Design & Installation Manual

Ceramic Fibre Lining Systems

CONTENTS

INTRODUCTION

Over the past 75 years, Thermal Ceramics has proven itself to be a world leader in solving problems for heat-intensive industries.

The refractory ceramic fibre manufactured by Thermal Ceramics is a highly versatile material. It can be spun or blown into bulk, laid into a blanket, folded into modules (Z-Blok®), formed into monolithic modules (Pyro-Bloc®), vacuum formed into boards and shapes, die-cut into gaskets, twisted into yarns, converted into liquid binders for coatings and cements. With this wide range of products, Thermal Ceramics can provide exactly the right product, or engineered system to fit your requirements. Thermal Ceramics has an experienced staff of refractory specialists to assist you in product selection, system design, and installation techniques.

Thermal Ceramics has enjoyed great success with its ceramic fibre products due to their cost-effectiveness and excellent insulating properties. They are lightweight and have low thermal conductivity's, excellent resistance to thermal shock, outstanding electrical resistivity, and good acoustical properties.

This Design and Installation Manual is intended to give the designers, installers, and users of Thermal Ceramics ceramic fibre products a broad range of information on how to select the most appropriate fibre system for a particular application, necessary design criteria, and how to correctly install the selected system.

Z-Blok 3 Module

The Z-Blok 3 Module is a folded blanket ceramic fibre module designed for industrial furnaces that can be used in applications that require corrosion barriers, a backup blanket layer, or a pre-determined anchor pattern.

The modules are supplied as standard in a plan dimension of 305 x 305mm. Modules of irregular shapes and size however can be supplied on request, to accommodate specific application profiles.

This manual will deal with the procedure for working with the standard sized module 305 x 305mm. The principles of installation remain the same for non standard modules and Thermal Ceramics will be pleased to offer additional information on this or any other matter.
The Z-Blok 3 Module utilises a time proven anchoring system to retain the folded blanket with two support tubes fitted during manufacture. The module is fixed to the wall using a T Bar yoke and a threaded anchor (supplied separately), which is welded to the casing. Z-Blok 3 Modules are available in densities 128 and 160 Kg/M^3 as standard, though other density modules can be

supplied on request. The standard module range offers modules between 100 and 350 mm in thickness.

The modules are supplied to a finished dimension (normally 305 x 305mm) and arrive at the job site semi compressed. The anchors are welded to the casing on centres which ensure that the modules are further compressed by a minimum of 4%. This compression of the module is achieved during installation and is **important** to the success of the finished lining.

The anchor hardware is made of 316 Stainless Steel as standard, alternative grades are available on request.

Figure 1 - Z-Blok 3 Module with Anchor Hardware

1.0 GENERAL

1.1 Design Considerations

Z-Blok 3 Modules are designed to be installed in a soldier course fashion with packing strips between each row of modules. Figure 2 shows the layout of a typical Z-Blok 3 Module installation. When using the soldier course system in overhead applications Thermal Ceramics advise the use of packing retaining staples.

