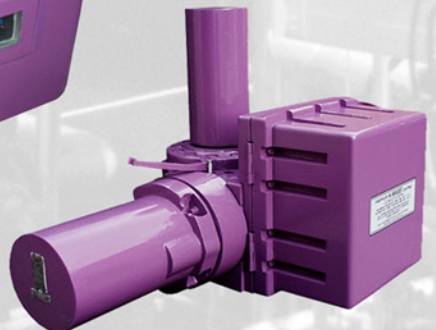
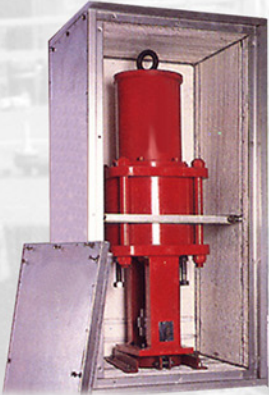


**T D THERMAL
DESIGNS®**

K-MASS®

**Passive Fire Protection
Solutions for
Critical Control Systems**



Why Passive Fire Protection of Critical Controls?

Passive Fire Protection is *risk minimization*. It is designed to reduce overall risk of loss (loss of availability, reliability, and resources) by providing specific, localized protection within the Fire Zone, *without* the instantaneous requirement for personnel or mechanical intervention.

Even after the most stringent Process Safety Management strategies and technology have been implemented, fire events occur. Human error, loss of product containment, and mechanical and electrical failure represent the majority of *risk* associated with Critical Control Systems failure in the Hydrocarbon Process Industry.

Passive Fire Protection of Critical Control Components represents the first step and the most reliable method of keeping risk at a manageable level by controlling losses. To reduce risk, "*Keep the Genie in the Bottle*".

After the fire starts and begins to consume the surrounding materials and product, the *heat flux* rapidly increases creating structural steel, vessel, controls, conduit, and piping failures allowing the "*Genie out of the Bottle*". Once the Genie is free, the fire consumes the plant, product, personnel, and profits.

Will the next fire be a flash fire quickly extinguished or a catastrophic loss?

Why K-Mass®?

Specifically designed and formulated for Critical Control Components, K-Mass® has become the preferred choice of protection based on performance. K-Mass® provides superior insulation characteristics in high *heat flux*, rapid temperature rise hydrocarbon fires by maintaining cooler surface temperatures, lower heat transfer rates, and cools the components in sudden ambient temperature increases to 1093°C / 2000°F.

The moldable intumescent, chemically inert compound becomes reactive in the presence of heat, expanding to many times its original size as it develops the insulating char that inhibits Critical Control Component temperature rise. This pyrolytic reaction shields wire insulation, solder connections, circuit boards, terminal blocks, relays and metallurgy allowing the Critical Control Components to operate during the fire.

The maintainability of the valve, actuator or Critical Control Component requires no separate motions or tools. Since the K-Mass® is molded to each individual exposed non-sacrificial part, the K-Mass® is removed with the component part. There are no additional labor or inspection costs to be added to the procured cost of the Passive Fire Protection.

K-Mass® and its application are tested in accordance with the 60,000 ± 5000 BTU/hr/ft² heat flux, UL 1709 Rapid Rise Fire Test of Protection Materials for Structural Steel. Structural steel fire test temperature criteria are less stringent than the pass/fail criteria of Critical Control Components. Some structural steel loses up to 50% of its strength at temperatures below 440°C/824°F, temperatures well above the failure point of electrical and electronic equipment, and metallurgy used in the manufacture of components for Critical Control Circuits.

The ability of process controls to operate, while the fire location is identified, decisions are made, and corrective action taken is the critical function in *minimizing* the size and *effect* of a hydrocarbon fire. K-Mass® provides the time to allow these activities to be successfully undertaken saving; property, processes, products, personnel and profits.

Why Thermal Designs, Inc. ?

