

TVA flowmeter

for saturated steam flow measurement



The innovative TVA steam flowmeter



Designed for steam by the steam experts...

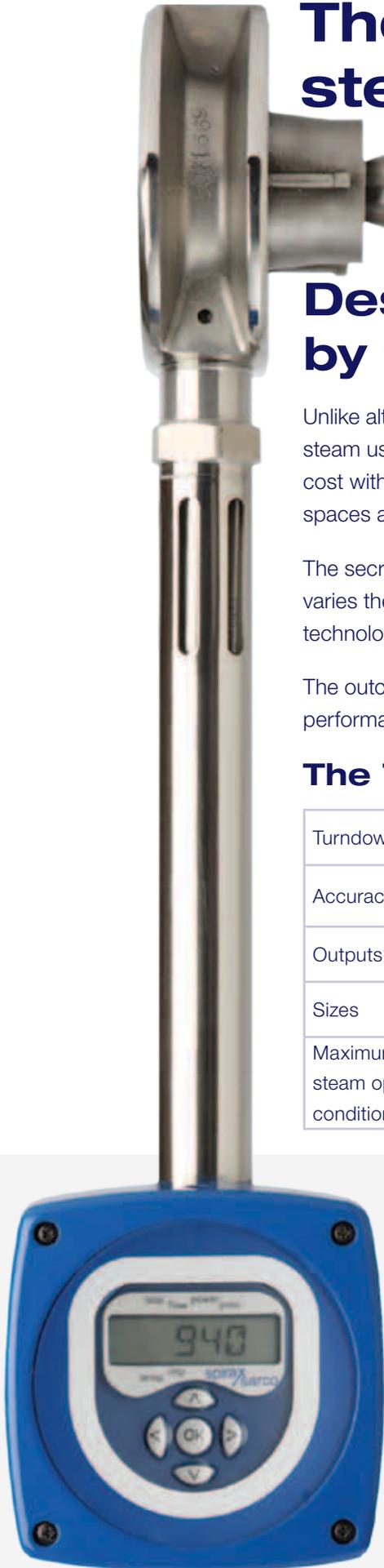
Unlike alternative technologies the TVA measures the complete flow range capturing all steam used. There is no need for multiple pipe entries making installation quicker, lower cost with fewer potential leak paths. The TVA can be installed in most confined spaces as it doesn't require long lengths of uninterrupted pipe to ensure accuracy.

The secret lies in the use of a specially profiled cone that conditions the steam flow and varies the flow area so that it continues to measure at low flowrates where other technologies fail.

The outcome is an innovative steam flowmeter with an unrivalled combination of high performance and low total cost of ownership.

The TVA range at a glance

Turndown	50:1
Accuracy	± 2% measured value from 10% to 100% maximum flowrate ± 0.2% FSD, from 2% to 10% maximum flowrate
Outputs	4-20 mA, pulse, RS232 Modbus
Sizes	DN50, DN80 and DN100
Maximum steam operating conditions	Horizontal 464 psig @ 462°F (32 bar g @ 239°C) Vertical 101 psig @ 338°F (7 bar g @ 170°C)



The innovative TVA steam flowmeter

- Simple to install in confined spaces
- Measures the complete steam flow range
- Designed for steam by steam experts
- High performance with low total cost of ownership
- Easy to use

