ASBESTOS

CASRN: 1332-21-4

Generic designation referring usually to six types of naturally occurring mineral fibers that are or have been commercially exploited. These fibers belong to two mineral groups: serpentines and amphiboles. The serpentine group contains a single asbestiform variety: chrysotile; five asbestiform varieties of amphiboles are known: anthophyllite **asbestos**, grunerite **asbestos** (amosite), riebeckite **asbestos** (crocidolite), tremolite, actinolite **asbestos**. Commercial products may contain one or more of the various mineral fibers.

FULL RECORD DISPLAY

Displays all fields in the record.
For other data, click on the Table of Contents

Human Health Effects:

Evidence for Carcinogenicity:

Classification of carcinogenicity: 1) evidence in humans: sufficient; 2) evidence in animals: sufficient. Overall summary evaluation of carcinogenic risk to humans is Group 1: The agent is carcinogenic to humans.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. S7 106 (1987)] **PEER REVIEWED**

CLASSIFICATION: A; human carcinogen. BASIS FOR CLASSIFICATION: Observation of increased mortality and incidence of lung cancer, mesotheliomas and gastrointestinal cancer in occupationally exposed workers are consistent across investigators and study populations. Animal studies by inhalation in two strains of rats showed similar findings for lung cancer and mesotheliomas. Animal evidence for carcinogenicity via ingestion is limited (male rats fed intermediate-range chrysotile fibers; i.e., greater than (>) 10 um length, developed benign polyps), and epidemiologic data in this regard are inadequate. HUMAN CARCINOGENICITY DATA: Sufficient. ANIMAL CARCINOGENICITY DATA: Sufficient.
[U.S. Environmental Protection Agency's Integrated Risk Information System (IRIS). Summary on Asbestos (1332-21-4). Available from, as of March 15, 2000: http://www.epa.gov/iris/ **PEER REVIEWED**

A1: Confirmed human carcinogen. /**Asbestos**, all forms/
[American Conference of Governmental Industrial Hygienists TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH, 2008, p. 13] **QC REVIEWED**

Asbestos: known to be a human carcinogen.
[DHHS/National Toxicology Program; Eleventh Report on Carcinogens: Asbestos (1332-21-4) (January 2005). Available from, as of July 31, 2009: http://ntp.niehs.nih.gov/ntp/roc/eleventh/profiles/s016asbe.pdf **QC REVIEWED**

Human Toxicity Excerpts:

/HUMAN EXPOSURE STUDIES/ The /prospective/ study of /17,800/ USA and Canadian insulators /exposed primarily to chrysotile ...and amosite showed that/ lung tumors ...accounted for ...21% of /2271/ deaths. 8% were from mesothelioma of the pleura or peritoneum, and 7% ...from **asbestos** ...675 excess malignacies occurred, constituting 30% of all deaths. In addition ...the incidences of cancers of the larynx, pharynx and buccal cavity, and kidney were significantly elevated. Other tumors... as a group... were significantly in excess.
[Selikoff IJ et al; Ann NY Acad Sci 330: 91-116 as cited in USEPA; Asbestos Health Assessment Update (Draft) p.11-13 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Exposure-response relationship for mesothelioma /was compared/ from 3 studies /and showed that/ no deaths were seen for exposure periods <3 months. At >3 to 15.4 months exposure, the deaths/1000 person years ranged from 0.5 to 1.7 and at 57 months exposure, 1.7 deaths/1000 person years.
[USEPA; Asbestos Health Assessment Update (Draft) p.14-16 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Retirees of the largest USA **asbestos** manufacturer showed lung cancer risks ranging from 1.7 times that expected in the lowest exposure category to 5.6 times that exposed in the highest.
[Enterline PE, Henderson V; Arch Environ Health 27: 312-17 (1973) as cited in USEPA; Asbestos Health Assessment Update (Draft) p.5 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Among some exposed groups, 50 to 80% of individuals employed for 20 or more years were found to have abnormal x-rays characteristic of **asbestos** exposure. ...The progression of asbestosis depends on both cumulative exposure and time from exposure.
[Lewinsohn HC; R Soc Health J 92: 69-77 (1972) as cited in USEPA; Asbestos Health Assessment Update (Draft) p.5 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Among female workers, ovarian cancer has been found in excess.
[Newhouse ML et al; Br J Ind Med 29: 134-41 (1972) as cited in USEPA; Asbestos Health Assessment Update (Draft) p.57 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Death from bronchogenic carcinoma among **asbestos** workers was more frequent than expected in the general population, and was the leading cause of death among insulation workers (3 times more common than mesothelioma). Three cohorts were followed. Among New York-New Jersey insulation workers in the construction industry with 20 or more years of exposure to **asbestos**, the incidence of lung cancer was approximately 8/1000 man-years, an eightfold increase over the general USA population.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.113 (1979) NRCC No. 16452] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Cancers of the digestive tract (stomach, colon, rectum) were also linked to **asbestos** exposure. In a study of 623 **asbestos** workers, these cancers accounted for 41 deaths while only 13 were expected from experience with the general population. During processing of rice, the Japanese add talc which usually has **asbestos** as an impurity. There was a positive correlation between the incidence of stomach cancer and rice consumption in the Japanese. Futhermore, chrysotile and amphibole **asbestos** fibers were found in the gastric tumors.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.19 (1979) NRCC No. 16452] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ **Asbestos** fibers are toxic to macrophages, cells responsible for

cleaning infectious agents and foreign material from the respiratory tract.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.19 (1979) NRCC No. 16452] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Respiratory exposure to high levels of **asbestos** in the workplace has been associated with pain in the chest, pleural frictional rubbing, rales (wheezing sound in the lower pulmonary region), cyanosis (low oxygen content of blood), loss of weight, clubbing of the fingers and formation of **asbestos** warts on the hands.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.17 (1979) NRCC No. 16452] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ The specific diseases associated with **asbestos** are: asbestosis (a form of fibrosis of the lung); cancers of the bronchi, pleura & peritoneum & probably other organs; & **asbestos** corns of the skin. All these, with the exception of corns, are due to the inhalation of **asbestos** fibers & consequently any process which gives rise to large amounts of **asbestos** dust may constitute a health hazard.
[International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983., p. 187] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ A study of the largest factory of the company but not limited to retirees, shows a considerably different mortality pattern. All 689 maintenance and production employees on January 1, 1959, who were first employed at least 20 years earlier were followed through 1976. In this group, 274 deaths occurred, whereas 188.19 were expected. Fourteen pleural and 12 peritoneal mesotheliomas accounted for nearly 10% of the deaths, most recurring before age 65. A strong correlation with estimated dust exposure was seen in deaths from asbestosis, but not with the **asbestos** related malignancies. Gastrointestinal cancer was especially high in the lowest of four dust categories (11 observed versus 3.15 expected) and only elevated slightly in the higher exposure categories. In the highest dust category, the overall cancer was not dramatically increased, but 40% of the deaths were from asbestosis. Individuals in this department tended to die of nonmalignant disease before reaching the age of greatest risk for cancer.
[Enterline PE et al; J Occup Med 14: 897 (1972) as cited in USEPA; Ambient Water Quality Criteria Doc: Asbestos p.C-76-77 (1980) EPA 440/5-80-022] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Spicules of **asbestos** easily penetrate the skin, especially the fingers in those bagging the fiber. Chronic irritation of the dermis occurs with the formation of corns ...Cancers of the skin are not produced.
[International Labour Office. Encyclopedia of Occupational Health and Safety. Volumes I and II. New York: McGraw-Hill Book Co., 1971., p. 122] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Asbestosis is a diffuse, nonuniform, interstitial fibrosis of the lungs that is generally most severe in the basilar portions. As a result of the fibrosis, some of the air spaces (alveoli) are not perfused with blood and may not be ventilated because of stiff, thickened alveolar walls. The fibrosis makes the lungs less compliant, thereby increasing the energy requirement for breathing. There is increased impairment in diffusion of gases leading to increasing breathlessness.
[American Conference of Governmental Industrial Hygienists. Documentation of Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 2001. Cincinnati, OH. 2001., p. 3] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ **Asbestos** corns on the fingers (areas of thickened skin surrounding implanted fibers) are now much less common because much of the **asbestos fiber** is packed mechanically and gloves are worn. Corns do not lead to skin tumors and disappear on removal of the fibers.

[International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983., p. 189] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Diseases in nonoccupationally exposed persons living near sources of **asbestos** and familial exposures have occurred when the worker did not shower or wore the same clothes home that had been worn during work. Also, domestic exposures have been associated with household repairs, and do-it yourself construction using products containing **asbestos** or when disturbing products containing **asbestos**.
[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V1 507] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Asbestosis is defined as a diffuse interstitial fibrosis of the lung, the result of exposure to **asbestos** dust. Neither the clinical features nor the pathology are sufficiently different from other causes of interstitial fibrosis to allow confident diagnosis without evidence of significant exposure to **asbestos** dust in the past, or the detection of **asbestos** fibers or bodies in the lung tissue greatly in excess of that commonly seen in the general population. ...Asbestosis is usually used to describe the parenchymal fibrosis but not that occurring in the parietal pleura.
[International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983., p. 188] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ ...In 1998... the exposure response relationships between environmental exposure to crocidolite and mesothelioma /was examined/. The cohort consisted of 4,659 persons who had lived near the Wittenoom crocidolite mine and mill in Western Australia for at lease one month between 1943 and 1993. Twenty seven mesothelioma cases, 18 of whom were females, occurred in the cohort. Of these, 12 were wives of mine or mill workers, 11 were children and one was a brother of an employee. The other three cases were employees. Nine of the 27 cases were younger than 40 years at the time of diagnosis. Length of residence in the are and estimated cumulative crocidolite exposure were significantly positively associated with an increased mesothelioma risk. /Crocidolite absestos/
[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V1 506] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ /Pathology of asbestosis/: The retained fibers in the alveolar region are 3 um or less in diameter but may be up to 200 um long. ...A portion of the longer fibers, especially amphiboles, become coated with an iron protein complex producing the drumstick appearance of **asbestos** bodies. All types of **asbestos** cause similar fibrosis. The fibrosis starts in the resp bronchioles with collections of macrophages containing fibers, and others lying free. These deposits organize, collagen replacing the initial reticulum web. Initially only a few respiratory bronchioles are affected, but the fibrosis spreads centrally to the terminal bronchioles and peripherally to the acinus. The areas increase in size and coalesce causing diffuse interstitial fibrosis with shrinkage. The process starts in the bases spreading upwards as the disease progresses; in advanced disease the whole lung structure is distorted and replaced by dense fibrosis, cysts, and some areas of emphysema. The pleura, both visceral and parietal surfaces, are affected by the fibrosis. ...The visceral surface may be sclerosed up to 1 cm thick. In the parietal pleura thickening starts as a basket-weave pattern of fibroblasts, the sheets of fibrosis lying along the line of the ribs especially in the lower thorax and posteriorly. The edges become rolled and crenated and, after many years, calcified. The parietal thickening may be extensive and thick with little or no parenchymal fibrosis.
[International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983., p. 188] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Crocidolite was commonly use din the production of gas mask canisters during World War II and mortality among these workers was investigated... . They found of 1,088 workers exposed between 1940 and 1945 and followed through 1976, that there were 22 pleural and 7 peritoneal mesotheliomas and that there was a linear relationship between employment duration and the risk of mesothelioma. There was also a modest excess of bronchial carcinoma. ...Similar results /were found in a study of/... a smaller cohort of gas mask workers in Canada and found that 7% of all deaths were due to mesotheliomas. /Crocidolite/
[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V1 500] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ All types of **asbestos** are known to cause inflammatory changes in lung and pleurae ...and lung cancer. However, there is experimental and epidemiologic evidence that there may be differences in the potential of different **asbestos** types to produce disease. ...It has been suggested that crocidolite has greatest potential to produce disease; chrysotile, the smallest; with amosite occupying an intermediate position.
[American Conference of Governmental Industrial Hygienists. Documentation of Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 2001. Cincinnati, OH. 2001., p. 3] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ ...The occurence of pleural and peritoneal mesotheliomas in the crocidolite mining areas of Northwest Cape Province, in South Africa /was investigated/. It was found that these tumors occurred in both the men working in the mines and mills and in the transporting and handling of the material as well as the nonmining population living in the vicinity. Thirty three cases (22 males and 11 females) of diffuse mesothelioma were described. All but on e of them had possible exosure to crocidolite. /Crocidolite/
[Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 1-9 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V1 500] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Numerous reports from several countries have described cases or series of pleural and peritoneal mesotheliomas in relation to occupational exposure to various types and mixtures of **asbestos** (including talc containing **asbestos**), although occupational exposures have not been identified in all cases. Mesotheliomas of the tunica vaginalis testis and of the pericardium have been reported in persons occupationally exposed to **asbestos**. ...In some of these case reports and in other studies, **asbestos** fibers were identified in the lung. Amphibole fibers usually predominated, but in a few cases mainly or only chrysotile fibers were found. The long latency required for mesotheliomas to develop after **asbestos** exposure has been documented in a number of publications. An increasing proportion of cases has been seen with increasing duration of exposure.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. S7 106 (1987)] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ In human lung specimens asbestosis is seen first, and it is more advanced in the lower lobes, especially subpleural regions. In addition to peribronchiolar fibrosis, there is an intense peribronchiolar cellular reaction that may narrow and obstruct the airway lumen. High-resolution computed tomography (CT) demonstrates thickening of interlobular septa, parallel subpleural fibrotic lines, as well as honeycombing in more advanced cases. **Asbestos** bodies (AB) are characteristically observed in tissue sections. The number of bodies per gram dry lung tissue in the general population is generally fewer than 500, but twice as many are found in the lungs of blue-collar males. Persons with pleural plaques have 10,000 to 20,000 bodies per gram and persons with parenchymal asbestosis more than 100,000- and usually more than a million per gram of lung, which correlates with the dictum of observing at least one **asbestos** body per high power field. /It was/... estimated that recovery by bronchoalveolar lavage of 1 AB per mL correlated with 1,000 to 3,000 AB

