AUSTRALIAN PIPELINE VALVE®

ANSI VALVE RATINGS, STANDARDS & DESIGN ASME B16.34

This overview attempts to provide just some of the factors to be considered when selecting and specifying ANSI rated valves. The following information provides some of the design criteria users should evaluate and research when considering ASME valve suitability based on materials, pressure and temperature and interpreting relevant valve standards accordingly.

DESIGN SCOPE

This technical summary describes the design basis and standards that apply to Australian Pipeline Valve (APV) ASME B16.34 (B31 codes) valves and lists pressure-temperature ratings for APV valves and strainers. Australian Pipeline Valve valves covered by ASME standards include ball, check, gate, globe & plug valves as well as strainers.

DESIGN BASIS

Process industry piping systems are designed in accordance with the ASME Codes for Pressure Piping, B31, which specifies design and construction requirements for all types of piping systems. B31.1, 'Power Piping' and B31.3, 'Chemical and Petroleum Refinery Piping', relate to systems that utilise APV products.

PROCESS VALVE STANDARDS

Australian Pipeline Valve ASME rated valves conform to ANSI/ASME B16.34. This standard covers process valves with flanged, butt weld, socket weld and threaded ends. It specifies design requirements, materials, pressure-temperature ratings, dimensions, wall thickness and manufacturing requirements. In the interest of standardisation, B16.34 and its associated standard for flanges, ANSI/ASME B16.5, have established eight pressure classes and many material groups for process system valves and flanges. B16.34 also includes standard minimum wall thickness dimensions for each pressure class. B16.34 and B16.5 list the pressure-temperature ratings for each class and material group.

Materials:- Pressure-containing parts are manufactured from materials listed in B16.34, the B31 codes or ASME Boiler and Pressure Vessel Code Section VIII.

Design:- The design requirements of B16.34, including minimum wall thickness, are used for ASME standard APV valves.

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OTHER STANDARDS

Numerous other Standards exist for non ANSI rated valves such as API, BS, JIS, AS, MSS, DIN etc. Australia Pipeline Valve manufacture many valves in this category but only in some of the APV family of brands such as Flowturn and Superseal. Valves made to these standards can share ANSI ratings. For example APV-Flowturn needle valves are manufactured to MSS SP-99 which governs the material selection, design, ratings,testing and connection. The nominated cold working pressure (CWP) of these non ANSI valves must be equated to ANSI classes. Then the temperature rating must also be considered. These non ANSI valves typically have a pressure/temperature chart for each trim configuration.

SYSTEM REQUIREMENTS

The B31 piping codes require that component pressure-temperature ratings be equal to or greater than system design pressure and temperature to ensure system integrity and safety. Pressure and temperature requirements for both system design conditions and normal operating conditions should be considered in selecting the most suitable component.

Other considerations:- When selecting a valve, the requirements of the system and effects outside the system should all be considered such as:

Low temperature:- Applications for service below the CWP temperature range require special consideration. Some materials lose impact strength and should not be used at low temperatures. Many non-metals become hard and lose their ability to seal. Most lubricants harden, which can make a valve inoperable. Humidity in the air can for ice in and around a cold valve, making it inoperable and may even cause damage.

Environment:- Also consider the effect of the environment on valve function, materials, compatibility, ratings, installation, operation and maintenance. Examples of consideration:

- Valve ratings, assume the temperature to be that of the valve body, dictated by the system fluid. External sources of temperature overheating external parts should also be taken into account.
- Actuators, handles, solenoids and other accessories often have lower temperature ratings than the valves they operate, hence all heat sources must be considered.
- A corrosive environment may damage external body parts as well as seals, gaskets and lubricants not exposed to the system fluid, reducing the valve's pressure containing and operating capability.
- Outdoor exposure can also affect a valve. Water may enter a valve or actuator and prevent operation particularly if it freezes. Dirt, dust, salt, mildew and mud can enter the valve or actuator openings and cause damage and prevent operation.

