FLUKE®

Hart Scientific®

9112A

Calibration Furnace User's Guide

Rev. 5B2901

Fluke Corporation, Hart Scientific Division
799 E. Utah Valley Drive • American Fork, UT 84003-9775 • USA
Phone: +1.801.763.1600 • Telefax: +1.801.763.1010
E-mail: support@hartscientific.com

www.hartscientific.com

Rev. 5B2901

Table of Contents

1 Before You Start 1

1.1 Symbols Used 1

1.2 Safety Information 2

1.2.1 WARNINGS 2

1.2.2 Cautions 4

1.3 Authorized Service Centers. 5

2 Introduction 9

3 Specifications and Environmental Conditions 11

3.1 Specifications 11

3.2 Environmental Conditions. 11

3.3 Warranty. 11

4 Installation 13

4.1 Unpacking & Inspection 13

4.2 Location 13

4.3 “Dry-out” Period 14

4.4 Power 14

4.5 Equilibration Block Assembly Installation 14

4.6 Probe Installation 14

5 Parts and Controls 17

5.1 Front View. 17

5.1.1 Temperature Controller 17

5.1.2 Over Temperature Cutout 18

5.1.3 Power and Heater Switches 18

5.2 Heater Assembly 19

5.2.1 Equilibration Block Assembly 19

5.2.2 Temperature Control and Cutout Sensor 20

5.3 Back View. 21

5.3.1 The Power Cable 21

5.3.2 Nomenclature 21

5.3.3 Fuses 21

6 Operation 23

6.1 Overview 23

6.2 Operating the Furnace 23

7 Digital Communication Interface 25

8 Maintenance 27

9 Appendix A - Material Safety Data Sheets (MSDS) 29

Figures

Figure 1 Front View 17
Figure 2 Sectional Side View 19
Figure 3 Back View 20
Figure 4 RS-232 Cable Wiring 25

1 Before You Start

1.1 Symbols Used

Table 1 lists the International Electrical Symbols. Some or all of these symbols may be used on the instrument or in this manual.

Table 1 *International Electrical Symbols*

Symbol	Description
	AC (Alternating Current)
	AC-DC
	Battery
	CE Complies with European Union Directives
	DC
	Double Insulated
	Electric Shock
	Fuse
	PE Ground
	Hot Surface (Burn Hazard)
	Read the User's Manual (Important Information)
	Off
	On

Symbol	Description
	Canadian Standards Association
CAT II	OVERVOLTAGE (Installation) CATEGORY II, Pollution Degree 2 per IEC1010-1 refers to the level of Impulse Withstand Voltage protection provided. Equipment of OVERVOLTAGE CATEGORY II is energy-consuming equipment to be supplied from the fixed installation. Examples include household, office, and laboratory appliances.
	C-TIC Australian EMC Mark
	The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) mark.

1.2 Safety Information

Use this instrument only as specified in this manual. Otherwise, the protection provided by the instrument may be impaired.

The following definitions apply to the terms "Warning" and "Caution".

- "WARNING" identifies conditions and actions that may pose hazards to the user.
- "CAUTION" identifies conditions and actions that may damage the instrument being used.

1.2.1 ⚠ WARNINGS

To avoid personal injury, follow these guidelines.

DISCLAIMER: *Hart Scientific manufactures instruments for the purpose of temperature calibration. Instruments used for applications other than calibration are used at the discretion and sole responsibility of the customer. Hart Scientific cannot accept any responsibility for the use of instruments for any application other than temperature calibration.*

GENERAL

Appropriate personal safety protection should be worn by the operator at all times while using the furnace.

DO NOT use the instrument for any application other than calibration work. The instrument was designed for temperature calibration. Any other use of the unit may cause unknown hazards to the user.

DO NOT use the unit in environments other than those listed in the user's guide.

Completely unattended operation is not recommended.

Follow all safety guidelines listed in the user's manual.

Calibration Equipment should only be used by Trained Personnel.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired or safety hazards may arise.

Inspect the instrument for damage before each use. DO NOT use the instrument if it appears damaged or operates abnormally.

Before initial use, or after transport, or after storage in humid or semi-humid environments, or anytime the instrument has not been energized for more than 10 days, the instrument needs to be energized for a "dry-out" period of 2 hours before it can be assumed to meet all of the safety requirements of the IEC 1010-1. If the product is wet or has been in a wet environment, take necessary measures to remove moisture prior to applying power such as storage in a low humidity temperature chamber operating at 50°C for 4 hours or more.

The instrument is intended for indoor use only.

BURN HAZARD

High temperatures may be present in this equipment. Fires and severe burns may result if personnel fail to observe safety precautions.

The furnace generates extreme temperatures. Precautions must be taken to prevent personal injury or damage to objects. Probes may be extremely hot when removed from the furnace. Cautiously handle probes to prevent personal injury. Carefully place probes on a heat resistant surface rack until they are at room temperature.

DO NOT lift the back of this instrument with the equilibration block in place. The equilibration block will fall out of the instrument.

DO NOT operate near flammable materials. Extreme temperatures could ignite the flammable material.

Use of this instrument at HIGH TEMPERATURES for extended periods of time requires caution.

DO NOT touch the well access cover of the instrument, it is extremely hot.

For compliance with IEC 1010-1, it is recommended that the cutout mode always be set to the manual mode requiring user intervention to reset the instrument.

Take extreme care in handling hot probes. The extreme temperatures generated in a furnace of this type can cause serious personal injury. Do not touch them on external surfaces of the furnace or set them on any other surfaces unable to withstand those temperatures. A fire hazard exists. Do not touch the access tube end plate or severe burns can result.

ELECTRICAL HAZARD

These guidelines must be followed to ensure that the safety mechanisms in this instrument will operate properly. This instrument must be plugged into a 230 VAC (± 10%) 50/60 Hz only electric outlet. The power cord of the instrument is equipped with a three-pronged grounding plug for your protection against electrical shock hazards. It must be plugged directly into a properly grounded three-prong receptacle. The receptacle must be installed in accordance with local codes and ordinances. or adapter plug. Additionally, the instrument has a Permanent Earth Ground that must be connected during use. DO NOT use an extension cord Consult a qualified electrician.

Always replace the power cord with an approved cord of the correct rating and type. If you have questions, contact a Hart Scientific Authorized Service Center (see Section 1.3).

The instrument is not equipped with easily accessible fuses. The fuses are located inside the control drawer. We do not recommend replacing the fuses without calling a Hart Scientific Authorized Service Center first.

High voltage is used in the operation of this equipment. Severe injury or death may result if personnel fail to observe the safety precautions. Before working inside the equipment, turn off the power and disconnect the power cord.

Always ensure that the equilibration block ground is connection prior to use of the instrument.

1.2.2 ⚠ Cautions

Always operate this instrument at room temperature between 41°F and 104°F (5°C to 40°C). Allow sufficient air circulation by leaving at least 18 inches (45 cm) of clearance around the instrument. DO NOT place instrument in a corner or block the back of the instrument. Extreme temperatures are emitted from the back and front of the furnace. Allow sufficient space in front of the furnace to work and to insert and remove the probes.

Read Section 4, Installation, before placing the instrument into service.

DO NOT use fluids to clean out the well. Fluids could leak into and damage the instrument.

Never introduce any foreign material into the probe hole of the insert. Fluids, etc. can leak into the instrument causing damage.

DO NOT change the values of the calibration constants from the factory set values. The correct setting of these parameters is important to the safety and proper operation of the unit.

Read and understand the controller operation prior to operating the instrument. The controller manufacturer's manual is included with the instrument.

DO NOT operate this instrument in an excessively wet, oily, dusty, or dirty environment.

The unit is a precision instrument. Although it has been designed for optimum durability and trouble free operation, it must be handled with care.

Most probes have handle temperature limits. Be sure that the probe handle temperature limit is not exceeded in the air above the instrument.

The instrument and any thermometer probes used with it are sensitive instruments that can be easily damaged. Always handle these devices with care. Do not allow them to be dropped, struck, stressed, or overheated.

When calibrating PRTs always follow correct calibration procedure and calibrate from high temperatures to low temperatures with the appropriate triple point of water checks. Never immerse a wet or cold PRT into a bath filled with hot medium. Severe damage to the PRT may result as well as personal injury to the calibration technician.

This furnace is not designed to be portable. Therefore, moving the furnace once it has been installed should be kept to a minimum. To safely move the furnace, two people are required. One person should lift the furnace at each end of the furnace, place their hand under the control drawer, and lift simultaneously being careful not to tip. Ensure that the furnace is de-energized and cooled to less then 100°C. Remove the equilibration block prior to moving. The equilibration block can damage the fused silica tube that is extremely fragile.

The control probe must be inserted properly in the instrument and plugged into the socket at the back of the furnace. DO NOT operate the furnace without the control probe properly inserted and attached. The furnace will not operate correctly without the control probe. Injury to operating personnel and permanent damage to the furnace could occur.

Components and heater lifetimes can be shortened by continuous high temperature operation.

If a mains supply power fluctuation occurs, immediately turn off the furnace. Power bumps from brown-outs and black-outs can damage the instrument. Wait until the power has stabilized before re-energizing the furnace.

The probe and the block may expand at different rates. Allow for probe expansion inside the well as the block heats. Otherwise, the probe may become stuck in the well.

Be aware that the equilibration block expands as the furnace heats. It will extend beyond the front of the furnace at high temperatures anywhere from ¼ to approximately ½ inch. This is normal and is due to thermal expansion.

Take care that all sensors used as references or being calibrated in the furnace are capable of withstanding the desired temperature range to be used.

1.3 Authorized Service Centers

Please contact one of the following Authorized Service Centers to coordinate service on your Hart product:

Hart Scientific, Inc.