per gram dry lung parenchyma. AB form around amphibole fibers in preference to chrysotile and contain iron with the morphologic appearance of hemosiderin. Analysis of the coating identifies a ferritin core containing ferric oxyhydroxide, hydrous ferric oxides, acid mucopolysaccharides int he matrix protein, and calcium and phosphorus. Only a small proportion of the total fiber burden i the lung ever becomes coated, probably not more than 1%, and the proportion increases with fiber length. Coated fibers are less toxic to alveolar macrophages than uncoated ones.
[Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 272] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Environmental exposure either in the houses of **asbestos** workers or in the neighborhood of **asbestos** mines or factories has been noted in some of the cases. It has been est that a third of the mesotheliomas occurring in the USA may be due to nonoccupational exposure. In a study from Israel, the incidence of mesothelioma was found to be higher among those born in the USA or in Europe relative to those born in Israel.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. S7 106 (1987)] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ It is believed that alterations in both humoral and cell-mediated immunity occur in individuals exposed to **asbestos** and exhibiting asbestosis. Decreased /delayed hypersensitivity response/ (DHR) and fewer T cells circulating in the periphery as well as decreased T-cell proliferative responses have been reported to be associated with asbestosis. Autoantibodies and increased serum immunoglobulin levels have also been observed.
[Klaassen, C.D. (ed). Casarett and Doull's Toxicology. The Basic Science of Poisons. 6th ed. New York, NY: McGraw-Hill, 2001., p. 444] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ No clear excess of cancer has been associated with the presence of **asbestos** fibers in drinking water.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. S7 108 (1987)] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ The authors investigated the prevalence of **asbestos**-related disorders among the inhabitants of Guzelyurt, a town in Malatya, located in eastern Turkey. ...Eighty-five patients (9.2%) had **asbestos**-related radiological findings; risk increased with age. Calcified pleural plaques were seen more frequently in individuals > or = 50 yr of age, compared with younger subjects ($p<0.01$).
[Hasanoglu HC et al; Arch Environ Health 58 (3): 144-50 (2003)] **PEER REVIEWED**
PubMed Abstract

/HUMAN EXPOSURE STUDIES/ ...Eight cases of malignant pleural mesothelioma (MPM) in bakers, pastry cooks, and biscuit cooks engaged in making, baking/cooking and selling pastry/bread /are described/ in two hospital-based series in Italy totaling 222 cases during the period from 1990 to 1997. Field investigations revealed **asbestos**-containing material in ovens for baking bread manufactured prior to the 1980s.
[Ascoli V et al; Am J Industr Med 40 (4): 371-373 (2001)] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ Diseases considered to be associated with **asbestos** exposure /eg, in insulation workers/ include ... bronchogenic carcinoma, and cancers of the /gastrointestinal tract/ including esophageal, stomach, colon, and rectum.
[USEPA/OHEA; Asbestos Health Assessment Update (Draft) p.5 (1984) EPA 600/8-84-

0034A] **PEER REVIEWED**

/HUMAN EXPOSURE STUDIES/ A retrospective study of 197 workers was carried out to analyze deaths from asbestosis or **asbestos**-related disease. The number of deaths from mesothelioma (101) was almost double that from bronchogenic carcinoma (67), and more than 3 times that from asbestosis (29).
[Barnes R; Med J Aust 2: 221-24 (1983)] **PEER REVIEWED** PubMed Abstract

/HUMAN EXPOSURE STUDIES/ **Asbestos** can cross the mammalian placental barrier. Furthermore, **asbestos** is a common contaminant of the talc used as a dusting powder for contraceptives from which it may enter the uterus. Research is needed to determine the level of in utero **asbestos** exposure and possible effects to the fetus because of inhalation or ingestion of **asbestos** or the use of talc-bearing contraceptives.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.138 (1979) NRCC No. 16452] **PEER REVIEWED**

/SIGNS AND SYMPTOMS/ The cardinal symptom of asbestosis is dyspnea, which may have a variable but progressive course. Dyspnea on climbing two flights of stairs is characteristic; however,by the time dyspnea on exertion develops, the disease has already reached a progressive stage. Cough and sputum are common, and a pleuritic chest pain or chest tightness may occur. These symptoms, however, may also herald concomitant disease such as lung cancer or pleural effusion. In the posterolateral basilar aspects of the chest, end-inspiratory, dry, crackles (rales) that do not clear with coughing may be heard with a stethoscope.
[Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 272] **PEER REVIEWED**

/SIGNS AND SYMPTOMS/ The signs and symptoms of asbestosis are similar to those caused by other diffuse interstitial fibroses of the lung. Increased breathlessness on exertion is usually the first symptom, sometimes associated with aching or transient sharp pains in the chest. A cough is not usually present except in the late stages when distressing paroxysms occur. Increased sputum is not present unless there is bronchitis, the result of smoking. The onset of symptoms (except following very heavy exposure) is usually slow and the subject may have forgotten having any contact with **asbestos**. Persistent dull chest pain and hemoptysis indicate the need to investigate further the diagnosis of bronchial or mesothelial cancer. The most important physical sign is the presence of high-pitched fine crepitations (crackles) at full inspiration and persisting after coughing. They occur initially in the lower axillae and extend more widely later. ...Clubbing of the fingers and toes was formerly regarded as an important physical sign. ...Its severity does not relate well to other aspects of the diagnosis. ...It is possible that its presence relates to the rapidity of progression of the disease.
[International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983., p. 188] **PEER REVIEWED**

/SIGNS AND SYMPTOMS/ Changes in pulmonary function considered most characteristic of **asbestos** are: 1) General reduction of lung volume, especially vital capacity (VC); 2) Decrease of pulmonary flow rates as indicated by forced expiratory volume in one second FEV (1.0); 3) Impaired alveolar-capillary diffusing capacity, reflected by reduced oxygenation of the arterial blood and increased alveolar-arterial partial pressure oxygen gradient (alveolar-capillary block syndrome).
[USDHEW/NCI; Asbestos: An Information Resource p.36 (1978) DHEW Pub No. NIH 79-1681] **PEER REVIEWED**

/CASE REPORTS/ Metastases in multiple distant sites, including the skin, developed in a 54 yr old man with diffuse malignant abdominal mesothelioma. This might represent the first reported case of cutaneous metastasis arising from malignant mesothelioma. Recent advances in diagnostic techniques, such as electron microscopy, may be helpful in differentiating this condition from metastatic

adenocarcinoma.
[Ordonez NG, Smith JL Jr; Arch Dermatol 119 (10): 827-30 (1983)] **PEER REVIEWED** PubMed Abstract

/CASE REPORTS/ A 64 yr old white male insulator had been employed from 1942-1988 (46 yr) insulating powerhouses and government buildings without wearing respiratory tract protection. He mixed **asbestos** "mud" as a helper in the 1940s. He had smoked one pack of cigarettes per day from age 19-53. He had no symptoms of dyspnea, cough, phlegm, or hemoptysis. Bibasilar end-inspiratory rales were auscultated, and he had no clubbing. His posteroanterior chest radiograph was read according to the 1980 International Classification of the Radiographs of the Pneumoconioses as a 2/3 profusion of irregular opacities in the four lower lung zones with bilateral circumscribed and diffuse pleural thickening with calcifications. The pulmonary parenchyma was diffusely positive on a gallium-67 lung scintigraphy. Pulmonary function tests revealed a vital capacity of 73% of predicted, total lung capacity 68%, forced expired volume in 1 second 77%, and diffusing capacity 57%; this picture was consistent with restrictive impairment. Bronchoalveolar lavage revealed 355,000 cells/mL --81% macrophages, 10% lymphocytes, 7% neutrophils, and 2% eosinophils with many **asbestos** bodies. After 1 year's follow-up, a solitary nodule was observed in the left upper lung field that contained adenocarcinoma cells on needle biopsy. Lobectomy was performed to remove the tumor.
[Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 281] **PEER REVIEWED**

/CASE REPORTS/ ...Two cases of constrictive pericarditis in subjects previously exposed to **asbestos** /are reported/.
[Trosini-Desert V et al; Rev Mal Respir 20 (4): 622-7 (2003)] **PEER REVIEWED** PubMed Abstract

/CASE REPORTS/ This case was a 79-year-old man with pleural plaques, which had been pointed out in the left lung field on chest X-ray six years ago. A new shadow in the right chest appeared in 1999 and was closely examined. Cytological class IV carcinoma was detected in his lung tissue obtained by broncho-fiberscope. Lobectomy of the right upper lobe was performed, and calcified pleural plaques were found on the chest wall. The clinical diagnosis was poorly differentiated squamous cell carcinoma, T1N0M0. In World War II when he was 26 years old, he had worked as a boiler man on a battle cruiser for one year. The amount of **asbestos** bodies (AB) was 3,348 per gram dry lung tissue. The cores of AB and **asbestos** fibers were examined and showed that amosite was the most prevalent and crocidolite, tremolite and chrysotile were present in that order. After leaving the navy, he had worked as a farmer throughout his life, suggesting that he had never contacted **asbestos** occupationally after being a boiler man. It is strongly suggested that he had been exposed to **asbestos** during his work as a boiler man and that produced pleural plaques and lung cancer 50 years' later.
[Hiraoka T et al; Ind Health 39 (2): 194-7 (2001)] **PEER REVIEWED** PubMed Abstract

/EPIDEMIOLOGY STUDIES/ The **asbestos fiber** burden in the ovaries of women indirectly exposed to **asbestos** was examined. Ovaries were studied from 13 women in household contact with men who had documented exposure to **asbestos** and 17 women undergoing incidental oophorectomy. Ovarian tissue samples were prepared for analytic electron microscopic examination; assessments included fiber identity, size, and amount. Significant **asbestos fiber** burdens were detected in nine out of the 13 exposed subjects and in six out of the 17 subjects with no known exposure history. Three exposed women had **asbestos** counts over 1 million fibers per gram wet weight, versus one out of the 17 women with no history of exposure. Fibers were generally small in length and narrow in diameter. Both chrysotile and crocidolite **asbestos** fibers were detected. The authors conclude that **asbestos** fibers do reach the ovaries and appear to be present more frequently and in higher amounts in women with a documented exposure history

[Heller DS et al; Am J Ind Med 29 (5): 435-9 (1996)] **PEER REVIEWED** PubMed Abstract

