



PSP 2012

FOR REFRACTORY CERAMIC FIBERS

The manufacturers of refractory ceramic fiber (“RCF”)¹ based products have been and remain committed to workplace measures intended to promote the health and safety of their employees and customers. Therefore, the principal members of the refractory ceramic fiber industry plan to continue to implement the recommendations of the voluntary Product Stewardship Program (“PSP”) to continue to protect and safeguard workers and address the RCF-related interests of the Occupational Safety and Health Administration (“OSHA”), the National Institute for Occupational Safety and Health (“NIOSH”) and the Environmental Protection Agency (“EPA”).

The members of the HTIW Coalition, which include Thermal Ceramics Inc., Unifrax I LLC, ANH Refractories and Nutec Fibratex (based in Mexico), are committed to implementation of the PSP recommendations described herein.² The HTIW Coalition

1 Refractory ceramic fiber (“RCF”), CAS # 142844-00-6, belongs to a family of inorganic materials commonly referred to as synthetic vitreous fibers (“SVF”), which also includes fiber glass, mineral wool and rock wool. RCF’s are also referred to as man-made vitreous fibers (“MMVF”), man-made mineral fibers (“MMMMF”), or synthetic mineral fibers.

2 The HTIW Coalition was formed in 2011 to replace its predecessor the Refractory Ceramic Fibers Coalition (“RCFC”), which previously implemented this program. HTIW Coalition members produce all of the RCF manufactured in North America. As explained further below, the HTIW Coalition umbrella also includes new, more soluble fiber products developed pursuant to the research and development elements of this program. “RCFC” is used in this document to refer to specific actions taken by or directed to the predecessor

and its member companies will seek continued support and endorsement of the PSP by the aforementioned agencies following consultation on key program elements and priorities. In addition, the HTIW Coalition and its member companies will seek to continue the cooperative working relationships with these agencies, which have proven valuable in promoting worker health and safety.

The HTIW Coalition and its member companies recognize that the PSP should embody comprehensive recommendations for addressing RCF-related interests and promote recommended work practices and exposure reduction by encouraging customers and their employees to utilize training aids, such as videos and other relevant literature. This commitment, called PSP 2012, builds on the history of the PSP by the RCF industry. Throughout the history of the PSP, it has been customary to revisit the program requirements on a five-year basis. This PSP 2012 continues that tradition and represents the third iteration of the program that was first endorsed by OSHA in 2002. Key differences between PSP 2012 and the prior program, which was known as PSP-HTW, are addressed in the relevant discussions below.

BACKGROUND

RCF was first commercialized in the early 1950's. Over time, until the mid-1980's, health effects testing of synthetic vitreous fibers, including RCF, did not reveal any noteworthy toxic properties. Later testing at the Los Alamos National Laboratories (circa 1985) suggested the potential for RCF-related lung disease. Subsequently (circa 1988-1992), the industry sponsored a maximum tolerated dose ("MTD") study and a multi-dose study at the Research Consulting Company ("RCC") laboratories in Geneva, Switzerland. These animal studies (Fischer 344 rats) indicated that lifetime exposure to specially prepared, rodent-respirable RCF produced no significant health effects at the lowest dose level (approximately 25 f/cc), an upward sloping dose-response curve with

organization; in all other instances "HTIW Coalition" is used to refer to both the predecessor and the current organization.

increasing dose (approximately 75 and 150 f/cc), and noteworthy impacts (fibrosis, lung cancer and mesothelioma) following high dose (approximately 200 f/cc) exposure. In addition, a separate MTD study was conducted in hamsters (Syrian Golden). No dose-response curve could be determined in that study as only one high dose was administered. The hamster study produced pulmonary and pleural fibrosis and mesothelioma, but no lung cancer. These studies were insufficient to determine the significance to workers with occupational exposure (as most workplace exposures are below 0.5 f/cc); nonetheless, the studies did indicate a set of potential health effects that warranted further investigation and analysis, along with the implementation of prudent risk reduction measures. [For a more detailed description of the health studies and some associated risk reduction measures, see Attachment 1 – a generic Safety Data Sheet (“SDS”) representing the information typically available to those using RCF products.]

In the 1990's, the RCF industry began to interact with Federal regulatory agencies interested in RCF exposure issues. As a part of its PSP, the HTIW Coalition and its predecessors continuously have communicated and cooperated with various regulators to address their concerns. Key aspects of these regulatory relationships are summarized below.

Occupational Safety and Health Administration

Section 6 (a) of the Occupational Safety and Health Act of 1970 directed the Secretary of Labor to promulgate permissible exposure limits (“PELs”) to promote occupational health and safety, which were to be based upon federal or national consensus standards. Section 6 (b) of the Act set out the procedures for OSHA to follow in updating, revising and promulgating additional PELs. Recognizing that PELs could become outdated as new scientific evidence becomes available, OSHA instituted rulemaking efforts to update a large number of PELs.

In June, 1992, OSHA proposed to amend PELs for air contaminants in the construction, maritime and agricultural industries. In this notice, OSHA also proposed the addition of manmade mineral fibers, including RCF, to the Table Z list of air contaminants, with a proposed PEL of 1 f/cc (57 Fed. Reg. pp 26195-202, covering the general industry as well), which was equivalent to the recommended exposure guideline (“REG”) adopted by the HTIW Coalition in 1991. In proposing the 1 f/cc PEL, OSHA stated:

OSHA is proposing a 1 f/cc 8-hour TWA limit for the respirable fibers of fibrous glass, including refractory ceramic fibers. OSHA preliminarily concludes that this limit will substantially reduce the significant risk of nonmalignant respiratory disease that exists in the absence of a limit for workers in all sectors...At this time OSHA believes it is premature for the Agency to reach a final decision on an exposure limit based on carcinogenicity. However, the proposed limit will also clearly increase the protection of workers from this effect as well.

Prior to that proposal, there were no specific OSHA limits governing occupational exposures to refractory ceramic fiber, although RCF is subject to OSHA’s 15 mg/m³ (5 mg/m³ respirable) 8-hour TWA limit for total respirable dusts and particulates not otherwise regulated.

In 1992, the United States Court of Appeals for the Eleventh Circuit vacated and remanded the air contaminants rule for general industry. As a result of the court’s decision, OSHA withdrew the proposed rule, including the proposed PEL for refractory ceramic fiber. HTIW Coalition members supported the proposed PEL of 1 f/cc (at that time), and were disappointed in the court’s decision and subsequent withdrawal of the proposal.

Subsequently, OSHA announced its proposed “Priority Planning Process” in August, 1994. This system was designed to prioritize potential occupational safety and health concerns in order to target agency resources for standard setting. The results of OSHA’s “Priority Planning Process” were announced on December 13, 1995. “Synthetic mineral fibers” was one of the substances identified by OSHA as a priority.

Regarding synthetic fibers, OSHA indicated that the Agency “will work with business, labor, the professional community, and the states as partners to encourage worker protection without developing new rules at this time.” In particular, OSHA endorsed “voluntary approaches [that] seek to correct workplace hazards through cooperative actions.” OSHA also indicated that three different action approaches would be considered for the priorities not slated for rulemaking: 1) intervention approach; 2) voluntary approach; and 3) informational approach.

RCFC and its member companies worked closely with OSHA to formalize the existing PSP as a “voluntary approach” and in 2002, OSHA endorsed a five year voluntary product stewardship program, called PSP 2002 (see press releases and letters in Attachment VIII). In 2004, Assistant Secretary Henshaw congratulated RCFC for its efforts under PSP 2002 (see August 3, 2004 letter in Attachment VIII). The subsequent program, PSP-HTW, continued and built upon PSP 2002. PSP-HTW was endorsed by Assistant Secretary Faulke in 2007 (see May 23, 2007 letter in Attachment VIII). This PSP 2012 continues that tradition and represents the third iteration of the program that was first endorsed by OSHA in 2002.

National Institute for Occupational Safety and Health (NIOSH)

NIOSH has had a long-term interest in “fibers” in general and a particular interest in RCF since the late 1980's. NIOSH conducted health hazard evaluations at a power plant [Gorman, 1987] and a foundry [Cantor, 1987] using RCF insulation. In 1990, NIOSH conducted a health hazard technology assessment at a steel foundry [O'Brien, 1990]. NIOSH collected and analyzed RCF samples. In 1992, NIOSH conducted a health hazard evaluation at an RCF manufacturing facility [Lyman, 1992]. Company industrial hygiene data, collected from 1980 to 1988, were provided to NIOSH for review.

In 2006, NIOSH published its “Criteria for a Recommended Standard, Occupational Exposure to Refractory Ceramic Fibers”, <http://www.cdc.gov/niosh/docs/2006-123/>. NIOSH conducted a comprehensive review of the published scientific literature and other scientific information concerning occupational exposure to RCF. Based on this review, NIOSH recommends an exposure limit of 0.5 f/cc of air as a time-weighted average concentration for up to a 10 hour work shift during a 40 hour work week. A copy of the NIOSH press release may be found at <http://www.cdc.gov/niosh/updates/upd-06-12-06.html> and in Attachment VIII.

The HTIW Coalition and NIOSH have engaged in partnering agreements principally focused on joint assessments of the efficiency of various engineering controls in controlling RCF fiber emissions.

Environmental Protection Agency

Following submission of the results of RCF toxicological experiments from the HTIW Coalition’s predecessor, RCFC, EPA took an active interest in assessing the risks associated with RCF manufacturing and use. On November 21, 1991 [56 Fed. Reg. 58693], EPA initiated a priority review of RCF pursuant to Section 4(f) of the Toxic Substances Control Act (“TSCA”). Upon conclusion of the Section 4(f) review, EPA determined: (1) the RCF data furnished no basis for action to address “imminent hazards” under TSCA Section 7; (2) a significant new use rule (“SNUR”) for RCF under TSCA, Section 5, may be appropriate; and (3) the available data were not sufficient to determine whether exposure to RCF poses unreasonable risk which would justify additional EPA action under TSCA, Section 6.

EPA decided to initiate a further investigation of RCF, which would “include a more comprehensive evaluation of risk and a consideration of the benefits of the substance, the economic consequences of regulation and actions undertaken by the industry to reduce exposures . . .” On May 14, 1993 [58 Fed. Reg. 28517], EPA announced the

signing of a voluntary Consent Agreement with RCFC and its member companies. Commenting on the RCFC PSP, EPA stated:

In addition to developing the exposure monitoring consent order with EPA, RCFC has developed and implemented a Product Stewardship Program (PSP). The program consists of seven elements: health effects research, workplace exposure monitoring, workplace exposure control measures, exposure assessments, product research, special studies, and a communications program. EPA is particularly encouraged by the commitment of RCFC to monitor workplace exposures to RCFs, and to look for ways to reduce exposures. EPA believes that such a program is a significant step towards the reduction in the risk of RCFs. Results from the exposure testing consent order should help determine the effectiveness of industry's stewardship of RCFs.

The EPA agreement required RCFC members to perform exposure monitoring for the purposes of estimating average workplace concentrations, studying time trends and comparing estimated exposures across functional job categories. Exposure monitoring data were compiled and submitted to EPA every six months for a period of five years³. The obligations of the consent agreement were successfully completed in mid-1998.

Upon the conclusion of the agreement, RCFC and EPA generally agreed that (1) atmospheric RCF emissions are quantitatively small, and are of negligible concern to general public health or the environment, and (2) any initiatives taken should focus principally towards exposure management in the workplace.

Regulatory Interest Conclusion

For over 20 years, the HTIW Coalition has consulted with OSHA, NIOSH and EPA over a wide variety of RCF-related issues and data. This consultative process was productive in that it enabled important points of view from experienced individuals to be

3 RCFC also had periodic meetings with OSHA and NIOSH to share the data and analyses submitted to EPA pursuant to the Consent Agreement.

considered. The HTIW Coalition and its member companies and their PSP 2012 will continue to benefit from the interest and involvement of the aforementioned agencies.

A PRODUCT STEWARDSHIP PROGRAM APPROACH **FOR REFRACTORY CERAMIC FIBER PRODUCTS**

Member companies of the HTIW Coalition began to develop and implement a comprehensive PSP for RCFs in 1990. The PSP is designed to assist RCF manufacturers and end-users in the evaluation, control and reduction of workplace exposures to RCFs. Program recommendations are intended to help ensure the proper handling, manufacture, storage, use and disposal of RCF products. The PSP is composed of key elements that include: communications, workplace monitoring, evaluation of workplace controls, exposure assessments, health effects research, product research and special studies. In addition, the PSP encourages the implementation of engineering and process controls in the workplace and the use of appropriate respirators together with other personal protective equipment. The experience, data and evaluations conducted during the past fifteen years have resulted in substantial reductions in RCF workplace exposures and provided a firm foundation for prioritizing future PSP initiatives.

