

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



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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

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



Steel Schedule [mm] - EN versus ASME

Dim		EN		SCH 40		SCH 40/EN
3/4"	(26,9)	0,102"	(2,6)	0,109"	(2,78)	1,1
1-1/4"	(42,4)	0,102"	(2,6)	0,140"	(3,56)	1,4
2"	(60,3)	0,114"	(2,9)	0,154"	(3,91)	1,3
3"	(88,9)	0,126"	(3,2)	0,216"	(5,49)	1,7
5"	(139,7)	0,142"	(3,6)	0,258"	(6,55)	1,8
8"	(219,1)	0,177"	(4,5)	0,322"	(8,18)	1,8
12"	(323,9)	0,220"	(5,6)	0,406"	(10,3)	1,8
16"	(406,4)	0,248"	(6,3)	0,500"	(12,7)	2,0
20"	(508,0)	0,248"	(6,3)	0,626"	(15,9)	2,5



Water Treatment

- Conductivity $\mu\text{S}/\text{cm} < 10$ (demineralisation)
- PH value 9,5 – 10,0
- Hardness $\text{dH}^\circ < 0,5$ (removing limescale – softening)
- Oxygen-free (deoxygenation)
- Clear and sludge-free
- Oil-free



Steel Schedule [mm] - EN contra ASME

Pipe according to schedule SCH 40 have a wall thickness 1.1 – 2.5 times as thick as EN schedule.

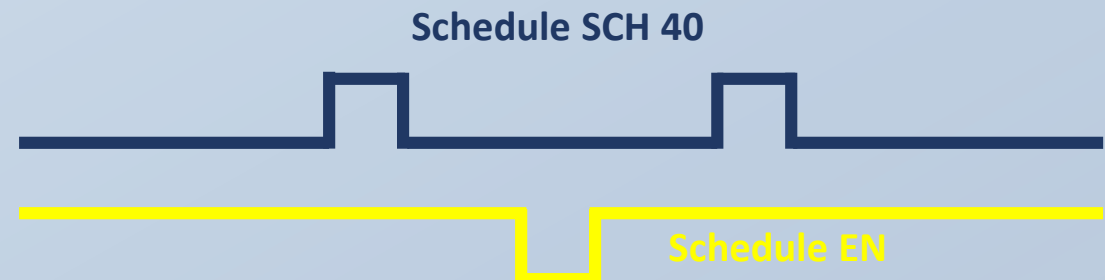
It means that axial force and movements will be 1.1-2.5 times as big in schedule SCH 40 compared to EN schedule.

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)

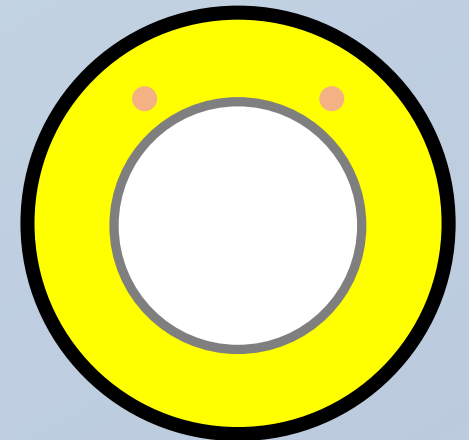
(Polyurethane, min 3,43 lb/ft³, min pressure strength 22 psi)

- 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



Overview: Foam and outer casing - ASME B31.1

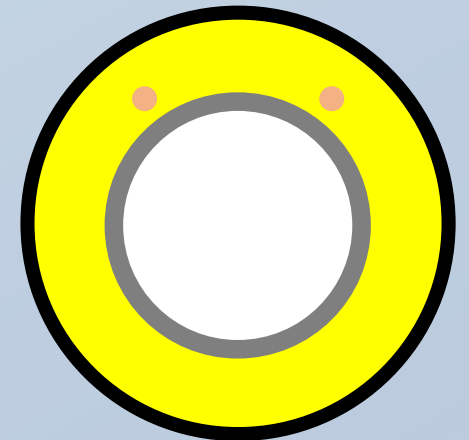
ASME B31.1 Power Piping is not specific to manufactured insulated bonded pipe used for hot water distribution systems and is not based on foam insulation or outer casings to the extent the EN does - EN goes deeper in to optimization and performance