/EPIDEMIOLOGY STUDIES/ A number of epidemiological studies of respiratory cancer and mesothelioma have been reported in relation to exposure to unspecified or complex mixtures of **asbestos** in shipyard work. The risk ratio for lung cancer has usually been moderately increased... in these studies and in studies on various other occupational groups with similarly job-related but unspecified or complex **asbestos** exposures. Risk ratios of about 2-5 have been reported in some studies, but the ratio was considerably higher in one rather small study and did not exceed unity in another. In one study, individuals suffering from asbestosis had a considerably greater risk for lung cancer, with a risk ratio of 9.0. In some of the studies referred to, a number of mesotheliomas were also observed. Abdominal mesotheliomas have been mistaken for pancreatic cancer. Mesothelioma cases have been observed to have a relatively lower fiber content in the lung than lung cancer cases.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. S7 106 (1987)] **PEER REVIEWED**

/EPIDEMIOLOGY STUDIES/ Laryngeal cancer has been considered in 2 case control studies, resulting in risk ratios of 2.4 and 2.3 that relate to shipyard work and unspecified exposure, respectively. A cohort study of insulation workers showed a relative risk of 1.9, based on 9 cases. A case series indicated a high frequency of exposure to **asbestos**, especially in low-grade smokers. ...Two correlation studies have also indicated a relationship between laryngeal cancer and exposure to **asbestos**.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. S7 107 (1997)] **PEER REVIEWED**

/EPIDEMIOLOGY STUDIES/ A group of health scientists tested the association between the use of **asbestos**-cement piping for drinking water supplies and the incidence of kidney and gastrointestinal cancers in Utah. The study found no consistent cancer incidence difference in communities with **asbestos** pipes compared to communities without the pipes. Leaching from the pipes was minimal.
[Sadler TD et al; J Commun Hlth 9 (4): 285-93 (1984)] **PEER REVIEWED**

/EPIDEMIOLOGY STUDIES/ The prevalence of atypical cytology has been determined in relation to age, smoking and **asbestos** exposure for male workers employed in 3 mines in the Province of Quebec. Overall participation was 71%. Out of 867 participating workers, 626 (72%) presented a deep cough specimen within normal limits, 74 (8.5%) presented a specimen with mild atypical metaplasia and 10 (1.2%) presented a specimen with moderate atypical metaplasia. Four lung carcinomas were identified. 5% of the workers initially interviewed did not return their specimen and 12.7% had unsatisfactory test results. Proportions of cellular atypia increased with age and **asbestos** exposure. Using logistic regression analysis, estimated probabilities of abnormal cytology for workers aged 25 years when they started mining increased with both years of **asbestos** exposure and exposure index measured in fibers per cu m.
[Kobusch AB et al; J Chron Dis 37 (8): 599-607 (1984)] **PEER REVIEWED** PubMed Abstract

/EPIDEMIOLOGY STUDIES/ The cause-specific mortality experience of 31,150 male **asbestos** workers in England and Wales (1971-1981) was evaluated in a retrospective cohort study. The study population was divided into workers with occupational exposure before the inception of **asbestos** regulations in 1969 and those who worked with **asbestos** only after 1969. Duration of exposure ranges from <10 to >20 yr. Information on exposure concentration was not provided. Overall mortality was lower than expected but there was a statistically significant excess of lung cancer deaths in workers

exposed prior to 1969 (SMR=136, p<0.01). There was a small nonsignificant increase in lung cancer in workers exposed after 1969; however, the time from first exposure for this group is too short to exclude an excess of **asbestos** related disease. Insulation workers had the greatest excess of lung cancer deaths (SMR=256). There was no excess in alimentary tract cancer and the population showed a signifcant deficit in bowel cancer mortality (SMR=54).
[Hodgson JT, Jones RD; Br J Ind Med 43: 158-64 (1986)] **PEER REVIEWED** PubMed Abstract Full text: PMC1007626

/EPIDEMIOLOGY STUDIES/ The role of **asbestos** exposure was studied in a case-control study of 175 lung cancer cases and 176 controls during a 5 yr period from two county hospitals in Norway. Information on **asbestos** exposure was obtained from personal interviews, and allocated to four exposure categories according to intensity and duration of exposure. A statistically significant (p<0.007) trend in risk ratio related to degree of exposure was observed, with a more than fourfold risk among the heavily exposed. The strongest association was found between **asbestos** exposure and small cell carcinoma (RR=3), and the weakest association between **asbestos** exposure and adenocarcinoma (RR=2.2). Very high risk ratios were observed among **asbestos**-exposed subjects who were heavy smokers, and the interaction conformed more closely to a multiplicative model than to an additive one.
[Kjuus H et al; Scand J Work Environ Health 12: 203-9 (1986)] **PEER REVIEWED** PubMed Abstract

/EPIDEMIOLOGY STUDIES/ In a cross sectional study, the frequencies of baseline and benzo(a) pyrene induced sister chromatid exchanges were measured in peripheral blood lymphocytes from 22 male **asbestos** exposed workers and 10 nonexposed workers of comparable age. Four groups were defined for study based on **asbestos** exposure and cigarette smoking. Mean duration of **asbestos** exposure was 31.3 yr in smokers and 29.3 yr in nonsmokers. The mean pack yr history of smoking for the **asbestos** exposed population was 45.7 pack yr and 75 pack yr in controls. Among **asbestos** exposed workers, lymphocytes from those who smoked were significantly more susceptible to the induction of SCE by in vitro exposure to benzo(a)pyrene (p=0.01) than were the lymphocytes from nonsmokers. Active smoking elevated the baseline SCE frequency in both **asbestos**-exposed and nonexposed workers (p=0.001). **Asbestos** exposure alone was not associated with an enhanced susceptibility to the induction of SCE by benzo(a)pyrene or with an elevation in baseline SCE.
[Kelsey KT et al; JNCI 77 (2): 321-27 (1986)] **PEER REVIEWED** PubMed Abstract

/EPIDEMIOLOGY STUDIES/ In a study involving 17,800 insulation workers, the death rate for non-smokers was 5.17 times that of a non-smoking control population. The death rate was 53.24 times that of the non-smoking control population or 4.90 times the death rate for a comparable group of non-exposed smokers. Cancers of the larynx, pharynx, and buccal cavity in insulators were also found to be associated with cigarette smoking, together with some non-malignant **asbestos** effects such as fibrosis and deaths due to asbestosis.
[Hammond EC et al; Arch Environ Health 29: 341 (1979) as cited in USEPA; Health and Environmental Effects Profile for Asbestos; p.12-11 (1979) EPA No 12] **PEER REVIEWED**

/EPIDEMIOLOGY STUDIES/ Cancer mortality for the populations was studied in 40 census tracts of Escambia County, FL that have been receiving drinking water through **asbestos** cement pipes for up to 40 years. Cancer mortality data from these 40 census tracts were compared with data from other tracts where **asbestos** cement pipe was not in use. No statistical association was observed between cancer deaths and the use of **asbestos** cement.
[Millette JR et al; Environ Health Perspect 53: 91-98 (1983) as cited in USEPA, Office of Drinking Water; Criteria Document (Draft): Asbestos p.VI-13 (1985)] **PEER REVIEWED**

/EPIDEMIOLOGY STUDIES/ The mortality of a large workforce employed to manufacture friction

products was analyzed. All individuals employed after 1940 were included in the study and the mortality experience through 1979 was determined. Exposure estimates were made by reconstructing work and ventilation conditions of earlier years. Fiber measurements from these reconstructed conditions suggested that exposures before 1931 exceeded 20 fibers/ml but those afterwards seldom exceeded 5 fibers/ml. From 1970, exposures were less than 1 fiber/ml. These relatively low intensities of exposure kept the average cumulative exposure for the group to less than 50 fibers- yr/ml. The overall mortality of all study participants, 10 years and more after the onset of exposure, was no greater than expected for all causes. The number of deaths from cancer of the lung and pleura was slightly elevated in men (151 observed vs 139.5 expected) but the excess was largely accounted for by eight mesothelioma deaths. No unusual mortality was found in study participants employed 10 or more years. Using a case control analysis according to cumulative exposure, estimated that the lung cancer increased risk was 0.06% per fiber yr/ml (KI = 0.0006) with an upper 90% confidence limit of 0.8% per fiber yr/ml.
[Newhouse ML, Berry G; Br J Ind Med 36: 98-112 (1983) as cited in USEPA; Asbestos Health Assessment Update (Draft) p.47 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

/EPIDEMIOLOGY STUDIES/ The effect of past exposure to **asbestos** on natural killer (NK) cell number and activity is uncertain. We measured NK cell number and activity in 1052 retired **asbestos** workers without symptomatic lung disease, lung cancer, or mesothelioma and with a long latency period from exposure; results were compared with those for 100 healthy age-matched controls. The exposed workers showed a decreased NK cell activity and increased NK cell number, yielding a 10.8 higher odds ratio for low NK activity per cell compared with controls (95% confidence interval 6.4 to 18.4), which was due to both a decrease in NK cell activity and an increase in NK cell number. **Asbestos** exposure of 10 years or more increased the risk of low NK activity per cell. We conclude that exposure to **asbestos** is associated with diminished effectiveness of NK cells and a concomitant increase in the number of NK circulating cells.
[Froom P et al; J Occup Environ Med 42 (1): 19-24 (2000)] **PEER REVIEWED** PubMed Abstract

/EPIDEMIOLOGY STUDIES/ To measure the impact on survival of being exposed to **asbestos** cement dust. Survival of 866 **asbestos** cement workers and 755 controls was studied with Cox's proportional hazards regression models with age as the basic time variable. The effect of cumulative exposure up to the age of 40 was investigated in an internal analysis of 635 **asbestos** cement workers who had dose estimates. The death risk was higher for the **asbestos** cement workers than for the controls with a hazard ratio (HR) of 1.15 (95% confidence interval was 1.00 to 1.31). The increased risk found seemed to be confined to the period 20-40 years from start of employment. The estimates of the cohort effect were almost unaffected by adjustment for smoking habits. The estimates of the exposure effect rose with increasing dose (< 4 fibre-years/ml (f-y/ml): HR = 1.00, 4-9.9 f-y/ml: HR = 1.06, > or = 10 f-y/ml: HR = 1.35, for workers with at least five years of employment), and were higher when restricted only to deaths from malignant or non-malignant respiratory disease. However, none of the point estimates were significantly increased. Median age at death was two years lower in the high than in the low, exposure group. The results indicate that even a moderate **asbestos** exposure may shorten the median duration of life in an exposed population. Compared with the estimated effect on duration of life from ever being a smoker, that of ever being an **asbestos** cement worker was less, although that of having a high exposure was similar.
[Albin M et al; : Occup Environ Med 53 (2): 87-93 (1996)] **PEER REVIEWED**

/EPIDEMIOLOGY STUDIES/ One hundred and twenty-two sheet metal workers in New England were examined over a 10-year interval for loss of pulmonary function and the development of asbestosis or **asbestos**-related pleural fibrosis. Regression models using the generalized estimating equation (GEE) approach were created to investigate the relationship between exposure and pulmonary function after adjusting for smoking status, age, height, and **asbestos**-related x-ray changes. A history of shipyard work was a significant contributor to the loss of forced vital capacity (FVC). Among smokers, loss in

forced expiratory volume at 1 sec (FEV1) also had a significant relationship to prior shipyard work. There was a borderline significant relationship between percentage predicted FEV1 and cumulative years of **asbestos** exposure in smokers, as well as years-since-initial-exposure in never-smokers. This study supports previous findings of obstructive airway changes in **asbestos**-exposed workers and identifies shipboard work as an important predictor of loss in pulmonary function even years after shipyard exposure to **asbestos** has ceased.
[Glencross PM et al; Am J Ind Med 32 (5): 460-6 (1997)] **PEER REVIEWED** PubMed Abstract

