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).

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Senior Internal Corrosion Technologist Theory Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Code</td>
<td>SICT</td>
</tr>
<tr>
<td>Time</td>
<td>2 ½ hours*</td>
</tr>
<tr>
<td>Number of Questions</td>
<td>75</td>
</tr>
<tr>
<td>Format</td>
<td>Computer Based Testing (CBT)</td>
</tr>
</tbody>
</table>

**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:

<table>
<thead>
<tr>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 years of verifiable internal corrosion-related work experience in a pipeline environment <strong>AND</strong> active Internal Corrosion Technologist certification</td>
</tr>
<tr>
<td>OR</td>
</tr>
<tr>
<td>Bachelor’s Degree in Physical Science or Engineering <strong>AND</strong> 4 years of verifiable internal corrosion-related work experience in a pipeline environment</td>
</tr>
</tbody>
</table>

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 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$_2$S
   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.


**Calculators**

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

### Standard Calculator

<table>
<thead>
<tr>
<th>Standard Mode Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add: +</td>
</tr>
<tr>
<td>Subtract: -</td>
</tr>
<tr>
<td>Multiply: ×</td>
</tr>
<tr>
<td>Divide: ÷</td>
</tr>
<tr>
<td>Negative: (−)</td>
</tr>
<tr>
<td>Percentage: %</td>
</tr>
<tr>
<td>Square Root: √</td>
</tr>
<tr>
<td>Example: $4\sqrt{}$</td>
</tr>
<tr>
<td>Reciprocal (Inverse): X</td>
</tr>
<tr>
<td>Example: $\frac{1}{X}$</td>
</tr>
<tr>
<td>Store value to variable: M+</td>
</tr>
<tr>
<td>Example: 3</td>
</tr>
<tr>
<td>Access variable: MRC</td>
</tr>
<tr>
<td>Example: 7</td>
</tr>
<tr>
<td>Clear variable: M−</td>
</tr>
</tbody>
</table>

### Scientific Calculator

<table>
<thead>
<tr>
<th>Scientific Mode Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add: +</td>
</tr>
<tr>
<td>Subtract: −</td>
</tr>
<tr>
<td>Multiply: ×</td>
</tr>
<tr>
<td>Divide: ÷</td>
</tr>
<tr>
<td>Percentage: 2nd [%]</td>
</tr>
<tr>
<td>Square Root: √</td>
</tr>
<tr>
<td>Example: 4</td>
</tr>
<tr>
<td>Reciprocal (Inverse): X−1</td>
</tr>
<tr>
<td>Example: 2−1 enter</td>
</tr>
<tr>
<td>Store value to variable: sto or 2nd store</td>
</tr>
<tr>
<td>Example: 3</td>
</tr>
<tr>
<td>Access variable: X</td>
</tr>
<tr>
<td>Example: 7</td>
</tr>
</tbody>
</table>

### 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 6 7 8 9 0 .
  e.g. 123456.7800

- **Scientific** Notation
  (1 digit to the left of decimal and appropriate power of 10)
  mode menu options
  NORM SCI ENG  e.g. 1.2345678*10^5
  .g. 1.2345678*10^5

- **Engineering** Notation
  (number from 1 to 999 times 10 to an integer power that is a multiple of 3)
  mode menu options
  NORM SCI ENG  e.g. 123.45678*10^3
  .g. 123.45678*10^3
Fractions

Simple fractions \(\frac{n}{d}\)

Mixed numbers \(2nd\) [Un

Conversion b/w simple fraction and mixed number \(2nd\) [ \(\Rightarrow\) Un/d]

Conversion b/w fraction and decimal \(2nd\) \(\Rightarrow\) d]

Powers, roots, and inverses

Square a value \(x^2\)

Cube a value \(\wedge\)

Raise value to specified power \(\wedge\) Example \((2^4)\) \(2 \wedge 4\)

Square root \(2nd\) \(\sqrt{}\) Example \((\sqrt{16})\) \(2nd\) \(\sqrt{}\) 16

Reciprocal \(x^{-1}\) Example \((n^{th}\) root): \(5^{th}\) root of 8: \(5 \ 2nd\) \(\sqrt{}\) 8

Pi

\(\pi\)

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.

