Thermal Ceramics

PYRO-BLOC®
Y™, Y2™, E™, AND E2™
MODULE
DESIGN AND INSTALLATION
MANUAL

TABLE OF CONTENTS

List of Figures

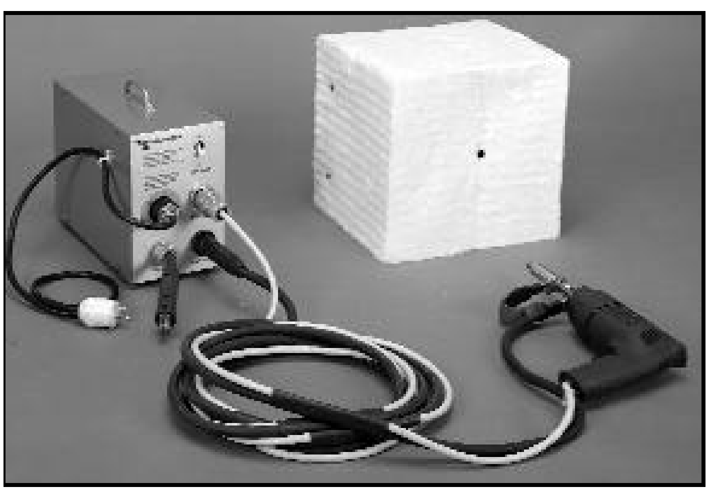


Figure 1 - Pyro-Bloc Y Module, Stud Gun and Control Box

INTRODUCTION

Over the past 81 years, Thermal Ceramics has proven itself to be a world leader in solving problems for heat-intensive industries.

The refractory ceramic fiber manufactured by Thermal Ceramics is a highly versatile material. It can be spun or blown into bulk, air-laid into a blanket, folded into modules, formed into monolithic modules (Pyro-Bloc), converted into boards and shapes, die-cut into gaskets, twisted into yarns, woven into rope and cloth, and blended 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 fiber products due to their cost-effectiveness and excellent insulating properties. They are lightweight and have low thermal conductivities, 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 fiber products a broad range of information on how to select the most appropriate fiber system for a particular application, necessary design criteria, and how to correctly install the selected system.

PLEASE NOTE: This manual has been designed to easily accommodate new or revised information. Holders of the manual are advised to keep their address current with the Advertising and Sales Promotion Department at Thermal Ceramics in Augusta, Georgia. Any questions or comments regarding this manual should be addressed to your local Thermal Ceramics representative.

PYRO-BLOC Y, Y^2, E, & E^2 MODULES

The Pyro-Bloc Modules are uniquely composed of two monolithic pieces of edge grain ceramic fiber (Pyro-Log) with an internal yoke and two support tubes. Pyro-Bloc Y and Y^2 Modules are available in densities ranging from 8-15 pcf and in thickness from 3-12 inches. Pyro-Bloc E and E^2 Modules are available in a density of 8 pcf and in thicknesses of 3-6 inches.

One advantage of the Pyro-Bloc Y Module is its fast, easy and reliable installation using the Pyro-Bloc stud gun. It welds the stud, tightens and torques the nut and checks the weld, all with only one pull of the trigger. As no pre-layout of studs is required, the installation of Pyro-Bloc Y Modules is faster than other modular systems. The specific topics covered in this manual are:

- Lining Considerations
- Site Preparations
- Equipment
- Installation
- Troubleshooting

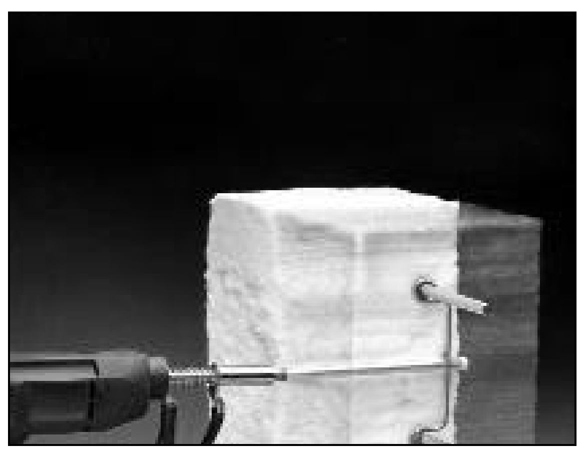


Figure 2 - Pyro-Bloc Module Cutaway

1. GENERAL

1.1 Lining Considerations

The Pyro-Bloc Y, Y^2, E, and E^2 Modules lining can be installed using a soldier course pattern with or without batten strips or a parquet pattern can be used. Figures 4, 5, and 6 show Pyro-Bloc Modules as they would typically be installed using soldier course for the walls and parquet in the roof sections.

Prior to shooting the Pyro-Bloc Modules, chalklines can be laid out on the wall, if desired, to help ensure an even compression of modules during installation.

When cutting and fitting of modules is required, best results will be obtained by trimming equally from opposite edges of the module to keep the stud centered as much as possible. This is outlined in the attached cutting detail. It also is best to cut less than necessary and compress the module into place to get a good tight joint. (Figure 3)

