Steam trace heating

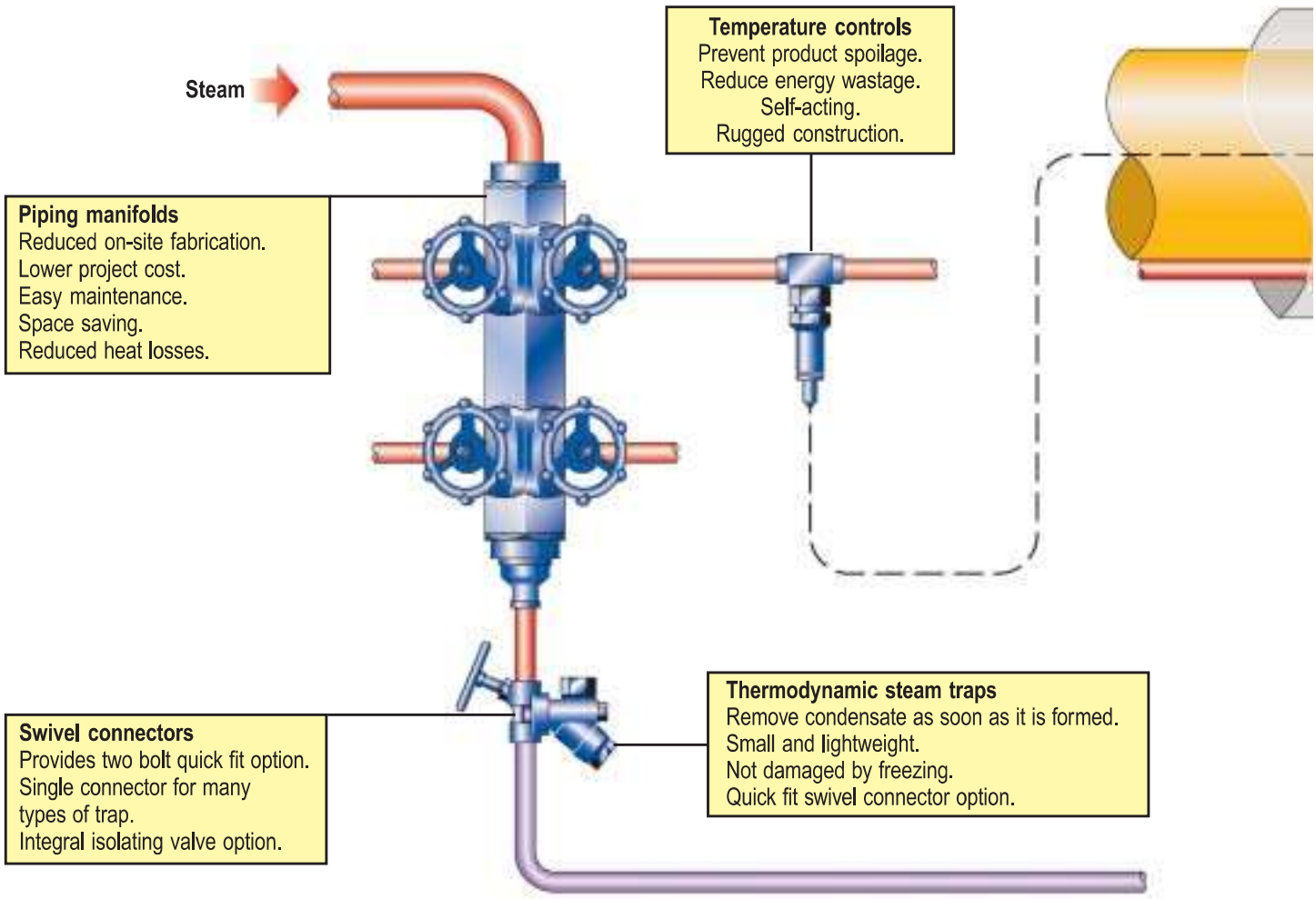
spirax sarco

Spirax Sarco steam tracing systems

An efficient and reliable trace heating system is a vital component of the modern process plant. Its use ensures that optimum pumping viscosity is maintained, product solidification or spoilage does not occur and damage from adverse ambient conditions is avoided.