The HTIW Coalition and its member companies have taken the initiative to develop a new product stewardship strategic plan, entitled PSP 2012. The predecessors of PSP 2012, PSP-HTW and PSP-2002, were voluntary plans compiled with the counsel of representatives from OSHA, EPA and NIOSH, as well as the input of a variety of stakeholders representing organized labor, associated industry groups, end-users and other interested parties. PSP 2012 continues this comprehensive program and is designed to build upon the successes of the past as well as to focus resources upon the highest priorities for future stewardship efforts. The program envisions a continued working and reporting relationship with regulators, particularly OSHA and NIOSH, and other interested stakeholders and, as a successor to the prior PSPs, enters into its third five year term after two successful five year periods. Just as originally envisioned in 2002, PSP 2012 will continue to be composed of the following key elements.

KEY FEATURES OF PSP 2012

Scope⁴ - PSP 2012 applies to the manufacture, fabrication, furnace-lining installation and removal, and other occupational settings where exposure to refractory ceramic fiber may occur. The HTIW Coalition and its member companies will be directly responsible for implementing the recommendations of PSP 2012 in their own operations. In addition, the HTIW Coalition and its member companies will undertake the activities described herein to educate RCF end-users about PSP 2012 and the implications for possible regulatory oversight, to encourage compliance with these guidelines, and to encourage appropriate associations to adopt PSP 2012 guidelines.

The HTIW Coalition and its member companies believe that it is not in the best interest of the industry or its customers to acquiesce to situations where the spirit and intent of PSP 2012 is being ignored. As a result, the HTIW Coalition and its member companies will use their best efforts to educate RCF users who are known to allow persistent inconsistencies with the guidelines of PSP 2012 and to encourage mitigation of such inconsistencies. If such actions do not succeed, the HTIW Coalition and its members will consider further actions to facilitate consistency with the PSP guidelines. If the HTIW Coalition or its members become aware of RCF importers whose actions are substantially inconsistent with this Program, appropriate regulatory authorities will be notified.

4 PSP 2012 involves two separate groups: (1) RCF manufacturers and (2) RCF contractors, customers and end-users. RCF manufacturers are committing to implementing the recommendations noted herein. When referring to RCF manufacturers, operative words like “will” and “shall” have been used to demonstrate a proactive commitment. With regard to the second group (e.g., end-users), operative words like “recommend” and “encourage” have been used to indicate a desired behavior or result, but reflect the RCF manufacturers’ lack of control over the second group. Any phrasing ambiguity, regarding relative roles and responsibilities of each group, should be addressed within the general context of the intent described in this footnote.

One of the key elements of the RCF PSP is a research program to develop new fiber products that present less potential hazard for RCF workers. This is known as the "3D program" because it addresses the three key elements of potential fiber toxicity -- dose, dimension and durability. This research program has resulted in development of alkaline earth silicate ("AES") wools, also known as "soluble" fibers."⁵ Results of animal toxicity tests indicate that these new soluble fiber products are likely to significantly reduce any potential hazard from workplace fiber exposure.⁶ Although these products have many of the same market applications as RCF, they are not substitutes for RCF in all applications at the present time because they do not tolerate continuous service temperatures as high as RCF and in certain applications they have insufficient mechanical properties.

Recognizing the potential of these additional products for hazard reduction, the North American RCF manufacturers have decided to expand the scope of their product stewardship efforts to include other high temperature insulating wools. In furtherance of this decision, the members of RCFC have changed the name of their trade association to HTIW Coalition. In addition to RCF's, the product stewardship efforts of the Coalition will now also encompass AES wools and polycrystalline wool ("PCW") products.⁷

The AES wools have chemical compositions that are dramatically different from typical RCF products. This class of fiber chemistries incorporates various combinations to produce a relatively non-durable fiber product with desirable high temperature capabilities. As non-durable chemicals, these fiber types are regarded as presenting little hazard potential. Members of the Coalition also manufacture and/or market a range of high alumina polycrystalline fiber products that are used in applications with service temperatures higher than those tolerated by either AES wools or RCF. PCW fibers typically are of greater diameter and length than either AES wools or RCF and do not

5 AES wools, CAS No. 436083-99-7, are also SVFs.

6 See, for example, Fraunhofer certificates at <http://www.morganthermalceramics.com/resources/superwool-resources/>

7 PCW, CAS No. 675106-31-7, are crystalline as opposed to vitreous MMMFs.

produce significant quantities of respirable fibers in use, thereby resulting in very low doses for exposed workers.

For these reasons, a comprehensive program such as PSP 2012 does not appear appropriate at present for the AES wools and PCW fiber products, and they are not included in PSP 2012, which remains limited to RCF-based products. However, the Coalition continues to recommend feasible reduction of employee exposure to respirable dusts. In the absence of other guidance, the Coalition has found that it is generally feasible to control occupational fiber exposures for AES wools and PCW fibers to 1 f/cc or less. These principles will be reflected in the MSDSs, training materials and other related information distributed by the Coalition with respect to these products.

Recommended Exposure Guideline – In the absence of an RCF PEL, the HTIW Coalition members utilize a recommended exposure guideline (“REG”) of 0.5 f/cc, 8-hour TWA. The REG is based upon the data obtained pursuant to the PSP and EPA Consent Agreement discussed above, which indicate that it is generally feasible⁸ to maintain a workplace concentration of 0.5 f/cc with engineering controls in many RCF operations, and the the HTIW Coalition philosophy that it is prudent to implement feasible and necessary workplace engineering controls.⁹ [See Attachment II]

The REG is not based upon any conclusion of relative hazard or risk. Attainment of the REG is expected to reduce any risk that may exist from higher workplace concentrations. A detailed and comprehensive quantitative risk assessment¹⁰ is

8 Furnace lining installation and removal, and some finishing activities are notable exceptions. End-users should examine available engineering and process control technology and employ practicable methods to reduce ambient fiber concentrations, where appropriate. Currently available engineering and process controls may be ineffective for these job tasks, hence respirator use may be required.

9 The term “feasible,” as used throughout this document, means technologically and economically feasible.

10 Quantitative Risk Assessment of Refractory Ceramic Fibers in the Occupational Environment, Sciences International, Inc., 1998; Quantitative Assessment of the Risk of

available, which HTIW Coalition members believe provides useful insight into the potential effectiveness of the RCF PSP.

PSP 2012 continues to be premised upon a recommendation to reduce RCF exposures to the lowest feasible level. The REG for RCF is a useful benchmark in this regard. Where it is feasible to reduce workplace concentrations to levels below 0.5 f/cc, we recommend doing so. Where workplace concentrations have been reduced to levels below 0.5 f/cc, the HTIW Coalition recommends continued efforts to maintain the lowest levels consistently achieved.

At this time, the HTIW Coalition is not proposing to revise the 0.5 f/cc REG, as our data continue to show that attainment of this guideline is not feasible in many operations in the absence of respirator use. However, the data also indicate that in many exposure scenarios an 8-hour time weighted average ("TWA") fiber concentration of 0.25 fibers f/cc may be necessary to maintain the REG consistently. Further, many RCF operations now are attaining concentration levels at or below 0.25 f/cc.

Despite this historical improvement, the data presented in the Coalition's 2011 Report to OSHA indicate that, in some job categories, rates of improvement have decreased, suggesting that we are near the limits of present control technologies.¹¹ This was recognized by OSHA officials in the April 2011 annual meeting with the Coalition to discuss PSP results. While RCF manufacturers and customers continue to demonstrate high rates of compliance with the industry's REG (93% - 96%, including effects of respirators), weighted average TWA concentrations increased in 2010, after having declined substantially over the years. Such upticks have occurred in the past

Lung Cancer Associated with Occupational Exposure to Refractory Ceramic Fibers, S. Moolgavkar, et.al., Risk Analysis, Vol. 19, Number 4, 1999; Lung Cancer Risk Associated with Exposure to Man-Made Fibers, S. Moolgavkar, et.al., Drug and Chemical Toxicology, 23(1), p. 223-242, 2001.

11 See Everest Consulting Associates, "PSP-HTW: A Voluntary Product Stewardship Program, 2011 Report to OSHA" (March 2011).

and are within the historical statistical variability of the data. Nonetheless HTIW Coalition members took actions described in the Report to identify “assignable causes” for these increases and to implement measures to reduce fiber concentrations. The precise measures are described in detail in the Report (pp. 36-37, 42-44).

The HTIW Coalition intends to build on these efforts during the term of PSP 2012 by establishing a pilot program to reduce reliance on respiratory protection in job categories where the TWA concentrations consistently have been above the REG. A committee will be established to identify the job categories that should be addressed and to choose specific industry segments and sites at which corrective measures similar to those described in the 2011 Report to OSHA will be implemented. Successful measures will then be recommended to customers with similar operations.

In this manner, the Coalition hopes to stimulate further reduction of the TWA concentrations for RCF job categories to levels below the REG within the time frame of this program. Should future data indicate that airborne concentrations below the REG generally are feasible, the Coalition will take action to reduce the REG to the new feasible level.

Control Measures – The HTIW Coalition and its member companies will strive to use product design, engineering controls, work practices, respiratory protection or a combination thereof to achieve, for each of its workers, exposure control consistent with the provisions of this Program. While engineering controls will be used where feasible and necessary, the industry may utilize other techniques to assure worker protection. Where workplace exposures are currently below the voluntary 0.5 f/cc, 8-hour TWA REG, the HTIW Coalition and its member companies are committed to a continuing improvement program to reduce workplace exposure further.

The HTIW Coalition and its member companies will also provide information to RCF product users regarding exposure control techniques and best practices. The HTIW

Coalition and its member companies will, on a case-by-case basis, provide assistance or guidance to end-users and encourage users to develop and implement effective exposure controls.

Work Practices - The HTIW Coalition and its member companies will continue to encourage employers and employees to follow proper handling guidelines for RCF. The HTIW Coalition will continue to provide recommended work practice guidelines, in both video and written format. These work practices will include recommendations for cost-effective engineering controls, proper respirator use, use of protective clothing and workplace handling guidelines. These work practice guidelines demonstrate the industry's product stewardship commitment and its desire to promote the continuous improvement of appropriate handling and use techniques for RCF products. [See Attachment III]

Worker Training - The HTIW Coalition and its member companies will continue to provide health and safety training for their employees consistent with applicable OSHA requirements for Hazard Communication and ultimately consistent with the Global Harmonization System of Classification and Labeling of Chemicals ("GHS"). In addition, the HTIW Coalition and its member companies will continue to provide health and safety training to end-users, consistent with targets established herein. HTIW Coalition member companies will also participate in trade shows, conferences and other relevant events that provide suitable forums for communicating RCF-related health and safety information and guidance to end-users. The HTIW Coalition will develop a communications program designed to promote and advertise training seminars and other training opportunities.

Respirator Use - The HTIW Coalition and its member companies support OSHA's respiratory protection standards [29 CFR 1910.134 and 29 CFR 1926.103] that form the basis for the HTIW Coalition's respiratory protection program. Training programs and

materials will incorporate all relevant requirements of OSHA's respiratory protection standard.

The HTIW Coalition and its member companies will utilize appropriate respiratory protection when employee exposures are not "reliably" below the industry guidelines contained herein (based upon task-specific information; preferably employer-specific data, but relevant data from other sources may also be used). The HTIW Coalition and its member companies will recommend the use of appropriate respiratory protection to end-users, in the circumstances where occupational exposures may exceed industry guidelines and effective engineering controls are not readily available [See Attachment IV].

When workers use respirators, the HTIW Coalition recommends the use of respirators certified by NIOSH under 42 CFR Part 84. The Coalition believes that the correct respirator for the vast majority of RCF workplace exposures is N-95. This is clarified in the NIOSH Pocket Guide to Chemical Hazards, reprinted at <http://www.cdc.gov/niosh/npg/npgd0432.html>. RCFs are within the category of manmade mineral fibers. With respect to such fibers, the Guide provides:

Respirator Recommendations

NIOSH

Up to 5X REL:

(APF = 5) Any quarter-mask respirator.

Up to 10X REL:

(APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100.

Pursuant to these recommendations, N-95 respirators are appropriate for exposures up to 10 times the NIOSH Recommended Exposure Limit (REL). With respect to RCF, both the NIOSH REL and the industry REG have been set at 0.5 fibers per cubic centimeter of air (f/cm³). Accordingly, N-95 would provide the necessary protection for exposures up to 5 f/cm³. The exposure levels measured by both OSHA and contemporaneous industry sampling are well below this level. Further, the Respirator Selection Guide published by 3M Corporation, the primary respirator manufacturer, specifically recommends use of N-95 respirators for RCF exposures (<http://www2.lbl.gov/ehs/chsp/html/OdorThresholds-3MRespiratorSelectionGuide.pdf> page 84). In cases where exposures are known to be above 5.0 f/cc, 8-hour TWA, a filter efficiency of 100% should be used.¹²

End-users will be advised that employers are subject to the provisions of the OSHA respiratory protection standard [29 CFR 1910.134] and that OSHA may consider the HTIW Coalition's respirator use recommendations during evaluations of end-user compliance with the standard. The HTIW Coalition and its member companies will encourage RCF users to use respiratory protection consistent with PSP 2012, and to comply with the provisions of OSHA's respiratory protection standard applicable to employer required programs (29 CFR 1910.134). In situations where no respiratory protection is recommended under PSP 2012, HTIW Coalition member companies will provide appropriate respiratory protection upon the request of their employees, provided the employer determines that such respirator use will not in itself create a hazard, and will encourage other employers to do so as well.

