THORPE PRODUCTS COMPANY

Typical Ceramic Fiber Module Questions & Answers

Last revised 09 Feb 2004

Thorpe Products Company:

1. Who is Thorpe Products Company?

   Thorpe Products Company is a distributor and fabricator of industrial insulation and refractory products. Thorpe Products is headquartered in Houston, Texas, and is a subsidiary of Thorpe Corporation, whose operations began in 1954. The Engineering Products division of Thorpe Products Company was organized to provide design, engineering, and installation supervision for direct material sales of Thorpe's large format modular system, tube seals, and other specialty refractory products.

2. What makes Thorpe Products different than other companies, which design and fabricate ceramic fiber module systems?

   Thorpe does not manufacture refractory ceramic fiber blanket. A thorough review of the customer specifications and design conditions allows Thorpe to select the appropriate materials from various suppliers to provide the best value in terms of cost and performance. Integrated module manufacturers have a "sell what we make" directive. In many cases, the best materials may not be available from one supplier. Thorpe takes a detailed engineering approach to each and every refractory application.

3. How long has Thorpe been producing ceramic fiber modules?

   Thorpe invented, patented, and started producing Z-Blok® I modules in 1976 and large format Z-Blok II® modules in 1981.

4. What type of module systems does Thorpe Products design and produce?

   Thorpe offers both the original Z-Blok® I module system (12" x 12" format) and the Z-Blok® II module system (up to 24" x 24" large format).

5. What type of experience and references does Thorpe Products offer?

   Thorpe has designed and installed hundreds of thousands of large format modules for most industries. A detailed listing of the equipment and customers served by Thorpe is available upon request.

6. What type of engineering and design does Thorpe Products offer?

   Thorpe offers custom engineered ceramic fiber and refractory heater linings primarily for the Chemical Processing and Hydrocarbon Processing Industry applications. They also offer custom engineered insulation and refractory accessories.

7. Does Thorpe engineer and provide penetration seals, burner tiles, peepsight surrounds, or any other accessories?

   Yes, Thorpe offers a wide range of refractory related accessory products. Thorpe has a completely integrated industrial sewing shop capable of manufacturing all types of penetration seals, removable insulation covers, etc.

Raw Material Sourcing and Manufacturing:

1. What is refractory ceramic fiber and how is made?

   Refractory ceramic fiber is manufactured by melting an appropriate blend of pure refractory oxide grains or kaolin clay in an electric arc furnace. A controlled stream of molten material pours from the bottom of the furnace into a fiberizing

machine. Two different types of fiberizing machines are used. The stream is accelerated by contact with either a series of high-speed spinning wheels (spun), or a high velocity jet of air (blown). In each case the viscous molten material is rapidly dispersed and accelerated in tiny high velocity molten droplets that stretch out and cool into long ceramic fibers that are collected in a bulk form. A portion of the molten material solidifies as a small bead called shot. Low shot content means better insulating value at a given density.

2. What are the differences between spun and blown ceramic fiber blanket?
   Because the rotating speed, diameter and spacing of the spinning wheels can be optimized, the spinning process affords better control over the physical characteristics of the resulting fiber. Spun fiber is typically longer, larger in diameter and contains less shot than its blown counterpart. Converted to needled blanket, spun fiber produces blanket that has a higher tensile strength, is more resilient and shrinks less than blanket made from blown fiber of the same chemical composition. The blowing process produces fibers that are shorter, smaller in diameter and often contain more shot. Thorpe uses spun fibers for all of its module production resulting in the strongest module on market.
3. What applications can ceramic fiber module systems be successfully used?
   Any applications which favor selection factors such as: temperature extremes, low thermal mass, lightweight, thermal insulation, thermal shock, resiliency, acoustical insulation, and installed cost are usually very good candidates for ceramic fiber.
4. What applications are not good for ceramic fiber module systems?
   Application which involve chemical attack, corrosion, mechanical abuse, or abrasion, must be reviewed very carefully when considering a ceramic fiber module system.
5. How does Thorpe specify and control quality of the raw material manufacturing?
   Thorpe issues detailed purchase specifications with technical requirements to all pre-qualified vendors. In addition, 3rd party laboratories often conduct final material testing.
6. What is the basic construction of the Z-Blok module and how is it manufactured?
   This is a serpentine folded blanket module system. The folds of blanket are pre-compressed and banded to the nominal installed density. Each module has at least two alloy beams, which impale and mechanically attach each fold to a stainless steel channel. All metallic hardware is located on the cold face. Please refer to brochure for schematic of the construction.
7. How does Thorpe identify or mark the individual modules?
   All items are located and described in the Bill of Materials as part of the detail engineering drawing package. The corresponding item number is marked on the cardboard packaging on each module.

