

Formula 1

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Formula 2

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Detailed Explanation

NACE MR0175/ISO 15156 is a three-part international standard (Parts 1–3) jointly published by NACE International (now AMPP) and ISO, addressing materials for use in H₂S-containing environments. Part 1 provides general principles and application guidelines; Part 2 covers carbon and low-alloy steels; and Part 3 addresses corrosion-resistant alloys (CRAs), including stainless steels, nickel-based alloys, and titanium alloys. While originally intended for upstream oil & gas 'sour service', the standard's rigorous framework for evaluating hydrogen-assisted degradation—especially its emphasis on hardness limits (e.g., ≥22 HRC for many martensitic steels), avoidance of susceptible microstructures (e.g., untempered martensite), and mandatory SSC testing per NACE TM0177—has become foundational for hydrogen infrastructure engineering. In green hydrogen applications, such as PEM and alkaline electrolyzers operating at 30–100 bar with high-purity H₂, materials are exposed to atomic hydrogen generated at cathodes or via permeation through membranes/seals; this atomic H can diffuse into susceptible metals, causing loss of ductility, delayed fracture, or catastrophic failure—making MR0175/ISO 15156 a critical reference for qualifying structural, piping, and pressure-boundary materials. Engineers adapt the standard by mapping electrolyzer-specific conditions (e.g., H₂ partial pressure, temperature, surface condition, cyclic loading) to equivalent 'sour severity' parameters, applying conservative environmental limits and supplementing with additional tests like slow strain rate testing (SSRT) or fracture mechanics-based threshold stress intensity (K_{ISCC}) measurements to validate HE resistance beyond the original scope.

Key Components

#	Component
1	Material Qualification Criteria
2	Hardness and Microstructure Limits
3	Environmental Severity Parameters (pH, H ₂ S/H ₂ partial pressure, temperature)

Applications

#	Application
1	Selection of pressure vessel and piping materials for hydrogen electrolyzers
2	Qualification of bipolar plates and end-plates in PEM electrolyzer stacks
3	Material screening for high-pressure hydrogen compressors and storage vessels in green H ₂ plants

Related Concepts

#	Concept
1	Sulfide Stress Cracking (SSC)
2	Hydrogen Permeation
3	Slow Strain Rate Testing (SSRT)

Tags

hydrogen embrittlement, NACE MR0175, ISO 15156, green hydrogen, electrolyzer materials, sour service

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