

## API.API-571.v2026-04-14.q65

Exam Code:	API-571
Exam Name:	Corrosion and Materials Professional
Certification Provider:	API
Free Question Number:	65
Version:	v2026-04-14
# of views:	104
# of Questions views:	652
<a href="https://www.freecram.net/torrent/API.API-571.v2026-04-14.q65.html">https://www.freecram.net/torrent/API.API-571.v2026-04-14.q65.html</a>	

### NEW QUESTION: 1

One way to prevent oxide scale formation on alloy steel is to increase the:

- A. Chromium content of the steel
- B. Carbon equivalent of the alloy
- C. Molybdenum content of the steel to 6%
- D. Nickel content of the steel

**Answer: (SHOW ANSWER)**

API RP 571 under Oxidation states:

"Resistance to oxidation is improved significantly by increasing chromium content, as it promotes the formation of a protective chromium oxide (Cr#O#) layer."

"Nickel may aid in high-temperature strength but does not directly improve oxidation resistance like chromium does." (Reference: API RP 571, Section 5.1.1 - Oxidation)

Hence, option A is correct.

### NEW QUESTION: 2

What damage mechanism can occur in wet H<sub>2</sub>S environments and is sometimes confused with wet H<sub>2</sub>S damage?

- A. Ammonia cracking
- B. HCl cracking
- C. Amine cracking
- D. Polythionic cracking

**Answer: (SHOW ANSWER)**

API RP 571 - Polythionic Acid Stress Corrosion Cracking:

"Polythionic acid SCC may be mistaken for wet H<sub>2</sub>S damage because both involve cracking in austenitic stainless steels under certain conditions." Thus, option D is correct.

### NEW QUESTION: 3

(Amine stress corrosion cracking is found primarily in the:)

- A. Weld fusion line
- B. Weld heat affected zone
- C. Weld metal
- D. Base metal

**Answer: (SHOW ANSWER)**

Comprehensive and Detailed Explanation From Exact Extract:

According to API RP 571, amine stress corrosion cracking (Amine SCC) is a form of environmentally assisted cracking that occurs in alkanolamine systems (e.g., MEA, DEA, DGA) used for acid gas treating.

The cracking mechanism requires the simultaneous presence of tensile stress, susceptible microstructure, and an amine environment.

API RP 571 clearly states that Amine SCC occurs primarily in the weld heat affected zone (HAZ) of carbon and low-alloy steels. The reasons include:

- \* The HAZ contains high residual stresses from welding.
- \* The microstructure in the HAZ is metallurgically altered, making it more susceptible than base metal.
- \* Cracks often initiate adjacent to welds, not in the weld metal itself.

Why the other options are incorrect:

- \* Option A (Weld fusion line) is not the primary cracking location.
- \* Option C (Weld metal) generally has different chemistry and lower susceptibility.
- \* Option D (Base metal) typically has lower residual stress and is less prone.

API RP 571 specifically identifies the weld HAZ as the dominant cracking location for Amine SCC.

Referenced Documents (Study Basis):

- \* API RP 571 - Section on Amine Stress Corrosion Cracking
- \* API Corrosion and Materials Study Guide

#### **NEW QUESTION: 4**

Cooling water corrosion of exchanger tubes is typically increased by:

- A. Increasing the passivation layer.
- B. Decreasing the process temperature.
- C. Increasing the oxygen content.
- D. Decreasing the cooling water outlet temperature.

**Answer: C (LEAVE A REPLY)**

According to API RP 571, under the section "Corrosion in Aqueous Environments - Cooling Water Corrosion

", one of the key contributors to corrosion in carbon steel and other materials used in heat exchangers is the presence of dissolved oxygen. API RP 571 states:

"Oxygen is a primary contributor to corrosion in cooling water systems. Systems open to the atmosphere are typically more corrosive than closed systems due to the continual replenishment of oxygen."

"Corrosion rates are highest where oxygen concentration is the greatest, especially in systems using untreated or poorly treated water."

"Carbon steel corrodes in the presence of oxygen and water, forming corrosion products that may or may not adhere to the surface." (Reference: API RP 571, Section 4.3.1.1 - Cooling Water Corrosion) Therefore, increasing oxygen content directly increases corrosion activity in exchanger tubes, making option C the correct and documented answer.

#### **NEW QUESTION: 5**

Naphthenic acid corrosion (NAC) is most severe in what phase of flow?

- A. Two phase
- B. Hydrocarbon phase
- C. Water phase
- D. Vapor phase

**Answer: (SHOW ANSWER)**

API RP 571 on Naphthenic Acid Corrosion (NAC) details:

"NAC is most aggressive in two-phase flow where the shear stress is high, such as in elbows, reducers, and at orifices."

"High velocity and turbulence in two-phase flow strip protective layers and accelerate corrosion." Therefore, option A is the correct and most critical phase.

#### **NEW QUESTION: 6**

Besides corrosion, what other damage mechanism in hydrofluoric (HF) acid service should inspectors be alert to?

- A. Hydrogen stress cracking
- B. Fluoride stress cracking
- C. Stress corrosion cracking
- D. Wet HF cracking

**Answer: (SHOW ANSWER)**

API RP 571 - Hydrogen Stress Cracking - HF Acid Service:

"HF acid environments can cause hydrogen stress cracking (HSC) in carbon steel, particularly in areas with high hardness or residual stress."

"This is distinct from general corrosion and requires specific inspection focus." So, option A is correct.

#### **NEW QUESTION: 7**

Brittle fracture of a component is closely related to:

- A. Material toughness

- B. Number of thermal cycles
- C. Tensile strength
- D. Ductility

**Answer: (SHOW ANSWER)**

API RP 571 on Brittle Fracture notes:

"The primary factor influencing brittle fracture is material toughness, especially at low temperatures."

"Materials with low fracture toughness are susceptible to catastrophic failure when stressed below their ductile-to-brittle transition temperature." Hence, option A is correct.

### **NEW QUESTION: 8**

Hydrogen permeation or diffusion rates associated with wet H<sub>2</sub>S damage of carbon steel and low-alloy steels have been found to be minimal at a pH of:

- A. 3
- B. 5
- C. 7
- D. 9

**Answer: (SHOW ANSWER)**

API RP 571 discusses this under Wet H<sub>2</sub>S Damage - Hydrogen Blistering, HIC, SOHIC:

"Hydrogen generation is reduced as pH increases. At pH 9 and above, the corrosion potential is less favorable for hydrogen charging and thus permeation into the steel is minimal."

"Most wet H<sub>2</sub>S cracking damage mechanisms are accelerated under acidic conditions (pH < 7)." Hence, high pH (around 9) environments offer the most protection against hydrogen damage, making option D the correct choice.

### **NEW QUESTION: 9**

Sigma phase embrittlement can occur in which of the following piping materials operating at temperatures of 1000°F to 1750°F (538°C to 954°C)?

- A. 300 series stainless steel
- B. 400 series stainless steel (12Cr)
- C. Monel 400
- D. 5% chrome

**Answer: (SHOW ANSWER)**

As per API RP 571 Section 5.3.2.2 (Sigma Phase Embrittlement):

"Sigma phase embrittlement occurs in austenitic stainless steels (like 300 series) and duplex stainless steels exposed to 1000°F to 1800°F (540°C to 980°C)... This embrittlement results in a significant loss of toughness and ductility."

