Specification on End Closures, Connectors and Swivels

API SPECIFICATION 6H
SECOND EDITION, MAY 1,1998

EFFECTIVE DATE: NOVEMBER 1, 1998

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Specification on End Closures, Connectors and Swivels

1 Scope

This specification covers the following:

a. Pipeline closures.
b. Connectors.
c. Couplings.
d. Misalignment devices (swivels).
e. Split mechanical fittings.

This specification does not apply to welded, flanged, or threaded fittings that are specified in other recognized standards.

Appendices A and B provide recommended purchaser guidelines to assist the purchaser in decisions which are optional to the purchaser and in assuring that adequate information is communicated to the manufacturer.

2 References

This specification includes by references, either in total or in part, other API industry and government standards as listed below.

API
Spec 5L *Specification for Line Pipe*

AISI[1]
Steel Designations *Standard Steels*
1008—1026,
4130, 4140, and 8630

ANSI[2]
B16.5 *Pipe Flanges and Flanged Fittings*

ANSI/ASME
B31.4 *Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols*
B31.8 *Gas Transmission and Distribution Piping Systems*

ASME[3]
Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels
Boiler and Pressure Vessel Code, Section VIII, Division 2: Rules for Construction of Pressure Vessels, Alternative Rules
Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

ASTM[4]
A29 *Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished, General Requirements for*
A105 *Specification for Forgings, Carbon Steel, for Piping Components*
A106 *Specification for Seamless Carbon Steel Pipe for High-Temperature Service*
A181 *Specification for Forgings, Carbon Steel for General Purpose Piping*
A182 *Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service*
A193 *Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service*
A194 *Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service*
A216 *Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service*
A217 *Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure Containing Parts, Suitable for High-Temperature Service*
A218 *Specification for Zinc-Coated Steel Wire Strand*
A242 *Specification for High-Strength Low-Alloy Structural Steel*
A255 *Method for End-Quench Test for Hardenability of Steel*
A285 *Specification for Pressure Vessel Plates, Carbon Steel, Low and Intermediate-Tensile Strength*
A320 *Specification for Alloy Steel Bolting Materials for Low-Temperature Service*
A333 *Specification for Seamless and Welded Steel Pipe for Low-Temperature Service*
A350 *Specification for Forgings, Carbon and Low-Alloy Steel, Requiring Notch Toughness Testing for Piping Components*

[1]American Iron and Steel Institute, 1101 17th Street, N.W., Washington, DC 20005.
[2]American National Standards Institute, 11 West 42nd Street, New York, New York 10036.
[3]American Society for Mechanical Engineers, 345 East 47th Street, New York, New York 10017.
[4]American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428-2959.

A351 *Specification for Steel Castings, Austenitic, for High-Temperature Service*
A352 *Specification for Steel Castings, Ferritic and Martensitic, for Pressure Containing Parts, Suitable for Low Temperature Service*
A370 *Test Methods and Definitions for Mechanical Testing of Steel Products*
A381 *Specification for Metal-Arc-Welded Steel Pipe for Use With High-Pressure Transmission Systems*
A441 *Specification for High-Strength Low-Alloy Structural Manganese Vanadium Steel*
A487 *Specification for Steel Castings Suitable for Pressure Service*
A513 *Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing*
A515 *Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate-and Higher-Temperature Service*
A516 *Specification for Pressure Vessel Plates, Carbon Steel, for Moderate and Lower-Temperature Service*
A519 *Specification for Seamless Carbon and Alloy Steel Mechanical Tubing*
A533 *Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel*
A537 *Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel*
A572 *Specification for High-Strength Low-Alloy Columbium-Vanadium Steel of Structural Quality*
A633 *Specification for Normalized High-Strength Low-Alloy Structural Steel*
A675 *Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties*
A694 *Specification for Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service*
A707 *Specification for Flanges, Forged, Carbon and Alloy Steel for Low-Temperature Service*
A737 *Pressure Vessel Plates, High Strength, Low Alloy Steel*
A757 *Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing and Other Applications, for Low-Temperature Service*

CFR[5]
Title 49, Part 195, *Transportation of Hazardous Liquids by Pipeline*

MIL–STD[6]
120 *Gage Inspection*

MSS[7]
SP-44 *Steel Pipe Line Flanges*

NACE[8]
MR0175 *Material Requirements, Sulfide Stress Cracking Resistant Metallic Materials for Oil Field Equipment*

ASNT[9]
SNT–TC-1A *Recommended Practices*

3 Definitions

3.1 fitting: The term "fitting" as used in this specification refers to all devices listed in Section 1.

3.2 NPS: Abbreviation for Nominal Pipe Size in inches.

3.3 raised face: A flange face having a flat surface protruding $^1/_{16}$ (3.18 mm) or $^1/_4$ (6.35 mm) inch beyond the outer flange face.

3.4 ring joint face: A flange face having a specially shaped groove located between the bolt holes and the flange bore.

3.5 closure: The term as used in this specification refers to both the cap and hub.

3.6 PN: The metric equivalent class rating.

4 General

4.1 FITTING CLASSES

Fittings covered by this specification shall be furnished in the following classes:

Class 150	Class 900
Class 300	Class 1500
Class 400	Class 2500
Class 600	

[5]Research and Special Programs Administration, U.S. Department of Transportation. The *Code of Federal Regulations* is available from the U.S. Government Printing Office, Washington, DC 20402.
[6]Department of Defense, standards are available from Defense Automated Printing, 700 Robbins Ave., Bldg. 4, Section 9, Philadelphia, Pennsylvania 19111.
[7]Manufacturers Standardization Society of the Valve Fittings Industry, Inc., 127 Park Street, N.E., Vienna, Virginia 22180.
[8]NACE International, 1440 South Creek Drive, P.O. Box 218340, Houston, Texas 77218-8340.
[9]American Society on Non-Destructive Testing, 1711 Arlington Lane, P.O. Box 28518, Columbus, Ohio 43228.

