TR 2024-09 Flange Specifications

TR Number	**24-09**
Primary Reference	192.147
Secondary Reference	
Purpose	The GM under 192.147 (i.e., Flanges) may warrant review for current industry practices.
Origin/Rationale	The following GM may require updates. • ASME PCC-1, which is a newer standard, may be worth including in Section 3 of the GM (“Flange Installation and Maintenance”). • In 1.1 (f), ductile flanges are permitted in the GM and refer to 192.145 (a) (i.e., Valves). This citation should probably be referencing B16.42 similar to B31.8. • Under GM 1.2 (f)(1), the 2022 version of B31.8 does not reference “6-inch diameter and larger” as listed. Instead, it references Mandatory Appendix I of B31.8. • Under 2.1 (a), the 450F citation is 400F in the latest versions of both B31.8 and B16.5. • Under 2.1 (e), the current version of B31.8 references “ASME” where the guide cites “American National Standard”. • Under 2.2(b), B31.8 allows some metallic gaskets on Class 150 flanges whereas our GM discourages all metallic gaskets. From a Formatting point of view, please also consider the following: • Under GM 1.2, I am unsure if our formatting procedures require the cited title to be in quotations. • There is a fair number of direct copies of B31.8. I am unsure how much is allowed (from a copyright point of view) considering this committee’s history with B31.8. This may need to be reviewed depending upon the Committee’s position.
Notes	
Assigned to	Design

Note: Revisions are shown in yellow highlight and red font.

Section 192.147

1 FLANGES

1.1 Flange types.

(a) The dimensions and drilling for all line or end flanges should conform to one of the following standards.

ASME B16.1, ASME B16.5, ASME B16.24, ASME B16.36, ASME B16.42, ASME B16.47, ASME B16.48, ASME B31.8, AWWA C207, or MSS SP-44 as listed in either §192.7 or Guide Material Appendix G-192-1.

Flanges cast or forged integral with pipe, fittings, or valves in sizes and for the maximum service rating covered by the standards listed above may be used subject to the facing, bolting, and gasketing requirements of this paragraph and 1.2, 2.1 and 2.2 below.

(b) Threaded companion flanges that comply with either ASME B16.1 or ASME B16.5 (see §192.7 for IBR for both), in sizes and for maximum service ratings covered by these standards, may be used.

(c) Lapped flanges in sizes and pressure standards established by ASME B16.5 may be used.

(d) Slip-on welding flanges in sizes and pressure standards established in ASME B16.5 may be used. Slip-on flanges of rectangular section may be substituted for hubbed slip-on flanges provided the thickness is increased as required to produce equivalent strength as determined by calculations made in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII (see listing in §192.7, not IBR for §192.147).

(e) Welding neck flanges in sizes and pressure standards established in ASME B16.5 and MSS SP-44 (see §192.7 for IBR for both) and ASME B16.47 may be used. The bore of the flanges should correspond to the inside diameter of the pipe used. For acceptable welding end treatment, see Guide Material Appendix G-192-5, Figure 192.235B.

(f) Flanges made of ductile iron should conform to material and dimensional standards listed in ASME B16.42 and §192.145~~(a)~~ and should be subject to all service restrictions as outlined for valves in that paragraph. The bolting requirements for ductile-iron flanges should be the same as for carbon and low-alloy steel flanges as listed in 2.1 below.

1.2 Flange facings.

(a) Cast iron, ductile iron, and steel flanges should have contact faces finished in accordance with MSS SP-6, Standard Finishes for Contact Faces of Pipe Flanges ~~of~~ and Connecting-End Flanges of Valves and Fittings.

(b) Class 25 and Class 125 cast iron integral or threaded companion flanges may be used with a full-face gasket or with a flat ring gasket extending to the inner edge of the bolt holes. When using a full-face gasket, the bolting may be of alloy steel (e.g., ASTM A193). When using a ring gasket, the bolting should be of carbon steel, without heat treatment other than stress relief, equivalent to ASTM A307 Grade B.

(c) When bolting together two Class 250 integral or threaded companion cast iron flanges, having 1/16 inch raised faces, the bolting should be of carbon steel, without heat treatment other than stress relief, equivalent to ASTM A307 Grade B.

(d) Class 150 steel flanges may be bolted to Class 125 cast iron flanges. When such construction is used, the 1/16 inch raised face on the steel flange should be removed. When bolting such flanges together, using a flat ring gasket extending to the inner edge of the bolt holes, the bolting should be of carbon steel, without heat treatment other than stress relief, equivalent to ASTM A307 Grade B. When bolting such flanges together using a full-face gasket, the bolting may be alloy steel (ASTM A193).

