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Standard Guide for
Evaluating Corrosion Properties of Wrought Iron- and Nickel-Based Corrosion Resistant Alloys for Chemical Process Industries[1]

This standard is issued under the fixed designation G157; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers an evaluation approach that is designed to provide information on the corrosion properties of wrought iron- and nickel-based alloys for the chemical process industries. This guide incorporates test conditions for general corrosion measurements in a variety of environments, crevice corrosion resistance in chloride environments, and stress corrosion cracking resistance in chloride environments.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1193 Specification for Reagent Water

G1 Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens

G15 Terminology Relating to Corrosion and Corrosion Testing (Withdrawn 2010)[3]

G30 Practice for Making and Using U-Bend Stress-Corrosion Test Specimens

G36 Practice for Evaluating Stress-Corrosion-Cracking Resistance of Metals and Alloys in a Boiling Magnesium Chloride Solution

G46 Guide for Examination and Evaluation of Pitting Corrosion

G48 Test Methods for Pitting and Crevice Corrosion Resistance of Stainless Steels and Related Alloys by Use of Ferric Chloride Solution

G123 Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution

3. Terminology

3.1 Terms such as *crevice corrosion, stress corrosion cracking*, and *corrosion rate* are defined in Terminology G15.

4. Significance and Use

4.1 This guide is intended to provide a series of evaluations that will assist engineers dealing with chemical environments in selecting appropriate alloys (**1-3**). In chemical environments, an important issue for determining general corrosion resistance is the temperature at which an alloy transitions from corrosion at a low rate to corrosion at a much higher rate. Other important concerns include the tendency towards crevice corrosion and stress corrosion cracking resistance, especially in hot chloride-containing aqueous environments.

4.2 This guide is also intended for alloy developers to assist them in choosing environments and test methods that are of particular interest to the chemical process industries.

4.3 The use of this approach will allow direct comparisons to be made among alloys from various suppliers and, thereby, to assist engineers in selecting the most appropriate materials for further testing to determine suitability in their application.

5. General Corrosion Resistance

5.1 The general corrosion resistance of nickel- and iron-based alloys is determined in 14 test solutions at various temperatures to determine the lowest temperature at which the corrosion rate exceeds 0.13 mm/y (5 mpy). The test solutions are listed in Table 1. A suggested procedure is provided in Appendix X1. The test is run on three coupons of metal for each environment. The tests are run for two 48-h exposures with one specimen exposed for the total 96 h. Welded specimens may be used if results are required on weldments.

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[1] This guide is under the jurisdiction of ASTM Committee G01 on Corrosion of Metals and is the direct responsibility of Subcommittee G01.05 on Laboratory Corrosion Tests.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

TABLE 1 Fourteen Environments for Evaluating General Corrosion Resistance

Corrodent	Formula	Concentration, %^{A}
Hydrochloric Acid	HCl	0.2, 1.0, 5.0
Sulfuric Acid	H_2SO_4	10, 60, 96^B
Nitric Acid	HNO_3	10, 70^B
Phosphoric Acid	H_3PO_4	85^B
Formic Acid	HCOOH	50
Acetic Acid	CH_3COOH	80
Sodium Hydroxide	NaOH	50
Hydrochloric Acid + Ferric Chloride	HCl + $FeCl_3$	1.0 HCl + 0.3 $FeCl_3$^{C}
Acetic Acid + Acetic Anhydride	$CH_3COOH + (CH_3CO)_2O$	50/50

^{A} All chemicals are ACS reagent grade mixed with Specification D1193 Type 4 reagent water.
^{B} Undiluted reagent grade acid may be used.
^{C} Ferric chloride concentration calculated on anhydrous basis.

5.2 The corrosion rates are based on mass loss measurements with appropriate conversion to thickness loss as shown in Appendix X1.

5.3 The results of the tests in each solution should be reported on a summary results sheet. A typical format is shown in Fig. 1 and Fig. 2.

6. Six Percent Ferric Chloride Solution Critical Crevice Corrosion Temperature

6.1 The crevice corrosion resistance of each alloy is to be evaluated as described in Test Methods G48, Method D. The standard exposure period of 72 h is to be used. Mass loss results are also to be obtained and reported in this environment.

6.2 The results of this test are to be reported as discussed in Test Methods G48. The results should also be entered on the summary results sheet shown in Fig. 3.