Note: The class designations above are the same as the rating designations of ANSI B16.5, and therefore indicate the applicable connecting flanges. Other pressure classes may be per the manufacturer's written specification.

4.2 PRESSURE RATINGS

Fittings manufactured under this specification shall have maximum operating pressure ratings corresponding to the classes shown in Table1.

Table 1—Maximum Operating Pressure Ratings
-20°F to 250°F
(-29°C to 121°C)

Class		Ratings, psig (bar)[a]	
150	(PN 20)	285	(19.5)
300	(PN 50)	740	(51.0)
400	(PN 64)	990	(68.3)
600	(PN 100)	1480	(102.0)
900	(PN 150)	2220	(153.1)
1500	(PN 250)	3705	(255.5)
2500	(PN 420)	6170	(425.4)

[a]1 bar = 100 kPa

4.3 TEMPERATURE RATINGS

a. The temperature range shall be established and marked on the fitting identification plate.
b. For service temperatures below -20ºF (-29ºC), materials shall be certified in accordance with the appropriate ASTM material specifications for low temperature service.
c. Maximum service temperature may be limited by either the nonmetallic seal ring or the metal used in the fitting. If the metal is the limiting temperature factor, the Maximum Operating Pressure in Table 1 of this specification shall be derated as required for the specific materials listed in ASME Section VIII, Division 1.

4.4 MANUFACTURER'S HYDROSTATIC TEST

a. All fittings shall be subjected to a minimum hydrostatic test equal to or greater than 1.5 times the maximum operating pressure rating. There shall be no visible leakage or harmful inelastic deformation under the test pressure.
b. All cast components and welds must be free of paint or lacquer during hydrostatic testing.
c. If fitting weld ends are welded for hydrostatic testing, all weld metal and at least $^3/_{16}$ inch [4.8 mm] of base metal must be machined off the weld end. No welding or machining (other than weld end preparation) shall be done on a fitting after hydrotest unless either the entire unit is retested, or all weld areas pass subsequent NDE.
d. During the manufacturer's hydrostatic test, the closed end(s) must not be restrained by fixtures such that the pressure load is not fully carried by the fitting under test.
e. The duration of the hydrostatic test shall be a minimum of one hour.
f. After testing, nonmetallic seals may be replaced and all internal metallic surfaces shall be coated with a water-displacing rust preventive.

4.5 DIMENSIONS

The inside diameter throughout the bore of all fittings shall not be less than the nominal inside diameter of the matching pipe minus $^1/_{16}$ inch (1.6 mm).

4.6 WELDING ENDS

Welding ends shall conform to the appropriate designs shown in ANSI B31.4, Figure 434. 8.6(a)-A or B, or in ANSI B31.8 App. I, Figures 14, 15 unless otherwise required by the manufacturer's written specification. The welding ends shall have all burrs removed from both inside and outside edges.

4.7 FLANGED ENDS

End flanges shall be furnished with raised face or ring-joint face. Dimensions, tolerances, finishes including drilling templates, flange facing, spot facing, and back facing for flanges NPS 24 and smaller, but excluding NPS 22, shall conform to ANSI B16.5. Dimensions and tolerances for flanges for NPS 22 and for NPS 26 and larger shall conform to MSS SP-44. Ring-joint end flanges may be furnished either raised or full face. Other types of end flanges may be used per the manufacturer's written specification.

4.8 BOLTING

Bolting shall generally be at a quality and strength not less than ASTM A193-B7. Nuts shall be at a quality and strength not less than ASTM A194 Gr2H. For sour service applications, bolting shall be of a quality and strength not less than ASTM-A193-B7M. Nuts shall be of a quality and strength not less than ASTM-A194-Gr2M.

5 Design

5.1 DESIGN METHODS

Fittings shall be designed in accordance with one or more of the following methods:

Note: In the event stress levels calculated by these methods exceed the allowable stresses, other industry accepted methods must be used to justify these stresses. Fatigue analysis and localized bearing stress values are beyond the scope of this specification.

a. ASME. The design methodology as described in the *ASME Boiler and Pressure Vessel Code*, Section VIII, Division 2, Appendix 4, may be used for design calculations for

pressure-containing equipment. Design allowable stresses shall be limited by the following criteria:

$$S_T = .83S_Y \text{ and } S_m = \frac{2S_Y}{3} \quad (1)$$

where

S_m = design stress intensity at rated working pressure, psi,

S_T = maximum allowable general primary membrane stress intensity at hydrostatic test pressure, psi,

S_Y = material minimum specified yield strength, psi.

b. Distortion Energy Theory. The distortion energy theory method may be used for design calculations for pressure containing equipment. The basic pressure vessel wall thickness may be sized by combining triaxial stresses based on hydrostatic test pressure and limited by the following criteria:

$$S_E = S_Y \quad (2)$$

where

S_E = maximum allowable equivalent stress computed by the Distortion Energy Theory method, psi,

S_Y = material minimum specified yield strength, psi.

c. Experimental Stress Analysis. Experimental stress analysis as described in the ASME Boiler and Pressure Vessel Code, Section VIII, Division 2, Appendix 6.

d. Proof Test Analysis. Proof testing as described in the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Part UG-101.

