

DEP SPECIFICATION

SPECIFICATION FOR ANCHORING SYSTEMS OF UNSHAPED REFRACTORY LINING MATERIALS

DEP 44.24.32.33-Gen.

September 2012

DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for stainless steel anchors, ceramic anchors, and support hardware for retaining or supporting unshaped refractory materials in engineered monolithic lining construction. This DEP includes requirements for material classification, spacing, and installation for all the common types of anchoring and support.

This DEP does not cover the classification, specification, qualification testing, and acceptance criteria for trademark, floor steel or hex mesh anchors used in fluidized cat cracking units (FCCU) applications. For requirements for anchoring systems used in FCCU applications refer to FCCU Application DEP 64.24.32.12-Gen.

This DEP does not cover anchors and support systems for brick linings. For anchors and support for brick linings refer to DEP 44.24.90.34-Gen. and related DEPs for bricks and shapes.

The content in this DEP is based partially on material previously contained in DEP 64.24.32.30-Gen., December 1997 (now withdrawn).

1.2 ASSOCIATED DEPS

The following DEPs are intended to be used in conjunction with each other for unshaped refractory.

DEP 44.24.32.30-Gen.	Unshaped refractory materials for monolithic refractory linings
DEP 44.24.32.31-Gen.	Classification of unshaped refractory lining materials
DEP 44.24.32.32-Gen.	Specification for sampling and testing of unshaped refractory lining materials
DEP 44.24.32.33-Gen.	Specification for anchoring systems of unshaped refractory lining materials
DEP 64.24.32.33-Gen.	Guidelines for curing, drying and firing of unshaped refractory lining materials
DEP 64.24.32.34-Gen.	Refractory Contractor selection and applicator qualification for installation of unshaped refractory lining materials
DEP 64.24.32.35-Gen.	Construction design details of unshaped refractory lining materials

1.3 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorisation to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of

this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.4 DEFINITIONS

1.4.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant, authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.4.2 Specific definitions

Term	Definition
Batch	A number of raw material components traceably formulated by weight in a proportional and quality controlled recipe collected in a mixer for blending of a single repeatable finished product brand of material for packaging in individual bags or pails.
Batch Lot	A blended batch discharged and stored in bulk (outside the blending mixer) prior to forming into ceramic anchors.
Brand	An individual material or product name designated by the Manufacturer to identify materials matching physical properties of specific types.
Bullnose	Term to describe 90 degree turn in monolithic construction around an outside corner.
Cold Face	Reference to layer directly in contact with the vessel or support steel shell.
Engineered Monolithic Construction	A monolithic lining from unshaped materials where layer configuration along with types and locations of anchors, supports expansion and construction joints from success based installation standards and procedures are detailed on construction detail drawings.
False Anchoring	It is a term for temporary support to un-fired plastic refractory monolithic construction that is not intended as part of the permanent engineered refractory design. False anchoring may or may not be left in during drying and initial firing.
Fire Cut	Properly sized and placed cuts to allow for differential radial expansion of a plate ring inside a circular structure to avoid warping.
Hammer Test	A subjective test of green or fired unshaped material applied in a large sample or installation in which the refractory is impacted with a hammer to gauge soundness and uniformity via audible response.
Hot Face	Reference to layer of material exposed directly to the process.
In-house	A term used in this DEP to describe the material Manufacturers QA/QC procedures for product quality; specifically laboratory sampling, specimen preparation, testing and documentation of test results.

