Senior Internal Corrosion Technologist

Exam Preparation Guide

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Introduction

The Senior Internal Corrosion Technologist Theory Exam is designed to assess whether a candidate has the requisite knowledge and skills that a minimally qualified Senior Internal Corrosion Technologist must possess. The exam consists of 75 multiple-choice questions covering intermediate and basic areas of the Senior Internal Corrosion Technologist Body of Knowledge (BOK).

Test Name	Senior Internal Corrosion Technologist Theory Exam
Test Code	SICT
Time	2 ½ hours*
Number of Questions	75
Format	Computer Based Testing (CBT)

NOTE: A Pass/Fail result is provided at the end of the exam.

- *Total Seat Time includes 10 minutes for a Tutorial & Non-Disclosure Agreement and 140 minutes for the Exam.
- The course manual is **NOT** provided in the exam. Reference material is provided as a PDF for conversions and applicable standards.

Target Audience

The Senior Internal Corrosion Technologist should have a thorough understanding of electrochemical and corrosion principals, field testing, laboratory analysis, monitoring techniques, and mitigation strategies. This person should also be capable of comprehensive environment assessments required to develop and manage internal corrosion control programs, have sufficient knowledge and experience to determine corrective action for high-level internal corrosion problems within a pipeline system, be able to implement internal corrosion integrity programs as directed, and be able to conduct and direct all phases of ICDA.

The Senior Internal Corrosion Technologist should also possess the skills and knowledge required for the Internal Corrosion Technologist. Successful candidates will have a firm grasp of internal corrosion and assessment methods, including both direct and indirect methods. Successful candidates will also have knowledge of locating internal corrosion damage, system evaluation, and monitoring strategy and techniques.

The successful candidates will also understand internal corrosion mitigation methods, including selecting the appropriate methods, implementing these methods, and determining their effectiveness. Long-term integrity management and data integration is also important.

Requirements

Requirements for Senior Internal Corrosion Technologist:

- ■ Work Experience
- ■ Ethics Course Requirement
- ■ Core Certification Exam
- ■ Application

Work Experience Requirement:
Choose one of the following work experience options:
8 years of verifiable internal corrosion-related work experience in a pipeline environment **AND** active Internal Corrosion Technologist certification
OR
Bachelor's Degree in Physical Science or Engineering **AND** 4 years of verifiable internal corrosion-related work experience in a pipeline environment
Ethics Course Requirement:
Ethics for the Corrosion Professional Course **OR** an equivalent training
Course Recommendation:
Successful completion of AMPP Internal Corrosion for Pipelines – Advanced Course
Core Exam Requirement:
Senior Internal Corrosion Technologist Theory Exam
Application Requirement:
Approved Senior Internal Corrosion Technologist application

Note: Completion of course does not entitle the candidate to the certification.

Upon successful completion of requirements, the candidate will be awarded a Senior Internal Corrosion Technologist certification.

Senior Internal Corrosion Technologist – Knowledge and Skill Areas Tested

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

1. BASICS (15%)

A. Corrosion Theory

1. Understand the composition of a basic corrosion cell and the electrochemical reactions.

2. Understand and identify forms of corrosion, corrosion mechanisms, and corrosive species.

3. Understand and identify the various operating conditions, environments, and facilities and how they impact the internal corrosion process.

2. ASSESSMENT OF INTERNAL CORROSION (60%)

A. Assessment Methods

1. Identify the characteristics of indirect and direct methods used for detecting and evaluating internal corrosion severities.

2. Describe the conditions used to determine between indirect versus direct methods.

B. Indirect Methods

1. Identify the components in a gas, liquid, or solid analysis used to assess the environment for internal corrosion.

2. Understand the components typical of physical tests, chemical tests (dissolved gases), cations, and anions that characterize liquid and solids analysis.

3. Identify the methods of analysis that can be used determine levels of constituents.

4. Understand and apply the various models used to predict internal corrosion.

5. Understand and utilize proper collection and preservation techniques of liquids and solid samples on internal surface of piping/components for field and laboratory testing.

