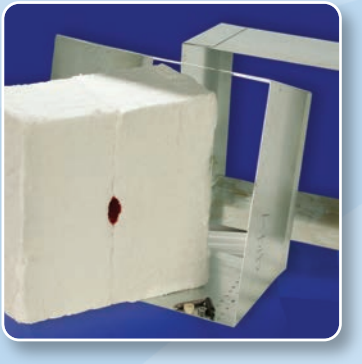
Pyro-Bloc®
M Module

Design and installation guidelines




Morgan Advanced Materials

THERMAL CERAMICS

Morgan Advanced Materials

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Pyro-Bloc® Module

For more than 50 years, the Thermal Ceramics Pyro-Bloc Module has been the industry standard for furnace, boiler and kiln linings.

The Pyro-Bloc Module is a versatile choice for many applications. In the Petrochemical and Power Generation markets Pyro-Bloc Modules are thermal insulation solutions in radiant heater sections and HRSG ductwork and auxiliary burners and in the Ceramics and Glass markets, Pyro-Bloc Modules are located in the kiln lining and base for kiln cars. In Iron and Steel modules are often found in wall sections of many heat treating and forging furnaces.

This design and installation manual will cover the Pyro-Bloc Modules, hardware options, recommended installation instructions and typical lining and design details that are common across many industrial applications in markets from Petrochemical to Iron and Steel to Aluminum.

For more than 50 years, the Thermal Ceramics Pyro-Bloc Modules has been the industry standard for furnace, boiler and kiln linings.

Pyro-Log™: the base for all Pyro-Bloc Modules
Pyro-Log is an uncompressed monolithic mass of high temperature insulating fibre. Pyro-Log fibre is available in 6 and 8 inch (152 and 203 mm) thicknesses with densities up to 15 pcf (240 kg/m^3). Manufactured in AES and RCF fibres, Pyro-Log fibre is the basic building block for all Pyro-Bloc modules.

All Pyro-Log fibre is produced with a special lubricant that allows the fibres to be intensely needled to attain densities up to 15 pcf (240 kg/m^3). The lubricant also adds pliability which allows true multi-directional compression during installation. At moderate temperatures, typically no more than 400°F (204°C), this lubricant burns out and the fibre mass becomes rigid.

This feature, unique to the manufacturing of Pyro-Log fibre, assists during Pyro-Bloc module installations and provides the durability and toughness necessary for long life.

Pyro-Bloc® Module hardware

Pyro-Bloc Modules are marketed as base Pyro-Bloc Y and Pyro-Bloc M Modules. Pyro-Bloc Modules are available in AES and RCF fibre grades.

	Continuous use temperature, °F (°C)	Classification temperature rating, °F (°C)
Superwool Plus (AES)	2000 (1093)	2192 (1200)
Superwool HT (AES)	2200 (1204)	2372 (1300)
R Grade (RCF)	2200 (1204)	2400 (1316)
ZR Grade (RCF)	2450 (1343)	2600 (1427)
C Grade (RCF)	2500 (1371)	2600 (1427)

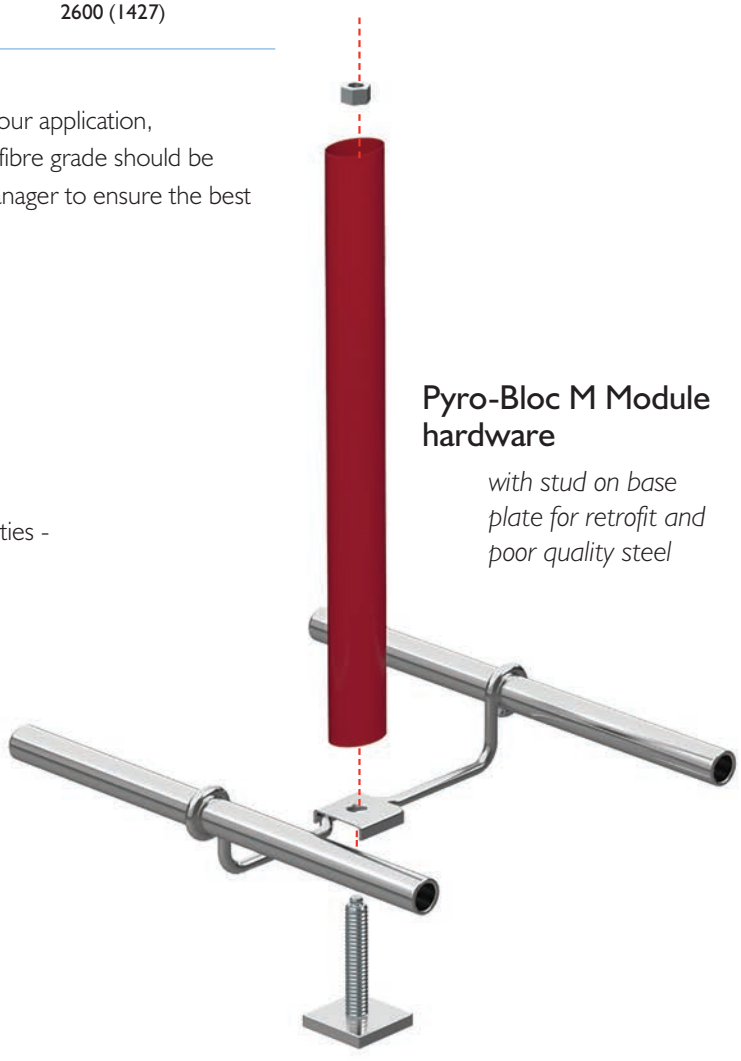
Fibre grade offers varying features and benefits dependent upon your application, atmosphere, and operating temperature. Technical aspects of the fibre grade should be discussed with your local Morgan Advanced Materials Account Manager to ensure the best Pyro-Bloc Module is selected for your application requirements.

The two technical manuals that can be reviewed are the:

1. Technical aspects of ceramic fibre

2. Superwool technical fibres

These documents carefully discuss the technical variations, properties - physical and chemical - related to the fibre grades offered by Morgan Advanced Materials.