799 E. Utah Valley Drive
American Fork, UT 84003-9775
USA

Phone: +1.801.763.1600
Telefax: +1.801.763.1010
E-mail: support@hartscientific.com

Fluke Nederland B.V.

Customer Support Services
Science Park Eindhoven 5108
5692 EC Son
NETHERLANDS

Phone: +31-402-675300
Telefax: +31-402-675321
E-mail: ServiceDesk@fluke.nl

Fluke Int'l Corporation

Service Center - Instrimpex
Room 2301 Sciteck Tower
22 Jianguomenwai Dajie
Chao Yang District
Beijing 100004, PRC
CHINA

Phone: +86-10-6-512-3436
Telefax: +86-10-6-512-3437
E-mail: xingye.han@fluke.com.cn

Fluke South East Asia Pte Ltd.

Fluke ASEAN Regional Office
Service Center
60 Alexandra Terrace #03-16
The Comtech (Lobby D)
118502
SINGAPORE

Phone: +65 6799-5588

Telefax: +65 6799-5588

E-mail: antng@singa.fluke.com

When contacting these Service Centers for support, please have the following information available:

- Model Number
- Serial Number
- Voltage
- Complete description of the problem

2 Introduction

The 9112A Calibration Furnace was designed specifically for calibrating PRTs, fiber optic sensors and thermocouples at higher temperature ranges up to 1100°C. The furnace utilizes an equilibration block capable of making comparison measurements on multiple probes. The standard equilibration block is sized for ¼ inch probes, however, custom options are possible. Temperature stability is better than ± 0.1°C throughout the range and the gradient between wells at full insertion is less than 0.5°C (± 0.25°C).

The temperature control system utilizes a digital controller with a Type K thermocouple control sensor and RS-232 interface. The controller displays the set temperature and the actual temperature simultaneously. The display shows temperature to the nearest degree in °C or °F (shipped in °C). The temperature is set with convenient up and down buttons on the front panel.

Sensors being calibrated as well as the furnace itself are protected from excessive temperature with an over-temperature cutout. The cutout is easily adjusted from the front panel. This device is relay operated and protects against the possibility of thermal runaway due to a shorted solid-state relay which controls the heaters.

3 Specifications and Environmental Conditions

3.1 Specifications

Operating Range	300°C to 1100°C
Stability	300°C ±0.05°C 500°C ±0.05°C 700°C ±0.1°C 1000°C ±0.1°C 1100°C ±0.1°C
Uniformity	300°C ±0.05°C 500°C ±0.08°C 700°C ±0.2°C 1000°C ±0.25°C 1100°C ±0.3°C
Stabilization Time	Typically 2 hours midrange, slower at the low temperature end (4 hours), faster at the high temperature end
Heater Power	3700 Watts High
Power Requirements	230 VAC (±10%), 50/60 Hz, 20 A
Outside Dimensions	18" H x 14.25"W x 26"D (457mm x 362mm x 660mm)
Weight	72.5 lbs

3.2 Environmental Conditions

Although the instrument has been designed for optimum durability and trouble-free operation, it must be handled with care. The instrument should not be operated in an excessively dusty or dirty environment. Maintenance and cleaning recommendations can be found in the Maintenance Section of this manual.

The instrument operates safely under the following conditions:

- temperature range: 5 - 40°C (41 - 104°F)
- ambient relative humidity: 15 - 50%
- pressure: 75kPa - 106kPa
- mains voltage within ± 10% of nominal
- vibrations in the calibration environment should be minimized
- altitude less than 2000 meters
- indoor use only

3.3 Warranty

Fluke Corporation, Hart Scientific Division (Hart) warrants this product to be free from defects in material and workmanship under normal use and service

for a period as stated in our current product catalog from the date of shipment. This warranty extends only to the original purchaser and shall not apply to any product which, in Hart's sole opinion, has been subject to misuse, alteration, abuse or abnormal conditions of operation or handling.

Software is warranted to operate in accordance with its programmed instructions on appropriate Hart products. It is not warranted to be error free.

Hart's obligation under this warranty is limited to repair or replacement of a product which is returned to Hart within the warranty period and is determined, upon examination by Hart, to be defective. If Hart determines that the defect or malfunction has been caused by misuse, alteration, abuse or abnormal conditions or operation or handling, Hart will repair the product and bill the purchaser for the reasonable cost of repair.

To exercise this warranty, the purchaser must forward the product after calling or writing Hart for authorization. Hart assumes NO risk for in-transit damage.

For service or assistance, please contact an Authorized Service Center (see Section 1.3).

THE FOREGOING WARRANTY IS PURCHASER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OR MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE OR USE. HART SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR LOSS WHETHER IN CONTRACT, TORT, OR OTHERWISE.

4 Installation

4.1 Unpacking & Inspection

The furnace has been carefully packed for safe shipment by traditional means. Unpacking should be done carefully. Check carefully for all parts. If any damage has occurred, you should notify the shipper immediately and make the appropriate claim.

The equilibration block assembly has been packed separately in order to protect the fused silica tube from breakage during shipment. The block assembly should not be installed into the furnace until it has been placed in its final location.

Verify that the following components are present:

- Furnace
- 2 – Thermocouples
- Equilibration Block Assembly (2 pieces)
- Block Assembly Instruction Sheet
- Diskette
- Controller Manual
- User's Guide
- Serial Cable

4.2 Location

The furnace is intended to be installed into any typical calibration facility environment. The best results from the furnace are realized if the temperature fluctuations in the room are not excessive. A minimum of 18 inches free air space around the furnace must be allowed. This air space allows exchange to occur and safely remove heat from the furnace.

WARNING: *This furnace is intended for high temperature use and consequently a fire danger exists. DO NOT mount the furnace on a flammable surface and keep fire-extinguishing equipment near by.*

Extremely humid environments may require startup on low heat after long periods of disuse.

4.3 "Dry-out" Period

WARNING: *Before initial use, after transport, and any time the instrument has not been energized for more than 10 days, the instrument needs to be energized for a "dry-out" period of 1-2 hours before it can be assumed to meet all of the safety requirements of the IEC 1010-1. If the product is wet or has been in a wet environment, take necessary measures to remove moisture prior to applying power such as storage in a low humidity temperature chamber operating at 50°C for 4 hours or more.*

4.4 Power

The furnace utilizes a grounded AC supply of 230 VAC (±10%), 20 amps, single phase, 50/60 HZ. An eight foot 2 conductor with ground, power cord is provided. A separate ground connection is provided and required to permanently connect the instrument to earth ground for added operator safety.

WARNING: *Ensure accessability to the mains plug for disconnection from supply source.*

4.5 Equilibration Block Assembly Installation

After the furnace has been installed and the permanent earth ground appropriately attached, the equilibration block assembly may be inserted. Carefully insert the block assembly into the tube with its insulation packing per Figure 1. Extreme care should be taken installing the Equilibration Block since it is very heavy and the fused silica tube is very fragile. A 1/8 to ¼ inch air gap between the front access plate and the front panel of the furnace is required in order to prevent the front panel from getting too hot. Care must be taken to prevent dirt, insulation, or anything else from getting between the block and the fused silica tube or it might break during heat up due to thermal expansion differences. The fit between the block and the tube is typically loose in order to accommodate this expansion.

CAUTION: *If the furnace must be moved for any reason, remove the block assembly to prevent breakage of the fused silica tube.*

4.6 Probe Installation

Install the temperature control and over temperature cutout probes from the as shown in Figure 1 and Figure 3. Insert the probes carefully to the depth shown in order to insure that the sensor is properly located in the equilibration block. The control probe should be inserted through the guard cover first so that the cover can be properly installed afterward. Position the rear guard block as

shown and then insert the insulation (ceramic fiber, see MSDS in the Appendix) being careful no to bend the probe sheath. The insulation should generally block air movement in and out of the back of the fused silica tube. Install the Guard Cover to prevent physical contact with parts that become dangerously hot when in use. Be sure to connect the probes properly on the rear panel.

5 Parts and Controls

5.1 Front View

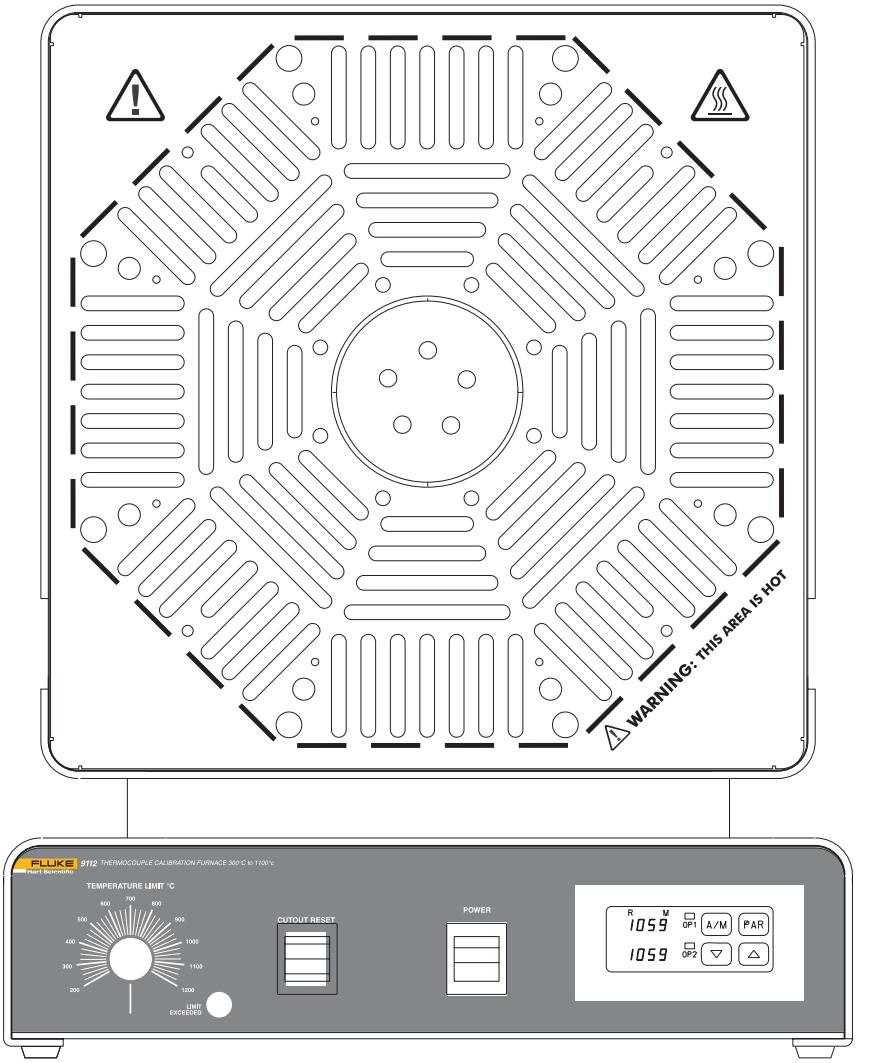

Figure 1 *Front View*

5.1.1 Temperature Controller

The temperature controller is a full PID micro-processor based instrument as indicated. The controller is set to cover the range of 0 to 1100°C and features