![Calculator Image]

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

<table>
<thead>
<tr>
<th>EMF</th>
<th>electromotive force – any voltage unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>E or e</td>
<td>any voltage unit</td>
</tr>
<tr>
<td>V</td>
<td>volts</td>
</tr>
<tr>
<td>mV</td>
<td>millivolts</td>
</tr>
<tr>
<td>µV</td>
<td>microvolts</td>
</tr>
<tr>
<td>I</td>
<td>any amperage unit</td>
</tr>
<tr>
<td>mA</td>
<td>milliamperes or milliamps</td>
</tr>
<tr>
<td>µA</td>
<td>microamperes or microamps</td>
</tr>
<tr>
<td>R or Ω</td>
<td>Resistance</td>
</tr>
</tbody>
</table>

| 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 milliampere|
| 0.100 ampere      | = 100 milliampere |
| 0.010 ampere      | = 10 milliampere  |
| 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

<table>
<thead>
<tr>
<th>U.S. Unit</th>
<th>SI Conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 A/ft²</td>
<td>10.76 A/m²</td>
</tr>
<tr>
<td>1 acre</td>
<td>4,047 m² = 0.4047 ha</td>
</tr>
<tr>
<td>1 Ah/lb</td>
<td>2.205 Ah/kg</td>
</tr>
<tr>
<td>1 bbl (oil, U.S.)</td>
<td>159 L = 0.159 m³</td>
</tr>
<tr>
<td>1 bpd (oil)</td>
<td>159 L/d = 0.159 m³/d</td>
</tr>
<tr>
<td>1 BTU</td>
<td>1,055 J</td>
</tr>
<tr>
<td>1 BTU/ft²</td>
<td>11,360 J/m²</td>
</tr>
<tr>
<td>1 BTU/h</td>
<td>0.2931 W</td>
</tr>
<tr>
<td>1 BTU/hft²</td>
<td>3.155 W/m² (K-factor)</td>
</tr>
<tr>
<td>1 BTU/hft²°F</td>
<td>5.678 W/m²K</td>
</tr>
<tr>
<td>1 BTU-in/hft²°F</td>
<td>0.1442 W/m²K</td>
</tr>
<tr>
<td>1 cfm</td>
<td>28.32 L/min = 0.02832 m³/min</td>
</tr>
<tr>
<td></td>
<td>= 40.78 m³/d</td>
</tr>
<tr>
<td>1 cup</td>
<td>236.6 mL = 0.2366 L</td>
</tr>
<tr>
<td>1 cycle/s</td>
<td>1 Hz</td>
</tr>
<tr>
<td>1 ft</td>
<td>0.3048 m</td>
</tr>
<tr>
<td>1 ft²</td>
<td>0.0929 m² = 929 cm²</td>
</tr>
<tr>
<td>1 ft³</td>
<td>0.02832 m³ = 28.32 L</td>
</tr>
<tr>
<td>1 ft-lbf (energy)</td>
<td>1.356 J</td>
</tr>
<tr>
<td>1 ft-lbf (torque)</td>
<td>1.356 Nm</td>
</tr>
<tr>
<td>1 ft/s</td>
<td>0.3048 m/s</td>
</tr>
<tr>
<td>1 gal (Imp.)</td>
<td>4.546 L = 0.004546 m³</td>
</tr>
<tr>
<td>1 gal (U.S.)</td>
<td>3.785 L = 0.003785 m³</td>
</tr>
<tr>
<td>1 gal (U.S.)/min (gpm)</td>
<td>3.785 L/min = 0.2271 m³/h</td>
</tr>
<tr>
<td>1 gal/bag (U.S.)</td>
<td>89 mL/kg (water/cement ratio)</td>
</tr>
<tr>
<td>1 grain</td>
