



Expo – Removable/Reusable Competition

Written Test Study Guide

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Brief History of R/R Insulation Blankets

Removable/Reusable (R/R) Insulation Blankets were first used by the Marine Industry in the early 20th century. Navy and Coast Guard vessels, as well as commercial ships around the world, used R/R insulation blankets to insulate equipment in their engine rooms to reduce noise and heat to make these areas more people friendly and a safer place to work. Fiberglass and high purity silica replaced asbestos as the primary material used to make R/R insulation blankets in the early 1970's as a result of the health issues associated with asbestos.

Starting in the late 1970's, when energy prices skyrocketed, industrial plants also started using R/R insulation blankets on their "high maintenance, high temperature" equipment as a way of reducing their energy cost. At about this same time, safety became a more important issue with industrial and commercial facilities. Safety engineers were hired by many industrial and commercial plants as a result of the Federal Government's Occupational Safety and Health Administration's (OSHA) increasing pressure to insure safe working practices.

Applications

Today, R/R insulation blankets are a very cost effective way to insulate high maintenance equipment that operates at temperatures above 140 degrees F., or have noise levels above – decibels. These are the US government's recommended maximum safe levels of operation for equipment in the workplace. At the same time, small, medium and large high maintenance equipment operating above 250 degrees F. will yield a "Return on Investment" (ROI) for R/R insulation blankets to a user of less than one year. This means that if an end user invests \$1,000 to insulate the high temperature equipment, the user will get their \$1,000 repaid in energy savings in one year and still have the insulation saving them money in the future.

Applications for R/R insulation blankets are found in most industrial and commercial facilities around the world. Applications include any high maintenance, high temperature or high noise piping, valves, fittings and equipment found in just about every heavy commercial and industrial facility. Industries that have the largest number of applications for R/R insulation blankets include oil refiners, chemical and petro-chemical plants, pulp and paper mills, textile mills, steel and aluminum manufacturing plants, mining facilities, food processing plants, automobile and automotive plants, aircraft and aerospace plants, military and commercial marine, and power generation facilities, to name a few.

In nuclear power generation, the US Government's Nuclear Regulatory Commission (NRC) has guidelines that must be met for all forms of insulation, including R/R insulation blankets, to insure that corrosion problems do not exist. This standard is called NRC 1.36. In industry and the military, the insulation corrosion resistant standard is called Mil I 24244. The Coast Guard, US Military and many industrial end users' standard for needled fiberglass felted blanket insulation is USCG 16411. This specification insures the quality of the product is being met. The Coast Guard and many US military facilities require that Mil C 20079 G is met for fabrics, thread and tape before the materials can be used to construct R/R insulation blankets.

Materials

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Fabric Materials Hot Face, Cold Face, Gussets

Silicone Rubber Coated or Impregnated Fiberglass & Silica:

A Silicone rubber coated or impregnated fiberglass & silica fabrics are designed for maximum use to 500 degrees F. The silicone coating is used to weatherproof the reinforcing fiberglass or silica fabrics and core blanket insulation from moisture or getting wet. In addition, the silicone

coating protects the R/R insulation blanket from light chemical attacks. Special care should be exercised with silicone coatings operating at temperatures above 700 degrees F. Silicone can, under certain conditions, become flammable and ignite. This will usually cause the coated fabric to fail or much worse if on critical equipment. A silicone coated/impregnated silica fabric is sometimes used as a weather barrier fabric in very hot applications. The high purity silica fabric maintains better tensile strength if the silicone is accidentally burned off. A typical application for using a silicone coated silica fabric would be as a cold face fabric for a blanket for an engine exhaust system.