/EPIDEMIOLOGY STUDIES/ Several experimental and epidemiological studies have indicated augmentation of **asbestos** induced diseases by cigarette smoke by the mechanisms, which are still unknown. To determine whether smoking affects genetic system of the cells and further modifies **asbestos** induced genotoxicity, whole blood from non-smokers and smokers was exposed to **asbestos** fibres separately in vitro and micronucleus test was performed. The number of micronuclei was found to be significantly higher (P<0 05) in cases of smoker's lymphocytes, **asbestos** exposed non-smokers lymphocytes as well as **asbestos** exposed smokers lymphocytes, as compared with unexposed non-smokers lymphocytes. Further we investigated involvement of chromosome 1 in the damaging process using multicolor FISH technique. FISH is fast and reliable method, distinguishing both structural and numerical alterations. The centric/pericentric regions of chromosome 1 (cen-q12) were labeled, as the pericentric heterochromatin region 1 (q12) is quite large, highly repetitive and prone to breakage. Multicolor FISH assay suggested that the genetic damage by **asbestos** fibres mainly involve chromosome 1 but in case of cigarette smoking the damage is not strictly connected to chromosome 1 only, but also involves damage to other chromosomes. Further the study suggested that smoking makes genetic system of the cells more vulnerable to the deleterious effects of **asbestos**.
[Lohani M et al; Toxicol Lett 136 (1): 55-63 (2002)] **PEER REVIEWED** PubMed Abstract

/EPIDEMIOLOGY STUDIES/ Many **asbestos**-exposed individuals complain of chest pain for which there is no clear explanation. To determine whether chest pain is associated with the presence of benign pleural or parenchymal disease on chest radiograph, we studied 1,280 subjects undergoing surveillance because of prior **asbestos** exposure at Wittenoom, Western Australia. All subjects completed the Rose questionnaire on chest pain and this revealed 556 subjects (43%) who experienced some chest pain. A posterior-anterior chest radiograph was performed at the same clinic visit and was subsequently graded independently by two experienced readers for diffuse parenchymal disease and pleural disease. Logistic regression models adjusted for sex, age, and cumulative **asbestos** exposure indicated that the presence of chest pain was significantly associated with the presence of both benign pleural disease and diffuse parenchymal disease. Further analysis after stratification of chest pain into nonanginal and anginal pain showed that there was a significant association between anginal pain and the presence of pleural and parenchymal **asbestos**-induced radiologic abnormalities and an association of nonanginal pain with parenchymal disease. We conclude that radiographic evidence of either parenchymal or pleural disease in subjects exposed to **asbestos** is significantly related to the presence of chest pain, particularly anginal pain.
[Mukherjee S et al; Am J Respir Crit Care Med 162 (5): 1807-11 (2000)] **PEER REVIEWED** PubMed Abstract

/EPIDEMIOLOGY STUDIES/ **Asbestos** exposure has been definitively found to be associated with both mesothelioma and lung cancer. Nevertheless, in the overall population of oil refinery workers potentially exposed to **asbestos**, many studies clearly show a definitely increased risk of mesothelioma, but no proven excess of lung cancer after comparison to the general population. Through the presentation of new data and the re-appraisal of two recent and independent epidemiological studies conducted in Liguria, Italy, and Ontario, Canada, we attempt to shed light on this apparently paradoxical finding. Lung cancer mortality was studied among maintenance workers exposed to **asbestos**, and

among two other subgroups of refinery employees: blue collar and white collar workers. The comparison with blue collar workers was performed in order to take into account the role of healthy worker effect, smoking habit, and the socioeconomic level. The comparison with white collar workers was performed to control for other occupational lung carcinogens. Results reveal a consistency between the two studies and show that 96-100% of the mesotheliomas and 42-49% of the lung tumors arising among maintenance workers were attributable to **asbestos** exposure. Our new analysis, estimating two cases of **asbestos**-related lung cancer for each case of mesothelioma, confirms published findings on the magnitude of **asbestos**-related tumors in oil refineries.
[Gennaro V et al; Am J Ind Med 37 (3): 275-82 (2000)] **PEER REVIEWED** PubMed Abstract

/EPIDEMIOLOGY STUDIES/ ...The cause-specific mortality of all Italian women compensated for asbestosis and alive December 31, 1979, was investigated through October 30, 1997. In the total cohort, which included 631 subjects, 277 deaths occurred. Cause-specific SMRs (Standardized Mortality Ratio) were computed using the national rates for comparison. A significantly increased mortality for all diseases related to **asbestos** exposure was observed. Mortality for all causes, all neoplasms, lung cancer, uterine cancer, ovarian cancer, and non-neoplastic respiratory diseases was significantly increased. Separate analyses for textile (n=276) and **asbestos**-cement (n=278) workers were performed. Women employed in the textile industry, mainly exposed to chrysotile, who are compensated at a younger age, showed higher SMRs for lung cancer and asbestosis. Women in the **asbestos**-cement industry, mainly exposed to crocidolite containing **asbestos** mixtures, experienced higher mortality for pleural malignancies. /Chrysotile and crocidolite **asbestos**/
[Germani D et al; Am J Ind Med 36 (1): 129-34 (1999)] **PEER REVIEWED** PubMed Abstract

/HUMAN EXPOSURE STUDIES/ Five types of **asbestos** plus silica and glass wool fibers were tested for their ability to activate alternative complement pathway and generate chemotactic factor activity from fresh normal human serum. All 5 of the **asbestos** fibers tested (including anthophyllite and crocidolite) activated the alternative pathway. In addition it was demonstrated that chemotactic factor activity was generated when **asbestos** fibers were incubated with fresh normal human serum. These observations suggest that the complement system may mediate the initial inflammatory response observed upon exposure to certain types of **asbestos** fibers.
[Wilson MR et al; J Allergy Clin Immunol 60 (4): 218-22 (1977)] **PEER REVIEWED** PubMed Abstract

/HUMAN EXPOSURE STUDIES/ The thoracic lymph nodes are a part of the clearance system from lung tissue. Accumulation of dust in these nodes are known to occur following some types of exposure. However, no information exists as to **asbestos** content in lymph nodes from the general population. The study cohort consisted of 21 individuals previously defined as nonoccupationally exposed to **asbestos**. Tissue burden of **asbestos** obtained from lung analysis by analytical electron microscopy was compared with burden in the lymph nodes. No **asbestos** fibers were detected in nodes from 8 cases. The majority of the fibers found in lymph nodes were short (<5 um) and most often noncommercial amphiboles. Ferruginous bodies (FBs) were detected in lymph node from only two samples. The total **asbestos** burden in the lung tissue from these individuals was quite low. However, in 12 of the 13 cases that had positive nodes, the tissue burden in the node was appreciably heavier per gram than in the lung. This raises the question as to whether the lymph nodes, though less efficient clearance, may be better indicators of lifetime exposure to dust than lung tissue.
[Dodson RF et al; Am J Ind Med 37 (2): 169-74 (2000)] **PEER REVIEWED** PubMed Abstract

/OTHER TOXICITY INFORMATION/ Crocidolite, a carcinogenic **asbestos** in humans, specifically induces mesothelioma. ...The cytogenotoxic effects of crocidolite in a human mesothelioma cell line,

MSTO211H, and a human promyelocytic leukemia cell line, HL60 /were investigated/. Using confocal laser scanning microscopy, /it was/ found that the MSTO211H cells had phagocytotic activity, whereas the HL60 cells did not. In the MSTO211H cells, crocidolite decreased the cell population and increased the numbers of polynucleated cells (PN) and tetraploid cells, and increased the coefficients of variation (CV) of DNA contents in G0/G1 cells and the formation of 8-hydroxydeoxyguanosine. In contrast, crocidolite showed none of these cytogenotoxic effects in HL60 cells. To investigate the importance of phagocytosis in the cytogenotoxicity of crocidolite, ...the crocidolite-phagocytosed cells /were sorted/ from less-phagocytosed cells by fluorescence-activated cell sorting, and ...the differences in cytogenotoxicity between these two cell groups /were studied/. ...Significant increases in the numbers of PN and tetraploid cells and the CV in the crocidolite-phagocytosed cells /were found/ compared to the less-phagocytosed cells. These findings indicate that MSTO211H cells are susceptible to the cytogenotoxic effects of **asbestos** due to their phagocytotic activity, and that the MSTO211H cell line is suitable for the detection of such effects on human cells by **asbestos** and other materials which need to be phagocytosed to exert their toxicity. /Crocidolite/
[Takeuchi T et al; Mutat Res 438 (1): 63-70 (1999)] **PEER REVIEWED** PubMed Abstract

Medical Surveillance:

The employer shall institute a medical surveillance program for all employees who are or will be exposed to airborne concentrations of fibers of **asbestos** at or above the TWA and/or excursion limit. ...All medical examinations and procedures /must be/ performed by or under the supervision of a licensed physician... .
[29 CFR 1910.1001(l)(1); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 20, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

...A pre-placement medical examination shall be provided or made available by the employer. Such examination shall include, as a minimum, a medical and work history; a complete physical examination of all systems with emphasis on the respiratory system, the cardiovascular system and digestive tract; completion of the respiratory disease standardized questionnaire in Appendix D to /the OSHA **asbestos** standard/, Part 1; a chest roentgenogram (posterior-anterior 14X17 inches); pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV(1.0)); and any additional tests deemed appropriate by the examining physician. Interpretation and classification of chest roentgenogram shall be conducted in accordance with Appendix E to /the OSHA **asbestos** standard/.
[29 CFR 1910.1001(l)(2); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 20, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Periodic medical examinations shall be made available annually. The scope of the medical examination shall be in conformance with the protocol established in /pre-placement examination/. ...Chest roentgenogram shall be conducted in accordance with /the following schedule:/ 0-10 years since first exposure- every 5 yr for employees age 15-45 yr; 10+ years since first exposure- every 5 yr for employees age 15-35, every 2 yr for employees age 35-45, and every 1 yr for employees age 45+ years. /from table/
[29 CFR 1910.1001(l)(3); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 20, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

The employer shall provide, or make available, a termination of employment medical examination for any employee who has been exposed to airborne concentrations of fibers of **asbestos** at or above the TWA and/or excursion limit. The medical examination shall be in accordance with the requirements of the periodic examinations... and shall be given within 30 calendar days before or after the date of termination of employment.
[29 CFR 1910.1001(l)(4); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 20, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Pre-employment medical examinations should include the following: Medical history, family history, history of smoking, consumption of alcohol, and an occupational history. Physical examinations should include: oral cavity, cheek, and abdomen which includes a digital examination of the rectum. Spirometry: Including measurements of vital capacity, forced vital capacity, and forced expiratory volume at one second. Chest X-ray: postero-anterior and lateral views (14x17 inch), along /with/ sputum cytology /examination/. /**Asbestos** cmpd/
[USDHEW/NCI; Asbestos: An Information Resource p.93 (1978) DHEW Pub No. NIH 79-1681] **PEER REVIEWED**

Asbestos workers with clinical symptoms of hoarseness, or pain, or soreness of the throat should be referred to an ear, nose, and throat specialist for a detailed otolaryngologic examination of the upper respiratory tract /for detection of laryngeal cancer/.
[USDHEW/NCI; Asbestos: An Information Resource p.96 (1978) DHEW Pub No. NIH 79-1681] **PEER REVIEWED**

Populations at Special Risk:

Special groups at risk may include neonates and children; however, no data exist on the relative sensitivity to **asbestos** of infants and children undergoing rapid growth. Concern exists because fibers deposited in the tissues of young may have an extremely long residence time during which malignant changes could occur. In addition, risk could be influenced by differential absorption rates which have not been fully studied at this time. Individuals on kidney dialysis machines may also be at greater risk as fluids, potentially contaminated with **asbestos** fibers can enter the blood stream directly or, in selected instances, the peritoneal cavity (peritoneal dialysis). An increased risk is also associated with increased exposure to **asbestos** in water in municipalities such as San Francisco or Seattle where **asbestos** occurs naturally in water, in cities where there is a interaction between aggressive water and **asbestos**-cement pipe, or in cities whose water may be contaminated as a result of **asbestos** operations.
[USEPA; Ambient Water Quality Criteria Doc: Asbestos p.C-99 (1980) EPA 440/5-80-022] **PEER REVIEWED**