As a leader in the development of Passive Fire Protection Products for the Hydrocarbon and Chemical Process Industries, Thermal Designs, Inc. has researched and tested hundreds of materials enabling the offering of the current Passive Fire Protection Solutions. Quality and Craftsmanship are synonymous in the design and manufacture of our products. 23 years of experience have led the serious Fire & Safety professionals to Thermal Designs, Inc. in search of long term, reliable, low cost solutions for passive fire protection.

Registered and Trade Named Products, K-Mass®, Fireproof Enclosures™, K-Guards™, Ceramic Fiber Liners, and K-Cabs™ are manufactured at facilities in Corsham, Wiltshire, UK, Houston, TX, and Alberta, Canada for delivery anywhere in the world. Products have been "*Real World*" fire tested as well as laboratory Explosion, Jet Type and Hydrocarbon Pool Fire tested and / or certified to UL 1709, by Bureau Veritas, Faverdale Technology Centre, Sintef of Norway, and Southwest Research Institute.

Thermal Designs, Inc. is not only a manufacturer of passive fire protection; it is also a distributor of Pyrotenax Power and Communication Cable and the 3M-product line of Endothermic Mats and Caulks. Why is TDI the preferred provider of Critical Control Circuit passive fire protection? TDI is the "*One Stop Shop*" for "*Tested Solutions*" applied to Critical Control Components from Actuators through Valves and all the operational equipment in the Fire Zone.

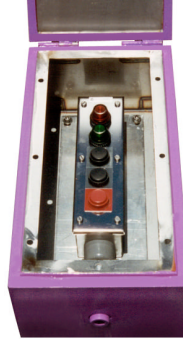


K-MASS® "Keeps the Genie in the Bottle"



K-Cabs™

K-Cabs™ are custom designed and fabricated K-Mass® coated, stainless steel, instrument and electrical component cabinets. K-Cabs™ are tested to provide a minimum of 30 minutes of protection in a 1093°C/2000°F Hydrocarbon Fire. The cabinet is designed to NEMA -4X requirements, which allow for mounting of non-arcing or sparking electrical components and terminal strips within the cabinet. K-Cabs™ have been installed in many major Oil Producers' facilities in hazardous zones or locations.



Application Data

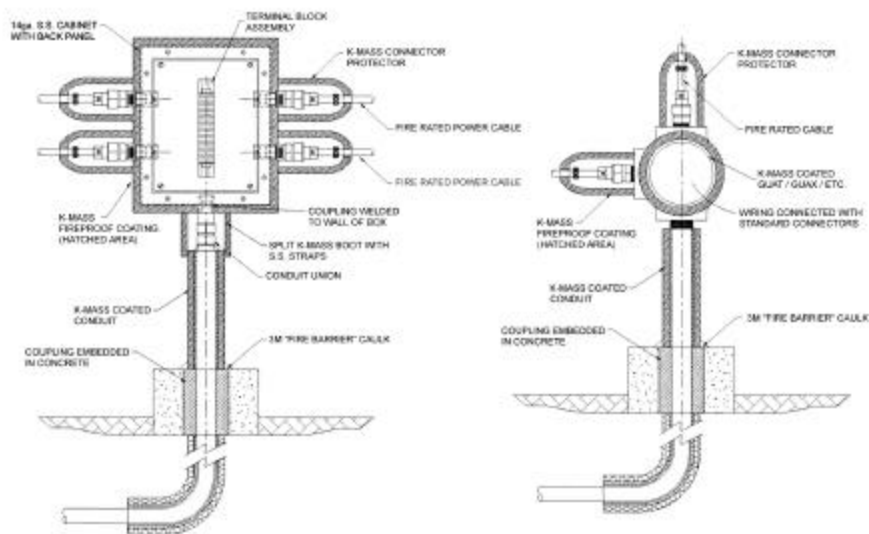
K-Cabs™ have few restrictions in their design and application. Each application is custom designed to meet the space, mounting, connection, and equipment layout requirements of the specified application. A dimensioned drawing or sketch of the required components with orientation for mounting and equipment to be protected is required for accurate product quotation. Drawings are submitted for approval after receipt of purchase order.