two LED type displays. The upper display normally indicates the actual temperature while the lower display indicates the set temperature. The displays are also utilized in setup and alarm functions. Other indicators include the OP1 and OP2 indicator lights. The OP1 indicator lights when the heater is on. The OP2 is not functional on the unit. The "R" indicator lights during programmed ramping. The "M" indicator flashes if the sensor fails. If the sensor opens, the heaters shut off.

The up and down Temperature Adjustment arrow keys are the only temperature controls normally used. A quick single stroke increments or decrements the temperature setting. Holding the buttons down causes a gradual acceleration of the temperature setting. These same buttons are used to adjust other parameters in conjunction with the "PAR" button.

Further information about the controller operation can be obtained from the temperature controller installation and operation manual included with the instrument.

5.1.2 Over Temperature Cutout

The over temperature cutout is located at the left side of the control panel. The controls include a temperature limit adjustment control knob calibrated in Celsius and "limit exceeded" indicator light. The cutout is adjustable by the user within the temperature range of the furnace with divisions shown every 25°C. The indicator light turns on when the set limit is reached. The cutout can be set to Manual Reset or Auto Reset. The button on front panel allows the user to reset the cutout. The unit leaves the factory with the unit set in the Manual Reset Mode. In the Auto Reset Mode, the temperature resets when it has dropped about 20 degrees.

The cutout is provided to allow the user to set the maximum furnace temperature to a point within the safe range of the sensor(s) being calibrated and to protect the furnace from exceeding its own safe operating range. Limiting the top end also helps extend the life of the heaters.

The cutout controls a relay which is wired in series with the heater circuit. The cutout is provided as a safety backup in case the solid state relay driven by the temperature controller fails (shorts) causing thermal runaway.

5.1.3 Power and Heater Switches

The power switch is located just left of the temperature controller. The top is pressed inward to turn the unit on.

Note: The internal fans are wired ahead of the switch so they stay on until the unit is cooled even though the main power may have been turned off. This way the outer surfaces of the enclosure are not heated to dangerous levels from stored heat.

5.2 Heater Assembly

The heater is a made of fiber ceramic insulating material with imbedded heating. The heater is made up with two halves, each with a separate heating element. The heating elements are wired in parallel.

The heater is primarily a radiating device and is rated for a maximum furnace operating temperature of 1100°C. Realize, however, that the higher the operating temperature, the lower the lifetime of the heater. Limiting the number of hours at the extreme high end of the temperature range to only the time required for calibrations increases the longevity of your furnace heating element.

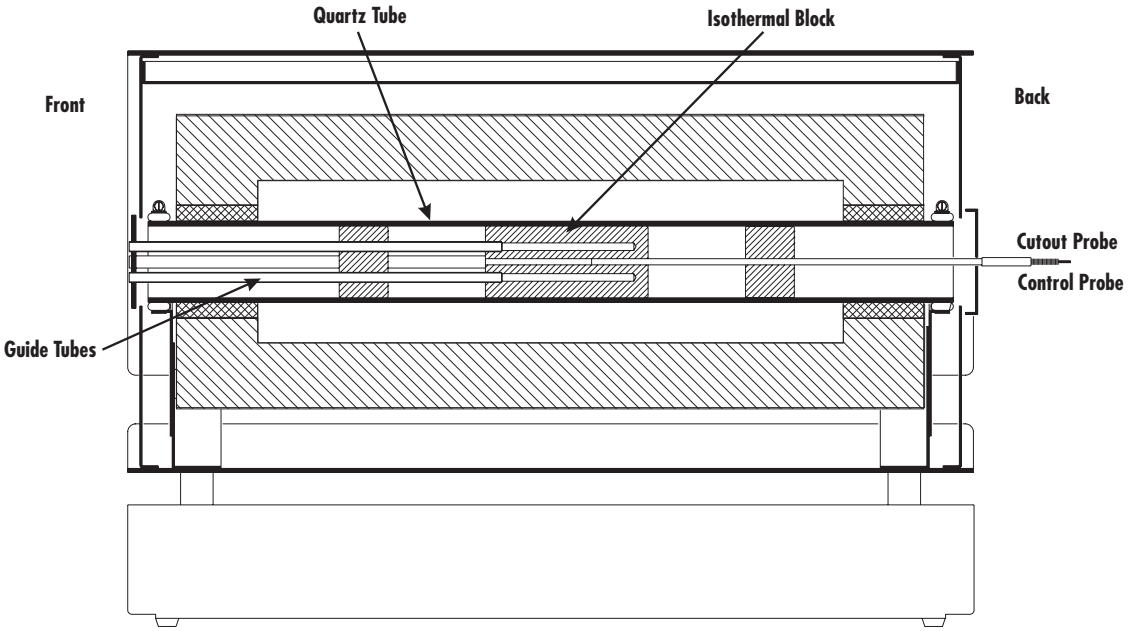

Figure 2 *Sectional Side View*

5.2.1 Equilibration Block Assembly

The Equilibration Block Assembly consists of 1) the test well, 2) access tubes and end plate, 3) the front and rear guard blocks, 4) insulation on each end and 5) the center block. The center block is intended to stabilize the temperature fluctuations and to conduct heat between the test wells in order to equalize them. The guard blocks shunt heat to the various probes to reduce heat loss out the ends. The whole assembly is supported by a fused silica tube. All heated materials are fused silica, ceramic fiber, or Inconel (alloy 600).

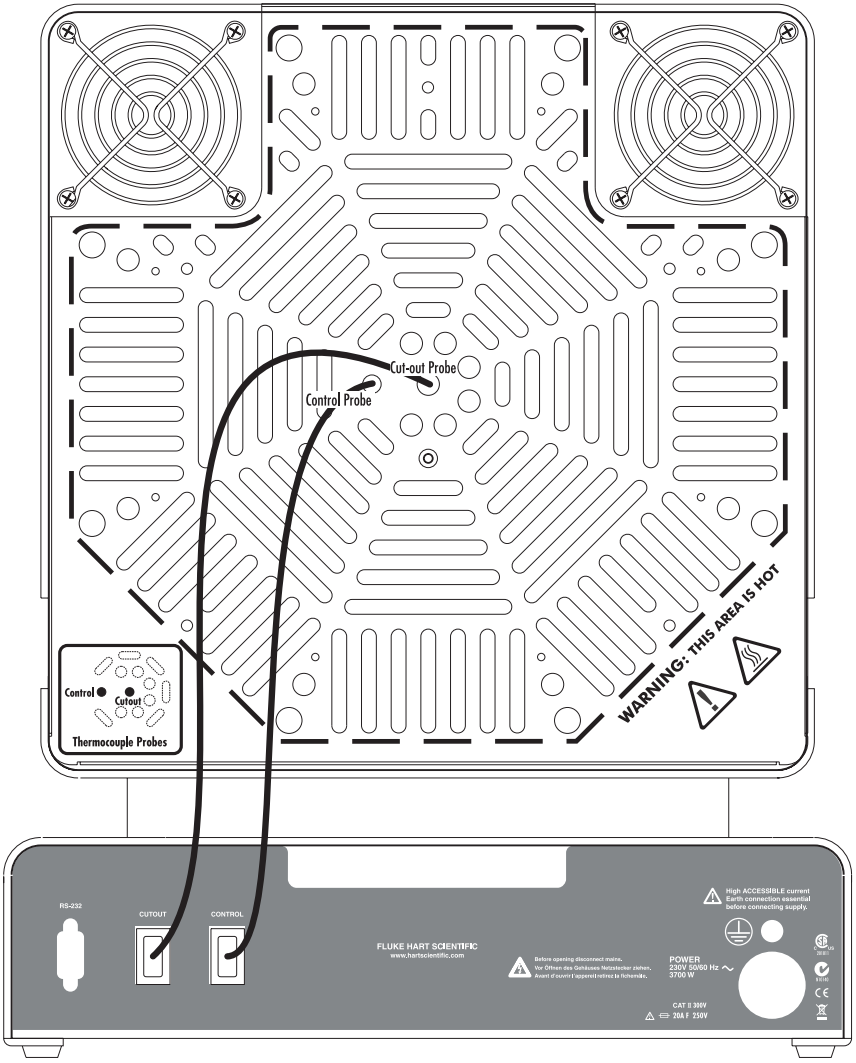

Figure 3 *Back View*

5.2.2 Temperature Control and Cutout Sensor

The temperature control sensor is a Type K Thermocouple as indicated. This sensor is 3/16 inch in diameter and 12 inches long. Its location in the block is important and can cause the gradient in the block to move back and forth. The probe is normally inserted as shown in Figures 2 and 3.