Hypersusceptible individuals have not been defined for ingested exposures to mineral fibers. It is well known that smokers exposed to **asbestos** dusts from inhalation are at a higer risk of developing lung cancer than are nonsmokers with similar exposures.
[Hammond EC et al; Health Hazards of Asbestos Exposure 473-90 (1979) as cited in USEPA; Office of Drinking Water; Criteria Document (Draft): Asbestos p.VI-21 (1985)] **PEER REVIEWED**

Variability in susceptibility to **asbestos**-induced respiratory tissue damage may be related to individual genetic differences in ability to detoxify reactive electrophilic molecules (e.g., reactive oxygen radicals and nitrogen oxide) produced during pulmonary disposition of fibers.
[DHHS/ATSDR; Toxicological Profile for Asbestos p.114 (2001)] **PEER REVIEWED**

NAT2 is another Phase II enzyme that displays genetic polymorphisms (one associated with slow acetylation and another with fast acetylation) that also may be associated with susceptibility to **asbestos** toxicity. Among a group of subjects exposed to high levels of **asbestos**, individuals who lacked the GSTM1 gene and had the slow NAT2 genotype showed a 4-fold increased risk for developing nonmalignant respiratory disorders and an 8-fold increased risk for developing mesothelioma compared with individuals with the GSTM1 gene and the fast NAT2 genotype.
[DHHS/ATSDR; Toxicological Profile for Asbestos p.114 (2001)] **PEER REVIEWED**

Recent studies have shown that a high percentage of human mesotheliomas also test positive for the presence of Simian Virus 40 (SV40). Based on this finding, it has been suggested that SV40-infected individuals who are exposed to **asbestos** might be at increased risk for developing mesothelioma.
[DHHS/ATSDR; Toxicological Profile for Asbestos p.115 (2001)] **PEER REVIEWED**

Probable Routes of Human Exposure:

Asbestos /enters the human body/ from gastrointestinal and respiratory tract exposure.
[Nat'l Research Council Canada; Asbestos p.14 (1979) NRCC No. 16452] **PEER REVIEWED**

Asbestos is usually taken into the body by inhalation or ingestion and it is then distributed to most organs via the blood or lymphatic systems.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.23 (1979) NRCC No. 16452] **PEER REVIEWED**

ASBESTOS FIBERS MAY BE LIBERATED INTO AIR ... IN MINING, MILLING, PROCESSING, OF **ASBESTOS** CONTAINING PRODUCTS & DUMPING WASTE. ... FIBERS LESS THAN 3 UM IN DIAM & FROM 10-200 UM IN LENGTH ARE MOST IMPORTANT CAUSE OF ASBESTOSIS.
[International Labour Office. Encyclopedia of Occupational Health and Safety. Volumes I and II. New York: McGraw-Hill Book Co., 1971., p. 123] **PEER REVIEWED**

CONTENTS & TYPES OF **ASBESTOS** IN FIREPROOFING INSULATION MATERIALS SPRAYED ON CEILINGS OF 127 BUILDINGS THROUGHOUT THE USA WERE STUDIED. DURING REMOVAL OF SPRAYED MATERIALS, WORKERS WERE EXPOSED TO EXTREMELY HIGH CONCENTRATIONS (AVG 16.4 FIBERS/CC) WHEN DRY METHODS WERE USED. WHEN WET METHODS WERE USED DURING REMOVAL, THE AIRBORNE FIBER CONCENTRATIONS WERE REDUCED TO LESS THAN 2 FIBERS/CC.
[PAIK NW ET AL; AM IND HYG ASSOC J 44 (6): 428-32 (1983)] **PEER REVIEWED** PubMed Abstract

... EXPOSURES OCCUR DURING END-PRODUCT USE, AMONG **ASBESTOS** INSULATION WORKERS, AMONG BRAKE REPAIR & BRAKE MAINTENANCE WORKERS, & AS RESULT OF INDIRECT OCCUPATIONAL EXPOSURES, PARTICULARLY IN SHIP BUILDING & SHIP REPAIR, & IN CONSTRUCTION INDUSTRY. OTHER EXPOSURES OCCUR IN RELATION TO INSPECTION & MAINTENANCE WORK ON **ASBESTOS** CONTAINING STRUCTURES & EQUIPMENT, IN REFINERIES & CHEMICAL PLANTS, BUILDINGS, RAILWAY LOCOMOTIVES & WAGONS, SHIPYARDS & POWER PLANTS. ... BUILDING DEMOLITION & WASTE DISPOSAL. ... EXPOSURE MAY OCCUR DURING WEARING OF **ASBESTOS** SAFETY GARMENTS.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php

p. V14 37 (1977)] **PEER REVIEWED**

Talc /which is often contaminated with **asbestos**/ is used in the following products: cosmetics, spray and dusting powder, insecticides, white shoe polishes, as a filler for soap, dusting powders for toy balloons, condoms, and contraceptive diaphragms.
[Nat'l Research Council Canada; Asbestos p.51 (1979) NRCC No. 16452] **PEER REVIEWED**

Insulation workers using **asbestos** materials and automotive brake repairmen have been exposed to airborne **asbestos** levels up to 133 and 72 fibers/cu m, respectively.
[Nat'l Research Council Canada; Asbestos p.13 (1979) NRCC No. 16452] **PEER REVIEWED**

Exposure to airborne **asbestos** in the home may /result from use of/ spackling compounds, certain types of insulation, and some workers may bring home some material ... on their work clothing.
[Nat'l Research Council Canada; Asbestos p.13 (1979) NRCC No. 16452] **PEER REVIEWED**

Exposure profiles for respirable silica dust in 15 mining industry groups that were prepared from the 1977-1981 Mine Safety and Health Administration (MSHA) MIDAS files are presented as probability distribution graphs. The dust exposure data have been organized into data sets according to industry group, operation category, and location (surface and underground) as discussed in this report. There are 15 industry groups: copper, gold and silver, iron, lead and zinc, molybdenum, uranium, other metals, limestone, other stone, clay and shale, **asbestos**, talc, oil shale, sand and gravel, and other nonmetals. Operation and location are classified into 14 categories: surface drilling; underground drilling, blasting, cutting and boring; surface production; surface mobile transport; surface haulageway maintenance; underground production; underground haulageway maintenance; crushing or grinding, and sizing; concentrating and finishing; non specific surface; and non specific underground.
[Chen CK et al; Technological Feasibility of Controlling Asbestos and Silica at Mines and Mills. 248 pp (1983) NIOSH Contract No. PHS-NIOSH-210-81-4101] **PEER REVIEWED**

Occupational settings in which individuals who may be at risk from indirect exposure to **asbestos** include: gold mining, cigarette filter manufacture, automobile transmission parts manufacture, dentistry, and agriculture.
[Nat'l Research Council Canada; Asbestos p.46 (1979) NRCC No. 16452] **PEER REVIEWED**

Asbestos is present in the soil, water and air, and may be added to these media from mining, wearing of automobile brake linings, **asbestos** textile manufacturing, **asbestos** spraying for fireproofing, and the use of **asbestos** in construction materials. The multitude of uses for this non-combustible insulating material means that exposure may be both occupational and non-occupational (environmental); for most people, exposure to at least a low level of **asbestos** ocurs on a daily basis.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.23 (1979) NRCC No. 16452] **PEER REVIEWED**

... Dietary materials that have been reported to contain, or are likely to contain, **asbestos** include foods such as vegetable oil, lard, mayonnaise, ketchup and meats ... and beverages such as beers, sherries, ports, vermouth and soft drinks.
[USEPA, Office of Drinking Water; Criteria Document (Draft): Asbestos p.IV-8 (1985)] **PEER REVIEWED**

Currently, all major commercial **asbestos** varieties, chrysotile, amosite, and crocidolite, have been found

to produce a significant incidence of **asbestos**-related disease among workers ocupationally exposed in mining and milling, in manufacturing, and in the use of materials containing the fiber. The predominant route of exposure has been inhalation, although some **asbestos** may be swallowed directly or after being brought up from the rspiratory tract. Not only has **asbestos** disease been found among individuals exposed to the fiber directly as a result of excessive work exposures in decades past, but **asbestos**-associated cancer has also been identified, albeit less frequently, among those with inhalation exposures of lesser intensity, including those who had worked near the application or removal of **asbestos** material, those with history or residing in the vicinity of **asbestos** plants, and those who had lived in the household of an **asbestos** worker.
[USEPA; Ambient Water Quality Criteria Doc: Asbestos p.63 (1980) EPA 440/5-80-022] **PEER REVIEWED**

DOMESTIC EXPOSURE OF HOUSEHOLD CONTACTS TO **ASBESTOS** MAY OCCUR FROM DUSTS BROUGHT HOME ON WORKERS' CLOTHES, SHOES, HAIR, EQUIPMENT, ETC. ... **ASBESTOS** LEVELS /WERE FOUND/ RANGING FROM 100-500 NG/CU M IN THE HOUSES OF WORKMEN.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V14 38 (1977)] **PEER REVIEWED**

Certain beverages are either made from water already containing **asbestos** fibers or are clarified (beer, wine) by filtration through **asbestos** filter pads from which fibers may be released. The **asbestos fiber** levels in other foods are largely unknown.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.14 (1979) NRCC No. 16452] **PEER REVIEWED**

The hazard from environmental **asbestos** exposure showed that mesothelioma could occur among individuals whose potential **asbestos** exposure consisted of having resided near an **asbestos** factory or in the household of an **asbestos** worker. Twenty of 76 cases from the files of the London hospital were the result of such exposures.
[Newhouse ML, Thompson H; Br J Ind Med 22: 261 (1965) as cited in USEPA; Asbestos Health Assessment Update (Draft) p.114 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

A field study was conducted to measure **asbestos fiber** concentrations during brake repair for mechanics in the Federal Republic of Germany. In addition to **asbestos** air sampling, 210 occupational histories describing working conditions under which brake maintenance is carried out were evaluated. Ninety dust concentration measurements in 76 service stations with static and personal samplers during brake maintenance operations. Sampling times varied from less than 3 min to more than 1 hr depending on the duration of the work operation. Samples were analyzed by phase contrast microscopy and scanning transmission electron microscopy. Fiber concentrations during brake service operations were 0.1X10+6/cu m (0.1 fiber per cc) on average. Average fiber dosages (fiber concentration X sampling time) ranged from 4X10+6 fiber/cu m/min for dry brushing and grinding to 10X10+6 fibers/cu m/min for machine grinding. Electron microscopy of brake drum dust indicated very high concentrations of short fibers; fibers with lengths > 5 um constituted less than 1% of all the chrysotile fibers counted.
[Rodelsperger K et al; Am J Ind Med 10: 63-72 (1986)] **PEER REVIEWED** PubMed Abstract

Average Daily Intake:

Assuming that **asbestos** is present at the highest accurate concentration, ie, > 9999.99 million fibers/liter

the daily intake for a 70 kg adult male consuming 2 liters of drinking water/day would be > 20 billion fibers/day.
[Millette JR et al; Environ Health Perspect 53: 91-98 (1983) as cited in USEPA; Office of Drinking Water; Criteria Document (Draft): Asbestos p.IV-8 (1985)| **PEER REVIEWED**

Emergency Medical Treatment:

Emergency Medical Treatment:

EMT Copyright Disclaimer:

The following Overview, *** **ASBESTOS** ***, is relevant for this HSDB record chemical.

Life Support:

o This overview assumes that basic life support measures have been instituted.

Clinical Effects:

0.2.1 SUMMARY OF EXPOSURE

0.2.1.1 ACUTE EXPOSURE

A) USES: **Asbestos** has been mined for use in a variety of manufactured products due to its low cost and desirable properties, such as heat and fire resistance, wear and friction characteristics, tensile strength, heat, electrical, and sound insulation, adsorption capacity, and resistance to chemical and biological attack. It has been mostly used in building materials, friction products, and heat-resistant fabrics.

B) TOXICOLOGY: **Asbestos** exposure occurs from inhalation of airborne fibers or from ingestion of fibers. All **asbestos fiber** types are fibrogenic and known to cause asbestosis, pleural changes, lung cancer, and mesothelioma. Most human studies have examined exposure to chrysotile, the most widely used type of **asbestos**. Asbestosis has been reported in populations exposed to amosite, crocidolite, tremolite, and anthophyllite **asbestos**. Crocidolite has the greatest potential to produce disease, followed by amosite and chrysotile.