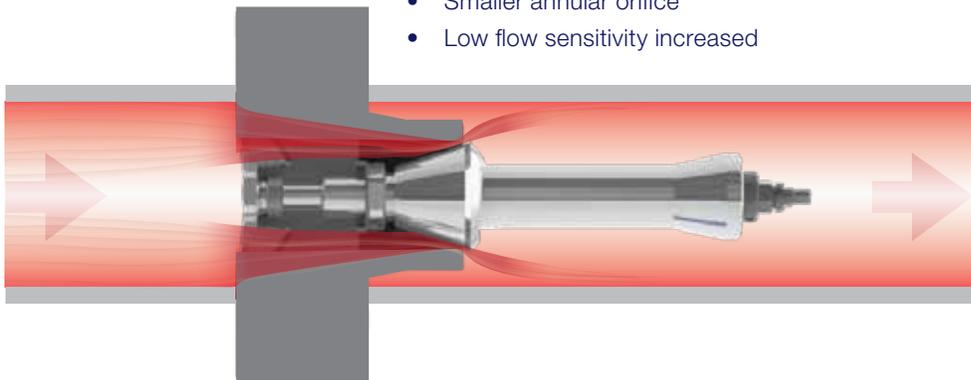
How the TVA works

As flow increases, the cone moves to open an annular orifice and produce a bending moment on an internal sensing beam...

Steam flow causes the profiled cone to move axially against the resistance of a spring held by a measurement beam. As flow increases, the cone moves to open an annular orifice and produces a bending moment on the beam. This force, together with a temperature measurement from an internal sensor at the beam tip, are fed to the integral electronics head to calculate and display flowrate, total flow, power, temperature, pressure and energy. The unique design creates a near-linear relationship between flowrate and output, making it possible to measure both high and low flows accurately.

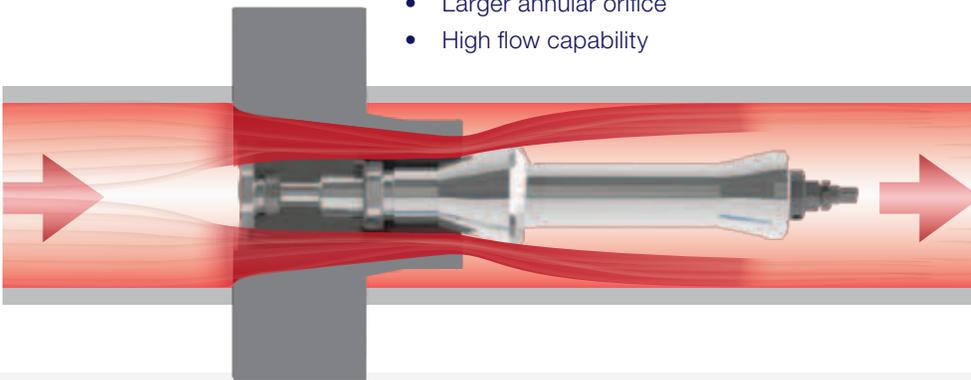
Low flow

- Cone retracts
- Smaller annular orifice
- Low flow sensitivity increased



High flow

- Cone extends
- Larger annular orifice
- High flow capability



The innovative moving cone design not only provides exceptional flow range capability, it reshapes the flow profile to allow installation with short pipe runs.

Its large surface area disperses the high impact energy of wet steam, making it very resistant to erosion and reliable in the long-term.

Once calibrated the TVA rarely needs adjusting.

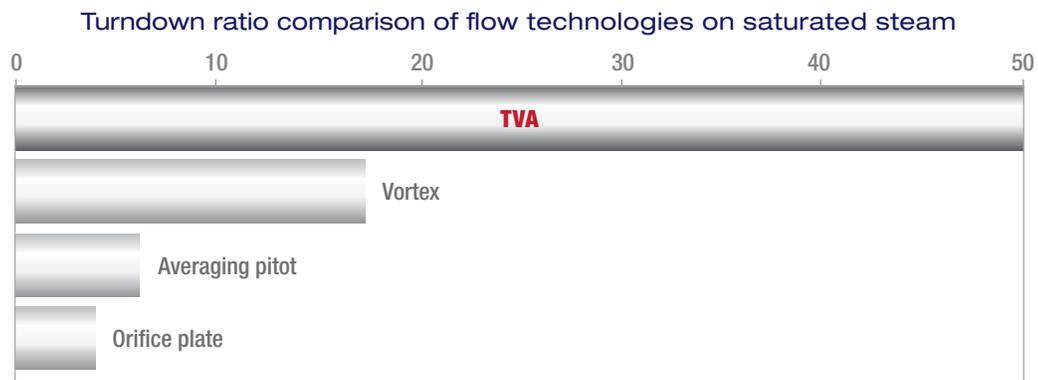
TVA measures all your energy

Energy savings from targeting and monitoring initiatives require accurate measurement across the minimum and maximum steam flowrate...

