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PSP 2022

FOR REFRACTORY CERAMIC FIBERS

This document sets forth the basic principles of the Product Stewardship Program (PSP) for refractory ceramic fiber (“RCF”) products.¹ The members of the HTIW Coalition, which include Morgan Thermal Ceramics, Alkegen (formerly Unifrax I LLC), HarbisonWalker International and Nutec, are committed to implementation of the recommendations and guidance described herein.² The PSP is intended to promote the health and safety of their employees and customers and to 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”).

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- 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. RCFs are also referred to as man-made vitreous fibers (“MMVF”), man-made mineral fibers (“MMMMF”), or synthetic mineral fibers (“SMF”).
 - 2 The HTIW Coalition was originally named the Refractory Ceramic Fibers Coalition (“RCFC”). The name was changed to HTIW Coalition in 2011. HTIW Coalition members produce all of the RCF manufactured in North America. As explained further below, the HTIW Coalition umbrella also includes new, less biopersistent fiber products developed pursuant to the research and development elements of this program (together RCF and these newer fibers are referred to as “HTIW,” which refers to “high temperature insulating wools”). “RCFC” is used in this document to refer to specific actions taken by or directed to the predecessor organization; in all other instances “HTIW Coalition” is used to refer to both the predecessor and the current organization.

The HTIW Coalition and its member companies recognize that the PSP should embody comprehensive guidance for addressing potential RCF exposures in the workplace. This commitment, called PSP 2022, builds on the history of the PSP developed 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 2022 continues that tradition and represents the fifth iteration of the program that was first endorsed by OSHA in 2002.³

BACKGROUND

RCF was first commercialized in the early 1950's. Until the mid-1980's, testing of synthetic vitreous fibers, including RCF, did not reveal any noteworthy adverse health effects. 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 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

³ This PSP 2022 omits several of the detailed attachments provided in the earlier documents to explain the original basis for various PSP provisions. Portions of those remain relevant to this version and can be accessed with the prior documents on the HTIW Coalition website. <http://www.htiwcoalition.org/>

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.

In conjunction with the animal study results, HTIW Coalition members sponsored a long term epidemiological study of morbidity and mortality in U.S. RCF workers, conducted by researchers at the University of Cincinnati (“UC”). In 2016, the UC morbidity study was concluded after 30 years of follow-up.⁴ The researchers noted that “to our knowledge, this is the longest ongoing longitudinal study of workers exposed to SVFs, predominately RCF.” They concluded that “after 30 years of follow-up, no excess of lung cancers in the mortality study and no significant association with radiographic findings of interstitial fibrosis were found in this group of workers.” The occurrence of pleural plaques was stable. The study also found a reported increase in leukemia mortality, but noted that it was surprising and unlikely to be related to RCF exposure. The elevated SMR for urinary tract cancers found earlier (2003) in the total cohort was found only in the subgroup with highest cumulative exposure, and the finding was very sensitive to sample size. While one mesothelioma case was found, it was reported for a worker with prior asbestos exposure, could not be confirmed and did not significantly elevate the SMR for mesothelioma.

Although the UC morbidity study was terminated in 2016, the mortality study is continuing. In early 2022, the researchers published an updated report on the mortality study.⁵ The updated conclusions may be summarized as follows:

1. No associations were found with RCF exposure and mortality from lung cancer, all cancers or all causes;

4 LeMasters, G. K., et al., (2017). *A thirty-year mortality and respiratory morbidity study of Refractory Ceramic Fiber workers*. *Inhal. Toxicol.*, 29(10): 462-470

5 LeMasters, G. K., et al., (2022, in press). *Mortality of workers employed in refractory ceramic fiber manufacturing: An update*. *J. Appl. Toxicol.* (<https://analyticalsciencejournals.onlinelibrary.wiley.com/doi/full/10.1002/jat.4295>)

2. RCF exposure was associated with mortality from leukemia, but as in the 2017 report there were no cases in the high exposure group, leading the authors to conclude that RCF exposure was unlikely to be the causal agent;
 3. RCF exposure was associated with mortality from urinary tumors, as in the prior report, but the authors concluded that the association was likely multifactorial, given past histories of smoking and past industrial exposures;
- Two cases of mesothelioma were reported, but an association with RCF

exposure was not established, as in the prior report (which examined one of the two current cases). It is noteworthy that 5 years since the report of the first case, there is no tissue confirmation of a mesothelioma.