12 The NIOSH Criteria Document for RCF recommends a 100 series filter because it has an assigned protection factor (APF) of 10. See NIOSH, "Occupational Exposure to Refractory Ceramic Fibers, Criteria for a Recommended Standard," p. 7 (May 2006). However, the CD recommendation is not explained further, and the NIOSH guidance quoted above indicates that N-95 respirators are considered to have an APF of 10.

The HTIW Coalition, in consultation with EPA, OSHA, NIOSH and other parties, will review this program periodically and will modify it expeditiously where a change is appropriate.

Medical Monitoring - HTIW Coalition manufacturing companies will maintain medical monitoring programs for workers producing RCF, consistent with acceptable surveillance practices and protocols. The medical monitoring program was designed by epidemiology researchers at the University of Cincinnati to investigate and identify any incidence of RCF-related health effects. In particular, the study employs chest X-rays and spirometry tests to identify potential instances of fibrosis, lung cancer or mesothelioma. There are no specific medical monitoring requirements for RCF, therefore the researchers have incorporated the study elements that they believe to be the most appropriate for a study population exposed to respirable fiber dusts. [See Attachment V for a more detailed description.]

Exposure Monitoring - The HTIW Coalition and its member companies will continue RCF exposure monitoring in their facilities to ensure that employee exposure is well controlled and consistent with the guidance contained herein. [See Attachment VI]

The HTIW Coalition and its member companies will encourage end-users to evaluate workplace exposures to RCF. On a case-by-case basis, the HTIW Coalition and its member companies may use trained professionals (e.g., Industrial Hygienists, HVAC Engineers, etc.) to assist end-users in determining worker exposures, and to advise them on engineering controls, respiratory protection and proper handling practices. The HTIW Coalition and its member companies will ensure that the employers and employees being monitored are provided with the results of any monitoring activities. Exposure monitoring results will be provided, in summary form, to others, without entity identification. In other cases, the HTIW Coalition and its member companies may recommend contractors or consultants, who have the appropriate skills and experience, to assist end-users with exposure monitoring efforts; the end-user will be encouraged to

share monitoring results with the HTIW Coalition with the same attention to entity confidentiality. In addition, the HTIW Coalition and its member companies will commit monitoring resources towards identifying best practices for engineering and process controls along with improved handling practices.

The HTIW Coalition and its member companies will continue to utilize the current database of representative exposure limits for manufacturing and end-use applications for RCF to identify opportunities to promote exposure reduction initiatives. The HTIW Coalition will update and maintain its exposure database to show changes in exposure, over time, (1) generally, and for (2) specific operations and (3) types of workers. In addition, the HTIW Coalition will evaluate the success of various techniques employed to reduce exposure.

Product Research – The HTIW Coalition will continue to encourage research to develop new, improved RCF product forms. New RCF product research generally focuses on three key elements - dose, dimension and durability. To reduce the potential for worker exposure (i.e., reduce dose), various methods are being explored to contain RCF. HTIW Coalition members are investigating options to alter the size distribution (i.e., dimension) of RCF to reduce the fraction in the respirable range (less than 3 microns in diameter) while maintaining key performance properties.

Because RCF is a mature product that has been extensively tested, there are no plans for any new, significant testing program for RCF. The manufacture of new RCF-based products may incorporate improvements in engineering or process controls, encapsulation of fibers, or other similar measures designed to control the release of airborne fibers.

From time to time, each HTIW Coalition member company may develop and introduce other fiber chemistries that fall outside of the range of RCF compositions (RCF is typically made from kaolin clay or a combination of alumina and silica). As discussed

above, the HTIW Coalition and its member companies include non-RCF products (e.g., AES wools and PCW) in their product stewardship efforts. However these non-RCF products are not included within the scope of PSP 2012.

Consumer Products - The HTIW Coalition and its member companies will continue to use their best efforts to ensure that exposures in consumer product applications are well controlled. Use of RCF in a consumer product in a manner that may cause significant exposure, under proper use and maintenance conditions, is deemed to be inconsistent with the intent of PSP 2012.

Waste Minimization and Disposal - The HTIW Coalition and its member companies will continue to study, recommend and implement waste minimization programs designed to reduce quantities of waste produced per unit of product and to increase recycling rates where practicable and effective. The HTIW Coalition also shall continue to study after-service and solid waste handling procedures of HTIW Coalition members and their customers and to recommend appropriate handling procedures for disposal of friable RCF wastes.

Environmental Responsibility - HTIW Coalition members will continue to design and/or modify their processes to minimize consumption of natural resources and energy and to eliminate, to the extent feasible, the generation of waste materials and releases to the environment. In so doing, the companies will continue to focus on source reduction as the preferred approach to waste management, followed by internal recycle/recovery. Treatment or disposal will be employed as a last resort.

HTIW Coalition members will strive to design and/or modify their products and packaging in a manner that minimizes environmental impact throughout the product's life cycle. This includes ultimate disposal in a manner that assures that all applicable regulatory requirements are met.

Reporting - The HTIW Coalition, on behalf of its member companies, will generate interim annual reports to OSHA to document progress on PSP 2012 during the first four years and generate a detailed report to OSHA at the end of five years. The HTIW Coalition and its member companies intend to make copies of the interim annual PSP 2012 reports and the comprehensive five year report available to NIOSH, EPA and various customer organizations. The HTIW Coalition plans to complete the first interim summary annual report upon completion of the first monitoring year in the next five year period, with subsequent interim summary reports upon completion of monitoring years through the subsequent four years of PSP 2012.

The HTIW Coalition's five year report will detail the specific activities undertaken by the Coalition and its member companies to implement PSP 2012 during the second five year period. The five year report will provide detailed exposure monitoring results and information on program performance, including progress on program deliverables and specific measures of program performance. [See Attachment VII]. The reports also will provide details of the latest available information from the HTIW Coalition's epidemiological study and medical surveillance program. The HTIW Coalition recognizes that the recipient agencies may make the annual reports available to affected employee organizations or other interested parties.

In addition, throughout the term of this program the HTIW Coalition will keep OSHA, NIOSH and EPA officials informed of significant developments in the scientific and medical assessment of RCF products through periodic informal meetings. Prior to the conclusion of PSP 2012, the HTIW Coalition and its member companies will consult with OSHA, NIOSH and EPA regarding the desire and need for further efforts to address RCF-related matters. The HTIW Coalition also will continue to be available for annual meetings with OSHA, NIOSH and EPA if desired.

Compliance Date - The HTIW Coalition and its member companies have maintained an aggressive Product Stewardship Program since 1990. PSP initiatives are routinely

undertaken and are ongoing. Implementation schedules for individual PSP 2012 initiatives will be adopted and used to track progress and compliance. [See Attachment VI and VII]

CONCLUSION

The HTIW Coalition and its member companies are confident that PSP 2012 addresses the key components of RCF product stewardship. This voluntary program continues many of the initiatives embraced during the past twenty years along with additional elements. The HTIW Coalition and its member companies recognize that substantial uncontrolled workplace exposure to RCF may present a potential hazard to employees, and this program is intended to present recommendations for reducing or eliminating any such potential hazard.

The industry recognizes that it is prudent to adopt RCF exposure controls where feasible and necessary. Compliance with PSP 2012 is likely to reduce potential health risks in places of employment and other activities involving RCF manufacturing or use. Further, the industry also recognizes that PSP 2012 is an appropriate vehicle for encouraging the continued reduction of RCF workplace exposures, at both manufacturing and end-user facilities, and that there are engineering controls, work practices and personal protective equipment readily available to implement PSP 2012.

The HTIW Coalition and its member companies recognize that PSP 2012 is a voluntary program. However, the HTIW Coalition and its members believe that compliance with the PSP recommendations is an effective and preferable alternative to additional RCF regulation. While PSP 2012 is designed to coordinate the management of RCF-related issues and initiatives over a five year term, the HTIW Coalition and its member companies recognize that significant, new scientific developments or material changes in the positions recommended by recognized and credible expert bodies may make it necessary for the HTIW Coalition to modify PSP 2012 at an earlier date. Should any such scientific developments or material changes occur, the HTIW Coalition will inform any regulatory representatives involved with PSP 2012, RCF end-users and other interested parties.

SAFETY DATA SHEET

This sample SDS represents a generic composite of the information typically made available in RCF SDSs provided by HTIW Coalition member companies.

SAFETY DATA SHEET

SDS No. M0001

Effective Date: []

1. IDENTIFICATION

(a) Product identifier used on the label [Trade name] REFRACTORY CERAMIC FIBER (RCF)

(b) Other means of identification **BULK FIBERS**
[Trade names]

BLANKETS
[Trade names]

PAPERS
[Trade names]

[Other]

- (c) Recommended use of the chemical and restrictions on use
- **Primary Use:** Refractory Ceramic Fiber (RCF) materials are used primarily in industrial high temperature insulating applications. Examples include heat shields, heat containment, gaskets, expansion joints, industrial furnaces, ovens, kilns, boilers and other process equipment at applications up to 1400°C. RCF based products are not intended for direct sale to the general public. While RCFs are used in the manufacture of some consumer products, such as catalytic converter mats and wood burning stoves, the materials are contained, encapsulated, or bonded within the units.
 - **Secondary Use:** Conversion into wet and dry mixtures and articles (refer to section 8).
 - **Tertiary Use:** Installation, removal (industrial and professional) / Maintenance and service life (industrial and professional) (refer to section 8).

Uses Advised Against

Spraying of dry product.

d) Name, address, and telephone number [Manufacturer Name]
[Manufacturer Address]

Product Stewardship Information Hotline
[Number]

For additional information or SDSs, visit our web page, [http://www.\[website\].com](http://www.[website].com) or call [number]

(e) Emergency phone number [Emergency number]

2. HAZARDS IDENTIFICATION

(a) Classification of the chemical in accordance with paragraph (d) of §1910.1200

The U.S. Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (HCS) 2012 indicates that IARC Group 2B corresponds to OSHA HCS 2012 Category 2 carcinogen classification (see, e.g., §1910.1200, Appendix F, Part D).

(b) Signal word, hazard statement(s), symbol(s) and precautionary statement(s) in accordance with paragraph (f) of §1910.1200

Under OSHA HCS 2012, RCF is classified as a category 2 carcinogen.

Hazard Pictogram



Signal Word

Warning

Hazard Statements

Suspected of causing cancer by inhalation.

Precautionary statements

Do not handle until all safety instructions have been read and understood.

Use respiratory protection as required; see section 8 of the Safety Data Sheet.

If concerned about exposure, get medical advice.

Store in a manner to minimize airborne dust.

Dispose of waste in accordance with local, state and federal regulations.

Supplementary Information

May cause temporary mechanical irritation to exposed eyes, skin or respiratory tract.

Minimize exposure to airborne dust.

(c) Describe any hazards not otherwise classified that have been identified during the classification process

Mild mechanical irritation to skin, eyes and upper respiratory system may result from exposure.

These effects are usually temporary.

(d) Mixture rule

Not applicable.

3. COMPOSITION / INFORMATION ON INGREDIENTS

(a) <u>Chemical Name</u>	(c) <u>AS Number</u>	<u>REACH Reg. No.</u>	<u>% BY WEIGHT</u>
Refractory Ceramic Fiber (RCF)	142844-00-6	01-2119458050-50-XXXX	100

(b) Common Name

Refractory Ceramic Fiber

Synonyms: RCF, ceramic fiber, Alumino Silicate Wool (ASW), synthetic vitreous fiber (SVF), man-made vitreous fiber (MMVF), man-made mineral fiber (MMMF), high temperature insulation wool (HTIW)

(d) Impurities and stabilizing additives

Not applicable.

4. FIRST AID MEASURES

(a) Description of necessary measures, subdivided according to the different routes of exposure, i.e., inhalation, skin and eye contact, and ingestion

SKIN

Handling of this material may cause mild mechanical temporary skin irritation. If this occurs, rinse affected areas with water and wash gently. Do not rub or scratch exposed skin.

EYES

In case of eye contact, flush abundantly with water; have eye wash available. Do not rub eyes.

NOSE AND THROAT

If these become irritated move to a dust free area, drink water and blow nose. If symptoms persist, seek medical advice.

(b) Most important symptoms/effects, acute and delayed

Mild mechanical irritation to skin, eyes and upper respiratory system may result from exposure. These effects are usually temporary.

(c) Indication of immediate medical attention and special treatment needed, if necessary

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

(a) Suitable (and unsuitable) extinguishing media

Use extinguishing agent suitable for surrounding combustible materials.

(b) Specific hazards arising from the chemical (e.g., nature of any hazardous combustion products):

Non-combustible products, class of reaction to fire is zero.
Packaging and surrounding materials may be combustible

(c) Special protective equipment and precautions for fire-fighters

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

6. ACCIDENTAL RELEASE MEASURES

(a) Personal precautions, protective equipment, and emergency procedures

Minimize airborne dust. Compressed air or dry sweeping should not be used for cleaning. See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines.

(b) Methods and materials for containment and cleaning up

Frequently clean the work area with vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

7. HANDLING AND STORAGE

(a) Precautions for safe handling

Handle fiber carefully to minimize airborne dust. Limit use of power tools unless in conjunction with local exhaust ventilation. Use hand tools whenever possible.

