How do the differences between the standards (EN, ASTM and ASME) effect the quality, cost and expected service life of a DE scheme?

Speakers:
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Norm compliance

ASME B31.1 - EN13941 main differences

• ASME B31.1 are for pipe above ground and EN 13941 are for directly buried pipes.

• ASME B31.1 cover pressure pipes and other components for heat stations etc.

• EN 13941 cover district heating pipes – pre-insulated bounded pipe systems for directly buried hot water networks
Norm compliance

Regulations and standards - Impact - Quality

<table>
<thead>
<tr>
<th>Standard</th>
<th>Type</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| ASME B36.10    | Welded and seamless wrought pipe | EN 10220 | Seamless and welded steel tubes  
Dimensions and masses per unit length |
| ASTM A53       | Steel pipe                  | EN 10217 | Welded steel pipe                               |
| ASTM A106      | Seamless steel pipe         | EN 10216 | Seamless steel pipe                              |
|                |                             | EN 253   | District heating pipes                          |
|                |                             | EN 15698-1 | Twin pipes                                    |
|                |                             | EN 15698-2 | Twin pipes fittings and valves                |
|                |                             | EN 448   | District heating fittings                       |
|                |                             | EN 488   | District heating valves                         |
|                |                             | EN 489   | District heating joints                         |
| ASME B31.1     | Power piping                | EN 13941 | Design and installation of district heating pipes |
|                |                             | EN 14419 | Surveillance systems                            |

Third party EUROHEAT & POWER controls production and issues certificate if production complies with the above standards
Steel grades

- EN standards use steel grade P235GH (P235GH are similar to Grade B material)

- Grade P235GH are also mentioned in: ASME Boiler and Pressure Vessel Code, Section II, Materials
<table>
<thead>
<tr>
<th>Dim</th>
<th>EN</th>
<th>SCH 40</th>
<th>SCH 40/EN</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4”</td>
<td>0,102”</td>
<td>0,109”</td>
<td>1,1</td>
</tr>
<tr>
<td>1-1/4”</td>
<td>0,102”</td>
<td>0,140”</td>
<td>1,4</td>
</tr>
<tr>
<td>2”</td>
<td>0,114”</td>
<td>0,154”</td>
<td>1,3</td>
</tr>
<tr>
<td>3”</td>
<td>0,126”</td>
<td>0,216”</td>
<td>1,7</td>
</tr>
<tr>
<td>5”</td>
<td>0,142”</td>
<td>0,258”</td>
<td>1,8</td>
</tr>
<tr>
<td>8”</td>
<td>0,177”</td>
<td>0,322”</td>
<td>1,8</td>
</tr>
<tr>
<td>12”</td>
<td>0,220”</td>
<td>0,406”</td>
<td>1,8</td>
</tr>
<tr>
<td>16”</td>
<td>0,248”</td>
<td>0,500”</td>
<td>2,0</td>
</tr>
<tr>
<td>20”</td>
<td>0,248”</td>
<td>0,626”</td>
<td>2,5</td>
</tr>
</tbody>
</table>
Water Treatment

- Conductivity $\mu$S/cm < 10 (demineralisation)
- PH value 9.5 – 10.0
- Hardness dH° < 0.5 (removing limescale – softening)
- Oxygen-free (deoxygenation)
- Clear and sluge-free
- Oil-free
Pipe according to schedule SCH 40 have a wall thickness 1.1 – 2.5 times as thick as EN schedule.

It means that axial force and movements will be 1.1-2.5 times as big in schedule SCH 40 compared to EN schedule.

Due to the large movements, extra U-bends are required to avoid fatigue breakage in the steel pipe.

When choosing ASME instead of EN:

➔ 1.1 to 2.5 times cost in steel
➔ Extra cost to more U-bends
Overview: Foam and outer casing - EN 13941

Foam have 2 functions (sandwich construction)
(Polyurethane, min 3.43 lb/ft³, min pressure strength 22 psi)
• Minimize heat loss from the pipe
• Transfer axial forces from the steel pipe to the ground

Casing have 2 functions (sandwich construction)
(PEHD black, min PE80)
• Protect the foam from water and mechanical damage
• Obtain a known friction between pipe and soil
ASME B31.1 Power Piping is not specific to manufactured insulated bonded pipe used for hot water distribution systems and is not based on foam insulation or outer casings to the extent the EN does - EN goes deeper in to optimization and performance.

