PIP RFSA1000
Refractory Anchor and Accessory Specification
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

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1. Introduction

1.1 Purpose
This Practice provides requirements for anchors, accessories, welding consumables and metal fiber reinforcement for refractory linings.

1.2 Scope
This Practice describes materials, styles, and dimensions of metallic and non-metallic anchors, welding consumables and accessories for refractory linings installed in equipment, vessels, and piping. This Practice also provides requirements for plastic caps or coatings for anchor tips and metal fibers for reinforcement of monolithic refractory linings. This Practice also provides requirements for marking and positive material identification (PMI) of metal anchors and accessories.

2. References

Applicable parts of the following Practices and industry codes and standards shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate.

2.1 Process Industry Practices (PIP)
- PIP VESPMI01 – Positive Material Identification Specification

2.2 Industry Codes and Standards
- American Petroleum Institute (API)
  - API Standard 560 – Fired Heaters for General Refinery Services
- ASTM International
  - ASTM A36/A36M – Standard Specification for Carbon Structural Steel
  - ASTM A479/A479M – Standard Specification for Stainless Steel Bars and Shapes for use in Boilers and Other Pressure Vessels
  - ASTM A516/A516M – Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower- Temperature Service
  - ASTM A820/A820M – Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
  - ASTM A992/A992M – Standard Specification for Structural Steel Shapes
3. Definitions

Terms used in this Practice are defined in accordance with ASTM C71, API Standard 936 and as follows:

accessories: Non-anchor component of a refractory retention system or reinforcement (e.g., C-clip for non-metallic anchor used in monolithic castable and plastic linings, metallic needle or fiber used for reinforcement of monolithic refractory linings)

hexalt anchor: Individual metallic anchor used as an alternative to hexmesh or other continuous closed cell anchor in thin layer abrasion resistant linings. Hexalt anchors are especially suited for repairs, sharply curved surfaces, doubly curved surfaces, and lining with variable thicknesses.

multi-component lining: Two or more layers of the same or different refractory types forming a lining

purchaser: Party who awards the contract to the supplier. The purchaser may be the owner or the owner’s authorized agent.

purchaser’s inspector: Purchaser’s authorized representative with authority to act in the interest of, and on behalf of, the purchaser in all quality assurance matters

reinforcement: Metallic needles (fibers) for reinforcing monolithic refractory lining

technical ceramics: Oxides with high purity, fine grains, low porosity, pressed and sintered (e.g., non-metallic pin-stud used in anchoring of ceramic fiber blanket lining)

V anchor: Metallic anchor for monolithic refractory linings made of rod or bar stock configured in one or more forms of V shapes (e.g., wavy and doublehook footed V)

Y anchor: Footed wavy V or double hook V anchor for thick monolithic refractory linings with a vertical bend offset between foot and V part of the anchor forming a shape of Y
4. Requirements

4.1 General

4.1.1 Conflicts, Exceptions and Deviations

4.1.1.1 All conflicts between the referenced documents and this Practice shall be submitted in writing to purchaser for clarification and resolution before proceeding with the lining application.

4.1.1.2 All exceptions, deviations, and substitutions to the requirements specified herein and in referenced documents shall be approved by the purchaser.

4.1.2 Regulations and Material Safety Data Sheets (MSDS)

4.1.2.1 Anchor and accessory materials and their applications shall be in accordance with all applicable federal, state, and local codes and regulations on surface preparation, welding, storage, handling, safety, and environmental requirements.

4.1.2.2 Anchors and accessory materials shall be in accordance with manufacturers’ product data sheets.

4.1.2.3 Installation instructions and, if applicable, MSDS shall be provided. These documents shall be available at the installation site.

4.1.3 Documentation

4.1.3.1 For metal anchors and accessories, mill certificates and certification of post forming heat treatments shall be provided.

4.1.3.2 For non-metallic anchors and accessories, manufacturer’s certified data sheets shall be provided.

4.1.3.3 For stainless steel fibers (needles), mill certificates and certification of post forming heat treatment shall be provided.

4.1.4 Notification

If inspection of anchors and accessories is specified in the purchase order, purchaser’s inspector(s) shall be given adequate notice for the inspection to be completed before shipment.

4.2 Metallic Anchors

4.2.1 General

4.2.1.1 Marking

1. Each metallic anchor shall be marked for identification purposes.

2. Each component of continuous assemblies shall be marked (e.g., each strip of hexmesh).

3. Marking shall be by color coding, stamping or etching and shall be visible in the installed position.

4. Color coding shall be in accordance with the requirements of API Standard 936, except that chloride content of the paint shall not
exceed 50 ppm. Paint shall be compatible with the anchor material throughout the operating temperature range.

5. Color coding shall be applied after completion of all heat treatments.

6. Stamping or etching of wire anchors (e.g., V anchors) shall be performed towards the end of one of the tines, after bending, and before any heat treatment.

7. Marking shall be such that each anchor has a complete identification mark.

4.2.1.2 Anchor Tip Caps and Coatings

1. V and Y anchors made of metal rods used in monolithic linings greater than or equal to 75 mm (3 inches) thick shall have tips covered with plastic caps or coated with mastic or other coatings that will burn out by about 315°C (600°F).

2. Caps or coatings shall be 0.75-1.25 mm (30-50 mils) thick, covering 13 mm (½ inch) of the anchor tips, and of contrasting color to the anchor for ease of inspection and identification.

3. Plastic caps shall be delivered loose and installed after welding, post weld heat treatment, and grit blasting, and immediately before installing refractory.

4. Mastic or other coatings shall be applied after completion of welding, post weld heat treatment, and grit blasting and dried immediately before installing refractory.

5. Coating and/or plastic cap shall not be detrimental to the anchor material and shall be approved by the purchaser.

4.2.1.3 Dimensional tolerances of the anchor and accessories shall be in accordance with manufacturer’s standards.

4.2.1.4 Welding consumable, metallic fibers, anchor and accessory composition shall be confirmed by PMI as follows:

a. Welding consumables: PMI shall be performed in accordance with PIP VESPMI01.

b. Individual anchor: PMI shall be performed on randomly selected samples consisting of 0.5 percent (rounded up to the next whole number) of each component style, component size, metallurgy and manufacturer, with a minimum of one sample per container.

c. Continuous assemblies (e.g., hexmesh and flexmesh): PMI shall be performed at one random location on each continuous assembly.

d. Metallic reinforcing fibers: Perform PMI on one randomly selected sample per pallet or fraction of a pallet for each style, metallurgy (lot and heat), and manufacturer with a minimum of one sample. Sample size shall be adequate for the testing method used.
4.2.2 Materials

4.2.2.1 Metallic anchors shall be made of stainless steel or nickel alloys. Carbon steel anchors shall not be permitted.

4.2.2.2 Accessories shall be made of stainless steel or nickel alloys except that carbon steel may be used for anchor attachment accessories exposed to operating temperatures of 425°C (800°F) or less and attached to a carbon steel shell.