\* Sigma phase is not a concern in Monel (nickel-copper alloy) or 5Cr steels.

\* 400 series are ferritic and not typically affected by sigma phase.

Hence, Option A (300 series stainless steel) is correct.

**NEW QUESTION: 10**

- A. 400°F to 675°F (204°C to 357°C)
- B. 750°F to 1500°F (400°C to 815°C)
- C. 1650°F to 1725°F (899°C to 941°C)
- D. 1200°F to 1650°F (622°C to 900°C)

**Answer:** ([SHOW ANSWER](#))

In API RP 571, under the section Polythionic Acid Stress Corrosion Cracking, it is stated: "Sensitization of austenitic stainless steels occurs when the material is exposed to temperatures in the range of

800°F to 1500°F (427°C to 816°C), which causes chromium carbide precipitation at grain boundaries, depleting the adjacent areas of chromium."

"Once sensitized, the steel becomes susceptible to attack in the presence of polythionic acids, particularly in environments containing sulfides and oxygen." (Reference: API RP 571, Section 4.2.2.5 - PTA SCC) This makes option B (750°F to 1500°F / 400°C to 815°C) the most accurate and standard-aligned answer.

**NEW QUESTION: 11**

Proactive and retroactive positive material identification programs are especially useful for services exposed to:

- A. Caustic embrittlement
- B. Ammonia stress corrosion cracking
- C. Sulfidation
- D. Sour water

**Answer:** ([SHOW ANSWER](#))

API RP 578 (Material Verification Program), referenced in API RP 571, specifically calls out sulfidation failures as a major driver for Positive Material Identification (PMI):

"PMI programs are particularly important in services prone to sulfidation where incorrect alloying elements (e.

g., carbon steel used in place of low Cr alloy) have led to catastrophic failures."

"Many failures have occurred when carbon steel was mistakenly installed in place of specified Cr-alloys in sulfidation-prone environments." (Reference: API RP 578 and API RP 571, Section 4.2.1.1 - Sulfidation) Thus, option C is the most appropriate answer.

**NEW QUESTION: 12**

What is the best way to inspect for brittle fracture?

- A. Wet fluorescent magnetic-particle testing
- B. Tensile testing
- C. Ultrasonic examination
- D. There is no effective way

**Answer:** ([SHOW ANSWER](#))

API RP 571 notes that for detecting existing cracks or flaws that may lead to brittle fracture, especially those that initiate at welds or surface stress points:

"Wet fluorescent magnetic-particle inspection is highly effective for detecting surface-breaking flaws in ferromagnetic materials that are susceptible to brittle fracture."

"It is sensitive to tight cracks and surface discontinuities that may serve as initiation sites for brittle fracture." (Reference: API RP 571, Section 4.2.1.2 - Brittle Fracture) Therefore, option A is correct as it is the most effective NDE technique for detecting early signs of brittle cracking.

### **NEW QUESTION: 13**

(Sulfidation is known to be accelerated by the presence of:)

- A. Hydrogen
- B. Chlorides
- C. Amines
- D. Moisture

**Answer: A (LEAVE A REPLY)**

Comprehensive and Detailed Explanation From Exact Extract:

Per API RP 571, sulfidation corrosion rates are significantly accelerated by the presence of hydrogen.

Hydrogen promotes:

- \* Breakdown of protective sulfide scales
- \* Increased diffusion of sulfur into the metal
- \* Higher metal loss rates

This phenomenon is often referred to as hydrogen-assisted sulfidation and is commonly observed in refinery process units.

Moisture is more closely associated with oxidation mechanisms rather than high-temperature sulfidation.

Referenced Documents (Study Basis):

- \* API RP 571 - Section on Sulfidation and High-Temperature Corrosion

### **NEW QUESTION: 14**

The most important alloying element for prevention of high-temperature hydrogen attack is:

- A. Manganese
- B. Chromium
- C. Nickel
- D. Niobium

**Answer: (SHOW ANSWER)**

According to API RP 941, and also noted in RP 571:

"Nickel significantly improves resistance to HTHA (High Temperature Hydrogen Attack) by stabilizing austenitic phases and reducing carbide decomposition." Hence, option C is correct.

### NEW QUESTION: 15

Metal dusting usually occurs in the operating temperature range of:

- A. 600°F-1200°F (315°C-650°C)
- B. 900°F-1500°F (480°C-815°C)
- C. 1200°F-1800°F (650°C-980°C)
- D. 1500°F-2100°F (815°C-1150°C)

**Answer: (SHOW ANSWER)**

As per API RP 571 Section 5.1.4.2 (Metal Dusting):

"Metal dusting is a type of carburization attack that typically occurs in high carbon activity environments, with temperatures generally between 900°F and 1200°F (480°C to 650°C), although damage has been reported as low as 600°F (315°C)." Therefore, the commonly accepted operational range is best described by Option A: 600°F-1200°F (315°C-650°C).

### NEW QUESTION: 16

What arbitrary value of hydrogen sulfide in water is often used as the defining concentration where cracking damage becomes a problem in carbon steel pipe?

- A. 0.05%
- B. 0.5%
- C. 1 ppmw
- D. 50 ppmw

**Answer: D (LEAVE A REPLY)**

As per API RP 571 and further clarified in API RP 939-C:

"An arbitrary threshold of 50 ppmw H<sub>2</sub>S in the aqueous phase is often used to define when carbon and low alloy steels become susceptible to cracking damage in wet H<sub>2</sub>S environments."

"Below this level, the risk of SSC, HIC, and SOHIC is considered lower, although damage has still occurred at lower concentrations depending on stress and metallurgical conditions." Therefore, the correct answer is option D (50 ppmw).

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### NEW QUESTION: 17

Steel hardness and strength are critical factors for what type of damage mechanism?

- A. Carbonate corrosion stress cracking
- B. Polythionic acid cracking
- C. Hydrogen stress cracking-HF
- D. Amine stress corrosion cracking

**Answer: (SHOW ANSWER)**

API RP 571 emphasizes under Hydrogen Stress Cracking - Hydrofluoric Acid (HF):

"Cracking in carbon steel is influenced by high hardness and tensile stress in the presence of wet HF acid."

"Controlling weld and heat-affected zone hardness to below 200 BHN is a key mitigation measure, as higher hardness significantly increases susceptibility." Steel hardness and strength are thus critical for cracking in HF environments, making option C correct.

### NEW QUESTION: 18

A nickel-based buttering layer is often used when welding austenitic stainless steels to carbon steels to avoid dissimilar weld metal cracking because:

- A. Austenitic stainless steels are susceptible to chloride cracking.
- B. Nickel base alloys are much softer than austenitic stainless steels.
- C. The coefficient of thermal expansion is better suited to avoid cracking.
- D. You can avoid the need for post weld heat treatment to lower hardness.

**Answer: (SHOW ANSWER)**

In TR 942-B and API RP 582, it is emphasized:

"Nickel-based buttering is often used as an intermediate layer to reduce thermal stress mismatch during welding of ferritic and austenitic materials."