5.2 DESIGN DOCUMENTATION

The documentation of designs shall include methods, assumptions, calculations, and design requirements. Design requirements shall include, but shall not be limited to, those criteria for size, testing and operating pressures, material, environmental, API specification requirements, and other pertinent requirements upon which the design is to be based. Design documentation media shall be clear, legible, reproducible, and retrievable.

5.3 DESIGN REVIEW

The design documentation shall be reviewed and verified by any qualified individual other than the individual who created the original design.

5.4 DESIGN VERIFICATION

Manufacturers are required to document their verification procedures and the results of performance verification of designs.

6 Material

6.1 FITTING MATERIAL

All pressure containing or product contacting components of fittings covered by this specification, including end flanges and weld ends, shall be made of materials conforming to one or more the specifications shown in the appropriate Material Specifications Tables in Sections 8–12.

6.2 NONMETALLIC PARTS

Nonmetallic parts and elements, which usually include such items as seals, injectable material, and lubricants, shall be of material in accordance with the manufacturer's written specifications.

6.3 WELDING QUALIFICATIONS

All welding procedures, welders, and welding operators used in the fabrication of fittings under this specification shall be qualified under ASME Boiler and Pressure Vessel Code, Section IX.

6.4 SULFIDE STRESS CRACKING—SOUR SERVICE

When sour service is specified, materials shall comply with NACE MR0175 to resist sulfide stress cracking.

6.5 LOW TEMPERATURE REQUIREMENTS

The material for fittings having design temperatures below -20°F shall be tested in accordance with the impact test provisions of the latest revision of ASTM A370, *Mechanical Testing of Steel Products*, using the Charpy V notch technique.

a. A minimum of one impact test (three specimens) shall be conducted on a representative test bar on each heat of the material in the final heat treated condition. This heat qualification test may be performed prior to actual manufacturing, provided that the heat treatment is performed in actual production equipment. The results of the test shall conform to Table 2, except for bolting material which shall be tested in

accordance with ASTM A320. Thermal stress relief treatments need not be included in the heat qualification test.

b. Test coupons shall be cut from a separate or attached block, taken from the same heat and, where applicable, reduced by forging and given the same heat treatment as the product materials that they represent.

c. The Charpy impact test temperature shall be no higher than the temperature specified. The actual test temperature shall be the minimum temperature stamped on the name plate.

d. Bolting materials shall be in accordance with ASTM A320 L7 or ASTM A320 L7M.

6.6 WELDING REQUIREMENTS

a. The grades of steel indicated in the Materials Specifications Tables in Sections 8 through 12 for welding ends represent materials which are generally suitable for field welding into pipeline systems. These grades do not necessarily possess equal degrees of weldability; therefore, the purchaser should establish for himself a suitable welding procedure.

b. Repair welding by the manufacturer is permitted, but shall be in accordance with ASTM A216, Section 10, "Repair by Welding."

Table 2—Charpy V Notch Impact Requirements

Actual Ultimate Strength of the Material KSI (KPA)	Minimum Charpy V Notch Impact Energy (Average of Three Specimens) ft.-lb (J)
85 or less (586 or less)	15 (20)
86–100 (587–689)	20 (27)
Over 100 (Over 689)	25 (34)

7 Marking—Fitting Marking

Fittings manufactured to this specification shall be marked as shown on Table 3 in the units in which ordered (see note).

Note: Users of this specification should note that there is no longer a requirement for marking a product with the API monogram. API continues to license use of the monogram on products covered by this specification, but it is administered by the staff of the Institute separately from the specification. Marking requirements using the monogram are contained in Appendix D. No other use of the monogram is permitted. Licensees may mark products in conformance with Section 7 or Appendix D, and nonlicensees may mark products in conformance with Section 7.

Table 3—Fitting Marking

1 Marking	2 Application
1. Manufacturer's name or trademark	On name plate
2. Spec 6H	On name plate
3. Temperature range	On name plate
4. Maximum field test pressure	On name plate
5. Maximum operating pressure	On name plate
6. Material designation[a]	On name plate
7. Seal material	On name plate
8. Nominal size/Pressure class	On name plate
9. Serial number	On body and name plate
10. Maximum bending moment[b] (connectors and misalignment devices only)	On name plate
11. Pipe grade and wall used in external load calculations[b] (connectors only)	On name plate

Notes:
[a] When body is fabricated of more than one type of steel, the weld end governs marking.
[b] For breakaway joints, mark the rated external load.

8 Pipeline Closures

8.1 SCOPE

This section is intended to provide minimum requirements for pipeline closures, and is not intended to apply to closures designed for attachment to pressure vessels or similar equipment.

8.2 DEFINITION

A pipeline closure is a quick opening device used to gain temporary access to the inside of the pipeline to which it is attached.

8.3 DESCRIPTION

A pipeline closure is a mechanical device usually consisting of a weld hub, a cap, a seal, and an optional support hinge. It may also include any other devices necessary to produce a pressure tight seal between the weld hub and the cap.

8.4 COMMON APPLICATIONS

Some common applications for permanent or temporary pipeline closures include, but are not limited to:

a. Cleaning/surveying pig launcher and receiver barrels.
b. Meter prover loops.
c. Meter strainers.
d. Blowdown risers.
e. Scraper traps.

8.5 OTHER NAMES

Some other commonly used descriptive terms for pipeline closures include but are not limited to:

a. Pipeline hinged closures.
b. Blanking caps.
c. Scraper trap closures.
d. Pig trap closures.
e. Blowdown closures.

