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Replacing GB/T 17186-1997

Calculation methods for the pipe flange joints - Part 1: Calculation method satisfies both strength and rigidity requirements

管法兰连接计算方法 第1部分：基于强度和刚度的计算方法

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Foreword

GB/T 17186 "Calculation methods for the pipe flange joints" is divided into the following 2 parts. - Part

1 Scope

GB/T 17186.1-2015 is the Chinese national standard on calculation methods for the pipe flange joints - part 1: calculation method satisfies both strength and rigidity requirements, in the field of fluid systems and general-purpose components. The /T suffix marks it as a recommended standard: it is not compulsory by itself, but it becomes binding as soon as a contract, a tender or a customer specification calls it up - which in practice is how most foreign buyers meet it. It was issued on 10 December 2015 by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China; Standardization Administration of China, and has been in force since 1 July 2016. Classification: ICS 23.040.60, CCS J15. This page is published from the official record of the standard held by the Chinese standards administration: the identification, the dates, the classification and the issuing body are taken from there. The clause text, the tables and the numeric limits are in the document itself, which is delivered complete in English translation.

This Part of GB/T 17186 specifies the calculation method for bolted circular pipe flange

joints with gaskets. This Part applies to calculations for narrow-face pipe flanges where the gasket is entirely within a closed circumference formed by the bolt holes. The flange sealing surfaces outside this circumference do not contact each other. This Part is mainly applicable to connection calculations for Class series pipe flanges. This Part outlines the basic requirements for strength calculation and stiffness verification of pipe flange joints.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB 150.2, Pressure vessels -- Part

3 Symbols

The following symbols apply to this document. Flange outer diameter; mm The actual total cross-sectional area of the bolt at the root diameter of the thread or the minimum diameter of the unthreaded portion. Take the smaller one; mm

4 General

4.1 When using this method to calculate pipe flange joints, only the effects of fluid static pressure and gasket tightening force need to be considered. If the flange is subjected to external loads other than the internal and external pressures of the fluid, an appropriate margin shall be allowed.

4.2 For Class series pipe flanges used on pipelines, it is recommended to use Class series pipe flanges conforming to GB/T 9112~9124, GB/T 13402, GB/T 17241, and GB/T 15530.However, this is limited to the dimensions and pressure-temperature ratings within each standard. For Class series pipe flanges whose dimensions and pressure-temperature ratings conform to GB/T 9112~9124, GB/T 13402, GB/T 17241 (all parts), and GB/T 15530 (all parts), calculations are generally not required. For pipe flanges that do not conform to the above standards (including flange type, dimensions, pressure-temperature ratings, etc.), the flange strength and stiffness shall be checked according to the design conditions using this calculation method. The radial distance from the bolt center circle to the intersection of the flange neck and back; mm For integral and necked flanges. Coefficient related to the K value (see Figure 2) Flange thickness; mm Flange thickness of loose flange with flange; mm The nominal thickness of the nozzle or housing connected to the flange or ferrule; mm When calculated for an integral flange, it is twice the thickness g

0.When calculated for a loose flange, it is twice the pipe wall thickness required for internal pressure, but not less than 6 mm; mm Coefficient related to K (see Figure 2) Coefficient for integral flanges (see Figure 4) Coefficient for loose flanges (see Figure 6) Bolt load

designed for flanges in operating or pre-tightened gasket condition (see 7.5); N Minimum bolt load required under operating conditions (see 7.3); N Minimum initial bolt load required to pre-tightening the shims (see 7.3); N Width, determined based on the contact width between the flange and the gasket, is used to determine the basic sealing width b0 of the gasket (see Table 3); mm Coefficient related to K (see Figure 2) Pre-tightening sealing pressure; the minimum clamping force per unit area of the gasket or connection contact surface that must be applied to form an initial seal; MPa Coefficient related to K (see Figure 2) Allowable stress of bolts at room temperature; MPa Allowable bolt stress at design temperature; MPa Design allowable stress of flange material at design temperature (operating condition) or ambient temperature (with pre-tightened gasket); MPa Allowable design stress of the nozzle neck, container, or pipe wall material at the design temperature (operating condition) or ambient temperature (pre-tightening gasket); MPa Calculated axial stress of flange neck; MPa Calculated radial stress of flange ring; MPa Calculated tangential stress of flange ring; MPa

4.3 The design procedure for bolted flange connections includes. - Determine the gasket material and type; - Determine the bolt material, specifications, and quantity; - Determine the flange material, sealing surface type, and structural dimensions; - Check the flange strength (design allowable stress); - Check the flange stiffness.

4.4 Explanations of the main clauses in the standard are provided in Annex A. Considerations for designing bolted flange connections are provided in Annex B.

5 Materials

5.1 Flange materials shall comply with the provisions of GB/T 9124, GB/T 13402, GB/T 17241.7, and GB/T 15530.8.Other materials conforming to relevant standards may be selected according to user requirements.

5.2 Flanges manufactured using ferritic steel and designed according to this Part. When the flange section thickness is greater than 50 mm, it shall be fully annealed, normalized, normalized and tempered, or quenched and tempered.

5.3 Forged flanges made of carbon steel or low alloy steel shall be normalized.

5.4 The flange material to be welded shall have good weldability. Steel with a carbon content exceeding 0.35% shall not be welded.

5.5 Bolts, studs, nuts, and washers shall conform to GB/T 9125.The thread size of bolts and studs shall not be smaller than M

12.If bolts and studs with thread sizes smaller than M12 are used, alloy steel shall be used for iron-based bolts. Care shall be taken to avoid overloading small-diameter bolts.

5.6 When the thread specification is greater than M48, a fine thread shall be used.

5.7 Neck flanges shall be manufactured according to the following requirements.

a) Neck flanges are preferably forged from steel billets. They can be manufactured from hot-rolled or forged steel billets or forged bars through machining. The axis of the machined flange shall be parallel to the long axis of the original steel billet or forged bar;

b) Necked flanges shall not be machined from sheet metal. If used, they shall meet the following requirements. 1) The steel plate shall be tested ultrasonically for delamination defects; 2) The steel plate shall first be bent and butt-welded into a ring shape. The original surface of the steel plate and the axis of the flange after processing shall be parallel; 3) The butt joint of the ring shall adopt a full penetration butt weld structure; 4) The butt joints of the rings shall undergo post-weld heat treatment and 100% radiographic or ultrasonic testing. The thickness used to determine the requirements for post-weld heat treatment and radiographic testing shall be the smaller of t or (A - B)/2; 5) The outer surface of the flange back and neck shall be tested using magnetic particle or liquid penetrant testing.

6.1 Flange type structure diagram See Figure

1.For calculation purposes, flanges are classified into three types. loose flanges, integral flanges, and arbitrary flanges. See Annex C for a comparison on the classification of steel pipe flanges between this Part and GB/T 9112-2010.

6.2 Loose flanges

6.2.1 In Figure 1,

a) (1), (1a), (2), (2a), (3), (3a), (4), (4a), (4b), and (4c) are typical loose flanges and the locations of their loads and moments.

6.2.2 Welds and other structural details shall also meet the dimensional requirements in the corresponding drawings above.

6.2.3 Loose flanges are not effectively connected to the nozzle neck, vessel, or pipe wall to form a single integral structure. When designing this type of flange, it is assumed that this connection method will not produce the same mechanical strength as an integral connection method.

6.3 Integral flange

6.3.1 In Figure 1, b), (5), (6), (6a), (6b) and (7) are typical integral flanges and the locations of loads and moments.

6.3.2 Welds and other structural details shall also meet the dimensional requirements in the corresponding drawings above.