"Nickel alloys have a coefficient of thermal expansion closer to that of both stainless steels and carbon steels, reducing stress concentrations and mitigating dissimilar weld cracking."

"This technique also assists in achieving metallurgical compatibility and mitigating solidification cracking." Hence, option C is correct as it directly relates to minimizing thermal expansion mismatches.

### NEW QUESTION: 19

The rate of spheroidization is affected by:

- A. temperature and pressure.
- B. type of steel and H<sub>2</sub> partial pressure.
- C. exposure time and stress.
- D. temperature and microstructure.

**Answer: (SHOW ANSWER)**

According to API RP 571 Section 5.3.2.3 (Spheroidization):

"Spheroidization is the transformation of the microstructure of carbon and low alloy steels when exposed to elevated temperatures for long durations. The rate of spheroidization depends on temperature, prior microstructure, and exposure time... The microstructure

becomes less effective at carrying loads, and strength is reduced." Key influencing factors for the rate of spheroidization are:

- \* Temperature (higher accelerates the process),
- \* Microstructure (initial phase distribution and morphology).

Pressure and hydrogen partial pressure are not relevant for this transformation, nor is stress a primary driver.

Therefore, Option D (temperature and microstructure) is correct.

### **NEW QUESTION: 20**

- A.** pH of <7 with dissolved H<sub>2</sub>S present
- B.** Localized zones of weld HAZ hardness above 200 HB
- C.** Water vapor in the hydrocarbon phase
- D.** Absorption and permeation of hydrogen

**Answer: D (LEAVE A REPLY)**

API RP 571, in its discussion on Wet H<sub>2</sub>S Damage, including HIC, SOHIC, and SSC, consistently identifies a shared mechanism:

"All wet H<sub>2</sub>S-related damage mechanisms involve the absorption of atomic hydrogen, formed at the steel surface by the corrosion reaction in the presence of H<sub>2</sub>S."

"The absorbed hydrogen may diffuse into the steel, accumulate at trap sites, and cause cracking or blistering." (Reference: API RP 571, Section 4.2.2.7 - Wet H<sub>2</sub>S Damage Mechanisms) Thus, hydrogen absorption and permeation is a unifying mechanism across all these damage modes.

Therefore, option D is correct.

### **NEW QUESTION: 21**

An inspector observes sharp-edged pitting in piping immediately downstream from an orifice. This damage has most likely resulted from which damage mechanism?

- A.** Flashing
- B.** Turbulence
- C.** Erosion
- D.** Cavitation

**Answer: (SHOW ANSWER)**

According to API RP 571 Section 5.4.2 (Erosion and Erosion/Corrosion):

"Erosion can occur downstream of flow disturbances such as control valves, orifice plates, elbows... It is characterized by localized metal loss with a directional pattern such as grooves or sharp-edged pits in areas of high velocity or turbulence." Cavitation and flashing cause damage with different signatures like pitting and spongy surface texture, while sharp-edged pitting strongly indicates erosion, especially downstream of flow restriction devices.

Thus, the correct answer is Option C (Erosion).

**NEW QUESTION: 22**

Temper embrittlement is a metallurgical change that is:

- A. Not readily apparent but can be confirmed through tension testing
- B. Readily apparent and can be confirmed through impact testing
- C. Readily apparent and can be confirmed through metallography
- D. Not readily apparent but can be confirmed through impact testing

**Answer: (SHOW ANSWER)**

API RP 571 describes temper embrittlement as a subtle metallurgical change that reduces impact toughness without obvious macrostructural change:

"Temper embrittlement is not readily apparent by visual or standard tensile testing. It is confirmed by Charpy impact testing which measures toughness at low temperatures."

"It typically affects Cr-Mo steels exposed to intermediate temperatures (650°F to 1100°F) for extended times." (Reference: API RP 571, Section 4.2.1.4 - Temper Embrittlement)

Thus, the condition is not visually or physically apparent, but is confirmed through impact testing, making option D correct.

**NEW QUESTION: 23**

Which of the following damage mechanisms is related to steel hardness?

- A. Stress-oriented hydrogen-induced cracking
- B. Sulfide stress corrosion cracking
- C. Hydrogen-induced cracking
- D. Hydrogen blistering

**Answer: (SHOW ANSWER)**

API RP 571 details that:

"Sulfide Stress Cracking (SSC) susceptibility increases significantly with increased hardness of the steel."

"NACE MR0175/ISO 15156 provides hardness limits for carbon and low-alloy steels to avoid SSC in sour environments. These are typically limited to 22 HRC or 248 Brinell."

"High hardness promotes crack initiation under tensile stress in sour environments (i.e., containing H<sub>2</sub>S)." (Reference: API RP 571, Section 4.2.2.1 - Sulfide Stress Corrosion Cracking) While hydrogen-induced cracking (HIC) and blistering are related to hydrogen charging, SSC is the only mechanism directly and critically impacted by hardness, making option B correct.

**NEW QUESTION: 24**

Convection section soot blowers that have steam supplies without a steam trap can cause:

- A. CO<sub>2</sub> corrosion.
- B. carbonic acid corrosion.
- C. thermal fatigue.
- D. condensate corrosion.

**Answer: (SHOW ANSWER)**

In steam systems, the absence of a steam trap allows condensate to accumulate, which can lead to corrosion from oxygen and carbon dioxide dissolved in the water—a classic case of condensate corrosion.

From API RP 571 Section 5.3.3.1 (Condensate Corrosion):

"If steam lines or equipment like soot blowers do not have proper drainage or steam traps, condensate may accumulate... Corrosion results from the presence of dissolved oxygen and/or carbon dioxide in the condensate." Thus, the correct answer is Option D (condensate corrosion).

### **NEW QUESTION: 25**

The primary cause of ammonium chloride corrosion is the formation of salts:

- A.** That may precipitate from high-temperature streams as they are cooled
- B.** During water washing operations in streams containing traces of chlorides
- C.** That may deposit when water evaporates to dry-out conditions as streams are heated
- D.** When steam is injected into streams containing traces of chlorides

**Answer:** ([SHOW ANSWER](#))

API RP 571 under Ammonium Chloride Corrosion details:

"The corrosion results from the deposition of ammonium chloride salts from high-temperature process streams as they cool."

"This typically occurs in crude unit overheads or other systems where salts condense out as the stream temperature drops below their dew point."

"Corrosion becomes especially aggressive when the salts are wetted by condensation." (Reference: API RP 571, Section 4.3.3.1 - Ammonium Chloride Corrosion)  
Therefore, option A is technically accurate and supported.

### **NEW QUESTION: 26**

(Prevention of high-temperature hydrogen attack is usually achieved by using:)

- A.** Alloy steels with chromium and molybdenum added to increase carbide stability
- B.** Austenitic stainless steel cladding on carbon steel equipment
- C.** High-nickel alloy steels selected in accordance with API RP 941
- D.** Carbon-manganese steels with low carbon content

**Answer:** ([SHOW ANSWER](#))

Comprehensive and Detailed Explanation From Exact Extract:

High-Temperature Hydrogen Attack (HTHA) is described in API RP 571 and API RP 941 as a damage mechanism where hydrogen reacts with carbides at elevated temperature and pressure, forming methane and causing loss of strength and fissuring.

