

ISO 24251-1:2025-08 (E)

Prevention of hydrogen assisted brittle fracture of high-strength steel components - Part 1: Fundamentals and measures

Contents		Page
Foreword		iv
Introduction		v
1	Scope	1
2	Normative references	1
3	Terms and definitions	1
4	Abbreviated terms	4
5	Fundamentals	5
5.1	General description of hydrogen embrittlement	5
5.2	Conditions for hydrogen embrittlement failure	5
5.2.1	General	5
5.2.2	Material susceptibility	6
5.2.3	Tensile stress	7
5.2.4	Sources of atomic hydrogen	7
5.3	Mechanism of hydrogen embrittlement of high strength steel	8
5.4	Fundamentals of metallic coatings regarding hydrogen uptake and diffusion	9
5.4.1	General aspects of metallic electroplated protection layers	9
5.4.2	Hydrogen generation during coating process	9
5.4.3	Corrosion protection mechanisms by metallic layers	9
6	Preventive measures with regard to hydrogen embrittlement	12
6.1	General	12
6.2	Part design and manufacturing	13
6.3	Material related measures and heat treatment	13
6.4	Reduction of residual tensile stress (stress relief)	14
6.5	Measures related to coating processes	14
6.5.1	General	14
6.5.2	Pre-treatment -- Cleaning processes	15
6.5.3	Electroplating coating processes	15
6.5.4	Stripping of coatings	15
6.5.5	Corrective actions - Baking	16
6.6	Prevention of environmental hydrogen uptake	17
6.6.1	General	17
6.6.2	Environmentally appropriate design	17
Annex A (informative) Electroplating processes		18
Annex B (informative) Principles of electrochemical corrosion		20
Bibliography		23