The cutout sensor is the same as the control sensor, 12 inches long. This sensor is inserted through a tube in the back of the block. Its location here helps prevent the heater elements from overheating thus prolonging their life.

The sensor connectors are provided on the rear panel of the furnace for connecting the control and cutout thermocouples. They are Type K miniature connectors and allow for ease of system assembly and sensor replacement.

5.3 Back View

See Figure 3.

5.3.1 The Power Cable

The furnace is provided with a 12 gauge two conductor with ground power cable. The user must provide a connector to meet the needs of the installation. Be sure to follow electrical codes. A separate permanent earth ground is provided with this instrument. This is required to be installed correctly for safe operation of the instrument.

5.3.2 Nomenclature

The nomenclature on the rear of the furnace provides information to the user in case service is required. The nomenclature includes the manufacturer, manufacturer location, model number, and serial number specific to this unit. Refer to the model number and serial number whenever service is required.

5.3.3 Fuses

Two 20 A F 250 V fuses are used to protect the system, one for each leg of the 230 VAC power. The fuses are located inside the control cabinet. If the furnace fails to operate, check the fuses first.

Two 1 A F 250 V fuses are located inside the control cabinet for the controller.

6 Operation

6.1 Overview

The Model 9112A is basically a temperature controlled furnace utilizing a full PID micro-processor based temperature controller with a Type K thermocouple temperature sensor. The temperature controller sends a time proportional signal to the solid state relay which regulates the current to the heater. The heater power can be switched to HIGH or LOW power positions. The object of the temperature control is the equilibration block with test wells containing the reference probe and the sensors to be calibrated inside. The block provides a thermal mass which tends to stabilize the temperature and reduce the gradients between the test wells. The user settable "over-temperature cut-out" can open the heater circuit with a relay if the safe temperature for the test probe or for the furnace is exceeded. The enclosure is designed to limit the heat seen by the various components of the furnace as well as the user. The control section is in a separate cabinet below the furnace heat preventing damage or accuracy errors. The furnace part of the cabinet contains ventilation holes as well as two fans controlled by the thermostat. This cooling capability prevents the surface of the enclosure from getting dangerously hot. In the event that the fans should fail, a second thermostat is installed in the cabinet which shuts down the furnace heaters if the cabinet exceeds a safe temperature.

6.2 Operating the Furnace

Operating the Model 9112A is straight forward once you have grasped all the important principles.

When the unit is turned on, the cutout reset button must be pushed before the unit will heat.

Temperature selection is accomplished by using the up and down arrow keys on the front of the temperature controller. The lower display indicates the new temperature setting while the upper display shows the actual temperature. When scanning from one temperature to another, notice that the temperature controller seems to be ahead of the equilibration block temperature. This difference is because the temperature control sensor is near the outside of the block and it takes some time for the heat to conduct into the center. Depend on an external temperature monitor to establish when the equilibration block has reached the desired temperature and achieved stability.

The actual temperature indication made by the temperature controller is not intended to be a calibration reference, but to merely provide a general indication of the furnace temperature. NIST traceable standard thermometers are available and should be used in making comparison measurements. For less stringent measurements you may make a calibration of the controller and control probe at particular temperature points and use that with reasonable accuracy for a time.

CAUTION: *Take care that all sensors used as references or being calibrated in the furnace are capable of withstanding the desired temperature range to be used.*

WARNING: *Take extreme care in handling hot probes. The extreme temperatures generated in a furnace of this type can cause serious personal injury. Do not touch them on external surfaces of the furnace or set them on any other surfaces unable to withstand those temperatures. A fire hazard exists. Do not touch the access tube end plate or severe burns can result.*

Some kind of metal and/or ceramic fiber surface or container should be used to set the hot probes on to prevent injury, damage, and fire.

For best results, all reference or sample probes should be inserted into the full depth of the well. At this position the stability is the highest and the gradient the lowest. Each user should satisfy themselves as to what the uncertainties are in terms of stability and gradients between the test wells. Variations in equipment, probe size, configuration, etc affect these important factors. A solid (unstirred) mass such as in a furnace is subject to heat losses from the probe stem which varies from probe to probe and temperature to temperature. Typically, stabilities are less than ±0.1°C and can be as little as ±0.015°C at 500°C. Similarly, gradients between the measuring cells can range from ±0.2°C to well under ±0.1°C. For calibrations that must be less than full insertion into the test well, make your own comparisons between the reference and test cell at that depth to establish the uncertainties.

The furnace can be used throughout the temperature range of 300 to 1100°C. Lower temperatures are sluggish however. High integrating values are required to maintain controller stability (1200 sec) at the lower temperatures. Expect some offset from the indicated temperature and the actual temperature. Stability and gradients between test wells are similar at higher temperatures but time to stability is much longer.

7 Digital Communication Interface

To control the furnace through a computer, follow the instructions listed below. The program supplied is a demo program and may be altered by you for your specific needs.

First make the appropriate cable assembly for your computer system. The serial communications cable attaches to the calibrator through the DB-9 connector at the back of the instrument. Figure 4 shows the pin-out of this connector and suggested cable wiring. To eliminate noise, the serial cable should be shielded with low resistance between the connector (DB-9) and the shield.

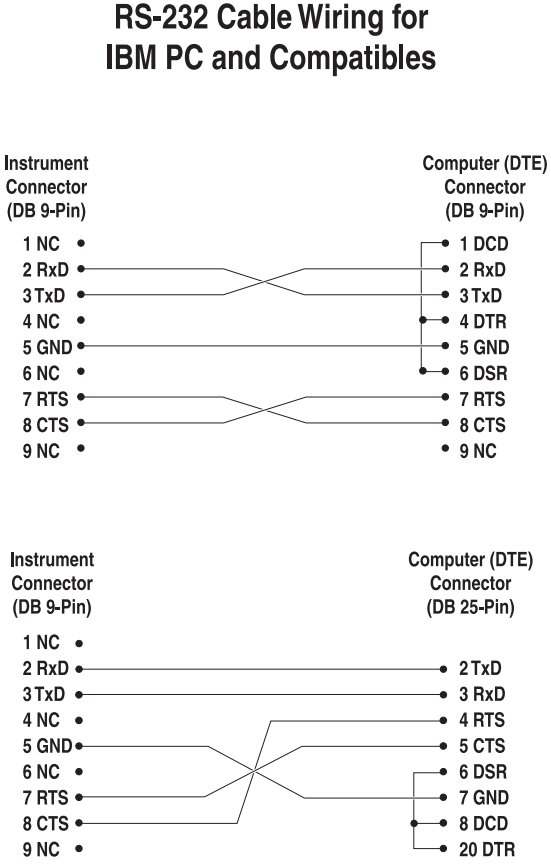

Figure 4 *RS-232 Cable Wiring*

Connect the appropriate connectors to your computer and to the furnace. To communicate with the furnace:

- Load GWBASIC
- Load and then run the program TC847.BAS
- Set the Baud Rate on the Controller of the 9112A to 9600
- Set the address of your furnace to 10 or greater
- Set the temperature or if needed the furnace parameters. A listing of the parameters and their meaning are in the following table.

Table 2. *Command Parameters*

PV	process value (temperature)
SL	set-point
OP	output power
XP	proportional band
TI	integration time
TD	derivative time
CH	Cycle time

To set a parameter, simply type in the parameter and the value. For example, to set the control temperature to 800°C, type SL=800.

8 Maintenance

The calibration instrument has been designed with the utmost care. Ease of operation and simplicity of maintenance have been a central theme in the product development. Therefore, with proper care the instrument should require very little maintenance. Avoid operating the instrument in an oily, wet, dirty, or dusty environment.

- If the outside of the instrument becomes soiled, it may be wiped clean with a damp cloth and mild detergent. Do not use harsh chemicals on the surface which may damage the paint.
- Be sure that the well of the furnace is kept clean and clear of any foreign matter. **Do not** use fluids to clean out the well.
- If a hazardous material is spilt on or inside the equipment, the user is responsible for taking the appropriate decontamination steps as outlined by the national safety council with respect to the material.
- If the mains supply cord becomes damaged, replace it with a cord with the appropriate gauge wire for the current of the instrument. If there are any questions, call Hart Scientific Customer Service for more information.
- Before using any cleaning or decontamination method except those recommended by Hart, users should check with Hart Scientific Customer Service to be sure that the proposed method will not damage the equipment.
- If the instrument is used in a manner not in accordance with the equipment design, the operation of the furnace may be impaired or safety hazards may arise.
- The over-temperature cut-out should be checked every 6 months to ensure that it is working properly. Set the unit to 300°C and let it stabilize. Turn the adjustable cutout knob down until the cutout is activated. Turn the knob back up and push the reset button.
- Periodically remove the equilibration block and use emery cloth to remove the oxidation build up on the block.

9 Appendix A - Material Safety Data Sheets (MSDS)

MATERIAL SAFETY DATA SHEET

MSDS No. M0001	Effective Date: 06/10/2003

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Group: **REFRACTORY CERAMIC FIBER PRODUCT**

Chemical Name: VITREOUS ALUMINOSILICATE FIBER

Synonym(s): RCF, ceramic fiber, synthetic vitreous fiber (SVF), man-made vitreous fiber (MMVF), man-made mineral fiber (MMMF)

Trade Names: **FIBERFRAX® CERAMIC FIBER PRODUCTS** , **INCLUDES:**

FIBERS

FIBERFRAX® HIGH PURITY FIBERS: HP-ODB; Module Trim; MT-HP; HP-Chopped; H Bulk; Regular Bulk, Spun Bulk, Fiberfrax FPP Fiber.

FIBERFRAX® 6000 SERIES FIBERS: All bulk fibers from 6000-AAA to 6100-ZZZ, 6900-70A to 6900-99Z.

