Steam Flow Meter Pressure and Temperature Correction

Corrects the reading of an orifice (DP) or vortex steam flow meter that runs away from its design pressure and temperature, using IAPWS-IF97 steam densities.

Method: IAPWS R7-97(2012) IF97; ISO 5167 (DP meters: mass flow proportional to the square root of density)

Input parameters

Unit system: SI

Parameter	Value	Unit
Meter reading (mass flow)	10,000	kg/h
Meter type	Differential pressure (orifice, nozzle, venturi)	
Design pressure (absolute)	10.500	bar
Design steam condition	Dry saturated	
Design temperature (superheated only)	250.00	°C
Actual pressure (absolute)	8.0000	bar
Actual steam condition	Dry saturated	
Actual temperature (superheated only)	250.00	°C

Calculated results

Parameter	Value	Unit
Corrected (true) steam flow	8,785.7	kg/h
Correction factor	0.87857	
Steam density at design	5.3907	kg/m³
Steam density actual	4.1610	kg/m³

Notes for this case

- Assumes the meter shows mass flow computed with the design density; a meter with live pressure and temperature compensation needs no correction.

Formula and method

$$k_{DP} = \sqrt{\frac{\rho_a}{\rho_d}} \qquad k_{vol} = \frac{\rho_a}{\rho_d} \qquad \dot{m} = k\,\dot{m}_i$$

Variables

$\dot{m}_i$	meter reading	kg/s
meter	differential pressure or volumetric	–
p_d	design pressure, absolute	Pa
state_d	design steam condition	–
T_d	design temperature	K
p_a	actual pressure, absolute	Pa
state_a	actual steam condition	–
T_a	actual temperature	K
$\dot{m}$	corrected steam flow	kg/s
k	correction factor	–
ρ_d	steam density at design	kg/m³
ρ_a	steam density actual	kg/m³

Method and standards

Differential-pressure meters follow √(Δp·ρ) (the principle of ISO 5167); volumetric meters measure volume, so mass scales with density. Steam densities from FireCAD's IAPWS-IF97.

Assumptions and limits

- Dry steam; the meter's other coefficients unchanged.
- Wet steam cannot be entered. A DP meter in wet steam reads high (the liquid adds to the differential), so applying only this density correction under-corrects; wet steam needs a two-phase meter correction and a known dryness fraction.

References

• IAPWS R7-97(2012) IF97
• ISO 5167 (DP meters: mass flow proportional to the square root of density)

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/instrumentation/flow/steam-meter-correction

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Reopens the calculator with the inputs of this report.