.9	1202.1	1.6804
280.0	265.3	411.05	386.98	815.3	1202.3	1.6511
285.0	270.3	412.65	388.73	813.7	1202.4	1.6228
290.0	275.3	414.23	390.46	812.1	1202.6	1.5954
295.0	280.3	415.79	392.16	810.5	1202.7	1.5689
300.0	285.3	417.33	393.84	809.0	1202.8	1.5433
320.0	305.3	423.29	400.39	803.0	1203.4	1.4485
340.0	325.3	428.97	406.66	797.1	1203.7	1.3645
360.0	345.3	434.40	412.67	791.4	1204.1	1.2895
380.0	365.3	439.60	418.45	785.8	1204.3	1.2222
400.0	385.3	444.59	424.0	780.5	1204.5	1.1613
420.0	405.3	449.39	429.4	775.2	1204.6	1.1061
440.0	425.3	454.02	434.6	770.0	1204.6	1.0556
460.0	445.3	458.50	439.7	764.9	1204.6	1.0094
480.0	465.3	462.82	444.6	759.9	1204.5	0.9670
500.0	485.3	467.01	449.4	755.0	1204.4	0.9278
520.0	505.3	471.07	454.1	750.1	1204.2	0.8915
540.0	525.3	475.01	458.6	745.4	1204.0	0.8578
560.0	545.3	478.85	463.0	740.8	1203.8	0.8265
580.0	565.3	482.58	467.4	736.1	1203.5	0.7973
600.0	585.3	486.21	471.6	731.6	1203.2	0.7698
620.0	605.3	489.75	475.7	727.2	1202.9	0.7440
640.0	625.3	493.21	479.8	722.7	1202.5	0.7198
660.0	645.3	496.58	483.8	718.3	1202.1	0.6971
680.0	665.3	499.88	487.7	714.0	1201.7	0.6757
700.0	685.3	503.10	491.5	709.7	1201.2	0.6554
720.0	705.3	506.25	495.3	705.4	1200.7	0.6362
740.0	725.3	509.34	499.0	701.2	1200.2	0.6180
760.0	745.3	512.36	502.6	697.1	1199.7	0.6007
780.0	765.3	515.33	506.2	692.9	1199.1	0.5843
800.0	785.3	518.23	509.7	688.9	1198.6	0.5687
820.0	805.3	521.08	513.2	684.8	1198.0	0.5538
840.0	825.3	523.88	516.6	680.8	1197.4	0.5396
860.0	845.3	526.63	520.0	676.8	1196.8	0.5260
880.0	865.3	529.33	523.3	672.8	1196.1	0.5130
900.0	885.3	531.98	526.6	668.8	1195.4	0.5006
920.0	905.3	534.59	529.8	664.9	1194.7	0.4886
940.0	925.3	537.16	533.0	661.0	1194.0	0.4772
960.0	945.3	539.68	536.2	657.1	1193.3	0.4663
980.0	965.3	542.17	539.3	653.3	1192.6	0.4557
1000.0	985.3	544.61	542.4	649.4	1191.8	0.4456
1050.0	1035.3	550.57	550.0	639.9	1189.9	0.4218
1100.0	1085.3	556.31	557.4	630.4	1187.8	0.4001
1150.0	1135.3	561.86	564.6	621.0	1185.6	0.3802
1200.0	1185.3	567.22	571.7	611.7	1183.4	0.3619
1250.0	1235.3	572.42	578.6	602.4	1181.0	0.3450
1300.0	1285.3	577.46	585.4	593.2	1178.6	0.3293
1350.0	1335.3	582.35	592.1	584.0	1176.1	0.3148
1400.0	1385.3	587.10	598.7	574.7	1173.4	0.3012
1450.0	1435.3	591.73	605.2	565.5	1170.7	0.2884
1500.0	1485.3	596.23	611.6	556.3	1167.9	0.2765
1600.0	1585.3	604.90	624.1	538.0	1162.1	0.2548
1700.0	1685.3	613.15	636.3	519.6	1155.9	0.2354
1800.0	1785.3	621.03	648.3	501.1	1149.4	0.2179
1900.0	1885.3	628.58	660.1	482.4	1142.4	0.2021
2000.0	1985.3	635.82	671.7	463.4	1135.1	0.1878
2100.0	2085.3	642.77	683.3	444.1	1127.4	0.1746
2200.0	2185.3	649.46	694.8	424.4	1119.2	0.1625
2300.0	2285.3	655.91	706.5	403.9	1110.4	0.1513
2400.0	2385.3	662.12	718.4	382.7	1101.1	0.1407
2500.0	2485.3	668.13	730.6	360.5	1091.1	0.1307
2600.0	2585.3	673.94	743.0	337.2	1080.2	0.1213
2700.0	2685.3	679.55	756.2	312.1	1068.3	0.1123
2800.0	2785.3	684.99	770.1	284.7	1054.8	0.1035
2900.0	2885.3	690.26	785.4	253.6	1039.0	0.0947
3000.0	2985.3	695.36	802.5	217.8	1020.3	0.0858
3100.0	3085.3	700.31	825.0	168.1	993.1	0.0753
3200.0	3185.3	705.11	872.4	62.0	934.4	0.0580
3206.2	3191.5	705.40	902.7	0.0	902.7	0.0503

Example Problem

Use Figure 2-1 to calculate the F factor for the following conditions:

T = 660°F
h = 10 ft–0 in.
t = 1 in.
K = 1 (skirt fully insulated)
70°F = Ambient temperature
T_{al} = Average temperature

Step 1. $\frac{Kh}{\sqrt{t}} = \frac{1 \times 10 \text{ ft}}{1} = 10$

Step 2. Enter the chart at the point along the bottom line where $kh/\sqrt{t}$. Then move up vertically to the point where the curve intersects. Then move horizontally to the left to find the temperature correction factor, F, which in this example is equal to 0.22.

Step 3. $T_1 = T - 70°F = 530°F$.

Step 4. $T_{al} = F \times T_1 = 0.22 \times 530°F = 116.6°F$ or 117°F.

Step 5. $T_a = T_{al} + 70°F = 117°F + 70°F = 187°F$.

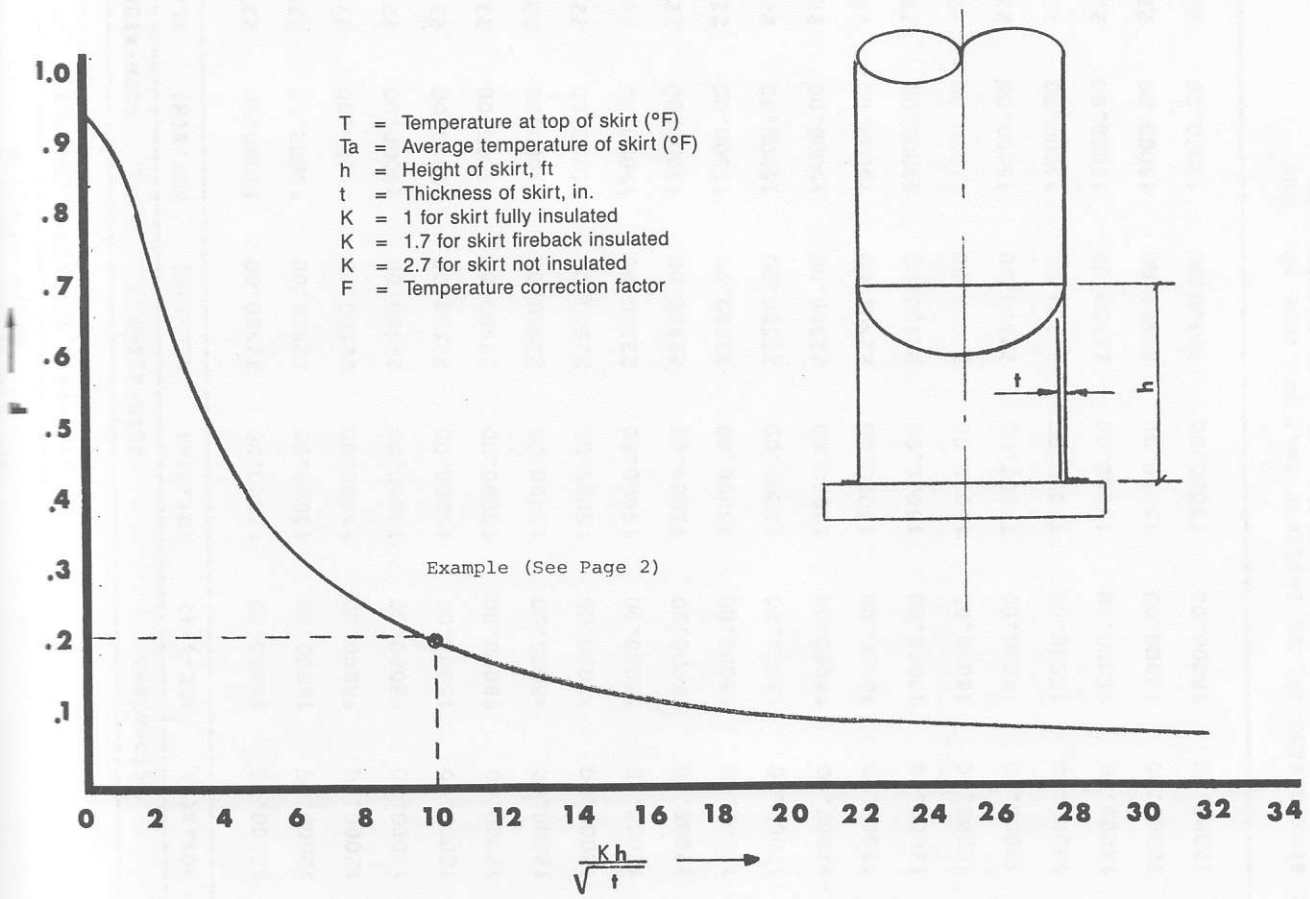

Figure 2-1. Curve for determination of average skirt temperature.

3

Allowable Stress Range for ANSI/ASME Power Piping Code B31.1 (1985)

This chapter contains allowable thermal stresses for petroleum piping. Values of Sh taken from ANSI/ASME Code B31.3-1980, Appendix A, Table 1. (Used courtesy of the American Society of Mechanical Engineers.)

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) F=1

MATERIAL	ASTM-A53-A		ASTM-A53-B		ASTM-A106-B		API-5L-GR-B		ASTM-A139-B	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
100.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
110.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
120.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
130.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
140.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
150.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
160.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
170.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
180.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
190.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
200.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
210.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
220.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
230.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
240.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
250.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
260.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
270.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
280.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
290.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
300.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	ASTM-A53-A		ASTM-A53-B		ASTM-A106-B		API-5L-GR-B		ASTM-A139-B	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
310.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
320.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
330.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
340.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
350.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
360.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
370.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
380.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
390.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
400.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
410.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
420.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
430.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
440.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
450.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
460.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
470.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
480.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
490.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
500.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
510.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	ASTM-A53-A		ASTM-A53-B		ASTM-A106-B		API-5L-GR-B		ASTM-A139-B	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
520.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
530.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
540.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
550.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
560.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
570.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
580.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
590.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
600.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
610.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
620.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
630.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
640.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
650.00	12000.00	18000.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	12000.00	18000.00
660.00	11940.00	17985.00	14880.00	22470.00	14880.00	22470.00	14880.00	22470.00	11900.00	17975.00
670.00	11880.00	17970.00	14760.00	22440.00	14760.00	22440.00	14760.00	22440.00	11800.00	17950.00
680.00	11820.00	17955.00	14640.00	22410.00	14640.00	22410.00	14640.00	22410.00	11700.00	17925.00
690.00	11760.00	17940.00	14520.00	22380.00	14520.00	22380.00	14520.00	22380.00	11600.00	17900.00
700.00	11700.00	17925.00	14400.00	22350.00	14400.00	22350.00	14400.00	22350.00	11500.00	17875.00
710.00	11500.00	17875.00	14120.00	22280.00	14120.00	22280.00	14120.00	22280.00	11280.00	17820.00
720.00	11300.00	17825.00	13840.00	22210.00	13840.00	22210.00	13840.00	22210.00	11060.00	17765.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	ASTM-A53-A		ASTM-A53-B		ASTM-A106-B		API-5L-GR-B		ASTM-A139-B	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
730.00	11100.00	17775.00	13560.00	22140.00	13560.00	22140.00	13560.00	22140.00	10840.00	17710.00
740.00	10900.00	17725.00	13280.00	22070.00	13280.00	22070.00	13280.00	22070.00	10620.00	17655.00
750.00	10700.00	17675.00	13000.00	22000.00	13000.00	22000.00	13000.00	22000.00	10400.00	17600.00
760.00	10360.00	17590.00	12560.00	21890.00	12560.00	21890.00	12560.00	21890.00	10040.00	17510.00
770.00	10020.00	17505.00	12120.00	21780.00	12120.00	21780.00	12120.00	21780.00	9680.00	17420.00
780.00	9680.00	17420.00	11680.00	21670.00	11680.00	21670.00	11680.00	21670.00	9320.00	17330.00
790.00	9340.00	17335.00	11240.00	21560.00	11240.00	21560.00	11240.00	21560.00	8960.00	17240.00
800.00	9000.00	17250.00	10800.00	21450.00	10800.00	21450.00	10800.00	21450.00	8600.00	17150.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A335-P2		A335-P5,B,C		A335-GR-P9		A335-GR-P11		A335-GR-P22	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
100.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
110.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
120.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
130.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
140.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
150.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
160.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
170.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
180.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
190.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
200.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
210.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
220.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
230.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
240.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
250.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
260.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
270.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
280.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
290.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
300.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A335-P2		A335-P5,B,C		A335-GR-P9		A335-GR-P11		A335-GR-P22	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
310.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
320.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
330.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
340.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
350.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
360.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
370.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
380.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
390.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
400.00	13800.00	20700.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00	15000.00	22500.00
410.00	13800.00	20700.00	14950.00	22487.50	14950.00	22487.50	15000.00	22500.00	15000.00	22500.00
420.00	13800.00	20700.00	14900.00	22475.00	14900.00	22475.00	15000.00	22500.00	15000.00	22500.00
430.00	13800.00	20700.00	14850.00	22462.50	14850.00	22462.50	15000.00	22500.00	15000.00	22500.00
440.00	13800.00	20700.00	14800.00	22450.00	14800.00	22450.00	15000.00	22500.00	15000.00	22500.00
450.00	13800.00	20700.00	14750.00	22437.50	14750.00	22437.50	15000.00	22500.00	15000.00	22500.00
460.00	13800.00	20700.00	14700.00	22425.00	14700.00	22425.00	15000.00	22500.00	15000.00	22500.00
470.00	13800.00	20700.00	14650.00	22412.50	14650.00	22412.50	15000.00	22500.00	15000.00	22500.00
480.00	13800.00	20700.00	14600.00	22400.00	14600.00	22400.00	15000.00	22500.00	15000.00	22500.00
490.00	13800.00	20700.00	14550.00	22387.50	14550.00	22387.50	15000.00	22500.00	15000.00	22500.00
500.00	13800.00	20700.00	14500.00	22375.00	14500.00	22375.00	15000.00	22500.00	15000.00	22500.00
510.00	13800.00	20700.00	14450.00	22362.50	14450.00	22362.50	15000.00	22500.00	15000.00	22500.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A335-P2		A335-P5,B,C		A335-GR-P9		A335-GR-P11		A335-GR-P22	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
520.00	13800.00	20700.00	14400.00	22350.00	14400.00	22350.00	15000.00	22500.00	15000.00	22500.00
530.00	13800.00	20700.00	14350.00	22337.50	14350.00	22337.50	15000.00	22500.00	15000.00	22500.00
540.00	13800.00	20700.00	14300.00	22325.00	14300.00	22325.00	15000.00	22500.00	15000.00	22500.00
550.00	13800.00	20700.00	14250.00	22312.50	14250.00	22312.50	15000.00	22500.00	15000.00	22500.00
560.00	13800.00	20700.00	14200.00	22300.00	14200.00	22300.00	15000.00	22500.00	15000.00	22500.00
570.00	13800.00	20700.00	14150.00	22287.50	14150.00	22287.50	15000.00	22500.00	15000.00	22500.00
580.00	13800.00	20700.00	14100.00	22275.00	14100.00	22275.00	15000.00	22500.00	15000.00	22500.00
590.00	13800.00	20700.00	14050.00	22262.50	14050.00	22262.50	15000.00	22500.00	15000.00	22500.00
600.00	13800.00	20700.00	14000.00	22250.00	14000.00	22250.00	15000.00	22500.00	15000.00	22500.00
610.00	13800.00	20700.00	13940.00	22235.00	13940.00	22235.00	15000.00	22500.00	15000.00	22500.00
620.00	13800.00	20700.00	13880.00	22220.00	13880.00	22220.00	15000.00	22500.00	15000.00	22500.00
630.00	13800.00	20700.00	13820.00	22205.00	13820.00	22205.00	15000.00	22500.00	15000.00	22500.00
640.00	13800.00	20700.00	13760.00	22190.00	13760.00	22190.00	15000.00	22500.00	15000.00	22500.00
650.00	13800.00	20700.00	13700.00	22175.00	13700.00	22175.00	15000.00	22500.00	15000.00	22500.00
660.00	13800.00	20700.00	13640.00	22160.00	13640.00	22160.00	15000.00	22500.00	15000.00	22500.00
670.00	13800.00	20700.00	13580.00	22145.00	13580.00	22145.00	15000.00	22500.00	15000.00	22500.00
680.00	13800.00	20700.00	13520.00	22130.00	13520.00	22130.00	15000.00	22500.00	15000.00	22500.00
690.00	13800.00	20700.00	13460.00	22115.00	13460.00	22115.00	15000.00	22500.00	15000.00	22500.00
700.00	13800.00	20700.00	13400.00	22100.00	13400.00	22100.00	15000.00	22500.00	15000.00	22500.00
710.00	13800.00	20700.00	13340.00	22085.00	13340.00	22085.00	15000.00	22500.00	15000.00	22500.00
720.00	13800.00	20700.00	13280.00	22070.00	13280.00	22070.00	15000.00	22500.00	15000.00	22500.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A335-P2		A335-P5,B,C		A335-GR-P9		A335-GR-P11		A335-GR-P22	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
730.00	13800.00	20700.00	13220.00	22055.00	13220.00	22055.00	15000.00	22500.00	15000.00	22500.00
740.00	13800.00	20700.00	13160.00	22040.00	13160.00	22040.00	15000.00	22500.00	15000.00	22500.00
750.00	13800.00	20700.00	13100.00	22025.00	13100.00	22025.00	15000.00	22500.00	15000.00	22500.00
760.00	13740.00	20685.00	13040.00	22010.00	13040.00	22010.00	15000.00	22500.00	15000.00	22500.00
770.00	13680.00	20670.00	12980.00	21995.00	12980.00	21995.00	15000.00	22500.00	15000.00	22500.00
780.00	13620.00	20655.00	12920.00	21980.00	12920.00	21980.00	15000.00	22500.00	15000.00	22500.00
790.00	13560.00	20640.00	12860.00	21965.00	12860.00	21965.00	15000.00	22500.00	15000.00	22500.00
800.00	13500.00	20625.00	12800.00	21950.00	12800.00	21950.00	15000.00	22500.00	15000.00	22500.00
810.00	13420.00	20605.00	12640.00	21910.00	12740.00	21935.00	14880.00	22470.00	14880.00	22470.00
820.00	13340.00	20585.00	12480.00	21870.00	12680.00	21920.00	14760.00	22440.00	14760.00	22440.00
830.00	13260.00	20565.00	12320.00	21830.00	12620.00	21905.00	14640.00	22410.00	14640.00	22410.00
840.00	13180.00	20545.00	12160.00	21790.00	12560.00	21890.00	14520.00	22380.00	14520.00	22380.00
850.00	13100.00	20525.00	12000.00	21750.00	12500.00	21875.00	14400.00	22350.00	14400.00	22350.00
860.00	13040.00	20510.00	11660.00	21665.00	12400.00	21850.00	14140.00	22285.00	14140.00	22285.00
870.00	12980.00	20495.00	11320.00	21580.00	12300.00	21825.00	13880.00	22220.00	13880.00	22220.00
880.00	12920.00	20480.00	10980.00	21495.00	12200.00	21800.00	13620.00	22155.00	13620.00	22155.00
890.00	12860.00	20465.00	10640.00	21410.00	12100.00	21775.00	13360.00	22090.00	13360.00	22090.00
900.00	12800.00	20450.00	10300.00	21325.00	12000.00	21750.00	13100.00	22025.00	13100.00	22025.00
910.00	12080.00	20270.00	9760.00	21190.00	11760.00	21690.00	12680.00	21920.00	12680.00	21920.00
920.00	11360.00	20090.00	9220.00	21055.00	11520.00	21630.00	12260.00	21815.00	12260.00	21815.00
930.00	10640.00	19910.00	8680.00	20920.00	11280.00	21570.00	11840.00	21710.00	11840.00	21710.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A335-P2		A335-P5,B,C		A335-GR-P9		A335-GR-P11		A335-GR-P22	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
940.00	9920.00	19730.00	8140.00	20785.00	11040.00	21510.00	11420.00	21605.00	11420.00	21605.00
950.00	9200.00	19550.00	7600.00	20650.00	10800.00	21450.00	11000.00	21500.00	11000.00	21500.00
960.00	8540.00	19385.00	7200.00	20550.00	10340.00	21335.00	10120.00	21280.00	10360.00	21340.00
970.00	7880.00	19220.00	6800.00	20450.00	9880.00	21220.00	9240.00	21060.00	9720.00	21180.00
980.00	7220.00	19055.00	6400.00	20350.00	9420.00	21105.00	8360.00	20840.00	9080.00	21020.00
990.00	6560.00	18890.00	6000.00	20250.00	8960.00	20990.00	7480.00	20620.00	8440.00	20860.00
1000.00	5900.00	18725.00	5600.00	20150.00	8500.00	20875.00	6600.00	20400.00	7800.00	20700.00
1010.00	0.00	0.00	5300.00	20075.00	7900.00	20725.00	6100.00	20275.00	7400.00	20600.00
1020.00	0.00	0.00	5000.00	20000.00	7300.00	20575.00	5600.00	20150.00	7000.00	20500.00
1030.00	0.00	0.00	4700.00	19925.00	6700.00	20425.00	5100.00	20025.00	6600.00	20400.00
1040.00	0.00	0.00	4400.00	19850.00	6100.00	20275.00	4600.00	19900.00	6200.00	20300.00
1050.00	0.00	0.00	4100.00	19775.00	5500.00	20125.00	4100.00	19775.00	5800.00	20200.00
1060.00	0.00	0.00	3880.00	19720.00	5060.00	20015.00	3880.00	19720.00	5480.00	20120.00
1070.00	0.00	0.00	3660.00	19665.00	4620.00	19905.00	3660.00	19665.00	5160.00	20040.00
1080.00	0.00	0.00	3440.00	19610.00	4180.00	19795.00	3440.00	19610.00	4840.00	19960.00
1090.00	0.00	0.00	3220.00	19555.00	3740.00	19685.00	3220.00	19555.00	4520.00	19880.00
1100.00	0.00	0.00	3000.00	19500.00	3300.00	19575.00	3000.00	19500.00	4200.00	19800.00
1110.00	0.00	0.00	2800.00	19450.00	3080.00	19520.00	0.00	0.00	0.00	0.00
1120.00	0.00	0.00	2600.00	19400.00	2860.00	19465.00	0.00	0.00	0.00	0.00
1130.00	0.00	0.00	2400.00	19350.00	2640.00	19410.00	0.00	0.00	0.00	0.00
1140.00	0.00	0.00	2200.00	19300.00	2420.00	19355.00	0.00	0.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A335-P2		A335-P5,B,C		A335-GR-P9		A335-GR-P11		A335-GR-P22	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
1150.00	0.00	0.00	2000.00	19250.00	2200.00	19300.00	0.00	0.00	0.00	0.00
1160.00	0.00	0.00	1860.00	19215.00	2060.00	19265.00	0.00	0.00	0.00	0.00
1170.00	0.00	0.00	1720.00	19180.00	1920.00	19230.00	0.00	0.00	0.00	0.00
1180.00	0.00	0.00	1580.00	19145.00	1780.00	19195.00	0.00	0.00	0.00	0.00
1190.00	0.00	0.00	1440.00	19110.00	1640.00	19160.00	0.00	0.00	0.00	0.00
1200.00	0.00	0.00	1300.00	19075.00	1500.00	19125.00	0.00	0.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP304		A312-TP304L		A312-TP316		A312-TP316L		A312-TP317	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
100.00	18800.00	28200.00	15700.00	23550.00	18800.00	28200.00	15600.00	23400.00	18800.00	28200.00
110.00	18490.00	28122.50	15700.00	23550.00	18800.00	28200.00	15410.00	23352.50	18540.00	28135.00
120.00	18180.00	28045.00	15700.00	23550.00	18800.00	28200.00	15220.00	23305.00	18280.00	28070.00
130.00	17870.00	27967.50	15700.00	23550.00	18800.00	28200.00	15030.00	23257.50	18020.00	28005.00
140.00	17560.00	27890.00	15700.00	23550.00	18800.00	28200.00	14840.00	23210.00	17760.00	27940.00
150.00	17250.00	27812.50	15700.00	23550.00	18800.00	28200.00	14650.00	23162.50	17500.00	27875.00
160.00	16940.00	27735.00	15700.00	23550.00	18800.00	28200.00	14460.00	23115.00	17240.00	27810.00
170.00	16630.00	27657.50	15700.00	23550.00	18800.00	28200.00	14270.00	23067.50	16980.00	27745.00
180.00	16320.00	27580.00	15700.00	23550.00	18800.00	28200.00	14080.00	23020.00	16720.00	27680.00
190.00	16010.00	27502.50	15700.00	23550.00	18800.00	28200.00	13890.00	22972.50	16460.00	27615.00
200.00	15700.00	27425.00	15700.00	23550.00	18800.00	28200.00	13700.00	22925.00	16200.00	27550.00
210.00	15540.00	27385.00	15660.00	23540.00	18760.00	28190.00	13520.00	22880.00	16000.00	27500.00
220.00	15380.00	27345.00	15620.00	23530.00	18720.00	28180.00	13340.00	22835.00	15800.00	27450.00
230.00	15220.00	27305.00	15580.00	23520.00	18680.00	28170.00	13160.00	22790.00	15600.00	27400.00
240.00	15060.00	27265.00	15540.00	23510.00	18640.00	28160.00	12980.00	22745.00	15400.00	27350.00
250.00	14900.00	27225.00	15500.00	23500.00	18600.00	28150.00	12800.00	22700.00	15200.00	27300.00
260.00	14740.00	27185.00	15460.00	23490.00	18560.00	28140.00	12620.00	22655.00	15000.00	27250.00
270.00	14580.00	27145.00	15420.00	23480.00	18520.00	28130.00	12440.00	22610.00	14800.00	27200.00
280.00	14420.00	27105.00	15380.00	23470.00	18480.00	28120.00	12260.00	22565.00	14600.00	27150.00
290.00	14260.00	27065.00	15340.00	23460.00	18440.00	28110.00	12080.00	22520.00	14400.00	27100.00
300.00	14100.00	27025.00	15300.00	23450.00	18400.00	28100.00	11900.00	22475.00	14200.00	27050.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

$S(A)=F*(1.25*S(C)+0.25*S(H))$, $F=1$

MATERIAL	A312-TP304		A312-TP304L		A312-TP316		A312-TP316L		A312-TP317	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
310.00	13990.00	26997.50	15240.00	23435.00	18370.00	28092.50	11790.00	22447.50	14120.00	27030.00
320.00	13880.00	26970.00	15180.00	23420.00	18340.00	28085.00	11680.00	22420.00	14040.00	27010.00
330.00	13770.00	26942.50	15120.00	23405.00	18310.00	28077.50	11570.00	22392.50	13960.00	26990.00
340.00	13660.00	26915.00	15060.00	23390.00	18280.00	28070.00	11460.00	22365.00	13880.00	26970.00
350.00	13550.00	26887.50	15000.00	23375.00	18250.00	28062.50	11350.00	22337.50	13800.00	26950.00
360.00	13440.00	26860.00	14940.00	23360.00	18220.00	28055.00	11240.00	22310.00	13720.00	26930.00
370.00	13330.00	26832.50	14880.00	23345.00	18190.00	28047.50	11130.00	22282.50	13640.00	26910.00
380.00	13220.00	26805.00	14820.00	23330.00	18160.00	28040.00	11020.00	22255.00	13560.00	26890.00
390.00	13110.00	26777.50	14760.00	23315.00	18130.00	28032.50	10910.00	22227.50	13480.00	26870.00
400.00	13000.00	26750.00	14700.00	23300.00	18100.00	28025.00	10800.00	22200.00	13400.00	26850.00
410.00	12920.00	26730.00	14670.00	23292.50	18090.00	28022.50	10720.00	22180.00	13310.00	26827.50
420.00	12840.00	26710.00	14640.00	23285.00	18080.00	28020.00	10640.00	22160.00	13220.00	26805.00
430.00	12760.00	26690.00	14610.00	23277.50	18070.00	28017.50	10560.00	22140.00	13130.00	26782.50
440.00	12680.00	26670.00	14580.00	23270.00	18060.00	28015.00	10480.00	22120.00	13040.00	26760.00
450.00	12600.00	26650.00	14550.00	23262.50	18050.00	28012.50	10400.00	22100.00	12950.00	26737.50
460.00	12520.00	26630.00	14520.00	23255.00	18040.00	28010.00	10320.00	22080.00	12860.00	26715.00
470.00	12440.00	26610.00	14490.00	23247.50	18030.00	28007.50	10240.00	22060.00	12770.00	26692.50
480.00	12360.00	26590.00	14460.00	23240.00	18020.00	28005.00	10160.00	22040.00	12680.00	26670.00
490.00	12280.00	26570.00	14430.00	23232.50	18010.00	28002.50	10080.00	22020.00	12590.00	26647.50
500.00	12200.00	26550.00	14400.00	23225.00	18000.00	28000.00	10000.00	22000.00	12500.00	26625.00
510.00	12120.00	26530.00	14360.00	23215.00	17900.00	27975.00	9940.00	21985.00	12430.00	26607.50

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
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HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP304		A312-TP304L		A312-TP316		A312-TP316L		A312-TP317	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
520.00	12040.00	26510.00	14320.00	23205.00	17800.00	27950.00	9880.00	21970.00	12360.00	26590.00
530.00	11960.00	26490.00	14280.00	23195.00	17700.00	27925.00	9820.00	21955.00	12290.00	26572.50
540.00	11880.00	26470.00	14240.00	23185.00	17600.00	27900.00	9760.00	21940.00	12220.00	26555.00
550.00	11800.00	26450.00	14200.00	23175.00	17500.00	27875.00	9700.00	21925.00	12150.00	26537.50
560.00	11720.00	26430.00	14160.00	23165.00	17400.00	27850.00	9640.00	21910.00	12080.00	26520.00
570.00	11640.00	26410.00	14120.00	23155.00	17300.00	27825.00	9580.00	21895.00	12010.00	26502.50
580.00	11560.00	26390.00	14080.00	23145.00	17200.00	27800.00	9520.00	21880.00	11940.00	26485.00
590.00	11480.00	26370.00	14040.00	23135.00	17100.00	27775.00	9460.00	21865.00	11870.00	26467.50
600.00	11400.00	26350.00	14000.00	23125.00	17000.00	27750.00	9400.00	21850.00	11800.00	26450.00
610.00	11360.00	26340.00	13940.00	23110.00	16940.00	27735.00	9360.00	21840.00	11760.00	26440.00
620.00	11320.00	26330.00	13880.00	23095.00	16880.00	27720.00	9320.00	21830.00	11720.00	26430.00
630.00	11280.00	26320.00	13820.00	23080.00	16820.00	27705.00	9280.00	21820.00	11680.00	26420.00
640.00	11240.00	26310.00	13760.00	23065.00	16760.00	27690.00	9240.00	21810.00	11640.00	26410.00
650.00	11200.00	26300.00	13700.00	23050.00	16700.00	27675.00	9200.00	21800.00	11600.00	26400.00
660.00	11180.00	26295.00	13660.00	23040.00	16620.00	27655.00	9160.00	21790.00	11540.00	26385.00
670.00	11160.00	26290.00	13620.00	23030.00	16540.00	27635.00	9120.00	21780.00	11480.00	26370.00
680.00	11140.00	26285.00	13580.00	23020.00	16460.00	27615.00	9080.00	21770.00	11420.00	26355.00
690.00	11120.00	26280.00	13540.00	23010.00	16380.00	27595.00	9040.00	21760.00	11360.00	26340.00
700.00	11100.00	26275.00	13500.00	23000.00	16300.00	27575.00	9000.00	21750.00	11300.00	26325.00
710.00	11040.00	26260.00	13460.00	22990.00	16260.00	27565.00	8960.00	21740.00	11280.00	26320.00
720.00	10980.00	26245.00	13420.00	22980.00	16220.00	27555.00	8920.00	21730.00	11260.00	26315.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP304		A312-TP304L		A312-TP316		A312-TP316L		A312-TP317	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
730.00	10920.00	26230.00	13380.00	22970.00	16180.00	27545.00	8880.00	21720.00	11240.00	26310.00
740.00	10860.00	26215.00	13340.00	22960.00	16140.00	27535.00	8840.00	21710.00	11220.00	26305.00
750.00	10800.00	26200.00	13300.00	22950.00	16100.00	27525.00	8800.00	21700.00	11200.00	26300.00
760.00	10760.00	26190.00	13240.00	22935.00	16060.00	27515.00	8760.00	21690.00	11160.00	26290.00
770.00	10720.00	26180.00	13180.00	22920.00	16020.00	27505.00	8720.00	21680.00	11120.00	26280.00
780.00	10680.00	26170.00	13120.00	22905.00	15980.00	27495.00	8680.00	21670.00	11080.00	26270.00
790.00	10640.00	26160.00	13060.00	22890.00	15940.00	27485.00	8640.00	21660.00	11040.00	26260.00
800.00	10600.00	26150.00	13000.00	22875.00	15900.00	27475.00	8600.00	21650.00	11000.00	26250.00
810.00	10560.00	26140.00	0.00	0.00	15860.00	27465.00	8560.00	21640.00	10980.00	26245.00
820.00	10520.00	26130.00	0.00	0.00	15820.00	27455.00	8520.00	21630.00	10960.00	26240.00
830.00	10480.00	26120.00	0.00	0.00	15780.00	27445.00	8480.00	21620.00	10940.00	26235.00
840.00	10440.00	26110.00	0.00	0.00	15740.00	27435.00	8440.00	21610.00	10920.00	26230.00
850.00	10400.00	26100.00	0.00	0.00	15700.00	27425.00	8400.00	21600.00	10900.00	26225.00
860.00	10360.00	26090.00	0.00	0.00	15680.00	27420.00	0.00	0.00	10880.00	26220.00
870.00	10320.00	26080.00	0.00	0.00	15660.00	27415.00	0.00	0.00	10860.00	26215.00
880.00	10280.00	26070.00	0.00	0.00	15640.00	27410.00	0.00	0.00	10840.00	26210.00
890.00	10240.00	26060.00	0.00	0.00	15620.00	27405.00	0.00	0.00	10820.00	26205.00
900.00	10200.00	26050.00	0.00	0.00	15600.00	27400.00	0.00	0.00	10800.00	26200.00
910.00	10160.00	26040.00	0.00	0.00	15560.00	27390.00	0.00	0.00	10780.00	26195.00
920.00	10120.00	26030.00	0.00	0.00	15520.00	27380.00	0.00	0.00	10760.00	26190.00
930.00	10080.00	26020.00	0.00	0.00	15480.00	27370.00	0.00	0.00	10740.00	26185.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP304		A312-TP304L		A312-TP316		A312-TP316L		A312-TP317	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
940.00	10040.00	26010.00	0.00	0.00	15440.00	27360.00	0.00	0.00	10720.00	26180.00
950.00	10000.00	26000.00	0.00	0.00	15400.00	27350.00	0.00	0.00	10700.00	26175.00
960.00	9960.00	25990.00	0.00	0.00	15380.00	27345.00	0.00	0.00	10680.00	26170.00
970.00	9920.00	25980.00	0.00	0.00	15360.00	27340.00	0.00	0.00	10660.00	26165.00
980.00	9880.00	25970.00	0.00	0.00	15340.00	27335.00	0.00	0.00	10640.00	26160.00
990.00	9840.00	25960.00	0.00	0.00	15320.00	27330.00	0.00	0.00	10620.00	26155.00
1000.00	9800.00	25950.00	0.00	0.00	15300.00	27325.00	0.00	0.00	10600.00	26150.00
1010.00	9740.00	25935.00	0.00	0.00	15140.00	27285.00	0.00	0.00	10580.00	26145.00
1020.00	9680.00	25920.00	0.00	0.00	14980.00	27245.00	0.00	0.00	10560.00	26140.00
1030.00	9620.00	25905.00	0.00	0.00	14820.00	27205.00	0.00	0.00	10540.00	26135.00
1040.00	9560.00	25890.00	0.00	0.00	14660.00	27165.00	0.00	0.00	10520.00	26130.00
1050.00	9500.00	25875.00	0.00	0.00	14500.00	27125.00	0.00	0.00	10500.00	26125.00
1060.00	9380.00	25845.00	0.00	0.00	14080.00	27020.00	0.00	0.00	10460.00	26115.00
1070.00	9260.00	25815.00	0.00	0.00	13660.00	26915.00	0.00	0.00	10420.00	26105.00
1080.00	9140.00	25785.00	0.00	0.00	13240.00	26810.00	0.00	0.00	10380.00	26095.00
1090.00	9020.00	25755.00	0.00	0.00	12820.00	26705.00	0.00	0.00	10340.00	26085.00
1100.00	8900.00	25725.00	0.00	0.00	12400.00	26600.00	0.00	0.00	10300.00	26075.00
1110.00	8660.00	25665.00	0.00	0.00	11880.00	26470.00	0.00	0.00	10100.00	26025.00
1120.00	8420.00	25605.00	0.00	0.00	11360.00	26340.00	0.00	0.00	9900.00	25975.00
1130.00	8180.00	25545.00	0.00	0.00	10840.00	26210.00	0.00	0.00	9700.00	25925.00
1140.00	7940.00	25485.00	0.00	0.00	10320.00	26080.00	0.00	0.00	9500.00	25875.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP304		A312-TP304L		A312-TP316		A312-TP316L		A312-TP317	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
1150.00	7700.00	25425.00	0.00	0.00	9800.00	25950.00	0.00	0.00	9300.00	25825.00
1160.00	7380.00	25345.00	0.00	0.00	9320.00	25830.00	0.00	0.00	8920.00	25730.00
1170.00	7060.00	25265.00	0.00	0.00	8840.00	25710.00	0.00	0.00	8540.00	25635.00
1180.00	6740.00	25185.00	0.00	0.00	8360.00	25590.00	0.00	0.00	8160.00	25540.00
1190.00	6420.00	25105.00	0.00	0.00	7880.00	25470.00	0.00	0.00	7780.00	25445.00
1200.00	6100.00	25025.00	0.00	0.00	7400.00	25350.00	0.00	0.00	7400.00	25350.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP321		A312-TP347		A376- TP304		A376- TP316		A376-TP321	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
100.00	18800.00	28200.00	18800.00	28200.00	18700.00	28050.00	18800.00	28200.00	18800.00	28200.00
110.00	18760.00	28190.00	18710.00	28177.50	18390.00	27972.50	18800.00	28200.00	18760.00	28190.00
120.00	18720.00	28180.00	18620.00	28155.00	18080.00	27895.00	18800.00	28200.00	18720.00	28180.00
130.00	18680.00	28170.00	18530.00	28132.50	17770.00	27817.50	18800.00	28200.00	18680.00	28170.00
140.00	18640.00	28160.00	18440.00	28110.00	17460.00	27740.00	18800.00	28200.00	18640.00	28160.00
150.00	18600.00	28150.00	18350.00	28087.50	17150.00	27662.50	18800.00	28200.00	18600.00	28150.00
160.00	18560.00	28140.00	18260.00	28065.00	16840.00	27585.00	18800.00	28200.00	18560.00	28140.00
170.00	18520.00	28130.00	18170.00	28042.50	16530.00	27507.50	18800.00	28200.00	18520.00	28130.00
180.00	18480.00	28120.00	18080.00	28020.00	16220.00	27430.00	18800.00	28200.00	18480.00	28120.00
190.00	18440.00	28110.00	17990.00	27997.50	15910.00	27352.50	18800.00	28200.00	18440.00	28110.00
200.00	18400.00	28100.00	17900.00	27975.00	15600.00	27275.00	18800.00	28200.00	18400.00	28100.00
210.00	18290.00	28072.50	17750.00	27937.50	15440.00	27235.00	18760.00	28190.00	18290.00	28072.50
220.00	18180.00	28045.00	17600.00	27900.00	15280.00	27195.00	18720.00	28180.00	18180.00	28045.00
230.00	18070.00	28017.50	17450.00	27862.50	15120.00	27155.00	18680.00	28170.00	18070.00	28017.50
240.00	17960.00	27990.00	17300.00	27825.00	14960.00	27115.00	18640.00	28160.00	17960.00	27990.00
250.00	17850.00	27962.50	17150.00	27787.50	14800.00	27075.00	18600.00	28150.00	17850.00	27962.50
260.00	17740.00	27935.00	17000.00	27750.00	14640.00	27035.00	18560.00	28140.00	17740.00	27935.00
270.00	17630.00	27907.50	16850.00	27712.50	14480.00	26995.00	18520.00	28130.00	17630.00	27907.50
280.00	17520.00	27880.00	16700.00	27675.00	14320.00	26955.00	18480.00	28120.00	17520.00	27880.00
290.00	17410.00	27852.50	16550.00	27637.50	14160.00	26915.00	18440.00	28110.00	17410.00	27852.50
300.00	17300.00	27825.00	16400.00	27600.00	14000.00	26875.00	18400.00	28100.00	17300.00	27825.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP321		A312-TP347		A376- TP304		A376- TP316		A376-TP321	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
310.00	17280.00	27820.00	16300.00	27575.00	13890.00	26847.50	18370.00	28092.50	17280.00	27820.00
320.00	17260.00	27815.00	16200.00	27550.00	13780.00	26820.00	18340.00	28085.00	17260.00	27815.00
330.00	17240.00	27810.00	16100.00	27525.00	13670.00	26792.50	18310.00	28077.50	17240.00	27810.00
340.00	17220.00	27805.00	16000.00	27500.00	13560.00	26765.00	18280.00	28070.00	17220.00	27805.00
350.00	17200.00	27800.00	15900.00	27475.00	13450.00	26737.50	18250.00	28062.50	17200.00	27800.00
360.00	17180.00	27795.00	15800.00	27450.00	13340.00	26710.00	18220.00	28055.00	17180.00	27795.00
370.00	17160.00	27790.00	15700.00	27425.00	13230.00	26682.50	18190.00	28047.50	17160.00	27790.00
380.00	17140.00	27785.00	15600.00	27400.00	13120.00	26655.00	18160.00	28040.00	17140.00	27785.00
390.00	17120.00	27780.00	15500.00	27375.00	13010.00	26627.50	18130.00	28032.50	17120.00	27780.00
400.00	17100.00	27775.00	15400.00	27350.00	12900.00	26600.00	18100.00	28025.00	17100.00	27775.00
410.00	17100.00	27775.00	15350.00	27337.50	12820.00	26580.00	18090.00	28022.50	17100.00	27775.00
420.00	17100.00	27775.00	15300.00	27325.00	12740.00	26560.00	18080.00	28020.00	17100.00	27775.00
430.00	17100.00	27775.00	15250.00	27312.50	12660.00	26540.00	18070.00	28017.50	17100.00	27775.00
440.00	17100.00	27775.00	15200.00	27300.00	12580.00	26520.00	18060.00	28015.00	17100.00	27775.00
450.00	17100.00	27775.00	15150.00	27287.50	12500.00	26500.00	18050.00	28012.50	17100.00	27775.00
460.00	17100.00	27775.00	15100.00	27275.00	12420.00	26480.00	18040.00	28010.00	17100.00	27775.00
470.00	17100.00	27775.00	15050.00	27262.50	12340.00	26460.00	18030.00	28007.50	17100.00	27775.00
480.00	17100.00	27775.00	15000.00	27250.00	12260.00	26440.00	18020.00	28005.00	17100.00	27775.00
490.00	17100.00	27775.00	14950.00	27237.50	12180.00	26420.00	18010.00	28002.50	17100.00	27775.00
500.00	17100.00	27775.00	14900.00	27225.00	12100.00	26400.00	18000.00	28000.00	17100.00	27775.00
510.00	17030.00	27757.50	14880.00	27220.00	12030.00	26382.50	17900.00	27975.00	17020.00	27755.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP321		A312-TP347		A376- TP304		A376- TP316		A376-TP321	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
520.00	16960.00	27740.00	14860.00	27215.00	11960.00	26365.00	17800.00	27950.00	16940.00	27735.00
530.00	16890.00	27722.50	14840.00	27210.00	11890.00	26347.50	17700.00	27925.00	16860.00	27715.00
540.00	16820.00	27705.00	14820.00	27205.00	11820.00	26330.00	17600.00	27900.00	16780.00	27695.00
550.00	16750.00	27687.50	14800.00	27200.00	11750.00	26312.50	17500.00	27875.00	16700.00	27675.00
560.00	16680.00	27670.00	14780.00	27195.00	11680.00	26295.00	17400.00	27850.00	16620.00	27655.00
570.00	16610.00	27652.50	14760.00	27190.00	11610.00	26277.50	17300.00	27825.00	16540.00	27635.00
580.00	16540.00	27635.00	14740.00	27185.00	11540.00	26260.00	17200.00	27800.00	16460.00	27615.00
590.00	16470.00	27617.50	14720.00	27180.00	11470.00	26242.50	17100.00	27775.00	16380.00	27595.00
600.00	16400.00	27600.00	14700.00	27175.00	11400.00	26225.00	17000.00	27750.00	16300.00	27575.00
610.00	16340.00	27585.00	14700.00	27175.00	11360.00	26215.00	16940.00	27735.00	16260.00	27565.00
620.00	16280.00	27570.00	14700.00	27175.00	11320.00	26205.00	16880.00	27720.00	16220.00	27555.00
630.00	16220.00	27555.00	14700.00	27175.00	11280.00	26195.00	16820.00	27705.00	16180.00	27545.00
640.00	16160.00	27540.00	14700.00	27175.00	11240.00	26185.00	16760.00	27690.00	16140.00	27535.00
650.00	16100.00	27525.00	14700.00	27175.00	11200.00	26175.00	16700.00	27675.00	16100.00	27525.00
660.00	16040.00	27510.00	14680.00	27170.00	11160.00	26165.00	16620.00	27655.00	16040.00	27510.00
670.00	15980.00	27495.00	14660.00	27165.00	11120.00	26155.00	16540.00	27635.00	15980.00	27495.00
680.00	15920.00	27480.00	14640.00	27160.00	11080.00	26145.00	16460.00	27615.00	15920.00	27480.00
690.00	15860.00	27465.00	14620.00	27155.00	11040.00	26135.00	16380.00	27595.00	15860.00	27465.00
700.00	15800.00	27450.00	14600.00	27150.00	11000.00	26125.00	16300.00	27575.00	15800.00	27450.00
710.00	15780.00	27445.00	14620.00	27155.00	10960.00	26115.00	16260.00	27565.00	15780.00	27445.00
720.00	15760.00	27440.00	14640.00	27160.00	10920.00	26105.00	16220.00	27555.00	15760.00	27440.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP321		A312-TP347		A376- TP304		A376- TP316		A376-TP321	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
730.00	15740.00	27435.00	14660.00	27165.00	10880.00	26095.00	16180.00	27545.00	15740.00	27435.00
740.00	15720.00	27430.00	14680.00	27170.00	10840.00	26085.00	16140.00	27535.00	15720.00	27430.00
750.00	15700.00	27425.00	14700.00	27175.00	10800.00	26075.00	16100.00	27525.00	15700.00	27425.00
760.00	15660.00	27415.00	14700.00	27175.00	10740.00	26060.00	16060.00	27515.00	15660.00	27415.00
770.00	15620.00	27405.00	14700.00	27175.00	10680.00	26045.00	16020.00	27505.00	15620.00	27405.00
780.00	15580.00	27395.00	14700.00	27175.00	10620.00	26030.00	15980.00	27495.00	15580.00	27395.00
790.00	15540.00	27385.00	14700.00	27175.00	10560.00	26015.00	15940.00	27485.00	15540.00	27385.00
800.00	15500.00	27375.00	14700.00	27175.00	10500.00	26000.00	15900.00	27475.00	15500.00	27375.00
810.00	15480.00	27370.00	14700.00	27175.00	10460.00	25990.00	15860.00	27465.00	15480.00	27370.00
820.00	15460.00	27365.00	14700.00	27175.00	10420.00	25980.00	15820.00	27455.00	15460.00	27365.00
830.00	15440.00	27360.00	14700.00	27175.00	10380.00	25970.00	15780.00	27445.00	15440.00	27360.00
840.00	15420.00	27355.00	14700.00	27175.00	10340.00	25960.00	15740.00	27435.00	15420.00	27355.00
850.00	15400.00	27350.00	14700.00	27175.00	10300.00	25950.00	15700.00	27425.00	15400.00	27350.00
860.00	15380.00	27345.00	14700.00	27175.00	10260.00	25940.00	15680.00	27420.00	15380.00	27345.00
870.00	15360.00	27340.00	14700.00	27175.00	10220.00	25930.00	15660.00	27415.00	15360.00	27340.00
880.00	15340.00	27335.00	14700.00	27175.00	10180.00	25920.00	15640.00	27410.00	15340.00	27335.00
890.00	15320.00	27330.00	14700.00	27175.00	10140.00	25910.00	15620.00	27405.00	15320.00	27330.00
900.00	15300.00	27325.00	14700.00	27175.00	10100.00	25900.00	15600.00	27400.00	15300.00	27325.00
910.00	15280.00	27320.00	14680.00	27170.00	10060.00	25890.00	15560.00	27390.00	15280.00	27320.00
920.00	15260.00	27315.00	14660.00	27165.00	10020.00	25880.00	15520.00	27380.00	15260.00	27315.00
930.00	15240.00	27310.00	14640.00	27160.00	9980.00	25870.00	15480.00	27370.00	15240.00	27310.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP321		A312-TP347		A376- TP304		A376- TP316		A376-TP321	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
940.00	15220.00	27305.00	14620.00	27155.00	9940.00	25860.00	15440.00	27360.00	15220.00	27305.00
950.00	15200.00	27300.00	14600.00	27150.00	9900.00	25850.00	15400.00	27350.00	15200.00	27300.00
960.00	14920.00	27230.00	14480.00	27120.00	9860.00	25840.00	15380.00	27345.00	14920.00	27230.00
970.00	14640.00	27160.00	14360.00	27090.00	9820.00	25830.00	15360.00	27340.00	14640.00	27160.00
980.00	14360.00	27090.00	14240.00	27060.00	9780.00	25820.00	15340.00	27335.00	14360.00	27090.00
990.00	14080.00	27020.00	14120.00	27030.00	9740.00	25810.00	15320.00	27330.00	14080.00	27020.00
1000.00	13800.00	26950.00	14000.00	27000.00	9700.00	25800.00	15300.00	27325.00	13800.00	26950.00
1010.00	12960.00	26740.00	13620.00	26905.00	9660.00	25790.00	15140.00	27285.00	12960.00	26740.00
1020.00	12120.00	26530.00	13240.00	26810.00	9620.00	25780.00	14980.00	27245.00	12120.00	26530.00
1030.00	11280.00	26320.00	12860.00	26715.00	9580.00	25770.00	14820.00	27205.00	11280.00	26320.00
1040.00	10440.00	26110.00	12480.00	26620.00	9540.00	25760.00	14660.00	27165.00	10440.00	26110.00
1050.00	9600.00	25900.00	12100.00	26525.00	9500.00	25750.00	14500.00	27125.00	9600.00	25900.00
1060.00	9060.00	25765.00	11500.00	26375.00	9360.00	25715.00	14080.00	27020.00	9060.00	25765.00
1070.00	8520.00	25630.00	10900.00	26225.00	9220.00	25680.00	13660.00	26915.00	8520.00	25630.00
1080.00	7980.00	25495.00	10300.00	26075.00	9080.00	25645.00	13240.00	26810.00	7980.00	25495.00
1090.00	7440.00	25360.00	9700.00	25925.00	8940.00	25610.00	12820.00	26705.00	7440.00	25360.00
1100.00	6900.00	25225.00	9100.00	25775.00	8800.00	25575.00	12400.00	26600.00	6900.00	25225.00
1110.00	6520.00	25130.00	8500.00	25625.00	8580.00	25520.00	11880.00	26470.00	6520.00	25130.00
1120.00	6140.00	25035.00	7900.00	25475.00	8360.00	25465.00	11360.00	26340.00	6140.00	25035.00
1130.00	5760.00	24940.00	7300.00	25325.00	8140.00	25410.00	10840.00	26210.00	5760.00	24940.00
1140.00	5380.00	24845.00	6700.00	25175.00	7920.00	25355.00	10320.00	26080.00	5380.00	24845.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP321		A312-TP347		A376- TP304		A376- TP316		A376-TP321	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
1150.00	5000.00	24750.00	6100.00	25025.00	7700.00	25300.00	9800.00	25950.00	5000.00	24750.00
1160.00	4720.00	24680.00	5760.00	24940.00	7360.00	25215.00	9320.00	25830.00	4720.00	24680.00
1170.00	4440.00	24610.00	5420.00	24855.00	7020.00	25130.00	8840.00	25710.00	4440.00	24610.00
1180.00	4160.00	24540.00	5080.00	24770.00	6680.00	25045.00	8360.00	25590.00	4160.00	24540.00
1190.00	3880.00	24470.00	4740.00	24685.00	6340.00	24960.00	7880.00	25470.00	3880.00	24470.00
1200.00	3600.00	24400.00	4400.00	24600.00	6000.00	24875.00	7400.00	25350.00	3600.00	24400.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A358---304		COPPER-B42-3		RED-BRASS-B1		NICKELB161#5		NICKELB161)5	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
100.00	16900.00	25350.00	6000.00	9000.00	8000.00	12000.00	8000.00	12000.00	6700.00	10050.00
110.00	16620.00	25280.00	5880.00	8970.00	8000.00	12000.00	7970.00	11992.50	6670.00	10042.50
120.00	16340.00	25210.00	5760.00	8940.00	8000.00	12000.00	7940.00	11985.00	6640.00	10035.00
130.00	16060.00	25140.00	5640.00	8910.00	8000.00	12000.00	7910.00	11977.50	6610.00	10027.50
140.00	15780.00	25070.00	5520.00	8880.00	8000.00	12000.00	7880.00	11970.00	6580.00	10020.00
150.00	15500.00	25000.00	5400.00	8850.00	8000.00	12000.00	7850.00	11962.50	6550.00	10012.50
160.00	15220.00	24930.00	5280.00	8820.00	8000.00	12000.00	7820.00	11955.00	6520.00	10005.00
170.00	14940.00	24860.00	5160.00	8790.00	8000.00	12000.00	7790.00	11947.50	6490.00	9997.50
180.00	14660.00	24790.00	5040.00	8760.00	8000.00	12000.00	7760.00	11940.00	6460.00	9990.00
190.00	14380.00	24720.00	4920.00	8730.00	8000.00	12000.00	7730.00	11932.50	6430.00	9982.50
200.00	14100.00	24650.00	4800.00	8700.00	8000.00	12000.00	7700.00	11925.00	6400.00	9975.00
210.00	13960.00	24615.00	4790.00	8697.50	8000.00	12000.00	7680.00	11920.00	6390.00	9972.50
220.00	13820.00	24580.00	4780.00	8695.00	8000.00	12000.00	7660.00	11915.00	6380.00	9970.00
230.00	13680.00	24545.00	4770.00	8692.50	8000.00	12000.00	7640.00	11910.00	6370.00	9967.50
240.00	13540.00	24510.00	4760.00	8690.00	8000.00	12000.00	7620.00	11905.00	6360.00	9965.00
250.00	13400.00	24475.00	4750.00	8687.50	8000.00	12000.00	7600.00	11900.00	6350.00	9962.50
260.00	13260.00	24440.00	4740.00	8685.00	8000.00	12000.00	7580.00	11895.00	6340.00	9960.00
270.00	13120.00	24405.00	4730.00	8682.50	8000.00	12000.00	7560.00	11890.00	6330.00	9957.50
280.00	12980.00	24370.00	4720.00	8680.00	8000.00	12000.00	7540.00	11885.00	6320.00	9955.00
290.00	12840.00	24335.00	4710.00	8677.50	8000.00	12000.00	7520.00	11880.00	6310.00	9952.50
300.00	12700.00	24300.00	4700.00	8675.00	8000.00	12000.00	7500.00	11875.00	6300.00	9950.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A358---304		COPPER-B42-3		RED-BRASS-B1		NICKELB161#5		NICKELB161)5	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
310.00	12600.00	24275.00	4530.00	8632.50	7700.00	11925.00	7500.00	11875.00	6290.00	9947.50
320.00	12500.00	24250.00	4360.00	8590.00	7400.00	11850.00	7500.00	11875.00	6280.00	9945.00
330.00	12400.00	24225.00	4190.00	8547.50	7100.00	11775.00	7500.00	11875.00	6270.00	9942.50
340.00	12300.00	24200.00	4020.00	8505.00	6800.00	11700.00	7500.00	11875.00	6260.00	9940.00
350.00	12200.00	24175.00	3850.00	8462.50	6500.00	11625.00	7500.00	11875.00	6250.00	9937.50
360.00	12100.00	24150.00	3680.00	8420.00	6200.00	11550.00	7500.00	11875.00	6240.00	9935.00
370.00	12000.00	24125.00	3510.00	8377.50	5900.00	11475.00	7500.00	11875.00	6230.00	9932.50
380.00	11900.00	24100.00	3340.00	8335.00	5600.00	11400.00	7500.00	11875.00	6220.00	9930.00
390.00	11800.00	24075.00	3170.00	8292.50	5300.00	11325.00	7500.00	11875.00	6210.00	9927.50
400.00	11700.00	24050.00	3000.00	8250.00	5000.00	11250.00	7500.00	11875.00	6200.00	9925.00
410.00	11630.00	24032.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
420.00	11560.00	24015.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
430.00	11490.00	23997.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
440.00	11420.00	23980.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
450.00	11350.00	23962.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
460.00	11280.00	23945.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
470.00	11210.00	23927.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
480.00	11140.00	23910.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
490.00	11070.00	23892.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
500.00	11000.00	23875.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
510.00	10930.00	23857.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A358---304		COPPER-B42-3		RED-BRASS-B1		NICKELB161#5		NICKELB161)5	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
520.00	10860.00	23840.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
530.00	10790.00	23822.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
540.00	10720.00	23805.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
550.00	10650.00	23787.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
560.00	10580.00	23770.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
570.00	10510.00	23752.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
580.00	10440.00	23735.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
590.00	10370.00	23717.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
600.00	10300.00	23700.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
610.00	10280.00	23695.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
620.00	10260.00	23690.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
630.00	10240.00	23685.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
640.00	10220.00	23680.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
650.00	10200.00	23675.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
660.00	10160.00	23665.00	0.00	0.00	0.00	0.00	7480.00	11870.00	6200.00	9925.00
670.00	10120.00	23655.00	0.00	0.00	0.00	0.00	7460.00	11865.00	6200.00	9925.00
680.00	10080.00	23645.00	0.00	0.00	0.00	0.00	7440.00	11860.00	6200.00	9925.00
690.00	10040.00	23635.00	0.00	0.00	0.00	0.00	7420.00	11855.00	6200.00	9925.00
700.00	10000.00	23625.00	0.00	0.00	0.00	0.00	7400.00	11850.00	6200.00	9925.00
710.00	9940.00	23610.00	0.00	0.00	0.00	0.00	7380.00	11845.00	6160.00	9915.00
720.00	9880.00	23595.00	0.00	0.00	0.00	0.00	7360.00	11840.00	6120.00	9905.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A358---304		COPPER-B42-3		RED-BRASS-B1		NICKELB161#5		NICKELB161)5	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
730.00	9820.00	23580.00	0.00	0.00	0.00	0.00	7340.00	11835.00	6080.00	9895.00
740.00	9760.00	23565.00	0.00	0.00	0.00	0.00	7320.00	11830.00	6040.00	9885.00
750.00	9700.00	23550.00	0.00	0.00	0.00	0.00	7300.00	11825.00	6000.00	9875.00
760.00	9660.00	23540.00	0.00	0.00	0.00	0.00	7280.00	11820.00	5980.00	9870.00
770.00	9620.00	23530.00	0.00	0.00	0.00	0.00	7260.00	11815.00	5960.00	9865.00
780.00	9580.00	23520.00	0.00	0.00	0.00	0.00	7240.00	11810.00	5940.00	9860.00
790.00	9540.00	23510.00	0.00	0.00	0.00	0.00	7220.00	11805.00	5920.00	9855.00
800.00	9500.00	23500.00	0.00	0.00	0.00	0.00	7200.00	11800.00	5900.00	9850.00
810.00	9480.00	23495.00	0.00	0.00	0.00	0.00	6920.00	11730.00	5880.00	9845.00
820.00	9460.00	23490.00	0.00	0.00	0.00	0.00	6640.00	11660.00	5860.00	9840.00
830.00	9440.00	23485.00	0.00	0.00	0.00	0.00	6360.00	11590.00	5840.00	9835.00
840.00	9420.00	23480.00	0.00	0.00	0.00	0.00	6080.00	11520.00	5820.00	9830.00
850.00	9400.00	23475.00	0.00	0.00	0.00	0.00	5800.00	11450.00	5800.00	9825.00
860.00	9360.00	23465.00	0.00	0.00	0.00	0.00	5540.00	11385.00	5540.00	9760.00
870.00	9320.00	23455.00	0.00	0.00	0.00	0.00	5280.00	11320.00	5280.00	9695.00
880.00	9280.00	23445.00	0.00	0.00	0.00	0.00	5020.00	11255.00	5020.00	9630.00
890.00	9240.00	23435.00	0.00	0.00	0.00	0.00	4760.00	11190.00	4760.00	9565.00
900.00	9200.00	23425.00	0.00	0.00	0.00	0.00	4500.00	11125.00	4500.00	9500.00
910.00	9140.00	23410.00	0.00	0.00	0.00	0.00	4340.00	11085.00	4340.00	9460.00
920.00	9080.00	23395.00	0.00	0.00	0.00	0.00	4180.00	11045.00	4180.00	9420.00
930.00	9020.00	23380.00	0.00	0.00	0.00	0.00	4020.00	11005.00	4020.00	9380.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A358---304		COPPER-B42-3		RED-BRASS-B1		NICKELB161#5		NICKELB161)5	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
940.00	8960.00	23365.00	0.00	0.00	0.00	0.00	3860.00	10965.00	3860.00	9340.00
950.00	8900.00	23350.00	0.00	0.00	0.00	0.00	3700.00	10925.00	3700.00	9300.00
960.00	8880.00	23345.00	0.00	0.00	0.00	0.00	3560.00	10890.00	3560.00	9265.00
970.00	8860.00	23340.00	0.00	0.00	0.00	0.00	3420.00	10855.00	3420.00	9230.00
980.00	8840.00	23335.00	0.00	0.00	0.00	0.00	3280.00	10820.00	3280.00	9195.00
990.00	8820.00	23330.00	0.00	0.00	0.00	0.00	3140.00	10785.00	3140.00	9160.00
1000.00	8800.00	23325.00	0.00	0.00	0.00	0.00	3000.00	10750.00	3000.00	9125.00
1010.00	8760.00	23315.00	0.00	0.00	0.00	0.00	2880.00	10720.00	2880.00	9095.00
1020.00	8720.00	23305.00	0.00	0.00	0.00	0.00	2760.00	10690.00	2760.00	9065.00
1030.00	8680.00	23295.00	0.00	0.00	0.00	0.00	2640.00	10660.00	2640.00	9035.00
1040.00	8640.00	23285.00	0.00	0.00	0.00	0.00	2520.00	10630.00	2520.00	9005.00
1050.00	8600.00	23275.00	0.00	0.00	0.00	0.00	2400.00	10600.00	2400.00	8975.00
1060.00	8480.00	23245.00	0.00	0.00	0.00	0.00	2320.00	10580.00	2320.00	8955.00
1070.00	8360.00	23215.00	0.00	0.00	0.00	0.00	2240.00	10560.00	2240.00	8935.00
1080.00	8240.00	23185.00	0.00	0.00	0.00	0.00	2160.00	10540.00	2160.00	8915.00
1090.00	8120.00	23155.00	0.00	0.00	0.00	0.00	2080.00	10520.00	2080.00	8895.00
1100.00	8000.00	23125.00	0.00	0.00	0.00	0.00	2000.00	10500.00	2000.00	8875.00
1110.00	7780.00	23070.00	0.00	0.00	0.00	0.00	1900.00	10475.00	1900.00	8850.00
1120.00	7560.00	23015.00	0.00	0.00	0.00	0.00	1800.00	10450.00	1800.00	8825.00
1130.00	7340.00	22960.00	0.00	0.00	0.00	0.00	1700.00	10425.00	1700.00	8800.00
1140.00	7120.00	22905.00	0.00	0.00	0.00	0.00	1600.00	10400.00	1600.00	8775.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A358---304		COPPER-B42-3		RED-BRASS-B1		NICKELB161#5		NICKELB161)5	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
1150.00	6900.00	22850.00	0.00	0.00	0.00	0.00	1500.00	10375.00	1500.00	8750.00
1160.00	6620.00	22780.00	0.00	0.00	0.00	0.00	1440.00	10360.00	1440.00	8735.00
1170.00	6340.00	22710.00	0.00	0.00	0.00	0.00	1380.00	10345.00	1380.00	8720.00
1180.00	6060.00	22640.00	0.00	0.00	0.00	0.00	1320.00	10330.00	1320.00	8705.00
1190.00	5780.00	22570.00	0.00	0.00	0.00	0.00	1260.00	10315.00	1260.00	8690.00
1200.00	5500.00	22500.00	0.00	0.00	0.00	0.00	1200.00	10300.00	1200.00	8675.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	B165 MONEL-N		ASTM-B167-#5		ASTM-B167-)5		AL-B241-6061		AL-B241-6063	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
100.00	16600.00	24900.00	20000.00	30000.00	16700.00	25050.00	9500.00	14250.00	7500.00	11250.00
110.00	16400.00	24850.00	20000.00	30000.00	16560.00	25015.00	9500.00	14250.00	7490.00	11247.50
120.00	16200.00	24800.00	20000.00	30000.00	16420.00	24980.00	9500.00	14250.00	7480.00	11245.00
130.00	16000.00	24750.00	20000.00	30000.00	16280.00	24945.00	9500.00	14250.00	7470.00	11242.50
140.00	15800.00	24700.00	20000.00	30000.00	16140.00	24910.00	9500.00	14250.00	7460.00	11240.00
150.00	15600.00	24650.00	20000.00	30000.00	16000.00	24875.00	9500.00	14250.00	7450.00	11237.50
160.00	15400.00	24600.00	20000.00	30000.00	15860.00	24840.00	9500.00	14250.00	7440.00	11235.00
170.00	15200.00	24550.00	20000.00	30000.00	15720.00	24805.00	9500.00	14250.00	7430.00	11232.50
180.00	15000.00	24500.00	20000.00	30000.00	15580.00	24770.00	9500.00	14250.00	7420.00	11230.00
190.00	14800.00	24450.00	20000.00	30000.00	15440.00	24735.00	9500.00	14250.00	7410.00	11227.50
200.00	14600.00	24400.00	20000.00	30000.00	15300.00	24700.00	9500.00	14250.00	7400.00	11225.00
210.00	14500.00	24375.00	20000.00	30000.00	15220.00	24680.00	9340.00	14210.00	7160.00	11165.00
220.00	14400.00	24350.00	20000.00	30000.00	15140.00	24660.00	9180.00	14170.00	6920.00	11105.00
230.00	14300.00	24325.00	20000.00	30000.00	15060.00	24640.00	9020.00	14130.00	6680.00	11045.00
240.00	14200.00	24300.00	20000.00	30000.00	14980.00	24620.00	8860.00	14090.00	6440.00	10985.00
250.00	14100.00	24275.00	20000.00	30000.00	14900.00	24600.00	8700.00	14050.00	6200.00	10925.00
260.00	14000.00	24250.00	20000.00	30000.00	14820.00	24580.00	8540.00	14010.00	5960.00	10865.00
270.00	13900.00	24225.00	20000.00	30000.00	14740.00	24560.00	8380.00	13970.00	5720.00	10805.00
280.00	13800.00	24200.00	20000.00	30000.00	14660.00	24540.00	8220.00	13930.00	5480.00	10745.00
290.00	13700.00	24175.00	20000.00	30000.00	14580.00	24520.00	8060.00	13890.00	5240.00	10685.00
300.00	13600.00	24150.00	20000.00	30000.00	14500.00	24500.00	7900.00	13850.00	5000.00	10625.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	B165 MONEL-N		ASTM-B167-#5		ASTM-B167-)5		AL-B241-6061		AL-B241-6063	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
310.00	13560.00	24140.00	20000.00	30000.00	14450.00	24487.50	7560.00	13765.00	4700.00	10550.00
320.00	13520.00	24130.00	20000.00	30000.00	14400.00	24475.00	7220.00	13680.00	4400.00	10475.00
330.00	13480.00	24120.00	20000.00	30000.00	14350.00	24462.50	6880.00	13595.00	4100.00	10400.00
340.00	13440.00	24110.00	20000.00	30000.00	14300.00	24450.00	6540.00	13510.00	3800.00	10325.00
350.00	13400.00	24100.00	20000.00	30000.00	14250.00	24437.50	6200.00	13425.00	3500.00	10250.00
360.00	13360.00	24090.00	20000.00	30000.00	14200.00	24425.00	5860.00	13340.00	3200.00	10175.00
370.00	13320.00	24080.00	20000.00	30000.00	14150.00	24412.50	5520.00	13255.00	2900.00	10100.00
380.00	13280.00	24070.00	20000.00	30000.00	14100.00	24400.00	5180.00	13170.00	2600.00	10025.00
390.00	13240.00	24060.00	20000.00	30000.00	14050.00	24387.50	4840.00	13085.00	2300.00	9950.00
400.00	13200.00	24050.00	20000.00	30000.00	14000.00	24375.00	4500.00	13000.00	2000.00	9875.00
410.00	13190.00	24047.50	20000.00	30000.00	13960.00	24365.00	0.00	0.00	0.00	0.00
420.00	13180.00	24045.00	20000.00	30000.00	13920.00	24355.00	0.00	0.00	0.00	0.00
430.00	13170.00	24042.50	20000.00	30000.00	13880.00	24345.00	0.00	0.00	0.00	0.00
440.00	13160.00	24040.00	20000.00	30000.00	13840.00	24335.00	0.00	0.00	0.00	0.00
450.00	13150.00	24037.50	20000.00	30000.00	13800.00	24325.00	0.00	0.00	0.00	0.00
460.00	13140.00	24035.00	20000.00	30000.00	13760.00	24315.00	0.00	0.00	0.00	0.00
470.00	13130.00	24032.50	20000.00	30000.00	13720.00	24305.00	0.00	0.00	0.00	0.00
480.00	13120.00	24030.00	20000.00	30000.00	13680.00	24295.00	0.00	0.00	0.00	0.00
490.00	13110.00	24027.50	20000.00	30000.00	13640.00	24285.00	0.00	0.00	0.00	0.00
500.00	13100.00	24025.00	20000.00	30000.00	13600.00	24275.00	0.00	0.00	0.00	0.00
510.00	13100.00	24025.00	20000.00	30000.00	13560.00	24265.00	0.00	0.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	B165 MONEL-N		ASTM-B167-#5		ASTM-B167-)5		AL-B241-6061		AL-B241-6063	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
520.00	13100.00	24025.00	20000.00	30000.00	13520.00	24255.00	0.00	0.00	0.00	0.00
530.00	13100.00	24025.00	20000.00	30000.00	13480.00	24245.00	0.00	0.00	0.00	0.00
540.00	13100.00	24025.00	20000.00	30000.00	13440.00	24235.00	0.00	0.00	0.00	0.00
550.00	13100.00	24025.00	20000.00	30000.00	13400.00	24225.00	0.00	0.00	0.00	0.00
560.00	13100.00	24025.00	20000.00	30000.00	13360.00	24215.00	0.00	0.00	0.00	0.00
570.00	13100.00	24025.00	20000.00	30000.00	13320.00	24205.00	0.00	0.00	0.00	0.00
580.00	13100.00	24025.00	20000.00	30000.00	13280.00	24195.00	0.00	0.00	0.00	0.00
590.00	13100.00	24025.00	20000.00	30000.00	13240.00	24185.00	0.00	0.00	0.00	0.00
600.00	13100.00	24025.00	20000.00	30000.00	13200.00	24175.00	0.00	0.00	0.00	0.00
610.00	13100.00	24025.00	20000.00	30000.00	13180.00	24170.00	0.00	0.00	0.00	0.00
620.00	13100.00	24025.00	20000.00	30000.00	13160.00	24165.00	0.00	0.00	0.00	0.00
630.00	13100.00	24025.00	20000.00	30000.00	13140.00	24160.00	0.00	0.00	0.00	0.00
640.00	13100.00	24025.00	20000.00	30000.00	13120.00	24155.00	0.00	0.00	0.00	0.00
650.00	13100.00	24025.00	20000.00	30000.00	13100.00	24150.00	0.00	0.00	0.00	0.00
660.00	13100.00	24025.00	20000.00	30000.00	13080.00	24145.00	0.00	0.00	0.00	0.00
670.00	13100.00	24025.00	20000.00	30000.00	13060.00	24140.00	0.00	0.00	0.00	0.00
680.00	13100.00	24025.00	20000.00	30000.00	13040.00	24135.00	0.00	0.00	0.00	0.00
690.00	13100.00	24025.00	20000.00	30000.00	13020.00	24130.00	0.00	0.00	0.00	0.00
700.00	13100.00	24025.00	20000.00	30000.00	13000.00	24125.00	0.00	0.00	0.00	0.00
710.00	13080.00	24020.00	20000.00	30000.00	12980.00	24120.00	0.00	0.00	0.00	0.00
720.00	13060.00	24015.00	20000.00	30000.00	12960.00	24115.00	0.00	0.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	B165 MONEL-N		ASTM-B167-#5		ASTM-B167-)5		AL-B241-6061		AL-B241-6063	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
730.00	13040.00	24010.00	20000.00	30000.00	12940.00	24110.00	0.00	0.00	0.00	0.00
740.00	13020.00	24005.00	20000.00	30000.00	12920.00	24105.00	0.00	0.00	0.00	0.00
750.00	13000.00	24000.00	20000.00	30000.00	12900.00	24100.00	0.00	0.00	0.00	0.00
760.00	12940.00	23985.00	20000.00	30000.00	12860.00	24090.00	0.00	0.00	0.00	0.00
770.00	12880.00	23970.00	20000.00	30000.00	12820.00	24080.00	0.00	0.00	0.00	0.00
780.00	12820.00	23955.00	20000.00	30000.00	12780.00	24070.00	0.00	0.00	0.00	0.00
790.00	12760.00	23940.00	20000.00	30000.00	12740.00	24060.00	0.00	0.00	0.00	0.00
800.00	12700.00	23925.00	20000.00	30000.00	12700.00	24050.00	0.00	0.00	0.00	0.00
810.00	12360.00	23840.00	19920.00	29980.00	12620.00	24030.00	0.00	0.00	0.00	0.00
820.00	12020.00	23755.00	19840.00	29960.00	12540.00	24010.00	0.00	0.00	0.00	0.00
830.00	11680.00	23670.00	19760.00	29940.00	12460.00	23990.00	0.00	0.00	0.00	0.00
840.00	11340.00	23585.00	19680.00	29920.00	12380.00	23970.00	0.00	0.00	0.00	0.00
850.00	11000.00	23500.00	19600.00	29900.00	12300.00	23950.00	0.00	0.00	0.00	0.00
860.00	10400.00	23350.00	18880.00	29720.00	12200.00	23925.00	0.00	0.00	0.00	0.00
870.00	9800.00	23200.00	18160.00	29540.00	12100.00	23900.00	0.00	0.00	0.00	0.00
880.00	9200.00	23050.00	17440.00	29360.00	12000.00	23875.00	0.00	0.00	0.00	0.00
890.00	8600.00	22900.00	16720.00	29180.00	11900.00	23850.00	0.00	0.00	0.00	0.00
900.00	8000.00	22750.00	16000.00	29000.00	11800.00	23825.00	0.00	0.00	0.00	0.00
910.00	0.00	0.00	14920.00	28730.00	11560.00	23765.00	0.00	0.00	0.00	0.00
920.00	0.00	0.00	13840.00	28460.00	11320.00	23705.00	0.00	0.00	0.00	0.00
930.00	0.00	0.00	12760.00	28190.00	11080.00	23645.00	0.00	0.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	B165 MONEL-N		ASTM-B167-#5		ASTM-B167-)5		AL-B241-6061		AL-B241-6063	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
940.00	0.00	0.00	11680.00	27920.00	10840.00	23585.00	0.00	0.00	0.00	0.00
950.00	0.00	0.00	10600.00	27650.00	10600.00	23525.00	0.00	0.00	0.00	0.00
960.00	0.00	0.00	9880.00	27470.00	9880.00	23345.00	0.00	0.00	0.00	0.00
970.00	0.00	0.00	9160.00	27290.00	9160.00	23165.00	0.00	0.00	0.00	0.00
980.00	0.00	0.00	8440.00	27110.00	8440.00	22985.00	0.00	0.00	0.00	0.00
990.00	0.00	0.00	7720.00	26930.00	7720.00	22805.00	0.00	0.00	0.00	0.00
1000.00	0.00	0.00	7000.00	26750.00	7000.00	22625.00	0.00	0.00	0.00	0.00
1010.00	0.00	0.00	6500.00	26625.00	6500.00	22500.00	0.00	0.00	0.00	0.00
1020.00	0.00	0.00	6000.00	26500.00	6000.00	22375.00	0.00	0.00	0.00	0.00
1030.00	0.00	0.00	5500.00	26375.00	5500.00	22250.00	0.00	0.00	0.00	0.00
1040.00	0.00	0.00	5000.00	26250.00	5000.00	22125.00	0.00	0.00	0.00	0.00
1050.00	0.00	0.00	4500.00	26125.00	4500.00	22000.00	0.00	0.00	0.00	0.00
1060.00	0.00	0.00	4200.00	26050.00	4200.00	21925.00	0.00	0.00	0.00	0.00
1070.00	0.00	0.00	3900.00	25975.00	3900.00	21850.00	0.00	0.00	0.00	0.00
1080.00	0.00	0.00	3600.00	25900.00	3600.00	21775.00	0.00	0.00	0.00	0.00
1090.00	0.00	0.00	3300.00	25825.00	3300.00	21700.00	0.00	0.00	0.00	0.00
1100.00	0.00	0.00	3000.00	25750.00	3000.00	21625.00	0.00	0.00	0.00	0.00
1110.00	0.00	0.00	2840.00	25710.00	2840.00	21585.00	0.00	0.00	0.00	0.00
1120.00	0.00	0.00	2680.00	25670.00	2680.00	21545.00	0.00	0.00	0.00	0.00
1130.00	0.00	0.00	2520.00	25630.00	2520.00	21505.00	0.00	0.00	0.00	0.00
1140.00	0.00	0.00	2360.00	25590.00	2360.00	21465.00	0.00	0.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.1

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	B165 MONEL-N		ASTM-B167-#5		ASTM-B167-)5		AL-B241-6061		AL-B241-6063	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
1150.00	0.00	0.00	2200.00	25550.00	2200.00	21425.00	0.00	0.00	0.00	0.00
1160.00	0.00	0.00	2160.00	25540.00	2160.00	21415.00	0.00	0.00	0.00	0.00
1170.00	0.00	0.00	2120.00	25530.00	2120.00	21405.00	0.00	0.00	0.00	0.00
1180.00	0.00	0.00	2080.00	25520.00	2080.00	21395.00	0.00	0.00	0.00	0.00
1190.00	0.00	0.00	2040.00	25510.00	2040.00	21385.00	0.00	0.00	0.00	0.00
1200.00	0.00	0.00	2000.00	25500.00	2000.00	21375.00	0.00	0.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

4

Allowable Stress Range for ANSI/ASME Petroleum Piping Code B31.3 (1984)

This chapter contains allowable thermal stresses for power piping.