Steam applications often have widely fluctuating loads due to seasonal or process variation. Measuring steam under these conditions presents two distinct challenges. The first is having the ability to measure at both the minimum and maximum flowrates. The second is compensating for the changes in steam density. For some technologies these are challenges that are beyond them or can only be overcome at great cost.

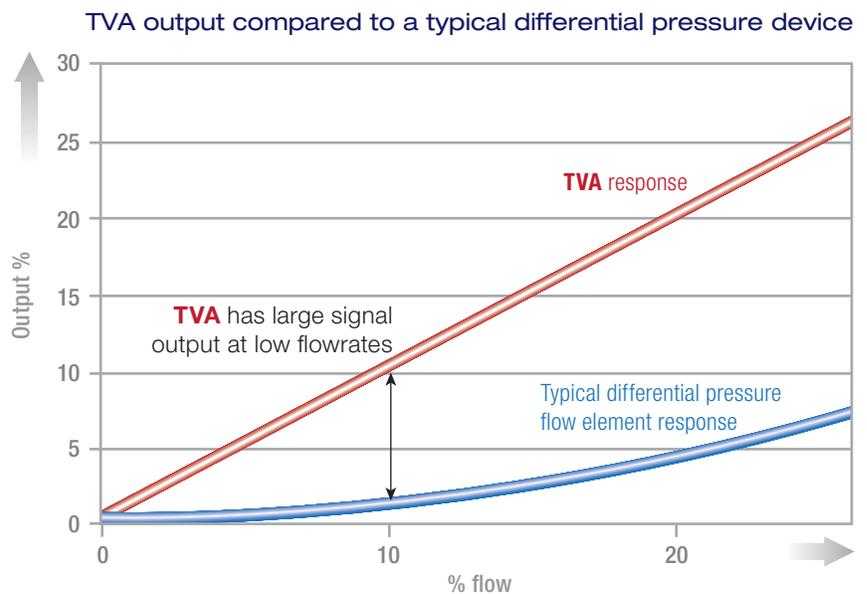
The TVA is uniquely designed to meet these challenges in a single integral flowmeter.

Challenge 1 - Measuring both minimum and maximum flowrates (turndown)



For many technologies their low flow measuring capability is a problem due to a drop off in signal. Differential pressure devices have a square root relationship with flowrate so their signal decays quickly. Additionally, vortex devices can't generate sufficient eddies at low flow and cease to measure. Consequently, steam can continue to be consumed but goes unmeasured.

The TVA outperforms these devices as it generates a large output signal and continues to measure where other technologies can't.



The near linear flow response of the TVA allows accurate and repeatable measurement over a wide flow range turndown of 50:1, consequently all energy is measured.

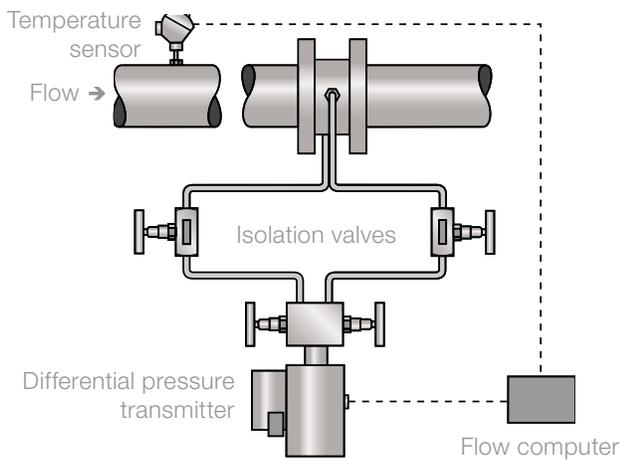
Challenge 2 – Compensating for steam density changes

Steam density alters with pressure changes caused by varying process loads. This can significantly affect the accuracy of the measured flow results. An uncompensated volumetric steam flowmeter calibrated to operate at 70 psig will over-read by 12.6% when used at 60 psig.