Pyro-Bloc M Module hardware

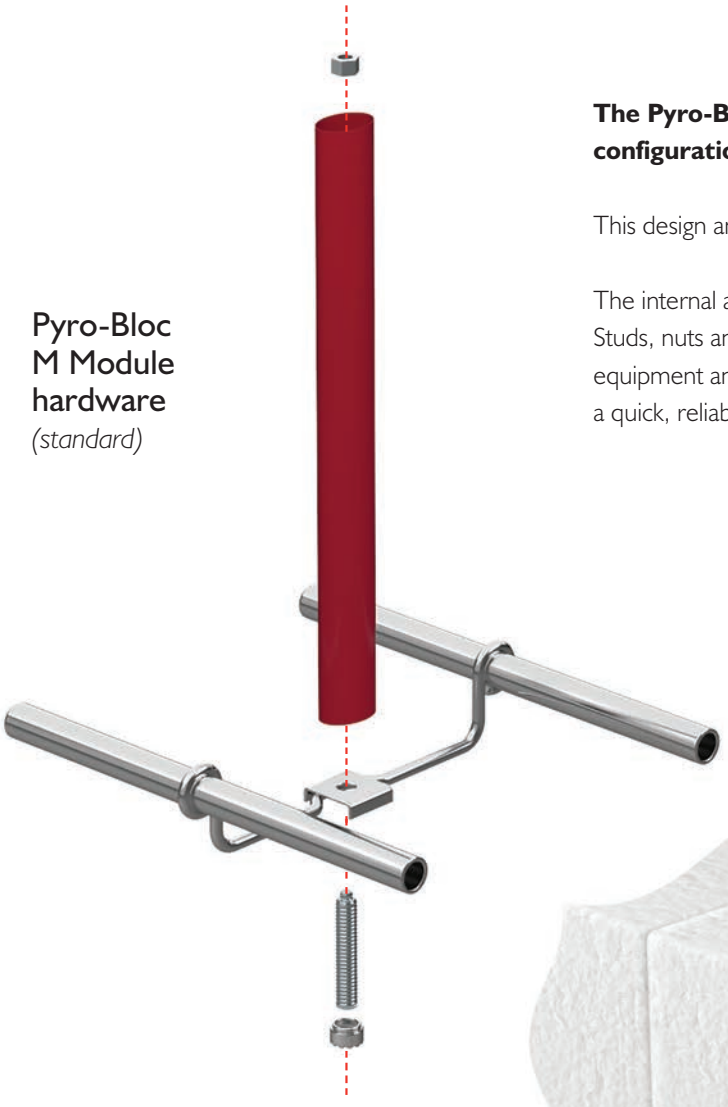
with stud on base plate for retrofit and poor quality steel

The Pyro-Bloc M Module also comes with additional hardware and configurations options.

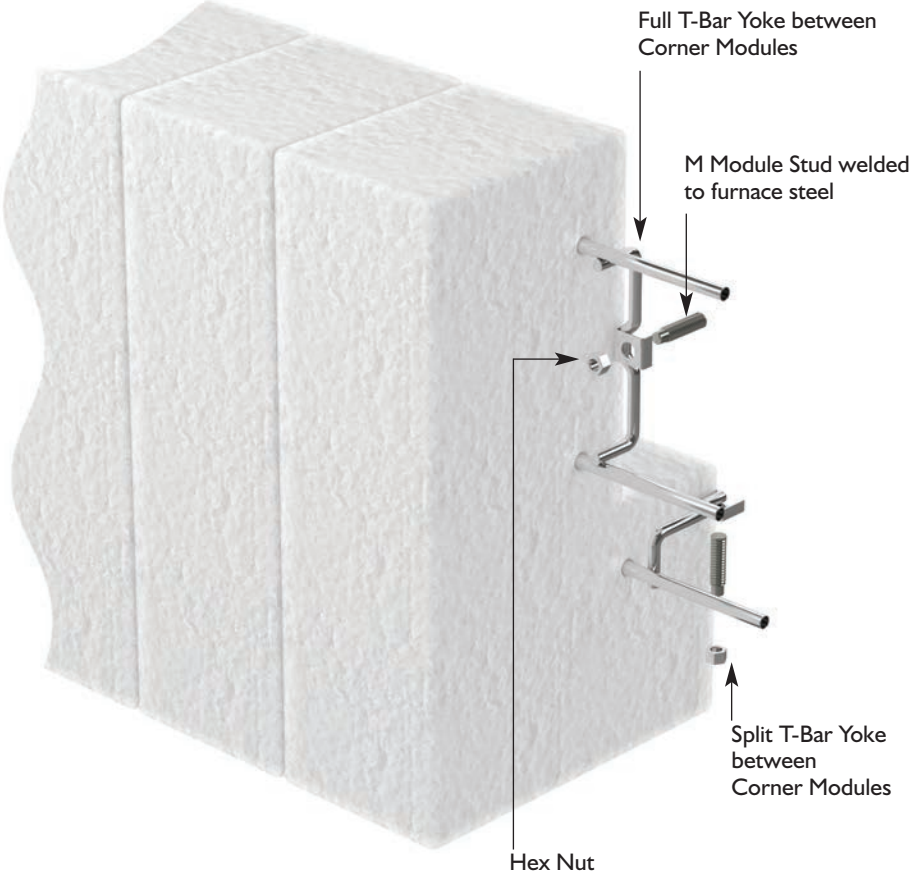
This design and installation manual will cover these solutions.

The internal anchor hardware is stainless steel for the Pyro-Bloc M Module. Studs, nuts and installation tools are purchased separately. The installation equipment and tools described in this manual have been developed to ensure a quick, reliable installation.

Pyro-Bloc M Module hardware
(standard)

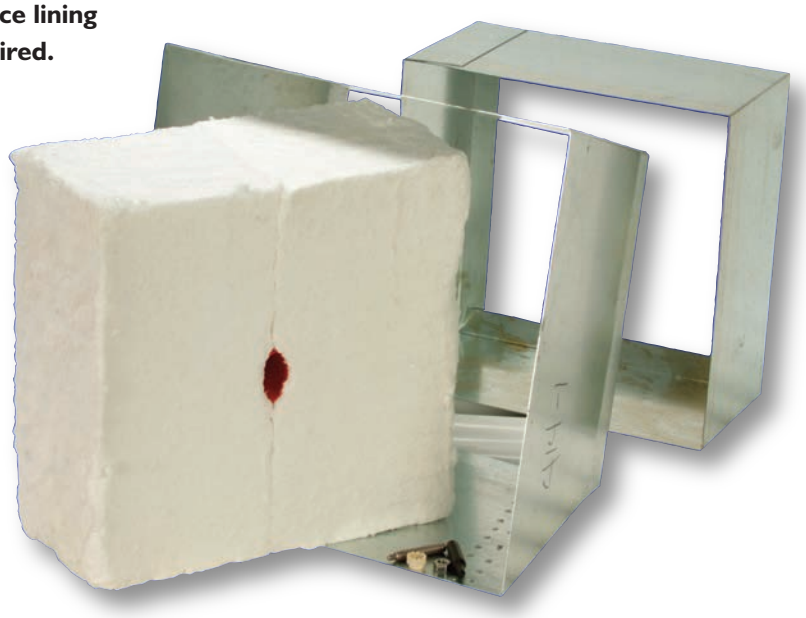


Pyro-Bloc T-Bar Module hardware



Pyro-Bloc® M Module

The Pyro-Bloc M and M² Modules are often used in furnace lining system designs where a corrosion barrier on shell is required.