PTFE or Teflon Impregnated Fabrics & Films:

PTFE or Teflon (E. I. DuPont's trade name for their PTFE) is a high temperature thermoplastic that is finely milled and emulsified so it can be impregnated into fabrics and made into films. The maximum use temperature for PTFE fabrics and films is 550 degrees F. There are PTFE impregnated fiberglass and amamid fabrics and pure PTFE films that are designed and best applied in high temperature, R/R insulation blanket applications where hostile chemicals are present. PTFE is the most "inert" (Resistant to Chemical Attack) high temperature coating that can be applied to a fabric and made into films. Typical applications for PTFE impregnated fiberglass fabrics and films include areas where strong acids and alkalines are present. PTFE films are used in the most severe chemically hostile applications. Also, due to its non-stick property, PTFE impregnated fabrics and films can be more easily cleaned than other types of coated fabrics. Unlike silicone rubber, PTFE is not flammable under most conditions at high temperatures. This non-flammability property makes PTFE impregnated fiberglass or high purity silica fabrics a much better choice when needing a coated fabric as a weather barrier in applications above 500 degrees F.

Other Coated Fiberglass or Silica Fabrics:

There are many different coatings that are applied to fiberglass and silica fabrics for use in industry. However, other than silicone rubber and PTFE, impregnating fiberglass and high purity silica, Vermiculite or Latex has the most use as applied to R/R insulation blankets. A very low density, wash coating of Latex is sometimes used as a weave set and aid in holding the fabrics together during fabrication. Latex will burn off at temperatures above 300 degrees F. Vermiculite is used for doing the same job as Latex for applications above 300 degrees F. to 1500 degrees F. The high temperature Vermiculite coating is also a better conductor of heat than either the fiberglass or high purity silica fabric. This property allows the heat to transfer throughout the coating first keeping the fiberglass fabric temperature lower for some applications. A high degree of care should be exercised when using a Vermiculite coated or impregnated fiberglass fabric for R/R insulation blanket applications. The Vermiculite coating "will not" increase the fabric use temperature above the normal use temperature of fiberglass when used as the hot face material for R/R insulation blankets.

Fiberglass and High Purity Silica Fabrics:

E Type fiberglass fabrics are well suited for making R/R insulation blankets because this material is widely available, inexpensive, lightweight, has high temperature properties, has very good tensile strength, and is made into a wide variety of weights, thicknesses and widths. The fiberglass fabrics that are used for making R/R insulation blankets are manufactured using an extruded, non-respirable, type E fiberglass yarn and then woven into a variety of extremely flexible fabrics. Fiberglass retains about 70% of its strength after use at 500 degrees F., 50% of its strength after use at 700 degrees F., and 10% of its strength after use at 1000 degrees F.

Using a type 304 stainless steel blanket mesh should seriously be considered when the R/R insulation blanket application goes above 500 degrees F. due to tensile and abrasion strength losses. Type E fiberglass has reasonably good chemical resistance, however, has serious problems with elevated alkaline or caustic materials. It must be completely investigated to insure that the untreated or uncoated fiberglass fabric being used to make the R/R insulation blanket is chemically compatible with the application.

High purity (96% and above) silica fabrics should be strongly considered when applications temperatures exceed 700 degrees F. These fabrics will retain most of their original tensile strength after use at 1000 degrees F. and better than 50% after use at 1300 degrees F. The high use temperature is around 1800 degrees F., however, retains very little tensile or abrasion strength and has a melt point around 3000 degrees F. Due to the lack of abrasion resistance with these fabrics, stainless steel blanket mesh should be considered for all applications. Like E type fiberglass, high purity silica fabrics have problems with high alkaline or caustic materials.

Laminated Fabrics:

Aluminized polyester laminated to fiberglass fabrics are an effective way of making reasonably high temperature fabrics that both look good and are very cleanable. They also make a reasonably good vapor barrier where applicable. The maximum temperature limit of 300 degrees F. for polyester is the main drawback to this fabric for R/R insulation blankets. This product's main use as applied to R/R insulation is in the marine industry as the weather barrier fabric.

Aluminum foil laminated to fiberglass has been used in the US Coast Guard and Navy for many years as flange spray shields and for R/R insulation blankets. This material must meet Mil C 20079 before it can be used by the military. The temperature limit is 300 degrees F. The industrial plants started using this material for R/R insulation blankets with a high temperature adhesive (500 degrees) with single and multiple plies of 1 mil aluminum foil laminated to a fiberglass fabric. The temperature limit for this upgraded fabric is 500 degrees F.