TERMINOLOGY

The terminology used here is taken from B31, SP-99, B16.34, B16.5 related standards. These terms are used in process industries. *These terms may have quite different meanings in other industries.*

MATERIAL STRESS, STRENGTH AND SAFETY FACTORS

Material strengths are defined by yield and tensile strengths, which are determined by a destructive test on a sample. ASTM material specifications establish minimum values of yield and tensile strengths.

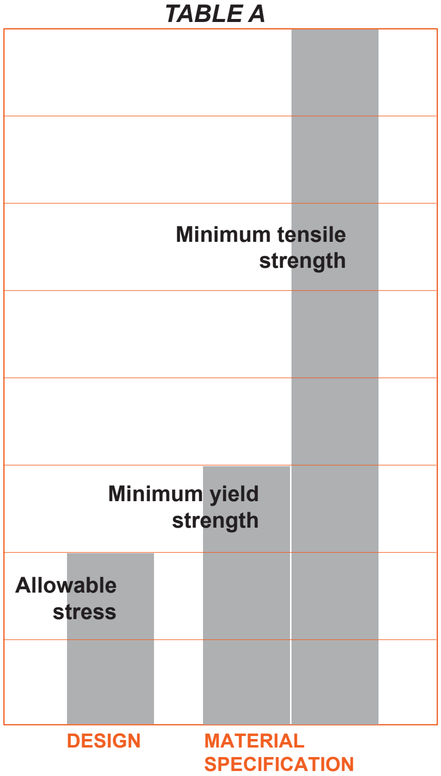
Yield strength:- The stress at which the test specimen has elongated and will no longer return to its original length. At this point, the material has undergone permanent deformation, or yield.

Tensile strength:- The stress required to break a material when a test specimen is pulled in tension.

Allowable stress:- The value of stress used to determine the dimensions and pressure ratings of piping systems, valves and other components. The value of allowable stress is always less than the minimum yield and tensile strengths of the material and normally is specified.

Safety factor:- The ratio between the allowable stress and the minimum tensile or yield strength of the material. In B31.1, the safety factor is based on one fourth of the minimum tensile strength or two thrids of the minimum yield strength, whichever is less; in B31.3, it is based on one third of the minimum tensile strength or two thirds of the minimum yield strength, wichever is less. Table 'A' below shows the design basis and the material specification relationships.

TABLE A



TESTING

The component shell test and the system hydrostatic test are done at 1.5 times the CWP or the system design pressure - which raises the stress level to a value close to the minimum yield strength of the material.

Shell test:- A test for *valves*, defined by B16.34, The purpose is to check for distortion and external leakage (but not seat leakage). B16.34 requires valves to be tested with water at 1.5 times the 100ºF (38ºC) *valve* rating for 15 seconds or longer. The valve is partially open. All APV valves are tested to API598 or API6D. Some Flowturn valves may be tested to MSS, BS or AS standards.

VALVE RATINGS

There are four main terminologies associated with valve pressure temperature ratings:

Cold working pressure (CWP) rating:- *The maximum allowable cold working pressure* of a valve in ambient conditions, usually from -20 to 100ºF (-28 to 37ºC).

Pressure rating:- The *maximum allowable working pressure* of the valve at the temperature given in the selected table.

Rating temperature:- The temperature of the *pressure-containing shell* of the valve. It is assumed to be the same as the system fluid temperature.

Temperature ratings:- The maximum and minimum temperatures at which the valve can be used.

VALVE SELECTION

Standards serve to promote safety by aiding the designer in selecting components. Total system design must be considered to ensure safe, trouble-free performance when selecting a valve. Valve function, materials compatibility, adequate ratings and proper installation, operation and maintenance are the responsibilities of the system designer and user.

Valve body metals properties:- Table B1 below shows a typical ANSI B16.34 pressure temperature curve for a selected valve body material 'group'.