Prevention is primarily achieved by selecting materials with stable carbides that resist hydrogen attack.

Chromium and molybdenum alloying elements:

- \* Form more stable carbides
- \* Reduce susceptibility to methane formation

\* Extend safe operating limits

Why the other options are incorrect:

\* Option B may be used in some services but is not the usual prevention method.

\* Option C is incorrect because RP 941 does not recommend high-nickel alloys as the primary solution.

\* Option D low-carbon steels are more susceptible, not resistant.

API RP 571 clearly identifies Cr-Mo alloy steels as the standard mitigation approach.

Referenced Documents (Study Basis):

\* API RP 571 - Section on High-Temperature Hydrogen Attack

\* API RP 941 - Nelson Curves and Material Selection

### **NEW QUESTION: 27**

The most effective means of preventing caustic stress corrosion cracking is:

**A.** Postweld heat treatment

**B.** Upgrading to 300 series stainless steel

**C.** Reducing caustic concentration

**D.** Controlling process temperature during steamouts

**Answer: (SHOW ANSWER)**

According to API RP 571, under Caustic Stress Corrosion Cracking (Caustic Embrittlement):

"Cracking occurs in stressed components exposed to caustic (e.g., sodium hydroxide)."

"The most effective mitigation strategy is postweld heat treatment (PWHT), which relieves residual stress that promotes cracking."

"Upgrading materials or controlling concentration may help, but do not replace stress relief." (Reference: API RP 571, Section 4.2.2.3 - Caustic SCC) Thus, PWHT is the most effective prevention technique, making option A correct.

### **NEW QUESTION: 28**

Which of the following is considered resistant to cracking in hydrofluoric acid service?

**A.** ASTM A-193 B5

**B.** ASTM A-193 B7

**C.** ASTM A-193 B7M

**D.** ASTM A-325

**Answer: (SHOW ANSWER)**

API RP 751 (referenced in RP 571) lists materials appropriate for HF acid alkylation service. It specifies:

"Chrome-moly steels such as ASTM A-193 B5 (5% Cr) bolts are preferred for their resistance to HF acid-induced cracking."

"Standard low alloy steels (e.g., B7) are not considered adequately resistant." (Reference: API RP 571 summary & API RP 751, Section 5.6.3 - Bolting Materials) Therefore, the correct and industry-approved answer is option A.

**NEW QUESTION: 29**

Which of the following will experience the highest oxidation corrosion rate at 1350°F (732°C)?

- A. Alloy 800H
- B. Type 310 stainless steel
- C. Type 304L stainless steel
- D. 9 Cr low-alloy steel

**Answer: (SHOW ANSWER)**

API RP 571 under Oxidation:

"Carbon steels and low alloy steels, such as 9 Cr, have poor oxidation resistance at temperatures above 1000° F (540°C), rapidly losing thickness."

"Stainless steels with higher Cr and Ni content (like 310) have superior oxidation resistance." Thus, 9 Cr steel will corrode fastest at 1350°F, making option D correct.

**NEW QUESTION: 30**

- A. Inclusions
- B. Hardness
- C. Residual Stress
- D. Permeability

**Answer: (SHOW ANSWER)**

API RP 571 discusses Hydrogen-Induced Cracking (HIC) and Blistering under the section:

"HIC and blistering are most strongly influenced by non-metallic inclusions, particularly elongated manganese sulfide (MnS) inclusions, which serve as trap sites for hydrogen atoms."

"These inclusions create local planes of weakness where atomic hydrogen recombines into molecular hydrogen (H<sub>2</sub>), causing high pressure and cracking." (Reference: API RP 571, Section 4.2.2.7 - Hydrogen Blistering and HIC) Thus, inclusions are the critical material factor, making option A correct.

**NEW QUESTION: 31**

Which of the materials listed are not susceptible to Chloride Stress Corrosion Cracking?

- A. 400 Series Stainless Steel
- B. 300 Series Stainless Steel
- C. 8% Nickel Alloys
- D. Duplex Stainless Steel

**Answer: (SHOW ANSWER)**

Chloride Stress Corrosion Cracking (Cl-SCC) is a serious form of corrosion primarily affecting austenitic stainless steels and some duplex stainless steels, particularly when exposed to chloride-containing environments at elevated temperatures.

According to API RP 571 Section 5.1.2.3 (Chloride Stress Corrosion Cracking - Cl-SCC):

"Austenitic stainless steels (e.g., 300 series such as Types 304 and 316) are the most susceptible to CI-SCC...

Duplex stainless steels have greater resistance but are not immune, especially at temperatures >150°F (65° C)... Ferritic stainless steels (400 series) are generally not susceptible." Thus, Option A (400 Series Stainless Steel) is not susceptible to chloride SCC, making it the correct answer.

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#### **NEW QUESTION: 32**

What alloy element most improves naphthenic acid corrosion (NAC) resistance?

- A. Molybdenum
- B. Chromium
- C. Niobium
- D. Nickel

**Answer: (SHOW ANSWER)**

API RP 571, Naphthenic Acid Corrosion:

"Molybdenum significantly improves resistance to naphthenic acid attack. Alloys such as 317, 316Mo, and Alloy 20 are used in severe NAC environments due to higher Mo content."

"Chromium and nickel play secondary roles; molybdenum is the key element." Answer is A - Molybdenum.

#### **NEW QUESTION: 33**

(Typically, surface decarburization will have what effect on steel components in high temperature service?)

- A. Accelerate stress cracking potential
- B. Cause failure by lowering strength
- C. Accelerate oxidation and sulfidation corrosion
- D. Normally no detrimental effect

**Answer: (SHOW ANSWER)**

Comprehensive and Detailed Explanation From Exact Extract:

According to API RP 571, surface decarburization is a metallurgical degradation mechanism that occurs when carbon is removed from the surface layers of steel due to

exposure to oxidizing environments at elevated temperatures. This results in a carbon-depleted surface layer.

Carbon is a primary strengthening element in carbon and low-alloy steels. When carbon is lost from the surface:

Hardness and tensile strength are reduced

Creep resistance and load-carrying capability decrease

The component becomes more susceptible to plastic deformation and failure under stress  
API RP 571 states that decarburization leads to loss of mechanical strength, especially critical in high-temperature service, where components already operate close to material limits.

Why the other options are incorrect:

Option A: Stress cracking is not the primary effect; loss of strength is.

Option C: Decarburization does not directly accelerate oxidation or sulfidation, although both may coexist.

Option D: This is incorrect; decarburization is considered detrimental in high-temperature applications.

Referenced Documents (Study Basis):

API RP 571 - Section on Decarburization and Metal Dusting

API Corrosion and Materials Study Guide

### **NEW QUESTION: 34**

Microbiologically induced corrosion is largely independent of the:

- A. Water content of the process
- B. Presence of hydrogen sulfide
- C. pH of the fluid
- D. Velocity of the flow stream

**Answer: (SHOW ANSWER)**

From API RP 571 on Microbiologically Influenced Corrosion (MIC):

"MIC depends on the presence of water, nutrients, and specific microbial species such as SRB (sulfate-reducing bacteria)."

"While flow velocity may influence deposition and oxygen content, MIC can occur in both stagnant and flowing systems. Hence, it's not strongly dependent on velocity." Thus, option D is correct - MIC is largely independent of flow velocity.