7. Chloride Stress Corrosion Resistance

7.1 The resistance to chloride stress corrosion cracking is an important characteristic of alloys used in the chemical process industries. Two environments are provided to evaluate and report chloride stress corrosion cracking behavior—acidified sodium chloride and magnesium chloride. The magnesium chloride environment is highly acidic and, as a consequence, tends to cause many suitably resistant alloys to fail. The acidified sodium chloride environment gives results closer to experience in cooling water and process water environments.

Commercial Designation UNS Number
Heat Treatment Designation

Manufacturer:	XXX
Common Trade Designations:	XXX
Nominal Composition - Mass %	Cr Ni Mo etc.
Mechanical Properties:	
Yield Strength	MPa (ksi)
Tensile Strength	MPa (ksi)
Elongation	%
Reduction in Area	%
Hardness	

Analysis of Specimen

Test Condition - (Heat Treatment)

FIG. 1 Summary Results Form - Alloy Description

Corrodent	Material: %(mass/ mass)	Temp.^{A} °C	Corrosion Rates, mm/y (mpy)			Remarks
			0 - 48 h	48 - 96 h	0 - 96 h	
HCl	0.2					
	1.0					
	5.0					
HCl +	1.0					
$FeCl_3$	0.3					
H_2SO_4	10					
	60					
	96					
HNO_3	10					
	70					
H_3PO_4	85					
HCOOH	50					
CH_3COOH	80					
CH_3COOH	50					
+						
$(CH_3CO)_2O$	50					
NaOH	50					

^{A} An entry to be made for each environment where the corrosion rate is below 0.13 mm/y and at the next higher temperature where the corrosion rate exceeds 0.13 mm/y.

FIG. 2 Summary Results Form - General Corrosion Resistance

Material:

G48 Method D **Critical Crevice Corrosion Temperature - Acidified 6% $FeCl_3$**

Test No.	CCT Determined. °C	No. of Attacked Areas	Maximum Depth of Attack, mm	Mass Loss Area^A mg/cm^2
X				
Y				
Z				

G123 **Acidified 25% NaCl Stress Corrosion Cracking**

Replicate ID	Days		Crack Location	Final pH	Crack Morphology^D
	Before Crack^B	To Crack^C			
1					
2					
3					

Magnesium Chloride Stress Corrosion Cracking

Replicate ID	Days		Crack Location	Crack Morphology^D
	Before Crack^B	To Crack^C		
1				
2				
3				

^{A} This measurement is an addition to the requirements of G48 Method D.
^{B} No. of days in test when specimen was observed with no cracks visible.
^{C} No. of days in test when specimen was first observed with cracks.
^{D} Crack Morphology observed after metallographic sectioning.
IG = Intergranular TG = Transgranular M = Mixed

FIG. 3 Summary Results Form - Localized Corrosion Performance

7.2 *Acidified Sodium Chloride Test*—Test Method G123 should be used to evaluate all alloys for resistance to chloride stress corrosion cracking. The specimen design suggested in Test Method G123 should be used, if possible. This design is based on the Practice G30 U-bend and the tests should be carried out with at least triplicate specimens for a period of 1000 h. The results are to be reported as described in Test Method G123 and entered on the summary results sheet. See Fig. 3.

7.3 *Magnesium Chloride Test, Optional*—Alloys that do not crack in the acidified sodium chloride environment may be tested in a magnesium chloride test. The test environment is described in Practice G36. U-bend specimens similar to those suggested in Test Method G123 should be used with triplicate replication. The test should be run for 30 days or until cracking is observed. The specimens should be removed at convenient intervals not to exceed three days during exposure and examined for cracking. The time to first crack is reported. Metallographic sectioning is to be carried out on at least one of each set of replicates at the end of the exposure to document the crack morphology or, in the case of surviving specimens, that no microcracks are present. The result of this test is to be reported on the summary results sheet (Fig. 3).

8. Report

8.1 The results of these tests are to be reported as specified in the test method referenced. The summary results sheets shown in Figs. 1-3 provide a convenient form to present the results in a consistent format.