FIBERFRAX® 7000 SERIES FIBERS: 7000-AA to 7100-ZZ.

FIBERFRAX® MILLED FIBERS: EF-119; HP Ball Milled A; HP Ball Milled B; HP Ball Milled C/D.

FIBERFRAX® HIGH INDEX FIBERS: W-657; W-707; W-758; HS-95C; MX-135-CW; MX-400-CW; HS-70; HS-70C.

FIBERFRAX® HSA™ FIBERS: HSA-K; HSA-HP.

FIBERFRAX® KAOLIN FIBERS: K-Chopped; KMTX; MT; MTX; MT-T; MX-150.

BLANKETS

Durablanket® AC; Durablanket® HP; Durablanket® HP-S; Durablanket® S; Durablanket® Strip; Duraback®; Duraback® S; Tank Car Insulation; TCB; SMB; QSB600; QSB800; FIBERMAT®; LO-CON™ BLANKET

PAPERS

FIBERFRAX® BINDERLESS PAPERS: 972-AH; 972-FH; 972-JH; 882-FH; 882-JH; HSA-F without binder; HSA-J without binder.

Manufacturer/Supplier: **Unifrax Corporation**
2351 Whirlpool St.
Niagara Falls, NY 14305-2413
Product Stewardship Information Hotline
1-800-322-2293 (Monday - Friday 8:00 a.m. - 4:30 p.m. EST)
For additional MSDSs, visit our web page, http: //www.unifrax.com, or call Unifrax Customer Service at (716) 278-3872

CHEMTREC Assist: CHEMTREC will provide assistance for chemical emergencies. Call **1-800-424-9300**

2. COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENTS	CAS NUMBER	% BY WEIGHT
Refractories, Fibers, Aluminosilicate	142844-00-6	100

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

WARNING!

POSSIBLE CANCER HAZARD BY INHALATION.
(See Section 11 for more information)

CHRONIC EFFECT

There has been no increased incidence of respiratory disease in studies examining occupationally exposed workers. In animal studies, long-term laboratory exposure to doses hundreds of times higher than normal occupational exposures has produced fibrosis, lung cancer, and mesothelioma in rats or hamsters. The fibers used in those studies were specially sized to maximize rodent respirability.

OTHER POTENTIAL EFFECTS

TARGET ORGANS:
Respiratory Tract (nose & throat), Eyes, Skin

RESPIRATORY TRACT (nose & throat) IRRITATION:
If inhaled in sufficient quantity, may cause temporary, mild mechanical irritation to respiratory tract. Symptoms may include scratchiness of the nose or throat, cough or chest discomfort.

EYE IRRITATION:
May cause temporary, mild mechanical irritation. Fibers may be abrasive; prolonged contact may cause damage to the outer surface of the eye.

SKIN IRRITATION:
May cause temporary, mild mechanical irritation. Exposure may also result in inflammation, rash or itching.

GASTROINTESTINAL IRRITATION:
Unlikely route of exposure.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:
Pre-existing medical conditions, including dermatitis, asthma or chronic lung disease may be aggravated by exposure; individuals who have a history of allergies may experience greater amounts of skin and respiratory irritation.

HAZARD CLASSIFICATION

Although studies, involving occupationally exposed workers, have not identified any increased incidence of respiratory disease, results from animal testing have been used as the basis for hazard classification. In each of the following cases, the conclusions are qualitative only and do not rest upon any quantitative analysis suggesting that the hazard actually may occur at current occupational exposure levels.

In October 2001, the **International Agency for Research on Cancer (IARC)** confirmed that Group 2b (possible human carcinogen) remains the appropriate IARC classification for RCF.

The Seventh Annual Report on Carcinogens (1994), prepared by the **National Toxicology Program (NTP),** classified respirable RCF and glasswool as substances reasonably anticipated to be carcinogens.

The **American Conference of Governmental Industrial Hygienists (ACGIH)** has classified RCF as “A2-Suspected Human Carcinogen.”

The **Commission of The European Communities (DG XI)** has classified RCF as a substance that should be regarded as if it is carcinogenic to man.

The **State of California**, pursuant to Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of

1986, has listed "ceramic fibers (airborne fibers of respirable size)" as a chemical known to the State of California to cause cancer.

The **Canadian Environmental Protection Agency (CEPA)** has classified RCF as "probably carcinogenic" (Group 2).

The **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A – Materials Causing Other Toxic Effects

The **Hazardous Materials Identification System (HMIS)** –

Health 1* Flammability 0 Reactivity 0 Personal Protection Index: X (Employer Determined)
(* denotes potential for chronic effects)

4. FIRST AID MEASURES

FIRST AID PROCEDURES

RESPIRATORY TRACT (nose & throat) IRRITATION:
If respiratory tract irritation develops, move the person to a dust free location. Get medical attention if the irritation continues. See Section 8 for additional measures to reduce or eliminate exposure.

EYE IRRITATION:
If eyes become irritated, flush immediately with large amounts of lukewarm water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Do not rub eyes. Get medical attention if irritation persists.

SKIN IRRITATION:
If skin becomes irritated, remove soiled clothing. Do not rub or scratch exposed skin. Wash area of contact thoroughly with soap and water. Using a skin cream or lotion after washing may be helpful.

GASTROINTESTINAL IRRITATION:
If gastrointestinal tract irritation develops, move the person to a dust free environment.

NOTES TO PHYSICIANS:
Skin and respiratory effects are the result of temporary, mild mechanical irritation; fiber exposure does not result in allergic manifestations.

5. FIRE FIGHTING MEASURES

NFPA Codes: **Flammability: 0** **Health: 1** **Reactivity: 0** **Special: 0**

NFPA Unusual Hazards: None
Flammable Properties: None
Flash Point: None
Hazardous Decomposition Products: None
Unusual Fire and Explosion Hazard: None
Extinguishing Media: Use extinguishing media suitable for type of surrounding fire.

6. ACCIDENTAL RELEASE MEASURES

SPILL PROCEDURES

Avoid creating airborne dust. Dust suppressing cleaning methods such as wet sweeping or vacuuming should be used to clean the work area. If vacuuming, the vacuum must be equipped with a HEPA filter. Compressed air or dry sweeping should not be used for cleaning.

7. HANDLING AND STORAGE

STORAGE

Store in original container in a dry area. Keep container closed when not in use.

HANDLING

Handle ceramic fiber carefully. Limit use of power tools unless in conjunction with local exhaust. Use hand tools whenever possible. Frequently clean the work area with HEPA filtered vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

EMPTY CONTAINERS

Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE GUIDELINES

COMPONENTS	OSHA PEL	MANUFACTURER REG
Refractories, Fibers, Aluminosilicate	None Established*	0.5 f/cc, 8-hr. TWA**

***** There is no specific regulatory standard for RCF in the U.S. OSHA's "Particulate Not Otherwise Regulated (PNOR)" standard [29 CFR 1910.1000, Subpart Z, Air Contaminants] applies generally; Total Dust 15 mg/m^3; Respirable Fraction 5 mg/m^3.

** The Refractory Ceramic Fibers Coalition (RCFC) has sponsored comprehensive toxicology and epidemiology studies to identify potential RCF-related health effects [see Section 11 for more details], consulted experts familiar with fiber and particle science, conducted a thorough review of the RCF-related scientific literature, and further evaluated the data in a state-of-the-art quantitative risk assessment. Based on these efforts and in the absence of an OSHA PEL, RCFC has adopted a recommended exposure guideline, as measured under NIOSH Method 7400 B. The manufacturers' REG is intended to promote occupational health and safety through prudent exposure control and reduction and it reflects relative technical and economic feasibility as determined by extensive industrial hygiene monitoring efforts undertaken pursuant to an agreement with the U.S. Environmental Protection Agency.

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

RCF-related occupational exposure limits vary internationally. Regulatory OEL examples include: Australia – 0.5 f/cc; Austria – 0.5 f/cc; Canada – 0.5 to 1.0 f/cc; Denmark – 1.0 f/cc; France – 0.6 f/cc; Germany – 0.5 f/cc; Netherlands – 1.0 f/cc; New Zealand – 1.0 f/cc; Norway – 2.0 f/cc; Poland – 2.0 f/cc; Sweden – 1.0 f/cc; United Kingdom – 2.0 f/cc. Non-regulatory OEL examples include: ACGIH TLV 0.2 f/cc; RCFC REG 0.5 f/cc. The

objectives and criteria underlying each of these OEL decisions also vary. The evaluation of occupational exposure limits and determining their relative applicability to the workplace is best performed, on a case-by-case basis, by a qualified Industrial Hygienist.

ENGINEERING CONTROLS

Use engineering controls such as local exhaust ventilation, point of generation dust collection, down draft work stations, emission controlling tool designs, and materials handling equipment designed to minimize airborne fiber emissions.

PERSONAL PROTECTION EQUIPMENT

Respiratory Protection – RCF:

When engineering and/or administrative controls are insufficient to maintain workplace concentrations within the 0.5 f/cc REG, the use of appropriate respiratory protection, pursuant to the requirements of OSHA Standards 29 CFR 1910.134 and 29 CFR 1926.103, is recommended. The following information is provided as an example of appropriate respiratory protection for aluminosilicate fibers. The evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified Industrial Hygienist.