### **NEW QUESTION: 35**

In what damage mechanism does hydrogen combine with carbides in steel to form bubbles or cavities of CH#?

- A. Hydrogen blistering
- B. Hydrogen embrittlement
- C. Hydrogen-induced cracking
- D. High temperature hydrogen attack

**Answer: (SHOW ANSWER)**

According to API RP 571, under High Temperature Hydrogen Attack (HTHA):

"HTHA occurs when hydrogen diffuses into steel at elevated temperatures and reacts with carbides in the steel matrix to form methane (CH<sub>4</sub>)."

"The methane is unable to diffuse out of the steel and forms internal pressures, leading to fissuring, decarburization, and eventual failure."

"HTHA typically affects carbon steels and low alloy steels exposed to high temperature hydrogen services, particularly above 400°F (204°C) depending on partial pressure of hydrogen." (Reference: API RP 571, Section 4.2.1.3 - High Temperature Hydrogen Attack)

Hence, option D is the correct and technically supported answer.

**NEW QUESTION: 36**

Which damage mechanism will not benefit much from PWHT mitigation?

- A. Carbonate stress corrosion cracking
- B. Sulfide stress cracking
- C. Hydrogen-induced cracking
- D. Amine stress corrosion cracking

**Answer: (SHOW ANSWER)**

API RP 571 discusses Hydrogen-Induced Cracking (HIC) and Blistering:

"Postweld heat treatment (PWHT) does not significantly reduce susceptibility to HIC, as the mechanism is primarily driven by hydrogen charging in wet H<sub>2</sub>S environments and steel cleanliness, not residual stresses."

"PWHT is more effective for SSC, SOHIC, and other stress-driven mechanisms." Thus, HIC will not benefit much from PWHT, making option C correct.

**NEW QUESTION: 37**

(Graphitization occurs in:)

- A. Aluminum
- B. Stainless steel
- C. Carbon steel
- D. Monel

**Answer: C (LEAVE A REPLY)**

Comprehensive and Detailed Explanation From Exact Extract:

According to API RP 571, graphitization is a high-temperature degradation mechanism that occurs in carbon and carbon-molybdenum steels exposed for long periods at temperatures typically above 800 °F (425 °C).

In this process:

- \* Iron carbides decompose into free graphite nodules
- \* The steel loses strength, ductility, and pressure-retaining capability
- \* Failures can occur without significant wall loss

Graphitization does not occur in aluminum, stainless steels, or nickel-copper alloys such as Monel.

Referenced Documents (Study Basis):

\* API RP 571 - Section on Graphitization

**NEW QUESTION: 38**

To avoid cooling water scaling, process side inlet temperatures should be below:

- A. 140°F (60°C)
- B. 150°F (66°C)
- C. 175°F (79°C)
- D. 212°F (100°C)

**Answer: (SHOW ANSWER)**

API RP 571 under Cooling Water Corrosion and Scaling:

"Cooling water scaling tends to occur more rapidly as water temperature increases. To minimize scaling, inlet temperatures to exchangers should be kept below 140°F (60°C) where possible."

"Above this temperature, calcium carbonate and other salts tend to precipitate more readily." Thus, option A is correct.

**NEW QUESTION: 39**

(A metal cracks because of stress relaxation during postweld heat treatment (PWHT) of a heavy wall section.

This type of cracking is best categorized as:)

- A. PWHT cracking
- B. Thermal fatigue cracking
- C. Reheat cracking
- D. Temper embrittlement cracking

**Answer: (SHOW ANSWER)**

Comprehensive and Detailed Explanation From Exact Extract:

Reheat cracking is explicitly defined in API RP 571 as cracking that occurs during postweld heat treatment or elevated temperature exposure due to stress relaxation in the heat affected zone of welded components.

Key characteristics per API RP 571 include:

- \* Occurs during PWHT or high-temperature service
- \* Associated with creep-strength-enhanced steels (e.g., Cr-Mo steels)
- \* Driven by stress relaxation and grain boundary weakness
- \* Most common in heavy wall sections

Why the other options are incorrect:

- \* Option A (PWHT cracking) is a non-specific term; API classifies this mechanism as reheat cracking.
- \* Option B (Thermal fatigue) requires cyclic temperature changes, not stress relaxation.

\* Option D (Temper embrittlement) does not cause cracking during PWHT.

API RP 571 uses reheat cracking as the correct classification.

Referenced Documents (Study Basis):

\* API RP 571 - Section on Reheat Cracking

\* API Welding Metallurgy Study Guide

### **NEW QUESTION: 40**

**A.** Where deposits form within piping or equipment

**B.** In the presence of dissimilar metals in electrical contact in a corrosive environment

**C.** At high temperatures in the presence of sulfur compounds

**D.** By mechanical stress and fatigue in metal structures

**Answer: (SHOW ANSWER)**

Comprehensive and Detailed Explanation From Exact Extract:

Concentration Cell Corrosion is defined in API RP 571 as a form of electrochemical corrosion driven by differences in concentration of corrosive species, most commonly oxygen, under deposits or within crevices.

This type of corrosion typically occurs:

Beneath deposits, scale, or fouling

In stagnant zones or crevices

Where oxygen concentration differs between adjacent areas

The area with lower oxygen concentration becomes anodic and corrodes preferentially, while the oxygen-rich area becomes cathodic.

Why the other options are incorrect:

Option B describes galvanic corrosion, not concentration cell corrosion.

Option C refers to high-temperature sulfidation, unrelated to concentration gradients.

Option D describes mechanical damage mechanisms, not electrochemical corrosion.

API RP 571 clearly categorizes concentration cell corrosion as being associated with deposits or crevice conditions, making Option A the correct description.

Referenced Documents (Study Basis):

API RP 571 - Section on Concentration Cell and Crevice Corrosion

API Corrosion Fundamentals Study Guide

### **NEW QUESTION: 41**

What type of damage is affected by higher hydrogen partial pressures?

**A.** Hydrogen-induced cracking

**B.** Hydrogen embrittlement

**C.** Hydrogen blistering

**D.** High temperature hydrogen attack

**Answer: D (LEAVE A REPLY)**

According to API RP 941 and API RP 571, High Temperature Hydrogen Attack (HTHA) is highly influenced by hydrogen partial pressure at elevated temperatures:

"The likelihood and rate of HTHA increase with both temperature and hydrogen partial pressure. Operating beyond established material limits on the Nelson Curves can lead to internal decarburization and methane formation in the steel." (Reference: API RP 571, Section 4.2.1.3 - High Temperature Hydrogen Attack) Therefore, among all listed damage types, HTHA is the most directly affected by high hydrogen partial pressures, making option D correct.

#### **NEW QUESTION: 42**

Temper embrittlement is defined as:

- A.** An increase in ductility and notch toughness caused by postweld heat treatment (PWHT) or high- temperature service above 120°F (49°C).
- B.** A reduction in ductility and notch toughness caused by postweld heat treatment (PWHT) or low- temperature service below 120°F (49°C).
- C.** A reduction in fracture toughness caused by long-term exposure in the temperature range of 650°F to 1070°F (345°C to 575°C).
- D.** An increase in toughness caused by long-term exposure in the temperature range of 650°F to 1100°F (345°C to 595°C).