4.2.2.3 Metallic anchors and accessories shall be in accordance with the following standards:
   a. For carbon steel, ASTM A36
   b. For chromium and chromium-nickel stainless steel plate, sheet, and strip for pressure vessels and for general applications, ASTM A240
   c. For stainless steel bar, sheet and strip, ASTM A479
   d. For killed carbon steel bars and plates, ASTM A516
   e. For iron-chromium and iron-chromium-nickel castings, ASTM A743
   f. For structural steel shapes, ASTM A992
   g. For Alloy 601 ASTM B168 for plate sheet and strip or B166 for rod and bar.

4.2.2.4 Selection of metallic anchor and accessory materials shall be in accordance with Table 1 for the maximum expected temperature of the anchor and accessory.

4.2.2.5 Metallic anchors and accessories shall not be made of carbon steel except where noted in this Specification.

4.2.2.6 If process conditions require a special metallurgy, anchors and accessories shall be made of appropriate alloys.

4.2.2.7 Metal anchors cold worked into a V or other individual anchor shapes shall be solution annealed after forming.

4.2.2.8 Hexmesh, flexmesh, tab or hexalt anchors shall not be solution annealed.
### Table 1 – Maximum Allowable Metal Anchor Operating Temperatures

<table>
<thead>
<tr>
<th>Anchor Material</th>
<th>°C</th>
<th>°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 400 Series (Note 3)</td>
<td>650</td>
<td>1200</td>
</tr>
<tr>
<td>Type 304</td>
<td>760</td>
<td>1400</td>
</tr>
<tr>
<td>Type 304H</td>
<td>815</td>
<td>1500</td>
</tr>
<tr>
<td>Type 316</td>
<td>760</td>
<td>1400</td>
</tr>
<tr>
<td>Type 321 (Note 4)</td>
<td>760</td>
<td>1400</td>
</tr>
<tr>
<td>Type 347 (Note 4)</td>
<td>760</td>
<td>1400</td>
</tr>
<tr>
<td>Type 309 (Note 5)</td>
<td>815</td>
<td>1500</td>
</tr>
<tr>
<td>Type 310 (Note 5)</td>
<td>925</td>
<td>1700</td>
</tr>
<tr>
<td>Alloy 330</td>
<td>1040</td>
<td>1900</td>
</tr>
<tr>
<td>Alloy 601</td>
<td>1095</td>
<td>2000</td>
</tr>
</tbody>
</table>

**NOTES:**
1. For the purpose of material selection, anchor temperature is considered to be the same as the refractory temperature at the tip of the anchor.
2. Anchor materials and temperature limits are based on API Standard 560 and industry best practices.
3. Type 400 Series shall be specified only for hexmesh, flexmesh, tab, and hexalt anchors, and for use only with components made of carbon steel or low chrome (i.e., less than or equal to 12 Cr).
4. Type 321 and 347 are preferred if polythionic acid can form during operation.
5. Type 309 and 310 can also be used if sulfur is present in the process stream.

#### 4.2.3 Welding Consumables

4.2.3.1 Welding consumables for welding alloy anchors and accessories shall be in accordance with the following standards:

a. For covered carbon steel welding electrodes, *AWS A5.1/ASME SFA-5.1*

b. For bare carbon steel welding electrodes and rods, *AWS A5.18/ASME SFA-5.18*

c. For covered stainless steel welding electrodes, *AWS A5.4/ASME SFA-5.4*

d. For bare stainless steel welding electrodes and rods, *AWS A5.9/ASME SFA-5.9*

e. For nickel and nickel-alloy covered welding electrodes, *AWS A5.11/ASME SFA 5.11*

f. For bare nickel and nickel alloy welding electrodes and rods, *AWS A5.14/ASME SFA-5.14*
4.2.3.2 Selection of welding consumable materials for the associated anchor materials shall be in accordance with Table 2.

**Table 2 – Welding Consumable Material** (Note 1)

<table>
<thead>
<tr>
<th>Anchor Material</th>
<th>Carbon Steel Shell</th>
<th>Type 304 Shell</th>
<th>Low Alloy Shell</th>
<th>Other Alloy Shell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 400 Series</td>
<td>E309-XX/ER309</td>
<td>NR (Note 2)</td>
<td>ENiCrFe-2 (Note 3)</td>
<td>NR (Note 2)</td>
</tr>
<tr>
<td>Type 304/304H</td>
<td>E309-XX/ER309</td>
<td>E308-XX/ER308</td>
<td>ENiCrFe-2 (Note 3)</td>
<td>See Note 4</td>
</tr>
<tr>
<td>Type 316</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 321</td>
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<td>Type 347</td>
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<tr>
<td>Type 309</td>
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<tr>
<td>Type 310</td>
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<td></td>
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</tr>
<tr>
<td>Alloy 330</td>
<td></td>
<td>ENiCrFe-3 or ENiCrMo-3</td>
<td></td>
<td>See Note 4</td>
</tr>
<tr>
<td>Alloy 601</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
1. Welding consumables shall be in accordance with Section 4.2.3.1.
2. Welding the listed anchor material to the shell material is not recommended (NR).
3. For high sulfur environment use E309-XX/ER309.
4. Purchaser shall specify the metallurgy of the welding consumable.

4.2.4 Monolithic Lining Anchors

4.2.4.1 Single-Component Linings

1. Thicknesses less than or equal to 75 mm (3 inches)
   a. Anchors shall be Longhorn type in accordance with RFSA1001.
   b. Plastic caps or coatings shall not be specified for anchor tips.
2. Alternative stack, header box and duct lining thickness 50 mm (2 inches)
   a. Anchors shall be the modified picket fence (bent wire strand) in accordance with RFSA1002.
   b. Wire mesh shall not be permitted as anchors for refractory linings.
3. Thicknesses 75-150 mm (3-6 inches)
   a. Anchors shall be one of the following:
      (1) Footed wavy V, uneven legs, in accordance with RFSA1003, Detail (A)
      (2) Footed double-hook V, uneven legs, in accordance with RFSA1003, Detail (B)
   b. The foot of an anchor shall be in accordance with RFSA1003, Detail (C) or (D).
4. Thicknesses greater than 150 mm (6 inches)
   a. Anchors shall be one of the following:
      (1) Footed wavy Y, uneven legs, in accordance with RFSA1004, Detail (A)
      (2) Footed double hook Y, uneven legs, in accordance with RFSA1004, Detail (B)
   b. The foot of an anchor shall be in accordance with RFSA1004, Detail (C).

