GAS TRANSMISSION and DISTRIBUTION PIPING SYSTEMS

TENTATIVE
SUBJECT TO REVISION OR WITHDRAWAL
Specific Authorization Required for Reproduction or Quotation
ASME Standards and Certification
804.7.3 Pipe Manufacturing Processes. Types and names of welded joints are used herein according to their common usage as defined in AWS A3.0, or as specifically defined as follows:

(a) double submerged-arc-welded pipe: pipe having a longitudinal or helical butt joint produced by at least two passes, one of which is on the inside of the pipe. Coalescence is produced by heating with an electric arc or arcs between the bare metal electrode or electrodes and the work. The welding is shielded by a blanket of granular, fusible material on the work. Pressure is not used, and filler metal for the inside and outside welds is obtained from the electrode or electrodes. Typical specifications are ASTM A381 and API 5L.

(b) electric-flash-welded pipe: pipe having a longitudinal butt joint wherein coalescence is produced simultaneously over the entire area of abutting surfaces by the heat obtained from resistance to the flow of electric current between the two surfaces, and by the application of pressure after heating is substantially completed. Flashing and upsetting are accompanied by expulsion of metal from the joint. A typical specification is API 5L.

(c) electric-fusion-welded pipe: pipe having a longitudinal butt joint wherein coalescence is produced in the preformed tube by manual or automatic electric-arc welding. The weld may be single or double and may be made with or without the use of filler metal. Typical specifications are ASTM A134 and ASTM A139, which permit single or double welds with or without the use of filler metal. Additional typical specifications are ASTM A671 and ASTM A672, which require both inside and outside welds and the use of filler metal. The most common type of electric-fusion welded pipe is submerged-arc welded (SAW) pipe, which is described in para. 804.7.3(ag), and has typical specifications of ASTM A381 and API 5L.

(b) electric-fusion welded (EFW) pipe: pipe having a longitudinal (straight or helical) butt joint wherein coalescence is produced in the preformed tube by manual or automatic electric-arc welding. The weld may be single or double pass and may be made with or without the use of filler metal. Typical specifications are ASTM A134 and ASTM A139, which permit single or double welds with or without the use of filler metal. Additional typical specifications are ASTM A671, ASTM A672, and ASTM A691, which require both inside and outside welds and the use of filler metal. The most common type of electric-fusion welded pipe is submerged-arc welded (SAW) pipe, which is described in para. 804.7.3(ag), and has typical specifications of ASTM A381 and API 5L.

(c) electric-induction welded (EW) pipe: pipe having one longitudinal (straight or helical) seam produced by low- or high-frequency electric welding. The process of forming a seam is done by electric-resistance welding, wherein the edges to be welded are mechanically pressed together and the heat for welding is generated by the resistance to flow of electric current applied by induction (no electric contact) or conduction. Typical specifications are ASTM A53, ASTM A135, ASTM A333 and API 5L.

(1) high-frequency welded (HFW) pipe: EW pipe produced with a welding current frequency equal to or greater than 70 kHz as stated in API 5L.

(2) low-frequency welded (LFW) pipe: EW pipe produced with a welding current frequency less than 70 kHz as stated in API 5L.

Note: 360 Hz had been a common upper limit for LFW pipe manufactured prior to 1980.
<table>
<thead>
<tr>
<th>ASME B31.8-2018</th>
<th>Revise Pipe Manufacturing Process Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRESENT TEXT with Standards Committee Approved Revisions per Items 17-954 &amp; 17-2554</strong></td>
<td><strong>PROPOSED CHANGES</strong></td>
</tr>
<tr>
<td>(d) electric-resistance-welded pipe: pipe produced in individual lengths or in continuous lengths from coiled skelp and subsequently cut into individual lengths. The resulting lengths have a longitudinal butt joint wherein coalescence is produced by the heat obtained from resistance of the pipe to the flow of electric current in a circuit of which the pipe is a part, and by the application of pressure. Typical specifications are ASTM A53, ASTM A135 and API 5L.</td>
<td>(d) electric-resistance welded (EW or ERW) pipe: see electric-induction welded (EW) pipe.</td>
</tr>
</tbody>
</table>
| (e) furnace butt welded pipe  
(1) bell-welded: furnace-welded pipe produced in individual lengths from cut-length skelp. The pipe’s longitudinal butt joint forge welded by the mechanical pressure is developed in drawing the furnace-heated skelp through a cone-shaped die (commonly known as a welding bell), which serves as a combined forming and welding die. Typical specifications are ASTM A53 and API 5L.  
(2) continuous-welded: furnace-welded pipe produced in continuous lengths from coiled skelp and subsequently cut into individual lengths. The pipe’s longitudinal butt joint is forge-welded by the mechanical pressure developed in rolling the hot-formed skelp through a set of round pass welding rolls. Typical specifications are ASTM A53 and API 5L. | (e) furnace-butt welded, continuous-welded (CW) pipe: furnace-welded pipe produced in continuous lengths from coiled skelp and subsequently cut into individual lengths. The pipe’s longitudinal butt joint is forge-welded by the mechanical pressure developed in rolling the hot-formed skelp through a set of round pass welding rolls. Typical specifications are ASTM A53 and API 5L. |
| (f) seamless pipe: a wrought tubular product made without a welded seam. It is manufactured by hot-working steel and, if necessary, by subsequently cold-finishing the hot-worked tubular product to produce the desired shape, dimensions, and properties. Typical specifications are ASTM A53, ASTM A106, and API 5L. | (f) seamless (SMLS) pipe: pipe without a welded seam, produced by a hot-forming process, which can be followed by cold sizing, cold finishing and/or heat treatment to produce the desired shape, dimensions and properties. Typical specifications are ASTM A53, ASTM A106, ASTM A333 and API 5L. |
| (g) submerged-arc welded (SAW) pipe: pipe having one or two straight seams, or one helical seam, produced by the submerged-arc welding process. At least one submerged-arc welding pass is made on the outside of the pipe. In addition, there is at least one additional SAW pass on the inside of the pipe which results in pipe sometimes described as double submerged-arc welded (DSAW) pipe. The SAW process produces melting and coalescence of metals by heating them with an arc or arcs between a bare metal consumable electrode or electrodes and the work, wherein the arc and molten metal are shielded by a blanket of granular flux. Pressure is not used and part or all of the filler metal is obtained from the electrodes. Typical specifications are ASTM A381 and API 5L. API 5L also allows two straight seams for pipe diameters greater than or equal to 36 in. (914 mm). | (g) submerged-arc welded (SAW) pipe: pipe having one or two straight seams, or one helical seam, produced by the submerged-arc welding process. At least one submerged-arc welding pass is made on the outside of the pipe. In addition, there is at least one additional SAW pass on the inside of the pipe which results in pipe sometimes described as double submerged-arc welded (DSAW) pipe. The SAW process produces melting and coalescence of metals by heating them with an arc or arcs between a bare metal consumable electrode or electrodes and the work, wherein the arc and molten metal are shielded by a blanket of granular flux. Pressure is not used and part or all of the filler metal is obtained from the electrodes. Typical specifications are ASTM A381 and API 5L. API 5L also allows two straight seams for pipe diameters greater than or equal to 36 in. (914 mm). |
### ASME B31.8-2018

### Revise Pipe Manufacturing Process Definitions

<table>
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<th>PROPOSED CHANGES</th>
</tr>
</thead>
</table>
| **814.1.1 Steel Pipe**
  (a) Steel pipe manufactured in accordance with the following standards may be used: |
| NOTE: Information on historic pipe manufacturing processes, including legacy seams such as lap welded, electric-flash welded, single submerged-arc welded, etc., can be found in ASME Research Report, CRTD Vol. 43, “History of Line Pipe Manufacturing in North America”. |
| API 5L [Note (1)] | Line Pipe |
| ASTM A53/A53M | Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless Pipe |
| ASTM A106/A106M | Seamless Carbon Steel Pipe for High-Temperature Service |
| ASTM A134 | Steel, Electric-Fusion (Arc)-Welded Pipe (Sizes NPS 16 and Over) |
| ASTM A135/A135M | Electric-Resistance-Welded Steel Pipe |
| ASTM A139/A139M | Electric-Fusion (Arc)-Welded Steel Pipe (Sizes NPS 4 and Over) |
| ASTM A333/A333M | Seamless and Welded Steel Pipe for Low-Temperature Service |
| ASTM A381 | Metal-Arc-Welded Steel Pipe for Use With High-Pressure Transmission Systems |
| ASTM A671 | Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures |
| ASTM A672 | Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures |
| ASTM A691 | Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High-Pressure Service at High Temperatures |

**NOTE:**
(1) The provisions of API 5L, 45th edition, apply unless otherwise provided for, prohibited by, or limited by this edition of ASME B31.8.
841.1.2 Fracture Control and Arrest

(b) Brittle Fracture Control. To ensure that the pipe has adequate ductility, fracture toughness testing shall be performed in accordance with the testing procedures of supplementary requirements SR5 or SR6 of API 5L (43rd edition) or Annex G of API 5L (45th edition), or other equivalent alternatives. If the operating temperature is below 50°F (10°C), an appropriate lower test temperature shall be used when determining adherence to the minimum impact values in (c) and shear appearance as outlined below. The appropriate lower test temperature shall be taken to be at or below the lowest expected metal temperature during pressure testing (if with air or gas) and during service, having regard to past recorded temperature data and possible effects of lower air and ground temperatures. The average shear value of the fracture appearance of three Charpy specimens from each heat shall not be less than 60%, and the all-heat average for each order per diameter, size, and grade shall not be less than 80%. Alternatively, when dropweight tear testing is specified, at least 80% of the heats shall exhibit a fracture appearance shear area of 40% or more at the specified test temperature.

(c) Ductile Fracture Arrest. To ensure that the pipeline has adequate toughness to arrest a ductile fracture, the pipe shall be tested in accordance with the procedures of supplementary requirements SR5 of API 5L (43rd edition) or Annex G of API 5L (45th edition). The all-heat average of the Charpy energy values shall meet or exceed the energy value calculated using one of the following equations that have been developed in various pipeline research programs:

Equations & Note omitted for convenience.

For API 5L pipe, the minimum impact values shall be the greater of those given by the equations above or those required by API 5L for PSL 2 pipe. Annex G of API 5L (45th edition) contains additional acceptable methodologies for establishing minimum or all heat average Charpy energy values.

For pipe manufactured to other standards where the minimum impact values are specified within that standard, those minimum requirements shall be maintained. In cases where the pipe manufacturing standard does not specify the minimum impact requirements, the minimum impact requirements of API 5L (45th edition) shall be utilized.

Equations & Note omitted for convenience.

For API 5L pipe, the minimum impact values shall be the greater of those given by the equations above or those required by API-5L for PSL 2 pipe. Annex G of API 5L (45th edition) contains additional acceptable methodologies for establishing minimum or all heat average Charpy energy values.

For pipe manufactured to other standards where the minimum impact values are specified within that standard, those minimum requirements shall be maintained. In cases where the pipe manufacturing standard does not specify the minimum impact requirements, the minimum impact requirements of API 5L (45th edition) shall be utilized.

NOTE: The limitations to only PSL 2 pipe in Annex G of API 5L are not applicable.
### 851.4.3 Permanent Field Repair of Welds Having Injurious Defects

(c) If a manufacturing defect is found in a double submerged-arc welded seam or high-frequency ERW seam, a full encirclement welded split sleeve shall be installed.

(d) If a manufacturing defect is discovered in a low frequency ERW weld seam or any seam having a factor $E$ less than 1.0 in Table 841.1.7-1, or if hydrogen stress cracking is found in any weld zone, a full encirclement welded split sleeve designed to carry maximum allowable operating pressure shall be installed.

### MANDATORY APPENDIX A REFERENCES

**A-2 API**

*API Spec 5L (45th Edition, December, 2012, including Errata through April 2015), Specification for Line Pipe*

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NOTES: (1) Underline and blue indicates revised and new text.  
(2) Strikethrough and red indicates deleted text.  
(3) Green indicates revised since the prior ballot. 

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(6/6/20)
<table>
<thead>
<tr>
<th>A-3 ASME</th>
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<tr>
<th>A-6 AWWA</th>
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<thead>
<tr>
<th>A-10 GTI</th>
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</table>
| GRI-00/0154 (2000), Design Guide for Polyethylene Gas Pipes Across Bridges  
GRI-91/0284 (1991), Guidelines for Pipelines Crossing Highways  
Publisher: Gas Technology Institute (GTI), 1700 South Mount Prospect Road, Des Plaines, IL 60018 (www.gastechnology.org) | GRI-00/0154 (2000), Design Guide for Polyethylene Gas Pipes Across Bridges  
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<tr>
<th>A-13 NACE</th>
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</table>
| *ANSI/NACE MR0175/ISO 15156:2015, Petroleum and Natural Gas Industries — Materials for Use in H2S Containing Environments in Oil and Gas Production - Parts 1, 2, and 3  
NACE Corrosion Data Survey (1985)  
NACE SP0169-2013, Control of External Corrosion on Underground or Submerged Metallic Piping Systems  
NACE SP0177-2014, Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems  
Publisher: National Association of Corrosion Engineers (NACE International), 1440 South Creek Drive, Houston, TX 77084-4906 (www.nace.org) | *ANSI/NACE MR0175/ISO 15156:2015, Petroleum and Natural Gas Industries — Materials for Use in H2S Containing Environments in Oil and Gas Production - Parts 1, 2, and 3  
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1 See Note in para. 814.1.1 regarding the use of the 45th edition of API 5L.  
2 This publication has been superseded, withdrawn, or is no longer in print.

### NONMANDATORY APPENDIX C

**PUBLICATIONS THAT DO NOT APPEAR IN THE CODE OR MANDATORY APPENDIX A**

<table>
<thead>
<tr>
<th>C-4 ASME</th>
<th>C-4 ASME</th>
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| *ASME B31.12-2014, Hydrogen Piping and Pipelines  
Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org) | *ASME B31.12-2014, Hydrogen Piping and Pipelines  
Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org) |

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<thead>
<tr>
<th>C-5 ASTM</th>
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</table>
| ASTM A197/A197M-00(R2015), Standard Specification for Cupola Malleable Iron  
ASTM A211-75(R1985), Standard Specification for Spiral-Welded Steel or Iron Pipe  
ASTM A216/A216M-16, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service |
### 843.4.5 Water Piping.

<table>
<thead>
<tr>
<th>Record No. 10-975</th>
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<tbody>
<tr>
<td><strong>843.4.5 Water Piping.</strong></td>
</tr>
<tr>
<td>All water piping within gas compressing stations shall be constructed in accordance with ASME B31.1.</td>
</tr>
</tbody>
</table>

- **(a) Process Water Piping.** Process water piping, including water/glycol, water/ methanol, and similar water admixture piping within gas compressing stations, shall be constructed in accordance with an applicable appropriate ASME B31 piping code Code Section.

- **(b) Plumbing Systems.** Plumbing systems, such as water distribution systems and sanitary drains and vents, shall be constructed in accordance with the International Plumbing Code (IPC), Uniform Plumbing Code (UPC), or other recognized plumbing code in accordance with the prevailing requirements of the authority having jurisdiction.

### 843.4.6 Steam Piping.

<table>
<thead>
<tr>
<th>Record No. 10-975</th>
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<tr>
<td><strong>843.4.6 Steam, Steam Condensate, and Hot Water Utility/Heating Piping.</strong> All steam, steam condensate, and hot water heating/utility water piping within gas compressing stations shall be constructed in accordance with ASME B31.1 or ASME B31.3.</td>
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</tbody>
</table>

- **843.4.6 Steam Piping.** All steam piping within gas compressing stations shall be constructed in accordance with ASME B31.1 or ASME B31.3.

### NOTES:
- (1) Underline and blue indicates revised and new text.
- (2) Strikethrough and red indicates deleted text.
- (3) Green and underlined indicates revised and new text following ballot #13-2827RC101 comments.
- (4) Strikethrough and green indicates deleted text following ballot #13-2827RC101 comments.
A-11 IEEE
A-12 MSS
A-13 NACE
A-14 NFPA
A-15 PPI
A-16 PRCI

A-11 IAPMO
Uniform Plumbing Code (UPC), latest edition
Publisher: International Association of Plumbing and Mechanical Officials (IAPMO), 4755 E. Philadelphia St., Ontario, CA 91761 (www.iapmo.org)

A-12 ICC
International Plumbing Code (IPC), 2015
Publisher: International Code Council (ICC), 500 New Jersey Avenue, NW, 6th Floor, Washington, DC 20001 (www.iccsafe.org)

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A-12 A-14 MSS
A-13 A-15 NACE
A-14 A-16 NFPA
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A-16 A-18 PRCI

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<table>
<thead>
<tr>
<th>Current Text B31.8</th>
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<tr>
<td><strong>803 PIPING SYSTEMS</strong></td>
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<tr>
<td><strong>DEFINITIONS</strong></td>
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<tr>
<td><strong>803.1 General Terms and Definitions</strong></td>
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<td>****</td>
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<td>gas: as used in this Code, is any gas or mixture of gases suitable for domestic or industrial fuel and transmitted or distributed to the user through a piping system. The common types are natural gas, manufactured gas, and liquefied petroleum gas distributed as a vapor, with or without the admixture of air.</td>
<td>gas: as used in this Code, is any hydrocarbon vapor gas or mixture of hydrocarbon vapor gases suitable for use as, or for processing into, domestic or industrial fuel or process feedstock and transmitted or distributed to the user through a piping system. The common types are natural gas, manufactured gas, and liquefied petroleum gas distributed as a vapor, with or without the admixture of air other components.</td>
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<tr>
<td>Current Code Language:</td>
<td>Proposed modification:</td>
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<tr>
<td>834.5 Attachments of Supports and Anchors</td>
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<td>(a) If the pipe is designed to operate at a hoop stress of less than 50% of the specified minimum yield strength, structural supports or anchors may be welded directly to the pipe. Proportioning and welding strength requirements of such attachments shall conform to standard structural practice.</td>
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<td>(b) If the pipe is designed to operate at a hoop stress of 50% or more of the specified minimum yield strength, structural supports or anchors shall not be welded directly to the pipe. Where it is necessary to provide a welded attachment, structural supports or anchors shall be welded to a member that fully encircles the pipe. The connection of the pipe to the encircling member shall be by continuous, rather than intermittent, welds, or by use of a bolted or clamped mechanical connection.</td>
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<tr>
<td>Proposed modification:</td>
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<td></td>
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<tr>
<td>(a) The method of attachment of supports and anchors to pipe shall be such that the pipe can be visually inspected for external corrosion and wear at the interface of the pipe and the support or anchor, or shall be such that corrosion and wear at the interface of the pipe and the support or anchor is prevented.</td>
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**Color key:**
- Red, underlined: proposed language included for current re-ballot
- Red, strike-through: proposed language to be removed in current re-ballot
<table>
<thead>
<tr>
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<tr>
<td><strong>831.4.1 General Requirements.</strong> All welded branch connections shall meet the following requirements:</td>
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<td>(a) When branch connections are made to pipe in the form of a single connection or in a header or manifold as a series of connections, the design must be adequate to control the stress levels in the pipe within safe limits. The construction shall accommodate the stresses in the remaining pipe wall due to the opening in the pipe or header, the shear stresses produced by the pressure acting on the area of the branch opening, and any external loadings due to thermal movement, weight, vibration, etc. The following paragraphs provide design rules for the usual combinations of the above loads, except for excessive external loads.</td>
<td>(a) When branch connections are made to pipe in the form of a single connection or in a header or manifold as a series of connections, the design must be adequate to control the stress levels in the pipe within safe limits. The construction shall accommodate the stresses in the remaining pipe wall due to the opening in the pipe or header, the shear stresses produced by the pressure acting on the area of the branch opening, and any external loadings due to thermal movement, weight, vibration, etc. The following paragraphs provide design rules for the usual combinations of the above loads, except for excessive external loads.</td>
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<td>(b) The reinforcement required in the crotch section of a welded branch connection shall be determined by the rule that the metal area available for reinforcement shall be equal to or greater than the required area as defined in this paragraph as well as in Mandatory Appendix F, Figure F-5.</td>
<td>(b) The reinforcement required in the crotch section of a welded branch connection shall be determined by the rule that the metal area available for reinforcement shall be equal to or greater than the required area as defined in this paragraph as well as in Mandatory Appendix F, Figure F-5.</td>
</tr>
<tr>
<td>(c) The required cross-sectional area, ( AR ), is defined as the product of ( d ) times ( t ): ( AR = dt ) where ( d ) = the greater of the length of the finished opening in the header wall measured parallel to the axis of the run or the inside diameter of the branch connection ( t ) = the nominal header wall thickness required by para. 841.1.1 for the design pressure and temperature When the pipe wall thickness includes an allowance for corrosion or erosion, all dimensions used shall result after the anticipated corrosion or erosion has taken place.</td>
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header as defined in (c) and that lies within the reinforcement area as defined in (e)
(2) the cross-sectional area that results from any excess thickness available in the branch wall thickness over the minimum thickness required for the branch and that lies within the reinforcement area as defined in (e)
(3) the cross-sectional area of all added reinforcing metal that lies within the reinforcement area, as defined in (e), including that of solid weld metal that is conventionally attached to the header and/or branch
(e) The area of reinforcement, shown in Mandatory Appendix F, Figure F-5, is defined as a rectangle whose length shall extend a distance, \(d\), on each side of the transverse centerline of the finished opening and whose width shall extend a distance of 21/2 times the header wall thickness on each side of the surface of the header wall. In no case, however, shall it extend more than 21/2 times the thickness of the branch wall from the outside surface of the header or of the reinforcement, if any.
(f) The material of any added reinforcement shall have an allowable working stress at least equal to that of the header wall, except that material of lower allowable stress may be used if the area is increased in direct ratio of the allowable stress for header and reinforcement material, respectively.
(g) The material used for ring or saddle reinforcement may be of specifications differing from those of the pipe, provided the cross-sectional area is made in direct proportion to the relative strength of the pipe and reinforcement materials at the operating temperatures and provided it has welding qualities comparable to those of the pipe. No credit shall be taken for the additional strength of material having a higher strength than that of the part to be reinforced.
(h) When rings or saddles cover the weld between branch and header, a vent hole shall be provided in the ring or saddle to reveal leakage in the weld between branch and header and to provide venting during welding and heat treating operations. Vent holes should
be plugged during service to prevent crevice corrosion between pipe and reinforcing member, but no plugging material that would be capable of sustaining pressure within the crevice should be used.  

(i) The use of ribs or gussets shall not be considered as contributing to reinforcement of the branch connection. This does not prohibit the use of ribs or gussets for purposes other than reinforcement, such as stiffening.  

(j) The branch shall be attached by a weld for the full thickness of the branch or header wall plus a fillet weld, $W_1$, as shown in Mandatory Appendix I, Figures I-1 and I-2. The use of concave fillet welds is preferred to further minimize corner stress concentration. Ring or saddle reinforcement shall be attached as shown by Figure I-2. When a full fillet is not used, it is recommended that the edge of the reinforcement be relieved or chamfered at approximately 45 deg to merge with the edge of the fillet.  

(k) Reinforcement rings and saddles shall be accurately fitted to the parts to which they are attached. Mandatory Appendix I, Figures I-2 and I-3 illustrate some acceptable forms of reinforcement.  

(l) Branch connections attached at an angle less than 85 deg to the run become progressively weaker as the angle decreases. Any such design must be given individual study, and sufficient reinforcement must be provided to compensate for the inherent weakness of such construction. The use of encircling ribs to support the flat or re-entering surfaces is permissible and may be included in the strength calculations. The designer is cautioned that stress concentrations near the ends of partial ribs, straps, or gussets may defeat their reinforcing value.

| 831.4.2 Special Requirements. In addition to the requirements of para. 831.4.1, branch connections must meet the special... | 831.4.2 Special Requirements. In addition to the requirements of para. 831.4.1, branch connections must meet the special... |
requirements of the following paragraphs as given in Table 831.4.2-1:

(a) Smoothly contoured wrought steel tees of proven design are preferred. When tees cannot be used, the reinforcing member shall extend around the circumference of the header. Pads, partial saddles, or other types of localized reinforcement are prohibited.

(b) Smoothly contoured tees of proven design are preferred. When tees are not used, the reinforcing member should be of the complete encirclement type, but may be of the pad type, saddle type, or a welding outlet fitting type.