The UC researchers have advised that “continued reduction in exposure to RCF is prudent in both manufacturing and end-user settings,” and that “the mortality study will be ongoing and deaths from all causes monitored.” HTIW Coalition and its members are committed to these actions as discussed in this PSP.

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. HTIW Coalition and its members are in the process of revising the SDS to reflect the results of the 2022 epidemiological update

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 predecessor have communicated and cooperated continuously with various regulators to address their concerns. Key aspects of these regulatory relationships are summarized below.

Occupational Safety and Health Administration

In June 1992, OSHA proposed to update its permissible exposure limits (“PELs”) for air contaminants in the construction, maritime and agricultural industries. In this notice, OSHA proposed a PEL for manmade mineral fibers, including RCF, 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 RCFC 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 RCF, although it 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 RCF. 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 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.”

RCFC and its member companies worked closely with OSHA to formalize their PSP as a “voluntary approach” and in 2002, OSHA endorsed a five year voluntary product stewardship program, called PSP 2002.⁶ In 2004, Assistant Secretary Henshaw congratulated RCFC for its efforts under PSP 2002. The subsequent program, PSP-HTW, continued and built upon PSP 2002. PSP-HTW was endorsed by Assistant Secretary Faulke in 2007. PSP-HTW was followed by PSP 2012 which also continued and built upon its predecessor and was endorsed by Assistant Secretary Michaels. PSP 2017 was the most recent PSP program and was endorsed by Deputy Assistant Secretary Sweatt in October 2017. PSP 2022 continues the tradition of its predecessors and represents the fifth iteration of the program that was first endorsed by OSHA in 2002.

National Institute for Occupational Safety and Health (NIOSH)

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 recommended 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, the same as the current REG in the RCF PSP. From time to time the HTIW Coalition partners with NIOSH to perform joint assessments of the efficiency of various engineering controls in controlling RCF fiber emissions.

Environmental Protection Agency

⁶ Letters and press releases containing OSHA’s endorsements of the earlier PSPs are available on the HTIW Coalition website (<http://www.htiwcoalition.org/documentation.html>).

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”). As a result of the Section 4(f) review, 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. The agreement was the first TSCA consent order under which manufacturers agreed conduct monitoring in both manufacturer and customer operations. Exposure monitoring data were compiled and submitted to EPA every six months for a period of five years⁷. In addition, members were required to conduct stack monitoring to determine the level of RCF emissions, if any, from manufacturing facilities. 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 of negligible concern to general public health or the environment, and (2) any initiatives taken should focus principally towards exposure management in the workplace.

⁷ RCFC also had periodic meetings with OSHA and NIOSH to share the data and analyses submitted to EPA pursuant to the Consent Agreement.

For over 30 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 considered. The HTIW Coalition and its member companies and their PSP 2022 will continue to benefit from the interest and involvement of these agencies.

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

HTIW Coalition member companies began to develop and implement a comprehensive PSP for RCF in 1990. The PSP is designed to assist RCF manufacturers, processors and end-users in the evaluation, control and reduction of workplace exposures to RCF. 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 30 years have resulted in substantial reductions in RCF workplace exposures and provided a firm foundation for prioritizing future PSP initiatives.

This PSP 2022 represents the continuing efforts of the HTIW Coalition and its member companies to update and improve the prior programs. The program envisions a continued working and reporting relationship with regulators and other interested stakeholders and, as a successor to the prior PSPs, will run for a fifth five year term after four successful five year periods. Just as originally envisioned in 2002, PSP 2022 will continue to be composed of the key elements described in the following section.