8.6 DESIGN

a. Pipeline closures shall be designed in accordance with Section 5 of this specification. The total loading on a closure is limited to the internal pressure, the sealing loads, and the weight of the closure cap. A mechanical device for seal release during opening, and seal compression during closing, shall be supplied with the closure if required by the manufacturer's design.
b. For liquid pipelines which must meet the requirements of Title 49 *CFR* Part 195, the rules of ASME Section VIII, Division 1 shall be used for new closure design and for design documentation of existing designs that are based on those rules.

8.7 CLOSURE CONFIGURATIONS

Pipeline closures may be equipped with a hinge or other type handling device. All hinges shall be designed for attachment to the weld hub. The following optional types of hinges are defined:

a. None.
b. Vertical (for attachment to a vertical installation): A lifting device shall be provided to lift and swing the closure cap clear for vertical access into the opened closure. Provisions shall be made to limit the amount of force required to lift the cap.
c. Horizontal; Right Hand (for attachment to a horizontal installation): A handling device shall be provided to support the closure cap in the opened position, and to permit it to be swung and stowed on the right-hand-side (when facing the closure).
d. Horizontal; Left Hand: Same as 8.7c except that the handling device shall be capable of stowing the cap on the left-hand-side (when facing the closure).
e. Horizontal; bi-directional: Same as 8.7c except that the handling device shall be capable of stowing the cap on either side of the closure.

Note: Special provisions in the closure hinge design may be necessary to ensure safe operation of an angular closure installation.

8.8 MATERIALS

a. Caps, weld hubs, and support hinges shall be made of materials conforming to one or more of the specifications shown in of Table 4, Column 1.
b. Welding ends shall be made of materials conforming to one or more of the specifications shown in of Table 4, Column 2.

8.9 PRESSURE WARNING DEVICE

All pipeline closures shall be equipped with a pressure warning device which must be opened before the closure can be opened. Closing the pressure warning device shall not be possible until the closure cap is safely engaged. The device shall be constructed and located so that it is accessible for inspection and cannot be readily rendered inoperative. A non-bleed type of pressure warning device is required for toxic or sour service.

8.10 CORROSIVE SERVICE ENVIRONMENT

When a corrosive service environment is anticipated the pressure warning device and the hinge mechanism shall be contrusted of corrosion resistant material.

8.11 END CONFIGURATION

Closures shall be manufactured only with welding ends.

Table 4—Material Specifications—Closures

	1	Applicable Specifications	2
General Classification	Closure Caps and Hubs		All Closure Welding Ends
Castings:	ASTM A216 Gr WCB ASTM A216 Gr WCC ASTM A351 Gr CFBM ASTM A351 Gr CFBC ASTM A351 Gr CF3N ASTM A352 Gr LCB § ASTM A352 Gr LCC ASTM A352 Gr LC1 ASTM A352 Gr LC2 ASTM A352 Gr LC21 ASTM A352 Gr LC3 ASTM A487 Gr 1N ASTM A487 Gr 1Q ASTM A487 Gr 2N ASTM A487 Gr 2Q		ASTM A216 Gr WCB ASTM A216 Gr WCC ASTM A217 Gr WC1 ASTM A352 Gr LCB ASTM A352 Gr LCC ASTM A487 Gr 1N ASTM A487 Gr 1Q ASTM A757 Gr A1Q ASTM A757 Gr A2Q

Table 4—Material Specifications—Closures (continued)

	1	Applicable Specifications	2
General Classification	Closure Caps and Hubs		All Closure Welding Ends
Castings: (cont'd)	ASTM A487 Gr 4N ASTM A487 Gr 4Q ASTM A487 Gr 4QA ASTM A487 Gr CA6NM ASTM A487 Gr CA15M ASTM A757 Gr A1Q ASTM A757 Gr A2Q ASTM A757 Gr B2N ASTM A757 Gr BZQ ASTM A757 Gr B3N ASTM A757 Gr B4Q ASTM A757 Gr C1Q ASTM A757 Gr D1N1 ASTM A757 Gr D1Q1 ASTM A757 Gr D1N2 ASTM A757 Gr D1Q2 ASTM A757 Gr D1N3 ASTM A757 Gr D1Q3 ASTM A757 Gr E1Q ASTM A757 Gr E2Q1 ASTM A757 Gr E2N1 ASTM A757 Gr E2Q2 ASTM A757 Gr E2N3 ASTM A757 Gr E2Q3 ASTM A757 Gr E3N		
Forgings:	ASTM A105 ASTM A182 Gr F1 ASTM A182 Gr F316 ASTM A182 Gr F316L ASTM A182 Gr F347 ASTM A350 Gr LF1 ASTM A350 Gr LF2 ASTM A350 Gr LF3 ASTM A182 Gr F11 ASTM A182 Gr F12 ASTM A182 Gr F2 ASTM A182 Gr F6 ASTM A694 ASTM A707		ASTM A105 ASTM A181 Gr 11 ASTM A182 Gr F1 ASTM A350 Gr LF1 ASTM A350 Gr LF2 ASTM A694 ASTM A707
Rolled Plates and Shapes:	ASTM A515 ASTM A516 ASTM A537 CL1 and CL2[a] ASTM A737 Gr B ASTM A737 Gr C		ASTM A255 Gr B ASTM A242 for welding ASTM A441 ASTM A515 ASTM A516 ASTM A537 CL1[a] ASTM A533 Gr A and B ASTM A633 Gr C ASTM A737 Gr B ASTM A737 Gr C

Table 4—Material Specifications—Closures (continued)

	1	Applicable Specifications	2
General Classification	Closure Caps and Hubs		All Closure Welding Ends
Pipe:	ASTM A381 ASTM A106 Gr A and B ASTM A333 Gr 1, 3 and 6 API SPEC 5L[b]		ASTM A381 ASTM A106 Gr B only ASTM A333 Gr 1,3 & 6 API SPEC 5L[b]
Bolting:	ASTM A193-B7 ASTM A194-Gr2H ASTM A193-B7M ASTM A194-Gr2M ASTM A320-L7 ASTM A320-L7M		

Notes:

[a] Steel plate thicker than 2 $^1/_2$ in. (63.5 mm), but having all other properties indicated in the ASTM specification, may be used.