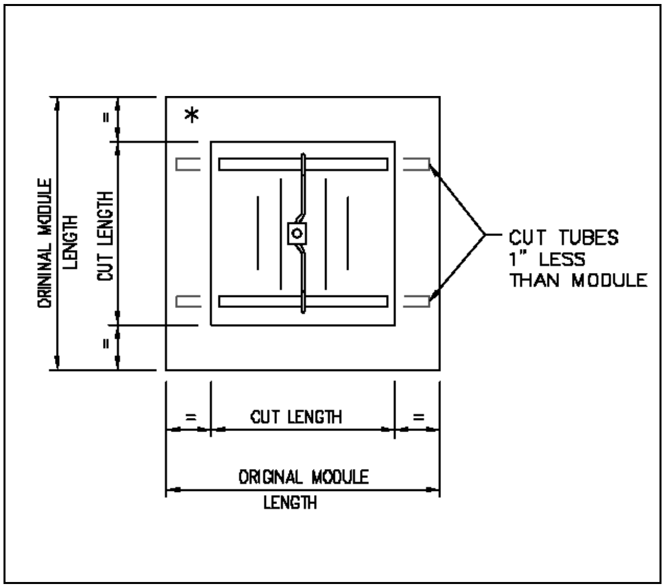
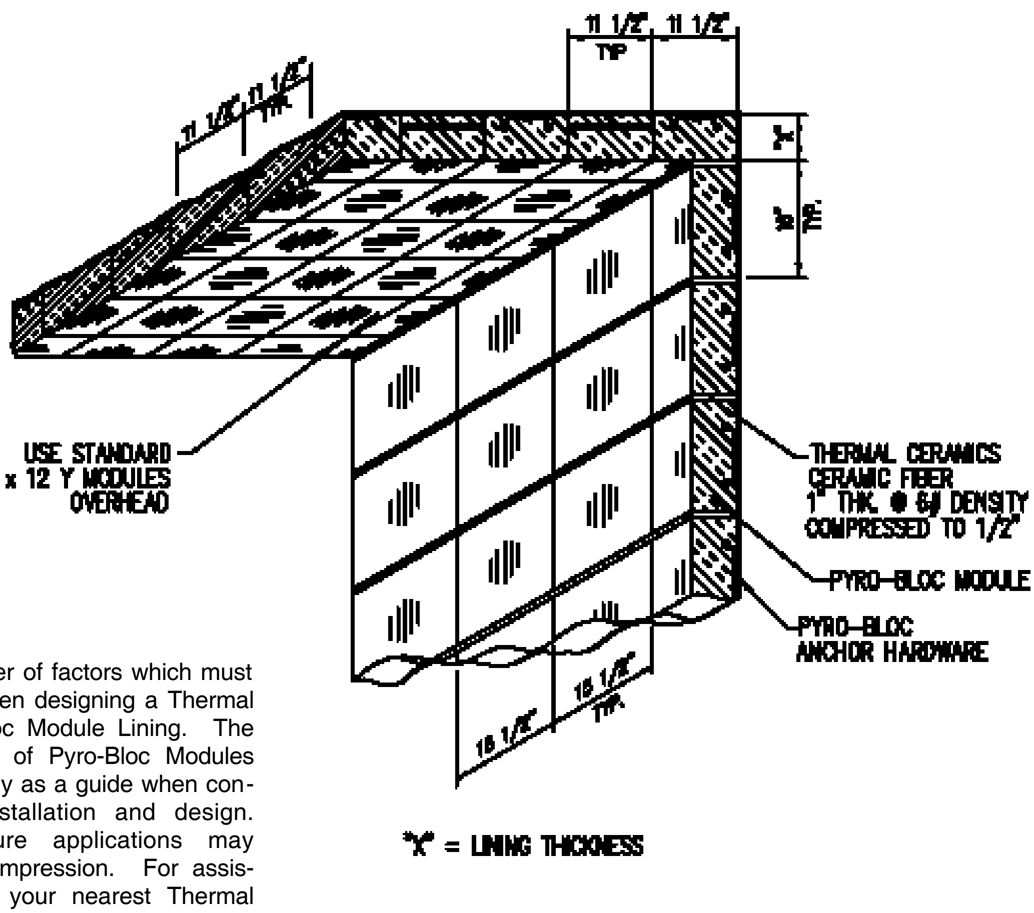


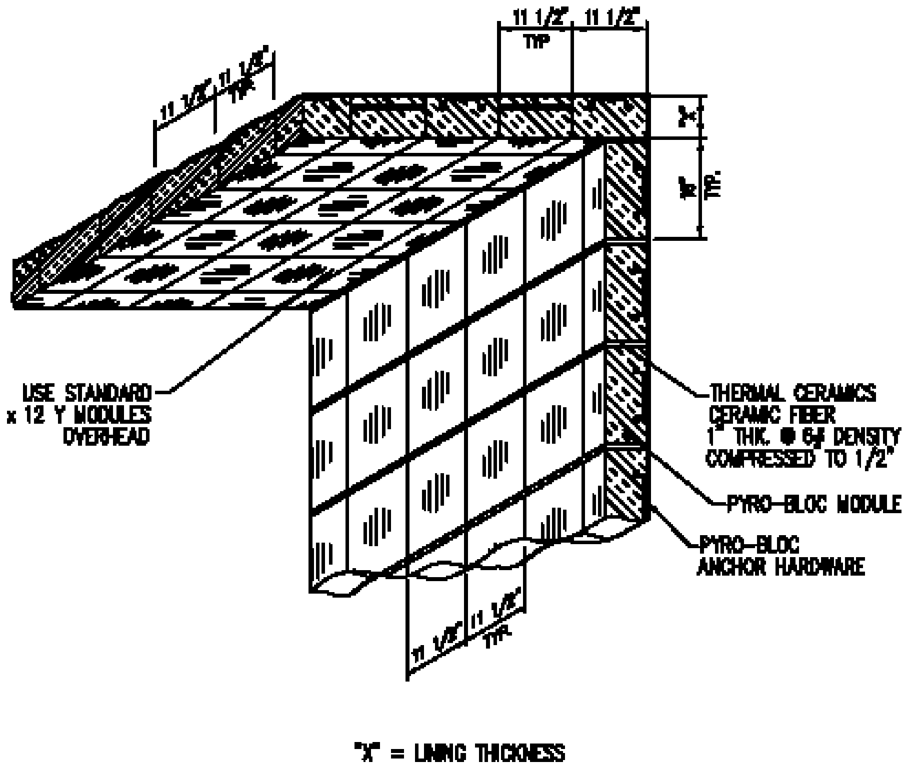
Figure 3 - Typical Module Cutting Detail