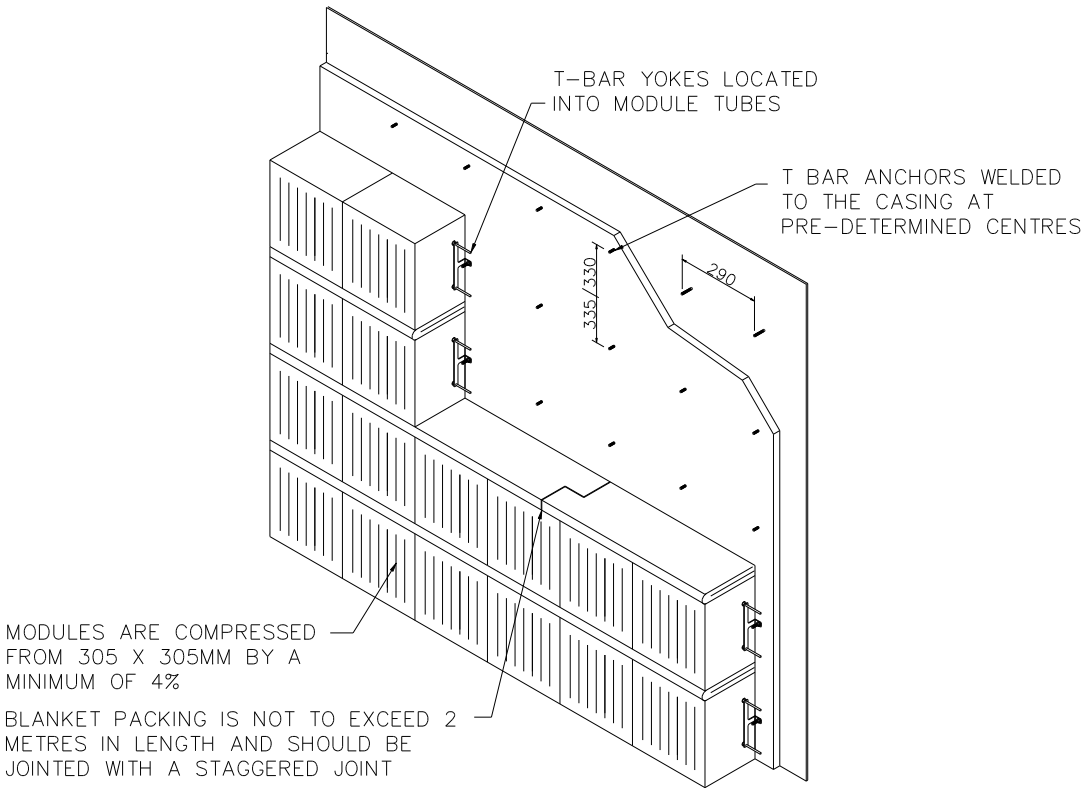


Figure 2 - Typical Z-Blok 3 Module Lining and Anchor Layout

Prior to installing the Z-Blok 3 Modules, it is necessary to lay out the anchor pattern and weld the anchors in place. At this point any or all of the following linings can be applied; stalastic coating, blanket backup, Stainless Steel or Aluminium foil as a vapour barrier. The specific operating conditions for your particular furnace will determine the need for stalastic coatings, back-up blanket, or vapour barriers.

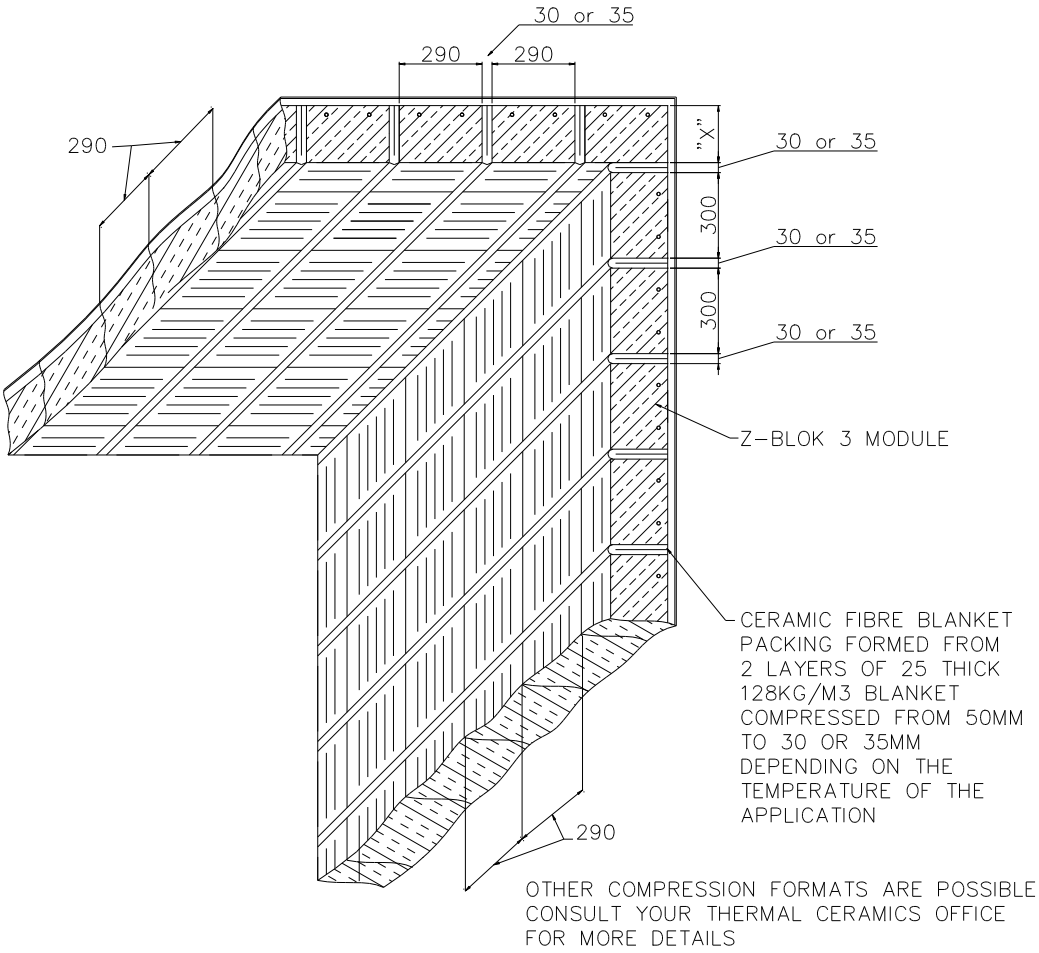


Figure 3 - Typical Z-Blok 3 Module Lining

Once the anchors and backup materials are in place, the Z-Blok 3 Modules can be installed.