4.2.4.2 Multi-Component Linings
1. Two refractory components or layers
   a. Anchors shall be one of the following:
      (1) Stud with footed wavy V, uneven legs, in accordance with RFSA1005, Detail (A)
      (2) Stud with footed double-hook V, uneven legs, in accordance with RFSA1005, Detail (B)
   b. Studs shall be threaded and manufactured in accordance with RFSA1005, Detail (C) or (D).
   c. The threaded part of a stud shall be provided with masking tape or a plastic cover for protection during application of the backup refractory.
   d. The foot of an anchor shall be in accordance with RFSA1005, Detail (E).
   e. The V part of an anchor shall be fitted with a flanged nut manufactured in accordance with RFSA1005, Detail (F), and fused/welded inside the foot of the V.
   f. Individual parts of the anchor shall be manufactured such that the V part screws onto the threaded stud to assemble into one-piece two-component anchor in accordance with RFSA1005, Detail (A) or (B).

2. Greater than two refractory components or layers
   a. Anchors shall be one of the following:
      (1) Stud with footed wavy V, uneven legs, in accordance with RFSA1005, Detail (A)
      (2) Stud with footed double-hook V, uneven legs, in accordance with RFSA1005, Detail (B)
   b. The stud height shall be adjusted to accommodate all of the backup refractory layers (i.e., the V portion of the anchor is in the hot face layer).
   c. Anchor details shall be in accordance with Section 4.2.4.2, Item 1.
4.2.4.3 Hexmesh Lining

1. Single-component thin abrasion-resistant lining
   a. Lance hexmesh
      (1) Hexmesh anchors shall be tight clenched, lance type, made of 2 mm (14 USS gauge) minimum strips in accordance with RFSA1006, Detail (A).
      (2) Hexmesh shall be 25 mm (1 inch) deep unless another size (e.g., 19 mm (3/4 inch), 38 mm (1 ½ inches) or 50 mm (2 inches)) is specified by the purchaser.
      (3) Clenches, lances and perforations in 25 mm (1 inch) deep hexmesh shall be offset in accordance with RFSA1006, Detail (B).
      (4) Clenches, lances and perforations in 19 mm (3/4 inch) deep hexmesh shall be centered in accordance with RFSA1006, Detail (B).
      (5) Each hexmesh cell shall have two lances projecting into the hex area as shown in RFSA1006, Detail (C).
      (6) Lances shall not be opposite each other.
      (7) Clenches of a hexmesh shall be in accordance with RFSA1006, Detail (D).
      (8) The 38 mm (1 ½ inch) and 50 mm (2 inch) deep hexmesh shall comply with Section 4.2.4.3, Item 1. a. (1) through (3) and (5) through (7) with an additional row of clenches, lances and perforations located half way between the top of the hexmesh and the top of the lower row of clenches, lances and perforations.
   b. Non-lance hexmesh
      (1) If specified in the purchase order, non-lance hexmesh (i.e., hexmesh without lances) may be used.
      (2) Hexmesh shall be tight clenched made of 2 mm (14 USS gauge) minimum strips in accordance with RFSA1007, Detail (A).
      (3) Hexmesh shall be 25 mm (1 inch) deep unless another size (e.g., 19 mm (3/4 inch), 38 mm (1 ½ inches) or 50 mm (2 inches)) is specified by the purchaser.
      (4) Clenches and perforations in the 25 mm (1 inch) deep hexmesh shall be offset in accordance with RFSA1007, Detail (B).
      (5) Clenches and perforations in the 19 mm (3/4 inch) deep hexmesh shall be centered in accordance with RFSA1007, Detail (B).
      (6) Each hexmesh cell shall have two bonding holes as shown in RFSA1007, Detail (B).
(7) Clenches of a hexmesh shall be in accordance with RFSA1007, Detail (D).

(8) The 38 mm (1 ½ inch) and 50 mm (2 inch) deep hexmesh shall comply with Section 4.2.4.3, Item 1.b. (1) through (3) and (5) through (7) with an additional row of clenches, bonding holes and perforations located half way between the top of the hexmesh and the top of the lower row of clenches, bonding holes and perforations.

2. Multi-component abrasion-resistant lining
   a. Two-component hexmesh anchor systems for thin abrasion-resistant lining backed by insulating refractory shall consist of threaded stud and washer standoff to which hexmesh cells are attached in accordance with RFSA1008, Detail (A).
   b. Material, cell dimensions, and manufacture of hexmesh shall be in accordance with Section 4.2.4.3, Item 1.a for lance hexmesh and Section 4.2.4.3, Item 1.b for non-lance hexmesh.
   c. Studs and washers shall be of the same alloy as the hexmesh and manufactured in accordance with RFSA1008, Detail (B).
   d. Protruding threads of studs shall be covered with masking tape or plastic caps during application of insulating refractory.

4.2.4.4 Flexmesh Lining

1. Flexmesh anchors may be used in areas of single axis of curvature where hexmesh and hexalt anchors are not practical. The use of flexmesh anchors shall be limited to repair of abrasion resistant linings in low to moderate abrasion and non-coking services.

2. Flexmesh anchors shall be in accordance with RFSA1009.

3. Flexmesh anchors shall be 2 mm (1/4 USS gauge) minimum strips.

4. Unless 19 mm (3/4 inch) deep flexmesh is specified in the purchase order, flexmesh shall be 25mm (1 inch) deep.

5. The size (dimensions) of the flexmesh cells shall be in accordance with RFSA1009.

6. Each flexmesh cell shall have two lances, projecting into the flex area in accordance with RFSA1009.

4.2.4.5 Tabs

1. Tab anchors may be used at corners and curved surfaces.

2. If used in conjunction with hexmesh or flexmesh anchored linings, tabs shall be made of the same alloy, bar thickness and depth as the hexmesh or flexmesh.

