EPA Method 19 F-Factors from the Ultimate Analysis

Dry (Fd), wet (Fw) and carbon (Fc) F-factors of a fuel from its ultimate analysis and gross calorific value by US EPA Method 19 (volumes at 20 °C, 1 atm).

Method: US EPA 40 CFR Part 60 Appendix A-7; Method 19; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Carbon %	45.000	%
Hydrogen % (excluding moisture)	3.5000	%
Sulphur %	0.50000	%
Nitrogen %	1.0000	%
Oxygen % (excluding moisture)	5.0000	%
Moisture %	10.000	%
Gross calorific value (same basis)	17,000	kJ/kg

Calculated results

Parameter	Value	Unit
Dry F-factor (dscm per GJ)	293.22	
Wet F-factor (wscm per GJ)	325.66	
Carbon F-factor (scm CO_2 per GJ)	52.941	

Notes for this case

- Method 19 standard conditions are 20 °C and 760 mm Hg; convert before mixing with 0 °C normal volumes.

Formula and method

$$F_d = K\frac{22.7H + 9.57C + 3.54S + 0.86N - 2.85O}{GCV}, \quad F_w = K\frac{34.74H + 9.57C + 3.54S + 0.86N - 2.85O + 1.30\,H_2O}{GCV}, \quad F_c = K\frac{2.0C}{GCV}$$

Variables

C	Carbon %	-
H	Hydrogen % (excluding moisture)	-
S	Sulphur %	-
N	Nitrogen %	-
O	Oxygen % (excluding moisture)	-
H_2O	Moisture %	-
GCV	Gross calorific value (same basis)	J/kg
F_d	Dry F-factor (dscm per GJ)	-
F_w	Wet F-factor (wscm per GJ)	-
F_c	Carbon F-factor (scm CO_2 per GJ)	-
K	10^{-5} (kJ/J)/%, so that with GCV in kJ/kg the F-factor is in m^3/J; shown $\times 10^9$ per GJ	-

Method and standards

US EPA Method 19 (40 CFR Part 60 Appendix A-7), Eqs. 19-13 to 19-15 in metric form, at 20 °C and 760 mm Hg. The outputs are in m^3 per GJ in every unit system; for dscf/MMBtu divide by 0.02684.

Assumptions and limits

- Analysis and GCV on the same basis; hydrogen and oxygen exclude the moisture. The calculator cannot check the basis.
- The analysis must total no more than 100 %, contain some carbon or hydrogen, and give positive F-factors.

References

- US EPA 40 CFR Part 60 Appendix A-7
- Method 19
- Eqs. 19-13 to 19-15 (metric constants Khd 22.7, Kc 9.57, Ks 3.54, Kn 0.86, Ko 2.85, Khw 34.74, Kw 1.30, Kcc 2.0; $K = 10^{-5}$)

Report details

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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/epa-f-factors

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Reopens the calculator with the inputs of this report.