The Z-Blok 3 Module is easy to cut or trim to allow for obstructions such as burners or inspection doors. Best results will be achieved if the module is trimmed, so that the anchor tubes will remain in line with the pre-determined anchor pattern. It is best to cut less than necessary and compress the module into place to ensure the tightest possible joint.

Bullnose areas, which are traditionally problem areas, are easily accommodated by the Pyro-Bloc Corner Module. Pyro-Bloc Corner Modules can be installed using the Pyro-Bloc T Bar anchoring system. Figure 4 illustrates the Pyro-Bloc Corner Module and anchoring system.

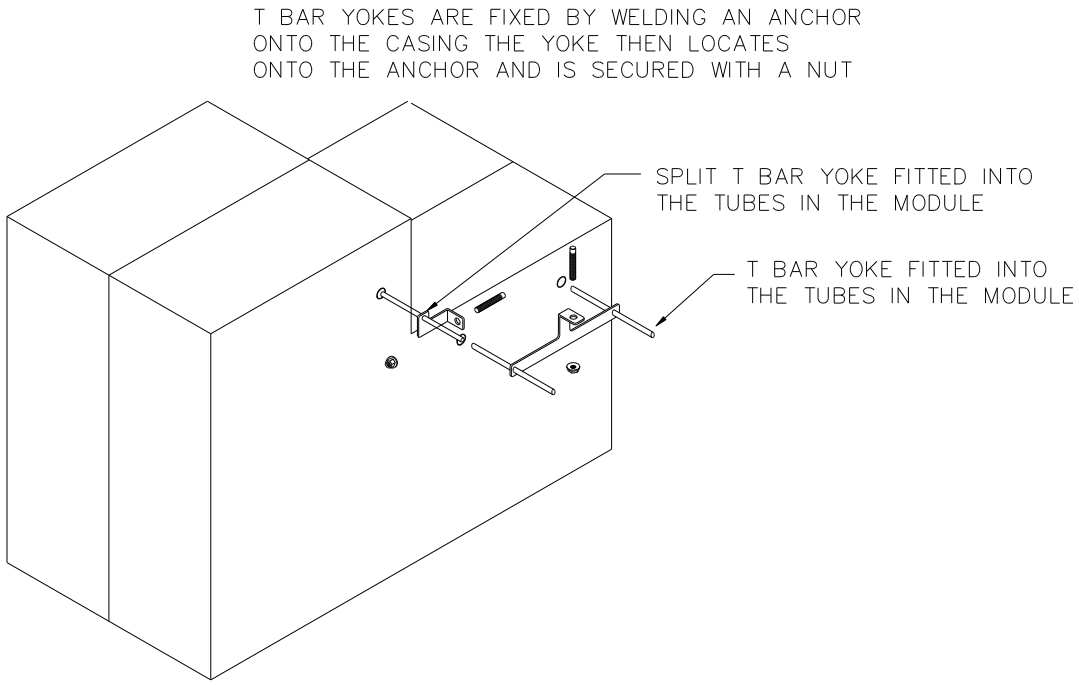


Figure 4 - Pyro-Bloc Corner Module

1.2 Design Check List

When planning to carry out a modular lining a simple check list of items required will ensure a trouble free installation. A full range of special yokes and anchors are available to ensure that all lining configurations can be installed efficiently.

The following list and material quantities assumes the use of standard
305 x 305mm modules and a soldier course layout with 35mm compressed blanket packing.

- Modules to line the prescribed area (approx 10.31 per M^2).
  - Temperature grade
  - Density
  - Thickness

- Ceramic Fibre blanket packing in 128Kg/M^3 x 25mm thick, of the same temperature grade as the modules (approx 0.3 linear metres per module).

- Overage for modules and blanket packing is dependent on site location and complexity of the project and can vary between 2.5% to 10%

- Anchor sets of the correct length depending on backing lining. Note one anchor set extra is required per row of modules.

- Overage for anchor sets suggested at 5 to10%.

- T Bar yokes. Note one T-Bar yoke extra is required per row of modules.

- Overage for T Bar yokes suggested at 2.5 to 5%

- Packing retaining staples, necessary for overhead applications. Suggested centres are one staple at 600mm to 900mm centres depending on lining thickness and application.

- If casing coatings are specified check the thickness of coating required and quantities of material.

- Vapour barriers in Stainless Steel and Aluminium normally require an overlap and or sealing with adhesive tape. Check an allowance has been made for these factors in the material quantities.
- Plastic anchor covers to protect the anchor threads if stalastic coating is being used. These are optional items dependant on the type of coating to be used.

1.3 Site Preparation

The steel surface to be lined should be free of heavy rust or scale, non-conductive paints, dried refractory cements or oil. Sandblasting, wire brushing or grinding will be required to clean the surface. Local grinding is recommended at each anchor location prior to welding.

Set up good scaffolding so there will be easy access to the areas to be lined. Also, make arrangements for the material to be as close to the work area as possible without being in the way, so it can be efficiently delivered to the work crews.