3. The following types of tabs shall be provided:
   a. Corner Tab – L-shaped tab with rigid shape in accordance with RFSA1010, Detail (A)
b. Variable Corner Tab - Two-piece tab with adjustable angle per RFSA1010, Detail (B)
c. End Tab (U-Tab) – U-shaped tab used at ends or edges of plates per RFSA1010, Detail (C)
d. Radius Tab – Hemispherical tabs used on curved surfaces per RFSA1011
e. Monster Corner Tab – 100 mm (4 inch) variable tab per RFSA1012

4.2.4.6 Hexalt Anchors

1. Except as otherwise specified in this Practice, hexalt anchors for abrasion resistant linings shall be made of 2 mm (14 USS gauge) minimum bars.

2. Type-S Anchors (i.e., anchors fabricated into S-shapes from plate).
   a. Mini Type-S anchor for 19 mm (3/4 inch) or 25 mm (1 inch) deep shall be in accordance with RFSA1013, Detail (A), for use in corners, edges, and other small areas.
   b. Regular Type-S anchor for 19 mm (3/4 inch) or 25 mm (1 inch) deep shall be in accordance with RFSA1013, Detail (B).
   c. General purpose Type-S anchors for 38 mm (1½ inches) to 150 mm (6 inches) deep abrasion-resistant or other linings shall be in accordance with RFSA1014.

3. Type-C Anchor (i.e., anchors fabricated into E-shapes from plate)
   a. Type-C anchors shall be 25 mm (1 inch) deep.
   b. Type-C anchors shall be in accordance with RFSA1015.

4. Type-T Anchor (i.e., anchors fabricated into circular rings from plate)
   a. Type-T anchors shall be 19 mm (3/4 inch) or 25 mm (1 inch) deep.
   b. Type-T anchors shall be in accordance with RFSA1016.

5. Type-K Anchor (i.e., anchors designed to approximate hexmesh when installed but without continuous cell configuration)
   a. Type-K anchors shall be made of 2.8 mm (12 USS gauge) thick bars and welded at one location.
   b. Type-K anchors shall be 19 mm (3/4 inch) or 25 mm (1 inch) deep.
   c. Type-K anchors shall be in accordance with RFSA1017.

6. Type-D Anchor (i.e., anchors designed to approximate hexmesh similar to Type-K anchor but with three contact points for increased (multiple) welding and greater stability)
   a. Type-D anchors shall be 25-mm (1-inch) deep.
b. Type-D anchors shall be in accordance with RFSA1018.

7. **Hexcell and Half Hexcell Anchors (i.e., anchor systems with individual single hex cells)**
   a. Hexcell or half hexcell anchors shall be 19-mm (3/4-inch), 25-mm (1-inch), or 50-mm (2-inches) deep.
   b. Hexcell or half hexcell anchors used in thin abrasion resistant linings shall be provided with offset lances and shall be made in accordance with RFSA1019.

8. **Speed Cells® (i.e., anchors similar to hexcells using a single hex cell disc system but designed for attachment to a shell using a threaded stud)**
   a. Speed Cells® shall be 19-mm (3/4-inch) or 25-mm (1-inch) deep.
   b. Speed Cells® shall be in accordance with RFSA1020.

4.2.4.7 **Anchors for Plastic Refractory Lining**

1. **Lining thickness less than 50 mm (2 inches)**
   Anchors for single-component thin abrasion-resistant plastic refractory linings shall be one of the following:
   a. For less than or equal to 25-mm (1-inch) thick linings, hexmesh in accordance with Section 4.2.4.3.
   b. If approved by purchaser, for linings greater than 25 mm (1 inch) and less than 50 mm (2 inches) thick, hexmesh may be used in accordance with 4.2.4.3.
   c. For less than or equal to 25 mm (1 inch) thick linings, flexmesh, in accordance with Section 4.2.4.4
   d. Tabs in accordance with Section 4.2.4.5
   e. Hexalt anchors in accordance with Section 4.2.4.6

   **Comment:** Hexalt anchors Types-C, T, K, D and Speed Cells® can only be used with linings less than or equal to 25 mm (1 inch) thick. Type-S and Hexcell can be used with thicker linings.

2. **Lining thickness 50-150 mm (2-6 inches)**
   a. If approved by purchaser, for 50 mm (2 inches) thick linings, hexmesh may be used in accordance with 4.2.4.3.
   b. Longhorn and V-type anchors as follows:
      (1) Suitable only for repairs, field joints, and other areas with a minimum dimension not greater than 450 mm (18 inches)
      (2) For 50-75 mm (2-3 inches) thick linings, longhorn anchors in accordance with Section 4.2.4.1, Item 1
      (3) For 75-150 mm (3-6 inches) thick linings, footed V-type, wavy V or double-hook V, uneven legs, anchors in accordance with Section 4.2.4.1, Item 3
c. Hexalt anchors as follows:
   (1) Suitable for new installations, repair areas, and field joints
   (2) Hexalt anchors in accordance with Sections 4.2.4.6, Item 2.
      c. for 50-100 mm (2-4 inches) thick linings and 4.2.4.6, Item 7 for 50 mm (2 inch) thick linings. Anchor heights shall match thickness of the lining.

d. Castings as follows:
   (1) Suitable for new installations, repair areas, and field joints
   (2) Anchor casting in accordance with RFSA1021, Detail (A) or (B) with RFSA1021, Detail (D) wall clip, and support shelves in accordance with RFSA1021, Detail (F) or (G)
   (3) Shell attachments used with anchor castings or any accessories used to attach castings to a shell may be made of carbon steel if attached to a carbon steel shell and the temperature of the attachments cannot be greater than 425°C (800°F).

3. Lining thickness greater than 150 mm (6 inches)
a. Anchors for single-component thick plastic refractory linings shall be anchor castings consisting of anchor and accessories (i.e., shelf support, shell attachment and hanger) in accordance with RFSA1021.

b. Shell attachments used with anchor castings or any accessories used to attach castings to a shell may be made of carbon steel if attached to a carbon steel shell and the temperature of the attachments cannot be greater than 425°C (800°F).

4. Multi-component lining
a. Anchor castings and accessories shall be in accordance with Section 4.2.4.7, Item 3.

b. Attachments from shell to anchor castings (wall clip) shall be adjusted so that the wall clip extends beyond the backup refractory to allow installation of the anchor link or support shelf.