9. Keywords

9.1 chemical process industry; crevice corrosion; general corrosion; iron-base corrosion resistant alloys; nickel-base corrosion resistant alloys; stress corrosion cracking

APPENDIX

(Nonmandatory Information)

X1. SUGGESTED LABORATORY TESTING OF IRON- AND NICKEL-BASED ALLOYS FOR CORROSION RESISTANCE IN SELECTED MEDIA FOR GENERAL CORROSION PERFORMANCE

X1.1 Scope

X1.1.1 This test method describes a suggested procedure for corrosion tests to determine the relative resistance of wrought iron- and nickel-based alloys to corrosion in selected media. These tests are intended to provide corrosion data suitable for preliminary evaluation prior to testing for specific chemical applications.

X1.1.2 Each alloy is tested in the as-manufactured condition; as-welded specimens may be included. (See X1.3.10.2 for when only the as-welded condition need be tested.)

X1.1.3 Specimen evaluation procedures provide for mass loss measurements for evaluation of general corrosion and low power surface microscopic examination for presence of localized corrosion, such as pitting, stress corrosion, intergranular attack, end-grain corrosion, and preferential weld attack.

X1.2 Apparatus

X1.2.1 A 1000 mL Erlenmeyer flask equipped with a reflux condenser, a sparger with a fitted glass disc for deaerating certain solutions, a specimen support system, and a means for controlling the temperature of the contents of the flask are recommended for all tests.

X1.2.2 All components of the apparatus described in X1.2.1 which are in contact with the test environment (liquid and gas phases) are to be made of glass or polytetrafluoroethylene (PTFE) or other inert nonconductive material.

X1.2.3 The temperature-regulating device used for tests at temperatures other than the boiling temperature should be capable of controlling the temperature of the contents of the flask to within ±1°C of the selected test temperature.

X1.2.4 The specimen support system should be designed so that the specimen is separated from the flask and its internal components. The specimen is to be maintained in a vertical position, totally immersed in the test solution. One desirable support system is to use an individual glass cradle for each specimen.

X1.2.5 A nitrogen sparging system, which is used for initial deaeration in tests at temperatures below boiling and in non-oxidizing solutions, should be capable of sparging nitrogen at the rate of 100 mL/min. A device to prevent backflow of test solution into the gas supply system should be included.

X1.3 Test Specimens

X1.3.1 The specimens should be made from sheet, plate, or strip produced by commercial methods.

X1.3.2 Material from which the specimens are made should be in the annealed condition, the final heat treatment being done after any cold rolling. Temperature of the final heat treatment and method of cooling should be reported.

X1.3.3 Thickness of the sheet materials used for specimens should be between 1.5 and 4.8 mm (0.06 and 0.188 in.). Width of the specimens should be 20 mm (0.8 in.) and the length 50 mm (2.0 in.).

X1.3.4 Specimens are to be cut to size by a machining operation. If sheared specimens are used, the sheared edges are to be removed by grinding or machining; the amount of metal removed by machining should equal the thickness of the specimen.

X1.3.5 All specimens should be abraded to provide a uniform surface finish free of scale and dirt, and to remove any sharp edges or burrs due to machining or drilling operations. The final step in this abrading operation should be done with wet No. 80 or dry No. 120 grit abrasive paper. Exercise care to avoid overheating the surface. This step should be omitted when the intent of the test is to evaluate mill finish or other surface conditions.

X1.3.6 Specimens should be stamped with identifying letters and numbers, using clean, hardened steel stamps.

X1.3.7 Specimens should be measured prior to test and the total exposed area, including edges, calculated and reported to the closest 65 mm^2 (0.1 in.^{2}).

X1.3.8 Following the abrasive treatment, the specimens should be cleaned with a magnesium oxide paste or detergent solution to remove any residual dirt or grease, rinsed in water, and dipped in acetone and air dried.

X1.3.9 The dried specimens should be weighed to an accuracy of at least ±0.2 mg. Weighed specimens should be stored in a desiccator for at least 24 h before use.

X1.3.10 Two kinds of specimens may be used: (*1*) as manufactured specimens and (*2*) as-welded specimens.

X1.3.10.1 *As-Manufactured Specimens*—These specimens should be prepared according to the procedure described in X1.3.1-X1.3.9.