KEY FEATURES OF PSP 2022

Scope⁸ - PSP 2022 applies to the manufacture, fabrication, furnace-lining installation and removal of RCF, and to other occupational settings where exposure to RCF may occur. The HTIW Coalition member companies will be directly responsible for implementing the recommendations of PSP 2022 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 2022 and the implications for possible regulatory oversight, to encourage compliance with these guidelines, and to encourage other organizations to adopt PSP 2022 guidelines as appropriate.

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 2022 are 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 2022 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.

8 PSP 2022 involves two separate groups: (1) RCF manufacturers (HTIW Coalition members) and (2) RCF contractors, customers and end-users. The HTIW Coalition members are committing to implementing the recommendations noted herein. When referring to the HTIW Coalition members as 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 HTIW Coalition members 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 research program has resulted in development of alkaline earth silicate (“AES”) wools, also known as “low biopersistent” fibers (“LBP”).”⁹ Results of animal toxicity tests indicate that these new LBP products are likely to significantly reduce any potential hazard from workplace fiber exposure.¹⁰ 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.

The AES wools have chemical compositions that are dramatically different from typical RCF products. The chemistries of this class of fiber products incorporate various combinations of chemicals to produce relatively non-durable fiber products with desirable low biopersistence properties and high temperature capabilities. These non-durable fiber types are regarded as presenting little hazard potential. Members of the Coalition also manufacture and/or market a range of high alumina polycrystalline wools (“PCW”) 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 produce significant quantities of respirable fibers in use, thereby resulting in very low doses for exposed workers.

Recognizing the potential of these additional products for hazard reduction, the members of the Coalition 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 changed the name of their trade association to HTIW

⁹ AES wools, CAS No. 436083-99-7, are also SVFs.

¹⁰ See, for example, Fraunhofer certificates at <http://www.morganthermalceramics.com/resources/superwool-resources/>

Coalition. In addition to RCFs, the product stewardship efforts of the Coalition now also encompass AES wools and PCW products.¹¹

For the reasons described above, a comprehensive program such as PSP 2022 does not appear appropriate at present for the AES wools and PCW fiber products, and they are not included in PSP 2022, 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 members have 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 SDSs, training materials and other related information distributed by the Coalition members 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 feasible¹² to maintain a workplace concentration of 0.5 f/cc with engineering controls in many RCF operations, and the HTIW Coalition philosophy that it is prudent to implement feasible and necessary workplace engineering controls.¹³

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

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

12 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.

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

concentrations. A detailed and comprehensive quantitative risk assessment¹⁴ is available, which HTIW Coalition members believe provides useful insight into the potential effectiveness of the RCF PSP.

PSP 2022 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, the HTIW Coalition recommends 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.

Control Measures – The HTIW Coalition 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 also will 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

14 Quantitative Risk Assessment of Refractory Ceramic Fibers in the Occupational Environment, Sciences International, Inc., 1998; Quantitative Assessment of the Risk of Lung Cancer Associated with Occupational Exposure to Refractory Ceramic Fibers, S. Moolgavkar, et.al., Risk Analysis, Vol. 19, Number 4, 1999, p 599-611; Lung Cancer Risk Associated with Exposure to Man-Made Fibers, S. Moolgavkar, et.al., Drug and Chemical Toxicology, 23(1), p. 223-242, 2001.

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 II).

Worker Training - The HTIW Coalition member companies will continue to provide health and safety training for their employees consistent with applicable OSHA requirements for Hazard Communication and the Hazard Communication Standard which incorporates the Global Harmonization System of Classification and Labeling of Chemicals ("GHS"). In addition, the HTIW Coalition 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 and its member companies will maintain 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 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 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 III).

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>. RCF is 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.¹⁵

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 2022, 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 2022, 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. 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 member companies continue medical surveillance programs for RCF-exposed employees. The primary purpose of these programs (consisting of X-ray and pulmonary function tests) is to inform employees of

15 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.

any possible work related health issues that might need to be addressed by their physicians.