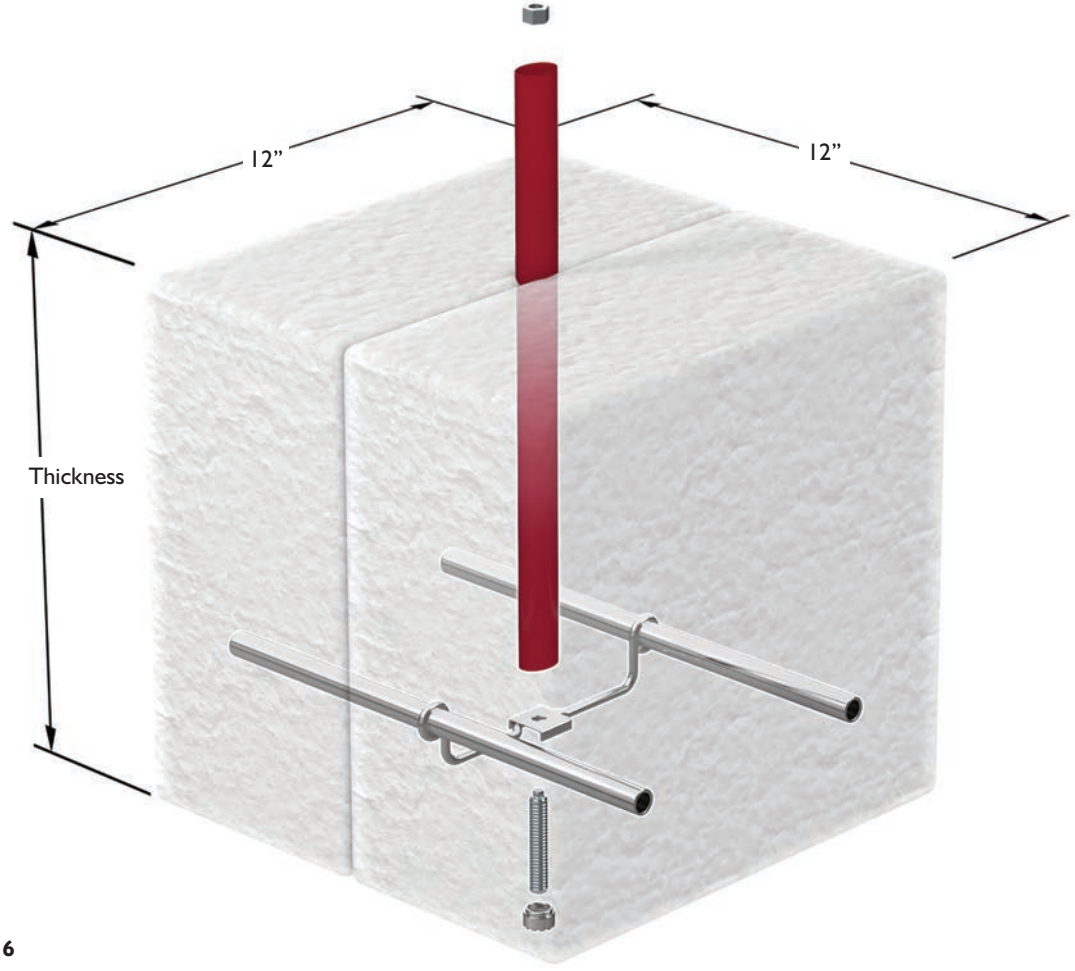


Pyro-Bloc M Modules are a monolithic edge-grain fibre module designed for industrial furnaces that require corrosion barriers, a back-up blanket layer, or a pre-laid-out stud system. Pyro-Bloc M Modules utilize an internal M-Module yoke and two support tubes.

Pyro-Bloc M Modules are available in densities up to 15 pcf (240 kg/m^3) and in thicknesses from 3 to12 inches (76 to 305 mm) in 1 inch (25.4mm) increments.

The Pyro-Bloc M Modules are available as:

- 12 x 12 inch (305mm x 305mm) modules
- 6 x 12 inch (152mm x 305mm) split long fibre modules
- 12 x 6 inch (305mm x 152mm) split short fibre modules
- 12 x 16 inch (305 x 406mm) modules
- Thickness from 3 to 12 inches (76mm - 305mm) in 1 inch (25.4mm) increments



The Pyro-Bloc M² Modules are available as:

- 16 x 16 inch (406mm x 406mm) modules, 1.78 ft²/module (0.165m²)
- Thickness from 3 to 12 inches (76mm - 305mm) in 1 inch (25.4mm) increments

Velocity resistance of the Pyro-Bloc® Modules

Pyro-Bloc Modules are widely used for high temperature furnace and kiln linings in a range of industrial settings
This monolithic fibre has been developed with specific properties in mind. These include superior compensation for shrinkage in comparison to traditional materials, rigidization on firing (because a special lubricant utilised during manufacturing processes) and high density, resulting in exceptional vibration and velocity resistance.

What is velocity resistance?

Velocity resistance within this context refers to the ability of a material to withstand furnace gas flow, although more widely it can be likened to drag. It is an important property of any fibre to be used within furnaces and kilns and is typically measured in either metres per second (m/s) or feet per second (ft/s).

Laminar flow and turbulent flow explained?

Laminar flow refers to the smooth flow of gas or liquid over an object meaning there are no disruptions, cross-currents or eddies. Laminar flow is far less destructive to furnace linings than turbulent flow, which is a far more random and chaotic flow pattern.

Turbulent flow occurs in areas that restrict or dramatically change the flow characteristics. In these areas it is important to consider a lining that has a higher velocity resistance for improved longevity and performance.

Pyro-Bloc Module velocity data

Maximum velocities for laminar flow across the surface of Pyro-Bloc Modules:

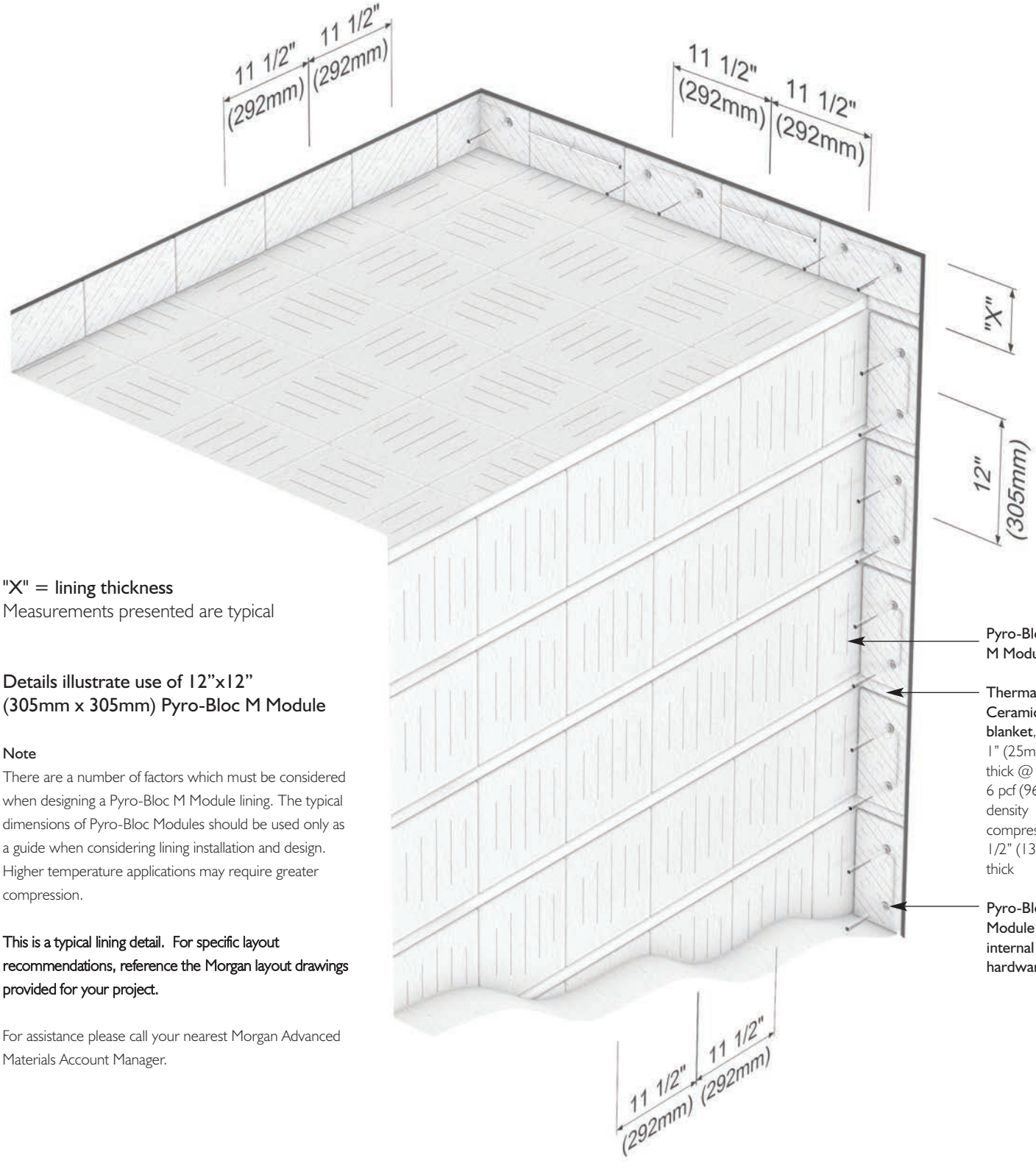
Pyro-Bloc Module density	Velocity, ft/s (m/s)
8 pcf (96kg/m^3)	100 (30)
10 pcf (160 kg/m^3)	125 (37)
12 pcf (192 kg/m^3)	150 (45)
15 pcf (240 kg/m^3)	150 (45)

Coatings

With the application of specific coatings, it is possible to raise the velocity resistance of a hot face. Coatings are generally spray applied and are typically either silica or alumina.

Caution should be exercised with coatings. Some coatings can reduce the temperature capability of the fibre.
Consult with your Morgan Advanced Materials Account Manager.

Pyro-Bloc® M Module typical lining detail



"X" = lining thickness
Measurements presented are typical

Details illustrate use of 12"x12" (305mm x 305mm) Pyro-Bloc M Module

Note
There are a number of factors which must be considered when designing a Pyro-Bloc M 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.

This is a typical lining detail. For specific layout recommendations, reference the Morgan layout drawings provided for your project.

For assistance please call your nearest Morgan Advanced Materials Account Manager.

Installing a Pyro-Bloc® M Module

Lining Considerations:

Pyro-Bloc M Module linings are typically installed in a soldier course fashion on vertical walls with batten strip and in a parquet pattern on a roof as illustrated on page 8.

Prior to installing Pyro-Bloc M Modules, it is necessary to lay out the required stud pattern and weld the studs in place. The specific operating conditions for your particular furnace will determine the need for the next recommended lining and installation considerations - a stalastic coating, back-up blanket or vapor barriers.

The stalastic coating can now be applied to the steel casing. Depending on the design, a layer of Thermal Ceramics Blanket for back-up as well as a layer of stainless steel foil for a vapor barrier may be installed.

Once the studs and back-up materials are in place, our recommended installation steps of the Pyro-Bloc M-Modules can begin. The yoke in the Pyro-Bloc M Modules have an offset to allow for the stud to be in the center of the module.

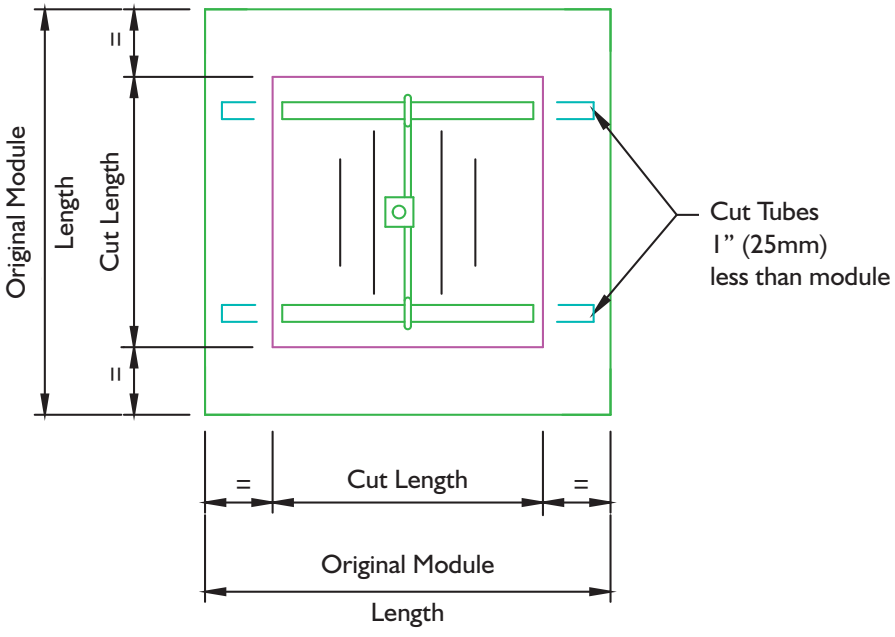
Pyro-Bloc M Modules are easy to cut or trim to allow for obstructions such as burners or peep sites. Best results will be achieved if the module is trimmed equally from opposite sides of the module, so that the stud will remain centered as closely as possible as illustrated in below. It is best to cut less than what is necessary and compress the module into place to ensure the tightest possible joint.