(b) Conditions for safe storage, including any incompatibilities

Store in a manner to minimize airborne dust.

EMPTY CONTAINERS

Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

(a) OSHA permissible exposure limit (PEL), American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV), and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the safety data sheet, where available

<u>Component</u>	<u>OSHA PEL</u>	<u>NIOSH REL</u>	<u>ACGIH TLV</u>	<u>MANUFACTURER REG</u>
Refractory Ceramic , Fiber (RCF),	None established*	0.5 f/cc, 8-hr. TWA	0.2 f/cc TLV, 8-hr. TWA	0.5 f/cc, 8-hr. TWA**

*Except for the state of California, where the PEL for RCF is 0.2 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/m³; Respirable Fraction 5 mg/m³.

**In the absence of an OSHA PEL, the HTIW Coalition has adopted a recommended exposure guideline (REG), as measured under NIOSH Method 7400 B. For further information on the history and development of the REG see "Rationale for the Recommended Exposure Guideline" at Attachment II of the HTIW Coalition Product Stewardship Program http://www.htiwcoalition.org/documents/PSP_2012.pdf.

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

RCF-related occupational exposure limits vary internationally. Regulatory OEL examples include: California, 0.2 f/cc; Canadian provincial OELs ranging from 0.2 to 1.0 f/cc. The objectives and criteria underlying each of these OEL decisions also vary. The evaluation of occupational exposure limits and the determination of their applicability to the workplace are best performed, on a case-by-case basis, by a qualified Industrial Hygienist.

(b) Appropriate 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.

(c) Individual protection measures, such as personal protective equipment

Skin Protection

Wear personal protective equipment (e.g gloves), 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, employees should be informed on best practices to minimize non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, and rinse washer before washing other household clothes.

Eye Protection

As necessary, wear goggles or safety glasses with side shields.

Respiratory Protection

When engineering and/or administrative controls are insufficient to maintain workplace concentrations below the 0.5 f/cc REG or a regulatory OEL, the use of appropriate respiratory protection, pursuant to the requirements of OSHA Standards 29 CFR 1910.134 and 29 CFR 1926.103, is recommended. A NIOSH certified respirator with a filter efficiency of at least 95% should be used. The 95% filter efficiency recommendation is based on NIOSH respirator selection logic sequence for exposure to manmade mineral fibers. Pursuant to NIOSH recommendations, N-95 respirators are appropriate for exposures up to 10 times the NIOSH Recommended Exposure Limit (REL). With respect to RCF, both the NIOSH REL and the industry REG have been set at 0.5 fibers per cubic centimeter of air (f/cm³). Accordingly, N-95 would provide the necessary protection for exposures up to 5 f/cm³. Further, the Respirator Selection Guide published by 3M Corporation, the primary respirator manufacturer, specifically recommends use of N-95 respirators for RCF exposures. In cases where exposures are known to be above 5.0 f/cm³, 8 hour TWA, a filter efficiency of 100% should be used. Other factors to

consider are the NIOSH filter series N, R or P -- (N) **N**ot resistant to oil, (R) **R**esistant to oil and (P) oil **P**roof. These recommendations are not designed to limit informed choices, provided that respiratory protection decisions comply with 29 CFR 1910.134.

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.

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.

9. PHYSICAL AND CHEMICAL PROPERTIES

(a) Appearance	White, fibrous wool	(j) Upper/lower flammability or explosive limits	Not applicable
(b) Odor	Odorless	(k) Vapor pressure	Not applicable
(c) Odor threshold	Not applicable	(l) Vapor density	Not applicable
(d) pH	Not applicable	(m) Relative density	2.50 - 2.75
(e) Melting point	1760° C (3200° F)	(n) Solubility	Insoluble
(f) Initial boiling point and boiling range	Not applicable	(o) Partition coefficient: n-octanol/water	Not applicable
(g) Flash point	Not applicable	(p) Auto-ignition temperature	Not applicable
(h) Evaporation rate	Not applicable	(q) Decomposition temperature	Not applicable
(i) Flammability	Not applicable	(r) Viscosity	Not applicable

10. STABILITY AND REACTIVITY

(a) Reactivity

RCF is non-reactive.

(b) Chemical stability

As supplied RCF is stable and inert.

(c) Possibility of hazardous reactions

None.

(d) Conditions to avoid

Please refer to handling and storage advice in Section 7.

(e) Incompatible materials

None.

(f) Hazardous decomposition products

None.

11. TOXICOLOGICAL INFORMATION

For more details on scientific publications referenced in this SDS see <http://www.htiwcoalition.org/publications.html> (a) through (d)

TOXICOKINETICS, METABOLISM AND DISTRIBUTION

Basic Toxicokinetics

Exposure is predominantly by inhalation or ingestion. Man-made vitreous fibers of a similar size to RCF have not been shown to migrate from the lung and/or gut and do not become located in other organs of the body.

Human Toxicological Data/Epidemiology Data

In order to determine possible human health effects following RCF exposure, the University of Cincinnati has been conducting medical surveillance studies on RCF workers in the U.S.A; this epidemiological study has been ongoing for 25 years and medical surveillance of RCF workers continues. The Institute of Occupational Medicine (IOM) has conducted medical surveillance studies on RCF workers in European manufacturing facilities.

Pulmonary morbidity studies among production workers in the U.S.A. and Europe have demonstrated an absence of interstitial fibrosis. In the European study a reduction of lung capacity among smokers has been identified, however, based on the latest results from a longitudinal study of workers in the U.S.A. with over 17-year follow-up, there has been no accelerated rate of loss of lung function (McKay et al. 2011).

A statistically significant correlation between pleural plaques and cumulative RCF exposure was evidenced in the U.S.A. longitudinal study.

The U.S.A. mortality study showed no excess mortality related to all deaths, all cancer, or malignancies or diseases of the respiratory system including mesothelioma (LeMasters et al. 2003).

Information on Toxicological Effects

- *Acute toxicity: short term inhalation*
No data available: Short term tests have been undertaken to determine fiber (bio) solubility rather than toxicity; repeat dose inhalation tests have been undertaken to determine chronic toxicity and carcinogenicity.
- *Acute toxicity: oral*
No data available: Repeated dose studies have been carried out using gavage. No effect was found.
- *Skin corrosion/irritation*
Not a chemical irritant according to test method OECD no. 404.
- *Serious eye damage/irritation*
Not possible to obtain acute toxicity information due to the morphology and chemical inertness of the substance.
- *Respiratory or skin sensitization*
No evidence from human epidemiological studies of any respiratory or skin sensitization potential.
- *Germ cell mutagenicity/genotoxicity*
Method: In vitro micronucleus test

Species: Hamster (CHO)
Dose: 1-35 mg/ml
Routes of administration: In suspension
Results: Negative

- *Carcinogenicity*

Method: Inhalation, multi-dose

Species: Rat

Dose: 3 mg/m³, 9 mg/m³ and 16 mg/m³

Routes of administration: Nose only inhalation

Results: Fibrosis just reached significant levels at 16 and 9 mg/m³ but not at 3 mg/m³. None of the parenchymal tumor incidences were higher than the historical control values for this strain of animal.

Method: Inhalation, single dose

Species: Rat

Dose: 30 mg/m³

Routes of administration: Nose only inhalation

Results: Rats were exposed to a single concentration of 200 WHO fibers/ml specially prepared RCF for 24 months. High incidence of exposure-related pulmonary neoplasms (bronchoalveolar adenomas and carcinomas) was observed. A small number of mesotheliomas were observed in each of the fiber exposure groups (Mast et al 1995a).

Method: Inhalation, single dose

Species: Hamster

Dose: 30 mg/m³

Routes of administration: Nose only inhalation

Results: Hamsters were exposed to a single concentration of 260 WHO fibers/ml specially prepared RCF for 18 months and developed lung fibrosis, a significant number of pleural mesotheliomas (42/102) but no primary lung tumors (McConnell et al 1995).

Method: Inhalation, single dose

Species: Rat

Dose: RCF1: 130 F/ml and 50 mg/m³ (25% of non fibrous particles)

RCF1a: 125 F/ml and 26 mg/m³ (2% of non fibrous particles)

Routes of administration: Nose only inhalation

Results: Rats were exposed to RCF1 and RCF1a for 3 weeks. The objective of the study was to compare lung retention and biological effects of the original RCF1 compared to RCF1a. The main difference of these 2 samples was the non-fibrous particle content of respectively 25% versus 2%. The post treatment observation was 12 months. Alveolar clearance was barely retarded after RCF1A exposure. After RCF1 exposure, however, a severe retardation of clearance was observed. (Bellmann et al 2001).

After intraperitoneal injection of ceramic fibers into rats in three experiments (Smith et al 1987, Pott et al 1987, Davis et al 1984), mesotheliomas were found in the abdominal cavity in two studies, while the third report (Pott et al 1987) had incomplete histopathology. Only a few mesotheliomas were found in the abdominal cavity of hamsters after intraperitoneal injection in one experiment (Smith et al 1987). However, the ceramic fibers tested were of relatively large diameter. When rats and hamsters were exposed via intraperitoneal injection, tumor incidence was related to fiber length and dose (Smith et al 1987, Pott et al 1987, Miller et al 1999, Pott et

al 1989). (From SCOEL publication (EU Scientific Committee on Occupational Exposure Limits) SCOEL/SUM/165, September 2011).

- *Reproductive toxicity*
Method: Gavage
Species: Rat
Dose: 250mg/kg/day
Routes of administration: Oral
Results: No effects were seen in an OECD 421 screening study. There are no reports of any reproductive toxic effects of mineral fibers. Exposure to these fibers is via inhalation and effects seen are in the lung. Clearance of fibers is via the gut and the feces, so exposure of the reproductive organs is extremely unlikely.
- *STOT-Single exposure*
Not applicable
- *STOT-Repeated exposure*
Not applicable
- *Aspiration hazard*
Not applicable

See the following review publications for a summary and discussion:

Interpretation of these animal experiments is complex and there is not complete agreement among scientists internationally. A summary of the evidence relating to RCF carcinogenicity in vivo can be found in SCOEL/SUM/165 and in Utell and Maxim 2010.

Other information

Numerous studies indicate the relevance of biopersistence as a determinant of toxic effects of fiber exposure. (Maxim et al 2006).

Irritant Properties

Negative results have been obtained in animal studies (EU method B 4) for skin irritation. Inhalation exposures using the nose only route produce simultaneous heavy exposures to the eyes, but no reports of excess eye irritation exist. Animals exposed by inhalation similarly show no evidence of respiratory tract irritation.

Human data confirm that only mechanical irritation, resulting in itching, occurs in humans. Screening at manufacturers' plants in the UK has failed to show any human cases of skin conditions related to fiber exposure.

(e) International Agency for Research on Cancer and National Toxicology Program

IARC, in 1988, Monograph v.43 (and later reaffirmed in 2002, v.81), classified RCF as possibly carcinogenic to humans (group 2B). IARC evaluated the possible health effects of RCF as follows:

- There is inadequate evidence in humans for the carcinogenicity of RCF.
- There is sufficient evidence in experimental animals for the carcinogenicity of RCF.

The Annual Report on Carcinogens (latest edition), prepared by NTP, classified respirable RCF as "reasonably anticipated" to be a carcinogen).

Not classified by OSHA.

12. ECOLOGICAL INFORMATION (Non-mandatory)

- | | |
|---|---|
| (a) Ecotoxicity (aquatic and terrestrial, where available) | No known aquatic toxicity. |
| (b) Persistence and degradability | These products are insoluble materials that remain stable over time and are chemically identical to inorganic compounds found in the soil and sediment; they remain inert in the natural environment. |
| (c) Bioaccumulative potential | No bioaccumulative potential. |
| (d) Mobility in soil | No mobility in soil. |
| (e) Other adverse effects (such as hazardous to the ozone layer) | No adverse effects of this material on the environment are anticipated. |

13. DISPOSAL CONSIDERATIONS (Non-mandatory)

Waste Management

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

Disposal

This product, as manufactured, is not classified as a listed or characteristic hazardous waste according to U. S. Federal regulations (40 CFR 261). Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under U. S. 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 (Non-mandatory)

- | | |
|---|------------------------|
| (a) UN number | Not Applicable |
| (b) UN proper shipping name | Not Applicable |
| (c) Transport hazard class(es) | Not Applicable |
| (d) Packing group, if applicable | Not Applicable |
| (e) Environmental hazards (e.g., Marine pollutant (Yes/No)) | Not a marine pollutant |
| (f) Transport in bulk (according to Annex II of MARPOL 73/78 and the IBC Code) | Not Applicable |
| (g) Special precautions which a user needs to be aware of, or needs to comply with, in connection with transport or conveyance either within or outside their premises | Not Applicable |

Canadian TDG Hazard Class & PIN: Not regulated.

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

15. REGULATORY INFORMATION (Non-mandatory)

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).

Hazard Categories: Immediate Hazard – No
Delayed Hazard – Yes
Fire Hazard – No
Pressure Hazard – No
Reactivity Hazard - No

Toxic Substances Control Act (TSCA) - RCF is not required to be listed on the TSCA inventory.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the **Clean Air Act (CAA)** - this product 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)** – 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).