Exposure Monitoring - The HTIW Coalition member companies will continue RCF exposure monitoring in their facilities, and at customer and end-user operations, to ensure that employee exposure is well controlled and consistent with the guidance contained herein, in accordance with the exposure monitoring plan set forth in Attachment IV.

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 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 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. 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 member companies include non-RCF products (e.g., AES wools and PCW) in their product stewardship efforts. However, these other non-RCF products are not included within the scope of PSP 2022.

Consumer Products - The HTIW Coalition 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 2022.

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 and its member companies 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 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 2022 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 will make copies of the reports available to anyone requesting them, including NIOSH, EPA and various customer organizations.

The HTIW Coalition's five year report will detail the specific activities undertaken by the Coalition and its member companies to implement PSP 2022 during the 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. The report also will provide details of the latest available information from the HTIW Coalition members companies' medical surveillance programs. The HTIW Coalition recognizes that recipient agencies may make the annual reports available to affected employee organizations or other interested parties.

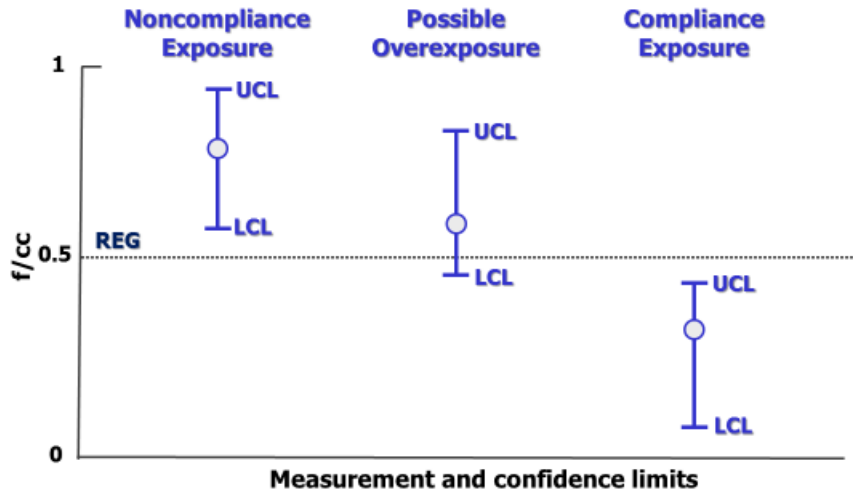
In addition, throughout the term of this program the HTIW Coalition will keep OSHA, NIOSH and EPA officials informed of significant developments in the scientific and medical assessment of RCF products as they may occur

Compliance Principles - In 2012 and 2013, OSHA brought actions seeking to enforce various provisions of the RCF PSP against a customer of one of the HTIW Coalition members. To the knowledge of the HTIW Coalition and its members, all such actions have been settled to date.

In an attempt to clarify PSP compliance issues for future reference, HTIW Coalition developed the general principles for PSP compliance stated in Attachment V. All are based on current and longstanding OSHA regulations or policies. A major issue in past proceedings has been the confidence limits for monitoring data indicating exceedance of the REG. The proper approach is depicted in the following figure, which is derived from the OSHA Technical Manual. In addition, as discussed in the compliance principles, it is important to remember that the REG is not the same as an OSHA PEL and cannot be enforced as such.



What is overexposure (OSHA Technical Manual)?



Sources: OSHA, 1999 (OSHA Technical Manual); Leidel et al., 1977 (NIOSH Sampling Strategy Manual) ²

OSHA staff have reviewed the HTIW Coalition compliance principles and agree that they provide valuable compliance information. While these principles apply generally, HTIW Coalition recognizes that each specific case must be judged on its own merits.

CONCLUSION

The HTIW Coalition and its member companies are confident that PSP 2022 addresses the key components of RCF product stewardship. This voluntary program continues many of the initiatives embraced during the past thirty years along with additional elements, and is intended to present feasible recommendations for reducing workplace exposure to RCF.

The HTIW Coalition and its member companies recognize that it is prudent to adopt RCF exposure controls where feasible and necessary. Further, they also recognize that PSP 2022 is an appropriate vehicle for encouraging the continuous 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 2022.