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	ASTM-A53-A		ASTM-A53-B		ASTM-A106-B		API-5L-GR-B		ASTM-A139-B	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
100.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
110.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
120.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
130.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
140.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
150.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
160.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
170.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
180.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
190.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
200.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
210.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
220.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
230.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
240.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
250.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
260.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
270.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
280.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
290.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00
300.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	16000.00	24000.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	ASTM-A53-A		ASTM-A53-B		ASTM-A106-B		API-5L-GR-B		ASTM-A139-B	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
310.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	0.00	0.00
320.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	0.00	0.00
330.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	0.00	0.00
340.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	0.00	0.00
350.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	0.00	0.00
360.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	0.00	0.00
370.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	0.00	0.00
380.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	0.00	0.00
390.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	0.00	0.00
400.00	16000.00	24000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	0.00	0.00
410.00	16000.00	24000.00	19890.00	29972.50	19890.00	29972.50	19890.00	29972.50	0.00	0.00
420.00	16000.00	24000.00	19780.00	29945.00	19780.00	29945.00	19780.00	29945.00	0.00	0.00
430.00	16000.00	24000.00	19670.00	29917.50	19670.00	29917.50	19670.00	29917.50	0.00	0.00
440.00	16000.00	24000.00	19560.00	29890.00	19560.00	29890.00	19560.00	29890.00	0.00	0.00
450.00	16000.00	24000.00	19450.00	29862.50	19450.00	29862.50	19450.00	29862.50	0.00	0.00
460.00	16000.00	24000.00	19340.00	29835.00	19340.00	29835.00	19340.00	29835.00	0.00	0.00
470.00	16000.00	24000.00	19230.00	29807.50	19230.00	29807.50	19230.00	29807.50	0.00	0.00
480.00	16000.00	24000.00	19120.00	29780.00	19120.00	29780.00	19120.00	29780.00	0.00	0.00
490.00	16000.00	24000.00	19010.00	29752.50	19010.00	29752.50	19010.00	29752.50	0.00	0.00
500.00	16000.00	24000.00	18900.00	29725.00	18900.00	29725.00	18900.00	29725.00	0.00	0.00
510.00	15880.00	23970.00	18740.00	29685.00	18740.00	29685.00	18740.00	29685.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	ASTM-A53-A		ASTM-A53-B		ASTM-A106-B		API-5L-GR-B		ASTM-A139-B	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
520.00	15760.00	23940.00	18580.00	29645.00	18580.00	29645.00	18580.00	29645.00	0.00	0.00
530.00	15640.00	23910.00	18420.00	29605.00	18420.00	29605.00	18420.00	29605.00	0.00	0.00
540.00	15520.00	23880.00	18260.00	29565.00	18260.00	29565.00	18260.00	29565.00	0.00	0.00
550.00	15400.00	23850.00	18100.00	29525.00	18100.00	29525.00	18100.00	29525.00	0.00	0.00
560.00	15280.00	23820.00	17940.00	29485.00	17940.00	29485.00	17940.00	29485.00	0.00	0.00
570.00	15160.00	23790.00	17780.00	29445.00	17780.00	29445.00	17780.00	29445.00	0.00	0.00
580.00	15040.00	23760.00	17620.00	29405.00	17620.00	29405.00	17620.00	29405.00	0.00	0.00
590.00	14920.00	23730.00	17460.00	29365.00	17460.00	29365.00	17460.00	29365.00	0.00	0.00
600.00	14800.00	23700.00	17300.00	29325.00	17300.00	29325.00	17300.00	29325.00	0.00	0.00
610.00	14740.00	23685.00	17240.00	29310.00	17240.00	29310.00	17240.00	29310.00	0.00	0.00
620.00	14680.00	23670.00	17180.00	29295.00	17180.00	29295.00	17180.00	29295.00	0.00	0.00
630.00	14620.00	23655.00	17120.00	29280.00	17120.00	29280.00	17120.00	29280.00	0.00	0.00
640.00	14560.00	23640.00	17060.00	29265.00	17060.00	29265.00	17060.00	29265.00	0.00	0.00
650.00	14500.00	23625.00	17000.00	29250.00	17000.00	29250.00	17000.00	29250.00	0.00	0.00
660.00	14480.00	23620.00	16960.00	29240.00	16960.00	29240.00	16960.00	29240.00	0.00	0.00
670.00	14460.00	23615.00	16920.00	29230.00	16920.00	29230.00	16920.00	29230.00	0.00	0.00
680.00	14440.00	23610.00	16880.00	29220.00	16880.00	29220.00	16880.00	29220.00	0.00	0.00
690.00	14420.00	23605.00	16840.00	29210.00	16840.00	29210.00	16840.00	29210.00	0.00	0.00
700.00	14400.00	23600.00	16800.00	29200.00	16800.00	29200.00	16800.00	29200.00	0.00	0.00
710.00	13660.00	23415.00	16040.00	29010.00	16040.00	29010.00	16040.00	29010.00	0.00	0.00
720.00	12920.00	23230.00	15280.00	28820.00	15280.00	28820.00	15280.00	28820.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	ASTM-A53-A		ASTM-A53-B		ASTM-A106-B		API-5L-GR-B		ASTM-A139-B	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
730.00	12180.00	23045.00	14520.00	28630.00	14520.00	28630.00	14520.00	28630.00	0.00	0.00
740.00	11440.00	22860.00	13760.00	28440.00	13760.00	28440.00	13760.00	28440.00	0.00	0.00
750.00	10700.00	22675.00	13000.00	28250.00	13000.00	28250.00	13000.00	28250.00	0.00	0.00
760.00	10420.00	22605.00	12560.00	28140.00	12560.00	28140.00	12560.00	28140.00	0.00	0.00
770.00	10140.00	22535.00	12120.00	28030.00	12120.00	28030.00	12120.00	28030.00	0.00	0.00
780.00	9860.00	22465.00	11680.00	27920.00	11680.00	27920.00	11680.00	27920.00	0.00	0.00
790.00	9580.00	22395.00	11240.00	27810.00	11240.00	27810.00	11240.00	27810.00	0.00	0.00
800.00	9300.00	22325.00	10800.00	27700.00	10800.00	27700.00	10800.00	27700.00	0.00	0.00
810.00	9020.00	22255.00	10380.00	27595.00	10380.00	27595.00	10380.00	27595.00	0.00	0.00
820.00	8740.00	22185.00	9960.00	27490.00	9960.00	27490.00	9960.00	27490.00	0.00	0.00
830.00	8460.00	22115.00	9540.00	27385.00	9540.00	27385.00	9540.00	27385.00	0.00	0.00
840.00	8180.00	22045.00	9120.00	27280.00	9120.00	27280.00	9120.00	27280.00	0.00	0.00
850.00	7900.00	21975.00	8700.00	27175.00	8700.00	27175.00	8700.00	27175.00	0.00	0.00
860.00	7620.00	21905.00	8260.00	27065.00	8260.00	27065.00	8260.00	27065.00	0.00	0.00
870.00	7340.00	21835.00	7820.00	26955.00	7820.00	26955.00	7820.00	26955.00	0.00	0.00
880.00	7060.00	21765.00	7380.00	26845.00	7380.00	26845.00	7380.00	26845.00	0.00	0.00
890.00	6780.00	21695.00	6940.00	26735.00	6940.00	26735.00	6940.00	26735.00	0.00	0.00
900.00	6500.00	21625.00	6500.00	26625.00	6500.00	26625.00	6500.00	26625.00	0.00	0.00
910.00	6100.00	21525.00	6100.00	26525.00	6100.00	26525.00	6100.00	26525.00	0.00	0.00
920.00	5700.00	21425.00	5700.00	26425.00	5700.00	26425.00	5700.00	26425.00	0.00	0.00
930.00	5300.00	21325.00	5300.00	26325.00	5300.00	26325.00	5300.00	26325.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	ASTM-A53-A		ASTM-A53-B		ASTM-A106-B		API-5L-GR-B		ASTM-A139-B	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
940.00	4900.00	21225.00	4900.00	26225.00	4900.00	26225.00	4900.00	26225.00	0.00	0.00
950.00	4500.00	21125.00	4500.00	26125.00	4500.00	26125.00	4500.00	26125.00	0.00	0.00
960.00	4100.00	21025.00	4100.00	26025.00	4100.00	26025.00	4100.00	26025.00	0.00	0.00
970.00	3700.00	20925.00	3700.00	25925.00	3700.00	25925.00	3700.00	25925.00	0.00	0.00
980.00	3300.00	20825.00	3300.00	25825.00	3300.00	25825.00	3300.00	25825.00	0.00	0.00
990.00	2900.00	20725.00	2900.00	25725.00	2900.00	25725.00	2900.00	25725.00	0.00	0.00
1000.00	2500.00	20625.00	2500.00	25625.00	2500.00	25625.00	2500.00	25625.00	0.00	0.00
1010.00	2320.00	20580.00	2320.00	25580.00	2320.00	25580.00	2320.00	25580.00	0.00	0.00
1020.00	2140.00	20535.00	2140.00	25535.00	2140.00	25535.00	2140.00	25535.00	0.00	0.00
1030.00	1960.00	20490.00	1960.00	25490.00	1960.00	25490.00	1960.00	25490.00	0.00	0.00
1040.00	1780.00	20445.00	1780.00	25445.00	1780.00	25445.00	1780.00	25445.00	0.00	0.00
1050.00	1600.00	20400.00	1600.00	25400.00	1600.00	25400.00	1600.00	25400.00	0.00	0.00
1060.00	1480.00	20370.00	1480.00	25370.00	1480.00	25370.00	1480.00	25370.00	0.00	0.00
1070.00	1360.00	20340.00	1360.00	25340.00	1360.00	25340.00	1360.00	25340.00	0.00	0.00
1080.00	1240.00	20310.00	1240.00	25310.00	1240.00	25310.00	1240.00	25310.00	0.00	0.00
1090.00	1120.00	20280.00	1120.00	25280.00	1120.00	25280.00	1120.00	25280.00	0.00	0.00
1100.00	1000.00	20250.00	1000.00	25250.00	1000.00	25250.00	1000.00	25250.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A335-P2		A335-P5,B,C		A335-GR-P9		A335-GR-P11		A335-GR-P22	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
100.00	18300.00	27450.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
110.00	18300.00	27450.00	19810.00	29952.50	19810.00	29952.50	19870.00	29967.50	19850.00	29962.50
120.00	18300.00	27450.00	19620.00	29905.00	19620.00	29905.00	19740.00	29935.00	19700.00	29925.00
130.00	18300.00	27450.00	19430.00	29857.50	19430.00	29857.50	19610.00	29902.50	19550.00	29887.50
140.00	18300.00	27450.00	19240.00	29810.00	19240.00	29810.00	19480.00	29870.00	19400.00	29850.00
150.00	18300.00	27450.00	19050.00	29762.50	19050.00	29762.50	19350.00	29837.50	19250.00	29812.50
160.00	18300.00	27450.00	18860.00	29715.00	18860.00	29715.00	19220.00	29805.00	19100.00	29775.00
170.00	18300.00	27450.00	18670.00	29667.50	18670.00	29667.50	19090.00	29772.50	18950.00	29737.50
180.00	18300.00	27450.00	18480.00	29620.00	18480.00	29620.00	18960.00	29740.00	18800.00	29700.00
190.00	18300.00	27450.00	18290.00	29572.50	18290.00	29572.50	18830.00	29707.50	18650.00	29662.50
200.00	18300.00	27450.00	18100.00	29525.00	18100.00	29525.00	18700.00	29675.00	18500.00	29625.00
210.00	18220.00	27430.00	18030.00	29507.50	18030.00	29507.50	18630.00	29657.50	18450.00	29612.50
220.00	18140.00	27410.00	17960.00	29490.00	17960.00	29490.00	18560.00	29640.00	18400.00	29600.00
230.00	18060.00	27390.00	17890.00	29472.50	17890.00	29472.50	18490.00	29622.50	18350.00	29587.50
240.00	17980.00	27370.00	17820.00	29455.00	17820.00	29455.00	18420.00	29605.00	18300.00	29575.00
250.00	17900.00	27350.00	17750.00	29437.50	17750.00	29437.50	18350.00	29587.50	18250.00	29562.50
260.00	17820.00	27330.00	17680.00	29420.00	17680.00	29420.00	18280.00	29570.00	18200.00	29550.00
270.00	17740.00	27310.00	17610.00	29402.50	17610.00	29402.50	18210.00	29552.50	18150.00	29537.50
280.00	17660.00	27290.00	17540.00	29385.00	17540.00	29385.00	18140.00	29535.00	18100.00	29525.00
290.00	17580.00	27270.00	17470.00	29367.50	17470.00	29367.50	18070.00	29517.50	18050.00	29512.50
300.00	17500.00	27250.00	17400.00	29350.00	17400.00	29350.00	18000.00	29500.00	18000.00	29500.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A335-P2		A335-P5,B,C		A335-GR-P9		A335-GR-P11		A335-GR-P22	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
310.00	17440.00	27235.00	17380.00	29345.00	17380.00	29345.00	17950.00	29487.50	17990.00	29497.50
320.00	17380.00	27220.00	17360.00	29340.00	17360.00	29340.00	17900.00	29475.00	17980.00	29495.00
330.00	17320.00	27205.00	17340.00	29335.00	17340.00	29335.00	17850.00	29462.50	17970.00	29492.50
340.00	17260.00	27190.00	17320.00	29330.00	17320.00	29330.00	17800.00	29450.00	17960.00	29490.00
350.00	17200.00	27175.00	17300.00	29325.00	17300.00	29325.00	17750.00	29437.50	17950.00	29487.50
360.00	17140.00	27160.00	17280.00	29320.00	17280.00	29320.00	17700.00	29425.00	17940.00	29485.00
370.00	17080.00	27145.00	17260.00	29315.00	17260.00	29315.00	17650.00	29412.50	17930.00	29482.50
380.00	17020.00	27130.00	17240.00	29310.00	17240.00	29310.00	17600.00	29400.00	17920.00	29480.00
390.00	16960.00	27115.00	17220.00	29305.00	17220.00	29305.00	17550.00	29387.50	17910.00	29477.50
400.00	16900.00	27100.00	17200.00	29300.00	17200.00	29300.00	17500.00	29375.00	17900.00	29475.00
410.00	16840.00	27085.00	17190.00	29297.50	17190.00	29297.50	17470.00	29367.50	17900.00	29475.00
420.00	16780.00	27070.00	17180.00	29295.00	17180.00	29295.00	17440.00	29360.00	17900.00	29475.00
430.00	16720.00	27055.00	17170.00	29292.50	17170.00	29292.50	17410.00	29352.50	17900.00	29475.00
440.00	16660.00	27040.00	17160.00	29290.00	17160.00	29290.00	17380.00	29345.00	17900.00	29475.00
450.00	16600.00	27025.00	17150.00	29287.50	17150.00	29287.50	17350.00	29337.50	17900.00	29475.00
460.00	16540.00	27010.00	17140.00	29285.00	17140.00	29285.00	17320.00	29330.00	17900.00	29475.00
470.00	16480.00	26995.00	17130.00	29282.50	17130.00	29282.50	17290.00	29322.50	17900.00	29475.00
480.00	16420.00	26980.00	17120.00	29280.00	17120.00	29280.00	17260.00	29315.00	17900.00	29475.00
490.00	16360.00	26965.00	17110.00	29277.50	17110.00	29277.50	17230.00	29307.50	17900.00	29475.00
500.00	16300.00	26950.00	17100.00	29275.00	17100.00	29275.00	17200.00	29300.00	17900.00	29475.00
510.00	16240.00	26935.00	17070.00	29267.50	17070.00	29267.50	17150.00	29287.50	17900.00	29475.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A335-P2		A335-P5,B,C		A335-GR-P9		A335-GR-P11		A335-GR-P22	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
520.00	16180.00	26920.00	17040.00	29260.00	17040.00	29260.00	17100.00	29275.00	17900.00	29475.00
530.00	16120.00	26905.00	17010.00	29252.50	17010.00	29252.50	17050.00	29262.50	17900.00	29475.00
540.00	16060.00	26890.00	16980.00	29245.00	16980.00	29245.00	17000.00	29250.00	17900.00	29475.00
550.00	16000.00	26875.00	16950.00	29237.50	16950.00	29237.50	16950.00	29237.50	17900.00	29475.00
560.00	15940.00	26860.00	16920.00	29230.00	16920.00	29230.00	16900.00	29225.00	17900.00	29475.00
570.00	15880.00	26845.00	16890.00	29222.50	16890.00	29222.50	16850.00	29212.50	17900.00	29475.00
580.00	15820.00	26830.00	16860.00	29215.00	16860.00	29215.00	16800.00	29200.00	17900.00	29475.00
590.00	15760.00	26815.00	16830.00	29207.50	16830.00	29207.50	16750.00	29187.50	17900.00	29475.00
600.00	15700.00	26800.00	16800.00	29200.00	16800.00	29200.00	16700.00	29175.00	17900.00	29475.00
610.00	15640.00	26785.00	16760.00	29190.00	16760.00	29190.00	16600.00	29150.00	17900.00	29475.00
620.00	15580.00	26770.00	16720.00	29180.00	16720.00	29180.00	16500.00	29125.00	17900.00	29475.00
630.00	15520.00	26755.00	16680.00	29170.00	16680.00	29170.00	16400.00	29100.00	17900.00	29475.00
640.00	15460.00	26740.00	16640.00	29160.00	16640.00	29160.00	16300.00	29075.00	17900.00	29475.00
650.00	15400.00	26725.00	16600.00	29150.00	16600.00	29150.00	16200.00	29050.00	17900.00	29475.00
660.00	15340.00	26710.00	16540.00	29135.00	16540.00	29135.00	16080.00	29020.00	17900.00	29475.00
670.00	15280.00	26695.00	16480.00	29120.00	16480.00	29120.00	15960.00	28990.00	17900.00	29475.00
680.00	15220.00	26680.00	16420.00	29105.00	16420.00	29105.00	15840.00	28960.00	17900.00	29475.00
690.00	15160.00	26665.00	16360.00	29090.00	16360.00	29090.00	15720.00	28930.00	17900.00	29475.00
700.00	15100.00	26650.00	16300.00	29075.00	16300.00	29075.00	15600.00	28900.00	17900.00	29475.00
710.00	14840.00	26585.00	15680.00	28920.00	15680.00	28920.00	15520.00	28880.00	17900.00	29475.00
720.00	14580.00	26520.00	15060.00	28765.00	15060.00	28765.00	15440.00	28860.00	17900.00	29475.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A335-P2		A335-P5,B,C		A335-GR-P9		A335-GR-P11		A335-GR-P22	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
730.00	14320.00	26455.00	14440.00	28610.00	14440.00	28610.00	15360.00	28840.00	17900.00	29475.00
740.00	14060.00	26390.00	13820.00	28455.00	13820.00	28455.00	15280.00	28820.00	17900.00	29475.00
750.00	13800.00	26325.00	13200.00	28300.00	13200.00	28300.00	15200.00	28800.00	17900.00	29475.00
760.00	13740.00	26310.00	13120.00	28280.00	13120.00	28280.00	15160.00	28790.00	17360.00	29340.00
770.00	13680.00	26295.00	13040.00	28260.00	13040.00	28260.00	15120.00	28780.00	16820.00	29205.00
780.00	13620.00	26280.00	12960.00	28240.00	12960.00	28240.00	15080.00	28770.00	16280.00	29070.00
790.00	13560.00	26265.00	12880.00	28220.00	12880.00	28220.00	15040.00	28760.00	15740.00	28935.00
800.00	13500.00	26250.00	12800.00	28200.00	12800.00	28200.00	15000.00	28750.00	15200.00	28800.00
810.00	13440.00	26235.00	12660.00	28165.00	12660.00	28165.00	14900.00	28725.00	15060.00	28765.00
820.00	13380.00	26220.00	12520.00	28130.00	12520.00	28130.00	14800.00	28700.00	14920.00	28730.00
830.00	13320.00	26205.00	12380.00	28095.00	12380.00	28095.00	14700.00	28675.00	14780.00	28695.00
840.00	13260.00	26190.00	12240.00	28060.00	12240.00	28060.00	14600.00	28650.00	14640.00	28660.00
850.00	13200.00	26175.00	12100.00	28025.00	12100.00	28025.00	14500.00	28625.00	14500.00	28625.00
860.00	13120.00	26155.00	11860.00	27965.00	11960.00	27990.00	14160.00	28540.00	14160.00	28540.00
870.00	13040.00	26135.00	11620.00	27905.00	11820.00	27955.00	13820.00	28455.00	13820.00	28455.00
880.00	12960.00	26115.00	11380.00	27845.00	11680.00	27920.00	13480.00	28370.00	13480.00	28370.00
890.00	12880.00	26095.00	11140.00	27785.00	11540.00	27885.00	13140.00	28285.00	13140.00	28285.00
900.00	12800.00	26075.00	10900.00	27725.00	11400.00	27850.00	12800.00	28200.00	12800.00	28200.00
910.00	12080.00	25895.00	10320.00	27580.00	11240.00	27810.00	12440.00	28110.00	12440.00	28110.00
920.00	11360.00	25715.00	9740.00	27435.00	11080.00	27770.00	12080.00	28020.00	12080.00	28020.00
930.00	10640.00	25535.00	9160.00	27290.00	10920.00	27730.00	11720.00	27930.00	11720.00	27930.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A335-P2		A335-P5,B,C		A335-GR-P9		A335-GR-P11		A335-GR-P22	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
940.00	9920.00	25355.00	8580.00	27145.00	10760.00	27690.00	11360.00	27840.00	11360.00	27840.00
950.00	9200.00	25175.00	8000.00	27000.00	10600.00	27650.00	11000.00	27750.00	11000.00	27750.00
960.00	8540.00	25010.00	7560.00	26890.00	9960.00	27490.00	10360.00	27590.00	10360.00	27590.00
970.00	7880.00	24845.00	7120.00	26780.00	9320.00	27330.00	9720.00	27430.00	9720.00	27430.00
980.00	7220.00	24680.00	6680.00	26670.00	8680.00	27170.00	9080.00	27270.00	9080.00	27270.00
990.00	6560.00	24515.00	6240.00	26560.00	8040.00	27010.00	8440.00	27110.00	8440.00	27110.00
1000.00	5900.00	24350.00	5800.00	26450.00	7400.00	26850.00	7800.00	26950.00	7800.00	26950.00
1010.00	0.00	0.00	5480.00	26370.00	6920.00	26730.00	7340.00	26835.00	7400.00	26850.00
1020.00	0.00	0.00	5160.00	26290.00	6440.00	26610.00	6880.00	26720.00	7000.00	26750.00
1030.00	0.00	0.00	4840.00	26210.00	5960.00	26490.00	6420.00	26605.00	6600.00	26650.00
1040.00	0.00	0.00	4520.00	26130.00	5480.00	26370.00	5960.00	26490.00	6200.00	26550.00
1050.00	0.00	0.00	4200.00	26050.00	5000.00	26250.00	5500.00	26375.00	5800.00	26450.00
1060.00	0.00	0.00	3940.00	25985.00	4660.00	26165.00	5200.00	26300.00	5480.00	26370.00
1070.00	0.00	0.00	3680.00	25920.00	4320.00	26080.00	4900.00	26225.00	5160.00	26290.00
1080.00	0.00	0.00	3420.00	25855.00	3980.00	25995.00	4600.00	26150.00	4840.00	26210.00
1090.00	0.00	0.00	3160.00	25790.00	3640.00	25910.00	4300.00	26075.00	4520.00	26130.00
1100.00	0.00	0.00	2900.00	25725.00	3300.00	25825.00	4000.00	26000.00	4200.00	26050.00
1110.00	0.00	0.00	2720.00	25680.00	3080.00	25770.00	3700.00	25925.00	3960.00	25990.00
1120.00	0.00	0.00	2540.00	25635.00	2860.00	25715.00	3400.00	25850.00	3720.00	25930.00
1130.00	0.00	0.00	2360.00	25590.00	2640.00	25660.00	3100.00	25775.00	3480.00	25870.00
1140.00	0.00	0.00	2180.00	25545.00	2420.00	25605.00	2800.00	25700.00	3240.00	25810.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A335-P2		A335-P5,B,C		A335-GR-P9		A335-GR-P11		A335-GR-P22	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
1150.00	0.00	0.00	2000.00	25500.00	2200.00	25550.00	2500.00	25625.00	3000.00	25750.00
1160.00	0.00	0.00	1860.00	25465.00	2060.00	25515.00	2240.00	25560.00	2800.00	25700.00
1170.00	0.00	0.00	1720.00	25430.00	1920.00	25480.00	1980.00	25495.00	2600.00	25650.00
1180.00	0.00	0.00	1580.00	25395.00	1780.00	25445.00	1720.00	25430.00	2400.00	25600.00
1190.00	0.00	0.00	1440.00	25360.00	1640.00	25410.00	1460.00	25365.00	2200.00	25550.00
1200.00	0.00	0.00	1300.00	25325.00	1500.00	25375.00	1200.00	25300.00	2000.00	25500.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP304		A312-TP304L		A312-TP316		A312-TP316L		A312-TP317	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
100.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
110.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
120.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
130.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
140.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
150.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
160.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
170.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
180.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
190.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
200.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
210.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
220.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
230.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
240.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
250.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
260.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
270.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
280.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
290.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00
300.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00	16700.00	25050.00	20000.00	30000.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP304		A312-TP304L		A312-TP316		A312-TP316L		A312-TP317	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
310.00	19870.00	29967.50	16610.00	25027.50	19930.00	29982.50	16580.00	25020.00	19930.00	29982.50
320.00	19740.00	29935.00	16520.00	25005.00	19860.00	29965.00	16460.00	24990.00	19860.00	29965.00
330.00	19610.00	29902.50	16430.00	24982.50	19790.00	29947.50	16340.00	24960.00	19790.00	29947.50
340.00	19480.00	29870.00	16340.00	24960.00	19720.00	29930.00	16220.00	24930.00	19720.00	29930.00
350.00	19350.00	29837.50	16250.00	24937.50	19650.00	29912.50	16100.00	24900.00	19650.00	29912.50
360.00	19220.00	29805.00	16160.00	24915.00	19580.00	29895.00	15980.00	24870.00	19580.00	29895.00
370.00	19090.00	29772.50	16070.00	24892.50	19510.00	29877.50	15860.00	24840.00	19510.00	29877.50
380.00	18960.00	29740.00	15980.00	24870.00	19440.00	29860.00	15740.00	24810.00	19440.00	29860.00
390.00	18830.00	29707.50	15890.00	24847.50	19370.00	29842.50	15620.00	24780.00	19370.00	29842.50
400.00	18700.00	29675.00	15800.00	24825.00	19300.00	29825.00	15500.00	24750.00	19300.00	29825.00
410.00	18580.00	29645.00	15700.00	24800.00	19160.00	29790.00	15390.00	24722.50	19160.00	29790.00
420.00	18460.00	29615.00	15600.00	24775.00	19020.00	29755.00	15280.00	24695.00	19020.00	29755.00
430.00	18340.00	29585.00	15500.00	24750.00	18880.00	29720.00	15170.00	24667.50	18880.00	29720.00
440.00	18220.00	29555.00	15400.00	24725.00	18740.00	29685.00	15060.00	24640.00	18740.00	29685.00
450.00	18100.00	29525.00	15300.00	24700.00	18600.00	29650.00	14950.00	24612.50	18600.00	29650.00
460.00	17980.00	29495.00	15200.00	24675.00	18460.00	29615.00	14840.00	24585.00	18460.00	29615.00
470.00	17860.00	29465.00	15100.00	24650.00	18320.00	29580.00	14730.00	24557.50	18320.00	29580.00
480.00	17740.00	29435.00	15000.00	24625.00	18180.00	29545.00	14620.00	24530.00	18180.00	29545.00
490.00	17620.00	29405.00	14900.00	24600.00	18040.00	29510.00	14510.00	24502.50	18040.00	29510.00
500.00	17500.00	29375.00	14800.00	24575.00	17900.00	29475.00	14400.00	24475.00	17900.00	29475.00
510.00	17390.00	29347.50	14720.00	24555.00	17810.00	29452.50	14310.00	24452.50	17810.00	29452.50

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

$$S(A)=F*(1.25*S(C)+0.25*S(H)) \quad , \quad F=1$$

MATERIAL	A312-TP304		A312-TP304L		A312-TP316		A312-TP316L		A312-TP317	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
520.00	17280.00	29320.00	14640.00	24535.00	17720.00	29430.00	14220.00	24430.00	17720.00	29430.00
530.00	17170.00	29292.50	14560.00	24515.00	17630.00	29407.50	14130.00	24407.50	17630.00	29407.50
540.00	17060.00	29265.00	14480.00	24495.00	17540.00	29385.00	14040.00	24385.00	17540.00	29385.00
550.00	16950.00	29237.50	14400.00	24475.00	17450.00	29362.50	13950.00	24362.50	17450.00	29362.50
560.00	16840.00	29210.00	14320.00	24455.00	17360.00	29340.00	13860.00	24340.00	17360.00	29340.00
570.00	16730.00	29182.50	14240.00	24435.00	17270.00	29317.50	13770.00	24317.50	17270.00	29317.50
580.00	16620.00	29155.00	14160.00	24415.00	17180.00	29295.00	13680.00	24295.00	17180.00	29295.00
590.00	16510.00	29127.50	14080.00	24395.00	17090.00	29272.50	13590.00	24272.50	17090.00	29272.50
600.00	16400.00	29100.00	14000.00	24375.00	17000.00	29250.00	13500.00	24250.00	17000.00	29250.00
610.00	16360.00	29090.00	13940.00	24360.00	16940.00	29235.00	13440.00	24235.00	16940.00	29235.00
620.00	16320.00	29080.00	13880.00	24345.00	16880.00	29220.00	13380.00	24220.00	16880.00	29220.00
630.00	16280.00	29070.00	13820.00	24330.00	16820.00	29205.00	13320.00	24205.00	16820.00	29205.00
640.00	16240.00	29060.00	13760.00	24315.00	16760.00	29190.00	13260.00	24190.00	16760.00	29190.00
650.00	16200.00	29050.00	13700.00	24300.00	16700.00	29175.00	13200.00	24175.00	16700.00	29175.00
660.00	16160.00	29040.00	13660.00	24290.00	16620.00	29155.00	13140.00	24160.00	16620.00	29155.00
670.00	16120.00	29030.00	13620.00	24280.00	16540.00	29135.00	13080.00	24145.00	16540.00	29135.00
680.00	16080.00	29020.00	13580.00	24270.00	16460.00	29115.00	13020.00	24130.00	16460.00	29115.00
690.00	16040.00	29010.00	13540.00	24260.00	16380.00	29095.00	12960.00	24115.00	16380.00	29095.00
700.00	16000.00	29000.00	13500.00	24250.00	16300.00	29075.00	12900.00	24100.00	16300.00	29075.00
710.00	15920.00	28980.00	13460.00	24240.00	16260.00	29065.00	12840.00	24085.00	16260.00	29065.00
720.00	15840.00	28960.00	13420.00	24230.00	16220.00	29055.00	12780.00	24070.00	16220.00	29055.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP304		A312-TP304L		A312-TP316		A312-TP316L		A312-TP317	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
730.00	15760.00	28940.00	13380.00	24220.00	16180.00	29045.00	12720.00	24055.00	16180.00	29045.00
740.00	15680.00	28920.00	13340.00	24210.00	16140.00	29035.00	12660.00	24040.00	16140.00	29035.00
750.00	15600.00	28900.00	13300.00	24200.00	16100.00	29025.00	12600.00	24025.00	16100.00	29025.00
760.00	15520.00	28880.00	13240.00	24185.00	16060.00	29015.00	12560.00	24015.00	16060.00	29015.00
770.00	15440.00	28860.00	13180.00	24170.00	16020.00	29005.00	12520.00	24005.00	16020.00	29005.00
780.00	15360.00	28840.00	13120.00	24155.00	15980.00	28995.00	12480.00	23995.00	15980.00	28995.00
790.00	15280.00	28820.00	13060.00	24140.00	15940.00	28985.00	12440.00	23985.00	15940.00	28985.00
800.00	15200.00	28800.00	13000.00	24125.00	15900.00	28975.00	12400.00	23975.00	15900.00	28975.00
810.00	15140.00	28785.00	12960.00	24115.00	15860.00	28965.00	12340.00	23960.00	15860.00	28965.00
820.00	15080.00	28770.00	12920.00	24105.00	15820.00	28955.00	12280.00	23945.00	15820.00	28955.00
830.00	15020.00	28755.00	12880.00	24095.00	15780.00	28945.00	12220.00	23930.00	15780.00	28945.00
840.00	14960.00	28740.00	12840.00	24085.00	15740.00	28935.00	12160.00	23915.00	15740.00	28935.00
850.00	14900.00	28725.00	12800.00	24075.00	15700.00	28925.00	12100.00	23900.00	15700.00	28925.00
860.00	14840.00	28710.00	12620.00	24030.00	15660.00	28915.00	12040.00	23885.00	15660.00	28915.00
870.00	14780.00	28695.00	12440.00	23985.00	15620.00	28905.00	11980.00	23870.00	15620.00	28905.00
880.00	14720.00	28680.00	12260.00	23940.00	15580.00	28895.00	11920.00	23855.00	15580.00	28895.00
890.00	14660.00	28665.00	12080.00	23895.00	15540.00	28885.00	11860.00	23840.00	15540.00	28885.00
900.00	14600.00	28650.00	11900.00	23850.00	15500.00	28875.00	11800.00	23825.00	15500.00	28875.00
910.00	14560.00	28640.00	11500.00	23750.00	15480.00	28870.00	11740.00	23810.00	15480.00	28870.00
920.00	14520.00	28630.00	11100.00	23650.00	15460.00	28865.00	11680.00	23795.00	15460.00	28865.00
930.00	14480.00	28620.00	10700.00	23550.00	15440.00	28860.00	11620.00	23780.00	15440.00	28860.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

$S(A)=F*(1.25*S(C)+0.25*S(H))$, F=1

MATERIAL	A312-TP304		A312-TP304L		A312-TP316		A312-TP316L		A312-TP317	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
940.00	14440.00	28610.00	10300.00	23450.00	15420.00	28855.00	11560.00	23765.00	15420.00	28855.00
950.00	14400.00	28600.00	9900.00	23350.00	15400.00	28850.00	11500.00	23750.00	15400.00	28850.00
960.00	14280.00	28570.00	9480.00	23245.00	15380.00	28845.00	11440.00	23735.00	15380.00	28845.00
970.00	14160.00	28540.00	9060.00	23140.00	15360.00	28840.00	11380.00	23720.00	15360.00	28840.00
980.00	14040.00	28510.00	8640.00	23035.00	15340.00	28835.00	11320.00	23705.00	15340.00	28835.00
990.00	13920.00	28480.00	8220.00	22930.00	15320.00	28830.00	11260.00	23690.00	15320.00	28830.00
1000.00	13800.00	28450.00	7800.00	22825.00	15300.00	28825.00	11200.00	23675.00	15300.00	28825.00
1010.00	13480.00	28370.00	7500.00	22750.00	15140.00	28785.00	11120.00	23655.00	15140.00	28785.00
1020.00	13160.00	28290.00	7200.00	22675.00	14980.00	28745.00	11040.00	23635.00	14980.00	28745.00
1030.00	12840.00	28210.00	6900.00	22600.00	14820.00	28705.00	10960.00	23615.00	14820.00	28705.00
1040.00	12520.00	28130.00	6600.00	22525.00	14660.00	28665.00	10880.00	23595.00	14660.00	28665.00
1050.00	12200.00	28050.00	6300.00	22450.00	14500.00	28625.00	10800.00	23575.00	14500.00	28625.00
1060.00	11700.00	27925.00	6060.00	22390.00	14080.00	28520.00	10680.00	23545.00	14080.00	28520.00
1070.00	11200.00	27800.00	5820.00	22330.00	13660.00	28415.00	10560.00	23515.00	13660.00	28415.00
1080.00	10700.00	27675.00	5580.00	22270.00	13240.00	28310.00	10440.00	23485.00	13240.00	28310.00
1090.00	10200.00	27550.00	5340.00	22210.00	12820.00	28205.00	10320.00	23455.00	12820.00	28205.00
1100.00	9700.00	27425.00	5100.00	22150.00	12400.00	28100.00	10200.00	23425.00	12400.00	28100.00
1110.00	9300.00	27325.00	4880.00	22095.00	11880.00	27970.00	9920.00	23355.00	11880.00	27970.00
1120.00	8900.00	27225.00	4660.00	22040.00	11360.00	27840.00	9640.00	23285.00	11360.00	27840.00
1130.00	8500.00	27125.00	4440.00	21985.00	10840.00	27710.00	9360.00	23215.00	10840.00	27710.00
1140.00	8100.00	27025.00	4220.00	21930.00	10320.00	27580.00	9080.00	23145.00	10320.00	27580.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP304		A312-TP304L		A312-TP316		A312-TP316L		A312-TP317	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
1150.00	7700.00	26925.00	4000.00	21875.00	9800.00	27450.00	8800.00	23075.00	9800.00	27450.00
1160.00	7360.00	26840.00	3840.00	21835.00	9320.00	27330.00	8320.00	22955.00	9320.00	27330.00
1170.00	7020.00	26755.00	3680.00	21795.00	8840.00	27210.00	7840.00	22835.00	8840.00	27210.00
1180.00	6680.00	26670.00	3520.00	21755.00	8360.00	27090.00	7360.00	22715.00	8360.00	27090.00
1190.00	6340.00	26585.00	3360.00	21715.00	7880.00	26970.00	6880.00	22595.00	7880.00	26970.00
1200.00	6000.00	26500.00	3200.00	21675.00	7400.00	26850.00	6400.00	22475.00	7400.00	26850.00
1210.00	5740.00	26435.00	3080.00	21645.00	7020.00	26755.00	6060.00	22390.00	7020.00	26755.00
1220.00	5480.00	26370.00	2960.00	21615.00	6640.00	26660.00	5720.00	22305.00	6640.00	26660.00
1230.00	5220.00	26305.00	2840.00	21585.00	6260.00	26565.00	5380.00	22220.00	6260.00	26565.00
1240.00	4960.00	26240.00	2720.00	21555.00	5880.00	26470.00	5040.00	22135.00	5880.00	26470.00
1250.00	4700.00	26175.00	2600.00	21525.00	5500.00	26375.00	4700.00	22050.00	5500.00	26375.00
1260.00	4500.00	26125.00	2500.00	21500.00	5220.00	26305.00	4460.00	21990.00	5220.00	26305.00
1270.00	4300.00	26075.00	2400.00	21475.00	4940.00	26235.00	4220.00	21930.00	4940.00	26235.00
1280.00	4100.00	26025.00	2300.00	21450.00	4660.00	26165.00	3980.00	21870.00	4660.00	26165.00
1290.00	3900.00	25975.00	2200.00	21425.00	4380.00	26095.00	3740.00	21810.00	4380.00	26095.00
1300.00	3700.00	25925.00	2100.00	21400.00	4100.00	26025.00	3500.00	21750.00	4100.00	26025.00
1310.00	3540.00	25885.00	2020.00	21380.00	3900.00	25975.00	3300.00	21700.00	3900.00	25975.00
1320.00	3380.00	25845.00	1940.00	21360.00	3700.00	25925.00	3100.00	21650.00	3700.00	25925.00
1330.00	3220.00	25805.00	1860.00	21340.00	3500.00	25875.00	2900.00	21600.00	3500.00	25875.00
1340.00	3060.00	25765.00	1780.00	21320.00	3300.00	25825.00	2700.00	21550.00	3300.00	25825.00
1350.00	2900.00	25725.00	1700.00	21300.00	3100.00	25775.00	2500.00	21500.00	3100.00	25775.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP304		A312-TP304L		A312-TP316		A312-TP316L		A312-TP317	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
1360.00	2780.00	25695.00	1580.00	21270.00	2940.00	25735.00	2360.00	21465.00	2940.00	25735.00
1370.00	2660.00	25665.00	1460.00	21240.00	2780.00	25695.00	2220.00	21430.00	2780.00	25695.00
1380.00	2540.00	25635.00	1340.00	21210.00	2620.00	25655.00	2080.00	21395.00	2620.00	25655.00
1390.00	2420.00	25605.00	1220.00	21180.00	2460.00	25615.00	1940.00	21360.00	2460.00	25615.00
1400.00	2300.00	25575.00	1100.00	21150.00	2300.00	25575.00	1800.00	21325.00	2300.00	25575.00
1410.00	2200.00	25550.00	1080.00	21145.00	2180.00	25545.00	1700.00	21300.00	2180.00	25545.00
1420.00	2100.00	25525.00	1060.00	21140.00	2060.00	25515.00	1600.00	21275.00	2060.00	25515.00
1430.00	2000.00	25500.00	1040.00	21135.00	1940.00	25485.00	1500.00	21250.00	1940.00	25485.00
1440.00	1900.00	25475.00	1020.00	21130.00	1820.00	25455.00	1400.00	21225.00	1820.00	25455.00
1450.00	1800.00	25450.00	1000.00	21125.00	1700.00	25425.00	1300.00	21200.00	1700.00	25425.00
1460.00	1720.00	25430.00	980.00	21120.00	1620.00	25405.00	1240.00	21185.00	1620.00	25405.00
1470.00	1640.00	25410.00	960.00	21115.00	1540.00	25385.00	1180.00	21170.00	1540.00	25385.00
1480.00	1560.00	25390.00	940.00	21110.00	1460.00	25365.00	1120.00	21155.00	1460.00	25365.00
1490.00	1480.00	25370.00	920.00	21105.00	1380.00	25345.00	1060.00	21140.00	1380.00	25345.00
1500.00	1400.00	25350.00	900.00	21100.00	1300.00	25325.00	1000.00	21125.00	1300.00	25325.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP321		A312-TP347		A376- TP304		A376- TP316		A376-TP321	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
100.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
110.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
120.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
130.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
140.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
150.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
160.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
170.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
180.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
190.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
200.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
210.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
220.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
230.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
240.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
250.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
260.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
270.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
280.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
290.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00
300.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00	20000.00	30000.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP321		A312-TP347		A376- TP304		A376- TP316		A376-TP321	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
310.00	19860.00	29965.00	20000.00	30000.00	19870.00	29967.50	19930.00	29982.50	19860.00	29965.00
320.00	19720.00	29930.00	20000.00	30000.00	19740.00	29935.00	19860.00	29965.00	19720.00	29930.00
330.00	19580.00	29895.00	20000.00	30000.00	19610.00	29902.50	19790.00	29947.50	19580.00	29895.00
340.00	19440.00	29860.00	20000.00	30000.00	19480.00	29870.00	19720.00	29930.00	19440.00	29860.00
350.00	19300.00	29825.00	20000.00	30000.00	19350.00	29837.50	19650.00	29912.50	19300.00	29825.00
360.00	19160.00	29790.00	20000.00	30000.00	19220.00	29805.00	19580.00	29895.00	19160.00	29790.00
370.00	19020.00	29755.00	20000.00	30000.00	19090.00	29772.50	19510.00	29877.50	19020.00	29755.00
380.00	18880.00	29720.00	20000.00	30000.00	18960.00	29740.00	19440.00	29860.00	18880.00	29720.00
390.00	18740.00	29685.00	20000.00	30000.00	18830.00	29707.50	19370.00	29842.50	18740.00	29685.00
400.00	18600.00	29650.00	20000.00	30000.00	18700.00	29675.00	19300.00	29825.00	18600.00	29650.00
410.00	18470.00	29617.50	19990.00	29997.50	18580.00	29645.00	19160.00	29790.00	18470.00	29617.50
420.00	18340.00	29585.00	19980.00	29995.00	18460.00	29615.00	19020.00	29755.00	18340.00	29585.00
430.00	18210.00	29552.50	19970.00	29992.50	18340.00	29585.00	18880.00	29720.00	18210.00	29552.50
440.00	18080.00	29520.00	19960.00	29990.00	18220.00	29555.00	18740.00	29685.00	18080.00	29520.00
450.00	17950.00	29487.50	19950.00	29987.50	18100.00	29525.00	18600.00	29650.00	17950.00	29487.50
460.00	17820.00	29455.00	19940.00	29985.00	17980.00	29495.00	18460.00	29615.00	17820.00	29455.00
470.00	17690.00	29422.50	19930.00	29982.50	17860.00	29465.00	18320.00	29580.00	17690.00	29422.50
480.00	17560.00	29390.00	19920.00	29980.00	17740.00	29435.00	18180.00	29545.00	17560.00	29390.00
490.00	17430.00	29357.50	19910.00	29977.50	17620.00	29405.00	18040.00	29510.00	17430.00	29357.50
500.00	17300.00	29325.00	19900.00	29975.00	17500.00	29375.00	17900.00	29475.00	17300.00	29325.00
510.00	17210.00	29302.50	19840.00	29960.00	17390.00	29347.50	17810.00	29452.50	17210.00	29302.50

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP321		A312-TP347		A376- TP304		A376- TP316		A376-TP321	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
520.00	17120.00	29280.00	19780.00	29945.00	17280.00	29320.00	17720.00	29430.00	17120.00	29280.00
530.00	17030.00	29257.50	19720.00	29930.00	17170.00	29292.50	17630.00	29407.50	17030.00	29257.50
540.00	16940.00	29235.00	19660.00	29915.00	17060.00	29265.00	17540.00	29385.00	16940.00	29235.00
550.00	16850.00	29212.50	19600.00	29900.00	16950.00	29237.50	17450.00	29362.50	16850.00	29212.50
560.00	16760.00	29190.00	19540.00	29885.00	16840.00	29210.00	17360.00	29340.00	16760.00	29190.00
570.00	16670.00	29167.50	19480.00	29870.00	16730.00	29182.50	17270.00	29317.50	16670.00	29167.50
580.00	16580.00	29145.00	19420.00	29855.00	16620.00	29155.00	17180.00	29295.00	16580.00	29145.00
590.00	16490.00	29122.50	19360.00	29840.00	16510.00	29127.50	17090.00	29272.50	16490.00	29122.50
600.00	16400.00	29100.00	19300.00	29825.00	16400.00	29100.00	17000.00	29250.00	16400.00	29100.00
610.00	16340.00	29085.00	19240.00	29810.00	16360.00	29090.00	16940.00	29235.00	16340.00	29085.00
620.00	16280.00	29070.00	19180.00	29795.00	16320.00	29080.00	16880.00	29220.00	16280.00	29070.00
630.00	16220.00	29055.00	19120.00	29780.00	16280.00	29070.00	16820.00	29205.00	16220.00	29055.00
640.00	16160.00	29040.00	19060.00	29765.00	16240.00	29060.00	16760.00	29190.00	16160.00	29040.00
650.00	16100.00	29025.00	19000.00	29750.00	16200.00	29050.00	16700.00	29175.00	16100.00	29025.00
660.00	16040.00	29010.00	18920.00	29730.00	16160.00	29040.00	16620.00	29155.00	16040.00	29010.00
670.00	15980.00	28995.00	18840.00	29710.00	16120.00	29030.00	16540.00	29135.00	15980.00	28995.00
680.00	15920.00	28980.00	18760.00	29690.00	16080.00	29020.00	16460.00	29115.00	15920.00	28980.00
690.00	15860.00	28965.00	18680.00	29670.00	16040.00	29010.00	16380.00	29095.00	15860.00	28965.00
700.00	15800.00	28950.00	18600.00	29650.00	16000.00	29000.00	16300.00	29075.00	15800.00	28950.00
710.00	15780.00	28945.00	18580.00	29645.00	15920.00	28980.00	16250.00	29062.50	15780.00	28945.00
720.00	15760.00	28940.00	18560.00	29640.00	15840.00	28960.00	16200.00	29050.00	15760.00	28940.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
'**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP321		A312-TP347		A376- TP304		A376- TP316		A376-TP321	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
730.00	15740.00	28935.00	18540.00	29635.00	15760.00	28940.00	16150.00	29037.50	15740.00	28935.00
740.00	15720.00	28930.00	18520.00	29630.00	15680.00	28920.00	16100.00	29025.00	15720.00	28930.00
750.00	15700.00	28925.00	18500.00	29625.00	15600.00	28900.00	16050.00	29012.50	15700.00	28925.00
760.00	15660.00	28915.00	18460.00	29615.00	15520.00	28880.00	16020.00	29005.00	15660.00	28915.00
770.00	15620.00	28905.00	18420.00	29605.00	15440.00	28860.00	15990.00	28997.50	15620.00	28905.00
780.00	15580.00	28895.00	18380.00	29595.00	15360.00	28840.00	15960.00	28990.00	15580.00	28895.00
790.00	15540.00	28885.00	18340.00	29585.00	15280.00	28820.00	15930.00	28982.50	15540.00	28885.00
800.00	15500.00	28875.00	18300.00	29575.00	15200.00	28800.00	15900.00	28975.00	15500.00	28875.00
810.00	15470.00	28867.50	17720.00	29430.00	15140.00	28785.00	15860.00	28965.00	15460.00	28865.00
820.00	15440.00	28860.00	17140.00	29285.00	15080.00	28770.00	15820.00	28955.00	15420.00	28855.00
830.00	15410.00	28852.50	16560.00	29140.00	15020.00	28755.00	15780.00	28945.00	15380.00	28845.00
840.00	15380.00	28845.00	15980.00	28995.00	14960.00	28740.00	15740.00	28935.00	15340.00	28835.00
850.00	15350.00	28837.50	15400.00	28850.00	14900.00	28725.00	15700.00	28925.00	15300.00	28825.00
860.00	15340.00	28835.00	15300.00	28825.00	14840.00	28710.00	15660.00	28915.00	15280.00	28820.00
870.00	15330.00	28832.50	15200.00	28800.00	14780.00	28695.00	15620.00	28905.00	15260.00	28815.00
880.00	15320.00	28830.00	15100.00	28775.00	14720.00	28680.00	15580.00	28895.00	15240.00	28810.00
890.00	15310.00	28827.50	15000.00	28750.00	14660.00	28665.00	15540.00	28885.00	15220.00	28805.00
900.00	15300.00	28825.00	14900.00	28725.00	14600.00	28650.00	15500.00	28875.00	15200.00	28800.00
910.00	15270.00	28817.50	14880.00	28720.00	14560.00	28640.00	15480.00	28870.00	15180.00	28795.00
920.00	15240.00	28810.00	14860.00	28715.00	14520.00	28630.00	15460.00	28865.00	15160.00	28790.00
930.00	15210.00	28802.50	14840.00	28710.00	14480.00	28620.00	15440.00	28860.00	15140.00	28785.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP321		A312-TP347		A376- TP304		A376- TP316		A376-TP321	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
940.00	15180.00	28795.00	14820.00	28705.00	14440.00	28610.00	15420.00	28855.00	15120.00	28780.00
950.00	15150.00	28787.50	14800.00	28700.00	14400.00	28600.00	15400.00	28850.00	15100.00	28775.00
960.00	14880.00	28720.00	14640.00	28660.00	14280.00	28570.00	15380.00	28845.00	14840.00	28710.00
970.00	14610.00	28652.50	14480.00	28620.00	14160.00	28540.00	15360.00	28840.00	14580.00	28645.00
980.00	14340.00	28585.00	14320.00	28580.00	14040.00	28510.00	15340.00	28835.00	14320.00	28580.00
990.00	14070.00	28517.50	14160.00	28540.00	13920.00	28480.00	15320.00	28830.00	14060.00	28515.00
1000.00	13800.00	28450.00	14000.00	28500.00	13800.00	28450.00	15300.00	28825.00	13800.00	28450.00
1010.00	12960.00	28240.00	13620.00	28405.00	13480.00	28370.00	15140.00	28785.00	12960.00	28240.00
1020.00	12120.00	28030.00	13240.00	28310.00	13160.00	28290.00	14980.00	28745.00	12120.00	28030.00
1030.00	11280.00	27820.00	12860.00	28215.00	12840.00	28210.00	14820.00	28705.00	11280.00	27820.00
1040.00	10440.00	27610.00	12480.00	28120.00	12520.00	28130.00	14660.00	28665.00	10440.00	27610.00
1050.00	9600.00	27400.00	12100.00	28025.00	12200.00	28050.00	14500.00	28625.00	9600.00	27400.00
1060.00	9060.00	27265.00	11500.00	27875.00	11700.00	27925.00	14080.00	28520.00	9060.00	27265.00
1070.00	8520.00	27130.00	10900.00	27725.00	11200.00	27800.00	13660.00	28415.00	8520.00	27130.00
1080.00	7980.00	26995.00	10300.00	27575.00	10700.00	27675.00	13240.00	28310.00	7980.00	26995.00
1090.00	7440.00	26860.00	9700.00	27425.00	10200.00	27550.00	12820.00	28205.00	7440.00	26860.00
1100.00	6900.00	26725.00	9100.00	27275.00	9700.00	27425.00	12400.00	28100.00	6900.00	26725.00
1110.00	6520.00	26630.00	8500.00	27125.00	9300.00	27325.00	11880.00	27970.00	6520.00	26630.00
1120.00	6140.00	26535.00	7900.00	26975.00	8900.00	27225.00	11360.00	27840.00	6140.00	26535.00
1130.00	5760.00	26440.00	7300.00	26825.00	8500.00	27125.00	10840.00	27710.00	5760.00	26440.00
1140.00	5380.00	26345.00	6700.00	26675.00	8100.00	27025.00	10320.00	27580.00	5380.00	26345.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP321		A312-TP347		A376- TP304		A376- TP316		A376-TP321	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
1150.00	5000.00	26250.00	6100.00	26525.00	7700.00	26925.00	9800.00	27450.00	5000.00	26250.00
1160.00	4720.00	26180.00	5760.00	26440.00	7360.00	26840.00	9320.00	27330.00	4720.00	26180.00
1170.00	4440.00	26110.00	5420.00	26355.00	7020.00	26755.00	8840.00	27210.00	4440.00	26110.00
1180.00	4160.00	26040.00	5080.00	26270.00	6680.00	26670.00	8360.00	27090.00	4160.00	26040.00
1190.00	3880.00	25970.00	4740.00	26185.00	6340.00	26585.00	7880.00	26970.00	3880.00	25970.00
1200.00	3600.00	25900.00	4400.00	26100.00	6000.00	26500.00	7400.00	26850.00	3600.00	25900.00
1210.00	3400.00	25850.00	4180.00	26045.00	5740.00	26435.00	7020.00	26755.00	3340.00	25835.00
1220.00	3200.00	25800.00	3960.00	25990.00	5480.00	26370.00	6640.00	26660.00	3080.00	25770.00
1230.00	3000.00	25750.00	3740.00	25935.00	5220.00	26305.00	6260.00	26565.00	2820.00	25705.00
1240.00	2800.00	25700.00	3520.00	25880.00	4960.00	26240.00	5880.00	26470.00	2560.00	25640.00
1250.00	2600.00	25650.00	3300.00	25825.00	4700.00	26175.00	5500.00	26375.00	2300.00	25575.00
1260.00	2420.00	25605.00	3080.00	25770.00	4500.00	26125.00	5220.00	26305.00	2180.00	25545.00
1270.00	2240.00	25560.00	2860.00	25715.00	4300.00	26075.00	4940.00	26235.00	2060.00	25515.00
1280.00	2060.00	25515.00	2640.00	25660.00	4100.00	26025.00	4660.00	26165.00	1940.00	25485.00
1290.00	1880.00	25470.00	2420.00	25605.00	3900.00	25975.00	4380.00	26095.00	1820.00	25455.00
1300.00	1700.00	25425.00	2200.00	25550.00	3700.00	25925.00	4100.00	26025.00	1700.00	25425.00
1310.00	1580.00	25395.00	2060.00	25515.00	3540.00	25885.00	3900.00	25975.00	1580.00	25395.00
1320.00	1460.00	25365.00	1920.00	25480.00	3380.00	25845.00	3700.00	25925.00	1460.00	25365.00
1330.00	1340.00	25335.00	1780.00	25445.00	3220.00	25805.00	3500.00	25875.00	1340.00	25335.00
1340.00	1220.00	25305.00	1640.00	25410.00	3060.00	25765.00	3300.00	25825.00	1220.00	25305.00
1350.00	1100.00	25275.00	1500.00	25375.00	2900.00	25725.00	3100.00	25775.00	1100.00	25275.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A312-TP321		A312-TP347		A376- TP304		A376- TP316		A376-TP321	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
1360.00	1040.00	25260.00	1440.00	25360.00	2780.00	25695.00	2940.00	25735.00	1040.00	25260.00
1370.00	980.00	25245.00	1380.00	25345.00	2660.00	25665.00	2780.00	25695.00	980.00	25245.00
1380.00	920.00	25230.00	1320.00	25330.00	2540.00	25635.00	2620.00	25655.00	920.00	25230.00
1390.00	860.00	25215.00	1260.00	25315.00	2420.00	25605.00	2460.00	25615.00	860.00	25215.00
1400.00	800.00	25200.00	1200.00	25300.00	2300.00	25575.00	2300.00	25575.00	800.00	25200.00
1410.00	740.00	25185.00	1140.00	25285.00	2200.00	25550.00	2180.00	25545.00	740.00	25185.00
1420.00	680.00	25170.00	1080.00	25270.00	2100.00	25525.00	2060.00	25515.00	680.00	25170.00
1430.00	620.00	25155.00	1020.00	25255.00	2000.00	25500.00	1940.00	25485.00	620.00	25155.00
1440.00	560.00	25140.00	960.00	25240.00	1900.00	25475.00	1820.00	25455.00	560.00	25140.00
1450.00	500.00	25125.00	900.00	25225.00	1800.00	25450.00	1700.00	25425.00	500.00	25125.00
1460.00	460.00	25115.00	880.00	25220.00	1720.00	25430.00	1620.00	25405.00	460.00	25115.00
1470.00	420.00	25105.00	860.00	25215.00	1640.00	25410.00	1540.00	25385.00	420.00	25105.00
1480.00	380.00	25095.00	840.00	25210.00	1560.00	25390.00	1460.00	25365.00	380.00	25095.00
1490.00	340.00	25085.00	820.00	25205.00	1480.00	25370.00	1380.00	25345.00	340.00	25085.00
1500.00	300.00	25075.00	800.00	25200.00	1400.00	25350.00	1300.00	25325.00	300.00	25075.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A358---304		COPPER-B42-D		RED-BRAS-B43		NICKELB161#5		NICKELB161)5	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
100.00	17000.00	25500.00	15000.00	22500.00	8000.00	12000.00	8000.00	12000.00	6700.00	10050.00
110.00	17000.00	25500.00	14620.00	22405.00	8000.00	12000.00	7970.00	11992.50	6670.00	10042.50
120.00	17000.00	25500.00	14240.00	22310.00	8000.00	12000.00	7940.00	11985.00	6640.00	10035.00
130.00	17000.00	25500.00	13860.00	22215.00	8000.00	12000.00	7910.00	11977.50	6610.00	10027.50
140.00	17000.00	25500.00	13480.00	22120.00	8000.00	12000.00	7880.00	11970.00	6580.00	10020.00
150.00	17000.00	25500.00	13100.00	22025.00	8000.00	12000.00	7850.00	11962.50	6550.00	10012.50
160.00	17000.00	25500.00	12720.00	21930.00	8000.00	12000.00	7820.00	11955.00	6520.00	10005.00
170.00	17000.00	25500.00	12340.00	21835.00	8000.00	12000.00	7790.00	11947.50	6490.00	9997.50
180.00	17000.00	25500.00	11960.00	21740.00	8000.00	12000.00	7760.00	11940.00	6460.00	9990.00
190.00	17000.00	25500.00	11580.00	21645.00	8000.00	12000.00	7730.00	11932.50	6430.00	9982.50
200.00	17000.00	25500.00	11200.00	21550.00	8000.00	12000.00	7700.00	11925.00	6400.00	9975.00
210.00	17000.00	25500.00	11180.00	21545.00	8000.00	12000.00	7680.00	11920.00	6390.00	9972.50
220.00	17000.00	25500.00	11160.00	21540.00	8000.00	12000.00	7660.00	11915.00	6380.00	9970.00
230.00	17000.00	25500.00	11140.00	21535.00	8000.00	12000.00	7640.00	11910.00	6370.00	9967.50
240.00	17000.00	25500.00	11120.00	21530.00	8000.00	12000.00	7620.00	11905.00	6360.00	9965.00
250.00	17000.00	25500.00	11100.00	21525.00	8000.00	12000.00	7600.00	11900.00	6350.00	9962.50
260.00	17000.00	25500.00	11080.00	21520.00	8000.00	12000.00	7580.00	11895.00	6340.00	9960.00
270.00	17000.00	25500.00	11060.00	21515.00	8000.00	12000.00	7560.00	11890.00	6330.00	9957.50
280.00	17000.00	25500.00	11040.00	21510.00	8000.00	12000.00	7540.00	11885.00	6320.00	9955.00
290.00	17000.00	25500.00	11020.00	21505.00	8000.00	12000.00	7520.00	11880.00	6310.00	9952.50
300.00	17000.00	25500.00	11000.00	21500.00	8000.00	12000.00	7500.00	11875.00	6300.00	9950.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A358---304		COPPER-B42-D		RED-BRAS-B43		NICKELB161#5		NICKELB161)5	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
310.00	16890.00	25472.50	10320.00	21330.00	7700.00	11925.00	7500.00	11875.00	6290.00	9947.50
320.00	16780.00	25445.00	9640.00	21160.00	7400.00	11850.00	7500.00	11875.00	6280.00	9945.00
330.00	16670.00	25417.50	8960.00	20990.00	7100.00	11775.00	7500.00	11875.00	6270.00	9942.50
340.00	16560.00	25390.00	8280.00	20820.00	6800.00	11700.00	7500.00	11875.00	6260.00	9940.00
350.00	16450.00	25362.50	7600.00	20650.00	6500.00	11625.00	7500.00	11875.00	6250.00	9937.50
360.00	16340.00	25335.00	6920.00	20480.00	6200.00	11550.00	7500.00	11875.00	6240.00	9935.00
370.00	16230.00	25307.50	6240.00	20310.00	5900.00	11475.00	7500.00	11875.00	6230.00	9932.50
380.00	16120.00	25280.00	5560.00	20140.00	5600.00	11400.00	7500.00	11875.00	6220.00	9930.00
390.00	16010.00	25252.50	4880.00	19970.00	5300.00	11325.00	7500.00	11875.00	6210.00	9927.50
400.00	15900.00	25225.00	4200.00	19800.00	5000.00	11250.00	7500.00	11875.00	6200.00	9925.00
410.00	15790.00	25197.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
420.00	15680.00	25170.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
430.00	15570.00	25142.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
440.00	15460.00	25115.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
450.00	15350.00	25087.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
460.00	15240.00	25060.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
470.00	15130.00	25032.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
480.00	15020.00	25005.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
490.00	14910.00	24977.50	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
500.00	14800.00	24950.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
510.00	14720.00	24930.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A358---304		COPPER-B42-D		RED-BRAS-B43		NICKELB161#5		NICKELB161)5	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
520.00	14640.00	24910.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
530.00	14560.00	24890.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
540.00	14480.00	24870.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
550.00	14400.00	24850.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
560.00	14320.00	24830.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
570.00	14240.00	24810.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
580.00	14160.00	24790.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
590.00	14080.00	24770.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
600.00	14000.00	24750.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
610.00	13940.00	24735.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
620.00	13880.00	24720.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
630.00	13820.00	24705.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
640.00	13760.00	24690.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
650.00	13700.00	24675.00	0.00	0.00	0.00	0.00	7500.00	11875.00	6200.00	9925.00
660.00	13680.00	24670.00	0.00	0.00	0.00	0.00	7480.00	11870.00	6200.00	9925.00
670.00	13660.00	24665.00	0.00	0.00	0.00	0.00	7460.00	11865.00	6200.00	9925.00
680.00	13640.00	24660.00	0.00	0.00	0.00	0.00	7440.00	11860.00	6200.00	9925.00
690.00	13620.00	24655.00	0.00	0.00	0.00	0.00	7420.00	11855.00	6200.00	9925.00
700.00	13600.00	24650.00	0.00	0.00	0.00	0.00	7400.00	11850.00	6200.00	9925.00
710.00	13520.00	24630.00	0.00	0.00	0.00	0.00	7380.00	11845.00	6180.00	9920.00
720.00	13440.00	24610.00	0.00	0.00	0.00	0.00	7360.00	11840.00	6160.00	9915.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A358---304		COPPER-B42-D		RED-BRAS-B43		NICKELB161#5		NICKELB161)5	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
730.00	13360.00	24590.00	0.00	0.00	0.00	0.00	7340.00	11835.00	6140.00	9910.00
740.00	13280.00	24570.00	0.00	0.00	0.00	0.00	7320.00	11830.00	6120.00	9905.00
750.00	13200.00	24550.00	0.00	0.00	0.00	0.00	7300.00	11825.00	6100.00	9900.00
760.00	13140.00	24535.00	0.00	0.00	0.00	0.00	7280.00	11820.00	6060.00	9890.00
770.00	13080.00	24520.00	0.00	0.00	0.00	0.00	7260.00	11815.00	6020.00	9880.00
780.00	13020.00	24505.00	0.00	0.00	0.00	0.00	7240.00	11810.00	5980.00	9870.00
790.00	12960.00	24490.00	0.00	0.00	0.00	0.00	7220.00	11805.00	5940.00	9860.00
800.00	12900.00	24475.00	0.00	0.00	0.00	0.00	7200.00	11800.00	5900.00	9850.00
810.00	12860.00	24465.00	0.00	0.00	0.00	0.00	6920.00	11730.00	5880.00	9845.00
820.00	12820.00	24455.00	0.00	0.00	0.00	0.00	6640.00	11660.00	5860.00	9840.00
830.00	12780.00	24445.00	0.00	0.00	0.00	0.00	6360.00	11590.00	5840.00	9835.00
840.00	12740.00	24435.00	0.00	0.00	0.00	0.00	6080.00	11520.00	5820.00	9830.00
850.00	12700.00	24425.00	0.00	0.00	0.00	0.00	5800.00	11450.00	5800.00	9825.00
860.00	12660.00	24415.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
870.00	12620.00	24405.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
880.00	12580.00	24395.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
890.00	12540.00	24385.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
900.00	12500.00	24375.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
910.00	12440.00	24360.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
920.00	12380.00	24345.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
930.00	12320.00	24330.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A358---304		COPPER-B42-D		RED-BRAS-B43		NICKELB161#5		NICKELB161)5	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
940.00	12260.00	24315.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
950.00	12200.00	24300.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
960.00	12100.00	24275.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
970.00	12000.00	24250.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
980.00	11900.00	24225.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
990.00	11800.00	24200.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1000.00	11700.00	24175.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1010.00	11420.00	24105.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1020.00	11140.00	24035.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1030.00	10860.00	23965.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1040.00	10580.00	23895.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1050.00	10300.00	23825.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1060.00	9900.00	23725.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1070.00	9500.00	23625.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1080.00	9100.00	23525.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1090.00	8700.00	23425.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1100.00	8300.00	23325.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1110.00	7940.00	23235.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1120.00	7580.00	23145.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1130.00	7220.00	23055.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1140.00	6860.00	22965.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A358---304		COPPER-B42-D		RED-BRAS-B43		NICKELB161#5		NICKELB161)5	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
1150.00	6500.00	22875.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1160.00	6220.00	22805.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1170.00	5940.00	22735.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1180.00	5660.00	22665.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1190.00	5380.00	22595.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1200.00	5100.00	22525.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1210.00	4880.00	22470.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1220.00	4660.00	22415.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1230.00	4440.00	22360.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1240.00	4220.00	22305.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1250.00	4000.00	22250.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1260.00	3820.00	22205.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1270.00	3640.00	22160.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1280.00	3460.00	22115.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1290.00	3280.00	22070.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1300.00	3100.00	22025.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1310.00	2980.00	21995.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1320.00	2860.00	21965.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1330.00	2740.00	21935.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1340.00	2620.00	21905.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1350.00	2500.00	21875.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	A358---304		COPPER-B42-D		RED-BRAS-B43		NICKELB161#5		NICKELB161)5	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
1360.00	2400.00	21850.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1370.00	2300.00	21825.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1380.00	2200.00	21800.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1390.00	2100.00	21775.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1400.00	2000.00	21750.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1410.00	1900.00	21725.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1420.00	1800.00	21700.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1430.00	1700.00	21675.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1440.00	1600.00	21650.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1450.00	1500.00	21625.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1460.00	1440.00	21610.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1470.00	1380.00	21595.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1480.00	1320.00	21580.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1490.00	1260.00	21565.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1500.00	1200.00	21550.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	B165MONEL-NC		ASTM-B167-#5		ASTM-B167-)5		AL-B241-6061		AL-B241-6063	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
100.00	18200.00	27300.00	16700.00	25050.00	20000.00	30000.00	12700.00	19050.00	10000.00	15000.00
110.00	18020.00	27255.00	16700.00	25050.00	20000.00	30000.00	12700.00	19050.00	9980.00	14995.00
120.00	17840.00	27210.00	16700.00	25050.00	20000.00	30000.00	12700.00	19050.00	9960.00	14990.00
130.00	17660.00	27165.00	16700.00	25050.00	20000.00	30000.00	12700.00	19050.00	9940.00	14985.00
140.00	17480.00	27120.00	16700.00	25050.00	20000.00	30000.00	12700.00	19050.00	9920.00	14980.00
150.00	17300.00	27075.00	16700.00	25050.00	20000.00	30000.00	12700.00	19050.00	9900.00	14975.00
160.00	17120.00	27030.00	16700.00	25050.00	20000.00	30000.00	12700.00	19050.00	9880.00	14970.00
170.00	16940.00	26985.00	16700.00	25050.00	20000.00	30000.00	12700.00	19050.00	9860.00	14965.00
180.00	16760.00	26940.00	16700.00	25050.00	20000.00	30000.00	12700.00	19050.00	9840.00	14960.00
190.00	16580.00	26895.00	16700.00	25050.00	20000.00	30000.00	12700.00	19050.00	9820.00	14955.00
200.00	16400.00	26850.00	16700.00	25050.00	20000.00	30000.00	12700.00	19050.00	9800.00	14950.00
210.00	16300.00	26825.00	16700.00	25050.00	20000.00	30000.00	12490.00	18997.50	9480.00	14870.00
220.00	16200.00	26800.00	16700.00	25050.00	20000.00	30000.00	12280.00	18945.00	9160.00	14790.00
230.00	16100.00	26775.00	16700.00	25050.00	20000.00	30000.00	12070.00	18892.50	8840.00	14710.00
240.00	16000.00	26750.00	16700.00	25050.00	20000.00	30000.00	11860.00	18840.00	8520.00	14630.00
250.00	15900.00	26725.00	16700.00	25050.00	20000.00	30000.00	11650.00	18787.50	8200.00	14550.00
260.00	15800.00	26700.00	16700.00	25050.00	20000.00	30000.00	11440.00	18735.00	7880.00	14470.00
270.00	15700.00	26675.00	16700.00	25050.00	20000.00	30000.00	11230.00	18682.50	7560.00	14390.00
280.00	15600.00	26650.00	16700.00	25050.00	20000.00	30000.00	11020.00	18630.00	7240.00	14310.00
290.00	15500.00	26625.00	16700.00	25050.00	20000.00	30000.00	10810.00	18577.50	6920.00	14230.00
300.00	15400.00	26600.00	16700.00	25050.00	20000.00	30000.00	10600.00	18525.00	6600.00	14150.00

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HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	B165MONEL-NC		ASTM-B167-#5		ASTM-B167-)5		AL-B241-6061		AL-B241-6063	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
310.00	15340.00	26585.00	16700.00	25050.00	20000.00	30000.00	10100.00	18400.00	6140.00	14035.00
320.00	15280.00	26570.00	16700.00	25050.00	20000.00	30000.00	9600.00	18275.00	5680.00	13920.00
330.00	15220.00	26555.00	16700.00	25050.00	20000.00	30000.00	9100.00	18150.00	5220.00	13805.00
340.00	15160.00	26540.00	16700.00	25050.00	20000.00	30000.00	8600.00	18025.00	4760.00	13690.00
350.00	15100.00	26525.00	16700.00	25050.00	20000.00	30000.00	8100.00	17900.00	4300.00	13575.00
360.00	15040.00	26510.00	16700.00	25050.00	20000.00	30000.00	7600.00	17775.00	3840.00	13460.00
370.00	14980.00	26495.00	16700.00	25050.00	20000.00	30000.00	7100.00	17650.00	3380.00	13345.00
380.00	14920.00	26480.00	16700.00	25050.00	20000.00	30000.00	6600.00	17525.00	2920.00	13230.00
390.00	14860.00	26465.00	16700.00	25050.00	20000.00	30000.00	6100.00	17400.00	2460.00	13115.00
400.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	5600.00	17275.00	2000.00	13000.00
410.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
420.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
430.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
440.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
450.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
460.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
470.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
480.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
490.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
500.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
510.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00

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BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	B165MONEL-NC		ASTM-B167-#5		ASTM-B167-)5		AL-B241-6061		AL-B241-6063	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
520.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
530.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
540.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
550.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
560.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
570.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
580.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
590.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
600.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
610.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
620.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
630.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
640.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
650.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
660.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
670.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
680.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
690.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
700.00	14800.00	26450.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
710.00	14760.00	26440.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
720.00	14720.00	26430.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00

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HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	B165MONEL-NC		ASTM-B167-#5		ASTM-B167-)5		AL-B241-6061		AL-B241-6063	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
730.00	14680.00	26420.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
740.00	14640.00	26410.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
750.00	14600.00	26400.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
760.00	14520.00	26380.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
770.00	14440.00	26360.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
780.00	14360.00	26340.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
790.00	14280.00	26320.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
800.00	14200.00	26300.00	16700.00	25050.00	20000.00	30000.00	0.00	0.00	0.00	0.00
810.00	0.00	0.00	16660.00	25040.00	19920.00	29980.00	0.00	0.00	0.00	0.00
820.00	0.00	0.00	16620.00	25030.00	19840.00	29960.00	0.00	0.00	0.00	0.00
830.00	0.00	0.00	16580.00	25020.00	19760.00	29940.00	0.00	0.00	0.00	0.00
840.00	0.00	0.00	16540.00	25010.00	19680.00	29920.00	0.00	0.00	0.00	0.00
850.00	0.00	0.00	16500.00	25000.00	19600.00	29900.00	0.00	0.00	0.00	0.00
860.00	0.00	0.00	16380.00	24970.00	18880.00	29720.00	0.00	0.00	0.00	0.00
870.00	0.00	0.00	16260.00	24940.00	18160.00	29540.00	0.00	0.00	0.00	0.00
880.00	0.00	0.00	16140.00	24910.00	17440.00	29360.00	0.00	0.00	0.00	0.00
890.00	0.00	0.00	16020.00	24880.00	16720.00	29180.00	0.00	0.00	0.00	0.00
900.00	0.00	0.00	15900.00	24850.00	16000.00	29000.00	0.00	0.00	0.00	0.00
910.00	0.00	0.00	14840.00	24585.00	14920.00	28730.00	0.00	0.00	0.00	0.00
920.00	0.00	0.00	13780.00	24320.00	13840.00	28460.00	0.00	0.00	0.00	0.00
930.00	0.00	0.00	12720.00	24055.00	12760.00	28190.00	0.00	0.00	0.00	0.00

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HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	B165MONEL-NC		ASTM-B167-#5		ASTM-B167-)5		AL-B241-6061		AL-B241-6063	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
940.00	0.00	0.00	11660.00	23790.00	11680.00	27920.00	0.00	0.00	0.00	0.00
950.00	0.00	0.00	10600.00	23525.00	10600.00	27650.00	0.00	0.00	0.00	0.00
960.00	0.00	0.00	9880.00	23345.00	9880.00	27470.00	0.00	0.00	0.00	0.00
970.00	0.00	0.00	9160.00	23165.00	9160.00	27290.00	0.00	0.00	0.00	0.00
980.00	0.00	0.00	8440.00	22985.00	8440.00	27110.00	0.00	0.00	0.00	0.00
990.00	0.00	0.00	7720.00	22805.00	7720.00	26930.00	0.00	0.00	0.00	0.00
1000.00	0.00	0.00	7000.00	22625.00	7000.00	26750.00	0.00	0.00	0.00	0.00
1010.00	0.00	0.00	6500.00	22500.00	6500.00	26625.00	0.00	0.00	0.00	0.00
1020.00	0.00	0.00	6000.00	22375.00	6000.00	26500.00	0.00	0.00	0.00	0.00
1030.00	0.00	0.00	5500.00	22250.00	5500.00	26375.00	0.00	0.00	0.00	0.00
1040.00	0.00	0.00	5000.00	22125.00	5000.00	26250.00	0.00	0.00	0.00	0.00
1050.00	0.00	0.00	4500.00	22000.00	4500.00	26125.00	0.00	0.00	0.00	0.00
1060.00	0.00	0.00	4200.00	21925.00	4200.00	26050.00	0.00	0.00	0.00	0.00
1070.00	0.00	0.00	3900.00	21850.00	3900.00	25975.00	0.00	0.00	0.00	0.00
1080.00	0.00	0.00	3600.00	21775.00	3600.00	25900.00	0.00	0.00	0.00	0.00
1090.00	0.00	0.00	3300.00	21700.00	3300.00	25825.00	0.00	0.00	0.00	0.00
1100.00	0.00	0.00	3000.00	21625.00	3000.00	25750.00	0.00	0.00	0.00	0.00
1110.00	0.00	0.00	6800.00	22575.00	2840.00	25710.00	0.00	0.00	0.00	0.00
1120.00	0.00	0.00	10600.00	23525.00	2680.00	25670.00	0.00	0.00	0.00	0.00
1130.00	0.00	0.00	14400.00	24475.00	2520.00	25630.00	0.00	0.00	0.00	0.00
1140.00	0.00	0.00	18200.00	25425.00	2360.00	25590.00	0.00	0.00	0.00	0.00

NOTE ?- ALL ZERO STRESS VALUES INDICATE THAT THE CODE DOES NOT
**** RECOMMEND THE USE OF THE MATERIAL AT THAT TEMPERATURE

HOT STRESS AND ALLOW. STRESS RANGE
BASED ON B31.3

S(A)=F*(1.25*S(C)+0.25*S(H)) , F=1

MATERIAL	B165MONEL-NC		ASTM-B167-#5		ASTM-B167-)5		AL-B241-6061		AL-B241-6063	
TEMP(F)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)	HOT,S(H)	ALL,S(A)
1150.00	0.00	0.00	22000.00	26375.00	2200.00	25550.00	0.00	0.00	0.00	0.00
1160.00	0.00	0.00	18000.00	25375.00	2160.00	25540.00	0.00	0.00	0.00	0.00
1170.00	0.00	0.00	14000.00	24375.00	2120.00	25530.00	0.00	0.00	0.00	0.00
1180.00	0.00	0.00	10000.00	23375.00	2080.00	25520.00	0.00	0.00	0.00	0.00
1190.00	0.00	0.00	6000.00	22375.00	2040.00	25510.00	0.00	0.00	0.00	0.00
1200.00	0.00	0.00	2000.00	21375.00	2000.00	25500.00	0.00	0.00	0.00	0.00

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5

Stress Intensification and Flexibility Factors

The following is an explanation of the terms used in figuring flexibility and stress intensification factors. Refer to Tables 5-1 through 5-3 for a tabular listing of the factors for different piping configurations. Figures 5-1 and 5-2 illustrate these factors for widely spaced, two-weld and three-weld miter elbows, respectively.

Definitions

h = Flexibility characteristic

k = Flexibility factor (never less than unity, factor for torsion equal to unity)

i = Stress intensification factor (never less than unity, factor for torsion equal to unity)

$\overline{T}$ = Nominal wall thickness of the fitting for elbows, and miter bends, in.

$\overline{T}$ = Nominal wall thickness of the matching pipe for tees, in.

T_o = Crotch thickness of tee, in.

T_r = Pad or saddle thickness, when t_r is 1.5T, use $h = 4T/r^2$, in.

$\emptyset$ = One-half angle between adjacent miter axes, deg

r_2 = Mean radius of matching pipe, in.

R_1 = Bend radius of welding elbow or pipe bend, in.

- For closely spaced miters $R_1 = S \cot \emptyset / 2$
- For widely spaced miters $R_1 = [r_2 (1 + \cot \emptyset)]/2$

r_x = Radius of curvature of the external contoured portion of the outlet measured in the plane containing the axis of the run and branch in inches. This is subjected to the following limitations:

- *Minimum radius.* This dimension must not be less than .05 D_{ob} except with a branch diameter larger than 30 in. It need not exceed 1.50 inches.
- *Maximum radius.* For outlet pipe sizes 8 inches nominal and larger, this dimension must not exceed 0.10 D_{ob} + 0.50 in. For outlet pipe sizes less than 8 in. nominal, this dimension shall not be greater than 1.25 in.
- When the external contour contains more than one radius, the radius of any arc sector of approximately 45° must meet the requirements for maximum and minimum of radii.
- Machining must not be employed in order to meet the preceding requirements.

S = Miter spacing at centerline, in.

- Closely spaced miter bend: $S < r_2 (1 + \tan \emptyset)$
- Widely spaced miter bend: $S \geq r_2 (1 + \tan \emptyset)$

D_{ob} = O.D. of branch, in.

C_1 = Correction factor for curves with one end flanged, $C_1 = h^{1/6}$

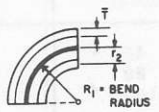
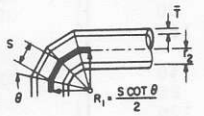
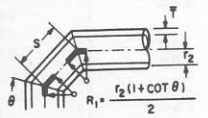
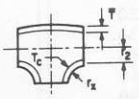
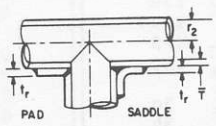
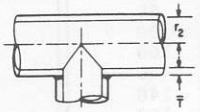
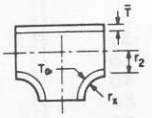
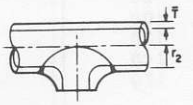
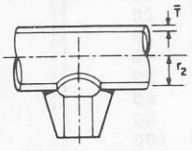
C_2 = Correction factor for curves with both ends flanged, $C_2 = h^{1/3}$

The piping code does not specify any particular distance from the end of the elbows arc or the centerline or a miter weld in which a flange will be effective in modifying the K and i factors on these items. Until a better definition is published, the following rules can be applied:

- Weld elbows—Modify the k and i factor when the butt weld of the flange is within one pipe diameter of the butt of the elbow.

(Text continued on page 120.)

Table 5-1
Flexibility and Stress Intensification Factors

Description	Flexibility Factor k	Stress Int. Factor[1,8] Outplane i_o	Stress Int. Factor[1,8] Inplane i_i	Flexibility Characteristic h	Sketch
Welding elbow or pipe bend	$\frac{1.65}{h}$	$\frac{0.75}{h^{2/3}}$	$\frac{0.9}{h^{2/3}}$	$\frac{\bar{T}R_1}{(r_2)^2}$	
Closely spaced miter bend $s < r_2\ (1 + \tan\theta)$	$\frac{1.52}{h^{5/6}}$	$\frac{0.9}{h^{2/3}}$	$\frac{0.9}{h^{2/3}}$	$\frac{\cot\theta}{2}\ \frac{\bar{T}s}{(r_2)^2}$	
Single miter bend or widely spaced miter bend $s \geq r_2\ (1 + \tan\theta)$	$\frac{1.52}{h^{5/6}}$	$\frac{0.9}{h^{2/3}}$	$\frac{0.9}{h^{2/3}}$	$\frac{1+\cot\theta}{2}\ \frac{\bar{T}}{r_2}$	
Welding tee per ANSI B16.9 with $r_x \geq 1/8\ D_b$ $T_c \geq 1.5\ \bar{T}$	1	$\frac{0.9}{h^{2/3}}$	$3/4\ i_o + 1/4$	$4.4\ \frac{\bar{T}}{r_2}$	
Reinforced fabricated tee with pad or saddle	1	$\frac{0.9}{h^{2/3}}$	$3/4\ i_o + 1/4$	$\frac{(\bar{T}+\frac{1}{2}t_r)^{5/2}}{\bar{T}^{3/2}\ r_2}$	
Unreinforced fabricated tee	1	$\frac{0.9}{h^{2/3}}$	$3/4\ i_o + 1/4$	$\frac{\bar{T}}{r_2}$	
Extruded welding tee $T_c < 1.5\ \bar{T}$	1	$\frac{0.9}{h^{2/3}}$	$3/4\ i_o + 1/4$	$\left(1 + \frac{r_x}{r_2}\right)\frac{\bar{T}}{r_2}$	
Welded-in contour insert $r_x \geq 1/8\ D_b$ $T_c \geq 1.5\ \bar{T}$	1	$\frac{0.9}{h^{2/3}}$	$3/4\ i_o + 1/4$	$4.4\ \frac{\bar{T}}{r_2}$	
Branch welded-on fitting (integrally reinforced)	1	$\frac{0.9}{h^{2/3}}$	$\frac{0.9}{h^{2/3}}$	$3.3\ \frac{\bar{T}}{r_2}$	

ANSI/ASME B31.3d–1984

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Table 5-2
Stress Intensification Factors for Branch Connections

PIPE SIZE	SCH	WELDING TEE, WELDED CONTOUR INSERT	
		i_i INPLANE	i_o OUTPLANE
2"	40	1.19	1.25
	80	1.00	1.00
	160	1.00	1.00
3"	40	1.22	1.29
	80	1.01	1.02
	160	1.00	1.00
4"	40	1.34	1.45
	80	1.10	1.13
	120	1.00	1.00
	160	1.00	1.00
	XXS	1.00	1.00
6"	40	1.52	1.69
	80	1.18	1.24
	120	1.02	1.03
	160	1.00	1.00
	XXS	1.00	1.00
8"	20	1.89	2.19
	30	1.78	2.04
	40	1.63	1.84
	60	1.45	1.60
	80	1.27	1.36
	100	1.15	1.20
	120	1.03	1.04
	140	1.00	1.00
	XXS	1.00	1.00
	160	1.00	1.00
10"	20	2.16	2.55
	30	1.92	2.22
	40	1.73	1.97
	60	1.44	1.58
	80	1.30	1.40
	100	1.17	1.23
	120	1.07	1.09
	140	1.00	1.00
	160	1.00	1.00
12"	20	2.40	2.87
	30	2.03	2.37
	Std	1.88	2.17
	40	1.80	2.06
	XS	1.59	1.78
	60	1.48	1.64
	80	1.32	1.43
	100	1.17	1.23
	120	1.07	1.09
	140	1.00	1.00
	160	1.00	1.00
14"	10	2.54	3.05
	20	2.22	2.63
	30	1.99	2.32
	40	1.81	2.08
	XS	1.68	1.90
	60	1.52	1.69
	80	1.32	1.43
	100	1.17	1.23
	120	1.08	1.10
	140	1.00	1.00
	160	1.00	1.00
16"	10	2.70	4.07
	20	2.41	3.49
	30	2.16	3.09
	40	1.81	2.53
	60	1.55	2.09
	80	1.34	1.76
	100	1.20	1.52

PIPE SIZE	SCH	WELDING TEE, WELDED CONTOUR INSERT	
		i_i INPLANE	i_o OUTPLANE
16"	120	1.08	1.35
	140	1.00	1.19
	160	1.00	1.13
18"	10	2.97	3.62
	20	2.59	3.12
	ST	2.31	2.75
	30	2.10	2.47
	XS	1.95	2.26
	40	1.82	2.09
	60	1.53	1.71
	80	1.35	1.46
	100	1.20	1.26
	120	1.08	1.11
	140	1.01	1.01
	160	1.00	1.00
20"	10	3.17	3.89
	20	2.46	2.95
	30	2.07	2.43
	40	1.87	2.16
	60	1.56	1.74
	80	1.35	1.47
	100	1.20	1.26
	120	1.10	1.13
	140	1.01	1.01
	160	1.00	1.00
24"	10	3.54	4.39
	20	2.76	3.35
	XS	2.31	2.75
	30	2.16	2.54
	40	1.91	2.21
	60	1.56	1.75
	80	1.37	1.49
	100	1.20	1.27
	120	1.09	1.12
	140	1.01	1.02
	160	1.00	1.00
26"	.250	3.73	4.64
	10	3.25	4.00
	Std	2.90	3.53
	20	2.43	2.90
30"	.250	4.08	5.11
	10	3.55	4.40
	Std	3.17	3.89
	20	2.65	3.20
	30	2.31	2.75
34"	.250	4.42	5.56
	10	3.84	4.79
	Std	3.42	4.23
	20	2.86	3.48
	30	2.49	2.99
	40	2.35	2.80
36"	.250	4.59	5.78
	10	3.99	4.98
	Std	3.55	4.40
	20	2.97	3.62
	30	2.58	3.11
	40	2.31	2.75
42"	.250	5.06	6.40
	.312	4.39	5.52
	Std	3.91	4.88
	20	3.27	4.02
	30	2.85	3.46
	40	2.54	3.05

Table 5-2
Continued

PIPE SIZE	SCH	BRANCH WELDED - ON FITTING
		$i_i=i_o$
		INPLANE OUTPLANE
2"	40	1.51
	80	1.18
	160	1.00
3"	40	1.57
	80	1.29
	160	1.00
4"	40	1.76
	80	1.36
	120	1.13
	160	1.0
	XXS	1.0
6"	40	2.27
	80	1.51
	120	1.25
	160	1.04
	XXS	1.00
8"	20	2.66
	30	2.47
	40	2.24
	60	1.90
	80	1.64
	100	1.45
	120	1.28
	140	1.16
	XXS	1.10
	160	1.06
10"	20	3.10
	30	2.68
	40	2.35
	60	2.36
	80	1.70
	100	1.48
	120	1.32
	140	1.18
	160	1.08
12"	20	3.47
	30	2.98
	Std.	2.64
	40	2.50
	XS	2.16
	60	1.99
	80	1.73
	100	1.49
	120	1.32
	140	1.22
	160	1.08
14"	10	3.70
	20	2.88
	30	2.64
	40	2.50
	XS	2.16
	60	1.99
	80	1.73
	100	1.49
	120	1.32
	140	1.22
	160	1.08
16"	10	4.07
	20	3.49
	30	3.09
	40	2.53
	60	2.09
	80	1.76
	100	1.52

PIPE SIZE	SCH	BRANCH WELDED - ON FITTING
		$i_i=i_o$
		INPLANE OUTPLANE
16"	120	1.35
	140	1.19
	160	1.13
18"	10	4.39
	20	3.79
	ST	3.34
	30	3.01
	XS	2.75
	40	2.53
	60	2.07
	80	1.77
	100	1.53
	120	1.35
	140	1.23
	160	1.11
20"	10	4.73
	20	3.58
	30	2.95
	40	2.62
	60	2.10
	80	1.72
	100	1.53
	120	1.36
	140	1.22
	160	1.12
24"	10	5.36
	20	4.09
	XS	3.34
	30	3.08
	40	2.69
	60	2.12
	80	1.80
	100	1.53
	120	1.36
	140	1.24
	160	1.13
26"	.250	5.66
	10	4.86
	Std	4.39
	20	3.53
30"	.250	6.25
	10	5.36
	Std	4.74
	20	3.91
	30	3.34
34"	.250	6.56
	10	5.80
	Std	5.17
	20	4.24
	30	3.64
	40	3.41
36"	.250	7.03
	10	6.08
	Std	5.36
	20	4.39
	30	3.79
	40	3.34
42"	.250	7.82
	.312	7.75
	Std	5.96
	20	4.89
	30	4.20
	40	3.70

Table 5-2
Continued

PIPE SIZE	SCH	*REINFORCED FABRICATED TEE	
		i_i INPLANE	i_o OUTPLANE
2"	40	1.53	1.70
	80	1.25	1.33
	160	1.00	1.00
3"	40	1.58	1.77
	80	1.30	1.40
	160	1.04	1.05
4"	40	1.74	1.99
	80	1.41	1.54
	120	1.20	1.27
	160	1.08	1.10
	XXS	1.00	1.00
6"	40	1.62	1.83
	80	1.53	1.70
	120	1.31	1.41
	160	1.14	1.18
	XXS	1.01	1.02
8"	20	2.50	3.00
	30	2.34	2.79
	40	2.14	2.52
	60	1.86	2.14
	80	1.64	1.85
	100	1.48	1.64
	120	1.32	1.43
	140	1.23	1.30
	XXS	1.17	1.23
	160	1.15	1.20
10"	20	2.87	3.49
	30	2.52	3.03
	40	2.27	2.69
	60	1.87	2.16
	80	1.68	1.91
	100	1.50	1.67
	120	1.37	1.49
	140	1.24	1.32
	160	1.16	1.21
12"	20	3.18	3.91
	30	2.68	3.24
	Std	2.48	2.97
	40	2.36	2.81
	XS	2.07	2.43
	60	1.94	2.25
	80	1.71	1.94
	100	1.51	1.68
	120	1.37	1.49
	140	1.28	1.37
	160	1.17	1.22
14"	10	3.38	4.17
	20	2.94	3.59
	30	2.63	3.17
	40	2.38	2.84
	XS	2.20	2.60
	60	1.98	2.31
	80	1.72	1.96
	100	1.50	1.67
	120	1.38	1.50
	140	1.27	1.36
	160	1.19	1.25
16"	10	3.68	4.57
	20	3.20	3.93
	30	2.85	3.47
	40	2.39	2.85
	60	2.02	2.36
	80	1.74	1.98
	100	1.53	1.71
16"	120	1.39	1.52
	140	1.26	1.35
	160	1.19	1.25
18"	10	3.96	4.94
	20	3.45	4.26
	ST	3.06	3.75
	30	2.79	3.38
	XS	2.57	3.09
	40	2.39	2.85
	60	2.00	2.33
	80	1.74	1.99
	100	1.54	1.72
	120	1.39	1.52
	140	1.29	1.39
	160	1.20	1.26
20"	10	4.23	5.31
	20	3.28	4.04
	30	2.71	3.28
	40	2.46	2.95
	60	2.04	2.38
	80	1.74	1.99
	100	1.54	1.72
	120	1.41	1.54
	140	1.29	1.38
	160	1.20	1.26
24"	10	4.74	5.99
	20	3.67	4.56
	XS	3.06	3.75
	30	2.85	3.47
	40	2.55	3.07
	60	2.04	2.39
	80	1.77	2.03
	100	1.55	1.73
	120	1.40	1.53
	140	1.30	1.40
	160	1.20	1.27
26"	.250	5.00	6.34
	10	4.35	5.46
	Std	3.87	4.82
	20	3.23	3.97
30"	.250	5.49	6.98
	10	4.76	6.01
	Std	4.23	5.31
	20	3.77	4.69
	30	3.07	3.76
34"	.250	5.94	7.59
	10	5.16	6.54
	Std	4.59	5.78
	20	3.82	4.76
	30	3.32	4.09
	40	3.12	3.82
36"	.250	6.17	7.89
	10	5.35	6.80
	Std	4.75	6.00
	20	3.96	4.95
	30	3.44	4.25
	40	3.07	3.76
42"	.250	6.81	8.75
	.312	5.90	7.53
	Std	5.24	6.66
	20	4.36	5.48
	30	3.79	4.72
	40	3.38	4.17

*REINFORCED FABRICATED TEE PAD THICKNESS EQUAL TO NOMINAL THICKNESS OF PIPE HEADER

Table 5-2
Continued

PIPE SIZE	SCH	UNREINFORCED FABRICATED TEE	
		i_i INPLANE	i_o OUTPLANE
2"	40	2.76	3.35
	80	2.22	2.63
	160	1.64	1.85
3"	40	2.85	3.47
	80	2.30	2.74
	160	1.80	2.07
4"	40	3.18	3.90
	80	2.52	3.03
	120	2.13	2.50
	160	1.88	2.17
	XXS	1.61	1.81
6"	40	3.68	4.57
	80	2.76	3.34
	120	2.33	2.77
	160	1.98	2.31
	XXS	1.76	2.01
8"	20	4.67	5.89
	30	4.37	5.49
	40	3.96	4.95
	60	3.41	4.21
	80	2.98	3.64
	100	2.67	3.22
	120	2.35	2.80
	140	2.17	2.56
	XXS	2.07	2.43
	160	2.02	2.36
10"	20	5.39	6.85
	30	4.71	5.95
	40	4.21	5.28
	60	3.44	4.25
	80	3.07	3.76
	100	2.72	3.29
	120	2.45	2.93
	140	2.19	2.59
	160	2.03	2.37
12"	20	6.02	7.69
	30	5.03	6.37
	Std	4.62	5.83
	40	4.39	5.52
	XS	3.84	4.78
	60	3.55	4.40
	80	3.12	3.83
	100	2.73	3.30
	120	2.45	2.93
	140	2.27	2.69
	160	2.05	2.40
14"	10	6.40	8.20
	20	5.54	7.05
	30	4.92	6.22
	40	4.44	5.59
	XS	4.08	5.10
	60	3.65	4.53
	80	3.14	3.85
	100	2.72	3.29
	120	2.46	2.94
	140	2.25	2.67
	160	2.09	2.45
16"	10	6.92	8.89
	20	6.04	7.72
	30	5.36	6.81
	40	4.45	5.60
	60	3.73	4.64
	80	3.18	3.90
	100	2.78	3.37

PIPE SIZE	SCH	UNREINFORCED FABRICATED TEE	
		i_i INPLANE	i_o OUTPLANE
16"	120	2.49	2.99
	140	2.23	2.64
	160	2.10	2.46
18"	10	7.53	9.71
	20	6.52	8.36
	ST	5.79	7.38
	30	5.23	6.64
	XS	4.80	6.07
	40	4.45	5.60
	60	3.69	4.58
	80	3.19	3.92
	100	2.79	3.39
	120	2.49	2.99
	140	2.29	2.72
	160	2.10	2.47
20"	10	8.08	10.44
	20	6.21	7.94
	30	5.14	6.52
	40	4.60	5.80
	60	3.75	4.67
	80	3.21	3.94
	100	2.79	3.39
	120	2.52	3.03
	140	2.28	2.70
	160	2.11	2.48
24"	10	9.09	11.79
	20	6.99	8.98
	XS	5.79	7.38
	30	5.36	6.81
	40	4.71	5.94
	60	3.77	4.69
	80	3.24	3.99
	100	2.79	3.39
	120	2.52	3.02
	140	2.31	2.74
	160	2.13	2.50
26"	.250	9.60	12.46
	10	8.30	10.73
	Std	7.56	9.75
	20	6.10	7.80
30"	.250	10.54	13.72
	10	9.12	11.82
	Std	8.08	10.44
	20	6.68	8.57
	30	5.79	7.38
34"	.250	11.44	14.92
	10	9.90	12.86
	Std	8.77	11.36
	20	7.26	9.35
	30	6.26	8.01
	40	5.90	7.53
36"	.250	11.88	15.50
	10	10.27	13.36
	Std	9.12	11.82
	20	7.54	9.72
	30	6.54	8.38
	40	5.79	7.38
42"	.250	13.14	17.19
	.312	11.37	14.82
	Std	10.30	13.40
	20	8.35	10.80
	30	7.21	9.28
	40	6.40	8.20

Table 5-3
Flanged Elbows—Flexibility Factors and Stress Intensification Factors

SIZE	WALL THICK	NOT FLANGED		BOTH END FLANGED		ONE END FLANGED	
		i	i_o	i_2	$i_o 2$	i_1	$i_o 1$
2"	.065	3.25	2.71	1.71	1.43	2.35	1.97
2"	.109	2.24	1.74	1.42	1.10	1.78	1.39
2"	.154	1.73	1.44	1.25	1.04	1.47	1.22
2"	.218	1.32	1.03	1.09	1.00	1.20	1.00
2"	.343	1.00	1.00	1.00	1.00	1.00	1.00
2"	.436	1.00	1.00	1.00	1.00	1.00	1.00
2 ½"	.083	3.06	2.55	1.66	1.38	2.26	1.88
2 ½"	.120	2.36	1.83	1.46	1.13	1.86	1.44
2 ½"	.203	1.59	1.24	1.20	1.00	1.38	1.08
2 ½"	.276	1.25	1.00	1.06	1.00	1.15	1.00
2 ½"	.375	1.00	1.00	1.00	1.00	1.00	1.00
2 ½"	.552	1.00	1.00	1.00	1.00	1.00	1.00
3"	.083	3.54	2.95	1.78	1.49	2.52	2.09
3"	.120	2.74	2.28	1.57	1.31	2.08	1.73
3"	.216	2.78	1.48	1.28	1.06	1.50	1.25
3"	.300	1.38	1.15	1.12	1.00	1.24	1.03
3"	.438	1.01	1.00	1.00	1.00	1.00	1.00
3"	.600	1.00	1.00	1.00	1.00	1.00	1.00
3 ½"	.083	3.85	3.21	1.87	1.55	2.68	2.23
3 ½"	.120	2.97	2.47	1.64	1.36	2.20	1.83
3 ½"	.226	1.88	1.56	1.30	1.08	1.56	1.30
3 ½"	.318	1.44	1.20	1.14	1.00	1.28	1.07
3 ½"	.636	1.00	1.00	1.00	1.00	1.00	1.00
4"	.083	4.13	3.44	1.93	1.61	2.83	2.35
4"	.120	3.19	2.66	1.70	1.41	2.33	1.94
4"	.237	1.96	1.63	1.33	1.11	1.61	1.34
4"	.337	1.50	1.25	1.16	1.00	1.32	1.10
4"	.438	1.22	1.01	1.05	1.00	1.13	1.00
4"	.531	1.04	1.00	1.00	1.00	1.00	1.00
4"	.674	1.00	1.00	1.00	1.00	1.00	1.00
5"	.109	3.93	3.28	1.88	1.57	2.72	2.27
5"	.134	3.41	2.84	1.76	1.46	2.45	2.04
5"	.258	2.13	1.78	1.38	1.16	1.72	1.44
5"	.375	1.61	1.34	1.20	1.00	1.39	1.16
5"	.500	1.29	1.00	1.09	1.00	1.18	1.00
5"	.625	1.07	1.00	1.00	1.00	1.02	1.00
5"	.750	1.00	1.00	1.00	1.00	1.00	1.00
6"	.109	4.41	3.68	1.99	1.66	2.96	2.47
6"	.134	3.81	3.18	1.85	1.54	2.66	2.22
6"	.280	2.27	1.89	1.43	1.19	1.80	1.50
6"	.432	1.65	1.37	1.22	1.01	1.42	1.18
6"	.562	1.34	1.12	1.10	1.00	1.21	1.01
6"	.718	1.10	1.00	1.00	1.00	1.05	1.00
6"	.864	1.00	1.00	1.00	1.00	1.00	1.00
8"	.109	5.20	4.34	2.16	1.81	3.35	2.80
8"	.148	4.23	3.52	1.96	1.63	2.88	2.39
8"	.250	2.92	2.44	1.63	1.35	2.18	1.82
8"	.277	2.72	2.27	1.57	1.31	2.06	1.72
8"	.322	2.45	2.04	1.49	1.24	1.91	1.59
8"	.406	2.06	1.72	1.36	1.14	1.68	1.40
8"	.500	1.77	1.47	1.27	1.06	1.50	1.24
8"	.593	1.55	1.30	1.18	1.00	1.35	1.13
8"	.718	1.34	1.11	1.11	1.00	1.21	1.00
8"	.812	1.23	1.02	1.06	1.00	1.14	1.00
8"	.875	1.14	1.00	1.01	1.00	1.07	1.00
8"	.906	1.11	1.00	1.00	1.00	1.05	1.00

Note: i_o, $i_o 1$, $i_o 2$ are out-of-plane intensification factors

i, i_1, i_2 are in plane intensification factors

Table 5-3
Continued

SIZE	WALL THICK	NOT FLANGED		BOTH END FLANGED		ONE END FLANGED	
		i	i_o	i_2	$i_o 2$	i_1	$i_o 1$
10"	.134	5.23	4.36	2.17	1.81	3.37	2.81
10"	.165	4.55	3.79	2.03	1.69	3.03	2.53
10"	.250	3.41	2.84	1.75	1.46	2.44	2.04
10"	.307	2.94	2.45	1.63	1.35	2.18	1.82
10"	.365	2.61	2.17	1.53	1.28	2.00	1.66
10"	.500	2.08	1.73	1.37	1.14	1.69	1.40
10"	.593	1.83	1.52	1.28	1.07	1.53	1.27
10"	.718	1.58	1.32	1.19	1.00	1.37	1.14
10"	.843	1.40	1.17	1.12	1.00	1.25	1.05
10"	1.00	1.22	1.00	1.05	1.00	1.13	1.00
10"	1.125	1.11	1.00	1.00	1.00	1.05	1.00
12"	.156	5.26	4.39	2.18	1.82	3.39	2.83
12"	.180	4.79	3.99	2.08	1.73	3.16	2.63
12"	.250	3.81	3.18	1.85	1.54	2.66	2.22
12"	.330	3.14	2.61	1.69	1.41	2.30	1.91
12"	.375	2.87	2.39	1.61	1.34	2.15	1.79
12"	.406	2.71	2.26	1.56	1.30	2.06	1.72
12"	.500	2.33	1.94	1.45	1.21	1.84	1.53
12"	.562	2.15	1.79	1.41	1.17	1.73	1.44
12"	.687	1.85	1.54	1.29	1.08	1.55	1.29
12"	.843	1.58	1.32	1.19	1.00	1.37	1.15
12"	1.000	1.39	1.16	1.12	1.00	1.25	1.04
12"	1.125	1.27	1.06	1.07	1.00	1.17	1.00
12"	1.312	1.12	1.00	1.00	1.00	1.06	1.00
14"	.250	3.90	3.25	1.87	1.56	2.70	2.25
14"	.312	2.35	2.79	1.74	1.45	2.41	2.00
14"	.375	2.92	2.44	1.62	1.35	2.17	1.82
14"	.438	2.68	2.23	1.57	1.31	2.05	1.71
14"	.500	2.33	1.94	1.45	1.21	1.84	1.53
14"	.593	2.12	1.77	1.38	1.15	1.73	1.44
14"	.750	1.79	1.49	1.27	1.06	1.51	1.26
14"	.937	1.51	1.26	1.17	1.00	1.33	1.10
14"	1.093	1.34	1.12	1.10	0.92	1.21	1.01
14"	1.250	1.21	1.01	1.05	1.00	1.13	1.00
14"	1.406	1.09	1.00	1.00	1.00	1.04	1.00
16"	.250	4.27	3.55	1.96	1.64	2.90	2.41
16"	.312	3.81	3.18	1.83	1.52	2.60	2.16
16"	.375	3.23	2.70	1.71	1.42	2.34	1.96
16"	.500	2.63	2.19	1.54	1.28	2.01	1.68
16"	.656	2.17	1.81	1.40	1.17	1.74	1.45
16"	.843	1.81	1.51	1.28	1.06	1.52	1.27
16"	1.031	1.55	1.29	1.18	1.00	1.35	1.13
16"	1.218	1.37	1.14	1.11	1.00	1.23	1.03
16"	1.438	1.20	1.00	1.04	1.00	1.12	1.00
16"	1.593	1.10	1.00	1.03	1.00	1.05	1.00
18"	.25	4.62	3.85	2.04	1.70	3.07	2.56
18"	.312	3.98	3.32	1.90	1.58	2.75	2.29
18"	.475	3.52	2.93	1.78	1.49	2.51	2.09
18"	.438	3.16	2.63	1.69	1.41	2.31	1.93
18"	.500	2.87	2.39	1.61	1.34	2.15	1.79
18"	.562	2.63	2.19	1.54	1.28	2.01	1.68
18"	.750	2.15	1.79	1.39	1.16	1.73	1.44
18"	.937	1.82	1.52	1.28	1.07	1.53	1.27
18"	1.156	1.56	1.30	1.18	0.99	1.36	1.14
18"	1.375	1.36	1.13	1.11	1.00	1.23	1.02
18"	1.562	1.23	1.00	1.05	1.00	1.14	1.00
18"	1.781	1.11	1.00	1.00	1.00	1.05	1.00

Note: i_o, $i_o 1$, $i_o 2$ are out-of-plane intensification factors
i, i_1, i_2 are in plane intensification factors

Table 5-3
Continued

SIZE	WALL THICK	NOT FLANGED i	NOT FLANGED i_o	BOTH END FLANGED i_2	BOTH END FLANGED i_{o2}	ONE END FLANGED i_1	ONE END FLANGED i_{o1}
20"	.250	4.97	4.14	2.12	1.77	3.24	2.70
20"	.375	3.77	3.14	1.84	1.53	2.64	2.20
20"	.500	3.08	2.57	1.67	1.39	2.26	1.89
20"	.593	2.74	2.28	1.57	1.31	2.08	1.73
20"	.812	2.18	1.82	1.38	1.15	1.75	1.46
20"	1.031	1.84	1.53	1.29	1.07	1.54	1.28
20"	1.281	1.56	1.30	1.19	1.00	1.36	1.13
20"	1.500	1.38	1.15	1.11	1.00	1.24	1.03
20"	1.750	1.22	1.02	1.05	1.00	1.13	1.00
20"	1.968	1.11	1.00	1.00	1.00	1.05	1.00
24"	.250	5.63	4.69	2.25	1.88	3.55	2.96
24"	.375	4.29	3.57	1.97	1.64	2.91	2.42
24"	.500	3.52	2.93	1.78	1.48	2.51	2.09
24"	.562	3.24	2.70	1.71	1.42	2.35	1.96
24"	.687	2.80	2.34	1.59	1.32	2.11	1.76
24"	.968	2.20	1.83	1.39	1.15	1.76	1.46
24"	1.218	1.86	1.55	1.30	1.08	1.55	1.29
24"	1.531	1.56	1.30	1.19	1.00	1.36	1.13
24"	1.812	1.37	1.15	1.13	1.00	1.23	1.04
24"	2.062	1.24	1.03	1.06	1.00	1.15	1.00
24"	2.343	1.12	1.00	1.00	1.00	1.06	1.00
30"	.250	6.57	5.47	2.43	2.03	3.99	3.33
30"	.312	5.63	4.69	2.25	1.88	3.56	2.96
30"	.375	4.97	4.14	2.12	1.77	3.24	2.70
30"	.500	4.11	3.42	1.93	1.61	2.82	2.34
30"	.625	3.52	2.93	1.78	1.49	2.51	2.09
30"	.750	3.08	2.57	1.67	1.39	2.27	1.89

- Miter bends—Modify the K and i factor when the butt weld of the flange is located within one and one half pipe diameters of the nearest miter weld measured from the centerline of the pipe.

