

# Thermal Relief of Pipelines

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Tech Talk No: **T011**  
Product: **Thermal Relief of Pipelines**

To: **General Distribution**

a) *Section 9.7.12.2 of AS 1940 - 1993*

is attached and describes how the problem can occur.

Over pressuring of a pipeline due to thermal expansion of the liquid is common.

Thermal relief valves are sometimes not fitted because of a possible technical breach of Measurement regulations as relief will be from an after - meter location.

b) *Static pressure limit* for Liquip loading arms is 1,000 kPa on site and 1500 kPa test.

API 513 coupler is limited to 1,000 kPa test and 600 kPa in service.

These pressures can easily be exceeded if thermal relief is not fitted.

c) *Example of calculation*

Take a typical length of pipeline, an average loading arm, and petrol.

Typical run from set-stop valve to API coupler is 10 metres of 100 mm bore.

Volume is 78.55 litres of petrol. Coeff of cubic expansion is 0.0011 per °C.

ASSUME A TEMPERATURE INCREASE OF 10°C.

Then increase in volume due to thermal expansion of the product is 0.863 litres.

The pipeline also expands due to temperature. Assuming a mixture of steel and aluminium pipework, the internal volume increases by 0.05 litres.

**Note: Nett change in vol = 0.813 litres**

This volume has to go somewhere.

*Compressibility of petrol* is very low. At 2000 kPa, our volume of 78.55 litre reduces by only 0.006 litres.

*The elasticity of pipework* is also very low. At 2000 kPa, our volume of 78.55 litres increases by only 0.02 litres.

*Stainless steel drop hose*, when new, expands by 5% under 2000 kPa pressure. A typical drop hose is 2 metres long x 100 mm bore and so expands by 0.785 litres.

Summing up the nett volumes of  $0.813 - 0.006 - 0.02 = 0.787$  litres

we see it is very close to the 2000 kPa pressure required to inflate the hose to accommodate the hot products volume increase.

- d) *Other lengths* of pipe and different temperature increases can be inserted in the above to give a proportional change.
- e) *If product is automotive distillate* this has a cubic coeff of 0.00084 per °C and in our theoretical pipe calculation the volume increase from 10°C warming will be 0.623 litres in 78.55 litres. This will theoretically create a pressure of 1,450 kPa.
- f) This data is physical fact.

Reasons for excess pressure **not** being evident on many loading arms will vary from valve seats not sealing properly to product being temperature stable.

If excess pressure does show up, then if a hydro static relief valve is not present, do not be surprised.

**David Gregory**