

ISO/TR 22824:2024-12 (E)

Welding - Best practices for specification and measurement of ferrite in stainless steel weld metal

Contents		Page
Foreword		v
Introduction		vi
1	Scope	1
2	Normative references	1
3	Terms and definitions	1
4	Metallurgical phenomena of ferrite in stainless steel weld metal	2
4.1	General	2
4.2	Solidification mode	3
4.2.1	General	3
4.2.2	A solidification mode (austenitic)	3
4.2.3	AF solidification mode (primary austenite)	3
4.2.4	FA solidification mode (primary ferrite)	3
4.2.5	F solidification mode (ferritic)	4
4.2.6	Mixed solidification modes	4
4.3	Solid state phase transformation of ferrite to austenite	5
4.3.1	General	5
4.3.2	A solidification mode alloys	6
4.3.3	AF solidification mode alloys	6
4.3.4	FA solidification mode alloys	6
4.3.5	F solidification mode alloys	7
4.4	Constitution diagrams	7
4.5	Effects of welding conditions on ferrite	11
4.5.1	General	11
4.5.2	Welding conditions which affect chemical composition	12
4.5.3	Welding conditions which don't affect chemical composition	13
4.6	Alpha prime and intermetallic phase formation	13
4.7	Chromium nitrides and secondary austenite	14
4.8	Postweld heat treatment	14
5	Effects of ferrite variations on service performance of stainless steel weld metal	15
5.1	General	15
5.2	Tensile properties at ambient temperatures	16
5.3	Toughness	16
5.4	Resistance to chloride stress corrosion cracking (CSCC)	16
5.5	Susceptibility to corrosion in certain media	17
5.6	Creep resistance	17
6	Measurement of ferrite in stainless steel weld metal	18
6.1	General	18
6.2	Considerations in ferrite measurement	19
6.3	Metallographic percent ferrite by optical methods	19
6.4	Metallographic measurement of ferrite by EBSD	20
6.5	Ferrite measurement by x-ray diffraction	20
6.6	Ferrite measurement by electrochemical dissolution of austenite	20
6.7	Ferrite measurement by saturation magnetization	20
6.8	Ferrite measurement by magnetic attraction	20

6.9	Measurement by magnetic permeability (magnetic induction)	21
6.10	Location and volume of measurement	22
6.11	Measurement in the HAZ	23
6.12	Reproducibility of measurement	23
6.13	Correlations between Ferrite Number and ferrite percent	23
7	Specification of ferrite in stainless steel weld metal	24
7.1	General	24
7.2	Non-magnetic requirements	25
7.3	Service environments in which ferrite is aggressively attacked	25
7.4	Cryogenic applications requiring weld metal toughness	25
7.5	High temperature service	26
7.6	Dissimilar welds	26
7.7	Buffer layers and cladding	26
7.8	Duplex ferritic-austenitic welds	27
8	Outliers in ferrite measurement	27
9	Conclusions	28
	Bibliography	30