Although not specified by the Code, this will apply to both closely and widely spaced miters.

Note: Large-diameter thin-wall piping elbows and miters are affected by internal line pressure. According to a "Batelle" report to the AGA, the flexibility factors on these items are seriously impaired by internal pressure. To correct the values from Table 5-1:

Divide K by:

$$(1 + 6)\ \frac{(P)}{E_c}\ \frac{(r)^{7/3}}{t^2}\ \frac{(R_1)^{1/3}}{r_2}$$

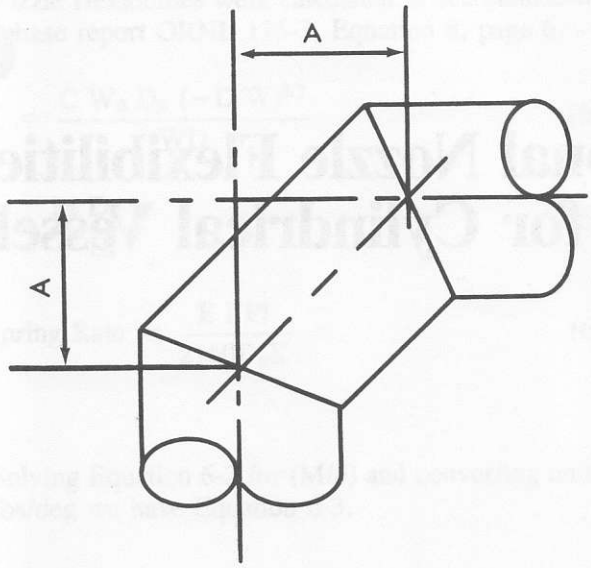
Divide i by:

$$(1 + 3.25)\ \frac{(P)}{E_c}\ \frac{(r)^{5/2}}{t^2}\ \frac{(R_1)^{2/3}}{r^2}$$

Factors and Characteristics h, k, and i

	h	k	l
Butt-weld joint	—	1	1.0
Reducer	—	1	1.0
Weld-neck flange	—	1	1.0
Double-welded slip-on flange	—	1	1.2
Fillet-welded joint—single weld	—	1	1.3
Socket-welded flange	—	1	1.3
Single-welded slip-on flange	—	1	1.3
Lap-joint flange (with ANSI Code B16.9 lap-joint stub)	—	1	1.6
Screwed pipe joint or screwed flange	—	1	2.3
Corrugated straight pipe or corrugated or creased bend.	—	5	2.5

Note: Factors shown apply to bending flexibility factor for torsion equal to 0.9.

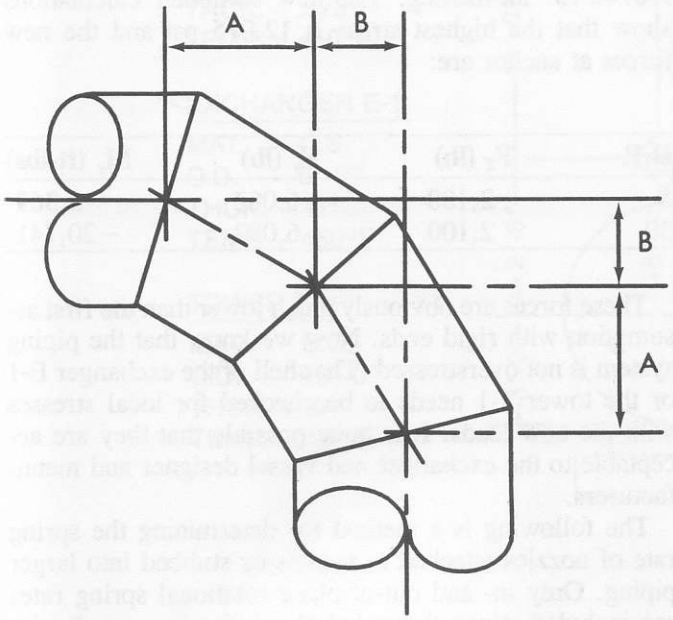


Widely Spaced Miters

D = Pipe Size (in.)	0.250 Wall 2-Weld Miter		0.375 Wall 2-Weld Miter		Dimensions (in decimals of feet)
	K	$i_i = i_o$	K	$i_i = i_o$	A
12	14.2	5.4	10.1	4.1	0.878
14	15.4	5.7	10.9	4.4	1.025
16	17.3	6.3	12.2	4.8	1.171
18	19.1	6.8	13.5	5.2	1.318
20	20.8	7.3	14.8	5.6	1.464
24	24.3	8.3	17.3	6.3	1.757
26	26.0	8.7	18.5	6.6	1.903
30	29.3	9.6	20.8	7.3	2.196
32	30.9	10.0	22.0	7.6	2.343
32	32.6	10.4	23.2	8.0	2.489
36	34.2	10.9	24.3	8.3	2.636
40	37.3	11.7	26.6	8.9	2.938
42	38.9	12.0	27.7	9.2	3.075
48	43.5	13.2	31.0	10.0	3.514
54	48.0	14.2	34.2	10.9	3.954
60	52.4	15.3	37.3	11.9	4.393
72	61.0	17.3	43.5	13.2	5.272

K = flexibility factor
i_o = out-of-plane stress intensification factor
i_i = in-plane stress intensification factor

Figure 5-1. Flexibility and stress intensification factors of two-weld miter elbows.



Widely Spaced Miters

D = Pipe Size (in.)	0.250 Wall 3-Weld Miter		0.375 Wall 3-Weld Miter		Dimensions (in decimals of feet)	
	K	$i_i = i_o$	K	$i_i = i_o$		B
12	10.8	4.3	7.7	3.3	0.696	0.401
14	11.7	4.6	8.3	3.5	0.812	0.468
16	13.1	5.1	9.3	3.8	0.928	0.535
18	14.5	5.5	10.3	4.2	1.044	0.602
20	15.9	5.9	11.3	4.5	1.160	0.669
24	18.5	6.7	13.1	5.1	1.392	0.803
26	19.8	7.0	14.1	5.3	1.508	0.870
30	22.3	7.7	15.9	5.9	1.740	1.004
32	23.6	8.1	16.8	6.1	1.856	1.071
34	24.8	8.4	17.6	6.4	1.972	1.138
36	26.0	8.7	18.5	6.6	2.088	1.205
40	28.4	9.4	20.2	7.1	2.320	1.339
42	29.6	9.7	21.1	7.4	2.436	1.406
48	33.1	10.6	23.6	8.1	2.784	1.607
54	36.6	11.5	26.0	8.7	3.132	1.808
60	39.9	12.3	28.4	9.4	3.480	2.009
72	46.5	13.9	33.1	10.6	4.176	2.411

K = flexibility factor
i_o = out-of-plane stress intensification factor
i_i = in-plane stress intensification factor

Figure 5-2. Flexibility and stress intensification factors of three-weld miter elbows.

6

Rotational Nozzle Flexibilities for Cylindrical Vessels

It is customary for piping stress analysts to model a piping system with rigid ends or anchors at the equipment nozzles. This assumption is acceptable when the system is flexible and the anchor loads are low. But anytime the system shows high loads and stresses, the analyst must determine how reasonable the assumption in modeling the nozzles as rigid anchors was.

The author has developed tables of rotational nozzle flexibilities for cylindrical vessels ranging in diameters from 2 ft to 20 ft and connecting nozzles ranging in diameters from 2 in. to 48 in. STD. thickness.*

To demonstrate how these flexibility factors really affect the accuracy of stress calculations for a simple piping system, an example where a 14-in. O.D. pipe from an exchanger E-1 ties to a tower T-1 is shown in Figure 6-1.

The computer stress calculation with rigid ends or anchors show a high stress of 33, 616 psi in the system and forces and moments at the nozzles as:

O.D.	F_x (lb)	F_y (lb)	M_z (ft-lb)
5	−11,113	−28,182	85,749
30	11,113	28,182	149,174

To reduce these high forces and moments, we will have to modify the piping configuration with more elbows or an additional expansion joint. But before we spend more time and money on these changes, let's model the nozzle data points 5 and 30 with flexible end conditions using the flexibility factors from Table 6-1. The table shows that for exchanger E-1 the in-plane rotational flexibility (R.F.) is $.626 \times 10^6$ in.-lbs/deg, and the out-of-plane R.F. is $.209 \times 10^6$ in.-lbs/deg. For the tower T-1 the in-plane R.F. is 1.22×10^6 in.-lbs/deg, and the out-of-plane R.F. is $.407 \times 10^6$ in.-lbs/deg. The new computer calculations show that the highest stress is 12,015 psi and the new forces at anchor are:

D.P.	F_x (lb)	F_y (lb)	M_z (ft-lbs)
5	−2,100	−6,082	3,369
30	2,100	6,082	−20,741

These forces are obviously much lower than the first assumption with rigid ends. Now we know that the piping system is not overstressed. The shell of the exchanger E-1 or the tower T-1 needs to be checked for local stresses with the new loads. It is quite possible that they are acceptable to the exchanger and vessel designer and manufacturers.

The following is a method for determining the spring rate of nozzles attached to vessels or stubbed into larger piping. Only in- and out-of-plane rotational spring rates are included, since the radial flexibility is normally ignored. Nozzle flexibilities should not be used if the nozzle

or pad diameter is greater than one third of the run or vessel diameter.

Nozzle flexibilities were calculated in accordance with the phase report ORNL 115-3, Equation 8, page 6.

$$K = \frac{C\, W_B\, D_B\, (-D/W)^{3/2}}{WD} \qquad (6\text{-}1)$$

$$\theta = \frac{M\, D_B\, K}{EI} \qquad (6\text{-}2)$$

$$\text{Spring Rate} = \frac{E\, I\, PI}{2160 D_B K} \qquad (6\text{-}3)$$

Solving Equation 6-2 for (M/θ) and converting units to ft-lbs/deg we have Equation 6-3.

where
- C = .09 for in-plane bending
- C = .27 for out-of-plane bending
- D = Diameter of vessel or run, in.
- D_B = Diameter of branch, in.
- E = Modulus of elasticity, psi
- I = Moment of inertia of branch, in.^{4}
- K = Flexibility factor
- M = Moment, in.-lbs
- PI = Circumference of a circle divided by the diameter
- θ = Angle of rotation, radians
- W = Wall thickness of vessel or run, in.
- W_B = Wall thickness of branch, in.

In-plane bending refers to *longitudinal* bending in the run or vessel in the plane formed by the intersection of the branch and vessel or run centerlines. *Out-of-plane* bending refers to *circumferential* bending in a plane perpendicular to the vessel or run diameter.

PIPE:
MAT. – C.S.
O.D. – 14″
THCK. – .375″
TEMP. – 450°F

EXCHANGER E-1:
MAT. – C.S.
O.D. – 5′-0″
THCK. – 1/2″
TEMP. – 450°F

TOWER T-1:
MAT. – C.S.
O.D. – 10′-0″
THCK. – 3/4″
TEMP. – 450°F

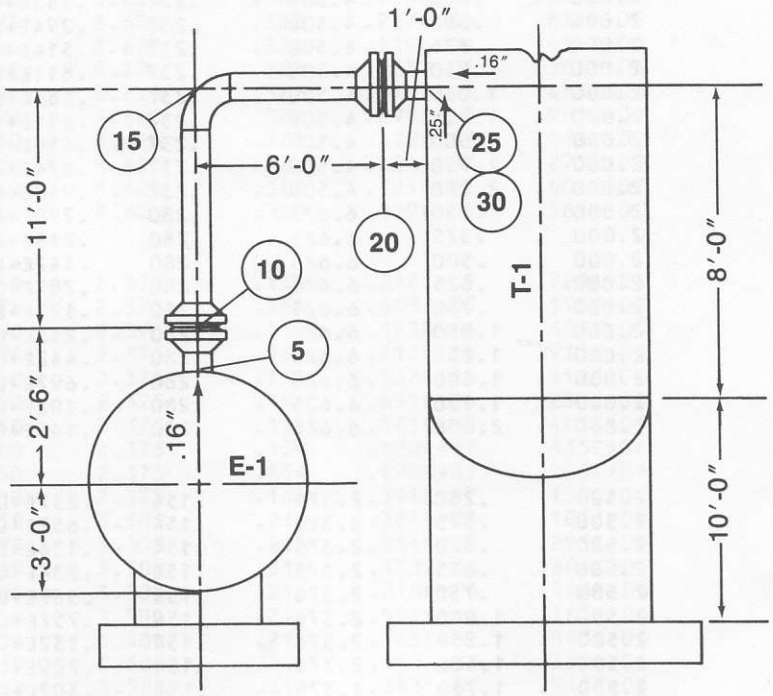


Figure 6-1. An example diagram of a piping system where 14-in. O.D. pipe from an exchanger ties to a tower.

Table 6-1
Rota Stiff Calculation, Cyl. Vessel

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
2.000	.250	2.375	.154	.265E+05	.882E+04
2.000	.375	2.375	.154	.729E+05	.243E+05
2.000	.500	2.375	.154	.150E+06	.499E+05
2.000	.625	2.375	.154	.261E+06	.871E+05
2.000	.750	2.375	.154	.412E+06	.137E+06
2.000	1.000	2.375	.154	.847E+06	.282E+06
2.000	1.250	2.375	.154	.148E+07	.493E+06
2.000	1.500	2.375	.154	.233E+07	.778E+06
2.000	1.750	2.375	.154	.343E+07	.114E+07
2.000	2.000	2.375	.154	.479E+07	.160E+07
2.000	.250	3.500	.216	.394E+05	.131E+05
2.000	.375	3.500	.216	.108E+06	.362E+05
2.000	.500	3.500	.216	.223E+06	.742E+05
2.000	.625	3.500	.216	.389E+06	.130E+06
2.000	.750	3.500	.216	.614E+06	.205E+06
2.000	1.000	3.500	.216	.126E+07	.420E+06
2.000	1.250	3.500	.216	.220E+07	.733E+06
2.000	1.500	3.500	.216	.347E+07	.116E+07
2.000	1.750	3.500	.216	.510E+07	.170E+07
2.000	2.000	3.500	.216	.712E+07	.237E+07
2.000	.250	4.500	.237	.520E+05	.173E+05
2.000	.375	4.500	.237	.143E+06	.478E+05
2.000	.500	4.500	.237	.294E+06	.981E+05
2.000	.625	4.500	.237	.514E+06	.171E+06
2.000	.750	4.500	.237	.811E+06	.270E+06
2.000	1.000	4.500	.237	.166E+07	.555E+06
2.000	1.250	4.500	.237	.291E+07	.969E+06
2.000	1.500	4.500	.237	.459E+07	.153E+07
2.000	1.750	4.500	.237	.674E+07	.225E+07
2.000	2.000	4.500	.237	.942E+07	.314E+07
2.000	.250	6.625	.280	.790E+05	.263E+05
2.000	.375	6.625	.280	.218E+06	.726E+05
2.000	.500	6.625	.280	.447E+06	.149E+06
2.000	.625	6.625	.280	.781E+06	.260E+06
2.000	.750	6.625	.280	.123E+07	.411E+06
2.000	1.000	6.625	.280	.253E+07	.843E+06
2.000	1.250	6.625	.280	.442E+07	.147E+07
2.000	1.500	6.625	.280	.697E+07	.232E+07
2.000	1.750	6.625	.280	.102E+08	.342E+07
2.000	2.000	6.625	.280	.143E+08	.477E+07
2.500	.250	2.375	.154	.237E+05	.789E+04
2.500	.375	2.375	.154	.652E+05	.217E+05
2.500	.500	2.375	.154	.134E+06	.446E+05
2.500	.625	2.375	.154	.234E+06	.779E+05
2.500	.750	2.375	.154	.369E+06	.123E+06
2.500	1.000	2.375	.154	.757E+06	.252E+06
2.500	1.250	2.375	.154	.132E+07	.441E+06
2.500	1.500	2.375	.154	.209E+07	.695E+06
2.500	1.750	2.375	.154	.307E+07	.102E+07
2.500	2.000	2.375	.154	.428E+07	.143E+07
2.500	.250	3.500	.216	.352E+05	.117E+05
2.500	.375	3.500	.216	.970E+05	.323E+05
2.500	.500	3.500	.216	.199E+06	.664E+05
2.500	.625	3.500	.216	.348E+06	.116E+06
2.500	.750	3.500	.216	.549E+06	.183E+06
2.500	1.000	3.500	.216	.113E+07	.376E+06
2.500	1.250	3.500	.216	.197E+07	.656E+06
2.500	1.500	3.500	.216	.310E+07	.103E+07
2.500	1.750	3.500	.216	.456E+07	.152E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
2.500	2.000	3.500	.216	.637E+07	.212E+07
2.500	.250	4.500	.237	.465E+05	.155E+05
2.500	.375	4.500	.237	.128E+06	.427E+05
2.500	.500	4.500	.237	.263E+06	.877E+05
2.500	.625	4.500	.237	.460E+06	.153E+06
2.500	.750	4.500	.237	.725E+06	.242E+06
2.500	1.000	4.500	.237	.149E+07	.496E+06
2.500	1.250	4.500	.237	.260E+07	.867E+06
2.500	1.500	4.500	.237	.410E+07	.137E+07
2.500	1.750	4.500	.237	.603E+07	.201E+07
2.500	2.000	4.500	.237	.842E+07	.281E+07
2.500	.250	6.625	.280	.707E+05	.236E+05
2.500	.375	6.625	.280	.195E+06	.649E+05
2.500	.500	6.625	.280	.400E+06	.133E+06
2.500	.625	6.625	.280	.699E+06	.233E+06
2.500	.750	6.625	.280	.110E+07	.367E+06
2.500	1.000	6.625	.280	.226E+07	.754E+06
2.500	1.250	6.625	.280	.395E+07	.132E+07
2.500	1.500	6.625	.280	.623E+07	.208E+07
2.500	1.750	6.625	.280	.917E+07	.306E+07
2.500	2.000	6.625	.280	.128E+08	.427E+07
2.500	.250	8.625	.322	.934E+05	.311E+05
2.500	.375	8.625	.322	.257E+06	.858E+05
2.500	.500	8.625	.322	.529E+06	.176E+06
2.500	.625	8.625	.322	.923E+06	.308E+06
2.500	.750	8.625	.322	.146E+07	.485E+06
2.500	1.000	8.625	.322	.299E+07	.997E+06
2.500	1.250	8.625	.322	.522E+07	.174E+07
2.500	1.500	8.625	.322	.824E+07	.275E+07
2.500	1.750	8.625	.322	.121E+08	.404E+07
2.500	2.000	8.625	.322	.169E+08	.564E+07
3.000	.250	2.375	.154	.216E+05	.720E+04
3.000	.375	2.375	.154	.595E+05	.198E+05
3.000	.500	2.375	.154	.122E+06	.407E+05
3.000	.625	2.375	.154	.213E+06	.711E+05
3.000	.750	2.375	.154	.337E+06	.112E+06
3.000	1.000	2.375	.154	.691E+06	.230E+06
3.000	1.250	2.375	.154	.121E+07	.402E+06
3.000	1.500	2.375	.154	.190E+07	.635E+06
3.000	1.750	2.375	.154	.280E+07	.933E+06
3.000	2.000	2.375	.154	.391E+07	.130E+07
3.000	.250	3.500	.216	.321E+05	.107E+05
3.000	.375	3.500	.216	.886E+05	.295E+05
3.000	.500	3.500	.216	.182E+06	.606E+05
3.000	.625	3.500	.216	.318E+06	.106E+06
3.000	.750	3.500	.216	.501E+06	.167E+06
3.000	1.000	3.500	.216	.103E+07	.343E+06
3.000	1.250	3.500	.216	.180E+07	.599E+06
3.000	1.500	3.500	.216	.283E+07	.945E+06
3.000	1.750	3.500	.216	.417E+07	.139E+07
3.000	2.000	3.500	.216	.582E+07	.194E+07
3.000	.250	4.500	.237	.425E+05	.142E+05
3.000	.375	4.500	.237	.117E+06	.390E+05
3.000	.500	4.500	.237	.240E+06	.801E+05
3.000	.625	4.500	.237	.420E+06	.140E+06
3.000	.750	4.500	.237	.662E+06	.221E+06
3.000	1.000	4.500	.237	.136E+07	.453E+06
3.000	1.250	4.500	.237	.237E+07	.791E+06
3.000	1.500	4.500	.237	.375E+07	.125E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
3.000	1.750	4.500	.237	.551E+07	.184E+07
3.000	2.000	4.500	.237	.769E+07	.256E+07
3.000	.250	6.625	.280	.645E+05	.215E+05
3.000	.375	6.625	.280	.178E+06	.593E+05
3.000	.500	6.625	.280	.365E+06	.122E+06
3.000	.625	6.625	.280	.638E+06	.213E+06
3.000	.750	6.625	.280	.101E+07	.335E+06
3.000	1.000	6.625	.280	.207E+07	.688E+06
3.000	1.250	6.625	.280	.361E+07	.120E+07
3.000	1.500	6.625	.280	.569E+07	.190E+07
3.000	1.750	6.625	.280	.837E+07	.279E+07
3.000	2.000	6.625	.280	.117E+08	.389E+07
3.000	.250	8.625	.322	.853E+05	.284E+05
3.000	.375	8.625	.322	.235E+06	.783E+05
3.000	.500	8.625	.322	.482E+06	.161E+06
3.000	.625	8.625	.322	.843E+06	.281E+06
3.000	.750	8.625	.322	.133E+07	.443E+06
3.000	1.000	8.625	.322	.273E+07	.910E+06
3.000	1.250	8.625	.322	.477E+07	.159E+07
3.000	1.500	8.625	.322	.752E+07	.251E+07
3.000	1.750	8.625	.322	.111E+08	.369E+07
3.000	2.000	8.625	.322	.154E+08	.515E+07
3.000	.250	10.750	.365	.107E+06	.358E+05
3.000	.375	10.750	.365	.296E+06	.986E+05
3.000	.500	10.750	.365	.608E+06	.203E+06
3.000	.625	10.750	.365	.106E+07	.354E+06
3.000	.750	10.750	.365	.167E+07	.558E+06
3.000	1.000	10.750	.365	.344E+07	.115E+07
3.000	1.250	10.750	.365	.600E+07	.200E+07
3.000	1.500	10.750	.365	.947E+07	.316E+07
3.000	1.750	10.750	.365	.139E+08	.464E+07
3.000	2.000	10.750	.365	.194E+08	.648E+07
3.500	.250	2.375	.154	.200E+05	.667E+04
3.500	.375	2.375	.154	.551E+05	.184E+05
3.500	.500	2.375	.154	.113E+06	.377E+05
3.500	.625	2.375	.154	.198E+06	.659E+05
3.500	.750	2.375	.154	.312E+06	.104E+06
3.500	1.000	2.375	.154	.640E+06	.213E+06
3.500	1.250	2.375	.154	.112E+07	.373E+06
3.500	1.500	2.375	.154	.176E+07	.588E+06
3.500	1.750	2.375	.154	.259E+07	.864E+06
3.500	2.000	2.375	.154	.362E+07	.121E+07
3.500	.250	3.500	.216	.298E+05	.992E+04
3.500	.375	3.500	.216	.820E+05	.273E+05
3.500	.500	3.500	.216	.168E+06	.561E+05
3.500	.625	3.500	.216	.294E+06	.980E+05
3.500	.750	3.500	.216	.464E+06	.155E+06
3.500	1.000	3.500	.216	.952E+06	.317E+06
3.500	1.250	3.500	.216	.166E+07	.554E+06
3.500	1.500	3.500	.216	.262E+07	.875E+06
3.500	1.750	3.500	.216	.386E+07	.129E+07
3.500	2.000	3.500	.216	.539E+07	.180E+07
3.500	.250	4.500	.237	.393E+05	.131E+05
3.500	.375	4.500	.237	.108E+06	.361E+05
3.500	.500	4.500	.237	.222E+06	.741E+05
3.500	.625	4.500	.237	.389E+06	.130E+06
3.500	.750	4.500	.237	.613E+06	.204E+06
3.500	1.000	4.500	.237	.126E+07	.419E+06
3.500	1.250	4.500	.237	.220E+07	.733E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
3.500	1.500	4.500	.237	.347E+07	.116E+07
3.500	1.750	4.500	.237	.510E+07	.170E+07
3.500	2.000	4.500	.237	.712E+07	.237E+07
3.500	.250	6.625	.280	.597E+05	.199E+05
3.500	.375	6.625	.280	.165E+06	.549E+05
3.500	.500	6.625	.280	.338E+06	.113E+06
3.500	.625	6.625	.280	.590E+06	.197E+06
3.500	.750	6.625	.280	.931E+06	.310E+06
3.500	1.000	6.625	.280	.191E+07	.637E+06
3.500	1.250	6.625	.280	.334E+07	.111E+07
3.500	1.500	6.625	.280	.527E+07	.176E+07
3.500	1.750	6.625	.280	.775E+07	.258E+07
3.500	2.000	6.625	.280	.108E+08	.361E+07
3.500	.250	8.625	.322	.790E+05	.263E+05
3.500	.375	8.625	.322	.218E+06	.725E+05
3.500	.500	8.625	.322	.447E+06	.149E+06
3.500	.625	8.625	.322	.780E+06	.260E+06
3.500	.750	8.625	.322	.123E+07	.410E+06
3.500	1.000	8.625	.322	.253E+07	.842E+06
3.500	1.250	8.625	.322	.441E+07	.147E+07
3.500	1.500	8.625	.322	.696E+07	.232E+07
3.500	1.750	8.625	.322	.102E+08	.341E+07
3.500	2.000	8.625	.322	.143E+08	.476E+07
3.500	.250	10.750	.365	.994E+05	.331E+05
3.500	.375	10.750	.365	.274E+06	.913E+05
3.500	.500	10.750	.365	.562E+06	.187E+06
3.500	.625	10.750	.365	.983E+06	.328E+06
3.500	.750	10.750	.365	.155E+07	.517E+06
3.500	1.000	10.750	.365	.318E+07	.106E+07
3.500	1.250	10.750	.365	.556E+07	.185E+07
3.500	1.500	10.750	.365	.877E+07	.292E+07
3.500	1.750	10.750	.365	.129E+08	.430E+07
3.500	2.000	10.750	.365	.180E+08	.600E+07
3.500	.250	12.750	.375	.120E+06	.399E+05
3.500	.375	12.750	.375	.329E+06	.110E+06
3.500	.500	12.750	.375	.676E+06	.225E+06
3.500	.625	12.750	.375	.118E+07	.394E+06
3.500	.750	12.750	.375	.186E+07	.621E+06
3.500	1.000	12.750	.375	.383E+07	.128E+07
3.500	1.250	12.750	.375	.668E+07	.223E+07
3.500	1.500	12.750	.375	.105E+08	.351E+07
3.500	1.750	12.750	.375	.155E+08	.517E+07
3.500	2.000	12.750	.375	.216E+08	.721E+07
4.000	.250	2.375	.154	.187E+05	.624E+04
4.000	.375	2.375	.154	.515E+05	.172E+05
4.000	.500	2.375	.154	.106E+06	.353E+05
4.000	.625	2.375	.154	.185E+06	.616E+05
4.000	.750	2.375	.154	.292E+06	.972E+05
4.000	1.000	2.375	.154	.599E+06	.200E+06
4.000	1.250	2.375	.154	.105E+07	.349E+06
4.000	1.500	2.375	.154	.165E+07	.550E+06
4.000	1.750	2.375	.154	.243E+07	.808E+06
4.000	2.000	2.375	.154	.339E+07	.113E+07
4.000	.250	3.500	.216	.278E+05	.928E+04
4.000	.375	3.500	.216	.767E+05	.256E+05
4.000	.500	3.500	.216	.157E+06	.525E+05
4.000	.625	3.500	.216	.275E+06	.917E+05
4.000	.750	3.500	.216	.434E+06	.145E+06
4.000	1.000	3.500	.216	.891E+06	.297E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
4.000	1.250	3.500	.216	.156E+07	.519E+06
4.000	1.500	3.500	.216	.245E+07	.818E+06
4.000	1.750	3.500	.216	.361E+07	.120E+07
4.000	2.000	3.500	.216	.504E+07	.168E+07
4.000	.250	4.500	.237	.368E+05	.123E+05
4.000	.375	4.500	.237	.101E+06	.338E+05
4.000	.500	4.500	.237	.208E+06	.694E+05
4.000	.625	4.500	.237	.363E+06	.121E+06
4.000	.750	4.500	.237	.573E+06	.191E+06
4.000	1.000	4.500	.237	.118E+07	.392E+06
4.000	1.250	4.500	.237	.206E+07	.685E+06
4.000	1.500	4.500	.237	.324E+07	.108E+07
4.000	1.750	4.500	.237	.477E+07	.159E+07
4.000	2.000	4.500	.237	.666E+07	.222E+07
4.000	.250	6.625	.280	.559E+05	.186E+05
4.000	.375	6.625	.280	.154E+06	.513E+05
4.000	.500	6.625	.280	.316E+06	.105E+06
4.000	.625	6.625	.280	.552E+06	.184E+06
4.000	.750	6.625	.280	.871E+06	.290E+06
4.000	1.000	6.625	.280	.179E+07	.596E+06
4.000	1.250	6.625	.280	.312E+07	.104E+07
4.000	1.500	6.625	.280	.493E+07	.164E+07
4.000	1.750	6.625	.280	.725E+07	.242E+07
4.000	2.000	6.625	.280	.101E+08	.337E+07
4.000	.250	8.625	.322	.739E+05	.246E+05
4.000	.375	8.625	.322	.204E+06	.678E+05
4.000	.500	8.625	.322	.418E+06	.139E+06
4.000	.625	8.625	.322	.730E+06	.243E+06
4.000	.750	8.625	.322	.115E+07	.384E+06
4.000	1.000	8.625	.322	.236E+07	.788E+06
4.000	1.250	8.625	.322	.413E+07	.138E+07
4.000	1.500	8.625	.322	.651E+07	.217E+07
4.000	1.750	8.625	.322	.958E+07	.319E+07
4.000	2.000	8.625	.322	.134E+08	.446E+07
4.000	.250	10.750	.365	.930E+05	.310E+05
4.000	.375	10.750	.365	.256E+06	.854E+05
4.000	.500	10.750	.365	.526E+06	.175E+06
4.000	.625	10.750	.365	.919E+06	.306E+06
4.000	.750	10.750	.365	.145E+07	.483E+06
4.000	1.000	10.750	.365	.298E+07	.992E+06
4.000	1.250	10.750	.365	.520E+07	.173E+07
4.000	1.500	10.750	.365	.820E+07	.273E+07
4.000	1.750	10.750	.365	.121E+08	.402E+07
4.000	2.000	10.750	.365	.168E+08	.561E+07
4.000	.250	12.750	.375	.112E+06	.373E+05
4.000	.375	12.750	.375	.308E+06	.103E+06
4.000	.500	12.750	.375	.633E+06	.211E+06
4.000	.625	12.750	.375	.111E+07	.368E+06
4.000	.750	12.750	.375	.174E+07	.581E+06
4.000	1.000	12.750	.375	.358E+07	.119E+07
4.000	1.250	12.750	.375	.625E+07	.208E+07
4.000	1.500	12.750	.375	.986E+07	.329E+07
4.000	1.750	12.750	.375	.145E+08	.483E+07
4.000	2.000	12.750	.375	.202E+08	.675E+07
4.000	.250	14.000	.375	.124E+06	.413E+05
4.000	.375	14.000	.375	.341E+06	.114E+06
4.000	.500	14.000	.375	.700E+06	.233E+06
4.000	.625	14.000	.375	.122E+07	.408E+06
4.000	.750	14.000	.375	.193E+07	.643E+06
4.000	1.000	14.000	.375	.396E+07	.132E+07
4.000	1.250	14.000	.375	.692E+07	.231E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
4.000	1.500	14.000	.375	.109E+08	.364E+07
4.000	1.750	14.000	.375	.160E+08	.535E+07
4.000	2.000	14.000	.375	.224E+08	.747E+07
5.000	.250	2.375	.154	.167E+05	.558E+04
5.000	.375	2.375	.154	.461E+05	.154E+05
5.000	.500	2.375	.154	.946E+05	.315E+05
5.000	.625	2.375	.154	.165E+06	.551E+05
5.000	.750	2.375	.154	.261E+06	.869E+05
5.000	1.000	2.375	.154	.535E+06	.178E+06
5.000	1.250	2.375	.154	.935E+06	.312E+06
5.000	1.500	2.375	.154	.148E+07	.492E+06
5.000	1.750	2.375	.154	.217E+07	.723E+06
5.000	2.000	2.375	.154	.303E+07	.101E+07
5.000	.250	3.500	.216	.249E+05	.830E+04
5.000	.375	3.500	.216	.686E+05	.229E+05
5.000	.500	3.500	.216	.141E+06	.469E+05
5.000	.625	3.500	.216	.246E+06	.820E+05
5.000	.750	3.500	.216	.388E+06	.129E+06
5.000	1.000	3.500	.216	.797E+06	.266E+06
5.000	1.250	3.500	.216	.139E+07	.464E+06
5.000	1.500	3.500	.216	.220E+07	.732E+06
5.000	1.750	3.500	.216	.323E+07	.108E+07
5.000	2.000	3.500	.216	.451E+07	.150E+07
5.000	.250	4.500	.237	.329E+05	.110E+05
5.000	.375	4.500	.237	.907E+05	.302E+05
5.000	.500	4.500	.237	.186E+06	.620E+05
5.000	.625	4.500	.237	.325E+06	.108E+06
5.000	.750	4.500	.237	.513E+06	.171E+06
5.000	1.000	4.500	.237	.105E+07	.351E+06
5.000	1.250	4.500	.237	.184E+07	.613E+06
5.000	1.500	4.500	.237	.290E+07	.967E+06
5.000	1.750	4.500	.237	.427E+07	.142E+07
5.000	2.000	4.500	.237	.596E+07	.199E+07
5.000	.250	6.625	.280	.500E+05	.167E+05
5.000	.375	6.625	.280	.138E+06	.459E+05
5.000	.500	6.625	.280	.283E+06	.943E+05
5.000	.625	6.625	.280	.494E+06	.165E+06
5.000	.750	6.625	.280	.779E+06	.260E+06
5.000	1.000	6.625	.280	.160E+07	.533E+06
5.000	1.250	6.625	.280	.279E+07	.932E+06
5.000	1.500	6.625	.280	.441E+07	.147E+07
5.000	1.750	6.625	.280	.648E+07	.216E+07
5.000	2.000	6.625	.280	.905E+07	.302E+07
5.000	.250	8.625	.322	.661E+05	.220E+05
5.000	.375	8.625	.322	.182E+06	.607E+05
5.000	.500	8.625	.322	.374E+06	.125E+06
5.000	.625	8.625	.322	.653E+06	.218E+06
5.000	.750	8.625	.322	.103E+07	.343E+06
5.000	1.000	8.625	.322	.211E+07	.705E+06
5.000	1.250	8.625	.322	.369E+07	.123E+07
5.000	1.500	8.625	.322	.583E+07	.194E+07
5.000	1.750	8.625	.322	.856E+07	.285E+07
5.000	2.000	8.625	.322	.120E+08	.399E+07
5.000	.250	10.750	.365	.832E+05	.277E+05
5.000	.375	10.750	.365	.229E+06	.764E+05
5.000	.500	10.750	.365	.471E+06	.157E+06
5.000	.625	10.750	.365	.822E+06	.274E+06
5.000	.750	10.750	.365	.130E+07	.432E+06
5.000	1.000	10.750	.365	.266E+07	.887E+06
5.000	1.250	10.750	.365	.465E+07	.155E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
5.000	1.500	10.750	.365	.734E+07	.245E+07
5.000	1.750	10.750	.365	.108E+08	.359E+07
5.000	2.000	10.750	.365	.151E+08	.502E+07
5.000	.250	12.750	.375	.100E+06	.333E+05
5.000	.375	12.750	.375	.276E+06	.919E+05
5.000	.500	12.750	.375	.566E+06	.189E+06
5.000	.625	12.750	.375	.989E+06	.330E+06
5.000	.750	12.750	.375	.156E+07	.520E+06
5.000	1.000	12.750	.375	.320E+07	.107E+07
5.000	1.250	12.750	.375	.559E+07	.186E+07
5.000	1.500	12.750	.375	.882E+07	.294E+07
5.000	1.750	12.750	.375	.130E+08	.432E+07
5.000	2.000	12.750	.375	.181E+08	.604E+07
5.000	.250	14.000	.375	.111E+06	.369E+05
5.000	.375	14.000	.375	.305E+06	.102E+06
5.000	.500	14.000	.375	.626E+06	.209E+06
5.000	.625	14.000	.375	.109E+07	.365E+06
5.000	.750	14.000	.375	.173E+07	.575E+06
5.000	1.000	14.000	.375	.354E+07	.118E+07
5.000	1.250	14.000	.375	.619E+07	.206E+07
5.000	1.500	14.000	.375	.976E+07	.325E+07
5.000	1.750	14.000	.375	.144E+08	.478E+07
5.000	2.000	14.000	.375	.200E+08	.668E+07
5.000	.250	16.000	.375	.128E+06	.426E+05
5.000	.375	16.000	.375	.352E+06	.117E+06
5.000	.500	16.000	.375	.723E+06	.241E+06
5.000	.625	16.000	.375	.126E+07	.421E+06
5.000	.750	16.000	.375	.199E+07	.664E+06
5.000	1.000	16.000	.375	.409E+07	.136E+07
5.000	1.250	16.000	.375	.715E+07	.238E+07
5.000	1.500	16.000	.375	.113E+08	.376E+07
5.000	1.750	16.000	.375	.166E+08	.552E+07
5.000	2.000	16.000	.375	.231E+08	.771E+07
5.000	.250	18.000	.375	.145E+06	.483E+05
5.000	.375	18.000	.375	.399E+06	.133E+06
5.000	.500	18.000	.375	.820E+06	.273E+06
5.000	.625	18.000	.375	.143E+07	.477E+06
5.000	.750	18.000	.375	.226E+07	.753E+06
5.000	1.000	18.000	.375	.464E+07	.155E+07
5.000	1.250	18.000	.375	.810E+07	.270E+07
5.000	1.500	18.000	.375	.128E+08	.426E+07
5.000	1.750	18.000	.375	.188E+08	.626E+07
5.000	2.000	18.000	.375	.262E+08	.875E+07
6.000	.250	2.375	.154	.153E+05	.509E+04
6.000	.375	2.375	.154	.421E+05	.140E+05
6.000	.500	2.375	.154	.864E+05	.288E+05
6.000	.625	2.375	.154	.151E+06	.503E+05
6.000	.750	2.375	.154	.238E+06	.794E+05
6.000	1.000	2.375	.154	.489E+06	.163E+06
6.000	1.250	2.375	.154	.854E+06	.285E+06
6.000	1.500	2.375	.154	.135E+07	.449E+06
6.000	1.750	2.375	.154	.198E+07	.660E+06
6.000	2.000	2.375	.154	.276E+07	.922E+06
6.000	.250	3.500	.216	.227E+05	.757E+04
6.000	.375	3.500	.216	.626E+05	.209E+05
6.000	.500	3.500	.216	.129E+06	.428E+05
6.000	.625	3.500	.216	.225E+06	.749E+05
6.000	.750	3.500	.216	.354E+06	.118E+06
6.000	1.000	3.500	.216	.727E+06	.242E+06
6.000	1.250	3.500	.216	.127E+07	.423E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN-LB/DEG INPLANE LONGI	OUTPLANE CIRCU
6.000	1.500	3.500	.216	.200E+07	.668E+06
6.000	1.750	3.500	.216	.295E+07	.982E+06
6.000	2.000	3.500	.216	.411E+07	.137E+07
6.000	.250	4.500	.237	.300E+05	.100E+05
6.000	.375	4.500	.237	.828E+05	.276E+05
6.000	.500	4.500	.237	.170E+06	.566E+05
6.000	.625	4.500	.237	.297E+06	.989E+05
6.000	.750	4.500	.237	.468E+06	.156E+06
6.000	1.000	4.500	.237	.961E+06	.320E+06
6.000	1.250	4.500	.237	.168E+07	.560E+06
6.000	1.500	4.500	.237	.265E+07	.883E+06
6.000	1.750	4.500	.237	.389E+07	.130E+07
6.000	2.000	4.500	.237	.544E+07	.181E+07
6.000	.250	6.625	.280	.456E+05	.152E+05
6.000	.375	6.625	.280	.126E+06	.419E+05
6.000	.500	6.625	.280	.258E+06	.860E+05
6.000	.625	6.625	.280	.451E+06	.150E+06
6.000	.750	6.625	.280	.711E+06	.237E+06
6.000	1.000	6.625	.280	.146E+07	.487E+06
6.000	1.250	6.625	.280	.255E+07	.850E+06
6.000	1.500	6.625	.280	.402E+07	.134E+07
6.000	1.750	6.625	.280	.592E+07	.197E+07
6.000	2.000	6.625	.280	.826E+07	.275E+07
6.000	.250	8.625	.322	.603E+05	.201E+05
6.000	.375	8.625	.322	.166E+06	.554E+05
6.000	.500	8.625	.322	.341E+06	.114E+06
6.000	.625	8.625	.322	.596E+06	.199E+06
6.000	.750	8.625	.322	.940E+06	.313E+06
6.000	1.000	8.625	.322	.193E+07	.643E+06
6.000	1.250	8.625	.322	.337E+07	.112E+07
6.000	1.500	8.625	.322	.532E+07	.177E+07
6.000	1.750	8.625	.322	.782E+07	.261E+07
6.000	2.000	8.625	.322	.109E+08	.364E+07
6.000	.250	10.750	.365	.759E+05	.253E+05
6.000	.375	10.750	.365	.209E+06	.698E+05
6.000	.500	10.750	.365	.430E+06	.143E+06
6.000	.625	10.750	.365	.750E+06	.250E+06
6.000	.750	10.750	.365	.118E+07	.395E+06
6.000	1.000	10.750	.365	.243E+07	.810E+06
6.000	1.250	10.750	.365	.425E+07	.142E+07
6.000	1.500	10.750	.365	.670E+07	.223E+07
6.000	1.750	10.750	.365	.984E+07	.328E+07
6.000	2.000	10.750	.365	.137E+08	.458E+07
6.000	.250	12.750	.375	.913E+05	.304E+05
6.000	.375	12.750	.375	.252E+06	.839E+05
6.000	.500	12.750	.375	.517E+06	.172E+06
6.000	.625	12.750	.375	.902E+06	.301E+06
6.000	.750	12.750	.375	.142E+07	.474E+06
6.000	1.000	12.750	.375	.292E+07	.974E+06
6.000	1.250	12.750	.375	.510E+07	.170E+07
6.000	1.500	12.750	.375	.805E+07	.268E+07
6.000	1.750	12.750	.375	.118E+08	.395E+07
6.000	2.000	12.750	.375	.165E+08	.551E+07
6.000	.250	14.000	.375	.101E+06	.337E+05
6.000	.375	14.000	.375	.279E+06	.928E+05
6.000	.500	14.000	.375	.572E+06	.191E+06
6.000	.625	14.000	.375	.999E+06	.333E+06
6.000	.750	14.000	.375	.158E+07	.525E+06
6.000	1.000	14.000	.375	.323E+07	.108E+07
6.000	1.250	14.000	.375	.565E+07	.188E+07
6.000	1.500	14.000	.375	.891E+07	.297E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
6.000	1.750	14.000	.375	.131E+08	.437E+07
6.000	2.000	14.000	.375	.183E+08	.610E+07
6.000	.250	16.000	.375	.117E+06	.389E+05
6.000	.375	16.000	.375	.322E+06	.107E+06
6.000	.500	16.000	.375	.660E+06	.220E+06
6.000	.625	16.000	.375	.115E+07	.384E+06
6.000	.750	16.000	.375	.182E+07	.606E+06
6.000	1.000	16.000	.375	.373E+07	.124E+07
6.000	1.250	16.000	.375	.652E+07	.217E+07
6.000	1.500	16.000	.375	.103E+08	.343E+07
6.000	1.750	16.000	.375	.151E+08	.504E+07
6.000	2.000	16.000	.375	.211E+08	.704E+07
6.000	.250	18.000	.375	.132E+06	.441E+05
6.000	.375	18.000	.375	.365E+06	.122E+06
6.000	.500	18.000	.375	.748E+06	.249E+06
6.000	.625	18.000	.375	.131E+07	.436E+06
6.000	.750	18.000	.375	.206E+07	.687E+06
6.000	1.000	18.000	.375	.423E+07	.141E+07
6.000	1.250	18.000	.375	.740E+07	.247E+07
6.000	1.500	18.000	.375	.117E+08	.389E+07
6.000	1.750	18.000	.375	.172E+08	.572E+07
6.000	2.000	18.000	.375	.239E+08	.798E+07
6.000	.250	20.000	.375	.148E+06	.493E+05
6.000	.375	20.000	.375	.408E+06	.136E+06
6.000	.500	20.000	.375	.837E+06	.279E+06
6.000	.625	20.000	.375	.146E+07	.487E+06
6.000	.750	20.000	.375	.231E+07	.769E+06
6.000	1.000	20.000	.375	.473E+07	.158E+07
6.000	1.250	20.000	.375	.827E+07	.276E+07
6.000	1.500	20.000	.375	.130E+08	.435E+07
6.000	1.750	20.000	.375	.192E+08	.639E+07
6.000	2.000	20.000	.375	.268E+08	.893E+07
6.000	.250	22.000	.375	.164E+06	.545E+05
6.000	.375	22.000	.375	.451E+06	.150E+06
6.000	.500	22.000	.375	.925E+06	.308E+06
6.000	.625	22.000	.375	.162E+07	.539E+06
6.000	.750	22.000	.375	.255E+07	.850E+06
6.000	1.000	22.000	.375	.523E+07	.174E+07
6.000	1.250	22.000	.375	.914E+07	.305E+07
6.000	1.500	22.000	.375	.144E+08	.481E+07
6.000	1.750	22.000	.375	.212E+08	.707E+07
6.000	2.000	22.000	.375	.296E+08	.987E+07
7.000	.250	2.375	.154	.141E+05	.471E+04
7.000	.375	2.375	.154	.390E+05	.130E+05
7.000	.500	2.375	.154	.800E+05	.267E+05
7.000	.625	2.375	.154	.140E+06	.466E+05
7.000	.750	2.375	.154	.220E+06	.735E+05
7.000	1.000	2.375	.154	.452E+06	.151E+06
7.000	1.250	2.375	.154	.790E+06	.263E+06
7.000	1.500	2.375	.154	.125E+07	.416E+06
7.000	1.750	2.375	.154	.183E+07	.611E+06
7.000	2.000	2.375	.154	.256E+07	.853E+06
7.000	.250	3.500	.216	.210E+05	.701E+04
7.000	.375	3.500	.216	.580E+05	.193E+05
7.000	.500	3.500	.216	.119E+06	.397E+05
7.000	.625	3.500	.216	.208E+06	.693E+05
7.000	.750	3.500	.216	.328E+06	.109E+06
7.000	1.000	3.500	.216	.673E+06	.224E+06
7.000	1.250	3.500	.216	.118E+07	.392E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
7.000	1.500	3.500	.216	.186E+07	.618E+06
7.000	1.750	3.500	.216	.273E+07	.909E+06
7.000	2.000	3.500	.216	.381E+07	.127E+07
7.000	.250	4.500	.237	.278E+05	.927E+04
7.000	.375	4.500	.237	.766E+05	.255E+05
7.000	.500	4.500	.237	.157E+06	.524E+05
7.000	.625	4.500	.237	.275E+06	.916E+05
7.000	.750	4.500	.237	.433E+06	.144E+06
7.000	1.000	4.500	.237	.890E+06	.297E+06
7.000	1.250	4.500	.237	.155E+07	.518E+06
7.000	1.500	4.500	.237	.245E+07	.817E+06
7.000	1.750	4.500	.237	.360E+07	.120E+07
7.000	2.000	4.500	.237	.503E+07	.168E+07
7.000	.250	6.625	.280	.422E+05	.141E+05
7.000	.375	6.625	.280	.116E+06	.388E+05
7.000	.500	6.625	.280	.239E+06	.797E+05
7.000	.625	6.625	.280	.418E+06	.139E+06
7.000	.750	6.625	.280	.659E+06	.220E+06
7.000	1.000	6.625	.280	.135E+07	.451E+06
7.000	1.250	6.625	.280	.236E+07	.787E+06
7.000	1.500	6.625	.280	.373E+07	.124E+07
7.000	1.750	6.625	.280	.548E+07	.183E+07
7.000	2.000	6.625	.280	.765E+07	.255E+07
7.000	.250	8.625	.322	.558E+05	.186E+05
7.000	.375	8.625	.322	.154E+06	.513E+05
7.000	.500	8.625	.322	.316E+06	.105E+06
7.000	.625	8.625	.322	.552E+06	.184E+06
7.000	.750	8.625	.322	.870E+06	.290E+06
7.000	1.000	8.625	.322	.179E+07	.596E+06
7.000	1.250	8.625	.322	.312E+07	.104E+07
7.000	1.500	8.625	.322	.492E+07	.164E+07
7.000	1.750	8.625	.322	.724E+07	.241E+07
7.000	2.000	8.625	.322	.101E+08	.337E+07
7.000	.250	10.750	.365	.703E+05	.234E+05
7.000	.375	10.750	.365	.194E+06	.646E+05
7.000	.500	10.750	.365	.398E+06	.133E+06
7.000	.625	10.750	.365	.695E+06	.232E+06
7.000	.750	10.750	.365	.110E+07	.365E+06
7.000	1.000	10.750	.365	.225E+07	.750E+06
7.000	1.250	10.750	.365	.393E+07	.131E+07
7.000	1.500	10.750	.365	.620E+07	.207E+07
7.000	1.750	10.750	.365	.911E+07	.304E+07
7.000	2.000	10.750	.365	.127E+08	.424E+07
7.000	.250	12.750	.375	.845E+05	.282E+05
7.000	.375	12.750	.375	.233E+06	.777E+05
7.000	.500	12.750	.375	.478E+06	.159E+06
7.000	.625	12.750	.375	.835E+06	.278E+06
7.000	.750	12.750	.375	.132E+07	.439E+06
7.000	1.000	12.750	.375	.271E+07	.902E+06
7.000	1.250	12.750	.375	.473E+07	.158E+07
7.000	1.500	12.750	.375	.745E+07	.248E+07
7.000	1.750	12.750	.375	.110E+08	.365E+07
7.000	2.000	12.750	.375	.153E+08	.510E+07
7.000	.250	14.000	.375	.936E+05	.312E+05
7.000	.375	14.000	.375	.258E+06	.859E+05
7.000	.500	14.000	.375	.529E+06	.176E+06
7.000	.625	14.000	.375	.925E+06	.308E+06
7.000	.750	14.000	.375	.146E+07	.486E+06
7.000	1.000	14.000	.375	.299E+07	.998E+06
7.000	1.250	14.000	.375	.523E+07	.174E+07
7.000	1.500	14.000	.375	.825E+07	.275E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
7.000	1.750	14.000	.375	.121E+08	.404E+07
7.000	2.000	14.000	.375	.169E+08	.565E+07
7.000	.250	16.000	.375	.108E+06	.360E+05
7.000	.375	16.000	.375	.298E+06	.992E+05
7.000	.500	16.000	.375	.611E+06	.204E+06
7.000	.625	16.000	.375	.107E+07	.356E+06
7.000	.750	16.000	.375	.168E+07	.561E+06
7.000	1.000	16.000	.375	.346E+07	.115E+07
7.000	1.250	16.000	.375	.604E+07	.201E+07
7.000	1.500	16.000	.375	.953E+07	.318E+07
7.000	1.750	16.000	.375	.140E+08	.467E+07
7.000	2.000	16.000	.375	.196E+08	.652E+07
7.000	.250	18.000	.375	.122E+06	.408E+05
7.000	.375	18.000	.375	.338E+06	.113E+06
7.000	.500	18.000	.375	.693E+06	.231E+06
7.000	.625	18.000	.375	.121E+07	.403E+06
7.000	.750	18.000	.375	.191E+07	.636E+06
7.000	1.000	18.000	.375	.392E+07	.131E+07
7.000	1.250	18.000	.375	.685E+07	.228E+07
7.000	1.500	18.000	.375	.108E+08	.360E+07
7.000	1.750	18.000	.375	.159E+08	.529E+07
7.000	2.000	18.000	.375	.222E+08	.739E+07
7.000	.250	20.000	.375	.137E+06	.457E+05
7.000	.375	20.000	.375	.377E+06	.126E+06
7.000	.500	20.000	.375	.775E+06	.258E+06
7.000	.625	20.000	.375	.135E+07	.451E+06
7.000	.750	20.000	.375	.213E+07	.712E+06
7.000	1.000	20.000	.375	.438E+07	.146E+07
7.000	1.250	20.000	.375	.766E+07	.255E+07
7.000	1.500	20.000	.375	.121E+08	.403E+07
7.000	1.750	20.000	.375	.178E+08	.592E+07
7.000	2.000	20.000	.375	.248E+08	.826E+07
7.000	.250	22.000	.375	.151E+06	.505E+05
7.000	.375	22.000	.375	.417E+06	.139E+06
7.000	.500	22.000	.375	.857E+06	.286E+06
7.000	.625	22.000	.375	.150E+07	.499E+06
7.000	.750	22.000	.375	.236E+07	.787E+06
7.000	1.000	22.000	.375	.485E+07	.162E+07
7.000	1.250	22.000	.375	.847E+07	.282E+07
7.000	1.500	22.000	.375	.134E+08	.445E+07
7.000	1.750	22.000	.375	.196E+08	.654E+07
7.000	2.000	22.000	.375	.274E+08	.914E+07
7.000	.250	24.000	.375	.166E+06	.553E+05
7.000	.375	24.000	.375	.457E+06	.152E+06
7.000	.500	24.000	.375	.938E+06	.313E+06
7.000	.625	24.000	.375	.164E+07	.546E+06
7.000	.750	24.000	.375	.259E+07	.862E+06
7.000	1.000	24.000	.375	.531E+07	.177E+07
7.000	1.250	24.000	.375	.927E+07	.309E+07
7.000	1.500	24.000	.375	.146E+08	.488E+07
7.000	1.750	24.000	.375	.215E+08	.717E+07
7.000	2.000	24.000	.375	.300E+08	.100E+08
7.000	.250	26.000	.375	.180E+06	.601E+05
7.000	.375	26.000	.375	.497E+06	.166E+06
7.000	.500	26.000	.375	.102E+07	.340E+06
7.000	.625	26.000	.375	.178E+07	.594E+06
7.000	.750	26.000	.375	.281E+07	.937E+06
7.000	1.000	26.000	.375	.577E+07	.192E+07
7.000	1.250	26.000	.375	.101E+08	.336E+07
7.000	1.500	26.000	.375	.159E+08	.530E+07
7.000	1.750	26.000	.375	.234E+08	.779E+07
7.000	2.000	26.000	.375	.327E+08	.109E+08

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
8.000	.250	2.375	.154	.132E+05	.441E+04
8.000	.375	2.375	.154	.364E+05	.121E+05
8.000	.500	2.375	.154	.748E+05	.249E+05
8.000	.625	2.375	.154	.131E+06	.436E+05
8.000	.750	2.375	.154	.206E+06	.687E+05
8.000	1.000	2.375	.154	.423E+06	.141E+06
8.000	1.250	2.375	.154	.739E+06	.246E+06
8.000	1.500	2.375	.154	.117E+07	.389E+06
8.000	1.750	2.375	.154	.171E+07	.572E+06
8.000	2.000	2.375	.154	.239E+07	.798E+06
8.000	.250	3.500	.216	.197E+05	.656E+04
8.000	.375	3.500	.216	.542E+05	.181E+05
8.000	.500	3.500	.216	.111E+06	.371E+05
8.000	.625	3.500	.216	.194E+06	.648E+05
8.000	.750	3.500	.216	.307E+06	.102E+06
8.000	1.000	3.500	.216	.630E+06	.210E+06
8.000	1.250	3.500	.216	.110E+07	.367E+06
8.000	1.500	3.500	.216	.174E+07	.578E+06
8.000	1.750	3.500	.216	.255E+07	.850E+06
8.000	2.000	3.500	.216	.356E+07	.119E+07
8.000	.250	4.500	.237	.260E+05	.867E+04
8.000	.375	4.500	.237	.717E+05	.239E+05
8.000	.500	4.500	.237	.147E+06	.490E+05
8.000	.625	4.500	.237	.257E+06	.857E+05
8.000	.750	4.500	.237	.405E+06	.135E+06
8.000	1.000	4.500	.237	.832E+06	.277E+06
8.000	1.250	4.500	.237	.145E+07	.485E+06
8.000	1.500	4.500	.237	.229E+07	.764E+06
8.000	1.750	4.500	.237	.337E+07	.112E+07
8.000	2.000	4.500	.237	.471E+07	.157E+07
8.000	.250	6.625	.280	.395E+05	.132E+05
8.000	.375	6.625	.280	.109E+06	.363E+05
8.000	.500	6.625	.280	.224E+06	.745E+05
8.000	.625	6.625	.280	.391E+06	.130E+06
8.000	.750	6.625	.280	.616E+06	.205E+06
8.000	1.000	6.625	.280	.126E+07	.422E+06
8.000	1.250	6.625	.280	.221E+07	.736E+06
8.000	1.500	6.625	.280	.349E+07	.116E+07
8.000	1.750	6.625	.280	.512E+07	.171E+07
8.000	2.000	6.625	.280	.715E+07	.238E+07
8.000	.250	8.625	.322	.522E+05	.174E+05
8.000	.375	8.625	.322	.144E+06	.480E+05
8.000	.500	8.625	.322	.295E+06	.985E+05
8.000	.625	8.625	.322	.516E+06	.172E+06
8.000	.750	8.625	.322	.814E+06	.271E+06
8.000	1.000	8.625	.322	.167E+07	.557E+06
8.000	1.250	8.625	.322	.292E+07	.973E+06
8.000	1.500	8.625	.322	.461E+07	.154E+07
8.000	1.750	8.625	.322	.677E+07	.226E+07
8.000	2.000	8.625	.322	.945E+07	.315E+07
8.000	.250	10.750	.365	.658E+05	.219E+05
8.000	.375	10.750	.365	.181E+06	.604E+05
8.000	.500	10.750	.365	.372E+06	.124E+06
8.000	.625	10.750	.365	.650E+06	.217E+06
8.000	.750	10.750	.365	.103E+07	.342E+06
8.000	1.000	10.750	.365	.210E+07	.701E+06
8.000	1.250	10.750	.365	.368E+07	.123E+07
8.000	1.500	10.750	.365	.580E+07	.193E+07
8.000	1.750	10.750	.365	.853E+07	.284E+07
8.000	2.000	10.750	.365	.119E+08	.397E+07
8.000	.250	12.750	.375	.791E+05	.264E+05
8.000	.375	12.750	.375	.218E+06	.726E+05

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
8.000	.500	12.750	.375	.447E+06	.149E+06
8.000	.625	12.750	.375	.781E+06	.260E+06
8.000	.750	12.750	.375	.123E+07	.411E+06
8.000	1.000	12.750	.375	.253E+07	.844E+06
8.000	1.250	12.750	.375	.442E+07	.147E+07
8.000	1.500	12.750	.375	.697E+07	.232E+07
8.000	1.750	12.750	.375	.103E+08	.342E+07
8.000	2.000	12.750	.375	.143E+08	.477E+07
8.000	.250	14.000	.375	.875E+05	.292E+05
8.000	.375	14.000	.375	.241E+06	.804E+05
8.000	.500	14.000	.375	.495E+06	.165E+06
8.000	.625	14.000	.375	.865E+06	.288E+06
8.000	.750	14.000	.375	.136E+07	.455E+06
8.000	1.000	14.000	.375	.280E+07	.934E+06
8.000	1.250	14.000	.375	.489E+07	.163E+07
8.000	1.500	14.000	.375	.772E+07	.257E+07
8.000	1.750	14.000	.375	.113E+08	.378E+07
8.000	2.000	14.000	.375	.158E+08	.528E+07
8.000	.250	16.000	.375	.101E+06	.337E+05
8.000	.375	16.000	.375	.278E+06	.928E+05
8.000	.500	16.000	.375	.572E+06	.191E+06
8.000	.625	16.000	.375	.999E+06	.333E+06
8.000	.750	16.000	.375	.158E+07	.525E+06
8.000	1.000	16.000	.375	.323E+07	.108E+07
8.000	1.250	16.000	.375	.565E+07	.188E+07
8.000	1.500	16.000	.375	.891E+07	.297E+07
8.000	1.750	16.000	.375	.131E+08	.437E+07
8.000	2.000	16.000	.375	.183E+08	.610E+07
8.000	.250	18.000	.375	.115E+06	.382E+05
8.000	.375	18.000	.375	.316E+06	.105E+06
8.000	.500	18.000	.375	.648E+06	.216E+06
8.000	.625	18.000	.375	.113E+07	.377E+06
8.000	.750	18.000	.375	.179E+07	.595E+06
8.000	1.000	18.000	.375	.367E+07	.122E+07
8.000	1.250	18.000	.375	.641E+07	.214E+07
8.000	1.500	18.000	.375	.101E+08	.337E+07
8.000	1.750	18.000	.375	.149E+08	.495E+07
8.000	2.000	18.000	.375	.207E+08	.691E+07
8.000	.250	20.000	.375	.128E+06	.427E+05
8.000	.375	20.000	.375	.353E+06	.118E+06
8.000	.500	20.000	.375	.725E+06	.242E+06
8.000	.625	20.000	.375	.127E+07	.422E+06
8.000	.750	20.000	.375	.200E+07	.666E+06
8.000	1.000	20.000	.375	.410E+07	.137E+07
8.000	1.250	20.000	.375	.716E+07	.239E+07
8.000	1.500	20.000	.375	.113E+08	.377E+07
8.000	1.750	20.000	.375	.166E+08	.554E+07
8.000	2.000	20.000	.375	.232E+08	.773E+07
8.000	.250	22.000	.375	.142E+06	.472E+05
8.000	.375	22.000	.375	.390E+06	.130E+06
8.000	.500	22.000	.375	.801E+06	.267E+06
8.000	.625	22.000	.375	.140E+07	.467E+06
8.000	.750	22.000	.375	.221E+07	.736E+06
8.000	1.000	22.000	.375	.453E+07	.151E+07
8.000	1.250	22.000	.375	.792E+07	.264E+07
8.000	1.500	22.000	.375	.125E+08	.416E+07
8.000	1.750	22.000	.375	.184E+08	.612E+07
8.000	2.000	22.000	.375	.256E+08	.855E+07
8.000	.250	24.000	.375	.155E+06	.517E+05
8.000	.375	24.000	.375	.428E+06	.143E+06
8.000	.500	24.000	.375	.878E+06	.293E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
8.000	.625	24.000	.375	.153E+07	.511E+06
8.000	.750	24.000	.375	.242E+07	.806E+06
8.000	1.000	24.000	.375	.497E+07	.166E+07
8.000	1.250	24.000	.375	.868E+07	.289E+07
8.000	1.500	24.000	.375	.137E+08	.456E+07
8.000	1.750	24.000	.375	.201E+08	.671E+07
8.000	2.000	24.000	.375	.281E+08	.936E+07
8.000	.250	26.000	.375	.169E+06	.562E+05
8.000	.375	26.000	.375	.465E+06	.155E+06
8.000	.500	26.000	.375	.954E+06	.318E+06
8.000	.625	26.000	.375	.167E+07	.556E+06
8.000	.750	26.000	.375	.263E+07	.877E+06
8.000	1.000	26.000	.375	.540E+07	.180E+07
8.000	1.250	26.000	.375	.943E+07	.314E+07
8.000	1.500	26.000	.375	.149E+08	.496E+07
8.000	1.750	26.000	.375	.219E+08	.729E+07
8.000	2.000	26.000	.375	.305E+08	.102E+08
8.000	.250	28.000	.375	.182E+06	.608E+05
8.000	.375	28.000	.375	.502E+06	.167E+06
8.000	.500	28.000	.375	.103E+07	.344E+06
8.000	.625	28.000	.375	.180E+07	.600E+06
8.000	.750	28.000	.375	.284E+07	.947E+06
8.000	1.000	28.000	.375	.583E+07	.194E+07
8.000	1.250	28.000	.375	.102E+08	.340E+07
8.000	1.500	28.000	.375	.161E+08	.536E+07
8.000	1.750	28.000	.375	.236E+08	.788E+07
8.000	2.000	28.000	.375	.330E+08	.110E+08
8.000	.250	30.000	.375	.196E+06	.653E+05
8.000	.375	30.000	.375	.540E+06	.180E+06
8.000	.500	30.000	.375	.111E+07	.369E+06
8.000	.625	30.000	.375	.194E+07	.645E+06
8.000	.750	30.000	.375	.305E+07	.102E+07
8.000	1.000	30.000	.375	.627E+07	.209E+07
8.000	1.250	30.000	.375	.109E+08	.365E+07
8.000	1.500	30.000	.375	.173E+08	.576E+07
8.000	1.750	30.000	.375	.254E+08	.846E+07
8.000	2.000	30.000	.375	.354E+08	.118E+08
9.000	.250	2.375	.154	.125E+05	.416E+04
9.000	.375	2.375	.154	.344E+05	.115E+05
9.000	.500	2.375	.154	.705E+05	.235E+05
9.000	.625	2.375	.154	.123E+06	.411E+05
9.000	.750	2.375	.154	.194E+06	.648E+05
9.000	1.000	2.375	.154	.399E+06	.133E+06
9.000	1.250	2.375	.154	.697E+06	.232E+06
9.000	1.500	2.375	.154	.110E+07	.367E+06
9.000	1.750	2.375	.154	.162E+07	.539E+06
9.000	2.000	2.375	.154	.226E+07	.752E+06
9.000	.250	3.500	.216	.186E+05	.618E+04
9.000	.375	3.500	.216	.511E+05	.170E+05
9.000	.500	3.500	.216	.105E+06	.350E+05
9.000	.625	3.500	.216	.183E+06	.611E+05
9.000	.750	3.500	.216	.289E+06	.964E+05
9.000	1.000	3.500	.216	.594E+06	.198E+06
9.000	1.250	3.500	.216	.104E+07	.346E+06
9.000	1.500	3.500	.216	.164E+07	.545E+06
9.000	1.750	3.500	.216	.241E+07	.802E+06
9.000	2.000	3.500	.216	.336E+07	.112E+07
9.000	.250	4.500	.237	.245E+05	.817E+04
9.000	.375	4.500	.237	.676E+05	.225E+05

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
9.000	.500	4.500	.237	.139E+06	.462E+05
9.000	.625	4.500	.237	.242E+06	.808E+05
9.000	.750	4.500	.237	.382E+06	.127E+06
9.000	1.000	4.500	.237	.785E+06	.262E+06
9.000	1.250	4.500	.237	.137E+07	.457E+06
9.000	1.500	4.500	.237	.216E+07	.721E+06
9.000	1.750	4.500	.237	.318E+07	.106E+07
9.000	2.000	4.500	.237	.444E+07	.148E+07
9.000	.250	6.625	.280	.373E+05	.124E+05
9.000	.375	6.625	.280	.103E+06	.342E+05
9.000	.500	6.625	.280	.211E+06	.703E+05
9.000	.625	6.625	.280	.368E+06	.123E+06
9.000	.750	6.625	.280	.581E+06	.194E+06
9.000	1.000	6.625	.280	.119E+07	.397E+06
9.000	1.250	6.625	.280	.208E+07	.694E+06
9.000	1.500	6.625	.280	.329E+07	.110E+07
9.000	1.750	6.625	.280	.483E+07	.161E+07
9.000	2.000	6.625	.280	.674E+07	.225E+07
9.000	.250	8.625	.322	.492E+05	.164E+05
9.000	.375	8.625	.322	.136E+06	.452E+05
9.000	.500	8.625	.322	.279E+06	.928E+05
9.000	.625	8.625	.322	.487E+06	.162E+06
9.000	.750	8.625	.322	.768E+06	.256E+06
9.000	1.000	8.625	.322	.158E+07	.525E+06
9.000	1.250	8.625	.322	.275E+07	.918E+06
9.000	1.500	8.625	.322	.434E+07	.145E+07
9.000	1.750	8.625	.322	.638E+07	.213E+07
9.000	2.000	8.625	.322	.891E+07	.297E+07
9.000	.250	10.750	.365	.620E+05	.207E+05
9.000	.375	10.750	.365	.171E+06	.570E+05
9.000	.500	10.750	.365	.351E+06	.117E+06
9.000	.625	10.750	.365	.613E+06	.204E+06
9.000	.750	10.750	.365	.967E+06	.322E+06
9.000	1.000	10.750	.365	.198E+07	.661E+06
9.000	1.250	10.750	.365	.347E+07	.116E+07
9.000	1.500	10.750	.365	.547E+07	.182E+07
9.000	1.750	10.750	.365	.804E+07	.268E+07
9.000	2.000	10.750	.365	.112E+08	.374E+07
9.000	.250	12.750	.375	.746E+05	.249E+05
9.000	.375	12.750	.375	.205E+06	.685E+05
9.000	.500	12.750	.375	.422E+06	.141E+06
9.000	.625	12.750	.375	.737E+06	.246E+06
9.000	.750	12.750	.375	.116E+07	.387E+06
9.000	1.000	12.750	.375	.239E+07	.795E+06
9.000	1.250	12.750	.375	.417E+07	.139E+07
9.000	1.500	12.750	.375	.657E+07	.219E+07
9.000	1.750	12.750	.375	.967E+07	.322E+07
9.000	2.000	12.750	.375	.135E+08	.450E+07
9.000	.250	14.000	.375	.825E+05	.275E+05
9.000	.375	14.000	.375	.227E+06	.758E+05
9.000	.500	14.000	.375	.467E+06	.156E+06
9.000	.625	14.000	.375	.815E+06	.272E+06
9.000	.750	14.000	.375	.129E+07	.429E+06
9.000	1.000	14.000	.375	.264E+07	.880E+06
9.000	1.250	14.000	.375	.461E+07	.154E+07
9.000	1.500	14.000	.375	.728E+07	.243E+07
9.000	1.750	14.000	.375	.107E+08	.357E+07
9.000	2.000	14.000	.375	.149E+08	.498E+07
9.000	.250	16.000	.375	.953E+05	.318E+05
9.000	.375	16.000	.375	.263E+06	.875E+05
9.000	.500	16.000	.375	.539E+06	.180E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
9.000	.625	16.000	.375	.941E+06	.314E+06
9.000	.750	16.000	.375	.149E+07	.495E+06
9.000	1.000	16.000	.375	.305E+07	.102E+07
9.000	1.250	16.000	.375	.533E+07	.178E+07
9.000	1.500	16.000	.375	.840E+07	.280E+07
9.000	1.750	16.000	.375	.124E+08	.412E+07
9.000	2.000	16.000	.375	.172E+08	.575E+07
9.000	.250	18.000	.375	.108E+06	.360E+05
9.000	.375	18.000	.375	.298E+06	.992E+05
9.000	.500	18.000	.375	.611E+06	.204E+06
9.000	.625	18.000	.375	.107E+07	.356E+06
9.000	.750	18.000	.375	.168E+07	.561E+06
9.000	1.000	18.000	.375	.346E+07	.115E+07
9.000	1.250	18.000	.375	.604E+07	.201E+07
9.000	1.500	18.000	.375	.953E+07	.318E+07
9.000	1.750	18.000	.375	.140E+08	.467E+07
9.000	2.000	18.000	.375	.196E+08	.652E+07
9.000	.250	20.000	.375	.121E+06	.403E+05
9.000	.375	20.000	.375	.333E+06	.111E+06
9.000	.500	20.000	.375	.683E+06	.228E+06
9.000	.625	20.000	.375	.119E+07	.398E+06
9.000	.750	20.000	.375	.188E+07	.628E+06
9.000	1.000	20.000	.375	.387E+07	.129E+07
9.000	1.250	20.000	.375	.675E+07	.225E+07
9.000	1.500	20.000	.375	.107E+08	.355E+07
9.000	1.750	20.000	.375	.157E+08	.522E+07
9.000	2.000	20.000	.375	.219E+08	.729E+07
9.000	.250	22.000	.375	.134E+06	.445E+05
9.000	.375	22.000	.375	.368E+06	.123E+06
9.000	.500	22.000	.375	.755E+06	.252E+06
9.000	.625	22.000	.375	.132E+07	.440E+06
9.000	.750	22.000	.375	.208E+07	.694E+06
9.000	1.000	22.000	.375	.427E+07	.142E+07
9.000	1.250	22.000	.375	.747E+07	.249E+07
9.000	1.500	22.000	.375	.118E+08	.393E+07
9.000	1.750	22.000	.375	.173E+08	.577E+07
9.000	2.000	22.000	.375	.242E+08	.806E+07
9.000	.250	24.000	.375	.146E+06	.488E+05
9.000	.375	24.000	.375	.403E+06	.134E+06
9.000	.500	24.000	.375	.828E+06	.276E+06
9.000	.625	24.000	.375	.145E+07	.482E+06
9.000	.750	24.000	.375	.228E+07	.760E+06
9.000	1.000	24.000	.375	.468E+07	.156E+07
9.000	1.250	24.000	.375	.818E+07	.273E+07
9.000	1.500	24.000	.375	.129E+08	.430E+07
9.000	1.750	24.000	.375	.190E+08	.632E+07
9.000	2.000	24.000	.375	.265E+08	.883E+07
9.000	.250	26.000	.375	.159E+06	.530E+05
9.000	.375	26.000	.375	.438E+06	.146E+06
9.000	.500	26.000	.375	.900E+06	.300E+06
9.000	.625	26.000	.375	.157E+07	.524E+06
9.000	.750	26.000	.375	.248E+07	.827E+06
9.000	1.000	26.000	.375	.509E+07	.170E+07
9.000	1.250	26.000	.375	.889E+07	.296E+07
9.000	1.500	26.000	.375	.140E+08	.468E+07
9.000	1.750	26.000	.375	.206E+08	.687E+07
9.000	2.000	26.000	.375	.288E+08	.960E+07
9.000	.250	28.000	.375	.172E+06	.573E+05
9.000	.375	28.000	.375	.474E+06	.158E+06
9.000	.500	28.000	.375	.972E+06	.324E+06
9.000	.625	28.000	.375	.170E+07	.566E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
9.000	.750	28.000	.375	.268E+07	.893E+06
9.000	1.000	28.000	.375	.550E+07	.183E+07
9.000	1.250	28.000	.375	.961E+07	.320E+07
9.000	1.500	28.000	.375	.152E+08	.505E+07
9.000	1.750	28.000	.375	.223E+08	.743E+07
9.000	2.000	28.000	.375	.311E+08	.104E+08
9.000	.250	30.000	.375	.185E+06	.615E+05
9.000	.375	30.000	.375	.509E+06	.170E+06
9.000	.500	30.000	.375	.104E+07	.348E+06
9.000	.625	30.000	.375	.182E+07	.608E+06
9.000	.750	30.000	.375	.288E+07	.959E+06
9.000	1.000	30.000	.375	.591E+07	.197E+07
9.000	1.250	30.000	.375	.103E+08	.344E+07
9.000	1.500	30.000	.375	.163E+08	.543E+07
9.000	1.750	30.000	.375	.239E+08	.798E+07
9.000	2.000	30.000	.375	.334E+08	.111E+08
9.000	.250	32.000	.375	.197E+06	.658E+05
9.000	.375	32.000	.375	.544E+06	.181E+06
9.000	.500	32.000	.375	.112E+07	.372E+06
9.000	.625	32.000	.375	.195E+07	.650E+06
9.000	.750	32.000	.375	.308E+07	.103E+07
9.000	1.000	32.000	.375	.632E+07	.211E+07
9.000	1.250	32.000	.375	.110E+08	.368E+07
9.000	1.500	32.000	.375	.174E+08	.580E+07
9.000	1.750	32.000	.375	.256E+08	.853E+07
9.000	2.000	32.000	.375	.357E+08	.119E+08
10.000	.250	2.375	.154	.118E+05	.394E+04
10.000	.375	2.375	.154	.326E+05	.109E+05
10.000	.500	2.375	.154	.669E+05	.223E+05
10.000	.625	2.375	.154	.117E+06	.390E+05
10.000	.750	2.375	.154	.184E+06	.615E+05
10.000	1.000	2.375	.154	.379E+06	.126E+06
10.000	1.250	2.375	.154	.661E+06	.220E+06
10.000	1.500	2.375	.154	.104E+07	.348E+06
10.000	1.750	2.375	.154	.153E+07	.511E+06
10.000	2.000	2.375	.154	.214E+07	.714E+06
10.000	.250	3.500	.216	.176E+05	.587E+04
10.000	.375	3.500	.216	.485E+05	.162E+05
10.000	.500	3.500	.216	.996E+05	.332E+05
10.000	.625	3.500	.216	.174E+06	.580E+05
10.000	.750	3.500	.216	.274E+06	.915E+05
10.000	1.000	3.500	.216	.563E+06	.188E+06
10.000	1.250	3.500	.216	.984E+06	.328E+06
10.000	1.500	3.500	.216	.155E+07	.517E+06
10.000	1.750	3.500	.216	.228E+07	.761E+06
10.000	2.000	3.500	.216	.319E+07	.106E+07
10.000	.250	4.500	.237	.233E+05	.775E+04
10.000	.375	4.500	.237	.641E+05	.214E+05
10.000	.500	4.500	.237	.132E+06	.439E+05
10.000	.625	4.500	.237	.230E+06	.766E+05
10.000	.750	4.500	.237	.363E+06	.121E+06
10.000	1.000	4.500	.237	.744E+06	.248E+06
10.000	1.250	4.500	.237	.130E+07	.433E+06
10.000	1.500	4.500	.237	.205E+07	.684E+06
10.000	1.750	4.500	.237	.302E+07	.101E+07
10.000	2.000	4.500	.237	.421E+07	.140E+07
10.000	.250	6.625	.280	.353E+05	.118E+05
10.000	.375	6.625	.280	.974E+05	.325E+05
10.000	.500	6.625	.280	.200E+06	.667E+05

