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API 936 Refractory Personnel - 202

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Question: 484

During material qualification, a refractory mix shows a cold crushing strength (CCS) of 12 MPa, below the specified 15 MPa. The inspector suspects improper mixing. What is the minimum mixing time for a low-cement castable per API 936?

A. 3 minutes
B. 4 minutes
C. 5 minutes
D. 6 minutes

Answer: C

Explanation: API 936 requires a minimum mixing time of 5 minutes for low-cement castables to ensure homogeneity and proper binder distribution, which directly affects CCS. Shorter times result in incomplete mixing, while 6 minutes exceeds the requirement without additional benefit.

Question: 485

While inspecting a refractory lining, you find that the contractor used a mix with a setting time of 6 hours, exceeding the specified 4 hours per ASTM C191. Per API STD 936, what is the potential issue, and what should be done?

A. Reduced strength; reject mix and retest
B. Increased porosity; repair affected areas
C. No impact; document observation
D. Surface cracking; monitor during dry-out

Answer: A

Explanation: A longer setting time (6 hours vs. 4 hours) per ASTM C191 can reduce strength due to improper hydration, per API STD 936, section 4.3.2. The mix should be rejected, and a new batch tested, per section 4.4.3.

Question: 486

During a wet-gunning installation of a 70% alumina castable in a FCCU riser, the contractor observes that the material is segregating at the nozzle, leading to inconsistent density. According to API 936, what is the most critical parameter to adjust to mitigate this issue while maintaining compliance with the execution plan?

A. Adjust the water content to exceed the manufacturer’s maximum limit by 0.5%

B. Increase the mix time by 30 seconds to ensure homogeneity before pumping
C. Decrease the pump pressure by 10% and increase the air velocity at the nozzle
D. Modify the nozzle angle to 45 degrees to enhance material flow

Answer: C

Explanation: Segregation during wet-gunning, as per API 936, is often caused by improper balance between pump pressure and air velocity, leading to uneven material distribution. Decreasing the pump pressure by 10% and increasing air velocity at the nozzle helps stabilize the material stream, ensuring consistent density without violating the manufacturer's water content limits, unnecessarily extending mix time, or altering the nozzle angle, which is not specified in API 936 as a primary control.

Question: 487

During a hand-packing operation, the contractor prepares test specimens for a 1600 kg/m³ plastic refractory. Per API 936, what is the minimum curing time before testing compressive strength per ASTM C133-97?

A. 12 hours
B. 48 hours
C. 36 hours
D. 24 hours

Answer: D

Explanation: API 936, referencing ASTM C133-97, requires a minimum curing time of 24 hours for plastic refractory test specimens before compressive strength testing to ensure proper setting. Shorter times (12 hours) risk inaccurate results, while 36 or 48 hours are unnecessary.

Question: 488

A refractory supplier provides a certificate for a castable with a modulus of rupture (MOR) of 12 MPa per ASTM C133. Core samples yield an MOR of 10 MPa. What is the maximum allowable deviation per API STD 936, and what action is required?

A. ±10%, accept material
B. ±15%, reject material
C. ±15%, accept material
D. ±10%, reject material

Answer: D

Explanation: Per API STD 936, the maximum allowable deviation for physical properties like MOR is ±10%. The measured MOR (10 MPa) deviates by (12 - 10) / 12 x 100 = 16.67%, exceeding the tolerance, so the material should be rejected. A ±15% limit is not specified in API STD 936. Accepting the material is incorrect due to non-compliance.

Question: 489

In a post-installation dry-out of a refractory lining, the contractor uses gas-fired burners with a maximum flame temperature of 1200°C. The dry-out schedule requires a maximum refractory surface temperature of 600°C. What control measure must be implemented to comply with API STD 936?

A. Use baffles to prevent direct flame contact
B. Maintain flame impingement on the refractory
C. Increase burner output to 1500°C
D. Ventilate the furnace to increase airflow

Answer: A

Explanation: API STD 936 prohibits direct flame impingement during dry-out to prevent localized overheating, which could exceed the specified 600°C surface temperature and cause spalling. Using baffles to diffuse the flame ensures indirect heating, maintaining uniform temperature control. Increasing burner output or maintaining flame impingement violates the standard, and ventilation alone does not address flame control.

Question: 490

A quality control inspector is reviewing the material qualification data for a phosphate-bonded plastic refractory. According to API TR 980, what is the critical temperature range for forming a permanent ceramic bond during initial heat-up?