(e) Class 300 steel flanges may be bolted to Class 250 cast iron flanges. Where such construction is used, the bolting should be of carbon steel, without heat treatment other than stress relief, equivalent to ASTM A307 Grade B. It is recommended that the raised face on the steel flange be removed. When this is done, bolting should be of carbon steel, without heat treatment other than stress relief, equivalent to ASTM A307 Grade B.

(f) Forged steel welding neck flanges with an outside diameter and drilling the same as ASME B16.1 (see §192.7 for IBR), but with modified flange thicknesses, hub dimensions, and special facing details, may be used to bolt against flat-faced cast iron flanges, and may operate at the pressure-temperature ratings given in ASME B16.1 Class 125 Cast Iron Pipe Flanges provided:

(1) The minimum flange thickness, T, of the steel flange is not less than that specified for ~~6-inch diameter and larger~~ ASME B31.8 lightweight flange requirements.

(2) Flanges are used with nonmetallic full-face gaskets extending to the periphery of the flange.

(3) The design joint has been proven by test to be suitable for the ratings.

2 FLANGE ACCESSORIES

2.1 Bolting.

(a) For all flange joints other than described under 1.2(c), (d), (e) and (f), the bolting should be made of alloy steel conforming to ASTM A193, A320, or A354, or of heat-treated carbon steel conforming to ASTM A449. However, bolting for ASME B16.5 Class 150 ~~American National Standard Class 250~~ and 300 flanges to be used at temperatures between minus 20 °F and plus 400 ~~450~~ °F may be made to ASTM A307, Grade B.

(b) Alloy steel bolting material conforming to ASTM A193 or ~~ASTM~~ A354 should be used for insulating flanges if such bolting is made ⅛ inch undersized.

(c) The materials used for nuts should conform to ASTM A194 and A307. A307 nuts may be used only with A307 bolting.

(d) All carbon and alloy steel bolts, stud bolts, and their nuts should be threaded in accordance with the following thread series and dimension class as required by ASME B1.1.
  (1) Carbon Steel - All carbon steel bolts and stud bolts should have coarse threads, Class 2A dimensions and their nuts, Class 2B dimensions.
  (2) Alloy Steel - All alloy steel bolts and stud bolts of 1 inch and smaller nominal diameters should be of the coarse thread series; nominal diameters 1⅛ inch and larger should be of the 8 thread series. Bolts and stud bolts should have a Class 2A dimension, and their nuts should have a Class 2B dimension.

(e) Bolts should have ~~American National Standard~~ regular square heads or heavy hexagonal heads and should have ~~American National Standard~~ heavy hexagonal nuts conforming to the dimensions of ASME B18.2.1 and B18.2.2.

(f) Nuts cut from bar stock in such a manner that the axis will be parallel to the direction of rolling of the bar may be used in all sizes for joints in which one or both flanges are cast iron, and for joints with steel flanges where the pressure does not exceed 250 psig. Such nuts should not be used for joints in which both flanges are steel and the pressure exceeds 250 psig except that, for nut sizes ½ inch and smaller, these limitations do not apply.

(g) For all flange joints, the bolts or stud bolts used should extend completely through the nuts.

2.2 Gaskets.

(a) Material for gaskets should be capable of withstanding the maximum pressure and maintaining its physical and chemical properties at any temperature to which it might reasonably be subjected in service.

(b) The following references provide additional guidance on the use and selection of gaskets.
  (1) ASME B16.5.
  (2) ASME B16.20.
  (3) ASME B16.21.
  (4) ASME PCC-1.

(c ~~b~~) ~~Gaskets used under pressure and at temperatures above 250 °F should be of noncombustible material.~~ Metallic gaskets, other than ring or spiral wound metal gaskets, should not be used with Class 150 standard or lower-rated flanges. Metallic gaskets should not be used with A307 Grade B bolts.

(d ~~c~~) Full-face gaskets should be used with all bronze, copper, and ~~flanges, and may be used with~~ Class 25 or Class 125 cast iron flanges. Flat ring gaskets with outside diameter extending to the inside of the bolt holes may be used with cast iron ~~flanges~~, ~~with~~ raised face steel ~~flanges~~, or ~~with~~ lapped steel flanges.

(e ~~d~~) In order to secure higher unit compression on the gasket, metallic gaskets of a width less than the full male face of the flange may be used with raised face, lapped, or large male and female facings. The width of the gasket for small male and female or for tongue and groove joints should be equal to the width of the male face or tongue.

(f ~~e~~) Rings for ring joints should be of dimensions established in ASME B16.20. The material for these rings should be suitable for the service conditions encountered and should be softer than the flanges.

2.3 Insulating kits.

(a) Insulating kits are available to provide electrical isolation at flanged connections. Insulating kits typically contain a gasket, washers, and sleeves for the bolts.

