Sensible Heat Loss in Ash (Bottom and Fly Ash)

Boiler efficiency loss from the heat carried away by hot bottom ash and fly ash, from the ash content, split, temperatures and specific heat (ASME PTC 4).

Method: ASME PTC 4-2013 Fired Steam Generators (sensible heat of residue); BIS IS 8753 (boiler efficiency)

Input parameters

Unit system: SI

Parameter	Value	Unit
Ash in the fuel, as fired	35.000	%
Share of ash leaving as fly ash	80.000	%
Carbon in the residue	2.0000	%
Bottom ash temperature leaving the furnace	600.00	°C
Fly ash temperature (gas temperature leaving the boiler)	140.00	°C
Reference temperature ASME PTC 4 uses 25 °C.	25.000	°C
Mean specific heat of the residue FireCAD uses 0.2 Btu/(lb·°F) = 0.837 kJ/(kg·K) for coal and biomass ash; enter your own value if you have one.	0.83736	kJ/(kg·K)
Gross calorific value of the fuel, as fired	18,600	kJ/kg

Calculated results

Parameter	Value	Unit
Sensible heat loss in ash, % of heat input	0.33282	%
Of which in bottom ash	0.18490	%
Of which in fly ash	0.14792	%
Residue per kg of fuel	0.35714	kg/kg

Formula and method

$$m_r = \frac{A}{1 - c_r}$$

$$L_b = \frac{m_r \, (1 - x_f) \, c_{p,r} \, (T_b - T_{ref})}{GCV} \qquad L_f = \frac{m_r \, x_f \, c_{p,r} \, (T_f - T_{ref})}{GCV} \qquad L_{ash} = L_b + L_f$$

Variables

A	ash in fuel, as fired	–
x_f	share of ash leaving as fly ash	–
c_r	carbon in residue	–
T_b	bottom ash temperature leaving	K
T_f	fly ash temperature (flue gas leaving)	K
T_{ref}	reference temperature, 25 °C in PTC 4	K
$c_{p,r}$	mean specific heat of residue	J/(kg·K)
GCV	gross calorific value	J/kg
L_{ash}	sensible heat loss in ash	–
L_b	of which in bottom ash	–
L_f	of which in fly ash	–

m_r	residue per kg of fuel	kg/kg

Method and standards

Sensible heat of residue as in ASME PTC 4: residue mass times mean specific heat times its rise above the reference temperature, split into bottom ash and fly ash. The default specific heat is 0.2 Btu/(lb·°F) = 837 J/(kg·K) for coal and biomass ash (FireCAD practice, confirmed 2026-11-11).

Assumptions and limits

- One mean specific heat for both ash streams; ash temperatures below the reference are rejected.
- Fly ash leaves at the flue gas temperature.

References

• ASME PTC 4-2013 Fired Steam Generators (sensible heat of residue)
• BIS IS 8753 (boiler efficiency)

Report details

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Release checks	3 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/boilers/ash-sensible-heat-loss

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Reopens the calculator with the inputs of this report.