

## Joule-Thomson Effect Compensation

### What is the J-T effect?

Typically it is taken to mean the drop in temperature that occurs when gas pressure is reduced.

The magnitude of the temperature drop depends on the starting pressure, the pressure change and the composition of the gas. The J-T coefficient, or the change in temperature per unit change in pressure is not a constant and is highly variable for any particular gas mixture depending on the starting and ending conditions.

Pressure reductions occur in pipeline systems where gas may be compressed to high pressure for long distance transmission, and then reduced in pressure for reticulation or direct use, such as at a City Gate Pressure Reduction Station, or at a Pipeline Compressor Station.

### Why is compensation required?

Under large pressure changes, the temperature of the gas or gas mixture can fall to a point where the gas or a component of the mixture starts to condense into a liquid, or in extreme cases to solidify (such as ice formation where traces of moisture exist).

The carry over of liquid droplets or ice particles into valves and other machinery components can cause equipment malfunction with catastrophic consequences.

The way to prevent this is to preheat the gas before the pressure reduction so that the temperature after expansion is above the saturation temperature of components of the gas mixture.

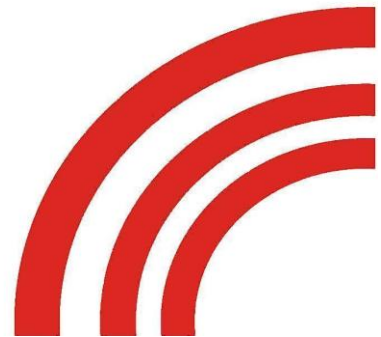
### What are the alternatives?

There are three main methods of heating gas flows. These are heat tracing the pipeline, a water bath heater and direct electric heating.

Heat tracing involves wrapping a heating cable around a length of pipe to heat the pipe which in turn heats the pipe contents.

A water bath heater is typically a horizontal cylindrical tank filled with water with a fire tube in the bottom with a gas pipe serpentine through the water to raise the gas temperature. Water bath heaters may also be heated with hot oil.

Direct electric heating has electric elements in the gas stream to heat the gas as it flows over the elements.



## What are the advantages and disadvantages of each alternative?

### Heat Tracing

Advantages	Disadvantages
Simple to install	Difficult to get fine control with variable flow
Can be retrofitted to an existing pipeline	Requires a reliable power supply on site
No ongoing maintenance	

### Water Bath Heater

Advantages	Disadvantages
Proven technology, with a large installed base	Difficult to get fine control with variable flow
Can use waste heat from other processes	High maintenance
Can operate in remote sites with no electricity supply	High capital cost

### Direct Electric Heater

Advantages	Disadvantages
Compact size	Requires a reliable power supply on site
Very fine and accurate control maximizes energy efficiency	No ongoing maintenance

## Why should you choose a Grimwood Direct Electric Heater?

- Grimwood has the proven capability to design and build direct electric heaters to the highest and most stringent standards in the world.
- Grimwood was the first heater manufacturer in the world to obtain an IECEx Certificate of Conformity for these products.
- Grimwood can analyze your process conditions to accurately confirm the true J-T effect based on the gas composition.
- Grimwood can design and build the control system to heat the gas to the temperature required depending on the flow rates, and inlet temperatures and pressures without unnecessary and wasteful overheating.
- Grimwood can deliver your heater with a short leadtime reducing your overall project lead time and working capital investment.
- Grimwood can provide on site commissioning assistance.
- Grimwood has industry leading understanding of the thermal design of the heaters to optimise heat transfer coefficients, element sheath temperatures and pressure drop.