(c) The reinforcement member may be of the complete encirclement type, pad type, saddle type, or welding outlet fitting type. The edges of reinforcement members should be tapered to the header thickness. It is recommended that legs of fillet welds joining the reinforcing member and header do not exceed the thickness of the header.

(d) Reinforcement calculations are not required for openings 2 in. (51 mm) and smaller in diameter; however, care should be taken to provide suitable protection against vibrations and other external forces to which these small openings are frequently subjected.

(e) All welds joining the header, branch, and reinforcing member shall be equivalent to those shown in Mandatory Appendix I, Figures I-1, I-2, and I-3.

(f) The inside edges of the finished opening shall, whenever possible, be rounded to a 1/8 in. (3.2 mm) radius. If the encircling member is thicker than the header and is welded to the header, the ends shall be tapered down to the header thickness, and continuous fillet welds shall be made. In the case of hot tap or plugging fittings, use special requirement (j).

(g) Reinforcement of openings is not mandatory; however, reinforcement may be required for special cases involving pressures over 100 psig (690 kPa), thin wall pipe, or severe external loads.

(h) If a reinforcement member is required, and the branch diameter is such that a localized type of reinforcement member would extend around more than half the circumference of the header, then a complete encirclement type of reinforcement member shall be used.
reinforcement member shall be used, regardless of the design hoop stress, or a smoothly contoured wrought steel tee of proven design may be used.

(i) The reinforcement may be of any type meeting the requirements of para. 831.4.1.

(j) For hot tap or plugging fittings of tee-type configurations (see Figure I-3.1), where the reinforcing sleeve is pressurized and thicker than the header, and the application results in additional loading such as that from hot tapping and plugging equipment, the following requirements apply:

(1) The minimum leg dimension of the fillet weld at the ends of the sleeve shall be 1.0\(t\) plus the gap observed or measured between the inside of the fitting and the outside of the pipe on installation, where \(t\) is the actual wall thickness of the pipe. This will result in a minimum effective weld throat of 0.7\(t\).

(2) The maximum leg dimension of the end fillet welds shall be 1.4\(t\) plus the gap observed or measured between the inside of the fitting and the outside of the pipe on installation, resulting in an effective weld throat not to exceed 1.0\(t\).

(3) If necessary, the fittings shall be tapered, beveled, or chamfered at their ends to a minimum approximate angle of 45 deg (with respect to the end face). Tapering, beveling, or chamfering should provide at least a nominal face to accommodate the fillet weld, but the face dimension should not exceed 1.4 times the calculated thickness required to meet the maximum hoop stress of the pressurized sleeve. The leg of the fillet deposited on the end face need not be carried out fully to the shoulder of the face if doing so would result in an oversized fillet weld.

(4) Because each installation may be unique, the taper or chamfer shall be the responsibility of the user or otherwise by agreement between user and manufacturer.

(k) MSS SP-97 fittings can be used up to one-half the size of the run pipe provided the following guidelines requirements are met.

(1) The branch outlet fitting design by either calculation or proof testing shall meet SP-97
guidelines requirements and fully reinforce the hole cut into the pipe.

(2) The material of the fitting shall be equal to or greater in strength to than the run pipe to which these will be inserted on welded. If the properties of the fitting do not match that of the pipe, additional reinforcement to compensate for the lower strength can shall be added proportionally.

(3) Fittings shall be fitted and installed using a full penetration weld with guidance from the manufacturer on weld contour.

(3 4) The outlet connection can be socket welded, threaded or butt weldeding. The connecting branch pipe can be any thickness provided it meets the design wall requirements for the service. Outlet sizes greater than one-half can be considered if additional engineering assessment is made.

In addition, Table E-1 for "Branch welded-on fitting (integrally reinforced) should be revised as shown below.
Branch welded-on fitting (integrally Reinforced), per in accordance with MSS SP-97 (Notes (1), (2), (9), and (11))
### Table 841.1.7-1 Longitudinal Weld Joint Quality Factor, $E$

<table>
<thead>
<tr>
<th>Spec. No.</th>
<th>Pipe Class</th>
<th>$E$ Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A53</td>
<td>Seamless</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Electric-resistance welded</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Furnace-buttwelded, continuous weld</td>
<td>0.60</td>
</tr>
<tr>
<td>ASTM A106</td>
<td>Seamless</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A134</td>
<td>Electric-fusion arc-welded</td>
<td>0.80</td>
</tr>
<tr>
<td>ASTM A135</td>
<td>Electric-resistance welded</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A139</td>
<td>Electric-fusion arc-welded</td>
<td>0.80</td>
</tr>
<tr>
<td>ASTM A333</td>
<td>Seamless</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Electric-resistance welded</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A381</td>
<td>Submerged-arc welded</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A671</td>
<td>Electric-fusion welded</td>
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<td>Classes 13, 23, 33, 43, 53</td>
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<tr>
<td></td>
<td>Classes 12, 22, 32, 42, 52</td>
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<td>ASTM A672</td>
<td>Electric-fusion welded</td>
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<td>Classes 13, 23, 33, 43, 53</td>
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<td>Classes 12, 22, 32, 42, 52</td>
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<td>API 5L</td>
<td>Electric welded</td>
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<td></td>
<td>Seamless</td>
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</tr>
<tr>
<td></td>
<td>Submerged-arc welded (straight seam</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>or helical seam)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Furnace-buttwelded, continuous weld</td>
<td>0.60</td>
</tr>
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</table>

**GENERAL NOTE:** Definitions for the various classes of welded pipe are given in para. 804.7.3.
### Table D-1
Specified Minimum Yield Strength for Steel Pipe Commonly Used in Piping Systems

<table>
<thead>
<tr>
<th>Spec No.</th>
<th>Grade</th>
<th>Type [Note (1)]</th>
<th>SMYS, psi (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>API 5L [Note (2)]</td>
<td>A25</td>
<td>BW, ERW, S</td>
<td>25,000 (172)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>A</td>
<td>ERW, S, DSA</td>
<td>30,000 (207)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>B</td>
<td>ERW, S, DSA</td>
<td>35,000 (241)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>X42</td>
<td>ERW, S, DSA</td>
<td>42,000 (290)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>X46</td>
<td>ERW, S, DSA</td>
<td>46,000 (317)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>X52</td>
<td>ERW, S, DSA</td>
<td>52,000 (359)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>X56</td>
<td>ERW, S, DSA</td>
<td>56,000 (386)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
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<td>ERW, S, DSA</td>
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<tr>
<td>API 5L [Note (2)]</td>
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<td>ERW, S, DSA</td>
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<tr>
<td>API 5L [Note (2)]</td>
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<td>ERW, S, DSA</td>
<td>80,000 (552)</td>
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<tr>
<td>ASTM A53</td>
<td>B</td>
<td>ERW, S</td>
<td>35,000 (241)</td>
</tr>
<tr>
<td>ASTM A106</td>
<td>A</td>
<td>S</td>
<td>30,000 (207)</td>
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<tr>
<td>ASTM A106</td>
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<td>S</td>
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<tr>
<td>ASTM A106</td>
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<td>B</td>
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<td>ASTM A139</td>
<td>A</td>
<td>EFW</td>
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<td>B</td>
<td>EFW</td>
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<td>C</td>
<td>EFW</td>
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<td>6</td>
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<td>7</td>
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<td>9</td>
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<td>ASTM A381</td>
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<td>Class Y-46</td>
<td>DSA</td>
<td>46,000 (317)</td>
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<td>Class Y-48</td>
<td>DSA</td>
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<td>Class Y-50</td>
<td>DSA</td>
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<tr>
<td>ASTM A381</td>
<td>Class Y-52</td>
<td>DSA</td>
<td>52,000 (359)</td>
</tr>
<tr>
<td>ASTM A381</td>
<td>Class Y-56</td>
<td>DSA</td>
<td>56,000 (386)</td>
</tr>
<tr>
<td>ASTM A381</td>
<td>Class Y-60</td>
<td>DSA</td>
<td>60,000 (414)</td>
</tr>
<tr>
<td>ASTM A381</td>
<td>Class Y-65</td>
<td>DSA</td>
<td>65,000 (448)</td>
</tr>
</tbody>
</table>

**Notes:**
1. Abbreviations: BW = furnace buttwelded; DSA = double submerged-arc welded; EFW = electric-fusion welded; ERW = electric-resistance welded; S = seamless.
2. Intermediate grades are available in API 5L.
3. See applicable plate specification for SMYS.

**General Note:** This table is not complete. For the minimum specified yield strength grades in other approved specifications, refer to the particular specification.
### Table D-1

**Specified Minimum Yield Strength for Steel Pipe Commonly Used in Piping Systems**

<table>
<thead>
<tr>
<th>Spec No.</th>
<th>Grade</th>
<th>Type [Note (1)]</th>
<th>SMYS, psi (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>API 5L [Note (2)]</td>
<td>A25</td>
<td>BW, ERW, LW, FH, HFW, SMLS, EW, SML</td>
<td>25,000 (172)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>A</td>
<td>ERW, LW, FH, HFW, SMLS, DSAW, SAWH, COW, COWL</td>
<td>30,000 (207)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>B</td>
<td>ERW, LW, FH, HFW, SMLS, DSAW, SAWH, COW, COWL</td>
<td>35,000 (241)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>X42</td>
<td>ERW, FH, HFW, SMLS, DSAW, SAWH, COW, COWL</td>
<td>42,000 (289)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>X46</td>
<td>ERW, FH, HFW, SMLS, DSAW, SAWH, COW, COWL</td>
<td>46,000 (317)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>X52</td>
<td>ERW, FH, HFW, SMLS, DSAW, SAWH, COW, COWL</td>
<td>52,000 (352)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>X56</td>
<td>ERW, FH, HFW, SMLS, DSAW, SAWH, COW, COWL</td>
<td>56,000 (386)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>X60</td>
<td>ERW, FH, HFW, SMLS, DSAW, SAWH, COW, COWL</td>
<td>60,000 (414)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>X65</td>
<td>ERW, FH, HFW, SMLS, DSAW, SAWH, COW, COWL</td>
<td>65,000 (448)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>X70</td>
<td>ERW, FH, HFW, SMLS, DSAW, SAWH, COW, COWL</td>
<td>70,000 (483)</td>
</tr>
<tr>
<td>API 5L [Note (2)]</td>
<td>X80</td>
<td>ERW, FH, HFW, SMLS, DSAW, SAWH, COW, COWL</td>
<td>80,000 (552)</td>
</tr>
</tbody>
</table>

**Notes:**

1. Underline and blue indicates revised and new text.
2. Strikethrough and red indicates deleted text.
3. See applicable plate specification for SMYS.

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

**NOTES:**

1. Abbreviations: **BW** = furnace butt-welded; **DSA** = double submerged-arc welded; **SAW** = saw with straight seam; **SAWH** = saw with helical seam; **EFW** = electric-fusion welded; **ERW** = electric-resistance welded; **LFW** = weld with low-frequency; **FH** = weld with high-frequency; **S** or **SMLS** = seamless; **CW** or **F** = COW or COWL = combination weld with straight seam.
2. Intermediate grades are available in API 5L.
3. See applicable plate specification for SMYS.
<table>
<thead>
<tr>
<th>ASME B31.8-2018 EDITION</th>
<th>Update Appendices D &amp; F concerning API Spec 5L</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRESENT TEXT with Standard Committee Approved Revisions per Items 17-2552 &amp; 17-2554</td>
<td>PROPOSED CHANGES</td>
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<td>A-4 ASTM</td>
<td>A-4 ASTM</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
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</tbody>
</table>

NOTES:  
1) Underline and blue indicates revised and new text.  
2) Strikethrough and red indicates deleted text
F-2 EXAMPLES ILLUSTRATING THE APPLICATION OF THE RULES FOR REINFORCEMENT OF WELDED BRANCH CONNECTIONS

F-2.1 Example 1

An NPS 8 outlet is welded to an NPS 24 header. The header material is API 5LX 46 with a 0.312 in. wall. The outlet is API 5L Grade B (Seamless) Schedule 40 with a 0.322 in. wall. The working pressure is 650 psig. The fabrication is in Location Class 1. Using para. 841.1, the longitudinal weld joint quality factor is 1.00. The temperature is 100°F. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Fig. F-6.

**F-2.1.1 Header.** Nominal wall thickness required:

$$t = \frac{PD}{2SFET} = \frac{650 \times 24}{2 \times 46,000 \times 0.60 \times 1.00 \times 1.00}$$

$$= 0.283 \text{ in.}$$

Excess thickness in header wall:

$$H - t = 0.312 - 0.283 = 0.029 \text{ in.}$$

**F-2.1.2 Outlet.** Nominal wall thickness required:

$$tb = \frac{650 \times 8.625}{2 \times 35,000 \times 0.60 \times 1.00 \times 1.00}$$

$$= 0.133 \text{ in.}$$

Excess thickness in outlet wall:

$$B - tb = 0.322 - 0.133 = 0.189 \text{ in.}$$

$$d = \text{inside diameter of opening} = 8.625 - 2 \times 0.322$$

$$= 7.981 \text{ in.}$$

---

**F-2.1 Example 1**

An NPS 8 outlet is welded to an NPS 24 header. The header material is API 5LX 46 with a 0.312 in. wall. The outlet is API 5L Grade B (Seamless) Schedule 40 with a 0.322 in. wall. The working pressure is 650 psig. The fabrication is in Location Class 1. Using para. 841.1, the longitudinal weld joint quality factor is 1.00. The temperature is 100°F. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Fig. F-6.

**F-2.1.1 Header.** Nominal wall thickness required:

$$t = \frac{PD}{2SFET} = \frac{650 \times 24}{2 \times 46,000 \times 0.60 \times 1.00 \times 1.00}$$

$$= 0.283 \text{ in.}$$

Excess thickness in header wall:

$$H - t = 0.312 - 0.283 = 0.029 \text{ in.}$$

**F-2.1.2 Outlet.** Nominal wall thickness required:

$$tb = \frac{650 \times 8.625}{2 \times 35,000 \times 0.60 \times 1.00 \times 1.00}$$

$$= 0.133 \text{ in.}$$

Excess thickness in outlet wall:

$$B - tb = 0.322 - 0.133 = 0.189 \text{ in.}$$

$$d = \text{inside diameter of opening} = 8.625 - 2 \times 0.322$$

$$= 7.981 \text{ in.}$$
ASME B31.8-2018 EDITION Update Appendices D & F concerning API Spec 5L

<table>
<thead>
<tr>
<th>PRESENT TEXT with Standard Committee Approved Revisions per Items 17-2552 &amp; 17-2554</th>
<th>PROPOSED CHANGES</th>
</tr>
</thead>
</table>
| **F-2.1.3 Reinforcement Required**  
\[ A_R = d \times t = 7.981 \times 0.283 = 2.259 \text{ in}^2 \] | **F-2.1.3 Reinforcement Required**  
\[ A_R = d \times t = 7.981 \times 0.283 = 2.259 \text{ in}^2 \]  
\[ A_R = d \times t = 7.981 \times 0.280 = 2.235 \text{ in}^2 \] |
| **F-2.1.4 Reinforcement Provided by Header**  
\[ A_1 = (H - t) \times d = 0.029 \times 7.981 = 0.231 \text{ in}^2 \] | **F-2.1.4 Reinforcement Provided by Header**  
\[ A_1 = (H - t) \times d = 0.029 \times 7.981 = 0.231 \text{ in}^2 \]  
\[ A_1 = (H - t) \times d = 0.032 \times 7.981 = 0.255 \text{ in}^2 \] |
| **F-2.1.5 Effective Area in Outlet**  
Height \( L = 2\frac{1}{2}B + M \) (assume \( \frac{1}{4} \) in. pad)  
\[ = (2\frac{1}{2} \times 0.322) + 0.25 = 1.055 \text{ in.} \]  
or \( L = 2\frac{1}{2}H = 2.5 \times 0.312 = 0.780 \text{ in.} \) Use \( L = 0.780 \text{ in.} \)  
\[ A_2 = 2(B - t_b) \times L = 2 \times 0.189 \times 0.780 = 0.295 \text{ in}^2 \]  
This must be multiplied by 35,000/46,000. [See para. 831.4.1(f)]  
\[ \text{Effective } A_2' = 0.295 \times \frac{35,000}{46,000} = 0.224 \text{ in}^2 \]  
Required area:  
\[ A_3 = A_R - A_1 - A_2' = 2.259 - 0.231 - 0.224 = 1.804 \text{ in}^2 \]  
Use a reinforced plate that is 0.250 in. thick (minimum practicable) \( \times 15.5 \text{ in.} \) in diameter.  
\[ \text{Area} = (15.500 - 8.625) \times 0.250 = 1.719 \text{ in}^2 \]  
Fillet welds (assuming two \( \frac{1}{4} \) in. welds each side):  
\[ \frac{1}{2} (0.25 \times 0.25) \times 4 = 0.125 \text{ in}^2 \]  
Total \( A_3 \) provided = 1.844 in.\(^2\)  
See also Fig. F-5. | **F-2.1.5 Effective Area in Outlet**  
Height \( L = 2\frac{1}{2}B + M \) (assume \( \frac{1}{4} \) in. pad)  
\[ = (2\frac{1}{2} \times 0.322) + 0.25 = 1.055 \text{ in.} \]  
or \( L = 2\frac{1}{2}H = 2.5 \times 0.312 = 0.780 \text{ in.} \) Use \( L = 0.780 \text{ in.} \)  
\[ A_2 = 2(B - t_b) \times L = 2 \times 0.189 \times 0.780 = 0.295 \text{ in}^2 \]  
\[ A_2 = 2(B - t_b) \times L = 2 \times 0.190 \times 0.780 = 0.296 \text{ in}^2 \]  
This must be multiplied by 35,000/46,000. [See para. 831.4.1(f)]  
\[ \text{Effective } A_2' = 0.295 \times \frac{35,000}{46,000} = 0.224 \text{ in}^2 \]  
\[ \text{Effective } A_2' = 0.296 \times \frac{35,500}{46,400} = 0.226 \text{ in}^2 \]  
Required area:  
\[ A_3 = A_R - A_1 - A_2' = 2.259 - 0.231 - 0.224 = 1.804 \text{ in}^2 \]  
\[ A_3 = A_R - A_1 - A_2' = 2.235 - 0.255 - 0.226 = 1.754 \text{ in}^2 \]  
Use a reinforced plate that is 0.250 in. thick (minimum practicable) \( \times 15.5 \text{ in.} \) in diameter.  
\[ \text{Area} = (15.500 - 8.625) \times 0.250 = 1.719 \text{ in}^2 \]  
Fillet welds (assuming two \( \frac{1}{4} \) in. welds each side):  
\[ \frac{1}{2} (0.25 \times 0.25) \times 4 = 0.125 \text{ in}^2 \]  
Total \( A_3 \) provided = 1.844 in.\(^2\)  
See also Fig. F-5. |
## F-2.1M Example 1M

A DN 200 outlet is welded to a DN 600 header. The header material is 317.2 MPa API 5L Grade L320 with a 7.92 mm wall. The outlet is 241.3 MPa API 5L Grade L245 (Seamless) with a 8.18 mm wall. The working pressure is 4.48 MPa. The fabrication is in Location Class 1. Using para. 841.1, the longitudinal weld joint quality factor is 1.00. The temperature is 37.8°C. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Fig. F-6.

### F-2.1M Header

Nominal wall thickness required:

$$ t = \frac{PD}{2SFET} = \frac{4.48 \times 609.6}{2 \times 317.16 \times 0.60 \times 1.00 \times 1.00} $$

$$ t = 7.178 \text{ mm} $$

Excess thickness in header wall:

$$ H - t = 7.925 - 7.178 = 0.747 \text{ mm} $$

### F-2.1M Outlet

Nominal wall thickness required:

$$ t_b = \frac{4.48 \times 219.1}{2 \times 241.32 \times 0.60 \times 1.00 \times 1.00} $$

$$ t_b = 3.390 \text{ mm} $$

Excess thickness in outlet wall:

$$ B - t_b = 8.179 - 3.390 = 4.788 \text{ mm} $$

$$ d = \text{inside diameter of opening} = 219.08 - 2 \times 8.179 $$

$$ d = 202.72 \text{ mm} $$

### F-2.1M Reinforcement Required

$$ A_R = d \cdot t = 202.72 \times 7.178 = 1455.2 \text{ mm}^2 $$

### F-2.1M Reinforcement Provided by Header

$$ A_1 = (H - t) \cdot d = 0.747 \times 202.72 = 151.34 \text{ mm}^2 $$

### F-2.1.1M Header

Nominal wall thickness required:

$$ t = \frac{PD}{2SFET} = \frac{4.48 \times 609.6}{2 \times 317.16 \times 0.60 \times 1.00 \times 1.00} $$

$$ t = 7.178 \text{ mm} $$

$$ t = 7.112 \text{ mm} $$

Excess thickness in header wall:

$$ H - t = 7.925 - 7.178 = 0.747 \text{ mm} $$

$$ H - t = 7.925 - 7.112 = 0.813 \text{ mm} $$

### F-2.1.2M Outlet

Nominal wall thickness required:

$$ t_b = \frac{4.48 \times 219.1}{2 \times 241.32 \times 0.60 \times 1.00 \times 1.00} $$

$$ t_b = 3.390 \text{ mm} $$

Excess thickness in outlet wall:

$$ B - t_b = 8.179 - 3.390 = 4.788 \text{ mm} $$

$$ B - t_b = 8.179 - 3.339 = 4.840 \text{ mm} $$

$$ d = \text{inside diameter of opening} = 219.08 - 2 \times 8.179 $$

$$ d = 202.72 \text{ mm} $$

### F-2.1.3M Reinforcement Provided by Header

$$ A_1 = (H - t) \cdot d = 0.747 \times 202.72 = 151.34 \text{ mm}^2 $$

$$ A_1 = (H - t) \cdot d = 0.813 \times 202.72 = 164.81 \text{ mm}^2 $$
## F-2.1.5M Effective Area in Outlet

Height \( L = \frac{1}{2}B + M \) (assume 6.35 mm pad)  
\[ L = \left(\frac{1}{2} \times 8.179\right) + 6.35 = 26.797 \text{ mm} \]

or \( L = \frac{1}{2}H = 2.5 \times 7.92 = 19.812 \text{ mm} \) Use \( L = 19.812 \text{ mm} \)

\[ A_2 = 2(B - t_b) \times L = 2 \times 4.788 \times 19.812 \]
\[ = 189.73 \text{ in.}^2 \]

This must be multiplied by 241.3/317.2. [See para. 831.4.1(f)]

Effective \( A'_{2} = 189.73 \times \frac{241.3}{317.2} = 144.36 \text{ mm}^2 \)

Required area:

\[ A_3 = A_R - A_1 - A'_{2} \]
\[ = 1455.2 - 151.34 - 144.36 = 1 \text{ 159.5 mm}^2 \]

Use a reinforced plate that is 6.35 mm thick (minimum practicable) \( \times 393.7 \text{ mm in diameter.} \)

\[ \text{Area} = (393.7 - 219.1) \times 6.35 = 1 \text{ 108.9 mm}^2 \]

Fillet welds (assuming two 6.35 mm welds each side):

\[ \frac{1}{2} (6.35 \times 6.35) \times 4 = 80.65 \text{ mm}^2 \]

Total \( A_3 \) provided = 1 189.5 mm²

See also Fig. F-5.