6. Understand the criteria for selecting an indirect assessment method/technique.

C. Direct Methods

1. Understand the factors for selecting the appropriate device for evaluating corrosion severity.

2. Be familiar with the parameters used in designing monitoring systems.

3. Identify tools and methods required to perform a comprehensive corrosion investigation and the criteria for selecting a direct assessment method/technique.

4. Understand and utilize the proper appropriate techniques used to preserve corroded/damaged piping components when conducting an investigation.

5. Understand the limitations of corrosion detection devices commonly used.

6. Be familiar with the types and purposes of corrosion coupons.

7. Be familiar with the types and purposes of electronic probes.

D. Locating Internal Corrosion Damage

1. Identify parameters involved in hydrostatic testing.

2. Understand the limitations of hydrostatic testing.

3. Understand the criteria for selecting an inspection tool.

4. Identify ILI compatibility assessment factors.

5. Understand ILI design factors considered for new construction.

6. Understand the components of an ILI data analysis and be able to interpret ILI data.

7. Be familiar with the four-step process of ICDA.

8. Understand ICDA pre-assessment objectives.

9. Identify the factors considered in ICDA feasibility assessment.

10. Understand ICDA indirect inspection objectives.

11. Understand the application of flow models for system analysis and ICDA.

12. Understand the ICDA detailed examination process.

13. Understand ICDA post-assessment factors used in determining reassessment intervals.

14. Identify other methods used in locating internal corrosion damage and utilize these methods when appropriate.

E. System Evaluation Strategy and Techniques

1. Understand the importance and role of each strategy and technique considered when designing an internal corrosion control program.

2. Understand the parameters used to weight and validate data integrity.

3. Utilize assessment data to implement a new or modify an internal corrosion control program.

4. Recognize when additional information is required and be able to recommend the method or technique that should be utilized to acquire the information.

F. Monitoring Strategy and Techniques

1. Have knowledge of and understand the various methods and techniques used for monitoring a pipeline environment for internal corrosion.

2. Understand the criteria for selection of a monitoring method/technique.

3. Identify operating parameters that may contribute to internal corrosion and utilize this information in the selection process.

4. Understand operating parameters that influence monitoring plans.

5. Be able to interpret data collected and recommend if corrective action is needed.

6. Implement an appropriate monitoring strategy for a given pipeline environment.

3. INTERNAL CORROSION MITIGATION (20%)

A. Mitigation Methods

1. Identify when design and operational parameters can be used to mitigate corrosion, including proper materials selection.

2. Recognize maintenance pigging as a form to control internal corrosion.

3. Have knowledge of the types of corrosion inhibitors commonly used.

4. Understand the conditions that influence the selection of chemicals and utilize this information when selecting a mitigation method.

5. Have knowledge of the type of biocides commonly used.

6. Recognize other factors that influence chemical change.

B. Selecting Appropriate Mitigation Methods

1. Understand the different of types of corrosion mitigation, including the criteria for selecting the most appropriate method for a given internal pipeline environment.

2. Identify the various operating regimes for proper application of mitigation strategies.

3. Identify the various operating conditions that influence the selection of types of pigs used.

C. Implementing Mitigation Methods

1. Understand the various operating conditions that influence when implementation should occur.

2. Understand the importance of training in implementation of mitigation and monitoring methods.

D. Determining Effectiveness

1. Understand the various operating conditions that influence an effective program strategy.

2. Identify available technologies used to evaluate program effectiveness.

4. LONG-TERM INTEGRITY MANAGEMENT (5%)

A. Data Integration

1. Understand the significance of key data and data relationships.

2. Recognize the various operating conditions that influence data results.

3. Understand individual components of data interpretation.

4. Be able to implement an internal corrosion integrity plan as directed.

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, as well as matching items. The questions are based on the knowledge and skills required for a Senior Internal Corrosion Technologist. While the AMPP training course is an excellent method of preparation, it is not the only reference used in the development of the questions. Additional references can be found in the Reference section.

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 of the following is a primary concern in hydrogen pipelines?