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
10.000	.625	6.625	.280	.349E+06	.116E+06
10.000	.750	6.625	.280	.551E+06	.184E+06
10.000	1.000	6.625	.280	.113E+07	.377E+06
10.000	1.250	6.625	.280	.198E+07	.659E+06
10.000	1.500	6.625	.280	.312E+07	.104E+07
10.000	1.750	6.625	.280	.458E+07	.153E+07
10.000	2.000	6.625	.280	.640E+07	.213E+07
10.000	.250	8.625	.322	.467E+05	.156E+05
10.000	.375	8.625	.322	.129E+06	.429E+05
10.000	.500	8.625	.322	.264E+06	.881E+05
10.000	.625	8.625	.322	.462E+06	.154E+06
10.000	.750	8.625	.322	.728E+06	.243E+06
10.000	1.000	8.625	.322	.149E+07	.498E+06
10.000	1.250	8.625	.322	.261E+07	.870E+06
10.000	1.500	8.625	.322	.412E+07	.137E+07
10.000	1.750	8.625	.322	.606E+07	.202E+07
10.000	2.000	8.625	.322	.846E+07	.282E+07
10.000	.250	10.750	.365	.588E+05	.196E+05
10.000	.375	10.750	.365	.162E+06	.540E+05
10.000	.500	10.750	.365	.333E+06	.111E+06
10.000	.625	10.750	.365	.581E+06	.194E+06
10.000	.750	10.750	.365	.917E+06	.306E+06
10.000	1.000	10.750	.365	.188E+07	.627E+06
10.000	1.250	10.750	.365	.329E+07	.110E+07
10.000	1.500	10.750	.365	.519E+07	.173E+07
10.000	1.750	10.750	.365	.763E+07	.254E+07
10.000	2.000	10.750	.365	.106E+08	.355E+07
10.000	.250	12.750	.375	.707E+05	.236E+05
10.000	.375	12.750	.375	.195E+06	.650E+05
10.000	.500	12.750	.375	.400E+06	.133E+06
10.000	.625	12.750	.375	.699E+06	.233E+06
10.000	.750	12.750	.375	.110E+07	.368E+06
10.000	1.000	12.750	.375	.226E+07	.754E+06
10.000	1.250	12.750	.375	.395E+07	.132E+07
10.000	1.500	12.750	.375	.624E+07	.208E+07
10.000	1.750	12.750	.375	.917E+07	.306E+07
10.000	2.000	12.750	.375	.128E+08	.427E+07
10.000	.250	14.000	.375	.783E+05	.261E+05
10.000	.375	14.000	.375	.216E+06	.719E+05
10.000	.500	14.000	.375	.443E+06	.148E+06
10.000	.625	14.000	.375	.774E+06	.258E+06
10.000	.750	14.000	.375	.122E+07	.407E+06
10.000	1.000	14.000	.375	.251E+07	.835E+06
10.000	1.250	14.000	.375	.438E+07	.146E+07
10.000	1.500	14.000	.375	.690E+07	.230E+07
10.000	1.750	14.000	.375	.101E+08	.338E+07
10.000	2.000	14.000	.375	.142E+08	.472E+07
10.000	.250	16.000	.375	.904E+05	.301E+05
10.000	.375	16.000	.375	.249E+06	.830E+05
10.000	.500	16.000	.375	.511E+06	.170E+06
10.000	.625	16.000	.375	.893E+06	.298E+06
10.000	.750	16.000	.375	.141E+07	.470E+06
10.000	1.000	16.000	.375	.289E+07	.964E+06
10.000	1.250	16.000	.375	.505E+07	.168E+07
10.000	1.500	16.000	.375	.797E+07	.266E+07
10.000	1.750	16.000	.375	.117E+08	.391E+07
10.000	2.000	16.000	.375	.164E+08	.545E+07
10.000	.250	18.000	.375	.102E+06	.342E+05
10.000	.375	18.000	.375	.282E+06	.941E+05
10.000	.500	18.000	.375	.580E+06	.193E+06
10.000	.625	18.000	.375	.101E+07	.338E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
10.000	.750	18.000	.375	.160E+07	.533E+06
10.000	1.000	18.000	.375	.328E+07	.109E+07
10.000	1.250	18.000	.375	.573E+07	.191E+07
10.000	1.500	18.000	.375	.904E+07	.301E+07
10.000	1.750	18.000	.375	.133E+08	.443E+07
10.000	2.000	18.000	.375	.186E+08	.618E+07
10.000	.250	20.000	.375	.115E+06	.382E+05
10.000	.375	20.000	.375	.316E+06	.105E+06
10.000	.500	20.000	.375	.648E+06	.216E+06
10.000	.625	20.000	.375	.113E+07	.377E+06
10.000	.750	20.000	.375	.179E+07	.595E+06
10.000	1.000	20.000	.375	.367E+07	.122E+07
10.000	1.250	20.000	.375	.641E+07	.214E+07
10.000	1.500	20.000	.375	.101E+08	.337E+07
10.000	1.750	20.000	.375	.149E+08	.495E+07
10.000	2.000	20.000	.375	.207E+08	.691E+07
10.000	.250	22.000	.375	.127E+06	.422E+05
10.000	.375	22.000	.375	.349E+06	.116E+06
10.000	.500	22.000	.375	.717E+06	.239E+06
10.000	.625	22.000	.375	.125E+07	.417E+06
10.000	.750	22.000	.375	.197E+07	.658E+06
10.000	1.000	22.000	.375	.405E+07	.135E+07
10.000	1.250	22.000	.375	.708E+07	.236E+07
10.000	1.500	22.000	.375	.112E+08	.372E+07
10.000	1.750	22.000	.375	.164E+08	.547E+07
10.000	2.000	22.000	.375	.229E+08	.764E+07
10.000	.250	24.000	.375	.139E+06	.463E+05
10.000	.375	24.000	.375	.383E+06	.128E+06
10.000	.500	24.000	.375	.785E+06	.262E+06
10.000	.625	24.000	.375	.137E+07	.457E+06
10.000	.750	24.000	.375	.216E+07	.721E+06
10.000	1.000	24.000	.375	.444E+07	.148E+07
10.000	1.250	24.000	.375	.776E+07	.259E+07
10.000	1.500	24.000	.375	.122E+08	.408E+07
10.000	1.750	24.000	.375	.180E+08	.600E+07
10.000	2.000	24.000	.375	.251E+08	.838E+07
10.000	.250	26.000	.375	.151E+06	.503E+05
10.000	.375	26.000	.375	.416E+06	.139E+06
10.000	.500	26.000	.375	.854E+06	.285E+06
10.000	.625	26.000	.375	.149E+07	.497E+06
10.000	.750	26.000	.375	.235E+07	.784E+06
10.000	1.000	26.000	.375	.483E+07	.161E+07
10.000	1.250	26.000	.375	.844E+07	.281E+07
10.000	1.500	26.000	.375	.133E+08	.444E+07
10.000	1.750	26.000	.375	.196E+08	.652E+07
10.000	2.000	26.000	.375	.273E+08	.911E+07
10.000	.250	28.000	.375	.163E+06	.543E+05
10.000	.375	28.000	.375	.449E+06	.150E+06
10.000	.500	28.000	.375	.922E+06	.307E+06
10.000	.625	28.000	.375	.161E+07	.537E+06
10.000	.750	28.000	.375	.254E+07	.847E+06
10.000	1.000	28.000	.375	.522E+07	.174E+07
10.000	1.250	28.000	.375	.911E+07	.304E+07
10.000	1.500	28.000	.375	.144E+08	.479E+07
10.000	1.750	28.000	.375	.211E+08	.705E+07
10.000	2.000	28.000	.375	.295E+08	.984E+07
10.000	.250	30.000	.375	.175E+06	.584E+05
10.000	.375	30.000	.375	.483E+06	.161E+06
10.000	.500	30.000	.375	.991E+06	.330E+06
10.000	.625	30.000	.375	.173E+07	.577E+06
10.000	.750	30.000	.375	.273E+07	.910E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
10.000	1.000	30.000	.375	.560E+07	.187E+07
10.000	1.250	30.000	.375	.979E+07	.326E+07
10.000	1.500	30.000	.375	.154E+08	.515E+07
10.000	1.750	30.000	.375	.227E+08	.757E+07
10.000	2.000	30.000	.375	.317E+08	.106E+08
10.000	.250	32.000	.375	.187E+06	.624E+05
10.000	.375	32.000	.375	.516E+06	.172E+06
10.000	.500	32.000	.375	.106E+07	.353E+06
10.000	.625	32.000	.375	.185E+07	.617E+06
10.000	.750	32.000	.375	.292E+07	.973E+06
10.000	1.000	32.000	.375	.599E+07	.200E+07
10.000	1.250	32.000	.375	.105E+08	.349E+07
10.000	1.500	32.000	.375	.165E+08	.550E+07
10.000	1.750	32.000	.375	.243E+08	.809E+07
10.000	2.000	32.000	.375	.339E+08	.113E+08
10.000	.250	36.000	.375	.212E+06	.705E+05
10.000	.375	36.000	.375	.583E+06	.194E+06
10.000	.500	36.000	.375	.120E+07	.399E+06
10.000	.625	36.000	.375	.209E+07	.697E+06
10.000	.750	36.000	.375	.330E+07	.110E+07
10.000	1.000	36.000	.375	.677E+07	.226E+07
10.000	1.250	36.000	.375	.118E+08	.394E+07
10.000	1.500	36.000	.375	.187E+08	.622E+07
10.000	1.750	36.000	.375	.274E+08	.914E+07
10.000	2.000	36.000	.375	.383E+08	.128E+08
11.000	.250	2.375	.154	.113E+05	.376E+04
11.000	.375	2.375	.154	.311E+05	.104E+05
11.000	.500	2.375	.154	.638E+05	.213E+05
11.000	.625	2.375	.154	.111E+06	.372E+05
11.000	.750	2.375	.154	.176E+06	.586E+05
11.000	1.000	2.375	.154	.361E+06	.120E+06
11.000	1.250	2.375	.154	.631E+06	.210E+06
11.000	1.500	2.375	.154	.995E+06	.332E+06
11.000	1.750	2.375	.154	.146E+07	.487E+06
11.000	2.000	2.375	.154	.204E+07	.681E+06
11.000	.250	3.500	.216	.168E+05	.559E+04
11.000	.375	3.500	.216	.462E+05	.154E+05
11.000	.500	3.500	.216	.949E+05	.316E+05
11.000	.625	3.500	.216	.166E+06	.553E+05
11.000	.750	3.500	.216	.262E+06	.872E+05
11.000	1.000	3.500	.216	.537E+06	.179E+06
11.000	1.250	3.500	.216	.938E+06	.313E+06
11.000	1.500	3.500	.216	.148E+07	.493E+06
11.000	1.750	3.500	.216	.218E+07	.725E+06
11.000	2.000	3.500	.216	.304E+07	.101E+07
11.000	.250	4.500	.237	.222E+05	.739E+04
11.000	.375	4.500	.237	.611E+05	.204E+05
11.000	.500	4.500	.237	.125E+06	.418E+05
11.000	.625	4.500	.237	.219E+06	.731E+05
11.000	.750	4.500	.237	.346E+06	.115E+06
11.000	1.000	4.500	.237	.710E+06	.237E+06
11.000	1.250	4.500	.237	.124E+07	.413E+06
11.000	1.500	4.500	.237	.196E+07	.652E+06
11.000	1.750	4.500	.237	.288E+07	.958E+06
11.000	2.000	4.500	.237	.402E+07	.134E+07
11.000	.250	6.625	.280	.337E+05	.112E+05
11.000	.375	6.625	.280	.929E+05	.310E+05
11.000	.500	6.625	.280	.191E+06	.636E+05
11.000	.625	6.625	.280	.333E+06	.111E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
11.000	.750	6.625	.280	.525E+06	.175E+06
11.000	1.000	6.625	.280	.108E+07	.360E+06
11.000	1.250	6.625	.280	.188E+07	.628E+06
11.000	1.500	6.625	.280	.297E+07	.991E+06
11.000	1.750	6.625	.280	.437E+07	.146E+07
11.000	2.000	6.625	.280	.610E+07	.203E+07
11.000	.250	8.625	.322	.445E+05	.148E+05
11.000	.375	8.625	.322	.123E+06	.409E+05
11.000	.500	8.625	.322	.252E+06	.840E+05
11.000	.625	8.625	.322	.440E+06	.147E+06
11.000	.750	8.625	.322	.694E+06	.231E+06
11.000	1.000	8.625	.322	.143E+07	.475E+06
11.000	1.250	8.625	.322	.249E+07	.830E+06
11.000	1.500	8.625	.322	.393E+07	.131E+07
11.000	1.750	8.625	.322	.577E+07	.192E+07
11.000	2.000	8.625	.322	.806E+07	.269E+07
11.000	.250	10.750	.365	.561E+05	.187E+05
11.000	.375	10.750	.365	.155E+06	.515E+05
11.000	.500	10.750	.365	.317E+06	.106E+06
11.000	.625	10.750	.365	.554E+06	.185E+06
11.000	.750	10.750	.365	.874E+06	.291E+06
11.000	1.000	10.750	.365	.179E+07	.598E+06
11.000	1.250	10.750	.365	.314E+07	.105E+07
11.000	1.500	10.750	.365	.495E+07	.165E+07
11.000	1.750	10.750	.365	.727E+07	.242E+07
11.000	2.000	10.750	.365	.102E+08	.338E+07
11.000	.250	12.750	.375	.674E+05	.225E+05
11.000	.375	12.750	.375	.186E+06	.619E+05
11.000	.500	12.750	.375	.382E+06	.127E+06
11.000	.625	12.750	.375	.666E+06	.222E+06
11.000	.750	12.750	.375	.105E+07	.350E+06
11.000	1.000	12.750	.375	.216E+07	.719E+06
11.000	1.250	12.750	.375	.377E+07	.126E+07
11.000	1.500	12.750	.375	.595E+07	.198E+07
11.000	1.750	12.750	.375	.874E+07	.291E+07
11.000	2.000	12.750	.375	.122E+08	.407E+07
11.000	.250	14.000	.375	.746E+05	.249E+05
11.000	.375	14.000	.375	.206E+06	.686E+05
11.000	.500	14.000	.375	.422E+06	.141E+06
11.000	.625	14.000	.375	.738E+06	.246E+06
11.000	.750	14.000	.375	.116E+07	.388E+06
11.000	1.000	14.000	.375	.239E+07	.796E+06
11.000	1.250	14.000	.375	.417E+07	.139E+07
11.000	1.500	14.000	.375	.658E+07	.219E+07
11.000	1.750	14.000	.375	.968E+07	.323E+07
11.000	2.000	14.000	.375	.135E+08	.450E+07
11.000	.250	16.000	.375	.862E+05	.287E+05
11.000	.375	16.000	.375	.237E+06	.792E+05
11.000	.500	16.000	.375	.487E+06	.162E+06
11.000	.625	16.000	.375	.852E+06	.284E+06
11.000	.750	16.000	.375	.134E+07	.448E+06
11.000	1.000	16.000	.375	.276E+07	.919E+06
11.000	1.250	16.000	.375	.482E+07	.161E+07
11.000	1.500	16.000	.375	.760E+07	.253E+07
11.000	1.750	16.000	.375	.112E+08	.372E+07
11.000	2.000	16.000	.375	.156E+08	.520E+07
11.000	.250	18.000	.375	.977E+05	.326E+05
11.000	.375	18.000	.375	.269E+06	.898E+05
11.000	.500	18.000	.375	.553E+06	.184E+06
11.000	.625	18.000	.375	.966E+06	.322E+06
11.000	.750	18.000	.375	.152E+07	.508E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
11.000	1.000	18.000	.375	.313E+07	.104E+07
11.000	1.250	18.000	.375	.546E+07	.182E+07
11.000	1.500	18.000	.375	.862E+07	.287E+07
11.000	1.750	18.000	.375	.127E+08	.422E+07
11.000	2.000	18.000	.375	.177E+08	.590E+07
11.000	.250	20.000	.375	.109E+06	.364E+05
11.000	.375	20.000	.375	.301E+06	.100E+06
11.000	.500	20.000	.375	.618E+06	.206E+06
11.000	.625	20.000	.375	.108E+07	.360E+06
11.000	.750	20.000	.375	.170E+07	.568E+06
11.000	1.000	20.000	.375	.350E+07	.117E+07
11.000	1.250	20.000	.375	.611E+07	.204E+07
11.000	1.500	20.000	.375	.963E+07	.321E+07
11.000	1.750	20.000	.375	.142E+08	.472E+07
11.000	2.000	20.000	.375	.198E+08	.659E+07
11.000	.250	22.000	.375	.121E+06	.403E+05
11.000	.375	22.000	.375	.333E+06	.111E+06
11.000	.500	22.000	.375	.683E+06	.228E+06
11.000	.625	22.000	.375	.119E+07	.398E+06
11.000	.750	22.000	.375	.188E+07	.628E+06
11.000	1.000	22.000	.375	.387E+07	.129E+07
11.000	1.250	22.000	.375	.675E+07	.225E+07
11.000	1.500	22.000	.375	.107E+08	.355E+07
11.000	1.750	22.000	.375	.157E+08	.522E+07
11.000	2.000	22.000	.375	.219E+08	.729E+07
11.000	.250	24.000	.375	.132E+06	.441E+05
11.000	.375	24.000	.375	.365E+06	.122E+06
11.000	.500	24.000	.375	.749E+06	.250E+06
11.000	.625	24.000	.375	.131E+07	.436E+06
11.000	.750	24.000	.375	.206E+07	.688E+06
11.000	1.000	24.000	.375	.424E+07	.141E+07
11.000	1.250	24.000	.375	.740E+07	.247E+07
11.000	1.500	24.000	.375	.117E+08	.389E+07
11.000	1.750	24.000	.375	.172E+08	.572E+07
11.000	2.000	24.000	.375	.240E+08	.799E+07
11.000	.250	26.000	.375	.144E+06	.480E+05
11.000	.375	26.000	.375	.397E+06	.132E+06
11.000	.500	26.000	.375	.814E+06	.271E+06
11.000	.625	26.000	.375	.142E+07	.474E+06
11.000	.750	26.000	.375	.224E+07	.748E+06
11.000	1.000	26.000	.375	.460E+07	.153E+07
11.000	1.250	26.000	.375	.804E+07	.268E+07
11.000	1.500	26.000	.375	.127E+08	.423E+07
11.000	1.750	26.000	.375	.187E+08	.622E+07
11.000	2.000	26.000	.375	.260E+08	.868E+07
11.000	.250	28.000	.375	.155E+06	.518E+05
11.000	.375	28.000	.375	.428E+06	.143E+06
11.000	.500	28.000	.375	.879E+06	.293E+06
11.000	.625	28.000	.375	.154E+07	.512E+06
11.000	.750	28.000	.375	.242E+07	.808E+06
11.000	1.000	28.000	.375	.497E+07	.166E+07
11.000	1.250	28.000	.375	.869E+07	.290E+07
11.000	1.500	28.000	.375	.137E+08	.457E+07
11.000	1.750	28.000	.375	.202E+08	.672E+07
11.000	2.000	28.000	.375	.281E+08	.938E+07
11.000	.250	30.000	.375	.167E+06	.557E+05
11.000	.375	30.000	.375	.460E+06	.153E+06
11.000	.500	30.000	.375	.945E+06	.315E+06
11.000	.625	30.000	.375	.165E+07	.550E+06
11.000	.750	30.000	.375	.260E+07	.868E+06
11.000	1.000	30.000	.375	.534E+07	.178E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
11.000	1.250	30.000	.375	.934E+07	.311E+07
11.000	1.500	30.000	.375	.147E+08	.491E+07
11.000	1.750	30.000	.375	.216E+08	.722E+07
11.000	2.000	30.000	.375	.302E+08	.101E+08
11.000	.250	32.000	.375	.179E+06	.595E+05
11.000	.375	32.000	.375	.492E+06	.164E+06
11.000	.500	32.000	.375	.101E+07	.337E+06
11.000	.625	32.000	.375	.176E+07	.588E+06
11.000	.750	32.000	.375	.278E+07	.928E+06
11.000	1.000	32.000	.375	.571E+07	.190E+07
11.000	1.250	32.000	.375	.998E+07	.333E+07
11.000	1.500	32.000	.375	.157E+08	.525E+07
11.000	1.750	32.000	.375	.231E+08	.772E+07
11.000	2.000	32.000	.375	.323E+08	.108E+08
11.000	.250	36.000	.375	.202E+06	.672E+05
11.000	.375	36.000	.375	.556E+06	.185E+06
11.000	.500	36.000	.375	.114E+07	.380E+06
11.000	.625	36.000	.375	.199E+07	.664E+06
11.000	.750	36.000	.375	.314E+07	.105E+07
11.000	1.000	36.000	.375	.645E+07	.215E+07
11.000	1.250	36.000	.375	.113E+08	.376E+07
11.000	1.500	36.000	.375	.178E+08	.593E+07
11.000	1.750	36.000	.375	.261E+08	.871E+07
11.000	2.000	36.000	.375	.365E+08	.122E+08
11.000	.250	40.000	.375	.225E+06	.749E+05
11.000	.375	40.000	.375	.619E+06	.206E+06
11.000	.500	40.000	.375	.127E+07	.424E+06
11.000	.625	40.000	.375	.222E+07	.740E+06
11.000	.750	40.000	.375	.350E+07	.117E+07
11.000	1.000	40.000	.375	.719E+07	.240E+07
11.000	1.250	40.000	.375	.126E+08	.419E+07
11.000	1.500	40.000	.375	.198E+08	.661E+07
11.000	1.750	40.000	.375	.291E+08	.971E+07
11.000	2.000	40.000	.375	.407E+08	.136E+08
12.000	.250	2.375	.154	.108E+05	.360E+04
12.000	.375	2.375	.154	.298E+05	.992E+04
12.000	.500	2.375	.154	.611E+05	.204E+05
12.000	.625	2.375	.154	.107E+06	.356E+05
12.000	.750	2.375	.154	.168E+06	.561E+05
12.000	1.000	2.375	.154	.346E+06	.115E+06
12.000	1.250	2.375	.154	.604E+06	.201E+06
12.000	1.500	2.375	.154	.952E+06	.317E+06
12.000	1.750	2.375	.154	.140E+07	.467E+06
12.000	2.000	2.375	.154	.195E+07	.652E+06
12.000	.250	3.500	.216	.161E+05	.536E+04
12.000	.375	3.500	.216	.443E+05	.148E+05
12.000	.500	3.500	.216	.909E+05	.303E+05
12.000	.625	3.500	.216	.159E+06	.529E+05
12.000	.750	3.500	.216	.250E+06	.835E+05
12.000	1.000	3.500	.216	.514E+06	.171E+06
12.000	1.250	3.500	.216	.898E+06	.299E+06
12.000	1.500	3.500	.216	.142E+07	.472E+06
12.000	1.750	3.500	.216	.208E+07	.694E+06
12.000	2.000	3.500	.216	.291E+07	.970E+06
12.000	.250	4.500	.237	.212E+05	.708E+04
12.000	.375	4.500	.237	.585E+05	.195E+05
12.000	.500	4.500	.237	.120E+06	.400E+05
12.000	.625	4.500	.237	.210E+06	.700E+05
12.000	.750	4.500	.237	.331E+06	.110E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
12.000	1.000	4.500	.237	.680E+06	.227E+06
12.000	1.250	4.500	.237	.119E+07	.396E+06
12.000	1.500	4.500	.237	.187E+07	.624E+06
12.000	1.750	4.500	.237	.275E+07	.918E+06
12.000	2.000	4.500	.237	.384E+07	.128E+07
12.000	.250	6.625	.280	.323E+05	.108E+05
12.000	.375	6.625	.280	.889E+05	.296E+05
12.000	.500	6.625	.280	.183E+06	.608E+05
12.000	.625	6.625	.280	.319E+06	.106E+06
12.000	.750	6.625	.280	.503E+06	.168E+06
12.000	1.000	6.625	.280	.103E+07	.344E+06
12.000	1.250	6.625	.280	.180E+07	.601E+06
12.000	1.500	6.625	.280	.285E+07	.949E+06
12.000	1.750	6.625	.280	.418E+07	.139E+07
12.000	2.000	6.625	.280	.584E+07	.195E+07
12.000	.250	8.625	.322	.426E+05	.142E+05
12.000	.375	8.625	.322	.118E+06	.392E+05
12.000	.500	8.625	.322	.241E+06	.804E+05
12.000	.625	8.625	.322	.421E+06	.140E+06
12.000	.750	8.625	.322	.665E+06	.222E+06
12.000	1.000	8.625	.322	.136E+07	.455E+06
12.000	1.250	8.625	.322	.238E+07	.795E+06
12.000	1.500	8.625	.322	.376E+07	.125E+07
12.000	1.750	8.625	.322	.553E+07	.184E+07
12.000	2.000	8.625	.322	.772E+07	.257E+07
12.000	.250	10.750	.365	.537E+05	.179E+05
12.000	.375	10.750	.365	.148E+06	.493E+05
12.000	.500	10.750	.365	.304E+06	.101E+06
12.000	.625	10.750	.365	.531E+06	.177E+06
12.000	.750	10.750	.365	.837E+06	.279E+06
12.000	1.000	10.750	.365	.172E+07	.573E+06
12.000	1.250	10.750	.365	.300E+07	.100E+07
12.000	1.500	10.750	.365	.474E+07	.158E+07
12.000	1.750	10.750	.365	.696E+07	.232E+07
12.000	2.000	10.750	.365	.972E+07	.324E+07
12.000	.250	12.750	.375	.646E+05	.215E+05
12.000	.375	12.750	.375	.178E+06	.593E+05
12.000	.500	12.750	.375	.365E+06	.122E+06
12.000	.625	12.750	.375	.638E+06	.213E+06
12.000	.750	12.750	.375	.101E+07	.336E+06
12.000	1.000	12.750	.375	.207E+07	.689E+06
12.000	1.250	12.750	.375	.361E+07	.120E+07
12.000	1.500	12.750	.375	.569E+07	.190E+07
12.000	1.750	12.750	.375	.837E+07	.279E+07
12.000	2.000	12.750	.375	.117E+08	.390E+07
12.000	.250	14.000	.375	.715E+05	.238E+05
12.000	.375	14.000	.375	.197E+06	.656E+05
12.000	.500	14.000	.375	.404E+06	.135E+06
12.000	.625	14.000	.375	.706E+06	.235E+06
12.000	.750	14.000	.375	.111E+07	.371E+06
12.000	1.000	14.000	.375	.229E+07	.762E+06
12.000	1.250	14.000	.375	.400E+07	.133E+07
12.000	1.500	14.000	.375	.630E+07	.210E+07
12.000	1.750	14.000	.375	.926E+07	.309E+07
12.000	2.000	14.000	.375	.129E+08	.431E+07
12.000	.250	16.000	.375	.825E+05	.275E+05
12.000	.375	16.000	.375	.227E+06	.758E+05
12.000	.500	16.000	.375	.467E+06	.156E+06
12.000	.625	16.000	.375	.815E+06	.272E+06
12.000	.750	16.000	.375	.129E+07	.429E+06
12.000	1.000	16.000	.375	.264E+07	.880E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
12.000	1.250	16.000	.375	.461E+07	.154E+07
12.000	1.500	16.000	.375	.728E+07	.243E+07
12.000	1.750	16.000	.375	.107E+08	.357E+07
12.000	2.000	16.000	.375	.149E+08	.498E+07
12.000	.250	18.000	.375	.936E+05	.312E+05
12.000	.375	18.000	.375	.258E+06	.859E+05
12.000	.500	18.000	.375	.529E+06	.176E+06
12.000	.625	18.000	.375	.924E+06	.308E+06
12.000	.750	18.000	.375	.146E+07	.486E+06
12.000	1.000	18.000	.375	.299E+07	.998E+06
12.000	1.250	18.000	.375	.523E+07	.174E+07
12.000	1.500	18.000	.375	.825E+07	.275E+07
12.000	1.750	18.000	.375	.121E+08	.404E+07
12.000	2.000	18.000	.375	.169E+08	.564E+07
12.000	.250	20.000	.375	.105E+06	.349E+05
12.000	.375	20.000	.375	.288E+06	.961E+05
12.000	.500	20.000	.375	.592E+06	.197E+06
12.000	.625	20.000	.375	.103E+07	.345E+06
12.000	.750	20.000	.375	.163E+07	.544E+06
12.000	1.000	20.000	.375	.335E+07	.112E+07
12.000	1.250	20.000	.375	.585E+07	.195E+07
12.000	1.500	20.000	.375	.922E+07	.307E+07
12.000	1.750	20.000	.375	.136E+08	.452E+07
12.000	2.000	20.000	.375	.189E+08	.631E+07
12.000	.250	22.000	.375	.116E+06	.386E+05
12.000	.375	22.000	.375	.319E+06	.106E+06
12.000	.500	22.000	.375	.654E+06	.218E+06
12.000	.625	22.000	.375	.114E+07	.381E+06
12.000	.750	22.000	.375	.180E+07	.601E+06
12.000	1.000	22.000	.375	.370E+07	.123E+07
12.000	1.250	22.000	.375	.647E+07	.216E+07
12.000	1.500	22.000	.375	.102E+08	.340E+07
12.000	1.750	22.000	.375	.150E+08	.500E+07
12.000	2.000	22.000	.375	.209E+08	.698E+07
12.000	.250	24.000	.375	.127E+06	.422E+05
12.000	.375	24.000	.375	.349E+06	.116E+06
12.000	.500	24.000	.375	.717E+06	.239E+06
12.000	.625	24.000	.375	.125E+07	.417E+06
12.000	.750	24.000	.375	.198E+07	.658E+06
12.000	1.000	24.000	.375	.405E+07	.135E+07
12.000	1.250	24.000	.375	.708E+07	.236E+07
12.000	1.500	24.000	.375	.112E+08	.372E+07
12.000	1.750	24.000	.375	.164E+08	.548E+07
12.000	2.000	24.000	.375	.229E+08	.765E+07
12.000	.250	26.000	.375	.138E+06	.459E+05
12.000	.375	26.000	.375	.380E+06	.127E+06
12.000	.500	26.000	.375	.779E+06	.260E+06
12.000	.625	26.000	.375	.136E+07	.454E+06
12.000	.750	26.000	.375	.215E+07	.716E+06
12.000	1.000	26.000	.375	.441E+07	.147E+07
12.000	1.250	26.000	.375	.770E+07	.257E+07
12.000	1.500	26.000	.375	.121E+08	.405E+07
12.000	1.750	26.000	.375	.179E+08	.595E+07
12.000	2.000	26.000	.375	.249E+08	.831E+07
12.000	.250	28.000	.375	.149E+06	.496E+05
12.000	.375	28.000	.375	.410E+06	.137E+06
12.000	.500	28.000	.375	.842E+06	.281E+06
12.000	.625	28.000	.375	.147E+07	.490E+06
12.000	.750	28.000	.375	.232E+07	.773E+06
12.000	1.000	28.000	.375	.476E+07	.159E+07
12.000	1.250	28.000	.375	.832E+07	.277E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
12.000	1.500	28.000	.375	.131E+08	.437E+07
12.000	1.750	28.000	.375	.193E+08	.643E+07
12.000	2.000	28.000	.375	.269E+08	.898E+07
12.000	.250	30.000	.375	.160E+06	.533E+05
12.000	.375	30.000	.375	.441E+06	.147E+06
12.000	.500	30.000	.375	.904E+06	.301E+06
12.000	.625	30.000	.375	.158E+07	.527E+06
12.000	.750	30.000	.375	.249E+07	.831E+06
12.000	1.000	30.000	.375	.512E+07	.171E+07
12.000	1.250	30.000	.375	.894E+07	.298E+07
12.000	1.500	30.000	.375	.141E+08	.470E+07
12.000	1.750	30.000	.375	.207E+08	.691E+07
12.000	2.000	30.000	.375	.289E+08	.965E+07
12.000	.250	32.000	.375	.171E+06	.570E+05
12.000	.375	32.000	.375	.471E+06	.157E+06
12.000	.500	32.000	.375	.967E+06	.322E+06
12.000	.625	32.000	.375	.169E+07	.563E+06
12.000	.750	32.000	.375	.266E+07	.888E+06
12.000	1.000	32.000	.375	.547E+07	.182E+07
12.000	1.250	32.000	.375	.956E+07	.319E+07
12.000	1.500	32.000	.375	.151E+08	.502E+07
12.000	1.750	32.000	.375	.222E+08	.739E+07
12.000	2.000	32.000	.375	.309E+08	.103E+08
12.000	.250	36.000	.375	.193E+06	.644E+05
12.000	.375	36.000	.375	.532E+06	.177E+06
12.000	.500	36.000	.375	.109E+07	.364E+06
12.000	.625	36.000	.375	.191E+07	.636E+06
12.000	.750	36.000	.375	.301E+07	.100E+07
12.000	1.000	36.000	.375	.618E+07	.206E+07
12.000	1.250	36.000	.375	.108E+08	.360E+07
12.000	1.500	36.000	.375	.170E+08	.568E+07
12.000	1.750	36.000	.375	.250E+08	.834E+07
12.000	2.000	36.000	.375	.349E+08	.116E+08
12.000	.250	40.000	.375	.215E+06	.717E+05
12.000	.375	40.000	.375	.593E+06	.198E+06
12.000	.500	40.000	.375	.122E+07	.406E+06
12.000	.625	40.000	.375	.213E+07	.709E+06
12.000	.750	40.000	.375	.335E+07	.112E+07
12.000	1.000	40.000	.375	.689E+07	.230E+07
12.000	1.250	40.000	.375	.120E+08	.401E+07
12.000	1.500	40.000	.375	.190E+08	.633E+07
12.000	1.750	40.000	.375	.279E+08	.930E+07
12.000	2.000	40.000	.375	.390E+08	.130E+08
13.000	.250	2.375	.154	.104E+05	.346E+04
13.000	.375	2.375	.154	.286E+05	.953E+04
13.000	.500	2.375	.154	.587E+05	.196E+05
13.000	.625	2.375	.154	.103E+06	.342E+05
13.000	.750	2.375	.154	.162E+06	.539E+05
13.000	1.000	2.375	.154	.332E+06	.111E+06
13.000	1.250	2.375	.154	.580E+06	.193E+06
13.000	1.500	2.375	.154	.915E+06	.305E+06
13.000	1.750	2.375	.154	.135E+07	.448E+06
13.000	2.000	2.375	.154	.188E+07	.626E+06
13.000	.250	3.500	.216	.154E+05	.515E+04
13.000	.375	3.500	.216	.425E+05	.142E+05
13.000	.500	3.500	.216	.873E+05	.291E+05
13.000	.625	3.500	.216	.153E+06	.509E+05
13.000	.750	3.500	.216	.241E+06	.802E+05
13.000	1.000	3.500	.216	.494E+06	.165E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
13.000	1.250	3.500	.216	.863E+06	.288E+06
13.000	1.500	3.500	.216	.136E+07	.454E+06
13.000	1.750	3.500	.216	.200E+07	.667E+06
13.000	2.000	3.500	.216	.279E+07	.932E+06
13.000	.250	4.500	.237	.204E+05	.680E+04
13.000	.375	4.500	.237	.562E+05	.187E+05
13.000	.500	4.500	.237	.115E+06	.385E+05
13.000	.625	4.500	.237	.202E+06	.672E+05
13.000	.750	4.500	.237	.318E+06	.106E+06
13.000	1.000	4.500	.237	.653E+06	.218E+06
13.000	1.250	4.500	.237	.114E+07	.380E+06
13.000	1.500	4.500	.237	.180E+07	.600E+06
13.000	1.750	4.500	.237	.265E+07	.882E+06
13.000	2.000	4.500	.237	.369E+07	.123E+07
13.000	.250	6.625	.280	.310E+05	.103E+05
13.000	.375	6.625	.280	.854E+05	.285E+05
13.000	.500	6.625	.280	.175E+06	.585E+05
13.000	.625	6.625	.280	.306E+06	.102E+06
13.000	.750	6.625	.280	.483E+06	.161E+06
13.000	1.000	6.625	.280	.992E+06	.331E+06
13.000	1.250	6.625	.280	.173E+07	.578E+06
13.000	1.500	6.625	.280	.273E+07	.911E+06
13.000	1.750	6.625	.280	.402E+07	.134E+07
13.000	2.000	6.625	.280	.561E+07	.187E+07
13.000	.250	8.625	.322	.410E+05	.137E+05
13.000	.375	8.625	.322	.113E+06	.376E+05
13.000	.500	8.625	.322	.232E+06	.773E+05
13.000	.625	8.625	.322	.405E+06	.135E+06
13.000	.750	8.625	.322	.639E+06	.213E+06
13.000	1.000	8.625	.322	.131E+07	.437E+06
13.000	1.250	8.625	.322	.229E+07	.763E+06
13.000	1.500	8.625	.322	.361E+07	.120E+07
13.000	1.750	8.625	.322	.531E+07	.177E+07
13.000	2.000	8.625	.322	.742E+07	.247E+07
13.000	.250	10.750	.365	.516E+05	.172E+05
13.000	.375	10.750	.365	.142E+06	.474E+05
13.000	.500	10.750	.365	.292E+06	.973E+05
13.000	.625	10.750	.365	.510E+06	.170E+06
13.000	.750	10.750	.365	.804E+06	.268E+06
13.000	1.000	10.750	.365	.165E+07	.550E+06
13.000	1.250	10.750	.365	.288E+07	.961E+06
13.000	1.500	10.750	.365	.455E+07	.152E+07
13.000	1.750	10.750	.365	.669E+07	.223E+07
13.000	2.000	10.750	.365	.934E+07	.311E+07
13.000	.250	12.750	.375	.620E+05	.207E+05
13.000	.375	12.750	.375	.171E+06	.570E+05
13.000	.500	12.750	.375	.351E+06	.117E+06
13.000	.625	12.750	.375	.613E+06	.204E+06
13.000	.750	12.750	.375	.967E+06	.322E+06
13.000	1.000	12.750	.375	.199E+07	.662E+06
13.000	1.250	12.750	.375	.347E+07	.116E+07
13.000	1.500	12.750	.375	.547E+07	.182E+07
13.000	1.750	12.750	.375	.804E+07	.268E+07
13.000	2.000	12.750	.375	.112E+08	.374E+07
13.000	.250	14.000	.375	.687E+05	.229E+05
13.000	.375	14.000	.375	.189E+06	.631E+05
13.000	.500	14.000	.375	.388E+06	.129E+06
13.000	.625	14.000	.375	.679E+06	.226E+06
13.000	.750	14.000	.375	.107E+07	.357E+06
13.000	1.000	14.000	.375	.220E+07	.732E+06
13.000	1.250	14.000	.375	.384E+07	.128E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
13.000	1.500	14.000	.375	.605E+07	.202E+07
13.000	1.750	14.000	.375	.890E+07	.297E+07
13.000	2.000	14.000	.375	.124E+08	.414E+07
13.000	.250	16.000	.375	.793E+05	.264E+05
13.000	.375	16.000	.375	.218E+06	.728E+05
13.000	.500	16.000	.375	.448E+06	.149E+06
13.000	.625	16.000	.375	.783E+06	.261E+06
13.000	.750	16.000	.375	.124E+07	.412E+06
13.000	1.000	16.000	.375	.254E+07	.846E+06
13.000	1.250	16.000	.375	.443E+07	.148E+07
13.000	1.500	16.000	.375	.699E+07	.233E+07
13.000	1.750	16.000	.375	.103E+08	.343E+07
13.000	2.000	16.000	.375	.143E+08	.478E+07
13.000	.250	18.000	.375	.899E+05	.300E+05
13.000	.375	18.000	.375	.248E+06	.826E+05
13.000	.500	18.000	.375	.508E+06	.169E+06
13.000	.625	18.000	.375	.888E+06	.296E+06
13.000	.750	18.000	.375	.140E+07	.467E+06
13.000	1.000	18.000	.375	.288E+07	.959E+06
13.000	1.250	18.000	.375	.502E+07	.167E+07
13.000	1.500	18.000	.375	.793E+07	.264E+07
13.000	1.750	18.000	.375	.117E+08	.388E+07
13.000	2.000	18.000	.375	.163E+08	.542E+07
13.000	.250	20.000	.375	.100E+06	.335E+05
13.000	.375	20.000	.375	.277E+06	.923E+05
13.000	.500	20.000	.375	.569E+06	.190E+06
13.000	.625	20.000	.375	.993E+06	.331E+06
13.000	.750	20.000	.375	.157E+07	.522E+06
13.000	1.000	20.000	.375	.322E+07	.107E+07
13.000	1.250	20.000	.375	.562E+07	.187E+07
13.000	1.500	20.000	.375	.886E+07	.295E+07
13.000	1.750	20.000	.375	.130E+08	.434E+07
13.000	2.000	20.000	.375	.182E+08	.606E+07
13.000	.250	22.000	.375	.111E+06	.370E+05
13.000	.375	22.000	.375	.306E+06	.102E+06
13.000	.500	22.000	.375	.629E+06	.210E+06
13.000	.625	22.000	.375	.110E+07	.366E+06
13.000	.750	22.000	.375	.173E+07	.577E+06
13.000	1.000	22.000	.375	.356E+07	.119E+07
13.000	1.250	22.000	.375	.621E+07	.207E+07
13.000	1.500	22.000	.375	.980E+07	.327E+07
13.000	1.750	22.000	.375	.144E+08	.480E+07
13.000	2.000	22.000	.375	.201E+08	.670E+07
13.000	.250	24.000	.375	.122E+06	.406E+05
13.000	.375	24.000	.375	.335E+06	.112E+06
13.000	.500	24.000	.375	.689E+06	.230E+06
13.000	.625	24.000	.375	.120E+07	.401E+06
13.000	.750	24.000	.375	.190E+07	.633E+06
13.000	1.000	24.000	.375	.390E+07	.130E+07
13.000	1.250	24.000	.375	.681E+07	.227E+07
13.000	1.500	24.000	.375	.107E+08	.358E+07
13.000	1.750	24.000	.375	.158E+08	.526E+07
13.000	2.000	24.000	.375	.220E+08	.735E+07
13.000	.250	26.000	.375	.132E+06	.441E+05
13.000	.375	26.000	.375	.365E+06	.122E+06
13.000	.500	26.000	.375	.749E+06	.250E+06
13.000	.625	26.000	.375	.131E+07	.436E+06
13.000	.750	26.000	.375	.206E+07	.688E+06
13.000	1.000	26.000	.375	.424E+07	.141E+07
13.000	1.250	26.000	.375	.740E+07	.247E+07
13.000	1.500	26.000	.375	.117E+08	.389E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
13.000	1.750	26.000	.375	.172E+08	.572E+07
13.000	2.000	26.000	.375	.240E+08	.799E+07
13.000	.250	28.000	.375	.143E+06	.477E+05
13.000	.375	28.000	.375	.394E+06	.131E+06
13.000	.500	28.000	.375	.809E+06	.270E+06
13.000	.625	28.000	.375	.141E+07	.471E+06
13.000	.750	28.000	.375	.223E+07	.743E+06
13.000	1.000	28.000	.375	.458E+07	.153E+07
13.000	1.250	28.000	.375	.799E+07	.266E+07
13.000	1.500	28.000	.375	.126E+08	.420E+07
13.000	1.750	28.000	.375	.185E+08	.618E+07
13.000	2.000	28.000	.375	.259E+08	.863E+07
13.000	.250	30.000	.375	.154E+06	.512E+05
13.000	.375	30.000	.375	.423E+06	.141E+06
13.000	.500	30.000	.375	.869E+06	.290E+06
13.000	.625	30.000	.375	.152E+07	.506E+06
13.000	.750	30.000	.375	.239E+07	.798E+06
13.000	1.000	30.000	.375	.492E+07	.164E+07
13.000	1.250	30.000	.375	.859E+07	.286E+07
13.000	1.500	30.000	.375	.135E+08	.452E+07
13.000	1.750	30.000	.375	.199E+08	.664E+07
13.000	2.000	30.000	.375	.278E+08	.927E+07
13.000	.250	32.000	.375	.164E+06	.547E+05
13.000	.375	32.000	.375	.453E+06	.151E+06
13.000	.500	32.000	.375	.929E+06	.310E+06
13.000	.625	32.000	.375	.162E+07	.541E+06
13.000	.750	32.000	.375	.256E+07	.853E+06
13.000	1.000	32.000	.375	.526E+07	.175E+07
13.000	1.250	32.000	.375	.918E+07	.306E+07
13.000	1.500	32.000	.375	.145E+08	.483E+07
13.000	1.750	32.000	.375	.213E+08	.710E+07
13.000	2.000	32.000	.375	.297E+08	.991E+07
13.000	.250	36.000	.375	.185E+06	.618E+05
13.000	.375	36.000	.375	.511E+06	.170E+06
13.000	.500	36.000	.375	.105E+07	.350E+06
13.000	.625	36.000	.375	.183E+07	.611E+06
13.000	.750	36.000	.375	.289E+07	.964E+06
13.000	1.000	36.000	.375	.594E+07	.198E+07
13.000	1.250	36.000	.375	.104E+08	.346E+07
13.000	1.500	36.000	.375	.164E+08	.545E+07
13.000	1.750	36.000	.375	.240E+08	.802E+07
13.000	2.000	36.000	.375	.336E+08	.112E+08
13.000	.250	40.000	.375	.207E+06	.689E+05
13.000	.375	40.000	.375	.570E+06	.190E+06
13.000	.500	40.000	.375	.117E+07	.390E+06
13.000	.625	40.000	.375	.204E+07	.681E+06
13.000	.750	40.000	.375	.322E+07	.107E+07
13.000	1.000	40.000	.375	.662E+07	.221E+07
13.000	1.250	40.000	.375	.116E+08	.385E+07
13.000	1.500	40.000	.375	.182E+08	.608E+07
13.000	1.750	40.000	.375	.268E+08	.893E+07
13.000	2.000	40.000	.375	.374E+08	.125E+08
13.000	.250	48.000	.375	.249E+06	.831E+05
13.000	.375	48.000	.375	.687E+06	.229E+06
13.000	.500	48.000	.375	.141E+07	.470E+06
13.000	.625	48.000	.375	.246E+07	.821E+06
13.000	.750	48.000	.375	.389E+07	.130E+07
13.000	1.000	48.000	.375	.798E+07	.266E+07
13.000	1.250	48.000	.375	.139E+08	.464E+07
13.000	1.500	48.000	.375	.220E+08	.733E+07
13.000	1.750	48.000	.375	.323E+08	.108E+08
13.000	2.000	48.000	.375	.451E+08	.150E+08

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
14.000	.250	2.375	.154	.100E+05	.333E+04
14.000	.375	2.375	.154	.276E+05	.918E+04
14.000	.500	2.375	.154	.566E+05	.189E+05
14.000	.625	2.375	.154	.988E+05	.329E+05
14.000	.750	2.375	.154	.156E+06	.520E+05
14.000	1.000	2.375	.154	.320E+06	.107E+06
14.000	1.250	2.375	.154	.559E+06	.186E+06
14.000	1.500	2.375	.154	.882E+06	.294E+06
14.000	1.750	2.375	.154	.130E+07	.432E+06
14.000	2.000	2.375	.154	.181E+07	.603E+06
14.000	.250	3.500	.216	.149E+05	.496E+04
14.000	.375	3.500	.216	.410E+05	.137E+05
14.000	.500	3.500	.216	.842E+05	.281E+05
14.000	.625	3.500	.216	.147E+06	.490E+05
14.000	.750	3.500	.216	.232E+06	.773E+05
14.000	1.000	3.500	.216	.476E+06	.159E+06
14.000	1.250	3.500	.216	.832E+06	.277E+06
14.000	1.500	3.500	.216	.131E+07	.437E+06
14.000	1.750	3.500	.216	.193E+07	.643E+06
14.000	2.000	3.500	.216	.269E+07	.898E+06
14.000	.250	4.500	.237	.197E+05	.655E+04
14.000	.375	4.500	.237	.542E+05	.181E+05
14.000	.500	4.500	.237	.111E+06	.371E+05
14.000	.625	4.500	.237	.194E+06	.648E+05
14.000	.750	4.500	.237	.306E+06	.102E+06
14.000	1.000	4.500	.237	.629E+06	.210E+06
14.000	1.250	4.500	.237	.110E+07	.366E+06
14.000	1.500	4.500	.237	.173E+07	.578E+06
14.000	1.750	4.500	.237	.255E+07	.850E+06
14.000	2.000	4.500	.237	.356E+07	.119E+07
14.000	.250	6.625	.280	.299E+05	.996E+04
14.000	.375	6.625	.280	.823E+05	.274E+05
14.000	.500	6.625	.280	.169E+06	.563E+05
14.000	.625	6.625	.280	.295E+06	.984E+05
14.000	.750	6.625	.280	.466E+06	.155E+06
14.000	1.000	6.625	.280	.956E+06	.319E+06
14.000	1.250	6.625	.280	.167E+07	.557E+06
14.000	1.500	6.625	.280	.263E+07	.878E+06
14.000	1.750	6.625	.280	.387E+07	.129E+07
14.000	2.000	6.625	.280	.541E+07	.180E+07
14.000	.250	8.625	.322	.395E+05	.132E+05
14.000	.375	8.625	.322	.109E+06	.363E+05
14.000	.500	8.625	.322	.223E+06	.744E+05
14.000	.625	8.625	.322	.390E+06	.130E+06
14.000	.750	8.625	.322	.615E+06	.205E+06
14.000	1.000	8.625	.322	.126E+07	.421E+06
14.000	1.250	8.625	.322	.221E+07	.736E+06
14.000	1.500	8.625	.322	.348E+07	.116E+07
14.000	1.750	8.625	.322	.512E+07	.171E+07
14.000	2.000	8.625	.322	.715E+07	.238E+07
14.000	.250	10.750	.365	.497E+05	.166E+05
14.000	.375	10.750	.365	.137E+06	.457E+05
14.000	.500	10.750	.365	.281E+06	.937E+05
14.000	.625	10.750	.365	.491E+06	.164E+06
14.000	.750	10.750	.365	.775E+06	.258E+06
14.000	1.000	10.750	.365	.159E+07	.530E+06
14.000	1.250	10.750	.365	.278E+07	.926E+06
14.000	1.500	10.750	.365	.438E+07	.146E+07
14.000	1.750	10.750	.365	.645E+07	.215E+07
14.000	2.000	10.750	.365	.900E+07	.300E+07
14.000	.250	12.750	.375	.598E+05	.199E+05
14.000	.375	12.750	.375	.165E+06	.549E+05
14.000	.500	12.750	.375	.338E+06	.113E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
14.000	.625	12.750	.375	.591E+06	.197E+06
14.000	.750	12.750	.375	.932E+06	.311E+06
14.000	1.000	12.750	.375	.191E+07	.638E+06
14.000	1.250	12.750	.375	.334E+07	.111E+07
14.000	1.500	12.750	.375	.527E+07	.176E+07
14.000	1.750	12.750	.375	.775E+07	.258E+07
14.000	2.000	12.750	.375	.108E+08	.361E+07
14.000	.250	14.000	.375	.662E+05	.221E+05
14.000	.375	14.000	.375	.182E+06	.608E+05
14.000	.500	14.000	.375	.374E+06	.125E+06
14.000	.625	14.000	.375	.654E+06	.218E+06
14.000	.750	14.000	.375	.103E+07	.344E+06
14.000	1.000	14.000	.375	.212E+07	.706E+06
14.000	1.250	14.000	.375	.370E+07	.123E+07
14.000	1.500	14.000	.375	.583E+07	.194E+07
14.000	1.750	14.000	.375	.858E+07	.286E+07
14.000	2.000	14.000	.375	.120E+08	.399E+07
14.000	.250	16.000	.375	.764E+05	.255E+05
14.000	.375	16.000	.375	.210E+06	.702E+05
14.000	.500	16.000	.375	.432E+06	.144E+06
14.000	.625	16.000	.375	.755E+06	.252E+06
14.000	.750	16.000	.375	.119E+07	.397E+06
14.000	1.000	16.000	.375	.244E+07	.815E+06
14.000	1.250	16.000	.375	.427E+07	.142E+07
14.000	1.500	16.000	.375	.674E+07	.225E+07
14.000	1.750	16.000	.375	.990E+07	.330E+07
14.000	2.000	16.000	.375	.138E+08	.461E+07
14.000	.250	18.000	.375	.866E+05	.289E+05
14.000	.375	18.000	.375	.239E+06	.796E+05
14.000	.500	18.000	.375	.490E+06	.163E+06
14.000	.625	18.000	.375	.856E+06	.285E+06
14.000	.750	18.000	.375	.135E+07	.450E+06
14.000	1.000	18.000	.375	.277E+07	.924E+06
14.000	1.250	18.000	.375	.484E+07	.161E+07
14.000	1.500	18.000	.375	.764E+07	.255E+07
14.000	1.750	18.000	.375	.112E+08	.374E+07
14.000	2.000	18.000	.375	.157E+08	.523E+07
14.000	.250	20.000	.375	.968E+05	.323E+05
14.000	.375	20.000	.375	.267E+06	.890E+05
14.000	.500	20.000	.375	.548E+06	.183E+06
14.000	.625	20.000	.375	.957E+06	.319E+06
14.000	.750	20.000	.375	.151E+07	.503E+06
14.000	1.000	20.000	.375	.310E+07	.103E+07
14.000	1.250	20.000	.375	.541E+07	.180E+07
14.000	1.500	20.000	.375	.854E+07	.285E+07
14.000	1.750	20.000	.375	.126E+08	.418E+07
14.000	2.000	20.000	.375	.175E+08	.584E+07
14.000	.250	22.000	.375	.107E+06	.357E+05
14.000	.375	22.000	.375	.295E+06	.984E+05
14.000	.500	22.000	.375	.606E+06	.202E+06
14.000	.625	22.000	.375	.106E+07	.353E+06
14.000	.750	22.000	.375	.167E+07	.556E+06
14.000	1.000	22.000	.375	.343E+07	.114E+07
14.000	1.250	22.000	.375	.599E+07	.200E+07
14.000	1.500	22.000	.375	.944E+07	.315E+07
14.000	1.750	22.000	.375	.139E+08	.463E+07
14.000	2.000	22.000	.375	.194E+08	.646E+07
14.000	.250	24.000	.375	.117E+06	.391E+05
14.000	.375	24.000	.375	.323E+06	.108E+06
14.000	.500	24.000	.375	.664E+06	.221E+06
14.000	.625	24.000	.375	.116E+07	.386E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
14.000	.750	24.000	.375	.183E+07	.610E+06
14.000	1.000	24.000	.375	.375E+07	.125E+07
14.000	1.250	24.000	.375	.656E+07	.219E+07
14.000	1.500	24.000	.375	.103E+08	.345E+07
14.000	1.750	24.000	.375	.152E+08	.507E+07
14.000	2.000	24.000	.375	.212E+08	.708E+07
14.000	.250	26.000	.375	.128E+06	.425E+05
14.000	.375	26.000	.375	.351E+06	.117E+06
14.000	.500	26.000	.375	.722E+06	.241E+06
14.000	.625	26.000	.375	.126E+07	.420E+06
14.000	.750	26.000	.375	.199E+07	.663E+06
14.000	1.000	26.000	.375	.408E+07	.136E+07
14.000	1.250	26.000	.375	.713E+07	.238E+07
14.000	1.500	26.000	.375	.112E+08	.375E+07
14.000	1.750	26.000	.375	.165E+08	.551E+07
14.000	2.000	26.000	.375	.231E+08	.770E+07
14.000	.250	28.000	.375	.138E+06	.459E+05
14.000	.375	28.000	.375	.380E+06	.127E+06
14.000	.500	28.000	.375	.779E+06	.260E+06
14.000	.625	28.000	.375	.136E+07	.454E+06
14.000	.750	28.000	.375	.215E+07	.716E+06
14.000	1.000	28.000	.375	.441E+07	.147E+07
14.000	1.250	28.000	.375	.770E+07	.257E+07
14.000	1.500	28.000	.375	.122E+08	.405E+07
14.000	1.750	28.000	.375	.179E+08	.595E+07
14.000	2.000	28.000	.375	.249E+08	.831E+07
14.000	.250	30.000	.375	.148E+06	.493E+05
14.000	.375	30.000	.375	.408E+06	.136E+06
14.000	.500	30.000	.375	.837E+06	.279E+06
14.000	.625	30.000	.375	.146E+07	.488E+06
14.000	.750	30.000	.375	.231E+07	.769E+06
14.000	1.000	30.000	.375	.474E+07	.158E+07
14.000	1.250	30.000	.375	.827E+07	.276E+07
14.000	1.500	30.000	.375	.131E+08	.435E+07
14.000	1.750	30.000	.375	.192E+08	.640E+07
14.000	2.000	30.000	.375	.268E+08	.893E+07
14.000	.250	32.000	.375	.158E+06	.528E+05
14.000	.375	32.000	.375	.436E+06	.145E+06
14.000	.500	32.000	.375	.895E+06	.298E+06
14.000	.625	32.000	.375	.156E+07	.521E+06
14.000	.750	32.000	.375	.247E+07	.822E+06
14.000	1.000	32.000	.375	.506E+07	.169E+07
14.000	1.250	32.000	.375	.885E+07	.295E+07
14.000	1.500	32.000	.375	.140E+08	.465E+07
14.000	1.750	32.000	.375	.205E+08	.684E+07
14.000	2.000	32.000	.375	.286E+08	.955E+07
14.000	.250	36.000	.375	.179E+06	.596E+05
14.000	.375	36.000	.375	.493E+06	.164E+06
14.000	.500	36.000	.375	.101E+07	.337E+06
14.000	.625	36.000	.375	.177E+07	.589E+06
14.000	.750	36.000	.375	.279E+07	.929E+06
14.000	1.000	36.000	.375	.572E+07	.191E+07
14.000	1.250	36.000	.375	.999E+07	.333E+07
14.000	1.500	36.000	.375	.158E+08	.525E+07
14.000	1.750	36.000	.375	.232E+08	.772E+07
14.000	2.000	36.000	.375	.324E+08	.108E+08
14.000	.250	40.000	.375	.199E+06	.664E+05
14.000	.375	40.000	.375	.549E+06	.183E+06
14.000	.500	40.000	.375	.113E+07	.376E+06
14.000	.625	40.000	.375	.197E+07	.656E+06
14.000	.750	40.000	.375	.311E+07	.104E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
14.000	1.000	40.000	.375	.638E+07	.213E+07
14.000	1.250	40.000	.375	.111E+08	.371E+07
14.000	1.500	40.000	.375	.176E+08	.586E+07
14.000	1.750	40.000	.375	.258E+08	.861E+07
14.000	2.000	40.000	.375	.361E+08	.120E+08
14.000	.250	48.000	.375	.240E+06	.801E+05
14.000	.375	48.000	.375	.662E+06	.221E+06
14.000	.500	48.000	.375	.136E+07	.453E+06
14.000	.625	48.000	.375	.237E+07	.791E+06
14.000	.750	48.000	.375	.374E+07	.125E+07
14.000	1.000	48.000	.375	.769E+07	.256E+07
14.000	1.250	48.000	.375	.134E+08	.448E+07
14.000	1.500	48.000	.375	.212E+08	.706E+07
14.000	1.750	48.000	.375	.311E+08	.104E+08
14.000	2.000	48.000	.375	.435E+08	.145E+08
15.000	.250	2.375	.154	.966E+04	.322E+04
15.000	.375	2.375	.154	.266E+05	.887E+04
15.000	.500	2.375	.154	.546E+05	.182E+05
15.000	.625	2.375	.154	.955E+05	.318E+05
15.000	.750	2.375	.154	.151E+06	.502E+05
15.000	1.000	2.375	.154	.309E+06	.103E+06
15.000	1.250	2.375	.154	.540E+06	.180E+06
15.000	1.500	2.375	.154	.852E+06	.284E+06
15.000	1.750	2.375	.154	.125E+07	.417E+06
15.000	2.000	2.375	.154	.175E+07	.583E+06
15.000	.250	3.500	.216	.144E+05	.479E+04
15.000	.375	3.500	.216	.396E+05	.132E+05
15.000	.500	3.500	.216	.813E+05	.271E+05
15.000	.625	3.500	.216	.142E+06	.473E+05
15.000	.750	3.500	.216	.224E+06	.747E+05
15.000	1.000	3.500	.216	.460E+06	.153E+06
15.000	1.250	3.500	.216	.803E+06	.268E+06
15.000	1.500	3.500	.216	.127E+07	.422E+06
15.000	1.750	3.500	.216	.186E+07	.621E+06
15.000	2.000	3.500	.216	.260E+07	.867E+06
15.000	.250	4.500	.237	.190E+05	.633E+04
15.000	.375	4.500	.237	.523E+05	.174E+05
15.000	.500	4.500	.237	.107E+06	.358E+05
15.000	.625	4.500	.237	.188E+06	.626E+05
15.000	.750	4.500	.237	.296E+06	.987E+05
15.000	1.000	4.500	.237	.608E+06	.203E+06
15.000	1.250	4.500	.237	.106E+07	.354E+06
15.000	1.500	4.500	.237	.167E+07	.558E+06
15.000	1.750	4.500	.237	.246E+07	.821E+06
15.000	2.000	4.500	.237	.344E+07	.115E+07
15.000	.250	6.625	.280	.289E+05	.962E+04
15.000	.375	6.625	.280	.795E+05	.265E+05
15.000	.500	6.625	.280	.163E+06	.544E+05
15.000	.625	6.625	.280	.285E+06	.951E+05
15.000	.750	6.625	.280	.450E+06	.150E+06
15.000	1.000	6.625	.280	.924E+06	.308E+06
15.000	1.250	6.625	.280	.161E+07	.538E+06
15.000	1.500	6.625	.280	.255E+07	.848E+06
15.000	1.750	6.625	.280	.374E+07	.125E+07
15.000	2.000	6.625	.280	.522E+07	.174E+07
15.000	.250	8.625	.322	.381E+05	.127E+05
15.000	.375	8.625	.322	.105E+06	.350E+05
15.000	.500	8.625	.322	.216E+06	.719E+05
15.000	.625	8.625	.322	.377E+06	.126E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
15.000	.750	8.625	.322	.595E+06	.198E+06
15.000	1.000	8.625	.322	.122E+07	.407E+06
15.000	1.250	8.625	.322	.213E+07	.711E+06
15.000	1.500	8.625	.322	.336E+07	.112E+07
15.000	1.750	8.625	.322	.494E+07	.165E+07
15.000	2.000	8.625	.322	.690E+07	.230E+07
15.000	.250	10.750	.365	.480E+05	.160E+05
15.000	.375	10.750	.365	.132E+06	.441E+05
15.000	.500	10.750	.365	.272E+06	.906E+05
15.000	.625	10.750	.365	.475E+06	.158E+06
15.000	.750	10.750	.365	.749E+06	.250E+06
15.000	1.000	10.750	.365	.154E+07	.512E+06
15.000	1.250	10.750	.365	.268E+07	.895E+06
15.000	1.500	10.750	.365	.424E+07	.141E+07
15.000	1.750	10.750	.365	.623E+07	.208E+07
15.000	2.000	10.750	.365	.869E+07	.290E+07
15.000	.250	12.750	.375	.578E+05	.193E+05
15.000	.375	12.750	.375	.159E+06	.530E+05
15.000	.500	12.750	.375	.327E+06	.109E+06
15.000	.625	12.750	.375	.571E+06	.190E+06
15.000	.750	12.750	.375	.900E+06	.300E+06
15.000	1.000	12.750	.375	.185E+07	.616E+06
15.000	1.250	12.750	.375	.323E+07	.108E+07
15.000	1.500	12.750	.375	.509E+07	.170E+07
15.000	1.750	12.750	.375	.749E+07	.250E+07
15.000	2.000	12.750	.375	.105E+08	.348E+07
15.000	.250	14.000	.375	.639E+05	.213E+05
15.000	.375	14.000	.375	.176E+06	.587E+05
15.000	.500	14.000	.375	.362E+06	.121E+06
15.000	.625	14.000	.375	.632E+06	.211E+06
15.000	.750	14.000	.375	.996E+06	.332E+06
15.000	1.000	14.000	.375	.205E+07	.682E+06
15.000	1.250	14.000	.375	.357E+07	.119E+07
15.000	1.500	14.000	.375	.564E+07	.188E+07
15.000	1.750	14.000	.375	.829E+07	.276E+07
15.000	2.000	14.000	.375	.116E+08	.386E+07
15.000	.250	16.000	.375	.738E+05	.246E+05
15.000	.375	16.000	.375	.203E+06	.678E+05
15.000	.500	16.000	.375	.417E+06	.139E+06
15.000	.625	16.000	.375	.729E+06	.243E+06
15.000	.750	16.000	.375	.115E+07	.383E+06
15.000	1.000	16.000	.375	.236E+07	.787E+06
15.000	1.250	16.000	.375	.413E+07	.138E+07
15.000	1.500	16.000	.375	.651E+07	.217E+07
15.000	1.750	16.000	.375	.957E+07	.319E+07
15.000	2.000	16.000	.375	.134E+08	.445E+07
15.000	.250	18.000	.375	.837E+05	.279E+05
15.000	.375	18.000	.375	.231E+06	.769E+05
15.000	.500	18.000	.375	.473E+06	.158E+06
15.000	.625	18.000	.375	.827E+06	.276E+06
15.000	.750	18.000	.375	.130E+07	.435E+06
15.000	1.000	18.000	.375	.268E+07	.893E+06
15.000	1.250	18.000	.375	.468E+07	.156E+07
15.000	1.500	18.000	.375	.738E+07	.246E+07
15.000	1.750	18.000	.375	.108E+08	.362E+07
15.000	2.000	18.000	.375	.151E+08	.505E+07
15.000	.250	20.000	.375	.936E+05	.312E+05
15.000	.375	20.000	.375	.258E+06	.859E+05
15.000	.500	20.000	.375	.529E+06	.176E+06
15.000	.625	20.000	.375	.925E+06	.308E+06
15.000	.750	20.000	.375	.146E+07	.486E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
15.000	1.000	20.000	.375	.299E+07	.998E+06
15.000	1.250	20.000	.375	.523E+07	.174E+07
15.000	1.500	20.000	.375	.825E+07	.275E+07
15.000	1.750	20.000	.375	.121E+08	.404E+07
15.000	2.000	20.000	.375	.169E+08	.565E+07
15.000	.250	22.000	.375	.103E+06	.345E+05
15.000	.375	22.000	.375	.285E+06	.950E+05
15.000	.500	22.000	.375	.585E+06	.195E+06
15.000	.625	22.000	.375	.102E+07	.341E+06
15.000	.750	22.000	.375	.161E+07	.538E+06
15.000	1.000	22.000	.375	.331E+07	.110E+07
15.000	1.250	22.000	.375	.578E+07	.193E+07
15.000	1.500	22.000	.375	.912E+07	.304E+07
15.000	1.750	22.000	.375	.134E+08	.447E+07
15.000	2.000	22.000	.375	.187E+08	.624E+07
15.000	.250	24.000	.375	.113E+06	.378E+05
15.000	.375	24.000	.375	.312E+06	.104E+06
15.000	.500	24.000	.375	.641E+06	.214E+06
15.000	.625	24.000	.375	.112E+07	.373E+06
15.000	.750	24.000	.375	.177E+07	.589E+06
15.000	1.000	24.000	.375	.363E+07	.121E+07
15.000	1.250	24.000	.375	.634E+07	.211E+07
15.000	1.500	24.000	.375	.999E+07	.333E+07
15.000	1.750	24.000	.375	.147E+08	.490E+07
15.000	2.000	24.000	.375	.205E+08	.684E+07
15.000	.250	26.000	.375	.123E+06	.411E+05
15.000	.375	26.000	.375	.340E+06	.113E+06
15.000	.500	26.000	.375	.697E+06	.232E+06
15.000	.625	26.000	.375	.122E+07	.406E+06
15.000	.750	26.000	.375	.192E+07	.640E+06
15.000	1.000	26.000	.375	.394E+07	.131E+07
15.000	1.250	26.000	.375	.689E+07	.230E+07
15.000	1.500	26.000	.375	.109E+08	.362E+07
15.000	1.750	26.000	.375	.160E+08	.532E+07
15.000	2.000	26.000	.375	.223E+08	.744E+07
15.000	.250	28.000	.375	.133E+06	.444E+05
15.000	.375	28.000	.375	.367E+06	.122E+06
15.000	.500	28.000	.375	.753E+06	.251E+06
15.000	.625	28.000	.375	.132E+07	.438E+06
15.000	.750	28.000	.375	.208E+07	.692E+06
15.000	1.000	28.000	.375	.426E+07	.142E+07
15.000	1.250	28.000	.375	.744E+07	.248E+07
15.000	1.500	28.000	.375	.117E+08	.391E+07
15.000	1.750	28.000	.375	.173E+08	.575E+07
15.000	2.000	28.000	.375	.241E+08	.803E+07
15.000	.250	30.000	.375	.143E+06	.477E+05
15.000	.375	30.000	.375	.394E+06	.131E+06
15.000	.500	30.000	.375	.809E+06	.270E+06
15.000	.625	30.000	.375	.141E+07	.471E+06
15.000	.750	30.000	.375	.223E+07	.743E+06
15.000	1.000	30.000	.375	.458E+07	.153E+07
15.000	1.250	30.000	.375	.799E+07	.266E+07
15.000	1.500	30.000	.375	.126E+08	.420E+07
15.000	1.750	30.000	.375	.185E+08	.618E+07
15.000	2.000	30.000	.375	.259E+08	.863E+07
15.000	.250	32.000	.375	.153E+06	.510E+05
15.000	.375	32.000	.375	.421E+06	.140E+06
15.000	.500	32.000	.375	.865E+06	.288E+06
15.000	.625	32.000	.375	.151E+07	.504E+06
15.000	.750	32.000	.375	.238E+07	.794E+06
15.000	1.000	32.000	.375	.489E+07	.163E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
15.000	1.250	32.000	.375	.855E+07	.285E+07
15.000	1.500	32.000	.375	.135E+08	.449E+07
15.000	1.750	32.000	.375	.198E+08	.661E+07
15.000	2.000	32.000	.375	.277E+08	.923E+07
15.000	.250	36.000	.375	.173E+06	.576E+05
15.000	.375	36.000	.375	.476E+06	.159E+06
15.000	.500	36.000	.375	.977E+06	.326E+06
15.000	.625	36.000	.375	.171E+07	.569E+06
15.000	.750	36.000	.375	.269E+07	.897E+06
15.000	1.000	36.000	.375	.553E+07	.184E+07
15.000	1.250	36.000	.375	.965E+07	.322E+07
15.000	1.500	36.000	.375	.152E+08	.508E+07
15.000	1.750	36.000	.375	.224E+08	.746E+07
15.000	2.000	36.000	.375	.313E+08	.104E+08
15.000	.250	40.000	.375	.192E+06	.642E+05
15.000	.375	40.000	.375	.530E+06	.177E+06
15.000	.500	40.000	.375	.109E+07	.363E+06
15.000	.625	40.000	.375	.190E+07	.634E+06
15.000	.750	40.000	.375	.300E+07	.100E+07
15.000	1.000	40.000	.375	.616E+07	.205E+07
15.000	1.250	40.000	.375	.108E+08	.359E+07
15.000	1.500	40.000	.375	.170E+08	.566E+07
15.000	1.750	40.000	.375	.250E+08	.832E+07
15.000	2.000	40.000	.375	.348E+08	.116E+08
15.000	.250	48.000	.375	.232E+06	.774E+05
15.000	.375	48.000	.375	.639E+06	.213E+06
15.000	.500	48.000	.375	.131E+07	.438E+06
15.000	.625	48.000	.375	.229E+07	.764E+06
15.000	.750	48.000	.375	.362E+07	.121E+07
15.000	1.000	48.000	.375	.743E+07	.248E+07
15.000	1.250	48.000	.375	.130E+08	.432E+07
15.000	1.500	48.000	.375	.205E+08	.682E+07
15.000	1.750	48.000	.375	.301E+08	.100E+08
15.000	2.000	48.000	.375	.420E+08	.140E+08
16.000	.250	2.375	.154	.935E+04	.312E+04
16.000	.375	2.375	.154	.258E+05	.859E+04
16.000	.500	2.375	.154	.529E+05	.176E+05
16.000	.625	2.375	.154	.924E+05	.308E+05
16.000	.750	2.375	.154	.146E+06	.486E+05
16.000	1.000	2.375	.154	.299E+06	.998E+05
16.000	1.250	2.375	.154	.523E+06	.174E+06
16.000	1.500	2.375	.154	.825E+06	.275E+06
16.000	1.750	2.375	.154	.121E+07	.404E+06
16.000	2.000	2.375	.154	.169E+07	.564E+06
16.000	.250	3.500	.216	.139E+05	.464E+04
16.000	.375	3.500	.216	.383E+05	.128E+05
16.000	.500	3.500	.216	.787E+05	.262E+05
16.000	.625	3.500	.216	.138E+06	.458E+05
16.000	.750	3.500	.216	.217E+06	.723E+05
16.000	1.000	3.500	.216	.445E+06	.148E+06
16.000	1.250	3.500	.216	.778E+06	.259E+06
16.000	1.500	3.500	.216	.123E+07	.409E+06
16.000	1.750	3.500	.216	.180E+07	.601E+06
16.000	2.000	3.500	.216	.252E+07	.840E+06
16.000	.250	4.500	.237	.184E+05	.613E+04
16.000	.375	4.500	.237	.507E+05	.169E+05
16.000	.500	4.500	.237	.104E+06	.347E+05
16.000	.625	4.500	.237	.182E+06	.606E+05
16.000	.750	4.500	.237	.287E+06	.956E+05

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
16.000	1.000	4.500	.237	.589E+06	.196E+06
16.000	1.250	4.500	.237	.103E+07	.343E+06
16.000	1.500	4.500	.237	.162E+07	.541E+06
16.000	1.750	4.500	.237	.238E+07	.795E+06
16.000	2.000	4.500	.237	.333E+07	.111E+07
16.000	.250	6.625	.280	.279E+05	.932E+04
16.000	.375	6.625	.280	.770E+05	.257E+05
16.000	.500	6.625	.280	.158E+06	.527E+05
16.000	.625	6.625	.280	.276E+06	.921E+05
16.000	.750	6.625	.280	.436E+06	.145E+06
16.000	1.000	6.625	.280	.894E+06	.298E+06
16.000	1.250	6.625	.280	.156E+07	.521E+06
16.000	1.500	6.625	.280	.246E+07	.821E+06
16.000	1.750	6.625	.280	.362E+07	.121E+07
16.000	2.000	6.625	.280	.506E+07	.169E+07
16.000	.250	8.625	.322	.369E+05	.123E+05
16.000	.375	8.625	.322	.102E+06	.339E+05
16.000	.500	8.625	.322	.209E+06	.696E+05
16.000	.625	8.625	.322	.365E+06	.122E+06
16.000	.750	8.625	.322	.576E+06	.192E+06
16.000	1.000	8.625	.322	.118E+07	.394E+06
16.000	1.250	8.625	.322	.206E+07	.688E+06
16.000	1.500	8.625	.322	.326E+07	.109E+07
16.000	1.750	8.625	.322	.479E+07	.160E+07
16.000	2.000	8.625	.322	.669E+07	.223E+07
16.000	.250	10.750	.365	.465E+05	.155E+05
16.000	.375	10.750	.365	.128E+06	.427E+05
16.000	.500	10.750	.365	.263E+06	.877E+05
16.000	.625	10.750	.365	.460E+06	.153E+06
16.000	.750	10.750	.365	.725E+06	.242E+06
16.000	1.000	10.750	.365	.149E+07	.496E+06
16.000	1.250	10.750	.365	.260E+07	.867E+06
16.000	1.500	10.750	.365	.410E+07	.137E+07
16.000	1.750	10.750	.365	.603E+07	.201E+07
16.000	2.000	10.750	.365	.842E+07	.281E+07
16.000	.250	12.750	.375	.559E+05	.186E+05
16.000	.375	12.750	.375	.154E+06	.514E+05
16.000	.500	12.750	.375	.316E+06	.105E+06
16.000	.625	12.750	.375	.553E+06	.184E+06
16.000	.750	12.750	.375	.872E+06	.291E+06
16.000	1.000	12.750	.375	.179E+07	.596E+06
16.000	1.250	12.750	.375	.313E+07	.104E+07
16.000	1.500	12.750	.375	.493E+07	.164E+07
16.000	1.750	12.750	.375	.725E+07	.242E+07
16.000	2.000	12.750	.375	.101E+08	.337E+07
16.000	.250	14.000	.375	.619E+05	.206E+05
16.000	.375	14.000	.375	.171E+06	.569E+05
16.000	.500	14.000	.375	.350E+06	.117E+06
16.000	.625	14.000	.375	.612E+06	.204E+06
16.000	.750	14.000	.375	.965E+06	.322E+06
16.000	1.000	14.000	.375	.198E+07	.660E+06
16.000	1.250	14.000	.375	.346E+07	.115E+07
16.000	1.500	14.000	.375	.546E+07	.182E+07
16.000	1.750	14.000	.375	.802E+07	.267E+07
16.000	2.000	14.000	.375	.112E+08	.373E+07
16.000	.250	16.000	.375	.715E+05	.238E+05
16.000	.375	16.000	.375	.197E+06	.656E+05
16.000	.500	16.000	.375	.404E+06	.135E+06
16.000	.625	16.000	.375	.706E+06	.235E+06
16.000	.750	16.000	.375	.111E+07	.371E+06
16.000	1.000	16.000	.375	.229E+07	.762E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
16.000	1.250	16.000	.375	.399E+07	.133E+07
16.000	1.500	16.000	.375	.630E+07	.210E+07
16.000	1.750	16.000	.375	.926E+07	.309E+07
16.000	2.000	16.000	.375	.129E+08	.431E+07
16.000	.250	18.000	.375	.810E+05	.270E+05
16.000	.375	18.000	.375	.223E+06	.744E+05
16.000	.500	18.000	.375	.458E+06	.153E+06
16.000	.625	18.000	.375	.801E+06	.267E+06
16.000	.750	18.000	.375	.126E+07	.421E+06
16.000	1.000	18.000	.375	.259E+07	.864E+06
16.000	1.250	18.000	.375	.453E+07	.151E+07
16.000	1.500	18.000	.375	.714E+07	.238E+07
16.000	1.750	18.000	.375	.105E+08	.350E+07
16.000	2.000	18.000	.375	.147E+08	.489E+07
16.000	.250	20.000	.375	.906E+05	.302E+05
16.000	.375	20.000	.375	.250E+06	.832E+05
16.000	.500	20.000	.375	.512E+06	.171E+06
16.000	.625	20.000	.375	.895E+06	.298E+06
16.000	.750	20.000	.375	.141E+07	.471E+06
16.000	1.000	20.000	.375	.290E+07	.966E+06
16.000	1.250	20.000	.375	.506E+07	.169E+07
16.000	1.500	20.000	.375	.799E+07	.266E+07
16.000	1.750	20.000	.375	.117E+08	.391E+07
16.000	2.000	20.000	.375	.164E+08	.547E+07
16.000	.250	22.000	.375	.100E+06	.334E+05
16.000	.375	22.000	.375	.276E+06	.920E+05
16.000	.500	22.000	.375	.567E+06	.189E+06
16.000	.625	22.000	.375	.990E+06	.330E+06
16.000	.750	22.000	.375	.156E+07	.520E+06
16.000	1.000	22.000	.375	.321E+07	.107E+07
16.000	1.250	22.000	.375	.560E+07	.187E+07
16.000	1.500	22.000	.375	.883E+07	.294E+07
16.000	1.750	22.000	.375	.130E+08	.433E+07
16.000	2.000	22.000	.375	.181E+08	.604E+07
16.000	.250	24.000	.375	.110E+06	.366E+05
16.000	.375	24.000	.375	.302E+06	.101E+06
16.000	.500	24.000	.375	.621E+06	.207E+06
16.000	.625	24.000	.375	.108E+07	.361E+06
16.000	.750	24.000	.375	.171E+07	.570E+06
16.000	1.000	24.000	.375	.351E+07	.117E+07
16.000	1.250	24.000	.375	.613E+07	.204E+07
16.000	1.500	24.000	.375	.968E+07	.323E+07
16.000	1.750	24.000	.375	.142E+08	.474E+07
16.000	2.000	24.000	.375	.199E+08	.662E+07
16.000	.250	26.000	.375	.119E+06	.398E+05
16.000	.375	26.000	.375	.329E+06	.110E+06
16.000	.500	26.000	.375	.675E+06	.225E+06
16.000	.625	26.000	.375	.118E+07	.393E+06
16.000	.750	26.000	.375	.186E+07	.620E+06
16.000	1.000	26.000	.375	.382E+07	.127E+07
16.000	1.250	26.000	.375	.667E+07	.222E+07
16.000	1.500	26.000	.375	.105E+08	.351E+07
16.000	1.750	26.000	.375	.155E+08	.516E+07
16.000	2.000	26.000	.375	.216E+08	.720E+07
16.000	.250	28.000	.375	.129E+06	.430E+05
16.000	.375	28.000	.375	.355E+06	.118E+06
16.000	.500	28.000	.375	.729E+06	.243E+06
16.000	.625	28.000	.375	.127E+07	.425E+06
16.000	.750	28.000	.375	.201E+07	.670E+06
16.000	1.000	28.000	.375	.412E+07	.137E+07
16.000	1.250	28.000	.375	.721E+07	.240E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
16.000	1.500	28.000	.375	.114E+08	.379E+07
16.000	1.750	28.000	.375	.167E+08	.557E+07
16.000	2.000	28.000	.375	.233E+08	.778E+07
16.000	.250	30.000	.375	.138E+06	.462E+05
16.000	.375	30.000	.375	.382E+06	.127E+06
16.000	.500	30.000	.375	.783E+06	.261E+06
16.000	.625	30.000	.375	.137E+07	.456E+06
16.000	.750	30.000	.375	.216E+07	.719E+06
16.000	1.000	30.000	.375	.443E+07	.148E+07
16.000	1.250	30.000	.375	.774E+07	.258E+07
16.000	1.500	30.000	.375	.122E+08	.407E+07
16.000	1.750	30.000	.375	.180E+08	.598E+07
16.000	2.000	30.000	.375	.251E+08	.836E+07
16.000	.250	32.000	.375	.148E+06	.493E+05
16.000	.375	32.000	.375	.408E+06	.136E+06
16.000	.500	32.000	.375	.837E+06	.279E+06
16.000	.625	32.000	.375	.146E+07	.488E+06
16.000	.750	32.000	.375	.231E+07	.769E+06
16.000	1.000	32.000	.375	.474E+07	.158E+07
16.000	1.250	32.000	.375	.828E+07	.276E+07
16.000	1.500	32.000	.375	.131E+08	.435E+07
16.000	1.750	32.000	.375	.192E+08	.640E+07
16.000	2.000	32.000	.375	.268E+08	.893E+07
16.000	.250	36.000	.375	.167E+06	.557E+05
16.000	.375	36.000	.375	.461E+06	.154E+06
16.000	.500	36.000	.375	.946E+06	.315E+06
16.000	.625	36.000	.375	.165E+07	.551E+06
16.000	.750	36.000	.375	.261E+07	.869E+06
16.000	1.000	36.000	.375	.535E+07	.178E+07
16.000	1.250	36.000	.375	.935E+07	.312E+07
16.000	1.500	36.000	.375	.147E+08	.491E+07
16.000	1.750	36.000	.375	.217E+08	.723E+07
16.000	2.000	36.000	.375	.303E+08	.101E+08
16.000	.250	40.000	.375	.186E+06	.621E+05
16.000	.375	40.000	.375	.514E+06	.171E+06
16.000	.500	40.000	.375	.105E+07	.351E+06
16.000	.625	40.000	.375	.184E+07	.614E+06
16.000	.750	40.000	.375	.291E+07	.968E+06
16.000	1.000	40.000	.375	.596E+07	.199E+07
16.000	1.250	40.000	.375	.104E+08	.347E+07
16.000	1.500	40.000	.375	.164E+08	.548E+07
16.000	1.750	40.000	.375	.242E+08	.805E+07
16.000	2.000	40.000	.375	.337E+08	.112E+08
16.000	.250	48.000	.375	.225E+06	.749E+05
16.000	.375	48.000	.375	.619E+06	.206E+06
16.000	.500	48.000	.375	.127E+07	.424E+06
16.000	.625	48.000	.375	.222E+07	.740E+06
16.000	.750	48.000	.375	.350E+07	.117E+07
16.000	1.000	48.000	.375	.719E+07	.240E+07
16.000	1.250	48.000	.375	.126E+08	.419E+07
16.000	1.500	48.000	.375	.198E+08	.660E+07
16.000	1.750	48.000	.375	.291E+08	.971E+07
16.000	2.000	48.000	.375	.407E+08	.136E+08
17.000	.250	2.375	.154	.907E+04	.302E+04
17.000	.375	2.375	.154	.250E+05	.833E+04
17.000	.500	2.375	.154	.513E+05	.171E+05
17.000	.625	2.375	.154	.897E+05	.299E+05
17.000	.750	2.375	.154	.141E+06	.471E+05
17.000	1.000	2.375	.154	.290E+06	.968E+05