The steel shell should preferably be 3mm or thicker. This will minimise the problem of blowing holes in the steel casing while trying to weld the anchors in place.

1.4 Installation Sequence

Prior to commencing installation it is advisable to plan the sequence of installation to remove or reduce the number of end of row module fixings necessary (stop end fixings). These inconvenient and time consuming occurrences can normally be avoided with a little planning at the start of the installation.

Normal procedure to line a furnace with a roof, three walls and a door is to start work by installing the end wall, followed by the side walls working from the back wall towards the door opening. The installation is completed by installing the roof and door linings.

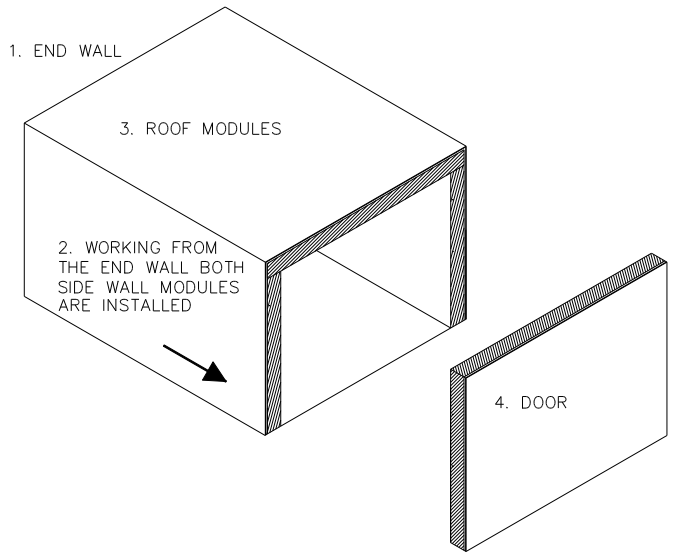


Figure 5 - Installation Sequence for a Three Fixed Wall, Roof and Separate Door Application.

A furnace with four fixed walls and a roof should be lined with the side and end walls lined in sequence to ensure an open face is maintained during the installation. By following this procedure it should be possible to minimise the number of stop end fixings (see section on stop end fixings).

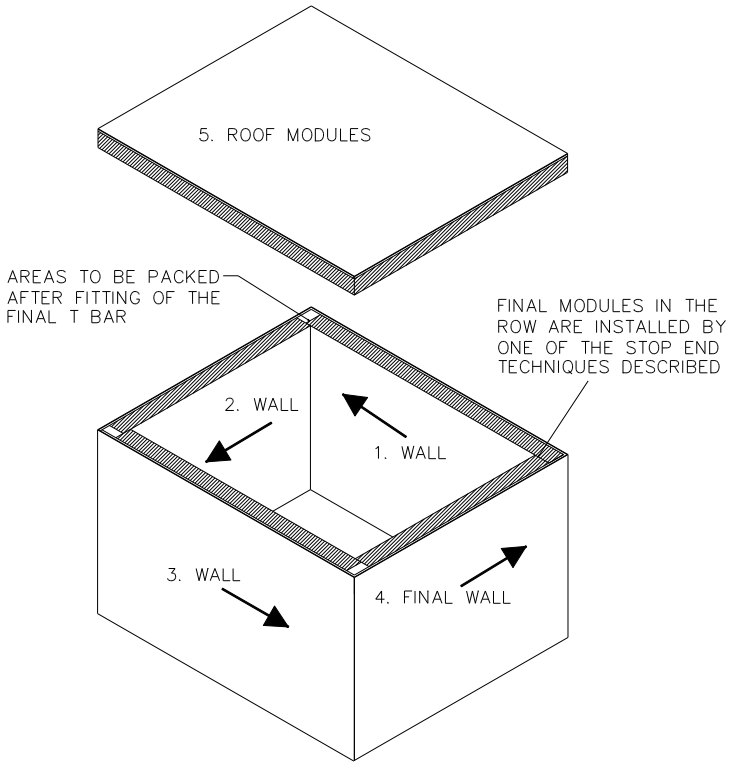


Figure 6 - Installation Sequence for a Four Fixed Wall and Roof Application.

2. INSTALLATION

2.1 Equipment Check List

The following list details the basic equipment required to carry out a typical Z-Blok 3 Module installation.

- Welding equipment suitable for welding 6mm diameter stainless steel bar.
- Hand Tools.
    - Tape Measure
    - Chalk line
    - Angle Grinder
    - Long bladed knife suitable for cutting Ceramic Fibre.
    - A means of cutting SS tubes in the modules and T Bar arms.
    - Slip plates (approx 1mm) sheet steel or plastic (lining thickness x 600mm) to allow modules to slide into position during installation.
    - 10mm socket and extension bar suitable to access the locking nut, through the thickness of the lining.
    - Tools to adjust welder; screwdriver, pliers, hexagonal keys etc.
    - Tamping tool to finish the surface. This can be formed in wood or expanded metal (300x 250mm). Alternatively a plastic builders float makes an ideal tool.