Term	Definition
Liquid Penetrant Inspection	Also called dye penetrate inspection (DPI) is a five stage non-destructive inspection method used to locate surface breaking defects in metals to detect welding surface defects such as hairline cracks and surface porosity.
Lot	The number of ceramic anchors manufactured from the same batch lot with the same procedures or process within an uninterrupted given period of time and with a unique ID/date code identifier.
Manufactured Lot	The number of metallic parts manufactured in the same manufacturing process from standard shop procedures from single traceable mill run of metal in an uninterrupted run or product.
Mill Run	The run of metal manufactured by the steel manufacturer subject to certification and traceability by steel mill industry specification.
Physical Properties- Compliance	Also referred to as compliance data, they are the guaranteed physical properties of materials used for anchoring in compliance procedure of total quality plan for qualifying materials prior to shipment. Compliance properties for materials from which metallic anchors and supports or ceramic anchors are manufactured, wherever possible, should be selected based on normal "in house" testing done by the Manufacturer. For metallic anchors and supports, chemical analysis is most often used as compliance and compliance properties for ceramic anchors may include tensile strength, cold crush strength, density porosity, and permanent reheat change.
Physical Properties- Design	Also referred to as design data, they are the guaranteed physical properties of materials used in compliance procedure for design purposes and are not normally done as part of Manufacturer normal quality control and are not required for product qualification, however, are part of the total quality plan for specifying and guaranteeing materials prior to shipment. Design data for metallic anchors and supports materials often include, co-efficient of reversible expansion, oxidation and corrosion resistance. Design data for ceramic anchors may include high temperature creep resistance, thermal conductivity and or chemical analysis. At the request of the Principal, design properties may also be used for compliance for qualifying materials prior to shipment under special conditions with specific temperature or atmospheric conditions.
Quality Assurance	Structured audit procedure to evaluate the effectiveness of a quality control program.
Refractory Contractor	The party that carries out all or part of the construction design, engineering, material procurement and installation of refractory materials. The refractory Contractor is assumed to have overall responsibility for the total quality control of the materials and services including those of any Sub-contractors or Suppliers related to the installation.
Run	The entire product produced (multiple batch or batch lots) from an uninterrupted production schedule from the individual manufacturing process utilizing the same manufacturing procedures including equipment, raw materials, blend, etc., with no changes.
Sample	A finished brick, metallic anchor or fabricated part ready for packaging.
Technical Data Sheet	Publication of "typical" and average information by Manufacturer to describe characteristics and physical properties of any given material brand or part from testing after or at a range of generally accepted temperatures, typically in accordance with standards organisation testing or approved in- house quality procedures.

Term	Definition
Weldment	Specially manufactured parts from welding together components cut or stamped from steel materials in accordance with engineering drawings provided by parts designer.

Other specific definitions and terms relating to unshaped refractory materials may be in accordance with ASTM C71, API 936 and ISO 1927. Where conflicts exist for the purpose of this and the family of related DEPs, these specific definitions shall be applied.

1.4.3 Abbreviations

Term	Definition
API	American Petroleum Institute
AQL	Acceptance quality limit
EU	European Organization for Standardization
FCCU	Fluidized cat cracking units
FCN	Field change notice
ISO	International Organization for Standardization
ITP	Inspection test plan
LCC	Low cement castable
LPI	Liquid penetrate inspection
MSDS	Material safety data sheets
MTR	Material test report
NDE	Non destructive evaluation
PMI	Positive material identification
QC/QA	Quality control and quality assurance
RFI	Request for information
TDS	Technical data sheet
ULCC	Ultra low cement castable

1.5 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets (). Other documents referenced by this DEP are listed in (12).

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using the DEP Feedback Form by:

- Entering comments directly in the DEP Feedback System on the Technical Standards Portal <http://www.shell.com/standards> (mandatory for users with access to Shell Wide Web);
- Clicking on the DEP Feedback Form button on the DEPs DVD-ROM main page (for users without access to Shell Wide Web);
- Requesting a copy of the DEP Feedback Form from the Administrator at standards@shell.com (for users without access to Shell Wide Web).

For the last two options, the completed DEP Feedback Form can be attached to an email and submitted to the Administrator at standards@shell.com. Only feedback that is entered into the Feedback Form will be considered.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

2. GENERAL CLASSIFICATION AND DESIGN OF ANCHORING SYSTEMS FOR ENGINEERED MONOLITHIC CONSTRUCTION

2.1 GENERAL CLASSIFICATION

Components of anchoring systems have two general classifications: metallic and ceramic.

Metallic anchors are further classified as “V” type or “Y” type with sub classification based on specific alloy or special features; see (6) Table 1.

Ceramic anchors are classified based on physical properties primarily chemical content; see (7) Table 2.

Unless otherwise specified, all anchors and or supports shall be supplied as a standard “part” from a refractory anchor Manufacturer with in-house documented and traceable manufacturing and quality control procedures and where the anchor or part has a Manufacturer's “standard” part and drawing number identifying all features materials and tolerances.

For any anchors and or supports where Manufacturer has no standard part number or drawing, one shall be created and approved by the Principal for compliance requirements of this DEP.

Fabricated parts may be special fitting clips for attachment of ceramic anchors to vessel shell, shelf supports or other fabrications and components used to support and stabilize monolithic construction with sub classifications based on alloy, part number and/or method of manufacture.