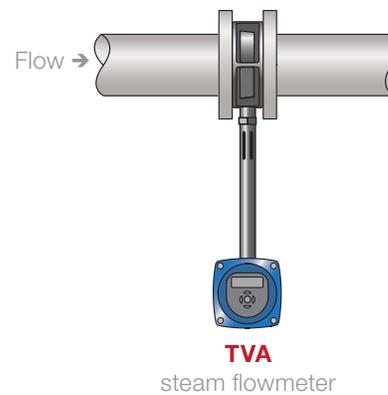
How saturated steam temperature and density change with pressure		
Steam pressure (psig)	Steam temperature (°F)	Density (lb/ft ³)
145	363	0.3523
70	316	0.1929
60	307	0.1713

} 12.6%

Traditional flowmetering system



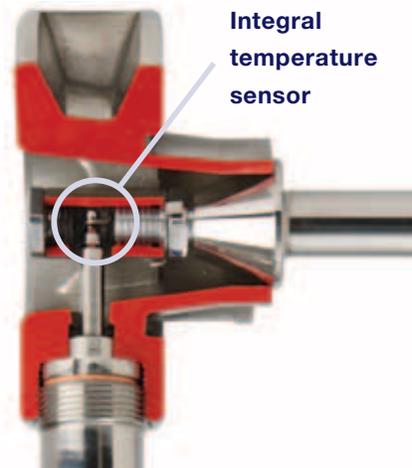
TVA flowmetering system



Flowmeters that require an external temperature or pressure sensor are expensive.

The TVA has an internal temperature sensor at the point of flow measurement which provides valuable advantages:

- No additional wiring and pipe entries, for simpler and lower cost installation with fewer leakage points.
- No additional pipe entries.
- Saturated steam flow measured directly in mass flow units.
- Higher performance through optimum positioning of the integral, fast response temperature sensor.



The integral density compensation of the TVA assures high performance under varying process conditions.

Easy, low cost installation and commissioning

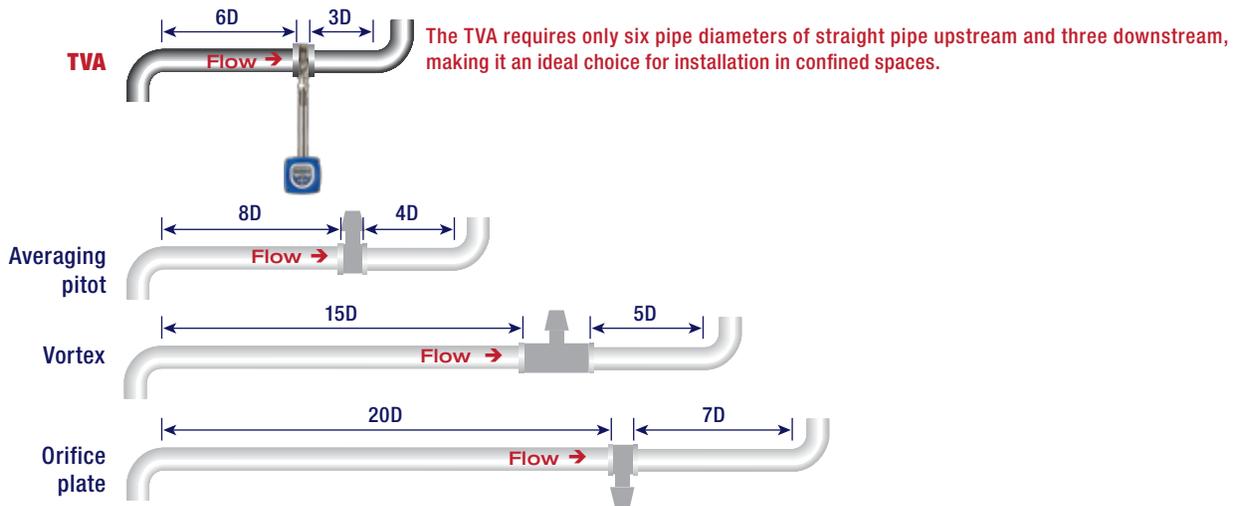
The integrated electronics of the TVA provide a single point of pipe entry, making installation easier, faster and lower cost...