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
17.000	1.250	2.375	.154	.507E+06	.169E+06
17.000	1.500	2.375	.154	.800E+06	.267E+06
17.000	1.750	2.375	.154	.118E+07	.392E+06
17.000	2.000	2.375	.154	.164E+07	.547E+06
17.000	.250	3.500	.216	.135E+05	.450E+04
17.000	.375	3.500	.216	.372E+05	.124E+05
17.000	.500	3.500	.216	.764E+05	.255E+05
17.000	.625	3.500	.216	.133E+06	.445E+05
17.000	.750	3.500	.216	.210E+06	.701E+05
17.000	1.000	3.500	.216	.432E+06	.144E+06
17.000	1.250	3.500	.216	.755E+06	.252E+06
17.000	1.500	3.500	.216	.119E+07	.397E+06
17.000	1.750	3.500	.216	.175E+07	.583E+06
17.000	2.000	3.500	.216	.244E+07	.815E+06
17.000	.250	4.500	.237	.178E+05	.595E+04
17.000	.375	4.500	.237	.492E+05	.164E+05
17.000	.500	4.500	.237	.101E+06	.336E+05
17.000	.625	4.500	.237	.176E+06	.588E+05
17.000	.750	4.500	.237	.278E+06	.927E+05
17.000	1.000	4.500	.237	.571E+06	.190E+06
17.000	1.250	4.500	.237	.997E+06	.332E+06
17.000	1.500	4.500	.237	.157E+07	.524E+06
17.000	1.750	4.500	.237	.231E+07	.771E+06
17.000	2.000	4.500	.237	.323E+07	.108E+07
17.000	.250	6.625	.280	.271E+05	.904E+04
17.000	.375	6.625	.280	.747E+05	.249E+05
17.000	.500	6.625	.280	.153E+06	.511E+05
17.000	.625	6.625	.280	.268E+06	.893E+05
17.000	.750	6.625	.280	.423E+06	.141E+06
17.000	1.000	6.625	.280	.868E+06	.289E+06
17.000	1.250	6.625	.280	.152E+07	.505E+06
17.000	1.500	6.625	.280	.239E+07	.797E+06
17.000	1.750	6.625	.280	.351E+07	.117E+07
17.000	2.000	6.625	.280	.491E+07	.164E+07
17.000	.250	8.625	.322	.358E+05	.119E+05
17.000	.375	8.625	.322	.987E+05	.329E+05
17.000	.500	8.625	.322	.203E+06	.676E+05
17.000	.625	8.625	.322	.354E+06	.118E+06
17.000	.750	8.625	.322	.558E+06	.186E+06
17.000	1.000	8.625	.322	.115E+07	.382E+06
17.000	1.250	8.625	.322	.200E+07	.668E+06
17.000	1.500	8.625	.322	.316E+07	.105E+07
17.000	1.750	8.625	.322	.464E+07	.155E+07
17.000	2.000	8.625	.322	.649E+07	.216E+07
17.000	.250	10.750	.365	.451E+05	.150E+05
17.000	.375	10.750	.365	.124E+06	.414E+05
17.000	.500	10.750	.365	.255E+06	.851E+05
17.000	.625	10.750	.365	.446E+06	.149E+06
17.000	.750	10.750	.365	.703E+06	.234E+06
17.000	1.000	10.750	.365	.144E+07	.481E+06
17.000	1.250	10.750	.365	.252E+07	.841E+06
17.000	1.500	10.750	.365	.398E+07	.133E+07
17.000	1.750	10.750	.365	.585E+07	.195E+07
17.000	2.000	10.750	.365	.817E+07	.272E+07
17.000	.250	12.750	.375	.542E+05	.181E+05
17.000	.375	12.750	.375	.149E+06	.498E+05
17.000	.500	12.750	.375	.307E+06	.102E+06
17.000	.625	12.750	.375	.536E+06	.179E+06
17.000	.750	12.750	.375	.846E+06	.282E+06
17.000	1.000	12.750	.375	.174E+07	.579E+06
17.000	1.250	12.750	.375	.303E+07	.101E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
17.000	1.500	12.750	.375	.478E+07	.159E+07
17.000	1.750	12.750	.375	.703E+07	.234E+07
17.000	2.000	12.750	.375	.982E+07	.327E+07
17.000	.250	14.000	.375	.600E+05	.200E+05
17.000	.375	14.000	.375	.165E+06	.552E+05
17.000	.500	14.000	.375	.340E+06	.113E+06
17.000	.625	14.000	.375	.593E+06	.198E+06
17.000	.750	14.000	.375	.936E+06	.312E+06
17.000	1.000	14.000	.375	.192E+07	.640E+06
17.000	1.250	14.000	.375	.336E+07	.112E+07
17.000	1.500	14.000	.375	.529E+07	.176E+07
17.000	1.750	14.000	.375	.778E+07	.259E+07
17.000	2.000	14.000	.375	.109E+08	.362E+07
17.000	.250	16.000	.375	.693E+05	.231E+05
17.000	.375	16.000	.375	.191E+06	.637E+05
17.000	.500	16.000	.375	.392E+06	.131E+06
17.000	.625	16.000	.375	.685E+06	.228E+06
17.000	.750	16.000	.375	.108E+07	.360E+06
17.000	1.000	16.000	.375	.222E+07	.739E+06
17.000	1.250	16.000	.375	.388E+07	.129E+07
17.000	1.500	16.000	.375	.611E+07	.204E+07
17.000	1.750	16.000	.375	.899E+07	.300E+07
17.000	2.000	16.000	.375	.125E+08	.418E+07
17.000	.250	18.000	.375	.786E+05	.262E+05
17.000	.375	18.000	.375	.217E+06	.722E+05
17.000	.500	18.000	.375	.445E+06	.148E+06
17.000	.625	18.000	.375	.777E+06	.259E+06
17.000	.750	18.000	.375	.123E+07	.408E+06
17.000	1.000	18.000	.375	.252E+07	.838E+06
17.000	1.250	18.000	.375	.439E+07	.146E+07
17.000	1.500	18.000	.375	.693E+07	.231E+07
17.000	1.750	18.000	.375	.102E+08	.340E+07
17.000	2.000	18.000	.375	.142E+08	.474E+07
17.000	.250	20.000	.375	.879E+05	.293E+05
17.000	.375	20.000	.375	.242E+06	.807E+05
17.000	.500	20.000	.375	.497E+06	.166E+06
17.000	.625	20.000	.375	.868E+06	.289E+06
17.000	.750	20.000	.375	.137E+07	.457E+06
17.000	1.000	20.000	.375	.281E+07	.937E+06
17.000	1.250	20.000	.375	.491E+07	.164E+07
17.000	1.500	20.000	.375	.775E+07	.258E+07
17.000	1.750	20.000	.375	.114E+08	.380E+07
17.000	2.000	20.000	.375	.159E+08	.530E+07
17.000	.250	22.000	.375	.972E+05	.324E+05
17.000	.375	22.000	.375	.268E+06	.893E+05
17.000	.500	22.000	.375	.550E+06	.183E+06
17.000	.625	22.000	.375	.960E+06	.320E+06
17.000	.750	22.000	.375	.151E+07	.505E+06
17.000	1.000	22.000	.375	.311E+07	.104E+07
17.000	1.250	22.000	.375	.543E+07	.181E+07
17.000	1.500	22.000	.375	.857E+07	.286E+07
17.000	1.750	22.000	.375	.126E+08	.420E+07
17.000	2.000	22.000	.375	.176E+08	.586E+07
17.000	.250	24.000	.375	.106E+06	.355E+05
17.000	.375	24.000	.375	.293E+06	.978E+05
17.000	.500	24.000	.375	.602E+06	.201E+06
17.000	.625	24.000	.375	.105E+07	.351E+06
17.000	.750	24.000	.375	.166E+07	.553E+06
17.000	1.000	24.000	.375	.341E+07	.114E+07
17.000	1.250	24.000	.375	.595E+07	.198E+07
17.000	1.500	24.000	.375	.939E+07	.313E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
17.000	1.750	24.000	.375	.138E+08	.460E+07
17.000	2.000	24.000	.375	.193E+08	.642E+07
17.000	.250	26.000	.375	.116E+06	.386E+05
17.000	.375	26.000	.375	.319E+06	.106E+06
17.000	.500	26.000	.375	.655E+06	.218E+06
17.000	.625	26.000	.375	.114E+07	.381E+06
17.000	.750	26.000	.375	.180E+07	.601E+06
17.000	1.000	26.000	.375	.370E+07	.123E+07
17.000	1.250	26.000	.375	.647E+07	.216E+07
17.000	1.500	26.000	.375	.102E+08	.340E+07
17.000	1.750	26.000	.375	.150E+08	.500E+07
17.000	2.000	26.000	.375	.210E+08	.698E+07
17.000	.250	28.000	.375	.125E+06	.417E+05
17.000	.375	28.000	.375	.345E+06	.115E+06
17.000	.500	28.000	.375	.707E+06	.236E+06
17.000	.625	28.000	.375	.124E+07	.412E+06
17.000	.750	28.000	.375	.195E+07	.650E+06
17.000	1.000	28.000	.375	.400E+07	.133E+07
17.000	1.250	28.000	.375	.699E+07	.233E+07
17.000	1.500	28.000	.375	.110E+08	.368E+07
17.000	1.750	28.000	.375	.162E+08	.540E+07
17.000	2.000	28.000	.375	.226E+08	.754E+07
17.000	.250	30.000	.375	.134E+06	.448E+05
17.000	.375	30.000	.375	.370E+06	.123E+06
17.000	.500	30.000	.375	.760E+06	.253E+06
17.000	.625	30.000	.375	.133E+07	.442E+06
17.000	.750	30.000	.375	.209E+07	.698E+06
17.000	1.000	30.000	.375	.430E+07	.143E+07
17.000	1.250	30.000	.375	.751E+07	.250E+07
17.000	1.500	30.000	.375	.118E+08	.395E+07
17.000	1.750	30.000	.375	.174E+08	.581E+07
17.000	2.000	30.000	.375	.243E+08	.811E+07
17.000	.250	32.000	.375	.144E+06	.479E+05
17.000	.375	32.000	.375	.396E+06	.132E+06
17.000	.500	32.000	.375	.812E+06	.271E+06
17.000	.625	32.000	.375	.142E+07	.473E+06
17.000	.750	32.000	.375	.224E+07	.746E+06
17.000	1.000	32.000	.375	.460E+07	.153E+07
17.000	1.250	32.000	.375	.803E+07	.268E+07
17.000	1.500	32.000	.375	.127E+08	.422E+07
17.000	1.750	32.000	.375	.186E+08	.621E+07
17.000	2.000	32.000	.375	.260E+08	.867E+07
17.000	.250	36.000	.375	.162E+06	.541E+05
17.000	.375	36.000	.375	.447E+06	.149E+06
17.000	.500	36.000	.375	.918E+06	.306E+06
17.000	.625	36.000	.375	.160E+07	.534E+06
17.000	.750	36.000	.375	.253E+07	.843E+06
17.000	1.000	36.000	.375	.519E+07	.173E+07
17.000	1.250	36.000	.375	.907E+07	.302E+07
17.000	1.500	36.000	.375	.143E+08	.477E+07
17.000	1.750	36.000	.375	.210E+08	.701E+07
17.000	2.000	36.000	.375	.294E+08	.979E+07
17.000	.250	40.000	.375	.181E+06	.603E+05
17.000	.375	40.000	.375	.498E+06	.166E+06
17.000	.500	40.000	.375	.102E+07	.341E+06
17.000	.625	40.000	.375	.179E+07	.596E+06
17.000	.750	40.000	.375	.282E+07	.939E+06
17.000	1.000	40.000	.375	.579E+07	.193E+07
17.000	1.250	40.000	.375	.101E+08	.337E+07
17.000	1.500	40.000	.375	.159E+08	.531E+07
17.000	1.750	40.000	.375	.234E+08	.781E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
17.000	2.000	40.000	.375	.327E+08	.109E+08
17.000	.250	48.000	.375	.218E+06	.727E+05
17.000	.375	48.000	.375	.601E+06	.200E+06
17.000	.500	48.000	.375	.123E+07	.411E+06
17.000	.625	48.000	.375	.215E+07	.718E+06
17.000	.750	48.000	.375	.340E+07	.113E+07
17.000	1.000	48.000	.375	.698E+07	.233E+07
17.000	1.250	48.000	.375	.122E+08	.406E+07
17.000	1.500	48.000	.375	.192E+08	.641E+07
17.000	1.750	48.000	.375	.283E+08	.942E+07
17.000	2.000	48.000	.375	.395E+08	.132E+08
18.000	.250	2.375	.154	.882E+04	.294E+04
18.000	.375	2.375	.154	.243E+05	.810E+04
18.000	.500	2.375	.154	.499E+05	.166E+05
18.000	.625	2.375	.154	.871E+05	.290E+05
18.000	.750	2.375	.154	.137E+06	.458E+05
18.000	1.000	2.375	.154	.282E+06	.941E+05
18.000	1.250	2.375	.154	.493E+06	.164E+06
18.000	1.500	2.375	.154	.778E+06	.259E+06
18.000	1.750	2.375	.154	.114E+07	.381E+06
18.000	2.000	2.375	.154	.160E+07	.532E+06
18.000	.250	3.500	.216	.131E+05	.437E+04
18.000	.375	3.500	.216	.362E+05	.121E+05
18.000	.500	3.500	.216	.742E+05	.247E+05
18.000	.625	3.500	.216	.130E+06	.432E+05
18.000	.750	3.500	.216	.205E+06	.682E+05
18.000	1.000	3.500	.216	.420E+06	.140E+06
18.000	1.250	3.500	.216	.733E+06	.244E+06
18.000	1.500	3.500	.216	.116E+07	.386E+06
18.000	1.750	3.500	.216	.170E+07	.567E+06
18.000	2.000	3.500	.216	.237E+07	.792E+06
18.000	.250	4.500	.237	.173E+05	.578E+04
18.000	.375	4.500	.237	.478E+05	.159E+05
18.000	.500	4.500	.237	.981E+05	.327E+05
18.000	.625	4.500	.237	.171E+06	.571E+05
18.000	.750	4.500	.237	.270E+06	.901E+05
18.000	1.000	4.500	.237	.555E+06	.185E+06
18.000	1.250	4.500	.237	.969E+06	.323E+06
18.000	1.500	4.500	.237	.153E+07	.510E+06
18.000	1.750	4.500	.237	.225E+07	.749E+06
18.000	2.000	4.500	.237	.314E+07	.105E+07
18.000	.250	6.625	.280	.263E+05	.878E+04
18.000	.375	6.625	.280	.726E+05	.242E+05
18.000	.500	6.625	.280	.149E+06	.497E+05
18.000	.625	6.625	.280	.260E+06	.868E+05
18.000	.750	6.625	.280	.411E+06	.137E+06
18.000	1.000	6.625	.280	.843E+06	.281E+06
18.000	1.250	6.625	.280	.147E+07	.491E+06
18.000	1.500	6.625	.280	.232E+07	.774E+06
18.000	1.750	6.625	.280	.342E+07	.114E+07
18.000	2.000	6.625	.280	.477E+07	.159E+07
18.000	.250	8.625	.322	.348E+05	.116E+05
18.000	.375	8.625	.322	.959E+05	.320E+05
18.000	.500	8.625	.322	.197E+06	.657E+05
18.000	.625	8.625	.322	.344E+06	.115E+06
18.000	.750	8.625	.322	.543E+06	.181E+06
18.000	1.000	8.625	.322	.111E+07	.371E+06
18.000	1.250	8.625	.322	.195E+07	.649E+06
18.000	1.500	8.625	.322	.307E+07	.102E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
18.000	1.750	8.625	.322	.451E+07	.150E+07
18.000	2.000	8.625	.322	.630E+07	.210E+07
18.000	.250	10.750	.365	.438E+05	.146E+05
18.000	.375	10.750	.365	.121E+06	.403E+05
18.000	.500	10.750	.365	.248E+06	.827E+05
18.000	.625	10.750	.365	.433E+06	.144E+06
18.000	.750	10.750	.365	.683E+06	.228E+06
18.000	1.000	10.750	.365	.140E+07	.468E+06
18.000	1.250	10.750	.365	.245E+07	.817E+06
18.000	1.500	10.750	.365	.387E+07	.129E+07
18.000	1.750	10.750	.365	.568E+07	.189E+07
18.000	2.000	10.750	.365	.794E+07	.265E+07
18.000	.250	12.750	.375	.527E+05	.176E+05
18.000	.375	12.750	.375	.145E+06	.484E+05
18.000	.500	12.750	.375	.298E+06	.994E+05
18.000	.625	12.750	.375	.521E+06	.174E+06
18.000	.750	12.750	.375	.822E+06	.274E+06
18.000	1.000	12.750	.375	.169E+07	.562E+06
18.000	1.250	12.750	.375	.295E+07	.982E+06
18.000	1.500	12.750	.375	.465E+07	.155E+07
18.000	1.750	12.750	.375	.683E+07	.228E+07
18.000	2.000	12.750	.375	.954E+07	.318E+07
18.000	.250	14.000	.375	.584E+05	.195E+05
18.000	.375	14.000	.375	.161E+06	.536E+05
18.000	.500	14.000	.375	.330E+06	.110E+06
18.000	.625	14.000	.375	.577E+06	.192E+06
18.000	.750	14.000	.375	.910E+06	.303E+06
18.000	1.000	14.000	.375	.187E+07	.622E+06
18.000	1.250	14.000	.375	.326E+07	.109E+07
18.000	1.500	14.000	.375	.515E+07	.172E+07
18.000	1.750	14.000	.375	.756E+07	.252E+07
18.000	2.000	14.000	.375	.106E+08	.352E+07
18.000	.250	16.000	.375	.674E+05	.225E+05
18.000	.375	16.000	.375	.186E+06	.619E+05
18.000	.500	16.000	.375	.381E+06	.127E+06
18.000	.625	16.000	.375	.666E+06	.222E+06
18.000	.750	16.000	.375	.105E+07	.350E+06
18.000	1.000	16.000	.375	.216E+07	.719E+06
18.000	1.250	16.000	.375	.377E+07	.126E+07
18.000	1.500	16.000	.375	.594E+07	.198E+07
18.000	1.750	16.000	.375	.873E+07	.291E+07
18.000	2.000	16.000	.375	.122E+08	.406E+07
18.000	.250	18.000	.375	.764E+05	.255E+05
18.000	.375	18.000	.375	.210E+06	.702E+05
18.000	.500	18.000	.375	.432E+06	.144E+06
18.000	.625	18.000	.375	.755E+06	.252E+06
18.000	.750	18.000	.375	.119E+07	.397E+06
18.000	1.000	18.000	.375	.244E+07	.815E+06
18.000	1.250	18.000	.375	.427E+07	.142E+07
18.000	1.500	18.000	.375	.674E+07	.225E+07
18.000	1.750	18.000	.375	.990E+07	.330E+07
18.000	2.000	18.000	.375	.138E+08	.461E+07
18.000	.250	20.000	.375	.854E+05	.285E+05
18.000	.375	20.000	.375	.235E+06	.785E+05
18.000	.500	20.000	.375	.483E+06	.161E+06
18.000	.625	20.000	.375	.844E+06	.281E+06
18.000	.750	20.000	.375	.133E+07	.444E+06
18.000	1.000	20.000	.375	.273E+07	.911E+06
18.000	1.250	20.000	.375	.477E+07	.159E+07
18.000	1.500	20.000	.375	.753E+07	.251E+07
18.000	1.750	20.000	.375	.111E+08	.369E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
18.000	2.000	20.000	.375	.155E+08	.515E+07
18.000	.250	22.000	.375	.944E+05	.315E+05
18.000	.375	22.000	.375	.260E+06	.867E+05
18.000	.500	22.000	.375	.534E+06	.178E+06
18.000	.625	22.000	.375	.933E+06	.311E+06
18.000	.750	22.000	.375	.147E+07	.491E+06
18.000	1.000	22.000	.375	.302E+07	.101E+07
18.000	1.250	22.000	.375	.528E+07	.176E+07
18.000	1.500	22.000	.375	.833E+07	.278E+07
18.000	1.750	22.000	.375	.122E+08	.408E+07
18.000	2.000	22.000	.375	.171E+08	.570E+07
18.000	.250	24.000	.375	.103E+06	.345E+05
18.000	.375	24.000	.375	.285E+06	.950E+05
18.000	.500	24.000	.375	.585E+06	.195E+06
18.000	.625	24.000	.375	.102E+07	.341E+06
18.000	.750	24.000	.375	.161E+07	.538E+06
18.000	1.000	24.000	.375	.331E+07	.110E+07
18.000	1.250	24.000	.375	.578E+07	.193E+07
18.000	1.500	24.000	.375	.912E+07	.304E+07
18.000	1.750	24.000	.375	.134E+08	.447E+07
18.000	2.000	24.000	.375	.187E+08	.624E+07
18.000	.250	26.000	.375	.112E+06	.375E+05
18.000	.375	26.000	.375	.310E+06	.103E+06
18.000	.500	26.000	.375	.636E+06	.212E+06
18.000	.625	26.000	.375	.111E+07	.371E+06
18.000	.750	26.000	.375	.175E+07	.585E+06
18.000	1.000	26.000	.375	.360E+07	.120E+07
18.000	1.250	26.000	.375	.629E+07	.210E+07
18.000	1.500	26.000	.375	.992E+07	.331E+07
18.000	1.750	26.000	.375	.146E+08	.486E+07
18.000	2.000	26.000	.375	.204E+08	.679E+07
18.000	.250	28.000	.375	.122E+06	.405E+05
18.000	.375	28.000	.375	.335E+06	.112E+06
18.000	.500	28.000	.375	.687E+06	.229E+06
18.000	.625	28.000	.375	.120E+07	.400E+06
18.000	.750	28.000	.375	.189E+07	.631E+06
18.000	1.000	28.000	.375	.389E+07	.130E+07
18.000	1.250	28.000	.375	.679E+07	.226E+07
18.000	1.500	28.000	.375	.107E+08	.357E+07
18.000	1.750	28.000	.375	.158E+08	.525E+07
18.000	2.000	28.000	.375	.220E+08	.733E+07
18.000	.250	30.000	.375	.131E+06	.435E+05
18.000	.375	30.000	.375	.360E+06	.120E+06
18.000	.500	30.000	.375	.738E+06	.246E+06
18.000	.625	30.000	.375	.129E+07	.430E+06
18.000	.750	30.000	.375	.204E+07	.678E+06
18.000	1.000	30.000	.375	.418E+07	.139E+07
18.000	1.250	30.000	.375	.730E+07	.243E+07
18.000	1.500	30.000	.375	.115E+08	.384E+07
18.000	1.750	30.000	.375	.169E+08	.564E+07
18.000	2.000	30.000	.375	.236E+08	.788E+07
18.000	.250	32.000	.375	.140E+06	.465E+05
18.000	.375	32.000	.375	.385E+06	.128E+06
18.000	.500	32.000	.375	.790E+06	.263E+06
18.000	.625	32.000	.375	.138E+07	.460E+06
18.000	.750	32.000	.375	.218E+07	.725E+06
18.000	1.000	32.000	.375	.447E+07	.149E+07
18.000	1.250	32.000	.375	.780E+07	.260E+07
18.000	1.500	32.000	.375	.123E+08	.410E+07
18.000	1.750	32.000	.375	.181E+08	.603E+07
18.000	2.000	32.000	.375	.253E+08	.842E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
18.000	.250	36.000	.375	.158E+06	.525E+05
18.000	.375	36.000	.375	.434E+06	.145E+06
18.000	.500	36.000	.375	.892E+06	.297E+06
18.000	.625	36.000	.375	.156E+07	.519E+06
18.000	.750	36.000	.375	.246E+07	.819E+06
18.000	1.000	36.000	.375	.504E+07	.168E+07
18.000	1.250	36.000	.375	.881E+07	.294E+07
18.000	1.500	36.000	.375	.139E+08	.463E+07
18.000	1.750	36.000	.375	.204E+08	.681E+07
18.000	2.000	36.000	.375	.285E+08	.951E+07
18.000	.250	40.000	.375	.176E+06	.586E+05
18.000	.375	40.000	.375	.484E+06	.161E+06
18.000	.500	40.000	.375	.994E+06	.331E+06
18.000	.625	40.000	.375	.174E+07	.579E+06
18.000	.750	40.000	.375	.274E+07	.913E+06
18.000	1.000	40.000	.375	.562E+07	.187E+07
18.000	1.250	40.000	.375	.982E+07	.327E+07
18.000	1.500	40.000	.375	.155E+08	.516E+07
18.000	1.750	40.000	.375	.228E+08	.759E+07
18.000	2.000	40.000	.375	.318E+08	.106E+08
18.000	.250	48.000	.375	.212E+06	.706E+05
18.000	.375	48.000	.375	.584E+06	.195E+06
18.000	.500	48.000	.375	.120E+07	.399E+06
18.000	.625	48.000	.375	.209E+07	.698E+06
18.000	.750	48.000	.375	.330E+07	.110E+07
18.000	1.000	48.000	.375	.678E+07	.226E+07
18.000	1.250	48.000	.375	.118E+08	.395E+07
18.000	1.500	48.000	.375	.187E+08	.623E+07
18.000	1.750	48.000	.375	.275E+08	.915E+07
18.000	2.000	48.000	.375	.383E+08	.128E+08
19.000	.250	2.375	.154	.858E+04	.286E+04
19.000	.375	2.375	.154	.237E+05	.788E+04
19.000	.500	2.375	.154	.486E+05	.162E+05
19.000	.625	2.375	.154	.848E+05	.283E+05
19.000	.750	2.375	.154	.134E+06	.446E+05
19.000	1.000	2.375	.154	.275E+06	.915E+05
19.000	1.250	2.375	.154	.480E+06	.160E+06
19.000	1.500	2.375	.154	.757E+06	.252E+06
19.000	1.750	2.375	.154	.111E+07	.371E+06
19.000	2.000	2.375	.154	.155E+07	.518E+06
19.000	.250	3.500	.216	.128E+05	.426E+04
19.000	.375	3.500	.216	.352E+05	.117E+05
19.000	.500	3.500	.216	.722E+05	.241E+05
19.000	.625	3.500	.216	.126E+06	.421E+05
19.000	.750	3.500	.216	.199E+06	.664E+05
19.000	1.000	3.500	.216	.409E+06	.136E+06
19.000	1.250	3.500	.216	.714E+06	.238E+06
19.000	1.500	3.500	.216	.113E+07	.375E+06
19.000	1.750	3.500	.216	.166E+07	.552E+06
19.000	2.000	3.500	.216	.231E+07	.771E+06
19.000	.250	4.500	.237	.169E+05	.563E+04
19.000	.375	4.500	.237	.465E+05	.155E+05
19.000	.500	4.500	.237	.955E+05	.318E+05
19.000	.625	4.500	.237	.167E+06	.556E+05
19.000	.750	4.500	.237	.263E+06	.877E+05
19.000	1.000	4.500	.237	.540E+06	.180E+06
19.000	1.250	4.500	.237	.943E+06	.314E+06
19.000	1.500	4.500	.237	.149E+07	.496E+06
19.000	1.750	4.500	.237	.219E+07	.729E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
19.000	2.000	4.500	.237	.306E+07	.102E+07
19.000	.250	6.625	.280	.256E+05	.855E+04
19.000	.375	6.625	.280	.707E+05	.236E+05
19.000	.500	6.625	.280	.145E+06	.484E+05
19.000	.625	6.625	.280	.253E+06	.845E+05
19.000	.750	6.625	.280	.400E+06	.133E+06
19.000	1.000	6.625	.280	.821E+06	.274E+06
19.000	1.250	6.625	.280	.143E+07	.478E+06
19.000	1.500	6.625	.280	.226E+07	.754E+06
19.000	1.750	6.625	.280	.332E+07	.111E+07
19.000	2.000	6.625	.280	.464E+07	.155E+07
19.000	.250	8.625	.322	.339E+05	.113E+05
19.000	.375	8.625	.322	.934E+05	.311E+05
19.000	.500	8.625	.322	.192E+06	.639E+05
19.000	.625	8.625	.322	.335E+06	.112E+06
19.000	.750	8.625	.322	.528E+06	.176E+06
19.000	1.000	8.625	.322	.108E+07	.361E+06
19.000	1.250	8.625	.322	.189E+07	.631E+06
19.000	1.500	8.625	.322	.299E+07	.996E+06
19.000	1.750	8.625	.322	.439E+07	.146E+07
19.000	2.000	8.625	.322	.613E+07	.204E+07
19.000	.250	10.750	.365	.427E+05	.142E+05
19.000	.375	10.750	.365	.118E+06	.392E+05
19.000	.500	10.750	.365	.241E+06	.805E+05
19.000	.625	10.750	.365	.422E+06	.141E+06
19.000	.750	10.750	.365	.665E+06	.222E+06
19.000	1.000	10.750	.365	.137E+07	.455E+06
19.000	1.250	10.750	.365	.239E+07	.795E+06
19.000	1.500	10.750	.365	.376E+07	.125E+07
19.000	1.750	10.750	.365	.553E+07	.184E+07
19.000	2.000	10.750	.365	.772E+07	.257E+07
19.000	.250	12.750	.375	.513E+05	.171E+05
19.000	.375	12.750	.375	.141E+06	.471E+05
19.000	.500	12.750	.375	.290E+06	.968E+05
19.000	.625	12.750	.375	.507E+06	.169E+06
19.000	.750	12.750	.375	.800E+06	.267E+06
19.000	1.000	12.750	.375	.164E+07	.547E+06
19.000	1.250	12.750	.375	.287E+07	.956E+06
19.000	1.500	12.750	.375	.452E+07	.151E+07
19.000	1.750	12.750	.375	.665E+07	.222E+07
19.000	2.000	12.750	.375	.929E+07	.310E+07
19.000	.250	14.000	.375	.568E+05	.189E+05
19.000	.375	14.000	.375	.157E+06	.522E+05
19.000	.500	14.000	.375	.321E+06	.107E+06
19.000	.625	14.000	.375	.561E+06	.187E+06
19.000	.750	14.000	.375	.885E+06	.295E+06
19.000	1.000	14.000	.375	.182E+07	.606E+06
19.000	1.250	14.000	.375	.317E+07	.106E+07
19.000	1.500	14.000	.375	.501E+07	.167E+07
19.000	1.750	14.000	.375	.736E+07	.245E+07
19.000	2.000	14.000	.375	.103E+08	.343E+07
19.000	.250	16.000	.375	.656E+05	.219E+05
19.000	.375	16.000	.375	.181E+06	.602E+05
19.000	.500	16.000	.375	.371E+06	.124E+06
19.000	.625	16.000	.375	.648E+06	.216E+06
19.000	.750	16.000	.375	.102E+07	.341E+06
19.000	1.000	16.000	.375	.210E+07	.699E+06
19.000	1.250	16.000	.375	.367E+07	.122E+07
19.000	1.500	16.000	.375	.578E+07	.193E+07
19.000	1.750	16.000	.375	.850E+07	.283E+07
19.000	2.000	16.000	.375	.119E+08	.396E+07

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
19.000	.250	18.000	.375	.743E+05	.248E+05
19.000	.375	18.000	.375	.205E+06	.683E+05
19.000	.500	18.000	.375	.421E+06	.140E+06
19.000	.625	18.000	.375	.735E+06	.245E+06
19.000	.750	18.000	.375	.116E+07	.386E+06
19.000	1.000	18.000	.375	.238E+07	.793E+06
19.000	1.250	18.000	.375	.416E+07	.139E+07
19.000	1.500	18.000	.375	.656E+07	.219E+07
19.000	1.750	18.000	.375	.964E+07	.321E+07
19.000	2.000	18.000	.375	.135E+08	.449E+07
19.000	.250	20.000	.375	.831E+05	.277E+05
19.000	.375	20.000	.375	.229E+06	.764E+05
19.000	.500	20.000	.375	.470E+06	.157E+06
19.000	.625	20.000	.375	.821E+06	.274E+06
19.000	.750	20.000	.375	.130E+07	.432E+06
19.000	1.000	20.000	.375	.266E+07	.887E+06
19.000	1.250	20.000	.375	.465E+07	.155E+07
19.000	1.500	20.000	.375	.733E+07	.244E+07
19.000	1.750	20.000	.375	.108E+08	.359E+07
19.000	2.000	20.000	.375	.150E+08	.502E+07
19.000	.250	22.000	.375	.919E+05	.306E+05
19.000	.375	22.000	.375	.253E+06	.844E+05
19.000	.500	22.000	.375	.520E+06	.173E+06
19.000	.625	22.000	.375	.908E+06	.303E+06
19.000	.750	22.000	.375	.143E+07	.478E+06
19.000	1.000	22.000	.375	.294E+07	.980E+06
19.000	1.250	22.000	.375	.514E+07	.171E+07
19.000	1.500	22.000	.375	.811E+07	.270E+07
19.000	1.750	22.000	.375	.119E+08	.397E+07
19.000	2.000	22.000	.375	.166E+08	.555E+07
19.000	.250	24.000	.375	.101E+06	.336E+05
19.000	.375	24.000	.375	.277E+06	.925E+05
19.000	.500	24.000	.375	.570E+06	.190E+06
19.000	.625	24.000	.375	.995E+06	.332E+06
19.000	.750	24.000	.375	.157E+07	.523E+06
19.000	1.000	24.000	.375	.322E+07	.107E+07
19.000	1.250	24.000	.375	.563E+07	.188E+07
19.000	1.500	24.000	.375	.888E+07	.296E+07
19.000	1.750	24.000	.375	.131E+08	.435E+07
19.000	2.000	24.000	.375	.182E+08	.608E+07
19.000	.250	26.000	.375	.109E+06	.365E+05
19.000	.375	26.000	.375	.302E+06	.101E+06
19.000	.500	26.000	.375	.619E+06	.206E+06
19.000	.625	26.000	.375	.108E+07	.361E+06
19.000	.750	26.000	.375	.171E+07	.569E+06
19.000	1.000	26.000	.375	.350E+07	.117E+07
19.000	1.250	26.000	.375	.612E+07	.204E+07
19.000	1.500	26.000	.375	.965E+07	.322E+07
19.000	1.750	26.000	.375	.142E+08	.473E+07
19.000	2.000	26.000	.375	.198E+08	.661E+07
19.000	.250	28.000	.375	.118E+06	.394E+05
19.000	.375	28.000	.375	.326E+06	.109E+06
19.000	.500	28.000	.375	.669E+06	.223E+06
19.000	.625	28.000	.375	.117E+07	.390E+06
19.000	.750	28.000	.375	.184E+07	.615E+06
19.000	1.000	28.000	.375	.378E+07	.126E+07
19.000	1.250	28.000	.375	.661E+07	.220E+07
19.000	1.500	28.000	.375	.104E+08	.348E+07
19.000	1.750	28.000	.375	.153E+08	.511E+07
19.000	2.000	28.000	.375	.214E+08	.714E+07
19.000	.250	30.000	.375	.127E+06	.424E+05

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
19.000	.375	30.000	.375	.350E+06	.117E+06
19.000	.500	30.000	.375	.719E+06	.240E+06
19.000	.625	30.000	.375	.126E+07	.419E+06
19.000	.750	30.000	.375	.198E+07	.660E+06
19.000	1.000	30.000	.375	.407E+07	.136E+07
19.000	1.250	30.000	.375	.710E+07	.237E+07
19.000	1.500	30.000	.375	.112E+08	.373E+07
19.000	1.750	30.000	.375	.165E+08	.549E+07
19.000	2.000	30.000	.375	.230E+08	.767E+07
19.000	.250	32.000	.375	.136E+06	.453E+05
19.000	.375	32.000	.375	.374E+06	.125E+06
19.000	.500	32.000	.375	.769E+06	.256E+06
19.000	.625	32.000	.375	.134E+07	.448E+06
19.000	.750	32.000	.375	.212E+07	.706E+06
19.000	1.000	32.000	.375	.435E+07	.145E+07
19.000	1.250	32.000	.375	.759E+07	.253E+07
19.000	1.500	32.000	.375	.120E+08	.399E+07
19.000	1.750	32.000	.375	.176E+08	.587E+07
19.000	2.000	32.000	.375	.246E+08	.820E+07
19.000	.250	36.000	.375	.153E+06	.511E+05
19.000	.375	36.000	.375	.423E+06	.141E+06
19.000	.500	36.000	.375	.868E+06	.289E+06
19.000	.625	36.000	.375	.152E+07	.505E+06
19.000	.750	36.000	.375	.239E+07	.797E+06
19.000	1.000	36.000	.375	.491E+07	.164E+07
19.000	1.250	36.000	.375	.858E+07	.286E+07
19.000	1.500	36.000	.375	.135E+08	.451E+07
19.000	1.750	36.000	.375	.199E+08	.663E+07
19.000	2.000	36.000	.375	.278E+08	.926E+07
19.000	.250	40.000	.375	.171E+06	.570E+05
19.000	.375	40.000	.375	.471E+06	.157E+06
19.000	.500	40.000	.375	.967E+06	.322E+06
19.000	.625	40.000	.375	.169E+07	.563E+06
19.000	.750	40.000	.375	.267E+07	.889E+06
19.000	1.000	40.000	.375	.547E+07	.182E+07
19.000	1.250	40.000	.375	.956E+07	.319E+07
19.000	1.500	40.000	.375	.151E+08	.503E+07
19.000	1.750	40.000	.375	.222E+08	.739E+07
19.000	2.000	40.000	.375	.310E+08	.103E+08
19.000	.250	48.000	.375	.206E+06	.687E+05
19.000	.375	48.000	.375	.568E+06	.189E+06
19.000	.500	48.000	.375	.117E+07	.389E+06
19.000	.625	48.000	.375	.204E+07	.679E+06
19.000	.750	48.000	.375	.321E+07	.107E+07
19.000	1.000	48.000	.375	.660E+07	.220E+07
19.000	1.250	48.000	.375	.115E+08	.384E+07
19.000	1.500	48.000	.375	.182E+08	.606E+07
19.000	1.750	48.000	.375	.267E+08	.891E+07
19.000	2.000	48.000	.375	.373E+08	.124E+08
20.000	.250	2.375	.154	.837E+04	.279E+04
20.000	.375	2.375	.154	.231E+05	.768E+04
20.000	.500	2.375	.154	.473E+05	.158E+05
20.000	.625	2.375	.154	.827E+05	.276E+05
20.000	.750	2.375	.154	.130E+06	.435E+05
20.000	1.000	2.375	.154	.268E+06	.892E+05
20.000	1.250	2.375	.154	.468E+06	.156E+06
20.000	1.500	2.375	.154	.738E+06	.246E+06
20.000	1.750	2.375	.154	.108E+07	.362E+06
20.000	2.000	2.375	.154	.151E+07	.505E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
20.000	.250	3.500	.216	.124E+05	.415E+04
20.000	.375	3.500	.216	.343E+05	.114E+05
20.000	.500	3.500	.216	.704E+05	.235E+05
20.000	.625	3.500	.216	.123E+06	.410E+05
20.000	.750	3.500	.216	.194E+06	.647E+05
20.000	1.000	3.500	.216	.398E+06	.133E+06
20.000	1.250	3.500	.216	.696E+06	.232E+06
20.000	1.500	3.500	.216	.110E+07	.366E+06
20.000	1.750	3.500	.216	.161E+07	.538E+06
20.000	2.000	3.500	.216	.225E+07	.751E+06
20.000	.250	4.500	.237	.164E+05	.548E+04
20.000	.375	4.500	.237	.453E+05	.151E+05
20.000	.500	4.500	.237	.931E+05	.310E+05
20.000	.625	4.500	.237	.163E+06	.542E+05
20.000	.750	4.500	.237	.256E+06	.855E+05
20.000	1.000	4.500	.237	.526E+06	.175E+06
20.000	1.250	4.500	.237	.920E+06	.307E+06
20.000	1.500	4.500	.237	.145E+07	.484E+06
20.000	1.750	4.500	.237	.213E+07	.711E+06
20.000	2.000	4.500	.237	.298E+07	.993E+06
20.000	.250	6.625	.280	.250E+05	.833E+04
20.000	.375	6.625	.280	.689E+05	.230E+05
20.000	.500	6.625	.280	.141E+06	.471E+05
20.000	.625	6.625	.280	.247E+06	.823E+05
20.000	.750	6.625	.280	.390E+06	.130E+06
20.000	1.000	6.625	.280	.800E+06	.267E+06
20.000	1.250	6.625	.280	.140E+07	.466E+06
20.000	1.500	6.625	.280	.220E+07	.735E+06
20.000	1.750	6.625	.280	.324E+07	.108E+07
20.000	2.000	6.625	.280	.452E+07	.151E+07
20.000	.250	8.625	.322	.330E+05	.110E+05
20.000	.375	8.625	.322	.910E+05	.303E+05
20.000	.500	8.625	.322	.187E+06	.623E+05
20.000	.625	8.625	.322	.326E+06	.109E+06
20.000	.750	8.625	.322	.515E+06	.172E+06
20.000	1.000	8.625	.322	.106E+07	.352E+06
20.000	1.250	8.625	.322	.185E+07	.616E+06
20.000	1.500	8.625	.322	.291E+07	.971E+06
20.000	1.750	8.625	.322	.428E+07	.143E+07
20.000	2.000	8.625	.322	.598E+07	.199E+07
20.000	.250	10.750	.365	.416E+05	.139E+05
20.000	.375	10.750	.365	.115E+06	.382E+05
20.000	.500	10.750	.365	.235E+06	.784E+05
20.000	.625	10.750	.365	.411E+06	.137E+06
20.000	.750	10.750	.365	.648E+06	.216E+06
20.000	1.000	10.750	.365	.133E+07	.444E+06
20.000	1.250	10.750	.365	.233E+07	.775E+06
20.000	1.500	10.750	.365	.367E+07	.122E+07
20.000	1.750	10.750	.365	.539E+07	.180E+07
20.000	2.000	10.750	.365	.753E+07	.251E+07
20.000	.250	12.750	.375	.500E+05	.167E+05
20.000	.375	12.750	.375	.138E+06	.459E+05
20.000	.500	12.750	.375	.283E+06	.943E+05
20.000	.625	12.750	.375	.494E+06	.165E+06
20.000	.750	12.750	.375	.780E+06	.260E+06
20.000	1.000	12.750	.375	.160E+07	.533E+06
20.000	1.250	12.750	.375	.280E+07	.932E+06
20.000	1.500	12.750	.375	.441E+07	.147E+07
20.000	1.750	12.750	.375	.648E+07	.216E+07
20.000	2.000	12.750	.375	.905E+07	.302E+07
20.000	.250	14.000	.375	.554E+05	.185E+05

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
20.000	.375	14.000	.375	.153E+06	.508E+05
20.000	.500	14.000	.375	.313E+06	.104E+06
20.000	.625	14.000	.375	.547E+06	.182E+06
20.000	.750	14.000	.375	.863E+06	.288E+06
20.000	1.000	14.000	.375	.177E+07	.590E+06
20.000	1.250	14.000	.375	.309E+07	.103E+07
20.000	1.500	14.000	.375	.488E+07	.163E+07
20.000	1.750	14.000	.375	.718E+07	.239E+07
20.000	2.000	14.000	.375	.100E+08	.334E+07
20.000	.250	16.000	.375	.639E+05	.213E+05
20.000	.375	16.000	.375	.176E+06	.587E+05
20.000	.500	16.000	.375	.362E+06	.121E+06
20.000	.625	16.000	.375	.632E+06	.211E+06
20.000	.750	16.000	.375	.996E+06	.332E+06
20.000	1.000	16.000	.375	.205E+07	.682E+06
20.000	1.250	16.000	.375	.357E+07	.119E+07
20.000	1.500	16.000	.375	.564E+07	.188E+07
20.000	1.750	16.000	.375	.829E+07	.276E+07
20.000	2.000	16.000	.375	.116E+08	.386E+07
20.000	.250	18.000	.375	.725E+05	.242E+05
20.000	.375	18.000	.375	.200E+06	.666E+05
20.000	.500	18.000	.375	.410E+06	.137E+06
20.000	.625	18.000	.375	.716E+06	.239E+06
20.000	.750	18.000	.375	.113E+07	.377E+06
20.000	1.000	18.000	.375	.232E+07	.773E+06
20.000	1.250	18.000	.375	.405E+07	.135E+07
20.000	1.500	18.000	.375	.639E+07	.213E+07
20.000	1.750	18.000	.375	.939E+07	.313E+07
20.000	2.000	18.000	.375	.131E+08	.437E+07
20.000	.250	20.000	.375	.810E+05	.270E+05
20.000	.375	20.000	.375	.223E+06	.744E+05
20.000	.500	20.000	.375	.458E+06	.153E+06
20.000	.625	20.000	.375	.801E+06	.267E+06
20.000	.750	20.000	.375	.126E+07	.421E+06
20.000	1.000	20.000	.375	.259E+07	.864E+06
20.000	1.250	20.000	.375	.453E+07	.151E+07
20.000	1.500	20.000	.375	.714E+07	.238E+07
20.000	1.750	20.000	.375	.105E+08	.350E+07
20.000	2.000	20.000	.375	.147E+08	.489E+07
20.000	.250	22.000	.375	.896E+05	.299E+05
20.000	.375	22.000	.375	.247E+06	.823E+05
20.000	.500	22.000	.375	.507E+06	.169E+06
20.000	.625	22.000	.375	.885E+06	.295E+06
20.000	.750	22.000	.375	.140E+07	.466E+06
20.000	1.000	22.000	.375	.287E+07	.956E+06
20.000	1.250	22.000	.375	.501E+07	.167E+07
20.000	1.500	22.000	.375	.790E+07	.263E+07
20.000	1.750	22.000	.375	.116E+08	.387E+07
20.000	2.000	22.000	.375	.162E+08	.541E+07
20.000	.250	24.000	.375	.982E+05	.327E+05
20.000	.375	24.000	.375	.270E+06	.902E+05
20.000	.500	24.000	.375	.555E+06	.185E+06
20.000	.625	24.000	.375	.970E+06	.323E+06
20.000	.750	24.000	.375	.153E+07	.510E+06
20.000	1.000	24.000	.375	.314E+07	.105E+07
20.000	1.250	24.000	.375	.549E+07	.183E+07
20.000	1.500	24.000	.375	.866E+07	.289E+07
20.000	1.750	24.000	.375	.127E+08	.424E+07
20.000	2.000	24.000	.375	.178E+08	.592E+07
20.000	.250	26.000	.375	.107E+06	.356E+05
20.000	.375	26.000	.375	.294E+06	.980E+05

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
20.000	.500	26.000	.375	.604E+06	.201E+06
20.000	.625	26.000	.375	.105E+07	.352E+06
20.000	.750	26.000	.375	.166E+07	.555E+06
20.000	1.000	26.000	.375	.341E+07	.114E+07
20.000	1.250	26.000	.375	.597E+07	.199E+07
20.000	1.500	26.000	.375	.941E+07	.314E+07
20.000	1.750	26.000	.375	.138E+08	.461E+07
20.000	2.000	26.000	.375	.193E+08	.644E+07
20.000	.250	28.000	.375	.115E+06	.384E+05
20.000	.375	28.000	.375	.318E+06	.106E+06
20.000	.500	28.000	.375	.652E+06	.217E+06
20.000	.625	28.000	.375	.114E+07	.380E+06
20.000	.750	28.000	.375	.180E+07	.599E+06
20.000	1.000	28.000	.375	.369E+07	.123E+07
20.000	1.250	28.000	.375	.644E+07	.215E+07
20.000	1.500	28.000	.375	.102E+08	.339E+07
20.000	1.750	28.000	.375	.149E+08	.498E+07
20.000	2.000	28.000	.375	.209E+08	.696E+07
20.000	.250	30.000	.375	.124E+06	.413E+05
20.000	.375	30.000	.375	.341E+06	.114E+06
20.000	.500	30.000	.375	.701E+06	.234E+06
20.000	.625	30.000	.375	.122E+07	.408E+06
20.000	.750	30.000	.375	.193E+07	.644E+06
20.000	1.000	30.000	.375	.396E+07	.132E+07
20.000	1.250	30.000	.375	.692E+07	.231E+07
20.000	1.500	30.000	.375	.109E+08	.364E+07
20.000	1.750	30.000	.375	.161E+08	.535E+07
20.000	2.000	30.000	.375	.224E+08	.747E+07
20.000	.250	32.000	.375	.132E+06	.441E+05
20.000	.375	32.000	.375	.365E+06	.122E+06
20.000	.500	32.000	.375	.749E+06	.250E+06
20.000	.625	32.000	.375	.131E+07	.436E+06
20.000	.750	32.000	.375	.206E+07	.688E+06
20.000	1.000	32.000	.375	.424E+07	.141E+07
20.000	1.250	32.000	.375	.740E+07	.247E+07
20.000	1.500	32.000	.375	.117E+08	.389E+07
20.000	1.750	32.000	.375	.172E+08	.572E+07
20.000	2.000	32.000	.375	.240E+08	.799E+07
20.000	.250	36.000	.375	.150E+06	.499E+05
20.000	.375	36.000	.375	.412E+06	.137E+06
20.000	.500	36.000	.375	.846E+06	.282E+06
20.000	.625	36.000	.375	.148E+07	.493E+06
20.000	.750	36.000	.375	.233E+07	.777E+06
20.000	1.000	36.000	.375	.479E+07	.160E+07
20.000	1.250	36.000	.375	.836E+07	.279E+07
20.000	1.500	36.000	.375	.132E+08	.440E+07
20.000	1.750	36.000	.375	.194E+08	.646E+07
20.000	2.000	36.000	.375	.271E+08	.902E+07
20.000	.250	40.000	.375	.167E+06	.556E+05
20.000	.375	40.000	.375	.459E+06	.153E+06
20.000	.500	40.000	.375	.943E+06	.314E+06
20.000	.625	40.000	.375	.165E+07	.549E+06
20.000	.750	40.000	.375	.260E+07	.866E+06
20.000	1.000	40.000	.375	.533E+07	.178E+07
20.000	1.250	40.000	.375	.932E+07	.311E+07
20.000	1.500	40.000	.375	.147E+08	.490E+07
20.000	1.750	40.000	.375	.216E+08	.720E+07
20.000	2.000	40.000	.375	.302E+08	.101E+08
20.000	.250	48.000	.375	.201E+06	.670E+05
20.000	.375	48.000	.375	.554E+06	.185E+06
20.000	.500	48.000	.375	.114E+07	.379E+06

Table 6-1
Continued

ROTA STIFF CALCULATION, CYL. VESSEL

VESSEL OD,FT	VESSEL TCK,IN	NOZZLE OD,IN	NOZZLE TCK,IN STD	ROT STIF IN.LB/DEG INPLANE LONGI	OUTPLANE CIRCU
20.000	.625	48.000	.375	.199E+07	.662E+06
20.000	.750	48.000	.375	.313E+07	.104E+07
20.000	1.000	48.000	.375	.643E+07	.214E+07
20.000	1.250	48.000	.375	.112E+08	.374E+07
20.000	1.500	48.000	.375	.177E+08	.591E+07
20.000	1.750	48.000	.375	.261E+08	.868E+07
20.000	2.000	48.000	.375	.364E+08	.121E+08

7

Pressure and Stress Ratios

By merely multiplying or dividing, P/S ratios may be used to readily determine:

1. Allowable working pressure
2. Working stress
3. Wall thickness required

This extreme simplicity arises because in the formulas devised to predict the stresses in a pipe under internal pressure, the P/S ratio may be equated to a quantity that is dependent only on the diameter and thickness of the pipe and the applicable allowance for threading, mechanical strength, and/or corrosion.

The general formula, adopted by the ASME Boiler Code in the section on power boilers and the ANSI Code for Pressure Piping is:

$$P = \frac{2\ S_E\ (t_m - A)}{D - 2y\ (t_m - A)}$$

This formula may be written as:

$$P/S = \frac{2(t_m - A)}{D - 2y(t_m - A)}$$

where P = Maximum internal service pressure, lbs/in.^{2}
S_E = Allowable stress in material due to internal pressure
t_m = Minimum pipe wall thickness, in.
A = Allowance for threading, mechanical strength, and/or corrosion, in.
D = Outside diameter of pipe, in.
y = Coefficient having values, as follows:

Temperature (°F)	Ferritic Seals (Carbon and Alloys except Austenitic)	Austenitic Steels (Cr-Ni stainless, such as Types 304, 316, and 347)
900	0.4	0.4
950	0.5	0.4
1,000	0.7	0.4
1,050	0.7	0.4
1,100	0.7	0.5
1,150	0.7	0.7

The y value in the general formula reflects the effect of creep at high temperatures. In some ANSI Code sections that do not cover temperatures over 900°F, the y value of .4 is directly inserted in the formula; the formula with y = .4 is known as the "modified lame" formula. In Sections 4 and 8 of ANSI B31 the Barlow formula is used, which is a special case of the general formula in which y = 0. In addition, Section 8 is based on nominal thickness rather than minimum thickness; the tabulated P/S ratios for y = 0 may be placed on a nominal wall basis by multiplying by 8/7.

Tables 7-1 through 7-4 give the precalculated values for the right-hand side of the preceding general equation for each pipe size and weight based on a wall thickness 87½% of nominal and for values of C varying from 0.0 to 100 in. in increments of .005 in. For any pipe size, wall thickness, and corrosion allowance the allowable working pressure is found merely by multiplying the P/S ratio by the allowable stress. Obviously, this relieves the designer from making annoying multiple arithmetical manipulations which might be subject to error.

(Text continued on page 250.)

Table 7-1
Pressure/Stress Ratios Where Y = 0.0

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
1/8	10S	.049	.2117	.1870	.1623	.1377	.1130	.0883	.0636	.0389	.0142		
1/8	40 ST 40S	.068	.2938	.2691	.2444	.2198	.1951	.1704	.1457	.1210	.0963	.0716	.0469
1/8	80 ST 80S	.095	.4105	.3858	.3611	.3364	.3117	.2870	.2623	.2377	.2130	.1883	.1636
1/4	10S	.065	.2106	.1921	.1736	.1551	.1366	.1181	.0995	.0810	.0625	.0440	.0255
1/4	40 ST 40S	.088	.2852	.2667	.2481	.2296	.2111	.1926	.1741	.1556	.1370	.1185	.1000
1/4	80 ST 80S	.119	.3856	.3671	.3486	.3301	.3116	.2931	.2745	.2560	.2375	.2190	.2005
3/8	10S	.065	.1685	.1537	.1389	.1241	.1093	.0944	.0796	.0648	.0500	.0352	.0204
3/8	40 ST 40S	.091	.2359	.2211	.2063	.1915	.1767	.1619	.1470	.1322	.1174	.1026	.0878
3/8	80 ST 80S	.126	.3267	.3119	.2970	.2822	.2674	.2526	.2378	.2230	.2081	.1933	.1785
1/2	10S	.083	.1729	.1610	.1491	.1372	.1253	.1134	.1015	.0896	.0777	.0658	.0539
1/2	40 ST 40S	.109	.2271	.2152	.2033	.1914	.1795	.1676	.1557	.1437	.1318	.1199	.1080
1/2	80 ST 80S	.147	.3062	.2943	.2824	.2705	.2586	.2467	.2348	.2229	.2110	.1991	.1872
1/2	160	.187	.3896	.3777	.3658	.3539	.3420	.3301	.3182	.3062	.2943	.2824	.2705
1/2	XX	.294	.6125	.6006	.5887	.5768	.5649	.5530	.5411	.5292	.5173	.5054	.4935
3/4	5S	.065	.1083	.0988	.0893	.0798	.0702	.0607	.0512	.0417	.0321	.0226	.0131
3/4	10S	.083	.1383	.1288	.1193	.1098	.1002	.0907	.0812	.0717	.0621	.0526	.0431
3/4	40S	.113	.1883	.1788	.1693	.1598	.1502	.1407	.1312	.1217	.1121	.1026	.0931
3/4	80S	.154	.2567	.2471	.2376	.2281	.2186	.2090	.1995	.1900	.1805	.1710	.1614
3/4		.188	.3133	.3038	.2943	.2848	.2752	.2657	.2562	.2467	.2371	.2276	.2181
3/4	160	.218	.3633	.3538	.3443	.3348	.3252	.3157	.3062	.2967	.2871	.2776	.2681
3/4	XX	.308	.5133	.5038	.4943	.4848	.4752	.4657	.4562	.4467	.4371	.4276	.4181
1	5S	.065	.0865	.0789	.0713	.0637	.0561	.0485	.0409	.0333	.0257	.0181	.0105
1	10S	.109	.1451	.1375	.1298	.1222	.1146	.1070	.0994	.0918	.0842	.0766	.0690
1	40 ST 40S	.133	.1770	.1694	.1618	.1542	.1466	.1390	.1314	.1238	.1162	.1086	.1010
1	80 ST 80S	.179	.2382	.2306	.2230	.2154	.2078	.2002	.1926	.1850	.1774	.1698	.1622
1		.219	.2914	.2838	.2762	.2686	.2610	.2534	.2458	.2382	.2306	.2230	.2154
1	160	.250	.3327	.3251	.3175	.3099	.3023	.2947	.2871	.2795	.2719	.2643	.2567
1	XX0	.358	.4764	.4688	.4612	.4536	.4460	.4384	.4308	.4232	.4156	.4080	.4004
11/4	5S	.065	.0685	.0625	.0565	.0505	.0444	.0384	.0324	.0264	.0203	.0143	.0083
11/4	10S	.109	.1149	.1089	.1029	.0968	.0908	.0848	.0788	.0727	.0667	.0607	.0547
11/4	40 ST 40S	.140	.1476	.1416	.1355	.1295	.1235	.1175	.1114	.1054	.0994	.0934	.0873
11/4	80 ST 80S	.191	.2014	.1953	.1893	.1833	.1773	.1712	.1652	.1592	.1532	.1471	.1411
11/4	160	.250	.2636	.2575	.2515	.2455	.2395	.2334	.2274	.2214	.2154	.2093	.2033
11/4	XX	.382	.4027	.3967	.3907	.3846	.3786	.3726	.3666	.3605	.3545	.3485	.3425

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
11/2	5S	.065	.0599	.0546	.0493	.0441	.0388	.0336	.0283	.0230	.0178	.0125	.0072
11/2	10S	.109	.1004	.0951	.0899	.0846	.0793	.0741	.0688	.0636	.0583	.0530	.0478
11/2	40 ST 40S	.145	.1336	.1283	.1230	.1178	.1125	.1072	.1020	.0967	.0914	.0862	.0809
11/2	80 ST 80S	.200	.1842	.1789	.1737	.1684	.1632	.1579	.1526	.1474	.1421	.1368	.1316
11/2	160	.281	.2588	.2536	.2483	.2430	.2378	.2325	.2272	.2220	.2167	.2114	.2062
11/2	XX	.400	.3684	.3632	.3579	.3526	.3474	.3421	.3368	.3316	.3263	.3211	.3158
2	5S	.065	.0479	.0437	.0395	.0353	.0311	.0268	.0226	.0184	.0142	.0100	.0058
2	10S	.109	.0803	.0761	.0719	.0677	.0635	.0593	.0551	.0508	.0466	.0424	.0382
2	40 ST 40S	.154	.1135	.1093	.1051	.1008	.0966	.0924	.0882	.0840	.0798	.0756	.0714
2		.167	.1231	.1188	.1146	.1104	.1062	.1020	.0978	.0936	.0894	.0852	.0809
2		.188	.1385	.1343	.1301	.1259	.1217	.1175	.1133	.1091	.1048	.1006	.0964
2	80 ST 80S	.218	.1606	.1564	.1522	.1480	.1438	.1396	.1354	.1312	.1269	.1227	.1185
2		.250	.1842	.1800	.1758	.1716	.1674	.1632	.1589	.1547	.1505	.1463	.1421
2		.312	.2299	.2257	.2215	.2173	.2131	.2088	.2046	.2004	.1962	.1920	.1878
2	160	.343	.2527	.2485	.2443	.2401	.2359	.2317	.2275	.2233	.2191	.2148	.2106
2	XX	.436	.3213	.3171	.3128	.3086	.3044	.3002	.2960	.2918	.2876	.2834	.2792
21/2	5S	.083	.0505	.0470	.0436	.0401	.0366	.0331	.0297	.0262	.0227	.0192	.0157
21/2	10S	.120	.0730	.0696	.0661	.0626	.0591	.0557	.0522	.0487	.0452	.0417	.0383
21/2	40 ST 40S	.203	.1236	.1201	.1166	.1131	.1097	.1062	.1027	.0992	.0957	.0923	.0888
21/2		.217	.1321	.1286	.1251	.1217	.1182	.1147	.1112	.1077	.1043	.1008	.0973
21/2	80 ST 80S	.276	.1680	.1645	.1610	.1576	.1541	.1506	.1471	.1437	.1402	.1367	.1332
21/2	160	.375	.2283	.2248	.2213	.2178	.2143	.2109	.2074	.2039	.2004	.1970	.1935
21/2	XX	.552	.3360	.3325	.3290	.3256	.3221	.3186	.3151	.3117	.3082	.3047	.3012
3	5S	.083	.0415	.0386	.0358	.0329	.0301	.0272	.0244	.0215	.0186	.0158	.0129
3	10S	.120	.0600	.0571	.0543	.0514	.0486	.0457	.0429	.0400	.0371	.0343	.0314
3		.125	.0625	.0596	.0568	.0539	.0511	.0482	.0454	.0425	.0396	.0368	.0339
3		.148	.0740	.0711	.0683	.0654	.0626	.0597	.0569	.0540	.0511	.0483	.0454
3		.188	.0940	.0911	.0883	.0854	.0826	.0797	.0769	.0740	.0711	.0683	.0654
3	40 ST 40S	.216	.1080	.1051	.1023	.0994	.0966	.0937	.0909	.0880	.0851	.0823	.0794
3		.241	.1205	.1176	.1148	.1119	.1091	.1062	.1034	.1005	.0976	.0948	.0919
3		.254	.1270	.1241	.1213	.1184	.1156	.1127	.1099	.1070	.1041	.1013	.0984
3		.289	.1445	.1416	.1388	.1359	.1331	.1302	.1274	.1245	.1216	.1188	.1159
3	80 XS 80S	.300	.1500	.1471	.1443	.1414	.1386	.1357	.1329	.1300	.1271	.1243	.1214
3		.312	.1560	.1531	.1503	.1474	.1446	.1417	.1389	.1360	.1331	.1303	.1274
3		.406	.2030	.2001	.1973	.1944	.1916	.1887	.1859	.1830	.1801	.1773	.1744

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
3	160	.438	.2190	.2161	.2133	.2104	.2076	.2047	.2019	.1990	.1961	.1933	.1904
3	XX	.600	.3000	.2971	.2943	.2914	.2886	.2857	.2829	.2800	.2771	.2743	.2714
31/2	5S	.083	.0363	.0338	.0313	.0288	.0263	.0238	.0213	.0188	.0163	.0138	.0113
31/2	10S	.120	.0525	.0500	.0475	.0450	.0425	.0400	.0375	.0350	.0325	.0300	.0275
31/2		.128	.0560	.0535	.0510	.0485	.0460	.0435	.0410	.0385	.0360	.0335	.0310
31/2		.134	.0586	.0561	.0536	.0511	.0486	.0461	.0436	.0411	.0386	.0361	.0336
31/2		.148	.0647	.0622	.0597	.0572	.0547	.0522	.0497	.0472	.0447	.0422	.0397
31/2		.188	.0822	.0797	.0772	.0747	.0722	.0697	.0672	.0647	.0622	.0597	.0572
31/2	40 ST 40S	.226	.0989	.0964	.0939	.0914	.0889	.0864	.0839	.0814	.0789	.0764	.0739
31/2		.281	.1229	.1204	.1179	.1154	.1129	.1104	.1079	.1054	.1029	.1004	.0979
31/2	80 XS 80S	.318	.1391	.1366	.1341	.1316	.1291	.1266	.1241	.1216	.1191	.1166	.1141
31/2		.344	.1505	.1480	.1455	.1430	.1405	.1380	.1355	.1330	.1305	.1280	.1255
31/2		.469	.2052	.2027	.2002	.1977	.1952	.1927	.1902	.1877	.1852	.1827	.1802
31/2		.636	.2782	.2757	.2732	.2707	.2682	.2657	.2632	.2607	.2582	.2557	.2532
4	5S	.083	.0323	.0301	.0278	.0256	.0234	.0212	.0189	.0167	.0145	.0123	.0101
4	10S	.120	.0467	.0444	.0422	.0400	.0378	.0356	.0333	.0311	.0289	.0267	.0244
4		.128	.0498	.0476	.0453	.0431	.0409	.0387	.0364	.0342	.0320	.0298	.0276
4		.134	.0521	.0499	.0477	.0454	.0432	.0410	.0388	.0366	.0343	.0321	.0299
4		.142	.0552	.0530	.0508	.0486	.0463	.0441	.0419	.0397	.0374	.0352	.0330
4		.165	.0642	.0619	.0597	.0575	.0553	.0531	.0508	.0486	.0464	.0442	.0419
4		.188	.0731	.0709	.0687	.0664	.0642	.0620	.0598	.0576	.0553	.0531	.0509
4		.205	.0797	.0775	.0753	.0731	.0708	.0686	.0664	.0642	.0619	.0597	.0575
4	40 ST40S	.237	.0922	.0899	.0877	.0855	.0833	.0811	.0788	.0766	.0744	.0722	.0699
4		.250	.0972	.0950	.0928	.0906	.0883	.0861	.0839	.0817	.0794	.0772	.0750
4		.271	.1054	.1032	.1009	.0987	.0965	.0943	.0921	.0898	.0876	.0854	.0832
4		.281	.1093	.1071	.1048	.1026	.1004	.0982	.0959	.0937	.0915	.0893	.0871
4		.300	.1167	.1144	.1122	.1100	.1078	.1056	.1033	.1011	.0989	.0967	.0944
4		.312	.1213	.1191	.1169	.1147	.1124	.1102	.1080	.1058	.1036	.1013	.0991
4	80 XS 80S	.337	.1311	.1288	.1266	.1244	.1222	.1199	.1177	.1155	.1133	.1111	.1088
4		.375	.1458	.1436	.1414	.1392	.1369	.1347	.1325	.1303	.1281	.1258	.1236
4	120	.438	.1703	.1681	.1659	.1637	.1614	.1592	.1570	.1548	.1526	.1503	.1481
4		.500	.1944	.1922	.1900	.1878	.1856	.1833	.1811	.1789	.1767	.1744	.1722
4	160	.531	.2065	.2043	.2021	.1998	.1976	.1954	.1932	.1909	.1887	.1865	.1843
4	XX	.674	.2621	.2599	.2577	.2554	.2532	.2510	.2488	.2466	.2443	.2421	.2399
5	5S	.109	.0343	.0325	.0307	.0289	.0271	.0253	.0235	.0217	.0199	.0181	.0163
5	10S	.134	.0422	.0404	.0386	.0368	.0350	.0332	.0314	.0296	.0278	.0260	.0242

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
5	40 ST 40S	.258	.0812	.0794	.0776	.0758	.0740	.0722	.0704	.0686	.0668	.0650	.0632
5		.352	.1107	.1089	.1071	.1053	.1035	.1017	.0999	.0981	.0964	.0946	.0928
5	80 XS 80S	.375	.1180	.1162	.1144	.1126	.1108	.1090	.1072	.1054	.1036	.1018	.1000
5		.438	.1378	.1360	.1342	.1324	.1306	.1288	.1270	.1252	.1234	.1216	.1198
5	120	.500	.1573	.1555	.1537	.1519	.1501	.1483	.1465	.1447	.1429	.1411	.1393
5	160	.625	.1966	.1948	.1930	.1912	.1894	.1876	.1858	.1840	.1822	.1804	.1786
5	XX	.750	.2359	.2341	.2323	.2305	.2287	.2269	.2251	.2234	.2216	.2198	.2180
6	5S	.109	.0288	.0273	.0258	.0243	.0228	.0212	.0197	.0182	.0167	.0152	.0137
6	10S	.134	.0354	.0339	.0324	.0309	.0294	.0278	.0263	.0248	.0233	.0218	.0203
6		.169	.0446	.0431	.0416	.0401	.0386	.0371	.0356	.0341	.0326	.0311	.0295
6		.180	.0475	.0460	.0445	.0430	.0415	.0400	.0385	.0370	.0355	.0340	.0325
6		.188	.0497	.0482	.0466	.0451	.0436	.0421	.0406	.0391	.0376	.0361	.0346
6		.219	.0578	.0563	.0548	.0533	.0518	.0503	.0488	.0473	.0458	.0443	.0428
6		.250	.0660	.0645	.0630	.0615	.0600	.0585	.0570	.0555	.0540	.0525	.0509
6		.277	.0732	.0717	.0702	.0686	.0671	.0656	.0641	.0626	.0611	.0596	.0581
6	40 ST 40S	.280	.0740	.0725	.0709	.0694	.0679	.0664	.0649	.0634	.0619	.0604	.0589
6		.375	.0991	.0975	.0960	.0945	.0930	.0915	.0900	.0885	.0870	.0855	.0840
6	80 XS 80S	.432	.1141	.1126	.1111	.1096	.1081	.1066	.1051	.1035	.1020	.1005	.0990
6		.500	.1321	.1306	.1291	.1275	.1260	.1245	.1230	.1215	.1200	.1185	.1170
6	120	.562	.1485	.1469	.1454	.1439	.1424	.1409	.1394	.1379	.1364	.1349	.1334
6	160	.718	.1897	.1882	.1866	.1851	.1836	.1821	.1806	.1791	.1776	.1761	.1746
6	XX	.864	.2282	.2267	.2252	.2237	.2222	.2207	.2192	.2177	.2162	.2146	.2131
8	5S	.109	.0221	.0210	.0198	.0186	.0175	.0163	.0152	.0140	.0128	.0117	.0105
8	10S	.148	.0300	.0289	.0277	.0266	.0254	.0242	.0231	.0219	.0208	.0196	.0184
8		.158	.0321	.0309	.0297	.0286	.0274	.0263	.0251	.0239	.0228	.0216	.0205
8		.165	.0335	.0323	.0312	.0300	.0288	.0277	.0265	.0254	.0242	.0230	.0219
8		.188	.0381	.0370	.0358	.0347	.0335	.0323	.0312	.0300	.0289	.0277	.0266
8		.203	.0412	.0400	.0389	.0377	.0366	.0354	.0342	.0331	.0319	.0308	.0296
8		.219	.0444	.0433	.0421	.0410	.0398	.0386	.0375	.0363	.0352	.0340	.0328
8		.238	.0483	.0471	.0460	.0448	.0437	.0425	.0413	.0402	.0390	.0379	.0367
8	20	.250	.0507	.0496	.0484	.0472	.0461	.0449	.0438	.0426	.0414	.0403	.0391
8	30	.277	.0562	.0550	.0539	.0527	.0516	.0504	.0492	.0481	.0469	.0458	.0446
8	40 ST 40S	.322	.0653	.0642	.0630	.0619	.0607	.0595	.0584	.0572	.0561	.0549	.0537
8		.344	.0698	.0686	.0675	.0663	.0652	.0640	.0628	.0617	.0605	.0594	.0582
8		.352	.0714	.0703	.0691	.0679	.0668	.0656	.0645	.0633	.0621	.0610	.0598
8		.375	.0761	.0749	.0738	.0726	.0714	.0703	.0691	.0680	.0668	.0657	.0645

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
8	60	.406	.0824	.0812	.0801	.0789	.0777	.0766	.0754	.0743	.0731	.0719	.0708
8		.469	.0952	.0940	.0928	.0917	.0905	.0894	.0882	.0870	.0859	.0847	.0836
8	80 XS 80S	.500	.1014	.1003	.0991	.0980	.0968	.0957	.0945	.0933	.0922	.0910	.0899
8	100	.593	.1203	.1192	.1180	.1168	.1157	.1145	.1134	.1122	.1110	.1099	.1087
8		.625	.1268	.1257	.1245	.1233	.1222	.1210	.1199	.1187	.1175	.1164	.1152
8	120	.718	.1457	.1445	.1434	.1422	.1410	.1399	.1387	.1376	.1364	.1352	.1341
8	140	.812	.1648	.1636	.1624	.1613	.1601	.1590	.1578	.1566	.1555	.1543	.1532
8	XX	.875	.1775	.1764	.1752	.1741	.1729	.1717	.1706	.1694	.1683	.1671	.1659
8	160	.906	.1838	.1827	.1815	.1803	.1792	.1780	.1769	.1757	.1746	.1734	.1722
10	5S	.134	.0218	.0209	.0200	.0190	.0181	.0172	.0162	.0153	.0144	.0134	.0125
10	10S	.165	.0269	.0259	.0250	.0241	.0231	.0222	.0213	.0203	.0194	.0185	.0176
10		.188	.0306	.0297	.0287	.0278	.0269	.0260	.0250	.0241	.0232	.0222	.0213
10		.203	.0330	.0321	.0312	.0303	.0293	.0284	.0275	.0265	.0256	.0247	.0237
10		.219	.0357	.0347	.0338	.0329	.0319	.0310	.0301	.0291	.0282	.0273	.0263
10	20	.250	.0407	.0398	.0388	.0379	.0370	.0360	.0351	.0342	.0333	.0323	.0314
10		.279	.0454	.0445	.0436	.0426	.0417	.0408	.0398	.0389	.0380	.0370	.0361
10	30	.307	.0500	.0490	.0481	.0472	.0463	.0453	.0444	.0435	.0425	.0416	.0407
10		.348	.0567	.0557	.0548	.0539	.0529	.0520	.0511	.0501	.0492	.0483	.0473
10	40 ST 40S	.365	.0594	.0585	.0576	.0566	.0557	.0548	.0538	.0529	.0520	.0510	.0501
10		.395	.0643	.0634	.0624	.0615	.0606	.0597	.0587	.0578	.0569	.0559	.0550
10	60 XS 80S	.500	.0814	.0805	.0795	.0786	.0777	.0767	.0758	.0749	.0740	.0730	.0721
10		.531	.0864	.0855	.0846	.0837	.0827	.0818	.0809	.0799	.0790	.0781	.0771
10	80	.593	.0965	.0956	.0947	.0937	.0928	.0919	.0910	.0900	.0891	.0882	.0872
10	100	.718	.1169	.1160	.1150	.1141	.1132	.1122	.1113	.1104	.1094	.1085	.1076
10		.750	.1221	.1212	.1202	.1193	.1184	.1174	.1165	.1156	.1147	.1137	.1128
10	120	.843	.1372	.1363	.1354	.1344	.1335	.1326	.1317	.1307	.1298	.1289	.1279
10	140	1.000	.1628	.1619	.1609	.1600	.1591	.1581	.1572	.1563	.1553	.1544	.1535
10		1.062	.1729	.1720	.1710	.1701	.1692	.1682	.1673	.1664	.1654	.1645	.1636
10	160	1.125	.1831	.1822	.1813	.1803	.1794	.1785	.1776	.1766	.1757	.1748	.1738
12	5S	.156	.0214	.0206	.0198	.0191	.0183	.0175	.0167	.0159	.0151	.0144	.0136
12	10S	.180	.0247	.0239	.0231	.0224	.0216	.0208	.0200	.0192	.0184	.0176	.0169
12		.203	.0279	.0271	.0263	.0255	.0247	.0239	.0232	.0224	.0216	.0208	.0200
12		.219	.0301	.0293	.0285	.0277	.0269	.0261	.0254	.0246	.0238	.0230	.0222
12		.238	.0327	.0319	.0311	.0303	.0295	.0287	.0280	.0272	.0264	.0256	.0248
12	20	.250	.0343	.0335	.0327	.0320	.0312	.0304	.0296	.0288	.0280	.0273	.0265
12		.279	.0383	.0375	.0367	.0359	.0352	.0344	.0336	.0328	.0320	.0312	.0305

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
12		.300	.0412	.0404	.0396	.0388	.0380	.0373	.0365	.0357	.0349	.0341	.0333
12	30	.330	.0453	.0445	.0437	.0429	.0422	.0414	.0406	.0398	.0390	.0382	.0375
12		.344	.0472	.0464	.0456	.0449	.0441	.0433	.0425	.0417	.0409	.0402	.0394
12	ST 40S	.375	.0515	.0507	.0499	.0491	.0483	.0475	.0468	.0460	.0452	.0444	.0436
12	40	.406	.0557	.0549	.0542	.0534	.0526	.0518	.0510	.0502	.0495	.0487	.0479
12		.438	.0601	.0593	.0585	.0578	.0570	.0562	.0554	.0546	.0538	.0531	.0523
12	XS 80S	.500	.0686	.0678	.0671	.0663	.0655	.0647	.0639	.0631	.0624	.0616	.0608
12	60	.562	.0771	.0764	.0756	.0748	.0740	.0732	.0724	.0716	.0709	.0701	.0693
12		.625	.0858	.0850	.0842	.0834	.0826	.0819	.0811	.0803	.0795	.0787	.0779
12	80	.687	.0943	.0935	.0927	.0919	.0912	.0904	.0896	.0888	.0880	.0872	.0865
12	100	.843	.1157	.1149	.1141	.1134	.1126	.1118	.1110	.1102	.1094	.1086	.1079
12		.875	.1201	.1193	.1185	.1177	.1170	.1162	.1154	.1146	.1138	.1130	.1123
12	120	1.000	.1373	.1365	.1357	.1349	.1341	.1333	.1325	.1318	.1310	.1302	.1294
12	140	1.125	.1544	.1536	.1528	.1521	.1513	.1505	.1497	.1489	.1481	.1474	.1466
12		1.219	.1673	.1665	.1657	.1650	.1642	.1634	.1626	.1618	.1610	.1603	.1595
12	160	1.312	.1801	.1793	.1785	.1777	.1769	.1762	.1754	.1746	.1738	.1730	.1722
14		.188	.0235	.0228	.0221	.0214	.0206	.0199	.0192	.0185	.0178	.0171	.0164
14		.220	.0275	.0268	.0261	.0254	.0246	.0239	.0232	.0225	.0218	.0211	.0204
14		.238	.0297	.0290	.0283	.0276	.0269	.0262	.0255	.0247	.0240	.0233	.0226
14	10	.250	.0313	.0305	.0298	.0291	.0284	.0277	.0270	.0262	.0255	.0248	.0241
14	20	.312	.0390	.0383	.0376	.0369	.0361	.0354	.0347	.0340	.0333	.0326	.0319
14	30ST	.375	.0469	.0462	.0454	.0447	.0440	.0433	.0426	.0419	.0412	.0404	.0397
14		.406	.0507	.0500	.0493	.0486	.0479	.0472	.0465	.0457	.0450	.0443	.0436
14	40	.438	.0547	.0540	.0533	.0526	.0519	.0512	.0505	.0497	.0490	.0483	.0476
14		.469	.0586	.0579	.0572	.0565	.0558	.0551	.0543	.0536	.0529	.0522	.0515
14	XS	.500	.0625	.0618	.0611	.0604	.0596	.0589	.0582	.0575	.0568	.0561	.0554
14	60	.593	.0741	.0734	.0727	.0720	.0713	.0706	.0698	.0691	.0684	.0677	.0670
14		.625	.0781	.0774	.0767	.0760	.0753	.0746	.0738	.0731	.0724	.0717	.0710
14		.656	.0820	.0813	.0806	.0799	.0791	.0784	.0777	.0770	.0763	.0756	.0749
14	80	.750	.0938	.0930	.0923	.0916	.0909	.0902	.0895	.0887	.0880	.0873	.0866
14	100	.937	.1171	.1164	.1157	.1150	.1143	.1136	.1128	.1121	.1114	.1107	.1100
14	120	1.093	.1366	.1359	.1352	.1345	.1338	.1331	.1323	.1316	.1309	.1302	.1295
14	140	1.250	.1563	.1555	.1548	.1541	.1534	.1527	.1520	.1512	.1505	.1498	.1491
14		1.344	.1680	.1673	.1666	.1659	.1651	.1644	.1637	.1630	.1623	.1616	.1609
14	160	1.406	.1757	.1750	.1743	.1736	.1729	.1722	.1715	.1707	.1700	.1693	.1686
16		.188	.0206	.0199	.0193	.0187	.0181	.0174	.0168	.0162	.0156	.0149	.0143

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
16		.238	.0260	.0254	.0248	.0242	.0235	.0229	.0223	.0217	.0210	.0204	.0198
16	10	.250	.0273	.0267	.0261	.0255	.0248	.0242	.0236	.0230	.0223	.0217	.0211
16		.281	.0307	.0301	.0295	.0289	.0282	.0276	.0270	.0264	.0257	.0251	.0245
16	20	.312	.0341	.0335	.0329	.0322	.0316	.0310	.0304	.0297	.0291	.0285	.0279
16		.344	.0376	.0370	.0364	.0357	.0351	.0345	.0339	.0332	.0326	.0320	.0314
16	30 ST	.375	.0410	.0404	.0398	.0391	.0385	.0379	.0373	.0366	.0360	.0354	.0348
16		.406	.0444	.0438	.0432	.0425	.0419	.0413	.0407	.0400	.0394	.0388	.0382
16		.438	.0479	.0473	.0467	.0460	.0454	.0448	.0442	.0435	.0429	.0423	.0417
16		.469	.0513	.0507	.0500	.0494	.0488	.0482	.0475	.0469	.0463	.0457	.0450
16	40 XS	.500	.0547	.0541	.0534	.0528	.0522	.0516	.0509	.0503	.0497	.0491	.0484
16		.531	.0581	.0575	.0568	.0562	.0556	.0550	.0543	.0537	.0531	.0525	.0518
16	60	.656	.0717	.0711	.0705	.0699	.0692	.0686	.0680	.0674	.0667	.0661	.0655
16		.688	.0752	.0746	.0740	.0734	.0727	.0721	.0715	.0709	.0702	.0696	.0690
16		.750	.0820	.0814	.0808	.0802	.0795	.0789	.0783	.0777	.0770	.0764	.0758
16	80	.843	.0922	.0916	.0910	.0903	.0897	.0891	.0885	.0878	.0872	.0866	.0860
16	100	1.031	.1128	.1121	.1115	.1109	.1103	.1096	.1090	.1084	.1078	.1071	.1065
16	120	1.218	.1332	.1326	.1320	.1313	.1307	.1301	.1295	.1288	.1282	.1276	.1270
16	140	1.438	.1573	.1567	.1560	.1554	.1548	.1542	.1535	.1529	.1523	.1517	.1510
16		1.500	.1641	.1634	.1628	.1622	.1616	.1609	.1603	.1597	.1591	.1584	.1578
16	160	1.593	.1742	.1736	.1730	.1724	.1717	.1711	.1705	.1699	.1692	.1686	.1680
18	10	.250	.0243	.0237	.0232	.0226	.0221	.0215	.0210	.0204	.0199	.0193	.0187
18	20	.312	.0303	.0298	.0292	.0287	.0281	.0276	.0270	.0264	.0259	.0253	.0248
18	ST	.375	.0365	.0359	.0353	.0348	.0342	.0337	.0331	.0326	.0320	.0315	.0309
18	30	.438	.0426	.0420	.0415	.0409	.0404	.0398	.0392	.0387	.0381	.0376	.0370
18	XS	.500	.0486	.0481	.0475	.0469	.0464	.0458	.0453	.0447	.0442	.0436	.0431
18	40	.562	.0546	.0541	.0535	.0530	.0524	.0519	.0513	.0507	.0502	.0496	.0491
18		.594	.0577	.0572	.0566	.0561	.0555	.0550	.0544	.0539	.0533	.0527	.0522
18		.625	.0608	.0602	.0597	.0591	.0585	.0580	.0574	.0569	.0563	.0558	.0552
18		.719	.0699	.0693	.0688	.0682	.0677	.0671	.0666	.0660	.0655	.0649	.0643
18	60	.750	.0729	.0724	.0718	.0712	.0707	.0701	.0696	.0690	.0685	.0679	.0674
18		.812	.0789	.0784	.0778	.0773	.0767	.0762	.0756	.0751	.0745	.0739	.0734
18	80	.937	.0911	.0905	.0900	.0894	.0889	.0883	.0878	.0872	.0867	.0861	.0855
18	100	1.156	.1124	.1118	.1113	.1107	.1102	.1096	.1091	.1085	.1079	.1074	.1068
18	120	1.375	.1337	.1331	.1326	.1320	.1315	.1309	.1303	.1298	.1292	.1287	.1281
18	140	1.562	.1519	.1513	.1507	.1502	.1496	.1491	.1485	.1480	.1474	.1469	.1463
18		1.688	.1641	.1636	.1630	.1624	.1619	.1613	.1608	.1602	.1597	.1591	.1586

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0									
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
18	160	1.781	.1732	.1726	.1720	.1715	.1709	.1704	.1698	.1693	.1687	.1682	.1676
20	10	.250	.0219	.0214	.0209	.0204	.0199	.0194	.0189	.0184	.0179	.0174	.0169
20		.312	.0273	.0268	.0263	.0258	.0253	.0248	.0243	.0238	.0233	.0228	.0223
20	20 ST	.375	.0328	.0323	.0318	.0313	.0308	.0303	.0298	.0293	.0288	.0283	.0278
20		.438	.0383	.0378	.0373	.0368	.0363	.0358	.0353	.0348	.0343	.0338	.0333
20	30 XS	.500	.0437	.0432	.0427	.0422	.0417	.0412	.0407	.0402	.0397	.0393	.0387
20		.562	.0492	.0487	.0482	.0477	.0472	.0467	.0462	.0457	.0452	.0447	.0442
20	40	.593	.0519	.0514	.0509	.0504	.0499	.0494	.0489	.0484	.0479	.0474	.0469
20		.625	.0547	.0542	.0537	.0532	.0527	.0522	.0517	.0512	.0507	.0502	.0497
20	60	.812	.0710	.0705	.0700	.0695	.0690	.0685	.0680	.0675	.0670	.0665	.0660
20		.875	.0766	.0761	.0756	.0751	.0746	.0741	.0736	.0731	.0726	.0721	.0716
20		.906	.0793	.0788	.0783	.0778	.0773	.0768	.0763	.0758	.0753	.0748	.0743
20	80	1.031	.0902	.0897	.0892	.0887	.0882	.0877	.0872	.0867	.0862	.0857	.0852
20		1.250	.1094	.1089	.1084	.1079	.1074	.1069	.1064	.1059	.1054	.1049	.1044
20	100	1.281	.1121	.1116	.1111	.1106	.1101	.1096	.1091	.1086	.1081	.1076	.1071
20	120	1.500	.1312	.1307	.1302	.1297	.1292	.1287	.1282	.1277	.1272	.1267	.1262
20	140	1.750	.1531	.1526	.1521	.1516	.1511	.1506	.1501	.1496	.1491	.1486	.1481
20		1.844	.1613	.1608	.1603	.1598	.1593	.1588	.1583	.1578	.1573	.1568	.1563
20	160	1.968	.1722	.1717	.1712	.1707	.1702	.1697	.1692	.1687	.1682	.1677	.1672
22	LG	.250	.0199	.0194	.0190	.0185	.0181	.0176	.0172	.0167	.0162	.0158	.0153
22	ST	.375	.0298	.0294	.0289	.0285	.0280	.0276	.0271	.0266	.0262	.0257	.0253
22	XS	.500	.0398	.0393	.0389	.0384	.0380	.0375	.0370	.0366	.0361	.0357	.0352
24	10	.250	.0182	.0178	.0174	.0170	.0166	.0161	.0157	.0153	.0149	.0145	.0141
24		.312	.0227	.0223	.0219	.0215	.0211	.0207	.0202	.0198	.0194	.0190	.0186
24	20 ST	.375	.0273	.0269	.0265	.0261	.0257	.0253	.0248	.0244	.0240	.0236	.0232
24		.438	.0319	.0315	.0311	.0307	.0303	.0299	.0294	.0290	.0286	.0282	.0278
24	XS	.500	.0365	.0360	.0356	.0352	.0348	.0344	.0340	.0335	.0331	.0327	.0323
24	30	.562	.0410	.0406	.0401	.0397	.0393	.0389	.0385	.0381	.0376	.0372	.0368
24		.625	.0456	.0452	.0447	.0443	.0439	.0435	.0431	.0427	.0422	.0418	.0414
24	40	.687	.0501	.0497	.0493	.0488	.0484	.0480	.0476	.0472	.0468	.0463	.0459
24		.750	.0547	.0543	.0539	.0534	.0530	.0526	.0522	.0518	.0514	.0509	.0505
24	60	.968	.0706	.0702	.0697	.0693	.0689	.0685	.0681	.0677	.0672	.0668	.0664
24		1.031	.0752	.0748	.0743	.0739	.0735	.0731	.0727	.0723	.0718	.0714	.0710
24	80	1.218	.0888	.0884	.0880	.0876	.0871	.0867	.0863	.0859	.0855	.0851	.0846
24	100	1.531	.1116	.1112	.1108	.1104	.1100	.1096	.1091	.1087	.1083	.1079	.1075

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
24	120	1.812	.1321	.1317	.1313	.1309	.1305	.1300	.1296	.1292	.1288	.1284	.1280
24	140	2.062	.1504	.1499	.1495	.1491	.1487	.1483	.1479	.1474	.1470	.1466	.1462
24		2.188	.1595	.1591	.1587	.1583	.1579	.1575	.1570	.1566	.1562	.1558	.1554
24	160	2.343	.1708	.1704	.1700	.1696	.1692	.1688	.1683	.1679	.1675	.1671	.1667
26	ST	.375	.0252	.0249	.0245	.0241	.0237	.0233	.0229	.0225	.0222	.0218	.0214
26	XS	.500	.0337	.0333	.0329	.0325	.0321	.0317	.0313	.0310	.0306	.0302	.0298
30	10	.312	.0182	.0179	.0175	.0172	.0169	.0165	.0162	.0159	.0155	.0152	.0149
30	ST	.375	.0219	.0215	.0212	.0209	.0205	.0202	.0199	.0195	.0192	.0189	.0185
30		.438	.0255	.0252	.0249	.0245	.0242	.0239	.0235	.0232	.0229	.0225	.0222
30	20 XS	.500	.0292	.0288	.0285	.0282	.0278	.0275	.0272	.0268	.0265	.0262	.0258
30		.562	.0328	.0324	.0321	.0318	.0314	.0311	.0308	.0304	.0301	.0298	.0294
30	30	.625	.0365	.0361	.0358	.0355	.0351	.0348	.0345	.0341	.0338	.0335	.0331
34	ST	.375	.0193	.0190	.0187	.0184	.0181	.0178	.0175	.0172	.0169	.0167	.0164
34	XS	.500	.0257	.0254	.0251	.0249	.0246	.0243	.0240	.0237	.0234	.0231	.0228
36	ST	.375	.0182	.0180	.0177	.0174	.0171	.0168	.0166	.0163	.0160	.0157	.0155
36	XS	.500	.0243	.0240	.0237	.0235	.0232	.0229	.0226	.0224	.0221	.0218	.0215
42	ST	.375	.0156	.0154	.0151	.0149	.0147	.0144	.0142	.0140	.0137	.0135	.0132
42	XS	.500	.0208	.0206	.0204	.0201	.0199	.0196	.0194	.0192	.0189	.0187	.0185
48	ST	.375	.0137	.0135	.0133	.0130	.0128	.0126	.0124	.0122	.0120	.0118	.0116
48	XS	.500	.0182	.0180	.0178	.0176	.0174	.0172	.0170	.0168	.0166	.0164	.0161

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
1/8	10S	.049	0.0000									
1/8	40 ST 40S	.068	.0222									
1/8	80 ST 80S	.095	.1389	.1142	.0895	.0648	.0401	.0154				
1/4	10S	.065	.0069									
1/4	40 ST 40S	.088	.0815	.0630	.0444	.0259	.0074					
1/4	80 ST 80S	.119	.1819	.1634	.1449	.1264	.1079	.0894	.0708	.0523	.0338	.0153
3/8	10S	.065	.0056									
3/8	40 ST 40S	.091	.0730	.0581	.0433	.0285	.0137					
3/8	80 ST 80S	.126	.1637	.1489	.1341	.1193	.1044	.0896	.0748	.0600	.0452	.0304
1/2	10S	.083	.0420	.0301	.0182	.0063						
1/2	40 ST 40S	.109	.0961	.0842	.0723	.0604	.0485	.0366	.0247	.0128	.0009	
1/2	80 ST 80S	.147	.1753	.1634	.1515	.1396	.1277	.1158	.1039	.0920	.0801	.0682
1/2	160	.187	.2586	.2467	.2348	.2229	.2110	.1991	.1872	.1753	.1634	.1515
1/2	XX	.294	.4815	.4696	.4577	.4458	.4339	.4220	.4101	.3982	.3863	.3744
3/4	5S	.065	.0036									
3/4	10S	.083	.0336	.0240	.0145	.0050						
3/4	40S	.113	.0836	.0740	.0645	.0550	.0455	.0360	.0264	.0169	.0074	
3/4	80S	.154	.1519	.1424	.1329	.1233	.1138	.1043	.0948	.0852	.0757	.0662
3/4		.188	.2086	.1990	.1895	.1800	.1705	.1610	.1514	.1419.	.1324	.1229
3/4	160	.218	.2586	.2490	.2395	.2300	.2205	.2110	.2014	.1919	.1824	.1729
3/4	XX	.308	.4086	.3990	.3895	.3800	.3705	.3610	.3514	.3419	.3324	.3229
1	5S	.065	.0029									
1	10S	.109	.0614	.0538	.0462	.0386	.0310	.0234	.0158	.0082	.0006	
1	40 ST 40S	.133	.0933	.0857	.0781	.0705	.0629	.0553	.0477	.0401	.0325	.0249
1	80 ST 80S	.179	.1546	.1470	.1394	.1317	.1241	.1165	.1089	.1013	.0937	.0861
1		.219	.2078	.2002	.1926	.1850	.1774	.1698	.1622	.1546	.1470	.1394
1	160	.250	.2490	.2414	.2338	.2262	.2186	.2110	.2034	.1958	.1882	.1806
1	XX0	.358	.3928	.3852	.3776	.3700	.3624	.3548	.3471	.3395	.3319	.3243
11/4	5S	.065	.0023									
11/4	10S	.109	.0486	.0426	.0366	.0306	.0245	.0185	.0125	.0065	.0005	
11/4	40 ST 40S	.140	.0813	.0753	.0693	.0633	.0572	.0512	.0452	.0392	.0331	.0271
11/4	80 ST 80S	.191	.1351	.1291	.1230	.1170	.1110	.1050	.0989	.0929	.0869	.0809
11/4	160	.250	.1973	.1913	.1852	.1792	.1732	.1672	.1611	.1551	.1491	.1431
11/4	XX	.382	.3364	.3304	.3244	.3184	.3123	.3063	.3003	.2943	.2883	.2822