    A. Embrittlement

    B. Formation of H_2S

    C. Corrosion due to presence of water

    D. Inability to use corrosion inhibitors

2. Which of the following is a characteristic of fresh water?

    A. Low bacteria levels

    B. Low pH

    C. High pH

    D. Low salt content

3. Which of the following are used to determine the water dew point of a pipeline?
   SELECT TWO (2)

    A. Water content

    B. CO_2 concentration

    C. Operating pressure

    D. BS&W

Answer Key

1. **A**
2. **D**
3. **A & C**

Preparation

Recommended Training

AMPP Internal Corrosion for Pipelines – Advanced Course

Recommended Study Material—Course Manual

AMPP Internal Corrosion for Pipelines – Advanced Course

Standards

Latest editions should be used for all standards. Certain content from these standards is incorporated in the AMPP Internal Corrosion for Pipelines – Advanced Course materials and some of them are included in the course manual.

IEEE/ASTM SI 10 (2002). "American National Standard for Use of the International System of Units (SI): The Modern Metric System." ASTM.

NACE International SP 0102 (2017). "In-Line Inspection of Pipelines." NACE International.

NACE International SP 0110 (2018). "Wet Gas Internal Corrosion Direct Assessment Methodology for Pipelines." NACE International.

NACE International SP 0116 (2016). "Multiphase Flow Internal Corrosion Direct Assessment (MP-ICDA) Methodology for Pipelines." NACE International.

NACE International SP 0206 (2016). "Internal Corrosion Direct Assessment Methodology for Pipelines Carrying Normally Dry Natural Gas (DG-ICDA)." NACE International.

NACE International SP 0208 (2008). "Internal Corrosion Direct Assessment Methodology for Liquid Petroleum Pipelines." NACE International.

NACE International SP 0775 (2018). "Preparation, Installation, Analysis, and Interpretation of Corrosion Coupons in Oilfield Operations." NACE International.
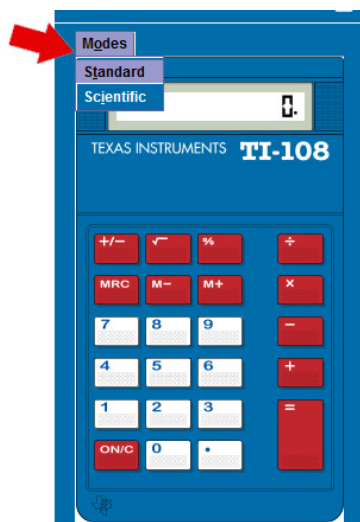
NACE International TM 0194 (2014). "Field Monitoring of Bacterial Growth in Oil and Gas Systems." NACE International.

NACE International 3T199 (2012). "Techniques for Monitoring Corrosion and Related Parameters in Field Applications." NACE International.

Calculators

Candidates will have access to either a TI Standard or TI Scientific calculator for use during the CBT Exam.

Standard Calculator

Standard Mode Functions

Function	Key	Example
Add	$+$	
Subtract	$-$	
Multiply	$\times$	
Divide	$\div$	
Negative	$(-)$	
Percentage	$\%$	
Square Root	$\sqrt{}$	Example: 4 $\sqrt{}$
Reciprocal (Inverse)	X	Example: 1 $\div$ ⬜
Store value to variable	M+	Example: 3 ⬜ ⬜ ⬜
Access variable	MRC	Example: 7 ⬜ ⬜ C ⬜
Clear variable	M- M C	

Scientific Calculator

Scientific Mode Functions

Function	Key	Example
Add	$+$	
Subtract	$-$	
Multiply	$\times$	
Divide	$\div$	
Negative	$(-)$	
Percentage	2nd [%]	
Square Root	$\sqrt{}$	Example: ⬜ ⬜ er
Reciprocal (Inverse)	X^{-1}	Example: 2 $^{-1}$ enter
Store value to variable	sto▶ yzt	Example: 3 ⬜ er o▶ yzt enter
Access variable	X^{yzt} or 2nd ecall]	Example: 7 ⬜ ⬜ ecall] er e er

Numeric Notation

Standard (Floating Decimal) Notation (digits to the left and right of decimal	mode menu options **NORM** SCI ENG e.g. 123456.78 FLOAT 0 1 2 3 **4** 5 … e.g. 123456.7800
Scientific Notation (1 digit to the left of decimal and appropriate power of 10)	mode menu options NORM **SCI** ENG .g. 1.2345678*105
Engineering Notation (numer from 1 to 999 times 10 to an integer power that is a multiple of 3)	mode menu options NORM **SCI** ENG .g. 123.45678*103

