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*Flanges are simple to assemble, and ensuring leak-free flanges is as easy as following the practices addressed in ASME standard PCC-1, Guidelines for Pressure Boundary Bolted Joint Assembly. The standard's 2010 revision roughly doubles the size of the 2000 version, incorporating lessons learned and feedback from contractors. An appendix provides requirements for an industry standard certification program for bolted joint assemblers. While following the standard will help maximize the probability of a leak-free joint, a troubleshooting guide is also provided should a leak occur.*

## ***ASME PCC-1 Guidelines for Pressure Boundary Bolted Joint Assembly—Lessons Learned***

Welding isn't the only way to assemble piping. Sometimes contractors screw pipe together and sometimes they use flanges. Flanges appear to be simple to assemble—and they are—but when you don't want them to leak, certain practices need to be followed. Those practices are addressed in ASME standard PCC-1, *Guidelines for Pressure Boundary Bolted Joint Assembly*. It was revised in 2010, roughly doubling its size as the result of “lessons learned” since its first publication in 2000. Among the lessons were the following:

- Never use gaskets that are not rated for the pressure to be applied, even if the gasket is “temporary” for testing purposes only. Such gaskets have failed causing fatalities.
- Don't reuse gaskets. Gaskets are typically designed to deform to make a seal; once they have been used, they are harder than they are supposed to be or they have taken a set; both conditions require more bolting load to create a seal and this may damage the flange face.
- Nuts should run freely over the stud; small imperfections in threads have a big effect on torque measurements leading to inaccuracy in tension loads in the studs; this can result in leakage.
- Excessive paint thickness on the flange surface under the washer can result in leakage if the paint deteriorates in service. Power wire brush around the washer contact surfaces to remove excessive paint.

Existing sections of PCC-1 have been revised based on feedback to the committee. The following discusses some of those changes.

Flange faces should be examined for pits, gouges, dents, scratches and burrs. Obviously, if a gasket is being replaced, remove all traces of the old one from the flange faces using solvents and soft wire brushes. Pay particular attention to damage that runs across the ridges as such damage provides a leak path. Appendix D provides maximum flaw depth as a function of the radial dimension of the flaw compared to the width of the seating surface; the longer the radial dimension of the flaw, the less the depth that is acceptable; no defects deeper than 0.050 inches deep are permitted for soft gaskets and 0.030 inches for hard gaskets. The appendix allows larger flaws for soft gaskets than for hard gaskets. It also provides guidance on how to determine if a gasket is “hard” or “soft.”

Appendix E addresses initial alignment of flanges. Previous requirements were based on B31 alignment requirements; this version specifies a bolt torque limit of 20% of target load needed to bring the flange faces into parallel alignment; if more than that is required, the design engineer should be consulted or other means should use local heating to adjust the alignment. This recognizes what is important is the relationship between the initial alignment force and system flexibility.

Standard through-hardened washers conforming to ASTM F-436 were specified in the previous version of PCC-1. These carbon steel washers are unsuitable for elevated temperature service (creep range) as they will deform over time allowing bolt tension to drop. They are also larger than the spot face on most flanges, so they bend into a cone during assembly—not a desirable trait. Appendix M provides a specification for carbon, low alloy, martensitic stainless and precipitation hardening stainless steel washers, and it provides dimensions for washers that match the facing requirements in MSS SP-9 for spot facing of flanges.

Gaskets should be positioned so that they do not extend into the flow stream. A light dusting of spray adhesive compatible with the process fluid should be applied to one gasket surface to hold it in place. Tape strips should never be used across the gasket face, nor should grease.

Bolts must be of sufficient length that the threads are fully engaged. Generally this means the end must be flush with the nut, although B31.3 allows the threads to be one thread short. One end should be lubricated and the nut installed so that the bolt is flush with the nut surface; all the excess threads should be at the other end of the bolt. Since bolt threads will rust in most environments, this practice makes the flush side nut easy to remove, even after years of service. Generally bolt lengths should be such that the excess threads do not protrude more than ½ inch (13 mm) to minimize the extent of corrosion that you have to deal with if the flange is disassembled. Used bolts should be examined for straightness, obvious damage and abuse; if acceptable, the bolt should be reconditioned in a lathe (a die will just drive rust into the surface, increasing friction during reassembly) then reexamined. Nuts should always be replaced, as should damaged or deformed washers.

After alignment and assembly, nuts should be hand-tightened and each stud numbered in preparation for torquing, then the nuts should be snugged up to 10- to 20 ft-lbs. Where the

nut does not hand tighten, the bolt should be examined to determine the cause and repaired or replaced as necessary.

