Flow Split between Parallel Tubes (Superheater Passes)

Flow in each of up to three parallel tubes between common headers from their bores, equivalent lengths and friction factors (equal pressure drop), Ganapathy Q3.25.

Method: Ganapathy; Steam Plant Calculations Manual; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Total flow	6,803.9	kg/h
Tube 1 inner diameter	50.800	mm
Tube 1 equivalent length	121.92	m
Tube 1 friction factor	0.019500	
Tube 2 inner diameter	44.450	mm
Tube 2 equivalent length	106.68	m
Tube 2 friction factor	0.020000	
Tube 3 inner diameter (0 = none)	50.800	mm
Tube 3 equivalent length	112.78	m
Tube 3 friction factor	0.019500	

Calculated results

Parameter	Value	Unit
Flow in tube 1	2,433.7	kg/h
Flow in tube 2	1,839.8	kg/h
Flow in tube 3	2,530.4	kg/h
Lowest flow relative to the mean	81.123	%

Notes for this case

- Check the metal temperature of the tube with the least flow.

Formula and method

$$\Delta p \propto \frac{fLW^2}{d^5} \Rightarrow W_i = W\frac{\sqrt{d_i^5/(f_i L_i)}}{\sum_j \sqrt{d_j^5/(f_j L_j)}}, \quad \frac{W_{min}}{\bar{W}} = \frac{n\,\min_i W_i}{W}$$

Variables

W	Total flow	kg/s
d_1	Tube 1 inner diameter	m
L_1	Tube 1 equivalent length	m
f_1	Tube 1 friction factor	-
d_2	Tube 2 inner diameter	m
L_2	Tube 2 equivalent length	m
f_2	Tube 2 friction factor	-
d_3	Tube 3 inner diameter (0 = none)	m
L_3	Tube 3 equivalent length	m
f_3	Tube 3 friction factor	-

W_1	Flow in tube 1	kg/s
W_2	Flow in tube 2	kg/s
W_3	Flow in tube 3	kg/s
$W_{min}/\bar{W}$	Lowest flow relative to the mean	-
n	number of tubes (2, or 3 when d_3 > 0)	-

Method and standards

Equal pressure drop in parallel passes.

Assumptions and limits

- Same fluid properties in all tubes; header pressure drop neglected. In a superheater the low-flow tube runs hotter, so its steam is lighter and its pressure drop per kg higher, which cuts its flow further: the split found here is optimistic for the worst tube.

References

- Ganapathy
- Steam Plant Calculations Manual
- 2nd ed. (Marcel Dekker, 1993)
- Q3.25 (flow in parallel passes of a superheater)
- Darcy pressure drop Δp ≈ f L W²/d⁵ at equal properties

Report details

Report reference	FCC-RB7P-13Z3 (the same inputs always give the same reference)
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Release checks	2 reference cases of this calculator, computed independently, are checked on every release

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

This calculator online

https://calc.firecad.com/boilers-power-plant/boiler-pressure-parts/parallel-tube-flow-split

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.