Refining Corrosion Technologist
NACE-RCT-001

Exam Preparation Guide
March 2018
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Introduction

The Refining Corrosion Technologist exam is designed to assess whether a candidate has the requisite knowledge and skills that a minimally qualified Refining Corrosion Technologist must possess. The 100 multiple-choice questions are based on the Refining Corrosion body of knowledge. A candidate should know the processes and corrosion mechanisms that are specific to the corrosion industry including both low and high temperature principles. A minimally qualified candidate will know the basic functions of each refinery process unit, the feed, chemical reaction, equipment, and end product necessary for converting crude oil into a salable product.

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Target Audience

The Refining Corrosion Technologist is responsible for identifying, locating, and controlling corrosion in refinery environments. A Refining Corrosion Technologist may be:

- Design engineer
- Process engineer
- Procurement agents
- Maintenance planners
- Service company representatives who support refineries
- Corrosion and equipment engineers
- Metallurgists
- Inspectors
- Inspection supervisors who works in major integrated companies associated with the refining industry (i.e. oil, refining, petrochemical, inspection, engineering and construction)
- Licensors, equipment, inhibitor and chemical treatment suppliers
Requirements

Requirements for Refining Corrosion Technologist

- Work Experience and Education Prerequisite
- Course
- 1 Core Exam
- Application

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<td>2 years verifiable Corrosion work experience in Refining</td>
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<td>And</td>
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<td>Bachelor’s Degree in Physical Sciences or Engineering</td>
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Course Requirements

Successfully complete the following course:

*Course - Corrosion Control In The Refining Industry or Equivalent Training*

Core Exam Requirements

Exam - Refining Corrosion Technologist Exam—NACE-RCT-001

Application Requirements

Approved Refining Corrosion Technologist

Submit Application

Candidates must apply for this certification by submitting an on-line application which is subject to approval. Applications must be submitted within 3 years of successful completion of exam.

Certification renewal requirements—

- Recertification application* required every 3 years
- 1.5 years of Corrosion work experience in refining
- 8 hours per year of ongoing Professional Development Activity (24 hours total for the 3 year cycle)

Upon successful completion of requirements, the candidate will be awarded a **Refining Corrosion Technologist Certification**.

*Approval required

*Equivalent training must include all topics covered in the Corrosion Control in the Refining Industry course (see Appendix A)
Exam Blue Print

Domain 1- Corrosion Principles–19%
- Low Temperature Corrosion Principals
  - Corrosion Rates and Polarization
  - Passivity
  - Temperature and Concentration
  - Low Temperature Conditions
- High Temperature Corrosion Principals
  - Rate Laws
  - High Temperature Conditions

Domain 2- Corrosion Mechanism–19%
- Metal Loss—General and/or Localized Corrosion
- Galvanic Corrosion
- Pitting
- Crevice Corrosion
- Intergranular Attack
- Erosion-Corrosion
- Hydrogen Chloride
- Ammonium Bisulfide (NH4HS)
- Carbon Dioxide
- Process Chemicals (level 2)
- Organic Chlorides
- Aluminum Chloride
- Sulfuric Acid
- Hydrofluoric Acid
- Phosphoric Acid
- Phenol (Carbolic Acid)
- Amines
- Atmospheric (External) Corrosion
- Corrosion Under Insulation (CUI)
- Soil Corrosion
- High-Temperature Sulfide Corrosion (Without Hydrogen Present)
- High-Temperature Sulfide Corrosion (With Hydrogen)
- Naphthenic Acid Corrosion
- High-Temperature Oxidation

Domain 3- Stress Corrosion Cracking–10%
- Chloride Stress Corrosion Cracking (CISCC)
- Alkaline Stress Corrosion Cracking (ASCC)
- Carbonic Acid (Wet CO2)
- Polythionic Acid Stress Corrosion Cracking (PTA SCC)
- Ammonia Stress Corrosion Cracking (NH3 SCC)
- Hydrogen Cyanide (HCN)
- SCC Prevention
- Wet H2S Cracking
  - Hydrogen Blistering
  - Sulfide Stress Cracking (SSC)
  - Hydrogen Induced Cracking (HIC)
  - Stress Oriented Hydrogen Induced Cracking (SOHIC)
- High-Temperature Hydrogen Attack (HTHA)

Domain 4- Metallurgical Failures–8%
- Grain Growth
- Graphitization
- Hardening
- Sensitization
- Sigma Phase
- 885°F (475°C) Embrittlement
- Temper Embrittlement
- Liquid Metal Embrittlement (LME)
- Carburization
- Metal Dusting
- Decarburization
- Selective Leaching

Domain 5- Mechanical Failures–2%
- Incorrect or Defective Materials
- Mechanical Fatigue
- Corrosion Fatigue
- Cavitation Damage
- Mechanical Damage
- Overloading
- Overpressuring
- Brittle Fracture
- Creep
- Stress Rupture
- Thermal Shock
- Thermal Fatigue
Domain 6- Unit Specific Corrosion Issues—34%

- Crude Distillation and Desalting
- Fluid Catalytic Cracking
- Cracked Light Ends Recovery
- Hydrofluoric Acid Alkylation
- Sulfuric Acid Alkylation
- Hydroprocessing
- Catalytic Reforming
- Delayed Coking
- Amine Treating
- Sulfur Recovery

