

ENGINEERING BULLETIN #170

What Does ASME B31.3 and B31.1 Compliance Mean for Metal Hoses?

ASME COMPLIANCE FOR METAL HOSES

The terms ASME B31.3 and B31.1 get tossed around a lot in our industry, but what does compliance with these oft-cited standards really mean?

ASME STANDARDS FOR PIPING SYSTEMS

The American Society of Mechanical Engineers (ASME) has established numerous standards for the design, manufacture and testing of various “mechanical devices” over its long history. Its aim has been and remains today to ensure safety and reliability.

Among these mechanical devices are piping systems, and one of the first standards issued by the organization was, in fact, related to pipe. “Standard for the Diameter and Overall Dimensions of Pipe and Its Threaded Ends” was issued in 1887 and sought to address issues around pipe standardization emerging with the advent of mass manufacturing.¹

Since then, all piping standards issued by ASME come under the umbrella of the B31 Series. B31.3 and B31.1 are standards within the B31 Series. There are others.

ASME B31.3 FOR PROCESS PIPING

ASME B31.3 contains the requirements for piping systems found in the industries where metal hose is most often used: petroleum refining, chemical manufacturing, pulp and paper, semiconductors, cryogenics, etc.

It covers everything related to the piping system including those critical flexible components—metal hoses. The sections related to metal hose discuss material composition, design parameters, welding procedures and minimum testing requirements.

¹ ASME. History of ASME Standards. <https://www.asme.org/codes-standards/about-standards/history-of-asme-standards>.

Some rules cite compliance with another ASME standard. For instance, standards for flanges are laid out in ASME B16.5. If a hose assembly with flanges is to comply with B31.3, its flanges need to comply with B16.5.

Similarly, other rules cite compliance with standards administered by different organizations. For instance, metal hoses must be specified to BS 6501, Part 1, a standard from the British Standards Institute that compliments ISO 10380, a standard from the International Organization for Standardization.

CATEGORIES OF FLUID SERVICE

Not all hoses are treated equally within ASME B31.3. The code divides pipes and hoses into six service categories based on flow media and operating conditions.

- Category D Fluid Service
- Category M Fluid Service
- Normal Fluid Service
- High-Pressure Fluid Service
- Elevated Temperature Fluid Service
- High Purity Fluid Service

The parameters for categorization determine testing and design requirements. For instance, pressure ratings of 2500 psi or greater would require compliance with High Pressure Fluid Service, and based on the testing requirements are going to be more applicable to hard pipe than to thinner-wall hose.

Those requirements are found in Chapter IX of ASME B31.3 and include the following:

- Charpy impact testing
- Liquid penetrant examination (LT)
- 100% Radiography inspection (RT)
- Hydrostatic or pneumatic/gas testing at 1.25 times working pressure

These requirements are more stringent than the requirements for hoses used in Category D Fluid Service, where media is non-flammable, non-toxic, and will not exceed 150 psi at service temperatures between -20°F and 366°F.

- Visual examination
- 5% RT inspection
- Air under water test at 1.5 times working pressure

A hose may be ASME B31.3 compliant if it meets the requirements for Category D Fluid Service, but that same hose will not necessarily also be compliant with ASME B31.3, Chapter IX for High Pressure Fluid Service.

If a hose will not be used in service as defined by Category D, Category M, High-Pressure, Elevated Temperature, or High Purity, it would be considered for use in Normal Fluid Service.

While this is the most common use case for metal hoses, it's worth pointing out just how comprehensive the code is (fluid service categories are just one example) to highlight that compliance with the code usually means compliance with certain sections or appendices rather than with the entire code.

ASME B31.1 FOR POWER PIPING

ASME B31.1 contains the requirements for piping systems in electric power generating stations, industrial and institutional plants, geothermal heating systems, and central and district heating and cooling systems. The flow media is most often water or steam.

With a more defined application, ASME B31.1 does not have the same need for separate service categories. The codes are similar to a certain degree though, broadly speaking, because the impact of a shutdown at a power plant can affect many thousands of people immediately, the requirements are more stringent to ensure a greater level of reliability. As an example, while ASME B31.3 references BS 6501 for the metal hose requirements, B31.1 has specific sections concerning them.

On the other hand, some requirements for hoses are the same. Both standards reference Section IX of ASME's Boiler and Pressure Vessel Code (BPVC).

ASME SECTION IX

"Section IX: Welding, Brazing and Fusing Qualifications" of ASME's BPVC sets the standard for quality welding. Welds must be performed in accordance with a documented Weld Procedure Specification (WPS) by a welder certified to code.

ASME Section IX is similarly comprehensive and not all sections relate to welding metal hose. Due to the quality materials in play, TIG welding is the preferred end fitting attachment method. Only the parts of Section IX relating to gas tungsten arc welding (GTAW), another term for TIG, are relevant.

HOW RELEVANT ARE ASME CODES IN THE METAL HOSE INDUSTRY?

These codes are voluntary. Their use ranges across industries and across companies within those industries. Many users don't require ASME compliant hoses. Many do. Even if there is no requirement for ASME compliance, many components, like flanges, will comply with B16.5 automatically.

There is also overlap between sound design and manufacturing processes and the ASME codes. For instance, Penflex is capable of fabricating hose assemblies to conform to either B31.3 or B31.1, but we would not do so unless compliance is required per the customer.

That said, there are many aspects of our production that inherently align with the code, like our standard air under water leak test. The fact that all Penflex welders are ASME Section IX certified would be another example. End fitting attachment welds are going to be done by ASME Section IX qualified welders, even if there is no requirement for this by the end user.

If compliance is requested, a certification is typically issued by the quality department to confirm design, testing and welding was carried out in accordance with the respective section or sections of the pertinent code.

Along with material selection, code compliance is another decision dictated by the piping system owner. Their ability to communicate clearly the relevant sections of these, or any other, codes helps to identify suppliers capable of meeting their needs.