Features of Construction

- Wall, Stanchion, or Actuator Mounting
- All 304 SS Welded Construction
- Reinforced Panel Construction
- Welded Full and Half Couplings
1/8" to 3" Rated 150 or 3000 psi
- Hinged or Threaded Fastener Cover
- Protected to 1093°C/2000°F for 30 Minutes
- Available with or without Internal Mounting Plate
- Intumescent Glass *Optional*
- Phenolic or SS Tags
- Installation of Hydraulic, Pneumatic or Electrical Components
- Extended Push Buttons

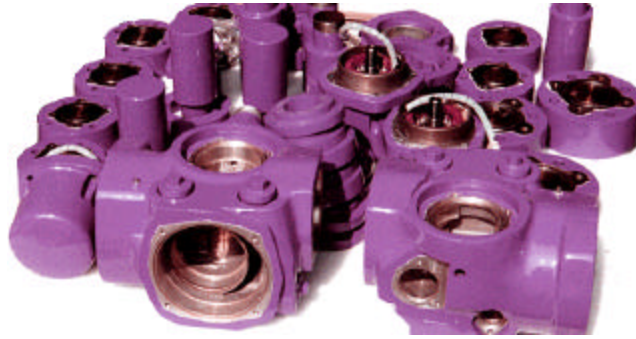
Benefits

- Can be Installed in any Orientation or Location
- Durable Corrosion Resistant
- Prohibits Oil Canning
- Allows Connection of Pipe, Conduit and Tube Fittings for Electrical, Hydraulic or Pneumatic Components
- Conforms to Installation Application Standards
- Meets or Exceeds UL 1709 Fire Test Requirements
- Can be utilized for Mechanical or Electrical Components
- Permits Viewing of Gauges and IR Communication
- Identifies Instruments and Provides Instructions
- In Fire Zone, Protected Instrument Enclosure
- Permits Instant Control Access without Opening



K-Mass® Intumescent Coating The “People Proof” Solution

K-Mass® is molded to each removable component part of an Actuator, Switch, Conduit Fitting, Junction Box or other Critical Control Component. This feature allows the coated item to be *field maintained* without additional maintenance or repair costs associated with insulation based Passive Fire Protection products.



The process of K-Mass® Coating is an arduous one that provides superior operating success in “Real World” fires. Fire Safety is Life Safety, economic and human. When considering the selection of the best materials and methods of protection a number of criteria must be examined including: Adequate testing for application? Projected product life? Cost of operation and maintenance? Ease of installation? Replacement cost of inventory, equipment, or facility? These points require review prior to Passive Fire Protection material selection.

Pre -Fire



Post Fire



Post Fire Inspection



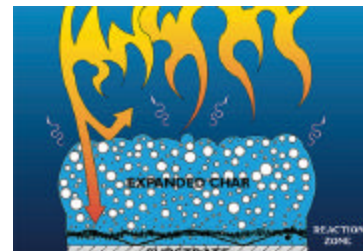
Features

- Chemically Inert
- No Interference with Local or Remote Controls
- Tested to Rigid Standards
- Provides 30 Minute 2000°F Protection of Electronic, Pneumatic & Hydraulic Equipment
- Segment Molded Coating
- Fixed Passive Fire Protection

Benefits

- Adds nothing to the fire
 - Original Equipment Design Features available and intact.
 - Exceeds ANSI/API 607 and UL 1709
 - Can be applied to all components in the Critical Control Circuit.
 - Total access to any component part without removal of the fire protection “ People Proof Design”
 - Always there when needed
- Requires minimum space to accommodate
No installation cost

HOW K-MASS® WORKS



Fire Starts

Upon exposure to fire, K-Mass® begins to intumesce in response to the heat by beginning a process of evaporative cooling and charring on the surface of the coating.