Unless otherwise specified, the alloy grade of any alloy or part shall be mechanically stamped and clearly visible on any surface of anchors or supports and hardware attachments. If alloy stamping is not provided, the tips or edges of parts or anchors shall be painted as outlined in (6) Table 1 or if not possible, all items shall be suitably marked in some other way approved by the Principal for field recognition.

2.2 ANCHOR AND SUPPORT SYSTEM DESIGN

2.2.1 General

All linings from unshaped materials shall have anchor system design engineered based on individual project requirements and success-based history in similar applications of the applicable Contractor.

Design of the anchoring and support system for multi-layered linings may incorporate the use of independent layer anchor designs or a design for anchorage of the backup layers by the hot face layout design with the use of different anchor types.

All components of the anchoring system shall be properly identified and detailed on the refractory construction design detail drawings and or anchor layout drawings provided by the appropriate Contractor.

All drawings shall be approved by the Principal and applicable Contractor responsible for associated work as part of the total quality plan prior to the start of any work.

Anchor systems consisting of “standard part” anchors designed to be cold formed such as tune fork shaped stampings for field splitting into “V” or “Y” or “standard part” “V” with standard nut circle welded to cold face apex of bend at the cold face and with no foot shall not be used.

No part of any metallic anchor or support shall be exposed to temperature beyond maximum use temperature indicated in Table 1 (6) for the selected alloy under high normal conditions, as verified by standard or equivalent computer aided steady state heat flow calculations ASTM 680.

2.2.2 Ceramic anchoring

Plastic refractory linings greater than 152 mm (6 in) should be anchored with ceramic anchor assemblies.

Wherever possible, ceramic anchors should be supplied inclusive of mating support clip and if not supplied as a unit, specific fit dimensions shall be provided by both individual suppliers to insure proper fit.

Flexible ceramic anchor systems may be used for monolithic linings from castable, where thermal resistance of practical alloy anchor is not high enough to allow proper support through effective length of any metallic "V" or "Y" anchor.

2.2.3 "V" and "Y" anchoring

"V" anchors shall be used for castable linings between 76 mm (3 in) and 150 mm (6 in) and may be used in thin plastic linings as further outlined herein.

For thin linings, less than 100 mm (4 in) where wire mesh anchoring is not practical, steer horn "V" type anchors without turned back ends, may be used to enable increased pitch spacing with additional support; see Figure 2.e.

"V" and "Y" anchor systems for high strength castables utilizing nuts or washers for flexibility and that are in monolithic construction that will require reversible expansion allowance require both the weld-on "V" anchor and the bolt-on "V" anchor (see Figure 4.b) to enable both rotation and expansion allowances (see Figure 16).

Each configured "V" in a single formed "Y" should divide a two layer lining at the change in angles of the "V"s as generally shown of Figure 2.b.

"Y" anchors shall be used for castable linings greater than 127 mm (5 in) thick or for multi-layered linings. The ratio of effective length between stem and "V" portion under normal conditions of two component "Y" designs shall be in general accordance with (3.3.1) and unless otherwise specified in dual layer linings the "V" portion effective length designed to suit the hot face layer thickness as generally shown in Figure 2.a.

Y-tree anchors or larger one piece formed "Y" generally configured as a double "V" can be used for thick castable installations such as, for corbels in heater linings or with multi-layered castable construction where ceramic anchors are not required or practical.

At bullnoses in multi layered linings, ratio of hot face thickness to insulating layers should be increased to minimize moment loading on anchors. This may be facilitated with the use of better insulating materials as back up in the isolated area of the bullnose.

"Standard part" commonly called X-mas tree anchors with straight short lengths of rod randomly welded across a single stem regardless of foot design shall not be used in any engineered monolithic construction.

2.2.4 Cast alloy anchors

Special alloy cast anchors for plastic linings greater than 152 mm (6 in) shall only be used in lining systems where thermal calculations and chemical compatibility verify safe use. See (6) Table 1.

Unless otherwise approved by Principal, special alloy cast anchors designed for anchorage of plastic linings shall not be used for castable monolithic construction.

2.2.5 Weldments

Fabrications or weldments from alloy plate or rod cold formed to shapes, similar to standard alloy cast shapes depicted in Figure 6.a and Figure 6.b, shall not be used in applications where there is sulphur in the fuel or where temperatures exceed 500 °C (930 °F).