4.2.5 Ceramic Fiber Lining Anchors

4.2.5.1 Wallpaper Blanket/Board Lining
1. Pin-stud and clip-washer for blanket lining
a. Pin-stud and clip-washer anchor system for anchoring one or more layers of ceramic fiber blanket shall be in accordance with RFSA1022, Detail (A) or (B).

b. Exposed parts of pin-studs and clip-washers may be protected from direct exposure to radiant heat or hot gases by a ceramic fiber diaper.
c. If specified in the purchase order, pin-stud anchor shall be protected with ceramic Cuplock in accordance with the following.

(1) The ceramic Cuplock with or without plug shall be in accordance with RFSA1022, Detail (C).

(2) Composition of the ceramic Cuplock and plug (if required) shall be in accordance with Table 3.

2. Threaded-stud and washer for blanket and board Lining

   a. Threaded-stud with washer and nut anchor system may be used if ceramic fiber board is specified alone or as the hot face layer of a wallpaper ceramic fiber lining.

   b. Threaded-stud and washer-nut anchor systems shall be in accordance with RFSA1023.

   c. Exposed parts of threaded-studs, washers and nuts may be protected from direct exposure to radiant heat or hot gases by a ceramic fiber diaper.

4.2.5.2 Module Lining

1. Stacked Lining

   a. Anchor systems for stacked module linings shall be made of spear-shaped plate or rod in accordance with RFSA1024.

   b. This applies to stacked module lining 150 mm (6 inches) or less in thickness.

2. Proprietary Module (e.g., Folded, Block, etc.) Lining

   a. Anchor systems for proprietary module linings shall be in accordance with manufacturer’s design and properly embedded in the lining.

   b. Anchor hardware of the module shall be attached to the shell by one of the following:

      (1) Straight Stud in accordance with RFSA1025, Detail (A)

      (2) L-Shaped Stud in accordance with RFSA1025, Detail (B)

      (3) Stud/Plate in accordance with RFSA1025, Detail (C)

4.2.6 Brick Lining Anchors

4.2.6.1 Insulating Fire Brick (IFB) Lining – Operating Temperature 1430°C (2600°F) and Below

1. Tie-back anchors (wall)

   a. Tie-back anchors for IFB wall linings shall be one of four types in accordance with RFSA1026, Detail (A), (B), (C), or (D).

   b. Accessories for attaching tie-back to a shell shall be in accordance with RFSA1026, Detail (E), (F), or (G).
c. Accessories for attaching tie-back anchors to a shell may be made of carbon steel if attached to a carbon steel shell and the temperature of the accessories cannot be greater than 425°C (800°F).

2. Support shelves (accessory)

Support shelves shall be in accordance with RFSA1021, Details (F) or (G) and the following:

a. Support 4 times the weight of brick lining associated with support shelf.

b. Support shelf may be made of carbon steel if attached to a carbon steel shell and the temperature of the shelf cannot be greater than 425°C (800°F).

*Comment:* Support shelves are used as accessories with tie-back IFB anchors.

4.2.6.2 Insulating Fire Brick (IFB) Operating Temperature Above 1430°C (2600°F) and Dense Brick Linings

Anchors for IFB linings with normal operating temperatures above 1430°C (2600°F), or dense brick linings, are made of non-metallic materials in accordance with Section 4.3. Details of the anchor and metallic accessories used to attach non-metallic anchors to the shell are provided in Section 4.3.5.

4.3 Non-Metallic Anchors

4.3.1 General

4.3.1.1 Non-metallic anchors include fired refractory shapes or brick type anchors for castable, plastic, dense brick and IFB (with operating temperature above 1430°C (2600°F)) linings, and non-metallic pin-stud with non-metallic clip-washer or ceramic Cuplock for ceramic fiber blanket and/or board linings.

4.3.1.2 Metallic accessories shall be made of appropriate austenitic stainless steel or high nickel alloys in accordance with Table 1.

4.3.1.3 If process conditions require a special metallurgy, accessories shall be made of appropriate alloys.

4.3.2 Composition

4.3.2.1 Non-metallic anchors and accessories shall be chemically compatible with and of quality equal to or greater than the refractory lining in which they are embedded.

4.3.2.2 Non-metallic anchor and accessory materials shall be in accordance with Table 3.
### Table 3 – Composition of Non-Metallic Anchors and Accessories (Castable, Plastic, IFB, Dense Brick and Ceramic Fiber Linings) (Note 1)

<table>
<thead>
<tr>
<th>Anchor Material</th>
<th>PCE</th>
<th>Temperature Limit</th>
<th>Application (Refractory Lining Type)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>°C</td>
<td>°F</td>
</tr>
<tr>
<td>1) Brick Anchors (ASTM C24 and C27) (Note 2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Fireclay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Low Duty</td>
<td>15</td>
<td>1430</td>
<td>2606</td>
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<tr>
<td>ii) Medium Duty</td>
<td>29</td>
<td>1659</td>
<td>3018</td>
</tr>
<tr>
<td>iii) High Duty</td>
<td>31 ½</td>
<td>1699</td>
<td>3090</td>
</tr>
<tr>
<td>iv) Superduty</td>
<td>33</td>
<td>1743</td>
<td>3169</td>
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<tr>
<td>b) High Alumina</td>
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<td></td>
</tr>
<tr>
<td>i) 50% Al₂O₃</td>
<td>34</td>
<td>1763</td>
<td>3205</td>
</tr>
<tr>
<td>ii) 60% Al₂O₃</td>
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<td>3245</td>
</tr>
<tr>
<td>iii) 70% Al₂O₃</td>
<td>36</td>
<td>1804</td>
<td>3279</td>
</tr>
<tr>
<td>iv) 80% Al₂O₃</td>
<td>37</td>
<td>1820</td>
<td>3308</td>
</tr>
<tr>
<td>v) 90%+ Al₂O₃</td>
<td>37+</td>
<td>&gt;1820</td>
<td>&gt;3308</td>
</tr>
<tr>
<td>2) Technical Ceramic Anchors and Accessories (Note 3)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>a) Cordierite Cuplock and Plug</td>
<td>1090</td>
<td>2000</td>
<td>Ceramic Fiber</td>
</tr>
<tr>
<td>b) Mullite Cuplock and Plug</td>
<td>1343</td>
<td>2450</td>
<td>Ceramic Fiber</td>
</tr>
<tr>
<td>c) High Alumina Pin-Stud and Clip-Washer</td>
<td>1510</td>
<td>2750</td>
<td>Ceramic Fiber</td>
</tr>
</tbody>
</table>

**NOTES:**
1. This Table is used for purchase of non-metallic anchors. It shall not be used for design purposes. Design considers many factors, such as, long term operating temperature, hot load deformation, and corrosion resistance.
2. The temperature limit is based upon ASTM C24 Pyrometric Cone Equivalent (PCE) and Classification only.
3. The temperature limit is based upon manufacturer's recommended continuous long term operating temperature.

