

	NACE MR0175 - 2015	NACE MR0103 - 2015	NACE SP0472 - 2015	EFC 16 - 2002
Hardness Limit Parent metal	<ul style="list-style-type: none"> • 22 HRC • 187 HBW (forging per A105) • 197 HBW (fitting per A234) • 190 HBW (low strength cold worked fitting material with less than 15% strain) 	<ul style="list-style-type: none"> • not required for P No.1 in Sec. IX ASME BPVC with heat treated condition per 13.1.1c • 200 HBW for stress relieved after cold forming • 225 HBW (hot bend) • 190 HBW (grade B cold bend fitting with less than 15% strain) 	N/A, standard only cover welds	250 HV 30
Hardness Limit Weld Metal	Table A.1	NACE SP0472	<ul style="list-style-type: none"> • not required when using exempt welding process/filler metal per Table. 2 or meets A-No. 1 chemical composition requirements • 210 HV 10 (average) • 248 HV 10 or 70.5 HR 15N • 200 HBW (for production welds) 	Table 8.1
Hardness Limit HAZ			<ul style="list-style-type: none"> • not required when base metal chemistry controls, PWHT, and minimum preheat of 93 °C are specified • 248 HV 10 	
Parent Metal Acceptance Criteria	<ul style="list-style-type: none"> • Individual readings exceeding limit may be acceptable if the average of several readings taken within close proximity does not exceed limit • No individual reading is greater than 2 HRC above limit 	<ul style="list-style-type: none"> • Individual readings exceeding limit may be acceptable if average of several readings taken within close proximity does not exceed limit • No individual reading exceeds the specified value by more than 2 HRC (or by more than 5 % for HBW or HV 10) 	N/A, standard only cover welds	<ul style="list-style-type: none"> • If single HV5 or HV10 measurement exceeds limit by less than 25 HV, then four further measurements to be made adjacent to the four sides of this indentation at the prescribed minimum distance between adjacent indentations set out in ISO 6507 1-3
Weld Metal Acceptance Criteria	N/A, assumed that no individual reading exceed limit	N/A, assumed that no individual reading exceed limit	N/A, assumed that no individual reading exceed limit	
HAZ Acceptance Criteria	N/A, assumed that no individual reading exceed limit	<ul style="list-style-type: none"> • Individual readings exceeding limit may be acceptable if average of three readings in the equivalent HAZ profile location adjacent to the hard HAZ reading (by repolishing existing specimen or additional specimens) does not exceed limit • No individual reading greater than 5 % above limit 	<ul style="list-style-type: none"> • Individual readings exceeding limit may be acceptable if average of three readings taken in the equivalent HAZ profile location adjacent to hard HAZ reading (by repolishing existing specimens or additional specimens) does not exceed values permitted • No individual reading greater than 10 HV 10 units above limit 	
Parent Metal Test Method	HRC, HBW (for certain product forms)	HBW	N/A, standard only cover welds	HV 30
Weld Metal Test Method	HV 5, HV 10, HR 15N	HV 5 (for low heat input and temper bead welds), HV 10	HBW, HV 10, HR 15N	HV 5 (for low arc energy welds), HV 10, HR 15N
HAZ Test Method				
Hardness Survey	Section 7.3.3.3	<ul style="list-style-type: none"> • Annex C • Section IX ASME BPVC paragraph QW-290.5 (c) & figure QW-462.12 for temper bead techniques, testing may use HV5, and instrumented indentation testing shall not be allowed. 	NACE MR0103	BS EN 4515-1
Production Test	N/A	NACE SP0472	<ul style="list-style-type: none"> • For vessel or tank butt welds, a minimum of one location per weld seam shall be tested • One test should be made for each 3 m of weld seam, one test shall be made on each nozzle flange-to-neck and nozzle neck-to shell/head weld • Each unique welding procedure used shall be tested • Number of tests and locations required shall be approved by the user • For piping welds, minimum of 5% of butt welds shall be tested, unless otherwise specified by the user 	N/A
Remarks	<ul style="list-style-type: none"> • Hardness greater than limit may be accepted when qualified by SSC testing per Annex B • HRC method may be used for welds & HAZ if the design stress does not exceed 2/3 of SMYS & PWHT applied • Tubular products with SMYS below 360 MPa and listed in Table A.2, hardness testing may be waived if agreed by equipment user • Weld cap maximum hardness may use 275 HV or 73.0 HR 15N when all following conditions are met; agreed by equipment user, parent metal thickness above 9 mm, and not exposed directly to sour environment 	Portable testing methods to verify compliance is prohibited unless approved by user, except to evaluate weld deposits per annex B & NACE SP0472	<ul style="list-style-type: none"> • Test on actual repair welds for cast, forged, or plate components may be waived by using weld test patch on accessible area • At least one hardness test shall be performed for each unique welding process/filler metal heat number combination used • Unless accepted by user, welds exceeding limit shall be removed and rewelded, or heat treated. Welds shall be retested and additional welds should be tested for each high-hardness weld that is found, at a rate determined by user 	<ul style="list-style-type: none"> • Hardness greater than limit may be accepted when qualified by SSC testing per Annex A • Maximum hardness may be relaxed in mildly sour environments per Table 8.1