[b] Only seamless or submerged arc-welded pipe shall be allowed. When cold expanded and/or controlled rolled pipe is selected, and heat treatment is required, the final mechanical properties of the material shall be determined by testing control coupons from each heat lot.

§ A modified ASTM A352, Grade LCB, may be required to meet the impact values specified in Table 2.

9 Connectors

9.1 GENERAL

This section is intended to provide minimum requirements for pipeline fittings used to mechanically join and seal pipe ends.

9.2 DEFINITION

A connector is a pipeline fitting used to create a rigid pressure containing joint in a pipeline or flowline. The use of a connector requires special preparation of the pipe ends. This preparation may consist of an improvement to the surface finish of the pipe, or the attachment of a companion fitting.

9.3 COMMON APPLICATIONS

Some common applications for pipeline connectors include, but are not limited to, the following connection types:

a. Pipeline to riser.
b. Pipeline to lateral.
c. Lateral to trunkline.
d. Flowline to subsea Xmas tree or template.
e. Flowline to underwater manifold/PLEM.
f. Floating production piping to riser.
g. Quick disconnects for flexible risers.
h. Pipeline repair.

9.4 OTHER NAMES

Some other commonly used descriptive terms for connectors include, but are not limited to:

a. Pipe length compensation joint.
b. Telescopic joint.
c. Collet connector.
d. Breakaway joint.
e. Mechanical connector.

9.5 DESIGN

Connectors shall be designed in accordance with Section 5 of this specification. Design loads for evaluating the acceptability of the connector shall include the forces due to internal pressure, both rated and tested, and all externally-applied loads (axial, shear, and bending).

9.6 END CONFIGURATIONS

Connectors shall be provided with welding ends or flanged ends.

9.7 MATERIALS

Connectors shall be made of materials conforming to one or more of the specifications listed in Table 5.

10 Couplings

10.1 GENERAL

This section is intended to provide minimum requirements for pipeline couplings used to connect bare ended pipe without requiring the use of welding.

10.2 DEFINITION

A coupling is a device that structurally attaches to and seals off a bare ended pipe through mechanical means.

10.3 DESCRIPTION

A coupling is a mechanical sleeve that provides a method of structurally attaching itself to the pipe by virtue of its internal components or through the use of separate tools. The cou-

Table 5—Material Specifications—Connectors

Castings	Forgings	Rolled Plate	Pipe	Bar
ASTM A216 Gr WCB	ASTM A105	ASTM A515	ASTM A106 GrB	ASTM A675 Gr7O
ASTM A216 Gr WCC	ASTM A182	ASTM A516	API SPEC 5L seamless[b]	
	ASTM A350 GrLF2	ASTM A537 CL1[a]		
	ASTM A694	ASTM A737 GrB&C		
	ASTM A707			
	AISI 4130			
	AISI 4140			
Bolting:	ASTM A193-B7			
	ASTM A194-Gr2H			
	ASTM A193-B7M			
	ASTM A194-Gr2M			
	ASTM A320-L7			
	ASTM A320-L7M			

Notes:
[a] Steel plate thicker than 2 1/2 in. (63.5 mm), but having all other properties indicated in the ASTM specification, may be used.
[b] Only seamless or submerged arc-welded pipe shall be allowed. When cold expanded and/or controlled rolled pipe is selected, and heat treatment is required, the final mechanical properties of the material shall be determined by testing control coupons from each heat lot.

pling contains seals that are capable of sealing the annular space between the outer surface of the pipe and the inner surface of the coupling. However, the sealing method may alternatively involve sealing on the pipe end face.

10.4 COMMON APPLICATIONS

Some common applications for the coupling include, but are not limited to:

a. Spool piece pipeline repair couplings.
b. Riser repair couplings.
c. Pipeline to riser couplings.
d. Pipeline mid-line couplings.

10.5 OTHER NAMES

Some other commonly used descriptive terms for couplings include, but are not limited to:

a. Repair couplings.
b. Swaged-on sleeves.
c. Shrunk-on sleeves.
d. Mechanical coupling.

10.6 DESIGN

Couplings shall be designed in accordance with Section 5 of this specification. Design loads for evaluating the acceptability of the coupling shall include the forces due to internal pressure, both rated and tested, and all externally applied loads (axial, shear, and bending).

10.7 MATERIALS

Coupling shall be made of materials conforming to one or more of the specifications shown in Table 6.

10.8 FIELD WELDING

The intent of this specification is to neither require nor prohibit subsequent field welding after installation. Provisions for field welding are dependent on the manufacturer's design

11 Misalignment Devices

11.1 GENERAL

This section is intended to provide minimum requirements for pipeline devices used to obtain angular and/or rotational alignment to facilitate ease of piping assembly or compensate for pipe movement under pressure.

11.2 DEFINITION

A misalignment device is a pipeline fitting used for connecting pipe ends and is capable of adjusting for either angular and/or rotational misalignment.

11.3 DESCRIPTION

A misalignment device is a mechanical fitting that consists of two or more components configured in such a way that the pipe ends connected by the device may be misaligned. The device can provide angular alignment and/or rotational adjustment capability.