Legacy bolt tightening pattern requirements were also examined to provide alternative patterns that reduce the time and effort required from the legacy pattern in which five passes at progressively higher torques were applied. Alternative patterns such as the 4-bolt pattern reduce the passes to as little as three; research has shown that flanges tightened following the alternative patterns work just as well as those tightened using the legacy pattern and sequence.

The question of how much torque to use is addressed with a table of standard torques for coated bolts and non-coated bolts, but the standard also has an appendix that allows one to calculate the appropriate torque based on minimum required gasket stress to seat the gasket both during assembly and operation. Coated bolts have a polyimide/amide coating applied by the manufacturer and the coated torque values apply only for initial tightening. The non-coated bolt torques assume that the nuts are free-running and that a suitable thread lubricant that is compatible with the gasket has been applied. Lubricants should be applied to the threads after insertion to avoid picking up particulate that would increase torque; lubricants must be suitable for the service temperature and bolting materials. Lubricants should never be applied to gaskets, and contamination of gaskets by lubricant should be avoided.

While welders have to be qualified, there are no similar requirements for those who assemble flanges. PCC-1 Appendix A provides requirements for a certification entity to create and administer an ASME Certified training and assessment program that provides an industry standard certification program for bolted joint assemblers. The appendix provides requirements for the minimum course content that includes a theoretical portion, practical demonstrations and practical assembly. The appendix proposes three levels of assembler qualification: Certified Bolting Specialist, Certified Senior Bolting Specialist, and Certified Bolting Specialist Instructor. In my opinion, the UA should become such an entity.

While following PCC-1 fully may not be necessary for many applications, the above provides some simple things a contractor should do to maximize the probability of a leak-free joint. If joints still leak, Appendix P provides troubleshooting guidelines, including a useful checklist.

PCC-1 costs a paltry \$89 and can be purchased as a PDF file at [www.asme.org](http://www.asme.org); just do a search for PCC-1.

## ***Become a Member of the National Certified Pipe Welding Bureau***

*The National Certified Pipe Welding Bureau (NCPWB) is a subsidiary of the Mechanical Contractors Association of America (MCAA). NCPWB was established to keep contractors informed about welding and brazing technology and to simplify welding and brazing qualification practices.*

### ***Save Time by Using Qualified Welding and Brazing Procedures***

As a contractor installing welded and brazed piping systems in accordance with ASME B31 Piping Codes, you are required to have welding and brazing procedure specifications and qualified welders and brazers as required by Section IX of ASME Boiler and Pressure Vessel Code. Writing and qualifying welding and brazing procedures to meet Section IX requirements is complex and time-consuming. You can save time by utilizing over 100 welding and brazing procedure specifications (WPSs and BPSs) that are qualified to ASME Section IX and are available for immediate use on piping without further qualifications.

### ***Lower Your Cost of Qualifying Welding and Brazing Procedures***

Qualifying a WPS or BPS can be expensive, particularly if you are inexperienced in the process. The cost of materials for welding, testing, and completing the paperwork can run thousands of dollars. Should a test specimen fail to meet Section IX requirements, the costs can more than double. NCPWB WPSs and BPSs are already qualified in accordance with Code, and they are also proven by decades of use by NCPWB members.

### ***Reduce Your Risk of Noncompliance***

Your risk of noncompliance is reduced because WPSs and BPSs:

- Are written by experts whose primary job is working with ASME Section IX,
- Reviewed by the entire NPCWB 43-member Technical Committee,
- Reviewed by a third party - Hartford Steam Boiler Insurance and Inspection Agency,

NCPWB procedures have been used successfully by members to make thousands of welds in piping systems from power plants and refineries to heating, air conditioning, and refrigeration systems. You further reduce your risk because NCPWB procedures are submitted for customer review—and typically accepted without comment.

### ***Access Qualified Welders Nationwide***

NCPWB works closely with the United Association (UA) in conducting welder qualification testing. This testing is done under a program that is accredited by Hartford Steam Boiler Insurance and Inspection Agency and is in full compliance with ASME Section IX. Testing has been standardized and test information is stored in a national database, making it easy to find a welder locally. These welders are qualified to use the process and to weld on the materials that a contractor needs for a job.

### ***Access Technical Experts in Welding and Brazing***

Members of NCPWB serve on a variety of ASME Committees, including ASME Subcommittee IX, B31.1, B31.3, B31.5 and B31.9. These members are available to answer questions about these codes and to provide guidance on how to comply with them.

### ***For information:***

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- Visit [www.mcaa.org/ncpwb](http://www.mcaa.org/ncpwb)