Pyro-Bloc Module cutting detail

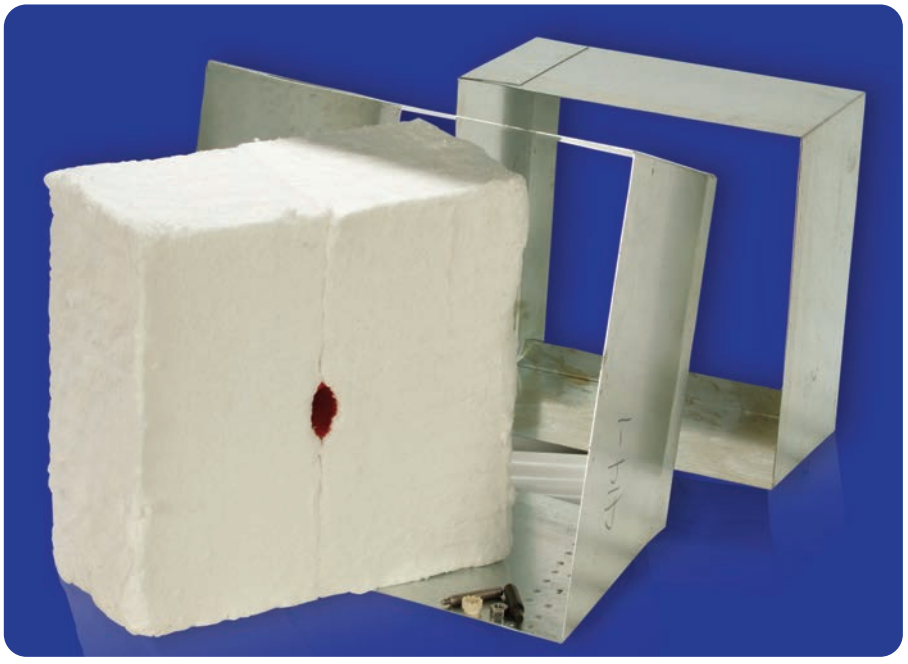
* Denotes cut modules to fit with adequate compression

When cutting and fitting of the module 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.

It is recommended to cut less than necessary and compress the module into place to get a good tight joint.



Site Preparation:



- Have access to the material.
  Keep the materials as close to the work area as possible without the material being in the way.

- Set up good scaffolding.
  The steel shell should be checked for thickness. Steel less than 1/8 inch (3.18 mm) 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.

- It is required that chalk lines be applied to the walls and roof prior to the installation of any Thermal Ceramics Pyro-Bloc M Modules.
  - M Modules: chalk lines show compressed, stud-to-stud dimensions of the module installation

- Roof installation recommendations for the Pyro-Bloc M Modules are to typically install in a parquet pattern.

- Side wall installation recommendations for the Pyro-Bloc M Modules are to install in a soldier course pattern with batten strips.

- Bullnose areas, which cause problems for other modular systems, are easily accommodated by Pyro-Bloc Corner-Bloc Modules. Pyro-Bloc Corner Modules are typically installed using the T-Bar hardware system. Images on pages 18-19 illustrate anchoring options for Pyro-Bloc Corner Modules.

- When cutting and fitting of Pyro-Bloc M 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. It is recommended to cut less than necessary and compress the module into place to get a good tight joint.

Equipment:

Pyro-Bloc M Modules requires the following equipment:

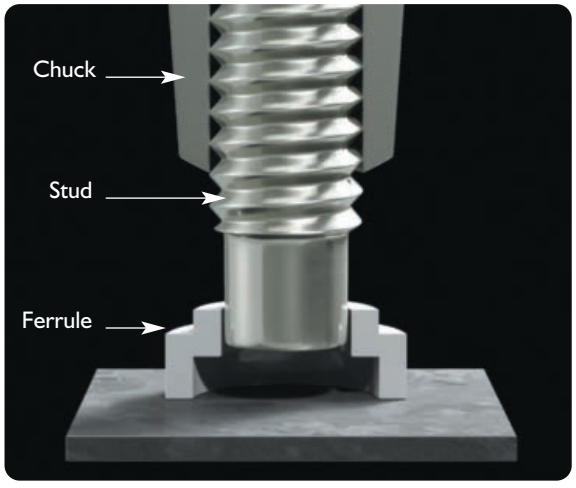
- M Modules
- Stud and nut hardware (sold separately)
- Compression box
- Compression funnel
- Steel slide plate
- Welding machine
- Guide rod
- Ratchet or drill
- *Plastic thread covers (used with back-up lining or stalastic coating)* optional

Morgan Advanced Materials recommends that when selecting the stud welding equipment, that you select a stud welding system similar to the Nelson Stud Gun and Welding Unit, Miller Stud Welding, or a similar reputable welding gun and welding machine.

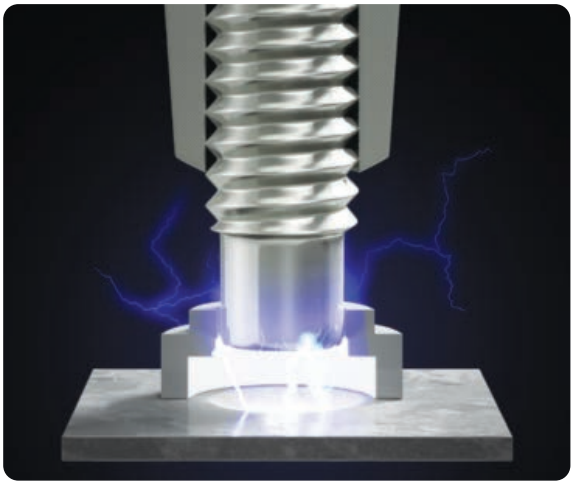
Typical Welding Conditions for Stud Welding of Steel

STUD Weld Base Diameter, in (mm)	WELD TIME Cycles*	WELD CURRENT 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, conditionof 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 studs.		

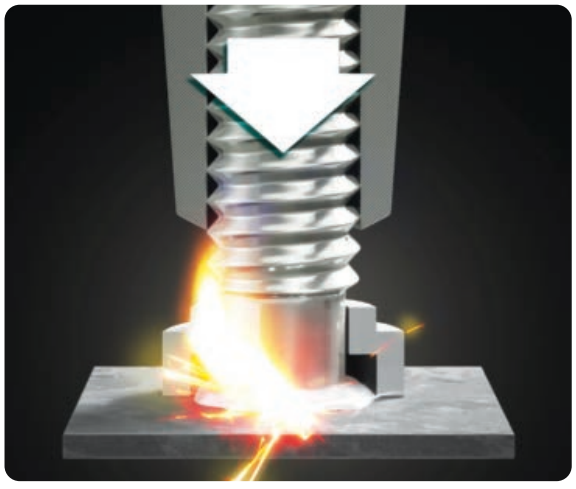
Weld inspection test and recommendations



a. Gun is properly positioned.



b. Trigger is depressed and stud is lifted, creating an arc.



c. Arcing period is completed and stud is plunged into the molten pool of metal on the base metal.

d. Gun is withdrawn from the welded stud, and ferrule is removed.

a. Good stud weld with a good flash formation

b. Stud weld in which plunge is too short

c. Hang-up

d. Poor alignment

e. Stud weld made with insufficient heat

f. Stud weld made with excessive heat

Installation Steps:

Now that the site preparation work and testing of the installation equipment is complete, it is time to begin installation of the Pyro-Bloc M Module. Follow these simple steps to ensure your Pyro-Bloc M Modules are installed to the manufacturer's recommended guidelines. There are a number of factors which must be considered when designing a Pyro-Bloc M Module lining. The typical dimensions of Pyro-Bloc M Modules should be used only as a guide when considering lining design and installation.