System Design:

1. What are the advantages of ceramic fiber module systems versus traditional hard refractory systems utilizing insulating firebrick and/or castables?
   Fiber systems offer numerous advantages such as: lower installed cost, lower thermal conductivity, less weight, lower heat storage, faster installation, easier to repair, mechanical shock and vibration resistance, no heat curing or dryout.
2. What are the advantages of ceramic fiber module system versus layered ceramic fiber blanket?
   Module systems offer numerous advantages such as: uniformity of thickness, a more rapid installation, easier to handle and store, no exposed anchor system on

hot face, withstands higher gas velocities, increased service life, improved mechanical abuse resistance, and easier to repair.

3. What is the nominal module size and specification of the Z-Blok II system?
   The maximum standard size of this large format module system is 24" x 24" for wall applications and 24" x 12" for roof applications. All of our modules are offered in various sizes, thicknesses, and densities to meet customer or service requirements.
4. What air velocity can the Z-Blok II system withstand?
   The standard Z-Blok II modules are capable of withstanding 75-100 feet per second velocity (assuming no particulates) without special rigidizing consideration.
5. What if the air velocity is greater than that?
   For higher velocities, Thorpe engineering will consider the suitability and effectiveness of various rigidizers and coatings.
6. Can the Z-Blok II system be used as burner tiles and/or peepsight surrounds?
   Yes, it is very common to use folded blanket based construction for an integrated burner block or peepsight surround.
7. Because ceramic fiber shrinks at high temperatures, how does Thorpe engineer the large format modules to limit this problem?
   All refractory fiber shrinks with time at high temperatures and a well-designed module system compensates for this shrinkage through the effective use of compression. All joints between modules must be in tight compression. Compressed batten strips are used to offset shrinkage effects at the joints between soldier courses. The hot face of 24" modules may also be cut across the folds on 8" centers to more evenly distribute the shrinkage that would otherwise be concentrated at the batten strips that are 24" apart.
8. What is a back-up liner and does Thorpe recommend it?
   A ½" or 1" thick ceramic fiber blanket back-up liner has become standard throughout the industry. This back-up liner offers another layer of safety protection in the event a shrinkage gap develops between modules. The high strength of the standard Z-Blok hardware and fasteners made from 304 stainless steel can easily handle the higher interface temperatures. Other alloys are available depending on the application requirements. Thorpe recommends the use of a back-up liner on most applications above 1800°F.
9. Does Thorpe recommend a parquet or soldier course installation pattern?
   Thorpe engineers all our large format module systems using the soldier course style. This style gives the installation contractor the most flexibility on the anchor layout.
10. What is the typical lifespan of a Z-Blok installation?
    There is no absolute answer to this question because of the many variables that can positively or negatively affect any refractory lining. Many of the roofs Thorpe designed and installed in ethylene radiant heaters in the early 1980's are still in operation today. Original module linings installed in refinery heaters in the late 1970's are still in excellent condition today. When the lining has not been mechanically or thermally abused, established customers have come to expect a module lining designed and supplied by Thorpe to last 15 years or more.

Competitor's Comparison:

1. What are the advantages of the Z-Blok II system over competitor's 12" x 12" module systems?
   The Z-Blok II module system offers large format sizes, stronger hardware system and attachments, precompressed, improved installation efficiency, and custom engineered to exact fit. Other module manufacturers typically engineer and send large quantity of standard blocks requiring field modifications at all furnace discontinuities.
2. How quickly can Thorpe provide modules for an emergency?
   Every effort is given to meet the customer's requirements. Thorpe understands the costs associated with unscheduled downtime.
3. Why doesn't the Z-Blok II system use blind welds or anchors in the joints?
   The Thorpe Z-Blok II module system is the most mechanically reliable system available. Blind welds can not be tested prior to installing modules and are therefore unreliable. All Z-Blok II anchors can be visually and mechanically tested. Systems that untilize anchors in the joionts between modules are susceptible to failure from temperature exposure.
4. What happens if the Z-Blok system is soaked with water? Will the modules fall off the wall?
   Many of our roof and wall linings have gotten wet during routine maintenance. The period of time is relatively short and no damage was done. The water steams off during the first firing. The stainless steel hardware and fastener will not rust. With each fold of blanket mechanically secured, no folds will sag or droop down. Extreme situations where a thick roof may be wet for long periods of time may lead to the tearing of the heavy wet fiber from the hardware.

Installation:

1. Can Thorpe provide field installation supervision of the Z-Blok system?
   At customer's request, Thorpe can supply field supervision to assist installation. This service is extra and must be negotiated depending on work conditions.
2. How easy is the Z-Blok system to install?
   The system incorporates an engineered installation drawing and custom tools to assist installing the modules. Inexperienced crews can install modules, but the experience of an installation supervisor can increase the productivity and quality of the overall installation.
3. How easy is the Z-Blok system to patch if problems arise?
   If necessary, replacement modules can be identified and specified directly from the bill of materials on the Thorpe installation drawing. Typically, the only patching required is the routine packing of shrinkage gaps which is accomplished using folds of ceramic fiber blanket or pumpable.
4. How much field modification is needed during installation?
   Thorpe makes every attempt to eliminate or minimize field modifications. The detail drawings will show all appropriate furnace dimensions and discontinuities. The module system will then be designed for custom fit.