## F-2.2 Example 2

An NPS 16 outlet is welded to an NPS 24 header. The header material is API 5LX 46 with a 0.312 in. wall. The outlet is API 5L Grade B (Seamless) Schedule 20 with a 0.312 in. wall. The working pressure is 650 psig. The fabrication is in Location Class 1. By para. 841.4.2, the reinforcement must be of the complete encirclement type. Using para. 841.1, the longitudinal weld joint quality factor is 1.00. The temperature is 100°F. Design factors \( F = 0.60, E = 1.00, \) and \( T = 1.00. \) For dimensions, see Fig. F-7.
<table>
<thead>
<tr>
<th>F-2.2.1 Header.</th>
<th>Nominal wall thickness required:</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t = \frac{PD}{2SFET} \times 650 \times 24 \times \frac{2 \times 1 \text{x}}{46,000 \times 0.6 \times 1.0 \times 1.0} )</td>
<td>( t = \frac{PD}{2SFET} \times \frac{650 \times 24}{2 \times 46,000 \times 0.6 \times 1.0 \times 1.0} )</td>
</tr>
<tr>
<td>= 0.283 in.</td>
<td>= 0.280 in.</td>
</tr>
</tbody>
</table>

Excess thickness in header wall:
\( H - t = 0.312 - 0.283 = 0.029 \text{ in.} \)

<table>
<thead>
<tr>
<th>F-2.2.2 Outlet.</th>
<th>Nominal wall thickness required:</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_b = \frac{650 \times 16}{2 \times 35,000 \times 0.6 \times 1.0 \times 1.0} )</td>
<td>( t_b = \frac{650 \times 16}{2 \times 35,500 \times 0.6 \times 1.0 \times 1.0} )</td>
</tr>
<tr>
<td>= 0.248 in.</td>
<td>= 0.244 in.</td>
</tr>
</tbody>
</table>

Excess thickness in outlet wall:
\( B - t_b = 0.312 - 0.248 = 0.064 \text{ in.} \)
\( d = \text{inside diameter of opening} = 16.000 - 2 \times 0.312 \)
\( d = 15.376 \text{ in.} \)

| F-2.2.3 Reinforcement Required | \( A_R = d \times t = 15.376 \times 0.283 = 4.351 \text{ in.}^2 \) |

<p>| F-2.2.4 Reinforcement Provided by Header | ( A_1 = (H - t) \times d = 0.029 \times 15.376 = 0.446 \text{ in.}^2 ) |</p>
<table>
<thead>
<tr>
<th>F-2.2.5 Effective Area in Outlet</th>
<th>F-2.2.5 Effective Area in Outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height $L = 2\frac{1}{2}B + M$ (assume 5/16 in. plate) $= (2\frac{1}{2} \times 0.312) + 0.312 = 1.092$ in.</td>
<td>Height $L = 2\frac{1}{2}B + M$ (assume 5/16 in. plate) $= (2\frac{1}{2} \times 0.312) + 0.312 = 1.092$ in.</td>
</tr>
<tr>
<td>$L = 2\frac{1}{2}H = 2.5 \times 0.312 = 0.780$ in. Use $L = 0.780$ in.</td>
<td>$L = 2\frac{1}{2}H = 2.5 \times 0.312 = 0.780$ in. Use $L = 0.780$ in.</td>
</tr>
<tr>
<td>$A_2 = 2(B - t_b) L = 2 \times 0.064 \times 0.780 = 0.100$ in.$^2$</td>
<td>$A_2 = 2(B - t_b) L = 2 \times 0.068 \times 0.780 = 0.106$ in.$^2$</td>
</tr>
<tr>
<td>This must be multiplied by 35,000/46,000. [See para. 831.4.1(f).]</td>
<td>This must be multiplied by $\frac{35,000}{46,000} \approx 0.076$ in.$^2$</td>
</tr>
<tr>
<td>Effective $A'_2 = 0.100 \times \frac{35,000}{46,000} = 0.076$ in.$^2$</td>
<td>Effective $A'_2 = 0.106 \times \frac{35,000}{46,000} = 0.081$ in.$^2$</td>
</tr>
<tr>
<td>Required area:</td>
<td>Required area:</td>
</tr>
<tr>
<td>$A_3 = A_R - A_1 - A'_2$</td>
<td>$A_3 = A_R - A_1 - A'_2$</td>
</tr>
<tr>
<td>$4.351 - 0.446 - 0.076 = 3.829$ in.$^2$</td>
<td>$4.305 - 0.492 - 0.081 = 3.732$ in.$^2$</td>
</tr>
<tr>
<td>Approximate required thickness of reinforcement:</td>
<td>Approximate required thickness of reinforcement:</td>
</tr>
<tr>
<td>$3.829 / (30 - 16) = 0.274$ in.</td>
<td>$3.829 / (30 - 16) = 0.274$ in.</td>
</tr>
<tr>
<td>Use a 0.312 in. plate minimum required length (neglecting welds):</td>
<td>Use a 0.312 in. plate minimum required length (neglecting welds):</td>
</tr>
<tr>
<td>$3.829 / 0.312 = 12.272$ in.</td>
<td>$3.829 / 0.312 = 12.272$ in.</td>
</tr>
<tr>
<td>$16 + 12.272 = 29$ in. (rounded to the next higher whole number)</td>
<td>$16 + 11.962 = 28$ in. (rounded to the next higher whole number)</td>
</tr>
<tr>
<td>Use a plate that is 29 in. long.</td>
<td>Use a plate that is 29 in. long.</td>
</tr>
<tr>
<td>$Area = 0.312 \times (29 - 16) = 4.056$ in.$^2$</td>
<td>$Area = 0.312 \times (28 - 16) = 3.744$ in.$^2$</td>
</tr>
<tr>
<td>Two $\frac{1}{4}$ in. welds to outlet:</td>
<td>Two $\frac{1}{4}$ in. welds to outlet:</td>
</tr>
<tr>
<td>$\frac{1}{2} \times (0.25 \times 0.25) \times 2 = 0.063$ in.$^2$</td>
<td>$\frac{1}{2} \times (0.25 \times 0.25) \times 2 = 0.063$ in.$^2$</td>
</tr>
<tr>
<td>Total $A_3$ provided = 4.119 in.$^2$</td>
<td>Total $A_3$ provided = 4.119 in.$^2$</td>
</tr>
<tr>
<td>The use of end welds is optional. See Fig. I-3.</td>
<td>The use of end welds is optional. See Fig. I-3.</td>
</tr>
</tbody>
</table>
F-2.2M Example 2M

A DN 400 outlet is welded to an DN 600 header. The header material is 317.2 MPa with a 7.92 mm wall. The outlet is 241.3 MPa (Seamless) with a 7.92 mm wall. The working pressure is 4.48 MPa. The fabrication is in Location Class 1. By para. 8.31.4.2, the reinforcement must be of the complete encirclement type. Using para. 8.41.1, the longitudinal weld joint quality factor is 1.00. The temperature is 37.8°C. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Fig. F-7.

F-2.2M Example 2M

A DN 400 outlet is welded to an DN 600 header. The header material is API 5L Grade L320 with a 7.92 mm wall. The outlet is API 5L Grade L245 (Seamless) with a 7.92 mm wall. The working pressure is 4.48 MPa. The fabrication is in Location Class 1. By para. 8.31.4.2, the reinforcement must be of the complete encirclement type. Using para. 8.41.1, the longitudinal weld joint quality factor is 1.00. The temperature is 37.8°C. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Fig. F-7.

F-2.2.1M Header. Nominal wall thickness required:

$$ t = \frac{PD}{2SFET} = \frac{4.48 \times 609.6}{2 \times 317.16 \times 0.60 \times 1.00 \times 1.00} = 7.178 \text{ mm} $$

Excess thickness in header wall:

$$ H - t = 7.925 - 7.178 = 0.747 \text{ mm} $$

F-2.2.1M Header. Nominal wall thickness required:

$$ t = \frac{PD}{2SFET} = \frac{4.48 \times 609.6}{2 \times 320 \times 0.60 \times 1.00 \times 1.00} \approx 7.178 \text{ mm} \quad 7.112 \text{ mm} $$

Excess thickness in header wall:

$$ H - t = 7.925 - 7.178 = 0.747 \text{ mm} \quad H - t = 7.925 - 7.112 = 0.813 \text{ mm} $$

F-2.2.2M Outlet. Nominal wall thickness required:

$$ t_o = \frac{4.48 \times 406.4}{2 \times 241.32 \times 0.60 \times 1.00 \times 1.00} = 6.290 \text{ mm} $$

Excess thickness in outlet wall:

$$ B - t_o = 7.925 - 6.290 = 1.635 \text{ mm} $$

$$ d = \text{inside diameter of opening} = 406.4 - 2 \times 7.925 = 390.55 \text{ mm} $$

F-2.2.2M Outlet. Nominal wall thickness required:

$$ t_o = \frac{4.48 \times 406.4}{2 \times 245 \times 0.60 \times 1.00 \times 1.00} = 6.193 \text{ mm} $$

Excess thickness in outlet wall:

$$ B - t_o = 7.925 - 6.193 = 1.732 \text{ mm} $$

$$ d = \text{inside diameter of opening} = 406.4 - 2 \times 7.925 = 390.55 \text{ mm} $$

F-2.2.3M Reinforcement Required

$$ A_R = d t = 390.55 \times 7.178 = 2803.5 \text{ mm}^2 $$

F-2.2.3M Reinforcement Required

$$ A_L = d t = 390.55 \times 7.178 = 2803.5 \text{ mm}^2 $$

$$ A_R = d t = 390.55 \times 7.112 = 2777.6 \text{ mm}^2 $$

F-2.2.4M Reinforcement Provided by Header

$$ A_1 = (H - t) d = 0.747 \times 390.55 = 291.56 \text{ mm}^2 $$

F-2.2.4M Reinforcement Provided by Header

$$ A_1 = (H - t) d = 0.813 \times 390.55 = 317.52 \text{ mm}^2 $$

NOTES:  
(1) Underline and blue indicates revised and new text.  
(2) Strikethrough and red indicates deleted text
F-2.2.5M Effective Area in Outlet

Height \( L = \frac{2}{1.5} B + M \) (assume 7.94 mm plate) = \((2\frac{1}{2} \times 7.92) + 7.94 = 27.75 \text{ mm}\)

\[
L = \frac{2}{1.5} H = 2.5 \times 7.92 = 19.812 \text{ mm} \quad \text{Use} \quad L = 19.812 \text{ mm}
\]

\[
A_2 = 2(B - t_b) L = 2 \times 1.635 \times 19.812 = 64.80 \text{ mm}^2
\]

This must be multiplied by 241.3/317.2. \[\text{See para. 831.4.1(f).}\]

Effective \( A' = \frac{64.80 \times 241.3}{317.2} = 49.30 \text{ mm}^2\)

Required area:

\[
A_3 = A_R - A_1 - A'_2
\]

\[
= 2803.5 - 291.56 - 49.30 = 2462.6 \text{ mm}^2
\]

Approximate required thickness of reinforcement:

\[
2462.6 / (762 - 406.4) = 6.925 \text{ mm}
\]

Use a 7.92 mm plate minimum required length (neglecting welds):

\[
2462.6 / 7.92 = 310.75 \text{ mm}
\]

406.4 + 310.75 = 736.6 mm (rounded to the next higher whole number in customary units, i.e., equivalent to 29 in.)

Use a plate that is 736.6 mm long.

Area = \(7.92 \times (736.6 - 406.4) = 2616.8 \text{ mm}^2\)

Two 6.35 mm welds to outlet:

\[
\frac{1}{2} \times (6.35 \times 6.35) \times 2 = 40.32 \text{ mm}^2
\]

Total \( A_3 \) provided = 2657.1 mm²

The use of end welds is optional. See Fig. I-3.
**803.7 Valves**

*bloc*k or *stop valve*: a valve installed for the purpose of blocking or stopping the flow of gas in a pipe.

*check valve*: a valve designed to permit flow in one direction and to close automatically to prevent flow in the reverse direction.

*curb valve*: a stop valve installed below grade in a service line at or near the property line, accessible through a curb box or standpipe, and operable by a removable key or wrench for shutting off the gas supply to a building. This valve is also known as a *curb shutoff* or *curb cock*.

*excess flow valve*: a valve designed to automatically stop or limit the flow of gas in a gas service line when the gas flow exceeds the maximum anticipated gas flow during normal operations.

*service line valve*: a stop valve readily operable and accessible for the purpose of shutting off the gas to the customer’s fuel line. The stop valve should be located in the service line ahead of the service regulator or ahead of the meter, if a regulator is not provided. The valve is also known as a *service line shutoff*, *service line cock*, or *meter stop*.

### 831 PIPING SYSTEM COMPONENTS

#### 831.4 Service lines: Excess Flow Valve Performance Standards.

Excess flow valves shall be manufactured and tested by the manufacturer in accordance with ASTM F1802, ASTM F2138, MSS SP-115, or the manufacturer's written specification.
849 GAS SERVICE LINES

********

849.1.6 Excess flow valve (EFV) installation.

The use of excess flow valves is recognized by the gas industry as an effective way to mitigate risks associated with excavation damage, natural force damage, and other outside force damage, e.g., vehicular damage on gas service lines. If the operator installs excess flow valves, they should be in accordance with the following requirements.

(a) The operator should consider installing an EFV on any new or replaced gas service line. Such a service line can typically serve the following categories of customers.

1. A service line to a single family residence (SFR);
2. A branched gas service line to a SFR installed concurrently with the primary SFR service line. (A single EFV may be installed to protect both service lines);
3. A branched gas service line to a SFR installed off a previously installed SFR gas service line that does not contain an EFV;
4. Multi-family installations with known customer loads at time of gas service installation, based on installed meter capacity less than 1,000 standard ft³/hr (28.3 m³/hr) per gas service and where the customer load is not expected to increase significantly over time; or
5. A single small commercial customer with known customer load at the time of service installation, based on installed meter capacity, up to 1,000 standard ft³/hr (28.3 m³/hr) served by a single gas service line and where the customer load is not expected to increase significantly over time.

(b) Excess flow valves are not recommended to be installed if one or more of the following conditions are present:

1. The gas service line will not operate at a pressure of 10 psig (69 kPa) or greater throughout the year;
2. The operator has prior experience with contaminants in the gas stream that could interfere with the EFV's operation or cause loss of service to a residence;
3. An EFV could interfere with necessary operation or maintenance activities, such as removing liquids from the line;
4. An EFV meeting performance standards in para. 831.1.4 is not commercially available to the operator; or
5. The anticipated maximum flow through the service line equals or exceeds 1,000 standard ft³/hr (28.3 m³/hr)
<table>
<thead>
<tr>
<th>PRESENT TEXT</th>
<th>PROPOSED CHANGES</th>
</tr>
</thead>
</table>
| *(c)* An operator should identify the presence of an excess flow valve in the service line. Examples include a tag, ring around the riser or statement on the service order.  
*(d)* An operator should locate an excess flow valve as near as practical to the fitting connecting the gas service line to its source of gas supply. | *(e)* An operator should perform a functional flow test for each excess flow valve installed, in accordance with the manufacturer’s instructions, to verify that the excess flow valve:  
(1) will close under excess flow conditions.  
(2) will properly reset in accordance with the manufacturer’s instructions.  
(3) is properly sized for both the length and nominal diameter of a given service line.  
*(f)* An operator should follow the manufacturer’s instructions when:  
(1) commissioning a new excess valve installation  
(2) resetting an existing excess flow valve after closure. |
| None |  
A-4 ASTM STANDARDS  
*ASTM F2138-12 Standard Specification for Excess Flow Valves for Natural Gas Service |
<table>
<thead>
<tr>
<th>ASME B31.8-2018 Edition</th>
<th>Hydrotest Requirements for Subsea Manifolds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRESENT TEXT</strong></td>
<td><strong>PROPOSED CHANGES</strong></td>
</tr>
<tr>
<td><strong>A847 TESTING</strong></td>
<td><strong>A847 TESTING</strong></td>
</tr>
<tr>
<td><strong>A847.1 General Provisions</strong></td>
<td><strong>A847.1 General Provisions</strong></td>
</tr>
<tr>
<td>All offshore pipelines shall be tested after installation and prior to operation within the provisions of this section.</td>
<td>All offshore pipelines, including prefabricated piping and special assemblies, shall be tested after installation and prior to operation within the provisions of this section. Prefabricated, pretested portions of offshore pipeline risers, jumpers, special assemblies, expansion loops and tie-in spools may be excluded from the pipeline system hydrostatic test when inclusion is not practical impracticable.</td>
</tr>
<tr>
<td><strong>A847.4 Test Procedure</strong></td>
<td><strong>A847.4 Test Procedure</strong></td>
</tr>
</tbody>
</table>
| The hydrostatic pressure test shall be conducted in accordance with a specified procedure that shall, at a minimum, provide for  
(a) performance of the test after installation and before initial operation of the pipeline system except as provided in para. A847.2.  
(b) the inclusion of prefabricated, pretested portions of offshore pipeline risers in the pipeline system hydrostatic test, whenever practical.  
(c) maintenance of the test and recording of results on pipeline and assemblies for a minimum of eight continuous hours at or above the specified pressure. All variations in test pressure shall be accounted for. Test duration of prefabricated piping may be 2 hr.  
(d) a retest if, during the hold time, a rupture or hazardous leak occurs that renders the test invalid. Retesting shall commence after repairs have been made. | The hydrostatic pressure test shall be conducted in accordance with a specified procedure that shall, at a minimum, provide for  
(a) performance of the test after installation and before initial operation of the pipeline system except as provided in para. A847.2.  
(b) the inclusion of prefabricated, pretested portions of offshore pipeline risers in the pipeline system hydrostatic test, whenever practical.  
(c) maintenance of the test and recording of results on the pipeline system and assemblies for a minimum of eight continuous hours at or above the specified pressure. All variations in test pressure shall be accounted for. Test duration of prefabricated piping may be 2 hr.  
(d) a retest if, during the hold time, a rupture or hazardous leak occurs that renders the test invalid. Retesting shall commence after repairs have been made. |
| **NOTES:**               | (1) Underline and blue indicates revised and new text.  
(2) Strikethrough and red indicates deleted text |
NOTE: An asterisk (*) indicates standards that have been accepted as American National Standards by the American National Standards Institute (ANSI).

C-1 AGA
AGA Catalog XL1001 (December 2010, including Errata 1 and 2), Classification of Locations for Electrical Installations in Gas Utility Areas
Directional Drilling Damage Prevention Guidelines for the Natural Gas Industry (December 2004)
Publisher: American Gas Association (AGA), 400 North Capitol Street, NW, Washington, DC 20001 (www.aga.org)


C-2 API
API RP 2A-LRFD (first edition, July 1993, including Errata and Supplements through February 1997), Recommended Practice for Planning, Designing, and Constructing Fixed Offshore Platforms — Load and Resistance Factor Design
*API RP 500 (third edition, December 2012, including Errata through January 2014), Recommended Practices for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2
Publisher: American Petroleum Institute (API), 1220 L Street, NW, Washington, DC 20005 (www.api.org)

C-3 ASCE
ASCE Manuals and Reports on Engineering Practices No. 89 — Pipeline Crossings Handbook (June 1996)

Publisher: American Society of Civil Engineers (ASCE), 1801 Alexander Bell Drive, Reston, VA 20191 (www.asce.org)

C-4 ASME
*ASME B1.20.3-1976 (R2013), Dryseal Pipe Threads (Inch)
*ASME B16.3-2011, Malleable Iron Threaded Fittings: Classes 150 and 300
*ASME B16.4-2011, Gray Iron Threaded Fittings: Classes 125 and 250
*ASME B16.14-2013, Ferrous Pipe Plugs, Bushings, and Locknuts With Pipe Threads
*ASME B16.15-2013, Cast Copper Alloy Threaded Fittings: Classes 125 and 250
*ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings
*ASME B16.22-2013, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
*ASME B16.25-2012, Buttwelding Ends
*ASME B31.12-2014, Hydrogen Piping and Pipelines
Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)

C-5 ASTM
ASTM A6/A6M-16, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A20/A20M-15, Standard Specification for General Requirements for Steel Plates for Pressure Vessels
ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel
ASTM A48/A48M-03(R2012), Standard Specification for Gray Iron Castings

1This publication has been superseded, withdrawn, or is no longer in print.
GRI-00/0192.02 (2001), GRI Guide for Locating and Using Pipeline Industry Research. Section 2: Defect Assessment
GRI-00/0192.03 (2001), GRI Guide for Locating and Using Pipeline Industry Research. Section 3: Identifying Types of Defects and Causes of Pipeline Failures
GRI-00/0192.05 (2001), GRI Guide for Locating and Using Pipeline Industry Research. Section 5: Line Pipe
GRI-00/0192.06 (2001), GRI Guide for Locating and Using Pipeline Industry Research. Section 6: Welding
GRI-00/0192.07 (2001), GRI Guide for Locating and Using Pipeline Industry Research. Section 7: Fittings and Components
GRI-00/0192.08 (2001), GRI Guide for Locating and Using Pipeline Industry Research. Section 8: Pipeline Repair Methods
GRI-00/0192.09 (2001), GRI Guide for Locating and Using Pipeline Industry Research. Section 9: Mechanical Damage
GRI-00/0192.10 (2001), GRI Guide for Locating and Using Pipeline Industry Research. Section 10: Corrosion
GRI-00/0192.11 (2001), GRI Guide for Locating and Using Pipeline Industry Research. Section 11: Stress Corrosion Cracking
GRI-00/0192.15 (2001), GRI Guide for Locating and Using Pipeline Industry Research. Section 15: Special Situations
GRI-00/0192.16 (2001), GRI Guide for Locating and Using Pipeline Industry Research. Section 16: Risk Assessment

GRI-00/0192.17 (2001), GRI Guide for Locating and Using Pipeline Industry Research. Section 17: Geographical Information Systems
GRI-96/0368 (1996), Guidelines for the Application of Guided Horizontal Drilling to Install Gas Distribution Pipe
Publisher: Gas Technology Institute (GTI), 1700 South Mount Prospect Road, Des Plaines, IL 60018 (www.gastechnology.org)

C-8 MSS

MSS SP-61-2013, Pressure Testing of Valves
Publisher: Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS), 127 Park Street, NE, Vienna, VA 22180 (www.msshq.org)

C-9 OTHER PUBLICATIONS

ANSI Z17.1-1973, American National Standard for Preferred Numbers
Publisher: American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036 (www.ansi.org)

Publisher: HDD Consortium, available through North American Society for Trenchless Technology (NASTT), 14500 Lorain Avenue #110063, Cleveland, OH 44111 (www.nastt.org)

Publisher: Pipeline Research Council International (PRCI), 3141 Fairview Park Drive, Suite 525, Falls Church, VA 22042 (www.prci.org)

Integrity Characteristics of Vintage Pipelines (2005)
Publisher: The INGAA Foundation, Inc. (INGAA), 20 F Street, NW, Washington, DC 20001 (www.ingaa.org)
**A-3 ASME**

*ASME B1.1-2003 (R2008), Unified Inch Screw Threads (UN and UNR Thread Form)*

*ASME B1.20.1-2013, Pipe Threads, General Purpose (Inch)*

*ASME B16.1-2015, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250*

*ASME B16.5-2013, Pipe Flanges and Flanged Fittings: NPS ½ Through NPS 24 Metric/Inch Standard*

*ASME B16.9-2012, Factory-Made Wrought Buttwelding Fittings*

*ASME B16.11-2011, Forged Fittings, Socket-Welding and Threaded*

*ASME B16.20-2012, Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed*

*ASME B16.24-2011, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500*

*ASME B16.33-2012, Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 175 psi (Sizes NPS ½ Through NPS 2)*