Higher temperature applications may require greater compression. At any time during this installation, if you have questions, we recommend you contact your Morgan Advanced Materials Account Manager or the on-site installation advisor.

Step 1

Measure the correct distance vertically and horizontally and mark with a chalk line.

Typically, for walls the stud spacing is 11 1/2 inch (292mm) horizontally and 12 inch (305mm) vertically while on roofs the spacing will be 11 1/2 x 11 1/2 inch (292 x 292mm).

Step 2

At the points where the chalk lines cross, weld an M-Module two-step stud onto the steel casing. Install the plastic covers over the studs and coat the steel casing with stalastic. At this point, back-up layers of blanket and stainless steel foil vapor barriers should be installed if being incorporated into the lining of the furnace.

*Plastic covers for the studs are not used if a coating or back-up blanket is not installed.

Step 3

Pyro-Bloc M Modules can now be installed. Insert the module (hot face side down) into a compression box using a compression funnel.

Step 4

Insert the guide rod through the red access tube and into the hole in the yoke tab. Lift compression box with module and guide rod into position and thread the guide rod onto the small tip on the M Module stud.

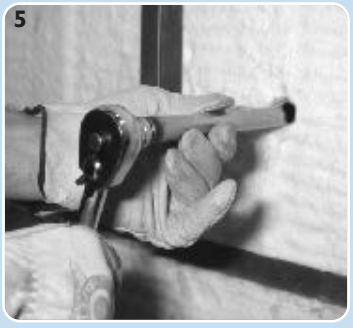
The module and compression box can now be pushed into place with the module yoke tab sliding onto the stud and against the steel casing.

Step 5

Insert a hex nut into the end of the nut driver and slide onto the guide rod.

Thread the nut by hand onto the stud. Remove the guide rod.

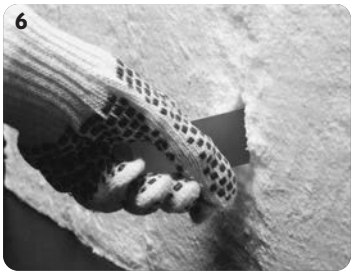
Using a ratchet or drill, tighten the nut onto the stud.



Step 6

Remove the collapsible red access tube.

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

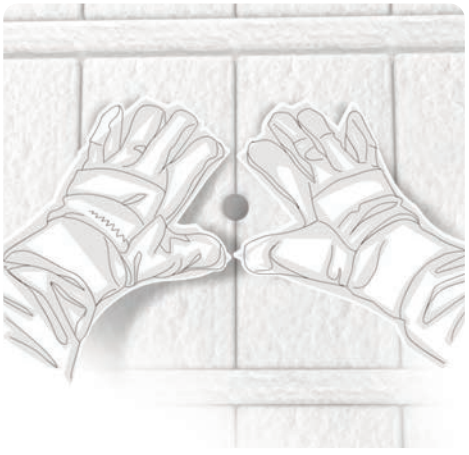


Step 7

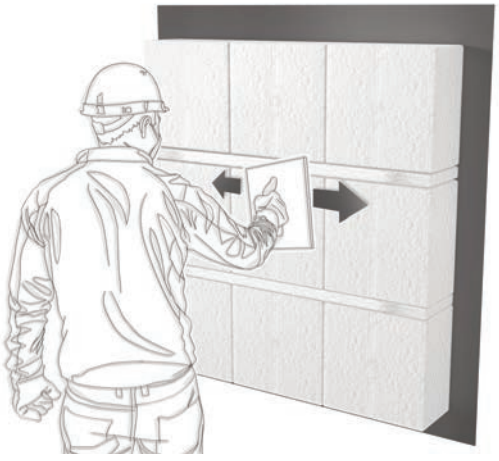
When all Pyro-Bloc M-Modules have been installed, the lining should be tamped out to further tighten all joints and close any gaps that may exist.

IMPORTANT INSTALLATION INFORMATION

After installation of the module REMOVE TUBE. Pyro-Bloc M Modules - red plastic access tube



Close tube opening



Tamp module in accordance with appropriate installation manual

Installation of Pyro-Bloc® Corner Module using T-Bar hardware

Step 1: Loosely attach the first pair of T-Bar yokes to the studs with nuts.

Step 2: Insert the T-Bar yoke tines into the first module support tubes.

Step 3: Screw the nut on the stud using the M module nut driver as required. Do not tighten the nut this will allow the yoke free movement in order to position the next module.

Step 4: Install the next corner module by sliding the internal tubes over the extending T-Bar yoke tines from the 1st module installed.

Step 5: Compress the unsupported side of the module and push the module towards the steel shell between the exposed stud on one side and the already installed module on the other side. Manipulate the next set of T-Bar yokes over the studs in this process. Both corner module legs should be installed at the same time.

Step 6: Screw and fully tighten nuts for the first corner module installed using the M module nut driver.

Step 7: Repeat steps 1-6 for following corner modules until course of modules is complete.

Step 8: Pat the fiber face to close any gaps and to smooth the fiber surface.

T-Bar hardware

* Vapor Barrier Applications: When a barrier is used, an extra length stud that extends through the fibre blanket and metal foil is provided. The blanket fiber, metal foil and metal foil sealant are installed before step 1.