No other form of trace heating offers the all round benefits of steam in terms of efficiency, low operating costs, controllability, flexibility and above all, safety.

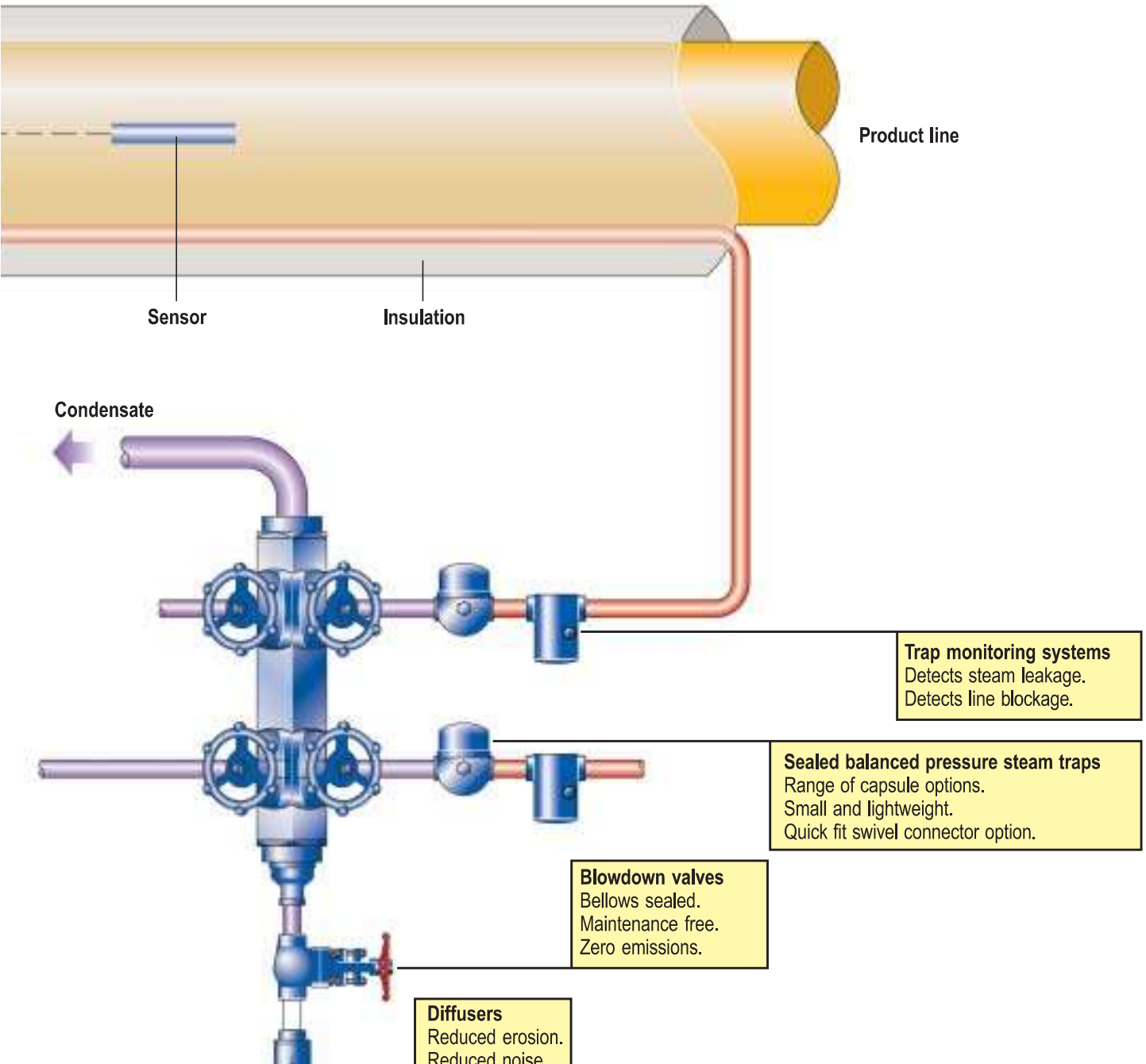
Spirax Sarco tracing system for critical application