The HTIW Coalition and its member companies recognize that PSP 2022 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 2022 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 2022 at an earlier date. Should any such scientific developments or material changes occur, the HTIW Coalition will inform regulatory representatives involved with PSP 2022, 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) Chemical Name | (c) CAS Number | REACH Reg. No. | % BY WEIGHT |
|--------------------------------|-----------------------|-----------------------|--------------------|
| 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.

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 final report of the U.S.A. mortality study was issued in 2017 (LeMasters et al 2017). The study concluded that "after 30 years of follow-up, no excess of lung cancers in the mortality study and no significant association with radiographic findings of interstitial fibrosis were found in this group of workers." The study also found a small incidence of other effects that appear unrelated to RCF exposure. The final mortality report does not change the current hazard classification for RCF.

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].

The manufacturers of refractory ceramic fibers (RCF), who comprise the membership of the HTIW Coalition, remain committed to the continued protection of the health and safety of their employees and all others who use or handle RCF. Building on its prior commitment to voluntary product stewardship, the HTIW Coalition has recently renewed its comprehensive Product Stewardship Program (PSP) for RCF, known as PSP 2022.

PSP 2022 is the fifth iteration of the Coalition's RCF product stewardship program first endorsed by OSHA in 2002 as PSP 2002, renewed in 2007 as PSP-HTW, in 2012 as PSP 2012 and in 2017 as PSP 2017. Like its predecessors, PSP 2022 is designed to encourage feasible and necessary control of fiber exposure in the workplace and thereby reduce any potential risk that could be posed by such exposure. For more information regarding this cooperative program that promotes the health and safety of fiber workers nationwide, 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.

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 ("HCS 2012"), 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 HCS2012 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 RCF should be filtered by a filtration media designed to capture RCF.
 - 3.2.2 If ventilation systems are used to capture RCF, 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 RCF 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 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 1910 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 1910, 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 RCF 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 APPLICATIONS¹⁶

7.1 FIBER PRODUCTION

- 7.1.1 In the absence of monitoring information which demonstrates that worker exposures are well-controlled (e.g., "reliably"¹⁷ 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.
- 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.

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

17 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 2022 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.

7.2 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 RCF” 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 facepiece, air purifying respirator to be used in conjunction

with the appropriate filter cartridge depending on the materials and conditions observed.

- 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-facepiece, air purifying respirator, to be used in conjunction with P95 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 2022

GUIDANCE FOR RESPIRATORY PROTECTION

When engineering and/or administrative controls are insufficient to maintain workplace concentrations below the 0.5 f/cc REG or an applicable regulatory Occupational Exposure Level (“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>. RCF is 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 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/cc). Accordingly,

N-95 would provide the necessary protection for exposures up to 5 f/cc. 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).¹⁸ 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) **Not** resistant to oil, (R) **Resistant** to oil and (P) oil **Proof**. 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 in this Attachment 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 non-fiber airborne hazards identified in the workplace. As noted above, the evaluation of workplace hazards and the identification of appropriate respiratory protection is best

18 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.

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 North American 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 may be exceeded. 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

If exposures are not reliably below the REG (0.5 f/cc), use of respiratory protection is recommended for the following fiber production tasks:

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 SDS 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.

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| <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 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

If exposures are not reliably below the REG (0.5 f/cc), use of respiratory protection is recommended for the following finishing tasks:

- 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 SDS 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 (e.g., inside a furnace), and relatively infrequent nature of these jobs precludes the use of typical engineering controls to reduce airborne RCF concentrations. 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 regularly 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

If exposures are not reliably below the REG (0.5 f/cc), use of respiratory protection is recommended for the following minor removal tasks:

- 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 SDS 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.

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

Discussion

The major removal job category covers tasks involved with removal of after-service RCF 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 (e.g., 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 SDS 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.