Where should the flowmeter be located? The most convenient place for obtaining the flow data may not provide accurate measurement because of the flow conditions, usually due to the proximity of pipe bends or other equipment.

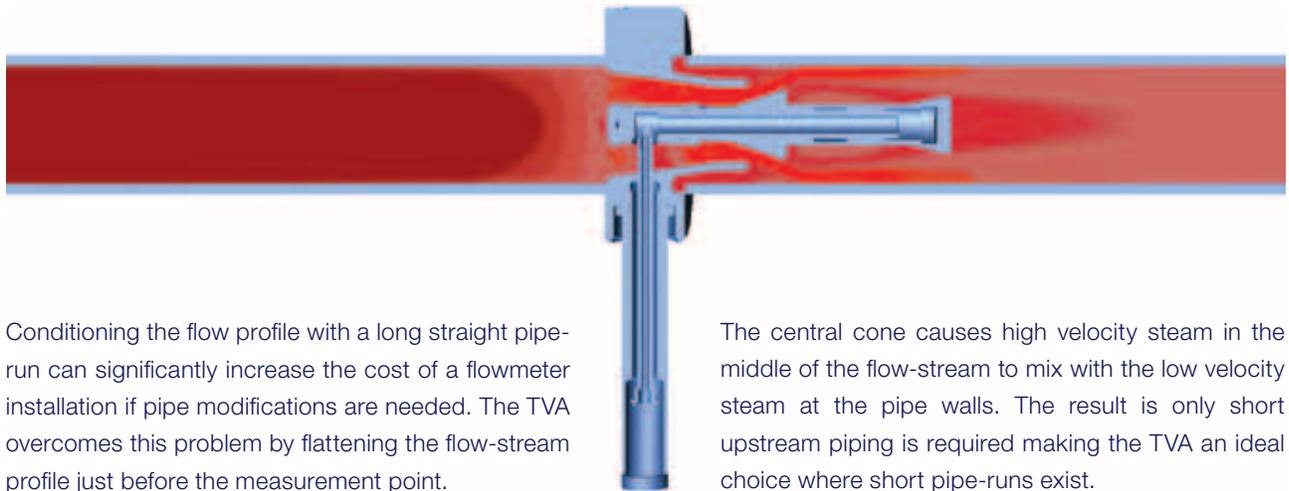
To provide accurate measurement and performance the profile of the flow-stream should be undisturbed as it enters and leaves the flowmeter. This is done by installing a minimum length of straight pipe upstream and downstream, the precise length of which depends on the technology employed.

Comparison of pipe requirements for different flow technologies on saturated steam

D = Pipe diameter



Conditioning the steam flow to reduce pipework changes



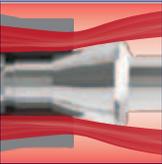
Conditioning the flow profile with a long straight pipe-run can significantly increase the cost of a flowmeter installation if pipe modifications are needed. The TVA overcomes this problem by flattening the flow-stream profile just before the measurement point.