(b) Insulating kits should be specified to be compatible with both the gas stream and the external environment (e.g., temperature, pressure, gas quality or composition, moisture).

(c) Assembly.
  (1) Carefully inspect the insulating kit components for rough edges, cracks, delaminations, or other defects that could contribute to crushing, cracking, or loss of seal under load.
  (2) Ensure proper flange alignment and follow the manufacturer's assembly instructions, including torque values that may vary from non-insulating flange assemblies.
  (3) Prior to coating or painting flanged connections, verify that desired insulating properties have been attained.
  (4) Coating or painting materials should be nonconductive.

(d) Post assembly.
(1) Where possible, include the assembled insulating flange in pressure testing or perform an instrumented leak test prior to coating or painting.
(2) If the assembly is to be buried, consider providing a test station with test leads and bonding wires for future test capability. See §§192.469 and 192.471.
(3) Consider providing for ground fault, lightning protection, or temporary bonding. See §192.467.
(e) NACE SP0286 provides additional technical guidance for insulating kits.

3 FLANGE INSTALLATION AND MAINTENANCE

Proper installation and maintenance of flanged joints are critical for maintaining safe operation of pipeline facilities.

3.1 Flange preparation.
(a) The sealing surfaces of the flanges should be clean and smooth within acceptable limits for the intended gasket.
(b) To seal properly, the ~~sealing~~ flange faces should be installed parallel to each other, with minimal rotational and lateral offset, and with proper gap between flanges.
(c) ASME PCC-1 provides additional guidance for inspection of the flange and the flange assembly.

3.2 Bolting methods.
Methods for tightening flange bolts may include the use of torque wrenches or the use of hydraulic stud tensioners.
(a) Bolt torque values.
(1) The proper bolt torque values are based on gasket material, flange size, flange type, flange rating, bolt size, bolt material, and thread lubricant. When available, the gasket manufacturer's recommended torque values should be followed.
(2) The minimum torque value represents the amount of force required to provide proper compression of the gasket to prevent leakage.
(3) The maximum torque value represents a torque limit to prevent gasket crushing, bolt yielding, flange deformation, or flange cracking Thread lubrication significantly influences the amount of torque actually applied to the flange assembly. All flange bolts should be lubricated, and lubrication can be accomplished by using pre-coated bolts or by the field application of thread lubricants.
(b) Bolt torque procedure.
Bolt torque should be applied evenly across the flange and is normally applied in several steps. Bolt torque should be applied using manual or hydraulic torque wrenches. The following method provides an example of applying torque. The number of steps may vary based on recommendations of the gasket manufacturer and operator requirements. Except for the final step, use a star or ~~criss~~cross pattern to tighten the bolts.
(1) Install and hand tighten all bolts and nuts.
(2) Tighten all bolts to 30% of the final torque value.
(3) Tighten all bolts to 60% of the final torque value.
(4) Tighten all bolts to 100% of the final torque value.
(5) Follow a circular pattern and ensure that all bolts are tightened to 100% of the final torque value.
(c) Hydraulic tensioning.
Hydraulic tensioning involves stretching the bolt to achieve a desired elongation as the nut is tightened onto the flange bolt. Advantages of hydraulic tensioning include the elimination of friction factor errors and more uniform gasket loading. The disadvantages of hydraulic tensioning include the need for longer studs, specialized equipment, and additional workspace.
(d) ASME PCC-1 provides additional guidance on flange tightening practices.

GMA G-192-1

GUIDE MATERIAL APPENDIX G-192-1

SUMMARY OF REFERENCES AND RELATED SOURCES

1.4 FLANGES		
ASME B16.24	Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500	§192.147
ASME B16.36	Orifice Flanges	§192.147
ASME B16.42	Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300	§192.147
ASME B16.47	Large Diameter Steel Flanges (NPS 26 through NPS 60)	§192.147
ASME B16.48	Line Blanks	§192.147
AWWA C207	Steel Pipe Flanges for Waterwork Service, Sizes 4 Inch Through 144 Inch	§192.147
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1.8 BOLTS & GASKETS		
…	…	…
ASME B18.2.2	Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)	§192.147
ASME PCC-1	Pressure Boundary Bolted Flange Joint Assembly	§192.147
ASTM A193	Alloy-Steel and Stainless Steel Bolting for High-Temperature or High Pressure Service and Other Special Purpose Applications	§192.147
…	...	...

1.9 CORROSION RELATED		
…	…	…
NACE SP0274	High-Voltage Electrical Inspection of Pipeline Coatings	§192.461
NACE SP0286	Electrical Isolation of Cathodically Protected Pipelines	§192.147
NACE SP0375	Field-Applied Underground Wax Coating Systems for Underground Pipelines: Application, Performance, and Quality Control	§192.461
…	...	...