C) EPIDEMIOLOGY: It has been estimated that of the 4 million workers heavily exposed to **asbestos**, at least 1.6 million (35% to 44%) are expected to die of **asbestos**-related cancers. It is estimated that between 58,000 and 75,000 **asbestos**-associated deaths will occur each year, which will account for between 13% and 18% of the total cancer deaths in the United States.

D) WITH POISONING/EXPOSURE

1) CHRONIC TOXICITY: **Asbestos** exposure increases the risk for non-malignant **asbestos**-related lung and pleural disorders (asbestosis, pleural plaques, pleural thickening, and pleural effusions), lung cancer, and mesothelioma. Chronic inhalation of **asbestos** fibers may lead to a characteristic pneumoconiosis termed asbestosis, a diffuse interstitial lung fibrosis. Individuals with fully developed asbestosis will experience dyspnea, which is often accompanied by rales or cough. Deficits in pulmonary function variables, (ie, forced expiratory volume in one second (FEV1) and forced vital capacity (FVC)), also occur. Asbestosis can cause cardiovascular effects, such as pulmonary hypertension and compensatory hypertrophy of the right heart (cor pulmonale). Besides asbestosis, chronic **asbestos** exposure causes lung cancer, mesothelioma (primarily of the pleura but also of the peritoneum), pleural disease, and pleural plaques. Tobacco smokers, exposed to **asbestos**, are at greater risk for lung cancer than nonsmokers. Cancers at sites other than the respiratory system have been linked to **asbestos** exposure, including gastrointestinal carcinomas, cancer of the kidney, brain, bladder, larynx, and pancreas, and unspecified malignant lymphomas. The ACGIH places **asbestos** (all forms) in category A1, Confirmed Human Carcinogen. The IARC classifies **asbestos** in Group 1: Carcinogenic to humans. The NTP classifies **asbestos** as a known carcinogen.

0.2.20 REPRODUCTIVE HAZARDS

A) Transplacental transfer of **asbestos** may occur, but this has not been linked with any adverse reproductive outcomes in humans.

0.2.21 CARCINOGENICITY

0.2.21.1 IARC CATEGORY

A) IARC Carcinogenicity Ratings for CAS12172-73-5 (IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2006; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2007; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010a; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2008; IARC, 2004):

1) Not Listed

B) IARC Carcinogenicity Ratings for CAS14567-73-8 (IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2006; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2007; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010a; IARC Working Group

on the Evaluation of Carcinogenic Risks to Humans, 2008; IARC, 2004):
1) Not Listed
C) IARC Carcinogenicity Ratings for CAS12001-28-4 (IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2006; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2007; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010a; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2008; IARC, 2004):
1) Not Listed
D) IARC Carcinogenicity Ratings for CAS17068-78-9 (IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2006; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2007; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010a; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2008; IARC, 2004):
1) Not Listed
E) IARC Carcinogenicity Ratings for CAS13768-00-8 (IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2006; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2007; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010a; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2008; IARC, 2004):
1) Not Listed
F) IARC Carcinogenicity Ratings for CAS1332-21-4 (IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2006; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2007; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010a; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2008; IARC, 2004):
1) IARC Classification
a) Listed as: **Asbestos**
b) Carcinogen Rating: 1
1) The agent (mixture) is carcinogenic to humans. The exposure circumstance entails exposures that are carcinogenic to humans. This category is used when there is sufficient evidence of carcinogenicity in humans. Exceptionally, an agent (mixture) may be placed in this category when evidence of carcinogenicity in humans is less than sufficient but there is sufficient evidence of carcinogenicity in experimental animals and strong evidence in exposed humans that the agent (mixture) acts through a relevant mechanism of carcinogenicity.
G) IARC Carcinogenicity Ratings for CAS12001-29-5 (IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2006; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2007; IARC Working

Group on the Evaluation of Carcinogenic Risks to Humans, 2010; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010a; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2008; IARC, 2004):

1) Not Listed

0.2.21.2 HUMAN OVERVIEW

A) **Asbestos** is a human carcinogen. The primary types of **asbestos**-related cancers are mesothelioma of the pleura and peritoneum and bronchogenic carcinoma.

B) An increasing number of reports are suggesting an association between asbestosis and gastrointestinal, renal, or laryngeal malignancies; these reports have been refuted by others.

Laboratory:

A) Monitor chest CT scan, chest x-ray, and pulmonary function tests in **asbestos**-exposed patients.

B) Open lung biopsy is the only definitive diagnostic test for asbestosis.

C) Bronchoalveolar lavage (BAL) has been recommended as an adjunct in the diagnosis of **asbestos**-related pulmonary diseases.

D) OSHA has specific clinical monitoring requirements for workers exposed to **asbestos**.

Treatment Overview:

0.4.3 INHALATION EXPOSURE

A) MANAGEMENT OF TOXICITY

1) Since there is no effective therapy for an established case of asbestosis, treatment is aimed at maintaining vital capacity and reducing respiratory work load. Treatment may include the following: vaccination against pneumococcal pneumonia and influenza, bronchodilator administration, adequate nutrition, home oxygen therapy, rebreathing and exercise training, and smoking cessation. Pharmacological agents to limit the progression of fibrosis as yet have not been developed.

B) DECONTAMINATION

1) PREHOSPITAL: Most **asbestos** exposures are of a chronic nature, such that traditional first aid is not appropriate. In the event of a heavy acute exposure, move the patient to fresh air. Monitor for respiratory distress. Administer oxygen and assist ventilation as required.

2) HOSPITAL: Most **asbestos** exposures are of a chronic nature, such that traditional first aid is not appropriate. In the event of a heavy acute exposure, move the patient to fresh air. Monitor for respiratory distress. Administer oxygen and assist ventilation as required. Treat bronchospasm with inhaled beta-2 agonist and oral or parenteral corticosteroids.

C) AIRWAY MANAGEMENT

1) Administer oxygen and assist ventilation as required. Treat bronchospasm with inhaled beta-2 agonist and oral or parenteral corticosteroids.

D) ANTIDOTE

1) None

E) PATIENT DISPOSITION

1) HOME CRITERIA: There is no role for home management.

2) OBSERVATION CRITERIA: Patients with known **asbestos** exposure require outpatient monitoring to detect complications.
3) ADMISSION CRITERIA: While there is no specific therapy for **asbestos** exposure, patients may require inpatient therapy for their poor pulmonary function or cancer treatment.
4) CONSULT CRITERIA: A toxicologist may be consulted to aid in determining if a patient's symptoms or cancer is from a previous exposure to **asbestos**. Consult a pulmonologist for patients with evidence of **asbestos**-induced pulmonary complications.

F) PITFALLS
1) Failure to recognize a worker is exposed to **asbestos** and not instituting appropriate industrial hygiene protective measures.

G) TOXICOKINETICS
1) **Asbestos** fibers thicker than 3 micrometers (mcm) in diameter or longer than 100 mcm are either not inhaled or are rapidly cleared from the respiratory tract. On a weight basis, only a very small proportion of inhaled fibers are retained. When inoculated intrapleurally, the majority of **asbestos** fibers were cleared during the first 10 days. Subsequently, there was very small elimination through the gut.
2) An inverse relationship between intensity of exposure and time of disease development has been suggested. Depending on the level of workplace exposure, the latency period may range from 5 to 6 years to 10 to 20 years.

H) DIFFERENTIAL DIAGNOSIS
1) The differential diagnosis of asbestosis includes coal workers, pneumonoconiosis, dermatomyositis, hypersensitivity pneumonitis, idiopathic pulmonary fibrosis, sarcoidosis, and silicosis.

Range of Toxicity:

A) TOXICITY: Low-level exposures or occupational exposure for under two years were not associated with increased mortality. Asbestosis has rarely been reported with intense exposure of only one day's duration. Lowest observed adverse effect levels (LOAELs) for systemic effects, determined from human inhalation studies, range from 25 to 54 fiber-year/mL (f-yr/mL, obtained by multiplying years of exposure times the average air concentration in fibers/mL) for intermediate exposure duration of 15 to 364 days. At the chronic exposure duration level (365 days or more), LOAELs ranged from 20 to 207 f-yr/mL for less serious systemic effects (those not expected to cause significant dysfunction or death or the significance is not entirely clear) and from 15 to 1271 f-yr/mL for serious systemic effects (those that evoke failure in a biological system and can lead to morbidity or mortality). LOAELs for cancer from chronic inhalation exposure, based on human studies, ranged from 5 to 1050 f-yr/mL.

[Rumack BH POISINDEX(R) Information System Micromedex, Inc., Englewood, CO, 2015; CCIS Volume 163, edition expires Feb, 2015. Hall AH & Rumack BH (Eds): TOMES(R) Information System Micromedex, Inc., Englewood, CO, 2015; CCIS Volume 163, edition

expires Feb, 2015.] **PEER REVIEWED**

Antidote and Emergency Treatment:

Emergency and supportive measures: Emphasis should be placed on prevention of exposure. All **asbestos** workers should be encouraged to stop smoking and to observe workplace control measures stringently. There is no known antidote. Persons exposed to **asbestos** dust and those assisting victims should wear protective equipment, including appropriate respirators and disposable gowns and caps. Watering down any dried material will help to prevent its dispersion into the air as dust. **Asbestos** is not absorbed through the skin. However, it may be inhaled from the skin and clothing, so removal of clothes and washing the skin is recommended.
[Olson, K.R. (ed.) Poisoning & Drug Overdose. 3rd edition. Lange Medical Books/McGraw-Hill, New York, NY. 1999., p. 99] **PEER REVIEWED**

Animal Toxicity Studies:

Evidence for Carcinogenicity:

Classification of carcinogenicity: 1) evidence in humans: sufficient; 2) evidence in animals: sufficient. Overall summary evaluation of carcinogenic risk to humans is Group 1: The agent is carcinogenic to humans.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. S7 106 (1987)] **PEER REVIEWED**

CLASSIFICATION: A; human carcinogen. BASIS FOR CLASSIFICATION: Observation of increased mortality and incidence of lung cancer, mesotheliomas and gastrointestinal cancer in occupationally exposed workers are consistent across investigators and study populations. Animal studies by inhalation in two strains of rats showed similar findings for lung cancer and mesotheliomas. Animal evidence for carcinogenicity via ingestion is limited (male rats fed intermediate-range chrysotile fibers; i.e., greater than (>) 10 um length, developed benign polyps), and epidemiologic data in this regard are inadequate. HUMAN CARCINOGENICITY DATA: Sufficient. ANIMAL CARCINOGENICITY DATA: Sufficient.
[U.S. Environmental Protection Agency's Integrated Risk Information System (IRIS). Summary on Asbestos (1332-21-4). Available from, as of March 15, 2000: http://www.epa.gov/iris/ **PEER REVIEWED**

A1: Confirmed human carcinogen. /**Asbestos**, all forms/
[American Conference of Governmental Industrial Hygienists TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH, 2008, p. 13] **QC REVIEWED**

Asbestos: known to be a human carcinogen.
[DHHS/National Toxicology Program; Eleventh Report on Carcinogens: Asbestos (1332-21-4) (January 2005). Available from, as of July 31, 2009: http://ntp.niehs.nih.gov/ntp/roc/eleventh/profiles/s016asbe.pdf **QC REVIEWED**

Non-Human Toxicity Excerpts:

/LABORATORY ANIMALS: Acute Exposure/ In early experiments, it was demonstrated that guinea pigs and monkeys exposed by /inhalation/ to 4 commercial types of **asbestos** developed fibrotic lesions of lung and pleura... . In more recent experiments, this finding has been confirmed in rats and hamsters.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V14 60 (1977)] **PEER REVIEWED**

/LABORATORY ANIMALS: Acute Exposure/ Benign **asbestos** pleurisy is a manifestation of **asbestos**-induced disease that is not uncommon but often is ignored. Crocidolite **asbestos** injected into the rabbit pleural space caused the appearance of chemotactic activity in an exudative effusion, characterized by a polymorphonuclear leukocyte response that peaked 4 hr after injection. /Crocidolite **asbestos**/
[Shore BL et al; Am Rev Respir Dis 128 (3): 481-85 (1983)] **PEER REVIEWED** PubMed Abstract