Spirax Sarco has provided knowledge, service and products for the control and efficient use of steam in tracing systems for over 85 years. We have a wealth of experience in its use in all industries and can

The advantages of steam trace heating are acknowledged by experienced piping engineers and plant operators worldwide:

Efficiency:	Steam is the most efficient carrier of heat energy. Often, steam tracing systems can use excess process steam that would otherwise go to waste.
Controllability:	Precise product temperatures can be maintained and tracing can be turned on and off automatically to suit ambient conditions. Empty product lines can be pre-heated or steam cleaned without any problem. Increased heat demand because of insulation degradation is automatically catered for.
Reliability:	Steam tracing systems are extremely rugged. Their operation is not affected by adverse conditions and they easily withstand the normal day to day knocks that occur in a process plant.
Flexibility:	Steam tracer outputs are easily adjusted without the need to change the installation. Systems are easily extended.
Safety:	Steam is inherently safe and suitable for use in all zones. It is the only totally 'no risk' solution to tracing applications.
Economic:	Steam tracing is very simple in its concept. It is easy to design and install and uses simple mechanical components that require no external power source.



The need for steam tracing

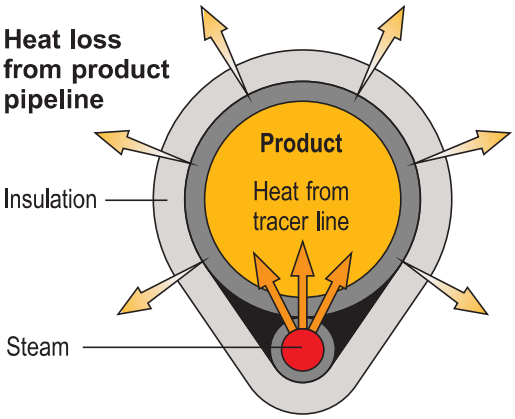
Steam tracing is very simple in its principle of operation. When a product in a pipeline is at a higher temperature than the air surrounding it, heat will pass through the wall of the pipeline from the product to the surrounding air.

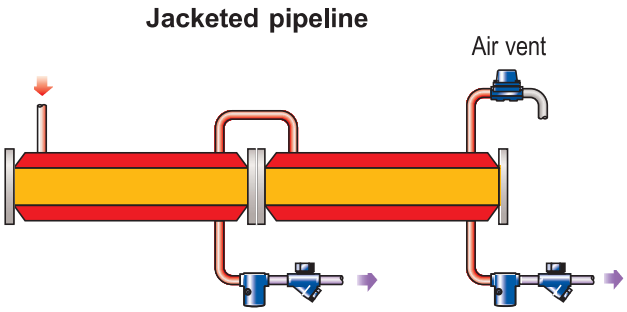
This heat loss will cause the temperature of the product to fall. Insulating the pipeline will significantly lower the rate at which heat is lost, but unfortunately, no insulation is 100% efficient.

Steam is a very efficient carrier of heat with a fixed relationship between its pressure and temperature. It can transport heat over long distances and gives up its heat at a constant temperature.

To make up the heat lost from the product pipeline, small bore steam pipes, or tracers, are attached to the product line. Heat from the steam passes into the product line and replaces the heat lost.

The amount of heat transferred, and therefore the product temperature, can easily be controlled by simple self-acting control systems. The same type of control can also be used in winterization applications, only allowing steam into the tracing line when the ambient temperature falls below a predetermined level.