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
11/2	5S	.065	.0020									
11/2	10S	.109	.0425	.0372	.0320	.0267	.0214	.0162	.0109	.0057	.0004	
11/2	40 ST 40S	.145	.0757	.0704	.0651	.0599	.0546	.0493	.0441	.0388	.0336	.0283
11/2	80 ST 80S	.200	.1263	.1211	.1158	.1105	.1053	.1000	.0947	.0895	.0842	.0789
11/2	160	.281	.2009	.1957	.1904	.1851	.1799	.1746	.1693	.1641	.1588	.1536
11/2	XX	.400	.3105	.3053	.3000	.2947	.2895	.2842	.2789	.2737	.2684	.2632
2	5S	.065	.0016									
2	10S	.109	.0340	.0298	.0256	.0214	.0172	.0129	.0087	.0045	.0003	
2	40 ST 40S	.154	.0672	.0629	.0587	.0545	.0503	.0461	.0419	.0377	.0335	.0293
2		.167	.0767	.0725	.0683	.0641	.0599	.0557	.0515	.0473	.0431	.0388
2		.188	.0922	.0880	.0838	.0796	.0754	.0712	.0669	.0627	.0585	.0543
2	80 ST 80S	.218	.1143	.1101	.1059	.1017	.0975	.0933	.0891	.0848	.0806	.0764
2		.250	.1379	.1337	.1295	.1253	.1211	.1168	.1126	.1084	.1042	.1000
2		.312	.1836	.1794	.1752	.1709	.1667	.1625	.1583	.1541	.1499	.1457
2	160	.343	.2064	.2022	.1980	.1938	.1896	.1854	.1812	.1769	.1727	.1685
2	XX	.436	.2749	.2707	.2665	.2623	.2581	.2539	.2497	.2455	.2413	.2371
21/2	5S	.083	.0123	.0088	.0053	.0018						
21/2	10S	.120	.0348	.0313	.0278	.0243	.0209	.0174	.0139	.0104	.0070	.0035
21/2	40 ST 40S	.203	.0853	.0818	.0783	.0749	.0714	.0679	.0644	.0610	.0575	.0540
21/2		.217	.0938	.0903	.0869	.0834	.0799	.0764	.0730	.0695	.0660	.0625
21/2	80 ST 805	.276	.1297	.1263	.1228	.1193	.1158	.1123	.1089	.1054	.1019	.0984
21/2	160	.375	.1900	.1865	.1830	.1796	.1761	.1726	.1691	.1657	.1622	.1587
21/2	XX	.552	.2977	.2943	.2908	.2873	.2838	.2803	.2769	.2734	.2699	.2664
3	5S	.083	.0101	.0072	.0044	.0015						
3	10S	.120	.0286	.0257	.0229	.0200	.0171	.0143	.0114	.0086	.0057	.0029
3		.125	.0311	.0282	.0254	.0225	.0196	.0168	.0139	.0111	.0082	.0054
3		.148	.0426	.0397	.0369	.0340	.0311	.0283	.0254	.0226	.0197	.0169
3		.188	.0626	.0597	.0569	.0540	.0511	.0483	.0454	.0426	.0397	.0369
3	40 ST 40S	.216	.0766	.0737	.0709	.0680	.0651	.0623	.0594	.0566	.0537	.0509
3		.241	.0891	.0862	.0834	.0805	.0776	.0748	.0719	.0691	.0662	.0634
3		.254	.0956	.0927	.0899	.0870	.0841	.0813	.0784	.0756	.0727	.0699
3		.289	.1131	.1102	.1074	.1045	.1016	.0988	.0959	.0931	.0902	.0874
3	80 XS 805	.300	.1186	.1157	.1129	.1100	.1071	.1043	.1014	.0986	.0957	.0929
3		.312	.1246	.1217	.1189	.1160	.1131	.1103	.1074	.1046	.1017	.0989
3		.406	.1716	.1687	.1659	.1630	.1601	.1573	.1544	.1516	.1487	.1459

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
3	160	.438	.1876	.1847	.1819	.1790	.1761	.1733	.1704	.1676	.1647	.1619
3	XX	.600	.2686	.2657	.2629	.2600	.2571	.2543	.2514	.2486	.2457	.2429
31/2	5S	.083	.0088	.0063	.0038	.0013						
31/2	10S	.120	.0250	.0225	.0200	.0175	.0150	.0125	.0100	.0075	.0050	.0025
31/2		.128	.0285	.0260	.0235	.0210	.0185	.0160	.0135	.0110	.0085	.0060
31/2		.134	.0311	.0286	.0261	.0236	.0211	.0186	.0161	.0136	.0111	.0086
31/2		.148	.0372	.0347	.0322	.0297	.0272	.0248	.0223	.0198	.0173	.0148
31/2		.188	.0547	.0522	.0497	.0473	.0448	.0423	.0398	.0373	.0348	.0323
31/2	40 ST 40S	.226	.0714	.0689	.0664	.0639	.0614	.0589	.0564	.0539	.0514	.0489
31/2		.281	.0954	.0929	.0904	.0879	.0854	.0829	.0804	.0779	.0754	.0729
31/2	80 XS 80S	.318	.1116	.1091	.1066	.1041	.1016	.0991	.0966	.0941	.0916	.0891
31/2		.344	.1230	.1205	.1180	.1155	.1130	.1105	.1080	.1055	.1030	.1005
31/2		.469	.1777	.1752	.1727	.1702	.1677	.1652	.1627	.1602	.1577	.1552
31/2		.636	.2507	.2482	.2457	.2432	.2407	.2382	.2357	.2332	.2307	.2282
4	5S	.083	.0078	.0056	.0034	.0012						
4	10S	.120	.0222	.0200	.0178	.0156	.0133	.0111	.0089	.0067	.0044	.0022
4		.128	.0253	.0231	.0209	.0187	.0164	.0142	.0120	.0098	.0076	.0053
4		.134	.0277	.0254	.0232	.0210	.0188	.0166	.0143	.0121	.0099	.0077
4		.142	.0308	.0286	.0263	.0241	.0219	.0197	.0174	.0152	.0130	.0108
4		.165	.0397	.0375	.0353	.0331	.0308	.0286	.0264	.0242	.0219	.0197
4		.188	.0487	.0464	.0442	.0420	.0398	.0376	.0353	.0331	.0309	.0287
4		.205	.0553	.0531	.0508	.0486	.0464	.0442	.0419	.0397	.0375	.0353
4	40 ST40S	.237	.0677	.0655	.0633	.0611	.0588	.0566	.0544	.0522	.0499	.0477
4		.250	.0728	.0706	.0683	.0661	.0639	.0617	.0594	.0572	.0550	.0528
4		.271	.0809	.0787	.0765	.0743	.0721	.0698	.0676	.0654	.0632	.0609
4		.281	.0848	.0826	.0804	.0782	.0759	.0737	.0715	.0693	.0671	.0648
4		.300	.0922	.0900	.0878	.0856	.0833	.0811	.0789	.0767	.0744	.0722
4		.312	.0969	.0947	.0924	.0902	.0880	.0858	.0836	.0813	.0791	.0769
4	80 XS 80S	.337	.1066	.1044	.1022	.0999	.0977	.0955	.0933	.0911	.0888	.0866
4		.375	.1214	.1192	.1169	.1147	.1125	.1103	.1081	.1058	.1036	.1014
4	120	.438	.1459	.1437	.1414	.1392	.1370	.1348	.1326	.1303	.1281	.1259
4		.500	.1700	.1678	.1656	.1633	.1611	.1589	.1567	.1544	.1522	.1500
4	160	.531	.1821	.1798	.1776	.1754	.1732	.1709	.1687	.1665	.1643	.1621
4	XX	.674	.2377	.2354	.2332	.2310	.2288	.2266	.2243	.2221	.2199	.2177
5	5S	.109	.0145	.0127	.0109	.0091	.0073	.0055	.0037	.0019	.0001	
5	10S	.134	.0224	.0206	.0188	.0170	.0152	.0134	.0116	.0098	.0080	.0062

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
5	40 ST 40S	.258	.0614	.0596	.0578	.0560	.0542	.0524	.0506	.0488	.0470	.0452
5		.352	.0910	.0892	.0874	.0856	.0838	.0820	.0802	.0784	.0766	.0748
5	80 XS 80S	.375	.0982	.0964	.0946	.0928	.0910	.0892	.0874	.0856	.0838	.0820
5		.438	.1180	.1162	.1144	.1126	.1108	.1090	.1072	.1054	.1036	.1018
5	120	.500	.1375	.1357	.1339	.1321	.1303	.1285	.1267	.1249	.1231	.1213
5	160	.625	.1768	.1750	.1732	.1714	.1696	.1679	.1661	.1643	.1625	.1607
5	XX	.750	.2162	.2144	.2126	.2108	.2090	.2072	.2054	.2036	.2018	.2000
6	5S	.109	.0122	.0107	.0092	.0077	.0062	.0046	.0031	.0016	.0001	
6	10S	.134	.0188	.0173	.0158	.0143	.0128	.0112	.0097	.0082	.0067	.0052
6		.169	.0280	.0265	.0250	.0235	.0220	.0205	.0190	.0175	.0160	.0145
6		.180	.0309	.0294	.0279	.0264	.0249	.0234	.0219	.0204	.0189	.0174
6		.188	.0331	.0315	.0300	.0285	.0270	.0255	.0240	.0225	.0210	.0195
6		.219	.0412	.0397	.0382	.0367	.0352	.0337	.0322	.0307	.0292	.0277
6		.250	.0494	.0479	.0464	.0449	.0434	.0419	.0404	.0389	.0374	.0358
6		.277	.0566	.0551	.0535	.0520	.0505	.0490	.0475	.0460	.0445	.0430
6	40 ST 40S	.280	.0574	.0558	.0543	.0528	.0513	.0498	.0483	.0468	.0453	.0438
6		.375	.0825	.0809	.0794	.0779	.0764	.0749	.0734	.0719	.0704	.0689
6	80 XS 80S	.432	.0975	.0960	.0945	.0930	.0915	.0900	.0885	.0869	.0854	.0839
6		.500	.1155	.1140	.1125	.1109	.1094	.1079	.1064	.1049	.1034	.1019
6	120	.562	.1318	.1303	.1288	.1273	.1258	.1243	.1228	.1213	.1198	.1183
6	160	.718	.1731	.1715	.1700	.1685	.1670	.1655	.1640	.1625	.1610	.1595
6	XX	.864	.2116	.2101	.2086	.2071	.2056	.2041	.2026	.2011	.1995	.1980
8	5S	.109	.0094	.0082	.0070	.0059	.0047	.0036	.0024	.0012	.0001	
8	10S	.148	.0173	.0161	.0150	.0138	.0126	.0115	.0103	.0092	.0080	.0068
8		.158	.0193	.0181	.0170	.0158	.0147	.0135	.0123	.0112	.0100	.0089
8		.165	.0207	.0196	.0184	.0172	.0161	.0149	.0138	.0126	.0114	.0103
8		.188	.0254	.0242	.0231	.0219	.0208	.0196	.0184	.0173	.0161	.0150
8		.203	.0284	.0273	.0261	.0250	.0238	.0226	.0215	.0203	.0192	.0180
8		.219	.0317	.0305	.0294	.0282	.0270	.0259	.0247	.0236	.0224	.0212
8		.238	.0355	.0344	.0332	.0321	.0309	.0297	.0286	.0274	.0263	.0251
8	20	.250	.0380	.0368	.0357	.0345	.0333	.0322	.0310	.0299	.0287	.0275
8	30	.277	.0434	.0423	.0411	.0400	.0388	.0377	.0365	.0353	.0342	.0330
8	40 ST 40S	.322	.0526	.0514	.0503	.0491	.0479	.0468	.0456	.0445	.0433	.0421
8		.344	.0570	.0559	.0547	.0536	.0524	.0512	.0501	.0489	.0478	.0466
8		.352	.0587	.0575	.0563	.0552	.0540	.0529	.0517	.0506	.0494	.0482
8		.375	.0633	.0622	.0610	.0599	.0587	.0575	.0564	.0552	.0541	.0529

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0								
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
8	60	.406	.0696	.0685	.0673	.0661	.0650	.0638	.0627	.0615	.0603	.0592
8		.469	.0824	.0812	.0801	.0789	.0778	.0766	.0754	.0743	.0731	.0720
8	80 XS 80S	.500	.0887	.0875	.0864	.0852	.0841	.0829	.0817	.0806	.0794	.0783
8	100	.593	.1076	.1064	.1052	.1041	.1029	.1018	.1006	.0994	.0983	.0971
8		.625	.1141	.1129	.1117	.1106	.1094	.1083	.1071	.1059	.1048	.1036
8	120	.718	.1329	.1318	.1306	.1294	.1283	.1271	.1260	.1248	.1237	.1225
8	140	.812	.1520	.1508	.1497	.1485	.1474	.1462	.1450	.1439	.1427	.1416
8	XX	.875	.1648	.1636	.1625	.1613	.1601	.1590	.1578	.1567	.1555	.1543
8	160	.906	.1711	.1699	.1688	.1676	.1664	.1653	.1641	.1630	.1618	.1606
10	5S	.134	.0116	.0107	.0097	.0088	.0079	.0069	.0060	.0051	.0041	.0032
10	10S	.165	.0166	.0157	.0148	.0138	.0129	.0120	.0110	.0101	.0092	.0083
10		.188	.0204	.0194	.0185	.0176	.0167	.0157	.0148	.0139	.0129	.0120
10		.203	.0228	.0219	.0210	.0200	.0191	.0182	.0172	.0163	.0154	.0144
10		.219	.0254	.0245	.0236	.0226	.0217	.0208	.0198	.0189	.0180	.0170
10	20	.250	.0305	.0295	.0286	.0277	.0267	.0258	.0249	.0240	.0230	.0221
10		.279	.0352	.0343	.0333	.0324	.0315	.0305	.0296	.0287	.0277	.0268
10	30	.307	.0397	.0388	.0379	.0370	.0360	.0351	.0342	.0332	.0323	.0314
10		.348	.0464	.0455	.0446	.0436	.0427	.0418	.0408	.0399	.0390	.0380
10	40 ST 40S	.365	.0492	.0483	.0473	.0464	.0455	.0445	.0436	.0427	.0417	.0408
10		.395	.0541	.0531	.0522	.0513	.0503	.0494	.0485	.0476	.0466	.0457
10	60 XS 80S	.500	.0712	.0702	.0693	.0684	.0674	.0665	.0656	.0647	.0637	.0628
10		.531	.0762	.0753	.0743	.0734	.0725	.0716	.0706	.0697	.0688	.0678
10	80	.593	.0863	.0854	.0844	.0835	.0826	.0817	.0807	.0798	.0789	.0779
10	100	.718	.1067	.1057	.1048	.1039	.1029	.1020	.1011	.1001	.0992	.0983
10		.750	.1119	.1109	.1100	.1091	.1081	.1072	.1063	.1053	.1044	.1035
10	120	.843	.1270	.1261	.1251	.1242	.1233	.1223	.1214	.1205	.1196	.1186
10	140	1.000	.1526	.1516	.1507	.1498	.1488	.1479	.1470	.1460	.1451	.1442
10		1.062	.1627	.1617	.1608	.1599	.1589	.1580	.1571	.1561	.1552	.1543
10	160	1.125	.1729	.1720	.1710	.1701	.1692	.1683	.1673	.1664	.1655	.1645
12	5S	.156	.0128	.0120	.0112	.0104	.0096	.0089	.0081	.0073	.0065	.0057
12	10S	.180	.0161	.0153	.0145	.0137	.0129	.0122	.0114	.0106	.0098	.0090
12		.203	.0192	.0185	.0177	.0169	.0161	.0153	.0145	.0137	.0130	.0122
12		.219	.0214	.0206	.0199	.0191	.0183	.0175	.0167	.0159	.0152	.0144
12		.238	.0240	.0233	.0225	.0217	.0209	.0201	.0193	.0185	.0178	.0170
12	20	.250	.0257	.0249	.0241	.0233	.0225	.0218	.0210	.0202	.0194	.0186
12		.279	.0297	.0289	.0281	.0273	.0265	.0257	.0250	.0242	.0234	.0226

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
12		.300	.0325	.0318	.0310	.0302	.0294	.0286	.0278	.0271	.0263	.0255
12	30	.330	.0367	.0359	.0351	.0343	.0335	.0327	.0320	.0312	.0304	.0296
12		.344	.0386	.0378	.0370	.0362	.0355	.0347	.0339	.0331	.0323	.0315
12	ST 40S	.375	.0428	.0421	.0413	.0405	.0397	.0389	.0381	.0374	.0366	.0358
12	40	.406	.0471	.0463	.0455	.0447	.0440	.0432	.0424	.0416	.0408	.0400
12		.438	.0515	.0507	.0499	.0491	.0484	.0476	.0468	.0460	.0452	.0444
12	XS 80S	.500	.0600	.0592	.0584	.0576	.0569	.0561	.0553	.0545	.0537	.0529
12	60	.562	.0685	.0677	.0669	.0662	.0654	.0646	.0638	.0630	.0622	.0615
12		.625	.0772	.0764	.0756	.0748	.0740	.0732	.0725	.0717	.0709	.0701
12	80	.687	.0857	.0849	.0841	.0833	.0825	.0817	.0810	.0802	.0794	.0786
12	100	.843	.1071	.1063	.1055	.1047	.1039	.1032	.1024	.1016	.1008	.1000
12		.875	.1115	.1107	.1099	.1091	.1083	.1075	.1068	.1060	.1052	.1044
12	120	1.000	.1286	.1278	.1271	.1263	.1255	.1247	.1239	.1231	.1224	.1216
12	140	1.125	.1458	.1450	.1442	.1434	.1426	.1419	.1411	.1403	.1395	.1387
12		1.219	.1587	.1579	.1571	.1563	.1555	.1548	.1540	.1532	.1524	.1516
12	160	1.312	.1715	.1707	.1699	.1691	.1683	.1675	.1667	.1660	.1652	.1644
14		.188	.0156	.0149	.0142	.0135	.0128	.0121	.0114	.0106	.0099	.0092
14		.220	.0196	.0189	.0182	.0175	.0168	.0161	.0154	.0146	.0139	.0132
14		.238	.0219	.0212	.0205	.0197	.0190	.0183	.0176	.0169	.0162	.0155
14	10	.250	.0234	.0227	.0220	.0212	.0205	.0198	.0191	.0184	.0177	.0170
14	20	.312	.0311	.0304	.0297	.0290	.0283	.0276	.0269	.0261	.0254	.0247
14	30ST	.375	.0390	.0383	.0376	.0369	.0362	.0354	.0347	.0340	.0333	.0326
14		.406	.0429	.0422	.0415	.0407	.0400	.0393	.0386	.0379	.0372	.0365
14	40	.438	.0469	.0462	.0455	.0447	.0440	.0433	.0426	.0419	.0412	.0405
14		.469	.0508	.0501	.0493	.0486	.0479	.0472	.0465	.0458	.0451	.0443
14	XS	.500	.0546	.0539	.0532	.0525	.0518	.0511	.0504	.0496	.0489	.0482
14	60	.593	.0663	.0656	.0648	.0641	.0634	.0627	.0620	.0613	.0606	.0598
14		.625	.0703	.0696	.0688	.0681	.0674	.0667	.0660	.0653	.0646	.0638
14		.656	.0741	.0734	.0727	.0720	.0713	.0706	.0699	.0691	.0684	.0677
14	80	.750	.0859	.0852	.0845	.0837	.0830	.0823	.0816	.0809	.0802	.0795
14	100	.937	.1093	.1086	.1078	.1071	.1064	.1057	.1050	.1043	.1036	.1028
14	120	1.093	.1288	.1281	.1273	.1266	.1259	.1252	.1245	.1238	.1231	.1223
14	140	1.250	.1484	.1477	.1470	.1462	.1455	.1448	.1441	.1434	.1427	.1420
14		1.344	.1601	.1594	.1587	.1580	.1573	.1566	.1559	.1551	.1544	.1537
14	160	1.406	.1679	.1672	.1665	.1657	.1650	.1643	.1636	.1629	.1622	.1615
16		.188	.0137	.0131	.0124	.0118	.0112	.0106	.0099	.0093	.0087	.0081

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
16		.238	.0192	.0185	.0179	.0173	.0167	.0160	.0154	.0148	.0142	.0135
16	10	.250	.0205	.0198	.0192	.0186	.0180	.0173	.0167	.0161	.0155	.0148
16		.281	.0239	.0232	.0226	.0220	.0214	.0207	.0201	.0195	.0189	.0182
16	20	.312	.0272	.0266	.0260	.0254	.0247	.0241	.0235	.0229	.0222	.0216
16		.344	.0307	.0301	.0295	.0289	.0282	.0276	.0270	.0264	.0257	.0251
16	30 ST	.375	.0341	.0335	.0329	.0323	.0316	.0310	.0304	.0298	.0291	.0285
16		.406	.0375	.0369	.0363	.0357	.0350	.0344	.0338	.0332	.0325	.0319
16		.438	.0410	.0404	.0398	.0392	.0385	.0379	.0373	.0367	.0360	.0354
16		.469	.0444	.0438	.0432	.0425	.0419	.0413	.0407	.0400	.0394	.0388
16	40 XS	.500	.0478	.0472	.0466	.0459	.0453	.0447	.0441	.0434	.0428	.0422
16		.531	.0512	.0506	.0500	.0493	.0487	.0481	.0475	.0468	.0462	.0456
16	60	.656	.0649	.0642	.0636	.0630	.0624	.0617	.0611	.0605	.0599	.0592
16		.688	.0684	.0677	.0671	.0665	.0659	.0652	.0646	.0640	.0634	.0627
16		.750	.0752	.0745	.0739	.0733	.0727	.0720	.0714	.0708	.0702	.0695
16	80	.843	.0853	.0847	.0841	.0835	.0828	.0822	.0816	.0810	.0803	.0797
16	100	1.031	.1059	.1053	.1046	.1040	.1034	.1028	.1021	.1015	.1009	.1003
16	120	1.218	.1263	.1257	.1251	.1245	.1238	.1232	.1226	.1220	.1213	.1207
16	140	1.438	.1504	.1498	.1492	.1485	.1479	.1473	.1467	.1460	.1454	.1448
16		1.500	.1572	.1566	.1559	.1553	.1547	.1541	.1534	.1528	.1522	.1516
16	160	1.593	.1674	.1667	.1661	.1655	.1649	.1642	.1636	.1630	.1624	.1617
18	10	.250	.0182	.0176	.0171	.0165	.0160	.0154	.0149	.0143	.0138	.0132
18	20	.312	.0242	.0237	.0231	.0226	.0220	.0214	.0209	.0203	.0198	.0192
18	ST	.375	.0303	.0298	.0292	.0287	.0281	.0276	.0270	.0265	.0259	.0253
18	30	.438	.0365	.0359	.0354	.0348	.0343	.0337	.0331	.0326	.0320	.0315
18	XS	.500	.0425	.0419	.0414	.0408	.0403	.0397	.0392	.0386	.0381	.0375
18	40	.562	.0485	.0480	.0474	.0469	.0463	.0457	.0452	.0446	.0441	.0435
18		.594	.0516	.0511	.0505	.0500	.0494	.0489	.0483	.0477	.0472	.0466
18		.625	.0547	.0541	.0535	.0530	.0524	.0519	.0513	.0508	.0502	.0497
18		.719	.0638	.0632	.0627	.0621	.0616	.0610	.0605	.0599	.0593	.0588
18	60	.750	.0668	.0662	.0657	.0651	.0646	.0640	.0635	.0629	.0624	.0618
18		.812	.0728	.0723	.0717	.0712	.0706	.0701	.0695	.0689	.0684	.0678
18	80	.937	.0850	.0844	.0839	.0833	.0828	.0822	.0817	.0811	.0805	.0800
18	100	1.156	.1063	.1057	.1052	.1046	.1041	.1035	.1029	.1024	.1018	.1013
18	120	1.375	.1276	.1270	.1265	.1259	.1253	.1248	.1242	.1237	.1231	.1226
18	140	1.562	.1457	.1452	.1446	.1441	.1435	.1430	.1424	.1419	.1413	.1407
18		1.688	.1580	.1574	.1569	.1563	.1558	.1552	.1547	.1541	.1536	.1530

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
18	160	1.781	.1670	.1665	.1659	.1654	.1648	.1643	.1637	.1632	.1626	.1620
20	10	.250	.0164	.0159	.0154	.0149	.0144	.0139	.0134	.0129	.0124	.0119
20		.312	.0218	.0213	.0208	.0203	.0198	.0193	.0188	.0183	.0178	.0173
20	20 ST	.375	.0273	.0268	.0263	.0258	.0253	.0248	.0243	.0238	.0233	.0228
20		.438	.0328	.0323	.0318	.0313	.0308	.0303	.0298	.0293	.0288	.0283
20	30 XS	.500	.0382	.0377	.0373	.0367	.0362	.0357	.0353	.0347	.0343	.0337
20		.562	.0437	.0432	.0427	.0422	.0417	.0412	.0407	.0402	.0397	.0392
20	40	.593	.0464	.0459	.0454	.0449	.0444	.0439	.0434	.0429	.0424	.0419
20		.625	.0492	.0487	.0482	.0477	.0472	.0467	.0462	.0457	.0452	.0447
20	60	.812	.0655	.0650	.0645	.0640	.0635	.0630	.0625	.0620	.0615	.0610
20		.875	.0711	.0706	.0701	.0696	.0691	.0686	.0681	.0676	.0671	.0666
20		.906	.0738	.0733	.0728	.0723	.0718	.0713	.0708	.0703	.0698	.0693
20	80	1.031	.0847	.0842	.0837	.0832	.0827	.0822	.0817	.0812	.0807	.0802
20		1.250	.1039	.1034	.1029	.1024	.1019	.1014	.1009	.1004	.0999	.0994
20	100	1.281	.1066	.1061	.1056	.1051	.1046	.1041	.1036	.1031	.1026	.1021
20	120	1.500	.1258	.1252	.1247	.1242	.1237	.1232	.1227	.1222	.1218	.1212
20	140	1.750	.1476	.1471	.1466	.1461	.1456	.1451	.1446	.1441	.1436	.1431
20		1.844	.1558	.1553	.1548	.1543	.1538	.1533	.1528	.1523	.1518	.1513
20	160	1.968	.1667	.1662	.1657	.1652	.1647	.1642	.1637	.1632	.1627	.1622
22	LG	.250	.0149	.0144	.0140	.0135	.0131	.0126	.0122	.0117	.0113	.0108
22	ST	.375	.0248	.0244	.0239	.0235	.0230	.0226	.0221	.0216	.0212	.0207
22	XS	.500	.0348	.0343	.0339	.0334	.0330	.0325	.0320	.0316	.0311	.0307
24	10	.250	.0136	.0132	.0128	.0124	.0120	.0116	.0111	.0107	.0103	.0099
24		.312	.0182	.0177	.0173	.0169	.0165	.0161	.0157	.0152	.0148	.0144
24	20 ST	.375	.0228	.0223	.0219	.0215	.0211	.0207	.0203	.0198	.0194	.0190
24		.438	.0274	.0269	.0265	.0261	.0257	.0253	.0249	.0244	.0240	.0236
24	XS	.500	.0319	.0315	.0310	.0306	.0302	.0298	.0294	.0290	.0285	.0281
24	30	.562	.0364	.0360	.0356	.0351	.0347	.0343	.0339	.0335	.0331	.0326
24		.625	.0410	.0406	.0402	.0397	.0393	.0389	.0385	.0381	.0377	.0372
24	40	.687	.0455	.0451	.0447	.0443	.0438	.0434	.0430	.0426	.0422	.0418
24		.750	.0501	.0497	.0493	.0489	.0484	.0480	.0476	.0472	.0468	.0464
24	60	.968	.0660	.0656	.0652	.0647	.0643	.0639	.0635	.0631	.0627	.0622
24		1.031	.0706	.0702	.0698	.0693	.0689	.0685	.0681	.0677	.0673	.0668
24	80	1.218	.0842	.0838	.0834	.0830	.0826	.0821	.0817	.0813	.0809	.0805
24	100	1.531	.1071	.1066	.1062	.1058	.1054	.1050	.1046	.1041	.1037	.1033

Table 7-1
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.0									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
24	120	1.812	.1275	.1271	.1267	.1263	.1259	.1255	.1250	.1246	.1242	.1238
24	140	2.062	.1458	.1454	.1449	.1445	.1441	.1437	.1433	.1429	.1424	.1420
24		2.188	.1550	.1545	.1541	.1537	.1533	.1529	.1525	.1520	.1516	.1512
24	160	2.343	.1663	.1658	.1654	.1650	.1646	.1642	.1638	.1633	.1629	.1625
26	ST	.375	.0210	.0206	.0202	.0199	.0195	.0191	.0187	.0183	.0179	.0175
26	XS	.500	.0294	.0290	.0287	.0283	.0279	.0275	.0271	.0267	.0263	.0260
30	10	.312	.0145	.0142	.0139	.0135	.0132	.0129	.0125	.0122	.0119	.0115
30	ST	.375	.0182	.0179	.0175	.0172	.0169	.0165	.0162	.0159	.0155	.0152
30		.438	.0219	.0215	.0212	.0209	.0206	.0202	.0199	.0195	.0192	.0189
30	20 XS	.500	.0255	.0252	.0248	.0245	.0242	.0238	.0235	.0232	.0228	.0225
30		.562	.0291	.0288	.0284	.0281	.0278	.0274	.0271	.0268	.0264	.0261
30	30	.625	.0328	.0325	.0321	.0318	.0315	.0311	.0308	.0305	.0301	.0298
34	ST	.375	.0161	.0158	.0155	.0152	.0149	.0146	.0143	.0140	.0137	.0134
34	XS	.500	.0225	.0222	.0219	.0216	.0213	.0210	.0207	.0204	.0201	.0199
36	ST	.375	.0152	.0149	.0146	.0143	.0141	.0138	.0135	.0132	.0130	.0127
36	XS	.500	.0212	.0210	.0207	.0204	.0201	.0199	.0196	.0193	.0190	.0187
42	ST	.375	.0130	.0128	.0125	.0123	.0121	.0118	.0116	.0113	.0111	.0109
42	XS	.500	.0182	.0180	.0177	.0175	.0173	.0170	.0168	.0165	.0163	.0161
48	ST	.375	.0114	.0112	.0110	.0108	.0105	.0103	.0101	.0099	.0097	.0095
48	XS	.500	.0159	.0157	.0155	.0153	.0151	.0149	.0147	.0145	.0143	.0141

Table 7-2
Pressure/Stress Ratios Where Y = 0.4

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
1/8	10S	.049	.2313	.2022	.1736	.1457	.1183	.0915	.0652	.0395	.0143		
1/8	40 ST 40S	.068	.3330	.3016	.2709	.2409	.2116	.1828	.1547	.1271	.1002	.0737	.0478
1/8	80 ST 80S	.095	.4911	.4562	.4221	.3887	.3561	.3243	.2931	.2626	.2328	.2036	.1750
1/4	10S	.065	.2300	.2081	.1866	.1654	.1445	.1239	.1037	.0837	.0641	.0448	.0257
1/4	40 ST 40S	.088	.3219	.2985	.2755	.2529	.2306	.2087	.1871	.1659	.1450	.1244	.1042
1/4	80 ST 80S	.119	.4560	.4303	.4051	.3803	.3559	.3320	.3084	.2852	.2624	.2400	.2179
3/8	10S	.065	.1807	.1638	.1471	.1306	.1143	.0982	.0822	.0665	.0510	.0357	.0205
3/8	40 ST 40S	.091	.2605	.2426	.2249	.2074	.1901	.1731	.1562	.1396	.1232	.1070	.0910
3/8	80 ST 80S	.126	.3758	.3563	.3371	.3181	.2994	.2810	.2628	.2448	.2271	.2095	.1922
1/2	10S	.083	.1858	.1721	.1586	.1452	.1319	.1188	.1058	.0929	.0802	.0676	.0551
1/2	40 ST 40S	.109	.2498	.2354	.2213	.2072	.1933	.1796	.1660	.1525	.1392	.1260	.1129
1/2	80 ST 80S	.147	.3490	.3336	.3184	.3034	.2885	.2737	.2592	.2447	.2305	.2163	.2024
1/2	160	.187	.4615	.4449	.4285	.4122	.3962	.3803	.3645	.3490	.3336	.3184	.3034
1/2	XX	.294	.8113	.7905	.7700	.7498	.7298	.7100	.6905	.6712	.6522	.6334	.6148
3/4	5S	.065	.1132	.1029	.0926	.0824	.0723	.0622	.0523	.0424	.0326	.0228	.0132
3/4	10S	.083	.1464	.1358	.1253	.1148	.1044	.0941	.0839	.0738	.0637	.0538	.0439
3/4	40S	.113	.2037	.1926	.1816	.1707	.1598	.1491	.1385	.1279	.1174	.1070	.0967
3/4	80S	.154	.2860	.2743	.2626	.2510	.2395	.2281	.2168	.2056	.1945	.1835	.1726
3/4		.188	.3582	.3458	.3335	.3214	.3093	.2973	.2854	.2737	.2620	.2504	.2389
3/4	160	.218	.4251	.4121	.3993	.3865	.3739	.3613	.3489	.3366	.3244	.3123	.3003
3/4	XX	.308	.6460	.6310	.6161	.6014	.5868	.5723	.5580	.5438	.5298	.5159	.5021
1	5S	.065	.0896	.0815	.0734	.0654	.0574	.0494	.0416	.0337	.0259	.0182	.0105
1	10S	.109	.1540	.1454	.1370	.1285	.1201	.1118	.1035	.0953	.0872	.0790	.0710
1	40 ST 40S	.133	.1905	.1817	.1730	.1643	.1557	.1472	.1387	.1302	.1218	.1135	.1052
1	80 ST 80S	.179	.2633	.2540	.2448	.2357	.2266	.2176	.2087	.1998	.1909	.1821	.1734
1		.219	.3299	.3202	.3105	.3010	.2915	.2820	.2726	.2633	.2540	.2448	.2357
1	160	.250	.3838	.3737	.3637	.3537	.3439	.3341	.3243	.3146	.3050	.2955	.2860
1	XX0	.358	.5886	.5770	.5656	.5542	.5429	.5316	.5205	.5094	.4984	.4875	.4767
1 1/4	5S	.065	.0705	.0641	.0578	.0515	.0452	.0390	.0328	.0266	.0205	.0144	.0083
1 1/4	10S	.109	.1204	.1138	.1073	.1007	.0942	.0878	.0813	.0749	.0685	.0622	.0559
1 1/4	40 ST 40S	.140	.1569	.1501	.1433	.1366	.1299	.1233	.1166	.1101	.1035	.0970	.0905
1 1/4	80 ST 80S	.191	.2190	.2119	.2048	.1978	.1908	.1838	.1769	.1700	.1632	.1563	.1496
1 1/4	160	.250	.2946	.2871	.2796	.2722	.2648	.2575	.2502	.2429	.2357	.2285	.2213
1 1/4	XX	.382	.4800	.4715	.4630	.4546	.4462	.4378	.4295	.4213	.4131	.4049	.3968

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
11/2	5S	.065	.0613	.0558	.0503	.0449	.0394	.0340	.0286	.0232	.0179	.0126	.0073
11/2	10S	.109	.1046	.0989	.0932	.0876	.0819	.0763	.0708	.0652	.0597	.0542	.0487
11/2	40 ST 40S	.145	.1411	.1352	.1294	.1236	.1178	.1120	.1063	.1006	.0949	.0893	.0836
11/2	80 ST 80S	.200	.1989	.1927	.1867	.1806	.1745	.1685	.1626	.1566	.1507	.1448	.1389
11/2	160	.281	.2887	.2822	.2757	.2692	.2628	.2563	.2500	.2436	.2373	.2310	.2247
11/2	XX	.400	.4321	.4249	.4177	.4105	.4034	.3963	.3893	.3823	.3753	.3684	.3614
2	5S	.065	.0488	.0445	.0401	.0358	.0314	.0271	.0228	.0186	.0143	.0100	.0058
2	10S	.109	.0830	.0785	.0740	.0696	.0651	.0607	.0563	.0519	.0475	.0432	.0388
2	40 ST 40S	.154	.1189	.1143	.1097	.1051	.1005	.0960	.0914	.0869	.0824	.0779	.0735
2		.167	.1294	.1248	.1201	.1155	.1109	.1063	.1018	.0972	.0927	.0882	.0837
2		.188	.1467	.1419	.1372	.1326	.1279	.1233	.1186	.1140	.1094	.1049	.1003
2	80 ST 80S	.218	.1717	.1669	.1621	.1573	.1526	.1478	.1431	.1384	.1337	.1291	.1244
2		.250	.1989	.1940	.1891	.1842	.1794	.1745	.1697	.1649	.1602	.1554	.1507
2		.312	.2532	.2481	.2430	.2379	.2329	.2279	.2229	.2179	.2129	.2080	.2030
2	160	.343	.2812	.2760	.2708	.2656	.2605	.2553	.2502	.2452	.2401	.2350	.2300
2	XX	.436	.3686	.3631	.3576	.3521	.3466	.3412	.3358	.3303	.3250	.3196	.3142
21/2	5S	.083	.0516	.0479	.0443	.0407	.0372	.0336	.0300	.0265	.0229	.0194	.0158
21/2	10S	.120	.0752	.0716	.0679	.0642	.0606	.0569	.0533	.0497	.0461	.0424	.0389
21/2	40 ST 40S	.203	.1300	.1261	.1223	.1185	.1147	.1109	.1071	.1033	.0996	.0958	.0921
21/2		.217	.1395	.1356	.1317	.1279	.1240	.1202	.1164	.1126	.1088	.1050	.1012
21/2	80 ST 80S	.276	.1801	.1761	.1721	.1682	.1642	.1603	.1563	.1524	.1485	.1446	.1407
21/2	160	.375	.2512	.2470	.2428	.2386	.2344	.2303	.2262	.2220	.2179	.2138	.2097
21/2	XX	.552	.3882	.3835	.3789	.3743	.3697	.3651	.3606	.3560	.3515	.3470	.3425
3	5S	.083	.0422	.0392	.0363	.0334	.0304	.0275	.0246	.0217	.0188	.0159	.0130
3	10S	.120	.0615	.0585	.0555	.0525	.0495	.0466	.0436	.0407	.0377	.0348	.0318
3		.125	.0641	.0611	.0581	.0551	.0521	.0492	.0462	.0432	.0403	.0373	.0344
3		.148	.0763	.0732	.0702	.0672	.0642	.0612	.0582	.0552	.0522	.0492	.0463
3		.188	.0977	.0946	.0915	.0885	.0854	.0823	.0793	.0763	.0732	.0702	.0672
3	40 ST 40S	.216	.1129	.1098	.1066	.1035	.1005	.0974	.0943	.0912	.0881	.0851	.0820
3		.241	.1266	.1235	.1203	.1172	.1140	.1109	.1078	.1047	.1016	.0985	.0954
3		.254	.1338	.1306	.1275	.1243	.1212	.1180	.1149	.1118	.1087	.1056	.1025
3		.289	.1534	.1501	.1469	.1437	.1406	.1374	.1342	.1310	.1279	.1247	.1216
3	80 XS 80S	.300	.1596	.1563	.1531	.1499	.1467	.1435	.1403	.1371	.1340	.1308	.1276
3		.312	.1664	.1631	.1599	.1567	.1534	.1502	.1470	.1438	.1406	.1374	.1343
3		.406	.2209	.2176	.2142	.2108	.2075	.2041	.2008	.1975	.1941	.1908	.1875

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
3	160	.438	.2400	.2366	.2332	.2298	.2264	.2230	.2196	.2162	.2128	.2095	.2061
3	XX	.600	.3409	.3372	.3335	.3299	.3262	.3226	.3189	.3155	.3117	.3081	.3045
31/2	5S	.083	.0368	.0343	.0317	.0291	.0266	.0240	.0215	.0190	.0164	.0139	.0114
31/2	10S	.120	.0536	.0510	.0484	.0458	.0432	.0407	.0381	.0355	.0329	.0304	.0278
31/2		.128	.0573	.0547	.0521	.0495	.0469	.0443	.0417	.0391	.0365	.0340	.0314
31/2		.134	.0600	.0574	.0548	.0522	.0496	.0470	.0444	.0418	.0392	.0367	.0341
31/2		.148	.0665	.0638	.0612	.0586	.0560	.0534	.0508	.0482	.0456	.0430	.0404
31/2		.188	.0850	.0824	.0797	.0771	.0744	.0718	.0691	.0665	.0638	.0612	.0586
31/2	40 ST 40S	.226	.1029	.1002	.0975	.0948	.0922	.0895	.0868	.0841	.0814	.0788	.0761
31/2		.281	.1293	.1265	.1238	.1210	.1183	.1155	.1128	.1101	.1074	.1046	.1019
31/2	80 XS 80S	.318	.1473	.1445	.1417	.1389	.1362	.1334	.1306	.1278	.1251	.1223	.1196
31/2		.344	.1601	.1573	.1545	.1517	.1489	.1461	.1433	.1405	.1377	.1349	.1321
31/2		.469	.2235	.2206	.2176	.2147	.2117	.2088	.2058	.2029	.2000	.1971	.1942
31/2		.636	.3131	.3099	.3068	.3036	.3005	.2974	.2942	.2911	.2880	.2849	.2818
4	5S	.083	.0327	.0304	.0281	.0259	.0236	.0213	.0191	.0168	.0146	.0123	.0101
4	10S	.120	.0476	.0452	.0429	.0407	.0384	.0361	.0338	.0315	.0292	.0270	.0247
4		.128	.0508	.0485	.0462	.0439	.0416	.0393	.0370	.0347	.0324	.0301	.0279
4		.134	.0532	.0509	.0486	.0463	.0440	.0417	.0394	.0371	.0348	.0325	.0303
4		.142	.0565	.0541	.0518	.0495	.0472	.0449	.0426	.0403	.0380	.0357	.0334
4		.165	.0659	.0635	.0612	.0589	.0565	.0542	.0519	.0496	.0473	.0450	.0427
4		.188	.0753	.0730	.0706	.0683	.0659	.0636	.0612	.0589	.0566	.0543	.0519
4		.205	.0823	.0800	.0776	.0753	.0729	.0705	.0682	.0659	.0635	.0612	.0589
4	40 ST40S	.237	.0957	.0933	.0909	.0885	.0861	.0838	.0814	.0790	.0767	.0743	.0720
4		.250	.1012	.0988	.0964	.0940	.0916	.0892	.0868	.0844	.0821	.0797	.0773
4		.271	.1100	.1076	.1052	.1028	.1004	.0980	.0956	.0932	.0908	.0884	.0860
4		.281	.1143	.1118	.1094	.1070	.1046	.1022	.0998	.0974	.0950	.0926	.0902
4		.300	.1224	.1199	.1175	.1151	.1126	.1102	.1078	.1054	.1030	.1006	.0982
4		.312	.1275	.1251	.1226	.1202	.1177	.1153	.1129	.1105	.1080	.1056	.1032
4	80 XS 80S	.337	.1383	.1358	.1334	.1309	.1284	.1260	.1235	.1211	.1187	.1162	.1138
4		.375	.1549	.1524	.1499	.1474	.1449	.1424	.1399	.1374	.1350	.1325	.1300
4	120	.438	.1828	.1802	.1777	.1751	.1726	.1701	.1675	.1650	.1625	.1600	.1574
4		.500	.2108	.2082	.2056	.2030	.2004	.1978	.1953	.1927	.1901	.1875	.1850
4	160	.531	.2251	.2225	.2198	.2172	.2146	.2120	.2093	.2067	.2041	.2015	.1989
4	XX	.674	.2928	.2900	.2873	.2845	.2818	.2790	.2763	.2735	.2708	.2681	.2654
5	5S	.109	.0348	.0329	.0311	.0292	.0274	.0256	.0237	.0219	.0201	.0182	.0164
5	10S	.134	.0429	.0410	.0392	.0373	.0355	.0336	.0318	.0299	.0281	.0262	.0244

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
5	40 ST 40S	.258	.0839	.0820	.0800	.0781	.0762	.0743	.0724	.0705	.0686	.0667	.0648
5		.352	.1159	.1139	.1119	.1100	.1080	.1061	.1041	.1022	.1002	.0983	.0963
5	80 XS 80S	.375	.1238	.1218	.1199	.1179	.1159	.1139	.1120	.1100	.1081	.1061	.1042
5		.438	.1458	.1438	.1418	.1398	.1378	.1358	.1338	.1318	.1298	.1278	.1258
5	120	.500	.1678	.1658	.1638	.1617	.1597	.1577	.1556	.1536	.1516	.1496	.1475
5	160	.625	.2134	.2113	.2092	.2071	.2049	.2028	.2007	.1987	.1966	.1945	.1924
5	XX	.750	.2605	.2583	.2561	.2540	.2518	.2496	.2474	.2453	.2431	.2409	.2388
6	5S	.109	.0291	.0276	.0260	.0245	.0230	.0214	.0199	.0184	.0168	.0153	.0138
6	10S	.134	.0359	.0344	.0328	.0313	.0297	.0282	.0266	.0251	.0235	.0220	.0205
6		.169	.0455	.0439	.0423	.0408	.0392	.0377	.0361	.0345	.0330	.0314	.0299
6		.180	.0485	.0469	.0453	.0438	.0422	.0407	.0391	.0375	.0360	.0344	.0329
6		.188	.0507	.0491	.0475	.0460	.0444	.0428	.0413	.0397	.0382	.0366	.0351
6		.219	.0592	.0576	.0561	.0545	.0529	.0513	.0498	.0482	.0466	.0451	.0435
6		.250	.0678	.0662	.0646	.0631	.0615	.0599	.0583	.0567	.0552	.0536	.0520
6		.277	.0754	.0738	.0722	.0706	.0690	.0674	.0658	.0642	.0626	.0610	.0595
6	40 ST 40S	.280	.0762	.0746	.0730	.0714	.0698	.0682	.0666	.0650	.0635	.0619	.0603
6		.375	.1031	.1015	.0999	.0982	.0966	.0950	.0934	.0917	.0901	.0885	.0869
6	80 XS 80S	.432	.1196	.1179	.1163	.1146	.1130	.1113	.1097	.1080	.1064	.1047	.1031
6		.500	.1394	.1378	.1361	.1344	.1327	.1311	.1294	.1277	.1261	.1244	.1227
6	120	.562	.1578	.1561	.1544	.1527	.1510	.1493	.1476	.1459	.1442	.1426	.1409
6	160	.718	.2052	.2035	.2017	.1999	.1982	.1964	.1947	.1929	.1912	.1894	.1877
6	XX	.864	.2512	.2493	.2475	.2457	.2439	.2420	.2402	.2384	.2366	.2348	.2330
8	5S	.109	.0223	.0211	.0200	.0188	.0176	.0164	.0153	.0141	.0129	.0117	.0106
8	10S	.148	.0304	.0292	.0280	.0268	.0257	.0245	.0233	.0221	.0209	.0197	.0186
8		.158	.0325	.0313	.0301	.0289	.0277	.0265	.0254	.0242	.0230	.0218	.0206
8		.165	.0339	.0327	.0316	.0304	.0292	.0280	.0268	.0256	.0244	.0233	.0221
8		.188	.0387	.0375	.0363	.0352	.0340	.0328	.0316	.0304	.0292	.0280	.0268
8		.203	.0419	.0407	.0395	.0383	.0371	.0359	.0347	.0335	.0323	.0311	.0299
8		.219	.0452	.0440	.0428	.0416	.0404	.0392	.0380	.0369	.0357	.0345	.0333
8		.238	.0492	.0480	.0468	.0456	.0444	.0432	.0420	.0408	.0396	.0384	.0372
8	20	.250	.0518	.0506	.0494	.0482	.0470	.0457	.0445	.0433	.0421	.0409	.0398
8	30	.277	.0575	.0563	.0551	.0539	.0527	.0514	.0502	.0490	.0478	.0466	.0454
8	40 ST 40S	.322	.0671	.0659	.0646	.0634	.0622	.0610	.0598	.0586	.0573	.0561	.0549
8		.344	.0718	.0706	.0694	.0681	.0669	.0657	.0645	.0632	.0620	.0608	.0596
8		.352	.0735	.0723	.0711	.0698	.0686	.0674	.0662	.0649	.0637	.0625	.0613
8		.375	.0785	.0772	.0760	.0748	.0736	.0723	.0711	.0699	.0686	.0674	.0662

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
8	60	.406	.0852	.0839	.0827	.0815	.0802	.0790	.0778	.0765	.0753	.0741	.0728
8		.469	.0989	.0977	.0964	.0952	.0939	.0927	.0914	.0902	.0889	.0877	.0865
8	80 XS 80S	.500	.1057	.1045	.1032	.1020	.1007	.0995	.0982	.0970	.0957	.0945	.0932
8	100	.593	.1264	.1251	.1238	.1226	.1213	.1200	.1187	.1175	.1162	.1149	.1137
8		.625	.1336	.1323	.1310	.1297	.1285	.1272	.1259	.1246	.1233	.1221	.1208
8	120	.718	.1547	.1534	.1521	.1508	.1495	.1482	.1469	.1456	.1443	.1430	.1417
8	140	.812	.1764	.1750	.1737	.1724	.1711	.1697	.1684	.1671	.1658	.1645	.1632
8	XX	.875	.1911	.1898	.1884	.1871	.1857	.1844	.1831	.1817	.1804	.1791	.1777
8	160	.906	.1984	.1971	.1957	.1944	.1930	.1917	.1903	.1890	.1877	.1863	.1850
10	5S	.134	.0220	.0211	.0201	.0192	.0182	.0173	.0163	.0154	.0145	.0135	.0126
10	10S	.165	.0272	.0262	.0253	.0243	.0234	.0224	.0215	.0205	.0196	.0186	.0177
10		.188	.0310	.0300	.0291	.0281	.0272	.0262	.0253	.0243	.0234	.0224	.0215
10		.203	.0335	.0325	.0316	.0306	.0297	.0287	.0278	.0268	.0259	.0249	.0240
10		.219	.0362	.0352	.0343	.0333	.0323	.0314	.0304	.0295	.0285	.0276	.0266
10	20	.250	.0414	.0404	.0395	.0385	.0375	.0366	.0356	.0347	.0337	.0327	.0318
10		.279	.0463	.0453	.0443	.0434	.0424	.0414	.0405	.0395	.0386	.0376	.0366
10	30	.307	.0510	.0500	.0491	.0481	.0471	.0462	.0452	.0442	.0433	.0423	.0413
10		.348	.0580	.0570	.0560	.0550	.0541	.0531	.0521	.0512	.0502	.0492	.0483
10	40 ST 40S	.365	.0609	.0599	.0589	.0579	.0570	.0560	.0550	.0541	.0531	.0521	.0511
10		.395	.0660	.0650	.0640	.0631	.0621	.0611	.0601	.0592	.0582	.0572	.0562
10	60 XS 80S	.500	.0841	.0831	.0821	.0812	.0802	.0792	.0782	.0772	.0762	.0752	.0742
10		.531	.0895	.0885	.0875	.0865	.0856	.0846	.0836	.0826	.0816	.0806	.0796
10	80	.593	.1004	.0994	.0984	.0974	.0964	.0954	.0944	.0934	.0924	.0914	.0904
10	100	.718	.1226	.1216	.1206	.1195	.1185	.1175	.1165	.1155	.1145	.1134	.1124
10		.750	.1284	.1273	.1263	.1253	.1243	.1232	.1222	.1212	.1202	.1191	.1181
10	120	.843	.1452	.1442	.1431	.1421	.1410	.1400	.1390	.1379	.1369	.1359	.1348
10	140	1.000	.1741	.1731	.1720	.1709	.1699	.1688	.1678	.1667	.1656	.1646	.1635
10		1.062	.1857	.1847	.1836	.1825	.1814	.1804	.1793	.1782	.1772	.1761	.1750
10	160	1.125	.1976	.1965	.1955	.1944	.1933	.1922	.1911	.1901	.1890	.1879	.1868
12	5S	.156	.0216	.0208	.0200	.0192	.0184	.0176	.0168	.0160	.0152	.0144	.0136
12	10S	.180	.0250	.0242	.0234	.0226	.0218	.0210	.0202	.0194	.0186	.0178	.0170
12		.203	.0282	.0274	.0266	.0258	.0250	.0242	.0234	.0226	.0218	.0210	.0202
12		.219	.0304	.0296	.0288	.0280	.0272	.0264	.0256	.0248	.0240	.0232	.0224
12		.238	.0331	.0323	.0315	.0307	.0299	.0291	.0283	.0275	.0267	.0259	.0251
12	20	.250	.0348	.0340	.0332	.0324	.0316	.0308	.0300	.0292	.0284	.0276	.0268
12		.279	.0389	.0381	.0373	.0365	.0357	.0349	.0340	.0332	.0324	.0316	.0308

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4									
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
12		.300	.0419	.0411	.0402	.0394	.0386	.0378	.0370	.0362	.0354	.0346	.0338
12	30	.330	.0461	.0453	.0445	.0437	.0429	.0421	.0413	.0404	.0396	.0388	.0380
12		.344	.0481	.0473	.0465	.0457	.0449	.0441	.0432	.0424	.0416	.0408	.0400
12	ST 40S	.375	.0526	.0517	.0509	.0501	.0493	.0485	.0477	.0468	.0460	.0452	.0444
12	40	.406	.0570	.0562	.0554	.0545	.0537	.0529	.0521	.0513	.0504	.0496	.0488
12		.438	.0616	.0608	.0600	.0591	.0583	.0575	.0567	.0558	.0550	.0542	.0534
12	XS 80S	.500	.0706	.0697	.0689	.0681	.0673	.0664	.0656	.0648	.0639	.0631	.0623
12	60	.562	.0796	.0788	.0779	.0771	.0763	.0754	.0746	.0738	.0729	.0721	.0713
12		.625	.0888	.0880	.0872	.0863	.0855	.0846	.0838	.0830	.0821	.0813	.0804
12	80	.687	.0980	.0971	.0963	.0955	.0946	.0938	.0929	.0921	.0912	.0904	.0895
12	100	.843	.1213	.1205	.1196	.1187	.1179	.1170	.1162	.1153	.1144	.1136	.1127
12		.875	.1262	.1253	.1244	.1236	.1227	.1218	.1210	.1201	.1193	.1184	.1175
12	120	1.000	.1452	.1444	.1435	.1426	.1417	.1408	.1400	.1391	.1382	.1373	.1365
12	140	1.125	.1646	.1637	.1628	.1619	.1610	.1601	.1592	.1584	.1575	.1566	.1557
12		1.219	.1793	.1784	.1775	.1766	.1757	.1748	.1739	.1730	.1721	.1712	.1703
12	160	1.312	.1941	.1931	.1922	.1913	.1904	.1895	.1886	.1877	.1868	.1859	.1850
14		.188	.0237	.0230	.0223	.0215	.0208	.0201	.0194	.0186	.0179	.0172	.0165
14		.220	.0278	.0271	.0263	.0256	.0249	.0242	.0234	.0227	.0220	.0213	.0205
14		.238	.0301	.0294	.0286	.0279	.0272	.0265	.0257	.0250	.0243	.0235	.0228
14	10	.250	.0316	.0309	.0302	.0295	.0287	.0280	.0273	.0265	.0258	.0251	.0243
14	20	.312	.0396	.0389	.0381	.0374	.0367	.0359	.0352	.0345	.0337	.0330	.0323
14	30ST	.375	.0478	.0470	.0463	.0455	.0448	.0441	.0433	.0426	.0418	.0411	.0404
14		.406	.0518	.0511	.0503	.0496	.0488	.0481	.0473	.0466	.0459	.0451	.0444
14	40	.438	.0560	.0552	.0545	.0537	.0530	.0522	.0515	.0508	.0500	.0493	.0485
14		.469	.0600	.0593	.0585	.0578	.0570	.0563	.0555	.0548	.0541	.0533	.0526
14	XS	.500	.0641	.0634	.0626	.0619	.0611	.0604	.0596	.0589	.0581	.0574	.0566
14	60	.593	.0764	.0756	.0749	.0741	.0734	.0726	.0718	.0711	.0703	.0696	.0688
14		.625	.0806	.0799	.0791	.0784	.0776	.0768	.0761	.0753	.0746	.0738	.0731
14		.656	.0848	.0840	.0833	.0825	.0817	.0810	.0802	.0794	.0787	.0779	.0772
14	80	.750	.0974	.0966	.0959	.0951	.0943	.0936	.0928	.0920	.0912	.0905	.0897
14	100	.937	.1229	.1221	.1213	.1205	.1197	.1190	.1182	.1174	.1166	.1158	.1150
14	120	1.093	.1445	.1437	.1429	.1421	.1413	.1405	.1397	.1389	.1381	.1373	.1366
14	140	1.250	.1667	.1659	.1650	.1642	.1634	.1626	.1618	.1610	.1602	.1594	.1586
14		1.344	.1801	.1793	.1785	.1776	.1768	.1760	.1752	.1744	.1736	.1727	.1719
14	160	1.406	.1890	.1882	.1874	.1866	.1857	.1849	.1841	.1833	.1824	.1816	.1808
16		.188	.0207	.0201	.0195	.0188	.0182	.0176	.0169	.0163	.0157	.0150	.0144

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
16		.238	.0263	.0257	.0250	.0244	.0238	.0231	.0225	.0218	.0212	.0206	.0199
16	10	.250	.0276	.0270	.0264	.0257	.0251	.0245	.0238	.0232	.0225	.0219	.0213
16		.281	.0311	.0305	.0298	.0292	.0286	.0279	.0273	.0266	.0260	.0254	.0247
16	20	.312	.0346	.0340	.0333	.0327	.0320	.0314	.0307	.0301	.0295	.0288	.0282
16		.344	.0382	.0376	.0369	.0363	.0356	.0350	.0343	.0337	.0331	.0324	.0318
16	30 ST	.375	.0417	.0411	.0404	.0398	.0391	.0385	.0378	.0372	.0365	.0359	.0353
16		.406	.0452	.0446	.0439	.0433	.0426	.0420	.0413	.0407	.0400	.0394	.0387
16		.438	.0488	.0482	.0475	.0469	.0462	.0456	.0450	.0443	.0437	.0430	.0424
16		.469	.0524	.0517	.0511	.0504	.0498	.0491	.0485	.0478	.0472	.0465	.0459
16	40 XS	.500	.0559	.0553	.0546	.0540	.0533	.0526	.0520	.0513	.0507	.0500	.0494
16		.531	.0595	.0588	.0581	.0575	.0568	.0562	.0555	.0549	.0542	.0536	.0529
16	60	.656	.0739	.0732	.0725	.0719	.0712	.0706	.0699	.0692	.0686	.0679	.0673
16		.688	.0776	.0769	.0763	.0756	.0749	.0743	.0736	.0729	.0723	.0716	.0710
16		.750	.0848	.0841	.0835	.0828	.0821	.0815	.0808	.0801	.0795	.0788	.0782
16	80	.843	.0957	.0951	.0944	.0937	.0930	.0924	.0917	.0910	.0904	.0897	.0890
16	100	1.031	.1181	.1174	.1167	.1160	.1154	.1147	.1140	.1133	.1126	.1119	.1113
16	120	1.218	.1407	.1400	.1393	.1386	.1379	.1372	.1365	.1358	.1352	.1345	.1338
16	140	1.438	.1678	.1671	.1664	.1657	.1650	.1643	.1636	.1629	.1622	.1615	.1607
16		1.500	.1756	.1749	.1742	.1734	.1727	.1720	.1713	.1706	.1699	.1692	.1684
16	160	1.593	.1873	.1866	.1858	.1851	.1844	.1837	.1830	.1822	.1815	.1808	.1801
18	10	.250	.0245	.0240	.0234	.0228	.0223	.0217	.0211	.0206	.0200	.0195	.0189
18	20	.312	.0307	.0301	.0296	.0290	.0284	.0279	.0273	.0267	.0262	.0256	.0250
18	ST	.375	.0370	.0364	.0359	.0353	.0347	.0341	.0336	.0330	.0324	.0319	.0313
18	30	.438	.0433	.0427	.0422	.0416	.0410	.0404	.0399	.0393	.0387	.0382	.0376
18	XS	.500	.0496	.0490	.0484	.0478	.0473	.0467	.0461	.0455	.0450	.0444	.0438
18	40	.562	.0559	.0553	.0547	.0541	.0535	.0530	.0524	.0518	.0512	.0506	.0501
18		.594	.0591	.0585	.0580	.0574	.0568	.0562	.0556	.0550	.0545	.0539	.0533
18		.625	.0623	.0617	.0611	.0605	.0599	.0594	.0588	.0582	.0576	.0570	.0565
18		.719	.0719	.0713	.0707	.0702	.0696	.0690	.0684	.0678	.0672	.0666	.0660
18	60	.750	.0751	.0745	.0739	.0733	.0728	.0722	.0716	.0710	.0704	.0698	.0692
18		.812	.0815	.0809	.0803	.0797	.0792	.0786	.0780	.0774	.0768	.0762	.0756
18	80	.937	.0945	.0939	.0933	.0927	.0922	.0916	.0910	.0904	.0898	.0892	.0886
18	100	1.156	.1177	.1171	.1165	.1159	.1152	.1146	.1140	.1134	.1128	.1122	.1116
18	120	1.375	.1412	.1406	.1400	.1394	.1388	.1381	.1375	.1369	.1363	.1357	.1350
18	140	1.562	.1617	.1611	.1604	.1598	.1592	.1585	.1579	.1573	.1567	.1560	.1554
18		1.688	.1756	.1750	.1744	.1737	.1731	.1725	.1718	.1712	.1706	.1699	.1693

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4									
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
18	160	1.781	.1860	.1854	.1848	.1841	.1835	.1828	.1822	.1816	.1809	.1803	.1796
20	10	.250	.0221	.0216	.0211	.0205	.0200	.0195	.0190	.0185	.0180	.0175	.0170
20		.312	.0276	.0271	.0266	.0261	.0256	.0250	.0245	.0240	.0235	.0230	.0225
20	20 ST	.375	.0332	.0327	.0322	.0317	.0312	.0307	.0302	.0297	.0291	.0286	.0281
20		.438	.0389	.0384	.0379	.0374	.0369	.0363	.0358	.0353	.0348	.0343	.0338
20	30 XS	.500	.0445	.0440	.0435	.0430	.0425	.0419	.0414	.0409	.0404	.0399	.0394
20		.562	.0502	.0496	.0491	.0486	.0481	.0476	.0470	.0465	.0460	.0455	.0450
20	40	.593	.0530	.0525	.0519	.0514	.0509	.0504	.0499	.0493	.0488	.0483	.0478
20		.625	.0559	.0554	.0549	.0543	.0538	.0533	.0528	.0523	.0517	.0512	.0507
20	60	.812	.0731	.0726	.0721	.0715	.0710	.0705	.0700	.0694	.0689	.0684	.0678
20		.875	.0790	.0784	.0779	.0774	.0769	.0763	.0758	.0753	.0747	.0742	.0737
20		.906	.0819	.0813	.0808	.0803	.0797	.0792	.0787	.0781	.0776	.0771	.0765
20	80	1.031	.0936	.0931	.0925	.0920	.0914	.0909	.0904	.0898	.0893	.0888	.0882
20		1.250	.1144	.1138	.1133	.1127	.1122	.1116	.1111	.1106	.1100	.1095	.1089
20	100	1.281	.1173	.1168	.1163	.1157	.1152	.1146	.1141	.1135	.1130	.1124	.1119
20	120	1.500	.1385	.1380	.1374	.1369	.1363	.1357	.1352	.1346	.1341	.1335	.1330
20	140	1.750	.1631	.1625	.1620	.1614	.1608	.1603	.1597	.1592	.1586	.1580	.1575
20		1.844	.1725	.1719	.1713	.1708	.1702	.1696	.1691	.1685	.1679	.1673	.1668
20	160	1.968	.1849	.1844	.1838	.1832	.1826	.1821	.1815	.1809	.1803	.1798	.1792
22	LG	.250	.0200	.0196	.0191	.0187	.0182	.0177	.0173	.0168	.0164	.0159	.0154
22	ST	.375	.0302	.0297	.0293	.0288	.0283	.0279	.0274	.0269	.0265	.0260	.0255
22	XS	.500	.0404	.0399	.0395	.0390	.0385	.0381	.0376	.0371	.0367	.0362	.0357
24	10	.250	.0184	.0179	.0175	.0171	.0167	.0163	.0158	.0154	.0150	.0146	.0141
24		.312	.0230	.0225	.0221	.0217	.0213	.0208	.0204	.0200	.0196	.0191	.0187
24	20 ST	.375	.0276	.0272	.0268	.0264	.0259	.0255	.0251	.0247	.0242	.0238	.0234
24		.438	.0324	.0319	.0315	.0311	.0306	.0302	.0298	.0294	.0289	.0285	.0281
24	XS	.500	.0370	.0366	.0361	.0357	.0353	.0349	.0344	.0340	.0336	.0331	.0327
24	30	.562	.0417	.0412	.0408	.0404	.0399	.0395	.0391	.0387	.0382	.0378	.0374
24		.625	.0464	.0460	.0456	.0451	.0447	.0443	.0438	.0434	.0430	.0425	.0421
24	40	.687	.0511	.0507	.0503	.0498	.0494	.0490	.0485	.0481	.0477	.0472	.0468
24		.750	.0559	.0555	.0550	.0546	.0542	.0537	.0533	.0529	.0524	.0520	.0516
24	60	.968	.0726	.0722	.0718	.0713	.0709	.0704	.0700	.0695	.0691	.0687	.0682
24		1.031	.0775	.0771	.0766	.0762	.0757	.0753	.0749	.0744	.0740	.0735	.0731
24	80	1.218	.0921	.0916	.0912	.0907	.0903	.0898	.0894	.0890	.0885	.0881	.0876
24	100	1.531	.1169	.1164	.1159	.1155	.1150	.1146	.1141	.1137	.1132	.1128	.1123

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
24	120	1.812	.1395	.1390	.1386	.1381	.1376	.1372	.1367	.1363	.1358	.1353	.1349
24	140	2.062	.1600	.1595	.1590	.1586	.1581	.1576	.1571	.1567	.1562	.1557	.1553
24		2.188	.1704	.1699	.1695	.1690	.1685	.1680	.1676	.1671	.1666	.1661	.1657
24	160	2.343	.1834	.1829	.1824	.1819	.1815	.1810	.1805	.1800	.1795	.1791	.1786
26	ST	.375	.0255	.0251	.0247	.0243	.0239	.0235	.0231	.0228	.0224	.0220	.0216
26	XS	.500	.0341	.0337	.0333	.0329	.0325	.0321	.0317	.0313	.0310	.0306	.0302
30	10	.312	.0183	.0180	.0177	.0173	.0170	.0166	.0163	.0160	.0156	.0153	.0150
30	ST	.375	.0221	.0217	.0214	.0211	.0207	.0204	.0200	.0197	.0194	.0190	.0187
30		.438	.0258	.0255	.0251	.0248	.0245	.0241	.0238	.0234	.0231	.0228	.0224
30	20 XS	.500	.0295	.0292	.0288	.0285	.0281	.0278	.0275	.0271	.0268	.0264	.0261
30		.562	.0332	.0329	.0325	.0322	.0319	.0315	.0312	.0308	.0305	.0301	.0298
30	30	.625	.0370	.0367	.0363	.0360	.0356	.0353	.0349	.0346	.0343	.0339	.0336
34	ST	.375	.0195	.0192	.0189	.0186	.0183	.0180	.0177	.0174	.0171	.0168	.0165
34	XS	.500	.0260	.0257	.0254	.0251	.0248	.0245	.0242	.0239	.0236	.0233	.0230
36	ST	.375	.0184	.0181	.0178	.0175	.0172	.0170	.0167	.0164	.0161	.0158	.0155
36	XS	.500	.0245	.0243	.0240	.0237	.0234	.0231	.0228	.0226	.0223	.0220	.0217
42	ST	.375	.0157	.0155	.0152	.0150	.0148	.0145	.0143	.0140	.0138	.0136	.0133
42	XS	.500	.0210	.0208	.0205	.0203	.0200	.0198	.0196	.0193	.0191	.0188	.0186
48	ST	.375	.0137	.0135	.0133	.0131	.0129	.0127	.0125	.0123	.0121	.0119	.0116
48	XS	.500	.0184	.0182	.0179	.0177	.0175	.0173	.0171	.0169	.0167	.0165	.0163

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
1/8	10S	.049	0.0000									
1/8	40 ST 40S	.068	.0224									
1/8	80 ST 80S	.095	.1471	.1197	.0928	.0665	.0408	.0155				
1/4	10S	.065	.0070									
1/4	40 ST 40S	.088	.0842	.0646	.0452	.0262	.0074					
1/4	80 ST 80S	.119	.1962	.1749	.1538	.1331	.1127	.0927	.0729	.0534	.0343	.0154
3/8	10S	.065	.0056									
3/8	40 ST 40S	.091	.0752	.0595	.0441	.0288	.0138					
3/8	80 ST 80S	.126	.1752	.1583	.1417	.1252	.1090	.0930	.0771	.0615	.0460	.0307
1/2	10S	.083	.0427	.0304	.0183	.0063						
1/2	40 ST 40S	.109	.1000	.0872	.0745	.0619	.0495	.0372	.0249	.0129	.0009	
1/2	80 ST 80S	.147	.1885	.1748	.1613	.1478	.1346	.1214	.1084	.0955	.0827	.0701
1/2	160	.187	.2885	.2737	.2592	.2447	.2305	.2163	.2024	.1885	.1748	.1613
1/2	XX	.294	.5964	.5783	.5603	.5426	.5251	.5077	.4906	.4737	.4569	.4404
3/4	5S	.065	.0036									
3/4	10S	.083	.0340	.0243	.0146	.0050						
3/4	40S	.113	.0865	.0763	.0662	.0562	.0463	.0365	.0267	.0170	.0074	
3/4	80S	.154	.1617	.1510	.1403	.1297	.1192	.1088	.0985	.0882	.0781	.0680
3/4		.188	.2276	.2163	.2051	.1940	.1830	.1720	.1612	.1504	.1398	.1292
3/4	160	.218	.2884	.2766	.2649	.2533	.2418	.2304	.2191	.2079	.1967	.1857
3/4	XX	.308	.4884	.4748	.4614	.4481	.4349	.4219	.4089	.3961	.3833	.3707
1	5S	.065	.0029									
1	10S	.109	.0630	.0550	.0471	.0392	.0314	.0236	.0159	.0082	.0006	
1	40 ST 40S	.133	.0970	.0888	.0807	.0726	.0646	.0566	.0486	.0408	.0329	.0252
1	80 ST 80S	.179	.1647	.1561	.1476	.1391	.1306	.1222	.1139	.1056	.0974	.0892
1		.219	.2266	.2176	.2087	.1998	.1909	.1821	.1734	.1647	.1561	.1476
1	160	.250	.2766	.2673	.2580	.2487	.2396	.2305	.2214	.2125	.2035	.1947
1	XX0	.358	.4660	.4553	.4447	.4342	.4238	.4134	.4031	.3929	.3828	.3727
11/4	5S	.065	.0023									
11/4	10S	.109	.0496	.0434	.0371	.0310	.0248	.0187	.0126	.0065	.0005	
11/4	40 ST 40S	.140	.0841	.0776	.0713	.0649	.0586	.0523	.0460	.0398	.0336	.0274
11/4	80 ST 80S	.191	.1428	.1361	.1294	.1228	.1162	.1096	.1030	.0965	.0900	.0836
11/4	160	.250	.2142	.2071	.2001	.1931	.1861	.1791	.1722	.1654	.1586	.1518
11/4	XX	.382	.3888	.3807	.3728	.3648	.3569	.3491	.3413	.3335	.3258	.3181

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
1 1/2	5S	.065	.0020									
1 1/2	10S	.109	.0432	.0378	.0324	.0270	.0216	.0163	.0110	.0057	.0004	
1 1/2	40 ST 40S	.145	.0780	.0724	.0669	.0613	.0558	.0503	.0449	.0394	.0340	.0286
1 1/2	80 ST 80S	.200	.1330	.1272	.1214	.1156	.1099	.1042	.0985	.0928	.0871	.0815
1 1/2	160	.281	.2185	.2123	.2061	.1999	.1938	.1877	.1816	.1756	.1696	.1636
1 1/2	XX	.400	.3546	.3477	.3409	.3341	.3274	.3207	.3140	.3073	.3007	.2941
2	5S	.065	.0016									
2	10S	.109	.0345	.0301	.0258	.0216	.0173	.0130	.0088	.0045	.0003	
2	40 ST 40S	.154	.0690	.0646	.0602	.0557	.0513	.0470	.0426	.0383	.0339	.0296
2		.167	.0792	.0747	.0702	.0658	.0614	.0570	.0526	.0482	.0438	.0395
2		.188	.0957	.0912	.0867	.0822	.0777	.0732	.0688	.0644	.0599	.0555
2	80 ST 80S	.218	.1198	.1152	.1106	.1060	.1014	.0969	.0923	.0878	.0833	.0788
2		.250	.1459	.1412	.1365	.1319	.1272	.1226	.1179	.1133	.1087	.1042
2		.312	.1981	.1932	.1884	.1835	.1787	.1738	.1690	.1642	.1595	.1547
2	160	.343	.2250	.2200	.2150	.2101	.2051	.2002	.1953	.1904	.1856	.1807
2	XX	.436	.3089	.3036	.2983	.2931	.2878	.2826	.2774	.2722	.2670	.2619
2 1/2	5S	.083	.0123	.0088	.0053	.0018						
2 1/2	10S	.120	.0353	.0317	.0281	.0246	.0210	.0175	.0140	.0105	.0070	.0035
2 1/2	40 ST 40S	.203	.0883	.0846	.0809	.0772	.0735	.0698	.0661	.0625	.0588	.0552
2 1/2		.217	.0975	.0937	.0900	.0863	.0826	.0788	.0751	.0715	.0678	.0641
2 1/2	80 ST 80S	.276	.1368	.1330	.1291	.1253	.1215	.1176	.1138	.1100	.1062	.1025
2 1/2	160	.375	.2056	.2016	.1975	.1935	.1894	.1854	.1814	.1774	.1734	.1695
2 1/2	XX	.552	.3380	.3335	.3291	.3246	.3202	.3158	.3114	.3070	.3026	.2982
3	5S	.083	.0101	.0072	.0044	.0015						
3	10S	.120	.0289	.0260	.0231	.0202	.0173	.0144	.0115	.0086	.0057	.0029
3		.125	.0315	.0285	.0256	.0227	.0198	.0169	.0140	.0111	.0082	.0054
3		.148	.0433	.0404	.0374	.0345	.0315	.0286	.0257	.0228	.0199	.0170
3		.188	.0642	.0612	.0582	.0552	.0522	.0492	.0463	.0433	.0404	.0374
3	40 ST 40S	.216	.0790	.0760	.0729	.0699	.0669	.0639	.0609	.0579	.0549	.0519
3		.241	.0924	.0893	.0862	.0832	.0801	.0771	.0741	.0710	.0680	.0650
3		.254	.0994	.0963	.0932	.0901	.0871	.0840	.0810	.0779	.0749	.0719
3		.289	.1184	.1153	.1122	.1091	.1060	.1028	.0998	.0967	.0936	.0905
3	80 XS 80S	.300	.1245	.1213	.1182	.1151	.1119	.1088	.1057	.1026	.0995	.0964
3		.312	.1311	.1279	.1248	.1216	.1185	.1154	.1123	.1091	.1060	.1029
3		.406	.1842	.1809	.1776	.1744	.1711	.1678	.1646	.1614	.1581	.1549

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORRUSION ALLOWANCE-INCHES Y=0.4									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
3	160	.438	.2028	.1995	.1961	.1928	.1895	.1862	.1829	.1796	.1763	.1731
3	XX	.600	.3009	.2973	.2937	.2902	.2866	.2831	.2795	.2760	.2725	.2690
31/2	5S	.083	.0088	.0063	.0038	.0013						
31/2	10S	.120	.0253	.0227	.0202	.0176	.0151	.0126	.0100	.0075	.0050	.0025
31/2		.128	.0288	.0263	.0237	.0212	.0186	.0161	.0136	.0110	.0085	.0060
31/2		.134	.0315	.0290	.0264	.0239	.0213	.0188	.0162	.0137	.0112	.0087
31/2		.148	.0378	.0352	.0327	.0301	.0276	.0250	.0224	.0199	.0174	.0148
31/2		.188	.0560	.0534	.0508	.0482	.0456	.0430	.0404	.0378	.0352	.0327
31/2	40 ST 40S	.226	.0735	.0708	.0682	.0655	.0629	.0603	.0577	.0551	.0525	.0498
31/2		.281	.0992	.0965	.0938	.0911	.0885	.0858	.0831	.0804	.0778	.0751
31/2	80 XS 80S	.318	.1168	.1141	.1114	.1087	.1059	.1032	.1005	.0978	.0951	.0924
31/2		.344	.1294	.1266	.1238	.1211	.1183	.1156	.1129	.1101	.1074	.1047
31/2		.469	.1913	.1884	.1855	.1826	.1797	.1769	.1740	.1712	.1683	.1655
31/2		.636	.2787	.2756	.2725	.2695	.2664	.2633	.2603	.2573	.2542	.2512
4	5S	.083	.0079	.0056	.0034	.0012						
4	10S	.120	.0224	.0202	.0179	.0157	.0134	.0112	.0089	.0067	.0045	.0022
4		.128	.0256	.0233	.0211	.0188	.0166	.0143	.0121	.0098	.0076	.0053
4		.134	.0280	.0257	.0234	.0212	.0189	.0167	.0144	.0122	.0099	.0077
4		.142	.0312	.0289	.0266	.0243	.0221	.0198	.0176	.0153	.0131	.0108
4		.165	.0404	.0381	.0358	.0335	.0312	.0289	.0267	.0244	.0221	.0199
4		.188	.0496	.0473	.0450	.0427	.0404	.0381	.0358	.0336	.0313	.0290
4		.205	.0565	.0542	.0519	.0496	.0473	.0450	.0427	.0404	.0381	.0358
4	40 ST40S	.237	.0696	.0673	.0649	.0626	.0603	.0579	.0556	.0533	.0510	.0487
4		.250	.0750	.0726	.0703	.0679	.0656	.0632	.0609	.0586	.0562	.0539
4		.271	.0837	.0813	.0789	.0766	.0742	.0718	.0695	.0671	.0648	.0625
4		.281	.0878	.0854	.0831	.0807	.0783	.0760	.0736	.0713	.0689	.0666
4		.300	.0958	.0934	.0910	.0886	.0862	.0838	.0815	.0791	.0767	.0744
4		.312	.1008	.0984	.0960	.0936	.0912	.0888	.0864	.0841	.0817	.0793
4	80 XS 80S	.337	.1114	.1089	.1065	.1041	.1017	.0993	.0969	.0945	.0921	.0897
4		.375	.1276	.1251	.1227	.1202	.1178	.1154	.1129	.1105	.1081	.1057
4	120	.438	.1549	.1524	.1499	.1474	.1449	.1425	.1400	.1375	.1350	.1326
4		.500	.1824	.1798	.1773	.1748	.1722	.1697	.1671	.1646	.1621	.1596
4	160	.531	.1964	.1938	.1912	.1886	.1861	.1835	.1809	.1784	.1758	.1733
4	XX	.674	.2626	.2599	.2572	.2545	.2518	.2491	.2464	.2438	.2411	.2384
5	5S	.109	.0146	.0128	.0110	.0092	.0073	.0055	.0037	.0019	.0001	
5	10S	.134	.0226	.0208	.0189	.0171	.0153	.0135	.0116	.0098	.0080	.0062

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
5	40 ST 40S	.258	.0629	.0610	.0592	.0573	.0554	.0535	.0516	.0498	.0479	.0460
5		.352	.0944	.0925	.0905	.0886	.0867	.0847	.0828	.0809	.0790	.0771
5	80 XS 80S	.375	.1022	.1003	.0983	.0964	.0944	.0925	.0906	.0886	.0867	.0848
5		.438	.1239	.1219	.1199	.1179	.1160	.1140	.1120	.1101	.1081	.1062
5	120	.500	.1455	.1435	.1415	.1395	.1375	.1355	.1335	.1315	.1295	.1275
5	160	.625	.1903	.1882	.1861	.1841	.1820	.1799	.1779	.1758	.1737	.1717
5	XX	.750	.2366	.2345	.2323	.2302	.2280	.2259	.2238	.2216	.2195	.2174
6	5S	.109	.0122	.0107	.0092	.0077	.0062	.0047	.0031	.0016	.0001	
6	10S	.134	.0189	.0174	.0159	.0143	.0128	.0113	.0098	.0083	.0067	.0052
6		.169	.0284	.0268	.0253	.0237	.0222	.0207	.0191	.0176	.0161	.0145
6		.180	.0313	.0298	.0282	.0267	.0252	.0236	.0221	.0205	.0190	.0175
6		.188	.0335	.0320	.0304	.0289	.0273	.0258	.0242	.0227	.0212	.0196
6		.219	.0419	.0404	.0388	.0373	.0357	.0342	.0326	.0311	.0295	.0280
6		.250	.0504	.0489	.0473	.0457	.0442	.0426	.0410	.0395	.0379	.0364
6		.277	.0579	.0563	.0547	.0531	.0516	.0500	.0484	.0469	.0453	.0437
6	40 ST 40S	.280	.0587	.0571	.0555	.0540	.0524	.0508	.0493	.0477	.0461	.0446
6		.375	.0853	.0837	.0820	.0804	.0788	.0772	.0756	.0740	.0724	.0708
6	80 XS 80S	.432	.1015	.0998	.0982	.0966	.0949	.0933	.0917	.0901	.0885	.0868
6		.500	.1211	.1194	.1177	.1161	.1144	.1128	.1111	.1095	.1079	.1062
6	120	.562	.1392	.1375	.1358	.1342	.1325	.1308	.1291	.1275	.1258	.1241
6	160	.718	.1859	.1842	.1824	.1807	.1790	.1772	.1755	.1738	.1721	.1703
6	XX	.864	.2312	.2294	.2276	.2258	.2240	.2222	.2204	.2186	.2169	.2151
8	5S	.109	.0094	.0082	.0071	.0059	.0047	.0036	.0024	.0012	.0001	
8	10S	.148	.0174	.0162	.0150	.0139	.0127	.0115	.0104	.0092	.0080	.0069
8		.158	.0195	.0183	.0171	.0159	.0148	.0136	.0124	.0112	.0101	.0089
8		.165	.0209	.0197	.0185	.0174	.0162	.0150	.0138	.0127	.0115	.0103
8		.188	.0257	.0245	.0233	.0221	.0209	.0197	.0186	.0174	.0162	.0150
8		.203	.0288	.0276	.0264	.0252	.0240	.0228	.0217	.0205	.0193	.0181
8		.219	.0321	.0309	.0297	.0285	.0273	.0262	.0250	.0238	.0226	.0214
8		.238	.0360	.0349	.0337	.0325	.0313	.0301	.0289	.0277	.0265	.0254
8	20	.250	.0386	.0374	.0362	.0350	.0338	.0326	.0314	.0302	.0290	.0278
8	30	.277	.0442	.0430	.0418	.0406	.0394	.0382	.0370	.0358	.0346	.0335
8	40 ST 40S	.322	.0537	.0525	.0513	.0501	.0489	.0477	.0465	.0453	.0441	.0429
8		.344	.0584	.0572	.0559	.0547	.0535	.0523	.0511	.0499	.0487	.0475
8		.352	.0601	.0589	.0576	.0564	.0552	.0540	.0528	.0516	.0504	.0492
8		.375	.0650	.0638	.0625	.0613	.0601	.0589	.0577	.0565	.0553	.0540

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
8	60	.406	.0716	.0704	.0692	.0679	.0667	.0655	.0643	.0631	.0618	.0606
8		.469	.0852	.0840	.0827	.0815	.0803	.0790	.0778	.0766	.0753	.0741
8	80 XS 80S	.500	.0920	.0907	.0895	.0882	.0870	.0857	.0845	.0833	.0820	.0808
8	100	.593	.1124	.1111	.1099	.1086	.1073	.1061	.1048	.1036	.1023	.1011
8		.625	.1195	.1182	.1170	.1157	.1144	.1132	.1119	.1106	.1094	.1081
8	120	.718	.1404	.1391	.1378	.1365	.1352	.1339	.1327	.1314	.1301	.1288
8	140	.812	.1618	.1605	.1592	.1579	.1566	.1553	.1540	.1527	.1514	.1501
8	XX	.875	.1764	.1751	.1738	.1724	.1711	.1698	.1685	.1671	.1658	.1645
8	160	.906	.1836	.1823	.1810	.1796	.1783	.1770	.1756	.1743	.1730	.1717
10	5S	.134	.0116	.0107	.0098	.0088	.0079	.0069	.0060	.0051	.0041	.0032
10	10S	.165	.0167	.0158	.0149	.0139	.0130	.0120	.0111	.0102	.0092	.0083
10		.188	.0205	.0196	.0186	.0177	.0168	.0158	.0149	.0139	.0130	.0121
10		.203	.0230	.0221	.0211	.0202	.0192	.0183	.0174	.0164	.0155	.0145
10		.219	.0257	.0247	.0238	.0228	.0219	.0209	.0200	.0191	.0181	.0172
10	20	.250	.0308	.0299	.0289	.0280	.0270	.0261	.0251	.0242	.0232	.0223
10		.279	.0357	.0347	.0338	.0328	.0319	.0309	.0300	.0290	.0281	.0271
10	30	.307	.0404	.0394	.0385	.0375	.0365	.0356	.0346	.0337	.0327	.0318
10		.348	.0473	.0463	.0454	.0444	.0434	.0425	.0415	.0406	.0396	.0386
10	40 ST 40S	.365	.0502	.0492	.0482	.0473	.0463	.0453	.0444	.0434	.0425	.0415
10		.395	.0553	.0543	.0533	.0524	.0514	.0504	.0494	.0485	.0475	.0465
10	60 XS 80S	.500	.0732	.0723	.0713	.0703	.0693	.0683	.0673	.0664	.0654	.0644
10		.531	.0786	.0776	.0766	.0756	.0747	.0737	.0727	.0717	.0707	.0697
10	80	.593	.0894	.0884	.0874	.0864	.0854	.0844	.0834	.0824	.0814	.0804
10	100	.718	.1114	.1104	.1094	.1084	.1074	.1063	.1053	.1043	.1033	.1023
10		.750	.1171	.1161	.1151	.1140	.1130	.1120	.1110	.1100	.1090	.1080
10	120	.843	.1338	.1328	.1317	.1307	.1297	.1286	.1276	.1266	.1256	.1245
10	140	1.000	.1625	.1614	.1604	.1593	.1583	.1572	.1562	.1551	.1541	.1530
10		1.062	.1740	.1729	.1718	.1708	.1697	.1687	.1676	.1665	.1655	.1644
10	160	1.125	.1858	.1847	.1836	.1825	.1815	.1804	.1793	.1783	.1772	.1761
12	5S	.156	.0129	.0121	.0113	.0105	.0097	.0089	.0081	.0073	.0065	.0057
12	10S	.180	.0162	.0154	.0146	.0138	.0130	.0122	.0114	.0106	.0098	.0091
12		.203	.0194	.0186	.0178	.0170	.0162	.0154	.0146	.0138	.0130	.0122
12		.219	.0216	.0208	.0200	.0192	.0184	.0176	.0168	.0160	.0152	.0145
12		.238	.0243	.0235	.0227	.0219	.0211	.0203	.0195	.0187	.0179	.0171
12	20	.250	.0260	.0252	.0244	.0236	.0228	.0220	.0212	.0204	.0196	.0188
12		.279	.0300	.0292	.0284	.0276	.0268	.0260	.0252	.0244	.0236	.0228