/LABORATORY ANIMALS: Acute Exposure/ ...C57BL/6-129 hybrid mice with genes for both the 55kd and 75kd receptors for TNF-alpha knocked out (TNF-alphaRKO) fail to develop fibroproliferative lesions after **asbestos** exposure. There is good evidence that TNF-alpha plays a major role in mediating interstitial pulmonary fibrosis. ...New data obtained by in situ hybridization /is presented/ showing that expression of the genes coding for transf orming growth factor alpha (TGF-alpha) and platelet-derived growth factor A-chain (PDGF-A) is reduced in the TNF-alphaRKO mice compared with control animals. In accordance with this observation, data on bromodeoxyuridine (BrdU) incorporation in the lungs of the TNF-alphaRKO mice show no increases over unexposed control animals. In contrast, wild-type control mice exposed to **asbestos** exhibit 15- to 20-fold increases in BrdU uptake and consequently develop fibrogenic lesions. Even though the levels of TNF-alpha gene expression and protein production were increased in the **asbestos**-exposed TNF-alphaRKO mice, the lack of receptor signaling protected the mice from developing fibroproliferative lesions. We agree with the view that TNF-alpha is essential for the development of interstitial pulmonary fibrosis and postulate that TNF-alpha mediates its effects through activation of other growth factors such as PDGF and TGF-alpha that control cell growth and matrix production.
[Liu JY et al; Am J Pathol 153 (6): 1839-47 (1998)] **PEER REVIEWED** PubMed Abstract Full text: PMC1866331

/LABORATORY ANIMALS: Acute Exposure/ .../It was found that an intrapleural/ dose of 40 mg **asbestos** dust on gelatin coated fiber-glass pledgets... /of/ 3 of the Union Internationale Contre le Cancer samples, crocidolite, amosite and Rhodesian chrysotile, all produced mesotheliomas in about 60% of Osborne Mendel rats. ...Mesotheliomas in Sprague Dawley rats treated with a single /intrapleural/ dose of 67 mg of chrysotile, amosite, or crocidolite /were observed/. /Crocidolite, amosite and Rhodesian chrysotile **asbestos**/
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V13 45 (1977)] **PEER REVIEWED**

/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ ...Groups of CD Wistar rats /were exposed/ to 5 Union Internationale Contre le Cancer **asbestos** samples (amosite, anthophyllite, crocidolite and Rhodesian and Canadian chrysotiles) at concentrations of about 12 mg/cu m respirable dust for 7 hr/day on 5 days/wk, for several lengths of exposure: 1 day (7 hr), 3 months, 6 months, 12 months or 24 months. At the end of exposures, the amount of dust in the lungs of animals exposed to the

2 chrysotile samples was much less than that in animals exposed to the 3 amphibole samples. However, all types of fiber produced asbestosis, which was progressive after removal from the dust. Futhermore, whereas no carcinomas of the lung were found in the control group, carcinomas of the lung and mesotheliomas were demonstrated in the groups exposed to Canadian chrysotile and to the amphiboles. Only carcinomas of the lung were seen with Rhodesian chrysotile ...an increasing incidence of neoplasms was observed with increasing exposures to each form of **asbestos**. Even as little as 1 day of exposure (providing the animals were allowed to survive and were observed) produced neoplasia.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V14 44 (1977)] **PEER REVIEWED**

/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ The effects of 3 months intermittent inhalational exposures of amphibole and serpentine **asbestos** on the constituents of the lower respiratory tract was studied. Bronchoalveolar lavage (BAL) analyses were performed on 3 groups of rats: 1 group was exposed to chrysotile (serpentine) **asbestos**, second group was exposed to crocidolite amphibole **asbestos**, while the third group was sham-exposed. The total BAL cell yields and macrophage content of BAL cells were significantly lower after **asbestos** exposure, especially in the chrysotile-exposed group. These effects persisted for as long as 1 yr after cessation of exposure. Multinucleated macrophages were seen in BAL cells from both **asbestos**-exposed groups. Striking ultrastructural alterations of macrophage morphology were noted in BAL cells from both groups of **asbestos** exposed rats. Chrysotile fibers were not seen in any BAL cells from chrysotile-exposed animals. However, 15 months after terminating the exposure regimen, a sizeable proportion of BAL macrophages from crocidolite-exposed rats contained phagocytosed **asbestos** fibers. /Amphibole and serpentine **asbestos**; chrysotile and crocidolite/
[Kagan E et al; Environ Res 32 (2): 382-97 (1983)] **PEER REVIEWED** PubMed Abstract

/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ Experimental coniosis was induced by intratracheal administration to rats of 25 mg or 50 mg of Portland cement, **asbestos**-cement, as well as chrysotile and crocidolite **asbestos**. The rats were sacrificed 90, 165 and 180 days after dust administration. The weight of wet lungs and hydroxyproline content in lungs were determined. Statistically significant lower values of fibrogenic effects indices following cement dust administration, as compared to those indices for the other dusts, were found. On the other hand, no significant differences were found between fibrogenic effects indices for **asbestos**-cement containing approx 13% of **asbestos** and pure **asbestos** dusts (chrysotile or crocidolite). Furthermore, it seems that the duration of dust action is more important than the dust dose in the development of fibrogenic asbestosis. /Chrysotile and crocidolite/
[Wozniak H, Wiecek E; Med Pr 35 (4): 269-72 (1984)] **PEER REVIEWED** PubMed Abstract

/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ 6 week old male F344 rats were fed 10 mg of **asbestos** 3 times/week for 10 weeks. The animal tissues were examined at 34 weeks or after their natural death. Intestinal cancer (not significant) was observed; however, no toxic effects were reported.
[Ward JM et al; J Environ Pathol Toxicol 3: 301-12 (1980) as cited in USEPA; Office of Drinking Water; Criteria Document (Draft): Asbestos p.V-5 (1985)] **PEER REVIEWED**

/LABORATORY ANIMALS: Subchronic or Prechronic Exposure/ Early lesions /similar to those reported earlier: multinucleated giant cells, lymphocytes, and fibroblasts/ were found in rats /following inhalation of **asbestos** fibers/ and consisted of a proliferation of macrophages and cell debris in the terminal bronchioles and alveolae.
[Davis JMG et al; Br J Cancer 37: 673-88 (1978) as cited in USEPA; Asbestos Health

Assessment Update (Draft) p.76 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ /Intrapleural administration to CD Wistar and Osborne-Mendel rats/ all commercial types of **asbestos** have produced mesotheliomas in C/D Wistar rats. A dose of 20 mg of the five UICC standard reference samples produced mesotheliomas in varying numbers - crocidolite 61%, amosite 36%, anthophyllite 34%, Canadian chrysotile 30% and Rhodesian chrysotile 19%. With a dose of 40 mg of **asbestos** dust on gelatin-coated fibre-glass pledgets, /it was/ found that three of the UICC samples, crocidolite, amosite and Rhodesian chrysotile, all produced mesotheliomas in about 60% of their Osborne-Mendel rats. Induced mesotheliomas with 60 mg of Russian chrysotile. In all these studies there was a long latent period between inoculation and appearance of the tumors. Evidence that the response was dose related. Mesotheliomas have also been produced by other workers: in rats, in hamsters and in rabbits.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V2 27 (1973)] **PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ All commercial forms of **asbestos** tested are carcinogenic in mice, rats, hamsters and rabbits. ...The size and shape of fibers influence the incidence of tumors; fibers <0.5 um in diameter are more active in producing tumors.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V14 80 (1977)] **PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ The effects of ingested **asbestos** on the colon of weanling F344 rats was studied. Based on results of preliminary experimentation, the dosage was established at 10% by weight of a standard laboratory diet. Two hundred forty animals comprised the test group; there were also 242 control rats fed 10% nonnutritive cellulose and a group of 121 controls was fed normal laboratory chow. The study was terminated at 32 months. Epithelial tumors of the colon (8 adenocarcinomas and 1 adenoma) were found in nine of the rats. Four tumors were in **asbestos** fed rats, two tumors in the nonnutritive cellulose fed group, and three tumors were found in the standard laboratory diet controls. Also, one malignant mesothelioma was found in the **asbestos** fed group. Although the differences in the numbers of tumors between **asbestos** fed animals and controls were not significant, the authors believe their experimentation suggests that ingested **asbestos** is not inert in the colon. Included in their result is the discovery that cyclic-AMP levels in the colon were significantly lower in **asbestos** fed animals vs controls.
[Donham KJ et al; Cancer (March Suppl) 45: 1073-84 (1980) as cited in USEPA; Office of Drinking Water; Criteria Document (Draft): Asbestos p.VII-2 (1985)] **PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ ...Ip injections of 20 mg amosite, crocidolite or chyrsotile /were given to/ groups of 11, 13, 13 Charles River CD rats, respectively. Three peritoneal mesotheliomas were observed with chrysotile, 3 with crocidolite and none with amosite, after 7-17 months. /Amosite, crocidolite or chyrsotile **asbestos**/
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V14 51 (1977)] **PEER REVIEWED**

/LABORATORY ANIMALS: Chronic Exposure or Carcinogenicity/ A study examined the carcinogenic effects of **asbestos** on groups of 22-24 animals fed 250 mg/week of amosite, crocidolite, or chrysotile in margarine for up to 25 months. No excess malignancies were found in the exposed group

compared with the margarine or undosed control groups. /Amosite, crocidolite, or chrysotile **asbestos**/
[Bolton RE et al; Environ Res 29: 134-50 (1982) as cited in USEPA, Office of Drinking Water; Criteria Document (Draft): Asbestos p.V-12 to V-13 (1985)] **PEER REVIEWED**

/LABORATORY ANIMALS: Developmental or Reproductive Toxicity/ Pregnant CD-1 mice /were given/ (10-12/dose) 4, 40 or 400 mg **asbestos**/kg bw (1.43, 14.3 or 143 mg **asbestos**/ml) in their drinking water during days 1-15 of gestation. Water consumption did not vary between the different dosage groups. There was also no difference in embryo survival between the treatment groups and the controls, which received only tap water. There were no signs of maternal toxicity.
[Schneider D, Maurer RR; Teratology 15: 273-80 (1977) as cited in USEPA; Office of Drinking Water; Criteria Document (Draft): Asbestos p.V-22 (1985)] **PEER REVIEWED**

/GENOTOXICITY/ In Chinese hamster cells, chrysotile and crocidolite have produced genetic damage and morphologic transformation. /Chrysotile and crocidolite/
[Sincock AM; Nature 257: 58 (1977) as cited in USEPA; Health and Environmental Effects Profile for Asbestos p.12-11 (1979)] **PEER REVIEWED**

/GENOTOXICITY/ Chrysotile, amosite, and anthophyllite showed no mutagenic activity toward tester strains of Escherichia coli or Salmonella typhimurium. /Chrysotile, amosite, & anthophyllite/
[Chamberlain M, Tarmy EM; Mutat Res 43: 159 (1977) as cited in USEPA; Health and Environmental Effects Profile for Asbestos p.12-11 (1979)] **PEER REVIEWED**

/GENOTOXICITY/ This study was carried out in order to assess the genotoxic effect of in vitro exposure to commercial chrysotile **asbestos**. V 79 cell line, known as a well-established cellular model, was used for detection of **asbestos** genotoxic potency. Conventional structural chromosomal aberration analysis and sister chromatid exchange (SCE) method were both used for **asbestos** genotoxicity assessment. Within the experimental protocol applied, V 79 cells were treated with **asbestos** in concentrations of 100 and 200 ug/mL F-10 (HAM) media during 90 days, respectively. Analysis of changes in chromosome structure as well as of cell ploidy was performed each tenth day of the experimental course, consecutively. Two hundred well spread metaphases were taken into account for chromosomal aberration analysis. Frequency of sister chromatid exchanges was observed in 50 cells per sample. The results of cytogenetic tests revealed structural chromosomal damages, SCE-elevation and changes in cell ploidy. Cytogenetic effect of **asbestos** obviously depended on the dose applied and on the period of incubation. The results of this study suggest that significant cytogenetic changes occurring after **asbestos** treatment might directly or indirectly be the part of the biological events responsible for eliciting **asbestos**-induced carcinogenesis. /Chrysotile **asbestos**/
[Trosic I et al; Zentralbl Hyg Umweltmed 199 (6): 558-67 (1997)] **PEER REVIEWED**
PubMed Abstract

/GENOTOXICITY/ Studies of exposed **asbestos** workers, residentially exposed Turkish villagers, mesothelioma patients, and lung cancer patients suggest that **asbestos** is genotoxic. The number of chromosomal aberrations and the rate of sister chromatid exchange were significantly elevated in the peripheral blood lymphocytes of **asbestos** workers compared to a control population (Fatma et al. 1991). The mean sister chromatid exchange rate was significantly increased (p=0.002) in nonsmoking **asbestos** insulators compared to a control population.
[DHHS/ATSDR; Toxicological Profile for Asbestos p.77 (2001)] **PEER REVIEWED**

/GENOTOXICITY/ A large number of studies indicate that **asbestos** fibers can cause chromosomal aberrations in Chinese hamster ovary (CHO) and Syrian hamster embryo (SHE) cells. The aberrations include aneuploidy (usually polyploidy), fragmentation, breaks, rearrangements, gaps, dicentrics, inversions, and rings.