** The steps listed above are for Pyro-Bloc M module stud anchoring with T-bar yokes.

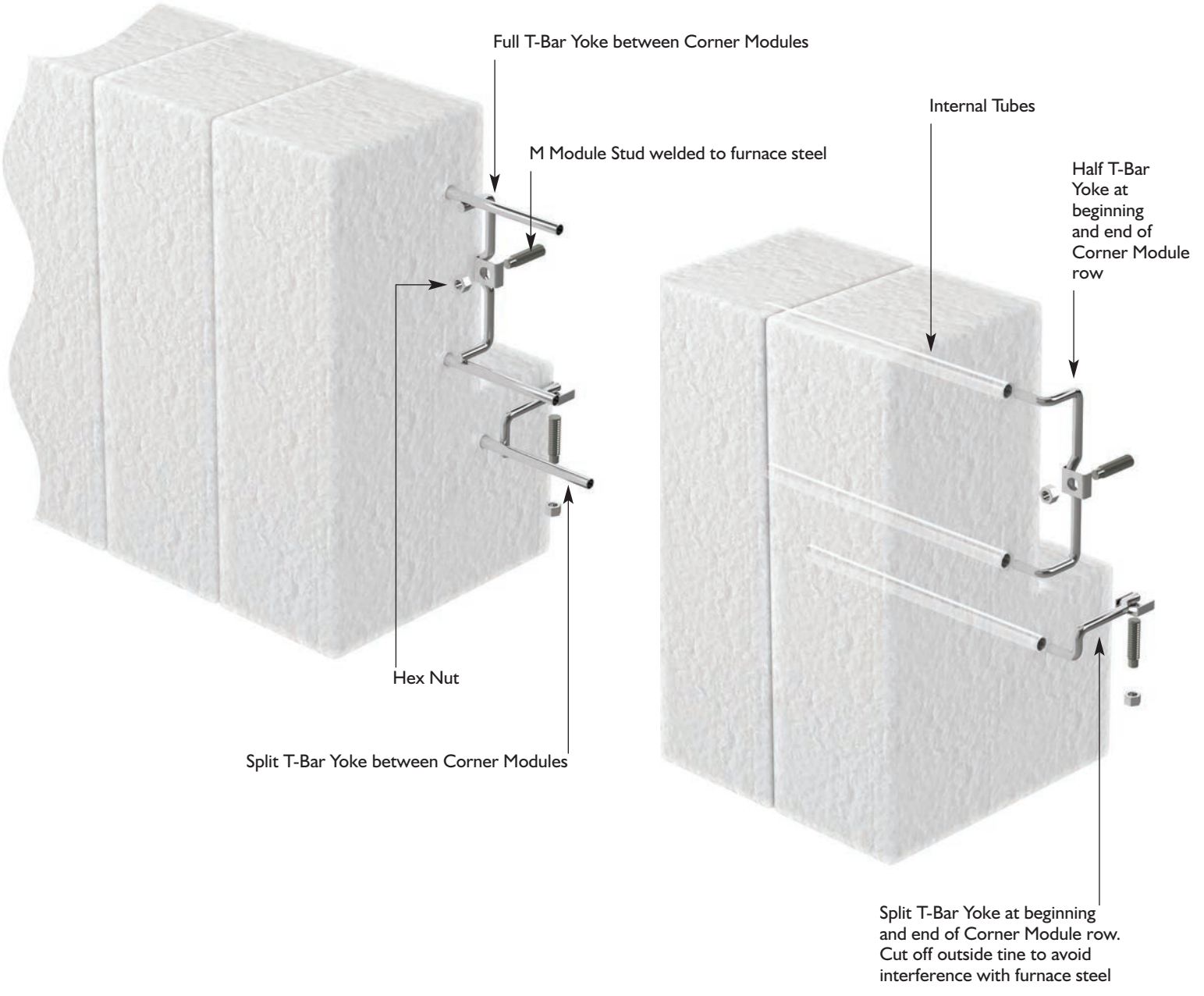
Pyro-Bloc® T-Bar Corner Module

Corner Module comes with internal tubes only

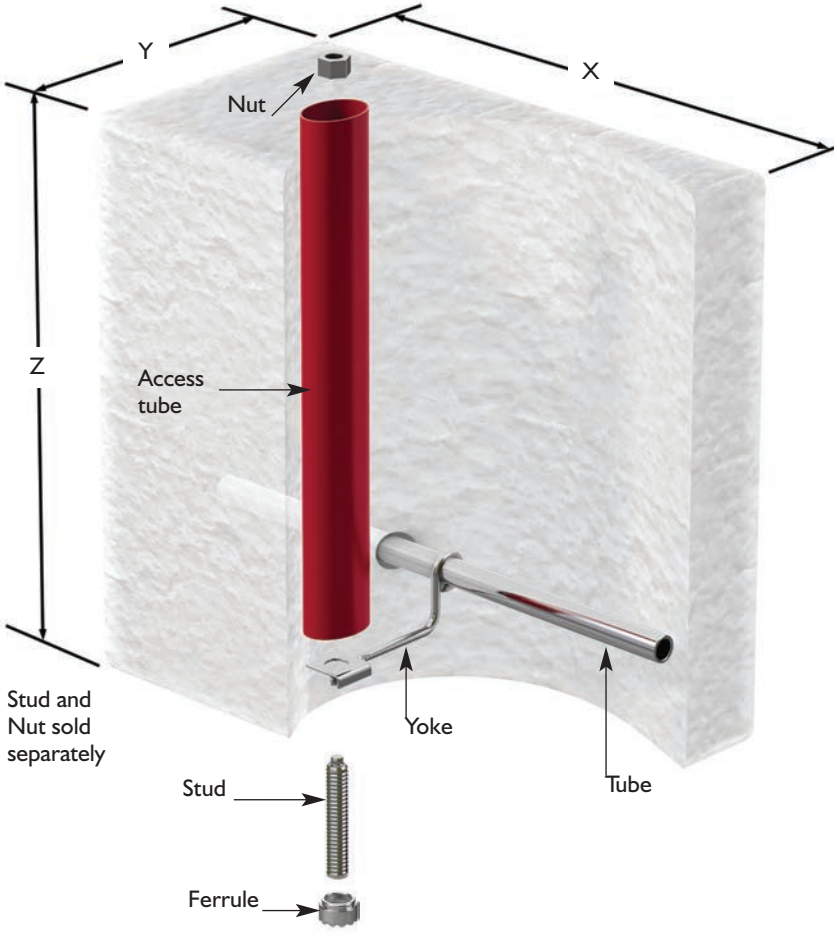
Note:

Module size and hardware are shown as example only.

Module size and hardware to be specified by customer or Morgan Advanced Materials design layout drawings.