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
12		.300	.0330	.0322	.0314	.0306	.0298	.0290	.0282	.0274	.0266	.0258
12	30	.330	.0372	.0364	.0356	.0348	.0340	.0332	.0324	.0316	.0308	.0300
12		.344	.0392	.0384	.0376	.0368	.0360	.0352	.0343	.0335	.0327	.0319
12	ST 40S	.375	.0436	.0428	.0420	.0412	.0403	.0395	.0387	.0379	.0371	.0363
12	40	.406	.0480	.0472	.0464	.0456	.0447	.0439	.0431	.0423	.0415	.0407
12		.438	.0526	.0518	.0509	.0501	.0493	.0485	.0477	.0469	.0460	.0452
12	XS 80S	.500	.0615	.0607	.0598	.0590	.0582	.0574	.0565	.0557	.0549	.0541
12	60	.562	.0704	.0696	.0688	.0680	.0671	.0663	.0655	.0646	.0638	.0630
12		.625	.0796	.0788	.0779	.0771	.0763	.0754	.0746	.0738	.0730	.0721
12	80	.687	.0887	.0879	.0870	.0862	.0853	.0845	.0837	.0828	.0820	.0812
12	100	.843	.1119	.1110	.1102	.1093	.1085	.1076	.1067	.1059	.1050	.1042
12		.875	.1167	.1158	.1150	.1141	.1132	.1124	.1115	.1107	.1098	.1090
12	120	1.000	.1356	.1347	.1339	.1330	.1321	.1313	.1304	.1295	.1286	.1278
12	140	1.125	.1548	.1539	.1530	.1522	.1513	.1504	.1495	.1486	.1478	.1469
12		1.219	.1694	.1685	.1677	.1668	.1659	.1650	.1641	.1632	.1623	.1614
12	160	1.312	.1841	.1832	.1823	.1814	.1805	.1796	.1787	.1778	.1769	.1760
14		.188	.0157	.0150	.0143	.0136	.0129	.0121	.0114	.0107	.0100	.0092
14		.220	.0198	.0191	.0183	.0176	.0169	.0162	.0155	.0147	.0140	.0133
14		.238	.0221	.0214	.0206	.0199	.0192	.0185	.0177	.0170	.0163	.0156
14	10	.250	.0236	.0229	.0222	.0214	.0207	.0200	.0193	.0185	.0178	.0171
14	20	.312	.0315	.0308	.0301	.0293	.0286	.0279	.0271	.0264	.0257	.0250
14	30ST	.375	.0396	.0389	.0382	.0374	.0367	.0360	.0352	.0345	.0338	.0330
14		.406	.0436	.0429	.0422	.0414	.0407	.0399	.0392	.0385	.0377	.0370
14	40	.438	.0478	.0470	.0463	.0456	.0448	.0441	.0433	.0426	.0419	.0411
14		.469	.0518	.0511	.0503	.0496	.0488	.0481	.0474	.0466	.0459	.0451
14	XS	.500	.0559	.0551	.0544	.0536	.0529	.0521	.0514	.0506	.0499	.0492
14	60	.593	.0681	.0673	.0666	.0658	.0651	.0643	.0636	.0628	.0621	.0613
14		.625	.0723	.0715	.0708	.0700	.0693	.0685	.0678	.0670	.0663	.0655
14		.656	.0764	.0757	.0749	.0741	.0734	.0726	.0719	.0711	.0704	.0696
14	80	.750	.0889	.0882	.0874	.0867	.0859	.0851	.0844	.0836	.0828	.0821
14	100	.937	.1143	.1135	.1127	.1119	.1111	.1104	.1096	.1088	.1080	.1073
14	120	1.093	.1358	.1350	.1342	.1334	.1326	.1318	.1310	.1302	.1294	.1286
14	140	1.250	.1578	.1569	.1561	.1553	.1545	.1537	.1529	.1521	.1513	.1505
14		1.344	.1711	.1703	.1695	.1687	.1678	.1670	.1662	.1654	.1646	.1638
14	160	1.406	.1800	.1792	.1783	.1775	.1767	.1759	.1751	.1742	.1734	.1726
16		.188	.0136	.0131	.0125	.0119	.0112	.0106	.0100	.0093	.0087	.0081

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
16		.238	.0193	.0187	.0180	.0174	.0168	.0161	.0155	.0149	.0142	.0136
16	10	.250	.0206	.0200	.0194	.0187	.0181	.0175	.0168	.0162	.0156	.0149
16		.281	.0241	.0235	.0228	.0222	.0215	.0209	.0203	.0196	.0190	.0184
16	20	.312	.0276	.0269	.0263	.0256	.0250	.0244	.0237	.0231	.0224	.0218
16		.344	.0311	.0305	.0299	.0292	.0286	.0279	.0273	.0267	.0260	.0254
16	30 ST	.375	.0346	.0340	.0333	.0327	.0320	.0314	.0308	.0301	.0295	.0288
16		.406	.0381	.0375	.0368	.0362	.0355	.0349	.0342	.0336	.0330	.0323
16		.438	.0417	.0411	.0404	.0398	.0391	.0385	.0378	.0372	.0366	.0359
16		.469	.0452	.0446	.0439	.0433	.0426	.0420	.0413	.0407	.0401	.0394
16	40 XS	.500	.0487	.0481	.0474	.0468	.0461	.0455	.0449	.0442	.0436	.0429
16		.531	.0523	.0516	.0510	.0503	.0497	.0490	.0484	.0477	.0471	.0464
16	60	.656	.0666	.0659	.0653	.0646	.0640	.0633	.0627	.0620	.0613	.0607
16		.688	.0703	.0696	.0690	.0683	.0677	.0670	.0663	.0657	.0650	.0644
16		.750	.0775	.0768	.0762	.0755	.0748	.0742	.0735	.0728	.0722	.0715
16	80	.843	.0883	.0877	.0870	.0863	.0857	.0850	.0843	.0837	.0830	.0823
16	100	1.031	.1106	.1099	.1092	.1085	.1079	.1072	.1065	.1058	.1051	.1045
16	120	1.218	.1331	.1324	.1317	.1310	.1303	.1296	.1289	.1282	.1275	.1268
16	140	1.438	.1600	.1593	.1586	.1579	.1572	.1565	.1558	.1551	.1544	.1537
16		1.500	.1677	.1670	.1663	.1656	.1649	.1642	.1635	.1628	.1621	.1613
16	160	1.593	.1794	.1786	.1779	.1772	.1765	.1758	.1751	.1744	.1736	.1729
18	10	.250	.0183	.0178	.0172	.0166	.0161	.0155	.0149	.0144	.0138	.0133
18	20	.312	.0245	.0239	.0233	.0228	.0222	.0216	.0211	.0205	.0199	.0194
18	ST	.375	.0307	.0302	.0296	.0290	.0284	.0279	.0273	.0267	.0262	.0256
18	30	.438	.0370	.0364	.0359	.0353	.0347	.0342	.0336	.0330	.0324	.0319
18	XS	.500	.0432	.0427	.0421	.0415	.0409	.0404	.0398	.0392	.0386	.0381
18	40	.562	.0495	.0489	.0483	.0478	.0472	.0466	.0460	.0455	.0449	.0443
18		.594	.0527	.0521	.0516	.0510	.0504	.0498	.0493	.0487	.0481	.0475
18		.625	.0559	.0553	.0547	.0541	.0536	.0530	.0524	.0518	.0512	.0507
18		.719	.0655	.0649	.0643	.0637	.0631	.0625	.0620	.0614	.0608	.0602
18	60	.750	.0686	.0681	.0675	.0669	.0663	.0657	.0651	.0645	.0640	.0634
18		.812	.0750	.0744	.0738	.0733	.0727	.0721	.0715	.0709	.0703	.0697
18	80	.937	.0880	.0874	.0868	.0862	.0856	.0850	.0844	.0838	.0832	.0826
18	100	1.156	.1110	.1104	.1098	.1092	.1086	.1080	.1074	.1068	.1062	.1056
18	120	1.375	.1344	.1338	.1332	.1326	.1320	.1313	.1307	.1301	.1295	.1289
18	140	1.562	.1548	.1541	.1535	.1529	.1523	.1516	.1510	.1504	.1498	.1491
18		1.688	.1687	.1680	.1674	.1668	.1661	.1655	.1649	.1642	.1636	.1630

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
18	160	1.781	.1790	.1784	.1777	.1771	.1765	.1758	.1752	.1745	.1739	.1733
20	10	.250	.0165	.0160	.0155	.0150	.0145	.0140	.0134	.0129	.0124	.0119
20		.312	.0220	.0215	.0210	.0205	.0200	.0195	.0189	.0184	.0179	.0174
20	20 ST	.375	.0276	.0271	.0266	.0261	.0256	.0251	.0246	.0240	.0235	.0230
20		.438	.0333	.0327	.0322	.0317	.0312	.0307	.0302	.0297	.0292	.0286
20	30 XS	.500	.0388	.0383	.0378	.0373	.0368	.0363	.0358	.0352	.0347	.0342
20		.562	.0445	.0439	.0434	.0429	.0424	.0419	.0413	.0408	.0403	.0398
20	40	.593	.0473	.0467	.0462	.0457	.0452	.0447	.0442	.0436	.0431	.0426
20		.625	.0502	.0497	.0491	.0486	.0481	.0476	.0471	.0465	.0460	.0455
20	60	.812	.0673	.0668	.0663	.0657	.0652	.0647	.0642	.0636	.0631	.0626
20		.875	.0731	.0726	.0721	.0716	.0710	.0705	.0700	.0694	.0689	.0684
20		.906	.0760	.0755	.0750	.0744	.0739	.0734	.0728	.0723	.0718	.0712
20	80	1.031	.0877	.0871	.0866	.0861	.0855	.0850	.0845	.0839	.0834	.0829
20		1.250	.1084	.1078	.1073	.1067	.1062	.1057	.1051	.1046	.1040	.1035
20	100	1.281	.1113	.1108	.1102	.1097	.1092	.1086	.1081	.1075	.1070	.1064
20	120	1.500	.1324	.1319	.1313	.1307	.1302	.1296	.1291	.1285	.1280	.1274
20	140	1.750	.1569	.1563	.1558	.1552	.1546	.1541	.1535	.1529	.1524	.1518
20		1.844	.1662	.1656	.1651	.1645	.1639	.1634	.1628	.1622	.1617	.1611
20	160	1.968	.1786	.1780	.1775	.1769	.1763	.1757	.1752	.1746	.1740	.1735
22	LG	.250	.0150	.0145	.0141	.0136	.0131	.0127	.0122	.0118	.0113	.0108
22	ST	.375	.0251	.0246	.0242	.0237	.0232	.0228	.0223	.0218	.0214	.0209
22	XS	.500	.0353	.0348	.0343	.0339	.0334	.0329	.0325	.0320	.0315	.0311
24	10	.250	.0137	.0133	.0129	.0125	.0120	.0116	.0112	.0108	.0104	.0099
24		.312	.0183	.0179	.0175	.0170	.0166	.0162	.0158	.0153	.0149	.0145
24	20 ST	.375	.0230	.0225	.0221	.0217	.0213	.0208	.0204	.0200	.0196	.0192
24		.438	.0277	.0272	.0268	.0264	.0260	.0255	.0251	.0247	.0243	.0238
24	XS	.500	.0323	.0319	.0314	.0310	.0306	.0302	.0297	.0293	.0289	.0284
24	30	.562	.0369	.0365	.0361	.0356	.0352	.0348	.0344	.0339	.0335	.0331
24		.625	.0417	.0412	.0408	.0404	.0400	.0395	.0391	.0387	.0382	.0378
24	40	.687	.0464	.0459	.0455	.0451	.0446	.0442	.0438	.0433	.0429	.0425
24		.750	.0511	.0507	.0503	.0498	.0494	.0490	.0485	.0481	.0477	.0472
24	60	.968	.0678	.0674	.0669	.0665	.0660	.0656	.0652	.0647	.0643	.0638
24		1.031	.0726	.0722	.0718	.0713	.0709	.0704	.0700	.0696	.0691	.0687
24	80	1.218	.0872	.0867	.0863	.0858	.0854	.0849	.0845	.0840	.0836	.0832
24	100	1.531	.1118	.1114	.1109	.1105	.1100	.1096	.1091	.1087	.1082	.1078

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.4									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
24	120	1.812	.1344	.1339	.1335	.1330	.1325	.1321	.1316	.1312	.1307	.1302
24	140	2.062	.1548	.1543	.1539	.1534	.1529	.1524	.1520	.1515	.1510	.1506
24		2.188	.1652	.1647	.1643	.1638	.1633	.1628	.1624	.1619	.1614	.1609
24	160	2.343	.1781	.1776	.1771	.1767	.1762	.1757	.1752	.1748	.1743	.1738
26	ST	.375	.0212	.0208	.0204	.0200	.0196	.0192	.0188	.0185	.0181	.0177
26	XS	.500	.0298	.0294	.0290	.0286	.0282	.0278	.0274	.0270	.0266	.0262
30	10	.312	.0146	.0143	.0139	.0136	.0133	.0129	.0126	.0123	.0119	.0116
30	ST	.375	.0183	.0180	.0177	.0173	.0170	.0167	.0163	.0160	.0156	.0153
30		.438	.0221	.0217	.0214	.0211	.0207	.0204	.0200	.0197	.0194	.0190
30	20 XS	.500	.0258	.0254	.0251	.0247	.0244	.0241	.0237	.0234	.0230	.0227
30		.562	.0295	.0291	.0288	.0284	.0281	.0278	.0274	.0271	.0267	.0264
30	30	.625	.0332	.0329	.0325	.0322	.0319	.0315	.0312	.0308	.0305	.0302
34	ST	.375	.0162	.0159	.0156	.0153	.0150	.0147	.0144	.0141	.0138	.0135
34	XS	.500	.0227	.0224	.0221	.0218	.0215	.0212	.0209	.0206	.0203	.0200
36	ST	.375	.0153	.0150	.0147	.0144	.0141	.0139	.0136	.0133	.0130	.0127
36	XS	.500	.0214	.0211	.0209	.0206	.0203	.0200	.0197	.0195	.0192	.0189
42	ST	.375	.0131	.0128	.0126	.0124	.0121	.0119	.0116	.0114	.0112	.0109
42	XS	.500	.0183	.0181	.0179	.0176	.0174	.0171	.0169	.0167	.0164	.0162
48	ST	.375	.0114	.0112	.0110	.0108	.0106	.0104	.0102	.0100	.0098	.0095
48	XS	.500	.0160	.0158	.0156	.0154	.0152	.0150	.0148	.0146	.0144	.0141

Table 7-3
Pressure/Stress Ratios Where Y = 0.5

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
1/8	10S	.049	.2368	.2063	.1767	.1478	.1197	.0923	.0657	.0397	.0143		
1/8	40 ST 40S	.068	.3444	.3110	.2785	.2469	.2161	.1862	.1571	.1288	.1012	.0743	.0480
1/8	80 ST 80S	.095	.5165	.4780	.4407	.4045	.3693	.3351	.3020	.2697	.2383	.2078	.1782
1/4	10S	.065	.2354	.2125	.1901	.1681	.1466	.1255	.1048	.0844	.0645	.0450	.0258
1/4	40 ST 40S	.088	.3326	.3077	.2833	.2594	.2360	.2131	.1907	.1687	.1471	.1260	.1053
1/4	80 ST 80S	.119	.4778	.4497	.4222	.3953	.3691	.3434	.3182	.2936	.2695	.2459	.2228
3/8	10S	.065	.1840	.1665	.1493	.1323	.1156	.0991	.0829	.0670	.0513	.0358	.0206
3/8	40 ST 40S	.091	.2675	.2486	.2300	.2118	.1938	.1761	.1587	.1416	.1247	.1081	.0918
3/8	80 ST 80S	.126	.3904	.3695	.3488	.3286	.3087	.2891	.2699	.2509	.2323	.2140	.1960
1/2	10S	.083	.1893	.1751	.1611	.1473	.1337	.1202	.1069	.0938	.0808	.0680	.0554
1/2	40 ST 40S	.109	.2562	.2411	.2263	.2116	.1972	.1829	.1688	.1549	.1412	.1276	.1142
1/2	80 ST 80S	.147	.3616	.3451	.3289	.3129	.2970	.2814	.2661	.2509	.2359	.2211	.2065
1/2	160	.187	.4838	.4656	.4476	.4299	.4125	.3953	.3783	.3616	.3451	.3289	.3129
1/2	XX	.294	.8829	.8584	.8342	.8105	.7872	.7643	.7417	.7195	.6977	.6762	.6551
3/4	5S	.065	.1145	.1039	.0935	.0831	.0728	.0626	.0525	.0426	.0327	.0229	.0132
3/4	10S	.083	.1486	.1377	.1269	.1161	.1055	.0950	.0846	.0743	.0641	.0540	.0440
3/4	40S	.113	.2079	.1964	.1849	.1736	.1624	.1514	.1404	.1295	.1188	.1082	.0976
3/4	80S	.154	.2945	.2820	.2697	.2575	.2454	.2334	.2216	.2099	.1984	.1869	.1756
3/4		.188	.3715	.3582	.3451	.3320	.3192	.3064	.2938	.2814	.2690	.2569	.2448
3/4	160	.218	.4440	.4299	.4159	.4021	.3884	.3749	.3615	.3483	.3353	.3224	.3096
3/4	XX	.308	.6906	.6735	.6565	.6398	.6234	.6071	.5910	.5751	.5594	.5439	.5286
1	5S	.065	.0904	.0821	.0739	.0658	.0577	.0497	.0417	.0338	.0260	.0182	.0105
1	10S	.109	.1564	.1476	.1389	.1302	.1216	.1131	.1046	.0962	.0879	.0797	.0715
1	40 ST 40S	.133	.1942	.1851	.1760	.1671	.1582	.1494	.1406	.1319	.1233	.1148	.1063
1	80 ST 80S	.179	.2704	.2607	.2510	.2414	.2319	.2225	.2131	.2038	.1946	.1855	.1765
1		.219	.3412	.3308	.3205	.3103	.3002	.2902	.2803	.2704	.2607	.2510	.2414
1	160	.250	.3991	.3882	.3774	.3667	.3561	.3456	.3352	.3249	.3146	.3045	.2944
1	XXO	.358	.6254	.6124	.5995	.5867	.5740	.5615	.5491	.5368	.5246	.5125	.5006
1 1/4	5S	.065	.0710	.0645	.0581	.0518	.0454	.0392	.0329	.0267	.0205	.0144	.0083
1 1/4	10S	.109	.1219	.1152	.1084	.1018	.0951	.0885	.0820	.0755	.0690	.0626	.0562
1 1/4	40 ST 40S	.140	.1593	.1524	.1454	.1385	.1316	.1248	.1180	.1113	.1046	.0979	.0913
1 1/4	80 ST 80S	.191	.2239	.2165	.2091	.2018	.1945	.1873	.1801	.1730	.1659	.1588	.1518
1 1/4	160	.250	.3036	.2956	.2877	.2798	.2720	.2643	.2566	.2489	.2414	.2338	.2263
1 1/4	XX	.382	.5042	.4948	.4855	.4762	.4670	.4579	.4488	.4398	.4309	.4220	.4132

Table 7-2
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
11/2	5S	.065	.0617	.0561	.0506	.0451	.0396	.0341	.0287	.0233	.0179	.0126	.0073
11/2	10S	.109	.1057	.0999	.0941	.0883	.0826	.0769	.0713	.0656	.0600	.0545	.0489
11/2	40 ST 40S	.145	.1431	.1371	.1311	.1251	.1192	.1133	.1075	.1016	.0958	.0901	.0843
11/2	80 ST 80S	.200	.2029	.1965	.1902	.1839	.1777	.1714	.1652	.1591	.1530	.1469	.1408
11/2	160	.281	.2973	.2904	.2835	.2766	.2698	.2631	.2564	.2497	.2430	.2364	.2299
11/2	XX	.400	.4516	.4437	.4359	.4281	.4204	.4127	.4051	.3975	.3899	.3824	.3750
2	5S	.065	.0491	.0447	.0403	.0359	.0315	.0272	.0229	.0186	.0143	.0101	.0058
2	10S	.109	.0837	.0791	.0746	.0701	.0656	.0611	.0566	.0522	.0477	.0433	.0390
2	40 ST 40S	.154	.1203	.1156	.1109	.1062	.1015	.0969	.0923	.0877	.0831	.0785	.0740
2		.167	.1311	.1263	.1216	.1169	.1122	.1075	.1028	.0982	.0935	.0889	.0844
2		.188	.1488	.1440	.1392	.1344	.1296	.1248	.1201	.1153	.1106	.1060	.1013
2	80 ST 80S	.218	.1747	.1697	.1647	.1598	.1549	.1501	.1452	.1404	.1356	.1308	.1260
2		.250	.2029	.1978	.1927	.1877	.1827	.1777	.1727	.1677	.1628	.1579	.1530
2		.312	.2598	.2544	.2491	.2437	.2385	.2332	.2280	.2227	.2176	.2124	.2072
2	160	.343	.2893	.2838	.2783	.2729	.2674	.2620	.2567	.2513	.2460	.2407	.2354
2	XX	.436	.3827	.3768	.3709	.3649	.3591	.3532	.3474	.3416	.3359	.3301	.3244
21/2	5S	.083	.0518	.0482	.0445	.0409	.0373	.0337	.0301	.0265	.0230	.0194	.0159
21/2	10S	.120	.0758	.0721	.0683	.0646	.0609	.0572	.0536	.0499	.0463	.0426	.0390
21/2	40 ST 40S	.203	.1317	.1278	.1238	.1199	.1160	.1121	.1083	.1044	.1006	.0967	.0929
21/2		.217	.1414	.1374	.1335	.1295	.1256	.1217	.1178	.1139	.1100	.1061	.1023
21/2	80 ST 80S	.276	.1834	.1793	.1751	.1710	.1669	.1629	.1588	.1548	.1507	.1467	.1427
21/2	160	.375	.2577	.2532	.2488	.2444	.2401	.2357	.2314	.2271	.2228	.2185	.2142
21/2	XX	.552	.4038	.3988	.3938	.3889	.3839	.3790	.3741	.3692	.3643	.3595	.3546
3	5S	.083	.0424	.0394	.0364	.0335	.0305	.0276	.0247	.0217	.0188	.0159	.0130
3	10S	.120	.0619	.0588	.0558	.0528	.0498	.0468	.0438	.0408	.0378	.0349	.0319
3		.125	.0645	.0615	.0584	.0554	.0524	.0494	.0464	.0434	.0404	.0375	.0345
3		.148	.0768	.0738	.0707	.0676	.0646	.0616	.0585	.0555	.0525	.0495	.0465
3		.188	.0986	.0955	.0924	.0892	.0861	.0830	.0799	.0768	.0738	.0707	.0676
3	40 ST 40S	.216	.1142	.1110	.1078	.1046	.1015	.0983	.0952	.0921	.0889	.0858	.0827
3		.241	.1282	.1250	.1218	.1186	.1154	.1122	.1090	.1058	.1027	.0995	.0964
3		.254	.1356	.1324	.1291	.1259	.1227	.1194	.1162	.1130	.1099	.1067	.1035
3		.289	.1558	.1524	.1491	.1458	.1426	.1393	.1360	.1328	.1295	.1263	.1231
3	80 XS 80S	.300	.1622	.1588	.1555	.1522	.1489	.1456	.1423	.1390	.1358	.1325	.1293
3		.312	.1692	.1658	.1625	.1592	.1558	.1525	.1492	.1459	.1426	.1394	.1361
3		.406	.2259	.2224	.2189	.2154	.2119	.2084	.2049	.2014	.1980	.1945	.1911

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
3	160	.438	.2459	.2423	.2387	.2352	.2316	.2281	.2245	.2210	.2175	.2140	.2105
3	XX	.600	.3529	.3490	.3451	.3411	.3372	.3333	.3295	.3256	.3217	.3179	.3140
31/2	5S	.083	.0370	.0344	.0318	.0292	.0267	.0241	.0215	.0190	.0164	.0139	.0114
31/2	10S	.120	.0539	.0513	.0487	.0460	.0434	.0408	.0382	.0356	.0330	.0305	.0279
31/2		.128	.0576	.0550	.0523	.0497	.0471	.0445	.0419	.0393	.0367	.0341	.0315
31/2		.134	.0604	.0577	.0551	.0525	.0498	.0472	.0446	.0420	.0394	.0368	.0342
31/2		.148	.0669	.0642	.0616	.0589	.0563	.0537	.0510	.0484	.0458	.0432	.0406
31/2		.188	.0858	.0831	.0804	.0777	.0750	.0723	.0696	.0669	.0642	.0616	.0589
31/2	40 ST 40S	.226	.1040	.1013	.0985	.0957	.0930	.0903	.0875	.0848	.0821	.0794	.0767
31/2		.281	.1310	.1282	.1253	.1225	.1197	.1169	.1141	.1113	.1085	.1057	.1030
31/2	80 XS 80S	.318	.1495	.1466	.1438	.1409	.1380	.1352	.1323	.1295	.1267	.1238	.1210
31/2		.344	.1627	.1598	.1569	.1540	.1511	.1482	.1453	.1425	.1396	.1368	.1339
31/2		.469	.2286	.2255	.2225	.2194	.2163	.2132	.2102	.2071	.2041	.2011	.1980
31/2		.636	.3232	.3198	.3165	.3131	.3098	.3065	.3032	.2998	.2965	.2932	.2900
4	5S	.083	.0328	.0305	.0282	.0259	.0237	.0214	.0191	.0169	.0146	.0124	.0101
4	10S	.120	.0478	.0455	.0431	.0408	.0385	.0362	.0339	.0316	.0293	.0270	.0247
4		.128	.0510	.0487	.0464	.0441	.0417	.0394	.0371	.0348	.0325	.0302	.0279
4		.134	.0535	.0512	.0488	.0465	.0442	.0419	.0395	.0372	.0349	.0326	.0303
4		.142	.0568	.0544	.0521	.0498	.0474	.0451	.0428	.0405	.0382	.0359	.0336
4		.165	.0663	.0639	.0616	.0592	.0568	.0545	.0522	.0498	.0475	.0452	.0428
4		.188	.0759	.0735	.0711	.0687	.0664	.0640	.0616	.0593	.0569	.0546	.0522
4		.205	.0830	.0806	.0782	.0758	.0734	.0710	.0687	.0663	.0639	.0616	.0592
4	40 ST40S	.237	.0966	.0942	.0917	.0893	.0869	.0845	.0821	.0797	.0773	.0749	.0725
4		.250	.1022	.0997	.0973	.0949	.0924	.0900	.0876	.0851	.0827	.0803	.0779
4		.271	.1113	.1088	.1063	.1038	.1014	.0989	.0965	.0941	.0916	.0892	.0868
4		.281	.1156	.1131	.1106	.1082	.1057	.1032	.1008	.0983	.0959	.0934	.0910
4		.300	.1239	.1214	.1189	.1164	.1139	.1114	.1090	.1065	.1040	.1016	.0991
4		.312	.1292	.1267	.1241	.1216	.1191	.1167	.1142	.1117	.1092	.1067	.1043
4	80 XS 80S	.337	.1402	.1377	.1352	.1326	.1301	.1276	.1251	.1226	.1201	.1176	.1151
4		.375	.1573	.1547	.1521	.1496	.1470	.1445	.1419	.1394	.1368	.1343	.1318
4	120	.438	.1862	.1835	.1809	.1783	.1756	.1730	.1704	.1678	.1652	.1626	.1600
4		.500	.2154	.2127	.2099	.2072	.2045	.2018	.1991	.1965	.1938	.1911	.1884
4	160	.531	.2303	.2275	.2248	.2220	.2193	.2165	.2138	.2111	.2084	.2057	.2030
4	XX	.674	.3016	.2987	.2958	.2928	.2899	.2870	.2841	.2812	.2783	.2755	.2726
5	5S	.109	.0349	.0330	.0312	.0293	.0275	.0256	.0238	.0219	.0201	.0183	.0164
5	10S	.134	.0431	.0412	.0393	.0374	.0356	.0337	.0319	.0300	.0282	.0263	.0245

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5									
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
5	40 ST 40S	.258	.0846	.0826	.0807	.0788	.0768	.0749	.0729	.0710	.0691	.0672	.0652
5		.352	.1172	.1152	.1132	.1112	.1092	.1072	.1052	.1032	.1012	.0992	.0973
5	80 XS 80S	.375	.1254	.1233	.1213	.1193	.1173	.1153	.1133	.1112	.1092	.1072	.1053
5		.438	.1480	.1459	.1438	.1418	.1397	.1377	.1356	.1336	.1315	.1295	.1274
5	120	.500	.1707	.1686	.1665	.1644	.1623	.1602	.1581	.1560	.1539	.1518	.1497
5	160	.625	.2180	.2158	.2136	.2114	.2092	.2070	.2049	.2027	.2005	.1983	.1962
5	XX	.750	.2675	.2652	.2629	.2606	.2583	.2560	.2537	.2514	.2492	.2469	.2446
6	5S	.109	.0292	.0277	.0261	.0246	.0230	.0215	.0199	.0184	.0169	.0153	.0138
6	10S	.134	.0360	.0345	.0329	.0314	.0298	.0282	.0267	.0251	.0236	.0221	.0205
6		.169	.0457	.0441	.0425	.0409	.0394	.0378	.0362	.0347	.0331	.0315	.0300
6		.180	.0487	.0471	.0455	.0440	.0424	.0408	.0392	.0377	.0361	.0345	.0330
6		.188	.0509	.0493	.0478	.0462	.0446	.0430	.0414	.0399	.0383	.0367	.0352
6		.219	.0596	.0580	.0564	.0548	.0532	.0516	.0500	.0484	.0468	.0453	.0437
6		.250	.0683	.0667	.0651	.0635	.0619	.0603	.0587	.0571	.0555	.0539	.0523
6		.277	.0759	.0743	.0727	.0711	.0695	.0678	.0662	.0646	.0630	.0614	.0598
6	40 ST 40S	.280	.0768	.0752	.0736	.0719	.0703	.0687	.0671	.0655	.0639	.0623	.0607
6		.375	.1042	.1025	.1009	.0992	.0976	.0959	.0942	.0926	.0909	.0893	.0876
6	80 XS 80S	.432	.1210	.1193	.1176	.1159	.1142	.1126	.1109	.1092	.1075	.1058	.1042
6		.500	.1414	.1397	.1380	.1362	.1345	.1328	.1311	.1294	.1277	.1260	.1242
6	120	.562	.1604	.1586	.1568	.1551	.1533	.1516	.1498	.1481	.1464	.1446	.1429
6	160	.718	.2095	.2077	.2059	.2040	.2022	.2004	.1985	.1967	.1949	.1931	.1913
6	XX	.864	.2576	.2557	.2538	.2519	.2500	.2480	.2461	.2442	.2423	.2404	.2386
8	5S	.109	.0224	.0212	.0200	.0188	.0176	.0165	.0153	.0141	.0129	.0117	.0106
8	10S	.148	.0305	.0293	.0281	.0269	.0257	.0245	.0233	.0222	.0210	.0198	.0186
8		.158	.0326	.0314	.0302	.0290	.0278	.0266	.0254	.0242	.0230	.0219	.0207
8		.165	.0340	.0328	.0317	.0305	.0293	.0281	.0269	.0257	.0245	.0233	.0221
8		.188	.0389	.0377	.0365	.0353	.0341	.0329	.0317	.0305	.0293	.0281	.0269
8		.203	.0421	.0408	.0396	.0384	.0372	.0360	.0348	.0336	.0324	.0312	.0300
8		.219	.0454	.0442	.0430	.0418	.0406	.0394	.0382	.0370	.0358	.0346	.0334
8		.238	.0495	.0483	.0471	.0458	.0446	.0434	.0422	.0410	.0398	.0386	.0374
8	20	.250	.0520	.0508	.0496	.0484	.0472	.0460	.0447	.0435	.0423	.0411	.0399
8	30	.277	.0578	.0566	.0554	.0542	.0529	.0517	.0505	.0493	.0481	.0468	.0456
8	40 ST 40S	.322	.0675	.0663	.0651	.0638	.0626	.0614	.0601	.0589	.0577	.0564	.0552
8		.344	.0723	.0711	.0698	.0686	.0674	.0661	.0649	.0636	.0624	.0612	.0599
8		.352	.0741	.0728	.0716	.0703	.0691	.0678	.0666	.0654	.0641	.0629	.0617
8		.375	.0791	.0778	.0766	.0753	.0741	.0729	.0716	.0704	.0691	.0679	.0666

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
8	60	.406	.0859	.0847	.0834	.0821	.0809	.0796	.0784	.0771	.0759	.0746	.0734
8		.469	.0999	.0986	.0974	.0961	.0948	.0935	.0923	.0910	.0897	.0885	.0872
8	80 XS 80S	.500	.1069	.1056	.1043	.1030	.1017	.1005	.0992	.0979	.0966	.0954	.0941
8	100	.593	.1280	.1267	.1254	.1241	.1228	.1215	.1202	.1189	.1176	.1163	.1150
8		.625	.1354	.1341	.1328	.1314	.1301	.1288	.1275	.1262	.1249	.1236	.1223
8	120	.718	.1571	.1558	.1544	.1531	.1517	.1504	.1491	.1477	.1464	.1451	.1437
8	140	.812	.1795	.1782	.1768	.1754	.1741	.1727	.1713	.1699	.1686	.1672	.1659
8	XX	.875	.1948	.1934	.1920	.1907	.1893	.1879	.1865	.1851	.1837	.1823	.1810
8	160	.906	.2024	.2010	.1996	.1982	.1968	.1954	.1940	.1926	.1912	.1899	.1885
10	5S	.134	.0221	.0211	.0202	.0192	.0183	.0173	.0164	.0154	.0145	.0135	.0126
10	10S	.165	.0272	.0263	.0253	.0244	.0234	.0225	.0215	.0206	.0196	.0187	.0177
10		.188	.0311	.0301	.0292	.0282	.0273	.0263	.0253	.0244	.0234	.0225	.0215
10		.203	.0336	.0326	.0317	.0307	.0298	.0288	.0278	.0269	.0259	.0250	.0240
10		.219	.0363	.0353	.0344	.0334	.0324	.0315	.0305	.0296	.0286	.0277	.0267
10	20	.250	.0415	.0406	.0396	.0386	.0377	.0367	.0357	.0348	.0338	.0329	.0319
10		.279	.0465	.0455	.0445	.0436	.0426	.0416	.0406	.0397	.0387	.0377	.0368
10	30	.307	.0513	.0503	.0493	.0483	.0474	.0464	.0454	.0444	.0435	.0425	.0415
10		.348	.0583	.0573	.0563	.0554	.0544	.0534	.0524	.0514	.0505	.0495	.0485
10	40 ST 40S	.365	.0612	.0603	.0593	.0583	.0573	.0563	.0553	.0543	.0534	.0524	.0514
10		.395	.0664	.0654	.0645	.0635	.0625	.0615	.0605	.0595	.0585	.0575	.0566
10	60 XS 80S	.500	.0848	.0838	.0828	.0818	.0808	.0798	.0788	.0778	.0768	.0758	.0748
10		.531	.0903	.0893	.0883	.0873	.0863	.0853	.0843	.0833	.0822	.0812	.0802
10	80	.593	.1014	.1004	.0994	.0984	.0973	.0963	.0953	.0943	.0932	.0922	.0912
10	100	.718	.1241	.1231	.1220	.1210	.1199	.1189	.1179	.1168	.1158	.1147	.1137
10		.750	.1300	.1290	.1279	.1269	.1258	.1248	.1237	.1227	.1216	.1206	.1195
10	120	.843	.1473	.1463	.1452	.1441	.1431	.1420	.1409	.1399	.1388	.1377	.1367
10	140	1.000	.1772	.1761	.1750	.1739	.1728	.1717	.1706	.1695	.1684	.1673	.1662
10		1.062	.1892	.1881	.1870	.1859	.1848	.1837	.1826	.1815	.1804	.1793	.1782
10	160	1.125	.2016	.2005	.1993	.1982	.1971	.1960	.1949	.1937	.1926	.1915	.1904
12	5S	.156	.0216	.0208	.0200	.0192	.0184	.0176	.0168	.0160	.0153	.0145	.0137
12	10S	.180	.0250	.0242	.0234	.0226	.0218	.0210	.0202	.0194	.0186	.0178	.0170
12		.203	.0283	.0275	.0266	.0258	.0250	.0242	.0234	.0226	.0218	.0210	.0202
12		.219	.0305	.0297	.0289	.0281	.0273	.0265	.0257	.0249	.0241	.0233	.0225
12		.238	.0332	.0324	.0316	.0308	.0300	.0292	.0284	.0276	.0267	.0259	.0251
12	20	.250	.0349	.0341	.0333	.0325	.0317	.0309	.0301	.0292	.0284	.0276	.0268
12		.279	.0390	.0382	.0374	.0366	.0358	.0350	.0342	.0334	.0325	.0317	.0309

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0,5									
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
12		.300	.0420	.0412	.0404	.0396	.0388	.0380	.0371	.0363	.0355	.0347	.0339
12	30	.330	.0463	.0455	.0447	.0439	.0431	.0422	.0414	.0406	.0398	.0390	.0382
12		.344	.0484	.0475	.0467	.0459	.0451	.0443	.0434	.0426	.0418	.0410	.0402
12	ST 40S	.375	.0528	.0520	.0512	.0504	.0495	.0487	.0479	.0471	.0462	.0454	.0446
12	40	.406	.0573	.0565	.0557	.0548	.0540	.0532	.0524	.0515	.0507	.0499	.0491
12		.438	.0620	.0611	.0603	.0595	.0587	.0578	.0570	.0562	.0553	.0545	.0537
12	XS 80S	.500	.0711	.0702	.0694	.0685	.0677	.0669	.0660	.0652	.0644	.0635	.0627
12	60	.562	.0802	.0794	.0785	.0777	.0768	.0760	.0752	.0743	.0735	.0726	.0718
12		.625	.0896	.0888	.0879	.0871	.0862	.0854	.0845	.0837	.0828	.0820	.0811
12	80	.687	.0990	.0981	.0972	.0964	.0955	.0946	.0938	.0929	.0921	.0912	.0904
12	100	.843	.1228	.1219	.1210	.1202	.1193	.1184	.1175	.1166	.1158	.1149	.1140
12		.875	.1278	.1269	.1260	.1251	.1242	.1233	.1225	.1216	.1207	.1198	.1189
12	120	1.000	.1474	.1465	.1456	.1447	.1438	.1429	.1420	.1411	.1402	.1393	.1384
12	140	1.125	.1673	.1664	.1655	.1646	.1637	.1627	.1618	.1609	.1600	.1591	.1582
12		1.219	.1826	.1817	.1807	.1798	.1789	.1779	.1770	.1761	.1751	.1742	.1733
12	160	1.312	.1979	.1970	.1960	.1951	.1941	.1932	.1922	.1913	.1903	.1894	.1885
14		.188	.0238	.0230	.0223	.0216	.0209	.0201	.0194	.0187	.0179	.0172	.0165
14		.220	.0279	.0271	.0264	.0257	.0250	.0242	.0235	.0228	.0220	.0213	.0206
14		.238	.0302	.0295	.0287	.0280	.0273	.0265	.0258	.0251	.0243	.0236	.0229
14	10	.250	.0317	.0310	.0303	.0295	.0288	.0281	.0273	.0266	.0259	.0251	.0244
14	20	.312	.0398	.0390	.0383	.0375	.0368	.0361	.0353	.0346	.0338	.0331	.0324
14	30ST	.375	.0480	.0473	.0465	.0458	.0450	.0443	.0435	.0428	.0420	.0413	.0405
14		.406	.0521	.0513	.0506	.0498	.0491	.0483	.0476	.0468	.0461	.0453	.0446
14	40	.438	.0563	.0555	.0548	.0540	.0533	.0525	.0518	.0510	.0503	.0495	.0488
14		.469	.0604	.0596	.0589	.0581	.0574	.0566	.0559	.0551	.0543	.0536	.0528
14	XS	.500	.0645	.0638	.0630	.0622	.0615	.0607	.0600	.0592	.0584	.0577	.0569
14	60	.593	.0770	.0762	.0754	.0747	.0739	.0731	.0724	.0716	.0708	.0701	.0693
14		.625	.0813	.0805	.0798	.0790	.0782	.0774	.0767	.0759	.0751	.0744	.0736
14		.656	.0855	.0847	.0840	.0832	.0824	.0816	.0809	.0801	.0793	.0785	.0778
14	80	.750	.0984	.0976	.0968	.0960	.0952	.0944	.0937	.0929	.0921	.0913	.0905
14	100	.937	.1244	.1236	.1228	.1220	.1212	.1204	.1196	.1188	.1180	.1172	.1164
14	120	1.093	.1466	.1458	.1450	.1442	.1434	.1425	.1417	.1409	.1401	.1393	.1384
14	140	1.250	.1695	.1687	.1678	.1670	.1661	.1653	.1645	.1636	.1628	.1620	.1611
14		1.344	.1834	.1826	.1817	.1809	.1800	.1792	.1783	.1775	.1766	.1758	.1749
14	160	1.406	.1927	.1918	.1910	.1901	.1893	.1884	.1875	.1867	.1858	.1850	.1841
16		.188	.0208	.0201	.0195	.0189	.0182	.0176	.0170	.0163	.0157	.0150	.0144

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
16		.238	.0264	.0257	.0251	.0245	.0238	.0232	.0225	.0219	.0213	.0206	.0200
16	10	.250	.0277	.0271	.0264	.0258	.0252	.0245	.0239	.0232	.0226	.0220	.0213
16		.281	.0312	.0306	.0299	.0293	.0286	.0280	.0274	.0267	.0261	.0254	.0248
16	20	.312	.0347	.0341	.0334	.0328	.0321	.0315	.0308	.0302	.0296	.0289	.0283
16		.344	.0383	.0377	.0370	.0364	.0358	.0351	.0345	.0338	.0332	.0325	.0319
16	30 ST	.375	.0419	.0412	.0406	.0399	.0393	.0386	.0380	.0373	.0367	.0360	.0354
16		.406	.0454	.0448	.0441	.0435	.0428	.0422	.0415	.0408	.0402	.0395	.0389
16		.438	.0491	.0484	.0478	.0471	.0465	.0458	.0452	.0445	.0438	.0432	.0425
16		.469	.0526	.0520	.0513	.0507	.0500	.0494	.0487	.0480	.0474	.0467	.0461
16	40 XS	.500	.0562	.0556	.0549	.0542	.0536	.0529	.0523	.0516	.0510	.0503	.0496
16		.531	.0598	.0592	.0585	.0578	.0572	.0565	.0558	.0552	.0545	.0539	.0532
16	60	.656	.0744	.0737	.0731	.0724	.0717	.0711	.0704	.0697	.0691	.0684	.0677
16		.688	.0782	.0775	.0768	.0762	.0755	.0748	.0742	.0735	.0728	.0721	.0715
16		.750	.0855	.0849	.0842	.0835	.0828	.0821	.0815	.0808	.0801	.0794	.0788
16	80	.843	.0967	.0960	.0953	.0946	.0939	.0932	.0925	.0919	.0912	.0905	.0898
16	100	1.031	.1195	.1188	.1181	.1174	.1167	.1160	.1153	.1146	.1139	.1132	.1125
16	120	1.218	.1427	.1420	.1413	.1406	.1399	.1391	.1384	.1377	.1370	.1363	.1356
16	140	1.438	.1707	.1700	.1692	.1685	.1678	.1670	.1663	.1656	.1648	.1641	.1634
16		1.500	.1787	.1780	.1772	.1765	.1758	.1750	.1743	.1735	.1728	.1721	.1713
16	160	1.593	.1909	.1901	.1894	.1886	.1879	.1871	.1864	.1856	.1849	.1841	.1834
18	10	.250	.0246	.0240	.0235	.0229	.0223	.0218	.0212	.0206	.0201	.0195	.0189
18	20	.312	.0308	.0302	.0297	.0291	.0285	.0279	.0274	.0268	.0262	.0257	.0251
18	ST	.375	.0371	.0366	.0360	.0354	.0348	.0343	.0337	.0331	.0325	.0320	.0314
18	30	.438	.0435	.0429	.0424	.0418	.0412	.0406	.0400	.0395	.0389	.0383	.0377
18	XS	.500	.0498	.0492	.0487	.0481	.0475	.0469	.0463	.0457	.0452	.0446	.0440
18	40	.562	.0562	.0556	.0550	.0544	.0538	.0532	.0527	.0521	.0515	.0509	.0503
18		.594	.0595	.0589	.0583	.0577	.0571	.0565	.0559	.0554	.0548	.0542	.0536
18		.625	.0627	.0621	.0615	.0609	.0603	.0597	.0591	.0585	.0580	.0574	.0568
18		.719	.0724	.0718	.0712	.0706	.0701	.0695	.0689	.0683	.0677	.0671	.0665
18	60	.750	.0757	.0751	.0745	.0739	.0733	.0727	.0721	.0715	.0709	.0703	.0697
18		.812	.0822	.0816	.0810	.0804	.0798	.0792	.0786	.0780	.0774	.0768	.0762
18	80	.937	.0954	.0948	.0942	.0936	.0930	.0924	.0918	.0912	.0906	.0900	.0894
18	100	1.156	.1191	.1185	.1178	.1172	.1166	.1160	.1153	.1147	.1141	.1135	.1129
18	120	1.375	.1433	.1426	.1420	.1413	.1407	.1401	.1394	.1388	.1382	.1375	.1369
18	140	1.562	.1643	.1637	.1630	.1624	.1617	.1611	.1604	.1598	.1591	.1585	.1579
18		1.688	.1788	.1781	.1775	.1768	.1761	.1755	.1748	.1742	.1735	.1729	.1722

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
18	160	1.781	.1896	.1889	.1882	.1876	.1869	.1862	.1856	.1849	.1843	.1836	.1829
20	10	.250	.0221	.0216	.0211	.0206	.0201	.0196	.0191	.0185	.0180	.0175	.0170
20		.312	.0277	.0272	.0267	.0261	.0256	.0251	.0246	.0241	.0236	.0231	.0226
20	20 ST	.375	.0334	.0328	.0323	.0318	.0313	.0308	.0303	.0297	.0292	.0287	.0282
20		.438	.0391	.0386	.0380	.0375	.0370	.0365	.0360	.0354	.0349	.0344	.0339
20	30 XS	.500	.0447	.0442	.0437	.0432	.0426	.0421	.0416	.0411	.0406	.0400	.0395
20		.562	.0504	.0499	.0494	.0488	.0483	.0478	.0473	.0467	.0462	.0457	.0452
20	40	.593	.0533	.0527	.0522	.0517	.0512	.0506	.0501	.0496	.0491	.0485	.0480
20		.625	.0562	.0557	.0552	.0546	.0541	.0536	.0531	.0525	.0520	.0515	.0510
20	60	.812	.0737	.0731	.0726	.0721	.0715	.0710	.0704	.0699	.0694	.0688	.0683
20		.875	.0796	.0791	.0785	.0780	.0774	.0769	.0764	.0758	.0753	.0748	.0742
20		.906	.0825	.0820	.0815	.0809	.0804	.0798	.0793	.0788	.0782	.0777	.0771
20	80	1.031	.0945	.0939	.0934	.0928	.0923	.0917	.0912	.0906	.0901	.0896	.0890
20		1.250	.1157	.1151	.1146	.1140	.1135	.1129	.1124	.1118	.1112	.1107	.1101
20	100	1.281	.1187	.1182	.1176	.1171	.1165	.1159	.1154	.1148	.1143	.1137	.1131
20	120	1.500	.1405	.1399	.1393	.1388	.1382	.1376	.1370	.1365	.1359	.1353	.1348
20	140	1.750	.1658	.1652	.1646	.1641	.1635	.1629	.1623	.1617	.1611	.1606	.1600
20		1.844	.1755	.1749	.1743	.1737	.1731	.1726	.1720	.1714	.1708	.1702	.1696
20	160	1.968	.1884	.1878	.1872	.1866	.1860	.1854	.1848	.1842	.1836	.1830	.1825
22	LG	.250	.0201	.0196	.0192	.0187	.0182	.0178	.0173	.0168	.0164	.0159	.0155
22	ST	.375	.0303	.0298	.0293	.0289	.0284	.0279	.0275	.0270	.0265	.0261	.0256
22	XS	.500	.0406	.0401	.0396	.0392	.0387	.0382	.0377	.0373	.0368	.0363	.0359
24	10	.250	.0184	.0180	.0175	.0171	.0167	.0163	.0159	.0154	.0150	.0146	.0142
24		.312	.0230	.0226	.0222	.0217	.0213	.0209	.0205	.0200	.0196	.0192	.0188
24	20 ST	.375	.0277	.0273	.0269	.0264	.0260	.0256	.0252	.0247	.0243	.0239	.0234
24		.438	.0325	.0320	.0316	.0312	.0307	.0303	.0299	.0294	.0290	.0286	.0282
24	XS	.500	.0371	.0367	.0363	.0358	.0354	.0350	.0345	.0341	.0337	.0333	.0328
24	30	.562	.0418	.0414	.0410	.0405	.0401	.0397	.0392	.0388	.0384	.0379	.0375
24		.625	.0466	.0462	.0458	.0453	.0449	.0445	.0440	.0436	.0432	.0427	.0423
24	40	.687	.0514	.0509	.0505	.0501	.0496	.0492	.0488	.0483	.0479	.0474	.0470
24		.750	.0562	.0558	.0553	.0549	.0545	.0540	.0536	.0531	.0527	.0523	.0518
24	60	.968	.0732	.0727	.0723	.0718	.0714	.0709	.0705	.0700	.0696	.0691	.0687
24		1.031	.0781	.0777	.0772	.0768	.0763	.0759	.0754	.0750	.0745	.0741	.0736
24	80	1.218	.0929	.0925	.0920	.0916	.0911	.0907	.0902	.0898	.0893	.0888	.0884
24	100	1.531	.1182	.1178	.1173	.1168	.1164	.1159	.1154	.1150	.1145	.1140	.1136

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
24	120	1.812	.1415	.1410	.1405	.1400	.1396	.1391	.1386	.1381	.1377	.1372	.1367
24	140	2.062	.1626	.1621	.1616	.1611	.1606	.1601	.1597	.1592	.1587	.1582	.1577
24		2.188	.1734	.1729	.1724	.1719	.1714	.1709	.1704	.1699	.1694	.1690	.1685
24	160	2.343	.1868	.1863	.1858	.1853	.1848	.1843	.1838	.1833	.1828	.1823	.1818
26	ST	.375	.0256	.0252	.0248	.0244	.0240	.0236	.0232	.0228	.0224	.0220	.0216
26	XS	.500	.0342	.0338	.0334	.0330	.0326	.0322	.0318	.0314	.0311	.0307	.0303
30	10	.312	.0184	.0180	.0177	.0173	.0170	.0167	.0163	.0160	.0157	.0153	.0150
30	ST	.375	.0221	.0218	.0214	.0211	.0208	.0204	.0201	.0197	.0194	.0191	.0187
30		.438	.0259	.0255	.0252	.0249	.0245	.0242	.0238	.0235	.0231	.0228	.0225
30	20 XS	.500	.0296	.0293	.0289	.0286	.0282	.0279	.0275	.0272	.0269	.0265	.0262
30		.562	.0333	.0330	.0326	.0323	.0320	.0316	.0313	.0309	.0306	.0302	.0299
30	30	.625	.0371	.0368	.0364	.0361	.0358	.0354	.0351	.0347	.0344	.0340	.0337
34	ST	.375	.0195	.0192	.0189	.0186	.0183	.0180	.0177	.0174	.0171	.0168	.0165
34	XS	.500	.0261	.0258	.0255	.0252	.0249	.0246	.0243	.0240	.0237	.0234	.0231
36	ST	.375	.0184	.0181	.0178	.0175	.0173	.0170	.0167	.0164	.0161	.0159	.0156
36	XS	.500	.0246	.0243	.0240	.0238	.0235	.0232	.0229	.0226	.0223	.0220	.0218
42	ST	.375	.0157	.0155	.0153	.0150	.0148	.0145	.0143	.0141	.0138	.0136	.0133
42	XS	.500	.0211	.0208	.0206	.0203	.0201	.0198	.0196	.0194	.0191	.0189	.0186
48	ST	.375	.0138	.0136	.0133	.0131	.0129	.0127	.0125	.0123	.0121	.0119	.0117
48	XS	.500	.0184	.0182	.0180	.0178	.0175	.0173	.0171	.0169	.0167	.0165	.0163

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
1/8	10S	.049	0.0000									
1/8	40 ST 40S	.068	.0225									
1/8	80 ST 80S	.095	.1493	.1211	.0937	.0670	.0409	.0156				
1/4	10S	.065	.0070									
1/4	40 ST 40S	.088	.0849	.0650	.0455	.0263	.0074					
1/4	80 ST 80S	.119	.2002	.1780	.1562	.1349	.1140	.0935	.0734	.0537	.0344	.0154
3/8	10S	.065	.0056									
3/8	40 ST 40S	.091	.0757	.0599	.0443	.0289	.0138					
3/8	80 ST 80S	.126	.1783	.1609	.1437	.1268	.1102	.0938	.0777	.0619	.0462	.0308
1/2	10S	.083	.0429	.0305	.0183	.0063						
1/2	40 ST 40S	.109	.1010	.0879	.0750	.0623	.0497	.0373	.0250	.0129	.0009	
1/2	80 ST 80S	.147	.1921	.1779	.1639	.1501	.1364	.1229	.1096	.0964	.0834	.0706
1/2	160	.187	.2970	.2814	.2661	.2509	.2359	.2211	.2065	.1921	.1779	.1639
1/2	XX	.294	.6343	.6138	.5936	.5737	.5542	.5349	.5159	.4972	.4788	.4606
3/4	5S	.065	.0036									
3/4	10S	.083	.0341	.0243	.0146	.0050						
3/4	40S	.113	.0872	.0769	.0667	.0566	.0465	.0366	.0268	.0170	.0074	
3/4	80S	.154	.1644	.1533	.1423	.1314	.1207	.1100	.0995	.0890	.0787	.0685
3/4		.188	.2329	.2210	.2094	.1978	.1864	.1750	.1638	.1527	.1418	.1309
3/4	160	.218	.2970	.2845	.2721	.2599	.2478	.2358	.2240	.2123	.2007	.1892
3/4	XX	.308	.5135	.4985	.4837	.4691	.4547	.4404	.4263	.4124	.3986	.3850
1	5S	.065	.0029									
1	10S	.109	.0634	.0553	.0473	.0394	.0315	.0237	.0159	.0082	.0006	
1	40 ST 40S	.133	.0979	.0896	.0813	.0731	.0650	.0569	.0489	.0409	.0330	.0252
1	80 ST 80S	.179	.1675	.1586	.1498	.1410	.1324	.1238	.1152	.1067	.0983	.0900
1		.219	.2319	.2225	.2131	.2038	.1946	.1855	.1765	.1675	.1586	.1498
1	160	.250	.2845	.2746	.2648	.2551	.2455	.2359	.2265	.2171	.2078	.1985
1	XX0	.358	.4888	.4770	.4654	.4539	.4425	.4312	.4201	.4090	.3980	.3871
11/4	5S	.065	.0023									
11/4	10S	.109	.0499	.0435	.0373	.0310	.0249	.0187	.0126	.0065	.0005	
11/4	40 ST 40S	.140	.0848	.0782	.0718	.0653	.0589	.0526	.0462	.0399	.0337	.0275
11/4	80 ST 80S	.191	.1449	.1380	.1311	.1243	.1175	.1108	.1041	.0974	.0908	.0843
11/4	160	.250	.2189	.2115	.2041	.1969	.1896	.1824	.1753	.1682	.1611	.1541
11/4	XX	.382	.4045	.3958	.3872	.3786	.3702	.3617	.3534	.3450	.3368	.3286

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES									Y=0.5
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
11/2	5S	.065	.0020									
11/2	10S	.109	.0434	.0379	.0325	.0271	.0217	.0163	.0110	.0057	.0004	
11/2	40 ST 40S	.145	.0786	.0730	.0673	.0617	.0561	.0506	.0451	.0396	.0341	.0287
11/2	80 ST 80S	.200	.1348	.1289	.1229	.1170	.1111	.1053	.0994	.0937	.0879	.0822
11/2	160	.281	.2234	.2169	.2104	.2040	.1976	.1913	.1850	.1787	.1725	.1663
11/2	XX	.400	.3676	.3602	.3529	.3457	.3385	.3313	.3242	.3171	.3100	.3030
2	5S	.065	.0016									
2	10S	.109	.0346	.0302	.0259	.0216	.0173	.0130	.0088	.0045	.0003	
2	40 ST 40S	.154	.0695	.0650	.0605	.0561	.0516	.0472	.0428	.0384	.0340	.0297
2		.167	.0798	.0753	.0707	.0662	.0617	.0573	.0528	.0484	.0440	.0396
2		.188	.0967	.0921	.0875	.0829	.0783	.0738	.0693	.0648	.0603	.0558
2	80 ST 80S	.218	.1212	.1165	.1118	.1071	.1025	.0978	.0932	.0886	.0840	.0795
2		.250	.1481	.1433	.1384	.1336	.1289	.1241	.1194	.1146	.1099	.1053
2		.312	.2021	.1970	.1920	.1869	.1819	.1769	.1719	.1670	.1620	.1571
2	160	.343	.2302	.2250	.2198	.2146	.2094	.2043	.1992	.1941	.1891	.1840
2	XX	.436	.3188	.3131	.3075	.3019	.2964	.2908	.2853	.2798	.2744	.2689
21/2	5S	.083	.0123	.0088	.0053	.0018						
21/2	10S	.120	.0354	.0318	.0282	.0246	.0211	.0175	.0140	.0105	.0070	.0035
21/2	40 ST 40S	.203	.0891	.0853	.0815	.0778	.0740	.0703	.0666	.0629	.0592	.0555
21/2		.217	.0984	.0946	.0908	.0870	.0832	.0795	.0757	.0720	.0683	.0645
21/2	80 ST 80S	.276	.1387	.1348	.1308	.1269	.1229	.1190	.1151	.1113	.1074	.1035
21/2	160	.375	.2099	.2057	.2015	.1973	.1931	.1889	.1848	.1806	.1765	.1724
21/2	XX	.552	.3498	.3450	.3403	.3355	.3308	.3261	.3214	.3167	.3120	.3074
3	5S	.083	.0101	.0072	.0044	.0015						
3	10S	.120	.0290	.0260	.0231	.0202	.0173	.0144	.0115	.0086	.0057	.0029
3		.125	.0316	.0286	.0257	.0228	.0198	.0169	.0140	.0111	.0082	.0054
3		.148	.0435	.0405	.0375	.0346	.0316	.0287	.0258	.0228	.0199	.0170
3		.188	.0646	.0616	.0585	.0555	.0525	.0495	.0465	.0435	.0405	.0375
3	40 ST 40S	.216	.0796	.0765	.0735	.0704	.0673	.0643	.0612	.0582	.0552	.0522
3		.241	.0932	.0901	.0870	.0839	.0808	.0777	.0746	.0715	.0685	.0654
3		.254	.1004	.0972	.0941	.0910	.0878	.0847	.0816	.0785	.0755	.0724
3		.289	.1198	.1166	.1134	.1103	.1071	.1039	.1008	.0976	.0945	.0913
3	80 XS 80S	.300	.1260	.1228	.1196	.1164	.1132	.1100	.1068	.1037	.1005	.0974
3		.312	.1328	.1296	.1264	.1231	.1199	.1167	.1135	.1103	.1072	.1040
3		.406	.1877	.1843	.1809	.1775	.1741	.1707	.1674	.1640	.1607	.1573

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
3	160	.438	.2070	.2035	.2000	.1966	.1932	.1897	.1863	.1829	.1795	.1761
3	XX	.600	.3102	.3064	.3026	.2989	.2951	.2913	.2876	.2838	.2801	.2764
31/2	5S	.083	.0089	.0063	.0038	.0013						
31/2	10S	.120	.0253	.0228	.0202	.0177	.0151	.0126	.0101	.0075	.0050	.0025
31/2		.128	.0289	.0263	.0238	.0212	.0187	.0161	.0136	.0111	.0085	.0060
31/2		.134	.0316	.0290	.0265	.0239	.0214	.0188	.0163	.0137	.0112	.0087
31/2		.148	.0380	.0354	.0328	.0302	.0276	.0251	.0225	.0199	.0174	.0149
31/2		.188	.0563	.0537	.0510	.0484	.0458	.0432	.0406	.0380	.0354	.0328
31/2	40 ST 40S	.226	.0740	.0713	.0687	.0660	.0633	.0607	.0580	.0554	.0527	.0501
31/2		.281	.1002	.0975	.0947	.0920	.0893	.0865	.0838	.0811	.0784	.0757
31/2	80 XS 80S	.318	.1182	.1154	.1126	.1098	.1071	.1043	.1015	.0988	.0960	.0933
31/2		.344	.1311	.1282	.1254	.1226	.1198	.1170	.1142	.1114	.1086	.1058
31/2		.469	.1950	.1920	.1890	.1860	.1830	.1801	.1771	.1741	.1712	.1682
31/2		.636	.2867	.2834	.2802	.2769	.2737	.2705	.2673	.2640	.2608	.2577
4	5S	.083	.0079	.0056	.0034	.0012						
4	10S	.120	.0225	.0202	.0179	.0157	.0134	.0112	.0089	.0067	.0045	.0022
4		.128	.0257	.0234	.0211	.0188	.0166	.0143	.0121	.0098	.0076	.0053
4		.134	.0281	.0258	.0235	.0212	.0190	.0167	.0144	.0122	.0099	.0077
4		.142	.0313	.0290	.0267	.0244	.0221	.0199	.0176	.0153	.0131	.0108
4		.165	.0405	.0382	.0359	.0336	.0313	.0290	.0267	.0245	.0222	.0199
4		.188	.0499	.0475	.0452	.0429	.0406	.0383	.0360	.0337	.0314	.0291
4		.205	.0568	.0545	.0522	.0498	.0475	.0452	.0428	.0405	.0382	.0359
4	40 ST40S	.237	.0701	.0677	.0653	.0630	.0606	.0583	.0559	.0536	.0512	.0489
4		.250	.0755	.0731	.0708	.0684	.0660	.0636	.0613	.0589	.0566	.0542
4		.271	.0844	.0819	.0795	.0771	.0747	.0724	.0700	.0676	.0652	.0629
4		.281	.0886	.0862	.0838	.0813	.0789	.0765	.0742	.0718	.0694	.0670
4		.300	.0967	.0942	.0918	.0894	.0870	.0845	.0821	.0797	.0773	.0749
4		.312	.1018	.0994	.0969	.0945	.0921	.0896	.0872	.0848	.0824	.0800
4	80 XS 80S	.337	.1126	.1101	.1077	.1052	.1027	.1003	.0978	.0954	.0930	.0905
4		.375	.1292	.1267	.1242	.1217	.1192	.1167	.1142	.1117	.1093	.1068
4	120	.438	.1574	.1548	.1522	.1496	.1471	.1445	.1420	.1394	.1369	.1343
4		.500	.1858	.1831	.1805	.1779	.1752	.1726	.1700	.1674	.1648	.1622
4	160	.531	.2003	.1976	.1949	.1922	.1896	.1869	.1843	.1816	.1790	.1763
4	XX	.674	.2697	.2669	.2640	.2612	.2583	.2555	.2527	.2499	.2471	.2442
5	5S	.109	.0146	.0128	.0110	.0092	.0074	.0055	.0037	.0019	.0001	
5	10S	.134	.0226	.0208	.0190	.0171	.0153	.0135	.0117	.0098	.0080	.0062

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
5	40 ST 40S	.258	.0633	.0614	.0595	.0576	.0557	.0538	.0519	.0500	.0481	.0463
5		.352	.0953	.0933	.0914	.0894	.0874	.0855	.0835	.0816	.0796	.0777
5	80 XS 80S	.375	.1033	.1013	.0993	.0973	.0953	.0934	.0914	.0894	.0875	.0855
5		.438	.1254	.1234	.1214	.1193	.1173	.1153	.1133	.1113	.1093	.1073
5	120	.500	.1477	.1456	.1435	.1415	.1394	.1374	.1353	.1333	.1312	.1292
5	160	.625	.1940	.1918	.1897	.1875	.1854	.1832	.1811	.1790	.1768	.1747
5	XX	.750	.2424	.2401	.2378	.2356	.2334	.2311	.2289	.2266	.2244	.2222
6	5S	.109	.0123	.0107	.0092	.0077	.0062	.0047	.0031	.0016	.0001	
6	10S	.134	.0190	.0174	.0159	.0144	.0128	.0113	.0098	.0083	.0067	.0052
6		.169	.0284	.0269	.0253	.0238	.0222	.0207	.0192	.0176	.0161	.0146
6		.180	.0314	.0299	.0283	.0268	.0252	.0237	.0221	.0206	.0190	.0175
6		.188	.0336	.0321	.0305	.0289	.0274	.0258	.0243	.0227	.0212	.0197
6		.219	.0421	.0405	.0390	.0374	.0358	.0343	.0327	.0312	.0296	.0280
6		.250	.0507	.0491	.0475	.0459	.0444	.0428	.0412	.0396	.0381	.0365
6		.277	.0582	.0566	.0550	.0534	.0518	.0503	.0487	.0471	.0455	.0439
6	40 ST 40S	.280	.0591	.0575	.0559	.0543	.0527	.0511	.0495	.0479	.0463	.0448
6		.375	.0860	.0844	.0827	.0811	.0795	.0778	.0762	.0746	.0729	.0713
6	80 XS 80S	.432	.1025	.1008	.0992	.0975	.0959	.0942	.0925	.0909	.0892	.0876
6		.500	.1225	.1208	.1192	.1175	.1158	.1141	.1124	.1107	.1090	.1074
6	120	.562	.1412	.1394	.1377	.1360	.1343	.1325	.1308	.1291	.1274	.1257
6	160	.718	.1894	.1876	.1858	.1840	.1822	.1804	.1786	.1769	.1751	.1733
6	XX	.864	.2367	.2348	.2329	.2310	.2291	.2273	.2254	.2235	.2217	.2198
8	5S	.109	.0094	.0082	.0071	.0059	.0047	.0036	.0024	.0012	.0001	
8	10S	.148	.0174	.0162	.0151	.0139	.0127	.0115	.0104	.0092	.0080	.0069
8		.158	.0195	.0183	.0171	.0160	.0148	.0136	.0124	.0113	.0101	.0089
8		.165	.0209	.0198	.0186	.0174	.0162	.0150	.0139	.0127	.0115	.0103
8		.188	.0257	.0245	.0233	.0222	.0210	.0198	.0186	.0174	.0162	.0151
8		.203	.0288	.0277	.0265	.0253	.0241	.0229	.0217	.0205	.0193	.0182
8		.219	.0322	.0310	.0298	.0286	.0274	.0262	.0250	.0238	.0227	.0215
8		.238	.0362	.0350	.0338	.0326	.0314	.0302	.0290	.0278	.0266	.0254
8	20	.250	.0387	.0375	.0363	.0351	.0339	.0327	.0315	.0303	.0291	.0279
8	30	.277	.0444	.0432	.0420	.0408	.0396	.0384	.0372	.0360	.0348	.0336
8	40 ST 40S	.322	.0540	.0528	.0516	.0503	.0491	.0479	.0467	.0455	.0443	.0431
8		.344	.0587	.0575	.0563	.0550	.0538	.0526	.0514	.0502	.0489	.0477
8		.352	.0604	.0592	.0580	.0568	.0555	.0543	.0531	.0519	.0506	.0494
8		.375	.0654	.0642	.0629	.0617	.0605	.0592	.0580	.0568	.0556	.0543

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
8	60	.406	.0721	.0709	.0696	.0684	.0672	.0659	.0647	.0635	.0622	.0610
8		.469	.0859	.0847	.0834	.0822	.0809	.0797	.0784	.0772	.0759	.0747
8	80 XS 80S	.500	.0928	.0915	.0903	.0890	.0877	.0865	.0852	.0840	.0827	.0814
8	100	.593	.1137	.1124	.1111	.1098	.1085	.1072	.1059	.1047	.1034	.1021
8		.625	.1210	.1197	.1184	.1171	.1158	.1145	.1132	.1119	.1106	.1093
8	120	.718	.1424	.1411	.1397	.1384	.1371	.1358	.1344	.1331	.1318	.1305
8	140	.812	.1645	.1631	.1618	.1604	.1591	.1577	.1564	.1550	.1537	.1523
8	XX	.875	.1796	.1782	.1768	.1755	.1741	.1727	.1713	.1700	.1686	.1673
8	160	.906	.1871	.1857	.1843	.1829	.1815	.1802	.1788	.1774	.1760	.1747
10	5S	.134	.0116	.0107	.0098	.0088	.0079	.0070	.0060	.0051	.0041	.0032
10	10S	.165	.0168	.0158	.0149	.0139	.0130	.0120	.0111	.0102	.0092	.0083
10		.188	.0206	.0196	.0187	.0177	.0168	.0158	.0149	.0140	.0130	.0121
10		.203	.0231	.0221	.0212	.0202	.0193	.0183	.0174	.0164	.0155	.0145
10		.219	.0257	.0248	.0238	.0229	.0219	.0210	.0200	.0191	.0181	.0172
10	20	.250	.0309	.0300	.0290	.0281	.0271	.0262	.0252	.0242	.0233	.0223
10		.279	.0358	.0349	.0339	.0329	.0320	.0310	.0300	.0291	.0281	.0272
10	30	.307	.0405	.0396	.0386	.0376	.0367	.0357	.0348	.0338	.0328	.0319
10		.348	.0475	.0465	.0456	.0446	.0436	.0427	.0417	.0407	.0398	.0388
10	40 ST 40S	.365	.0504	.0494	.0485	.0475	.0465	.0455	.0446	.0436	.0426	.0417
10		.395	.0556	.0546	.0536	.0526	.0516	.0507	.0497	.0487	.0477	.0468
10	60 XS 80S	.500	.0738	.0728	.0718	.0708	.0698	.0688	.0678	.0668	.0658	.0648
10		.531	.0792	.0782	.0772	.0762	.0752	.0742	.0732	.0722	.0712	.0702
10	80	.593	.0902	.0892	.0882	.0872	.0861	.0851	.0841	.0831	.0821	.0811
10	100	.718	.1127	.1116	.1106	.1095	.1085	.1075	.1064	.1054	.1044	.1034
10		.750	.1185	.1174	.1164	.1154	.1143	.1133	.1122	.1112	.1102	.1091
10	120	.843	.1356	.1346	.1335	.1324	.1314	.1303	.1293	.1282	.1272	.1261
10	140	1.000	.1652	.1641	.1630	.1619	.1608	.1597	.1586	.1576	.1565	.1554
10		1.062	.1770	.1759	.1748	.1737	.1726	.1716	.1705	.1694	.1683	.1672
10	160	1.125	.1893	.1882	.1870	.1859	.1848	.1837	.1826	.1815	.1804	.1793
12	5S	.156	.0129	.0121	.0113	.0105	.0097	.0089	.0081	.0073	.0065	.0057
12	10S	.180	.0162	.0154	.0146	.0138	.0130	.0122	.0114	.0106	.0099	.0091
12		.203	.0194	.0186	.0178	.0170	.0162	.0154	.0146	.0138	.0130	.0123
12		.219	.0217	.0209	.0201	.0193	.0185	.0177	.0169	.0161	.0153	.0145
12		.238	.0243	.0235	.0227	.0219	.0211	.0203	.0195	.0187	.0179	.0171
12	20	.250	.0260	.0252	.0244	.0236	.0228	.0220	.0212	.0204	.0196	.0188
12		.279	.0301	.0293	.0285	.0277	.0269	.0261	.0253	.0245	.0237	.0229

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
12		.300	.0331	.0323	.0315	.0307	.0299	.0290	.0282	.0274	.0266	.0258
12	30	.330	.0374	.0365	.0357	.0349	.0341	.0333	.0325	.0317	.0309	.0301
12		.344	.0393	.0385	.0377	.0369	.0361	.0353	.0345	.0337	.0328	.0320
12	ST 40S	.375	.0438	.0430	.0421	.0413	.0405	.0397	.0389	.0381	.0372	.0364
12	40	.406	.0482	.0474	.0466	.0458	.0449	.0441	.0433	.0425	.0417	.0409
12		.438	.0529	.0520	.0512	.0504	.0496	.0487	.0479	.0471	.0463	.0454
12	XS 80S	.500	.0619	.0610	.0602	.0594	.0585	.0577	.0569	.0560	.0552	.0544
12	60	.562	.0709	.0701	.0693	.0684	.0676	.0667	.0659	.0651	.0642	.0634
12		.625	.0803	.0794	.0786	.0777	.0769	.0760	.0752	.0743	.0735	.0726
12	80	.687	.0895	.0886	.0878	.0869	.0861	.0852	.0844	.0835	.0827	.0818
12	100	.843	.1131	.1123	.1114	.1105	.1096	.1088	.1079	.1070	.1062	.1053
12		.875	.1181	.1172	.1163	.1154	.1145	.1137	.1128	.1119	.1110	.1102
12	120	1.000	.1375	.1366	.1357	.1348	.1339	.1330	.1321	.1312	.1303	.1294
12	140	1.125	.1572	.1563	.1554	.1545	.1536	.1527	.1518	.1509	.1500	.1491
12		1.219	.1724	.1714	.1705	.1696	.1687	.1677	.1668	.1659	.1650	.1641
12	160	1.312	.1875	.1866	.1857	.1847	.1838	.1828	.1819	.1810	.1800	.1791
14		.188	.0158	.0150	.0143	.0136	.0129	.0121	.0114	.0107	.0100	.0093
14		.220	.0198	.0191	.0184	.0177	.0169	.0162	.0155	.0148	.0140	.0133
14		.238	.0221	.0214	.0207	.0199	.0192	.0185	.0178	.0170	.0163	.0156
14	10	.250	.0237	.0229	.0222	.0215	.0207	.0200	.0193	.0186	.0178	.0171
14	20	.312	.0316	.0309	.0302	.0294	.0287	.0280	.0272	.0265	.0258	.0250
14	30ST	.375	.0398	.0391	.0383	.0376	.0368	.0361	.0353	.0346	.0339	.0331
14		.406	.0438	.0431	.0423	.0416	.0409	.0401	.0394	.0386	.0379	.0371
14	40	.438	.0480	.0473	.0465	.0458	.0450	.0443	.0435	.0428	.0420	.0413
14		.469	.0521	.0513	.0506	.0498	.0491	.0483	.0476	.0468	.0461	.0453
14	XS	.500	.0562	.0554	.0547	.0539	.0532	.0524	.0517	.0509	.0502	.0494
14	60	.593	.0685	.0678	.0670	.0662	.0655	.0647	.0640	.0632	.0624	.0617
14		.625	.0728	.0721	.0713	.0705	.0698	.0690	.0682	.0675	.0667	.0659
14		.656	.0770	.0762	.0755	.0747	.0739	.0732	.0724	.0716	.0709	.0701
14	80	.750	.0897	.0890	.0882	.0874	.0866	.0859	.0851	.0843	.0835	.0828
14	100	.937	.1156	.1148	.1140	.1132	.1124	.1116	.1108	.1100	.1092	.1084
14	120	1.093	.1376	.1368	.1360	.1352	.1344	.1336	.1327	.1319	.1311	.1303
14	140	1.250	.1603	.1595	.1586	.1578	.1570	.1561	.1553	.1545	.1536	.1528
14		1.344	.1741	.1732	.1724	.1716	.1707	.1699	.1690	.1682	.1674	.1665
14	160	1.406	.1833	.1824	.1816	.1807	.1799	.1790	.1782	.1773	.1765	.1756
16		.188	.0138	.0131	.0125	.0119	.0113	.0106	.0100	.0094	.0087	.0081

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
16		.238	.0193	.0187	.0181	.0174	.0168	.0162	.0155	.0149	.0143	.0136
16	10	.250	.0207	.0200	.0194	.0188	.0181	.0175	.0169	.0162	.0156	.0150
16		.281	.0241	.0235	.0229	.0222	.0216	.0210	.0203	.0197	.0190	.0184
16	20	.312	.0276	.0270	.0263	.0257	.0251	.0244	.0238	.0231	.0225	.0219
16		.344	.0312	.0306	.0299	.0293	.0287	.0280	.0274	.0267	.0261	.0254
16	30 ST	.375	.0347	.0341	.0334	.0328	.0321	.0315	.0309	.0302	.0296	.0289
16		.406	.0382	.0376	.0370	.0363	.0357	.0350	.0344	.0337	.0331	.0324
16		.438	.0419	.0412	.0406	.0399	.0393	.0386	.0380	.0373	.0367	.0360
16		.469	.0454	.0448	.0441	.0435	.0428	.0422	.0415	.0409	.0402	.0396
16	40 XS	.500	.0490	.0483	.0477	.0470	.0464	.0457	.0451	.0444	.0437	.0431
16		.531	.0525	.0519	.0512	.0506	.0499	.0493	.0486	.0480	.0473	.0466
16	60	.656	.0670	.0664	.0657	.0650	.0644	.0637	.0631	.0624	.0617	.0611
16		.688	.0708	.0701	.0695	.0688	.0681	.0675	.0668	.0661	.0654	.0648
16		.750	.0781	.0774	.0767	.0761	.0754	.0747	.0741	.0734	.0727	.0720
16	80	.843	.0891	.0884	.0878	.0871	.0864	.0857	.0850	.0844	.0837	.0830
16	100	1.031	.1118	.1111	.1104	.1097	.1090	.1083	.1076	.1069	.1063	.1056
16	120	1.218	.1349	.1342	.1334	.1327	.1320	.1313	.1306	.1299	.1292	.1285
16	140	1.438	.1626	.1619	.1612	.1604	.1597	.1590	.1583	.1575	.1568	.1561
16		1.500	.1706	.1699	.1691	.1684	.1677	.1669	.1662	.1655	.1647	.1640
16	160	1.593	.1826	.1819	.1812	.1804	.1797	.1789	.1782	.1774	.1767	.1760
18	10	.250	.0184	.0178	.0172	.0167	.0161	.0155	.0150	.0144	.0138	.0133
18	20	.312	.0245	.0240	.0234	.0228	.0222	.0217	.0211	.0205	.0200	.0194
18	ST	.375	.0308	.0302	.0297	.0291	.0285	.0280	.0274	.0268	.0262	.0257
18	30	.438	.0371	.0366	.0360	.0354	.0348	.0343	.0337	.0331	.0325	.0320
18	XS	.500	.0434	.0428	.0423	.0417	.0411	.0405	.0399	.0394	.0388	.0382
18	40	.562	.0497	.0492	.0486	.0480	.0474	.0468	.0462	.0457	.0451	.0445
18		.594	.0530	.0524	.0518	.0513	.0507	.0501	.0495	.0489	.0483	.0478
18		.625	.0562	.0556	.0550	.0544	.0538	.0533	.0527	.0521	.0515	.0509
18		.719	.0659	.0653	.0647	.0641	.0635	.0629	.0623	.0618	.0612	.0606
18	60	.750	.0691	.0685	.0679	.0673	.0667	.0661	.0656	.0650	.0644	.0638
18		.812	.0756	.0750	.0744	.0738	.0732	.0726	.0720	.0714	.0708	.0702
18	80	.937	.0888	.0882	.0875	.0869	.0863	.0857	.0851	.0845	.0839	.0833
18	100	1.156	.1122	.1116	.1110	.1104	.1098	.1091	.1085	.1079	.1073	.1067
18	120	1.375	.1363	.1356	.1350	.1344	.1337	.1331	.1325	.1318	.1312	.1306
18	140	1.562	.1572	.1566	.1559	.1553	.1546	.1540	.1533	.1527	.1520	.1514
18		1.688	.1716	.1709	.1702	.1696	.1689	.1683	.1676	.1670	.1663	.1657

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
18	160	1.781	.1823	.1816	.1809	.1803	.1796	.1790	.1783	.1776	.1770	.1763
20	10	.250	.0165	.0160	.0155	.0150	.0145	.0140	.0135	.0130	.0125	.0119
20		.312	.0220	.0215	.0210	.0205	.0200	.0195	.0190	.0185	.0180	.0175
20	20 ST	.375	.0277	.0272	.0267	.0261	.0256	.0251	.0246	.0241	.0236	.0231
20		.438	.0334	.0329	.0323	.0318	.0313	.0308	.0303	.0298	.0292	.0287
20	30 XS	.500	.0390	.0385	.0380	.0374	.0369	.0364	.0359	.0354	.0348	.0343
20		.562	.0447	.0441	.0436	.0431	.0426	.0420	.0415	.0410	.0405	.0400
20	40	.593	.0475	.0470	.0464	.0459	.0454	.0449	.0443	.0438	.0433	.0428
20		.625	.0504	.0499	.0494	.0489	.0483	.0478	.0473	.0468	.0462	.0457
20	60	.812	.0678	.0672	.0667	.0662	.0656	.0651	.0646	.0640	.0635	.0630
20		.875	.0737	.0731	.0726	.0721	.0715	.0710	.0705	.0699	.0694	.0689
20		.906	.0766	.0761	.0755	.0750	.0744	.0739	.0734	.0728	.0723	.0718
20	80	1.031	.0885	.0879	.0874	.0868	.0863	.0857	.0852	.0846	.0841	.0836
20		1.250	.1096	.1090	.1085	.1079	.1073	.1068	.1062	.1057	.1051	.1046
20	100	1.281	.1126	.1120	.1115	.1109	.1104	.1098	.1092	.1087	.1081	.1076
20	120	1.500	.1342	.1336	.1330	.1325	.1319	.1313	.1308	.1302	.1296	.1291
20	140	1.750	.1594	.1588	.1582	.1576	.1571	.1565	.1559	.1553	.1547	.1542
20		1.844	.1690	.1684	.1678	.1673	.1667	.1661	.1655	.1649	.1643	.1637
20	160	1.968	.1819	.1813	.1807	.1801	.1795	.1789	.1783	.1777	.1771	.1765
22	LG	.250	.0150	.0145	.0141	.0136	.0132	.0127	.0122	.0118	.0113	.0109
22	ST	.375	.0251	.0247	.0242	.0237	.0233	.0228	.0223	.0219	.0214	.0210
22	XS	.500	.0354	.0349	.0344	.0340	.0335	.0330	.0326	.0321	.0316	.0312
24	10	.250	.0137	.0133	.0129	.0125	.0121	.0116	.0112	.0108	.0104	.0099
24		.312	.0183	.0179	.0175	.0171	.0166	.0162	.0158	.0154	.0149	.0145
24	20 ST	.375	.0230	.0226	.0222	.0217	.0213	.0209	.0205	.0200	.0196	.0192
24		.438	.0277	.0273	.0269	.0264	.0260	.0256	.0252	.0247	.0243	.0239
24	XS	.500	.0324	.0320	.0315	.0311	.0307	.0302	.0298	.0294	.0290	.0285
24	30	.562	.0371	.0366	.0362	.0358	.0353	.0349	.0345	.0340	.0336	.0332
24		.625	.0418	.0414	.0410	.0405	.0401	.0397	.0392	.0388	.0384	.0379
24	40	.687	.0466	.0461	.0457	.0453	.0448	.0444	.0440	.0435	.0431	.0427
24		.750	.0514	.0510	.0505	.0501	.0496	.0492	.0488	.0483	.0479	.0475
24	60	.968	.0683	.0678	.0674	.0669	.0665	.0660	.0656	.0651	.0647	.0642
24		1.031	.0732	.0727	.0723	.0718	.0714	.0709	.0705	.0700	.0696	.0692
24	80	1.218	.0879	.0875	.0870	.0866	.0861	.0857	.0852	.0848	.0843	.0839
24	100	1.531	.1131	.1126	.1122	.1117	.1112	.1108	.1103	.1099	.1094	.1089

Table 7-3
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.5									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
24	120	1.812	.1362	.1358	.1353	.1348	.1343	.1339	.1334	.1329	.1324	.1320
24	140	2.062	.1572	.1567	.1563	.1558	.1553	.1548	.1543	.1538	.1534	.1529
24		2.188	.1680	.1675	.1670	.1665	.1660	.1655	.1650	.1646	.1641	.1636
24	160	2.343	.1813	.1808	.1803	.1798	.1794	.1789	.1784	.1779	.1774	.1769
26	ST	.375	.0212	.0208	.0204	.0201	.0197	.0193	.0189	.0185	.0181	.0177
26	XS	.500	.0299	.0295	.0291	.0287	.0283	.0279	.0275	.0271	.0267	.0263
30	10	.312	.0146	.0143	.0140	.0136	.0133	.0129	.0126	.0123	.0119	.0116
30	ST	.375	.0184	.0180	.0177	.0174	.0170	.0167	.0163	.0160	.0157	.0153
30		.438	.0221	.0218	.0214	.0211	.0208	.0204	.0201	.0197	.0194	.0191
30	20 XS	.500	.0258	.0255	.0251	.0248	.0245	.0241	.0238	.0234	.0231	.0228
30		.562	.0295	.0292	.0289	.0285	.0282	.0278	.0275	.0271	.0268	.0265
30	30	.625	.0333	.0330	.0326	.0323	.0320	.0316	.0313	.0309	.0306	.0302
34	ST	.375	.0162	.0159	.0156	.0153	.0150	.0147	.0144	.0141	.0138	.0135
34	XS	.500	.0228	.0225	.0222	.0219	.0216	.0213	.0210	.0207	.0204	.0201
36	ST	.375	.0153	.0150	.0147	.0144	.0142	.0139	.0136	.0133	.0130	.0128
36	XS	.500	.0215	.0212	.0209	.0206	.0203	.0201	.0198	.0195	.0192	.0189
42	ST	.375	.0131	.0128	.0126	.0124	.0121	.0119	.0116	.0114	.0112	.0109
42	XS	.500	.0184	.0181	.0179	.0177	.0174	.0172	.0169	.0167	.0164	.0162
48	ST	.375	.0114	.0112	.0110	.0108	.0106	.0104	.0102	.0100	.0098	.0096
48	XS	.500	.0161	.0159	.0156	.0154	.0152	.0150	.0148	.0146	.0144	.0142

Table 7-4
Pressure/Stress Ratios Where Y = 0.7

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
1/8	10S	.049	.2486	.2152	.1832	.1523	.1227	.0941	.0665	.0400	.0143		
1/8	40 ST 40S	.068	.3699	.3316	.2949	.2597	.2259	.1934	.1622	.1322	.1033	.0754	.0485
1/8	80 ST 80S	.095	.5760	.5285	.4833	.4400	.3987	.3592	.3214	.2851	.2503	.2169	.1847
1/4	10S	.065	.2471	.2220	.1976	.1740	.1510	.1287	.1070	.0859	.0654	.0454	.0259
1/4	40 ST 40S	.088	.3563	.3279	.3003	.2736	.2477	.2226	.1982	.1746	.1516	.1292	.1075
1/4	80 ST 80S	.119	.5283	.4941	.4611	.4293	.3985	.3687	.3398	.3119	.2849	.2586	.2332
3/8	10S	.065	.1911	.1722	.1538	.1359	.1183	.1011	.0843	.0679	.0518	.0361	.0207
3/8	40 ST 40S	.091	.2826	.2616	.2411	.2211	.2016	.1825	.1639	.1457	.1279	.1105	.0935
3/8	80 ST 80S	.126	.4235	.3989	.3750	.3517	.3290	.3068	.2853	.2642	.2436	.2236	.2040
1/2	10S	.083	.1967	.1815	.1665	.1518	.1373	.1232	.1092	.0956	.0821	.0689	.0560
1/2	40 ST 40S	.109	.2700	.2533	.2370	.2210	.2052	.1898	.1747	.1598	.1453	.1309	.1169
1/2	80 ST 80S	.147	.3898	.3707	.3520	.3337	.3158	.2982	.2810	.2641	.2476	.2314	.2154
1/2	160	.187	.5357	.5134	.4917	.4704	.4496	.4292	.4093	.3898	.3707	.3520	.3337
1/2	XX	.294	1.0722	1.0363	1.0013	.9674	.9343	.9022	.8709	.8405	.8109	.7820	.7538
3/4	5S	.065	.1172	.1062	.0952	.0845	.0739	.0634	.0531	.0429	.0329	.0230	.0132
3/4	10S	.083	.1532	.1416	.1302	.1189	.1078	.0969	.0861	.0755	.0650	.0546	.0444
3/4	40S	.113	.2169	.2044	.1920	.1799	.1679	.1561	.1445	.1330	.1217	.1106	.0996
3/4	80S	.154	.3129	.2988	.2850	.2714	.2581	.2449	.2319	.2191	.2066	.1942	.1820
3/4		.188	.4014	.3859	.3706	.3557	.3409	.3264	.3122	.2981	.2843	.2708	.2574
3/4	160	.218	.4873	.4703	.4536	.4372	.4211	.4053	.3897	.3744	.3594	.3446	.3300
3/4	XX	.308	.8012	.7783	.7558	.7337	.7121	.6910	.6702	.6499	.6299	.6103	.5911
1	5S	.065	.0921	.0835	.0750	.0667	.0584	.0502	.0421	.0341	.0261	.0183	.0105
1	10S	.109	.1615	.1521	.1428	.1337	.1246	.1157	.1069	.0981	.0895	.0810	.0725
1	40 ST 40S	.133	.2020	.1922	.1824	.1728	.1633	.1539	.1447	.1355	.1264	.1175	.1086
1	80 ST 80S	.179	.2859	.2750	.2643	.2536	.2432	.2328	.2226	.2125	.2025	.1927	.1829
1		.219	.3661	.3542	.3425	.3308	.3194	.3081	.2969	.2859	.2750	.2643	.2536
1	160	.250	.4337	.4209	.4082	.3957	.3834	.3713	.3593	.3474	.3358	.3242	.3129
1	XXO	.358	.7148	.6978	.6811	.6647	.6485	.6325	.6168	.6013	.5861	.5711	.5563
1 1/4	5S	.065	.0720	.0654	.0588	.0523	.0459	.0395	.0331	.0269	.0206	.0145	.0083
1 1/4	10S	.109	.1250	.1179	.1108	.1039	.0970	.0901	.0834	.0766	.0700	.0634	.0568
1 1/4	40 ST 40S	.140	.1646	.1571	.1498	.1424	.1352	.1280	.1209	.1138	.1068	.0999	.0930
1 1/4	80 ST 80S	.191	.2344	.2263	.2182	.2103	.2024	.1946	.1868	.1791	.1716	.1640	.1566
1 1/4	160	.250	.3232	.3142	.3052	.2964	.2877	.2790	.2705	.2620	.2536	.2453	.2371
1 1/4	XX	.382	.5608	.5492	.5377	.5264	.5151	.5041	.4931	.4823	.4715	.4609	.4505