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

ASME is more material and safety rating specific

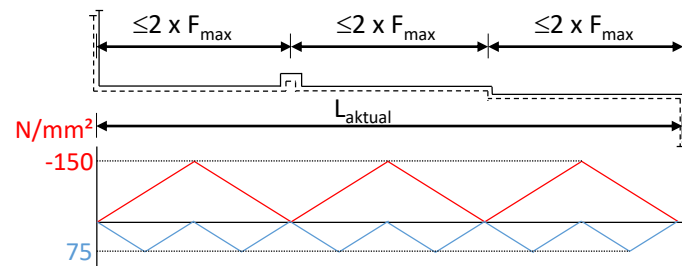
Performance and materials are selected by the engineer

Selection is primarily driven by customer preference

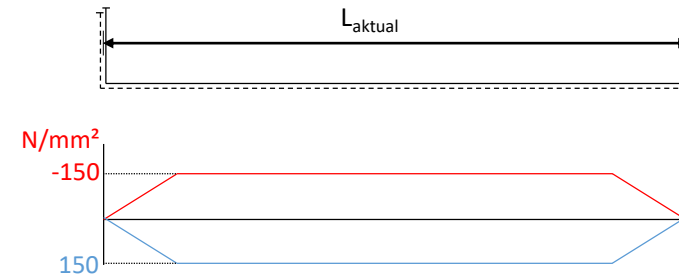


Design - Crucial differences in design - EN 13941

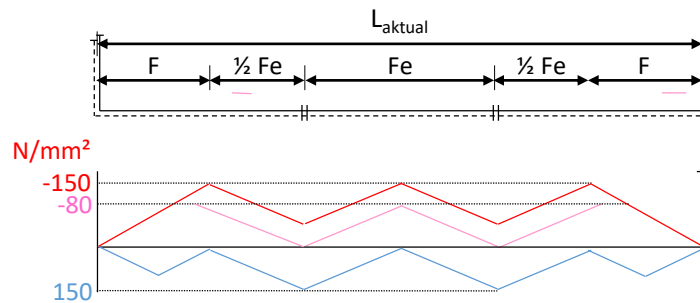
Laying method 1 - expansion bends



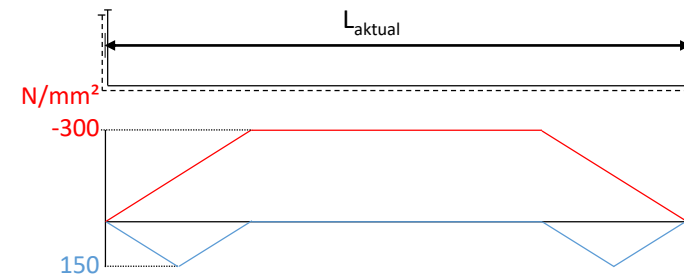
Laying method 2 - heat prestressing



Laying method 3 - prestressing elements



Laying method 4 - cold installation



Design - Crucial differences in design – ASME

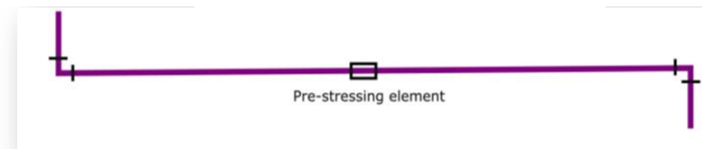
Anchors and support

EN 13941 Piping system

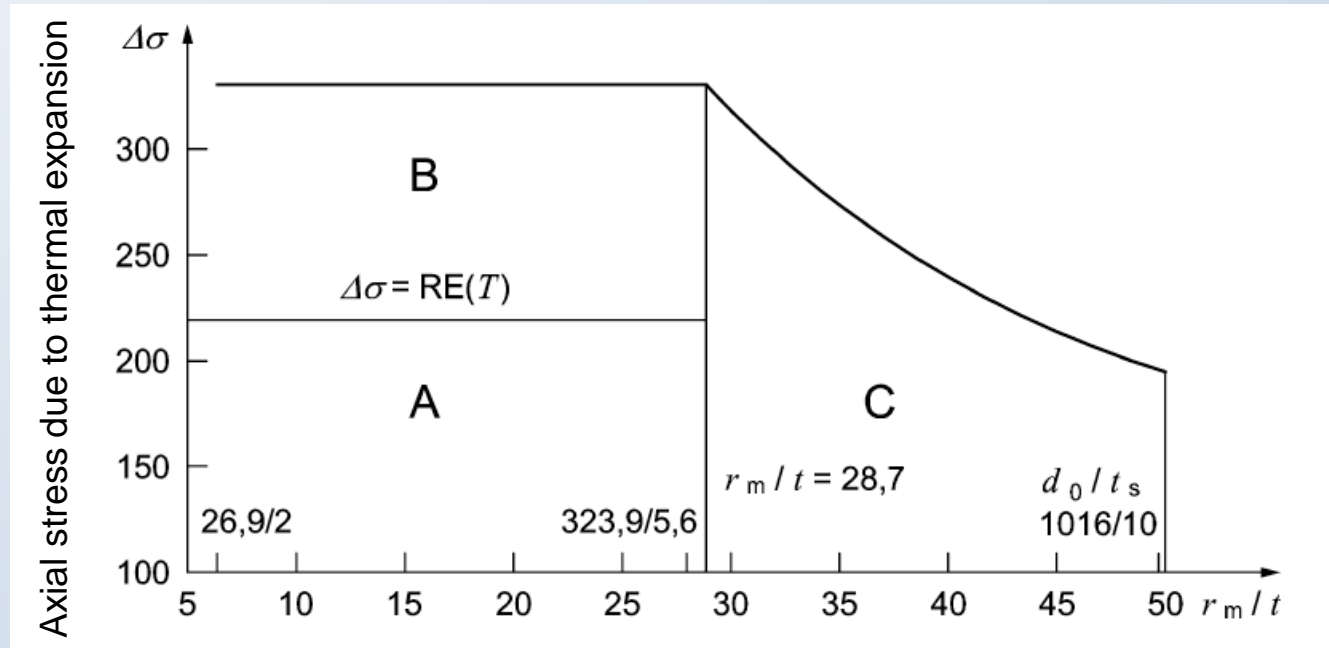