Fractions

Simple fractions	n/d
Mixed numbers	2nd [Un
Conversion b/w simple fraction and mixed number	2nd [◀▶ Un/d]
Conversion b/w fraction and decimal	2nd ◀▶ d]

Powers, roots, and inverses

Square a value	x^2	
Cube a value	^	
Raise value to specified power	^	Example (2^4) 2 ^ 4
Square root	2nd √]	Example ($\sqrt{16}$): 2nd [√] 16
Reciprocal	x^{-1}	Example (n^{th} root): 5th root of 8: 5 2nd [$^x\sqrt{}$] 8

Pi

PI (π)	π

Toggle

The scientific calculator might show the results of certain calculations as a fraction - possibly involving pi or a square root. To convert this kind of result to a single number with a decimal point, you will need to use the "toggle answer" button circled in the picture below. Pressing this button will change the display from a fractional to a decimal format.
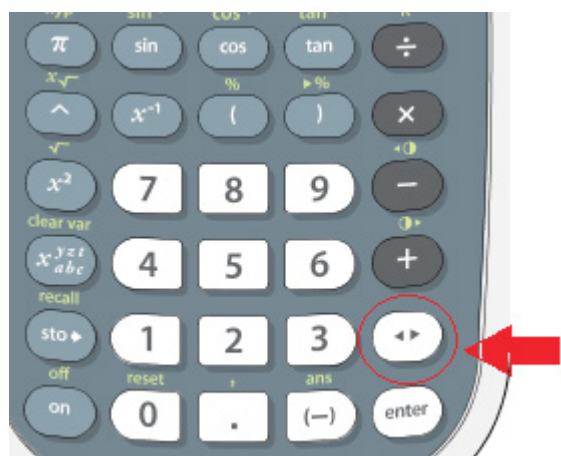
Answer Toggle

◀▶

Press the ◀▶ key to toggle the display result between fraction and decimal answers, exact square root and decimal, and exact pi and decimal.

Example

Answer toggle	2nd [√] 8 enter	$\sqrt{8}$ $2\sqrt{2}$
	◀▶	$\sqrt{8}$ $2\sqrt{2}$ $2\sqrt{2}$ 2.828427125

If you find this on-screen calculator difficult to use, raise your hand and ask the Test Administrator to provide you with a hand-held scientific calculator. If available, you will be provided with a scientific or non-scientific calculator. Candidates are not permitted to bring their own calculator into the testing room.

CONVERSIONS

EMF   electromotive force – any voltage unit
E or e   any voltage unit
V   volts
mV   millivolts
µV   microvolts
I   any amperage unit
mA   milliamperes or milliamps
µA   microamperes or microamps
R or Ω   Resistance

1,000,000 volts   =   1 megavolt
1,000 volts   =   1 kilovolt
1.0 volt   = 1000 millivolts
0.100 volt   =   100 millivolts
0.010 volt   =   10 millivolts
0.001 volt   =   1 millivolt
0.000001 volt   =   1 microvolt

1,000,000 amperes   =   1 mega-ampere
1,000 amperes   =   1 kiloampere
1.0 ampere   = 1000 milliamperes
0.100 ampere   =   100 milliamperes
0.010 ampere   =   10 milliamperes
0.001 ampere   =   1 milliampere
0.000001 ampere   =   1 microampere

1,000,000 ohms   =   1 mega-ohm
1,000 ohms   =   1 kilo-ohm
1.0 ohms   = 1000 milliohms
0.100 ohm   =   100 milliohms
0.010 ohm   =   10 milliohms
0.001 ohm   =   1 milliohm
0.000001 ohm   =   1 micro-ohm

1 meter   =   100 cm
1 meter   = 1000 mm
1 inch   =   2.54 cm
1 foot   = 30.48 cm

U.S. Customary/Metric Conversion for Units of Measure
Commonly Used in Corrosion-Related Publications