Valve trim metal properties:- Table B2 demonstrates how often trim materials can potentially reduce the temperature and pressure rating of the valve. Whilst trim materials are usually chosen to equal or surpass the rating of the body, with some types of valves, this is not always the case (especially with valves containing soft parts) and should therefore be taken into consideration.

Valve trim soft parts properties:- Table B3 then demonstrates how non metallic valve parts such as seat inserts, packings, O-rings, seats, liners etc. can further down-rate the temperature rating of the valve. PTFE packing for instance on a stainless steel gate or O-rings and seat inserts on a trunnion mounted ball valve can reduce the pressure/temperature rating.

TABLE B1

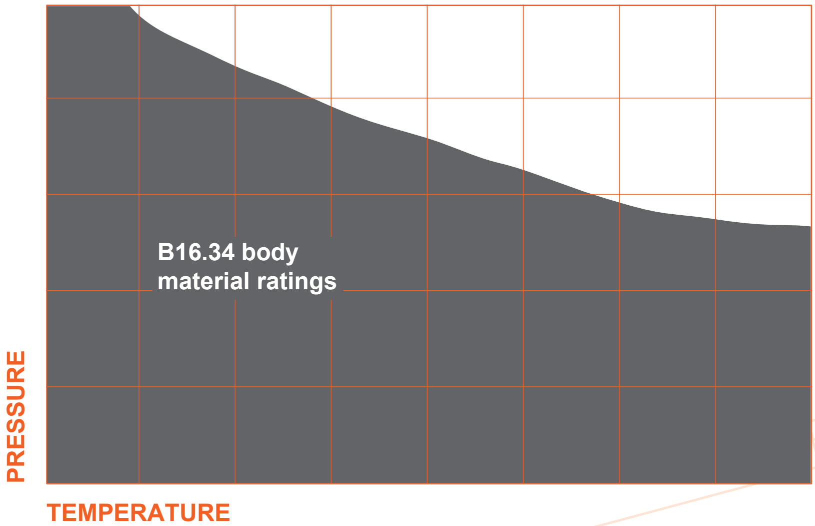


TABLE B2

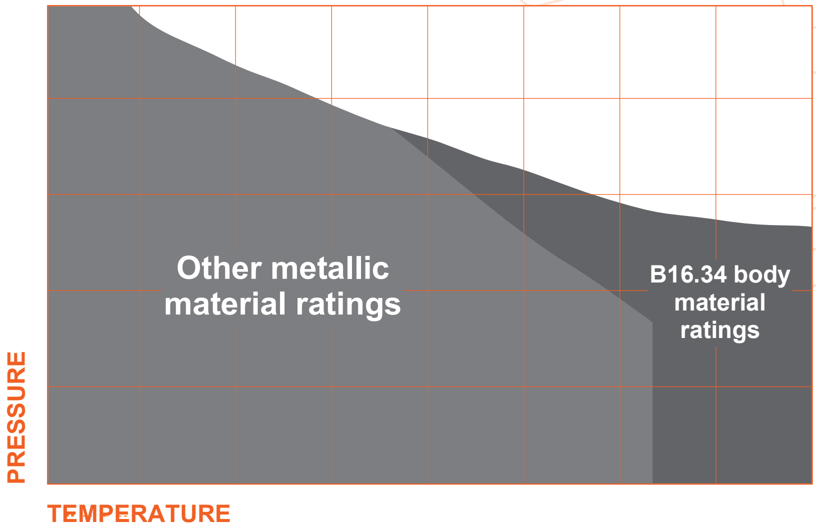
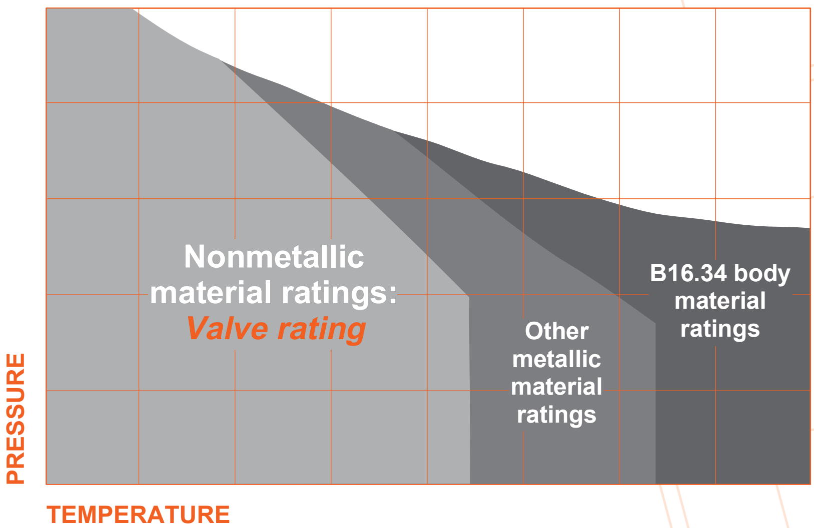