11.4 COMMON APPLICATIONS

Some common applications for misalignment devices include, but are not limited to:

a. Pipeline-to-riser connections.
b. Lateral line to trunkline connectors.

Table 6—Material Specification—Couplings Only

Castings:	ASTM A216 Gr WCB ASTM A216 Gr WCC ASTM A352 Gr LCC
Forgings:	ASTM A105 ASTM A182 ASTM A350 Gr LF2 ASTM A694 ASTM A707 AISI 4130 AISI 4140 AISI 8630
Plate:	ASTM A285 GrC ASTM A515 ASTM A516
Pipe:	ASTM A106 ASTM A333 Gr 6 API SPEC 5L[a]
Tube:	ASTM A513 Gr 1026 ASTM A519 Cr 1026
Bar:	ASTM A29 Gr 1018
Bolting:	ASTM A675 Gr 70 ASTM A193-B7 ASTM A194-Gr2H ASTM A193-B7M ASTM A194-Gr2M ASTM A320-L7 ASTM A320-L7M

Note:

[a] Only seamless or submerged arc-welded pipe shall be allowed. When cold expanded and/or controlled rolled pipe is selected, and heat treatment is required, the final mechanical properties of the material shall be determined by testing control coupons from each heat lot.

c. Flowline to subsea tree connections.

d. Flowline to underwater manifold/PLEM connections.

e. Spool piece pipeline repair connections.

11.5 DESIGN

Misalignment devices shall be designed in accordance with Section 5 of this specification. Design loads for evaluating the acceptability of the misalignment device shall include the forces due to internal pressure, both rated and tested, and all externally applied loads (axial, shear, and bending), except for devices designed to compensate for pipe movement under pressure.

11.6 END CONFIGURATIONS

The misalignment device may be provided with welding ends or with flanged ends.

11.7 MATERIALS

a. Components that weld to pipe shall be made of materials conforming to one or more of the specifications shown in of Table 7, Column 1.

b. Components not requiring welding may be made from materials conforming to one or more of the specifications shown in of Table 7, Column 1 or Column 2.

12 Split Mechanical Fittings

12.1 GENERAL

This section is intended to provide minimum requirements for pipeline split mechanical fittings used to repair or branch off an existing pipeline or its components.

12.2 DEFINITION

A split mechanical fitting encapsulates and seals off an area on the pipeline and can be classified as either “structural” or “nonstructural.” “Structural” seals off an area on the pipeline plus has a mechanical means of attaching to the pipe and adding structural reinforcement.

12.3 DESCRIPTION

A split mechanical fitting consists of two or more components usually assembled with bolting configured in such a way to seal off an area on the pipeline. The fitting may also have mechanical means of attaching to the pipe and adding structural reinforcement.

12.4 COMMON APPLICATIONS

Some common applications for the split mechanical fitting include, but are not limited to:

a. Pipeline repair.
b. Hot tap fitting (branch connection).
c. Fitting repair (flange, ell, etc.).
d. Pipe reinforcement.
e. Onstream line stop.

12.5 OTHER NAMES

Some other commonly used descriptive terms for split mechanical fittings include, but are not limited to:

a. Clamp.
b. Pipe repair clamp.
c. Hot tap fitting.
d. Mechanical branch.

Table 7—Material Specifications—Misalignment Devices Only

	Applicable Specifications	
	1	2
General Classifications	All Welding Ends	Remaining Components
Castings:	ASTM A216 Gr WCB ASTM A216 Gr WCC	ASTM A216 Gr WCB ASTM A216 Gr WCC
Forgings:	ASTM A105 ASTM A350 LF2 ASTM A694 ASTM A707	ASTM A105 ASTM A350 LF2 ASTM A694 ASTM A707 AISI 4130 AISI 4140 AISI 8630
Rolled plates and shapes:		ASTM A515 ASTM A516
Bolting:	ASTM A193-B7 ASTM A194-Gr2H ASTM A193-B7M ASTM A194-Gr2M ASTM A320-L7 ASTM A320-L7M	

Note:
Only seamless or submerged arc-welded pipe shall be allowed. When cold expanded and/or controlled rolled pipe is selected, and heat treatment is required, the final mechanical properties of the material shall be determined by testing control coupons from each heat lot.

12.6 DESIGN

Split mechanical fittings shall be designed in accordance with Section 5 of this specification. Design loads for evaluating the acceptability of the fitting shall include the forces due to internal pressure, both rated and tested, and all externally applied loads (axial, shear, and bending).

12.7 MATERIALS

a. Vents, side bars, hinges, and retainers shall be made of material conforming to one or more of the specifications shown in of Table 8, Column 4 .
b. Pressure-containing components shall be made of materials conforming to one or more of the specifications in Table 8, Column 2 or Column 3.

13 Quality Control Requirements

13.1 GENERAL

The purpose of this section is to specify the quality control requirements for parts and equipment manufactured to this specification.

13.2 MEASURING AND TESTING EQUIPMENT

a. General. Equipment used to inspect, test, or examine materials or other equipment shall be identified, controlled, calibrated, and adjusted at specified intervals in accordance with documented manufacturer instructions to maintain the accuracy required by this specification.

b. Dimensional Measuring Equipment. Dimensional measuring equipment shall be controlled and calibrated by the methods specified in the manufacturer's written specification or as specified in the applicable sections of MIL-STD-120 to maintain the accuracies specified by API and the manufacturer's specification.

c. Pressure Measuring Devices:

1. Type and Accuracy. Test pressure measuring devices shall be either pressure gages or pressure transducers and shall be accurate to at least ±2.0% of full scale rating.