The central cone causes high velocity steam in the middle of the flow-stream to mix with the low velocity steam at the pipe walls. The result is only short upstream piping is required making the TVA an ideal choice where short pipe-runs exist.

Installation and commissioning are made easy with a choice of outputs and intuitive menu driven LCD display / keypad.

Expensive communicators are not required.

Summary of key features and benefits

Key features	Key reasons	Key benefits
	<p>High accuracy</p> <p>Profiled cone produces linear signal output for high turndown.</p> <p>In-line density compensation.</p>	<p>Measures all your steam consumption and ensures better data for targeting energy savings.</p>
	<p>Quick and easy installation</p> <p>Integrated electronics gives a single point of pipe entry.</p> <p>Flow-stream is automatically conditioned by the cone, consequently no long lengths of straight pipe are required.</p>	<p>Reduces the cost of installation and valuable plant downtime.</p>
	<p>Easily integrated with a host control system</p> <p>Choice of digital ModBus, 4-20 mA and pulse outputs.</p>	<p>An easy addition to your monitoring and reporting system.</p>
	<p>Easy to commission</p> <p>A local LCD display and keypad, with intuitive menu, allow all parameters to be fully configured and displayed.</p>	<p>Quick to commission, reducing commissioning costs and valuable plant downtime.</p>
	<p>Long operating life</p> <p>Designed for steam by steam experts.</p> <p>Large profiled cone area with no sharp edges consequently the high impact energy of steam is dispersed.</p> <p>Once calibrated, the TVA rarely needs to be adjusted.</p>	<p>Set and forget.</p>
	<p>Unrivalled performance and low cost of ownership.</p> <p>High accuracy.</p> <p>Quick and easy installation and commissioning.</p> <p>Long operating life.</p>	<p>Larger profits for you.</p>



Would you like help with your flowmeter application?

The TVA is one of many flowmeter technologies available from Spirax Sarco. Why not let one of our engineers help you size and specify the best flowmeter for your application?

Alternatively, for further details of Spirax Sarco flowmeter products visit our website www.spiraxsarco.com/us

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TVA Flowmeter for Saturated Steam Service

Description

The Spirax Sarco TVA flowmeter is designed for use on saturated steam only and operates on the target principle, by measuring the force produced on a moving cone by the fluid flow. This strain is then converted into density compensated mass flowrate and is transmitted via a single loop powered 4-20 mA and pulsed output. TVA flowmeters also incorporate a totalised flow function and RS 232 Modbus communications.

Sizes and pipe connections

2", 3" and 4"

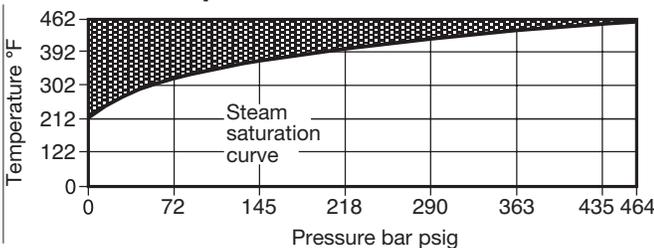
The TVA flowmeter is of wafer design, suitable for fitting between the following flanges: ASME (ANSI) B 16.5 Class 150 and Class 300

Note:

The Spirax Sarco TVA flowmeter should be installed in pipework manufactured to BS 1600 or ASME (ANSI) / ASME B 36.10 Schedule 40.

For systems with different standards/schedules, spool pieces manufactured from BS 1600 or ASME (ANSI) / ASME B 36.10 Schedule 40 pipe should be used. If this is not possible, please contact Spirax Sarco.