2.2 Installation Procedure

The Z-Blok 3 Modules are installed in a soldier course layout with a packing strip between rows. (Figure 2). The Z-Blok 3 Module requires a pre-determined anchor pattern so the first step is to establish the layout.

Step 1

Measure the correct distance vertically and horizontally and mark with a chalk line. Typically, the soldier course anchor spacing is 290mm horizontally and 335mm or 330mm vertically.

Step 2

At the points where the chalk lines cross it is good practise to spot grind an area approximately 10mm diameter to ensure that the weld is made onto clean steel. This is especially important on old steel casings.

Step 3
At the points where the chalk lines cross, weld a T Bar anchor onto the steel casing.

Step 4
If stalastic coating is being used it is a good idea to protect the threads of the anchors by installing plastic covers over the anchors. If a coating is not being used, plastic covers for the anchors are not needed. At this point, back-up layers of blanket and Aluminium or Stainless Steel foil vapour barriers should be installed if being incorporated into the lining of the furnace.

Step 5

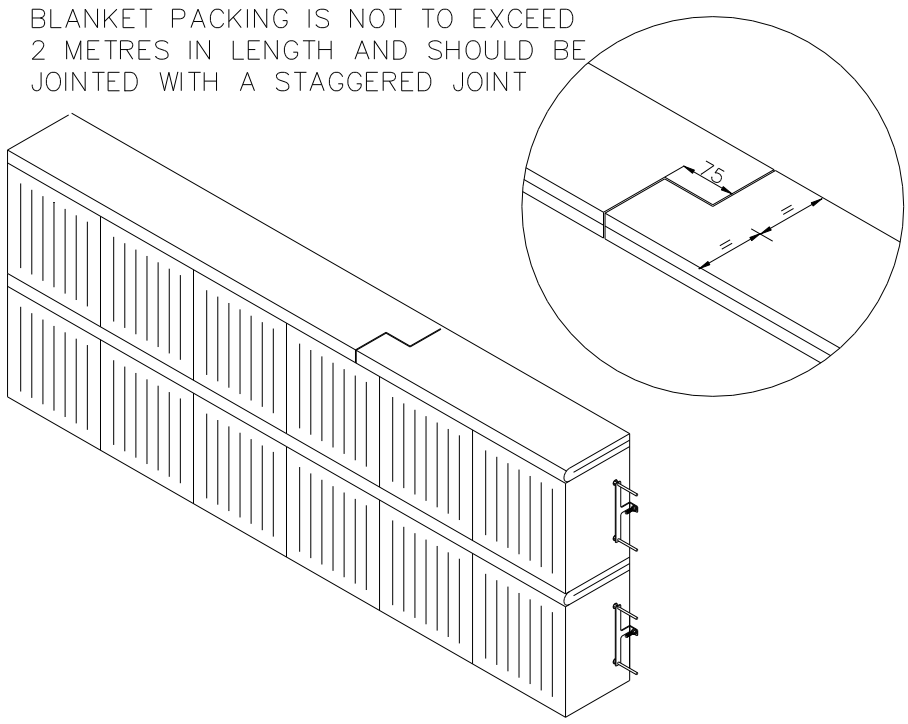
When the necessary backing coatings and or linings have been installed the Z-Blok 3 Modules can be installed. The modules are installed in rows therefore at the start of a row remove the arms from one side of a T Bar yoke. Locate the T Bar yoke onto the anchor which has been welded to the wall previously, fixing it into position with a locking nut.

Step 6

The tubes in the module are then located onto the arms of the T Bar yoke, another T Bar yoke is located into the tubes in the opposite end of the module. The module is then compressed into position.

Step 7

The sequence is completed by fitting the T Bar yoke onto the anchor and securing with the locking nut.



Step 8

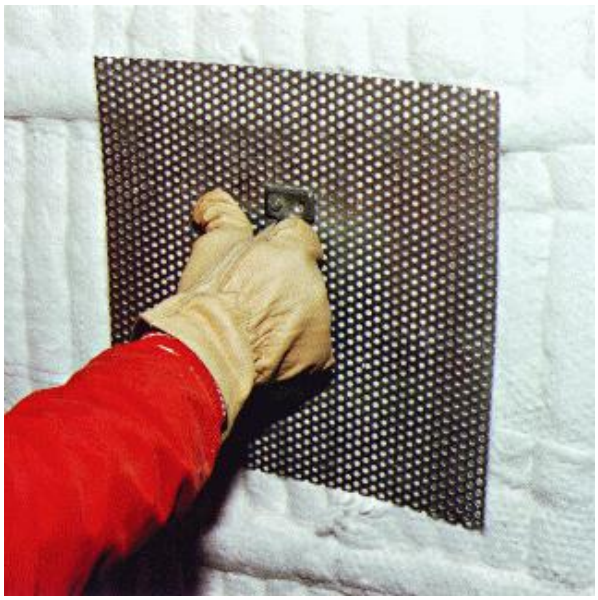
The procedure mentioned above is repeated until the row is completed. Before commencing the installation of another row of modules a packing strip of Ceramic Fibre blanket should be installed. This blanket packer should be jointed using a staggered joint and not exceed 2 metres in length.

