

ASME B31.3 Process Piping

Charles Becht IV, PhD, PE
Don Frikken, PE
Instructors

BECHT ENGINEERING COMPANY, INC. What's Different in B31.1 - 1



19. What's Different in B31.1

- Scope
- Organization of the Code
- Fluid Service Requirements
- Bases for Allowable Stresses
- Material Requirements
- Pressure Design Requirements
- Valve Requirements
- Fabrication and Installation
- Inspection, Examination and Testing

BECHT ENGINEERING COMPANY, INC. What's Different in B31.1 - 2

B31.1 Scope

Rules for this Code Section have been developed considering the needs for applications which include piping typically found in electric power generating stations, industrial and institutional plants, geothermal heating systems and central and district heating and cooling systems. (100.1)

B31.1 Scope

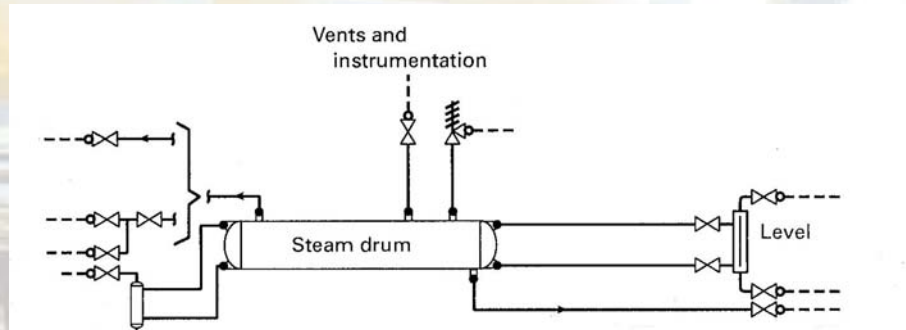
Power piping systems as covered by this Code apply to all piping and their component parts...They include but are not limited to

- steam
- water
- oil
- gas
- air

[100.1.2]

Boiler External Piping (BEP)

Generally defined as piping between the boiler and the first block valve.



BECHT ENGINEERING COMPANY, INC.

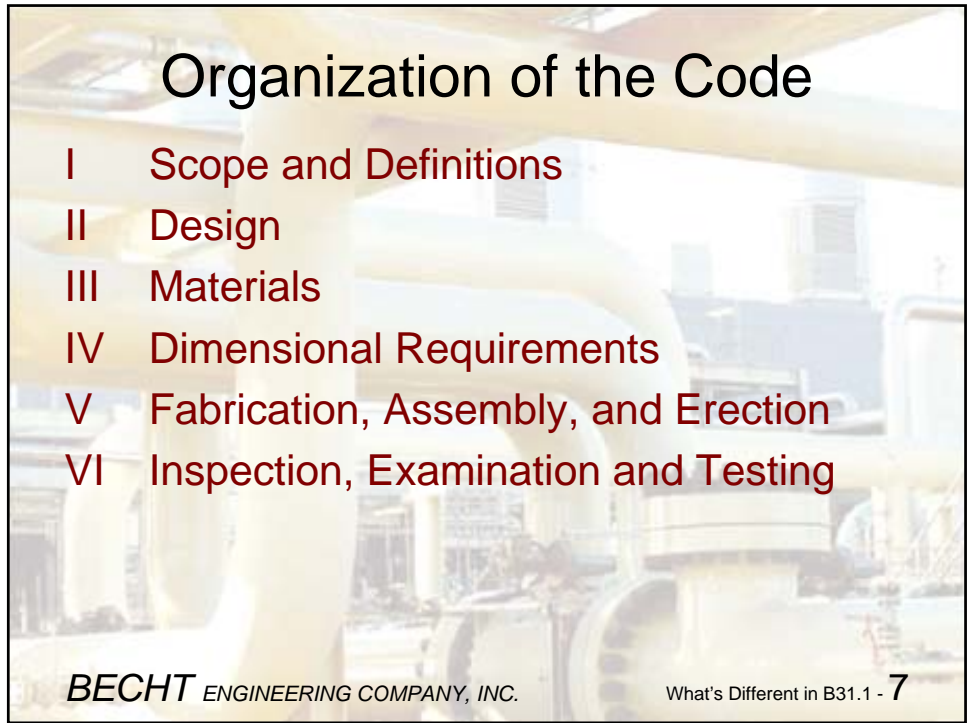
What's Different in B31.1 - 5

Boiler External Piping

- Technical requirements are in accordance with B31.1
- Administrative requirements are defined in ASME B&PV Code Section I and include requirements for
 - B&PV Code stamp
 - Data reports
 - Quality control
 - Inspection