2. Size and Range. Pressure measurements shall be made at not less than 25% nor more than 75% of the full pressure span of the gage.

3. Calibration Procedure. Pressure measuring devices shall be recalibrated with a master pressure measuring device or a dead weight tester at 25%, 50%, and 75% of scale.

4. Calibration Intervals. Intervals shall be established for calibrations based on repeatability and degree of usage and be part of the manufacturer's procedures.

d. Temperature Measuring Devices. When temperature charts are used, the temperature measuring device shall be capable of indicating 2ºF (1ºC) fluctuations.

Table 8—Material Specifications—Split Mechanical Fittings Only

Applicable Specifications			
1	2	3	4
General Classifications	Bodies	Flange	Components
Castings:	ASTM A216 Gr WCB	ASTM A216 Gr WCB	ASTM A216 Gr WCB
	ASTM A216 Gr WCC	ASTM A216 Gr WCC	ASTM A~216 Gr WCC
	ASTM A217 Gr Wel	ASTM A217 Gr Wel	ASTM A217 Gr Wel
	ASTM A217 Gr CA15	ASTM A217 Gr CA15	ASTM A217 Gr CA15
	ASTM A218 Gr WCB	ASTM A218 Gr WCB	ASTM A218 Gr WCB
	ASTM A218 Gr WCC	ASTM A218 Gr WCC	ASTM A218 Gr WCC
	ASTM A352 Gr LCB	ASTM A352 Gr LCB	ASTM A352 Gr LCB
	ASTM A352 Gr LCC	ASTM A352 Gr LCC	ASTM A352 Gr LCC
	ASTM A487 Gr 1N	ASTM A487 Gr 1N	ASTM A487 Gr 1N
	ASTM A487 Gr 1Q	ASTM A487 Gr 1Q	ASTM A487 Gr 1Q
	ASTM A757 Gr A1Q	ASTM A757 Gr A1Q	ASTM A757 Gr A1Q
	ASTM A757 Gr A2Q	ASTM A757 Gr A2Q	ASTM A757 Gr A2Q
Forgings:	ASTM A105	ASTM A105	ASTM A105
	ASTM A350 Gr LF1	ASTM A350 Gr LF1	ASTM A350 Gr LF1
	ASTM A350 Gr LF2	ASTM A350 Gr LF2	ASTM A350 Gr LF2
	ASTM A694	ASTM A694	ASTM A694
	ASTM A707	ASTM A707	ASTM A707
			AISI 4140
			AISI 4130
Plate:	ASTM A515	ASTM A515	ASTM A515
	ASTM A516	ASTM A516	ASTM A516
			AISI 1008
			AISI 1009
			AISI 1010
			AISI 1011
			AISI 1012
			AISI 1013
			AISI 1014
			AISI 1015
			AISI 1016
			AISI 1017
			AISI 1018
Pipe:	ASTM A106 Gr A	ASTM A106 Gr A	ASTM A106 Gr A
	ASTM A106 Gr B	ASTM A106 Gr B	ASTM A106 Gr B
	ASTM A106 Gr C	ASTM A106 Gr C	ASTM A106 Gr C
	API SPEC 5L[a]		API SPEC 5L[a]
Bar:			ASTM A29 Gr 1018
			ASTM A675 Gr 70
Bolting:	ASTM A193-B7		
	ASTM A194-Gr2H		
	ASTM A193-B7M		
	ASTM A194-Gr2M		
	ASTM A320-L7		
	ASTM A320-L7M		

Note: [a] Only seamless or submerged arc-welded pipe shall be allowed. When cold expanded and/or controlled rolled pipe is selected, and heat treatment is required, the final mechanical properties of the material shall be determined by testing control coupons from each heat lot.

13.3 QUALITY CONTROL PERSONNEL QUALIFICATIONS

a. NDE Personnel. NDE Personnel shall be qualified in accordance with requirements specified in SNT-TC-1A.

b. Visual Examination Personnel. Personnel performing visual examinations shall have an annual eye examination in accordance with SNT-TC-1A.

c. Welding Inspectors. Personnel performing visual inspection of welding operations and completed welds shall be qualified and certified as follows:

1. AWS certified welding inspector, or
2. AWS certified associate welding inspector, or
3. Welding inspector certified by the manufacturer's documented training program.

d. Other Personnel. All personnel performing other quality control activities directly affecting materials and product quality shall be qualified in accordance with manufacturer's documented requirements.

13.4 GENERAL QUALITY CONTROL REQUIREMENTS

a. Quality Control Instruction. All quality control instructions shall be documented and shall include appropriate methodology and acceptance criteria.

b. Nonconforming Material. The manufacturer shall have a documented procedure for controlling materials, parts and products which do not conform with this specification and the manufacturer's written specifications.

c. Welds. All pressure-containing welds and all repair welds shall be examined using methods and acceptance criteria in accordance with the manufacturer's written procedures.

d. Other Parts. Other parts shall be identified and conform to the requirements of this specification and the manufacturer's written specification.

e. Assembled Equipment.

1. General. The quality control requirements for assembled equipment include the pressure tests in accordance with this specification.
2. Serialization. Serialization is required on all assembled equipment.

13.5 RECORDS REQUIREMENTS

a. Records Required:

1. Weld Procedure Specification
2. Weld Procedure Qualification Record
3. Welder Qualification Record
4. NDE Personnel Qualification Records
5. Design Documentation
6. Material Test Records
7. Serialization Records

b. Records Control

1. Records required by this specification shall be legible, identifiable, retrievable, and protected from damage, deterioration, or loss.
2. Records required by this specification shall be retained by the manufacturer for a minimum of ten (10) years following the date of manufacture.