**Answer: (SHOW ANSWER)**

API RP 571 describes Temper Embrittlement as:

"A metallurgical degradation mechanism that leads to a reduction in fracture toughness due to long-term exposure in the temperature range of 650°F to 1070°F (345°C to 575°C)." "It affects Cr-Mo steels and is not easily detected except by impact testing." Therefore, option C most accurately defines the condition based on the recognized API description.

#### **NEW QUESTION: 43**

(Which of the following can be used to confirm 885 °F (475 °C) embrittlement?)

- A.** Metallographic testing
- B.** Ductility testing
- C.** Magnetic particle testing
- D.** Bend or impact testing

**Answer: (SHOW ANSWER)**

Comprehensive and Detailed Explanation From Exact Extract:

Per API RP 571, 885 °F (475 °C) embrittlement primarily affects carbon and low-alloy steels, causing a loss of toughness without obvious microstructural changes visible by routine metallography. Because the damage mechanism manifests as a shift in ductile-to-brittle transition temperature (DBTT), confirmation requires mechanical property testing, not surface or volumetric NDE.

Impact testing (Charpy V-notch) and bend testing are specifically cited as effective methods to demonstrate the loss of toughness and increased brittleness associated with 475 °C embrittlement.

Why the other options are incorrect:

- \* Metallography often shows little or no visible change.
- \* Magnetic particle testing only detects surface-breaking flaws.
- \* Ductility testing alone is not as definitive as impact toughness testing.

Referenced Documents (Study Basis):

- \* API RP 571 - Section on 885 °F (475 °C) Embrittlement
- \* API Corrosion and Materials Study Guide

#### **NEW QUESTION: 44**

Erosion and erosion-corrosion metal loss is characterized by:

- A.** smooth pits.
- B.** linear striations.
- C.** grooves and gullies.
- D.** rough pits and pock marks.

**Answer: (SHOW ANSWER)**

Erosion and erosion-corrosion are mechanical degradation mechanisms enhanced by fluid motion, and typically result in directional or flow-oriented metal loss patterns.

According to API RP 571 Section 5.4.2 (Erosion and Erosion/Corrosion):

"Erosion typically results in localized thinning, often described as grooves, gullies, or horseshoe-shaped patterns... The metal loss is directional and may occur in elbows, tees, reducers, and pumps." Hence, Option C (grooves and gullies) most accurately describes erosion and erosion-corrosion characteristics.

#### **NEW QUESTION: 45**

(Creep damage can be mitigated by:)

- A.** Postweld heat treatment at 1150 °F (621 °C)
- B.** Solution anneal heat treatment
- C.** Removing the damaged material
- D.** Preheating to 500 °F (260 °C) during repair welding

**Answer: (SHOW ANSWER)**

Comprehensive and Detailed Explanation From Exact Extract:

According to API RP 571, creep damage is a time-dependent, high-temperature damage mechanism that occurs when materials are exposed to stress at temperatures typically above about 700 °F (370 °C) for extended periods. Creep damage results in void formation, microcracking, grain boundary separation, and eventual rupture.

Once creep damage has occurred, it is considered irreversible metallurgical degradation.

API RP 571 clearly states that heat treatments cannot restore creep life because the material's microstructure has already been permanently damaged.

\* Option A (PWHT at 1150 °F) may relieve residual stresses but does not heal creep voids or microcracks.

\* Option B (Solution annealing) is applicable to certain stainless steels but is not effective for reversing creep damage, particularly in low-alloy and Cr-Mo steels.

\* Option D (Preheating during welding) helps prevent hydrogen-related cracking but has no effect on existing creep damage.

API RP 571 emphasizes that the only effective mitigation for creep damage is to remove the affected material and replace it with sound material, or to retire the component if damage is widespread. Fitness-for-service assessments (API 579-1/ASME FFS-1) may be used to evaluate remaining life, but mitigation requires material removal.

Referenced Documents (Study Basis):

\* API RP 571 - Section on Creep and Stress Rupture Damage

\* API Corrosion and Materials Study Guide

### NEW QUESTION: 46

H<sub>2</sub>S content, pH, temperature, velocity, and oxygen concentration are critical factors of:

- A. Sour water acid corrosion
- B. Sulfuric acid corrosion
- C. Naphthenic acid corrosion
- D. Polythionic acid cracking

**Answer: (SHOW ANSWER)**

API RP 571 identifies these parameters as critical to the corrosion rate of carbon and low alloy steels in sour water environments:

"The extent of corrosion in sour water is influenced by pH, H<sub>2</sub>S content, temperature, liquid velocity, and oxygen contamination."

"These factors control the formation and stability of protective iron sulfide layers." (Reference: API RP 571, Section 4.3.2.1 - Sour Water Corrosion) Therefore, the correct answer is A.

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### NEW QUESTION: 47

Phosphoric acid corrosion in polymerization units is usually found under what circumstances?

- A. Turbulent flows
- B. Low velocity areas

C. Two-phase flow

D. When the acid dries out

**Answer: (SHOW ANSWER)**

API RP 571 states under the section Phosphoric Acid Corrosion:

"Corrosion usually occurs when the acid dries out and forms concentrated phosphoric acid deposits, which are very aggressive to carbon steel."

"Drying or concentration occurs due to poor flow distribution or operational upsets.

Localized areas may experience acid concentration due to vaporization." (Reference: API RP 571, Section 4.3.3.8 - Phosphoric Acid Corrosion) Therefore, the most aggressive corrosion occurs when the acid dries out, making option D correct.

### **NEW QUESTION: 48**

The 300 series stainless steels (austenitic stainless steels) are generally resistant to oxidation up to what temperature?

A. 1300°F (704°C)

B. 1400°F (760°C)

C. 1500°F (815°C)

D. 1600°F (871°C)

**Answer: (SHOW ANSWER)**

According to API RP 571, under Oxidation:

"Austenitic stainless steels (300 Series) are generally used for oxidation resistance up to about 1500°F (815° C). At higher temperatures, scaling and loss of protective chromium oxide layers increase."

"Above these temperatures, specialized high-temperature alloys may be required." (Reference: API RP 571, Section 5.1.1 - Oxidation) Therefore, option C is the correct answer.

### **NEW QUESTION: 49**

(Increased corrosion rates have been observed in equipment and piping in HF acid service at what minimum threshold temperature?)

A. 100 °F (38 °C)

B. 150 °F (65 °C)

C. 212 °F (100 °C)

D. 250 °F (121 °C)

**Answer: (SHOW ANSWER)**

Comprehensive and Detailed Explanation From Exact Extract:

According to API RP 571, hydrofluoric (HF) acid corrosion rates increase significantly once operating temperatures exceed approximately 150 °F (65 °C).

Key points noted in API RP 571:

\* Below ~150 °F, corrosion rates are relatively low due to formation of protective iron fluoride films.

\* Above 150 °F, these films become unstable.

\* Corrosion rates increase rapidly with temperature, especially under high velocity and water contamination conditions.

Why the other options are incorrect:

\* Option A (100 °F) is below the threshold for accelerated corrosion.