BECHT ENGINEERING COMPANY, INC.

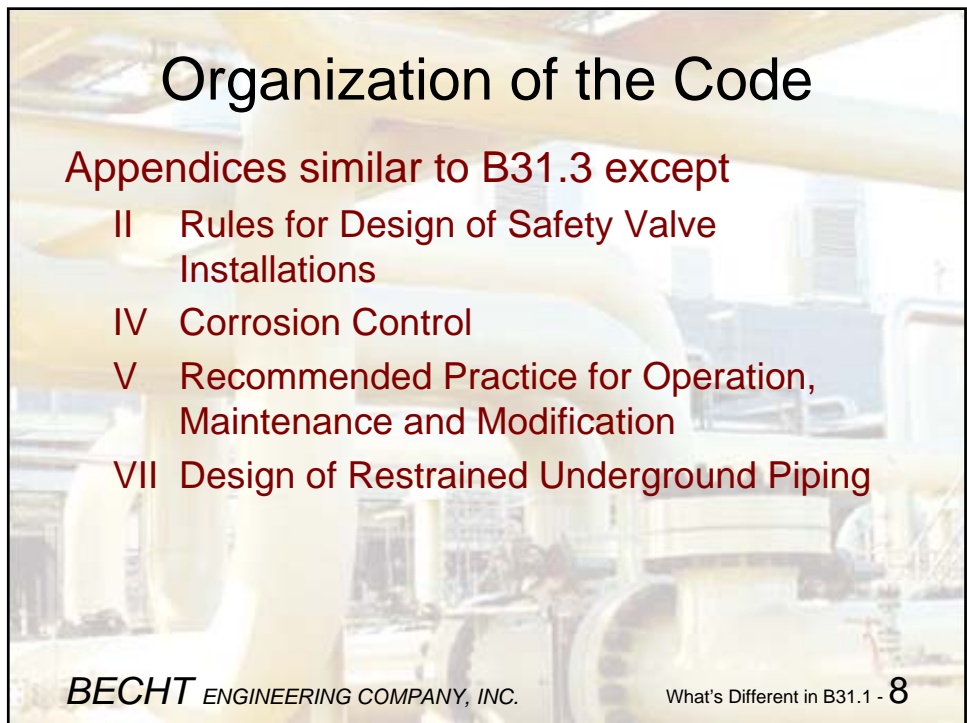
What's Different in B31.1 - 6



Organization of the Code

- I Scope and Definitions
- II Design
- III Materials
- IV Dimensional Requirements
- V Fabrication, Assembly, and Erection
- VI Inspection, Examination and Testing

BECHT ENGINEERING COMPANY, INC. What's Different in B31.1 - 7



Organization of the Code

Appendices similar to B31.3 except

- II Rules for Design of Safety Valve Installations
- IV Corrosion Control
- V Recommended Practice for Operation, Maintenance and Modification
- VII Design of Restrained Underground Piping

BECHT ENGINEERING COMPANY, INC. What's Different in B31.1 - 8

Organization of the Code

B31.1 provides specific requirements for

- Boiler External Piping (Steam, Feedwater, Blowoff, Blowdown and Drains)
- Blowoff and Blowdown Piping (Non-BEP)
- Instrument, Control and Sample Piping
- Spray Type Desuperheater Piping
- Pressure Reducing Valves
- Pressure Relief Piping

Organization of the Code

B31.1 provides specific requirements for

- Piping for Flammable or Combustible Liquids
- Piping for Flammable Gases and Toxic Fluids
- Piping for Corrosive Fluids
- Temporary Piping
- Steam Trap Piping
- Pump Suction and Discharge Piping
- District Heating and Steam Distribution Systems

Fluid Service Requirements

- B31.1 does not define specific fluid services, but does have limitations for piping systems handling certain fluids
- Specific requirements for components and joints are described in paras. 105-118.