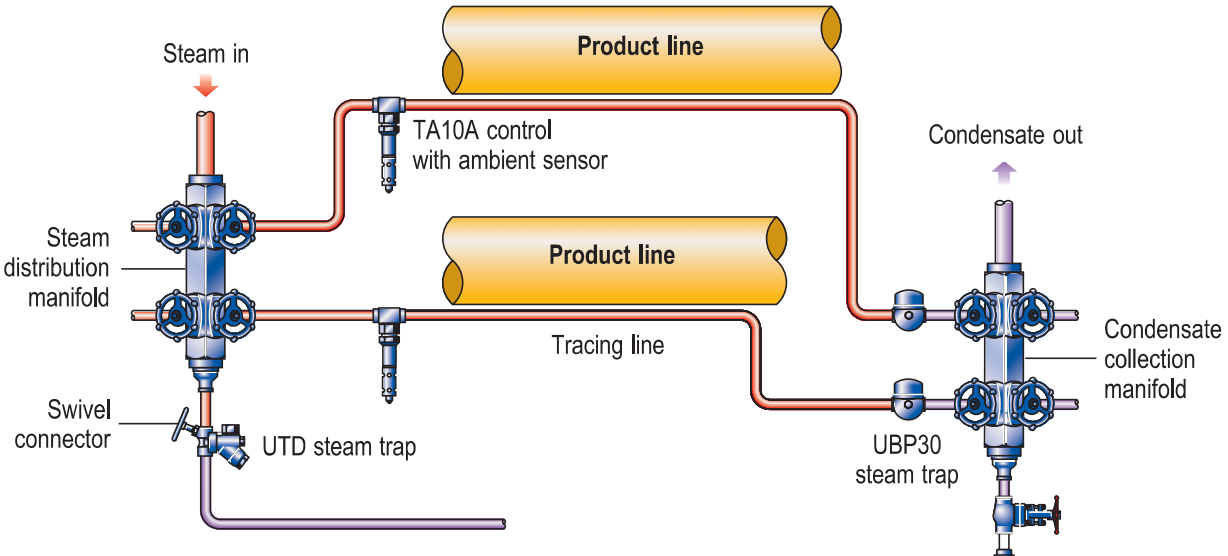




Types of steam heat tracing

We, at Spirax Sarco, are able to provide our customers with advice and products for all types of steam tracing from simple winterization to critical jacketed applications.

- **Jacketed** - used in ultra-critical applications, usually where a product temperature has to be maintained at an elevated temperature all of the time. The use of a steam jacket also allows quick pre-heating of the pipeline.
- **Critical** - here, steam tracing is used to maintain the temperature of a product that will solidify or spoil should its temperature fall below a predetermined level.
- **Non-critical** - tracing is used to maintain the product viscosity at its optimum pumping level.
- **Winterization** - to ensure pipelines are not damaged due to freezing in adverse weather conditions.
- **Instrument** - small bore steam tracing pipes, normally 10 mm, used to protect flowmeters, control valves, sampling stations, impulse lines etc.



Determining tracer requirements

To select the size and number of steam tracing lines required for a particular application, the rate of heat loss from the product pipeline under worst design conditions must be determined.

This rate of heat loss is dependant upon the difference between the product temperature and the ambient temperature. Other factors such as the thermal conductivity of the insulation, ambient wind speed and the emissivity of the insulation surface will affect this rate of loss.

Table 1 provides heat loss figures for insulated product pipelines up to 500 mm diameter with alternative figures for both 50 mm and 100 mm thickness insulation.

The Table gives rates for an average wind speed of 10 m/s which will be suitable for most applications.

Once the heat loss per metre from the insulated product pipeline is determined from Table 1, a suitable steam tracing line can be selected from Table 2. In some cases, multiple tracing lines fitted in parallel may be required.

Table 2 gives practical heat transfer rates from a steam tracing line into a product line. They already take into account losses from the tracing line to the surrounding air through the insulation.

The use of heat transfer cement as a fillet between the tracer and the product line will increase the rates shown in Table 2 by a factor of at least 2. It will also prevent hot spots and uneven heating.