- Bonded – pipe, insulation, and casing form one system
- Direct burial – earth / soil used to hold pipe and handle movement
- Foam pads are used for added support
- Single use in line compensators used

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 $\geq 5\%$
- B: Small pipe, high axial stress. Safety factor 6,67 at fatigue. Welding control $\geq 10\%$
- C: Big pipe, safety factor 10 at fatigue. Welding control $\geq 20\%$

Project class - Control level

EN 13941 100% leak tightness test with air
ASME B31.1 100% pressure test

Axial stress coming from thermal expansion

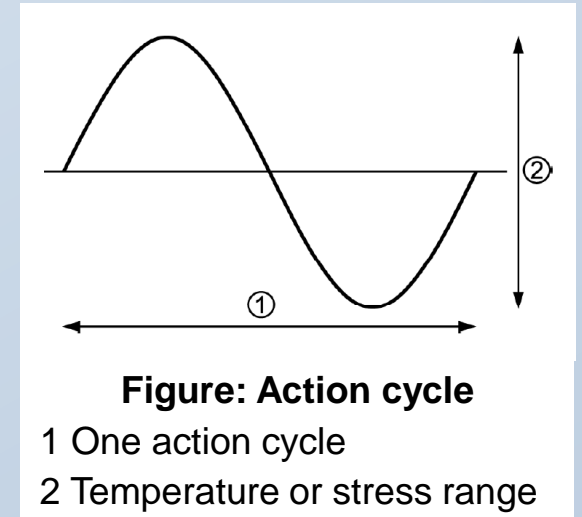
EN 13941 allows the pipe / material to absorb
a higher stress level than recommended by
ASME B31.1



