Chromium and Nickel Equivalents (Schaeffler and WRC-1992)

Chromium and nickel equivalents of stainless weld metal by the Schaeffler and WRC-1992 formulas, the Cr/Ni ratio and the solidification mode.

Method: Schaeffler (1949) and WRC-1992 (Kotecki and Siewert) equivalent formulas; solidification-mode ratios from Lippold and Kotecki; Welding Metallurgy and Weldability of Stainless Steels (Wiley, 2005)

Input parameters

Unit system: SI

Parameter	Value	Unit
Chromium (wt %)	19.500	%
Molybdenum (wt %)	0.20000	%
Silicon (wt %)	0.40000	%
Niobium (wt %)	0	%
Nickel (wt %)	10.000	%
Carbon (wt %)	0.020000	%
Manganese (wt %)	1.8000	%
Nitrogen (wt %)	0.050000	%
Copper (wt %)	0.10000	%

Calculated results

Parameter	Value	Unit
Schaeffler Cr equivalent	20.300	
Schaeffler Ni equivalent	11.500	
WRC-1992 Cr equivalent	19.700	
WRC-1992 Ni equivalent	11.725	
WRC-1992 ratio	1.6802	
Solidification mode (0 A, 1 AF, 2 FA, 3 F)	2.0000	

Notes for this case

- Modes from the WRC-1992 ratio: A (fully austenitic, below 1.25) and AF risk hot cracking; FA (1.48–1.95) with a few per cent ferrite is the usual target for 308L/316L welds. Read ferrite number from the WRC-1992 diagram itself.

Formula and method

$$Cr_{eq} = Cr + Mo + 0.7Nb, \quad Ni_{eq} = Ni + 35C + 20N + 0.25Cu \ \text{(WRC}-1992\text{)}$$

$$Cr_{eq} = Cr + Mo + 1.5Si + 0.5Nb, \quad Ni_{eq} = Ni + 30C + 0.5Mn \ \text{(Schaeffler)}$$

Variables

Cr	Chromium (wt %)	-
Mo	Molybdenum (wt %)	-
Si	Silicon (wt %)	-
Nb	Niobium (wt %)	-
Ni	Nickel (wt %)	-
C	Carbon (wt %)	-
Mn	Manganese (wt %)	-
N	Nitrogen (wt %)	-

Cu	Copper (wt %)	-
$Cr_{eq,S}$	Schaeffler Cr equivalent	-
$Ni_{eq,S}$	Schaeffler Ni equivalent	-
$Cr_{eq,WRC}$	WRC-1992 Cr equivalent	-
$Ni_{eq,WRC}$	WRC-1992 Ni equivalent	-
Cr_{eq}/Ni_{eq}	WRC-1992 ratio	-
mode	Solidification mode (0 A, 1 AF, 2 FA, 3 F)	-

Method and standards

Equivalent formulas.

Assumptions and limits

- Weld metal compositions. The ferrite number is not computed: read it from the WRC-1992 diagram. The Schaeffler Ni equivalent leaves out nitrogen, so for high-nitrogen fillers the two methods can disagree.

References

- Schaeffler (1949) and WRC-1992 (Kotecki and Siewert) equivalent formulas; solidification-mode ratios from Lippold and Kotecki
- Welding Metallurgy and Weldability of Stainless Steels (Wiley, 2005)

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/materials/welding/chromium-nickel-equivalent

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Reopens the calculator with the inputs of this report.