Note:

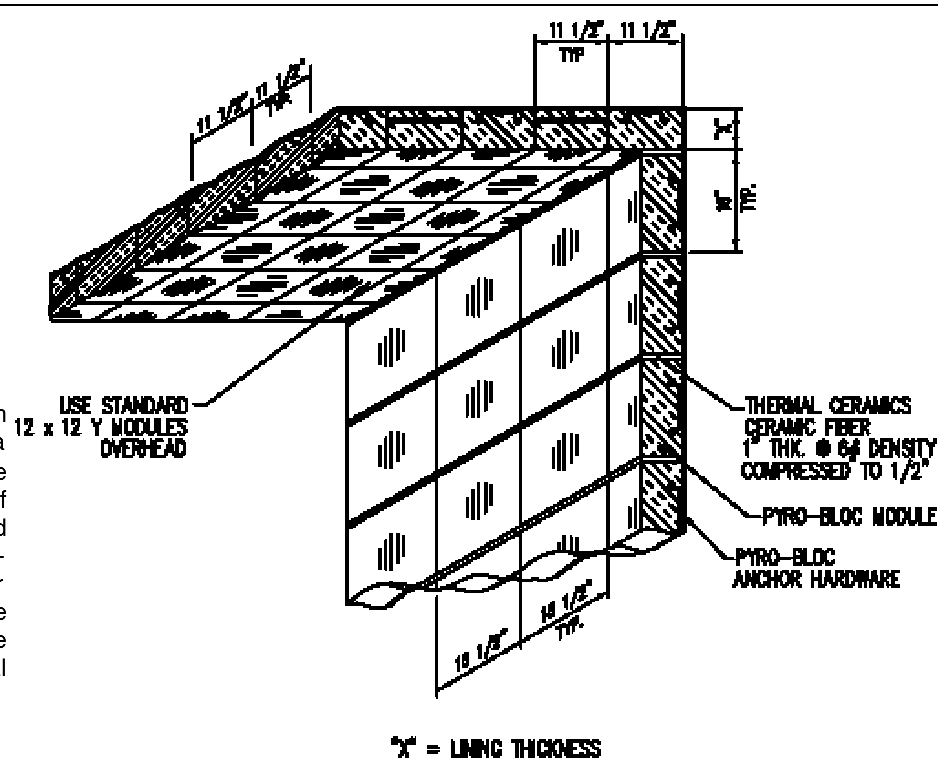
There are a number of factors which must be considered when designing a Thermal Ceramics Pyro-Bloc Module Lining. The typical dimensions of Pyro-Bloc Modules should be used only as a guide when considering lining installation and design. Higher temperature applications may require greater compression. For assistance please call your nearest Thermal Ceramcis representative.

Figure 4 - Typical Pyro-Bloc Y Module Lining



Note:
There are a number of factors which must be considered when designing a Thermal Ceramics Pyro-Bloc Module Lining. The typical dimensions of Pyro-Bloc Modules should be used only as a guide when considering lining installation and design. Higher temperature applications may require greater compression. For assistance please call your nearest Thermal Ceramcis representative.

Figure 5 - Typical Pyro-Bloc E Module Lining



Note:
There are a number of factors which must be considered when designing a Thermal Ceramics Pyro-Bloc Module Lining. The typical dimensions of Pyro-Bloc Modules should be used only as a guide when considering lining installation and design. Higher temperature applications may require greater compression. For assistance please call your nearest Thermal Ceramcis representative.

Figure 6 - Typical Pyro-Bloc Y^2 and E^2 Module Lining

Bullnose areas can cause problems for other modular systems, but the Pyro-Bloc Y Module can easily be made as a Corner Bloc Module as shown in Figure 7 to handle these corner areas without exposing a joint. For specific lining design information, contact a Thermal Ceramics representative.

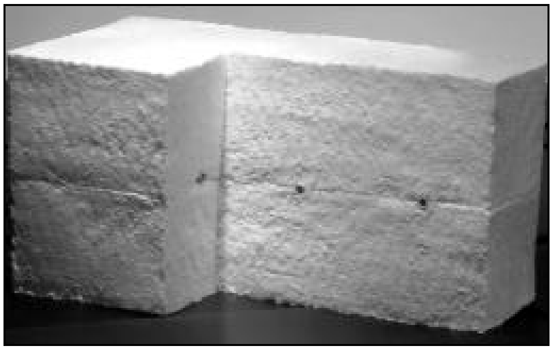


Figure 7 - Pyro-Bloc Corner Bloc Module

1.2 Site Preparation

It requires less than three seconds to stud weld one Pyro-Bloc Y, Y^2, E, or E^2 Module to a steel shell. The majority of the installation time will be consumed by actions other than the actual stud welding process. Consequently, the speed (and your costs) of the total installation will be governed by how efficiently the job is set up. The following are recommendations to help organize your job.

- A three man crew per gun is recommended. One man operates the gun and welds the module to the shell. The second man positions the module for welding while the third man brings the material to the work area and cuts special shapes.
- Have access to the material. Keep the materials as close to the work area as possible without the material being in the way. It is not very efficient to have entire crews sitting around with nothing to do while waiting for a forklift to deliver the needed materials.
- Set up good scaffolding. A proper and comfortable working height can expedite the installation rate by 20% to 25%.
- The steel shell should be 10 gauge or thicker. Steel less than ⅛" thick will be difficult to weld to without blowing holes. Also, a thin shell can flex significantly during operation.
- 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 is recommended to clean the surface, or at least the area where the stud is to be attached.
- Generally, the order of installation should be the roof, the rear wall, the side walls, and the door.