2.2.6 False anchoring

False anchoring shall be used in phosphate bonded plastic refractory linings under any of the following conditions:

- a) The lining is overhead or on a negatively sloped wall.
- b) Anchoring is not with ceramic anchors.
- c) Lining is intended to be in the un-fired condition for a period of time exceeding the Manufacturers requirements.
- d) The installed lining is downstream of other unshaped refractory work (particularly light weight and extra light weight castables), the equipment is without multiple burners and or is not easily ventilated during drying of the upstream lining.
- e) Limited control of airflow and temperature is available during drying and initial firing.
- f) There is a risk of drying and firing interruptions.
- g) Where adjusted and untested or new burner systems are used for drying and initial firing.
- h) The brand of material has a history of slumping problems.
- i) The Manufacturer/Supplier has included it in project specific procedures.

2.2.7 Woven wire mesh

Woven wire mesh anchoring may be used to reduce high-density pitch requirements of other types of anchors and where thermal shocks and vibration can be excessive.

Woven wire mesh shall not be used in linings thicker than 100 mm (4 in) without approval by the Principal.

2.2.8 Shear stops

Shear stops should be used

- If a material change takes place between any weaker (hot or cold) unshaped material is used against fired refractory brick or shape construction as generally shown in Figure 10.
- In bullnose construction to isolate bullnoses from critical high moment force dead loading.

2.2.9 Auxiliary attachments

Auxiliary attachments (4.1.3) and proper ceramic anchor length and or cutting should be used to minimize exposure of metallic components of any ceramic anchor assembly.

3. PHYSICAL CHARACTERISTICS AND DESIGN OF METALLIC ANCHORS

3.1 GENERAL

Metallic anchors shall be cold formed without mechanical damage from alloy straight or wavy rod stock into "V" and "Y" shapes or specialty cast into special shapes, as required and generally outlined herein. Cold formed fabrication may be from one piece formed shapes or from forming individual components and shop fabricating by welding or fitting.

Metallic anchors for intended use over 500 °C (932 °F) shall be from standard wavy "rod" alloy steel stock unless otherwise approved by the Principal. Wavy rod shall be from a "bending" rather than from a "braking" or "crimping" manufacturing process.

All cold formed anchors and or parts of stainless steel shall be supplied in a documented and traceable fully bright annealed condition.

Unless otherwise specified by the Principal, or in the purchase documentation, differential expansion protection on the tips or extended arms of "V" and "Y" anchors is not required for any castable or plastic installation.

If used, differential expansion protection shall be maximum 19 mm (3/4 in) long on the hot face end of "V" or "Y" anchors with tight fitting plastic caps that cannot be removed without

cutting, with paraffin wax or with a non-chloride containing tape layer. Either should be less than 2 mm (1/16 in) thick.

Alloy cast anchors shall be made from high-grade alloy steel in a fully quality managed foundry process.

3.2 WOVEN WIRE MESH FOR CASTABLE LININGS LESS THAN 100 MM (4 IN) THICK

Woven wire mesh shall be made from alloy as determined by the application and verified with steady state heat flow calculations.

Woven wire mesh shall have a minimum pitch of 50 mm x 50 mm (2 in x 2 in) increasing with lining thickness to reduce shearing affects, and a minimum diameter of 3 mm (1/8 in).

Woven wire mesh shall be attached to the steel with specially designed knock down pins of varying length.

- Pins should be in alternating lengths on alternating staggered pitch to eliminate any straight line of mesh or connecting shear planes through the lining thickness. The longest pin shall be covered by the lining by a minimum of 13 mm (1/2 in).
- For additional support, standard steerhorn-type anchors may be used in conjunction with knock-down pins; however, they shall not replace knock down pins. See Figure 2e.

Typical woven wire mesh anchoring is illustrated on Figure 1.