Pipe Fluid Service Requirements

- Furnace butt welded pipe is not permitted for flammable, combustible or toxic fluids

Joint Fluid Service Requirements

- Socket welding size limited for BEP and toxic fluids
- Threaded joints size limited by temperature and pressure; example maximum pressure for NPS 3 joint is 400 psi (2750 kPa)
- Pipe thinner than STD WT may not be threaded
- Pipe shall be Sch 80 seamless for
 - Steam over 250 psi (1750 kPa)
 - Water over 100 psi (700 kPa) and 220°F (105°C)

More Joint Fluid Service Requirements

- OD tubing compression and flared tubing limited to 2 in. (50 mm)
- Brazed joint may not be used for flammable or toxic fluids in fire hazard areas
- Soldered joints may not be used for flammable or toxic fluids
- Soldered joints may not be used in piping subject to vibration

Flanged Joint Requirements

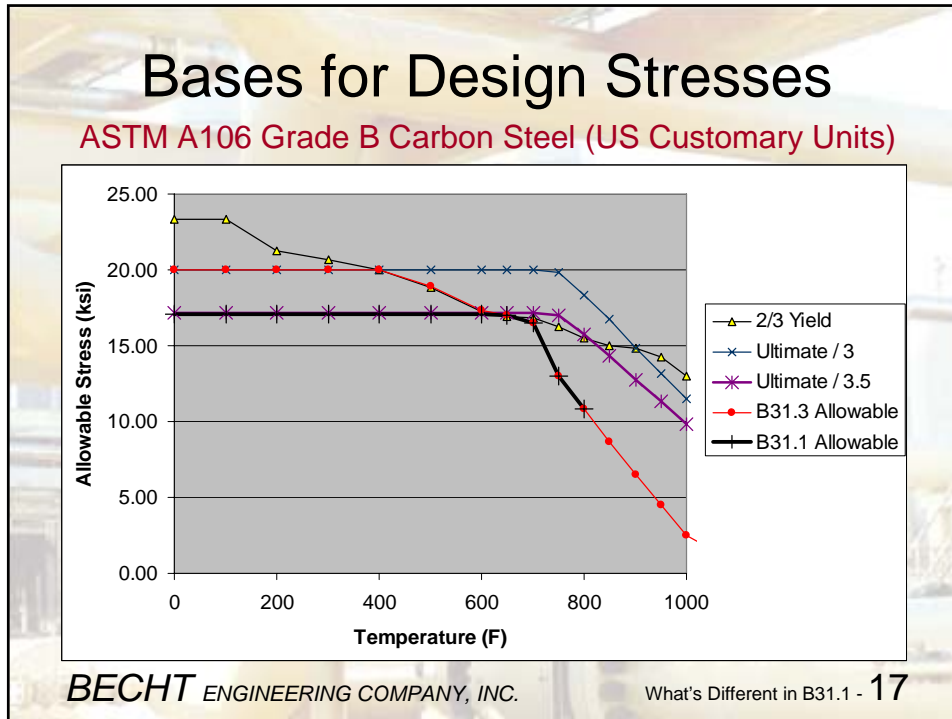
B31.1 has detailed requirements for flanged joints. Requirements include:

- Class 150 steel flanges bolted to Class 125 cast iron flanges are required to be flat faced...gasket required to be full face
- Bolting dimensions for both US customary and metric bolting
- Bolt material requirements as a function of flanges and gaskets

Bases for Design Stresses

Most Materials – (materials other than gray iron, malleable iron and bolting) below the creep range, the lowest of

- the specified minimum tensile strength divided by 3.5
- 1/3 of tensile strength at temperature
- 2/3 of specified minimum yield strength
- 2/3 of yield strength at temperature; except for austenitic stainless steels and nickel alloys with similar behavior, 90% of yield strength at temperature



B31.1 Material Requirements

- Materials for BEP must meet ASME B&PV Code requirements; unlisted materials may not be used
- Unlisted materials may be used for OD tubing compression and flared tube fittings
- Use at temperatures above maximum in stress tables generally not permitted
- No rules for use at temperatures below -20°F (-29°C)

BECHT ENGINEERING COMPANY, INC. What's Different in B31.1 - 18

Pressure Design

The rules for pressure design are essentially the same as for B31.3, but they are not identical.