---

1 See Note in para. 814.1.1 regarding the use of the 45th edition of API 5L.
<table>
<thead>
<tr>
<th>Description</th>
<th>Flexibility Factor, $k$</th>
<th>Stress Intensification Factor, $f$ [Notes (1) and (2)]</th>
<th>Flexibility Characteristic, $h$</th>
<th>Sketch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welding elbow or pipe bend [Notes (1)–(5)]</td>
<td>$\frac{1.65}{h}$</td>
<td>$\frac{0.75}{k^{\frac{1}{3}}}$</td>
<td>$\frac{0.9}{k^{\frac{1}{3}}}$</td>
<td><img src="image" alt="Sketch" /></td>
</tr>
<tr>
<td>Closely spaced miter bend $s &lt; r_2 (1 + \tan \theta)$ [Notes (1), (2), (3), and (5)]</td>
<td>$\frac{1.52}{k^{\frac{5}{6}}}$</td>
<td>$\frac{0.9}{k^{\frac{1}{3}}}$</td>
<td>$\frac{0.9}{k^{\frac{1}{3}}}$</td>
<td><img src="image" alt="Sketch" /></td>
</tr>
<tr>
<td>Single miter bend or widely spaced miter bend $s &gt; r_2 (1 + \tan \theta)$ [Notes (1), (2), and (5)]</td>
<td>$\frac{1.52}{k^{\frac{5}{6}}}$</td>
<td>$\frac{0.9}{k^{\frac{1}{3}}}$</td>
<td>$\frac{0.9}{k^{\frac{1}{3}}}$</td>
<td><img src="image" alt="Sketch" /></td>
</tr>
<tr>
<td>Welding tee per ASME B16.9 with $r_o \geq d/8$ $T_e \geq 1.5T$ [Notes (1), (2), and (6)]</td>
<td>1</td>
<td>$\frac{0.9}{k^{\frac{1}{3}}}$</td>
<td>$\frac{3}{4} l_o + \frac{1}{4}$</td>
<td><img src="image" alt="Sketch" /></td>
</tr>
<tr>
<td>Reinforced fabricated tee with pad or saddle [Notes (1), (2), (7)–(9)]</td>
<td>1</td>
<td>$\frac{0.9}{k^{\frac{1}{3}}}$</td>
<td>$\frac{3}{4} l_o + \frac{1}{4}$</td>
<td><img src="image" alt="Sketch" /></td>
</tr>
<tr>
<td>Unreinforced fabricated tee [Notes (1), (2), and (9)]</td>
<td>1</td>
<td>$\frac{0.9}{k^{\frac{1}{3}}}$</td>
<td>$\frac{3}{4} l_o + \frac{1}{4}$</td>
<td><img src="image" alt="Sketch" /></td>
</tr>
<tr>
<td>Extruded outlet $r_o \geq 0.05d$ $T_e &lt; 1.5T$ [Notes (1), (2), and (6)]</td>
<td>1</td>
<td>$\frac{0.9}{k^{\frac{1}{3}}}$</td>
<td>$\frac{3}{4} d_o + \frac{1}{4}$</td>
<td><img src="image" alt="Sketch" /></td>
</tr>
<tr>
<td>Welded-in contour insert $r_o \geq d/8$ $T_e \geq 1.5T$ [Notes (1), (2), and (10)]</td>
<td>1</td>
<td>$\frac{0.9}{k^{\frac{1}{3}}}$</td>
<td>$\frac{3}{4} d_o + \frac{1}{4}$</td>
<td><img src="image" alt="Sketch" /></td>
</tr>
<tr>
<td>Branch welded-on fitting (integally reinforced) [Notes (1), (2), (9), and (11)]</td>
<td>1</td>
<td>$\frac{0.9}{k^{\frac{1}{3}}}$</td>
<td>$\frac{0.9}{k^{\frac{1}{3}}}$</td>
<td><img src="image" alt="Sketch" /></td>
</tr>
</tbody>
</table>
Table E-1 Flexibility Factor, $k$, and Stress Intensification Factor, $i$ (Cont’d)

<table>
<thead>
<tr>
<th>Description</th>
<th>Flexibility Factor, $k$</th>
<th>Stress Intensification Factor, $i$</th>
<th>Sketch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butt weld [Notes (1) and (12)]</td>
<td>1</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>$\bar{T} \geq 0.237$ in. (6.02 mm), $\delta_{max} \leq \frac{1}{16}$ in. (1.59 mm), and $\delta_{avg}/\bar{T} \leq 0.13$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butt weld [Notes (1) and (12)]</td>
<td>1</td>
<td>1.9 max. or $[0.9 + 2.7(\delta_{avg}/\bar{T})]$, but not less than 1.0</td>
<td></td>
</tr>
<tr>
<td>$\bar{T} \geq 0.237$ in. (6.02 mm), $\delta_{max} \leq \frac{1}{16}$ in. (3.18 mm), and $\delta_{avg}/\bar{T} = $ any value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butt weld [Notes (1) and (12)]</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\bar{T} \leq 0.237$ in. (6.02 mm), $\delta_{max} \leq \frac{1}{16}$ in. (1.59 mm), and $\delta_{avg}/\bar{T} \leq 0.33$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tapered transition per ASME B16.25 [Note (1)]</td>
<td>1</td>
<td>1.9 max. or $\frac{D_t}{\bar{T}} + 3.6 \frac{\delta}{\bar{T}}$</td>
<td></td>
</tr>
<tr>
<td>Concentric reducer per ASME B16.9 [Notes (1) and (13)]</td>
<td>1</td>
<td>2.0 max. or $0.5 + 0.01\left(\frac{D_t}{\bar{T}}\right)^{1/2}$</td>
<td></td>
</tr>
<tr>
<td>Double-welded slip-on flange [Note (14)]</td>
<td>1</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Socket welding flange or fitting [Notes (14) and (15)]</td>
<td>1</td>
<td>2.1 max. or 2.1 $\bar{T}/C$, but not less than 1.3</td>
<td></td>
</tr>
<tr>
<td>Lap joint flange (with ASME B16.9 lap joint stub) [Note (14)]</td>
<td>1</td>
<td>1.6</td>
<td></td>
</tr>
<tr>
<td>Threaded pipe joint or threaded flange [Note (14)]</td>
<td>1</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Corrugated straight pipe, or corrugated or creased bend [Note (16)]</td>
<td>5</td>
<td>2.5</td>
<td></td>
</tr>
</tbody>
</table>
### Table E-1 Flexibility Factor, $k$, and Stress Intensification Factor, $i$ (Cont'd)

<table>
<thead>
<tr>
<th>Characteristic, $h$</th>
<th>Flexibility factor for elbows, $k = 1.65/h$</th>
<th>Flexibility factor for miters, $k = 1.52/h^{1/6}$</th>
<th>Stress intensification factor, $i = 0.9/h^{1/3}$</th>
<th>Stress intensification factor, $i = 0.75/h^{1/3}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.02</td>
<td>100</td>
<td>80</td>
<td>70</td>
<td>50</td>
</tr>
<tr>
<td>0.04</td>
<td>80</td>
<td>60</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>0.06</td>
<td>60</td>
<td>40</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>0.08</td>
<td>40</td>
<td>20</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>0.10</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>0.15</td>
<td>10</td>
<td>5</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>0.20</td>
<td>5</td>
<td>2.5</td>
<td>2.5</td>
<td>1.25</td>
</tr>
<tr>
<td>0.30</td>
<td>2.5</td>
<td>1.25</td>
<td>1.25</td>
<td>0.833</td>
</tr>
<tr>
<td>0.40</td>
<td>1.25</td>
<td>0.833</td>
<td>0.833</td>
<td>0.5</td>
</tr>
<tr>
<td>0.60</td>
<td>0.833</td>
<td>0.5</td>
<td>0.5</td>
<td>0.333</td>
</tr>
<tr>
<td>0.80</td>
<td>0.5</td>
<td>0.333</td>
<td>0.333</td>
<td>0.2</td>
</tr>
<tr>
<td>1.00</td>
<td>0.333</td>
<td>0.2</td>
<td>0.2</td>
<td>0.166</td>
</tr>
<tr>
<td>1.50</td>
<td>0.2</td>
<td>0.166</td>
<td>0.166</td>
<td>0.125</td>
</tr>
<tr>
<td>2.00</td>
<td>0.125</td>
<td>0.125</td>
<td>0.125</td>
<td>0.125</td>
</tr>
</tbody>
</table>

### Chart A

- The chart represents the relationship between the characteristic $h$ and the flexibility factor $k$ and stress intensification factor $i$.

### Chart B

- The chart illustrates the correlation factor $c_1$.
  - 1 End flanged $c_1 = h^{1/6}$
  - 2 Ends flanged $c_1 = h^{1/3}$

### Notes:

1. The nomenclature is as follows:
   - $D_o$: outside diameter, in. (mm)
   - $d$: outside diameter of branch, in. (mm)
   - $R_1$: bend radius of welding elbow or pipe bend, in. (mm)
   - $r_o$: radius of curvature of external contoured portion of outlet, measured in the plane containing the axes of the header and branch, in. (mm)
   - $r_2$: mean radius of matching pipe, in. (mm)
### Table E-1 Flexibility Factor, \( k \), and Stress Intensification Factor, \( i \) (Cont’d)

**NOTES: (Cont’d):**

- \( s \) = miter spacing at centerline, in. (mm)
- \( T = \) nominal wall thickness of piping component, in. (mm)
- \( T_e = \) for elbows and miter bends, the nominal wall thickness of the fitting, in. (mm)
- \( T_e = \) for welding tees, the nominal wall thickness of the matching pipe, in. (mm)
- \( T_e = \) for fabricated tees, the nominal wall thickness of the run or header (provided that if thickness is greater than that of matching pipe, increased thickness must be maintained for at least one run outside diameter to each side of the branch outside diameter), in. (mm)
- \( T_e = \) the crotch thickness of tees, in. (mm)
- \( t_e = \) pad or saddle thickness, in. (mm)
- \( \alpha = \) reducer cone angle, deg
- \( \delta = \) mismatch, in. (mm)
- \( \theta = \) one-half angle between adjacent miter axes, deg

(2) The flexibility factor, \( k \), applies to bending in any plane. The flexibility factors, \( k \), and stress intensification factors, \( i \), shall not be less than unity; factors for torsion equal unity. Both factors apply over the effective arc length (shown by heavy centerlines in the sketches) for curved and miter bends and to the intersection point for tees. The values of \( k \) and \( i \) can be read directly from Chart A by entering with the characteristic, \( h \), computed from the formulas given.

(3) Where flanges are attached to one or both ends, the values of \( k \) and \( i \) shall be corrected by the factors, \( C_w \), which can be read directly from Chart B, entering with the computed \( h \).

(4) The designer is cautioned that cast butt-welded fittings may have considerably heavier walls than that of the pipe with which they are used. Large errors may be introduced unless the effect of these greater thicknesses is considered.

(5) In large diameter thin-wall elbows and bends, pressure can significantly affect the magnitudes of \( k \) and \( i \). To correct values from the table, divide \( k \) by

\[
1 + 6 \left( \frac{P}{E_t} \frac{T}{T_e} \right)^{7/3} \left( \frac{T_e}{T} \right)^{1/3}
\]

divide \( i \) by

\[
1 + 3.25 \left( \frac{P}{E_t} \frac{T}{T_e} \right)^{5/2} \left( \frac{T_e}{T} \right)^{2/3}
\]

where

- \( E_t = \) cold modulus of elasticity, psi (MPa)
- \( P = \) gage pressure, psi (MPa)

(6) If the number of displacement cycles is less than 200, the radius and thickness limits specified need not be met. When the radius and thickness limits are not met and the number of design cycles exceeds 200, the out-plane and in-plane stress intensification factors shall be calculated as \( 1.12 / h^{2/3} \) and \( 0.67 / h^{2/3} \) + \( \frac{\delta}{h} \), respectively.

(7) When \( t_e > 1.5T \), use \( h = 4.05T/r_2 \).

(8) The minimum value of the stress intensification factor shall be 1.2.

(9) When the branch-to-run diameter ratio exceeds 0.5, but is less than 1.0, and the number of design displacement cycles exceeds 200, the out-plane and in-plane stress intensification factors shall be calculated as \( 1.8 / h^{2/3} \) and \( (0.67 / h^{2/3}) + \frac{\delta}{h} \), respectively, unless the transition weld between the branch and run is blended to a smooth concave contour. If the transition weld is blended to a smooth concave contour, the stress intensification factors in the table still apply.

(10) If the number of displacement cycles is less than 200, the radius and thickness limits specified need not be met. When the radius and thickness limits are not met and the number of design displacement cycles exceeds 200, the out-plane and in-plane stress intensification factors shall be calculated as \( 1.8 / h^{2/3} \) and \( (0.67 / h^{2/3}) + \frac{\delta}{h} \), respectively.

(11) The designer must be satisfied that this fabrication has a pressure rating equivalent to straight pipe.

(12) The stress intensification factors apply to girth butt welds between two items for which the wall thicknesses are between 0.875\( T \) and 1.1\( T \) for an axial distance of \( \sqrt{D_1 T} \), \( D_2 \) and \( T \) are nominal outside diameter and nominal wall thickness, respectively. \( \delta_{avg} \) is the average mismatch or offset.

(13) The equation applies only if the following conditions are met:

- (a) Cone angle \( \alpha \) does not exceed 60 deg, and the reducer is concentric.
- (b) The larger of \( D_1 T / T \) and \( D_2 T / T \) does not exceed 100.
- (c) The wall thickness is not less than \( T \), throughout the body of the reducer, except in and immediately adjacent to the cylindrical portion on the small end, where the thickness shall not be less than \( T_2 \).

(14) For some flanged joints, leakage may occur at expansion stresses otherwise permitted herein. The moment to produce leakage of a flanged joint with a gasket having no self-sealing characteristics can be estimated by the following equation:
Table E-1 Flexibility Factor, $k$, and Stress Intensification Factor, $i$ (Cont'd)

NOTES: (Cont’d):

\[ M_L = (C/4) \left( S_b A_b - P A_P \right) \]

where

- $A_b$ = total area of flange bolts, in.$^2$ (mm$^2$)
- $A_P$ = area to outside of gasket contact, in.$^2$ (mm$^2$)
- $C$ = bolt circle, in. (mm)
- $M_L$ = moment to produce flange leakage, in.-lb (mm-N)
- $P$ = internal pressure, psi (MPa)
- $S_b$ = bolt stress, psi (MPa)

(15) $C_w$ is the fillet weld length. For unequal lengths, use the smaller leg for $C_w$.
(16) Factors shown apply to bending. Flexibility factor for torsion equals 0.9.

(17) The stress intensification and flexibility factors from ASME B31J may be used instead of the stress intensification and flexibility factors herein. When using the stress intensification factors from ASME B31J, the maximum of in-plane $(i_i)$ and out-plane $(i_o)$ stress intensification factors shall be used in calculating stresses in accordance with para. 833.2 or A842.2.2. Alternatively, stress intensification factors may be developed using ASME B31J, Nonmandatory Appendix A.
805.1.4 Fabrication Terms and Definitions

- **heat treatment**: heating and cooling a solid metal or alloy in such a way as to obtain desired properties. Heating for the sole purpose of hot working is not considered heat treatment. If a weldment is heated and cooled in a controlled manner, then the term postweld heat treatment is used.
- **seam weld**: the longitudinal or helical seam in pipe, made in the pipe mill for the purpose of making a complete circular cross section.

817.1.3 Midrange Hoop Stress Service Level [Greater Than 6,000 psi (41 MPa) but Less Than 24,000 psi (165 MPa)].

- **Longitudinal Joint Factor**. If the type of longitudinal joint can be determined with certainty, the corresponding longitudinal joint factor, $E$ (Table 841.1.7-1 in Chapter IV), may be used. Otherwise, $E$ shall be taken as 0.60 for pipe NPS 4 (DN 100) and smaller, or 0.80 for pipe larger than NPS 4 (DN 100).

832.3 Flexibility Requirements

- **Properties of pipe and fittings for these calculations shall be based on nominal dimensions, and the joint factor $E$ shall be taken as 1.00.**

### NOTES:

1. Underline and blue indicates revised and new text.
2. Strikethrough and red indicates deleted text.
3. Green indicates changes from the previous revision of this item.
### 841 STEEL PIPE

#### 841.1 Steel Piping Systems Design Requirements

**841.1.1 Steel Pipe Design Formula**

(a) The design pressure for steel gas piping systems or the nominal wall thickness for a given design pressure shall be determined by the following formula (for limitations, see para. 841.1.3):

(U.S. Customary Units)

\[
P = \frac{2 S t}{D} FET
\]

(SI Units)

\[
(P = \frac{2000 S t}{D} FET)
\]

where

\(D\) = nominal outside diameter of pipe, in. (mm)

\(E\) = longitudinal joint factor obtained from Table 841.1.7-1 [see also para. 817.1.3(d)]

#### 841.1.7 Longitudinal Joint Factor. The longitudinal joint factor shall be in accordance with Table 841.1.7-1.
### Table 841.1.7-1  Longitudinal Joint Factor, $E$

<table>
<thead>
<tr>
<th>Spec. No.</th>
<th>Pipe Class</th>
<th>$E$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A53</td>
<td>Seamless</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Electric-resistance-welded</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Furnace-buttwelded, continuous weld</td>
<td>0.60</td>
</tr>
<tr>
<td>ASTM A106</td>
<td>Seamless</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A134</td>
<td>Electric-fusion arc-welded</td>
<td>0.80</td>
</tr>
<tr>
<td>ASTM A135</td>
<td>Electric-resistance-welded</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A139</td>
<td>Electric-fusion arc-welded</td>
<td>0.80</td>
</tr>
<tr>
<td>ASTM A333</td>
<td>Seamless</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A381</td>
<td>Electric-resistance-welded</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A671</td>
<td>Submerged-arc-welded</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Electric-fusion-welded Classes 13, 23, 33, 43, 53</td>
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<tr>
<td></td>
<td>Classes 12, 22, 32, 42, 52</td>
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<td>ASTM A672</td>
<td>Electric-fusion-welded Classes 13, 23, 33, 43, 53</td>
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<td>Classes 12, 22, 32, 42, 52</td>
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<tr>
<td>ASTM A691</td>
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<td>Classes 12, 22, 32, 42, 52</td>
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<td>API 5L</td>
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<td></td>
<td>Seamless</td>
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<tr>
<td></td>
<td>Submerged-arc-welded (longitudinal seam or helical seam)</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Furnace-buttwelded, continuous weld</td>
<td>0.60</td>
</tr>
</tbody>
</table>

**GENERAL NOTE:** Definitions for the various classes of welded pipe are given in para. 804.7.3.

### Table 841.1.7-1  Longitudinal Weld Joint Quality Factor, $E$

<table>
<thead>
<tr>
<th>Spec. No.</th>
<th>Pipe Class</th>
<th>$E$</th>
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<tbody>
<tr>
<td>ASTM A53</td>
<td>Seamless</td>
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<td></td>
<td>Electric-resistance-welded</td>
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<td></td>
<td>Furnace-buttwelded, continuous weld</td>
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<tr>
<td>ASTM A106</td>
<td>Seamless</td>
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<tr>
<td>ASTM A134</td>
<td>Electric-fusion arc-welded</td>
<td>0.80</td>
</tr>
<tr>
<td>ASTM A135</td>
<td>Electric-resistance-welded</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A139</td>
<td>Electric-fusion arc-welded</td>
<td>0.80</td>
</tr>
<tr>
<td>ASTM A333</td>
<td>Seamless</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A381</td>
<td>Electric-resistance-welded</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A671</td>
<td>Submerged-arc-welded</td>
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</tr>
<tr>
<td></td>
<td>Electric-fusion-welded Classes 13, 23, 33, 43, 53</td>
<td>0.80</td>
</tr>
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<td></td>
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<td>ASTM A672</td>
<td>Electric-fusion-welded Classes 13, 23, 33, 43, 53</td>
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</tr>
<tr>
<td></td>
<td>Seamless</td>
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<td></td>
<td>Submerged-arc-welded (longitudinal straight seam or helical seam)</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Furnace-buttwelded, continuous weld</td>
<td>0.60</td>
</tr>
</tbody>
</table>

**GENERAL NOTE:** Definitions for the various classes of welded pipe are given in para. 804.7.3.

### 841.3.2 Pressure Test Requirements to Prove Strength of Pipelines and Mains to Operate at Hoop Stresses of 30% or More of the Specified Minimum Yield Strength of the Pipe.

(c) Where one or both of the conditions in (b) exist, it is permissible to pressure test using air or nonflammable, nontoxic gases as the pressure test medium provided that all of the following conditions exist:

1. The maximum hoop stress during pressure testing is less than 50% of the specified minimum yield strength in Class 3 Locations, and less than 40% of the specified minimum yield strength in Class 4 Locations.
2. The maximum pressure at which the pipeline is to be operated does not exceed 80% of the maximum field test pressure.
3. The pipe involved has been confirmed to be fit for service and has a longitudinal joint factor of 1.00 (see Table 841.1.7-1).
### 851.4.3 Permanent Field Repair of Welds Having Injurious Defects

*(d)* If a manufacturing defect is discovered in a low frequency ERW weld seam or any seam having a factor $E$ less than 1.0 in Table 841.1.7-1, or if hydrogen stress cracking is found in any weld zone, a full encirclement welded split sleeve designed to carry maximum allowable operating pressure shall be installed.

### A814.1.1 Steel Pipe

Steel line pipe with a longitudinal joint factor of 1.00 in Table 841.1.7-1 shall be used.

### F-2.1 Example 1

An NPS 8 outlet is welded to an NPS 24 header. The header material is API 5LX 46 with a 0.312-in. wall. The outlet is API 5L Grade B (Seamless) Schedule 40 with a 0.322-in. wall. The working pressure is 650 psig. The fabrication is in Location Class 1. Using para. 841.1, the longitudinal joint factor is 1.00. The temperature is 100°F. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Fig. F-6.

### A814.1.1 Steel Pipe

Steel line pipe with a longitudinal weld joint quality factor of 1.00 in Table 841.1.7-1 shall be used.

### F-2.1M Example 1M

A DN 200 outlet is welded to a DN 600 header. The header material is 317.2 MPa with a 7.92-mm wall. The outlet is 241.3 MPa (Seamless) with a 8.18 mm wall. The working pressure is 4.48 MPa. The fabrication is in Location Class 1. Using para. 841.1, the longitudinal joint factor is 1.00. The temperature is 37.8°C. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Fig. F-6.

### F-2.2 Example 2

An NPS 16 outlet is welded to an NPS 24 header. The header material is API 5LX 46 with a 0.312-in. wall. The outlet is API 5L Grade B (Seamless) Schedule 20 with a 0.312-in. wall. The working pressure is 650 psig. The fabrication is in Location Class 1. By para. 831.4.2, the reinforcement must be of the complete encirclement type. Using para. 841.1, the longitudinal joint factor is 1.00. The temperature is 100°F. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Fig. F-7.

### F-2.2M Example 1M

A DN 200 outlet is welded to a DN 600 header. The header material is 317.2 MPa with a 7.92-mm wall. The outlet is 241.3 MPa (Seamless) with a 8.18 mm wall. The working pressure is 4.48 MPa. The fabrication is in Location Class 1. By para. 831.4.2, the reinforcement must be of the complete encirclement type. Using para. 841.1, the longitudinal weld joint quality factor is 1.00. The temperature is 37.8°C. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Fig. F-6.

### F-2.2 Example 2

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### F-2.2M Example 2M

A DN 200 outlet is welded to a DN 600 header. The header material is 317.2 MPa with a 7.92-mm wall. The outlet is 241.3 MPa (Seamless) with a 8.18 mm wall. The working pressure is 4.48 MPa. The fabrication is in Location Class 1. By para. 831.4.2, the reinforcement must be of the complete encirclement type. Using para. 841.1, the longitudinal weld joint quality factor is 1.00. The temperature is 37.8°C. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Fig. F-6.
<table>
<thead>
<tr>
<th>ASME B31.8-2016 EDITION</th>
<th>Revise Terminology for Longitudinal Joint Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRESENT TEXT with Standards Committee Approved Revisions per Item 17-773</strong></td>
<td><strong>PROPOSED CHANGES</strong></td>
</tr>
</tbody>
</table>

**F-2.2M Example 2M**

A DN 400 outlet is welded to an DN 600 header. The header material is 317.2 MPa with a 7.92 mm wall. The outlet is 241.3 MPa (Seamless) with a 7.92 mm wall. The working pressure is 4.48 MPa. The fabrication is in Location Class 1. By para. 831.4.2, the reinforcement must be of the complete encirclement type. Using para. 841.1, the longitudinal joint factor is 1.00. The temperature is 37.8°C. Design factors \( F = 0.60 \), \( E = 1.00 \), and \( T = 1.00 \). For dimensions, see Fig. F-7.

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design formula, steel pipe, 841.1.1
fabricated assemblies, steel, 841.1.9(a)
general provisions, 840.1
least nominal wall thickness, 841.1.5(a)
longitudinal joint factor, \( E \), Table 841.1.7-1

**F-2.2M Example 2M**

A DN 400 outlet is welded to an DN 600 header. The header material is 317.2 MPa with a 7.92 mm wall. The outlet is 241.3 MPa (Seamless) with a 7.92 mm wall. The working pressure is 4.48 MPa. The fabrication is in Location Class 1. By para. 831.4.2, the reinforcement must be of the complete encirclement type. Using para. 841.1, the longitudinal weld joint quality factor is 1.00. The temperature is 37.8°C. Design factors \( F = 0.60 \), \( E = 1.00 \), and \( T = 1.00 \). For dimensions, see Fig. F-7.

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least nominal wall thickness, 841.1.5(a)
longitudinal weld joint quality factor, \( E \), Table 841.1.7-1

NOTES: (1) Underline and blue indicates revised and new text.
(2) Strikethrough and red indicates deleted text.
(3) Green indicates changes from the previous revision of this item

5 of 5
(5/29/18)
804.7.3 Pipe Manufacturing Processes.

