

FLANGED DUCTILE IRON PIPE AND FITTINGS

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Flanged Ductile Iron and gray iron pipe and fittings have been an industry standard for plant piping for more than 65 years. The flanged ends of most pumps, valves, and other appurtenances are compatible with the flanged joints manufactured by DIPRA member companies. This article provides an overview of the applicable standards for flanged Ductile Iron pipe and fittings and discusses the compatibility with other commonly used flange standards.

Applicable Standards

Three ANSI/AWWA² standards currently cover flanged joints for Ductile Iron pipe and Ductile Iron and gray iron fittings that are used primarily in water and wastewater applications:

1. ANSI/AWWA C110/A21.10: “Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in. for Water.” All fitting flanges are integrally cast of Ductile Iron or gray iron and are flat-faced. Typically, the face is machined to ensure tolerance requirements for bearing surfaces. The standard also allows for back facing or spot facing to comply with flange thickness tolerance.

Ductile Iron flanged-joint fittings are rated for 250 psi working pressure. However, 24-inch and smaller flanged joints with Ductile Iron flanges may be rated for 350 psi with the use of special gaskets. Gray iron flanged joint fittings are rated for 250 psi for sizes 3- through 12-inch, and 150 psi and 250 psi for sizes 14- through 48-inch, depending on configuration. Refer to applicable tables in the standard for specifics of the pressure rating.

2. ANSI/AWWA C115/A21.15: “Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.” Nominal thicknesses of 3- to 54-inch pipe correspond to Special Thickness Class 53, and nominal thicknesses of 60- and 64-inch pipe correspond to Pressure Class 350. These minimum pipe classes are to accommodate the taper pipe thread necessary to install the flange.

The pipe and flange are faced after threading the flange onto the pipe. There are tolerance requirements for bearing surfaces and bolt holes. As described for ANSI/AWWA C110/A21.10, flanges are flat-faced (without projection or raised-face) and are furnished smooth or with shallow serrations. Flanges may be either back faced or spot faced if necessary to comply with the thickness tolerance. *Note:* A flanged pipe fabricated in compliance with ANSI/AWWA C115/A21.15 *will not* have a recessed or projected pipe end showing at the flange face. Once a flange is threaded on and faced, it *should not* be removed and interchanged in the field. The flange manufacturer’s mark, size, and letters DI (if Ductile Iron) or GI (if gray iron) are cast or stamped on the flanges. If the fabricator is other than the flange manufacturer, the fabricator’s mark is stamped with a metal die on each flange after assembly.

Flanges are available in both Ductile Iron and gray iron and are rated at 250 psi. However, 24-inch and smaller flanged joints with Ductile Iron flanges may be rated for a maximum working pressure of 350 psi with the use of special gaskets. Ductile Iron flanges may be either solid or hollow back. DIPRA recommends the use of Ductile Iron flanges on Ductile Iron pipe because of their superior strength and impact resistance. If Ductile Iron flanges are to be required, this must be *clearly stated* in the specifications and on the purchase order.

3. ANSI/AWWA C153/A21.53: “Ductile-Iron Compact Fittings for Water Service.” Fittings with flanged joints are covered in this standard for 54- through 64-inch sizes. Flanged joint fittings for sizes 3- through 24-inch are not covered by this standard due to the importance of standardized center-to-flange face dimensions for these sizes already covered in ANSI/AWWA C110/A21.10. All fittings flanges are integrally cast of Ductile Iron. Flanges are flat-faced (without projection or raised-face) and are furnished smooth or with shallow serrations. Flanges may be back faced or spot faced if necessary for compliance with the flange thickness tolerances.

Flanged fittings for sizes 54- through 64-inch are rated for 150 psi working pressure plus a surge allowance of at least 75 psi. Flanged fittings with higher working pressure ratings are available. For dimensions and pressure ratings, the manufacturer should be consulted.

Compatibility With Other Standards

It is very important to specify compatible flanges, including bolt patterns, gasket materials, and pressure ratings, especially when pumps, valves, hydraulic control devices, and other appurtenances are joined with flanged Ductile Iron pipe and Ductile Iron and gray iron fittings. Flat-faced Ductile Iron flanges, specified in ANSI/AWWA C110/A21.10, C115/A21.15 and C153/A21.53 can be connected to 0.06-inch raised-face flanges, provided appropriate gaskets and bolt torques are utilized; however, such connections are not recommended for gray iron flanges. The following flange standards are compatible with ANSI/AWWA C110/A21.10, C115/A21.15 and C153/A21.53 flanges:

- 1. ASME³/ANSI B16.1: “Cast Iron Pipe Flanges and Flanged Fittings,” Class 125 only.** The maximum allowable pressure-temperature ratings for these flanges range from 50 psi to 200 psi (refer to the standard for specific ratings). *Note:* The ASME/ANSI B16.1, Class 250 flange has a larger bolt circle, greater thickness, and uses larger bolts and is *not compatible* with ANSI/AWWA C110/A21.10 and C115/A21.15 flanges or ASME/ANSI B16.1, Class 125 flanges.
- 2. ASME/ANSI B16.5: “Pipe Flanges and Flanged Fittings,” Class 150 only (Flat and 0.06-inch Raised-Face Flanges).** This standard covers steel flanges through a nominal pipe size of 24-inch. The maximum allowable pressure-temperature ratings for these flanges range from 20 psi to 290 psi (refer to the standard for specific ratings). In some sizes, the bolt length requirements for this standard are longer. *Note:* ASME/ANSI B16.5 flanges in Class 150 with facings other than flat-face or 0.06-inch raised-face (i.e., ring joint, grooved face, etc.) and in all other rating classes (i.e., 300, 400, 600, 900, 1500 and 2500) are *not compatible* with ANSI/AWWA C110/A21.10 and C115/A21.15 flanges or ASME/ANSI B16.1, Class 125 flanges.
- 3. ASME/ANSI B16.42: “Ductile Iron Pipe Flanges and Flanged Fittings,” Class 150 only (Flat and 0.06-inch Raised-Face Flanges).** This standard covers flanges through a nominal pipe size of 24-inch. The maximum allowable pressure-temperature ratings for these flanges range from 125 psi to 250 psi (refer to the standard for specific ratings). In some sizes, the bolt length requirements for this standard are longer. *Note:* ASME/ANSI B16.42 Class 300 flanges are *not compatible* with ANSI/AWWA C110/A21.10 and C115/A21.15 flanges or ASME/ANSI B16.1, Class 125 flanges.
- 4. AWWA C207: “Steel Pipe Flanges for Waterworks Service,” Class B, Class D and Class E only.** The maximum allowable pressure rating for the Class B flange is 86 psi. The maximum allowable pressure rating for the Class D flange is 175 psi for 4- to 12-inch, and 150 psi for sizes larger than 12-inch. The maximum allowable pressure rating for the Class E flange is 275 psi. The bolt length requirements for Class B and Class D flanges of this standard are shorter. *Note:* The AWWA C207, Class F flange is *not compatible* with ANSI/AWWA C110/A21.10, C115/A21.15 and C153/A21.53 flanges or ASME/ANSI B16.1, Class 125 flanges.

Gaskets

Appendix A to the ANSI/AWWA C110/A21.10, C115/A21.15 and C153/A21.53 Standards requires a 1/8-inch-thick rubber gasket, either ring or full face, unless otherwise specified by the purchaser. The use of *thinner* gaskets (i.e., 1/16-inch) or material *other than* rubber should generally be avoided and used only when recommended by the manufacturer of the flanged pipe and/or fitting. Specially designed gaskets, in either the ring or full face patterns, are available with one or more annular rings (molded into the gasket) to improve performance. Flange joints with Ductile Iron flanges in the 24-inch and smaller sizes may be rated for 350 psi with the use of special gaskets whose rating is supported by performance testing as described in Sec. 4.5 of ANSI/AWWA C111/A21.11.

Bolts

Flange bolts are typically low-carbon steel in conformance with ASTM⁴ A307, grade B. Higher-strength bolts may properly be used on gray iron flanges with full face gaskets or on all Ductile Iron flanges (either ring or full face gaskets). Some stainless steel bolts can result in galling of threads that adversely affect sealability.

Installation

Flanged piping systems should be installed in accordance with the suggested procedures listed in the appendices of ANSI/AWWA C110/A21.10, C115/A21.15 and C153/A21.53 Standards. Questions concerning gaskets should be directed to the manufacturer. *Note:* In certain situations, the manufacturer may authorize test (and operating) pressures in excess of the maximum working pressure ratings listed in the above standards. The manufacturer should be contacted well in advance of preparation of final specifications or purchase of material in regard to higher pressures.

Flanged fittings, especially certain sizes of reducers, must be installed with the centerline of the bolt holes properly oriented to ensure correct alignment of the piping system.

While not recommended for sizes larger than 16-inch, pipe with threaded end(s) can be furnished with loose, pre-faced flanges for assembly of the flanges on the pipe in the field. This practice is discouraged because there have been past problems with field-tightening the flanges on the pipe (especially for larger diameters). The responsibility for proper alignment and tightening of the flanges in the field rests solely with the contractor or installer.

Conclusion

The use of flanged Ductile Iron pipe and Ductile Iron or gray iron fittings is a proven, cost-effective, and durable approach to plant piping. The reader is encouraged to verify that flanges and fittings meet the requirements of ANSI/AWWA C110/A21.10, C115/A21.15 or C153/A21.53 Standards.

References

¹American National Standards Institute

³American Society of Mechanical Engineers

²American Water Works Association

⁴American Society for Testing and Materials

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