Short Term Exposure

The surface char deepens in successive layers filling voids, insulating the equipment, cooling and reflecting the heat back into the fire.

Long Term Exposure

As the heat penetrates these charred layers, more foaming, filling, and charring occurs with a subsequent release of moisture which cools the substrate. The process continues until the fire is extinguished or the material is consumed.

A K-Mass® Advantage

Insulation vs. Intumescent

The success of insulation type passive fire protection methods at reflecting heat away from the materials being protected also enables the heat of operation to build up inside the protected component. The K-Factor of K-Mass® is 5 compared to the K-Factor of 1 for ceramic fiber insulation. This would indicate that if retained heat and temperature rise or maximum surface temperature are of concern, specification of K-Mass® as the proper fireproofing material is critical “to plant safety” applications and long term safe equipment operation.



Insulation Blanket



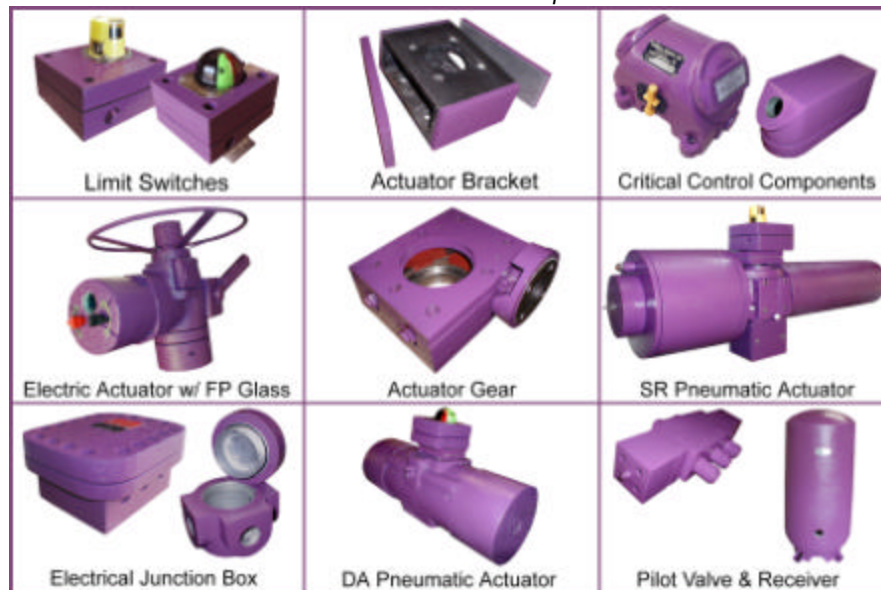
Insulation Enclosure



K-Mass® Coating

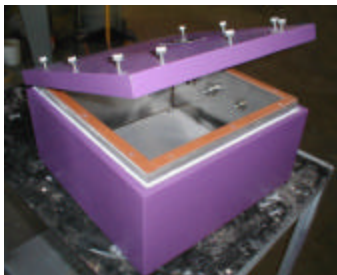
Insulation materials protect by *Thickness* inhibiting conduction; intumescent materials protect by endothermic *Chemical Reaction*, heat absorption, evaporative cooling, and reflection. Insulation is subject to break down under vibration and the elements. Differing rates of thermal expansion can cause seams to open, creating a loss of fireproofing integrity. Once the seams are opened a hot damp environment is created, providing an ideal atmosphere for corrosion. K-Mass® is anchored to the substrate and molded to a specified thickness providing corrosion protection as well as fireproofing. During a fire K-Mass® intumesces, closing the Flame Paths, blocking the heat and flame away from the temperature sensitive protected components.