The two Section Committees are working to make the requirements the same.

Design Pressure & Temperature

allowance for pressure and temperature variation: The Code allows the design pressure to be set below the most severe coincident pressure and temperature for the following variations:

- Can exceed allowable by 20% for no more than 1 hr/event and no more than 80 hr/year
- Can exceed allowable by 15% for no more than 8 hr/event and nor more than 800 hr/year

Design Pressure & Temperature

allowance for pressure and temperature variation - conditions:

- Except as limited by component standards
- Except as limited by manufacturers
- No limitations on cast iron or other non-ductile components
- No limitations on yield strength
- No limitations on longitudinal
- No limitations with respect to test pressure
- No permission from the owner required

Valve Requirements

Standard Valves Can be used within their pressure-temperature ratings and any additional limitations described in the Code

Nonstandard Valves Shall be of a design... which the manufacturer recommends for the service

Valve Requirements

All Valves

- must have “blow-out proof” stems
- OS&Y required for NPS 3 and larger above 600 psi (4150 kPa)
- screwed bonnets not permitted for steam above 250 psi (1750 kPa)

Fabrication and Installation

- Welder & brazer qualification and bending & forming requirements are very similar but not identical
- Preheating and heat treatment requirements are different
 - B31.3 requires neither preheating or heat treatment for carbon steel with thickness less than or equal to 3/4 in. (19.0 mm)
 - B31.1 requires preheating to 200°F (95°C) or heat treatment for the same thickness range

Fabrication and Installation

- Minimum socket weld size is 1.09 times nominal wall thickness versus B31.3 requirement for 1.25 time pressure design thickness
- Flange faces are required to be fitted so that gasket contact surfaces bear uniformly on the gasket
- Bolts must be threaded through the nut

Inspection, Examination and Testing

- Similar distinction between inspection and examination, but no specific "owner's inspector"
- Authorized inspector required for boiler external piping, ASME B&PV Code, Section I
- B31.1 does not include the concept of random with progressive examination... either 100% or none

Inspection, Examination and Testing

Examination is as required by Table 136.4:

| Over 750°F (400°C) | Over 1025 psig (70 bar) and 350 to 750°F (175 to 400°C) | All Others |
|--|--|-------------|
| Visual plus For NPS ≤ 2, MP or LP For NPS > 2, 100% radiography | Visual plus For wall thickness ≥ 3/4" (19 mm), 100% radiography | Visual only |

Inspection, Examination and Testing

- Visual examination is required for all welds with para. 136.4.2 acceptance criteria
 - No surface cracks
 - No surface undercut <1/32 in. (1.0 mm)
 - Limits on weld reinforcement
 - No surface lack of fusion
 - No incomplete penetration...applies when inside surface is readily accessible

Inspection, Examination and Testing

- BEP requires hydrotest in accordance with ASME B&PV Code, Section I
- Non BEP requires hydrotest or, at the owner's option, pneumatic, sensitive leak or initial service leak testing
- Lines open to the atmosphere do not require testing
- Joints must be exposed for examination during leak testing, except that insulated systems may be tested by fluid loss over time method

Inspection, Examination and Testing

- Pressure must be held a minimum of 10 minutes, and then may be reduced to design pressure for leak examination period
- Stress during hydrotest is limited to 90% S_Y , rather than 100% S_Y
- Hydrotest pressure is 1.5 times the design pressure...no temperature correction
- Pneumatic testing requires owner's approval
- Pneumatic test pressure is 1.2 to 1.5 times the design pressure