Corrosion Foundations Theory Exam

Exam Preparation Guide

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Introduction

The Corrosion Foundations exam is designed to assess whether a candidate has the requisite knowledge and skills to be certified as minimally qualified in Corrosion Foundations. The exam consists of 50 multiple-choice questions that are based on the entry-level Corrosion Foundations Body of Knowledge (BOK).

Test Name	Corrosion Foundations
Test Code	NACE-CF1-001
Time	1.5 hours*
Number of Questions	50
Format	Remote Proctored Computer-Based Testing (CBT)

NOTE: A pass/fail grade is provided at the end of the exam.

Exam time includes the non-disclosure agreement and the system tutorial.

NOTE: The course manual is **NOT** provided in the exam.

Target Audience

Candidates taking the Corrosion Foundations exam must have successfully completed the Basic Corrosion course, which includes passing the final exam administered at the end of the course. Candidates should have entry-level ability to recognize corrosion, understand its devastating potential, and monitor and/or control corrosion, especially as it relates to his or her area of responsibility. This includes technicians, salespersons, inspectors, managers, engineers, and others.

Requirements

Corrosion Foundations

- 1 course + 1 stand-alone exam

Work Experience Requirements
None
Course Requirements
Successful completion of the following course: Basic Corrosion
Exam Requirements
*Corrosion Foundationmultiple choice, **closed-book)

Note: A pass/fail grade is provided at the end of the exam.

****Note: The course manual is NOT provided in the exam.***

Upon successful completion of requirements, the candidate will be awarded a Corrosion Foundations Certification.

Corrosion Foundations – Knowledge and Skill Areas Tested

NOTE: At the end of the CBT exam, the candidate will receive a report of strengths and weaknesses that correspond to these domains.

1. BASICS

- 1.1. Definition and Forms of Corrosion
- 1.2. Importance of Corrosion
  - 1.2.1. Direct costs
  - 1.2.2. Excessive maintenance, repair, and replacement
  - 1.2.3. Indirect consequences of corrosion
  - 1.2.4. Environment
  - 1.2.5. Changes in engineering practice

2. CORROSION ELECTROCHEMISTRY

- 2.1. Electrochemical Reactions
- 2.2. Corrosion and Electrochemistry Terms
- 2.3. Oxidation / Reduction Reactions
- 2.4. Corrosion as an Electrochemical Process
- 2.5. Thermodynamics
  - 2.5.1. Potential
  - 2.5.2. Reference electrodes
  - 2.5.3. The galvanic series
  - 2.5.4. Nernst equation
  - 2.5.5. Pourbaix diagrams
- 2.6. Kinetics
  - 2.6.1. Faraday's Law
  - 2.6.2. E log I Curves (Evans Diagrams)
  - 2.6.3. Area effect
  - 2.6.4. Electrochemical cells
- 2.7. Passivity
  - 2.7.1. pH

3. CORROSIVE ENVIRONMENTS

- 3.1. Atmospheric Corrosion
  - 3.1.1. Industrial
  - 3.1.2. Marine
  - 3.1.3. Rural
  - 3.1.4. Indoor
  - 3.1.5. Under insulation

3.2. Water
    3.2.1. Dissolved gases
    3.2.2. Effects of dissolved salts
    3.2.3. pH
    3.2.4. Effects of mineral deposits
    3.2.5. Effects of liquid velocity
    3.2.6. Effects of temperature
    3.2.7. Microbiologically-Influenced Corrosion
3.3. Soils
3.4. High-Temperature Environments

4. MATERIALS

4.1. Properties
    4.1.1. Metallurgy fundamentals
    4.1.2. Forming methods
    4.1.3. Materials specifications
4.2. Metals
    4.2.1. Carbon steel and low-alloy steels
    4.2.2. Cast irons
    4.2.3. Stainless steels
    4.2.4. Copper alloys
    4.2.5. Titanium alloys
    4.2.6. Aluminum
    4.2.7. Zinc
4.3. Non-Metallic Materials
    4.3.1. Polymers
4.4. Composites
4.5. Concrete
    4.5.1. Components
    4.5.2. Field practice
    4.5.3. Corrosion of embedded steel
    4.5.4. Repair
4.6. Ceramics
    4.6.1. Ceramic materials vs metals

5. FORMS OF CORROSION

5.1. General Corrosion
    5.1.1. Definition, description, recognition, and mechanism
    5.1.2. Corrosion rates, predictability, and measurement
    5.1.3. Performance of metals and alloys
    5.1.4. Control of general corrosion attack