#### 4.3.3 Monolithic Lining Anchors

##### 4.3.3.1 Castable Lining

1. Non-metallic anchors for castable linings, roof or wall, shall be corrugated brick anchors with fixed attachments (e.g., C-clip) for attaching to a shell in accordance with RFSA1027.

2. The corrugated brick anchor shall extend to the hot face of a castable lining.

3. Composition of the corrugated brick anchor shall be in accordance with Table 3.

4. Accessories for attaching C-clip or other attachments to a shell may be made of carbon steel if attached to a carbon steel shell and the temperature of the accessories cannot be greater than 425°C (800°F).
4.3.3.2 Plastic Lining

1. Non-metallic anchors for plastic linings shall be as follows:
   
   a. Roof Lining
      Corrugated brick anchors with attachments in accordance with Section 4.3.3.1.
   
   b. Wall Lining
      Corrugated brick anchors with attachments in accordance with RFSA1027 or RFSA1028.
   
2. The corrugated brick anchor shall extend to the hot face of the plastic lining.

3. Composition of the corrugated brick anchor shall be in accordance with Table 3.

4. Accessories for attaching C-clip or other attachments to a shell may be made of carbon steel if attached to a carbon steel shell and the temperature of the accessories cannot be greater than 425°C (800°F).

4.3.4 Ceramic Fiber Lining Anchors

4.3.4.1 Non-metallic anchors for ceramic fiber blanket or blanket/board linings operating at temperatures equal to or greater than 1095°C (2000°F) shall be non-metallic pin-stud and washer anchors in accordance with RFSA1029.

4.3.4.2 Composition of non-metallic pin-stud and clip-washer shall be in accordance with Table 3, Technical Ceramic Anchors and Accessories.

4.3.5 Brick Lining Anchors (IFB linings with normal operating temperature above 1430°C (2600°F) or dense brick linings)

4.3.5.1 Non-metallic anchors (anchor brick) and accessories shall be in accordance with RFSA1030.

4.3.5.2 Composition of the anchor brick shall be compatible with brick in the lining and shall be in accordance with Table 3 for the applicable temperature.

4.3.5.3 Metallic accessories may be made of carbon steel if attached to a carbon steel shell and the temperature of the accessories cannot be greater than 425°C (800°F).

4.4 Metal Fiber Reinforcement

4.4.1 Metal fibers (i.e., needles) shall be in accordance with ASTM A820/A820M, Type III, melt extracted, soft and fully annealed.

4.4.2 Metal fibers shall be made of appropriate austenitic stainless steel or high nickel alloys in accordance with Table 1.

4.4.3 If process conditions require a special metallurgy, metal fibers shall be made of appropriate alloys.

4.4.4 Fibers shall be 0.5 mm (20 mils) nominal diameter, 19 mm or 25 mm (3/4 inch or 1 inch) long, and applied in accordance with Table 4.
### Table 4 – Amount of Metal Fiber Reinforcement (Weight Percent of Refractory)

<table>
<thead>
<tr>
<th>Installation</th>
<th>Fiber Length</th>
<th>Density of Refractory</th>
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<tr>
<td></td>
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<td>≤1600 kg/m³ (100 PCF)</td>
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<td>Cast</td>
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<tr>
<td>Gunned (Dry or Wet)</td>
<td>19 mm (3/4 inch)</td>
<td>4%</td>
</tr>
<tr>
<td>Pump Cast</td>
<td>19 mm (3/4 inch)</td>
<td>3%</td>
</tr>
<tr>
<td>Vibration Cast</td>
<td>25 mm (1 inch)</td>
<td>3%</td>
</tr>
<tr>
<td>Low Expansion Refractory (See Note)</td>
<td>Cast: 25 mm (1 inch)</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>Gunned: 19 mm (3/4 inch)</td>
<td>N/A</td>
</tr>
<tr>
<td>Self-Leveling</td>
<td>Cast: 25 mm (1 inch)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Pumped: 19 mm (3/4 inch)</td>
<td>N/A</td>
</tr>
<tr>
<td>Ramming, Thin Abrasion Resistant, T ≤ 38 mm (1-1/2 inch)</td>
<td>19 mm (3/4 inch)</td>
<td>2%</td>
</tr>
<tr>
<td>Ramming, Thick Lining, T 38 mm (1-1/2 inch)</td>
<td>25 mm (1 inch)</td>
<td>2%</td>
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**NOTE:** Fused silica or cordierite aggregate castable
(A) DETAIL OF LONG HORN ANCHOR

(B) MANUFACTURING DIMENSIONS

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NOTES:
1. T = LINING THICKNESS

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.
NOTES:

1. T = LINING THICKNESS

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.
(A) FOOTED WAVY V, UNEVEN LEGS

(B) FOOTED DOUBLE HOOK V, UNEVEN LEGS

(C) DETAIL OF 10 (3/8) FOOT

(D) DETAIL OF 25 (1) FOOT

(E) MANUFACTURING DIMENSIONS

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NOTES:
1. T = LINING THICKNESS
2. USE 8 (5/16) DIAMETER ANCHOR WITH TYPE 4 OR DENSER REFRACTORIES PER PIP RFSA1000, APPENDIX A, OR WHEN USING VIBRATION CASTING INSTALLATION.