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

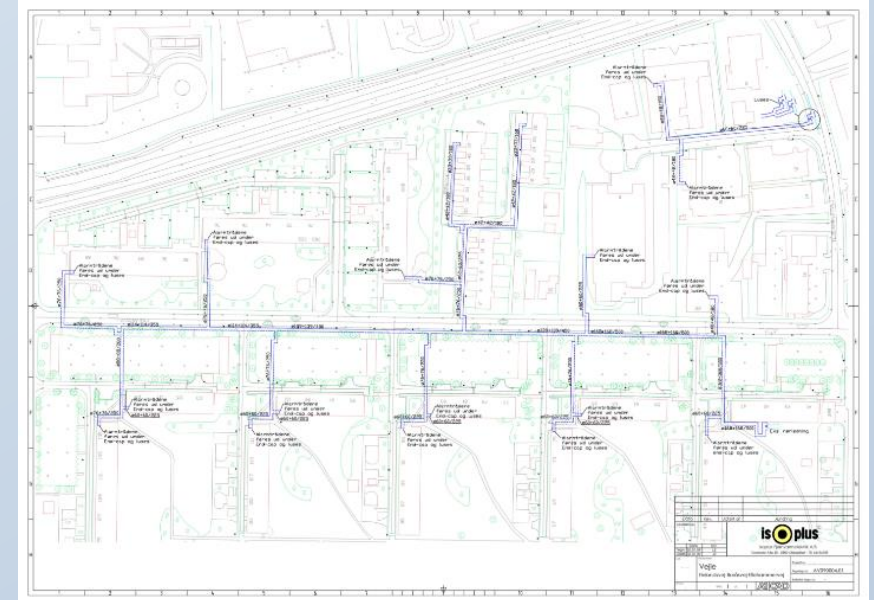
Documentation

All projects should be documented with

- Pipe drawing, as build.
- Leak detection system drawing, as build

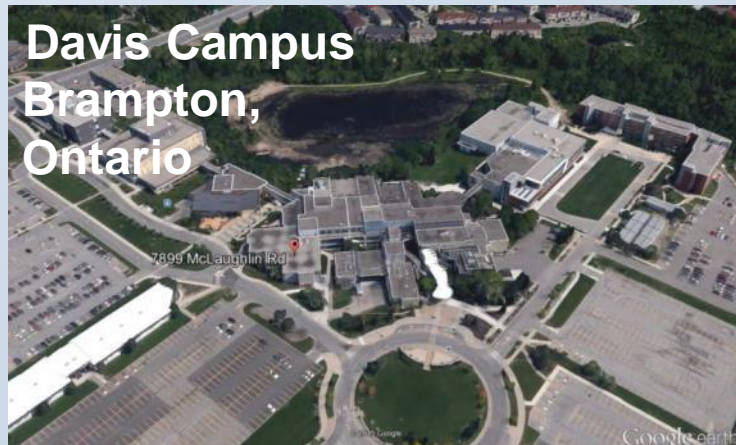
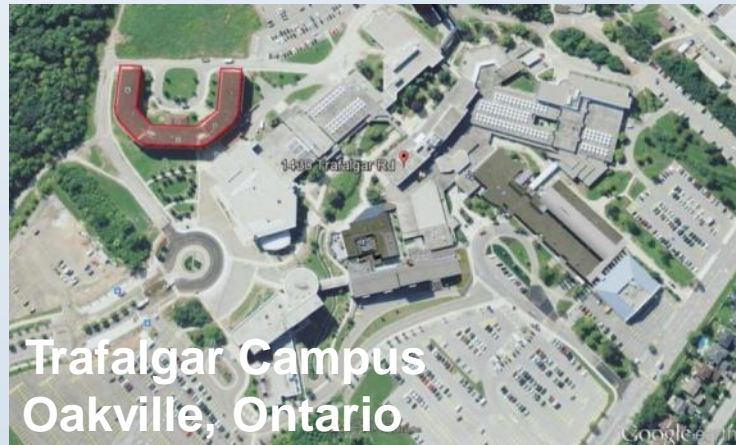
ASME or US Standards

- Project specific by drawings and specification are common
- Hydrostatic pressure test report
- Welding certifications and welding procedures