Europe **Integration of RCF into ANNEX XV of the REACH Regulation**

RCF is classified under the CLP (classification, labelling and packaging of substances and mixtures) regulation as a category 1B carcinogen. On January 13, 2010 the European Chemicals Agency (ECHA) updated the candidate list for authorization (Annex XV of the REACH regulation) and added 14 new substances in this list including aluminosilicate refractory ceramic fibers.

As a consequence, EU (European Union) or EEA (European Economic Area) suppliers of articles which contain aluminosilicate refractory ceramic fibers in a concentration above 0.1% (w/w) have to provide sufficient information, available to them, to their customers or upon requests to a consumer within 45 days of the receipt of the request. This information must ensure safe use of the article, and as minimum contains the name of the substance.

16. OTHER INFORMATION

Product Stewardship Program

[Manufacturer name] has established a program to provide customers with up-to-date information regarding the proper use and handling of refractory ceramic fiber. In addition, [Manufacturer name] 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 Product Stewardship Information Hotline at [phone number].

In 2002, OSHA endorsed a five year voluntary product stewardship program called PSP 2002. On May 23, 2007, HTIW Coalition's predecessor, RCFC, and its member companies renewed this voluntary product stewardship agreement with OSHA. On April 16, 2012, HTIW Coalition renewed this agreement.

This new five year program, called PSP 2012, continues and builds upon the earlier programs. PSP 2012 is a highly acclaimed, multifaceted strategic risk management initiative designed specifically to reduce workplace exposures to refractory ceramic fiber (RCF). For more information regarding PSP 2012, please visit <http://www.htiwcoalition.org>

Hazardous Materials Identification System (HMIS) Hazard Rating

HMIS Health	1* (* denotes potential for chronic effects)
HMIS Flammable	0
HMIS Reactivity	0
HMIS Personal Protective Equipment	X (To be determined by user)

Additional Information on After Service Material

As produced, all RCF fibers are vitreous (glassy) materials which do not contain crystalline silica. Continued exposure to elevated temperatures over time may cause these fibers to devitrify (become crystalline). The first crystalline formation (mullite) begins to occur at approximately 985° C (1805° F). Crystalline phase silica may begin to form at approximately 1100° C (2012° F). When the glass RCF fibers devitrify, they form a mixed mineral crystalline silica containing dust. The crystalline silica is trapped in grain boundaries within a matrix predominately consisting of mullite. 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 or furnace contaminants. 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 also studied mixed mineral crystalline silica containing dusts such as coal dusts (containing 5–15 % crystalline silica) and diatomaceous earth without seeing any evidence of disease. (IARC Monograph Vol. 68, 1997). NTP lists all polymorphs of crystalline silica as 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 EPA, 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 micrograms/cm² - by comparison, pure quartz or cristobalite were significantly active at much lower levels (circa 20 micrograms/cm²).

Revision Summary: Entire SDS revised to align with OSHA HCS 2012

Revision Date: [Date]

SDS Prepared By: [Manufacturer name]

DISCLAIMER

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Safety Data Sheet. Employers may use this SDS 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 SDS. Therefore, given the summary nature of this document, [manufacturer name] 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.

**RATIONALE FOR THE
RECOMMENDED EXPOSURE GUIDELINE (“REG”)**

REG HISTORY

There is no specific regulatory standard in the United States that governs occupational exposure to refractory ceramic fiber materials; however, laboratory investigations have indicated that specially prepared, rodent-respirable RCF caused adverse health effects, including cancer, in test animals in high doses. In the 1980’s, the RCF industry took the initiative to establish an initial REG of 2.0 f/cc, which was based upon a desire to minimize exposures to airborne fibers where necessary and feasible. Subsequently, in 1991, RCFC reduced the REG to 1.0 f/cc when it appeared that engineering or process controls were sufficiently developed to attain lower airborne concentrations. Monitoring data, accumulated during the mid-’90s, indicated that establishing a revised REG at 0.5 f/cc would be feasible in many RCF operations and consistent with the continuous improvement philosophy of the industry’s Product Stewardship Program. As a result, RCFC acted to establish a lower REG of 0.5 f/cc on October 31, 1997.

Like its predecessors, the 0.5 f/cc REG was based upon prudence and the belief that attainment of the REG would, in general, be feasible; it was not based upon any finding of significant risk at occupational exposure levels.¹ The RCF manufacturers continue to believe that the current scientific information for RCF does not permit reasonably accurate assessment of quantitative workplace health risk. The 0.5 f/cc REG was based solely upon an assumption that “less exposure is better” and a finding from exposure monitoring data that suggested a lower REG would be feasible for many occupational environments within the foreseeable future. Monitoring data, at the time,

1 The term “feasible,” as used throughout this document, means technologically and economically feasible.

also demonstrated that certain tasks (e.g., product finishing, installation and removal) would have an extremely difficult time complying with the REG, hence use of respiratory protection would be appropriate in those operations.

OTHER VIEWS ON THE SUBJECT

The REG recommended by the HTIW Coalition is not the only opinion on the subject. For example, NIOSH adopted 0.5 f/cc as the Recommended Exposure Limit (“REL”) in its 2006 “Criteria for a Recommended Standard, Occupational Exposure to Refractory Ceramic Fibers”, <http://www.cdc.gov/niosh/docs/2006-123/>. The American Conference of Governmental Industrial Hygienists (“ACGIH”) adopted a Threshold Limit Value of 0.2 f/cc for RCF. The HTIW Coalition reviewed ACGIH’s documentation in support of the TLV and found that it did little to provide an underlying rationale or analytical underpinning for such an exposure limit. In fact, previously, the National Academy of Sciences conducted a “Review of the U.S. Navy’s Exposure Standard for Manufactured Vitreous Fibers”, May 2000. In their review, the Academy stated that “In 1997, ACGIH proposed an exposure level of 0.1 f/cc for RCF, which was amended to a proposed 0.2 f/cc in 2000, but ACGIH has not provided a scientific rationale for either of these levels.”

In many countries, including the US, there is no regulatory standard that specifically addresses occupational exposure to RCF. However, some countries have examined the available science and established a regulatory standard. The following table provides examples of Occupational Exposure Levels (“OELs”) established in other countries.

COUNTRY	OEL
Australia	0.5 f/ml
Austria	0.5 f/ml
Belgium	0.5 f/ml
Canada	0.2-1.0 depending on province
Czech Republic	1.0 f/ml
Denmark	1.0 f/ml
Finland	0.2 f/ml

France	0.1 f/ml
Germany	None (0.5 0.25 f/ml for new sites)
Italy	0.2 f/ml
New Zealand	1.0 f/ml
Norway	0.1 f/ml
Poland	0.5 f/ml
Spain	0.5 f/ml
Sweden	0.2 f/ml
Switzerland	0.25 f/ml
The Netherlands	0.5 f/ml
UK	1.0 f/ml

The HTIW Coalition has concluded that its REG represents a level of workplace control that is generally feasible in most (although not all) operations with engineering and work practice controls. Moreover, PSP 2012 contains several provisions designed to ensure continuous improvement. For example:

- The PSP encourages reduction of workplace concentrations below 0.5 f/cc where the engineering controls necessary to do that are economically and technologically feasible, and the monitoring data indicate that in many operations it is already feasible to reduce workplace concentrations below the 0.5 f/cc REG;
- In many instances, reliable maintenance of the 0.5 f/cc REG may require control to lower levels;
- The PSP encourages continued improvement where feasible, regardless of attainment of the 0.5 f/cc REG;
- The PSP recommends use of respirators where exposures are unknown or where requested by employees.

Further, the PSP provides many other protections, in addition to the REG. Examples include recommended work practices and handling guidelines, communications and employee training provisions, medical monitoring and exposure monitoring.

QUANTITATIVE RISK ASSESSMENT

The HTIW Coalition also sponsored an analytical assessment of the risks associated with occupational exposure to RCF. The study entitled, "Quantitative Risk Assessment of Refractory Ceramic Fibers in the Occupational Environment (April 1998)" was prepared by Sciences International, Inc. and was based on the results of the animal studies conducted at RCC in the late 1980's. To date, there is no excess respiratory disease in the population exposed to RCF. The study team found that, on average, there would be less than one (0.68) excess cancer in the entire RCF exposed population (estimated to be about 30,000 domestically) when the best-fit model employed actual workplace exposures and identified respirator use. Although uncertainty remains given the range of assumptions used in the analysis, the study suggests that efforts to attain the 0.5 f/cc REG are likely to provide significant workplace protection.

A NEW REG NOW: POTENTIAL IMPLICATIONS

The HTIW Coalition has examined the current feasibility of adopting a REG below the recommended 0.5 f/cc level. Although the average exposure for all tasks combined is currently below the REG, there are a significant number of samples that are over or near that level. Hence, attaining broad compliance with the current REG, given the variability of the data, presents a noteworthy challenge.

A statistical analysis of the exposure monitoring database, maintained by Everest Consulting Associates, indicates that to achieve a 95% level of confidence that exposures remain consistently below the 0.5 f/cc REG (due to sample-to-sample variability), average workplace concentrations should be maintained below the REG. Manufacturers and customers alike will already be challenged with the prospect of

managing their workplace concentrations to ensure consistent attainment of the current REG.

Given the analysis of the HTIW Coalition's exposure monitoring data and the HTIW Coalition's assessment of currently available dust control technologies, it would not be technologically and economically feasible to maintain a lower REG now. Were the HTIW Coalition to adopt a lower REG at this time, it would further exacerbate the already difficult task of achieving consistent attainment of the REG. That said, the HTIW Coalition remains committed to the basic principle of "continuous improvement", especially in the area of exposure control and reduction.

FUTURE EFFORTS

Despite this historical improvement, the data presented in the Coalition's 2011 Report to OSHA indicates that in some job categories rates of improvement have decreased, suggesting that we are near the limits of present control technologies.² This was recognized by OSHA officials in the April 2011 annual meeting with the Coalition to discuss PSP results. While RCF manufacturers and customers continue to demonstrate high rates of compliance with the industry's REG (93% - 96%, including effects of respirators), weighted average TWA concentrations increased in 2010, after having declined substantially over the years. Such upticks have occurred in the past and are within the historical statistical variability of the data. Nonetheless HTIW Coalition members took actions described in the Report to identify "assignable causes" for these increases and to implement measures to reduce fiber concentrations. The precise measures are described in detail in the Report (pp. 36-37, 42-44).

The HTIW Coalition intends to build on these efforts during the term of PSP 2012 by establishing a pilot program to reduce reliance on respiratory protection in job

2 See Everest Consulting Associates, "PSP-HTW: A Voluntary Product Stewardship Program, 2011 Report to OSHA" (March 2011).

categories where the TWA concentrations consistently have been above the REG. A committee will be established to identify the job categories that should be addressed and to choose specific industry segments and sites at which corrective measures similar to those described in the 2011 Report to OSHA will be implemented. Successful measures will then be recommended to customers with similar operations.

In this manner, the Coalition hopes to stimulate further reduction of the TWA concentrations for RCF job categories to levels below the REG within the time frame of this program. Should future data indicate that airborne concentrations below the REG generally are feasible, the Coalition will take action to reduce the REG to the new feasible level.

In addition, during the term of PSP 2012, the HTIW Coalition plans to continue investigating ways to identify the “best practices” for specific engineering and process controls and to document improved handling guidelines. The first investigation of this kind yielded a document entitled: “Unit Operational Code of Practice & Engineering Control Guidebook – Band Saws,” which was published and distributed by RCFC. In this guideline, RCFC member companies’ Industrial Hygienists were able to design and test dust collection equipment for a type of band saw typically used for RCF finishing operations. Results showed that airborne concentrations could be reduced by greater than 99% percent through the use of well-designed dust collection techniques. As such, this assessment creates a “best-practices” benchmark to measure against; the HTIW Coalition recommends that end-users use this approach, or other similarly effective techniques, to control airborne RCF concentrations to levels consistently below the REG.

Based on an analysis of the Exposure Monitoring database and the product stewardship experiences gained during the past 20 years, the prior iterations of the PSP focused “best practices” investigations on certain criteria: (1) operations with the highest relative

exposures, (2) operations / equipment that are commonly used in the RCF industry, (3) work practices that present a significant potential to improve exposure control. These investigations often have resulted in findings that allow manufacturers and customers to employ superior methods without the time and cost associated with trial and error. For example, RCFC published four Work Practice Guidelines (all available on the HTIW Coalition's web site and attached hereto in Attachment III): RCF Finishing Operations, RCF Blanket Cutting, RCF After-Service Removal and Batching of RCF (including a discussion of water-misting techniques).

These "best practices" guides provide a basis for future recommendations that do not merely depend upon attainment of a single exposure limit or REG, especially when there are techniques readily available to achieve improved exposure control for specific operations. In particular, during the term of PSP 2012, the HTIW Coalition and interested regulators will evaluate these best practices guidelines to determine the suitability and feasibility of using them to establish operation-specific, exposure-control performance standards and investigate opportunities to develop additional best practices. In the interim, the HTIW Coalition will strongly encourage RCF end-users to employ these best practices techniques, or other similarly effective approaches, to ensure ambient fiber concentrations are well controlled.