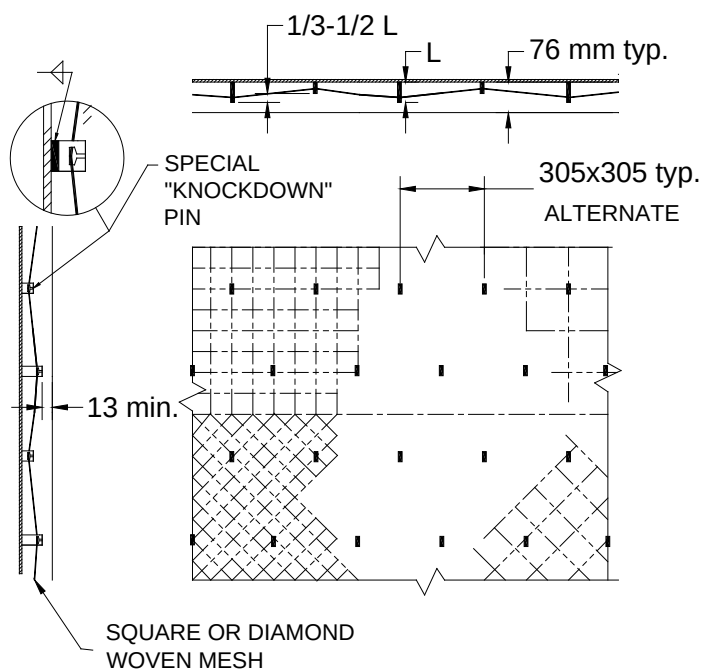


Figure 1 Woven wire mesh anchoring

3.3 "V" AND "Y" METALLIC ANCHORS

3.3.1 "V" and "Y" anchor minimum design requirements

Unless otherwise noted, diameter of rod for fabrication of "V" and "Y" anchors shall be 6 mm (1/4 in) for effective length less than 250 mm (10 in) and 8 mm (5/16 in) for effective length greater than 250 mm (10 in).

All bends shall have a bend radius equalling a minimum of 0.5 x diameter of rod used for anchor fabrication.

Hot face end of "V" and "Y" anchors shall be offset a minimum of 12 mm (1/2 in).

Under normal conditions the effective length of the longest tine of any "V" or "Y" anchor for regular castables shall not exceed the lining thickness less 25 mm (1 in).

If "V" type anchors are used for anchoring plastic refractory under normal conditions, the effective length to the longest tine of any assembly of "V" and supporting nut, shall be based on the high normal operating temperature of the service but generally not exceed the thickness of the plastic refractory less 12 mm (1/2 in).

The effective length of "V" and "Y" anchors for high strength, high purity regular castables, and chemically-bonded castables may be reduced in accordance with the Manufacturer's success-based history on standard engineering practice and steady-state heat flow calculations where approved by the Principal.

The effective length may be reduced to a minimum of 0.5 times the specified lining thickness for low cement castable (LCC) and ultra low cement castable (ULCC) depending on other design conditions and with approval by the Principal.

The angle between the tines of standard "V" type or "Y" type anchors shall be between 60° and 80° for both anchor types for linings greater than 100 mm (4 in), with the exception of special "steerhorn" types with greater angle and turned out edges; see (3.3.2) and Figure 2.e., and cold face bend of narrow "V" in formed one piece "Y" as shown on Figure 2.