Step 9

When the packing strip is in place the next row of modules can be installed. The anchor positions will ensure that the modules are compressed during installation. The uses of thin steel or plastic plates allow the modules to be slid into position making the task of obtaining the necessary compression easier.

Step 10

When the installation is complete, remove the plastic retaining bands from the module. This is carried out with the aid of a sharp knife.



Step 11

The procedure mentioned in steps 5 to 9 are repeated until the area to be lined is completed. The final task is to tamp the face of the lining to tighten all the joints, close any small superficial openings on the face of the lining and to improve the overall appearance.

2.3 Stop End Fixings.

The number of Stop end fixings can be greatly reduced and in some cases avoided all together, by taking time at the start of the installation to determine the best installation sequence. See section 1.3 Site Preparation.

When there is no alternative to making a stop end fixing, there are a number of alternatives that can be employed.

- Complete the row of modules 100mm short of the required length and pack the remaining area with 150mm of folded Ceramic Fibre blanket. This is not recommended in overhead applications.
- Turn the last module in the row through 90^{o} which will expose the tube ends and allow a conventional T Bar fixing to be used.
- Use a centre fixing in the last module of the row.

2.4 Repair of T Module Linings.

Z-Blok 3 Modules are designed to deliver a long working life in the most arduous conditions. In the event of the lining becoming damaged the modules are easily replaced.

The lining will continue to function even when it has been the mechanically damaged so long as the face of the lining is not broken, should the face of the lining become broken it is advisable to replace the module.

Replacement of a module is simple and as follows.

- Remove the fibre from the support tubes.
- Cut off the T Bar arms and remove the tubes.
- Cut a small hole in the backing blanket / foil and or clean an area in the stalastic coating in the centre of the area from which the module was removed.
- Weld an anchor in the position mentioned above.
- Using thin plastic or metal sheets insert a new centre fix module into the opening ensuring maximum compression is obtained with the existing lining.
- Open the centre of the module and secure the module in position with a locking nut.

If more than one module is being replaced the installation is more simple, the existing anchors can be utilised and the standard installation procedure adopted. Only the last module in the repair will require the special technique mentioned above.

3. Anchor Welding

The process of arc anchor welding involves the same principles as any other arc welding process. 1) Creation of welding heat by developing an arc between the anchor and the plate. 2) Bringing the two pieces together when the proper temperature is reached.

3.1 Types of Welding Equipment

The equipment needed includes a anchor gun, a control unit and an adequate DC welding current supply. The anchor is loaded into the properly sized chuck, the ceramic ferrule is placed in position over the end of the anchor and the gun is properly positioned for welding. The gun, control unit and welding machine are connected as shown in Figure A1 or A2 for welding.