MANUFACTURER'S RESPIRATORY PROTECTION RECOMMENDATIONS WHEN HANDLING RCF PRODUCTS	
Respirable Airborne Fiber Concentration (levels are 8-hr. time-weighted averages)	**Respirator Recommendation** †
Not yet determined but expected to be below 5.0 f/cc based on operation	Half-face, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge
"Reliably" less than 0.5 f/cc	Optional
0.5 f/cc to 5.0 f/cc	Half-face, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge
5.0 f/cc to 25 f/cc	Full-facepiece, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge or PAPR
Greater than 25 f/cc	PAPR with tight-fitting full facepiece or a supplied air respirator in continuous flow mode
When individual workers request respiratory protection as a matter of personal comfort or choice where exposures are "reliably" below 0.5 f/cc	A NIOSH certified respirator, such as a disposable particulate respirator, or respirators with filter cartridges rated N95 or better

†The P100 recommendation is a conservative default choice; in some case, solid arguments can be made that other respirator types (e.g., N95, R99, etc.) may be suitable for some tasks or work environments. The P100 recommendation is not designed to limit informed choices, provided that respiratory protection decisions comply with 29 CFR 1910.134.

Other Information:

- Concentrations based upon an eight-hour time weighted average (TWA) as determined by air samples collected and analyzed pursuant to NIOSH method 7400 (B) for airborne fibers.

- The manufacturer recommends the use of a full-facepiece air purifying respirator equipped with an appropriate particulate filter cartridge during furnace tear-out events and the removal of used RCF to

control exposures to airborne fiber and the potential presence of crystalline silica. If exposure levels are known, the respiratory protection chart provided above may be applied.

- Potential exposure to other airborne contaminants should be evaluated by a qualified Industrial Hygienist for the selection of appropriate respiratory protection and air monitoring.

Skin Protection:

Wear gloves, head coverings and full body clothing as necessary to prevent skin irritation. Washable or disposable clothing may be used. If possible, do not take unwashed clothing home. If soiled work clothing must be taken home, employers should ensure employees are thoroughly trained on the best practices to minimize or avoid non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, rinse washer before washing other household clothes, etc.).

Eye Protection:

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	White, odorless, fibrous material
CHEMICAL FAMILY:	Vitreous Aluminosilicate Fibers
BOILING POINT:	Not Applicable
WATER SOLUBILITY (%):	Not Soluble in Water
MELTING POINT:	1760° C (3200° F)
SPECIFIC GRAVITY:	2.50 – 2.75
VAPOR PRESSURE:	Not Applicable
pH:	Not Applicable
VAPOR DENSITY (Air = 1):	Not Applicable
% VOLATILE:	Not Applicable
MOLECULAR FORMULA:	Not Applicable

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY:	Stable under conditions of normal use.
INCOMPATIBILITY:	Soluble in hydrofluoric acid, phosphoric acid, and concentrated alkali.
CONDITIONS TO AVOID:	None.
HAZARDOUS DECOMPOSITION PRODUCTS:	None.
HAZARDOUS POLYMERIZATION:	Not Applicable.

11. TOXICOLOGICAL INFORMATION

HEALTH DATA SUMMARY

Epidemiological studies of RCF production workers have indicated no increased incidence of respiratory disease nor other significant health effects. In animal studies, long-term, high-dose inhalation exposure resulted in the development of respiratory disease in rats and hamsters.

EPIDEMIOLOGY

The University of Cincinnati is conducting an ongoing epidemiologic investigation. The evidence obtained from employees in U. S. RCF manufacturing facilities is as follows:

1) There is no evidence of any fibrotic lung disease (interstitial fibrosis) from evaluations of chest X-rays.

2) There is no evidence of an elevated incidence of lung disease among RCF manufacturing employees.

3) In early studies, an apparent statistical “trend” was observed, in the exposed population, between RCF exposure duration and some measures of lung function. The observations were clinically insignificant. If these observations were made on an individual employee, the results would be interpreted as being within the normal (predicted) respiratory range. A more recent longitudinal study of employees with 5 or more pulmonary function tests found that there was no effect on lung function associated with RCF production experience. Initial data (circa 1987) seemed to indicate an interactive effect between smoking and RCF exposure; more recent data, however, found no interactive effect. Nevertheless, to promote good health, RCF employees are still actively encouraged not to smoke.

4) Pleural plaques (thickening along the chest wall) have been observed in a small number of RCF employees. Some studies appear to show a relationship between the occurence of pleural plaques on chest radiographs and the following variables: (a) years since RCF production hire date; (b) duration of RCF production employment; and (c) cumulative RCF exposure. The best evidence to date indicates that pleural plaques are a marker of exposure only. Pleural plaques are not associated with pulmonary impairment. The pathogenesis of pleural plaques remains incompletely understood; however, the mechanism appears to be an inflammatory response caused by inhaled fibers.

TOXICOLOGY

A number of toxicological studies designed to identify any potential health effects from RCF exposure have been completed. In one study, conducted by the Research and Consulting Company, (Geneva, Switzerland), rats and hamsters were exposed to 30 mg/m³ (about 200 fibers/cc) of specially-prepared RCF for 6 hours/day, 5 days/week, for up to 24 months. In rats, a statistically significant increase in lung tumors was observed; two mesotheliomas (cancer of the pleural lining between the chest wall and lung) were also identified. Hamsters did not develop lung tumors; however, interstitial fibrosis and mesothelioma was found. Some, in the scientific community, have concluded that the “maximum tolerated dose” was exceeded and that significant particle contamination was a confounding issue; therefore, these study findings may not represent an accurate assessment of the potential for RCF to produce adverse health effects.

In a related multi-dose study with a similar protocol, other rats were exposed to doses of 16 mg/m³, 9 mg/m³, 3 mg/m³ which corresponds to about 115, 75, and 25 fibers per cubic centimeter respectively. This study found no statistically significant increase in lung cancer. Some cases of pleural and parenchymal fibrosis were seen in the 16 mg/m³ dose group. Some cases of mild fibrosis and one mesothelioma were observed in the 9 mg/m³ group. No acute respiratory effects were seen in the rats in the 3 mg/m³ exposure group, which suggests that there may be a dose/response threshold, below which irreversible respiratory impacts do not occur.

Other toxicological studies have been conducted which utilized non-physiological exposure methods such as intrapleural, intraperitoneal and intratracheal implantation or injection. Some of these studies have found that RCF is a potential carcinogen. Some experts, however, suggest that these tests have limited relevance because they bypass many of the biological mechanisms that prevent fiber deposition or facilitate fiber clearance.

To obtain more epidemiology or toxicology information, please call the toll free telephone number for the Unifrax Corporation Product Stewardship Program found in Section 16 - Other Information.

12. ECOLOGICAL INFORMATION

No ecological concerns have been identified.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT

To prevent waste materials from becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended.

DISPOSAL

RCF, as manufactured, is not classified as a hazardous waste according to Federal regulations (40 CFR 261). Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under Federal regulations, it is the waste generator's responsibility to properly characterize a waste material, to determine if it is a "hazardous" waste. Check local, regional, state or provincial regulations to identify all applicable disposal requirements.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

Hazard Class:	Not Regulated	United Nations (UN) Number:	Not Applicable
Labels:	Not Applicable	North America (NA) Number:	Not Applicable
Placards:	Not Applicable	Bill of Lading:	Product Name

INTERNATIONAL

Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train) or IMDG (ship).

15. REGULATORY INFORMATION

UNITED STATES REGULATIONS

EPA: **Superfund Amendments and Reauthorization Act (SARA)** Title III - This product does not contain any substances reportable under Sections 302, 304, 313, (40 CFR 372). Sections 311 and 312 (40 CFR 370) apply (delayed hazard).
Toxic Substances Control Act (TSCA) - All substances in this product are listed, as required, on the TSCA inventory. RCF has been assigned a CAS number; however, it is a simple mixture and therefore not required to be listed on the TSCA inventory. The components of RCF are listed on the inventory.
Comprehensive Environmental Response, Compensation and Liability Act (**CERCLA)** and the **Clean Air Act (CAA)** - RCF contains fibers with an average diameter greater than one micron and thus is not considered a hazardous air

pollutant.

OSHA: Comply with **Hazard Communication Standards** 29 CFR 1910.1200 and 29 CFR 1926.59 and the **Respiratory Protection Standards** 29 CFR 1910.134 and 29 CFR 1926.103.

California: Ceramic fibers (airborne particles of respirable size)" is listed in **Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986** as a chemical known to the State of California to cause cancer.

Other States: RCF products are not known to be regulated by states other than California; however, state and local OSHA and EPA regulations may apply to these products. If in doubt, contact your local regulatory agency.

INTERNATIONAL REGULATIONS

Canada: **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A – Materials Causing Other Toxic Effects
Canadian Environmental Protection Act (CEPA) - All substances in this product are listed, as required, on the Domestic Substance List (DSL)

European Union: **European Directive 97/69/EC** classified RCF as a Category 2 carcinogen; that is it "should be regarded as if it is carcinogenic to man."

16. OTHER INFORMATION

RCF DEVITRIFICATION

As produced, all RCF fibers are vitreous (glassy) materials which do not contain crystalline silica. Continued exposure to elevated temperatures may cause these fibers to devitrify (become crystalline). The first crystalline formation (mullite) begins to occur at approximately 985° C (1805° F). Crystalline silica (cristobalite) formation may begin at temperatures of approximately 1200° C (2192° F). The occurrence and extent of crystalline phase formation is dependent on the duration and temperature of exposure, fiber chemistry and/or the presence of fluxing agents. The presence of crystalline phases can be confirmed only through laboratory analysis of the "hot face" fiber.

IARC's evaluation of crystalline silica states "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)" and additionally notes "carcinogenicity in humans was not detected in all industrial circumstances studied" (IARC Monograph Vol. 68, 1997). NTP lists all polymorphs of crystalline silica amongst substances which may "reasonably be anticipated to be carcinogens".

IARC and NTP did not evaluate after-service RCF, which may contain various crystalline phases. However, an analysis of after-service RCF samples obtained pursuant to an exposure monitoring agreement with the USEPA, found that in the furnace conditions sampled, most did not contain detectable levels of crystalline silica. Other relevant RCF studies found that (1) simulated after-service RCF showed little, or no, activity where exposure was by inhalation or by intraperitoneal injection; and (2) after-service RCF was not cytotoxic to macrophage-like cells at concentrations up to 320 g/cm^2 - by comparison, pure quartz or cristobalite were significantly active at much lower levels (circa 20 g/cm^2).