A. 300–500°F (149–260°C)
B. 700–900°F (370–482°C)
C. 500–700°F (260–370°C)
D. 900–1100°F (482–593°C)

Answer: C

Explanation: API TR 980 specifies that phosphate-bonded plastic refractories form a permanent ceramic bond during heat-up between 500–700°F (260–370°C). This temperature range is critical for ensuring the material’s final bonding and structural integrity.

Question: 491

An inspector identifies a non-conformance in the curing process due to premature air drying. What is the maximum allowable air-drying time before corrective action is needed, per API STD 936?

A. 1 hour
B. 2 hours
C. 3 hours
D. 4 hours

Answer: B

Explanation: API STD 936 specifies that hydraulic-bonded castable refractories must not air dry for more than 2 hours before applying a curing compound. Premature drying beyond this requires corrective action, such as rewetting or applying a curing compound.

Question: 492

During a laboratory test for abrasion resistance per ASTM C704-15, a refractory specimen is subjected to a specific abrasive media under controlled conditions. If the initial weight of a specimen is 500.0 g, its dimensions are 50 mm x 50 mm x 50 mm, and the weight after testing is 485.2 g, what is the abrasion loss in cm^3, given the initial bulk density is 2.5 g/cm^3?

A. 6.32 cm^3
B. 6.12 cm^3
C. 5.92 cm^3
D. 6.52 cm^3

Answer: C

Explanation: To calculate abrasion loss per ASTM C704-15, the volume loss is determined using the weight loss and initial bulk density. Weight loss = 500.0 g - 485.2 g = 14.8 g. Initial bulk density = 2.5 g/cm^3. Volume loss = weight loss / density = 14.8 g / 2.5 g/cm^3 = 5.92 cm^3. The answer is 5.92 cm^3.

Question: 493

For a hydraulic-bonded castable refractory, what is the maximum allowable time for air drying before applying a membrane curing compound, per API STD 936?

A. 1 hour
B. 2 hours
C. 4 hours
D. 6 hours

Answer: B

Explanation: API STD 936 requires that hydraulic-bonded castable refractories not be allowed to air dry for more than 2 hours before applying a membrane curing compound to prevent premature drying, which could impair the curing process and reduce lining strength.

Question: 494

In a refractory-lined reactor, you perform visual inspection and note spalling over a 0.4 m² area. Per API STD 936, what is the maximum allowable spalled area, and which NDT method assesses subsurface damage?

A. 0.2 m², sonic testing
B. 0.4 m², hammer testing
C. 0.2 m², ultrasonic testing
D. 0.4 m², radiographic testing

Answer: C

Explanation: Per API STD 936, the maximum allowable spalled area is 0.2 m² for critical linings. The observed 0.4 m² exceeds this limit, requiring further evaluation. Ultrasonic testing is the most effective NDT method to assess subsurface damage, such as delamination or cracking, beneath the spalled area. Sonic testing lacks precision for subsurface defects. Hammer testing is limited to surface voids. Radiographic testing is impractical for thick linings.

Question: 495

During a laboratory test for a high-alumina castable, the technician measures a permanent linear change (PLC) of -0.4% after firing at 2912°F for 5 hours. The specification requires a PLC of -0.3% to +0.1%. What is the correct action?

A. Reject the material and notify the manufacturer
B. Conduct a re-test at a lower firing temperature
C. Accept the material, as the PLC is within 0.1% of the limit
D. Request owner approval to adjust the specification

Answer: A

Explanation: API STD 936 requires compliance with specified PLC ranges per ASTM C113-14. A PLC of -0.4% is outside the range of -0.3% to +0.1%, indicating non-compliance (Reject the material and notify the manufacturer). A 0.1% tolerance is not permitted (ruling out Accept the material, as the PLC is within 0.1% of the limit). Re-testing at a different temperature (Conduct a re-test at a lower firing temperature) or adjusting specifications (Request owner approval to adjust the specification) is not allowed without owner approval.

Question: 496

A refractory lining is being dried out using stress-relieving heating elements with a total output of 120 kW over a 25 m² surface. The schedule requires a hold at 450°C for 8 hours. What is the heat flux during this hold?

A. 3.2 kW/m²
B. 4.8 kW/m²
C. 6.4 kW/m²
D. 8 kW/m²

Answer: B

Explanation: Heat flux is calculated as 120 kW ÷ 25 m² = 4.8 kW/m². This supports the 450°C hold per API STD 936, ensuring uniform heating. Options like 3.2 kW/m² or 6.4 kW/m² do not match the calculated value, and 8 kW/m² is too high.