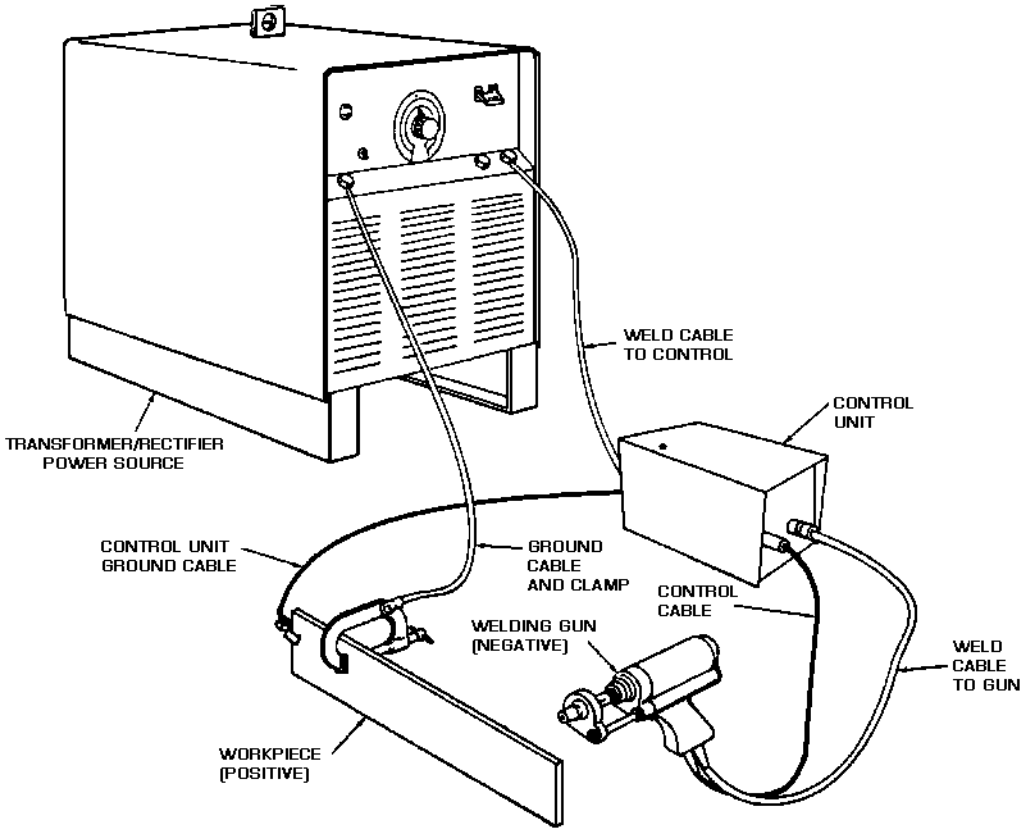


Figure A1 - Equipment Set-up with Separate Power Source and Control Box

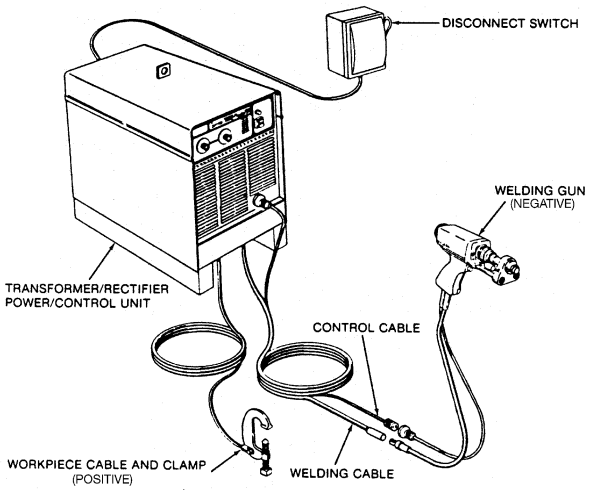


Figure A2 - Equipment Set-up with Power Source and Control Box Combined

3.2 The Welding Process

The welding process is shown in Figure A3. A solenoid coil within the gun is energised when the trigger is pulled. This lifts the anchor off the plate and creates an arc. The end of the anchor and the plate local to the anchor are melted by the arc. Upon completion of the pre-set arc period, the welding current is automatically shut off. The mainspring within the gun then plunges the anchor into the molten pool on the plate to complete the weld. The gun should then be lifted off the anchor and the ferrule broken off.

Installation rates for welding anchors in this manner will vary with the size of the anchor and other working conditions. However, an average rate is approximately six anchors per minute.

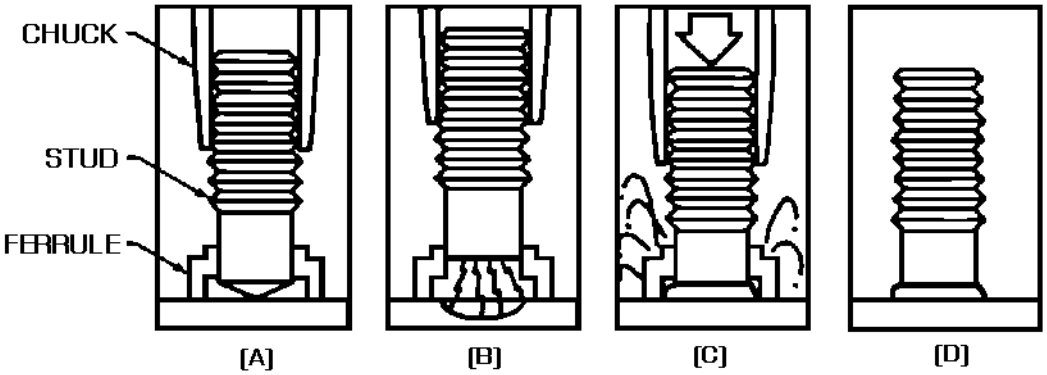


Figure A3 - The Welding Process

3.3 Equipment Set Up

To set up the gun for shooting anchors, set the plunge length to approximately 3mm **(Figure A4).** The approximate settings for weld time and weld current is provided in Table A1.