RCF AFTER-SERVICE REMOVAL

Respiratory protection should be provided in compliance with OSHA standards. During removal operations, a full face respirator is recommended to reduce inhalation exposure along with eye and respiratory tract irritation. A specific evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified industrial hygiene professional.

PRODUCT STEWARDSHIP PROGRAM

The Unifrax Corporation has established a program to provide customers with up-to-date information regarding the proper use and handling of refractory ceramic fiber. In addition, Unifrax Corporation has also established a program to monitor airborne fiber concentrations at customer facilities. If you would like more information about

this program, please call the Unifrax Corporation Product Stewardship Information Hotline at 1-800-322-2293.

On February 11, 2002, the Refractory Ceramic Fibers Coalition (RCFC) and the U.S. Occupational Safety and Health Administration (OSHA) introduced a voluntary worker protection program entitled PSP 2002, a comprehensive, multi-faceted risk management program designed to control and reduce workplace exposures to refractory ceramic fiber (RCF). Unifrax Corporation, as a member of RCFC, is participating in this highly acclaimed product stewardship program. For more information regarding PSP 2002, please call the Unifrax Corporation's Product Stewardship Information Hotline at 1-800-322-2293 or refer to the RCFC web site: http://www.rcfc.net.

DEFINITIONS

ACGIH:	American Conference of Governmental Industrial Hygienists
ADR:	Carriage of Dangerous Goods by Road (International Regulation)
CAA:	Clean Air Act
CAS:	Chemical Abstracts Service
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act
DSL:	Domestic Substances List
EPA:	Environmental Protection Agency
EU:	European Union
f/cc:	Fibers per cubic centimeter
HEPA:	High Efficiency Particulate Air
HMIS:	Hazardous Materials Identification System
IARC:	International Agency for Research on Cancer
IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m³:	Milligrams per cubic meter of air
mmpcf:	Million particles per cubic meter
NFPA:	National Fire Protection Association
NIOSH:	National Institute for Occupational Safety and Health
OSHA:	Occupational Safety and Health Administration
29 CFR 1910.134 & 1926.103:	OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59:	OSHA Hazard Communication Standards
PEL:	Permissible Exposure Limit (OSHA)
PIN:	Product Identification Number
PNOC:	Particulates Not Otherwise Classified
PNOR:	Particulates Not Otherwise Regulated
PSP:	Product Stewardship Program
RCFC:	Refractory Ceramic Fibers Coalition
RCRA:	Resource Conservation and Recovery Act
REG:	Recommended Exposure Guideline (RCFC)
REL:	Recommended Exposure Limit (NIOSH)
RID:	Carriage of Dangerous Goods by Rail (International Regulations)
SARA:	Superfund Amendments and Reauthorization Act
SARA Title III:	Emergency Planning and Community Right to Know Act
SARA Section 302:	Extremely Hazardous Substances
SARA Section 304:	Emergency Release
SARA Section 311:	MSDS/List of Chemicals and Hazardous Inventory
SARA Section 312:	Emergency and Hazardous Inventory
SARA Section 313:	Toxic Chemicals and Release Reporting
STEL:	Short Term Exposure Limit`
SVF:	Synthetic Vitreous Fiber
TDG:	Transportation of Dangerous Goods
TLV:	Threshold Limit Value (ACGIH)

TSCA:	Toxic Substances Control Act
TWA:	Time Weighted Average
WHMIS:	Workplace Hazardous Materials Information System (Canada)

Revision Summary: Section 1: Added new product name. Replaces 02/11/02 MSDS.

MSDS Prepared By: UNIFRAX RISK MANAGEMENT DEPARTMENT

DISCLAIMER

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Material Safety Data Sheet. Employers may use this MSDS to supplement other information gathered by them in their efforts to assure the health and safety of their employees and the proper use of the product. This summary of the relevant data reflects professional judgment; employers should note that information perceived to be less relevant has not been included in this MSDS. Therefore, given the summary nature of this document, Unifrax Corporation does not extend any warranty (expressed or implied), assume any responsibility, or make any representation regarding the completeness of this information or its suitability for the purposes envisioned by the user.

Thermal Ceramics

MATERIAL SAFETY DATA SHEET

MSDS No: 350	Date Prepared: 03/24/1992	Current Date: 7/26/2002 Last Revised: (03/20/2002)

1. PRODUCT AND COMPANY IDENTIFICATION

Product Group: **ALKALINE EARTH SILICATE (AES) WOOL PRODUCT**

Chemical Name: Calcium-Magnesium-Silicate Wool or Calcium-Magnesium-Zirconium-Silicate Wool

Synonyms: CMS, Synthetic Vitreous Fiber (SVF), Man-made Vitreous Fiber (MMVF), Man-made Mineral Fiber (MMMF)

Trade Names: Superwool™ (*) Bulks, Blankets, Mats and Modules (ALL GRADES)

Manufacturer/Supplier:

Thermal Ceramics Inc.
P. O. Box 923; Dept. 300
Augusta, GA 30903-0923

For Product Stewardship and Emergency Information -
Hotline: 1-800-722-5681
Fax: 706-560-4054

For additional MSDSs and to confirm this is the most current MSDS for the product, visit our web page [*www.thermalceramics.com*] or call our automated FaxBack: 1-800-329-7444

*** Superwool™ is a trademark of The Morgan Crucible Company plc**

2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT & CAS NUMBER	% BY WEIGHT	OSHA PEL	ACGIH TLV
Calcium-Magnesium-Silicate Mixture[1] 329211-92-9	100	15 mg/m^3 (total dust) 5 mg/m^3 (respirable dust)	10 mg/m^3 (inhalable dust) 3 mg/m^3 (respirable dust)
OR			
Calcium-Magnesium-Zirconium-Silicate Mixture[1] 308084-09-5	100	15 mg/m^3 (total dust) 5 mg/m^3 (respirable dust)	10 mg/m^3 (inhalable dust) 3 mg/m^3 (respirable dust)

[1] May contain alumina and titania as minor constituents

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines.)

3. HAZARDS IDENTIFICATION

- May cause temporary, mild mechanical irritation to the eyes, skin, nose and/or throat.
- Pre-existing skin and respiratory conditions may be aggravated by exposure.

4. FIRST AID MEASURES

RESPIRATORY TRACT (nose and throat) IRRITATION
If respiratory tract irritation develops, move the person to a dust free location. See Section 8 for additional measures to reduce or eliminate exposure.

EYE IRRITATION
If eyes become irritated, flush immediately with large amounts of lukewarm water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Do not rub eyes.

SKIN IRRITATION
If skin becomes irritated, remove soiled clothing. Do not rub or scratch exposed skin. Wash area of contact thoroughly with soap and water. Using a skin cream or lotion after washing may be helpful.

GASTROINTESTINAL IRRITATION
If gastrointestinal tract irritation develops, move the person to a dust free environment.

- If symptoms persist, seek medical attention. -

NOTE TO PHYSICIANS
Skin and respiratory effects are the result of temporary, mild mechanical irritation; fiber exposure does not result in allergic manifestations.

5. FIRE FIGHTING MEASURES

NFPA Codes: **Flammability: 0 , Health: 1 , Reactivity: 0 , Special: 0**

NFPA Unusual Hazards:	None
Flammable Properties:	None
Flash Point:	None
Hazardous Decomposition Products:	None
Unusual Fire and Explosion Hazard:	None
Extinguishing Media:	Use extinguishing media suitable for type of surrounding fire.

6. ACCIDENTAL RELEASE MEASURES

SPILL PROCEDURES
Avoid creating airborne dust. Dust suppressing cleaning methods such as wet sweeping or vacuuming should be used to clean the work area. If vacuuming, the vacuum should be equipped with a HEPA filter. Compressed air or dry sweeping should not be used for cleaning.

7. HANDLING AND STORAGE

STORAGE
Store in original factory container in a dry area. Keep container closed when not in use.

HANDLING
Limit use of power tools unless in conjunction with local exhaust. Use hand tools whenever possible. Frequently clean the work area with HEPA filtered vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

EMPTY CONTAINERS
Do not reuse the container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

MANUFACTURER'S RECOMMENDATION

It is prudent to reduce exposure to respirable dusts to the lowest attainable level through the use of engineering controls such as ventilation and dust collection devices. Industrial hygiene standards and occupational exposure limits may vary between countries, state and local jurisdictions. Contact your employer to determine which exposure levels apply to your facility. If no regulatory dust or other standards apply, a qualified industrial hygienist can assist with a specific workplace evaluation including recommendations for respiratory protection. In the absence of such guidance, the manufacturer generally recommends the control of CMS wool exposures to 1 fiber/cc or less.

ENGINEERING CONTROLS

Use feasible engineering controls such as local exhaust ventilation, point of generation dust collection, down draft work stations, emission controlling tool designs, and materials handling equipment designed to minimize airborne fiber emissions.

PERSONAL PROTECTION EQUIPMENT

Skin Protection

Wear gloves, head coverings and full body clothing as necessary to prevent skin irritation. Washable or disposable clothing may be used. If possible, do not take unwashed work clothing home. If soiled work clothing must be taken home, employers should ensure employees are trained on the best practices to minimize or avoid non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, rinse washer before washing other household clothes, etc.).