CONCLUSION

The HTIW Coalition has demonstrated its willingness to re-evaluate its REG and to act to lower the REG when it is feasible to do so. The HTIW Coalition is committed to continuous improvement in exposure control and periodically will re-examine the REG to determine the feasibility of reducing it further.

It is clear that there are a variety of views regarding what occupational RCF exposure level is appropriate. Each view depends on a perspective and a set of assumptions that

may be dramatically different. The range of opinions reflect general uncertainty, which is due to the lack of sufficient data needed to make a definitive, unambiguous determination of “safe” exposure threshold to which all parties agree.

Nevertheless, what seems to be most important is that all parties (e.g., OSHA, NIOSH, EPA, the HTIW Coalition, etc.) share a common interest in controlling RCF exposures and in taking the initiative to reduce exposures when it is feasible to do so. It is hoped that through PSP 2012, labor, industry, regulators and other interested stakeholders can each contribute to the effort to reduce RCF exposures and a future review of the REG. The HTIW Coalition retains the principal responsibility for taking action on the initiatives described in PSP 2012, however there is room for all interested parties to make a meaningful contribution.

RECOMMENDED WORK PRACTICES

1.0 GENERAL WORK PRACTICES APPLICABLE TO ALL WORK INVOLVING REFRACTORY CERAMIC FIBERS (RCF)

- 1.1 These recommended work practices are intended to be consistent with all applicable Federal (OSHA), State and Local requirements.
- 1.2 In accordance with OSHA's Hazard Communication Standard ("HAZCOM"), employees must receive training on the health effects, means of exposure, methods of protection and safe handling of RCF products. Compliance with all other applicable HAZCOM requirements shall be maintained.
- 1.3 Limiting contact with fibers will reduce potential skin irritation and the risk of adverse health effects. This Appendix describes several methods that will make the handling of RCF more appropriate and comfortable.

2.0 MINIMIZE DUST GENERATION

- 2.1 Keep all material in its packaging as long as practicable.
- 2.2 Tools and handling techniques that generate the least amount of dust should be used whenever possible. Hand tools should be used whenever possible. To the extent practicable, if power tools are to be used, they should be equipped with appropriate dust control systems.

- 2.3 Practice good housekeeping procedures. To the extent practicable, keep work areas clean and free of scrap RCF material.
- 2.4 Employ practicable work practices to minimize the creation of airborne dust. Follow good housekeeping procedures. Vacuum only with HEPA filtered equipment or an equivalent. If sweeping is necessary, use a dust suppressant and place material in closed containers. Do not use compressed air for clean-up purposes.
- 2.5 Where repair or maintenance of equipment either insulated with RCF or covered with settled RCF dust is necessary, clean the equipment first with a HEPA filtered vacuum or equivalent (where possible) or wipe the surface clean with a wet rag to remove excess dust and loose fibers.
- 2.6 Avoid unnecessary handling of scrap materials to prevent release of fiber. Where practicable, the use of covered disposal containers is recommended.

3.0 VENTILATION

- 3.1 Unless other proper procedures and control measures have been implemented, dust collection systems equipped with filtration media designed to capture RCF, (for example, HEPA filters) should be used in manufacturing and fabrication settings where appropriate and practicable.
 - 3.2.1 Prior to recirculation into interior work spaces, air containing RCFs should be filtered by a filtration media designed to capture RCF's.
 - 3.2.2 If ventilation systems are used to capture RCFs, they should be routinely checked and maintained.

4.0 WEAR APPROPRIATE CLOTHING

- 4.1 Some individuals develop temporary mechanical skin irritation (which is based on fiber shape - not a chemical interaction) when exposed to RCF. Skin irritation can be avoided by preventing RCFs from coming in contact with the skin. When irritation is of concern, wear long-sleeved, loose-fitting clothing, gloves and head covering to prevent skin irritation.
- 4.2 Remove RCF dust from work clothes, with a HEPA-filtered vacuum or other effective method, before leaving the work area.
- 4.3 Where it is practicable to do so for permanent work stations where employee exposures are not maintained reliably below the REG, employers are encouraged to provide employees with laundered (or disposable) work clothing, an area to change out of work clothes, and shower facilities. Where it is not practicable to do so, employers should ensure employees are trained on the best practices to minimize or avoid non-work dust exposure (e.g., vacuum clothing, wash work clothing separately, rinse washer before washing other household clothes, etc.).

5.0 WEAR APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT

- 5.1 With respect to RCF exposure, employers shall comply with all applicable provisions of 29 CFR Subpart I (governing the use of personal protective equipment).
- 5.2 To minimize upper respiratory tract irritation and other potential health hazards, measures should be taken to control exposure to airborne fiber. Such measures

will be dictated by the work environment and may include appropriate respiratory protective equipment.

- 5.3 When respiratory protection is used, employers shall follow the OSHA Respiratory Protection Standard, 29 CFR 1910.134 for general industry or the equivalent standard for other industry sectors. When respirators are needed by workers, the respirators must be certified by NIOSH under 42 CFR Part 84.
- 5.4 Safety glasses with side shields or other forms of eye protection in compliance with the appropriate SDS or OSHA standard should be worn whenever RCF products are being handled and airborne fibers are being generated or whenever required by the employer.
- 5.5 Personal protective equipment should be properly fitted and worn when required. Employers shall provide proper personal protective equipment where required.

6.0 REMOVAL OF FIBERS FROM THE SKIN AND EYES

- 6.1 With respect to RCF exposures, employers shall comply with all applicable provisions of 29 CFR, Subpart K (governing medical services and first aid).
- 6.2 If fibers accumulate on the skin, do not rub or scratch. Never remove fibers from the skin by blowing with compressed air. Wash exposed skin thoroughly.
- 6.3 If a skin rash develops due to mechanical irritation, wash the affected area gently with soap and water. The use of skin cream or lotion after washing may be helpful. Do not rub or scratch the exposed skin. Changing into clean clothing is recommended.

6.4 Should RCFs become deposited within the eye, do not rub the eyes. Flush them with water, or eyewash solution (if available). Consult a physician if irritation persists.

7.0 HANDLING PROCEDURES FOR SPECIFIC RCF APPLICATIONS³

7.1 FIBER PRODUCTION

7.1.1 In the absence of monitoring information which demonstrates that worker exposures are well-controlled (e.g., "reliably"⁴ below the REG of 0.5 f/cc, 8-hour TWA), workers engaged in "off-line fiber chopping" activities should wear the respirator specified in the applicable SDS or, if one is not specified, a NIOSH certified respirator with a filter efficiency of at least 95%. In cases where exposures are known to be above 5.0 f/cc, 8-hour TWA, a filter efficiency of 100% should be used.

7.1.2 All workers engaged in off-line fiber chopping operations should wear safety glasses with side shields or other forms of eye protection in compliance with the appropriate SDS or OSHA standard and gloves where it is appropriate to do so.

3 Applicable respiratory protection recommendations are more completely described in Attachment IV.

4 At this point, and elsewhere with similar references, airborne concentrations should be "reliably" below the REG of 0.5 f/cc (based upon task-specific information; preferably employer-specific data, but relevant data from other sources may also be used). Under OSHA's "action level" concept, airborne concentrations at one-half the REG would clearly be considered to be "reliably" below the REG. Under this PSP 2012, airborne concentrations are considered to be reliably below the REG if statistically valid monitoring indicates that average airborne concentrations are not likely to exceed the REG. End users should contact the fiber supplier for the most recent HTIW Coalition monitoring data and information on how to obtain employer-specific data.

7.1.3 Off-line fiber chopping activities have the potential to generate elevated levels of airborne dust. Use of engineering controls (dust collection) is recommended.

7.1.4 Keep all work surfaces clean and free of dust and debris.

7.2 FINISHING ACTIVITIES

7.2.1 In the absence of monitoring information which demonstrates that worker exposures are well-controlled (e.g., “reliably” below the REG of 0.5 f/cc, 8-hour TWA), workers engaged in “finishing” activities (e.g., cutting, sanding, planing, etc.) should wear the respirator specified in the applicable SDS or, if one is not specified, a NIOSH certified respirator with a filter efficiency of at least 95%. In cases where exposures are known to be above 5.0 f/cc, 8-hour TWA, a filter efficiency of 100% should be used.

7.2.2 All workers engaged in finishing operations should wear safety glasses with side shields or other forms of eye protection in compliance with the appropriate SDS or OSHA standard and gloves when it is appropriate to do so. In some cases, it may not be appropriate to use gloves, especially in some machining operations where the use of gloves may create a safety hazard.

7.2.3 Finishing operations have the potential to generate elevated levels of airborne dust due to the application of mechanical and/or physical energy (e.g., cutting, sawing, drilling, lathing, routing, milling, etc.). Finishing operations are well suited for engineering controls. Where feasible, engineering controls (dust collection) should be used to reduce the generation of airborne dust.

7.2.4 Keep all work surfaces clean and free of dust and debris.

7.2.5 All scrap RCF cuttings and debris should be placed in closed containers or sealed bags prior to transportation to an approved disposal facility.

7.3 RCF INSTALLATION

7.3.1 In the absence of monitoring information which demonstrates that worker exposures are well-controlled (e.g., “reliably” below the REG of 0.5 f/cc, 8-hour TWA), workers “installing RCFs” should wear the respirator specified in the applicable SDS or, if one is not specified, a NIOSH certified respirator with a filter efficiency of at least 95%. In cases where exposures are known to be above 5.0 f/cc, 8-hour TWA, a filter efficiency of 100% should be used.

7.3.2 To minimize exposures, the work area should be restricted to individuals involved in the installation project. All workers performing installation activities should wear disposable or washable work clothing, safety glasses with side shields or other forms of eye protection in compliance with the appropriate SDS or OSHA standard, gloves (where it is appropriate to do so), appropriate head covering and observe acceptable hygiene precautions.

7.3.3 The installation of RCF “modules” often requires a procedure referred to as “tamping,” to close gaps between modules and to create uniformity of the refractory surface. When feasible, spray the surface of RCF furnace modules lightly with a liquid surface treatment prior to tamping to reduce the generation of airborne dust.

7.3.4 All scrap RCF cuttings and debris should be placed in closed containers or sealed bags prior to transportation to an approved disposal facility.

7.4 AFTER-SERVICE RCF REMOVALS

- 7.4.1 In the absence of monitoring information which demonstrates that worker exposures are well-controlled (e.g., “reliably” below the REG of 0.5 f/cc, 8-hour TWA), workers “removing after-service RCF” from an enclosed space should wear the respirator specified in the applicable SDS or, if one is not specified, a NIOSH certified, full face piece, air purifying respirator to be used in conjunction with P100 particulate filter cartridges.
- 7.4.2 To minimize exposures, the work area should be restricted to individuals involved in the installation project. All workers performing installation activities should wear disposable or washable work clothing, safety glasses with side shields or other forms of eye protection in compliance with the appropriate SDS or OSHA standard, gloves (where it is appropriate to do so), appropriate head covering and observe acceptable hygiene precautions.
- 7.4.3 Whenever it is practicable, wet after-service RCF intended for removal, with water, or other suitable dust controlling agent, to reduce the generation of airborne dust during handling. Discretion is required - use limited amounts of water to avoid creating other workplace hazards (e.g., slipping, electrical).
- 7.4.4 All after-service fiber debris should be placed in closed containers or sealed bags prior to transportation to an appropriate disposal facility.

7.5 HANDLING RCF WASTE MATERIALS

- 7.5.1 In the absence of monitoring information which demonstrates that worker exposures are well-controlled (e.g., “reliably” below the REG of 0.5 f/cc, 8-hour TWA), workers engaged in RCF removal and disposal activities (e.g., used bag

house filters, settled dust from cyclones, empty RCF containers, etc.) should wear the respirator specified in the applicable SDS or, if one is not specified, a NIOSH certified, half-face piece, air purifying respirator, to be used in conjunction with P100 particulate filter cartridge. All workers engaged in waste handling activities should wear safety glasses with side shields or other forms of eye protection in compliance with the appropriate SDS or OSHA standard and gloves (where it is appropriate to do so).

- 7.5.2 Careful handling techniques should be employed. Vigorous movement or agitation of RCF materials can cause unnecessary amounts of airborne dust. To minimize the generation of airborne dusts, do not throw or drop RCF products, wastes, or scraps; use of smooth, deliberate motions is recommended.
- 7.5.3 When feasible, RCF waste materials should be wetted with a mist of water or other wetting agents to reduce the generation of airborne dusts. RCF waste material should be placed in covered containers or bags.

PSP 2012
GUIDANCE FOR RESPIRATORY PROTECTION

When engineering and/or administrative controls are insufficient to maintain workplace concentrations below the 0.5 f/cc REG or a regulatory OEL, the use of appropriate respiratory protection, pursuant to the requirements of OSHA Standards 29 CFR 1910.134 and 29 CFR 1926.103, is recommended. A NIOSH certified respirator with a filter efficiency of at least 95% should be used.