14 Storing And Shipping

14.1 PAINTING

All finished noncorrosion-resistant fittings shall be primed and/or painted.

14.2 DRAWING

After testing and before shipment, fittings shall be drained of test fluid and lubricated.

14.3 CORROSION PREVENTION

Prior to shipment, parts and equipment shall have exposed bare metallic surfaces protected with a rust preventative which will not become fluid and run at a temperature less than 125ºF.

14.4 SEALING SURFACE PROTECTION

Exposed sealing surfaces shall be protected from mechanical damage for shipping.

14.5 INSTRUCTIONS

The manufacturer shall furnish drawings and instructions concerning field assembly and maintenance of the fittings per the manufacturer's written specification.

APPENDIX A—PURCHASE GUIDELINES

This appendix provides recommended guidelines for inquiry and purchase of API Spec 6H fittings. The guidelines are intended to assist the purchaser in the decisions he must make as well as assuring that adequate information is communicated to the manufacturer.

1. Is API monogram required? (Appendix D)
2. Is purchaser inspection required? (Appendix B)
3. Nominal fitting size.
4. API pressure class.
5. Onshore or offshore use.
6. Matching pipe information:

   a. OD.
   b. Wall thickness.
   c. Material.
   d. Grade.
   e. Transported contents.

7. Seal material.
8. Service temperature range.
9. Maximum operating pressure.
10. Maximum field test pressure.
11. Coating requirements.
12. Special Service: i.e., sour or toxic service.
13. Special marking instructions.
14. Documentation requirements.
15. Is third party witnessing required?
16. Special test requirements.
17. Additional NDE Requirements.
18. Length between seals (where applicable).
19. Misalignment angle (misalignment devices only).
20. Regulatory agency requirements.

APPENDIX B—PURCHASER INSPECTION

B.1 Inspection Notice

When purchaser's inspector desires to witness the manufacture or testing of fittings, reasonable notice shall be given of the time at which manufacture and testing are to be done.

B.2 Inspection

While work on the contract of the purchaser is being performed, the purchaser's inspector shall have free entry at all times to all parts of the manufacturer's works which concern manufacture of the fittings ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy him that the fittings are being manufactured in accordance with this specification. All inspections should be made at the place of manufacture prior to shipment, and shall be so conducted as not to interfere unnecessarily with operation of the works.

B.3 Rejection During Manufacture

Completed or assembled fittings, or rough or finished components, whether made in the manufacturer's plant or purchased from other suppliers, if rejected by the purchaser's inspector, shall not be used to complete the purchaser order until rejected equipment or components are corrected or repaired using procedures approved by the purchaser's inspector. In the case of assembled or partially assembled fittings, this shall not be construed as preventing the manufacturer from salvaging sound components from rejected assemblies for reassembly with other sound components to form complete new fittings.

B.4 Compliance

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

APPENDIX C—METRIC CONVERSIONS

C.1

English units are preferred in all cases and shall be standard in this specification. The following factors are from API Std. 2564:

	LENGTH:
1 inch (in)	= 25.4 millimeters (mm)
	PRESSURE:
1 pound per square inch (psi)	= 0.06894757 bar
	STRESS:
1 pound per square inch (psi)	= 0.006894757 Megapascals (MPa)
	ENERGY:
1 foot-pound (ft-lb)	= 1.355818 Joule (J)
	TORQUE:
1 foot-pound (ft-lb)	= 1.355818 Newton-meter (N·m)
	MASS:
1 pound mass	= 0.4535924 kilogram (kg)

TEMPERATURE CONVERSION: The following formula may be used to convert degrees Fahrenheit (ºF) to degrees Celsius (ºC):

ºC = (5/9) (ºF-32)

C.2

In addition to the above conversions, the designations PN for nominal pressure and DN for nominal diameter are sometimes used in the designation of these commodities. For the purpose of this specification, the PN designations relate to the pressure classes, and the DN designations relate to NPS, or nominal pipe sizes, as follows:

Class 150	= PN 20	Class 300	= PN 50
Class 400	= PN 64	Class 600	= PN 100
Class 900	= PN 150	Class 1500	= PN 250
Class 2500	= PN 420		
NPS 2	= DN5O	NPS 2 $^1/_2$	= DN 65
NPS 3	= DN8O	NPS4	= DN 100

For NPS 4 and greater listed sizes, multiply the NPS by 25 to obtain the DN, except that there is no equivalent DN for NPS 36.

APPENDIX D—MARKING INSTRUCTIONS FOR API LICENSEES

D.1 Fitting Marking for API Licensees

Fittings manufactured to this specification shall be marked as shown on Table D.1 in the units in which ordered.

Table D.1—Fitting Marking for API Licensees

1 Marking	2 Application
1. Manufacturer's name or trademark	On name plate
2. API monogram[a]	On name plate
3. Temperature range	On name plate
4. Maximum field test pressure	On name plate
5. Maximum operating pressure	On name plate
6. Material designation[b]	On name plate
7. Seal material	On name plate
8. Nominal size/Pressure Class	On name plate
9. Serial number	On body and name plate
10. Maximum Bending Moment[c] (connectors and misalignment devices only)	On name plate
11. Pipe grade and wall used in external load calculations[c] (connectors only)	On name plate

Notes:

[a] API Licenses only. CONTACT API FOR INFORMATION ON LICENSING.

[b] When body is fabricated of more than one type of steel, the weld end governs marking.

[c] For breakaway joints, mark the rated external load.

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