5.2. Localized Corrosion
    5.2.1. Pitting
    5.2.2. Crevice corrosion
    5.2.3. Filiform corrosion
5.3. Galvanic Corrosion
    5.3.1. Definition
    5.3.2. Electrochemical process
    5.3.3. Galvanic series
    5.3.4. Corrosion rates
    5.3.5. Predicting galvanic attack
    5.3.6. Performance of metals and alloys
    5.3.7. Control of galvanic attack
5.4. Environmental Cracking
    5.4.1. Definition and mechanism
    5.4.2. Recognizing and controlling cracking factors
    5.4.3. Types
        5.4.3.1. Stress corrosion cracking (SCC)
        5.4.3.2. Hydrogen induced cracking (HIC)
        5.4.3.3. Sulfide stress cracking (SSC)
        5.4.3.4. Liquid metal embrittlement (LME)
        5.4.3.5. Corrosion fatigue (CF)
    5.4.4. Control of environmental cracking
5.5. Flow Assisted Corrosion
    5.5.1. Types
        5.5.1.1. Erosion-Corrosion
        5.5.1.2. Impingement
        5.5.1.3. Cavitation
    5.5.2. Control of flow assisted corrosion
5.6. Intragranular Corrosion
    5.6.1. Definition, description, and recognition
    5.6.2. Mechanism
    5.6.3. Performance of metals and alloys
    5.6.4. Control of intragranular corrosion
5.7. Dealloying
    5.7.1. Definition, description, and recognition
    5.7.2. Mechanism
    5.7.3. Performance of metals and alloys
    5.7.4. Control of dealloying
5.8. Fretting
    5.8.1. Definition, description, and recognition
    5.8.2. Mechanism and performance of metals and alloys
    5.8.3. Control of fretting

5.9. High-Temperature Oxidation / Corrosion
  5.9.1. Definition, description, and recognition
  5.9.2. Mechanism
  5.9.3. Performance of metals and alloys
  5.9.4. Control of high-temperature corrosion

6. DESIGNING FOR CORROSION CONTROL

6.1. Construction Parameters
  6.1.1. Welding
  6.1.2. Accommodating other corrosion measures
6.2. Process Parameters
  6.2.1. Temperature
  6.2.2. Velocity
  6.2.3. Pressure
  6.2.4. Chemistry
6.3. Drainage, Dissimilar Metals, and Crevices
6.4. Corrosion Allowance / Operating Lifetime
6.5. Maintenance and Inspection

7. CORROSION CONTROL METHODS

7.1. Materials Selection
  7.1.1. Factors that influence materials selection
  7.1.2. Comparison with other corrosion control methods
  7.1.3. Candidate materials
7.2. Modification of the Environment
  7.2.1. Corrosion inhibitors
  7.2.2. Water treatment
  7.2.3. Protective coatings
  7.2.4. Cathodic and anodic protection

8. INSPECTION AND MONITORING

8.1. Definitions
8.2. Inspection
  8.2.1. Inspection methods
    8.2.1.1. Visual
    8.2.1.2. Radiography
    8.2.1.3. Ultrasonic
    8.2.1.4. Eddy current inspection
    8.2.1.5. Dye penetrant inspection (DPI)
    8.2.1.6. Magnetic particle inspection (MPI)
    8.2.1.7. Positive materials identification (PMI)
    8.2.1.8. Thermographic
  8.2.2. Significance of inspections

8.3. Corrosion Monitoring
    8.3.1. Corrosion probes
    8.3.2. Mass-loss (weight-loss) coupons
    8.3.3. Electrical resistance probes
    8.3.4. Electrochemical methods
    8.3.5. Galvanic monitoring
    8.3.6. Hydrogen probes
    8.3.7. Water chemistry monitoring
    8.3.8. Microbiological fouling
8.4. Cathodic Protection Systems
    8.4.1. Inspection
    8.4.2. Monitoring

Types of Questions

Description of Questions

This closed-book exam consists of multiple-choice questions where some questions may have multiple answers that require more than one answer choice. The questions are based on the knowledge and skills required in the corrosion industry.

Sample Questions

The sample questions are included to illustrate the formats and types of questions that will be on the exam. Your performance on the sample questions should not be viewed as a predictor of your performance on the actual test.

1. Which type of corrosion occurs when a metal deteriorates at elevated temperatures due to direct chemical reactions between the metal and the environment?

   A. Crevice corrosion
   B. Fretting corrosion
   C. Stress corrosion cracking
   D. High-temperature corrosion

2. Which of the following are types of natural atmospheric exposures classified for understanding their effect on corrosion?
   SELECT ALL THAT APPLY

   A. Rural
   B. Indoor
   C. Marine
   D. Outdoor

Answer Key

1. **D**
2. **A, B, C**

Preparation

Training

Basic Corrosion – Course

Recommended Study Material
Books

Basic Corrosion—Course Manual and Materials

Computer-Based Test Tutorial

Please visit this link for a demonstration of the computer-based exam. You will have the opportunity to practice answering a variety of questions to help you get familiar the CBT exam format. You will also receive this tutorial link when you register for the exam:

Examity Tutorial Video