<td>0.06480 g = 64.80 mg</td>
</tr>
<tr>
<td>1 grain/ft³</td>
<td>2.288 mg/m³</td>
</tr>
<tr>
<td>1 grain/100 ft³</td>
<td>22.88 mg/m³</td>
</tr>
<tr>
<td>1 hp</td>
<td>0.7457 kW</td>
</tr>
<tr>
<td>1 microinch (μin)</td>
<td>0.0254 μm = 25.4 nm</td>
</tr>
<tr>
<td>1 in</td>
<td>0.0254 m = 25.4 cm = 25.4 mm</td>
</tr>
<tr>
<td>1 in²</td>
<td>6.452 cm² = 645.2 mm²</td>
</tr>
<tr>
<td>1 in³</td>
<td>16.387 cm³ = 0.01639 L</td>
</tr>
<tr>
<td>1 in-lbf (torque)</td>
<td>0.113 Nm</td>
</tr>
<tr>
<td>1 in-lbf</td>
<td>3.386 kPa</td>
</tr>
<tr>
<td>1 in-H₂O</td>
<td>249.1 Pa</td>
</tr>
<tr>
<td>1 knot</td>
<td>0.5144 m/s</td>
</tr>
<tr>
<td>1 ksl</td>
<td>6.895 MPa</td>
</tr>
<tr>
<td>1 lb</td>
<td>453.6 g = 0.4536 kg</td>
</tr>
<tr>
<td>1 lbf/ft²</td>
<td>47.88 Pa</td>
</tr>
<tr>
<td>1 lbf/ft³</td>
<td>16.02 kg/m³</td>
</tr>
<tr>
<td>1 lb/100 gal (U.S.)</td>
<td>1.198 g/L</td>
</tr>
<tr>
<td>1 lb/1,000 bbl</td>
<td>2.853 mg/L</td>
</tr>
<tr>
<td>1 mA/in²</td>
<td>0.155 m²/cm²</td>
</tr>
<tr>
<td>1 mA/ft²</td>
<td>10.76 m²/cm²</td>
</tr>
<tr>
<td>1 Mbpd (oil)</td>
<td>159 kl/d = 159 m³/d</td>
</tr>
<tr>
<td>1 mile</td>
<td>1.609 km</td>
</tr>
<tr>
<td>1 square mile</td>
<td>2.590 km²</td>
</tr>
<tr>
<td>1 mile (nautical)</td>
<td>1.852 km</td>
</tr>
<tr>
<td>1 mil</td>
<td>0.0254 mm = 25.4 μm</td>
</tr>
<tr>
<td>1 MMcf/d</td>
<td>2.832 x 10⁴ m³/d</td>
</tr>
<tr>
<td>1 mph</td>
<td>1.609 km/h</td>
</tr>
<tr>
<td>1 mpy</td>
<td>0.0254 mm/y = 25.4 μm/y</td>
</tr>
<tr>
<td>1 oz</td>
<td>28.35 g</td>
</tr>
<tr>
<td>1 oz fluid (Imp.)</td>
<td>28.41 mL</td>
</tr>
<tr>
<td>1 oz fluid (U.S.)</td>
<td>29.57 mL</td>
</tr>
<tr>
<td>1 oz/ft²</td>
<td>2.993 Pa</td>
</tr>
<tr>
<td>1 oz/gal (U.S.)</td>
<td>7.49 g/L</td>
</tr>
<tr>
<td>1 psi</td>
<td>0.006895 MPa = 6.895 kPa</td>
</tr>
<tr>
<td>1 qt (Imp.)</td>
<td>1.1365 L</td>
</tr>
<tr>
<td>1 qt (U.S.)</td>
<td>0.9464 L</td>
</tr>
<tr>
<td>1 tablespoon (tbs)</td>
<td>14.79 mL</td>
</tr>
<tr>
<td>1 teaspoon (tsp)</td>
<td>4.929 mL</td>
</tr>
<tr>
<td>1 ton (short)</td>
<td>907.2 kg</td>
</tr>
<tr>
<td>1 U.S. bag cement</td>
<td>42.63 kg (94 lb)</td>
</tr>
<tr>
<td>1 yd</td>
<td>0.9144 m</td>
</tr>
<tr>
<td>1 yd²</td>
<td>0.8361 m²</td>
</tr>
<tr>
<td>1 yd³</td>
<td>0.7646 m³</td>
</tr>
</tbody>
</table>

REFERENCES & STANDARDS USED TO DEVELOP THE REFERENCE MATERIAL