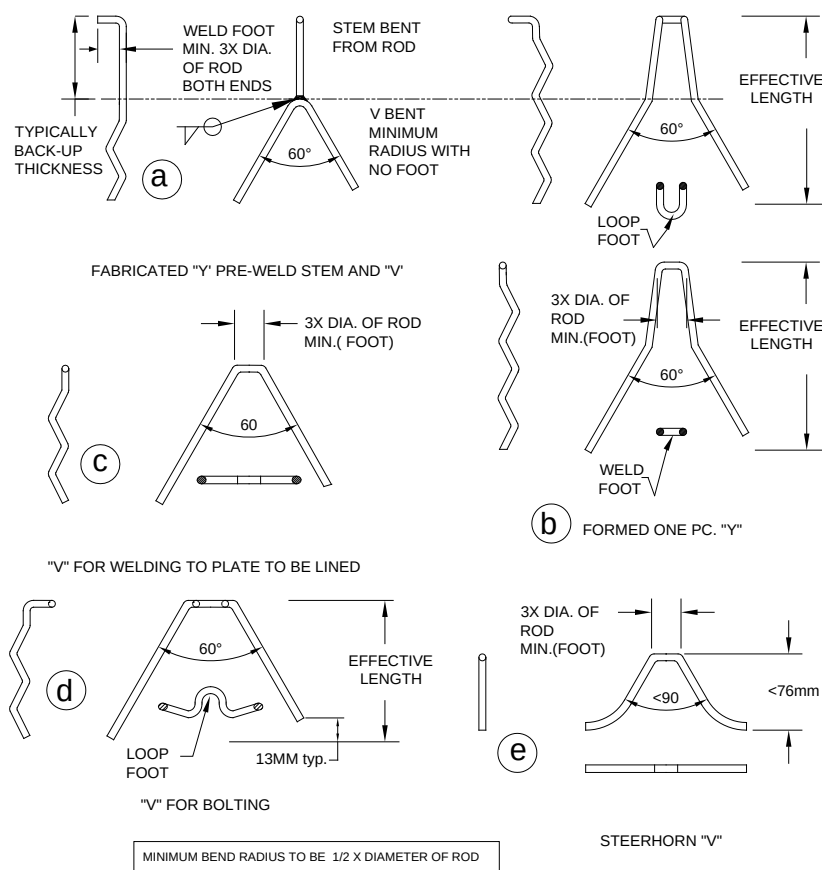


Figure 2 Typical "V" and "Y" anchors

3.3.2 "V" anchor

3.3.2.1 Minimum design requirements for "V" anchors:

- Forming shall be generally as shown on Figure 2c and Figure 2d.
- Wavy rod is not required for anchors less than 76 mm (3 in) effective length if operating temperature is below 500 °C (932 °F).

- c) "V" greater than 76 mm (3 in) effective length shall be from wavy rod.
- d) "V" anchors not used for the fabrication of "Y" anchors and for welding to the shell to be lined, shall have a welding foot minimum three times diameter of the rod to allow for proper welding. See Figure 2c.
- e) If required, the "foot" of the "V" may be bent into a loop shape to facilitate attachment by bolting or for fortified welding. See Figure 2d.
- f) "V" for bolting may be fabricated by pre-welding a nut to the appropriate hot or cold face side of the "loop footed" "V" for bolting Figure 3.
- g) "V" for use with thin layer plastic (Figure 6c) or for fortified weld attachment without any requirement for reversible expansion may be provided without any foot as generally shown on Figure 6c.
- h) "V" with nuts welded to the outside apex (cold face end) or any other portion of the "V" anchor fabricated without a foot, shall not be used in any application.

3.3.3 "Y" anchor

"Y" anchors may be from fabrication of two or more pieces of auxiliary or cold-formed components, or by cold forming a single length of rod into a "Y" shape from two different angled "V" as further outlined below.

3.3.3.1 Minimum design requirements for "Y" anchors fabricated from two components

- Fabrication consisting of a footed stem and a "V" shall be as generally shown in Figure 2a.
- Stem portion may be from straight rod and shall have a foot on the cold face end for a minimum of three times the diameter length to facilitate welding.
- The "V" used for this type of "Y" assembly shall be bent 60 - 80 degrees at the apex (3.3.1) and requires no welding foot but proper preparation to facilitate a good full circle weld to the stem.

3.3.3.2 Minimum design requirements for "Y" anchors fabricated from a single length of rod

- Bending shall generally be in the form of an uneven double "V" as shown on Figure 2.b from wavy rod.
- The cold face end may be a loop or single bend for the option of bolting or welding.

3.3.4 Y- tree anchors

3.3.4.1 Minimum design requirements for Y-tree anchors

- a) Fabrication and assembly of components shall be as generally shown on Figure 3. Note that the bolt may be on the hot face or the cold face side (as shown) of the attaching loop footed "V".
- b) For threaded assemblies, the stem portion may be made from a long bolt with appropriate thread length or appropriately sized alloy all-thread rod as shown.
- c) Unless otherwise specified, the thread length on the stem portion from whatever type shall have sufficient length to allow 1.5 times thickness of nut attached to "V" portion of assembly at the hot face end to accommodate additional field welding for high temperature applications. If required, this portion of the assembly shall be coated with wax or other suitable membrane to allow for differential expansion.
- d) If all-thread is used in a "heavy" lining system, the cold end should have a suitably sized standard nut welded flush to provide additional weld strength as shown on Figure 18.