Question: 497

For a gunning operation, API 936 requires a pre-installation mockup to qualify the applicator. The mockup must be gunned to a panel size of 1 m x 1 m with a thickness of 100 mm. What is the minimum number of test specimens required from this mockup for physical property testing?

A. 2 specimens
B. 5 specimens
C. 4 specimens
D. 3 specimens

Answer: D

Explanation: API 936 specifies that a minimum of three test specimens must be taken from a gunned mockup panel for physical property testing (e.g., compressive strength, density) to qualify the applicator. Options 2, 4, and 5 specimens do not meet the minimum requirement for ensuring consistent quality.

Question: 498

Which term, as defined in API STD 936, refers to the process of removing moisture from a newly installed refractory lining to prepare it for service?

A. Curing
B. Firing
C. Dryout
D. Sealing

Answer: C

Explanation: API STD 936 defines “dryout” as the controlled process of removing moisture from a newly installed refractory lining through heating to prepare it for service. Curing involves maintaining moisture for hydration, firing refers to high-temperature processing, and sealing involves applying protective compounds.

Question: 499

A refractory lining is tested for thermal shock resistance per ASTM C1100. The test requires cycling between 1000°C and 20°C for 10 cycles. If the lining fails after 8 cycles with a 20% mass loss, what is the minimum acceptable cycle count, and which inspection method verifies in-situ performance?

A. 5 cycles, core sampling
B. 5 cycles, infrared thermography
C. 10 cycles, core sampling
D. 10 cycles, ultrasonic testing

Answer: C

Explanation: Per ASTM C1100, the minimum acceptable cycle count for thermal shock resistance is 10 cycles with minimal mass loss. The lining’s failure at 8 cycles with 20% mass loss indicates non-compliance, requiring verification. Core sampling is the best method to extract samples for ASTM C1100 retesting to confirm in-situ performance. Infrared thermography detects temperature gradients, not thermal shock resistance. Ultrasonic testing identifies internal flaws, not thermal shock performance.

Question: 500

A contractor is mixing a high-alumina castable with a specified water content of 5.5% ± 0.5%. If 100 kg of dry mix is used, what is the acceptable water volume range in liters? (Assume water density is 1 kg/L.)

A. 4.5–5.5 L
B. 5.5–6.5 L
C. 5.0–6.0 L
D. 6.0–7.0 L

Answer: C

Explanation: For 100 kg of dry mix, 5.5% ± 0.5% water content translates to 5.0–6.0% by weight, or 5.0–6.0 kg. Since water density is 1 kg/L, this equals 5.0–6.0 L.

Question: 501

A castable installation in a heater uses a formwork with inadequate bracing, leading to bulging during vibration. The castable density is 135 lb/ft³, and the vibrator force is 1,800 lbf. What is the best corrective action per API 936?

A. Increase vibrator force to 2,000 lbf
B. Reduce castable density to 125 lb/ft³
C. Reinforce formwork with additional bracing
D. Use a lower frequency vibrator

Answer: C

Explanation: Reinforcing formwork with additional bracing prevents bulging, as API 936 requires rigid formwork to withstand vibration forces. Increasing force worsens bulging. Reducing density is impractical. Lowering frequency affects consolidation, not formwork stability.

Question: 502

For a refractory installation in a sulfur recovery unit, API STD 936 mandates strict environmental controls. During mixing, the relative humidity exceeds 85%, risking excessive water absorption in the dry castable mix. What is the applicator’s best action to mitigate this issue?

A. Add 2% extra water to the mix to compensate for absorption
B. Cover the dry mix with tarps and use dehumidifiers
C. Continue mixing but reduce the mixing time by 5 minutes
D. Store the mix in a heated warehouse for 24 hours

Answer: B

Explanation: API STD 936 requires controlling relative humidity to prevent water absorption in dry refractory mixes, which can affect material properties. Adding extra water risks over-wetting the mix, compromising strength. Reducing mixing time does not address humidity. Storing in a heated warehouse may help but delays installation unnecessarily. Covering the mix and using dehumidifiers directly mitigates high humidity, ensuring compliance with environmental controls.

Question: 503

A contractor adds 2% by weight of 310 stainless steel fibers to a 2200 kg batch of castable. The mixer operates at 60 rpm for 4 minutes. What is the maximum allowable mixing time to avoid fiber damage per API 936?

A. 3 minutes
B. 4 minutes
C. 5 minutes
D. 6 minutes

Answer: C

Explanation: API 936 recommends a maximum mixing time of 5 minutes for fiber-reinforced castables to avoid fiber damage. Option 5 minutes is correct. The current 4 minutes is within limits, but exceeding 5 minutes risks damage.