Pyro-Bloc® M Module 12x6

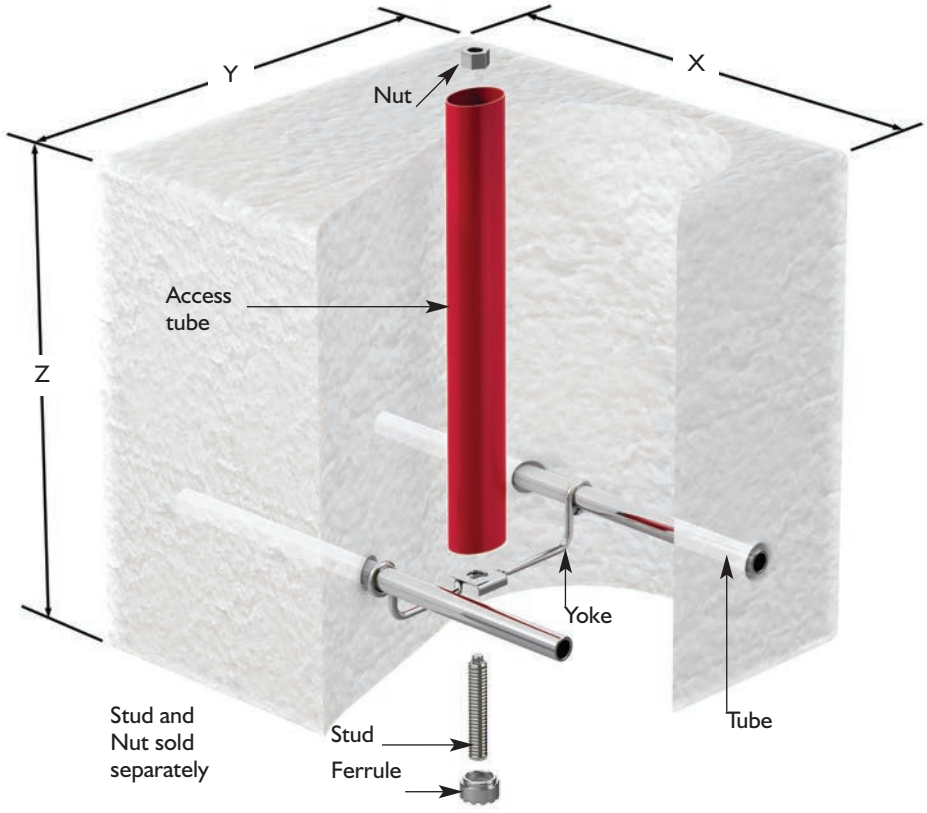


X (width) **x Y** (height) **x Z** (thickness)

Notes:

1. Studs, nuts and thread covers are sold separately.
2. Pyro-Bloc M Modules use pre-welded studs with center anchoring.
3. Pyro-Bloc M Modules recommend the use of compression boxes for installation.
4. Pyro-Bloc M Modules can be used with mastic coating and back-up blanket.
5. Dimension X is edge-grain.

Pyro-Bloc® M Module

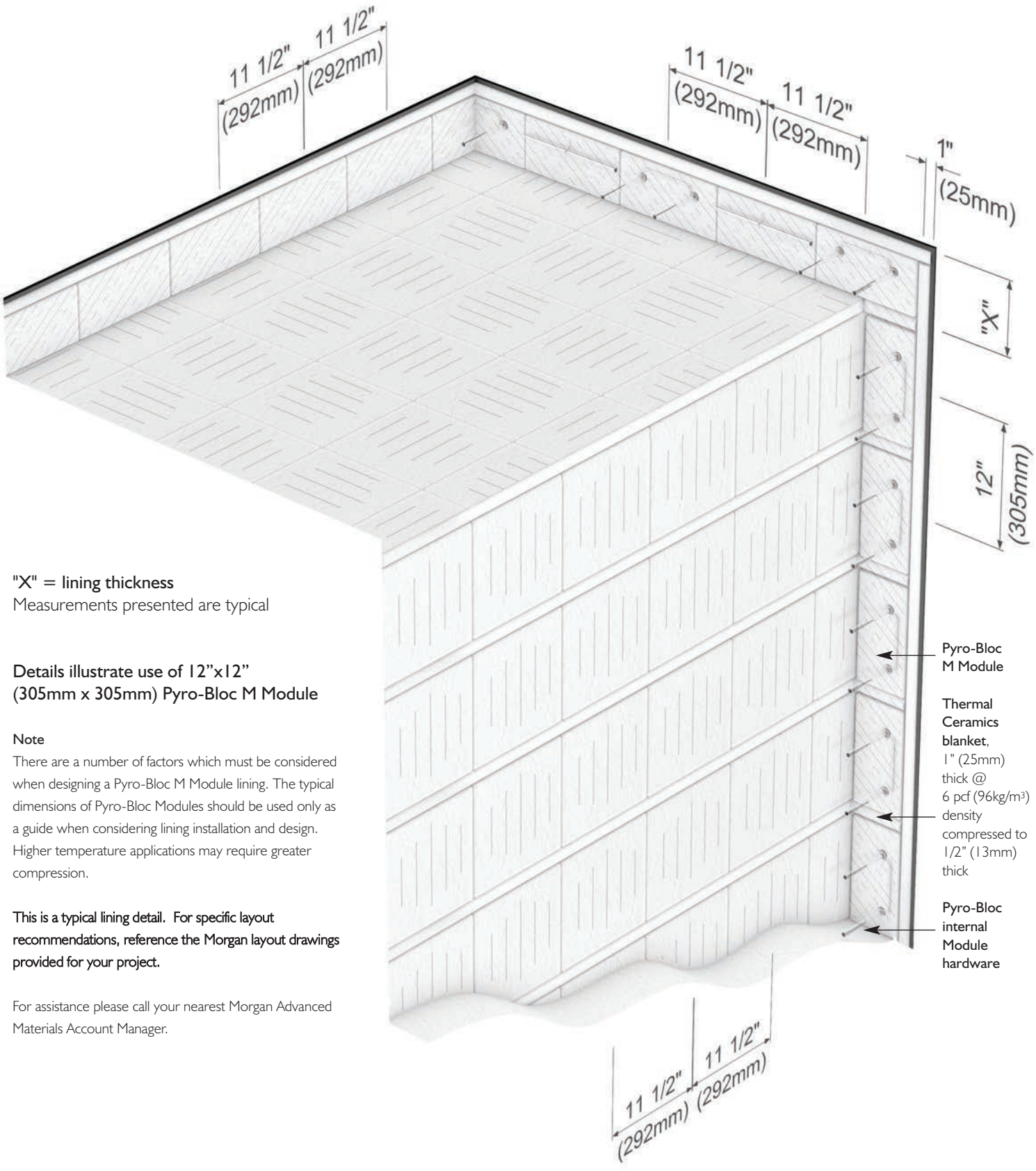


Pyro-Bloc M Modules are available in the following designs for single yoke, double tube, **X** (width) x **Y** (height) x **Z** (thickness):

X (width) x **Y** (height)

12 x 12 inch (305mm x 305mm)
6 x 12 inch (152mm x 305mm)
24 x 12 inch (610mm x 305mm)
8 x 16 inch (203mm x 406mm)
12 x 16 inch (305mm x 406mm)
12 x 24 inch (305mm x 610mm)
16 x 8 inch (406mm x 203mm)
16 x 12 inch (406mm x 305mm)
16 x 16 inch (406mm x 406mm)

Pyro-Bloc® M Module typical lining detail with Back-Up



"X" = lining thickness
Measurements presented are typical

Details illustrate use of 12"x12" (305mm x 305mm) Pyro-Bloc M Module

Note
There are a number of factors which must be considered when designing a Pyro-Bloc M 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.

This is a typical lining detail. For specific layout recommendations, reference the Morgan layout drawings provided for your project.

For assistance please call your nearest Morgan Advanced Materials Account Manager.

ABOUT MORGAN ADVANCED MATERIALS

Morgan Advanced Materials is a global engineering company offering world-leading competencies in materials science, specialist manufacturing and applications engineering.

We focus our resources on the delivery of products that help our customers to solve technically challenging problems, enabling them to address global trends such as energy demand, advances in healthcare and environmental sustainability.

What differentiates us?

Advanced material science and processing capabilities. Extensive applications engineering experience. A strong history of innovation and reinvention. Consistent and reliable performance. A truly global footprint. We find and invest in the best people.

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