Eye Protection

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

Respiratory Protection

When it is not possible or feasible to reduce respirable dust exposures through engineering controls, employees are encouraged to use good work practices together with respiratory protection. Comply with OSHA Respiratory Protection Standards, 29 CFR 1910.134 and 29 CFR 1926.103, for the particular hazard or airborne concentrations to be encountered in the work environment. For the most current information on respirator selection, contact your supplier.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	White odorless material with a wool type appearance
CHEMICAL FAMILY:	Calcium, Magnesium, Silicate Mixture
BOILING POINT:	Not Applicable
WATER SOLUBILITY (%):	Slight
MELTING POINT:	1275 - 1300°C (2327 - 2372°F)
SPECIFIC GRAVITY RANGE:	2.5 - 3.0
VAPOR PRESSURE:	Not Applicable
pH:	Not Applicable
VAPOR DENSITY (Air = 1):	Not Applicable
% VOLATILE:	Not Applicable
MOLECULAR FORMULA:	Not Applicable

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable under conditions of normal use
CHEMICAL INCOMPATIBILITIES: Avoid contact with strong acids.
CONDITIONS TO AVOID: None
HAZARDOUS DECOMPOSITION PRODUCTS: None
HAZARDOUS POLYMERIZATION: Not applicable

11. TOXICOLOGICAL INFORMATION

TOXICOLOGY
CMS wools have been tested for their biopersistence using methods devised by the European Union. The results from these studies exonerate CMS wools from carcinogen classification under the criteria listed in Nota Q of European Commission Directive 97/69/EU.

In a lifetime carcinogenicity test, rats were exposed by inhalation for two years (5 days a week; 6 hours a day) to CMS fibers at 200 WHO fibers/ml. There was neither fibrosis nor carcinogenic response; only reversible cellular changes were seen. Further, subchronic inhalation studies on rats with CMS fibers at concentrations of 150 fibers (>20 µm long) per ml for 90 days with follow up to 1 year showed neither inflammation nor cell proliferation. All parameters studied returned rapidly to baseline levels on cessation of exposure.

After-service, CMS wools may contain crystalline phases including some forms of silica. (See Section 16) However, CMS fibers heated to 1000°C for 2 weeks were not cytotoxic to macrophage-like cells at concentrations up to 320 µg/cm^2. In the same test, samples of pure crystalline quartz were significantly active at 20 µg/cm^2.

EPIDEMIOLOGY
This material has not been the subject of an epidemiology study.

NOTE
Neither the International Agency for Research on Cancer (IARC) nor the National Toxicology Program nor any other U.S. regulatory or classification entity has evaluated CMS wool. Superwool products are members of a family of materials whose properties are distinct in several ways from other man-made mineral fibers. In October 2001 IARC re-reviewed Man-Made Vitreous Fibers and "elected not to make an overall evaluation of the newly developed fibers" [such as CMS wool] but recognized that "those that have been tested appear to have low carcinogenic potential in experimental animals."

While CMS wool is an inert material that does not react with the skin, exposures may cause temporary mild mechanical irritation to the eyes, skin, nose and/or throat (for First Aid Measurers, see Section 4). Proper handling practices and the use of protective clothing (see Section 8) can minimize irritation.

12. ECOLOGICAL INFORMATION

No adverse effects of this material on the environment are anticipated.

13. DISPOSAL INFORMATION

WASTE MANAGEMENT
To prevent waste materials becoming airborne, a covered container or plastic bagging is recommended.

RCRA

CMS wool, as manufactured, is not classified as a hazardous waste according to Federal regulations (40 CFR 261). As manufactured, CMS wool was tested using EPA's Toxicity Characteristics Leaching Procedure (TCLP). Results showed there were no detectable contaminants or detectable leachable contaminants that exceeded the regulatory levels. Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under Federal regulations, it is the waste generator's responsibility to properly characterize a waste material, to determine if it is a "hazardous" waste. Check local, regional, state or provincial regulations to identify all applicable disposal requirements.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

Hazard Class:	Not regulated	United Nations (UN) Number:	Not applicable
Labels:	Not applicable	North America (NA) Number:	Not applicable
Placards:	Not applicable		
Bill of Lading:	Product name		

INTERNATIONAL

Not classified as dangerous goods under ADR (road), RID (train), IATA (air) or IMDG (ship).

15. REGULATORY INFORMATION

UNITED STATES REGULATIONS

SARA Title III:	This product does not contain any substances reportable under Sections 302, 304, 313 (40 CFR 372). Sections 311 and 312 apply.
OSHA:	Comply with Hazard Communication Standards 29 CFR 1910.1200 and 29 CFR 1926.59 and Respiratory Protection Standards 29 CFR 1910.134 and 29 CFR 1926.103.
TSCA:	CMS wools have been assigned two CAS numbers; however, they are not required to be listed on the TSCA inventory.
CERCLA:	CMS wool contains fibers with an average diameter greater than one micron and thus is not considered a CERCLA hazardous substance.
CAA:	CMS wool contains fibers with an average diameter greater than one micron and thus is not considered a hazardous air pollutant.
States:	CMS wools are not known to be regulated by any State. If in doubt, contact your local regulatory agency.

INTERNATIONAL REGULATIONS

Canada WHMIS:	No Canadian Workplace Hazardous Materials Information System categories apply to this product.
Canadian EPA:	All substances in this product are listed, as required, on the Domestic Substance List (DSL).
European Union:	These products are exonerated from any carcinogenic classification in the countries of the European Union under the provisions of Nota Q of the European Commission Directive 97/69/EC.

MATERIAL SAFETY DATA SHEET

MSDS No: 350	Date Prepared: 03/24/1992	Current Date: 7/26/2002 Last Revised: (03/20/2002)

16. OTHER INFORMATION

SUPERWOOL™ DEVITRIFICATION

As produced, Superwools™ are vitreous (glassy) AES Wools that do not contain crystalline silica. Continued exposure to elevated temperatures (>900^{0}C) may cause these materials to form crystalline phases, including crystalline silica. The occurrence and extent of crystalline silica formation is dependent on the duration and temperature of exposure, CMS Wool chemistry and/or the presence of fluxing agents. The presence of crystalline silica can be confirmed only through laboratory analysis of the "hot face" fiber. If crystalline silica is present, follow appropriate hygiene standards and national regulations.

Devitrified, after-service Superwool™, containing crystalline silica, has shown no adverse reactions in toxicity assays (See Section 11). These findings are consistent with IARC's evaluation, which states "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)" and additionally notes "carcinogenicity in humans was not detected in all industrial circumstances studied. Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs." (IARC Monograph Vol. 68, 1997).

Respirable dust from devitrified Superwool™ products can be controlled with ventilation, dust collectors or respiratory protection as detailed in Section 8 (above). Ventilation and respiratory protection should be provided in compliance with OSHA standards. The evaluation of workplace hazards and, if necessary, the identification of appropriate respiratory protection is best performed by qualified Industrial Hygienists.

For more information, call the Thermal Ceramics Product Stewardship Hotline (800-722-5681).

PRODUCT STEWARDSHIP PROGRAM

Morgan Thermal Ceramics has established a program to provide customers with up-to-date information regarding the proper use and handling of Superwool™. If you would like more information about this program, please call your local supplier or visit one of the following web sites.

Thermal Ceramics - Global	www.thermalceramics.com
Refractory Ceramic Fibers Coalition (USA)	www.RCFC.net
ECFIA (Europe)	www.ecfia.org

LABELING

As product information labels may be required on Superwool™ packages, check local destination regulations before shipping.

HMIS HAZARD RATING

HMIS Health:	1
HMIS Flammable:	0
HMIS Reactivity:	0

HMIS Personal Protective: To be determined by user

DEFINITIONS

MATERIAL SAFETY DATA SHEET

MSDS No: 350	Date Prepared: 03/24/1992	Current Date: 7/26/2002 Last Revised: (03/20/2002)

ACGIH:	American Conference of Governmental Industrial Hygienists
ADR:	Carriage of Dangerous Goods by Road (International Regulation)
CAA:	Clean Air Act
CAS:	Chemical Abstracts Service Registry Number
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act
EPA:	Environmental Protection Agency
EU:	European Union
f/cc:	Fibers per cubic centimeter
HEPA:	High Efficiency Particulate Air
HMIS:	Hazardous Materials Identification System
IARC:	International Agency for Research on Cancer
IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m^3 :	Milligrams per cubic meter of air
mppcf:	Million particles per cubic meter
MSHA:	Mine Safety and Health Administration
NFPA:	National Fire Protection Association
NIOSH:	National Institute for Occupational Safety and Health
OSHA:	Occupational Safety and Health Administration
PEL:	Permissible Exposure Limit
PNOC:	Particulates Not Otherwise Classified
PNOR:	Particulates Not Otherwise Regulated
RCRA:	Resource Conservation and Recovery Act
RID:	Carriage of Dangerous Goods by Rail (International Regulation)
SARA:	Superfund Amendments and Reauthorization Act
Title III:	Emergency Planning and Community Right to Know Act
…Section 302:	Extremely Hazardous Substances
…Section 304:	Emergency Release
…Section 311:	MSDS/List of Chemicals
…Section 312:	Emergency and Hazardous Inventory
…Section 313:	Toxic Chemicals Release Reporting
STEL:	Short-Term Exposure Limit
TCLP:	Toxicity Characteristics Leaching Procedures (EPA)
TLV:	Threshold Limit Values (ACGIH)
TSCA:	Toxic Substance Control Act
WHMIS:	Workplace Hazardous Materials Information System (Canada)

29 CFR 1910.134 & 1926.103: OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59: OSHA Hazard Communication Standards

Revision Summary: MSDS re-formatted in its entity. Minor changes applied.

MSDS Prepared By: THERMAL CERAMICS ENVIRONMENTAL, HEALTH & SAFETY DEPARTMENT

DISCLAIMER

Reasonable care has been taken in the preparation of the information contained in this Material Safety Data Sheet and the information provided is given in good faith. However, Thermal Ceramics Inc. assumes no responsibility as to the accuracy or suitability of such information and no warranty, expressed or implied, is made.