1.3 Stud Welding Equipment

- Welding Machine - Care should be taken to select a constant-current welding machine in good condition. A motor driven generator (electric) with 400 amps direct current and 75 to 100 volts , open circuit voltage is preferred. (Open circuit voltage is the voltage before striking an arc). Under ideal conditions, 300 amp motor drive generator units may be adequate. Rectifier units with 300 to 400 amps capacity can be used under certain conditions (minimum 75 OCV). If gasoline or diesel driven generators are used, be sure to set the throttle to high RPM's. The welding machine output must be DC voltage. Do not use AC output for stud welding. Do not use leads or grounds made from aluminum as there could be problems with the wire carrying enough current.
- Welding Cable - For welding cables over 50 feet, add 10% to the amperage setting for every additional 100 feet of cable. The welding machine should have at least a 2/0 welding cable.
- Pyro-Bloc Stud Gun and Control Box (See Figure 8).
- Sufficient length extension cord for control box.
- Tape measure.
- Needle nose pliers.
- 12" serrated knife (bread knife) for cutting fiber.
- Tamping tool to pat out the fiber surface. The tool is made from a 10" x 12" piece of expanded metal or plywood with a handle attached.
- 8" to 10" lineman pliers for cutting Y Module tubes.

1.4 Stud Gun Hook Up

1. Connect the Stud Gun welding cable to the receptacle marked Stud Gun on the Control Box.
2. Connect the Stud Gun control cable to the four pin receptacle marked Stud Gun on the Control Box.

1.5 Control Box Hook Up

1. Connect the welding unit cable to the terminal marked Welder on the Control Box. An adapter lug is provided with the Control Box if the welding machine cable does not have the proper female plug. Do not use an aluminum welding cable. The welding machine cable size should be at least a 2/0 cable.
2. Plug the AC power cord from the Stud Gun Control Box into an electrical outlet delivering 110 volts, 60 cycle AC (220 volts, 50 cycle AC control box is available upon request) power only. Do not plug into a DC welding machine.
3. Clamp the ground cable from your welding unit securely to the furnace shell. The success of your weld depends upon the adequacy of your ground. Be sure you have a Good Ground.
4. Adjust the weld machine controls to straight polarity, positive to the ground and negative to the stud gun control box. Stud firing reliability is much lower with reverse polarity. Set the amps to 300. For welding cables longer than 50 feet, add 10% to the amp setting for every additional 100 feet of cable. (For motor generator units, set the open circuit voltage (OVC) between 75 to 100). Turn on the welding machine.
5. If a gasoline or diesel driven generator is used, lock the throttle of the engine to the highest RPM.
6. Set the timer in the Stud Gun Control Box to 1.5 seconds.
7. After the welding equipment has been set up, shoot several trial studs to the furnace shell.
8. Test the weld by bending the stud over with a hammer. A weld is good when the stud will break off leaving part of the stud embedded in the weld fillet. Corrections can be determined by following the procedures in the Stud Welding Troubleshooting section.