\* Option C and D are well above the onset temperature but are not the minimum threshold.

API RP 571 explicitly identifies 150 °F (65 °C) as the critical temperature where corrosion acceleration begins.

Referenced Documents (Study Basis):

\* API RP 571 - Section on Hydrofluoric Acid Corrosion

\* API Alkylation Unit Corrosion Study Guide

### **NEW QUESTION: 50**

**A.** Boilers and steam generating equipment

**B.** Caustic treaters

**C.** Caustic injections in crude units

**D.** Caustic storage tanks (non-postweld heat treated)

**Answer: C (LEAVE A REPLY)**

API RP 571, under "Caustic Corrosion" (also referred to as Caustic Stress Corrosion Cracking or Caustic Cracking), notes that this form of damage is:

"Most commonly associated with the injection points of caustic (e.g., NaOH) in crude units, particularly upstream of desalter vessels and heat exchanger circuits."

"This damage occurs due to the combination of caustic environment and tensile stress, especially in carbon steel and low alloy steels."

"Stress relief heat treatment of welds can mitigate susceptibility."

(Reference: API RP 571, 3rd Edition, Section 4.2.2.3)

Thus, among the options, caustic injections in crude units are the most typical area of concern, making option C the correct answer.

### **NEW QUESTION: 51**

(What steel alloy is no longer recommended for services susceptible to HTHA?)

**A.** Mn-0.5 Mo steel

**B.** 1.25 Cr-0.5 Mo steel

**C.** 1 Cr-0.5 Mo steel

**D.** C-0.5 Mo steel

**Answer: (SHOW ANSWER)**

Comprehensive and Detailed Explanation From Exact Extract:

According to API RP 571 and API RP 941 (Nelson Curves), 1 Cr-0.5 Mo steel is no longer recommended for services susceptible to High-Temperature Hydrogen Attack (HTHA).

API RP 941 documents industry experience showing that 1 Cr-0.5 Mo steels have suffered HTHA damage below previously assumed safe operating limits, due to insufficient carbide

stability. As a result, this material has been removed from the Nelson Curves as an acceptable choice for new construction in hydrogen service.

By contrast:

\* Mn-0.5 Mo, C-0.5 Mo, and 1.25 Cr-0.5 Mo steels retain higher resistance due to more stable carbide structures.

Referenced Documents (Study Basis):

\* API RP 571 - Section on High-Temperature Hydrogen Attack

\* API RP 941 - Updated Nelson Curves and Material Recommendations

### **NEW QUESTION: 52**

Why are high-cycle fatigue cracks difficult to detect with nondestructive examination (NDE)?

- A. They are usually in 90° corners where inspection is difficult.
- B. Cracks are so tight they are often missed.
- C. Time required for crack growth is not predictable.
- D. They normally start on the I.D. surface.

**Answer: B (LEAVE A REPLY)**

According to API RP 571, high-cycle fatigue (HCF) is characterized by very tight, narrow cracks that can escape detection using typical NDE methods due to their minimal opening displacement and fine geometry.

\* From API RP 571 Section 5.2.1 (Fatigue - High Cycle):

"The cracks are usually tight and may be difficult to detect using conventional NDE techniques such as PT or MT. UT and RT may also have difficulty identifying these small, tight flaws, especially in early stages of propagation." The primary issue in NDE is not the geometry (such as 90° corners) or ID location, but rather the tightness and early-stage subtlety of the cracks which results in reduced detectability. Therefore, option B is correct as it aligns most accurately with API RP 571's detailed characterization of HCF detection challenges.

### **NEW QUESTION: 53**

Polythionic acid stress corrosion cracking is:

- A. Identified by transgranular cracking on the process side of equipment and piping.
- B. Found only in low carbon grades of austenitic stainless steel.
- C. Typically localized and may not be evident until a leak appears.
- D. Rarely found in process furnaces.

**Answer: (SHOW ANSWER)**

API RP 571 under Polythionic Acid Stress Corrosion Cracking (PTA SCC) specifies:

"Cracking is usually intergranular, and often localized, especially in sensitized austenitic stainless steels exposed to sulfur-containing environments during shutdown or cleaning."

"It is not always visible on inspection and may only become evident when a leak occurs." (Reference: API RP 571, Section 4.2.2.5 - PTA SCC) Hence, option C is correct as it best describes the detection difficulty and behavior of PTA SCC.

#### **NEW QUESTION: 54**

Corrosion under insulation mitigation is best achieved by:

- A. Using low-chloride insulation
- B. Maintaining process temperatures at the boiling point of water
- C. Implementing a carefully planned, periodic inspection program
- D. Using appropriate coatings

**Answer: (SHOW ANSWER)**

According to API RP 571 and API RP 583:

"The most effective mitigation of CUI is the use of appropriate coatings underneath the insulation, which are resistant to moisture and chloride ingress."

"Inspection and insulation selection are also important but are secondary controls." (Reference: API RP 571, Section 4.3.4 - Corrosion Under Insulation; API RP 583) Hence, option D is correct.

#### **NEW QUESTION: 55**

Which of the following is a critical factor for chloride stress corrosion cracking?

- A. Presence of nickel content less than 8%
- B. Presence of oxygen
- C. Presence of nickel content higher than 35%
- D. Use in an alkaline pH region

**Answer: B (LEAVE A REPLY)**

According to API RP 571, in the section on "Chloride Stress Corrosion Cracking (Cl-SCC)", several critical factors are outlined that contribute to the initiation and propagation of this mechanism. The document states:

"Critical factors include the presence of chlorides (even at ppm levels), oxygen, elevated temperatures, tensile stress, and susceptible materials such as austenitic stainless steels and some nickel alloys."

"Oxygen is an accelerant and promotes pitting that can lead to SCC initiation." (Reference: API RP 571, 3rd Edition, Section 4.2.2.2) Therefore, the presence of oxygen is a well-documented critical factor in Cl-SCC. It acts in conjunction with chlorides to initiate localized pitting, which then progresses into cracking. Hence, option B is the correct choice.

#### **NEW QUESTION: 56**

The type of organic acids in crude feedstocks that are of most concern for corrosion in crude unit overheads are those:

- A. With naphthenic acids

- B. With low molecular weight
- C. That are not soluble in naphtha
- D. That condense above the water dew point

**Answer: (SHOW ANSWER)**

API RP 571, under Organic Acid Corrosion, highlights:

"Corrosive organic acids in overhead systems are those that condense at temperatures above the water dew point. These acids condense independently of water and can form highly concentrated corrosive films."

"When acids condense first, they aggressively corrode carbon steel prior to any water wash mitigation." (Reference: API RP 571, Section 4.3.3.9 - Organic Acid Corrosion)

Hence, option D correctly identifies the most aggressive corrosion scenario.

### **NEW QUESTION: 57**

If thermal shock damage may be present, which of the following should be checked?

- A. Bulging at elbows
- B. Hot/cold injection points
- C. Hardness of the furnace outlet piping
- D. Surface exfoliation of furnace tubes

**Answer: (SHOW ANSWER)**

Under Thermal Fatigue and Shock, API RP 571 explains:

"Thermal shock damage often initiates at locations with sudden temperature changes, such as quench zones, cold/hot injection points, and areas subjected to rapid cycling."