Correction of hyphenation for para. 804.7.3 will be done under Record Item 08-1130.

805.1.3 Plastic Terms and Definitions

heat fusion joint: a joint made in thermoplastic piping by heating the parts sufficiently to permit fusion of the materials when the parts are pressed together.

805.1.4 Fabrication Terms and Definitions

cold-springing: where used in the Code, the fabrication of piping to an actual length shorter than its nominal length and forcing it into position so that it is stressed in the erected condition, thus compensating partially for the effects produced by the expansion due to an increase in temperature. Cold-spring factor is the ratio of the amount of cold spring provided to the total computed temperature expansion.

submerged arc welding: an arc welding process that uses an arc or arcs between a bare metal electrode or electrodes and the weld pool. The arc and molten metal are shielded by a blanket of granular flux on the workpieces. The process is used without pressure and with filler metal from the electrode and sometimes from a supplemental source (welding rod, flux, or metal granules).

805.2.4 Construction, Operation, and Maintenance Terms and Definitions

nondestructive examination (NDE) or nondestructive testing (NDT): a testing method, such as radiography, ultrasonic, magnetic testing, liquid penetrant, visual, leak testing, eddy current, and acoustic emission, or a testing technique, such as magnetic flux leakage, magnetic particle inspection, shear-wave ultrasonic, and contact compression-wave ultrasonic.

805.2.4 Construction, Operation, and Maintenance Terms and Definitions

nondestructive examination (NDE) or nondestructive testing (NDT): a testing method, such as radiography, ultrasonic, magnetic testing, liquid penetrant, visual, leak testing, eddy current, and acoustic emission, or a testing technique, such as magnetic flux leakage, magnetic particle inspection, shear-wave ultrasonic, and contact compression-wave ultrasonic.
### 826.3 Inspection and Tests for Quality Control of Welds on Piping Systems Intended to Operate at Hoop Stress Levels of 20% or More of the Specified Minimum Yield Strength

(a) The quality of each weld shall be examined by visual inspection.

(b) In addition, a certain percentage of the welds shall be examined through radiographic examination, ultrasonic testing, magnetic particle testing, or other comparable and acceptable methods of nondestructive testing. The trepanning method of nondestructive testing is prohibited.

### 831.2 Flanges

831.2.1 Flange Types and Facings

(i) When bolting together two Class 250 integral or threaded companion cast iron flanges having \( \frac{1}{16} \)-in. (1.6-mm) raised faces, the bolting shall be of carbon steel equivalent to ASTM A307 Grade B, without heat treatment other than stress relief.

(j) Class 150 steel flanges may be bolted to Class 125 cast iron flanges. When such construction is used, the \( \frac{1}{16} \)-in. (1.6-mm) raised face on the steel flange shall be removed. When bolting such flanges together using a flat ring gasket extending to the inner edge of the bolt holes, the bolting shall be of carbon steel equivalent to ASTM A307 Grade B, without heat treatment other than stress relief. When bolting such flanges together using a full-face gasket, the bolting may be alloy steel (ASTM A193).
### 831.2.2 Bolting

(c) Alloy-steel bolting material conforming to ASTM A193 or ASTM A354 shall be used for insulating flanges if such bolting is made $\frac{1}{8}$-in. (3.2-mm) undersized.

(e) All carbon and alloy-steel bolts, stud bolts, and their nuts shall be threaded in accordance with the following thread series and dimension classes as required by ASME B1.1.

1. **Carbon Steel.** All carbon-steel bolts and stud bolts shall have coarse threads having Class 2A dimensions, and their nuts shall have Class 2B dimensions.
2. **Alloy Steel.** All alloy-steel bolts and stud bolts of 1-in. (25-mm) and smaller nominal diameter shall be of the coarse-thread series; nominal diameters $\frac{1}{4}$ in. (29 mm) and larger shall be of the 8-thread series (8 threads per 25.4 mm). Bolts and stud bolts shall have a Class 2A dimension; their nuts shall have Class 2B dimension.

### 831.3.3 Branch Connections

(d) Threaded taps in ductile iron pipe are permitted without reinforcement to a size not more than 25% of the nominal diameter of the pipe, except that $\frac{1}{4}$-in. (DN 32) taps are permitted in NPS 4 (DN 100) pipe having a nominal wall thickness of not less than 0.380 in. (9.65 mm).

### 831.3.4 Openings for Gas Control Equipment in Cast Iron Pipe

Threaded taps used for gas control equipment in cast iron pipe (i.e., bagging off a section of main) are permitted without reinforcement to a size not more than 25% of the nominal diameter of the pipe, except that $\frac{1}{4}$-in. (DN 32) taps are permitted in NPS 4 (DN 100) pipe. Taps larger than those permitted above shall use a reinforcing sleeve.
### 832.3 Flexibility Requirements

(f) The total range in temperature from minimum design temperature to the maximum design temperature shall be considered in all expansion stress calculations, whether piping is cold-sprung or not. Should installation, start-up, or shutdown temperatures be outside of the design temperature range, the maximum possible temperature range shall be considered. In addition to the expansion of the line itself, the linear and angular movements of the equipment to which it is attached shall be considered.

(g) Flexibility calculations shall be based on the modulus of elasticity corresponding to the lowest temperature of the operational cycle.

(h) In order to modify the effect of expansion and contraction, runs of pipe may be cold-sprung. Cold-spring may be taken into account in the calculations of the reactions, provided an effective method of obtaining the designed cold-spring is specified and used.

### 832.4 Reactions

(a) Reaction forces and moments to be used in the design of restraints and supports for a piping system, and in evaluating the effects of piping displacements on connected equipment shall consider the full range of thermal displacement conditions plus weight and external loads. Cold-spring may be useful for maintaining reactions within acceptable limits.

### 833.7 Flexibility Analysis for Unrestrained Piping

NOTE: No general proof can be offered that this empirical equation always yields conservative results. It is not applicable to systems used in severe cyclic conditions. It should be used with caution in configurations such as unequal leg U-bends having \( L/U > 2.5 \); or nearly-straight “saw-tooth” runs; or where \( i \geq 5 \) due to thin-walled design; or where displacements not in the direction connecting anchor points constitute a large part of the total displacement. There is no assurance that terminal reactions will be acceptably low even if a piping system falls within the limitations of (a)(3).

### 833.9 Local Stresses

(a) High local stresses are usually generated at structural discontinuities and sites of local loadings. Although they may exceed the material yield strength, such stresses may often be disregarded because they are localized in influence and may be self-limiting or relieved by local deformation.
### 840.2 Buildings Intended for Human Occupancy

#### 840.2.1 General

(a) To determine the number of buildings intended for human occupancy for an onshore pipeline, lay out a zone \( \frac{1}{4} \text{mi} \) (0.4 km) wide along the route of the pipeline with the pipeline on the centerline of this zone, and divide the pipeline into random sections 1 mi (1.6 km) in length such that the individual lengths will include the maximum number of buildings intended for human occupancy. Count the number of buildings intended for human occupancy within each 1-mi (1.6-km) zone. For this purpose, each separate dwelling unit in a multiple dwelling unit building is to be counted as a separate building intended for human occupancy.

#### 840.2.2 Location Classes for Design and Construction

(a) Location Class 1. A Location Class 1 is any 1-mi (1.6-km) section that has 10 or fewer buildings intended for human occupancy. A Location Class 1 is intended to reflect areas such as wasteland, deserts, mountains, grazing land, farmland, and sparsely populated areas.

   (1) Class 1, Division 1. This Division is a Location Class 1 where the design factor of the pipe is greater than 0.72 but equal to or less than 0.80. (See Table 841.1.6-2 for exceptions to design factor.)

   (2) Class 1, Division 2. This Division is a Location Class 1 where the design factor of the pipe is equal to or less than 0.72. (See Table 841.1.6-2 for exceptions to design factor.)

(b) Location Class 2. A Location Class 2 is any 1-mi (1.6-km) section that has more than 10 but fewer than 46 buildings intended for human occupancy. A Location Class 2 is intended to reflect areas where the degree of population is intermediate between Location Class 1 and Location Class 3, such as fringe areas around cities and towns, industrial areas, ranch or country estates, etc.

(c) Location Class 3. A Location Class 3 is any 1-mi (1.6-km) section that has 46 or more buildings intended for human occupancy except when a Location Class 4 prevails. A Location Class 3 is intended to reflect areas such as suburban housing developments, shopping centers, residential areas, industrial areas, and other populated areas not meeting Location Class 4 requirements.
### Table 841.1.7-1 Longitudinal Joint Factor, \( E \)

<table>
<thead>
<tr>
<th>Spec. No.</th>
<th>Pipe Class</th>
<th>( E ) Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A53</td>
<td>Seamless</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Electric-resistance-welded</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Furnace-butt welded, continuous weld</td>
<td>0.60</td>
</tr>
<tr>
<td>ASTM A106</td>
<td>Seamless</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A134</td>
<td>Electric-fusion arc-welded</td>
<td>0.80</td>
</tr>
<tr>
<td>ASTM A135</td>
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<td>ASTM A333</td>
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<tr>
<td>ASTM A381</td>
<td>Submerged-arc-welded</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A671</td>
<td>Electric-fusion-welded</td>
<td>0.80</td>
</tr>
<tr>
<td>Classes 13, 23, 33, 43, 53</td>
<td>0.80</td>
<td></td>
</tr>
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<td>Classes 12, 22, 32, 42, 52</td>
<td>1.00</td>
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<td>ASTM A672</td>
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<td></td>
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<td>0.60</td>
</tr>
</tbody>
</table>

**GENERAL NOTE:** Definitions for the various classes of welded pipe are given in para. 804.7.3.

### 842.2.2 Thermoplastic Design Limitations

(d) For saddle-type service connections made by heat fusion techniques, it may be necessary for some materials that are intended for use at high operating pressures to require a heavier wall thickness than defined by the pressure design formula for sizes NPS 2 (DN 50) and smaller.

### Table 841.1.7-1 Longitudinal Joint Factor, \( E \)

<table>
<thead>
<tr>
<th>Spec. No.</th>
<th>Pipe Class</th>
<th>( E ) Factor</th>
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<td></td>
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<tr>
<td>Classes 12, 22, 32, 42, 52</td>
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<td>API 5L</td>
<td>Electric welded</td>
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<td>Seamless</td>
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<tr>
<td></td>
<td>Submerged-arc-welded</td>
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<tr>
<td></td>
<td>(longitudinal seam or helical seam)</td>
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</tr>
<tr>
<td></td>
<td>Furnace-butt welded, continuous weld</td>
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</tr>
</tbody>
</table>

**GENERAL NOTE:** Definitions for the various classes of welded pipe are given in para. 804.7.3.

### 842.2.2 Thermoplastic Design Limitations

(d) For saddle-type service connections made by heat fusion techniques, it may be necessary for some materials that are intended for use at high operating pressures to require a heavier wall thickness than defined by the pressure design formula for sizes NPS 2 (DN 50) and smaller.

**NOTES:**
1. Underline and blue indicates revised and new text.
2. Strikethrough and red indicates deleted text.

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(6/6/20)
<table>
<thead>
<tr>
<th><strong>PRESENT TEXT</strong></th>
<th><strong>PROPOSED CHANGES</strong></th>
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</thead>
</table>
| **842.2.9 Plastic Pipe and Tubing Joints and Connections**  
  *(b) Joint Requirements*  
  ...  
  *(5)* Heat-fusion or mechanical joints shall be used when joining polyethylene or polyamide 11 pipe, tubing, or fittings. PA-11 components may be joined to PA-11 components, and PE components may be joined to PE components. PE and PA-11 components shall not be heat-fused to each other. Polyethylene components made of different grades of materials may be heat-fused, provided that properly qualified procedures for joining the specific components are used. Any combination of PE materials with an ASTM D2513, Table 4, Pipe Category, melt index category C may be joined by heat fusion procedures such as those detailed in PPI TR-33. The Plastics Pipe Institute (PPI) publishes the following generic heat-fusion procedures: | **842.2.9 Plastic Pipe and Tubing Joints and Connections**  
  *(b) Joint Requirements*  
  ...  
  *(5)* Heat-fusion or mechanical joints shall be used when joining polyethylene or polyamide 11 pipe, tubing, or fittings. PA-11 components may be joined to PA-11 components, and PE components may be joined to PE components. PE and PA-11 components shall not be heat-fused to each other. Polyethylene components made of different grades of materials may be heat-fused, provided that properly qualified procedures for joining the specific components are used. Any combination of PE materials with an ASTM D2513, Table 4, Pipe Category, melt index category C may be joined by heat fusion procedures such as those detailed in PPI TR-33. The Plastics Pipe Institute (PPI) publishes the following generic heat-fusion procedures: |
| **842.3.2 Inspection and Handling Provisions.**  
  ...  
  *(c)* Skillful application of qualified techniques and the use of proper materials and equipment in good condition are required to achieve sound joints in plastic piping by the solvent cement, adhesive, or heat fusion methods. Inspection provisions shall be checked visually. If there is any reason to believe the joint is defective, it shall be removed and replaced. | **842.3.2 Inspection and Handling Provisions.**  
  ...  
  *(c)* Skillful application of qualified techniques and the use of proper materials and equipment in good condition are required to achieve sound joints in plastic piping by the solvent cement, adhesive, or heat fusion methods. Inspection provisions shall be checked visually. If there is any reason to believe the joint is defective, it shall be removed and replaced. |
| **851.4.3 Permanent Field Repair of Welds Having Injurious Defects**  
  ...  
  *(c)* If a manufacturing defect is found in a double submerged-arc-welded submerged-arc-welded seam or high frequency ERW seam, a full encirclement welded split sleeve shall be installed. | **851.4.3 Permanent Field Repair of Welds Having Injurious Defects**  
  ...  
  *(c)* If a manufacturing defect is found in a double submerged-arc-welded submerged-arc-welded seam or high frequency ERW seam, a full encirclement welded split sleeve shall be installed. |
### Tracking # 17-2554

<table>
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<th>ASME B31.8-2018 EDITION with Standards Committee Approved Revisions per Items 16-301 &amp; 17-773</th>
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<td><strong>PRESENT TEXT</strong></td>
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<tr>
<td><strong>861.1.4 Electrical Connections and Monitoring Points</strong></td>
<td><strong>861.1.4 Electrical Connections and Monitoring Points</strong></td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>(b) Special attention shall be given to the manner of installation of electrical leads used for corrosion control or testing to avoid harmful stress concentration at the point of attachment to the pipe. Acceptable methods include, but are not limited to (1) electrical leads attached directly on the pipe or by the thermit welding process, using copper oxide and aluminum powder. The size of the thermit welding charge shall not exceed a 15-g cartridge.</td>
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</tr>
<tr>
<td><strong>868.3 Installation of Electrical Connections</strong></td>
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</tr>
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<td><strong>A826 INSPECTION OF WELDS</strong></td>
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<tr>
<td><strong>A826.2 Inspection and Tests for Quality Control of Welds on Piping Systems</strong></td>
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</tr>
<tr>
<td><strong>A826.2.1 Extent of Examination.</strong> One-hundred percent of the total number of field welds on offshore pipelines and pipeline components that are subjected to loading by pipeline internal pressure shall be nondestructively inspected, if practical, but in no case shall less than 90% of such welds be inspected. The inspection shall cover 100% of the length of such inspected welds.</td>
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<tr>
<td><strong>A842.1.7 Residual Stresses.</strong> The pipeline system shall normally be installed in a manner so as to minimize residual stresses. The exception shall be when the designer purposefully plans for residual stresses (e.g., cold-springing of risers and pull-tube risers). When residual stresses are significant, they should be considered in the operating design of the pipeline system (see para. A842.2).</td>
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</tr>
<tr>
<td><strong>B803 SOUR GAS TERMS AND DEFINITIONS</strong></td>
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</tr>
<tr>
<td><em>Brinell Hardness Number (BHN):</em> a value to express the hardness of metals obtained by forcing a hard steel ball of specified diameter into the metal under a specified load. For the standard 3 000-kg load, numbers range from 81 to 945.</td>
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</table>

**NOTES:**
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(6/6/20)
B850  ADDITIONAL OPERATING AND MAINTENANCE CONSIDERATIONS AFFECTING THE SAFETY OF SOUR GAS PIPELINES

### B850.1 General

(c) Radius of exposure (ROE) to H₂S calculations shall be made using a suitable air dispersion equation such as the Pasquel-Gifford equation given as follows:

1. Each operator shall determine the hydrogen sulfide concentration in the gaseous mixture in the system. Suitable standards are GPA Plant Operations Test Manual, Section C, and GPA Standard 2265.

2. **Radius of Exposure Equations**
   - (a) Radius of exposure equation to the 100-ppm level of H₂S after dispersal:
     \[ X = \left[ (1.589) M Q \right]^{0.6258} \]
   - (b) Radius of exposure equation to the 500-ppm level of H₂S after dispersal:
     \[ X = \left[ (0.4546) M Q \right]^{0.6258} \]

where

- \( M \) = mol fraction of hydrogen sulfide in the gaseous mixture
- \( Q \) = maximum volume determined to be available for escape in cubic feet per day corrected to 14.65 psia and 60°F
- \( X \) = radius of exposure (ROE) in feet

3. **Metric Equations for Radius of Exposure**
   - (a) 100-ppm level of H₂S after dispersal:
     \[ X_m = \left[ (8.404) M Q_m \right]^{0.6258} \]
   - (b) 500-ppm level of H₂S after dispersal:
     \[ X_m = \left[ (2.404) M Q_m \right]^{0.6258} \]

where

- \( M \) = mol fraction of hydrogen sulfide in the gaseous mixture
- \( Q_m \) = maximum volume determined to be available for escape in cubic meters per day corrected to 101 kPa and 15.6°C
- \( X_m \) = radius of exposure (ROE) in meters

NOTE: The equations assume a 24-hr release. When a pipeline segment can be isolated in less than 24 hr, appropriate reductions in Q may be used.
(4) Examples of 100-ppm and 500-ppm ROE for various 24-hr releases and H2S mol fractions are shown in Tables B850.1-1 and B850.1-2. Metric examples of 100-ppm and 500-ppm ROE for various 24-hr releases and H2S mol fractions are shown in Tables B850.1-3 and B850.1-4.

Table B850.1-1 100-ppm ROE

Table B850.1-2 500-ppm ROE

Table B850.1-3 Metric Example for 100-ppm ROE

Table B850.1-4 Metric Example for 500-ppm ROE

B851 PIPELINE MAINTENANCE

B851.7 Pipeline Markers

(4) In addition to each sign required in para. 851.7(c) of Chapter V, for operations where the 100-ppm radius of exposure is greater than 50 ft (15 m), a “POISON GAS” sign shall be installed.

B854 LOCATION CLASS AND CHANGES IN NUMBER OF BUILDINGS INTENDED FOR HUMAN OCCUPANCY

B854.5 Concentrations of People in Location Classes 1 and 2

(d) Additional control and safety procedures or safety devices should be installed and maintained to prevent the undetected continuing release of hydrogen sulfide if any of the following conditions exist:

(1) The 100-ppm radius of exposure is in excess of 50 ft (15 m) and includes any part of a public area except a public road.
(2) The 500-ppm radius of exposure is greater than 50 ft (15 m) and includes any part of a public road.
(3) The 100-ppm radius of exposure is greater than 3,000 ft (915 m).
Table D-1  Specified Minimum Yield Strength for Steel Pipe Commonly Used in Piping Systems (Cont’d)

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

NOTES:
(1) Abbreviations: BW = furnace buttwelded; DSA = double submerged-arc welded; EFW = electric fusion welded; ERW = electric resistance welded; S = seamless.

F-2.1  Example 1

An NPS 8 outlet is welded to an NPS 24 header. The header material is API 5LX 46 with a 0.312-in. wall. The outlet is API 5L Grade B (Seamless) Schedule 40 with a 0.322-in. wall. The working pressure is 650 psig. The fabrication is in Location Class 1. Using para. 841.1, the longitudinal joint factor is 1.00. The temperature is 100°F. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Fig. F-6.
F-2.1.5 Effective Area in Outlet

Height \( L = 2\frac{1}{2}B + M \) (assume \( \frac{1}{4} \)-in. pad)
\[
= (2\frac{1}{2} \times 0.322) + 0.25 = 1.055 \text{ in.}
\]
or \( L = 2\frac{1}{2}H = 2.5 \times 0.312 = 0.780 \text{ in.} \). Use \( L = 0.780 \text{ in.} \).

\[
A_2 = 2(B - t_b) L = 2 \times 0.189 \times 0.780 = 0.295 \text{ in.}^2
\]
This must be multiplied by 35,000/46,000. [See para. 831.4.1(f)].

Effective \( A'_2 = 0.295 \times \frac{35,000}{46,000} = 0.224 \text{ in.}^2 \)

Required area:

\[
A_3 = A_R - A_1 - A'_2 = 2.259 - 0.231 - 0.224 = 1.804 \text{ in.}^2
\]

Use a reinforced plate that is 0.250 in. thick (minimum practicable) \( \times 15.5 \) in. in diameter.

Area = \((15.500 - 8.625) \times 0.250 = 1.719 \text{ in.}^2\)

Fillet welds (assuming two \( \frac{1}{4} \)-in. welds each side):

\[
\frac{1}{2} (0.25 \times 0.25) \times 4 = 0.125 \text{ in.}^2
\]

Total \( A_3 \) provided = 1.844 in.\(^2\)
See also Fig. F-5.

F-2.1M Example 1M

A DN 200 outlet is welded to a DN 600 header. The header material is 317.2 MPa with a 7.92-mm wall. The outlet is 241.3 MPa (Seamless) with a 8.18 mm wall. The working pressure is 4.48 MPa. The fabrication is in Location Class 1. Using para. 841.1, the longitudinal joint factor is 1.00. The temperature is 37.8°C. Design factors \( F = 0.60, E = 1.00, \) and \( T = 1.00 \). For dimensions, see Fig. F-6.
<table>
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<th>PROPOSED CHANGES</th>
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<tr>
<td><strong>F-2.2 Example 2</strong></td>
<td><strong>F-2.2 Example 2</strong></td>
</tr>
<tr>
<td>An NPS 16 outlet is welded to an NPS 24 header. The header material is API 5LX 46 with a 0.312-in. wall. The outlet is API 5L Grade B (Seamless) Schedule 20 with a 0.312-in. wall. The working pressure is 650 psig. The fabrication is in Location Class 1. By para. 831.4.2, the reinforcement must be of the complete encirclement type. Using para. 841.1, the longitudinal joint factor is 1.00. The temperature is 100°F. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Fig. F-7.</td>
<td>An NPS 16 outlet is welded to an NPS 24 header. The header material is API 5LX 46 with a <strong>0.312-in.</strong> wall. The outlet is API 5L Grade B (Seamless) Schedule 20 with a <strong>0.312-in.</strong> wall. The working pressure is 650 psig. The fabrication is in Location Class 1. By para. 831.4.2, the reinforcement must be of the complete encirclement type. Using para. 841.1, the longitudinal joint factor is 1.00. The temperature is 100°F. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Fig. F-7.</td>
</tr>
</tbody>
</table>
### F-2.2.5 Effective Area in Outlet

Height \( L = 2\frac{1}{2}B + M \) (assume \( 5/16 \)-in. plate)  
\[ = (2.5 \times 0.312) + 0.312 = 1.092 \text{ in.} \]

or

\[ L = 2\frac{1}{2}H = 2.5 \times 0.312 = 0.780 \text{ in.} \]  
Use \( L = 0.780 \text{ in.} \)

\[ A_2 = 2(B - t_b) L = 2 \times 0.064 \times 0.780 = 0.100 \text{ in.}^2 \]

This must be multiplied by 35,000/46,000 [See para. 831.4.1(f)].  
Effective \( A_2' = 0.100 \times 35,000/46,000 = 0.076 \text{ in.}^2 \)

Required area:

\[ A_3 = A_R - A_1 - A_2' \]
\[ = 4.351 - 0.446 - 0.076 = 3.829 \text{ in.}^2 \]

Approximate required thickness of reinforcement:

\[ 3.829 \div (30 - 16) = 0.274 \text{ in.} \]

Use a 0.312-in. plate minimum required length (neglecting welds):

\[ 3.829 \div 0.312 = 12.272 \text{ in.} \]

16 + 12.272 = 29 in. (rounded to the next higher whole number)

Use a plate that is 29 in. long.