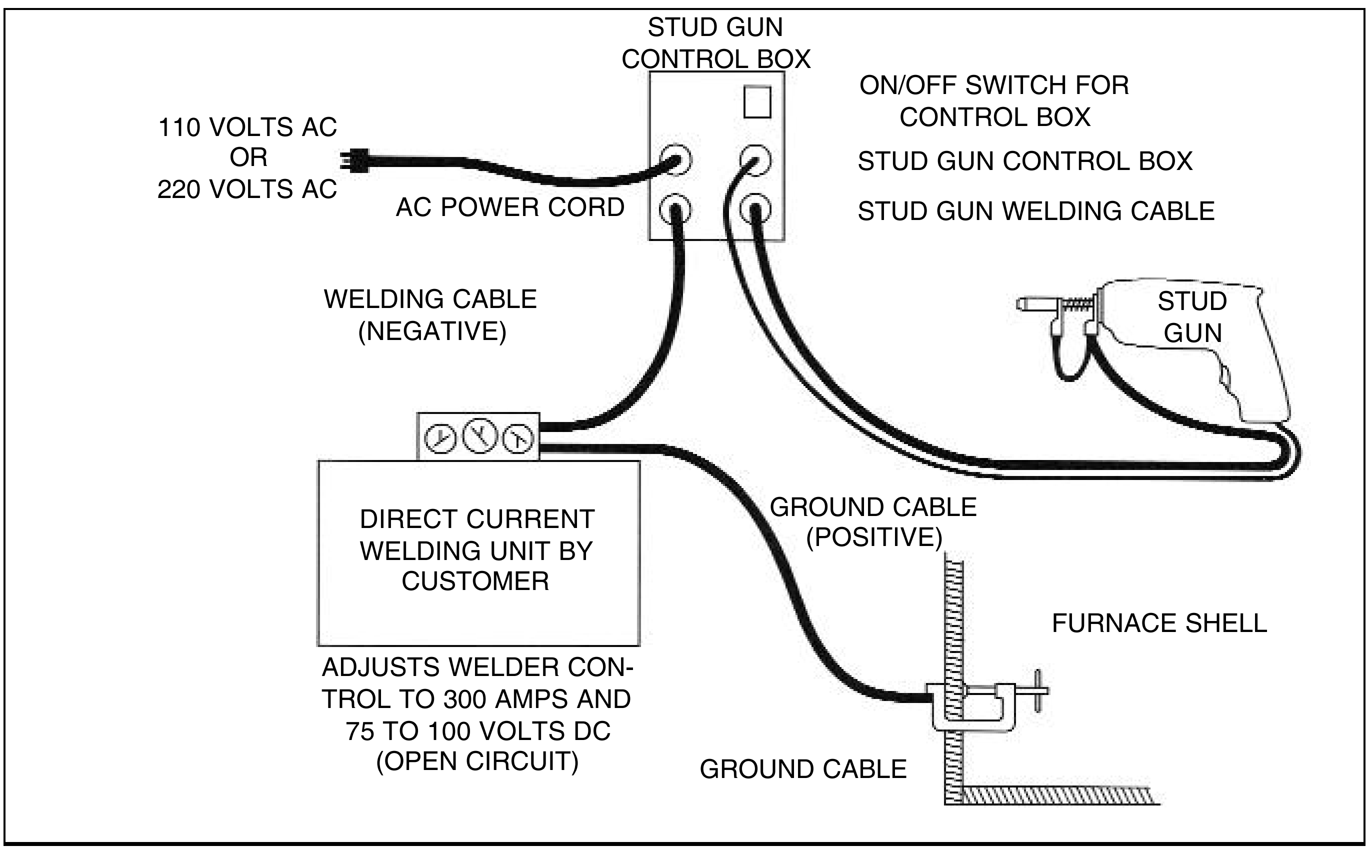


Figure 8 - Stud Gun/Control Box Hook Up

Item	Part No.	Description
1	SG39	Snout End
2	----	Round Head Machine Screw 8-32x1½"
3	SG40	Snout Collar
4	SG38	Snout Drive
5	SG34	Spring
6	SG35	Drill Motor
7	SG23	Gun Lug Front
8	SG15	Gun Lug Rear
9	SG27	Flat Braid Cable
10	SG20	Welding Cable
11	SG14	Welding Cable Plug
12	SG29	Gun Control Cord
13	SG18A	Gun Control Cord Plug

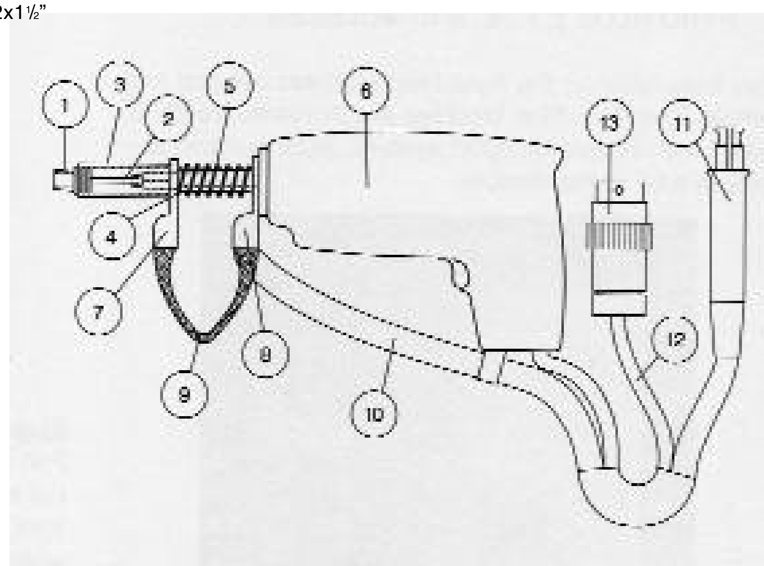


Figure 9 - Stud Gun Parts List

Item	Part No.	Description
1	SG04	Control Box Handle
2	SG33AA	Switch (110V Unit)
		or
	SG33B	Switch (220V Unit)
3	SG18	Receptacle - Stud Gun Control
4	SG12	Receptacle - Welding Current
5	SG20	Welding Cable
6	SG14	Plug to Welding Machine
7	SG13	Adapter Lug
8	SG41A	Compression Fitting
9	SG25	Plug - Control Box Power
10	SG17	Power Cord Receptacle
11	SG26	Power Cord
12	SG17A	Power Cord Plug (110V Unit)
		or
	SG47	Power Cord Plug (220V Unit)
13	SG48A	Timer
14	SG24	Transformer (220V Unit Only)
15	SG20	Welding Cable
16	SG23	Control Box Lug
17	SG32	Contactor
18	SG07	Diode
19	SG06	Capacitor
20	SG19	Enclosure Box

Contactor Replacement Parts

SG32A	Coil
SG32B	Contact Bridge
SG32C	Contact

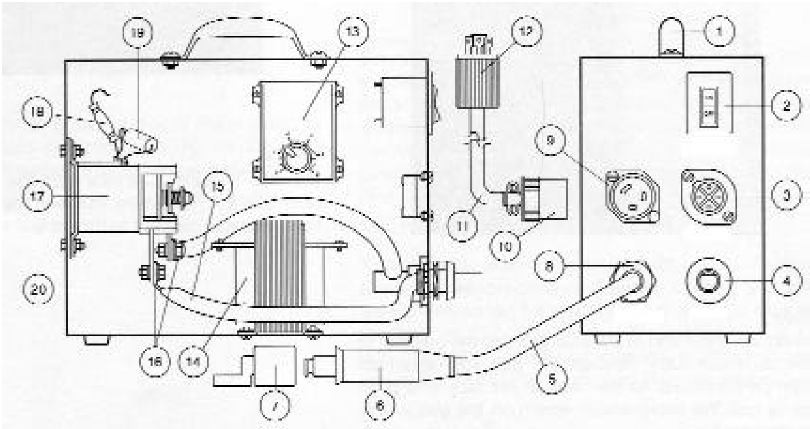


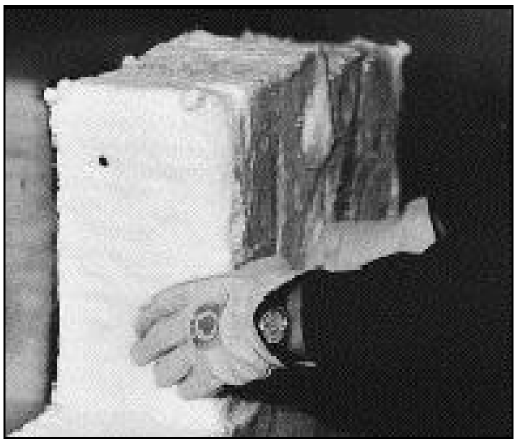
Figure 10 - Control Box Parts List

2. INSTALLATION: PYRO-BLOC Y, Y², E, & E² MODULES

The installation of the Pyro-Bloc Modules are fast and simple. The Pyro-Bloc Modules are delivered, ready to install with internal support system, stud, nut and aluminum tube in the module.