The 95% filter efficiency recommendation is based on NIOSH respirator selection logic sequence for exposure to manmade mineral fibers. This is clarified in the NIOSH Pocket Guide to Chemical Hazards, reprinted at <http://www.cdc.gov/niosh/npg/npgd0432.html>. RCFs are within the category of manmade mineral fibers. With respect to such fibers, the Guide provides:

Respirator Recommendations

NIOSH

Up to 5X REL:
(APF = 5) Any quarter-mask respirator.

Up to 10X REL:
(APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100. [Emphasis added.]

Pursuant to these recommendations, N-95 respirators are appropriate for exposures up to 10 times the NIOSH Recommended Exposure Limit (REL). With respect to RCF,

both the NIOSH REL and the industry REG have been set at 0.5 fibers per cubic centimeter of air (f/cm³). Accordingly, N-95 would provide the necessary protection for exposures up to 5 f/cm³. The exposure levels measured by both OSHA and contemporaneous industry sampling are well below this level. Further, the Respirator Selection Guide published by 3M Corporation, the primary respirator manufacturer, specifically recommends use of N-95 respirators for RCF exposures (<http://www2.lbl.gov/ehs/chsp/html/OdorThresholds-3MRespiratorSelectionGuide.pdf> page 84).⁵ In cases where exposures are known to be above 5.0 f/cc, 8-hour TWA, a filter efficiency of 100% should be used.

Other factors to consider are the NIOSH filter series N, R or P. (N) **N**ot resistant to oil, (R) **R**esistant to oil and (P) oil **P**roof. These recommendations are not designed to limit informed choices, provided that respiratory protection decisions comply with 29 CFR 1910.134.

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.

The information contained herein provides recommendations for appropriate respiratory protection for aluminosilicate fibers. Occupational environments vary widely; therefore, employers should ensure that these respiratory protection recommendations (a) adequately address all anticipated occupational exposures (including other, non-fiber related hazards), or (b) are modified to ensure compliance with OSHA's respiratory protection standard, if the recommended respirators are inadequate to address other

5 The NIOSH Criteria Document for RCF recommends a 100 series filter because it has an assigned protection factor (APF) of 10. See NIOSH, "Occupational Exposure to Refractory Ceramic Fibers, Criteria for a Recommended Standard," p. 7 (May 2006). However, the CD recommendation is not explained further, and the NIOSH guidance quoted above indicates that N-95 respirators are considered to have an APF of 10.

non-fiber airborne hazards identified in the workplace. The evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case-by-case basis, by an Industrial Hygienist or other qualified health and safety professional.

RCF JOB CATEGORIES

The HTIW Coalition will continue to assess its database of exposure monitoring information to identify specific job functions or tasks that have a significant potential for airborne RCF concentrations in excess of the REG of 0.5 f/cc. End users should contact the fiber supplier for the most recent HTIW Coalition monitoring data. In the absence of company or task-specific monitoring information which demonstrates that workplace concentrations are well-controlled (e.g., “reliably” below the REG, based upon task-specific information; preferably employer-specific data, but relevant data from other sources may also be used), the HTIW Coalition and its member companies will encourage and recommend the use of appropriate respiratory protection in the following circumstances:

JOB CATEGORY -

FIBER PRODUCTION

Discussion

All domestic RCF production takes place at plants operated by HTIW Coalition member companies. The HTIW Coalition workplace exposure database shows that most fiber production tasks are well-controlled, and are associated with relatively low fiber concentrations. The only fiber production task for which the REG is exceeded with relative frequency is chopping of bulk RCF fiber. In this process, loose bulk RCF is mechanically chopped to produce a finer, shorter-length fiber bulk that has improved

properties for certain applications. Because the bulk RCF is dry and not bound in any way, this process has the potential to generate airborne fiber levels above the REG. Engineering controls maintain typical workplace concentrations for chopping bulk beneath those associated with most finishing and removal tasks, but even so the REG is exceeded relatively frequently. The HTIW Coalition is examining alternate control methods in an effort to better control this operation and eliminate the need for respirators.

Respirator-Recommended Tasks

Fiber production tasks for which respiratory protection is recommended if exposures are believed to exceed 0.5 f/cc include:

RCF Form: - Bulk

Tasks: - Off-line chopping of bulk RCF fiber. This task is currently performed exclusively at the HTIW Coalition member fiber production plants.

Type of Respirator Recommended

- To address fiber exposures, use the respirator specified in the applicable MSDS or, if one is not specified, use a half-face, air purifying respirator equipped with a NIOSH certified respirator with a filter efficiency of at least 95%. In cases where exposures are known to be above 5.0 f/cc, 8-hour TWA, a filter efficiency of 100% should be used.

<u>JOB CATEGORY</u>
FINISHING

Discussion

Finishing tasks are mainly cutting, trimming, die stamping, or grinding operations that impart significant amounts of mechanical energy into the RCF part. The HTIW Coalition

workplace exposure database indicates that these tasks, if uncontrolled, may frequently result in airborne fiber concentrations above the REG when applied to RCF blanket, board, and formed parts. Finishing operations applied to other forms of RCF (e.g., felt, paper, textiles) are associated with significantly lower airborne concentrations during finishing, and are excluded from the list of jobs for which respirators are recommended.

Respirator-Recommended Tasks

Finishing tasks for which respiratory protection is recommended include:

- RCF Form: - Blanket
- Board
- Formed parts
- Tasks: - Using all types of power saws (e.g., table saws, band saws, circular saws)
- Handsaws
- Cutting with utility knives or scissors
- Die cutting
- All types of power sanders
- Hand sanding
- Grinding, routing, filing, milling
- Defeathering or deflashing formed parts
- Turning RCF parts on a lathe

Type of Respirator Recommended

- To address fiber exposures, use the respirator specified in the applicable MSDS or, if one is not specified, use a half-face, air purifying respirator equipped with a NIOSH certified respirator with a filter efficiency of at least 95%. In cases where exposures are known to be above 5.0 f/cc, 8-hour TWA, a filter efficiency of 100% should be used.

JOB CATEGORY

INSTALLATION

Discussion

Installation tasks cover the process of applying RCF insulation (primarily blanket and/or modules, and sometimes board) to large industrial furnaces, reactors, incinerators, and other large equipment. Usually, the size of the equipment, location of the work (inside of a furnace), and relatively infrequent nature of these jobs precludes the use of typical engineering controls to reduce airborne RCF concentrations. This said, the HTIW Coalition workplace exposure database indicates that there are significant differences among installation tasks. Specifically, the database shows that the REG may be exceeded frequently only when RCF is being installed and the RCF material is being cut to fit, or tamped (tamping is the process of striking installed RCF modules with a flat surface such as a board in order to seat the modules against the furnace wall, line them up and close gaps). Installation of RCF with no cutting or tamping is excluded from the list of respirator-required jobs. Also excluded are application of RCF to kiln cars and molds (these jobs generally take place in open, well ventilated areas and are associated with lower airborne concentrations), and application of cements or topcoats to furnace linings (if no cutting or tamping is being done).

Respirator-Recommended Tasks

Installation tasks for which respiratory protection is recommended include:

- RCF Form: - Blanket
- Modules
- Board
- Tasks: - Workers cutting or tamping RCF
- Hanging blanket or installing modules while other workers are cutting or tamping nearby

- All other workers in the vicinity of cutting or tamping (electricians, welders, supervisors, etc.)

Type of Respirator Recommended

- To address fiber exposures, use the respirator specified in the applicable MSDS or, if one is not specified, use a half-face, air purifying respirator equipped with a NIOSH certified respirator with a filter efficiency of at least 95%. In cases where exposures are known to be above 5.0 f/cc, 8-hour TWA, a filter efficiency of 100% should be used.

<u>JOB CATEGORY</u>
REMOVAL (MAJOR)

Discussion

The major removal job category covers tasks involved with removal of after-service RFC insulation from industrial furnaces, reactors, incinerators, kiln cars, molds, etc. Major removals are defined as those removals where entire furnace linings (or large portions such as sides or roofs) are removed.

Because many major removal jobs occur in confined spaces (inside furnaces), and because major removals are infrequent at any given site, engineering controls are generally not applicable. Pre-wetting is sometimes used in an effort to limit dust levels, but monitoring results show that this has only limited effectiveness. Major removals are done as quickly as possible (to limit down time) using mechanical tools or a high-pressure water lance; in the process, relatively high airborne RCF concentrations may be generated. The HTIW Coalition workplace exposure database shows that major removals have the highest average workplace fiber concentration among all job tasks, and also the highest rate of exceedence of the REG. Because there is currently no effective engineering control method for major removals, the HTIW Coalition

recommends that all workers involved with major removals use respiratory protection. Because fiber concentrations are potentially high and eye protection is an important consideration, the HTIW Coalition recommends a higher degree of personal protection for major removals (full-face or PAPR respirator vs. half-face for other tasks).

Respirator-Recommended Tasks

Major removal tasks for which respiratory protection is recommended include:

- RCF Form:
- Blanket (after service)
 - Modules (after service)
 - Board (after service)
- Tasks:
- All workers removing RCF (including water lance operators)
 - All workers bagging and disposing of removed RCF
 - All workers cleaning or sweeping up after removal
 - Supervisors and other workers in the vicinity during major removals

Type of Respirator Recommended

- To address fiber exposures, use the respirator specified in the applicable MSDS or, if one is not specified, use a full-face, air purifying respirator equipped with a NIOSH certified respirator with a filter efficiency of at least 95%. In cases where exposures are known to be above 5.0 f/cc, 8-hour TWA, a filter efficiency of 100% should be used.

<u>JOB CATEGORY</u>
REMOVAL (MINOR)

Discussion

Minor removals are defined as removal of after-service RCF from kiln cars, mold knockouts, and maintenance removals at industrial furnaces (e.g., spot removal of damaged modules to repair “hot spots”). These removals are smaller in scale than major removals, and in the case of kiln cars and mold knockouts, are performed in

relatively open areas. The HTIW Coalition workplace exposure database shows that workplace RCF concentrations associated with minor removals are significantly lower than those for major removals, but the REG is exceeded at a rate high enough to require respiratory protection. Because the RCF concentrations are lower than for major removals, half-face respirators are recommended rather than full-face.

Respirator-Recommended Tasks

Major removal tasks for which respiratory protection is recommended include:

- RCF Form:
- Blanket (after service)
 - Modules (after service)
 - Board (after service)
- Tasks:
- All workers removing RCF
 - All workers bagging and disposing of removed RCF
 - All workers cleaning or sweeping up after removal
 - Supervisors and other workers in the vicinity during removal

Type of Respirator Recommended

- To address fiber exposures, use the respirator specified in the applicable MSDS or, if one is not specified, use a half-face, air purifying respirator equipped with a NIOSH certified respirator with a filter efficiency of at least 95%. In cases where exposures are known to be above 5.0 f/cc, 8-hour TWA, a filter efficiency of 100% should be used.

ATTACHMENT V

EPIDEMIOLOGY STUDY ASSESSING RESPIRATORY EFFECTS OF WORKERS EXPOSED TO CERAMIC FIBERS

STUDY OVERVIEW

BACKGROUND

The refractory ceramic fiber (“RCF”) morbidity and mortality study of current and former employees at two sites of the Unifrax I LLC (formerly known as the North American Fibers Division of The Carborundum Company) and a similar surveillance program for current workers and leavers at Thermal Ceramics Inc. (including leavers at a plant formerly known as Vesuvius USA Corporation and Premier Refractories) has 25 years of data collection. This study has been conducted by investigators at the University of Cincinnati, College of Medicine (“UCCOM”).

The medical evaluation program has included the collection of occupational histories, respiratory symptom histories, and pulmonary function tests (“PFT”) every year from 1987 until 1994, and thereafter every third year through 2004 when PFTs were completed. Another important element of the study has been the collection of chest radiographs every three years.

OVERALL STUDY OBJECTIVES

This study was designed to determine the association between human health and exposure to RCF in the workplace. Key aspects of the study include an assessment of: (1) respiratory symptoms and lung function in relation to RCF exposure; (2) the

relationship between fiber exposure and the prevalence and incidence of radiographic changes including pleural plaques and interstitial changes; and (3) mortality data to identify excess deaths.

SUMMARY OF FINDINGS TO-DATE

Overall, the general health of RCF industry employees, some beginning work as early as 1952, is similar to that of employees who work in other dusty work environments. There have been no reports of mesothelioma. Mortality due to lung cancer is similar to background population rates. The mortality data related to the occurrence of kidney and bladder cancers was higher than expected. Whether or not this finding is work-related or due to a chance finding is yet undetermined, as the number of cases was small. The strength of the mortality study to detect potential cancer rate differences compared to state and national background populations will increase as the study population ages.

Work in the RCF industry was associated with an increase in reported respiratory symptoms and pleural plaques seen on chest X-rays. The rate of respiratory symptoms was generally similar to other worker populations in dusty environments. Pleural plaques in general are considered markers of fiber exposure and, in regard specifically to RCF exposure, have not been associated with an identified risk for lung disease. The study of chest X-rays has not shown any association between RCF exposure and scarring of tissue within the lung itself (interstitial fibrosis).