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| <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

Minor 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 SDS 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 IV

PSP 2022

Exposure Monitoring Plan

The HTIW Coalition 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 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 six functional job categories [Assembly, Auxiliary, Fiber Production, Finishing, Mixing/Forming, and Other (“NEC” – Not Elsewhere Classified)]. A total of approximately 300 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 seven 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 member companies 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.

ATTACHMENT V

PSP Compliance Principles

In 2012 and 2013, OSHA brought actions seeking to enforce various provisions of the Product Stewardship Program (PSP) for refractory ceramic fibers (RCF) against a customer of one of the HTIW Coalition members. To the knowledge of the HTIW Coalition and its members, all such actions have been settled to date.

In an attempt to clarify PSP compliance issues for future reference, HTIW Coalition offers the following general principles for PSP compliance. All are based on current and longstanding OSHA regulations or policies. While these principles apply generally, HTIW Coalition recognizes that each specific case must be judged on its own merits.

1. Applicable OSHA Standards. First and foremost, nothing in the RCF PSP authorizes noncompliance with applicable Occupational Safety and Health Standards. In the enforcement proceedings referenced above, HTIW Coalition reaffirmed that the RCF PSP cannot supersede applicable OSHA standards, such as the standards governing respiratory protection (29 CFR 1910.134). Compliance with all applicable standards is required. However, as discussed further below, neither the RCF Recommended Exposure Guideline (REG) contained in the PSP nor the NIOSH Recommended Exposure Limit (REL) for RCF, both of which have been established at 0.5 f/cc, are applicable OSHA standards.

2. General Duty. In the enforcement actions referenced above, OSHA citations have alleged that exceedance of the REG and REL, without installation of engineering controls thought by OSHA to be feasible, is a violation of the General Duty Clause.¹⁹ However, it is important to remember that unlike an OSHA Permissible Exposure Limit (PEL), neither the REG nor the REL have been determined to be necessary to prevent a significant workplace risk. Both are based primarily on determinations of the airborne concentration that is feasible to attain with engineering controls at most operations. Both HTIW Coalition and NIOSH believe that compliance with the 0.5 f/cc level will reduce whatever risk may be present. As NIOSH stated in the RCF Criteria Document:

At this time, the available health data do not provide sufficient evidence for deriving a precise health based occupational exposure limit to protect against lung cancer. However, given what is known from the animal and epidemiological data, NIOSH supports the intent of the PSP and concurs that a recommended exposure limit (REL) of 0.5 f/cm³ as a TWA for up to a 10-hr work shift during a 40-hr workweek will lower the risk for developing lung cancer.²⁰

However, neither the REG nor the REL are based on any determination that attainment is necessary to prevent a significant workplace health risk.

General Duty citations alleging exceedance of the REG or REL should be based on OSHA's Enforcement Policy for Respiratory Hazards Not Covered by OSHA Permissible Exposure Limits.²¹ The Policy states that in cases where an OSHA PEL does

¹⁹ The term "exceedance," as used herein, refers to airborne concentrations above the REG or REL in the absence of proper respiratory protection. As discussed below, airborne concentrations above the REG or REL would not constitute an exceedance if proper respiratory protection is used.

²⁰ See NIOSH, "Occupational Exposure to Refractory Ceramic Fibers, Criteria for a Recommended Standard," pp. v-vi (May 2006).

²¹ Memorandum from Kimberly Stille to Regional Administrators re: Enforcement Policy for Respiratory Hazards Not Covered by OSHA Permissible Exposure Limits (November 2, 2018). The Policy is available

not apply, OSHA will review other available occupational exposure references and recommendations. These include NIOSH RELs and manufacturers' recommendations such as the RCF REG.

As noted in the Policy, Section 5(a)(1) of the OSH Act requires each employer to "furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm." When enforcing this requirement, the Occupational Safety and Health Review Commission and court precedent have determined that the following elements must be established in order for OSHA to prove a violation of the General Duty Clause:

1. The employer failed to keep the workplace free of a hazard to which employees of that employer were exposed;
2. The hazard was recognized;
3. The hazard was causing or was likely to cause death or serious physical harm; and,
4. There was a feasible and useful method to correct the hazard.