Table 1 Heat loss from insulated process pipes - W/m

	Process pipeline diameter													
	100 mm		150 mm		200 mm		250 mm		300 mm		400 mm		500 mm	
Insulation thickness	50 mm	100 mm	50 mm	100 mm	50 mm	100 mm	50 mm	100 mm	50 mm	100 mm	50 mm	100 mm	50 mm	100 mm
Product / ambient Temperature difference °C 25	14	9	20	12	24	14	29	16	33	18	41	23	51	28
75	43	26	59	35	72	41	87	49	101	56	123	68	151	82
100	58	36	77	46	97	55	116	66	135	75	164	91	201	109
125	71	45	97	58	120	70	145	82	168	94	206	113	252	136
150	86	54	116	69	144	84	174	99	201	113	246	136	301	163
175	100	62	136	81	168	98	202	115	235	131	288	158	352	191
200	115	71	155	92	192	112	231	131	268	151	329	181	403	217

Note: 0.05 W/m K thermal conductivity insulation with a medium to low emissivity cladding

Table 2 Output from steam tracing lines - W/m

	Steel (NB)								Copper (OD)							
Steam pressure	3 bar g		5 bar g		7 bar g		9 bar g		3 bar g		5 bar g		7 bar g		9 bar g	
Tracer Dia.	15 mm	20 mm	15 mm	20 mm	15 mm	20 mm	15 mm	20 mm	15 mm	20 mm	15 mm	20 mm	15 mm	20 mm	15 mm	20 mm
Product temperature °C 10	113	145	125	161	135	174	143	184	80	107	89	119	96	129	102	135
50	79	101	92	118	101	130	109	141	56	75	65	87	72	97	78	104
75	58	74	71	91	80	103	88	114	41	55	50	67	57	77	63	84
100	37	47	50	64	59	76	67	86	26	35	35	47	42	56	48	64
150	-	-	8	10	17	22	25	32	-	-	5	7	12	16	18	24

Calculating steam demand

To calculate actual steam demand, the following simple formulae can be used:-

Total steam demand

$$\dot{m} = \frac{\dot{Q} \times L \times 3.6}{h_{fg}}$$

Individual tracer steam demand

$$\dot{m} = \frac{\dot{Q} \times L \times 3.6}{h_{fg} \times n}$$

$\dot{m}$ = Steam demand (kg/h)
$\dot{Q}$ = Heat loss from Table 1 (W/m)
L = Length of traced product pipeline (m)
h_{fg} = Specific enthalpy of evaporation (kJ/kg)
3 bar g = 2 133 kJ/kg
5 bar g = 2 086 kJ/kg
7 bar g = 2 048 kJ/kg
9 bar g = 2 015 kJ/kg

Determining tracer requirements example

A temperature of 100°C in a 300 mm line needs to be maintained. The minimum design ambient temperature is -15°C, steam pressure is 5 bar g and the line is 200 m long. The product line has 100 mm thick insulation with aluminium low emissivity cladding. Steam tracing lines will be steel, fitted in 50 metre lengths.

Step 1 - Determine heat loss from product line

1.1 Temperature difference between product and ambient air = 100°C - (-15°C) = 115°C.
1.2 From Table 1, next temperature difference line (left scale) above 115°C is 125°C.
1.3 Follow 125°C temperature difference line across table until the figure for 300 mm pipe with 100 mm thick insulation is reached.
1.4 Read off heat loss figure - 94 W/m

Step 2 - Select suitable tracer(s)

2.1 From Table 2, select the 100°C product temperature line from the left scale.
2.2 Follow the line across and read the tracer outputs from the 5 bar g column in the steel tracer section.
15 mm NB tracer = 50 W/m output
20 mm NB tracer = 64 W/m output
In this instance two 15 mm NB tracers fitted in parallel will be selected to provide the 94 W/m required to make up the heat losses from the product line. Note that if heat transfer cement were used, only one 15 mm NB tracer line would be required.

Step 3 - Calculate steam demand

3.1 Total steam demand

$$\frac{94\ \text{W/m} \times 200\ \text{m} \times 3.6}{2\,086\ \text{kJ/kg}} = 32\ \text{kg/h}$$

3.2 Individual tracer steam demand

$$\frac{94\ \text{W/m} \times 50\ \text{m} \times 3.6}{2\,086\ \text{kJ/kg} \times 2} = 4\ \text{kg/h}$$

Spirax Sarco steam tracing products

Spirax Sarco manufacture a range of high quality products for steam tracing systems. For assistance and advice on the most suitable components for your tracing system please contact your local Spirax Sarco company.