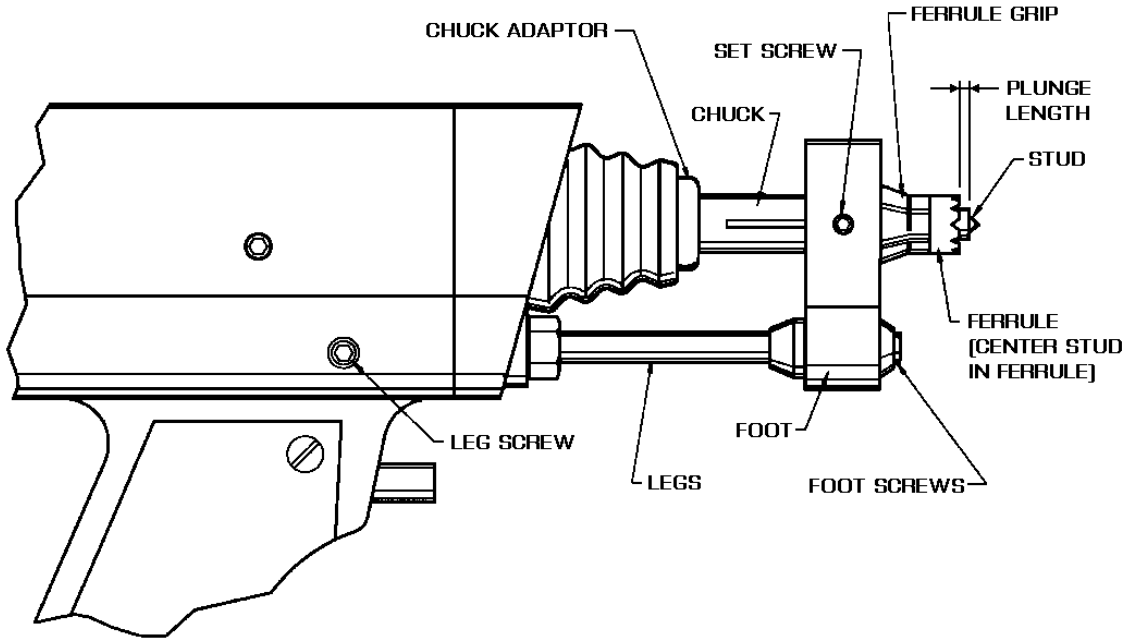


Figure A4 - Portable Anchor Gun

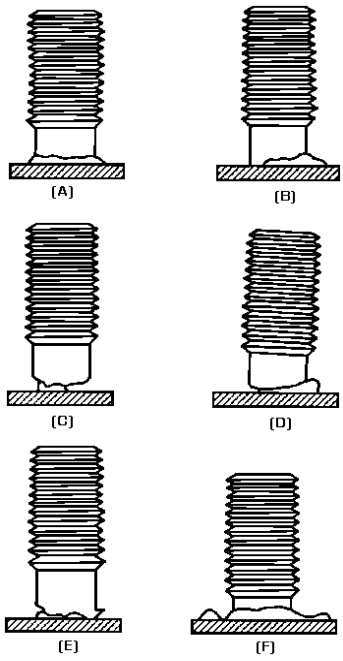
ANCHOR		WELD TIME	WELD CURRENT
Weld Base Diameter			
(in.)	(mm)	(Cycles)*	(Amperes)
1/4	6.4	10	400
5.16	7.9	15	500
3/8	9.5	20	550
7/16	11.1	25	675
1/2	12.7	30	800

*60 cycles equals 1 second

The above settings may vary due to the power source, condition of the work piece, age of equipment, length of cable used between power source and the control unit and the alloy to be used. After determination of proper settings, the unit is ready to weld anchors.

Table A1 - Typical Welding Conditions for Anchor Welding of Steel

3.4 Typical Welding Faults and Remedies



(A) Good anchor weld with a good flash formation

(B) Anchor weld in which plunge is too short

(C) Hang-up

(D) Poor alignment

(E) Anchor weld made with insufficient heat

(F) Anchor weld made with excessive heat

Figure A5 - Weld Inspection (Good and Bad Welds)

3.5 Weld Testing Methods

The most common methods for testing the welds are the hammer or bend test. These is carried out by striking the anchor with a hammer or by using a bending tool such as a pipe **(Figure A6).** In the case of a good weld, the anchor will break before the weld. In either case, the testing will damage the anchor, so shoot the test anchors on a separate plate or be prepared to grind smooth the area and weld another anchor.

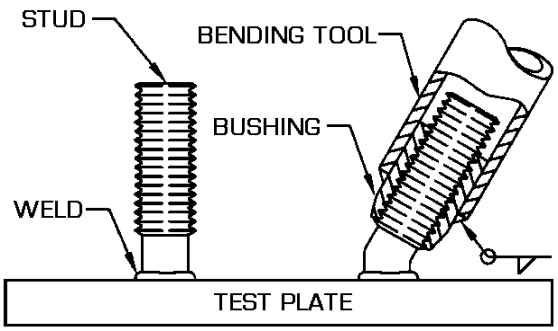


Figure A6 - Bend Test

PLEASE NOTE: To reduce the potential risk of health effects, Thermal Ceramics recommends engineering controls and safe work practices be followed by product users. Contact the Thermal Ceramics Product Stewardship Group to request detailed information contained in its MSDSs and product literature and videos.

This manual has been designed to easily accommodate new or revised information. Holders of the manual are advised to keep their address current with their main Thermal Ceramics office. Any questions or comments regarding this manual, health and safety issues or any other matter should be addressed to your local Thermal Ceramics representative.