Pressure/temperature limits

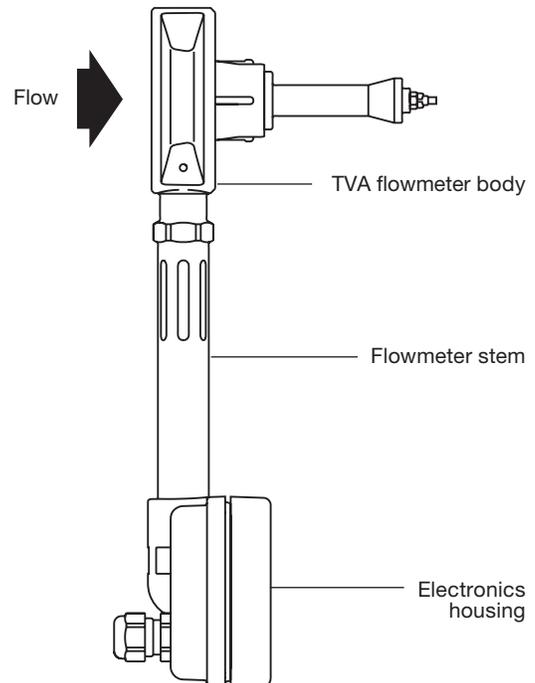


The product should not be used in this region due to software limitations.

Maximum design pressure	464 psig @ 462°F
Maximum design temperature	462°F
Minimum design temperature	32°F
Maximum operating pressure	Horizontal flow 464 psig @ 462°F Vertical flow 101 psig @ 338 F
Minimum operating pressure	9 psig
Maximum operating temperature (saturation)	462°F
Minimum operating temperature	32°F
Note: For lower operating temperatures consult Spirax Sarco	
Maximum electronics ambient temperature	131°F
Maximum electronics humidity level	90% RH (non-condensing)
Designed for a maximum cold hydraulic test pressure of	754 psig

Materials

Flowmeter body	Stainless steel S.316 1.4408 CF8M
Internals	431 S29/S303/S304/S316
Spring	Inconel X750 or equivalent
Flowmeter stem	Stainless steel 300 series
Electronics housing	Aluminium LM25



Technical data

IP rating	IP65 with correct cable glands
Power supply	Loop powered nominal 24 Vdc
Outputs	4 - 20 mA (proportional to mass flow) Pulsed output (V_{max} 28 Vdc R_{min} 10 kΩ)
Communication port	Modbus EIA 232C (RS 232)

Performance

The TVA flowmeter has inbuilt electronics which give a density compensated output. An LCD display is incorporated within the electronics head. The M750 display unit can be used to provide a remote display function if required, utilising the 4 - 20 mA output.

System uncertainty, to 95% confidence (2 STD): (in accordance with ISO 17025)

±2% of measured value from 10% to 100% of maximum rated flow.
±0.2% FSD, from 2% to 10% of maximum rated flow.

Turndown : up to 50:1

As the TVA flowmeter is a self contained unit, the uncertainty quoted is for the complete system. Many flowmeters claim a pipeline unit uncertainty and for a true system uncertainty, the individual uncertainty values of any associated equipment, such as DP cells, need to be added to the pipeline value.

Pressure drop

The pressure drop across the TVA is nominally 300 ins water gauge at maximum rated flow for the 2", and 200 inches water gauge for the 3" and 4".

Local regulation may restrict the use of this product below the conditions quoted. Limiting conditions refer to standard connections only.

In the interests of development and improvement of the product, we reserve the right to change the specification.