Blanket Mesh:

Blanket mesh should be a consideration for many applications and certainly when the temperature is above 500 degrees F. Blanket mesh is used as a coat of armor for the R/R insulation blanket, located on the outside of the weather barrier fabric and inside of the hot face materials. Blanket mesh helps reinforce the tensile strength and adds abrasion resistance to both the hot face and cold face fabrics.

Blanket mesh is a circular knitted, stainless steel wire mesh that is made for R/R insulation blankets in a few grades of stainless steel, diameters and wire thicknesses. The most common blanket mesh material is 304 SS, 0.011" wire diameter. Blanket mesh also comes in 316 SS wire for high corrosion areas and inconel wire for temperatures above 1200 degrees F. The circular knitted blanket mesh is also available in 0.008" & 0.0095" wire diameters and circular widths of 12", 18", 24", 30" and 42" in diameter. A 12" circular diameter can be cut and opened up to 24" flat width, the 18" circular to 36" flat, 24" circular to 48" flat, 30" circular to 60" flat, and 48" circular to 96" flat width. Most blanket mesh is available in 60 density (60 holes/sq. in.), however, other densities are available.

Blanket & Foam Insulation Materials

Needle Felted, Type E Fiberglass Blanket:

This material is the most commonly used core blanket insulation for R/R insulation blanket applications with temperatures ranging from 250-1200 degrees F. This blanket material starts out as extruded 6-13 micron diameter, type E grade fiberglass yarn. The yarn is then chopped to 2" average fiber lengths and opened (fluffed) so it can be further processed into a needled blanket. Starting as an extruded, 6-13 micron yarn insures that this blanket material is non-respirable and is safe to handle. The chopped and fluffed yarn is then laid out and needle felted together using zero resinous or organic binders. This insures a low smoke startup and because the blanket is needle felted together, the blanket will hold its thickness and shape after use at high temperatures and many cycles of removing and reinstalling the R/R blanket. One last feature is that because the fiber is extruded, this product has zero shot (material that didn't fiberize) and is ideal for use on high temperature/high vibration equipment.

This blanket is available in 6 lb. and 10-12 lb. density, a variety of thicknesses ranging from 1/8"-1-1/2" and custom widths. However, the most commonly used blanket meets the US Coast Guard 16411 specification, which is 60" wide, 10-12 lb. density, and 1/4", 1/2" and 1.0" thicknesses.

Needle Felted Silica Blanket"

This needle felted high purity silica blanket is most commonly used in very high temperature (1200-1500 degrees F.) R/R insulation blankets where there is high vibration present. This blanket is made from an extruded 6-9 micron thick, non-respirable, 96%-98% pure silica yarn. It is then processed in a similar way to the needle felted, type E. fiberglass blanket using zero resinous or organic binders. Due to the high price of this product, 1/4" and 1/2" thick needle felted silica blankets can be needle faced to the type E fiberglass blanket to achieve better economics. A typical application for this material would be an engine exhaust system. This is due to the very high temperature and vibration present.

The high purity silica blanket is available in a variety of thicknesses ranging from 1/8" – 1.0" and widths ranging from 24" – 60". The densities are standard in 6 lb. and 9 lb. density.

A composite of type E fiberglass and high purity silica fiber blankets are being needle felted together into a variety of customer thicknesses, widths and roll sizes. New Product

Ceramic Fiber Blanket:

Ceramic fiber blanket has been used in making R/R insulation blankets for a long time. This is an inexpensive, high temperature blanket that is available in a variety of densities, thicknesses, and widths. This blanket is made by melting a recipe of ceramic and either blowing or spinning this molten material into a fiber through a process that is very similar to make cotton candy. The fiber is then collected and needle felted into a blanket. The major problems with ceramic fiber blanket as applied to R/R insulation blankets are that the fiber is respirable and the blanket has a high percentage of shot. This blanket thickness will collapse in high vibration applications. The good points are the price, available, and high temperature use limit.