K-Mass® Protects Critical Control Components in the Fire Zone



Application Data

K-Mass® is an intumescent molded on protective coating, which can be bonded to a wide array of substrate materials. There are few restrictions to the surface or size of the equipment to be covered. Each exposed component part of the protected device is coated assuring fire protection regardless of the fire source. Equipment manufacturer, model number, and part number or dimensional drawings with accessories are required in order to provide a cost evaluation and product recommendation. Windows manufactured of Intumescent Glass, providing visual or IR access, can be located in the K-Mass® coating. Touted by end users as the best Passive Fireproofing material due to it's *in fire* insulation characteristics and People Proof “**always there**” dependability, K-Mass® is also regarded as a manageable, light weight solution for on and offshore applications.



K-Guard™ Passive Fireproofing Covers

K-Guards™ are custom designed and manufactured Passive Fire Protection covers that allow field fit to existing Critical Controls. Constructed from cast K-Mass® and tested to the rigorous conditions of a UL1709 Fire Test, K-Guards™ allow the protected equipment to operate and survive in exposures in excess of 1093°C/2000°F for 30 minutes. Levers and wheels extend outside the covers permitting operation without removal of covers. K-Guards™ reduce the cost of fireproofing electrical, hydraulic and pneumatic controls allowing refit to meet new API or insurance carrier requirements.



K-Guardä Removable Covers

Features

- Split Cover ClamShell Design
- Fire Tested to UL 1709
- Sealed Flame Paths
- Exceeds API 607 Test Temperature Criteria
- 304 SS Latches, Hinges and Captive Fasteners
- Fireproof Glass Windows

Benefits

- Easy Maintenance Access to Protected Equipment
- Able to withstand 1093°C/2000°F Hydrocarbon Fire
- Protects Component from Over Temperature
- Acceptable for Fire Safe Leak Tight Application
- Complete Corrosion and Fire Proof System
- Allows Testing without Removal of K-Guard™

K-Guard™ Critical Control Component Covers were tested to 1093°C/2000°F for 30 minutes: the valve maintained its operating characteristics throughout the test. This test exceeded the requirements of API 607 as documented in Southwest Research Institute Report 6-302.

FIRE TESTED MATERIALS

Passive Fire Protection Materials are tested to many different standards by many different methods. The real criterion for fireproof rating is test conditions to equipment failure under projected fire conditions. Be it Jet Fire, Pool Fire, or Pit Fire the pass failure criteria is the functional time gained for operations to isolate and remove the fuel from the fire allowing the processes to be controlled in an otherwise uncontrollable situation. Fire Testing is the only proof of valid exposure ratings. K-Mass® and K-Guards™ have undergone extensive testing allowing the coating thickness to be designed to the required fire rating.



Hydrocarbon Pool Fire



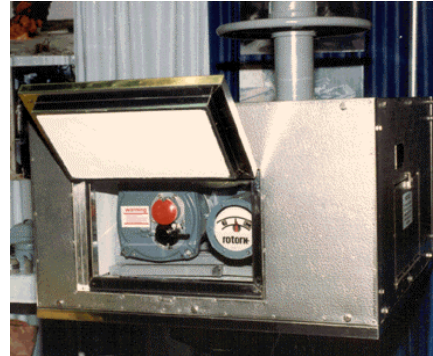
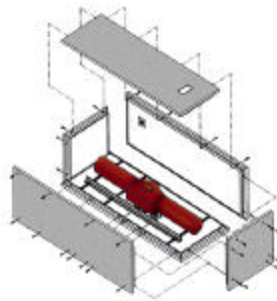
Gas Fired Furnace



Tested to Survive

Fireproof Enclosures™

Fireproof Enclosures are Custom Designed to provide 30 or 60 minutes of protection in 1093°C/2000°F Hydrocarbon Fires. Originally produced in 1979 the latest designs are optioneered to provide maximum flexibility of installation and maintenance while providing superior Fire Protection and greater product life than any other insulation type removable Passive Fire Protection in the market.