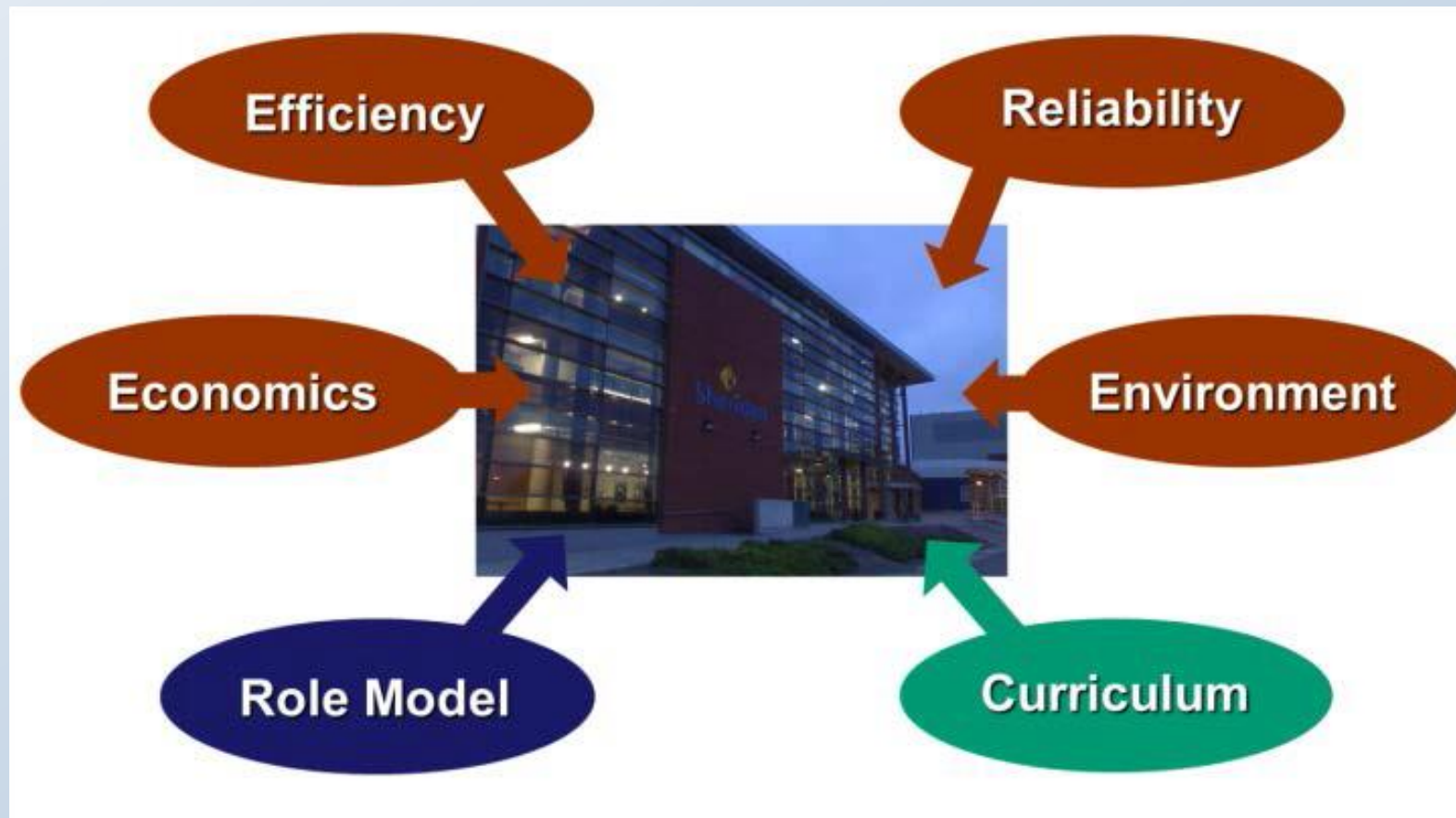
Case study - Sheridan

About Sheridan



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

Standard Energy Plan	Breakthrough Energy Plan
Uses a Forecasting Approach	Drives Exceptional Performance
Uses a Forecasting Approach	Uses a Backcasting Approach
Builds Technical Case, Then Financial	Builds Both Cases Simultaneously
Predetermines an Approach	Suggests Approaches, Then Tests
Uses Simple Financial Models	Uses Integrated Financial Models
Energy Savings < 20%	Energy Savings > 50%
	Inspires Organization
	Establishes Leadership Position

Project design comparison ASME B31.1 versus EN13941

Consultant - site inspection - Sheridan



Project design comparison ASME B31.1 versus EN13941

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!

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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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