Ceramic fiber blanket is available in 4 lb., 6 lb. and 8 lb. densities as standard and heavier custom densities when required. This blanket comes standard in 24" and 48" widths and 1/4",

1/2", 1.0", 1-1/2" and 2.0" thicknesses as standard. Ceramic fiber blanket also comes in a few different material recipes that yield temperature use limits of 1800-2800 degrees F. ranges.

Fiberglass with Organic Binders:

Low density fiberglass blanket is used to make R/R insulation blankets in low temperature applications (below 250 degrees F.) and in higher temperature applications when used in combination with another high temperature blanket on the hot face. This blanket is inexpensive, has good insulation properties and holds its density if the organic binder is not burned off.

This blanket is available in a variety of densities, thicknesses and widths from most local insulation distributors.

Flexible Foam Insulation:

Flexible closed cell Poly foam insulation can be used in cold and hot applications with a temperature range from -100 to +250 degrees F. These products are flexible, closed cell insulations that do not require fabrics to waterproof or to create a vapor barrier. Applications include hot water along with chilled refrigerated equipment. In addition, instrument freeze protection requiring low temperature tracing is a potential application.

Flexible closed cell silicone foam insulation can be used for hot and cold applications from -150 to +450 degrees F. temperatures.

Both poly and silicone foams are available in a variety of thicknesses and sizes.

Seam Materials Threads & Staples

Fiberglass Threads:

Plain (uncoated) and PTFE or Teflon coated fiberglass threads have been used in marine and industrial applications for over 40 years. It was first used in marine applications and other government requirements. The most popular product is manufactured to the Mil C 20079 G specification, which calls for a 25% by weight PTFE coating to the type E fiberglass thread. The PTFE coating acts both as a sewing lubricant and protection from chemical attack. This product is also available and popular with an additional silicone lubricant to aid in sewing and fabrication. The temperature use range is from -100 to +700 degrees F. for this product. Caution should be used in applications where an elevated amount of caustic is present. Fiberglass threads are available in a variety of thicknesses, strengths, yields and coatings.

Stainless Steel Threads:

Stainless steel (SS) threads have been around for industrial and military applications for the past 20-30 years. SS threads that can be easily machine sewn and also have good strength after use at elevated temperatures are relatively new. Multiple filaments numbers of 0.0017"-0.002" 304 SS, 316 SS and inconel wire is combined with a carrier thread (Kevlar, Nomex, Polyester, Nylon, etc.) to enable metal wire to be sewn. The temperature limits range from -200 to +1500 degrees F. for SS sewing threads. These threads can also be used in a chemically hostile application as the wire allows.

Kevlar Threads:

Kevlar is an E. I. DuPont product that was developed and has come to be known as one of the strongest manmade yarns and threads. Certain types of Kevlar yarns are made into ballistic or bullet-proof vests. The temperature limit is 450 degrees F. for continuous use. Kevlar has a problem with continued sunlight or UV exposure. It will start to decompose, losing its strength after a few hundred hours of direct exposure. Kevlar has relatively good chemical resistance. Consulting E. I. DuPont for specific data relative to a questionable application is recommended. Kevlar thread is available in a variety of thicknesses, strengths and yields.

Pure Teflon Threads:

Pure PTFE or Teflon threads are available for chemically aggressive areas or applications. Pure PTFE threads should be used for R/R insulation blankets in strong acid or alkaline environments. Pure PTFE threads have a temperature range from -100 to +500 degrees F. applications. PTFE threads are available in a variety of sizes and yields for machine sewing.

Hogring Staples:

Hogring staples have been used to construct R/R insulation blankets for industrial applications for the past 30 years. Hogring staples are very effective when SS blanket mesh is to encapsulate the entire hot and cold face materials. Hogring staples are available in a variety of wire materials (galvanized, SS, Monel, Inconel) and wire sizes (18 & 16 gage). Hogring staples are made for single and multiple staple, hand and automatic air operated tools.

Fastening and Accessories

Belting and Buckles:

Lacing Anchors & Tie Wire

Quilting

Velcro

Drawcord

Grommets

I.D. Tags