Hydrogen and Nitrogen Solubility in Liquid Steel (Sieverts' Law)

Equilibrium hydrogen and nitrogen contents of liquid iron at a gas partial pressure and temperature, and the vacuum needed to reach target levels.

Input parameters

Unit system: SI

Parameter	Value	Unit
Melt temperature	1,600.0	°C
Hydrogen partial pressure	1.0000	atm
Nitrogen partial pressure	0.79000	atm
Target hydrogen	2.0000	ppm
Target nitrogen	40.000	ppm

Calculated results

Parameter	Value	Unit
Equilibrium hydrogen	25.625	ppm
Equilibrium nitrogen	405.93	ppm
Hydrogen constant (ppm/atm½)	25.625	
Nitrogen constant (ppm/atm½)	456.70	
H_2 pressure in equilibrium with the target hydrogen	6.1723	mbar
N_2 pressure in equilibrium with the target nitrogen	7.7726	mbar

Notes for this case

- Ideal (Sieverts) solubility in pure liquid iron; alloying elements change it through interaction coefficients. In practice hydrogen removal is limited by water vapour and the mass transfer in the degasser, and nitrogen removal is slow, especially at high sulphur.

Formula and method

$$\log\frac{[\text{ppm H}]}{p_{H_2}^{1/2}} = -\frac{1900}{T} + 2.423, \quad \log\frac{[\text{ppm N}]}{p_{N_2}^{1/2}} = -\frac{188}{T} + 2.760$$

Variables

T	Melt temperature	K
p_{H_2}	Hydrogen partial pressure	Pa
p_{N_2}	Nitrogen partial pressure	Pa
$[H]^*$	Target hydrogen	-
$[N]^*$	Target nitrogen	-
$[H]$	Equilibrium hydrogen	-
$[N]$	Equilibrium nitrogen	-
K_H	Hydrogen constant (ppm/atm½)	-
K_N	Nitrogen constant (ppm/atm½)	-
$p^*_{H_2}$	H_2 pressure in equilibrium with the target hydrogen	Pa
$p^*_{N_2}$	N_2 pressure in equilibrium with the target nitrogen	Pa

Method and standards

Sieverts' law with published solubility constants for liquid iron.

Assumptions and limits

- Pure iron; dilute solutions.

Report details

Report reference	FCC-JGDC-YWBW (the same inputs always give the same reference)
Generated	23 November 2026, 17:51 UTC
Calculator	Hydrogen and Nitrogen Solubility in Liquid Steel (Sieverts' Law)
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/steel-gas-solubility-sieverts

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.