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.
FOOTED Y ANCHOR
T > 150 mm (6 INCHES)

(A) FOOTED WAVY Y-ANCHOR, UNEQUAL LEGS

(B) FOOTED DOUBLEHOOK Y-ANCHOR, UNEQUAL LEGS

(C) DETAIL OF FOOT

(D) MANUFACTURING DIMENSIONS

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NOTES:
1. T = LINING THICKNESS

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESES ARE IN INCHES, UNLESS NOTED OTHERWISE.
(A) L-STUD w/ FOOTED WAVY V UNEQUAL LEGS

(B) L-STUD w/ FOOTED DOUBLEHOOK V UNEQUAL LEGS

(C) DETAIL OF THREADED L-STUD (FOR BACKUP LINING)

(D) DETAIL OF THREADED STUD (FOR BACKUP LINING)

(E) DETAIL OF FOOT

(F) DETAIL OF FOOTED V W/ WELDED NUT

(H) MANUFACTURING DIMENSION OF V-ANCHOR (HOTFACE COMPONENT)

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NOTES:
1. T = HOT FACE LINING THICKNESS
2. A = HEIGHT OF V ANCHOR
3. L = BACKUP FOR GUNNING
4. L = BACKUP + 13 (1/2) FOR CASTING OR FORMING

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.
(A) PLAN VIEW OF HEXMESH, LANCE TYPE

(B) LOCATION OF LANCES, CLENCHES AND PERFORATIONS

25 (1) DEEP OFFSET LANCE

19 (3/4) DEEP CENTERED LANCE

(C) MANUFACTURING DIMENSIONS

(D) CLENCH DETAILS

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESES ARE IN INCHES, UNLESS NOTED OTHERWISE
(A) PLAN VIEW OF NON-LANCE HEXMESH

(B) LOCATION OF CLENCHES AND PERFORATIONS

25 (1) DEEP OFFSET HOLES

19 (3/4) DEEP CENTERED HOLES

(C) MANUFACTURING DIMENSIONS

(D) CLENCH DETAILS

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESES ARE IN INCHES, UNLESS NOTED OTHERWISE.
(A) ELEVATION VIEW OF STUD/WASHER & HEXMESH ANCHOR

HEXMESH PER RFSA1006 OR RFSA1007
AS APPLICABLE

THREADED STUD

19 OR 25
(3/4 OR 1)

WASHER

(B) DIMENSION OF STUD & WASHER

DRILL & TAP (SEE NOTE 1)

% OF WASHER

1/2" DIA-13 UNC

63 (2 1/2) SQUARE WASHER

NOTES:

1. WELD AFTER ASSEMBLY AND GRIND FLUSH

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.
(A) PLAN VIEW OF FLEXMESH ANCHOR

(B) LOCATION OF LANCES AND MANUFACTURING DIMENSION

NOTES:
1. A = 19 (3/4) OR 25 (1)
(A) CORNER TAB

RADIUS (SEE NOTE 4)

50 (2)

6 (1/4)

50 (2)

13 (1/2) TYP.

6 (1/4)

6 (1/4)

A

FIXED

(R) VARIABLE CORNER TAB

RIVET

50 (2)

13 (1/2) TYP.

6 (1/4)

6 (1/4)

A

ADJUSTABLE

(C) END TAB (U-TAB)

RADIUS (SEE NOTE 4)

13 (1/2) TYP.

6 (1/4)

6 (1/4)

6 (1/4)

A

A

SEE NOTE 3

NOTES:

1. A = 19 (3/4) OR 25 (1)
2. ALL METAL STRIPS 2 (14 ga) MINIMUM
3. STEEL THICKNESS
4. OUTSIDE RADIUS SHALL NOT BE GREATER THAN "A"

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESES ARE IN INCHES, UNLESS NOTED OTHERWISE

CAD FILENAME: RFSA1010.dwg
NOTES:
1. A = 19 (3/4) OR 25 (1)
2. INSIDE RADIUS BASED ON PIPE OUTSIDE RADIUS

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE
MONSTER CORNER TAB ANCHOR
LINING THICKNESS 100 mm (4 INCH)

TABS 10X10 (3/8 X 3/8)
2 (14 GAUGE) THICK
25 (1) DIAMETER HOLES

EDG VIEW

MONSTER CORNER TAB DIMENSIONS (SIDE VIEW)

NOTES:
1. MONSTER CORNER TAB ANCHOR FOR LININGS GREATER THAN 100 (4) ARE PER THE REFRAC TORY LINING DESIGNER.

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.

CAD FILENAME: RFSA1012.dwg
(A) MINI TYPE-S HEXALT ANCHOR, 19 (3/4) or 25 (1). (SEE NOTE 1).

(B) REGULAR TYPE-S ANCHOR, 19 (3/4) or 25 (1). (SEE NOTE 1).

NOTES:
1. TYPE-S HEXALT ANCHOR IS S-BAR ANCHOR AS MANUFACTURED BY VARIOUS MANUFACTURERS.
2. 10 (3/8) FOR 25 (1) DEEP ANCHOR
3. (1/8) FOR 19 (3/4) DEEP ANCHOR

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESES ARE IN INCHES, UNLESS NOTED OTHERWISE.
NOTES:

1. TYPE-S HEXALT ANCHOR IS S-BAR ANCHOR AS MANUFACTURED BY VARIOUS MANUFACTURERS

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESES ARE IN INCHES, UNLESS NOTED OTHERWISE.
NOTES:
1. TYPE-C HEXALT ANCHOR IS C-BAR OR CURL ANCHOR AS MANUFACTURED BY VARIOUS MANUFACTURERS.

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.
NOTES:

1. A = LINING THICKNESS 19 (3/4) OR 25 (1)

2. TYPE–T HEXALT IS KNOWN AS TACKO® ANCHOR MANUFACTURED BY AGC PLIBRICO JAPAN.

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.
NOTES:

1. TYPE-K HEXALT ANCHOR IS K-BAR® ANCHOR AS MANUFACTURED BY KRAEMER GUNITE, INC.

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.
(A) PLAN VIEW

(B) FABRICATION DIMENSION

NOTES:
1. TYPE-D HEXALT ANCHOR IS D-BAR® ANCHOR AS PATENTED BY DIAMOND REFRACTORY SERVICES.

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.
(A) 19 (3/4) TO 25 (1) HEXCELL

(B) 50 (2) HEXCELL

(C) 19 (3/4) TO 25 (1) HALF HEXCELL

(D) 50 (2) HALF HEXCELL

NOTES:
1. DIMENSIONS NOT SHOWN ARE BY ANCHOR FABRICATOR.

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESES ARE IN INCHES, UNLESS NOTED OTHERWISE.
NOTES:
1. SPEED CELL® HEXALT ANCHOR IS MADE BY SILICON BV & SILICON USA.

