Mould Lifting Force, Cope Weighting and Core Buoyancy

Metallostatic force lifting the cope, minimum cope weight, net upthrust on a core and liquid contraction head loss in the feeder for a sand casting.

Input parameters

Unit system: SI

Parameter	Value	Unit
Density of the liquid metal	7,000.0	kg/m³
Metal head above the mould surface (to the top of the sprue)	250.00	mm
Projected area of the casting at the joint	0.60000	m²
Mass of the cope (sand and box)	400.00	kg
Volume of cores immersed in metal	20.000	L
Core density	1,500.0	kg/m³
Casting volume (liquid)	80.000	L
Superheat at pouring	100.00	K
Liquid shrinkage per 100 °C of superheat	1.6000	%
Cross-section of the feeder or sprue at the top	314.00	cm²

Calculated results

Parameter	Value	Unit
Force lifting the cope	10.297	kN
Minimum total mass on the mould, cope included	1,050.0	kg
Extra weights needed on the cope	650.00	kg
Net upthrust on the cores	1,078.7	N
Liquid contraction of the casting	1.2800	L
Fall of the liquid level in the feeder	40.764	mm

Notes for this case

• A flat cope surface gives the largest force; for other shapes use the projected area. Allow a margin above the minimum weight for the dynamic pressure at the end of pouring. Cores need chaplets, prints or wiring to resist the upthrust.

Formula and method

$$F = \rho g h A, \quad m_{min} = \rho h A, \quad F_{core} = (\rho - \rho_{core}) g V_{core}, \quad \Delta h = \frac{V_c \beta_L \Delta T_{sh}/100}{A_f}$$

Variables

ρ	Density of the liquid metal	kg/m³
h	Metal head above the mould surface (to the top of the sprue)	m
A	Projected area of the casting at the joint	m²
m_{cope}	Mass of the cope (sand and box)	kg
V_{core}	Volume of cores immersed in metal	m³
ρ_{core}	Core density	kg/m³
V_c	Casting volume (liquid)	m³
ΔT_{sh}	Superheat at pouring	K
β_L	Liquid shrinkage per 100 °C of superheat	-

A_f	Cross-section of the feeder or sprue at the top	m²
F	Force lifting the cope	N
m_{min}	Minimum total mass on the mould, cope included	kg
m_{add}	Extra weights needed on the cope	kg
F_{core}	Net upthrust on the cores	N
ΔV_L	Liquid contraction of the casting	m³
Δh	Fall of the liquid level in the feeder	m

Method and standards

Hydrostatics of the filled mould.

Assumptions and limits

- Rigid mould; static metal.

Report details

Report reference	FCC-GHKB-CJZT (the same inputs always give the same reference)
Generated	23 November 2026, 17:51 UTC
Calculator	Mould Lifting Force, Cope Weighting and Core Buoyancy
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
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/materials/steelmaking-foundry/mould-lifting-force-core-buoyancy

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.