Area = 0.312 \times (29 - 16) = 4.056 \text{ in.}^2

Two \( \frac{1}{4} \)-in. welds to outlet:

\[ \frac{1}{2} \times (0.25 \times 0.25) \times 2 = 0.063 \text{ in.}^2 \]

Total \( A_3 \) provided = 4.119 \text{ in.}^2

The use of end welds is optional (see Fig. I-3).

### G-1 TEST PROCEDURES

(a) An initial test shall qualify a welder for work. Thereafter, the welder’s work shall be checked either by requalification at 1-yr intervals or by cutting out and testing production work at least every 6 months.

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**NOTES:**

1. Underline and blue indicates revised and new text.
2. Strikethrough and red indicates deleted text.

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(6/6/20)
## Table I-1 Lightweight Flanges

**GENERAL NOTES:**
(a) Lightweight flanges are flat-faced and designed for use with full-face gasket or asbestos sheet gasket extending to the bolt holes.

## Table I-1 Lightweight Flanges (Metric Dimensions)

**GENERAL NOTES:**
(a) Lightweight flanges are flat-faced and designed for use with full-face gasket or asbestos sheet gasket extending to the bolt holes.

### M-6.2 Procedure

(f) Once the underground leakage has been identified, additional holes and deeper holes shall be probed to bracket the area more closely. For example, test holes may be spaced 6 ft (1.8 m) apart initially. The 6-ft (1.8-m) spacing between the two highest test holes may then be probed with additional test holes with spacing as close as 12 in. (300 mm).

### INDEX

Cold-springing, 805.1.4

Heat fusion joint, 805.1.3(b)

Welding, 820
  stress-relieving, 825

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**NOTES:**
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(2) Strikethrough and red indicates deleted text.
RATIONALE Item 17-2619

Paragraph 825.2 requires all carbon steel welds over 1.25 inches in thickness to be thermally stress relieved after welding. Paragraph A825, limited to offshore installations, permits stress relief to be waived for any thickness provided it can be shown that a satisfactory welding procedure can be achieved without stress relief. It requires a demonstration such as the welding procedure qualification test where the tensile, toughness and hardness properties are measured for both the weld deposit and the HAZ. It permits a waiver if (1) these properties are within the specified limits for the material and the intended service and (2) an engineering analysis has been conducted to ensure that the mechanical properties of the weldment including the residual stresses are suitable for the intended service.

The need for some method of waiving stress relief of certain welds arises from the fact that the mechanical properties of modern line pipe may be significantly degraded by the 1100-1200 degree stress relieve temperature specified in the code. Additionally, it would be impractical and hazardous to stress relieve an in-service weld as the yield strength of the pipeline at stress relieve temperature would likely be insufficient to contain pipeline pressure. In support of the request to provide a waiver mechanism our analytical ability to precisely define the maximum service stresses and their distribution is greatly improved over that available when the stress relief requirements were first imposed. Logically the same rules that are successfully used offshore should not be prohibited onshore.

It should be noted that other Codes are in the process of addressing or have addressed similar type issues. Prior to the 2014 edition, ASME B31.1 used to require PWHT when the governing thickness exceeded 0.75 inches, now PWHT not mandatory unless a 200°F preheat was not used while welding material thicker than 25mm (1 in.) or if the single pass weld thickness exceeds 5mm (3/16 in.). The 2016 edition of ASME B31.3 adopted basically the identical requirements as B31.1 (see Record 03-1453). ASME Section VIII, Div.1 recently balloted a request to increase the governing thickness from 32mm (1.25 in.) to 76mm (3 in.) (see Record 15-1436). Some of the background information utilized to justify changing the other codes can be found in EPRI Reports 1022883 and 1019171 which are now included in the “Background Material File”.

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<tr>
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<td><strong>Chapter VIII</strong></td>
</tr>
<tr>
<td>A823 Qualification of Procedures and Welders. . . . . . . 106</td>
<td>A823 Qualification of Procedures and Welders. . . . . . . 106</td>
</tr>
<tr>
<td>A825 Stress Relieving . . . . . . . . . . . . . . . . . . . . 106</td>
<td><strong>A825 Stress Relieving</strong> . . . . . . . . . . . . . . . . . . . 106</td>
</tr>
<tr>
<td>A826 Inspection of Welds . . . . . . . . . . . . . . . . . . . 106</td>
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</tr>
</tbody>
</table>

NOTES:  (1) Underline and blue indicates revised and new text.  (2) Strikethrough and red indicates deleted text  (3/31/20)
825.2 Wall Thickness
Welds in all carbon steels shall be stress relieved when the nominal wall thickness exceeds 1 1/4 in. (32 mm).  

A825 STRESS RELIEVING
Stress relieving requirements may be waived, regardless of wall thickness, provided that it can be demonstrated that a satisfactory welding procedure without the use of postweld heat treatment has been developed. Such a demonstration shall be conducted on materials and under conditions that simulate, as closely as practical, the actual production welding. Measurements shall be taken of the tensile, toughness, and hardness properties of the weld and heat-affected zone. No stress relieving will be required if:
(a) the measurements indicate that the metallurgical and mechanical properties are within the limits specified for the materials and intended service, and
(b) an engineering analysis is conducted to ensure that the mechanical properties of the weldment and the residual stresses without postweld heat treatment are satisfactory for the intended service. In some cases, measurement of residual stresses may be required.

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stress relieving, A825

Color key:
Blue, underlined: proposed language included for current ballot

NOTES: (1) Underline and blue indicates revised and new text.
(2) Strikethrough and red indicates deleted text
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<th>Existing Language-841.3</th>
<th>Proposed Additional Language</th>
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<tr>
<td>(g) Test assemblies should be located considering accessibility, sources of test medium, and the elevation profile of the test segment. Selected locations should provide testing flexibility while limiting test pressures between the minimum test pressure and the selected maximum test pressure.</td>
<td>(h) Where water is used as the test medium, after the test and dewatering is completed, provisions shall be made to remove residual test water. Residual water could potentially be corrosive or cause operational problems such as freezing at pressure regulating equipment. Additional information regarding treatment of residual fluids for internal corrosion prevention may be found in International Pipeline Conference paper IPC2012-90308 “Pressure Test Planning to Prevent Internal Corrosion by Residual Fluids”. (i) Prior to placing the pipeline in service, purge with gas to displace the air and remove any potentially explosive air-gas mixture. See para. 841.2.7(e).</td>
</tr>
</tbody>
</table>

**Additional Reference for Mandatory Appendix A**

**A-3 ASME**

IPC2012-90308 “Pressure Test Planning to Prevent Internal Corrosion by Residual Fluids”

Proceedings of IPC2012, Ninth International Pipeline Conference, September 2012
### 831.3.1 Standard Fittings

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>(a) The minimum metal thickness of flanged or threaded fittings shall not be less than specified for the pressures and temperatures in the applicable ASME standards or the MSS standard practice.</td>
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</tr>
<tr>
<td>(b) Steel buttwelding fittings shall comply with either ASME B16.9 or MSS SP-75 and shall have pressure and temperature ratings based on stresses for pipe of the same or equivalent material. For adequacy of fitting design, the actual bursting strength of fittings shall at least equal the computed bursting strength of pipe of the designated material and wall thickness. Mill hydrostatic testing of factory-made steel buttwelding fittings is not required, but all such fittings shall be capable of withstanding a field test pressure equal to the test pressure established by the manufacturer, without failure or leakage, and without impairment of their serviceability. (c) Factory-made wrought steel buttwelding induction bends or hot bends shall comply with ASME B16.49.</td>
<td>(b) Steel buttwelding fittings shall comply with either ASME B16.9 or MSS SP-75 and shall have pressure and temperature ratings based on stresses for pipe of the same or equivalent material. For adequacy of fitting design, the actual bursting strength of fittings shall at least equal the computed bursting strength of pipe of the designated material and wall thickness. Mill hydrostatic testing of factory-made steel buttwelding fittings is not required, but all such fittings shall be capable of withstanding a field test pressure equal to the test pressure established by the manufacturer, without failure or leakage, and without impairment of their serviceability. (c) Factory-made wrought steel buttwelding induction bends or hot bends shall comply with ASME B16.49. Bends required to be suitable for segmentation shall also comply with Supplemental Requirement SR15.3 in ASME B16.49.</td>
</tr>
</tbody>
</table>

**Legend:**

Red denotes text proposed for addition on ballot 18-727 which has been retained.

Yellow highlighted text has been added subsequent to ballot 18-727
Table 841.1.6-2 Design Factors for Steel Pipe Construction

<table>
<thead>
<tr>
<th>Facility</th>
<th>Location Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Div. 1</td>
</tr>
<tr>
<td>Pipelines, mains, and service lines [see para. 840.2.2]</td>
<td>0.80</td>
</tr>
<tr>
<td>Crossings of roads, railroads without casing:</td>
<td></td>
</tr>
<tr>
<td>(a) Private roads</td>
<td>0.80</td>
</tr>
<tr>
<td>(b) Unimproved public roads</td>
<td>0.60</td>
</tr>
<tr>
<td>(c) Roads, highways, or public streets with hard surface and railroads</td>
<td>0.60</td>
</tr>
<tr>
<td>Crossings of roads, railroads with casing:</td>
<td></td>
</tr>
<tr>
<td>(a) Private roads</td>
<td>0.80</td>
</tr>
<tr>
<td>(b) Unimproved public roads</td>
<td>0.72</td>
</tr>
<tr>
<td>(c) Roads, highways, or public streets with hard surface and railroads</td>
<td>0.72</td>
</tr>
<tr>
<td>Parallel encroachment of pipelines and mains on roads and railroads:</td>
<td></td>
</tr>
<tr>
<td>(a) Private roads</td>
<td>0.80</td>
</tr>
<tr>
<td>(b) Unimproved public roads</td>
<td>0.80</td>
</tr>
<tr>
<td>(c) Roads, highways, or public streets with hard surface and railroads</td>
<td>0.60</td>
</tr>
<tr>
<td>Fabricated assemblies [see para. 841.1.9(a)]</td>
<td>0.60</td>
</tr>
<tr>
<td>Pipelines on bridges [see para. 841.1.9(b)]</td>
<td>0.60</td>
</tr>
<tr>
<td>Pressure/flow control and metering facilities [see para. 841.1.9(d)]</td>
<td>0.60</td>
</tr>
<tr>
<td>Compressor station piping</td>
<td>0.50</td>
</tr>
<tr>
<td>Liquid removal equipment constructed of pipe and fittings without internal welding [see section 836]</td>
<td>0.50</td>
</tr>
<tr>
<td>Near concentration of people in Location Classes 1 and 2 [see para. 840.3(b)]</td>
<td>0.50</td>
</tr>
</tbody>
</table>

(c) Decompression Cooling. When reduction of pressure due to depressurization is anticipated to result in a significant reduction in the temperature of the piping system or any portion thereof, the user of this Code is cautioned to evaluate the effects of decompression and associated cooling on material serviceability and induced stresses.

(d) Design of Metering and Pressure/Flow Control

1. All piping and piping components, up to and including the outlet stop valve(s) of individual meter and pressure/flow control runs, shall meet or exceed the maximum design pressure of the inlet piping system. Threaded reducing bushings should not be used in pressure/flow control facilities where they are subject to high frequency piping vibrations. The design requirements of para. 840.3 and Table 841.1.6-2 apply to the design requirements of this section.

2. All piping shall be tested in accordance with para. 841.3 and the Location Class requirements of Table 841.1.6-2. Instrumentation devices such as transmitters, recorders, controllers, etc., excluding testing instrumentation, should be isolated from the piping during the test. Test fluids shall be removed from piping and piping components and the piping purged with natural gas before placing the facilities in service.

(3) The corrosion control measures in Chapter VI, as appropriate, must be applied to meter and pressure/flow control piping.

(e) Metering Facilities. Particular consideration and attention shall be given to sizing meter run blowdowns and/or flow-restricting plates for turbine and positive displacement meters. Rapid depressurization of meter runs can damage or destroy meters due to meter overspin and high differentials and can endanger personnel.

(f) Other (Nonmandatory) Considerations for Metering Facilities

1. Meter proving reduces measurement uncertainty. Where meter design, size, and flow rate allows, consider installing meter proving taps.

2. Upstream dry gas filter(s) should be considered when installing rotary or turbine meters. Particulates and pipeline dust can contaminate meter lubricating oil and damage bearings and other internal meter components.

(g) Pressure/Flow Control Facilities

1. Overpressure protection shall be provided by the use of:
   - (a) a monitor regulator in series with a controlling regulator (each regulator run).
   - (b) adequately sized relief valve(s) downstream of the controlling regulator(s).
Item 17-2683

This revision is intended to add clarity to paragraph 841.2.4(c)(3) as a result of inquiry 17-1810. Inquiry 17-1810 asked if the requirements of 841.2.4(c)(3) also applied to spiral welded pipe. The following defined terms from 805.1.4 where utilized:

- **girth weld**: a complete circumferential butt weld joining pipe or components.
- **seam weld**: the longitudinal or helical seam in pipe, made in the pipe mill for the purpose of making a complete circular cross section.

---

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
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<tr>
<td>841.2.4 Pipe Surface Requirements Applicable to Pipelines and Mains to Operate at a Hoop Stress of 20% or More of the Specified Minimum Yield Strength.</td>
<td>841.2.4 Pipe Surface Requirements Applicable to Pipelines and Mains to Operate at a Hoop Stress of 20% or More of the Specified Minimum Yield Strength.</td>
</tr>
</tbody>
</table>

(c) Dents

(1) A dent may be defined as a depression that produces a gross disturbance in the curvature of the pipe wall (as opposed to a scratch or gouge, which reduces the pipe wall thickness). The depth of a dent shall be measured as the gap between the lowest point of the dent and a prolongation of the original contour of the pipe in any direction.

(2) A dent, as defined in (c)(1), that contains a stress concentrator such as a scratch, gouge, groove, or arc burn shall be removed by cutting out the damaged portion of the pipe as a cylinder.

(3) All dents that affect the curvature of the pipe at the longitudinal weld or any circumferential weld shall be removed. All dents that exceed a maximum depth of $\frac{1}{4}$ in. (6 mm) in pipe NPS 12 (DN 300) and smaller or 2% of the nominal pipe diameter in all pipe greater than NPS 12 (DN 300) shall not be permitted in pipelines or mains intended to operate at hoop stress levels of 40% or more of the specified minimum yield strength. When dents are removed, the damaged portion of the pipe shall be cut out as a cylinder. Insert patching and pounding out of the dents is prohibited.

---

*Color key:*

- **Blue, underlined**: proposed language included for current ballot

NOTES:  
(1) Underline and blue indicates revised and new text.  
(2) Strikethrough and red indicates deleted text  

1 of 1  
(1/22/18)
This Proposal

**Proposed Text change to B31.8**

Introduction

...  
(h) provisions for protecting pipelines from external and internal corrosion

Either U.S. Customary (USC) units or International System (SI, also known as metric) units may be used with this edition. Local customary units may also be used to demonstrate compliance with this Code. One system of units should be used consistently for requirements applying to a specific installation. The equations in this Code may be used with any consistent system of units. It is the responsibility of the organization performing calculations to ensure that a consistent system of units is used.

It is intended that this Edition of Code Section B31.8 not be retroactive. The latest edition issued at least 6 months before the original contract date for the first phase of activity covering a piping system or systems shall be the governing document, unless agreement is specifically made between contracting parties to use another issue, or unless the regulatory body having jurisdiction imposes the use of another issue or different requirements.

...

**801 GENERAL**

...

**801.3 Standard Dimensions**

Adherence to American National Standards Institute (ANSI) dimensions is strongly recommended wherever practicable. Paragraphs or notations specifying these and other dimensional standards in this Code, however, shall not be mandatory, provided that other designs of at least equal strength and tightness, capable of withstanding the same test requirements, are substituted.

**801.4 SI (Metric) Conversion Units of Measure**

This Code states values in both USC and SI units. Within the text, the SI units are shown in parentheses or in separate tables. The values stated in each system are not exact equivalents; therefore, each system of units should be used independently of the other.

When separate equations are provided for USC and SI units, those equations shall be executed using variables in the units associated with the specific equation. The results obtained from execution of these equations may be converted to other units.

When necessary to convert from one system of units to another, conversion should be made by rounding the values to the number of significant digits of implied precision in the starting value, but not less than four significant digits for use in calculations. For factors used in converting U.S. Customary USC units to SI units, see Nonmandatory Appendix J.
### A842.2.2 Design Against Yielding.

\[ \text{(c) Combined Stress for Pipelines. The combined stress shall not exceed the value given by the maximum shear stress equation (Tresca combined stress):} \]

\[
2 \left[ \left( \frac{S_L - S_h}{2} \right)^2 + S_i^2 \right]^{\frac{1}{2}} \leq F_{3S}
\]

### Proposed Changes

\[ \text{(c) Combined Stress for Pipelines. The combined stress shall not exceed the value given by the maximum shear stress equation (Tresca combined stress):} \]

\[
\max \left[ \left( \frac{S_L + S_h}{2} \right) - \left( \left( \frac{S_L - S_h}{2} \right)^2 + S_i^2 \right)^{\frac{1}{2}} \right] \leq F_{3S}
\]
## PRESENT TEXT

(d) Combined Stress for Risers and Platform Piping. The combined stress shall not exceed the value given by the maximum shear stress equation (Tresca combined stress):

\[
2 \left[ \frac{S_L - S_h}{2} \right] + S_i \right)^2 \right]^{\frac{1}{2}} \leq F_3 S
\]

## PROPOSED CHANGES

(d) Combined Stress for Risers and Platform Piping. The combined stress shall not exceed the value given by the maximum shear stress equation (Tresca combined stress):

\[
\max \left[ \frac{S_L + S_h}{2}, \frac{S_L - S_h}{2} \right] \left[ \left( \frac{S_L - S_h}{2} \right)^2 + S_i \right)^2 \right]^{\frac{1}{2}} \leq F_3 S
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F-2.1M Example 1M

A DN 200 outlet is welded to a DN 600 header. The header material is 317.2 MPa with a 7.92-mm wall. The outlet is 241.3 MPa (Seamless) with a 8.18 mm wall. The working pressure is 4.48 MPa. The fabrication is in Location Class 1. Using para. 841.1, the longitudinal joint factor is 1.00. The temperature is 37.8°C. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Figure F-6.

**F-2.1.1M Header.** Nominal wall thickness required:

\[
t = \frac{PD}{2SFET} = \frac{4.48 \times 609.6}{2 \times 317.16 \times 0.60 \times 1.00 \times 1.00} = 7.178 \text{ mm}
\]

Excess thickness in header wall:

\[
H - t = 7.925 - 7.178 = 0.747 \text{ mm}
\]

**F-2.1.2M Outlet.** Nominal wall thickness required:

\[
t_b = \frac{4.48 \times 219.1}{2 \times 241.32 \times 0.60 \times 1.00 \times 1.00} = 3.390 \text{ mm}
\]

Excess thickness in outlet wall:

\[
B - t_b = 8.179 - 3.390 = 4.788 \text{ mm}
\]

\[
d = \text{inside diameter of opening} = 219.08 - 2 \times 8.179 = 202.72 \text{ mm}
\]

**F-2.1.3M Reinforcement Required**

\[
A_R = dt = 202.72 \times 7.178 = 1,455.2 \text{ mm}^2
\]

**F-2.1.4M Reinforcement Provided by Header**

\[
A_4 = (H - t)d = 0.747 \times 202.72 = 151.34 \text{ mm}^2
\]

**Effective Area in Outlet**

Height $L = 2\frac{1}{2}B + M$ (assume 6.35 mm pad)

\[
= (2\frac{1}{2} \times 8.179) + 6.35 = 26.797 \text{ mm}
\]

or $L = 2\frac{1}{2}H = 2.5 \times 7.92 = 19.812 \text{ mm}$. Use $L = 19.812 \text{ mm}$.

\[
A_2 = (B - t_b)L = 2 \times 4.788 \times 19.812 = 189.73 \text{ mm}^2
\]

This must be multiplied by 241.3/317.2 [see para. 831.4.1(f)].

\[
\text{Effective } A'_2 = 189.73 \times \frac{241.3}{317.2} = 144.36 \text{ mm}^2
\]

**Required area:**

\[
\frac{1}{2}(0.25 \times 0.25) \times 4 = 0.125 \text{ in}^2
\]

Total $A_3$ provided = 1.844 in.$^2$

See also Figure F-5.
GENERAL NOTE: Sketch is drawn for condition where $K = 1.00$.

$$A_3 = A_R - A_1 - A'_2 = 1455.2 - 151.34 - 144.36$$
$$= 1159.5 \text{ mm}^2$$

Use a reinforced plate that is 6.35 mm thick (minimum practicable) $\times$ 393.7 mm in diameter.

\[
\text{Area} = (393.7 - 219.1) \times 6.35 = 1108.9 \text{ mm}^2
\]

Fillet welds (assuming two 6.35-mm welds each side):

\[
\frac{1}{2}(6.35 \times 6.35) \times 4 = 80.65 \text{ mm}^2
\]

Total $A_3$ provided $= 1189.5 \text{ mm}^2$

See also Figure F-5.

F-2.2 Example 2

An NPS 16 outlet is welded to an NPS 24 header. The header material is API 5LX 46 with a 0.312-in. wall. The outlet is API 5L Grade B ( Seam less) Schedule 20 with a 0.312-in. wall. The working pressure is 650 psig. The fabrication is in Location Class 1. By para. 831.4.2, the reinforcement must be of the complete encirclement type.
Using para. 841.1, the longitudinal joint factor is 1.00. The temperature is $100^\circ$F. Design factors $F = 0.60, E = 1.00$, and $T = 1.00$. For dimensions, see Figure F-7.

**F-2.2.1 Header.** Nominal wall thickness required:

\[ t = \frac{PD}{2SFET} = \frac{650 \times 24}{2 \times 46,000 \times 0.60 \times 1.00 \times 1.00} = 0.283 \text{ in.} \]

Excess thickness in header wall:

\[ H - t = 0.312 - 0.283 = 0.029 \text{ in.} \]

**F-2.2.2 Outlet.** Nominal wall thickness required:

\[ t_b = \frac{650 \times 16}{2 \times 35,000 \times 0.60 \times 1.00 \times 1.00} = 0.248 \text{ in.} \]

Excess thickness in outlet wall:

\[ B - t_b = 0.312 - 0.248 = 0.064 \text{ in.} \]

\[ d = \text{inside diameter of opening} = 16.000 - 2 \times 0.312 = 15.376 \text{ in.} \]

**F-2.2.3 Reinforcement Required**

\[ A_R = dt = 15.376 \times 0.283 = 4.351 \text{ in.}^2 \]

**F-2.2.4 Reinforcement Provided**

\[ A_2 = (H - t)d = 0.029 \times 15.376 = 0.446 \text{ in.}^2 \]

**F-2.2.5 Effective Area in Outlet**

\[ \text{Height } L = 2 \frac{1}{2} B + M \left( \text{assume } \frac{5}{16} \text{ in. plate} \right) \]

\[ = (2.5 \times 0.312) + 0.312 = 1.092 \text{ in.} \]

or

\[ L = 2 \frac{1}{2} H = 2.5 \times 0.312 = 0.780 \text{ in. Use } L = 0.780 \text{ in.} \]

\[ A_2 = 2(B - t_b)L = 2 \times 0.064 \times 0.780 = 0.100 \text{ in.}^2 \]

This must be multiplied by 35,000/46,000 [see para. 831.4.1(f)].

Effective \( A'_2 = 0.100 \times 35,000/46,000 = 0.076 \text{ in.}^2 \)

Required area:

\[ A_3 = A_R - A_1 - A'_2 = 4.351 - 0.446 - 0.076 = 3.829 \text{ in.}^2 \]

Approximate required thickness of reinforcement:

\[ 3.829/(30 - 16) = 0.274 \text{ in.} \]

Use a 0.312-in. plate minimum required length (neglecting welds):

\[ 3.829/0.312 = 12.272 \text{ in.} \]

\[ 16 + 12.272 = 29 \text{ in. (rounded to the next higher whole number)} \]

Use a plate that is 29 in. long:

Area $= 0.312 \times (29 - 16) = 4.056 \text{ in.}^2$

Two $\frac{1}{4}$-in. welds to outlet:

\[ \frac{1}{2} \times (0.25 \times 0.25) \times 2 = 0.063 \text{ in.}^2 \]

Total \( A_3 \) provided $= 4.119 \text{ in.}^2$

The use of end welds is optional (see Figure I-3).