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESES ARE IN INCHES, UNLESS NOTED OTHERWISE.
(A) WALL ANCHOR (GENERAL PURPOSE)
(SEE NOTE 1)

(B) HEAVY DUTY WALL ANCHOR
(SEE NOTE 1)

(C) ROOF ANCHOR CASTING
(SEE NOTE 1)

NOTES (SEE PAGE 3)

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE

CAD FILENAME: RFSA1021_1.dwg
(D) FLUSH MOUNT WALL CLIP (ACCESSORY)
(SEE NOTE 1)

1.5 mm (1/16") LARGER THAN BOLT SIZE

(E) EXTENSION WALL MOUNT WALL CLIP (ACCESSORY)
(SEE NOTE 1)

1.5 mm (1/16") LARGER THAN BOLT SIZE

(F) SHELF—SUPPORT ASSEMBLY WELDED TYPE
(SEE NOTE 1)

NOTES (SEE PAGE 3)

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE

CAD FILENAME: RFSA1021_2.dwg
(G) SHELF-SUPPORT BRACKET TYPE
(SEE NOTE 1)

SUPPORT BRACKET DETAILS

SUPPORT BRACKET

COMPONENTS

ASSEMBLY

NOTES:

1. DIMENSIONS NOT SHOWN ARE BY MANUFACTURER.

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE
(A) PIN–STUD AND CLIP–WASHER

MANUAL STICK WELD

STUD WELD

DETAIL SECTION A–A

(B) COLLAPSIBLE PIN–STUD AND CLIP–WASHER

MANUAL STICK WELD

STUD WELD

DETAIL SECTION B–B

NOTES (SEE PAGE 2)

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESES ARE IN INCHES, UNLESS NOTED OTHERWISE
(C) CERAMIC CUPLOCK DETAILS

(D) METALLIC PIN–STUD/CERAMIC CUPLOCK WASHER ASSEMBLY AND LINING DETAILS

NOTE:
1. FOR STUD LESS THAN 88 (3 1/2) THERE ARE ONLY 2 NOTCHES
2. WASHER HOLE SIZE TO ALLOW WASHER TO PASS WIDER PORTION OF THE STUD, TURN 1/4 TURN ON THE NARROW PORTION OF THE STUD TO RESULT IN AS TIGHT A FIT AS POSSIBLE

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENSHES ARE IN INCHES, UNLESS NOTED OTHERWISE

CAD FILENAME: RFSAT022_2.dwg
THREADED STUD WITH NUT–WASHER ANCHOR
CERAMIC FIBER BLANKET/BOARD LINING

1/4" X 24–UNC

STICK WELD
THREAD STUD

1/4" X 24–UNC

FLUX BALL

STUD WELD
THREAD STUD

1/4" X 24–UNC

HEX NUT

3/8

2 (14ga)

WASHER

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.
SPEAR-SHAPED ROD ANCHOR

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESES ARE IN INCHES, UNLESS NOTED OTHERWISE.
(A) STRAIGHT STUD

1/4"X24-UNC

6 (1/4) MINIMUM

AS SPECIFIED

(B) L-SHAPED STUD

1/4"X24-UNC

13 (1/2) TYP.

TANGENT LINE

31 (1 1/4)

19 (3/4)

50 (2)

AS SPECIFIED

(C) STUD WITH PLATE

1/4"X24-UNC

6 (1/4) MINIMUM

AS SPECIFIED

38 (1 1/2) SQUARE

6 (1/4)

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.
(A) 3 (1/8) RADIUS
3 (1/8) DIAMETER
15 (5/8) MINIMUM RADIUS

57 (2 1/4)

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(B) 3 (1/8) DIAMETER

57 (2 1/4)

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CAD FILENAME: RFSA1026_1.dwg
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DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.
(E) SQUARE NUT

(F) PLATE

1/2" SQUARE NUT

TOP VIEW    SIDE VIEW    TOP VIEW    SIDE VIEW

19 (3/4)

12 (1/2)

6 (1/4)

(G) PIPE

NPS 1/2" SCH. 40

25 (1)

TOP VIEW    SIDE VIEW

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESES ARE IN INCHES, UNLESS NOTED OTHERWISE.
(A) ANCHOR DETAILS WITH C-CLIP (NOTES 1, 2 AND 3)

(B) TYPICAL C-CLIP ANCHOR DETAIL

NOTES (SEE PAGE 2)
(C) ANCHOR DETAILS WITH BOLT CLIP (NOTES 1, 2, AND 3)

(D) TYPICAL BOLT CLIP ANCHOR DETAIL

NOTES:
1. T = TOTAL LINING THICKNESS
2. DIMENSIONS NOT SHOWN ARE PROVIDED BY MANUFACTURER

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE
(A) TYPICAL CORRUGATED BRICK ANCHOR DETAILS

(B) TYPICAL ANCHOR ACCESSORIES

1. ANCHOR LINK

LENGTH AS REQUIRED

2. WALL CLIP

(C) ANCHOR AND ACCESSORIES ASSEMBLY

ANCHOR LINK

CERAMIC BRICK ANCHOR

NOTES:

1. DIMENSIONS NOT SHOWN ARE BY BRICK/ANCHOR MANUFACTURER

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE
(A) NON-METALLIC PIN-STUD/WASHER ANCHOR DETAILS

A = TOTAL LINING THICKNESS – 25 (1)

DIA. 10 (3/8)

DIA. 7 (9/32)

DIA. 5 (3/16)

PIN-STUD

6 (1/4) THICK

8

11 (7/8)

22

38 (1 1/2)

WASHER

13

(7/8)

(B) THREADED-STUD

THREADED-STUD

(DIAMETER AND THREADS TO MATCH ADJUSTABLE HOLDER)

SHELL

32

(1 1/4)

(C) ADJUSTABLE HOLDER

STAINLESS STEEL

THREADED ADJUSTABLE HOLDER

5 (3/16) DIA. THROUGH HOLE

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE
(A) TYPICAL CORRUGATED BRICK ANCHOR DETAILS

(CERAMIC ANCHOR BRICK)

(B) TYPICAL ANCHOR ACCESSORIES

1. ANCHOR LINK (TYPICAL)

2. WALL CLIP (TYPICAL)

(C) ANCHOR AND ACCESSORIES ASSEMBLY

(ANCHOR BRICK)

(ANCHOR LINK)

(WALL CLIP)

NOTES:

1. ANCHOR BRICK SHALL BE SAME SIZE AS LINING BRICK
2. DIMENSIONS NOT SHOWN ARE BY THE MANUFACTURER.

DIMENSIONS ARE GIVEN IN MILLIMETERS. DIMENSIONS IN PARENTHESIS ARE IN INCHES, UNLESS NOTED OTHERWISE.