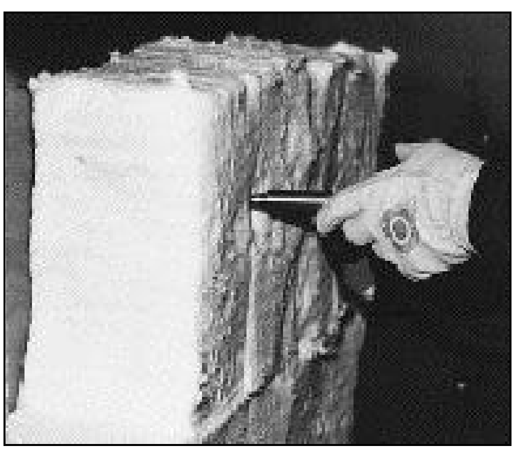
Step 1

Place the Pyro-Bloc Module so that the stud rests against the furnace-casing. Compress the module against adjacent modules by approximately 1/2" (Consult your Thermal Ceramics representative).



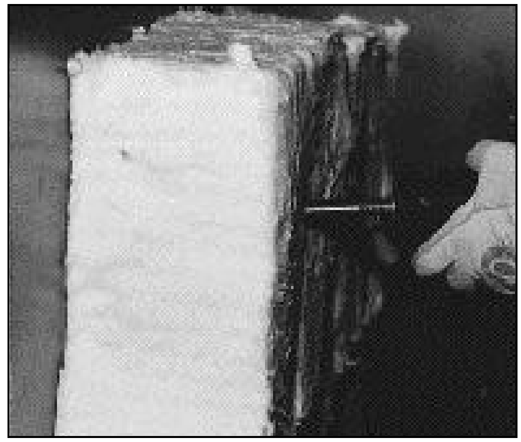
Step 2

Insert the snout end of the stud gun into the opening of the aluminum tube. Position the gun and aluminum tube perpendicular to the module hot face and push lightly until the compression spring on the gun is fully compressed.



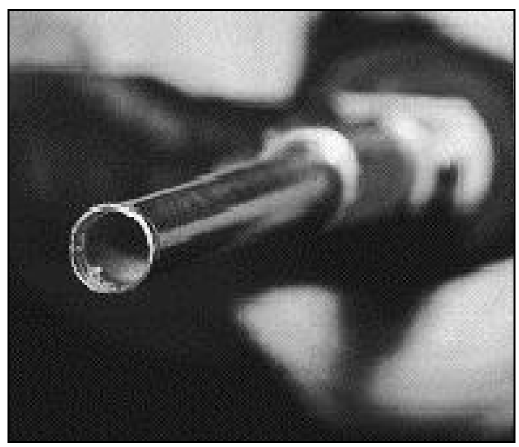
Step 3

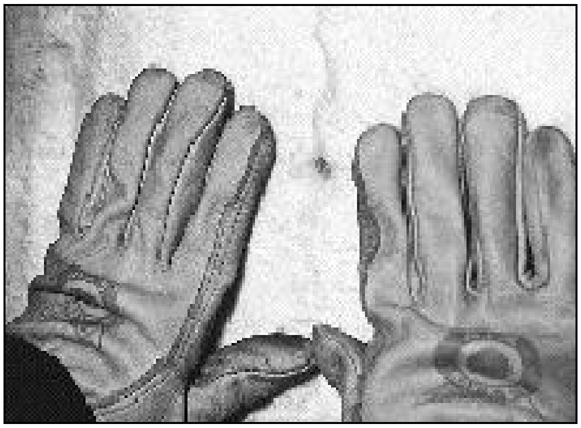
Pull and hold the trigger to make the weld and tighten the nut (do not release the trigger until the module is tight against the wall). Maintain pressure on the gun while it is tightening the nut. When the gun motor gears down and torques sharply in your hand, the nut is tight and the trigger may be released.



Step 4

Remove the aluminum tube from the nut using needle nose pliers if necessary, examine the end to ensure it has been rounded out to torque test the weld.





Step 5

Pinch the fiber closed over the stud to protect it from the heat.

Step 6

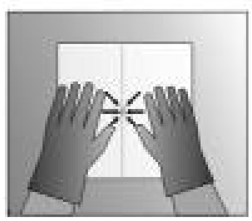
The final step is to tamp the hot face of the modules to help close any gaps that may exist. This can be done as a section is finished or after all the installation is complete.

IMPORTANT INSTALLATION INFORMATION

Install Pyro-Bloc Modules in Accordance with the Installation Manuals
Pyro-Bloc M Module - Installation Manual M #143 Issued 12/02 (or later)
Pyro-Bloc Y Module - Installation Manual M #142 Issued 7/01 (or later)

After installation of the Module - REMOVE TUBE

- **Pyro-Bloc M Module - Red Plastic Access Tube**
- **Pyro-Bloc Y Module - Aluminum Tube**



Close Tube Opening

Tamp Module in Accordance with Appropriate Installation Manual.