Application Data

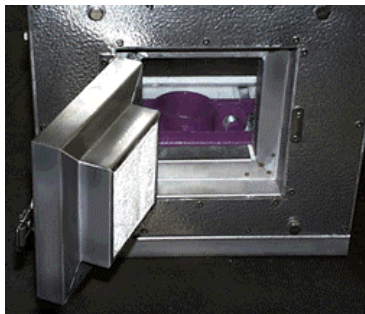
Fireproof Enclosures™ are Custom Designed, Captive Ceramic Fiber Insulated, Field Removable, Passive Fire Protective Enclosures. Only the item to be protected limits the product size. Traditionally specified to protect Valves, Actuators, Instruments and Electrical Panels. Fireproof Enclosures™ can be used anywhere a rigid, corrosion and impact resistant product is preferred. Fireproof Enclosures contain no asbestos.

Features of Construction

- Base, Valve, or Actuator Mounting
- All 304 SS Welded and Gusseted Construction
- Step Joint Design
- Welded Pass Thru Connections
1/8" to 3" Rated to 150 or 3000 psi
- Hinged Doors
- 304 SS Sheath Exterior
- Intumescent Glass *Optional*
- Phenolic or SS Tags
- Extended Push Buttons
- Protected to 1093°C/2000°F for 30 Minutes

Benefits

- Can be Installed in any Orientation or Location
- Durable, Corrosion Resistant
- Seals Out Flame Paths
- Allows Connection of Pipe, Conduit and Tube Fittings
- Allows Access to Operators for Adjustments
- Superior Chemical, Impact, and Moisture Protection
- Permits Viewing of Gauges and IR Communication
- Identifies Instruments and Provides Instructions
- Permits Instant Control Access without Opening
- Meets or Exceeds UL 1709 and ANSI/API 607 Fire Test Requirements



Fireproof Enclosure™ Door
Hinged Step Joint Design provides access to equipment and seals the flame path in the event of fire.



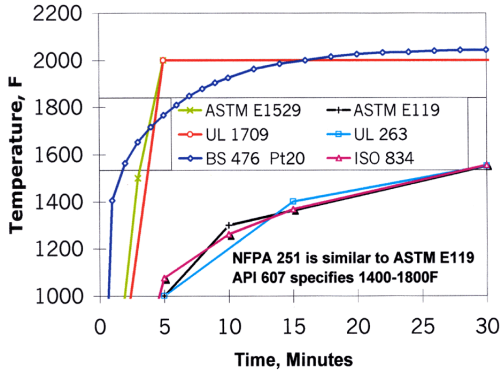
Enclosure Frame
Welded interlocking panel frames in a multitude of sizes allow enclosures to be manufactured in any size desired.



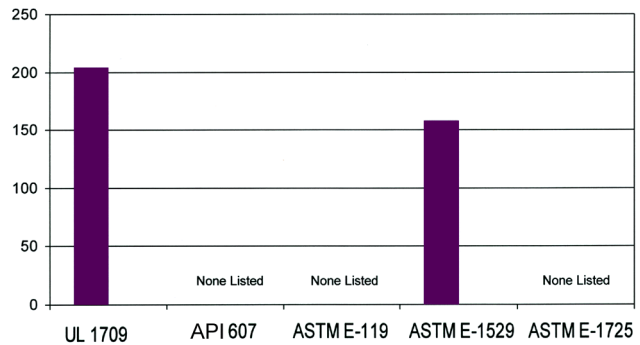
Custom Fitting Connections
A variety of welded stainless steel pass throughs and connections are available for hydraulic, pneumatic or electrical connection.

Product Tests, Characteristics and Standards

Flame Temperatures of Various Standards



Heat Flux of Various Fire Tests in kW/m²



Why UL 1709?