In discussing these requirements, the Policy states:

When applying these elements to respiratory hazards, it is important for Area Directors to *ensure that 5(a)(1) citations are not based solely on evidence that a measured exposure exceeded a recommended occupational exposure limit (OEL), such as a Threshold Limit Value (TLV), or based on the fact that there is a documented exposure to a recognized carcinogen. Unless the case file evidence proves all four of the above elements, the Area Office should issue a hazard alert letter (HAL). The HAL should advise the employer that one or more employees at the establishment was being, or had been, exposed to a potentially serious respiratory hazard from a chemical that exceeded an OEL, and provide a series of recommended exposure control suggestions (p. 1, emphasis in original).*

at <https://www.osha.gov/laws-regs/standardinterpretations/2018-11-02>.

The Policy also provides the following guidance for determining compliance with these elements when specifically applied to *respiratory* hazards:

- a. *The employer failed to keep the workplace free of a hazard to which employees of that employer were exposed* - The evidence should substantiate that regular and continuing employee exposure to the chemical at the measured levels could reasonably occur. However, if the exposed employees were wearing appropriate respiratory protection with no deficiencies in the respirator program, then the likelihood that OSHA could establish a respiratory hazard covered by the general duty clause would be low.
- b. *The hazard was recognized* - OSHA can establish this element in one of two ways.
 - (1) For employer recognition: Evidence may include employee complaints to management, illness and injury logs, consultant reports, a previous HAL, internal safety and health policies related to workplace operations involving the chemical that may refer to an OEL, or information from a manufacturer describing safety and health precautions for equipment or chemicals used in the workplace such as the chemical manufacturers' safety data sheet (SDS).
 - (2) For industry recognition: Evidence may include an industry or trade association's guidance document, or an assessment from an industry expert describing the work practice or operation used at the establishment and explaining the particular health hazards and recommended control measures. Alternatively, a similar publication from a (non-OSHA) federal, state, or local government agency, or from a professional organization, may also provide good evidence.

- c. *The hazard was causing or was likely to cause death or serious physical harm* - Although an illness or injury from the measured exposure need not have occurred yet, the strongest evidence is an employee illness/injury, hospitalization, fatality, or medical diagnosis related to workplace exposure. In the absence of this, the evidence must include more than just the fact that a measured exposure exceeded a TLV or REL, because these recommended limits may be much lower than the level at which a serious health effect may be experienced. In most cases, proving this element will require an expert or industry-related peer reviewed study to document that serious physical harm could occur at the measured level with continuing employee exposure. Additionally, establishing serious physical harm for some respiratory hazards may be particularly difficult if the resulting illness, such as cancer, would require a substantial period of time to occur.
- d. *There was a feasible and useful method to correct the hazard* - Evidence may include the SDS describing work practices for safe handling, engineering controls, and personal protective equipment, or published industry and/or NIOSH studies (e.g., health hazard evaluations (HHEs)) involving similar chemical processes or operations. Proving that feasible abatement measures would eliminate or materially reduce workplace exposure to a level that no longer presents a serious health hazard will likely require expert testimony.

The HTIW Coalition reiterates its commitment to achieve and maintain exposure levels at or beneath the REL and REL, both in plants operated by its member companies and those facilities operated by its customers. The Coalition maintains that attainment of

these guidelines is feasible in most operations without respiratory protection and in all cases with appropriate respiratory protection. The HTIW Coalition has published relevant outreach material on appropriate engineering controls and workplace practices for handling RCF. As necessary HTIW Coalition members work with customers to ensure that attainment of these guidelines is achieved. When presented with evidence to the contrary from customer monitoring or an OSHA inspection, the Coalition and its members will make this literature available to customers and offer suggestions for improvement to those facilities.