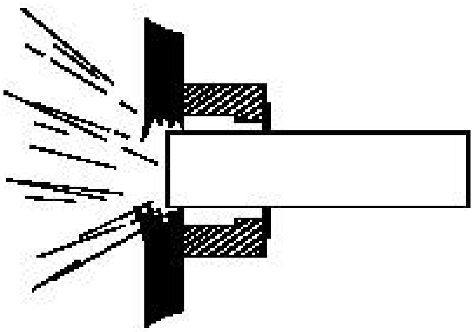
Notice:

Some of the products described in this literature contain Refractory Ceramic Fiber (RCF) and/or crystalline silica (cristobalite or quartz). Based on experimental animal data, the International Agency for Research on Cancer (IARC) has classified RCF, along with fibrous glasswool and mineral wool, as a possible human carcinogen (Group 2B) and respirable crystalline silica as a probable human carcinogen (Group 2A).

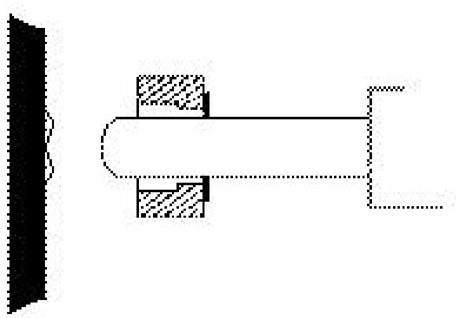
To reduce the potential risk of health effects, Thermal Ceramics recommends engineering controls and safe work practices be followed by product users. Contact the Thermal Ceramics Product Stewardship Group (1-800-722-5681) to request detailed information contained in its MSDSs and product literature and videos.

3. Troubleshooting

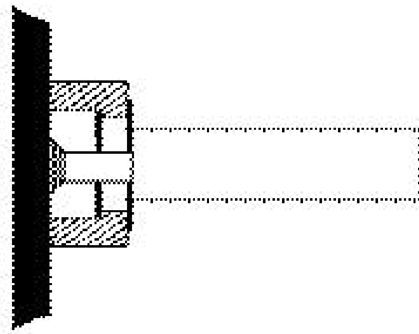
If a stud does not weld, carefully observe the "failed" stud and try to match it to the pictures. You will find a list of possible solutions under each picture.



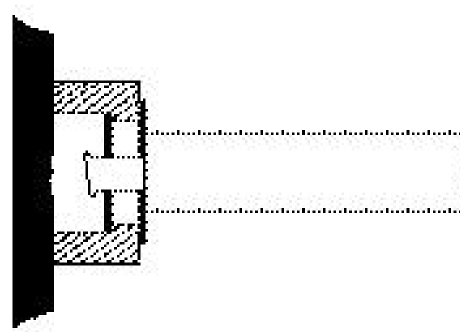
PROBLEM A - Hole in shell
Solution:
1. Check the steel shell thickness. Ten (0.135") guage steel is the recommended minimum thickness.
2. Stud hung up on something, try again.
3. Decrease the current in increments of 10 amps.
4. If current is reduced until the stud begins to appear as the figure in problem C, increase the voltage in 10 volt increments (Do Not Exceed 100 open circuit volts).
5. Push harder against the stud.



PROBLEM B - Torque broke the weld
Solution:
1. Push harder.
2. The stud my have been cocked slightly. Try to hold the gun and stud perpendicular to the steel shell.
3. Increase the time setting in the stud gun control box.



PROBLEM C - Stud tip fused to the shell
Solution:
1. Increase voltage slightly (10 volts). Continue to increase voltage but normally not beyond 100 volts DC.
2. Check ground.
3. If welding machine is gasoline driven, block machine to a fast idle. A gasoline driven machine generally can't recover quickly enough to blow the stud after the initial surge.
4. Current usually is not a problem. If 2 & 3 does not correct the problem, then leave the voltage at the highest setting and increase the curent in increments of 10 amps.
5. Too much pressure is being applied to the stud.



PROBLEM D - No plunge
Solution:
1. Check ground.
2. Increase the current.
3. Push harder.
4. Increase the time setting in the stud gun control box.

Amorphous: Having no definite crystalline structure or form.

Back-up Insulating Material: The layer or layers of insulating material that are located between the hot face insulating layer and the outer casing.

Blanket: A flexible unbonded ceramic fibrous insulating material of reasonably determinate dimensions.

Board: A substantially rigid or semi-rigid flat sheet produced by vacuum forming.

Bulk Fiber: Ceramic fibers in the "as-produced" state.

Butt Joint: A ceramic fiber wallpaper construction joint where edges of adjacent blankets meet.

Cold Face Temperature: Term used to denote the outside casing temperature.

Continuous Use Limit: Long-term (continuous) temperature limit for a product installed as a lining. This temperature is based upon product shrinkage, specifically what is considered to be a "manageable" or "controllable" shrinkage. This term is not to be confused with temperature rating.

Cristobalite: A crystalline phase of silica which will begin to form above 1800°F.

Devitrification: The phase transformation from glass to crystalline structure.

Edge-grain: The orientation of a fiber system in which strips of ceramic fiber blanket or felt are oriented perpendicular to the plane of the furnace casing.

Felt (Pressed): A flexible sheet product formed from ceramic fibers and bonded with an organic binder.

Heat Loss: The term used to denote the amount of heat being lost through a lining construction over time, measured in BTU/sq ft/min, (watts/sq in).

Heat Storage: The thermal property of a material wherein heat accumulates in the mass (which in refractories is a function primarily of the material's specific heat, mass, and temperature rise measured in Btu/lb/°F *(Cal/g/°C)*.

Heat Transfer: The study of heat flow mechanisms - conduction, convection, and radiation.