"These are critical inspection points for detecting cracking from thermal shock." Thus, option B best matches the described mechanism.

### **NEW QUESTION: 58**

Short-term stress rupture is a/an:

- A. failure caused by repeated cycling from elevated temperature, typically characterized by through-wall oxide filled ruptures with little bulging.
- B. elevated temperature failure caused by localized overheating, typically characterized by bulging and thinning.
- C. elevated temperature failure caused by diffusion of hydrogen into the material, typically characterized by blistering and cracking.
- D. cracking failure caused by sulfides formed at elevated temperature that convert to acids on exposure to moisture and oxygen.

**Answer: B (LEAVE A REPLY)**

From API RP 571 Section 5.3.2.1 (Creep and Stress Rupture):

"Short-term creep rupture is often associated with localized overheating and results in bulging and thinning, often with a characteristic 'fish-mouth' rupture appearance. These failures occur under sustained load in a short time (hours or days), typically in high-temperature service due to a sudden increase in temperature or poor heat distribution."

Thus, Option B accurately describes the mechanism and visual indications of short-term stress rupture.

**NEW QUESTION: 59**

The stream from a crude atmospheric overhead goes to the tube side of a shell-and-tube condenser with a temperature of 300°F (149°C) and a pressure of 10 psig (69 kPa). As the stream begins to condense water, its hydrochloric acid content lowers the water pH to about 4.0. Which of the following would be the best alloy selection for the tubes with cooling water on the shell side?

- A. 410 Stainless Steel
- B. Titanium
- C. 9 Cr-1 Mo Steel
- D. 316 Stainless Steel

**Answer: B (LEAVE A REPLY)**

API RP 571 notes in the context of Hydrochloric Acid Corrosion in overhead condensers: "Titanium is highly resistant to low pH acidic aqueous phases, including hydrochloric acid formed during condensation in overhead systems."

"Stainless steels like 316 and 410 are not suitable in the presence of free chlorides at low pH and elevated temperatures." (Reference: API RP 571, Section 4.3.3.3 - Hydrochloric Acid Corrosion) Thus, Titanium is the preferred alloy under the described acidic and high-temperature conditions, making option B correct.

**NEW QUESTION: 60**

- A. Sulfide Stress Corrosion Cracking (SCC)
- B. Amine Stress Corrosion Cracking
- C. Caustic Cracking
- D. Stress-Oriented Hydrogen-Induced Cracking (SOHIC)

**Answer: (SHOW ANSWER)**

As defined in API RP 571, under Hydrogen Blistering and HIC/SOHIC:

"SOHIC typically manifests as subsurface stepwise cracking, generally oriented perpendicular to the direction of stress."

"This mechanism initiates below the surface, typically in weld heat-affected zones, and requires metallographic or advanced ultrasonic methods to detect." By contrast, SSC, caustic cracking, and amine SCC are primarily surface-initiated, stress-related cracking mechanisms.

Thus, SOHIC is the subsurface mechanism in this list, making option D correct.

**NEW QUESTION: 61**

Severe internal grooving corrosion is found at the bottom of a 4-inch (101.6 mm) carbon steel piping system in steam condensate service. Which of the following is the most likely cause?

- A. Carbon dioxide corrosion
- B. Carbonate corrosion
- C. Ammonium bisulfide corrosion
- D. Erosion-corrosion

**Answer: (SHOW ANSWER)**

API RP 571 explains under Condensate Corrosion (CO# Corrosion):

"In condensate systems, carbon dioxide dissolves in the water forming carbonic acid, which leads to localized corrosion, including grooving and under-deposit attack, especially at low points like the bottom of horizontal piping."

"This is most commonly observed in steam condensate return lines, and the damage is localized due to stratification." This matches the scenario described, where internal grooving at the bottom of steam condensate piping is characteristic of CO#-induced corrosion. Hence, option A is correct.

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#### **NEW QUESTION: 62**

To detect wet insulation that might give rise to corrosion under insulation, which nondestructive examination (NDE) technique would be most useful?

- A. Deep penetrating eddy current
- B. Neutron backscatter
- C. Spectroscopy
- D. Low-intensity X-ray imaging scope

**Answer: (SHOW ANSWER)**

According to API RP 571 and API RP 583 (CUI-specific guidance):

"Neutron backscatter techniques are effective in detecting moisture within insulation systems, which can indicate areas of concern for corrosion under insulation (CUI)."

"This method provides non-invasive, quick identification of wet insulation without removing cladding." (Reference: API RP 571, Section 4.5.1 - Corrosion Under Insulation and API RP 583 - CUI Detection Techniques) Thus, neutron backscatter is the preferred NDE method for moisture detection, making option B correct.

#### **NEW QUESTION: 63**

Aggressive ammonium chloride corrosion often occurs:

- A. When the salts precipitate from high-temperature streams as they cool.
- B. In the absence of a free water phase.
- C. When excess water washing dissolves too much ammonium chloride.
- D. When dry salts are exposed to a small amount of free water.

**Answer: (SHOW ANSWER)**

According to API RP 571:

"Ammonium chloride corrosion is most aggressive when dry salts are exposed to a small amount of free water. This condition allows the formation of a concentrated acidic aqueous solution, which is highly corrosive to carbon steel."

"The corrosion mechanism is activated especially during startup and shutdown when condensation may occur on salt deposits." (Reference: API RP 571, Section 4.3.3.1 - Ammonium Chloride Corrosion) Hence, while salt deposition begins as temperatures drop, the most aggressive corrosion happens when water is introduced to dry salt, making option D correct.

#### **NEW QUESTION: 64**

Cracks formed by carbonate stress corrosion are best detected:

- A. with a penetrant testing technique used after abrasive or high pressure water blasting of the surface.
- B. with an Acoustic Emission Testing technique.
- C. ultrasonic shear wave examination because cracks develop internally.
- D. with a wet fluorescent magnetic-particle testing technique.

**Answer: (SHOW ANSWER)**

According to API RP 571 Section 5.1.2.6 (Carbonate Stress Corrosion Cracking - CSCC):

"The cracking is usually intergranular and is most commonly detected using wet fluorescent magnetic-particle testing (WFMT) after surface cleaning. PT may not be sensitive enough to detect fine cracks formed by this mechanism." Because CSCC cracks are typically surface-connected and very fine, WFMT offers the best visibility, especially after proper surface prep.

Therefore, Option D is correct.

#### **NEW QUESTION: 65**

Which of the following can increase the corrosion rate of carbon steel via hydrofluoric (HF) acid corrosion?

- A. High nitrogen content in process
- B. Oxygen contamination
- C. HF acid concentration above 98%
- D. Weld hardness above 200 BHN

**Answer: D (LEAVE A REPLY)**

According to API RP 571 and API RP 751:

"In HF alkylation units, carbon steel can be used if weld hardness is controlled to # 200 Brinell (BHN).

Exceeding this can significantly increase the corrosion rate and susceptibility to cracking."

"Hard welds act as preferential corrosion sites due to microstructural inhomogeneity and stress concentration." (Reference: API RP 571, Section 4.3.3.4 - Hydrofluoric Acid Corrosion; API RP 751, Section 5.3 - Materials of Construction) Thus, option D is correct.

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