Fiberglass or mineral wool insulation with aluminum or plastic cladding is more common.

ASME is more material and safety rating specific.

Performance and materials are selected by the engineer.

Selection is primarily driven by customer preference.
Design - Crucial differences in design - EN 13941

Laying method 1 - expansion bends

\[ \leq 2 \times F_{\text{max}} \]

Laying method 2 - heat prestressing

Laying method 3 - prestressing elements

Laying method 4 - cold installation
Design - Crucial differences in design – ASME
Anchors and support

EN 13941 Piping system
- Bonded – pipe, insulation, and casing form one system
- Direct burial – earth / soil used to hold pipe and handle movement
- Foam pads are used for added support
- Single use in line compensators used

ASME B31.1
- Based on pressure piping
- Engineered supports, anchors, and hangers
- Spring can hangers that allow for movement
- U-bends or expansion joints used (additional pipe and welding)
Project class - Control level

A: Small pipe, low axial stress. Safety factor 5 at fatigue. Welding control ≥5%
B: Small pipe, high axial stress. Safety factor 6.67 at fatigue. Welding control ≥ 10%
C: Big pipe, safety factor 10 at fatigue. Welding control ≥ 20%
EN 13941 100% leak tightness test with air
ASME B31.1 100% pressure test

Axial stress coming from thermal expansion
EN 13941 allows the pipe / material to absorb a higher stress level than recommended by ASME B31.1
Full load cycles

EN 13941 - Pipe are split in 3 different functions/types

1. House service connections 1000 cycles /30 year
2. Main pipelines 250 cycles /30 year
3. Major pipelines 100 cycles /30 year

ASME B31.1

1. Requires stress analysis for each application and service
2. Based on sustained load stresses and severe cyclic loads not normal operating cycles
3. Three stress categories: Primary, Secondary, Peak

Figure: Action cycle
1 One action cycle
2 Temperature or stress range
All projects should be documented with
• Pipe drawing, as build.
• Leak detection system drawing, as build

ASME or US Standards
• Project specific by drawings and specification are common
• Hydrostatic pressure test report
• Welding certifications and welding procedures
Case study - Sheridan

About Sheridan

Trafalgar Campus
Oakville, Ontario

Hazel McCallion Campus
Mississauga, Ontario

Davis Campus
Brampton, Ontario

Skilled Trades Centre
Oakville, Ontario
Case study - Sheridan

Broader goals
Case study - Sheridan

Trafalgar Campus District Energy Infrastructure
Case study - Sheridan

Davis Campus District Energy Infrastructure
# Case study - Sheridan

## Setting goals

<table>
<thead>
<tr>
<th>Standard Energy Plan</th>
<th>Breakthrough Energy Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses a Forecasting Approach</td>
<td>Drives Exceptional Performance</td>
</tr>
<tr>
<td>Uses a Forecasting Approach</td>
<td>Uses a Backcasting Approach</td>
</tr>
<tr>
<td>Builds Technical Case, Then Financial</td>
<td>Builds Both Cases Simultaneously</td>
</tr>
<tr>
<td>Predetermines an Approach</td>
<td>Suggests Approaches, Then Tests</td>
</tr>
<tr>
<td>Uses Simple Financial Models</td>
<td>Uses Integrated Financial Models</td>
</tr>
<tr>
<td>Energy Savings &lt; 20%</td>
<td>Energy Savings &gt; 50%</td>
</tr>
<tr>
<td></td>
<td>Inspires Organization</td>
</tr>
<tr>
<td></td>
<td>Establishes Leadership Position</td>
</tr>
</tbody>
</table>
Project design comparison ASME B31.1 versus EN13941

Consultant - site inspection - Sheridan
Foam balls

Benefits

- Simple and cost effective
Project design comparison ASME B31.1 versus EN13941

Quality control

Benefits
It is all in the norm!
We have forms for everything!
Project design comparison ASME B31.1 versus EN13941

Owner – lessons learned

• Certified welding procedures as part of tender requirements
• Thoroughly investigate existing site conditions
• Single-person responsibility for material
  • Confirm proper use
  • Carefully track stock
• Know your contract rights, and theirs
• Site coordination is important
Thank you for your attention

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