Swivel connector steam traps ▶

Spirax Sarco manufacture a complete range of lightweight, stainless steel steam traps for tracing applications. Their rugged design ensures reliable operation under all operating conditions.
If necessary, swivel connector steam traps can be replaced very quickly without the need to break into the tracing line.

◀ Steam distribution and condensate collection manifolds

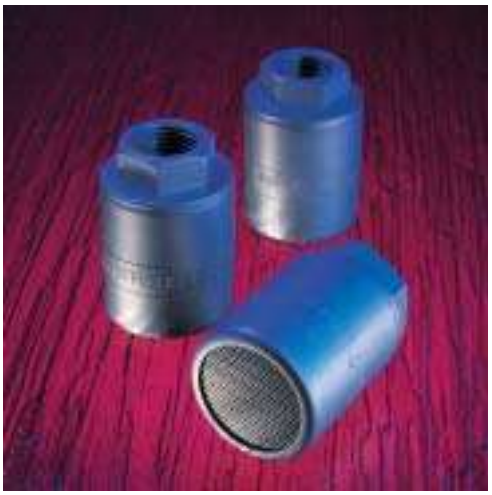
Space saving forged manifolds with integral piston valves eliminate the need for on site fabrication and testing.
Available in a number of configurations, all with pre-drilled mounting points.
Mounting kits and insulating jackets are available to further

◀ Self-acting temperature controls

Simple, reliable, self-contained temperature control systems that are intrinsically safe and require no external power source.
The TA10 control range, designed specifically for tracing applications, is manufactured from stainless steel and incorporate a bellows sealed valve arrangement.

Steam trap monitoring ▶

Spiratec provides a simple and accurate method of monitoring steam trap performance under operating conditions.
It will help save energy by reporting steam traps which have failed open and protect critical tracing applications by reporting steam traps which have failed closed.



◀ Diffusers

Fitted to the outlet of steam traps or blowdown valves discharging to atmosphere, the Spirax Sarco diffuser greatly reduces the problem of noise and erosion.
At 1 metre the sound pressure level will be reduced by 80%.

Bellows sealed stop valves ▶

The bellows sealed stop valve is a zero emissions valve providing long valve life with no maintenance.
This robust valve is unaffected by vibration and will operate over a wide range of pressures and temperatures.

◀ Pilot operated pressure reducing valves

A wide range of pressure reducing valves are available for applications where steam pressure needs to be reduced.
Spirax Sarco pilot operated pressure reducing valves will provide accurate control of secondary pressure where tracer temperature needs to be constant or must not exceed a predetermined level.

A partnership with Spirax Sarco provides knowledge, service and products worldwide for the control and efficient use of steam and other industrial fluids.

- **Worldwide support from a team of 3 900 dedicated employees.**
- **Local access to Spirax Sarco's expertise and products through 39 group companies in 32 countries.**
- **Valuable information, advice and interchange of ideas from customer training courses held in any of our 31 training centres worldwide.**
- **A comprehensive range of the highest quality products.**

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If you have difficulty finding a local contact please contact us at the number shown below.

Our comprehensive product range includes:

- **Boiler controls**
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- **Pneumatically and electronically actuated control valves**
- **Pressure reducing valves**
- **Self-acting temperature control valves**
- **Programmable electronic controllers**
- **Pneumatic transmitter controllers**
- **Safety valves**
- **Steam traps**
- **Steam trap monitoring systems**
- **Condensate pumps**
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- **Separators**
- **Strainers**
- **Stop valves**
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Spirax-Sarco Limited, Charlton House,
Cheltenham, Gloucestershire, GL53 8ER UK.
Tel: +44 (0)1242 521361 Fax: +44 (0)1242 573342
E-mail: Enquiries@SpiraxSarco.com
Internet: www.SpiraxSarco.com

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