There are many industrial fire test standards. Determining which are applicable and which are not can be a dilemma for the design, safety, and engineering professional. Which to use when? API 2218 is a comprehensive source of information on Fireproofing Practices in Petroleum and Petrochemical Processing Plants. However the option of what to use where is up to the purchaser. Let the buyer beware. At Thermal Designs, Inc. we have solved the issue of which tests for what by examining how a fire starts, what contributes to an explosion, and what happens after the explosion. We believe that most hydrocarbon fires can be managed by reducing the fuel leg of the fire triangle. This logic dictates that the Critical Controls must perform in "Real World" fires. The UL 1709 Rapid Rise Fire Test although designed for structural steel represents the "Real World" Flame Temperature and Heat Flux that can be expected in any Hydrocarbon Fire. UL 1709 provides the test criteria; Thermal Designs, Inc. provides products allowing the 30 minutes to find the fire, determine the corrective action and bring the fire under control; good engineering practice will allow diverting or de-inventory of fluids enabling active protection methods to extinguish the flames.

Material Properties of K-Mass®

Physical

| Test | Value |
|--|---|
| Density | ASTM D-792 1353.5 kg/m ³ 84.5 lb/ft ³ |
| Thermal Conductivity | ASTM C-177 0.29 W/m°C 2.03 BTUin/ft ² -hr°F |
| Coefficient of Thermal Expansion | ASTM D-695 -11°C to 31°C 60,7 x 10 ⁻⁶ cm/cm°C 12°F to 91°F 33.7 x 10 ⁻⁶ in/in°F |
| Maximum Continuous Service Temperature | 85.6°C/185°F |
| Permeability | |
| Gas (GTR) | ASTM D-1434 0 |
| Water (WVT) | ASTM C-355 0,06 g/m ² -h 0.09 grains/ft ² -hr |
| Color | Gray |

Chemical and Corrosion Resistance

| | | | |
|---------------------------|------------|------------------------------|------------------------|
| Salt Fog | ASTM B-117 | 2000 Hours | No Effect |
| Bases | | | |
| 20% Potassium Hydroxide | Submersion | 24 Hours | No Effect |
| 50% Sodium Hydroxide | Submersion | 24 Hours | No Effect |
| 100% Ammonium Hydroxide | Submersion | 24 Hours | No Effect |
| Acids | | | |
| 20% Sulfuric | Submersion | 24 Hours | Slight Darkening |
| 30% Hydrochloric | Submersion | 24 Hours | Slight Darkening |
| 50% Hydrofluoric | Submersion | 110 Hours | Slight Softening |
| Concentrated Hydrochloric | | | Moderate Darkening |
| Temperature Cycle | 12 weeks | 18°C to 60°C 0°F to 140°F | No Effect No Effect |

SEE WEB SITE FOR FURTHER DETAILS

Mechanical

| Test | Value |
|----------------------|---|
| Tensile Strength | ASTM D-638 > 188 kg/cm ² > 2600 psi |
| Compressive Strength | ASTM D-695 > 656 kg/cm ² > 9300 psi |
| Impact Strength | ASTM D-256 0,11 J/cm of notch 2.4in-lb/in of notch |
| Hardness | Shore D > 75 |
| Bond Strength | ASTM D-1002 > 113 kg/cm ² > 1600 psi |
| Shear Strength | ASTM D-1002 > 93 kg/cm ² > 1300 psi |

Material Properties of Fiber Insulation

| | |
|---|--|
| Average Density | 240.7 kg/m ³ 15 lb/ft ³ |
| Compressive Strength | 5.94 kPa 1240 lb/ft ² |
| K-Value at 2000°F | 1.26 |
| Melting Point | 1810°C 3200°F |
| Continuous Use Temperature | 1364°C 2300°F |
| Ceramic Fiber is Asbestos Free | |
| Excellent Chemical Resistance to Bases and Weak Acids | |

**SEARCHING FOR PASSIVE FIRE PROTECTION SOLUTIONS?
FOR FURTHER INFORMATION PLEASE CONTACT US AT ONE OF THE FOLLOWING LOCATIONS.**

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Houston, TX 77045
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Fax: (001)* 713-433-5227
E-mail sales@tdius.com

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Devizes, Wiltshire
England SN 10 5RQ
Phone: (44)* (0) 1380-816079
Fax: (44)* (0) 1380 813394
E-mail sales@tdiuk.com

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