Domain 7- Corrosion Monitoring—3%

- Radiography
- Ultrasonic thickness measurements
- Corrosion coupons
- Electrical resistance probes
- Hydrogen flux monitoring
- Corrosion monitoring sites
- Automated on-line monitoring

Domain 8- Failure Analysis and Nondestructive Testing—3%

- Surface deposit analysis
- Field metallographic replication
- Hardness Testing
- Positive material identification
- Macroscopic examination of fracture surfaces
- Microscopic examination
- Magnetic testing
  - Wet method
  - Dry method
- Penetrant testing
- Sectioning

Types of Questions

Description of Questions

The questions on this exam are multiple-choice where there is only one correct answer. The questions are based on the knowledge and skills required in the refining industry for a Refining Corrosion Technologist. While the NACE training course is an excellent method of preparation it is not the only reference used in the development of the questions.

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.

Domain 6-Unit Specific Corrosion

1. Which one of the following materials is NOT a common material of construction for sulfur pump component?
   a. Type 316 stainless steel
   b. Alloy 400
   c. Ductile iron
   d. Carbon steel
**Domain 2- Corrosion Mechanisms**

2. When two different metals or alloys are electrically joined in an electrolyte, the worst corrosion occurs on the metal or alloy closer to the
   a. Cathodic (noble) end of the galvanic series
   b. Anodic (active) end of the galvanic series
   c. Both metals
   d. No corrosion takes place

**Domain 8- Failure Analysis and Nondestructive Testing**

3. Penetrant testing is best at finding
   a. Creep voids
   b. Porosity
   c. Sub-surface cracks
   d. Surface-breaking cracks

**Domain 4- Metallurgical Failures**

4. High temperature carburization occurs in which part(s) of an FCC unit?
   a. Reactor and preheater
   b. Regenerator and flue gas treater
   c. Fractionator and crack light ends unit
   d. Reactor and regenerator

**Answer Key**

1. b
   Reference: NACE International Corrosion Control in the Refining Industry course materials. Chapter 12

2. b

3. d

4. d
   Reference: NACE International Corrosion Control in the Refining Industry course materials. Chapter 4
Preparation

Training

*NACE Course: Corrosion Control in the Refining Industry.*

The course table of contents is listed below—see APPENDIX A

www.nace.org/cstm/education/Course.aspx?id=34b24d54-b111-db11-953d-001438c08dca

Reference Material

- NACE Corrosion Control In The Refining Industry course materials, included with training.
- Select NACE Standard Practices and Technical Committee Reports, included with training.
- Select API Recommended Practices—[www.api.org/standards](http://www.api.org/standards)
# Appendix A

## CORROSION CONTROL IN THE REFINING INDUSTRY

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A  NACE Standard MR0103, “Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Environments”

B  NACE Standard TM0284, “Evaluation of Pipeline and Pressure Vessel Steels for Resistance to Hydrogen-Induced Cracking”

C  NACE Standard TM0177, “Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking and Stress Corrosion Cracking in H₂S Environments”


E  NACE SP0403, “Avoiding Caustic Stress Corrosion Cracking of Carbon Steel Refinery Equipment and Piping”

F  NACE Publication 34105, “Effect of Nonextractable Chlorides on Refining Corrosion and Fouling”

G  NACE SP0472, “Methods and Controls to Prevent In-Service Environmental Cracking of Carbon Steel Weldments in Corrosive Petroleum Refining Environments”

H  NACE SP0296, “Guidelines for Detection, Repair, and Mitigation of Cracking of Existing Petroleum Refinery Pressure Vessels in Wet H₂S Environments”

I  NACE Publication 8X194, “Materials and Fabrication Practices for New Pressure Vessels to be Used in Wet H₂S Refinery Environments”

J  NACE Publication 8X294, “Review of Published Literature on Wet H₂S Cracking of Steels Through 1989”
K  NACE Publication 5A171, “Materials for Receiving, Handling, and Storing Hydrofluoric Acid”

L  NACE Standard RP0391, Materials for Handling and Storage of Commercial (90 to 100%) Sulfuric Acid at Ambient Temperatures”

M  NACE SP0294, “Design, Fabrication, and Inspection of Tanks for the Storage of Concentrated Sulfuric Acid and Oleum at Ambient Temperatures”

N  NACE SP0205, ”Recommended Practice for the Design, Fabrication and Inspection of Tanks for the Storage of Petroleum Refining Alkylation Unit Spent Sulfuric Acid at Ambient Temperatures”

O  API Publication 941, “Steels for Hydrogen Service at Elevated Temperature and Pressure”

P  NACE Standard SP0170, “Protection of Austenitic Stainless Steels and Other Austenitic Alloys from Polythionic Acid Stress Corrosion Cracking During Shutdown of Refinery Equipment”

Q  NACE Publication 34103, “Overview of Sulfidic Corrosion in Petroleum Refining”


U NACE Standard TM0169, “Laboratory Corrosion Testing of Metals”

V NACE SP0590, “Recommended Practice for Prevention, Detection and Correction of Deaerator Cracking”

W

X NACE International Publication 34109 Crude Distillation Unit—Distillation Tower Overhead System Corrosion

Y UNS Numbers/Composition of Alloys

Z Glossary of Refinery Corrosion Related Terms