A decline in lung function was found on the initial 1987 cross-sectional pulmonary function study. This finding most likely represented the impact of higher dust and fiber exposure levels prior to 1987. The subsequent longitudinal study, however, did not demonstrate any effect of exposures to RCF and most likely reflects the impact of lower workplace exposures since 1987. The on-going state-of-the-art exposure and health

surveillance program in place has provided 25 years of information on the health of this work force. The study has generated 23 publications in the peer-reviewed literature including two recent summary publications. A final report of the lung function results was published in 2011 by McKay et al in *Occupational and Environmental Medicine*, “A long term study of pulmonary function among US refractory ceramic fibre workers”. The latest (2012) report of radiographic findings by Lockey et al. entitled, “Biopersistence of refractory ceramic fiber (RCF) in human lung tissue and a 20-year follow-up of radiographic pleural changes in workers” has been accepted by the *Journal of Occupational and Environmental Medicine*. This latter study showed in a small sample of cases, that RCF can persist in lungs up to 20 years after leaving employment.

EPIDEMIOLOGY STUDY CONTINUATION: 07/2011 THRU 12/2015

The HTIW Coalition and its member companies contracted with independent investigators at the UCCOM to continue the epidemiology study beyond 25 years. The extended study has four key objectives.

1. To continue an occupational and respiratory surveillance study of current and former employees at Unifrax Corporation and current employees and leavers at Thermal Ceramics (including leavers at a plant formerly known as Vesuvius USA Corporation and Premier Refractories) hired before 1985 and those workers with greater than five years of employment after 1985.
2. To continue the exposure response analysis.
3. To maintain a mortality registry for Unifrax Corporation former and current employees and repeat the mortality analyses.
4. To perform chest radiographic evaluations of the RCF cohort and interpret results.

The specific aims of this extended study include the following relevant outcomes:

1. Collect and interpret one additional set of chest radiographs from current and former workers and leavers through 2014.
2. Collect smoking and cancer data and relevant occupational history.

3. Obtain death certificates and cause of death and obtain consent from next-of-kin for release of relevant medical records of the deceased.

4. Construct exposure estimates and analysis of exposure-response relationships.

Discontinued efforts from previous study periods include the following:

- Enrollment of newly hired RCF manufacturing employees;
- Collection of Unifrax salesmen sales logs;
- Chest radiographs of workers enrolled into the current surveillance program after 1985 with less than five years employment duration;
- Collection of pulmonary function data;
- Collection of interim asbestos data;
- Collection of lung tissue data;
- Medical summary letters to employees with normal chest radiographs.

Continuation of this study will provide continuity of methodology, improved study power as a result of additional time and population aging, and enhanced understanding of the exposure-response relationship over a 25 year period. Of particular interest is the collection of new chest radiographs from workers hired after 1985, who lack the higher pre-1985 exposure levels and now have sufficient time since initial exposure for detecting potential radiographic changes. This population will help determine whether current lower exposure levels are associated with chest radiographic changes such as pleural plaques. It is also anticipated that there will be additional study power as the workforce ages to more confidently address any potential relationship between historical fiber exposure before 1985 and chest radiographic changes within the lung consistent with interstitial fibrosis.

PSP 2012
Exposure Monitoring Plan

The HTIW Coalition and its member companies will continue to conduct exposure monitoring activities, both at RCF manufacturing plants and at their customer and end-user facilities. The HTIW Coalition and its member companies will ensure that the employers and employees being monitored are provided with the results of any monitoring activities. Sample collection goals have been established for each of three primary program elements:

1. INTERNAL SAMPLING

Samples collected within RCF manufacturing plants will be categorized into 6 functional job categories [Assembly, Auxiliary, Fiber Production, Finishing, Mixing/Forming, and Other (“NEC” – Not Elsewhere Classified)]. A total of approximately 250 full-shift personal time-weighted average airborne fiber samples will be collected each year using NIOSH Method 7400, applying the “B” counting rules. The employees sampled will be randomly selected among all work shifts.

2. EXTERNAL SAMPLING

Samples collected within member companies’ customer and end-user facilities will be categorized into 7 functional job categories (Assembly, Auxiliary, Finishing, Installation, Mixing/Forming, Other (NEC), and Removal). A total of approximately 250 full-shift personal time weighted average airborne fiber samples will be collected each year using NIOSH Method 7400, applying the “B” counting rules.

Customer facilities being sampled will consist of those firms that are randomly selected and requested by the HTIW Coalition members to participate in exposure monitoring, as well as companies that request exposure monitoring assistance on their own. The employees sampled will be randomly selected among all work shifts when practical; however, the HTIW Coalition will also try to accommodate customer preferences for sample and/or shift selection.

HTIW Coalition members may encourage customers to develop their own independent sampling programs designed to be consistent with the sampling procedures followed by HTIW Coalition member companies. Where appropriate, data from such programs may be used to meet a portion of the HTIW Coalition's external (customer) sampling goals.

3. SPECIAL EMPHASIS SAMPLING

Special emphasis samples will be collected either at member companies manufacturing plants or at customer/end-user facilities. It will be left to the professional judgment of the industrial hygienist to determine what type of measurement is appropriate (e.g., personal or area, full shift or task length, gravimetric, etc.). The sample collection method and analytical techniques will be determined on a case-by-case basis.

All sample collection data will be recorded on sample data collection forms and entered into a database for analysis and reporting. A summary of all exposure monitoring activities will be reported as appropriate in the summary interim reports and the five year report.

FUNCTIONAL JOB CATEGORIES – SUMMARY DESCRIPTIONS:

Assembly Operations

The combining or assembling of RCF materials with other material (RCF or other),

except automotive applications. This includes factory assembly of small industrial furnace components when work is performed in an open area outside the furnace where engineering controls are practical.

Auxillary Operations

Jobs in which employees are “passively” exposed to RCF while performing their normal duties and whose exposures are not likely to parallel those of employees working directly with RCF materials. Includes certain jobs in which RCF may be handled, but with small probability of significant exposures (e.g., warehouse worker or person unloading completed parts for packaging).

Fiber Manufacturing

Includes employees involved in the production or manufacturing of RCF bulk or blanket, except for individuals in a supervisory capacity. Includes all job functions on the production line, from mixing the raw ingredients to packaging the finished product (bulk or blanket) at the end of the line.

Finishing

Involves employees involved in the cutting or machining of RCF materials after fiber manufacture. Hand held or power tools may be used in finishing operations.

Installation

Use of RCF materials in building or manufacturing industrial furnaces or boilers, refinery or petrochemical plant equipment, kilns, foundries, electric power generators, and industrial incinerators at end-user locations, and building large furnace parts at remote factories in cases where use of engineering controls is impractical [e.g., (1) work is performed in an enclosed area (i.e., inside the furnace); (2) large size or orientation of furnace parts precludes application of engineering controls]. Includes furnace maintenance. Does not include factory manufacture of small industrial furnace

components when work is performed in an open area outside the furnace where engineering controls could be used.

Mixing / Forming

Wet-end production of vacuum-cast shapes, board, felt, and paper. Includes mixing RCF putties, compounds or castables.

Other (NEC)

All duties performed in the production of RCF paper, textiles, and automotive components or other industry sectors not covered in any of the foregoing categories. Also, exposures that cannot reasonably be included in the other categories listed (i.e., NEC - not elsewhere classified). Industrial Hygiene personnel should explain tasks and industry sectors as fully as possible for observations in this category.

Removal

Removal of after-service RCF material from an industrial furnace, etc., that has completed its economic life. Includes the removal of RCF material in furnace maintenance.

PSP 2012

PROGRAM PERFORMANCE MEASUREMENTS

The primary purpose of a product stewardship program is to make health, safety and environmental protection an integral part of designing, manufacturing, marketing, distributing, using, recycling, and disposing of such products. In adopting this PSP 2012, the HTIW Coalition and its member companies confirm their continued commitment to promote prudent and practicable work practices for workers and end-users who design, manufacture, import, process, distribute, install, remove, and/or use RCF-based products. The following specific measurements will be used to evaluate the performance of the PSP 2012 program.

WORK PRACTICES

Element	Goal(s)	Measurement
Work Practices	<ul style="list-style-type: none"> ◆ To encourage all manufacturers, customers and end-users to follow proper work practices when handling RCF products 	<ul style="list-style-type: none"> ❖ Update and communicate HTIW Coalition recommendations for the proper handling of RCFs (ongoing) ❖ Promote HTIW Coalition training aids for the proper handling of RCFs (ongoing) ❖ Communicate “Best Practices” for work tasks with elevated airborne fiber concentrations (ongoing)

WORKER TRAINING

Element	Goal(s)	Measurement
Worker Training	<ul style="list-style-type: none"> ◆ To develop focused training materials ◆ To provide information to customers and end-users regarding potential occupational hazards, appropriate work practices and exposure controls 	<ul style="list-style-type: none"> ❖ HTIW Coalition will continue to develop and refine standardized employee training aids, including new aids such as on-line training techniques (ongoing) ❖ HTIW Coalition members commit to conduct PSP training sessions when requested ❖ The PSP 2012 five year report will contain information about the training sessions conducted, including the number of people trained, videos, brochures and other material distributed during training

MEDICAL MONITORING

Element	Goal(s)	Measurement
Medical Monitoring	<ul style="list-style-type: none"> ◆ To ensure exposed RCF manufacturing workers are evaluated for the potential manifestation of fiber exposure-related health effects ◆ To improve customer awareness of the medical surveillance requirements 	<ul style="list-style-type: none"> ❖ HTIW Coalition and its member companies will maintain a medical monitoring program for their workers producing RCF (ongoing) ❖ HTIW Coalition and its member companies will inform end-users about the key elements of HTIW Coalition

	of OSHA's Respiratory Protection Standard	medical surveillance program (ongoing)
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EXPOSURE MONITORING

Element	Goal(s)	Measurement
Exposure Monitoring	<ul style="list-style-type: none"> ◆ To evaluate and improve the relative understanding of workplace exposures ◆ To facilitate informed decisions regarding improvements in exposure management, including the use of respiratory protection 	<ul style="list-style-type: none"> ❖ Continue to evaluate existing exposure monitoring data to identify targets of opportunity to improve exposure management (ongoing) ❖ Continue monitoring at manufacturing facilities [TARGET: About 250 (8-hour. TWA) samples annually] to address employee RCF exposure and to support the epidemiology study (ongoing) ❖ Continue exposure monitoring at customer facilities [TARGET: About 250 (8-hour. TWA) samples annually] to: (1) provide feedback, (2) track exposure trends (ongoing)
	<ul style="list-style-type: none"> ◆ To focus resources upon prioritized initiatives to reduce occupational exposures to airborne fiber 	<ul style="list-style-type: none"> ❖ Identify specific job tasks/situations for exposure monitoring using various sampling techniques to: (1) evaluate the relative effectiveness of fiber control options, (2) facilitate fiber exposure reductions (ongoing) ❖ Data, analysis and findings shall be compiled in the PSP 2012 interim annual reports and the five year report and

		shared with OSHA, EPA, NIOSH, National Insulation Association and Vacuum Formers Association
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QUALITY ASSURANCE / QUALITY CONTROL

Element	Goal(s)	Measurement
Quality Assurance	<ul style="list-style-type: none"> ◆ To provide independent validations of exposure monitoring program results 	<ul style="list-style-type: none"> ❖ HTIW Coalition has prepared and adopted a quality assurance plan which it will continue to use (ongoing) ❖ HTIW Coalition will continue to utilize qualified independent auditors as a mechanism to evaluate fiber sample collection techniques (at manufacturer and customer plant sites). ❖ HTIW Coalition will require laboratory conducting fiber analysis (currently Clayton Laboratories) to annually provide evidence of its certification or other qualification (ongoing) ❖ HTIW Coalition will address any corrective measures required as a result of audit findings (ongoing)

CUSTOMER SERVICE ACTIVITIES

Element	Goal(s)	Measurement
Customer Service Activities	<ul style="list-style-type: none"> ◆ To determine “best” work practices, engineering controls and process controls ◆ Follow up on the best practices commitments made earlier – communicate to customers ◆ Develop labels and safety data sheets pursuant to the Global Harmonization System 	<p>HTIW Coalition will communicate the following types of information to its customers and end-users and will include a summary in the five year report (and as appropriate in the interim annual reports):</p> <ul style="list-style-type: none"> ❖ Narrative reports on the most effective control measures and work-practices identified ❖ Document customer work practice changes using questionnaires, personal visits or other methods ❖ Document number of individuals or companies requesting on-site training, monitoring or other assistance
Customer Service Activities	<ul style="list-style-type: none"> ◆ To promote continuous improvement in the appropriate handling and use of RCF products through employee and customer involvement 	<ul style="list-style-type: none"> ❖ Track number of hits on PSP 2012 on HTIW Coalition’s web site (ongoing) ❖ Track number of incoming inquiries to HTIW Coalition and company health and safety information numbers (ongoing) <p>Other customer service activities include:</p> <ul style="list-style-type: none"> ❖ HTIW Coalition has identified respirator manufacturers and distributors that provide free respirator fit testing and

		<p>training</p> <ul style="list-style-type: none">❖ A list of these distributors and manufacturers, grouped geographically, are available to customers (ongoing)
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**OSHA / NIOSH / HTIW Coalition
Press releases and letters**