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7									
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
1 1/2	5S	.065	.0625	.0568	.0511	.0455	.0399	.0344	.0289	.0234	.0180	.0126	.0073
1 1/2	10S	.109	.1080	.1019	.0959	.0899	.0840	.0781	.0723	.0665	.0608	.0551	.0494
1 1/2	40 ST 40S	.145	.1473	.1409	.1346	.1283	.1221	.1159	.1098	.1037	.0977	.0917	.0858
1 1/2	80 ST 80S	.200	.2115	.2046	.1977	.1909	.1842	.1775	.1709	.1643	.1578	.1513	.1449
1 1/2	160	.281	.3161	.3083	.3005	.2928	.2852	.2777	.2702	.2628	.2555	.2482	.2410
1 1/2	XX	.400	.4965	.4869	.4775	.4682	.4590	.4498	.4408	.4318	.4229	.4141	.4054
2	5S	.065	.0496	.0451	.0406	.0362	.0317	.0274	.0230	.0187	.0144	.0101	.0058
2	10S	.109	.0851	.0804	.0757	.0711	.0664	.0618	.0573	.0527	.0482	.0437	.0393
2	40 ST 40S	.154	.1233	.1183	.1134	.1085	.1036	.0988	.0940	.0892	.0845	.0798	.0751
2		.167	.1347	.1295	.1246	.1197	.1147	.1098	.1050	.1001	.0953	.0906	.0858
2		.188	.1534	.1483	.1431	.1381	.1330	.1280	.1230	.1181	.1131	.1083	.1034
2	80 ST 80S	.218	.1810	.1757	.1704	.1651	.1599	.1547	.1495	.1444	.1393	.1343	.1292
2		.250	.2115	.2059	.2005	.1950	.1896	.1842	.1788	.1735	.1683	.1630	.1578
2		.312	.2740	.2680	.2621	.2562	.2504	.2446	.2388	.2331	.2275	.2218	.2162
2	160	.343	.3071	.3009	.2947	.2886	.2826	.2765	.2706	.2646	.2587	.2529	.2471
2	XX	.436	.4145	.4075	.4006	.3937	.3869	.3801	.3734	.3667	.3601	.3535	.3470
2 1/2	5S	.083	.0524	.0486	.0449	.0412	.0376	.0339	.0303	.0267	.0231	.0195	.0159
2 1/2	10S	.120	.0770	.0731	.0693	.0655	.0617	.0579	.0542	.0504	.0467	.0430	.0393
2 1/2	40 ST 40S	.203	.1353	.1311	.1270	.1229	.1188	.1147	.1106	.1066	.1026	.0986	.0947
2 1/2		.217	.1455	.1413	.1371	.1330	.1288	.1247	.1206	.1165	.1125	.1084	.1044
2 1/2	80 ST 80S	.276	.1904	.1859	.1815	.1771	.1727	.1684	.1640	.1597	.1554	.1512	.1469
2 1/2	160	.375	.2717	.2668	.2619	.2570	.2522	.2474	.2426	.2379	.2331	.2285	.2238
2 1/2	XX	.552	.4393	.4334	.4275	.4217	.4158	.4101	.4043	.3986	.3929	.3873	.3817
3	5S	.083	.0427	.0397	.0367	.0337	.0307	.0277	.0248	.0218	.0189	.0160	.0130
3	10S	.120	.0626	.0595	.0564	.0533	.0503	.0472	.0442	.0412	.0381	.0351	.0321
3		.125	.0654	.0622	.0591	.0560	.0530	.0499	.0468	.0438	.0408	.0378	.0348
3		.148	.0780	.0749	.0717	.0686	.0654	.0623	.0592	.0561	.0530	.0500	.0469
3		.188	.1006	.0974	.0941	.0909	.0876	.0844	.0812	.0780	.0749	.0717	.0686
3	40 ST 40S	.216	.1168	.1135	.1102	.1069	.1036	.1003	.0970	.0938	.0905	.0873	.0841
3		.241	.1316	.1282	.1248	.1214	.1181	.1147	.1114	.1081	.1048	.1015	.0983
3		.254	.1394	.1360	.1325	.1291	.1257	.1224	.1190	.1157	.1123	.1090	.1057
3		.289	.1608	.1572	.1537	.1502	.1467	.1433	.1398	.1364	.1330	.1296	.1262
3	80 XS 80S	.300	.1676	.1640	.1605	.1570	.1535	.1500	.1465	.1430	.1396	.1361	.1327
3		.312	.1751	.1715	.1680	.1644	.1608	.1573	.1538	.1503	.1468	.1434	.1399
3		.406	.2366	.2328	.2289	.2251	.2212	.2174	.2137	.2099	.2061	.2024	.1987

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
3	160	.438	.2587	.2547	.2507	.2468	.2429	.2390	.2351	.2312	.2274	.2235	.2197
3	XX	.600	.3797	.3752	.3706	.3661	.3616	.3571	.3527	.3483	.3438	.3395	.3351
31/2	5S	.083	.0373	.0346	.0320	.0294	.0268	.0242	.0216	.0191	.0165	.0139	.0114
31/2	10S	.120	.0545	.0518	.0491	.0465	.0438	.0412	.0385	.0359	.0333	.0306	.0280
31/2		.128	.0583	.0556	.0529	.0502	.0475	.0449	.0422	.0396	.0369	.0343	.0317
31/2		.134	.0611	.0584	.0557	.0530	.0503	.0477	.0450	.0423	.0397	.0371	.0344
31/2		.148	.0678	.0651	.0624	.0596	.0569	.0542	.0515	.0489	.0462	.0435	.0409
31/2		.188	.0873	.0845	.0817	.0789	.0761	.0733	.0706	.0678	.0651	.0624	.0596
31/2	40 ST 40S	.226	.1062	.1033	.1005	.0976	.0948	.0919	.0891	.0863	.0835	.0807	.0779
31/2		.281	.1345	.1315	.1286	.1256	.1226	.1197	.1168	.1138	.1109	.1080	.1051
31/2	80 XS 80S	.318	.1541	.1511	.1480	.1450	.1420	.1389	.1359	.1329	.1300	.1270	.1240
31/2		.344	.1682	.1651	.1620	.1589	.1558	.1528	.1497	.1467	.1436	.1406	.1376
31/2		.469	.2396	.2362	.2328	.2294	.2261	.2227	.2194	.2161	.2128	.2095	.2062
31/2		.636	.3456	.3417	.3379	.3341	.3303	.3265	.3227	.3190	.3152	.3115	.3078
4	5S	.083	.0330	.0307	.0284	.0261	.0238	.0215	.0192	.0169	.0146	.0124	.0101
4	10S	.120	.0482	.0459	.0435	.0412	.0388	.0365	.0341	.0318	.0295	.0272	.0249
4		.128	.0516	.0492	.0468	.0445	.0421	.0397	.0374	.0351	.0327	.0304	.0281
4		.134	.0541	.0517	.0493	.0469	.0446	.0422	.0399	.0375	.0352	.0328	.0305
4		.142	.0574	.0550	.0526	.0503	.0479	.0455	.0432	.0408	.0385	.0361	.0338
4		.165	.0672	.0648	.0623	.0599	.0575	.0551	.0527	.0503	.0479	.0456	.0432
4		.188	.0771	.0746	.0721	.0697	.0672	.0648	.0624	.0600	.0576	.0552	.0528
4		.205	.0844	.0819	.0795	.0770	.0745	.0721	.0696	.0672	.0648	.0623	.0599
4	40 ST40S	.237	.0985	.0960	.0935	.0909	.0884	.0859	.0834	.0810	.0785	.0760	.0735
4		.250	.1043	.1018	.0992	.0967	.0942	.0916	.0891	.0866	.0841	.0816	.0792
4		.271	.1138	.1112	.1086	.1061	.1035	.1009	.0984	.0959	.0933	.0908	.0883
4		.281	.1183	.1157	.1131	.1106	.1080	.1054	.1029	.1003	.0978	.0952	.0927
4		.300	.1270	.1244	.1218	.1192	.1166	.1140	.1114	.1088	.1062	.1037	.1011
4		.312	.1326	.1299	.1273	.1247	.1221	.1194	.1168	.1142	.1116	.1091	.1065
4	80 XS 80S	.337	.1443	.1416	.1389	.1363	.1336	.1309	.1283	.1257	.1230	.1204	.1178
4		.375	.1624	.1597	.1569	.1542	.1515	.1488	.1460	.1434	.1407	.1380	.1353
4	120	.438	.1934	.1905	.1877	.1848	.1820	.1792	.1764	.1736	.1708	.1680	.1652
4		.500	.2251	.2221	.2191	.2162	.2133	.2103	.2074	.2045	.2016	.1987	.1958
4	160	.531	.2414	.2384	.2353	.2323	.2293	.2263	.2234	.2204	.2174	.2145	.2116
4	XX	.674	.3210	.3177	.3144	.3111	.3078	.3045	.3012	.2980	.2947	.2915	.2883
5	5S	.109	.0351	.0332	.0314	.0295	.0276	.0258	.0239	.0220	.0202	.0183	.0165
5	10S	.134	.0434	.0415	.0396	.0377	.0358	.0340	.0321	.0302	.0283	.0265	.0246

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
5	40 ST 40S	.258	.0860	.0840	.0820	.0800	.0780	.0760	.0740	.0720	.0701	.0681	.0661
5		.352	.1200	.1179	.1158	.1137	.1116	.1095	.1075	.1054	.1033	.1013	.0992
5	80 XS 80S	.375	.1286	.1265	.1243	.1222	.1201	.1180	.1159	.1138	.1117	.1096	.1075
5		.438	.1525	.1503	.1481	.1459	.1437	.1416	.1394	.1372	.1351	.1329	.1308
5	120	.500	.1767	.1745	.1722	.1700	.1677	.1655	.1632	.1610	.1588	.1566	.1544
5	160	.625	.2280	.2256	.2232	.2208	.2184	.2160	.2136	.2112	.2089	.2065	.2042
5	XX	.750	.2826	.2800	.2775	.2749	.2724	.2698	.2673	.2647	.2622	.2597	.2572
6	5S	.109	.0294	.0278	.0262	.0247	.0231	.0216	.0200	.0185	.0169	.0154	.0138
6	10S	.134	.0363	.0347	.0331	.0315	.0300	.0284	.0268	.0253	.0237	.0221	.0206
6		.169	.0461	.0445	.0429	.0413	.0397	.0381	.0365	.0349	.0333	.0317	.0302
6		.180	.0492	.0476	.0460	.0444	.0428	.0412	.0396	.0380	.0364	.0348	.0332
6		.188	.0514	.0498	.0482	.0466	.0450	.0434	.0418	.0402	.0386	.0370	.0354
6		.219	.0603	.0587	.0570	.0554	.0538	.0521	.0505	.0489	.0473	.0457	.0441
6		.250	.0692	.0676	.0659	.0643	.0626	.0610	.0593	.0577	.0561	.0545	.0528
6		.277	.0771	.0754	.0738	.0721	.0704	.0688	.0671	.0655	.0638	.0622	.0605
6	40 ST 40S	.280	.0780	.0763	.0747	.0730	.0713	.0697	.0680	.0663	.0647	.0630	.0614
6		.375	.1064	.1047	.1030	.1012	.0995	.0978	.0961	.0943	.0926	.0909	.0892
6	80 XS 80S	.432	.1240	.1222	.1205	.1187	.1169	.1152	.1134	.1116	.1099	.1081	.1064
6		.500	.1455	.1437	.1419	.1401	.1382	.1364	.1346	.1328	.1310	.1292	.1274
6	120	.562	.1657	.1638	.1619	.1600	.1582	.1563	.1545	.1526	.1508	.1489	.1471
6	160	.718	.2187	.2167	.2147	.2127	.2107	.2087	.2067	.2048	.2028	.2008	.1989
6	XX	.864	.2716	.2695	.2674	.2652	.2631	.2610	.2589	.2568	.2547	.2526	.2505
8	5S	.109	.0225	.0213	.0201	.0189	.0177	.0165	.0153	.0141	.0130	.0118	.0106
8	10S	.148	.0307	.0295	.0283	.0271	.0259	.0247	.0235	.0223	.0211	.0199	.0187
8		.158	.0328	.0316	.0304	.0292	.0280	.0268	.0256	.0244	.0232	.0220	.0208
8		.165	.0343	.0331	.0319	.0306	.0294	.0282	.0270	.0258	.0246	.0234	.0222
8		.188	.0392	.0380	.0367	.0355	.0343	.0331	.0319	.0307	.0295	.0283	.0271
8		.203	.0424	.0412	.0400	.0387	.0375	.0363	.0351	.0339	.0326	.0314	.0302
8		.219	.0459	.0446	.0434	.0422	.0409	.0397	.0385	.0373	.0360	.0348	.0336
8		.238	.0500	.0487	.0475	.0463	.0450	.0438	.0426	.0413	.0401	.0389	.0377
8	20	.250	.0526	.0513	.0501	.0489	.0476	.0464	.0452	.0439	.0427	.0415	.0402
8	30	.277	.0585	.0572	.0560	.0547	.0535	.0522	.0510	.0498	.0485	.0473	.0460
8	40 ST 40S	.322	.0685	.0672	.0659	.0647	.0634	.0621	.0609	.0596	.0583	.0571	.0558
8		.344	.0734	.0721	.0708	.0695	.0683	.0670	.0657	.0645	.0632	.0619	.0607
8		.352	.0752	.0739	.0726	.0713	.0701	.0688	.0675	.0662	.0650	.0637	.0624
8		.375	.0804	.0791	.0778	.0765	.0752	.0739	.0726	.0714	.0701	.0688	.0675

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
8	60	.406	.0874	.0861	.0848	.0835	.0822	.0809	.0796	.0783	.0770	.0758	.0745
8		.469	.1020	.1006	.0993	.0980	.0966	.0953	.0940	.0927	.0914	.0901	.0888
8	80 XS 80S	.500	.1092	.1079	.1065	.1052	.1038	.1025	.1012	.0999	.0985	.0972	.0959
8	100	.593	.1314	.1300	.1286	.1272	.1259	.1245	.1231	.1218	.1204	.1190	.1177
8		.625	.1392	.1378	.1364	.1350	.1336	.1322	.1308	.1295	.1281	.1267	.1253
8	120	.718	.1622	.1608	.1594	.1579	.1565	.1551	.1536	.1522	.1508	.1494	.1480
8	140	.812	.1862	.1848	.1833	.1818	.1803	.1789	.1774	.1759	.1745	.1730	.1716
8	XX	.875	.2027	.2012	.1997	.1982	.1967	.1952	.1937	.1922	.1907	.1892	.1878
8	160	.906	.2110	.2094	.2079	.2064	.2049	.2034	.2019	.2004	.1988	.1973	.1958
10	5S	.134	.0222	.0212	.0202	.0193	.0183	.0174	.0164	.0155	.0145	.0136	.0126
10	10S	.165	.0274	.0264	.0254	.0245	.0235	.0226	.0216	.0206	.0197	.0187	.0178
10		.188	.0313	.0303	.0293	.0284	.0274	.0264	.0255	.0245	.0235	.0226	.0216
10		.203	.0338	.0329	.0319	.0309	.0299	.0290	.0280	.0270	.0261	.0251	.0241
10		.219	.0366	.0356	.0346	.0336	.0327	.0317	.0307	.0297	.0288	.0278	.0268
10	20	.250	.0419	.0409	.0399	.0389	.0380	.0370	.0360	.0350	.0340	.0331	.0321
10		.279	.0469	.0459	.0449	.0439	.0430	.0420	.0410	.0400	.0390	.0380	.0371
10	30	.307	.0518	.0508	.0498	.0488	.0478	.0468	.0458	.0448	.0438	.0429	.0419
10		.348	.0590	.0580	.0570	.0560	.0550	.0540	.0530	.0520	.0510	.0500	.0490
10	40 ST 40S	.365	.0620	.0610	.0600	.0590	.0580	.0570	.0559	.0549	.0539	.0529	.0519
10		.395	.0673	.0663	.0653	.0643	.0633	.0623	.0612	.0602	.0592	.0582	.0572
10	60 XS 80S	.500	.0863	.0853	.0842	.0832	.0821	.0811	.0801	.0790	.0780	.0770	.0759
10		.531	.0920	.0910	.0899	.0889	.0878	.0868	.0857	.0847	.0836	.0826	.0815
10	80	.593	.1035	.1025	.1014	.1003	.0993	.0982	.0971	.0961	.0950	.0940	.0929
10	100	.718	.1273	.1262	.1251	.1240	.1229	.1218	.1207	.1196	.1185	.1174	.1163
10		.750	.1335	.1324	.1313	.1302	.1291	.1280	.1269	.1258	.1247	.1236	.1225
10	120	.843	.1518	.1507	.1495	.1484	.1473	.1461	.1450	.1439	.1428	.1416	.1405
10	140	1.000	.1837	.1825	.1814	.1802	.1790	.1778	.1766	.1755	.1743	.1731	.1720
10		1.062	.1967	.1955	.1943	.1931	.1919	.1907	.1895	.1883	.1871	.1859	.1847
10	160	1.125	.2101	.2088	.2076	.2064	.2052	.2040	.2028	.2015	.2003	.1991	.1979
12	5S	.156	.0217	.0209	.0201	.0193	.0185	.0177	.0169	.0161	.0153	.0145	.0137
12	10S	.180	.0251	.0243	.0235	.0227	.0219	.0211	.0203	.0195	.0187	.0179	.0171
12		.203	.0284	.0276	.0268	.0260	.0252	.0243	.0235	.0227	.0219	.0211	.0203
12		.219	.0307	.0299	.0291	.0283	.0274	.0266	.0258	.0250	.0242	.0234	.0226
12		.238	.0334	.0326	.0318	.0310	.0302	.0293	.0285	.0277	.0269	.0261	.0253
12	20	.250	.0352	.0343	.0335	.0327	.0319	.0311	.0302	.0294	.0286	.0278	.0270
12		.279	.0393	.0385	.0377	.0369	.0360	.0352	.0344	.0336	.0328	.0319	.0311

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
12		.300	.0424	.0416	.0407	.0399	.0391	.0383	.0374	.0366	.0358	.0350	.0341
12	30	.330	.0468	.0459	.0451	.0443	.0434	.0426	.0418	.0409	.0401	.0393	.0385
12		.344	.0488	.0480	.0472	.0463	.0455	.0446	.0438	.0430	.0421	.0413	.0405
12	ST 40S	.375	.0534	.0526	.0517	.0509	.0500	.0492	.0483	.0475	.0467	.0458	.0450
12	40	.406	.0580	.0571	.0563	.0554	.0546	.0538	.0529	.0521	.0512	.0504	.0495
12		.438	.0628	.0619	.0611	.0602	.0593	.0585	.0576	.0568	.0560	.0551	.0543
12	XS 80S	.500	.0721	.0712	.0704	.0695	.0686	.0678	.0669	.0661	.0652	.0643	.0635
12	60	.562	.0815	.0807	.0798	.0789	.0780	.0772	.0763	.0754	.0746	.0737	.0728
12		.625	.0913	.0904	.0895	.0886	.0877	.0868	.0860	.0851	.0842	.0833	.0824
12	80	.687	.1010	.1001	.0992	.0983	.0974	.0965	.0956	.0947	.0938	.0929	.0920
12	100	.843	.1259	.1250	.1240	.1231	.1222	.1213	.1204	.1194	.1185	.1176	.1167
12		.875	.1311	.1302	.1293	.1283	.1274	.1265	.1255	.1246	.1237	.1228	.1218
12	120	1.000	.1518	.1509	.1499	.1490	.1480	.1471	.1461	.1452	.1442	.1433	.1423
12	140	1.125	.1731	.1721	.1712	.1702	.1692	.1682	.1672	.1663	.1653	.1643	.1633
12		1.219	.1895	.1885	.1875	.1865	.1855	.1845	.1835	.1825	.1815	.1805	.1795
12	160	1.312	.2061	.2050	.2040	.2030	.2020	.2009	.1999	.1989	.1979	.1969	.1958
14		.188	.0239	.0232	.0224	.0217	.0209	.0202	.0195	.0187	.0180	.0173	.0165
14		.220	.0280	.0273	.0266	.0258	.0251	.0243	.0236	.0229	.0221	.0214	.0207
14		.238	.0304	.0296	.0289	.0282	.0274	.0267	.0259	.0252	.0244	.0237	.0230
14	10	.250	.0319	.0312	.0305	.0297	.0290	.0282	.0275	.0267	.0260	.0253	.0245
14	20	.312	.0401	.0393	.0386	.0378	.0371	.0363	.0356	.0348	.0341	.0333	.0326
14	30ST	.375	.0485	.0477	.0469	.0462	.0454	.0447	.0439	.0431	.0424	.0416	.0409
14		.406	.0526	.0519	.0511	.0503	.0496	.0488	.0480	.0473	.0465	.0457	.0450
14	40	.438	.0569	.0562	.0554	.0546	.0538	.0531	.0523	.0515	.0508	.0500	.0492
14		.469	.0611	.0604	.0596	.0588	.0580	.0573	.0565	.0557	.0549	.0542	.0534
14	XS	.500	.0654	.0646	.0638	.0630	.0622	.0615	.0607	.0599	.0591	.0584	.0576
14	60	.593	.0782	.0774	.0766	.0758	.0750	.0742	.0734	.0726	.0719	.0711	.0703
14		.625	.0826	.0818	.0810	.0803	.0795	.0787	.0779	.0771	.0763	.0755	.0747
14		.656	.0870	.0862	.0854	.0846	.0838	.0830	.0822	.0814	.0806	.0798	.0790
14	80	.750	.1003	.0995	.0987	.0979	.0971	.0963	.0954	.0946	.0938	.0930	.0922
14	100	.937	.1276	.1267	.1259	.1250	.1242	.1234	.1225	.1217	.1208	.1200	.1192
14	120	1.093	.1511	.1502	.1493	.1485	.1476	.1467	.1459	.1450	.1441	.1433	.1424
14	140	1.250	.1754	.1745	.1736	.1727	.1718	.1709	.1701	.1692	.1683	.1674	.1665
14		1.344	.1904	.1895	.1886	.1876	.1867	.1858	.1849	.1840	.1831	.1822	.1813
14	160	1.406	.2004	.1995	.1985	.1976	.1967	.1958	.1949	.1939	.1930	.1921	.1912
16		.188	.0209	.0202	.0196	.0189	.0183	.0177	.0170	.0164	.0157	.0151	.0145

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
16		.238	.0265	.0259	.0252	.0246	.0239	.0233	.0226	.0220	.0213	.0207	.0201
16	10	.250	.0279	.0272	.0266	.0259	.0253	.0246	.0240	.0233	.0227	.0221	.0214
16		.281	.0314	.0308	.0301	.0295	.0288	.0282	.0275	.0269	.0262	.0256	.0249
16	20	.312	.0350	.0343	.0336	.0330	.0323	.0317	.0310	.0304	.0297	.0291	.0284
16		.344	.0386	.0380	.0373	.0367	.0360	.0354	.0347	.0340	.0334	.0327	.0321
16	30 ST	.375	.0422	.0416	.0409	.0402	.0396	.0389	.0383	.0376	.0369	.0363	.0356
16		.406	.0458	.0452	.0445	.0438	.0432	.0425	.0418	.0412	.0405	.0399	.0392
16		.438	.0496	.0489	.0482	.0476	.0469	.0462	.0456	.0449	.0442	.0436	.0429
16		.469	.0532	.0525	.0519	.0512	.0505	.0499	.0492	.0485	.0478	.0472	.0465
16	40 XS	.500	.0569	.0562	.0555	.0548	.0542	.0535	.0528	.0521	.0515	.0508	.0501
16		.531	.0605	.0599	.0592	.0585	.0578	.0572	.0565	.0558	.0551	.0545	.0538
16	60	.656	.0755	.0749	.0742	.0735	.0728	.0721	.0714	.0707	.0700	.0693	.0686
16		.688	.0794	.0787	.0780	.0773	.0767	.0760	.0753	.0746	.0739	.0732	.0725
16		.750	.0870	.0863	.0856	.0849	.0842	.0835	.0828	.0821	.0814	.0807	.0800
16	80	.843	.0986	.0979	.0971	.0964	.0957	.0950	.0943	.0936	.0929	.0922	.0915
16	100	1.031	.1224	.1217	.1210	.1202	.1195	.1188	.1180	.1173	.1166	.1158	.1151
16	120	1.218	.1469	.1462	.1454	.1446	.1439	.1431	.1424	.1416	.1409	.1401	.1394
16	140	1.438	.1767	.1760	.1752	.1744	.1736	.1728	.1720	.1712	.1705	.1697	.1689
16		1.500	.1853	.1846	.1838	.1830	.1822	.1814	.1806	.1798	.1790	.1782	.1774
16	160	1.593	.1984	.1976	.1968	.1960	.1952	.1944	.1936	.1928	.1920	.1912	.1904
18	10	.250	.0247	.0242	.0236	.0230	.0224	.0219	.0213	.0207	.0201	.0196	.0190
18	20	.312	.0310	.0304	.0298	.0293	.0287	.0281	.0275	.0269	.0264	.0258	.0252
18	ST	.375	.0374	.0368	.0362	.0357	.0351	.0345	.0339	.0333	.0327	.0322	.0316
18	30	.438	.0439	.0433	.0427	.0421	.0415	.0409	.0404	.0398	.0392	.0386	.0380
18	XS	.500	.0503	.0497	.0491	.0485	.0479	.0474	.0468	.0462	.0456	.0450	.0444
18	40	.562	.0568	.0562	.0556	.0550	.0544	.0538	.0532	.0526	.0520	.0514	.0508
18		.594	.0602	.0596	.0590	.0584	.0578	.0572	.0566	.0560	.0554	.0548	.0542
18		.625	.0635	.0629	.0623	.0616	.0610	.0604	.0598	.0592	.0586	.0580	.0574
18		.719	.0735	.0729	.0723	.0717	.0710	.0704	.0698	.0692	.0686	.0680	.0674
18	60	.750	.0768	.0762	.0756	.0750	.0744	.0738	.0731	.0725	.0719	.0713	.0707
18		.812	.0836	.0829	.0823	.0817	.0811	.0805	.0798	.0792	.0786	.0780	.0774
18	80	.937	.0973	.0967	.0960	.0954	.0948	.0941	.0935	.0929	.0922	.0916	.0910
18	100	1.156	.1220	.1213	.1207	.1200	.1194	.1187	.1181	.1174	.1168	.1161	.1155
18	120	1.375	.1475	.1468	.1461	.1455	.1448	.1441	.1434	.1428	.1421	.1414	.1407
18	140	1.562	.1699	.1692	.1685	.1678	.1671	.1665	.1658	.1651	.1644	.1637	.1630
18		1.688	.1854	.1847	.1840	.1833	.1826	.1819	.1812	.1805	.1798	.1791	.1784

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
18	160	1.781	.1970	.1963	.1956	.1949	.1942	.1934	.1927	.1920	.1913	.1906	.1899
20	10	.250	.0222	.0217	.0212	.0207	.0202	.0196	.0191	.0186	.0181	.0176	.0171
20		.312	.0278	.0273	.0268	.0263	.0258	.0252	.0247	.0242	.0237	.0232	.0227
20	20 ST	.375	.0336	.0331	.0325	.0320	.0315	.0310	.0304	.0299	.0294	.0289	.0284
20		.438	.0394	.0389	.0383	.0378	.0373	.0367	.0362	.0357	.0352	.0346	.0341
20	30 XS	.500	.0451	.0446	.0441	.0435	.0430	.0425	.0419	.0414	.0409	.0404	.0398
20		.562	.0509	.0504	.0499	.0493	.0488	.0483	.0477	.0472	.0467	.0461	.0456
20	40	.593	.0538	.0533	.0528	.0522	.0517	.0512	.0506	.0501	.0495	.0490	.0485
20		.625	.0569	.0563	.0558	.0552	.0547	.0542	.0536	.0531	.0526	.0520	.0515
20	60	.812	.0748	.0742	.0737	.0731	.0726	.0720	.0715	.0709	.0704	.0698	.0693
20		.875	.0809	.0803	.0798	.0792	.0787	.0781	.0776	.0770	.0764	.0759	.0753
20		.906	.0839	.0834	.0828	.0823	.0817	.0811	.0806	.0800	.0795	.0789	.0783
20	80	1.031	.0963	.0957	.0952	.0946	.0940	.0935	.0929	.0923	.0917	.0912	.0906
20		1.250	.1184	.1179	.1173	.1167	.1161	.1155	.1149	.1143	.1138	.1132	.1126
20	100	1.281	.1216	.1210	.1205	.1199	.1193	.1187	.1181	.1175	.1169	.1163	.1158
20	120	1.500	.1445	.1439	.1433	.1427	.1421	.1415	.1409	.1403	.1397	.1391	.1385
20	140	1.750	.1715	.1709	.1703	.1696	.1690	.1684	.1678	.1671	.1665	.1659	.1653
20		1.844	.1819	.1813	.1806	.1800	.1794	.1787	.1781	.1775	.1768	.1762	.1756
20	160	1.968	.1958	.1952	.1945	.1939	.1932	.1926	.1919	.1913	.1906	.1900	.1894
22	LG	.250	.0202	.0197	.0192	.0188	.0183	.0178	.0174	.0169	.0164	.0160	.0155
22	ST	.375	.0305	.0300	.0295	.0290	.0286	.0281	.0276	.0272	.0267	.0262	.0257
22	XS	.500	.0409	.0404	.0400	.0395	.0390	.0385	.0380	.0376	.0371	.0366	.0361
24	10	.250	.0185	.0180	.0176	.0172	.0168	.0163	.0159	.0155	.0151	.0146	.0142
24		.312	.0231	.0227	.0223	.0218	.0214	.0210	.0205	.0201	.0197	.0193	.0188
24	20 ST	.375	.0279	.0274	.0270	.0266	.0261	.0257	.0253	.0249	.0244	.0240	.0236
24		.438	.0327	.0322	.0318	.0314	.0309	.0305	.0301	.0296	.0292	.0288	.0283
24	XS	.500	.0374	.0370	.0365	.0361	.0357	.0352	.0348	.0343	.0339	.0335	.0330
24	30	.562	.0422	.0417	.0413	.0409	.0404	.0400	.0395	.0391	.0387	.0382	.0378
24		.625	.0471	.0466	.0462	.0457	.0453	.0449	.0444	.0440	.0435	.0431	.0426
24	40	.687	.0519	.0515	.0510	.0506	.0501	.0497	.0492	.0488	.0483	.0479	.0475
24		.750	.0569	.0564	.0560	.0555	.0551	.0546	.0542	.0537	.0533	.0528	.0524
24	60	.968	.0743	.0738	.0733	.0729	.0724	.0720	.0715	.0710	.0706	.0701	.0697
24		1.031	.0794	.0789	.0784	.0780	.0775	.0770	.0766	.0761	.0756	.0752	.0747
24	80	1.218	.0947	.0942	.0938	.0933	.0928	.0923	.0919	.0914	.0909	.0904	.0900
24	100	1.531	.1211	.1206	.1201	.1196	.1191	.1187	.1182	.1177	.1172	.1167	.1162

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7										
			0.000	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050
24	120	1.812	.1456	.1451	.1446	.1441	.1436	.1431	.1426	.1421	.1416	.1411	.1405
24	140	2.062	.1680	.1675	.1670	.1665	.1660	.1654	.1649	.1644	.1639	.1634	.1629
24		2.188	.1796	.1791	.1785	.1780	.1775	.1770	.1764	.1759	.1754	.1749	.1743
24	160	2.343	.1941	.1935	.1930	.1924	.1919	.1914	.1908	.1903	.1898	.1892	.1887
26	ST	.375	.0257	.0253	.0249	.0245	.0241	.0237	.0233	.0229	.0225	.0221	.0217
26	XS	.500	.0345	.0341	.0337	.0333	.0329	.0325	.0320	.0316	.0312	.0308	.0304
30	10	.312	.0184	.0181	.0178	.0174	.0171	.0167	.0164	.0160	.0157	.0154	.0150
30	ST	.375	.0222	.0219	.0215	.0212	.0208	.0205	.0202	.0198	.0195	.0191	.0188
30		.438	.0260	.0257	.0253	.0250	.0246	.0243	.0239	.0236	.0233	.0229	.0226
30	20 XS	.500	.0298	.0294	.0291	.0287	.0284	.0280	.0277	.0273	.0270	.0267	.0263
30		.562	.0336	.0332	.0329	.0325	.0322	.0318	.0315	.0311	.0308	.0304	.0301
30	30	.625	.0374	.0371	.0367	.0364	.0360	.0357	.0353	.0350	.0346	.0343	.0339
34	ST	.375	.0196	.0193	.0190	.0187	.0184	.0181	.0178	.0175	.0172	.0169	.0165
34	XS	.500	.0262	.0259	.0256	.0253	.0250	.0247	.0244	.0241	.0238	.0235	.0232
36	ST	.375	.0185	.0182	.0179	.0176	.0173	.0170	.0168	.0165	.0162	.0159	.0156
36	XS	.500	.0247	.0244	.0242	.0239	.0236	.0233	.0230	.0227	.0224	.0221	.0219
42	ST	.375	.0158	.0156	.0153	.0151	.0148	.0146	.0143	.0141	.0139	.0136	.0134
42	XS	.500	.0211	.0209	.0207	.0204	.0202	.0199	.0197	.0194	.0192	.0189	.0187
48	ST	.375	.0138	.0136	.0134	.0132	.0130	.0127	.0125	.0123	.0121	.0119	.0117
48	XS	.500	.0185	.0183	.0180	.0178	.0176	.0174	.0172	.0170	.0168	.0165	.0163

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
1/8	10S	.049	0.0000									
1/8	40 ST 40S	.068	.0226									
1/8	80 ST 80S	.095	.1538	.1241	.0955	.0679	.0413	.0156				
1/4	10S	.065	.0070									
1/4	40 ST 40S	.088	.0864	.0659	.0459	.0264	.0074					
1/4	80 ST 80S	.119	.2085	.1845	.1613	.1387	.1167	.0953	.0745	.0543	.0346	.0154
3/8	10S	.065	.0056									
3/8	40 ST 40S	.091	.0769	.0606	.0447	.0291	.0138					
3/8	80 ST 80S	.126	.1849	.1662	.1480	.1301	.1127	.0956	.0789	.0626	.0467	.0310
1/2	10S	.083	.0432	.0307	.0184	.0063						
1/2	40 ST 40S	.109	.1031	.0895	.0762	.0631	.0502	.0376	.0251	.0129	.0009	
1/2	80 ST 80S	.147	.1998	.1845	.1695	.1547	.1402	.1260	.1120	.0983	.0848	.0716
1/2	160	.187	.3158	.2982	.2810	.2641	.2476	.2314	.2154	.1998	.1845	.1695
1/2	XX	.294	.7264	.6997	.6736	.6481	.6232	.5990	.5753	.5521	.5295	.5074
3/4	5S	.065	.0036									
3/4	10S	.083	.0344	.0245	.0147	.0050						
3/4	40S	.113	.0888	.0781	.0676	.0572	.0470	.0369	.0269	.0171	.0074	
3/4	80S	.154	.1700	.1581	.1465	.1350	.1237	.1125	.1015	.0906	.0800	.0694
3/4		.188	.2442	.2313	.2185	.2059	.1936	.1814	.1694	.1576	.1459	.1344
3/4	160	.218	.3157	.3016	.2878	.2741	.2607	.2475	.2345	.2217	.2091	.1967
3/4	XX	.308	.5722	.5537	.5356	.5177	.5002	.4830	.4661	.4495	.4332	.4171
1	5S	.065	.0029									
1	10S	.109	.0642	.0559	.0477	.0397	.0317	.0238	.0160	.0082	.0006	
1	40 ST 40S	.133	.0999	.0912	.0827	.0742	.0658	.0576	.0494	.0413	.0333	.0253
1	80 ST 80S	.179	.1733	.1638	.1544	.1451	.1360	.1269	.1179	.1091	.1003	.0916
1		.219	.2432	.2328	.2226	.2125	.2025	.1927	.1829	.1733	.1638	.1544
1	160	.250	.3016	.2906	.2796	.2688	.2581	.2476	.2372	.2269	.2168	.2067
1	XX0	.358	.5417	.5274	.5132	.4993	.4855	.4720	.4586	.4454	.4324	.4196
11/4	5S	.065	.0023									
11/4	10S	.109	.0504	.0439	.0376	.0312	.0250	.0188	.0126	.0065	.0005	
11/4	40 ST 40S	.140	.0862	.0795	.0728	.0662	.0596	.0531	.0467	.0403	.0339	.0276
11/4	80 ST 80S	.191	.1492	.1419	.1346	.1275	.1203	.1133	.1063	.0994	.0925	.0857
11/4	160	.250	.2289	.2208	.2128	.2049	.1971	.1893	.1816	.1740	.1665	.1590
11/4	XX	.382	.4401	.4298	.4197	.4097	.3998	.3899	.3802	.3706	.3611	.3517

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
11/2	5S	.065	.0020									
11/2	10S	.109	.0438	.0382	.0327	.0272	.0218	.0164	.0110	.0057	.0004	
11/2	40 ST 40S	.145	.0799	.0740	.0682	.0625	.0568	.0511	.0455	.0399	.0344	.0289
11/2	80 ST 80S	.200	.1386	.1323	.1260	.1198	.1136	.1075	.1015	.0955	.0895	.0836
11/2	160	.281	.2338	.2267	.2197	.2127	.2058	.1989	.1921	.1854	.1787	.1720
11/2	XX	.400	.3968	.3882	.3797	.3714	.3630	.3548	.3466	.3385	.3305	.3226
2	5S	.065	.0016									
2	10S	.109	.0348	.0304	.0260	.0217	.0174	.0131	.0088	.0045	.0003	
2	40 ST 40S	.154	.0705	.0658	.0613	.0567	.0522	.0476	.0432	.0387	.0343	.0299
2		.167	.0811	.0764	.0717	.0671	.0625	.0579	.0534	.0489	.0444	.0399
2		.188	.0986	.0938	.0890	.0843	.0796	.0749	.0702	.0656	.0610	.0565
2	80 ST 80S	.218	.1243	.1193	.1144	.1095	.1046	.0998	.0950	.0902	.0855	.0807
2		.250	.1526	.1475	.1424	.1373	.1323	.1272	.1223	.1173	.1124	.1075
2		.312	.2106	.2051	.1996	.1942	.1888	.1834	.1780	.1727	.1675	.1622
2	160	.343	.2413	.2356	.2299	.2242	.2186	.2130	.2075	.2020	.1965	.1911
2	XX	.436	.3405	.3340	.3277	.3213	.3150	.3088	.3026	.2964	.2903	.2842
21/2	5S	.083	.0124	.0088	.0053	.0018						
21/2	10S	.120	.0357	.0320	.0284	.0248	.0212	.0176	.0140	.0105	.0070	.0035
21/2	40 ST 40S	.203	.0907	.0868	.0829	.0790	.0751	.0713	.0675	.0637	.0599	.0561
21/2		.217	.1004	.0964	.0925	.0886	.0846	.0808	.0769	.0730	.0692	.0654
21/2	80 ST 80S	.276	.1427	.1385	.1343	.1302	.1260	.1219	.1179	.1138	.1097	.1057
21/2	160	.375	.2191	.2145	.2099	.2054	.2008	.1963	.1918	.1874	.1829	.1785
21/2	XX	.552	.3761	.3706	.3651	.3596	.3542	.3488	.3434	.3381	.3328	.3275
3	5S	.083	.0101	.0073	.0044	.0015						
3	10S	.120	.0292	.0262	.0232	.0203	.0174	.0144	.0115	.0086	.0057	.0029
3		.125	.0318	.0288	.0258	.0229	.0199	.0170	.0141	.0112	.0083	.0054
3		.148	.0439	.0408	.0378	.0348	.0318	.0289	.0259	.0229	.0200	.0171
3		.188	.0654	.0623	.0592	.0561	.0530	.0500	.0469	.0439	.0408	.0378
3	40 ST 40S	.216	.0809	.0777	.0746	.0714	.0683	.0651	.0620	.0589	.0558	.0527
3		.241	.0950	.0918	.0885	.0853	.0821	.0789	.0757	.0726	.0694	.0663
3		.254	.1024	.0991	.0959	.0926	.0894	.0862	.0830	.0798	.0766	.0734
3		.289	.1228	.1194	.1161	.1127	.1094	.1061	.1028	.0996	.0963	.0930
3	80 XS 80S	.300	.1293	.1259	.1225	.1192	.1158	.1125	.1092	.1059	.1026	.0993
3		.312	.1365	.1331	.1296	.1263	.1229	.1195	.1162	.1128	.1095	.1062
3		.406	.1950	.1913	.1876	.1840	.1804	.1767	.1731	.1696	.1660	.1624

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
3	160	.438	.2159	.2121	.2084	.2046	.2009	.1972	.1935	.1898	.1862	.1825
3	XX	.600	.3308	.3264	.3221	.3178	.3136	.3094	.3051	.3009	.2968	.2926
31/2	5S	.083	.0089	.0063	.0038	.0013						
31/2	10S	.120	.0254	.0229	.0203	.0177	.0152	.0126	.0101	.0075	.0050	.0025
31/2		.128	.0291	.0265	.0239	.0213	.0187	.0162	.0136	.0111	.0086	.0060
31/2		.134	.0318	.0292	.0266	.0240	.0214	.0189	.0163	.0138	.0112	.0087
31/2		.148	.0382	.0356	.0330	.0304	.0278	.0252	.0226	.0200	.0175	.0149
31/2		.188	.0569	.0542	.0515	.0489	.0462	.0435	.0409	.0382	.0356	.0330
31/2	40 ST 40S	.226	.0751	.0724	.0696	.0669	.0641	.0614	.0587	.0560	.0533	.0506
31/2		.281	.1023	.0994	.0965	.0937	.0909	.0880	.0852	.0824	.0796	.0769
31/2	80 XS 80S	.318	.1211	.1182	.1152	.1123	.1094	.1065	.1036	.1008	.0979	.0951
31/2		.344	.1346	.1316	.1286	.1257	.1227	.1198	.1168	.1139	.1110	.1081
31/2		.469	.2029	.1997	.1964	.1932	.1900	.1868	.1836	.1804	.1773	.1741
31/2		.636	.3041	.3005	.2968	.2932	.2895	.2859	.2823	.2788	.2752	.2717
4	5S	.083	.0079	.0056	.0034	.0012						
4	10S	.120	.0226	.0203	.0180	.0157	.0135	.0112	.0089	.0067	.0045	.0022
4		.128	.0258	.0235	.0212	.0189	.0166	.0144	.0121	.0098	.0076	.0054
4		.134	.0282	.0259	.0236	.0213	.0190	.0167	.0145	.0122	.0100	.0077
4		.142	.0315	.0291	.0268	.0245	.0222	.0199	.0177	.0154	.0131	.0109
4		.165	.0409	.0385	.0362	.0338	.0315	.0292	.0269	.0246	.0223	.0200
4		.188	.0504	.0480	.0456	.0433	.0409	.0386	.0362	.0339	.0316	.0293
4		.205	.0575	.0551	.0527	.0503	.0479	.0456	.0432	.0409	.0385	.0362
4	40 ST40S	.237	.0711	.0686	.0662	.0638	.0614	.0589	.0565	.0541	.0518	.0494
4		.250	.0767	.0742	.0718	.0693	.0669	.0644	.0620	.0596	.0572	.0548
4		.271	.0858	.0833	.0808	.0784	.0759	.0734	.0710	.0685	.0661	.0637
4		.281	.0902	.0877	.0852	.0827	.0802	.0777	.0753	.0728	.0704	.0679
4		.300	.0986	.0961	.0935	.0910	.0885	.0860	.0835	.0810	.0785	.0761
4		.312	.1039	.1014	.0988	.0963	.0938	.0913	.0887	.0862	.0837	.0813
4	80 XS 80S	.337	.1152	.1126	.1100	.1075	.1049	.1023	.0998	.0973	.0947	.0922
4		.375	.1327	.1300	.1274	.1247	.1221	.1195	.1169	.1143	.1117	.1091
4	120	.438	.1625	.1597	.1570	.1543	.1515	.1488	.1461	.1434	.1407	.1381
4		.500	.1930	.1901	.1873	.1844	.1816	.1788	.1760	.1732	.1704	.1676
4	160	.531	.2086	.2057	.2028	.1999	.1971	.1942	.1913	.1885	.1856	.1828
4	XX	.674	.2851	.2819	.2787	.2756	.2724	.2693	.2661	.2630	.2599	.2568
5	5S	.109	.0147	.0128	.0110	.0092	.0074	.0055	.0037	.0019	.0001	
5	10S	.134	.0227	.0209	.0190	.0172	.0154	.0135	.0117	.0099	.0080	.0062

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
5	40 ST 40S	.258	.0641	.0622	.0602	.0583	.0563	.0544	.0525	.0505	.0486	.0467
5		.352	.0971	.0951	.0931	.0910	.0890	.0870	.0849	.0829	.0809	.0789
5	80 XS 80S	.375	.1054	.1034	.1013	.0992	.0972	.0951	.0931	.0911	.0890	.0870
5		.438	.1286	.1265	.1244	.1223	.1201	.1180	.1159	.1138	.1117	.1096
5	120	.500	.1522	.1500	.1478	.1456	.1434	.1412	.1391	.1369	.1347	.1326
5	160	.625	.2018	.1995	.1972	.1948	.1925	.1902	.1879	.1856	.1833	.1810
5	XX	.750	.2547	.2522	.2497	.2472	.2448	.2423	.2399	.2374	.2350	.2325
6	5S	.109	.0123	.0108	.0092	.0077	.0062	.0047	.0031	.0016	.0001	
6	10S	.134	.0190	.0175	.0159	.0144	.0129	.0113	.0098	.0083	.0067	.0052
6		.169	.0286	.0270	.0255	.0239	.0223	.0208	.0192	.0177	.0161	.0146
6		.180	.0316	.0301	.0285	.0269	.0253	.0238	.0222	.0207	.0191	.0176
6		.188	.0338	.0323	.0307	.0291	.0275	.0260	.0244	.0229	.0213	.0197
6		.219	.0425	.0409	.0393	.0377	.0361	.0345	.0329	.0314	.0298	.0282
6		.250	.0512	.0496	.0480	.0464	.0448	.0432	.0416	.0400	.0384	.0368
6		.277	.0589	.0573	.0556	.0540	.0524	.0508	.0491	.0475	.0459	.0443
6	40 ST 40S	.280	.0598	.0581	.0565	.0549	.0532	.0516	.0500	.0484	.0468	.0452
6		.375	.0875	.0858	.0841	.0824	.0807	.0791	.0774	.0757	.0740	.0724
6	80 XS 80S	.432	.1047	.1029	.1012	.0995	.0977	.0960	.0943	.0926	.0909	.0892
6		.500	.1256	.1238	.1221	.1203	.1185	.1167	.1150	.1132	.1115	.1097
6	120	.562	.1453	.1434	.1416	.1398	.1380	.1361	.1343	.1325	.1307	.1289
6	160	.718	.1969	.1950	.1930	.1911	.1891	.1872	.1853	.1833	.1814	.1795
6	XX	.864	.2484	.2463	.2443	.2422	.2401	.2381	.2360	.2340	.2319	.2299
8	5S	.109	.0094	.0083	.0071	.0059	.0047	.0036	.0024	.0012	.0001	
8	10S	.148	.0175	.0163	.0151	.0139	.0128	.0116	.0104	.0092	.0080	.0069
8		.158	.0196	.0184	.0172	.0160	.0148	.0136	.0125	.0113	.0101	.0089
8		.165	.0210	.0198	.0186	.0175	.0163	.0151	.0139	.0127	.0115	.0104
8		.188	.0259	.0247	.0235	.0223	.0211	.0199	.0187	.0175	.0163	.0151
8		.203	.0290	.0278	.0266	.0254	.0242	.0230	.0218	.0206	.0194	.0182
8		.219	.0324	.0312	.0300	.0288	.0276	.0264	.0252	.0240	.0228	.0216
8		.238	.0364	.0352	.0340	.0328	.0316	.0304	.0292	.0280	.0268	.0256
8	20	.250	.0390	.0378	.0366	.0353	.0341	.0329	.0317	.0305	.0293	.0281
8	30	.277	.0448	.0436	.0423	.0411	.0399	.0387	.0374	.0362	.0350	.0338
8	40 ST 40S	.322	.0546	.0533	.0521	.0508	.0496	.0484	.0471	.0459	.0447	.0434
8		.344	.0594	.0582	.0569	.0557	.0544	.0532	.0519	.0507	.0494	.0482
8		.352	.0612	.0599	.0587	.0574	.0562	.0549	.0537	.0524	.0512	.0499
8		.375	.0663	.0650	.0637	.0625	.0612	.0600	.0587	.0574	.0562	.0549

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
8	60	.406	.0732	.0719	.0706	.0694	.0681	.0668	.0655	.0643	.0630	.0617
8		.469	.0875	.0861	.0848	.0835	.0822	.0809	.0797	.0784	.0771	.0758
8	80 XS 80S	.500	.0946	.0933	.0919	.0906	.0893	.0880	.0867	.0854	.0841	.0828
8	100	.593	.1163	.1150	.1136	.1123	.1109	.1096	.1082	.1069	.1056	.1042
8		.625	.1240	.1226	.1212	.1199	.1185	.1171	.1158	.1144	.1131	.1117
8	120	.718	.1466	.1452	.1438	.1423	.1409	.1395	.1382	.1368	.1354	.1340
8	140	.812	.1701	.1686	.1672	.1658	.1643	.1629	.1614	.1600	.1586	.1571
8	XX	.875	.1863	.1848	.1833	.1818	.1804	.1789	.1774	.1760	.1745	.1730
8	160	.906	.1943	.1929	.1914	.1899	.1884	.1869	.1854	.1839	.1825	.1810
10	5S	.134	.0117	.0107	.0098	.0088	.0079	.0070	.0060	.0051	.0042	.0032
10	10S	.165	.0168	.0159	.0149	.0140	.0130	.0121	.0111	.0102	.0092	.0083
10		.188	.0207	.0197	.0188	.0178	.0168	.0159	.0149	.0140	.0130	.0121
10		.203	.0232	.0222	.0213	.0203	.0194	.0184	.0174	.0165	.0155	.0146
10		.219	.0259	.0249	.0240	.0230	.0220	.0211	.0201	.0192	.0182	.0173
10	20	.250	.0311	.0302	.0292	.0282	.0273	.0263	.0253	.0244	.0234	.0224
10		.279	.0361	.0351	.0341	.0331	.0322	.0312	.0302	.0293	.0283	.0273
10	30	.307	.0409	.0399	.0389	.0379	.0370	.0360	.0350	.0340	.0330	.0321
10		.348	.0480	.0470	.0460	.0450	.0440	.0430	.0420	.0411	.0401	.0391
10	40 ST 40S	.365	.0509	.0499	.0489	.0480	.0470	.0460	.0450	.0440	.0430	.0420
10		.395	.0562	.0552	.0542	.0532	.0522	.0512	.0502	.0492	.0482	.0472
10	60 XS 80S	.500	.0749	.0739	.0728	.0718	.0708	.0698	.0687	.0677	.0667	.0657
10		.531	.0805	.0795	.0784	.0774	.0764	.0753	.0743	.0733	.0722	.0712
10	80	.593	.0919	.0908	.0897	.0887	.0876	.0866	.0856	.0845	.0835	.0824
10	100	.718	.1153	.1142	.1131	.1120	.1109	.1098	.1088	.1077	.1066	.1055
10		.750	.1214	.1203	.1192	.1181	.1170	.1159	.1148	.1137	.1127	.1116
10	120	.843	.1394	.1383	.1372	.1360	.1349	.1338	.1327	.1316	.1305	.1294
10	140	1.000	.1708	.1696	.1685	.1673	.1661	.1650	.1638	.1627	.1615	.1604
10		1.062	.1835	.1824	.1812	.1800	.1788	.1776	.1765	.1753	.1741	.1730
10	160	1.125	.1967	.1955	.1943	.1931	.1919	.1907	.1895	.1883	.1871	.1860
12	5S	.156	.0129	.0121	.0113	.0105	.0097	.0089	.0081	.0073	.0065	.0057
12	10S	.180	.0163	.0155	.0147	.0139	.0131	.0123	.0115	.0107	.0099	.0091
12		.203	.0195	.0187	.0179	.0171	.0163	.0155	.0147	.0139	.0131	.0123
12		.219	.0218	.0209	.0201	.0193	.0185	.0177	.0169	.0161	.0153	.0145
12		.238	.0245	.0236	.0228	.0220	.0212	.0204	.0196	.0188	.0180	.0172
12	20	.250	.0262	.0253	.0245	.0237	.0229	.0221	.0213	.0205	.0197	.0189
12		.279	.0303	.0295	.0287	.0278	.0270	.0262	.0254	.0246	.0238	.0230

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
12		.300	.0333	.0325	.0317	.0308	.0300	.0292	.0284	.0276	.0268	.0260
12	30	.330	.0376	.0368	.0360	.0352	.0343	.0335	.0327	.0319	.0311	.0302
12		.344	.0397	.0388	.0380	.0372	.0364	.0355	.0347	.0339	.0331	.0322
12	ST 40S	.375	.0442	.0433	.0425	.0417	.0408	.0400	.0392	.0384	.0375	.0367
12	40	.406	.0487	.0479	.0470	.0462	.0454	.0445	.0437	.0429	.0420	.0412
12		.438	.0534	.0526	.0517	.0509	.0500	.0492	.0484	.0475	.0467	.0459
12	XS 80S	.500	.0626	.0618	.0609	.0601	.0592	.0584	.0575	.0567	.0558	.0550
12	60	.562	.0720	.0711	.0702	.0694	.0685	.0676	.0668	.0659	.0651	.0642
12		.625	.0816	.0807	.0798	.0789	.0781	.0772	.0763	.0755	.0746	.0737
12	80	.687	.0911	.0902	.0894	.0885	.0876	.0867	.0858	.0849	.0841	.0832
12	100	.843	.1158	.1148	.1139	.1130	.1121	.1112	.1103	.1094	.1085	.1075
12		.875	.1209	.1200	.1191	.1181	.1172	.1163	.1154	.1145	.1136	.1126
12	120	1.000	.1414	.1404	.1395	.1385	.1376	.1366	.1357	.1348	.1338	.1329
12	140	1.125	.1624	.1614	.1604	.1594	.1585	.1575	.1565	.1556	.1546	.1536
12		1.219	.1785	.1775	.1765	.1755	.1746	.1736	.1726	.1716	.1706	.1696
12	160	1.312	.1948	.1938	.1928	.1918	.1908	.1898	.1888	.1878	.1868	.1858
14		.188	.0158	.0151	.0144	.0136	.0129	.0122	.0114	.0107	.0100	.0093
14		.220	.0199	.0192	.0184	.0177	.0170	.0163	.0155	.0148	.0141	.0133
14		.238	.0222	.0215	.0208	.0200	.0193	.0186	.0178	.0171	.0164	.0156
14	10	.250	.0238	.0230	.0223	.0216	.0208	.0201	.0194	.0186	.0179	.0172
14	20	.312	.0318	.0311	.0303	.0296	.0289	.0281	.0274	.0266	.0259	.0251
14	30ST	.375	.0401	.0394	.0386	.0379	.0371	.0363	.0356	.0348	.0341	.0334
14		.406	.0442	.0435	.0427	.0419	.0412	.0404	.0397	.0389	.0382	.0374
14	40	.438	.0485	.0477	.0470	.0462	.0454	.0447	.0439	.0432	.0424	.0416
14		.469	.0526	.0519	.0511	.0503	.0496	.0488	.0480	.0473	.0465	.0458
14	XS	.500	.0568	.0560	.0553	.0545	.0537	.0530	.0522	.0514	.0507	.0499
14	60	.593	.0695	.0687	.0679	.0671	.0664	.0656	.0648	.0640	.0632	.0625
14		.625	.0739	.0731	.0723	.0715	.0707	.0700	.0692	.0684	.0676	.0668
14		.656	.0782	.0774	.0766	.0758	.0750	.0742	.0734	.0727	.0719	.0711
14	80	.750	.0914	.0906	.0898	.0890	.0882	.0874	.0866	.0857	.0849	.0841
14	100	.937	.1183	.1175	.1166	.1158	.1150	.1141	.1133	.1125	.1116	.1108
14	120	1.093	.1415	.1407	.1398	.1389	.1381	.1372	.1364	.1355	.1347	.1338
14	140	1.250	.1656	.1647	.1638	.1629	.1620	.1612	.1603	.1594	.1585	.1576
14		1.344	.1804	.1795	.1786	.1776	.1767	.1758	.1749	.1740	.1731	.1722
14	160	1.406	.1903	.1893	.1884	.1875	.1866	.1857	.1848	.1839	.1829	.1820
16		.188	.0138	.0132	.0125	.0119	.0113	.0106	.0100	.0094	.0087	.0081

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
16		.238	.0194	.0188	.0181	.0175	.0169	.0162	.0156	.0149	.0143	.0137
16	10	.250	.0208	.0201	.0195	.0188	.0182	.0176	.0169	.0163	.0156	.0150
16		.281	.0243	.0236	.0230	.0223	.0217	.0210	.0204	.0198	.0191	.0185
16	20	.312	.0278	.0271	.0265	.0258	.0252	.0245	.0239	.0232	.0226	.0220
16		.344	.0314	.0308	.0301	.0295	.0288	.0282	.0275	.0269	.0262	.0256
16	30 ST	.375	.0350	.0343	.0337	.0330	.0324	.0317	.0311	.0304	.0297	.0291
16		.406	.0385	.0379	.0372	.0366	.0359	.0353	.0346	.0339	.0333	.0326
16		.438	.0422	.0416	.0409	.0403	.0396	.0389	.0383	.0376	.0370	.0363
16		.469	.0458	.0452	.0445	.0439	.0432	.0425	.0419	.0412	.0405	.0399
16	40 XS	.500	.0495	.0488	.0481	.0475	.0468	.0461	.0455	.0448	.0441	.0435
16		.531	.0531	.0524	.0518	.0511	.0504	.0498	.0491	.0484	.0477	.0471
16	60	.656	.0680	.0673	.0666	.0659	.0652	.0645	.0639	.0632	.0625	.0618
16		.688	.0718	.0711	.0704	.0697	.0691	.0684	.0677	.0670	.0663	.0656
16		.750	.0793	.0786	.0779	.0772	.0765	.0759	.0752	.0745	.0738	.0731
16	80	.843	.0907	.0900	.0893	.0886	.0879	.0872	.0865	.0858	.0851	.0844
16	100	1.031	.1144	.1136	.1129	.1122	.1115	.1107	.1100	.1093	.1086	.1078
16	120	1.218	.1386	.1378	.1371	.1363	.1356	.1348	.1341	.1334	.1326	.1319
16	140	1.438	.1681	.1673	.1665	.1658	.1650	.1642	.1634	.1627	.1619	.1611
16		1.500	.1766	.1758	.1750	.1743	.1735	.1727	.1719	.1711	.1703	.1696
16	160	1.593	.1896	.1888	.1880	.1872	.1864	.1856	.1848	.1840	.1832	.1824
18	10	.250	.0184	.0179	.0173	.0167	.0162	.0156	.0150	.0145	.0139	.0133
18	20	.312	.0246	.0241	.0235	.0229	.0223	.0218	.0212	.0206	.0201	.0195
18	ST	.375	.0310	.0304	.0298	.0293	.0287	.0281	.0275	.0270	.0264	.0258
18	30	.438	.0374	.0368	.0363	.0357	.0351	.0345	.0339	.0333	.0328	.0322
18	XS	.500	.0438	.0432	.0426	.0420	.0414	.0409	.0403	.0397	.0391	.0385
18	40	.562	.0502	.0496	.0490	.0485	.0479	.0473	.0467	.0461	.0455	.0449
18		.594	.0536	.0530	.0524	.0518	.0512	.0506	.0500	.0494	.0488	.0482
18		.625	.0568	.0562	.0556	.0550	.0544	.0538	.0532	.0526	.0520	.0514
18		.719	.0668	.0662	.0656	.0649	.0643	.0637	.0631	.0625	.0619	.0613
18	60	.750	.0701	.0695	.0689	.0683	.0676	.0670	.0664	.0658	.0652	.0646
18		.812	.0767	.0761	.0755	.0749	.0743	.0737	.0731	.0724	.0718	.0712
18	80	.937	.0904	.0897	.0891	.0885	.0879	.0872	.0866	.0860	.0854	.0847
18	100	1.156	.1148	.1142	.1135	.1129	.1122	.1116	.1109	.1103	.1096	.1090
18	120	1.375	.1401	.1394	.1387	.1381	.1374	.1367	.1361	.1354	.1347	.1341
18	140	1.562	.1623	.1616	.1609	.1602	.1596	.1589	.1582	.1575	.1568	.1561
18		1.688	.1776	.1769	.1762	.1755	.1748	.1741	.1734	.1727	.1720	.1714

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
18	160	1.781	.1892	.1884	.1877	.1870	.1863	.1856	.1849	.1842	.1835	.1828
20	10	.250	.0166	.0161	.0155	.0150	.0145	.0140	.0135	.0130	.0125	.0120
20		.312	.0221	.0216	.0211	.0206	.0201	.0196	.0191	.0185	.0180	.0175
20	20 ST	.375	.0278	.0273	.0268	.0263	.0258	.0253	.0247	.0242	.0237	.0232
20		.438	.0336	.0331	.0326	.0320	.0315	.0310	.0305	.0299	.0294	.0289
20	30 XS	.500	.0393	.0388	.0382	.0377	.0372	.0367	.0361	.0356	.0351	.0346
20		.562	.0451	.0445	.0440	.0435	.0429	.0424	.0419	.0413	.0408	.0403
20	40	.593	.0479	.0474	.0469	.0463	.0458	.0453	.0447	.0442	.0437	.0432
20		.625	.0509	.0504	.0499	.0493	.0488	.0483	.0477	.0472	.0467	.0461
20	60	.812	.0687	.0682	.0676	.0671	.0665	.0660	.0654	.0649	.0643	.0638
20		.875	.0748	.0742	.0737	.0731	.0726	.0720	.0715	.0709	.0704	.0698
20		.906	.0778	.0772	.0767	.0761	.0756	.0750	.0745	.0739	.0734	.0728
20	80	1.031	.0901	.0895	.0889	.0884	.0878	.0872	.0867	.0861	.0855	.0850
20		1.250	.1120	.1114	.1109	.1103	.1097	.1091	.1085	.1080	.1074	.1068
20	100	1.281	.1152	.1146	.1140	.1134	.1128	.1123	.1117	.1111	.1105	.1099
20	120	1.500	.1379	.1373	.1367	.1361	.1355	.1349	.1343	.1337	.1331	.1325
20	140	1.750	.1646	.1640	.1634	.1628	.1622	.1615	.1609	.1603	.1597	.1591
20		1.844	.1749	.1743	.1737	.1730	.1724	.1718	.1712	.1705	.1699	.1693
20	160	1.968	.1887	.1881	.1874	.1868	.1862	.1855	.1849	.1842	.1836	.1830
22	LG	.250	.0150	.0146	.0141	.0137	.0132	.0127	.0123	.0118	.0113	.0109
22	ST	.375	.0253	.0248	.0243	.0239	.0234	.0229	.0224	.0220	.0215	.0210
22	XS	.500	.0356	.0352	.0347	.0342	.0337	.0333	.0328	.0323	.0318	.0314
24	10	.250	.0138	.0134	.0129	.0125	.0121	.0117	.0112	.0108	.0104	.0100
24		.312	.0184	.0180	.0175	.0171	.0167	.0163	.0158	.0154	.0150	.0146
24	20 ST	.375	.0231	.0227	.0223	.0218	.0214	.0210	.0206	.0201	.0197	.0193
24		.438	.0279	.0275	.0270	.0266	.0262	.0257	.0253	.0249	.0244	.0240
24	XS	.500	.0326	.0322	.0317	.0313	.0309	.0304	.0300	.0296	.0291	.0287
24	30	.562	.0373	.0369	.0365	.0360	.0356	.0352	.0347	.0343	.0338	.0334
24		.625	.0422	.0418	.0413	.0409	.0404	.0400	.0396	.0391	.0387	.0382
24	40	.687	.0470	.0466	.0461	.0457	.0452	.0448	.0443	.0439	.0435	.0430
24		.750	.0519	.0515	.0510	.0506	.0501	.0497	.0492	.0488	.0484	.0479
24	60	.968	.0692	.0687	.0683	.0678	.0674	.0669	.0665	.0660	.0655	.0651
24		1.031	.0743	.0738	.0733	.0729	.0724	.0720	.0715	.0710	.0706	.0701
24	80	1.218	.0895	.0890	.0886	.0881	.0876	.0872	.0867	.0862	.0858	.0853
24	100	1.531	.1157	.1152	.1148	.1143	.1138	.1133	.1128	.1123	.1118	.1114

Table 7-4
Continued

NOMINAL PIPE SIZE	SCHEDULE NUMBER AND/OR WEIGHT	WALL THICKNESS	CORROSION ALLOWANCE-INCHES Y=0.7									
			0.055	0.060	0.065	0.070	0.075	0.080	0.085	0.90	0.095	0.100
24	120	1.812	.1400	.1395	.1390	.1385	.1380	.1375	.1370	.1365	.1360	.1355
24	140	2.062	.1623	.1618	.1613	.1608	.1603	.1598	.1592	.1587	.1582	.1577
24		2.188	.1738	.1733	.1728	.1722	.1717	.1712	.1707	.1702	.1696	.1691
24	160	2.343	.1882	.1876	.1871	.1866	.1860	.1855	.1850	.1844	.1839	.1834
26	ST	.375	.0213	.0209	.0205	.0201	.0197	.0193	.0190	.0186	.0182	.0178
26	XS	.500	.0300	.0296	.0292	.0288	.0284	.0280	.0276	.0272	.0268	.0264
30	10	.312	.0147	.0143	.0140	.0137	.0133	.0130	.0126	.0123	.0120	.0116
30	ST	.375	.0184	.0181	.0178	.0174	.0171	.0167	.0164	.0161	.0157	.0154
30		.438	.0222	.0219	.0215	.0212	.0208	.0205	.0202	.0198	.0195	.0191
30	20 XS	.500	.0260	.0256	.0253	.0249	.0246	.0242	.0239	.0235	.0232	.0229
30		.562	.0297	.0294	.0290	.0287	.0283	.0280	.0276	.0273	.0269	.0266
30	30	.625	.0336	.0332	.0329	.0325	.0322	.0318	.0315	.0311	.0308	.0304
34	ST	.375	.0162	.0159	.0156	.0153	.0150	.0147	.0144	.0141	.0138	.0135
34	XS	.500	.0229	.0226	.0223	.0219	.0216	.0213	.0210	.0207	.0204	.0201
36	ST	.375	.0153	.0151	.0148	.0145	.0142	.0139	.0136	.0134	.0131	.0128
36	XS	.500	.0216	.0213	.0210	.0207	.0204	.0201	.0199	.0196	.0193	.0190
42	ST	.375	.0131	.0129	.0126	.0124	.0122	.0119	.0117	.0114	.0112	.0109
42	XS	.500	.0184	.0182	.0180	.0177	.0175	.0172	.0170	.0167	.0165	.0163
48	ST	.375	.0115	.0113	.0110	.0108	.0106	.0104	.0102	.0100	.0098	.0096
48	XS	.500	.0161	.0159	.0157	.0155	.0153	.0151	.0148	.0146	.0144	.0142

Tables are presented for four values of y:

y = 0	(Barlow)	(Table 7-1)
y = 0.4	(Modified lame)	(Table 7-2)
y = 0.5	(Average diameter)	(Table 7-3)
y = 0.7	(Creep)	(Table 7-4)

Instructions and Examples

Example 1: Determining Allowable Working Pressure

Determine the maximum allowable working pressure in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII Division 1, 1977, for a 10-in., schedule 80 steam line, A106 Grade B materials, operating at 750°F.

Solution:

1. List known information about the pipe.

Size:	10-in. nom. (10.750 O.D.)
Weight (or schedule no.):	Schedule 80
Wall thickness = 7/8 t_{nom}:	.593 nom. (.518 min.)
Material:	A106 Grade B
Code section:	ASME, Section VIII Division 1, 1983
Operating temperature:	750°F
Corrosion allowance:	0 (The 1983 ASME Code formula does not include allowance for corrosion, therefore, it is the responsibility of the designer to adjust the wall thickness where corrosive conditions exist.)

2. Obtain from 1983 ASME Code the allowable stress:

   S = 12,900 psi

3. The following two solutions can be used to determine the maximum allowable working pressure permissible.

   - Using the design formula from the ASME Code, Section VIII, Division 1, 1983, and the symbol definitions contained therein:

$$P = \frac{S\,E\,t}{R + 0.6t}$$

$S = 12{,}900$ psi

$E = 1.00$ (See the 1983 ASME Code on joint efficiencies)

$t = t_{min}$ .518 in.

$R =$ Inside radius or $\frac{D_o}{2} - t_{min}$

$$P = \frac{(12{,}900)\,(1)\,(.518)}{4.857 + (.6)\,(.518)}$$

$$P = \frac{6{,}682}{5.167} = 1{,}293 \text{ psi}$$

   - A simpler, quicker method is to obtain the applicable P/S ratio from the pressure/stress ratio table listing Y = 0.4 (Table 7-2).

   Note: In the ASME Code, Section VIII, 1983, formula:

$$R = \frac{D_o}{2} - t_{min}$$

$$\text{thus } P = \frac{S\,E\,t}{R + 0.6t}$$

$$P/S = \frac{E\,t}{R + 0.6t}$$

$$E = 1.0$$

$$P/S = \frac{t}{\frac{D_o}{2} - t + 0.6t}$$

$$P/S = \frac{2t}{D_o - 2t + 1.2t}$$

$$P/S = \frac{2t}{D_o - 0.8t}$$

thus, y in the basic ASME formula

$$P/S = \frac{2\,(t_m - A)}{D - 2y\,(t_m - A)}$$

must equal 0.4

With the allowable stress(s) obtained from the ASME Code, Section VIII, Division 1, 1983, (12,900 psi) and the P/S ratio obtained from Table 7-2 (.1004)

$$P = S \times P/S$$

$$P = 12{,}900 \times .1004 = 1{,}295 \text{ psi}$$

Example 2: Determining Stress or Required Yield Strength

Determine the stress or required yield strength in accordance with the ANSI Code B31.8, 1982, on gas transmission and distribution piping systems for a 12-in., schedule 60, gas line, A106 Grade B materials, operating at 1,100 psi at 250°F.

Solutions:

1. List known information about the pipe:

Size:	12 in. nom. (12,750 O.D.)
Weight (or schedule no.):	Schedule 60
Wall thickness:	.562 nom.
Material:	A106 Grade B
Code section:	ANSI Code B31.8, 1982
Operating temperature:	250°F
Operating pressure, P:	1,100 psi
Corrosion allowance:	0

2. Obtain from the Code section on gas transmission:

Minimum yield strength	= 35,000 psi
Y factor	= 0
Design factor (F) for Type C construction	= 0.5

The following two solutions can be used to find the stress or required yield strength.

- Using the design formula from the ANSI Code B31.8, 1982, and the symbol definitions contained therein:

$$P = \frac{2ST}{D} \times F \times E \times T$$

$$S = \frac{P\,D}{2tFET}$$

$$P = 1{,}100$$

$$D = 12.75$$

$$t_{(nom)} = .562$$

$$F = .5$$

$$E = 1.0$$

$$T = 1.0$$

$$S = \frac{(1{,}100)\,(12.75)}{(2)\,(.562)\,(.5)\,(1)\,(1)}$$

$$S = \frac{14{,}025}{.562} = 24{,}955 \text{ psi}$$

Since the stress or required yield strength of 24,955 psi is less than the minimum yield strength of 35,000 psi for A106 Grade B pipe, the pipe correctly meets Code requirements.

- A simpler, quicker method is to obtain from Table 7-1 where y = 0, the applicable P/S ratio, and then multiply to determine the stress or required yield strength.

P/S ratio = .0771

Because we are using a construction factor of .5 from the ANSI Code B31.8 and because this Code is based on nominal wall, we must use the .5 fac-

tor and an 8/7 factor in the following formula along with our P/S ratio.

$$S = P - P/S\ (8/7)\ (.5)$$

$$S = 1{,}100 - .0771\ (8/7)\ (.5) = 24{,}967 \text{ psi}$$

Example 3: Determining Wall Thickness Required

In accordance with the ANSI Code B31.1.0, 1983, for power piping, determine the pipe wall thickness required for a 6-in. steam line, A106 Grade B pipe, operating at 900 psi at 750°F at maximum allowable stress, with a corrosion allowance of .050 in.

Solutions:

1. List known information about the pipe:

Size:	6 in. (6.625 O.D.)
Material:	A106 Grade B
Code section:	ANSI Code B31.1.0, 1983
Operating temperature:	750°F
Operating pressure, P:	900 psi
Corrosion allowance, C:	.050

2. Obtain from the ANSI Code section on power piping (1983) the allowable stress:

$S = 13{,}000$ psi
y factor $= 0.4$

The following two solutions can be used to find the required wall thickness.

- Using the design formula from ANSI Code B31.1.0 and the symbol definitions contained therein:

$$t_m = \frac{P\ D_o}{2(SE + Py)} + A$$

$P = 900$

$D_o = 6.625$

$S = 13{,}000$

$E = 1.0$

$y = .4$

$A = 0$

$$t_m = \frac{(900)\ (6.625)}{2\ [13{,}000 + (900)\ (.4)]}$$

$$t_m = \frac{5{,}962.5}{26{,}720} = .223$$

The nominal wall, T_{nom}, is equal to $.223 - 87\frac{1}{2}\%\ .223 \times 8/7 = .254$. Because the ANSI Code B31.1.0 design formula makes no allowance for corrosion and/or erosion, the corrosion allowance determined by the designer must be added to the nominal wall calculated. Therefore $T_{nom} = .254 + .050 = .304$.

Then, refer to Chapter 10 "Properties of Pipe" to determine the next thicker commercially available pipe, which is schedule 60, having a nominal wall thickness of .375.

- A simpler, quicker method is to calculate the minimum required P/S ratio by dividing P by S:

$$P/S = 900 = 13{,}000 = .0692$$

Using Table 7-2 (where $y = 0.4$) across from the 6-in. nominal pipe size under the column for .050 in. corrosion allowance, pick the pipe wall thickness having a P/S ratio equal to or greater than that just calculated. This value is .0869. Therefore, $t_{nom} = .375$ based on a P/S ratio of .0869 as shown in the table should be used.

Note: Interpolation: For values of C and y intermediate to those shown in the tables, linear interpolation may be used.

Note: Special calculations: Only the three most important uses for the P/S values have been illustrated. Those who would like to examine all of the uses are reminded that the tables may be employed to indicate the effect of operating temperature, corrosion allowance, material, and pipe size.

Branch Reinforcement

The various ANSI piping codes give formulae for the reinforcement of nozzle openings in two respects:

1. The *pressure* area cut by the opening must be replaced by reinforcing the area within a prescribed zone around the opening.
2. The welds which attach the reinforcement to the pipe must meet certain (essentially shear strength) requirements. The Petroleum Refinery Piping Code B31.3 (1980) gives detailed requirements in Section 304.3.3. The Power Piping Code B31.1 (1983) refers to Section 104.3.1 for a detailed description of this nozzle reinforcement design and calculation. For convenience, reprinted here is ANSI Code B31.3, Section 304.3.3 in Figure 7-1.

Section 304.3.3 of the ANSI Code B31.3—Reinforcement of Welded-Branch Connections

Additional reinforcement is required when it is not provided inherently in the components of the branch connection. This paragraph gives rules governing the pressure design of such branch connections for cases where the angle between the axes of the branch and of the run is between 45 and 90 degrees, inclusive.

Notation

The notations described below are used in the pressure design of branch connections. The notations are illustrated in Figure 7-2. Note the use of subscripts b for branch and h for run. Note also that Figure 7-1 does not indicate details for construction or welding.

- B = Angle between axes of branch and run, degrees
- b = Subscript referring to branch
- c = Corrosion allowance, in.
- D_o = Outside diameter of pipe, in.
- d_1 = Actual corroded length removed from run pipe, in.
  = $[D_{ob} - 2(T_b - c)]/\sin B$
  = d_1 or $[T_b - c) + (T_h - c) + d_1/2]$ whichever is greater, but in any case not more than D_{oh}
- h = Subscript referring to run or header
- L_4 = Altitude of reinforcement zone outside of run pipe, in.
  = 2.5 $(T_h - c)$ or 2.5 $(T_b - c) + t_e$, whichever is lesser
- t_e = Nominal thickness of reinforcing ring or saddle, in.
- T = Actual thickness of pipe, in. (by actual measurement, or minimum thickness permissible under purchase specification)
- T = Nominal thickness of pipe, in.
- t = Pressure design thickness of pipe according to the appropriate wall thickness equation or procedure in 304.1 in. When the branch does not intersect the longitudinal weld of the run, the stress value for seamless pipe, of comparable grade, may be used in determining t for the purpose of reinforcement calculation only. When the branch does intersect the longitudinal weld of the run, the weld joint factor of the run shall enter the calculation. When the branch contains a weld, the weld joint factor of the branch shall enter the calculation.

Required Area

The quantity $(t_h d_1)$ $(2 - \sin B)$ is known as the required area; in the case of right-angle nozzles, the required area becomes $t_h d_1$ square inches. The branch connection must be designed so that the reinforcement area defined in 304.3.3 (c) is not less than the required area.

Reinforcement Area

The reinforcement area shall be the sum of the following two areas.

1. The area lying within the reinforcement zone [defined in 304.3.3 (d)] resulting from any excess thickness available in the main run pipe wall and branch pipe wall over that required by the proper wall thickness equations, i.e., the thicknesses $T_h - t_h - c$ and $T_b - t_b - c$ multiplied by appropriate lengths. Any line having a thickness greater than that required for corrosion allowance and for pressure and other loading considerations will occasionally be in service until the excess thickness is also corroded away. If this is the basis of the design, the excess thickness cannot be used for reinforcement of pipe-to-pipe branch connections.
2. The area of all other metal within the reinforcement zone (defined in Section 304.3.3 (d)) provided by weld and other reinforcement metal properly attached to the run of branch. In computing areas of weld metal deposits, the minimum dimensions required shall be used unless a definite procedure is employed to instruct the welder to provide specific larger dimensions, in which case the latter dimensions may be used in calculations.

Portions of the reinforcement area may be composed of materials other than those of the main run pipe, but if the allowable stress of these materials is less than that for the

BRANCH REINFORCEMENT

304.1.2 Straight Pipe Under Internal Pressure

(a) For metallic pipe, the internal pressure design thickness (t) shall be not less than calculated by the following Equation 3, if t is less than $D_o/4$:

$$t = \frac{PD_o}{2(SE + PY)} \text{ or } t = \frac{Pd}{2(SE + PY\text{-}P)} \quad \ldots\ldots (3)$$

Table 304.1.1
Values of Y for Ferrous Materials

Temperature Degree °F	900 & Below	950	1000	1050	1100	1150 & Above
Ferritic Steels	0.4	0.5	0.7	0.7	0.7	0.7
Austenitic Steels	0.4	0.4	0.4	0.4	0.5	0.7

DESIGN CONDITIONS: ..... psig .....°F

	HEADER		BRANCH	
Nominal Size				
Outside Diameter	D_{oh}		D_{ob}	
Nominal Wall	$\bar{T}_h$		$\bar{T}_b$	
Actual or min. Wall	T_h		T_b	
Material Spec. ASTM				
Allowable Stress	S_h		S_b	
Joint Efficiency	E_h		E_b	
Y Coefficient	Y_h		Y_b	
Mech./Corr. Allow.	C_h		C_b	
Intersection Angle	β		β	

REQUIRED THICKNESS OF HEADER AND BRANCH:

$$t_h = \frac{PD_oh}{2S_hE_h + 2YhP} = \frac{\ldots\ldots x \ldots\ldots}{2 x \ldots\ldots x \ldots\ldots + 2 x \ldots\ldots x \ldots\ldots} = \ldots\ldots$$

$$t_b = \frac{PD_cb}{2S_bE_b + 2Y_bP} = \frac{\ldots\ldots x \ldots\ldots}{2 x \ldots\ldots x \ldots\ldots + 2 x \ldots\ldots x \ldots\ldots} = \ldots\ldots$$

LIMITS OF REINFORCEMENT:

$$d_1 = \frac{D_ob - 2(T_b - C_b)}{\sin\beta} = \frac{\ldots\ldots - 2x(\ldots\ldots - \ldots\ldots)}{\ldots\ldots} = \ldots\ldots$$

$d_2 = d_1$ or $= (T_b - C_b) + (T_h - C_h) + 0.5d_1 = (\ldots\ldots - \ldots\ldots) + (\ldots\ldots - \ldots\ldots) + 0.5 x \ldots\ldots = \ldots\ldots$

Select larger of the values, but not to exceed D_{oh} $\quad d_2 = \ldots\ldots$

$L_4 = 2.5(\bar{T}_h - C_h) = 2.5(\ldots\ldots - \ldots\ldots)$ or $= 2.5(\bar{T}_b - C_b) + t_e = 2.5(\ldots\ldots - \ldots\ldots) + \ldots\ldots$

Select lesser of the values ($t_e = 0$ if pad or saddle is not used) $L_4 = \ldots\ldots$

REQUIRED AND AVAILABLE REINFORCEMENT AREA:

Area $= t_hd_1 = \ldots\ldots x \ldots\ldots = \ldots\ldots$ sq. in. required.

$A_1 = (2d_2 - d_1)(T_h - t_h - C_h) = (2 x \ldots\ldots - \ldots\ldots)(\ldots\ldots - \ldots\ldots - \ldots\ldots) = \ldots\ldots$

$A_2 = 2L_4(T_b - t_b - C_b) = 2 x \ldots\ldots (\ldots\ldots - \ldots\ldots - \ldots\ldots) = \ldots\ldots$

$A_3 = t_f^2 = (\ldots\ldots)^2 = \ldots\ldots$

$A_1 + A_2 + A_3 = \ldots\ldots + \ldots\ldots + \ldots\ldots = \ldots\ldots$ sq. in. available.

Area A $- (A_1 + A_2 + A_3) = \ldots\ldots - \ldots\ldots = \ldots\ldots$ sq. in. of area in pad required - A_4

$A_4 \div 2$ = sq. in. of pad on each side of nozzle $= \ldots\ldots \div 2 = \ldots\ldots$

$$\frac{A_4 \div 2}{t_e} = L = \ldots\ldots \div \ldots\ldots = \ldots\ldots$$

QED use pad $t_e = \ldots\ldots$ x L = ...

Figure 7-1. Reproduction of ANSI/ASME Code B31.3, Section 304.3.3 giving detailed requirements for branch reinforcement.

main run pipe, the corresponding calculated area must be reduced in the ratio of the allowable stress values before being counted toward the reinforcement area. No additional credit shall be taken for materials having higher allowable stress values than for the main run pipe.

Reinforcement Zone

The reinforcement zone is a parallelogram whose length shall extend a distance d_2 on each side of the centerline of the branch pipe and whose width shall start at the inside surface of the main run pipe (in its corroded condition) and extend to the distance L_4 from the outside surface of the main run pipe measured perpendicular to this outside surface. (See Section 304.3.3(c) (1)).

Sample Calculations for Branch Reinforcement

Example 7-1

An NPS 8 run (header) in an oil piping system has an NPS 5 branch at right angles (Figure 7-3). Both pipes are Schedule 40 API 5L Grade A seamless. The design conditions are 300 psig at 400°F. The fillet welds at the crotch are minimum size in accordance with Section 327.4.4. A corrosion allowance of 0.10 in. is specified. Is additional reinforcement necessary?

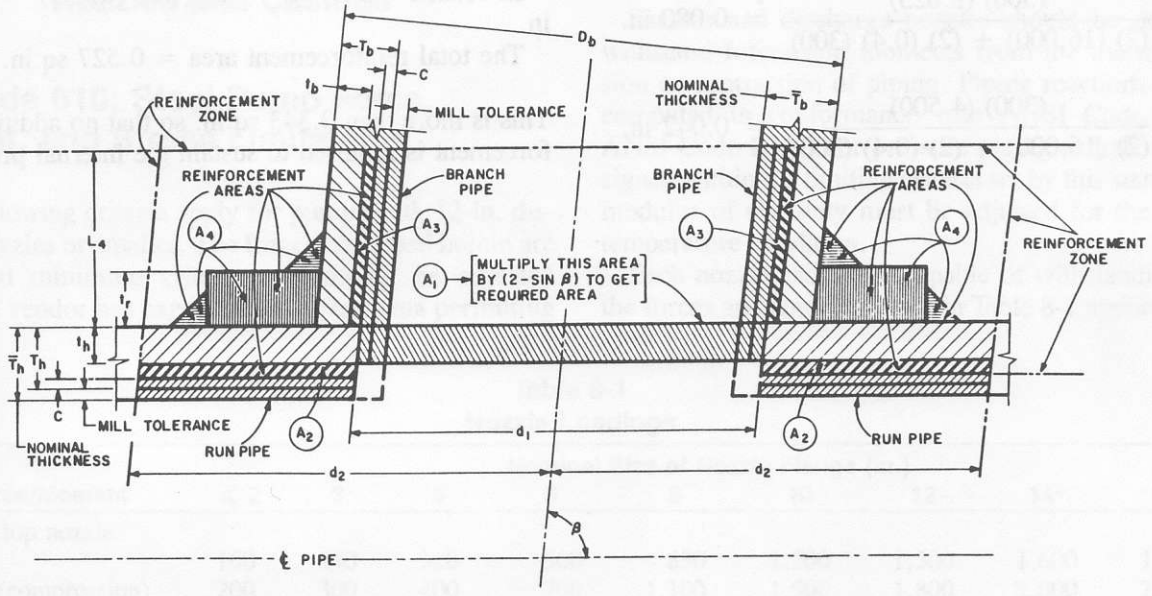


Figure 7-2. This figure illustrates the nomenclature used in ANSI Code B31.3, Section 304.3.3, 1980. It does not indicate complete welding details or a preferred method of construction. (Reprinted courtesy of the American Society of Mechanical Engineers.)

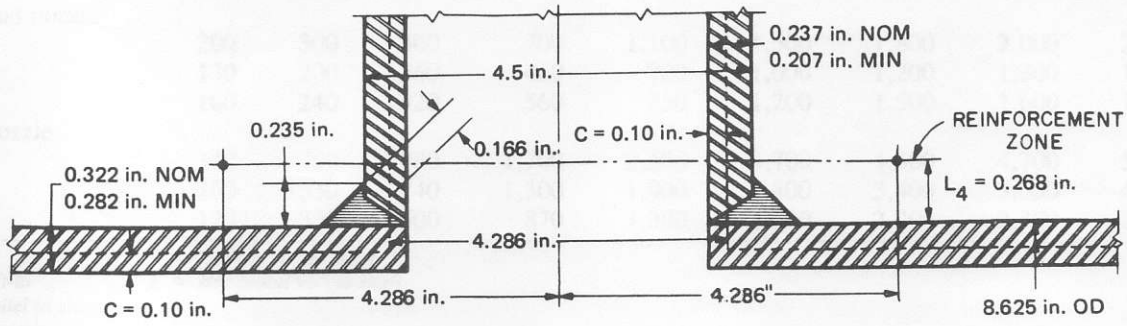


Figure 7-3. Figure of branch reinforcement for use in Example 7-1.

Solution

$SE = 16.0$ ksi.

$T_h = (0.322)\ (0.875) = 0.282$ in.

$T_b = (0.237)\ (0.875) = 0.207$ in.

$L_4 = 2.5(0.282 - 0.1) = 0.455$ in., or
$2.5(0.207 - 0.1) + 0 = 0.268$ in., whichever is less

$L_4 = 0.268$ in.

$d_1 = [4.5 - 2(0.207 - 0.1)]/\sin(90°) = 4.286$ in.

$$d_2 = (0.207 - 0.1) + (0.282 - 0.1) + \frac{4.286}{2}$$

$= 2.432$ in. or d_1, whichever is greater

$d_2 = 4.286$ in.

$$t_h = \frac{(300)\ (8.625)}{(2)\ (16{,}000) + (2)\ (0.4)\ (300)} = 0.080 \text{ in.}$$

$$t_b = \frac{(300)\ (4.500)}{(2)\ (16{,}000) + (2)\ (0.4)\ (300)} = 0.042 \text{ in.}$$

$t_c = 0.7\ (0.237) = 0.166$ in., or
$= 0.25$, whichever is less

$t_c = 0.166$ in.

$$\text{Minimum leg dimension of fillet weld} = \frac{0.166}{0.707}$$

$= 0.235$ in.

Thus, the required area, $A_1 = (0.080)\ (4.286)\ [2 - \sin(90°)] = 0.343$ sq. in.

The reinforcement area:

In run wall; $A_2 = (4.286)\ (0.282 - 0.08 - 0.10) = 0.437$ sq in.

In branch wall, $A_3 = (2)\ (0.268)\ [(0.207 - 0.042) - 0.10] = 0.035$ sq in.

In branch welds, $A_4 = (2)\ (1/2)\ (0.235)^2 = 0.055$ sq in.

The total reinforcement area = 0.527 sq in.

This is more than 0.343 sq in. so that no additional reinforcement is required to sustain the internal pressure.