TI-P337-50-US 04.11

TVA

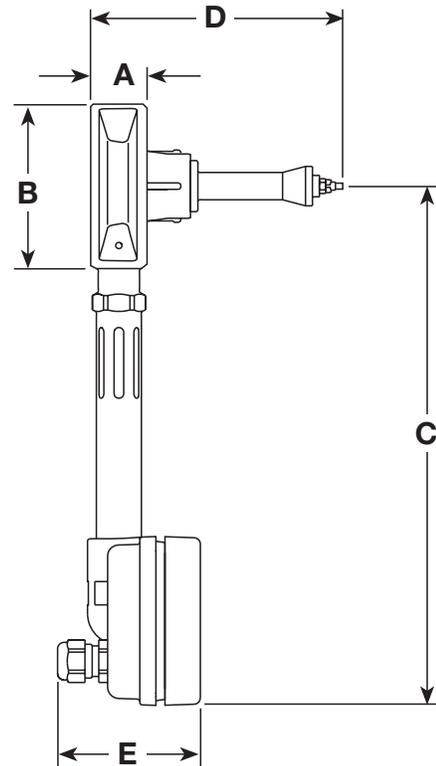
Flowmeter for Saturated Steam Service

Dimensions/weights (approximate) in inches and pounds

Size	A	B	C	D	E	Weight
2"	1.4	4.1	12.7	6.3	2.6	5.9
3"	1.8	5.4	13.1	6.3	2.6	9.7
4"	2.4	6.4	13.5	8.5	2.6	16.0

TVA flowmeter flow capacities and pressure drops

Flowmeter Type	Maximum QE US gal/min	Maximum DP Wg
2"	80	300
3"	203	200
4"	317	200



Sizing the TVA flowmeter for saturated steam (lb/hr)

(Horizontal orientation)

Maximum flowrates in lb/hr at different pressures (psig).

Notes:

- 1 - Maximum steam flowrates are calculated at maximum differential pressure.
- 2 - For vertical capacities please contact Spirax Sarco.
- 3 - The table below is a guide only.

Size	Steam pressure psig	15	44	73	102	145	174	218	290	363	435	464	psig
2"	Maximum flow	1,365	1,894	2,297	2,637	3,075	3,336	3,695	4,228	4,707	5,148	5,311	lb/hr
	Minimum flow	26	37	46	53	62	66	73	84	95	104	132	lb/hr
3"	Maximum flow	3,501	4,859	5,895	6,768	7,895	8,565	9,482	10,851	12,081	13,215	13,633	lb/hr
	Minimum flow	71	97	117	134	159	172	190	216	243	265	284	lb/hr
4"	Maximum flow	5,456	7,573	9,187	10,547	12,304	13,347	14,778	16,912	18,827	20,593	21,246	lb/hr
	Minimum flow	108	152	183	212	247	267	295	337	377	412	425	lb/hr

Safety information, installation and maintenance

For full details see the Installation and Maintenance Instructions (IM-P337-51 and IM-P337-52) supplied with the product.

The following main points are given for guidance only:

1. The TVA flowmeter should be mounted with a minimum of 6 straight pipe diameters upstream and 3 downstream. No valves, fittings or cross sectional changes are permitted within these pipe lengths. Where an increase in nominal pipe diameter is required, upstream of the flowmeter, the length of straight pipe should be increased to 12 diameters. Similarly, where a Spirax Sarco TVA is installed downstream of two 90 degree bends in two planes, a pressure reducing valve or a partly open valve, 12 upstream pipe diameters should be allowed.
2. It is important that the internal upstream and downstream diameters of pipe are smooth. Ideally seamless pipes should be used and there should be no intrusive weld beads on the internal diameter. It is also recommended that slip-on flanges are used to avoid this.
3. Care should be taken to install the TVA flowmeter concentrically in the line. If this is not done, flow measurement errors may occur.
4. The TVA flowmeter can be installed in any orientation up to a line pressure of 101 psig.
5. As for all steam flowmetering installations, good basic steam engineering practices should be followed:
 - Correct line drainage through adequate trapping.
 - Good alignment and support of associated pipework.
 - Line size changes achieved by the use of eccentric reducers.
 - Do not lag (insulate) the TVA body or the mating flanges.

How to order

Example: 1 off Spirax Sarco 4" TVA flowmeter for installation between ASME (ANSI) B 16.5 Class 150 flanges for use on saturated steam at 145 psig - Maximum flow 12,304 lb/hr.

Note: For details of the optional remote display see the relevant Spirax Sarco M750 literature.

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