High Alumina Fiber: A ceramic fiber containing more than 90% alumina, giving a high use limit. Mullite fiber is also used in high temperature applications.

High Purity (HP) Fiber: A ceramic fiber produced from synthetic alumina and silica.

Hot Face Insulating Material: The layer of lining insulating material that has at least one surface exposed to the full temperature of the furnace gases.

Kaolin Fiber: A ceramic fiber produced from calcined kaolin.

Laminar Flow: The flow of a gas in which the gas stream moves in straight lines parallel to the direction of the flow.

Layered Lining Wallpaper: Lining that is composed of several layers and thicknesses of refractory ceramic fiber.

Linear Shrinkage: The amount of shrinkage which occurs along the length of a material after it has been subjected to elevated temperatures and then cooled - measured in percent of original prefired length.

Lock Washers: Washers used in conjunction with Kao-Lok studs. They are slotted so that when pushed over the stud and then twisted 90° the washer is locked into place, other locking systems are available, such as cone anchors. Lock anchors come in ceramics or alloy metals to suit temperature requirements.

Maximum Temperature Rating: The temperature which is used by the industry as a loose classification of different grades of ceramic fiber. This is generally higher than the continuous use limit.

Module: A prefabricated unit which can be applied as a lining block to the inner face of a furnace structure.

Mortar/Cement: A ceramic-based adhesive for attaching ceramic fiber products to other surfaces.

Mullite: A crystalline phase of alumina-silica.

Overlap Construction: A construction technique used to accommodate shrinkage in ceramic fiber or to improve velocity resistance in which one edge of a blanket is lapped over an adjacent blanket edge by 4" to 12" and shares a common anchor stud and washer.

Paper: A roll product produced from ceramic fibers and organic binders on conventional paper-making machinery.

Parquet: A method of installing modular edge-grained forms of ceramic fiber so that the edge grain of one module is perpendicular to the edge grain of the adjacent modules.

Rigidizing: The practice of applying an inorganic hardening agent to the surface of ceramic fiber (by spray or brush) in order to improve its velocity resistance.

RCF: Refractory Ceramic Fiber.

Shingled Joint: A method of applying double layers of ceramic fiber blanket in such a way that half the width of each layer overlaps half the width of the adjacent layer.

Shot: A glassy material formed during fiberization.

Textile: Cloth, tape, sleeving, tubing, or other forms manufactured from ceramic fiber yarn.

Thermal Conductivity: The property of material to conduct heat - measured in Btu flow per hour through a square foot of area across one inch of thickness Btu•in/hr•ft•°F *(w/m •C°)*.

Thermal Resistivity: The property of a material to resist the flow of heat; the reciprocal of thermal conductivity.

Thermal Shock: A failure mechanism wherein sudden changes in temperature bring sufficient thermal mechanical stress in a material to cause cracking or spalling. As a general rule, the thermal shock resistance of a material is greater as the strength and thermal conductivity of a material increase and as the thermal expansion and modulus of elasticity decrease.

Turbulent Flow: Fluid flow in which the velocity of a given stream of gas changes constantly both in magnitude and direction.

Vacuum Forming: A method of producing molded shapes and flat board by converting fibers into a slurry and vacuuming them onto a screen former.

Veneer: Layer of ceramic fiber in either blanket or module form which is attached to the hot face of a brick, module or monolithic lining.

Wallpaper Construction: The term used to describe a ceramic fiber lining construction technique where the blanket is installed on a wall like a roll of wallpaper.

For further information, contact your nearest Thermal Ceramics technical sales office. You may also fax us toll-free at 1-800-KAOWOOL, or write to Thermal Ceramics, P. O. Box 923, Dept. 140, Augusta, GA 30903.

Global Headquarters
Thermal Ceramics Global
L'Européen - Bât. C
2, rue Joseph Monier
92859 Rueil-Malmaison Cedex, France
T: +33 (0)1 47 16 22 23
F: +33 (0)1 47 16 22 40
E-mail: info@tc-global.com

Global Marketing Offices
Thermal Ceramics Americas
2102 Old Savannah Road
Augusta • Georgia • 30906
T: +1 (706) 796 4200
F: +1 (706) 796 4398
E-Mail: tceramics@thermalceramics.com

Thermal Ceramics Asia Pacific
28 Jalan Kilang Barat
Kewalram House
Singapore • 159362
T: +65 6273 1351
F: +65 6273 0165
E-mail: thermalceramics@tcasia.com.sg

Thermal Ceramics Europe
Tebay Road • Bromborough • Wirral
CH62 3PH • England
T: +44 (0) 151 334 4030
F: +44 (0) 151 334 1684
E-mail: marketing@thermalceramics.co.uk

Sales and Marketing Office Locations

North America
Canada
T: +1 (905) 335 3414
F: +1 (905) 335 5145
Mexico
T: +52 (555) 576 6622
F: +52 (555) 576 3060
United States of America
Southeastern Region
T: +1 (800) 338 9284
F: +1 (706) 796 4324
Midwest Region
T: +1 (866) 785 2738
F: +1 (866) 785 2760
Eastern Region
T: +1 (866) 785 2763
F: +1 (866) 785 2764
Western Region
T: +1 (866) 785 2765
F: +1 (866) 785 2782

South America
Argentina
T: +54 (11) 4373 4439
F: +54 (11) 4372 3331
Brazil
T: +55 (11) 4178 1999
F: +55 (11) 4178 1675
Chile
T: +56 (2) 854 1064
F: +56 (2) 854 1952
Colombia
T: +57 (222) 82935/82803
F: +57 (222) 82935/82803
Guatemala
T: +50 (2) 4733 295/6
F: +50 (2) 4730 601
Venezuela
T: +58 (241) 878 3164
F: +58 (241) 878 6712

www.thermalceramics.com

12.02/M142/1M