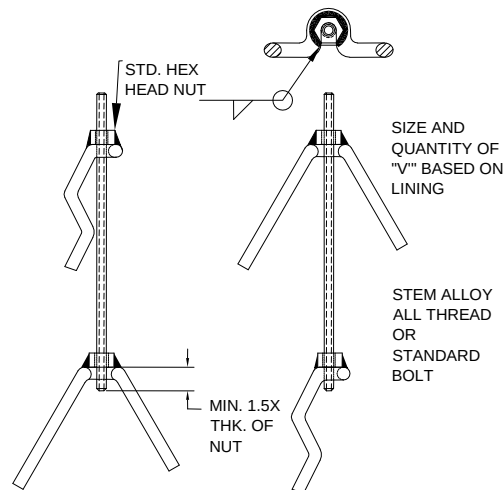


Figure 3 Special "Y"-tree anchor

3.3.5 "V" and "Y" anchors for LCC, ULCC, and extra strength regular castable

LCC, ULCC, and extra strength regular castable may have fortified welding and allow for flexibility in the anchor design as required.

3.3.5.1 Unless otherwise specified or approved by the Principal, the following lists the minimum design requirements for "V", "Y", and special "Y" for high strength castables that require flexibility in the design:

- a) Fabrication and assembly of components shall be as generally shown on Figure 4 with the "V" portion of "wavy" rod.
- b) Normal footed-type anchors shall not have foot welded solid to the shell to be lined.
- c) Loop footed (bolt on) "V" anchors with adjusted foot length for expansion allowance may be required where expansion allowances are required to allow for anchor pitch rotation Figure 4.b and Figure 16.
- d) "Y" anchors shall have the cold face portion of the stem formed to "hooks" for attachment by tac weld only to nuts, special washers fabricated from plate, or loops from bent rod welded to the shell to be lined as shown on Figure 4c, and Figure 4d. The "c" "d" attachments should be tac welded to foot of the "V" or "Y" anchor at the anchor Manufacturer shop and shipped to installation site as an assembly.

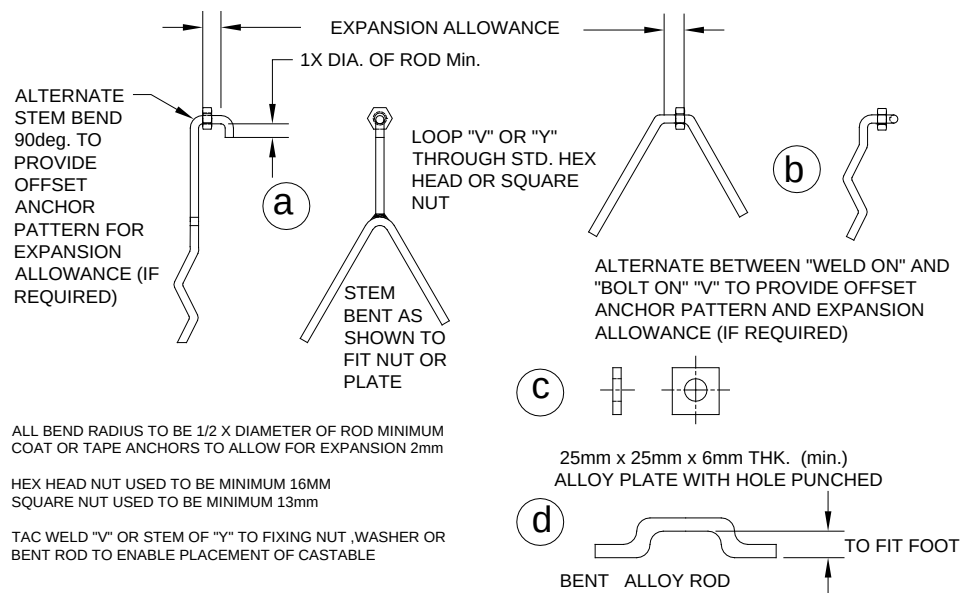


Figure 4 Typical "Y" and "V" anchors for high strength castable

3.3.6 Stud weld anchors

"V" and "Y" anchors suitable for stud welding shall be ordinary "V" and "Y" shaped anchors as shown on Figure 5, adapted to stud welding equipment (pinched foot). All specifications for stud welded anchors shall be subject to approval by the Principal.