X1.3.10.2 *As-Welded Specimens*—The principal reason for using these specimens is to evaluate the corrosion resistance of the weld deposit. However, where the corrosion resistance of the weld deposit is equal to, or better than, that of the parent metal, a welded specimen can be used in lieu of the as-manufactured specimen and thus avoid running an additional test. The welded specimens should be prepared from material described in X1.3.1 and X1.3.2. The minimum thickness of material for these specimens should be 3.0 mm (0.12 in.). The weld should be made so that it will be in the center of the specimen and be parallel to the long direction of the specimen. The weld should be a gas-tungsten arc (GTAW) with filler metal. The filler metal and welding procedure should correspond to that recommended by the manufacturer for fabrication of process equipment. The weld bead should be ground or machined flush with the base metal. The final preparation of the specimen should be as specified in X1.3.3-X1.3.9. There should be no post-weld heat treatment.

X1.4 Test Solutions

X1.4.1 Test solution should be prepared accurately from reagent grade chemicals conforming to the Specifications of the Committee on Analytical Reagents of the American Chemical Society,[4] and Specification D1193 Type IV reagent water.

X1.4.2 The compositions of the various test solutions are given in Table 1.

X1.4.3 The sparging gas, employed to deaerate non-oxidizing solutions to be used in tests at temperatures below the boiling point, should be nitrogen with a purity of at least 99.9 % and with an oxygen content of less than 0.02 %.

X1.4.4 *Procedure for Preparing Solutions:*

X1.4.4.1 *Hydrochloric Acid Solution*—Use hydrochloric acid 36.5 to 38 %, specific gravity 1.185 to 1.192. Prepare 1200 mL of each solution using the volumes shown as follows:

Desired %	mL Concentrated HCl	mL Reagent H_2O
0.2	5.4	1197
1.0	27.2	1184
5.0	139	1125

Add water to a 1.5 L beaker, then carefully and slowly add the reagent acid to the beaker while stirring the mixture. When cool, measure 600 mL into each flask for the test.

X1.4.4.2 *Sulfuric Acid Solution*—Use sulfuric acid 95 to 98 %, specific gravity 1.84 min. Prepare 800 mL of each solution using volumes shown as follows:

Desired %	mL Concentrated Acid	mL Reagent H_2O
10	72	1148
60	608	680

Add water to a 1.5 L beaker, then carefully and slowly add concentrated acid to flask with constant stirring. In the case of the 60 % solution, it is desirable to cool the mixture to 30°C after about half of the acid has been added to avoid boiling. Then complete the acid addition. When cool, measure 600 mL into each flask for the test.

X1.4.4.3 *Ten Percent Nitric Acid Solution*—Use nitric acid 69 to 70 %, specific gravity 1.416 to 1.424. Prepare 1200 mL of the 10 % solution as follows. Measure 1083 mL of water into the flask. Then carefully and slowly add 128 mL of the concentrated acid to the water with constant stirring. When cool, measure 600 mL into each flask for the test.

X1.4.4.4 *Fifty Percent Formic Acid Solution*—Use formic acid 88 % minimum (specific gravity 1.201 min). Prepare 1200 mL of 50 % solution as follows. Measure 597 mL of water into the flask. Then carefully and slowly, add 729 mL of the concentrated acid to the water with constant stirring. Measure 600 mL into each flask for the test.

X1.4.4.5 *Eighty Percent Acetic Acid Solution*—Use glacial acetic acid 99.7 min. Prepare 1200 mL of the 80 % solution as follows. Measure 256 mL of water into a 1.5 L beaker. Then carefully and slowly add 978 mL of the glacial acid to the water while stirring constantly. Measure 600 mL into each flask for the test.

X1.4.4.6 *Fifty Percent Sodium Hydroxide*—Use pellets 98 % min. Prepare 1200 mL of the 50 % solution as follows. Weigh 915 g of sodium hydroxide. Measure 915 mL of water into a 1.5 L beaker. Slowly add the sodium hydroxide pellets to the water with stirring. Cool the flask to 30°C after about half of the pellets have been added. Measure 600 mL into each flask for the test.

X1.4.4.7 *Hydrochloric Acid and Ferric Chloride*—Use concentrated HCl and $FeCl_3•6H_2O$ (97 to 102 %). Prepare 1200 mL of the 1.0 % HCl + 0.3 % $FeCl_3$ solution as follows. Weigh 6.03 g of $FeCl_3•6H_2O$ and add to a 1.5 L beaker. Add 1180 mL of water and stir until the crystals are dissolved. Add 27 mL of concentrated hydrochloric acid and stir until solution is uniform. Measure 600 mL into each flask for the test.