TABLE B3



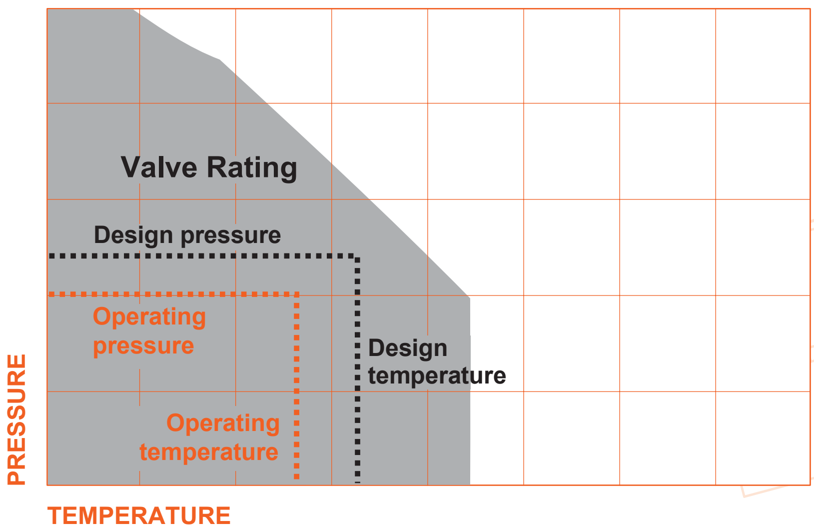
Of course at cold working pressure, the metallic and non metallic trim components chosen are normally equal than or superior to the body material and conform to the given ANSI class rating of the valve. However this does not necessarily apply with non ANSI rated valves.

Non ANSI rated valves:- Care should always be taken especially with lined valves, iron valves, very large diameter valves etc. Just because you order valves to it between ANSI class 150 flanges such as a rubber lined butterfly valve, knife gate valves or diaphragm valves for instance, it may only have a class 125 rating even though it has a carbon steel body, as the rubber line down-rates even the cold working pressure. These valves may also have alternative rating systems such as PN, BS, AS, JIS or just a given cold working pressure (CWP).

Other down rating factors:- Whilst integral end connections are normally matched to the stated working pressure rating and class rating of the valve, this is not always the case. For instance needle valves can be adapted with different end connections. Wafer style and lugged style lined butterfly valves, knife gate valves and also very large diameter valves can have a lower CWP than the flanges they mate with. After market pneumatic actuators may be fitted, sized based on pressure lower than the maximum allowable pressure of the valve itself.

Final selection:- Once the valve and all its elements have been considered in terms of pressure and temperature, the user must ensure the valve has an actual higher rating than the maximum design pressure and temperature. The actual 'normal' operating pressure & temperature will therefore fail safely within the rating of the valve itself. Table C below demonstrated the relationship.