3. Statistical Procedures. In the enforcement matter referenced above, an issue arose regarding the statistical procedures for determining exceedance of the RCF REG and REL. Although the REG and REL are not applicable OSHA standards, exceedance of them should be determined using the statistical procedures specified in Section II, Chapter 1, Part IV.D. of the OSHA Technical Manual (OTM) as in effect on August 1, 2014. As the OTM recognizes, all sampling and analytical methods have some degree of uncertainty as a result of sampling and analytical error (SAE). The SAE is used to determine the upper and lower confidence limits of the sampling results, and is especially important when sample results are near the level of the REG. As discussed in the OTM:

Error factors determined by statistical methods shall be incorporated into the sample results to obtain the lowest value of the true exposure (with a stated degree of statistical confidence) and also the highest value of the true exposure (also with a stated degree of statistical confidence).

Confidence limits are values at each end of the confidence interval, which is the probable range of the true value. The lower value is called the lower confidence limit (LCL), and the

upper value is the upper confidence limit (UCL). The LCL and the UCL are each termed one-sided because the main concern is with being confident that the true exposure is either less or greater than the PEL.

OSHA applies the LCL and UCL with a 95% statistical confidence limit and they are expressed here as LCL_{95%} and UCL_{95%}. SAEs that provide a one-sided 95% confidence limit have been developed and are reported out on the Air Sampling Report.

If the UCL_{95%} < 1.0, a violation does not exist.

If LCL_{95%} < 1.0 and the UCL_{95%} > 1.0, classify as possible overexposure.

If LCL_{95%} > 1.0, a violation exists.²² The OTM goes on to explain that the confidence limits are calculated differently depending on the type of sampling method used. With respect to results in the “possible overexposure” category, the OTM states:

If the results are in the "possible overexposure" category, consider further sampling, taking into consideration the seriousness of the hazard and pending citations. If further sampling is not conducted, or if additional measured exposures still fall into the "possible overexposure" category, the CSHO may wish to carefully explain to the employer and employee representative at the closing conference that the exposed employee(s) may be overexposed, but that there is insufficient data to document noncompliance. The employer should be encouraged to voluntarily reduce the exposure and/or to conduct further sampling to ensure that exposures are not in excess of the PEL.

²² Because the OTM is discussing compliance with PELs, the term “violation” is used. As discussed above and below the proper term with respect to the RCF REG or REL would be “exceedance,” because an exceedance is not a violation as with a PEL.

In interpreting these principles and procedures it is important to note that “overexposure” related to effective exposure should consider the protective effect of respirators.

4. **Objective data**. In the final crystalline silica standard, OSHA defined objective data as follows:

“Objective data” means information, such as air monitoring data from industry-wide surveys or calculations based on the composition of a substance, demonstrating employee exposure to respirable crystalline silica associated with a particular product or material or a specific process, task, or activity. The data must reflect workplace conditions closely resembling or with a higher exposure potential than the processes, types of material, control methods, work practices, and environmental conditions in the employer’s current operations. 81 Fed. Reg. 16710 (March 25, 2016).

The silica rule allows use of objective data for initial exposure assessments and various other purposes. As OSHA had noted in the silica proposal, OSHA has allowed employers to use objective data in lieu of initial monitoring in other standards, such as formaldehyde (29 CFR 1910.1048) and asbestos (29 CFR 1910.1001)(78 Fed. Reg. 56447). For example, the formaldehyde standard provides:

Where the employer documents, using objective data, that the presence of formaldehyde or formaldehyde-releasing products in the workplace cannot result in airborne concentrations of formaldehyde that would cause any employee to be exposed at or above the action level or the STEL under foreseeable conditions of use, the employer will not be required to measure employee exposure to formaldehyde.

As discussed in the PSP, the HTIW Coalition member companies have systematically collected objective data on RCF workplace exposures for over 20 years, and now maintain a large and sophisticated database on exposures in virtually all affected job categories. Representatives of HTIW Coalition meet annually with OSHA (and other

invitees) to discuss the latest data and exposure trends. In most if not all instances, the RCF data clearly meet the definition of objective data as proposed in the silica rule. In appropriate cases demonstrations of REG and REL attainment may be based on objective data as defined above.