X1.4.4.8 *Acetic Acid and Acetic Anhydride*—Use acetic anhydride and glacial acetic acid. Prepare 1200 ml of the 50 % to 50 % solution as follows. Using a 1.5 L beaker, add 605 mL of acetic acid. Then add 595 mL of acetic anhydride. Stir until uniform. Measure 600 mL into each flask for the test.

X1.5 Procedure

X1.5.1 The test solutions to be used are listed in Table 1. The test temperatures are to be selected from: 30°C, 50°C, 70°C, 90°C, 110°C, 130°C, and the boiling point, which can be substituted for the last two temperatures, as appropriate. The aim is to determine the lowest temperature at which the

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[4] Reagent Chemicals, *American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

corrosion rate exceeds 0.13 mm/y (5 mpy). Therefore, no further tests are required if the corrosion rate exceeds 0.13 mm/y (5 mpy) at 30°C or is less than 0.13 mm/y (5 mpy) at the maximum listed temperature.

X1.5.1.1 If tests are first run using as-manufactured specimens, later tests with as-welded specimens should be made only at the highest temperature at which the corrosion rate was below 0.13 mm/y (5 mpy) on as-welded specimens.

X1.5.1.2 The corrosion rate value to be used in determining the temperature at which the corrosion rate exceeds 0.13 mm/y (5 mpy) should be the value obtained in the 0 to 96 h test.

X1.5.1.3 An alloy should not be tested in solutions for which it is unsuitable.

X1.5.1.4 Rates greater than 1.3 mm/y (50 mpy) are not required to be reported.

X1.5.2 For each solution and temperature tested there should be two flasks, each containing one test specimen. The specimens should be totally immersed in the liquid phase and should be located so that the long dimension is vertical.

X1.5.3 The volume of the test solution is 600 mL.

X1.5.4 The rate of heating should be adjusted to bring the test solution to temperature as rapidly as possible. Boiling chips or other boiling aids should be added. The specimens are to be added when the solution is stable within 1°C of the test temperature.

X1.5.5 For tests at temperatures other than boiling temperature, the temperature is to be controlled to within ±1°C (1.8°F) of the desired temperature. For boiling temperature tests, the rate of boiling should be controlled so as to avoid excessive turbulence and bubble impingement.

X1.5.6 Before heating and adding the test specimens, solution requiring deaeration is to be sparged with nitrogen at a rate of flow of approximately 100 mL/min for ½ h.

X1.5.7 The duration of the tests is to be 48 or 96 h. The specimen in one flask should be removed after 48 h and replaced with a new specimen for exposure during the second 48-h period. The solution in this flask should also be renewed after the initial 48-h period and be deaerated, when applicable. The specimen in the second flask should not be removed until the end of the 96-h test period. The solutions, with the exception of the hydrochloric acid-ferric chloride solution and the hot concentrated nitric acid solution, need not be renewed in the 0 to 96 h tests. In the case of these two oxidizing solutions, deaeration is not required, but the solution should be changed after each 48 h exposure.

NOTE X1.1—Depletion of the ferric chloride concentration during the test period can occur reducing the oxidizing power of the solution for the ferric chloride tests. In nitric acid tests, accumulation for Cr^{+6} can accelerate the corrosion of chromium rich alloys.

X1.5.8 At the conclusion of the test, the specimens should be removed from the test solutions and immediately rinsed in cold water. Following this, the specimens should be rinsed in distilled water, then in acetone, and dried in air. They should be stored in a desiccator until weighed.

X1.5.9 After the above rinsing and drying operation, the specimens should be examined visually and the color, thickness, and physical nature of any deposits and corrosion products on the metal surface should be noted.

X1.5.10 The specimens should be cleaned of corrosion products and deposits by light scrubbing using water and a soft brush. Ultrasonic cleaning is permitted. Any remaining deposits or corrosion products should be removed by rubbing with a soft rubber eraser. The specimen should be washed in acetone, dried in air, and stored in a desiccator until weighed.

X1.5.11 If an additional cleaning procedure is required, the electrolytic cleaning procedure described in Practice G1 should be used.

X1.5.12 For each alloy, *blank* specimens may be weighed before and after being subjected to the specimen cleaning procedure in order to establish a correction for the cleaning procedure.