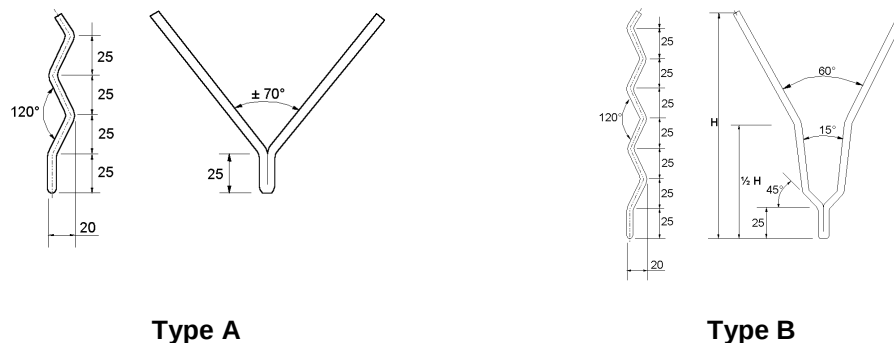


Figure 5 "V" and "Y" anchors for stud welding

3.4 METALLIC ANCHORS FOR PLASTIC LININGS

3.4.1 General requirements

All metallic anchor types for plastic linings installed by ramming shall be two components. Support attachment may be standard nuts, specially fabricated perforated washers or suitably shaped rods or strips welded to the support steel as generally shown on Figure 4c, Figure 4.d and Figure 6. All parts shall be packaged separately for separate installation.

3.4.2 "V" type

3.4.2.1 The following lists minimum design requirements for "V" type anchors used in plastic refractory

- "V" anchors shall be as outlined in Figure 6c and should be without welding foot or loop.

- “V” anchors shall not be used for linings greater than 100 mm (4 in).
- Rod stock for manufacture should be wavy and shall be a minimum 6 mm (1/4 in) in diameter.

3.4.3 Cast alloy steel

3.4.3.1 The following lists minimum design requirements for alloy castings used to anchor plastic refractory

- Alloy cast components and assembly shall be two pieces where one slides into the other, as generally shown on Figure 6a and Figure 6b.
- The supporting piece (that attaches to steel to be lined) may be in the shape of various widths “Z” allowing for movements and which may be of regular carbon steel or alloy steel based on specific project requirements.
- The anchor or hot face portion shall have sufficient section and be generally shaped like a “Y” or a “horse shoe” with built-in irregularities for best strength and holding power of plastic refractory.

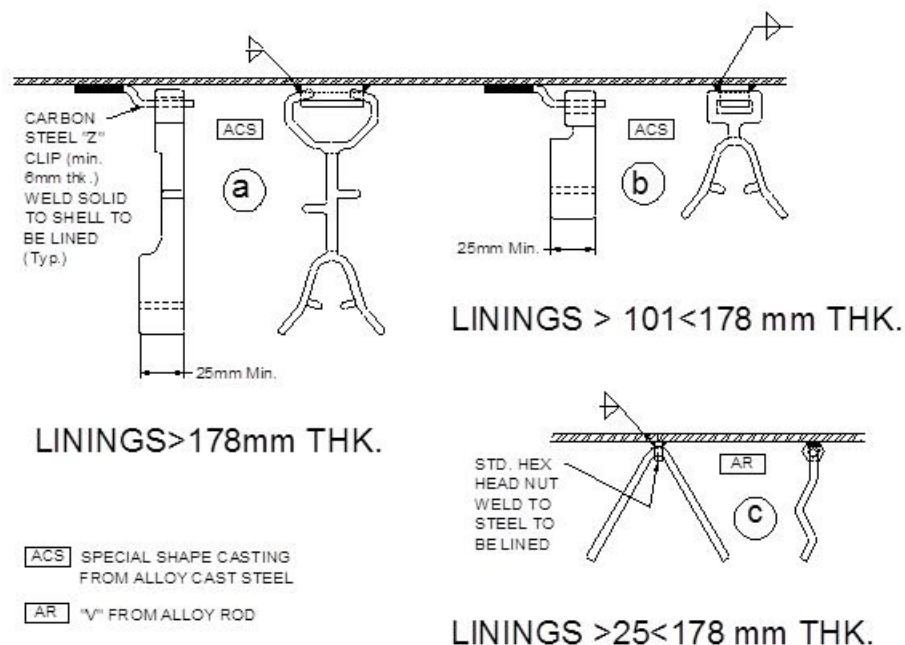


Figure 6 Metallic anchors for plastic refractory linings 25 mm - 230 mm (1 in – 9 in) thick

3.4.4 Hex metal sheets

Hex metal sheets may be used for attachment of plastic or castable linings less than 75 mm (3 in) for any application other than in the FCCU with the same general specifications as outlined in DEP 64.24.32.12-Gen.

For specialized application of the use of hex mesh or other trademark anchors for thin linings reference is given to DEP 64.24.32.12-Gen.