**F-2.2M Example 2M**

A DN 400 outlet is welded to an DN 600 header. The header material is 317.2 MPa with a 7.92 mm wall. The outlet is 241.3 MPa (seamless) with a 7.92 mm wall. The working pressure is 4.48 MPa. The fabrication is in
Location Class 1. By para. 831.4.2, the reinforcement must be of the complete encirclement type. Using para. 841.1, the longitudinal joint factor is 1.00. The temperature is 37.8°C. Design factors $F = 0.60$, $E = 1.00$, and $T = 1.00$. For dimensions, see Figure F-7.

**F-2.2.1M Header.** Nominal wall thickness required:

$$t = \frac{PD}{2SFET} = \frac{4.48 \times 609.6}{2 \times 317.16 \times 0.60 \times 1.00 \times 1.00} = 7.178 \text{ mm}$$

Excess thickness in header wall:

$$H - t = 7.925 - 7.178 = 0.747 \text{ mm}$$

**F-2.2.2M Outlet.** Nominal wall thickness required:

$$t_b = \frac{4.48 \times 406.4}{2 \times 241.32 \times 0.60 \times 1.00 \times 1.00} = 6.290 \text{ mm}$$

Excess thickness in outlet wall:

$$B - t_b = 7.925 - 6.290 = 1.635 \text{ mm}$$

$$d = \text{inside diameter of opening} = 406.4 - 2 \times 7.925 = 390.55 \text{ mm}$$

**F-2.2.3M Reinforcement Required**

$$A_R = dt = 390.55 \times 7.178 = 2803.5 \text{ mm}^2$$

**F-2.2.4M Reinforcement Provided**

$$A_1 = (H - t)\, d = 0.747 \times 390.55 = 291.56 \text{ mm}^2$$

**F-2.2.5M Effective Area in Outlet**

Height $L = 2 \frac{1}{2} B + M$ (assume 7.94 mm plate)

$$= (2.5 \times 7.92) + 7.94 = 27.75 \text{ mm}$$

or

$$L = 2 \frac{1}{2} H = 2.5 \times 7.92 = 19.812 \text{ mm}. \text{ Use } L = 19.812 \text{ mm}.$$  

$$A_2 = 2(B - t_b)L = 2 \times 1.635 \times 19.812 = 64.80 \text{ mm}^2$$

This must be multiplied by 241.3/317.2 [see para. 831.4.1(f)].

Effective $A'_2 = 64.80 \times 241.3/317.2 = 49.30 \text{ mm}^2$

Required area:

$$A_3 = A_R - A_1 - A'_2 = 2803.5 - 291.56 - 49.30 = 2462.6 \text{ mm}^2$$

Approximate required thickness of reinforcement:

$$\frac{2462.6}{(762 - 406.4)} = 6.925 \text{ mm}$$

Use a 7.92 mm plate minimum required length (neglecting welds):
Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures

ASTM A691 Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High-Pressure Service at High Temperatures

NOTE (1): The provisions of API 5L, 45th edition, apply unless otherwise provided for, prohibited by, or limited by this edition of ASME B31.8.

(b) Cold expanded pipe shall meet the mandatory requirements of API 5L.

814.1.2 Ductile Iron Pipe. Ductile iron pipe manufactured in accordance with ANSI A21.52, titled Ductile-Iron Pipe, Centrifugally Cast, for Gas, may be used.

814.1.3 Plastic Pipe and Components

(a) Plastic pipe and components manufactured in accordance with the following standards may be used:

(1) For polyethylene (PE) pipe, use

ASTM D2513 Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings

(2) For polyamide-11 (PA-11) pipe, use

ASTM D2517 Reinforced Epoxy Resin Gas Pressure Pipe and Fittings

ASTM F2945 Polyamide 11 Gas Pressure Pipe, Tubing, and Fittings

(b) Thermoplastic pipe, tubing, fittings, and cements conforming to ASTM D2513 shall be produced in accordance with the in-plant quality control program recommended in Annex A3 of that specification.

814.1.4 Qualification of Plastic Piping Materials

(a) In addition to complying with the provisions of para. 814.1.3, the user shall thoroughly investigate the specific plastic pipe, tubing, or fitting to be used and shall determine material serviceability for the conditions anticipated. The selected material shall be adequately resistant to the liquids and chemical atmospheres that may be encountered.

(b) When plastic pipe, tubing, or fittings of different material specifications are joined, a thorough investigation shall be made to determine that the materials are compatible with each other. See para. 842.2.9 for joining requirements.

814.2 Steel, Cast Iron, and Ductile Iron Piping Components

Specific requirements for these piping components that qualify under para. 811.1(a) are found in Chapter III.

815 EQUIPMENT SPECIFICATIONS

Except for the piping components and structural materials listed in Mandatory Appendix A and Nonmandatory Appendix C, it is not intended to include in this Code complete specifications for equipment. Certain details of design and fabrication, however, necessarily refer to equipment, such as pipe hangers, vibration dampeners, electrical facilities, engines, compressors, etc. Partial specifications for such equipment items are given herein, particularly if they affect the safety of the piping system in which they are to be installed. In other cases where this Code gives no specifications for the particular equipment item, the intent is that the safety provisions of this Code shall govern, insofar as they are applicable. In any case, the safety of equipment installed in a piping system shall be equivalent to that of other parts of the same system.

816 TRANSPORTATION OF LINE PIPE

Provisions should be made to protect the pipe, bevels, corrosion coating, and weight coating (if applicable) from damage during any transportation (highway, rail, and/or water) of line pipe.

Any line pipe to be transported by railroad, inland waterway, or by marine transportation shall be loaded and transported in accordance with API RP 5L1 or API RP 5LW. Where it is not possible to establish that the pipe was loaded and transported in accordance with the above referenced recommended practice, the pipe shall be hydrostatically tested for at least 2 hr to at least 1.25 times the maximum allowable operating pressure if installed in a Class 1 location, or to at least 1.5 times the maximum allowable operating pressure if installed in a Class 2, 3, or 4 Location, as applicable.

817 CONDITIONS FOR THE REUSE OF PIPE

817.1 Reuse of Steel Pipe

817.1.1 Equivalent Service Level. Removal of a portion of an existing steel line and reuse of the pipe, in the same line or in a line operating at the same or lower rated pressure, is permitted, provided that the fracture toughness of the removed pipe is commensurate with or exceeds that of the line operating at the same or lower rated pressure and the used pipe meets the restrictions of paras. 817.1.3(a), 817.1.3(f), and 817.1.3(i). Reuse of the pipe in the same line or in a line operating at the same or lower pressure and the same or higher temperature is permitted subject to the same para. 817.1.3 restrictions above and any derogations as required by Table 841.1.8-1. Removed pipe that is reinstalled in the same location need not be retested. Used pipe installed elsewhere is subject to paras. 817.1.3(i) and 817.1.3(j).
MANDATORY APPENDIX A
REFERENCES

These references may be immediately applied to materials purchased for use under this Code and shall be applied to all materials purchased at least 12 months after the date of issuance of the reference's latest edition, including addenda, if applicable. A component or pipe conforming to an earlier approved material specification edition purchased by the user before the date of issuance of a new edition or addenda may be used, provided the component or pipe is inspected and determined to be satisfactory for the service intended by the user.

Standards are incorporated in this Code by reference, and the names and addresses of the sponsoring organizations are shown in this Mandatory Appendix. It is not practical to refer to a specific edition of each publication throughout the Code text; instead, the specific edition reference dates are shown herein. Reference shall be limited to the specific edition cited below, except the user may use the latest published edition of ANSI approved standards unless specifically prohibited by this Code, and provided the user has reviewed the latest edition of the standard to ensure that the integrity of the pipeline system is not compromised. If a newer or amended edition of a standard is not ANSI approved, then the user shall use the specific edition reference date shown herein.

An asterisk (*) indicates that the specific edition of the standard has been accepted as an American National Standard by the American National Standards Institute (ANSI).

A-1 AGA

AGA Catalog No. XR0603 (October 2006), Plastic Pipe Manual for Gas Service
*ANSI/GPTC Z380.1 (2015, including Addenda 1 through 3), GPTC Guide for Gas Transmission and Distribution Piping Systems
Publisher: American Gas Association (AGA), 400 North Capitol Street, NW, Washington, DC 20001 (www.agap.org)

A-2 API

API RP 5L1 (seventh edition, September 2009, reaffirmed May 2015), Recommended Practice for Railroad Transportation of Line Pipe
*API RP 5LW (third edition, September 2009, reaffirmed May 2015), Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels
API RP 17B (fifth edition, May 2014), Recommended Practice for Flexible Pipe
API RP 80 (first edition, April 2000, reaffirmed January 2013), Guidelines for the Definition of Onshore Gas Gathering Lines
API RP 1102 (seventh edition, December 2007, including Errata through March 2014, reaffirmed December 2012), Steel Pipelines Crossing Railroads and Highways
*API RP 1110 (sixth edition, February 2013), Recommended Practice for the Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids, or Carbon Dioxide
Tracking # 19-666

(3) After a cut is made, immediately close all slots or open ends with tape, tightly fitted canvas, or other suitable materials.

(4) Do not permit two openings to remain uncovered at the same time. This is doubly important if the two openings are at different elevations.

(c) Welding, cutting, or other operations that could be a source of ignition shall not be done on a pipeline, main, or auxiliary apparatus that contains air, if it is connected to a source of gas, unless a suitable means has been provided to prevent the formation of an explosive mixture in the work area.

(d) In situations where welding or cutting must be done on facilities that are filled with air and connected to a source of gas, and the precautions recommended above cannot be taken, one or more of the following precautions, depending on circumstances at the jobsite, are suggested:

(1) Purging of the pipe or equipment upon which welding or cutting is to be done with an inert gas or continuous purging with air in such a manner that a combustible mixture does not form in the facility at the work area.

(2) Testing of the atmosphere in the vicinity of the zone to be heated before the work is started and at intervals as the work progresses with a combustible gas indicator or by other suitable means.

(3) Careful verification before and during the work ensuring that the valves that isolate the work from a source of gas do not leak.

(e) Purging of Pipelines and Mains

(1) When a pipeline or main is to be placed in service, the air in it shall be displaced. The following are some acceptable methods:

(a) Method 1. Introduce a moderately rapid and continuous flow of gas into one end of the line and vent the air out the other end. The gas flow shall be continued without interruption until the vented gas is free of air.

(b) Method 2. If the vent is in a location where the release of gas into the atmosphere may cause a hazardous condition, then a plug of inert gas shall be introduced between the gas and air. The gas flow shall then be continued without interruption until all of the air and inert gas have been removed from the facility. The vented gases shall be monitored and the vent shall be closed before any substantial quantity of combustible gas is released to the atmosphere.

(2) In cases where gas in a pipeline or main is to be displaced with air and the rate at which air can be supplied to the line is too small to make a procedure similar to but the reverse of that described in (1) feasible, a plug of inert gas should be introduced to prevent the formation of an explosive mixture at the interface between gas and air. Nitrogen or carbon dioxide can be used for this purpose.

(3) If a pipeline or main containing gas is to be removed, the operation may be carried out in accordance with (b), or the line may be first disconnected from all sources of gas and then thoroughly purged with air, water, or inert gas before any further cutting or welding is done.

(4) If a gas pipeline, main, or auxiliary equipment is to be filled with air after having been in service, and there is a reasonable possibility that the inside surfaces of the facility are wetted with volatile inflammable liquid, or such liquids might have accumulated in low places, purging procedures designed to meet this situation shall be used. Steaming of the facility until all combustible liquids have been evaporated and swept out is recommended. Filling of the facility with an inert gas and keeping it full of such gas during the progress of any work that may ignite an explosive mixture in the facility is an alternative recommendation. The possibility of striking static sparks within the facility must not be overlooked as a possible source of ignition.

(f) Whenever the accidental ignition in the open air of gas-air mixture may be likely to cause personal injury or property damage, precautions, such as the following, shall be taken:

(1) Prohibit smoking and open flames in the area.

(2) Install a metallic bond around the location of cuts in gas pipes to be made by means other than cutting torches.

(3) Take precautions to prevent static electricity sparks.

(4) Provide a fire extinguisher of appropriate size and type, in accordance with NFPA 10.

841.3 Testing After Construction

841.3.1 General Provisions. All piping systems shall be tested after construction to the requirements of this Code except for pre-tested fabricated assemblies and welded tie-in connections where post construction tie-in testing is not practical.

Additionally, single lengths or multiple welded lengths of pipe previously tested in accordance with this Code for the purposes of repair or replacement do not require a post construction retest.

(a) The circumferential welds associated with connecting pretested assemblies, pretested repair pipe lengths or sections, and welded tie-in connections not pressure tested after construction shall be inspected by radiographic or other accepted nondestructive methods in accordance with para. 826.2.

(b) Nonwelded tie-in connections not pressure tested after construction shall be leak tested at not less than the pressure available when the tie-in is placed into service.

(c) Pressure testing with water is recommended whenever possible; however, it is recognized that certain conditions may require testing with gases. When a gas is used as the test medium, the test pressure shall not exceed the maximum values stated in Tables 841.3.2-1 and 841.3.3-1.

826.3
(d) Welding procedure qualifications, as well as welder or welding operator qualifications, are valid only within the specified limits of the welding procedure. If changes are made in certain details, called “essential variables” or “essential changes,” additional qualification is required. API 1104 essential variables shall take precedence in matters not affected by the underwater environment, and AWS D3.6 shall govern those essential changes related to the underwater welding environment and working conditions.

A823 QUALIFICATION OF PROCEDURES AND WELDERS

Qualification of procedures and welders shall be in accordance with the requirements of section 823.1, except paras. 823.1 and 823.2 do not apply offshore.

(a) Welding procedures and welders performing atmospheric welding under this section shall be qualified under API 1104, except that for applications in which design, materials, fabrication, inspection, and testing are in accordance with the BPV Code, Section VIII, welding procedures and welders shall be qualified under the BPV Code, Section IX.

(b) Welding procedures and welders performing hyperbaric welding under this section shall be qualified in accordance with the testing provisions of API 1104 as supplemented by AWS D3.6, Specification for Underwater Welding for Type “O” Welds.

A825 STRESS RELIEVING

Stress relieving requirements may be waived, regardless of wall thickness, provided that it can be demonstrated that a satisfactory welding procedure without the use of postweld heat treatment has been developed. Such a demonstration shall be conducted on materials and under conditions that simulate, as closely as practical, the actual production welding. Measurements shall be taken of the tensile, toughness, and hardness properties of the weld and heat-affected zone. No stress relieving will be required if

(a) the measurements indicate that the metallurgical and mechanical properties are within the limits specified for the materials and intended service, and

(b) an engineering analysis is conducted to ensure that the mechanical properties of the weldment and the residual stresses without postweld heat treatment are satisfactory for the intended service. In some cases, measurement of residual stresses may be required.

A826 INSPECTION OF WELDS

A826.2 Inspection and Tests for Quality Control of Welds on Piping Systems

A826.2.1 Extent of Examination. One-hour percent of the total number of field welds on offshore pipelines and pipeline components that are subjected to loading by pipeline internal pressure shall be nondestructively inspected, if practical, but in no case shall less than 90% of such welds be inspected. The inspection shall cover 100% of the length of such inspected welds.

A826.2.2 Standard of Acceptability. All welds that are inspected must meet the standards of acceptability of API 1104 or the BPV Code, Section VIII, as appropriate for the service of the weld, or be appropriately repaired and re-inspected or removed.

A826.2.3 Alternative Flaw Acceptance Limits. For girth welds on a pipeline, alternative flaw acceptance limits may be established based on fracture mechanics analyses and fitness-for-purpose criteria as described in API 1104. Such alternative acceptance standards shall be supported by appropriate stress analyses, supplementary welding procedure test requirements, and nondestructive examinations beyond the minimum requirements specified herein. The accuracy of the nondestructive techniques for flaw depth measurement shall be verified by sufficient data to establish probabilities for the proposed inspection error allowance.

A830 PIPING SYSTEM COMPONENTS AND FABRICATION DETAILS

A830.1 General

The purpose of sections A831 through A835 is to provide a set of criteria for system components to be used in an offshore application.

A831 PIPING SYSTEM COMPONENTS

Cast iron or ductile iron shall not be used in flanges, fittings, or valve shell components.

All system components for offshore applications shall be capable of safely resisting the same loads as the pipe in the run in which they are included, except “weak links” (e.g., breakaway couplings) designed into a system to fail under specific loads. Consideration should be given to minimizing stress concentrations.

System components that are not specifically covered in section 831 shall be validated for fitness by either

(a) documented full scale prototype testing of the components or special assemblies, or
qualification specimen is metallurgically representative of full-scale pipeline welds.

NOTE: Both macrohardness and microhardness surveys of properly prepared qualification specimens are frequently used to determine the presence of thin HAZ hard zones. A commonly accepted maximum macrohardness limit near the inside surface is 250 HV10.

B824 PREHEATING

B824.5 Hydrogen Bake Out of Used Pipe

Pipe that has been used in sour gas service shall be heated for at least 20 min at 400°F (204°C) or higher to drive off any hydrogen in the metal. Heating shall be done just prior to welding. This heating should be in addition to and immediately preceding any preheating specified in the welding procedure for new pipe.

B825 STRESS RELIEVING

B825.1 Carbon Steels

The chemistry of the steel and welding procedure shall be controlled to limit the hardness of the weldment as required by para. B823.2.4. When the effectiveness of such controls is questionable, consideration shall be given to stress relieving welds in sour gas service. In general, temper bead welding, peening procedures, or low-temperature postweld heat treatment does not provide the equivalent protection from service cracking as does a full thermal stress relief.

B825.6 Stress Relieving Temperature

(a) Stress relieving is normally performed at a temperature of 1,100°F (593°C) for carbon steels and 1,200°F (649°C) for ferritic alloy steels. Other stress relieving procedures may be substituted when properly supported with metallurgical evidence. The exact temperature range shall be stated in the procedure specification.

(b) When stress relieving a joint between dissimilar metals having different stress relieving requirements, the material requiring the higher stress relieving temperature shall govern. Special considerations may be required for austenitic and other high alloys.

(c) The parts heated shall be brought slowly to the required temperature and held at that temperature for a period of time proportioned on the basis of at least 1 hr/in. (1 h/25 mm) of pipe wall thickness, but in no case less than 1/2 hr, and shall be allowed to cool slowly and uniformly.

(d) Records. A suitable record of the stress relief cycles shall be provided for each weld stress relieved.

(e) Temperature Control. A group of closely spaced welds, such as three welds on a tee, can be controlled and recorded by a single thermocouple.

B826 WELDING AND INSPECTION TESTS

B826.2 Inspection and Tests for Quality Control of Welds on Sour Gas Piping Systems

In addition to paras. 826.3(a) through 826.3(f), for sour gas lines in Class 3 or 4 Locations, compressor stations, major or navigable river crossings, railroad crossings, and road crossings, 100% of all field welds shall be checked by nondestructive inspection. Nondestructive inspection may be conducted before or after stress relieving.

B830 PIPING SYSTEM COMPONENTS AND FABRICATION DETAILS

In addition to section 830, all components shall meet the requirements of NACE MR0175/ISO 15156 as appropriate.

B831 PIPING SYSTEM COMPONENTS

B831.1 Valves and Pressure-Reducing Devices

B831.1.3 Pressure-Reducing Devices

(a) Instruments, instrument tubing, controllers, gages, and other components that become a part of the pressure containment system shall meet NACE MR0175/ISO 15156 requirements.

(b) Most copper-based alloys suffer severe corrosion in sour service. Use of such alloys in any components shall be investigated for suitability.

B831.2 Flanges

B831.2.2 Bolting

(h) Bolting exposed to sour gas and denied access to air due to thermal insulation, flange protectors, or certain design features shall meet the requirements of NACE MR0175/ISO 15156 as appropriate. Designers should note that bolting meeting NACE MR0175/ISO 15156 requirements, such as type ASTM A193 grade B7, have derated tensile properties, and the joint design shall be appropriate for such deration. Bolting opened to atmosphere may be conventional ASTM A193 grade B7 bolting.

B840 DESIGN, INSTALLATION, AND TESTING

This section concerns the design, installation, and testing of pipe in sour gas service.

B841 STEEL PIPE

B841.1 Steel Piping Systems Design Requirements

B841.1.2 Fracture Control and Arrest

(c) Fracture Control. Fracture control should be considered for sour gas service.
General Provisions and Definitions

801 GENERAL

801.1 Approved Standards and Specifications

Standards and specifications approved for use under this Code and the names and addresses of the sponsoring organizations are shown in Mandatory Appendix A. It is not considered practicable to refer to a specific edition of each of the standards and specifications in the individual Code paragraphs.

801.2 Use of Standards and Specifications Incorporated by Reference

Some standards and specifications cited in Mandatory Appendix A are supplemented by specific requirements elsewhere in this Code. Users of this Code are advised against attempting direct application of any of these standards without carefully observing the Code’s reference to that standard.

801.3 Standard Dimensions

Adherence to American National Standards Institute (ANSI) dimensions is strongly recommended wherever practicable. Paragraphs or notations specifying these and other dimensional standards in this Code, however, shall not be mandatory, provided that other designs of at least equal strength and tightness, capable of withstanding the same test requirements, are substituted.

801.4 SI (Metric) Conversion

For factors used in converting U.S. Customary units to SI units, see Nonmandatory Appendix J.

802 SCOPE AND APPLICATION

802.1 Scope

(a) This Code covers the design, fabrication, installation, inspection, and testing of pipeline facilities used for the transportation of gas. This Code also covers safety aspects of the operation and maintenance of those facilities. (See Mandatory Appendix Q for scope diagrams.)

(b) This Code does not apply to

(1) design and manufacture of pressure vessels covered by the BPV Code

(2) piping with metal temperatures above 450°F (232°C) (For low-temperature considerations, see section 812.)

(3) piping beyond the outlet of the customer’s meter set assembly (Refer to ANSI Z223.1/NFPA 54.)

(4) piping in oil refineries or natural gasoline extraction plants, gas treating plant piping other than the main gas stream piping in dehydration, and all other processing plants installed as part of a gas transmission system, gas manufacturing plants, industrial plants, or mines (See other applicable sections of the ASME Code for Pressure Piping, B31.)

(5) vent piping to operate at substantially atmospheric pressures for waste gases of any kind

(6) wellhead assemblies, including control valves, flow lines between wellhead and trap or separator, offshore platform production facility piping, or casing and tubing in gas or oil wells (For offshore platform production facility piping, see API RP 14E.)

(7) the design and manufacture of proprietary items of equipment, apparatus, or instruments

(8) the design and manufacture of heat exchangers (Refer to appropriate TEMA)s. (Refer to ASME B31.4.)

(9) liquid petroleum transportation piping systems (Refer to ASME B31.4.)

(10) liquid slurry transportation piping systems (Refer to ASME B31.4.)

(11) carbon dioxide transportation piping systems

(12) liquefied natural gas piping systems (Refer to NFPA 59A and ASME B31.3.)

(13) cryogenic piping systems

802.2 Intent

802.2.1 Adequacy for Normal Conditions. The requirements of this Code are adequate for safety under conditions usually encountered in the gas industry. Requirements for all unusual conditions cannot be specifically provided for, nor are all details of engineering and construction prescribed; therefore, activities involving the design, construction, operation, or maintenance of gas transmission, gathering, or distribution pipelines should be undertaken using supervisory personnel having the experience or knowledge to make adequate provision for such unusual conditions and specific

1 BPV Code references here and elsewhere in this Code are to the ASME Boiler and Pressure Vessel Code.

2 Tubular Exchanger Manufacturers Association, 25 North Broadway, Tarrytown, NY 10591.
A-3 ASME

*ASME B31.12-2019, Hydrogen Piping and Pipelines

*ASME B1.1-2005 (R2008), Unified Inch Screw Threads (UN and UNR Thread Form)

*ASME B1.20-1-2013, Pipe Threads, General Purpose (Inch)

*ASME B1.6.1-2015, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250

*ASME B1.6.5-2013, Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard

*ASME B1.6.9-2012, Factory-Made Wrought Butt welding Fittings

*ASME B1.11-2011, Forged Fittings, Socket-Welding and Threaded

*ASME B1.6.20-2012, Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed

*ASME B1.6.24-2011, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

*ASME B16.33-2012, Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 175 psi (Sizes NPS 1/2 Through NPS 2)

See Note in para B14.1.1 regarding the use of the 45th edition of API 5L.
NONMANDATORY APPENDIX C
PUBLICATIONS THAT DO NOT APPEAR IN THE CODE OR
MANDATORY APPENDIX A

NOTE: An asterisk (*) indicates standards that have been accepted as American National Standards by the American National Standards Institute (ANSI).

