Fuel Oil Volume Flow at Temperature (Expansion)

Density and volume flow of fuel oil at a heated temperature from its specific gravity at 60 °F and the expansion factor by °API band (Ganapathy Table 3.8).

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Fuel oil flow	453.59	kg/h
Specific gravity at 60/60 °F	0.91000	
Oil temperature	75.560	°C

Calculated results

Parameter	Value	Unit
API gravity	23.995	
Expansion factor per °F (× 1.8 for per K)	4.0000e-04	
Density at 60 °F	909.09	kg/m³
Density at temperature	871.44	kg/m³
Volume flow at 60 °F	498.95	L/h
Volume flow at temperature	520.51	L/h

Notes for this case

- Meter and pump volumes at the heating temperature; burners are rated by mass or by volume at 60 °F.

Formula and method

$$v_t = v_{60}[1 + E(t-60)]\ (t \text{ in } °\text{F}), \quad °API = \frac{141.5}{SG} - 131.5, \quad \rho_{60} = 999.0\,SG, \quad \rho_t = \frac{\rho_{60}}{1 + E(t-60)}$$

Variables

W	Fuel oil flow	kg/s
SG	Specific gravity at 60/60 °F	-
t	Oil temperature	K
$°API$	API gravity	-
E	Expansion factor per °F (multiply by 1.8 for per K)	1/°F
ρ_{60}	Density at 60 °F	kg/m³
ρ_t	Density at temperature	kg/m³
$\dot{V}_{60}$	Volume flow at 60 °F	m³/s
$\dot{V}_t$	Volume flow at temperature	m³/s

Method and standards

Ganapathy's Eq. (23) with the expansion factor chosen by °API band from his Table 3.8 (not reproduced here). Water at 60 °F is taken as 999.0 kg/m³. The volume correction tables of ASTM D1250 / API MPMS 11.1 are not used.

Assumptions and limits

- Linear expansion with temperature and a constant factor per °API band, so the result steps slightly at the band edges.
- Outside the table's °API bands (below 0 or above 94 °API) the end-band factor is used and a note appears.

References

- Ganapathy
- Steam Plant Calculations Manual

- 2nd ed. (Marcel Dekker, 1993)
- Q3.21
- Eq. (23) and Table 3.8 (expansion factors for fuel oils)

Report details

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Calculator	Fuel Oil Volume Flow at Temperature (Expansion)
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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/combustion/fuel-oil-volume-at-temperature

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.