TABLE C



SHUT OFF CHARACTERISTICS

Floating ball valves:- Care should be taken at very low pressures with floating ball valves. Floating balls may not seal leak tight at extremely low pressures as in the case of floating ball valves, some line pressure is often required to assist in energising a seal. This is especially true for valves designed for higher pressure applications where extremely low pressures are unlikely to be uncounted. Most APV ball valves are designed to isolate leak tight, even at extremely low pressures. However some fluids like diesel for instance can be extremely 'searching' and users should always specify the lowest pressure the valves could experience in the life of the valves. APV floating ball valves can even accommodate vacuum service but users must specify this. APV can on request ensure ball valves are supplied for very low pressures. This of course increases torque, which may alter the type of valve operator required.

Shut off class:- Most soft seated valves such as ball valves for instance are normally bubble tight on the seat and manufactured to ANSI Class VI requirements. Metal seated valves can be manufactured to Class VI (or equivalent BS, ISO, MSS classes) but generally are not drip tight on the seat as standard. ANSI Class tables indicate the allowable leakage per inch, per minute. Class V valves like check valves and globe valves for instance are allowed higher leakage rates than gate valves. Larger size valves are allowed higher leakage rates. Control valves and abrasive/solids handling valves are generally ANSI *Class IV*, which allows even higher levels of seat leakage.

Body leakage:- No external body or stem leakage is allowed on any APV valve. All valves are hydrostatic high pressure and low pressure pneumatic tested on body and seal to API598 or API6D. Where users hydrostatically test their line above the recommended test pressure of the valves themselves, operators may tighten the valve stem packing to avoid leakage. However this will increase torque and wear, hence ensure the stem packing is then readjusted. Fugitive emission packing can also be supplied on all APV valves and nitrogen testing can be performed.

ASME STANDARDS ASSOCIATED WITH VALVES & PIPING

ASME has two codes for pressure vessels and piping systems that have become the standard of the industrial process industries: the Boiler and Pressure Vessel Code and the Code for Pressure Piping.

ANSI/ASME boiler and pressure vessel code. Consists of 11 sections including:

- Power Boilers (Section I)
- Material Specifications (Section II)
- Pressure Vessels (Section VIII)

Although this code does not apply to valves, it is used so widely that it often is employed as a design guide. The material specifications in Section II are similar to ASTM specifications; some are identical.

ANSI/ASME B31 code for pressure piping is divided into several sections covering specific piping systems. The two that are most relevant to APV products are:

- B31.1, Power Piping
- B31.3, Chemical Plant and Petroleum Refinery Piping

These codes define the design requirements, acceptable materials, allowable stresses, component standards, dimensional standards, test requirements, construction and related topics for systems and components.

ANSI/ASME B16.5 pipe flanges and flanged fittings is a component standard that defines materials, dimensions and pressure-temperature ratings for flanges used in piping systems. It does not include valves but it is referenced in B31.

ANSI/ASME B16.34 valves-flanged, threaded and welding ends covers process valves with flanges, butt weld, socket weld and threaded ends. It defined pressure-temperature ratings, materials, design requirements and wall thickness for process valves. It is referenced in B31.
Both B16.34 and B16.5 have established standard pressure classes, material groups and pressure-temperature ratings. The rating tables in the two standards are identical.

ANSI/ASME B1.20.1 pipe threads defines the dimensions for standard NPT pipe threads.

ANSI/ASME B16.11 steel fittings socket weld and threaded defines the standard dimensions for pipe fittings.

ANSI/ASME B16.25 butt welding ends defines the dimensions and tolerances for butt weld preparations used on pipe, valve ends, flanges and other components.

MSS SP-PP instrument valves applies to steel and alloy valves of 1 inch nominal pipe size and smaller and pressure ratings of 10,000 psi and lower at 100ºF (38ºC).

API 598 valve inspection and testing defines the inspection and test requirements for valves purchased under API valve standards; it may be applied to other valves. It is widely recognised in the petroleum and chemical industries.

DISCLAIMER:-
This is a general overview. Information provided should not be used to make your operational or design decision. We accept no liability or responsibility for the information and do not guarnatee its correctness.