1 A/ft^2	= 10.76 A/m^2
1 acre	= 4,047 m^2 = 0.4047 ha
1 A·h/lb	= 2.205 A·h/kg
1 bbl (oil, U.S.)	= 159 L = 0.159 m^3
1 bpd (oil)	= 159 L/d = 0.159 m^3/d
1 Btu	= 1,055 J
1 Btu/ft^2	= 11,360 J/m^2
1 Btu/h	= 0.2931 W
1 Btu/h·ft^2	= 3.155 W/m^2 (K-factor)
1 Btu/h·ft^2·°F	= 5.678 W/m^2·K
1 Btu·in/h·ft^2·°F	= 0.1442 W/m·K
1 cfm	= 28.32 L/min = 0.02832 m^3/min
	= 40.78 m^3/d
1 cup	= 236.6 mL = 0.2366 L
1 cycle/s	= 1 Hz
1 ft	= 0.3048 m
1 ft^2	= 0.0929 m^2 = 929 cm^2
1 ft^3	= 0.02832 m^3 = 28.32 L
1 ft·lbf (energy)	= 1.356 J
1 ft·lbf (torque)	= 1.356 N·m
1 ft/s	= 0.3048 m/s
1 gal (Imp.)	= 4.546 L = 0.004546 m^3
1 gal (U.S.)	= 3.785 L = 0.003785 m^3
1 gal (U.S.)/min (gpm)	= 3.785 L/min = 0.2271 m^3/h
1 gal/bag (U.S.)	= 89 mL/kg (water/cement ratio)
1 grain	= 0.06480 g = 64.80 mg
1 grain/ft^3	= 2.288 g/m^3
1 grain/100 ft^3	= 22.88 mg/m^3
1 hp	= 0.7457 kW
1 microinch (μin)	= 0.0254 μm = 25.4 nm
1 in	= 0.0254 m = 2.54 cm = 25.4 mm
1 in^2	= 6.452 cm^2 = 645.2 mm^2
1 in^3	= 16.387 cm^3 = 0.01639 L
1 in·lbf (torque)	= 0.113 N·m
1 inHg	= 3.386 kPa

1 inH$_2$O	= 249.1 Pa
1 knot	= 0.5144 m/s
1 ksi	= 6.895 MPa
1 lb	= 453.6 g = 0.4536 kg
1 lbf/ft^2	= 47.88 Pa
1 lb/ft^3	= 16.02 kg/m^3
1 lb/100 gal (U.S.)	= 1.198 g/L
1 lb/1,000 bbl	= 2.853 mg/L
1 mA/in^2	= 0.155 mA/cm^2
1 mA/ft^2	= 10.76 mA/m^2
1 Mbpd (oil)	= 159 kL/d = 159 m^3/d
1 mile	= 1.609 km
1 square mile	= 2.590 km^2
1 mile (nautical)	= 1.852 km
1 mil	= 0.0254 mm = 25.4 μm
1 MMcfd	= 2.832 x 10^4 m^3/d
1 mph	= 1.609 km/h
1 mpy	= 0.0254 mm/y = 25.4 μm/y
1 oz	= 28.35 g
1 oz fluid (Imp.)	= 28.41 mL
1 oz fluid (U.S.)	= 29.57 mL
1 oz/ft^2	= 2.993 Pa
1 oz/gal (U.S.)	= 7.49 g/L
1 psi	= 0.006895 MPa = 6.895 kPa
1 qt (Imp.)	= 1.1365 L
1 qt (U.S.)	= 0.9464 L
1 tablespoon (tbs)	= 14.79 mL
1 teaspoon (tsp)	= 4.929 mL
1 ton (short)	= 907.2 kg
1 U.S. bag cement	= 42.63 kg (94 lb)
1 yd	= 0.9144 m
1 yd^2	= 0.8361 m^2
1 yd^3	= 0.7646 m^3

"American National Standard for Use of the International System of Units (SI): The Modern Metric System" ASTM SI 10. (2002). ASTM.

REFERENCES & STANDARDS USED TO DEVELOP THE REFERENCE MATERIAL

"American National Standard for Use of the International System of Units (SI): The Modern Metric System" ASTM SI 10. (2002). ASTM.

NACE SP 0102 (2017). "In-Line Inspection of Pipelines."

NACE SP 0110 (2018). "Wet Gas Internal Corrosion Direct Assessment Methodology for Pipelines."

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NACE 3T199 (2012). "Techniques for Monitoring Corrosion and Related Parameters in Field Applications."