Sealed System Expansion
Water Expands

82 °C

HEAT
Open Vented vs Sealed System
Open Vented

- Dead space in the loft
- Susceptible to freezing, exposed pipework, 8%
- Susceptible to corrosion, ingress of air
- Limited life cycle
Sealed System

- Valuable space reclaimed from loft space
- Freezing risk reduced, no exposed pipework
- Corrosion effects reduced, no ingress of air
- Longer life cycle
Terminology

◆ Heating Water (Sealed also Chilled and Condenser)
  ◆ Radiators, underfloor and air handling systems
  ◆ Heating expansion vessels (Typically Red)

◆ Hot Water (Unvented)
  ◆ Taps, showers and consumable systems
  ◆ Potable expansion vessels (Wholesome water)
Terminology

◆ Static Head / Static Height
  ◆ Distance between the bottom of the expansion vessel and highest point of the water system (estimate 3m per floor)

◆ Cold Fill Pressure
  ◆ Directly relates to the static height (10m=1bar)

◆ Pre Charge Pressure (Vessel Gas Charge)
  ◆ Pre-charge pressure = Cold Fill pressure
Static Height, Pressure & Gas Charge

10m

0 bar

1 bar

1 bar
Water Content

- To correctly size expansion equipment the total system volume is required

- Very often this is not known

- BS7074 pt1 states that for every 1KW of boiler power, 12 litres of system volume can be assumed
Highest Temperature

- To correctly size expansion equipment the highest water temperature must be used
- Typically LTHW (Low Temperature Heating Water) runs between 82 °C and 71 °C, therefore 82 °C is used for the calculation
- Typically CHW (Chilled Water) runs between 6 °C and 12 °C, therefore 12 °C would be used. Practically however, a maximum ambient of 35 °C is used for CHW
Safety

- A sealed system must be protected with a Safety Relief Valve

- This information should come from the system designer, and is set to protect the weakest point of the system

- Domestic applications are limited to a 3 bar maximum for the Safety Relief Valve
Expansion In Action

- 70 °C at the diaphragm
- Return Pipework
- Suction side of the circulating pump
- Cold fill pressure lower than hot ‘running’ pressure
Basic Vessel Sizing Example

Vessel Efficiency
(How much of the vessel can be used)

\[ \text{Vessel Efficiency} = \frac{P_{\text{MAX}} - P_{\text{MIN}}}{P_{\text{MAX}}} \]

- \( P_{\text{MAX}} \) = Maximum working pressure (Absolute)
- \( P_{\text{MIN}} \) = Minimum working pressure (Absolute)

Example System Details:
- 1200 litre system volume
- 7m static height
- 1 bar cold fill pressure (7m + 0.3 venting allowance)
- 3 bar maximum working pressure
- 82 deg.C Flow (3.02% co-efficient of expansion)

Expanded Volume

\[ \text{Expanded Volume} = \text{System Volume} \times \text{Co-efficient of Expansion} \]

Vessel Efficiency

\[ \frac{3+1}{4} - \frac{1+1}{4} = \frac{4-2}{4} = 0.5 \]

Expanded Volume = 1200 * 3.02% = 36.24 litres

Expansion Vessel Volume

\[ \text{Expansion Vessel Volume} = \frac{36.24}{0.5} \times 10\% = 79.73 \text{ litres} \]
Air In Radiators

- Car Tyres Run Cooler
  - Nitrogen

- Party Balloons
  - Behind Sofa

- Rubber Not Gas Tight
  - Gas Charge Depleted After 5 to 7 years
  - System Pressure Loss On Every Cycle
Domestic Example

- Expansion Vessel
- Safety Valve (3 bar)
- Pressure Gauge
- Filling Loop
  (must be disconnected after use)
- Manifold
- Mounting bracket
LTHW Example
CHW Example
MTHW – Medium Temperature Heating Water

- Water boils at 69 °C on the top of Mount Everest

- Water exposed to molten rock (over 700 °C) at the bottom of the sea bed does not boil

- The difference is pressure....
MTHW

- Water at atmospheric pressure turns to steam at 100 °C
- Antiflash Margin
  - BS7206 pt 2 (+11 °C)
- Pressure addition to the static height
  - Highest point is prevented from flashing to steam
- Intermediate Vessel
  - To remove heat from the water entering the vessel
MTHW Example
Sealed System Expansion

Any questions?

Thank you for your attention.