C-1 AGA
AGA Catalog XL1001 (December 2010, including Errata 1 and 2), Classification of Locations for Electrical Installations in Gas Utility Areas
Directional Drilling Damage Prevention Guidelines for the Natural Gas Industry (December 2004)
Publisher: American Gas Association (AGA), 400 North Capitol Street, NW, Washington, DC 20001 (www.agag.org)

C-2 API
API RP 2A-LRFD (first edition, July 1993, including Errata and Supplements through February 1997), Recommended Practice for Planning, Designing, and Constructing Fixed Offshore Platforms — Load and Resistance Factor Design
*API RP 500 (third edition, December 2012, including Errata through January 2014), Recommended Practices for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2
Publisher: American Petroleum Institute (API), 1220 L Street, NW, Washington, DC 20005 (www.api.org)

C-3 ASCE
ASCE Manuals and Reports on Engineering Practices No. 89 — Pipeline Crossings Handbook (June 1996)

C-4 ASME
*ASME B1.20.3-1976 (R2013), Dryseal Pipe Threads (Inch)
*ASME B16.3-2011, Malleable Iron Threaded Fittings: Classes 150 and 300
*ASME B16.4-2011, Gray Iron Threaded Fittings: Classes 125 and 250
*ASME B16.14-2013, Ferrous Pipe Plugs, Bushings, and Locknuts With Pipe Threads
*ASME B16.15-2013, Cast Copper Alloy Threaded Fittings: Classes 125 and 250
*ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings
*ASME B16.22-2013, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
*ASME B16.25-2012, ButtWelding Ends
*ASME B31.12-2014, Hydrogen Piping and Pipelines
Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)

C-5 ASTM
ASTM A6/A6M-16, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A20/A20M-15, Standard Specification for General Requirements for Steel Plates for Pressure Vessels
ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel
ASTM A48/A48M-03(R2012), Standard Specification for Gray Iron Castings

Publisher: American Society of Civil Engineers (ASCE), 1801 Alexander Bell Drive, Reston, VA 20191 (www.asce.org)

1 This publication has been superseded, withdrawn, or is no longer in print.
protecting the pipeline or main at such crossings. The crossing shall be located in the more stable bank and bed locations. The depth of the line, location of the bends installed in the banks, wall thickness of the pipe, and weighting of the line shall be selected based on the characteristics of the waterway. In addition to the above hazards, pipe exposed to cross-currents may be susceptible to vortex-induced vibration ("vortex shedding") in some flow regimes. This can cause fatigue damage in girth welds in the exposed spans. When these exposed span conditions are encountered, analyses shall be undertaken to determine whether this phenomenon is anticipated for the given pipe configuration and orientation and the anticipated water velocity conditions. Should conditions exist that could result in the pipe undergoing vibration and consequent fatigue damage, counteracting measures (burial, reburial, or vortex-shedding devices) shall be installed to reduce the potential for damage.

(d) Where pipelines and mains are exposed, such as at spans, trestles, and bridge crossings, the pipelines and mains shall be reasonably protected by distance or barriers from accidental damage by vehicular traffic or other causes.

(e) When pipelines and mains are installed above grade and exposed to cross-wind conditions, the pipelines and mains shall be reasonably protected from vortex-induced vibration. Such vibration can cause fatigue damage in girth welds in the exposed span. Analyses shall be undertaken to determine whether this phenomenon is anticipated for the given pipe configuration and orientation and the full range of naturally occurring wind conditions. Should conditions exist that could result in the pipe undergoing vibration and consequent fatigue damage, counteracting measures (strakes, vibration dampeners, or other vortex-shedding devices) shall be installed or the natural frequency of the piping system changed to reduce the potential for damage.

841.1.11 Cover, Clearance, and Casing Requirements for Buried Steel Pipelines and Mains

(a) Cover Requirements for Mains. Buried mains shall be installed with a cover not less than 24 in. (610 mm). Where this cover provision cannot be met, or where external loads may be excessive, the main shall be encased, bridged, or designed to withstand any such anticipated external loads. Where farming or other operations might result in deep plowing, in areas subject to erosion, or in locations where future grading is likely, such as road, highway, railroad, and ditch crossings, additional protection should be provided. [See (e) for suggested methods to provide additional protection.]

(b) Cover Requirements for Pipelines. Except for offshore pipelines, buried pipelines shall be installed with a cover not less than that shown in Table 841.1.11-1.

### Table 841.1.11-1 Pipeline Cover Requirements

<table>
<thead>
<tr>
<th>Location</th>
<th>For Normal Excavation</th>
<th>For Rock Excavation [Note (1)]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>For Normal Excavation</td>
<td>Pipe Size NPS 20 (DN 500)</td>
</tr>
<tr>
<td>Class 1</td>
<td>24 (610)</td>
<td>12 (300)</td>
</tr>
<tr>
<td>Class 2</td>
<td>30 (760)</td>
<td>18 (460)</td>
</tr>
<tr>
<td>Classes 3 and 4</td>
<td>30 (760)</td>
<td>24 (610)</td>
</tr>
<tr>
<td>Drainage ditch at public roads and railroad crossings (all locations)</td>
<td>36 (910)</td>
<td>24 (610)</td>
</tr>
</tbody>
</table>

NOTE: (1) Rock excavation is excavation that requires blasting.

API RP 1133 may be used for additional guidance.

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(b) Cover Requirements for Pipelines. Except for offshore pipelines, buried pipelines shall be installed with a cover not less than that shown in Table 841.1.11-1.
(b) a history of successful usage of these components or special assemblies produced by the same design method. Care should be exercised in any new application of existing designs to ensure suitability for the intended service.

A831.1 Valves and Pressure-Reducing Devices

A831.1.1 Valves. In addition to the valve standards listed in para. 831.1.1(a), the following specifications may be used:

- API Spec 6DSS/ISO 14723: Specification for Subsea Pipeline Valves
- API Spec 17D: Design and Operation of Subsea Production Systems — Subsea Wellhead and Tree Equipment

Thermal expansion and contraction calculations shall consider the temperature differential between material temperature during operations and material temperature during installation.

A834 SUPPORTS AND ANCHORAGE FOR EXPOSED PIPING

No attachment other than an encircling member shall be welded directly to the pipeline (see para. A842.2.7).

A835 ANCHORAGE FOR BURIED PIPING

Thermal expansion and contraction calculations shall consider the effects of fully saturated backfill material on soil restraint.

When a submerged pipeline is to be laid across a known fault zone, or in an earthquake-prone area where new faults are a possibility, consideration shall be given to the need for flexibility in the pipeline system and its components to minimize the possibility of damage due to seismic activity.

The requirements of para. 835.5(c) for header and branch connections are not applicable to offshore submerged piping systems. An appropriate means of preventing undue stresses at offshore submerged piping connections is to provide adequate flexibility at branch connections on the seabed.

A840 DESIGN, INSTALLATION, AND TESTING

A840.1 General Provisions

The design, installation, and testing of offshore gas transmission systems shall be in accordance with Chapter IV as specifically modified by the provisions of Chapter VIII. Also, all provisions of Chapter IV that depend on Location Class do not apply to offshore gas transmission systems, except that offshore pipelines approaching shoreline areas shall be additionally designed and tested consistently with Location Class provisions as determined in para. A840.2.

A840.2 Shoreline Approaches

Offshore pipelines approaching shoreline areas shall be additionally designed and tested consistently with Location Class provisions as determined in section 840, except that

(a) offshore pipelines in Location Classes 3 and 4 may alternatively be hydrostatically tested to a pressure not less than 1.25 times the maximum operating pressure so long as the provisions of section A826 are met

(b) for offshore pipelines, the provisions of section A847 supersede para. 841.3.2

A841 DESIGN CONSIDERATIONS

A841.1 Design Conditions

A number of physical parameters, henceforth referred to as design conditions, govern design of the offshore pipeline system so that it meets installation, operation, and other postinstallation requirements. Some of the factors that may influence the safety and reliability of an offshore pipeline and riser include

(a) waves
(b) current
(c) marine soils
(d) wind
(e) ice
(f) seismic activity
(g) platform motion
(h) temperature
(i) pressure
(j) water depth
(k) support settlement
(l) accidental loads
(m) commercial shipping
(n) fishing/shrimping activities

The design of offshore pipelines is often controlled by installation considerations rather than by operating load conditions.

Additional information for design conditions can be found in API RP 1111, para. 4.1.

A841.2 Installation Design Considerations

The design of an offshore pipeline system suitable for safe installation and the development of offshore pipeline construction procedures shall be based on consideration of the parameters listed in paras. A841.2.1 through A841.2.5. These parameters shall be considered to the extent that they are significant to the proposed system and applicable to the method of installation being considered.
A843.3.4 Pressure-Limiting Requirements for Offshore Compression Facilities

(c) Venting. Pressure relief valves shall be vented to atmosphere such that no hazard is created. Vent lines, common headers, and platform blowdown lines shall have sufficient capacity so that they will not interfere with the performance of the relief device.

A844 ON-BOTTOM STABILITY

Pipeline design for lateral and vertical stability is governed by seafloor bathymetry, soil characteristics, and by hydrodynamic, seismic, and soil behavior events having a significant probability of occurrence during the life of the system. Design conditions to consider are provided in the following subsections.

The pipeline system shall be designed to prevent horizontal and vertical movements, or shall be designed so that any movements will be limited to values not causing allowable stresses to be exceeded (see section A842).

Typical factors to be considered in the stability design include

(a) wave and current forces
(b) scour and resultant spanning
(c) liquefaction
(d) slope failure

Stability may be obtained by such means including, but not limited to, pipe submerged weight, trenching of pipe below grade, and anchoring.

When calculating hydrodynamic forces, the spatial variance of wave forces along the length of the pipeline may be taken into account.

Additional information on hydrostatic stability can be found in API RP 1111, para. 4.4.2.

A844.1 Design Storm Conditions

Design wave and current conditions for portions of a pipeline to be trenched shall be based on a return interval of no less than life or 100 yr, whichever is smaller. Portions of the pipeline system to be trenched shall be designed for wave and current conditions based on prudent assessment of the period of pipe exposure. The most unfavorable expected combination of wave and current conditions shall be used. Maximum wave and maximum current conditions do not necessarily occur simultaneously. The most unfavorable condition selection shall account for the timing of occurrence of the wave and current direction and magnitude.

A844.2 Stability Against Waves and Currents

A844.2.1 Submerged Weight. The submerged weight of the pipe may be designed (such as by weight coating) to resist or limit movement to acceptable values. Hydrodynamic forces shall be based on the wave and current values for the design storm condition for the specific location.

Wave and current directionality and concurrency shall be considered.

A844.2.2 Bottom Soils. The pipe–soil interaction factors that are used shall be representative of the bottom conditions at the site.

A844.2.3 Trenching. The pipeline and its appurtenances may be trenched below bottom grade to provide stability. The pipeline must be designed for wave and current stability prior to trenching. Such stability, however, need only be based on environmental conditions expected during the period of pipe exposure.

A844.2.4 Backfilling. Backfilling or other protective coverings, when necessary, shall be accomplished by using such materials and procedures to preclude damage to the pipeline and coatings.

A844.2.5 Anchoring. Anchoring may be used instead of or in conjunction with submerged weight to maintain stability. The anchors shall be designed to withstand lateral and vertical loads expected from the design storm condition. Anchors shall be spaced to prevent excessive stresses in the pipe sections between anchors. The anchoring system and adjacent pipe shall be designed to prevent scour and resultant spanning from overstressing the pipe. The effect of anchors on the cathodic protection system shall be considered.

A844.3 Shore Approaches

Pipe in the shore approach zone shall be trenched or bored to the depth necessary to prevent scouring, spanning, or stability problems that affect integrity and safe operation of the pipeline during its anticipated service life. Seasonal variation in the near shore thickness of seafloor sediments and shoreline erosion over the pipeline service life shall be considered.

A844.4 Slope Failure

The pipeline shall be designed for slope failure in zones of known or anticipated occurrence, such as mudslide zones and areas of seismic slumping. The design exposure period shall be no less than the expected life of the pipeline. If it is not practical to design the pipeline system to survive the event, the pipeline shall be designed for controlled breakaway with check valving to prevent blowdown of the pipeline.

A844.5 Soil Liquefaction

Design for the effects of liquefaction shall be performed for areas of known or expected occurrence. Soil liquefaction normally results from cyclic wave overpressures or seismic loading of susceptible soils. The bulk specific
A-3 ASME

*ASME B1.1-2003 (R2008), Unified Inch Screw Threads (UN and UNR Thread Form)
*ASME B1.20.1-2013, Pipe Threads, General Purpose (Inch)
*ASME B16.1-2015, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
*ASME B16.5-2013, Pipe Flanges and Flanged Fittings: NPS \( \frac{1}{2} \) Through NPS 24 Metric/Inch Standard
*ASME B16.9-2012, Factory-Made Wrought Buttwelding Fittings
*ASME B16.11-2011, Forged Fittings, Socket-Welding and Threaded
*ASME B16.20-2012, Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed
*ASME B16.24-2011, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500
*ASME B16.33-2012, Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 175 psi (Sizes NPS \( \frac{1}{2} \) Through NPS 2)

A-4 ASTM

ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
Proposal
The proposed change would be to modify Figure I-5(g) so that it is consistent with some common material specifications for weld neck flanges and butt weld fittings. It is possible that other material specification may still not comply with Figure I-5(g) because of the wide difference between different types of products. This proposed would ensure that many of the fittings manufactured to the more common specifications would also comply with the requirements of B31.8. The proposed changes would only apply to Figure I-5(g) as shown below in red.

**NOTES:**

1. No minimum when materials joined have equal specified minimum yield strengths.
2. Neither \( t_1 \), \( t_2 \), nor \( t_1 + t_2 \) shall exceed 0.5t

Replace the text in the box with the following text:

\[ t_1 \] [Note (2)]

Add text, three arrows and dashed line

Add text as Note 2
CURRENT WORDING
825.5 Connections and Attachments
All welding of connections and attachments shall be stress relieved when the pipe is required to be stress relieved by the rules of para. 825.3, with the following exceptions:

(a) fillet and groove welds not over $\frac{1}{2}$ in. (13 mm) leg size that attach connections not over NPS 2 (DN 50) pipe size

(b) fillet and groove welds not over $\frac{3}{8}$ in. (10 mm) groove size that attach supporting members or other nonpressure attachments

PROPOSED WORDING
825.5 Connections and Attachments
All welding of connections and attachments shall be stress relieved when the pipe is required to be stress relieved by the rules of para. 825.3, with the following exceptions:

(a) fillet and groove welds not over $\frac{1}{2}$ in. (13 mm) leg size that attach connections not over NPS 2 (DN 50) pipe size

(b) fillet and groove welds not over $\frac{3}{8}$ in. (10 mm) groove size that attach supporting members or other nonpressure attachments
API RP 1162 (second edition, December 2010, reaffirmed October 2015), Recommended Practice, Public Awareness Programs for Pipeline Operators
*API Spec 5L (45th edition, December 2012, including Errata through April 2015), Specification for Line Pipe
*API Spec 6A/ISO 10423:2009 (Modified) (20th edition, October 2010, including Errata and Addenda through February 2016), Specification for Wellhead and Christmas Tree Equipment
API Spec 6D (24th edition, August 2014, including Errata and Addenda through June 2016), Specification for Pipeline and Piping Valves
*API Spec 17D/ISO 13628-4 (second edition, May 2011, including Errata and Addenda through October 2015), Design and Operation of Subsea Production Systems — Subsea Wellhead and Tree Equipment
API Spec 17j (fourth edition, May 2014), Specification for Unbonded Flexible Pipe
API Std 1104 (21st edition, September 2013, including Errata and Addenda through May 2016), Welding of Pipelines and Related Facilities
Publisher: American Petroleum Institute (API), 1220 L Street, NW, Washington, DC 20005 (www.api.org)

A-3 ASME

*ASME B1.1-2003 (R2008), Unified Inch Screw Threads (UN and UNR Thread Form)
*ASME B1.20.1-2013, Pipe Threads, General Purpose (Inch)
*ASME B16.1-2015, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
*ASME B16.5-2013, Pipe Flanges and Flanged Fittings: NPS ½ Through NPS 24 Metric/Inch Standard
*ASME B16.9-2012, Factory-Made Wrought Buttwelding Fittings
*ASME B16.11-2011, Forged Fittings, Socket-Welding and Threaded
*ASME B16.20-2012, Metallic Gaskets for Pipe Flanges: Ring Joint, Spiral-Wound, and Jacketed
*ASME B16.24-2011, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500
*ASME B16.33-2012, Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 175 psi (Sizes NPS ½ Through NPS 2)

*ASME B16.34-2013, Valves — Flanged, Threaded, and Welding End
*ASME B16.38-2012, Large Metallic Valves for Gas Distribution: Manually Operated, NPS 2 1/2 (DN 65) to NPS 12 (DN 300), 125 psig (8.6 bar) Maximum
*ASME B16.40-2013, Manually Operated Thermoplastic Gas Shut-offs and Valves in Gas Distribution Systems
*ASME B16.42-2011, Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300
*ASME B16.47-2011, Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard
*ASME B16.49-2012, Factory-Made, Wrought Steel, Butt welding Induction Bends for Transportation and Distribution Systems
*ASME B18.2.1-2012 (including Errata through July 2013), Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
*ASME B18.2.2-2015, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
*ASME B31G-2012, Manual for Determining the Remaining Strength of Corroded Pipelines: Supplement to ASME B31 Code for Pressure Piping
*ASME B31Q-2014, Pipeline Personnel Qualification
*ASME B31.1-2016, Power Piping
*ASME B31.3-2014, Process Piping
*ASME B31.4-2016, Pipeline Transportation Systems for Liquids and Slurries
*ASME B31.8S-2016, Managing System Integrity of Gas Pipelines
*ASME B36.10M-2015, Welded and Seamless Wrought Steel Pipe
*ASME BPV Code: Section II, Materials; Section VIII, Rules for Construction of Pressure Vessels; and Section IX, Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators (2015)
*ASME PCC-2-2015 (including Supplement 1), Repair of Pressure Equipment and Piping

*ASME B16.21-2016, Nonmetallic Flat Gaskets for Pipe Flanges (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)

A-4 ASTM

ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

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3 See Note in para. B14.1.1 regarding the use of the 45th edition of API 5L.
(f) seamless pipe: a wrought tubular product made without a welded seam. It is manufactured by hot-working steel and, if necessary, by subsequently cold-finishing the hot-worked tubular product to produce the desired shape, dimensions, and properties. Typical specifications are ASTM A53, ASTM A106, and API 5L.

804.8

For plastic pipe, see para. 805.1.3.

805 DESIGN, FABRICATION, OPERATION, AND TESTING TERMS AND DEFINITIONS

805.1 General

805.1.1 Area

class location: a geographic area along the pipeline classified according to the number and proximity of buildings intended for human occupancy and other characteristics that are considered when prescribing design factors for construction, operating pressures, and methods of testing pipelines and mains located in the area and applying certain operating and maintenance requirements.

location class: see class location.

right-of-way (ROW): a strip of land on which pipelines, railroads, power lines, roads, highways, and other similar facilities are constructed. The ROW agreement secures the right to pass over property owned by others. ROW agreements generally allow the right of ingress and egress for the operation and maintenance of the facility, and the installation of the facility. The ROW width can vary with the construction and maintenance requirements of the facility’s operator and is usually determined based on negotiation with the affected landowner by legal action, or by permitting authority.

805.1.2 Leakage Investigative Terms and Definitions.

For definitions of gas leakage control criteria investigation terms, see Nonmandatory Appendix M.

805.1.3 Plastic Terms and Definitions

adhesive joint: a joint made in plastic piping by the use of an adhesive substance that forms a continuous bond between the mating surfaces without dissolving either one of them.

dimension ratio (DR): the ratio of outside pipe diameter to wall thickness of thermoplastic pipe. It is calculated by dividing the specified outside diameter of the pipe by the specified minimum wall thickness.

heat fusion joint: a joint made in thermoplastic piping by heating the parts sufficiently to permit fusion of the materials when the parts are pressed together.

hydrostatic design basis (HDB): one of a series of established stress values (specified in ASTM D2837) for a plastic compound obtained by categorizing the long-term hydrostatic strength determined in accordance with ASTM D2837. Established HDBs are listed in PPI TR-4.

long-term hydrostatic strength: the estimated hoop stress in pounds per square inch (MPa) in a plastic pipe wall that will cause failure of the pipe at an average of 100,000 hr when subjected to a constant hydrostatic pressure. (See Mandatory Appendix D.)

solvent cement joint: a joint made in thermoplastic piping by the use of a solvent or solvent cement that forms a continuous bond between the mating surfaces.

standard dimension of a weld made by one of the welds specified by outside pipe diameter to wall thickness of thermoplastic pipe. It is calculated by dividing the specified outside diameter of the pipe by the specified wall thickness.

805.1.4 Fabrication Terms and Definitions

arc weld: a group of welding processes that produces coalescence of metals by heating them with an arc. The processes are used with or without the application of pressure and with or without filler metal.

arc welding: see arc weld.

butt joint: a joint between two members aligned approximately in the same plane. See Figures 1(A), 2(A), 3, 51(A), and 51(B) in AWS A3.0.

butt weld: a nonstandard term for a weld in a butt joint.

cold-springing: where used in the Code, the fabrication of piping to an actual length shorter than its nominal length and forcing it into position so that it is stressed in the erected condition, thus compensating partially for the effects produced by the expansion due to an increase in temperature. Cold-spring factor is the ratio of the amount of cold spring provided to the total computed temperature expansion.

fillet weld: a weld of approximately triangular cross section joining two surfaces approximately at right angles to each other in a lap joint, tee joint, or corner joint.

girth weld: a complete circumferential butt weld joining pipe or components.

heat treatment: heating and cooling a solid metal or alloy in such a way as to obtain desired properties. Heating for the sole purpose of hot working is not considered heat treatment. If a weldment is heated and cooled in a controlled manner, then the term "postweld heat treatment" is used.

seam weld: the longitudinal or helical seam in pipe, made in the pipe mill for the purpose of making a complete circular cross section.

stress relieving: heating a metal to a suitable temperature, holding at that temperature long enough to reduce residual stresses, and then cooling slowly enough to minimize the development of new residual stresses.
<table>
<thead>
<tr>
<th>PRESENT TEXT</th>
<th>PROPOSED CHANGES</th>
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<tbody>
<tr>
<td>826.3 Inspection and Tests for Quality Control of Welds on Piping Systems Intended to Operate at Hoop Stress Levels of 20% or More of the Specified Minimum Yield Strength</td>
<td>826.3 Inspection and Tests for Quality Control of Welds on Piping Systems Intended to Operate at Hoop Stress Levels of 20% or More of the Specified Minimum Yield Strength</td>
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<tr>
<td>(d) When radiographic examination is employed, a procedure meeting the requirements of API 1104 shall be followed.</td>
<td>(d) When radiographic examination, ultrasonic testing, or magnetic particle inspection is employed, a procedure meeting the requirements of API 1104 shall be followed.</td>
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841.3 Testing After Construction

841.3.1 General Provisions

| (a) The circumferential welds associated with connecting pretested assemblies, pretested repair pipe lengths or sections, and welded tie-in connections not pressure tested after construction shall be inspected by radiographic or other accepted nondestructive methods in accordance with para. 826.2. | (a) The circumferential welds associated with connecting pretested assemblies, pretested repair pipe lengths or sections, and welded tie-in connections not pressure tested after construction shall be inspected by radiographic or other comparable and accepted nondestructive methods in accordance with para. 826.2 paras. 826.3(c) and 826.3(d). |