X1.5.13 If the mass-loss corrosion rate values (see X1.6.1) for the three specimens at a given test temperature (see X1.5.1) differ by a factor greater than four (ratio of the highest corrosion rate to the lowest corrosion rate), the test should be repeated at least one time unless the maximum corrosion rate is less than 0.13 mm/y (5 mpy).

X1.6 Evaluation of Specimens After Test

X1.6.1 The cleaned specimens should be weighed to an accuracy of at least ±0.2 mg, and the mass loss during test determined, making an appropriate correction for the *blank* loss during cleaning (see X1.5.12). The corrosion rate should be calculated from this corrected mass loss using the following equations:

$$\text{Corrosion rate (mpy)} = \frac{534 \times \text{mass loss (mg)}}{\text{area (in.}^2) \times \text{time (h)} \times \text{metal density (g/cm}^3)} \tag{X1.1}$$

$$\text{Corrosion rate (mm/y)} = 0.0254 \times \text{corrosion rate (mpy)} \tag{X1.2}$$

X1.6.2 The cleaned specimens should be inspected using a low-power (20×) binocular microscope and a record made of the surface appearance, noting any irregularities in the corrosive attack, such as pitting, stress corrosion cracking (as at stamped numbers), end grain attack, preferential weld attack, heat-affected zone (HAZ) corrosion, and cratering. In the case of pitting, their location should be noted and a qualitative description of their number should be provided. The nature of the pits should be characterized, that is, shallow or deep, rounded or steep-sided, narrow or wide. See Guide G46. These observations should be noted on the report sheet.

X1.7 Reporting the Data

X1.7.1 For each corrosion test, a report sheet should be prepared. The items to be reported are discussed individually as follows:

X1.7.2 *Alloy Description*—Each alloy tested should be described by its commercial name (trade name), manufacturer, UNS number, and nominal composition, as specified by the manufacturer.

X1.7.3 *Alloy Composition*—The heat number of the material tested should be reported together with the heat analysis.

X1.7.4 *Heat Treatment*—The final heat treatment conditions temperature and cooling method used by the manufacturer should be reported.

X1.7.5 *Test Apparatus*—The apparatus should be identified in the report by reference to the appropriate section of this test method, with any pertinent additional details added.

X1.7.6 *Test Solution*—The volume and composition of the test solution should be reported. Include any make-up required during the test.

X1.7.7 *Sparging Gas*—The purity of the nitrogen and amount used for each test where deaeration was required should be reported.

X1.7.8 *Temperature*—The temperature of the test solution should be reported for the normal test period.

X1.7.9 *Welded Specimens*—The welding procedure and the filler metal used should be reported.

X1.7.10 *Appearance*—The appearance of the test specimens after the test, including a description of the various forms of corrosion found (see X1.6.2), should be reported.

X1.7.11 *Corrosion Rates*—Corrosion rates calculated from mass loss measurements (see X1.6.1) should be reported for each specimen. Corrosion rates should be reported to two significant figures only, with the minimum unit being 0.01 mm/y (0.1 mpy). Values less than 0.003 mm/y (0.1 mpy) should be reported as < 0.01 mm/y (< 0.1 mpy).

X1.7.11.1 All corrosion rates should be reported as mm/y with mpy values in parentheses immediately following the metric units.

X1.7.12 *Summary Report*—A summary report sheet should be prepared for each alloy and each test solution which shall include only items in X1.7.2 and X1.7.6-X1.7.11.1.

X1.7.13 Data from all tests are to be reported unless the test can be rejected for a known experimental error (for example, loss of temperature control).

REFERENCES

(1) Treseder, R. S. and Kachik, E. A.,"MTI Corrosion Tests for Iron- and Nickel-Base Corrosion Resistance Alloys," *Laboratory Corrosion Tests and Standards, ASTM STP 866*, G. S. Haynes and R. Baboian, Eds., ASTM, 1985, pp 373–399.

(2) Treseder, R. S. and Degnan, T. F., *Corrosion Testing of Iron-and Nickel-Base Alloys*, Part 1 Test Methods (Revised), MTI Publication Vol 46, Materials Technology Institute of the Chemical Process Industries, Inc., St. Louis, MO 1995.

(3) Degnan, T. F., *Corrosion Testing of Iron- and Nickel-Base Alloys*, Part II: Test Data, MTI Publication Vol 47, Materials Technology Institute of the Chemical Process Industries, Inc., St. Louis, MO 1995.