Question: 504

During a flash set of a castable in a duct, the mix reaches 105°F with 7% water addition. The datasheet specifies 6.5% water at 80°F. What is the most effective preventive measure per API 936?

A. Add a dispersant to the mix
B. Use a borate-based retarder
C. Reduce water addition to 6%
D. Cool the aggregate to 60°F

Answer: B

Explanation: Using a borate-based retarder controls rapid setting at high temperatures (105°F), per API 936. Adding a dispersant affects flow, not setting. Cooling aggregate is less practical. Reducing water may compromise workability.

Question: 505

A refractory sample fails a cold crushing strength test with a result of 30 MPa, against a specification of 35 MPa minimum, per API STD 936. What should the inspector recommend?

A. Accept the sample if other properties meet specifications
B. Conduct a retest with a new sample
C. Request a variance from the owner
D. Reject the sample and investigate the cause

Answer: D

Explanation: A cold crushing strength of 30 MPa fails to meet the minimum specification of 35 MPa, requiring rejection of the sample per API STD 936. Investigating the cause ensures quality control. Accepting the sample violates the specification. Retesting is not appropriate without addressing the failure's cause. Requesting a variance is secondary to rejection and investigation.

Question: 506

During a dry-out procedure for a dense castable refractory, the contractor proposes a heating rate of 100°F/hr (56°C/hr) to 1000°F (538°C). What is the inspector's action per API 936?

A. Approve the rate as it meets general guidelines
B. Verify the rate against the manufacturer's data sheet
C. Request a revised schedule with hold points
D. Reject the rate and require a slower heating schedule

Answer: B

Explanation: API 936, Section 4.2.7, mandates that dry-out heating rates must follow the manufacturer's recommendations, as rates vary based on material composition and thickness. The inspector must verify the proposed rate against the manufacturer's data sheet. Approving without verification risks thermal shock. Rejecting outright is premature without data. Requesting hold points is secondary to verifying the rate.

Question: 507

During equipment qualification for a vibratable castable, the inspector observes segregation in the test panel. What is the most likely cause per API 936?

A. Excessive vibration time exceeding 90 seconds
B. Inadequate mixing time below 3 minutes
C. Incorrect water content above 7%
D. Low-frequency vibration below 50 Hz

Answer: A

Explanation: API 936 notes that excessive vibration time can cause segregation in vibratable castables, separating aggregates from the matrix. Inadequate mixing affects homogeneity but not segregation during placement, incorrect water content impacts flowability, and low-frequency vibration is less likely to cause segregation.

Question: 508

During a refractory installation, the inspector notes that the contractor's mixing time exceeds the manufacturer's maximum by 30%. What is the inspector's action?

A. Accept if the material appears uniform
B. Verify the mixing time with the owner
C. Request retesting of the mixed material
D. Reject the batch for non-compliance

Answer: D

Explanation: API 936, Section 4.2.3, requires mixing times to comply with the manufacturer's specifications to ensure material consistency. Exceeding the maximum by 30% is a non-conformance, requiring batch rejection. Visual uniformity is insufficient. Retesting or owner verification does not address the procedural violation.

Question: 509

During a post-installation inspection, the inspector finds that the contractor failed to maintain curing records for a hydraulic-bonded castable. Per API 936, what is the consequence?

A. Reject the installation for non-compliance
B. Require retesting of physical properties
C. Accept the installation if visual inspection passes
D. Request retroactive documentation from the contractor

Answer: A

Explanation: API 936, Section 5.2.8, mandates that contractors maintain detailed curing records as part of quality control documentation. Failure to provide these records is a non-conformance, leading to rejection of the installation. Visual inspection cannot substitute for records. Retesting or retroactive documentation does not address the procedural violation.

Question: 510

During a density test per ASTM C134, a refractory sample's dimensions are 100 mm x 50 mm x 25 mm, and its weight is 0.3125 kg. What is the density in lb/ft^3, given 1 kg/m^3 = 0.06243 lb/ft^3?

A. 156 lb/ft^3
B. 100 lb/ft^3
C. 150 lb/ft^3
D. 175 lb/ft^3

Answer: A

Explanation: Volume = 0.1 m x 0.05 m x 0.025 m = 0.000125 m^3. Density = 0.3125 kg / 0.000125 m^3 = 2500 kg/m^3. Convert to lb/ft^3: 2500 x 0.06243 = 156.075 lb/ft^3.

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