[DHHS/ATSDR; Toxicological Profile for Asbestos p.78 (2001)] **PEER REVIEWED**

/GENOTOXICITY/ ...Crocidolite induced transformations of Syrian hamster embryo cells. In cultured rodent cells, ...crocidolite induced chromosomal aberrations, ...and ...sister chromatid exchanges. /Crocidolite/
[Sheftel, V.O.; Indirect Food Additives and Polymers. Migration and Toxicology. Lewis Publishers, Boca Raton, FL. 2000., p. 829] **PEER REVIEWED**

/GENOTOXICITY/ [Mutation research 76: 169 (1980)] Escherichia coli WP2,uvrA - reverse mutation studies with metabolic activation: negative.
[GENE-TOX Program: Current Status of Bioassay in Genetic Toxicology. U.S. Environmental Protection Agency, Washington, DC. Office of Toxic Substances and Pesticides. (For program information, contact Environmental Mutagen Information Center, Oak Ridge National Laboratory, Post Office Box Y, Oak Ridge, Tennessee 37830, Telephone (615) 574-7871)] **PEER REVIEWED**

/ALTERNATIVE IN VITRO TESTS/ The hemolytic activity of short **asbestos** fibers was studied using rat and sheep red blood cells. The initial velocity of hemolysis is proportional to the concentration of fibers.
[Pele JP, Calvert R; Environ Res 31 (1): 164-75 (1983)] **PEER REVIEWED** PubMed Abstract

/ALTERNATIVE IN VITRO TESTS/ The effects of Union Internationale Contre le Cancer crocidolite and chrysolite A, either oxalic acid-leached or unleached, on the viability, morphology and growth characteristics of rat pleural mesothelial cells (PMC) were examined. Addition of 5 or 10 ug/ml of crocidolite, either leached or unleached, did not significantly change the growth rate. A slight vacuolation of the cells occurred. Leached chrysotile inhibited growth at a concentration of 50 ug/ml; with 5 or 10 ug/ml, no spreading occurred, but a shrinkage of some cells was observed. Results confirm the different in vitro reactivities of the 2 kinds of unleached **asbestos** fibers. Leaching of chrysotile fibers decreased their reactivity; alternatively, leaching of crocidolite increased the effects on PMC. /Chrysotile and Crocidolite/
[Jaurand MC et al; Environ Health Perspect 51: 153-58 (1983)] **PEER REVIEWED** PubMed Abstract Full text: PMC1569277

/ALTERNATIVE IN VITRO TESTS/ The ability of particulate air pollutants (and possible constituents) to alter pulmonary host defenses was examined using an in vitro alveolar macrophage cytotoxicity assay and an in vivo bacterial infectivity screening test which employed intratracheal injection of the particles. A wide range of response between particles was seen at the 1.0 mg/ml level in vitro and the 0.1 mg/mouse level in vivo. A sample of fluidized-bed coal fly ash, bentonite, **asbestos**, some ambient air particles and heavy metal oxides greatly increased susceptibility to pulmonary bacterial infection. Most coal fly ash samples and some air particles caused moderate increases in infectivity, while diesel particulates, volcanic ash, and crystalline silica caused only small increases. Cytotoxic effects on macrophages in vitro were observed with most of the particles. The in vivo and in vitro assays produced a similar ranking of toxicity, however, not all particles that were highly cytotoxic were potent in increasing bacterial infectivity. Increased toxicity measurable by either assay often appeared to be associated with small size or with the presence of metal in the particles.
[USEPA/HERL; Inhalable Particles and Pulmonary Host Defense: In Vivo and In Vitro Effects of Ambient Air and Combustion Particles 15 pp. (1985) EPA 600/J-85-026] **PEER REVIEWED**

/ALTERNATIVE IN VITRO TESTS/ The ability of **asbestos**-elicited murine peritoneal macrophages to release superoxide anion and hydrogen peroxide, following in vitro triggering has been investigated. The **asbestos**-elicited macrophages produced increased levels of superoxide and hydrogen peroxide

compared to control macrophages and similar levels to those produced by Corynebacterium parvum elicited macrophages. The supernatants from **asbestos**-elicited macrophages which had been triggered in vitro were capable of impairing the ability of alpha-1-protease inhibitor to inhibit elastase function. The catalase sensitivity of this effect showed it to be due to hydrogen peroxide.
[Donaldson K et al; Inflammation 9 (2): 139-47 (1985)] **PEER REVIEWED** PubMed Abstract

/ALTERNATIVE IN VITRO TESTS/ Enzymatic studies on asbestotic rat lungs revealed increased levels of fumarase and cytochrome C oxidase, and decreased levels of aconitase.
[Rahman Q et al; Environ Res 14: 487-98 (1977) as cited in Nat'l Research Council Canada; Asbestos p.80 (1979) NRCC No. 16452] **PEER REVIEWED**

/ALTERNATIVE IN VITRO TESTS/ Rats which received **asbestos** intratracheally had... decreased number of lung mitochondria, decreased activities of magnesium(2+) and calcium(2+)-activated ATPase and increased activities of cytochrome C oxidase and diaphorase.
[Beg MU et al; Environ Physiol Biochem 3: 185-91 (1973) as cited in Nat'l Research Council Canada; Asbestos p.80 (1979) NRCC No. 16452] **PEER REVIEWED**

/ALTERNATIVE IN VITRO TESTS/ Treatment of calf thymus DNA with various types of **asbestos** fibers in the presence of hydrogen peroxide under physiological conditions (pH 7.4, 37 deg C) resulted in the hydroxylation of the C-8 position of guanine residues. DNA strand scission was also detected after these treatments.
[Kasai H, Nishimura S; Gann 75 (10): 841-44 (1984)] **PEER REVIEWED** PubMed Abstract

/ALTERNATIVE IN VITRO TESTS/ ... After **asbestos** suspension and filtrate treatment of V79 cells, the value of hue for indicating P53 protein expression was significantly lowered, and such abnormal expression was especially observed in binucleate cells and polykaryocytes.
[Liu L et al; Sichuan Da Xue Xue Bao Yi Xue Ban 34 (3): 516-8 (2003)] **PEER REVIEWED** PubMed Abstract

/OTHER TOXICITY INFORMATION/ Pet dogs with spontaneous mesothelioma were used to identify environmental exposures that might increase their owner's risk of **asbestos**-related disease. Eighteen histologically confirmed canine mesotheliomas were diagnosed at the veterinary hospital of the University of Pennsylvania, Philadelphia, from April 1977 to December 1981. Sixteen owners of cases and 32 owners of age, breed, and sex-matched controls were interviewed to determine their occupation and medical history and their dog's medical history, life style, diet, and exposure to **asbestos**. An **asbestos**-related occupation or hobby of a household member and use of flea repellants on the dog were significantly associated with mesothelioma. In addition, there was a trend indicating an increased risk of mesothelioma with an urban residence. Lung tissue from three dogs with mesothelioma and one dog with squamous cell carcinoma of the lung had higher levels of chrysotile **asbestos** fibers than lung tissue from control dogs.
[Glickman LT et al; Environ Res 32 (2): 305-13 (1983)] **PEER REVIEWED** PubMed Abstract

/OTHER TOXICITY INFORMATION/ ...Female Wistar rats received an intratracheal instillation of 5 mg chrysotile (0.5 mL saline) as well as intragastric garlic treatment (1% body weight (v/w); 6 days/wk). Effect of garlic treatment was evaluated after 1, 15, 30, 90, and 180 days by assaying aryl hydrocarbon hydroxylase (AHH), glutathione (GSH), glutathione S-transferase (GST), and production of thiobarbituric acid reactive substances (TBARS) in rat lung microsome. AHH and TBARS formation were significantly reduced at day 90 and day 180 in chrysotile treated garlic cofed rats; GSH recovered 15 days later to the near normal level and GST elevated significantly after treatment of garlic as compared to chrysotile alone treated rat lung microsome.

[Ameen M et al; J Biochem Mol Toxicol 17 (6): 366-71 (2003)] **PEER REVIEWED**
PubMed Abstract

National Toxicology Program Studies:

Carcinogenesis studies of crocidolite **asbestos** were conducted with male and female F344/N rats. This form of **asbestos** was administered at a concentration of 1% in pelleted diet for the lifetime of the rats starting with the dams of the study animals The studies were started in January 1978 and ended in December 1980. Group sizes were 118 for male and female controls and 250 for male and female crocidolite **asbestos** exposed rats. Conclusions: Under the conditions of these feed studies, crocidolite **asbestos** was not overtly toxic and did not cause a carcinogenic response in F344/N rats for their lifetime.
[Toxicology & Carcinogenesis Studies of Crocidolite Asbestos in F344/N Rats (Feed Studies). Technical Report Series No. 280 (1988) NIH Publication No. 89-2536 U.S. Department of Health and Human Services, National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, NC 27709] **PEER REVIEWED**

Ongoing Test Status:

The following link will take the user to the National Toxicology Program (NTP) Test Agent Search Results page, which tabulates all of the "Standard Toxicology & Carcinogenesis Studies", "Developmental Studies", and "Genetic Toxicity Studies" performed with this chemical. Clicking on the "Testing Status" link will take the user to the status (i.e., in review, in progress, in preparation, on test, completed, etc.) and results of all the studies that the NTP has done on this chemical. /**Asbestos**, crocidolite/ [http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchresults&searchterm=12001-28-4
[Available from: http://ntp-apps.niehs.nih.gov/ntp_tox/index.cfm?fuseaction=ntpsearch.searchresults&searchterm=12001-28-4 **QC REVIEWED**

TSCA Test Submissions:

Chronic toxicity was evaluated in 50 male Sprague-Dawley rats, and 15 male Syrian hamsters exposed to **asbestos** via inhalation at a nominal concentration of 85 mg/m3 for 7 months, followed by a lifetime observation period. In the exposed rat group, the pulmonary responses included alveolar adenomatous proliferation, non-progressive fibrosis, squamous metaplasia and a substantial incidence of pulmonary carcinoma formation (6/34). Mean body weight of exposed rats was significantly lower after 1 month of exposure, it remained low until 14 months post exposure. Mortality data for the rat group indicated no significant difference between exposed and control rats. Mortality in the exposed hamster group was significantly increased during the 7 month exposure period. No pulmonary neoplasms were noted in the surviving hamsters, (the ability to evaluate long-term pulmonary effects was severely limited due to early mortality of 8/15 hamsters). The mean body weight for hamsters was statistically decreased during the first month of exposure, but statistically increased and remained so for the remainder of the study. Histopathologic studies of other, non-pulmonary tissues were not significantly different from the control group for rats or hamsters.
[Dow Chemical Co.; Effects From Chronic Inhalation of Asbestos Pipe-Covering Dust in

Rats and Hamsters. (1976), EPA Document No. 878211593, Fiche No. OTS0206137] **UNREVIEWED**

Metabolism/ Pharmacokinetics:

Metabolism/ Metabolites:

Asbestos has ... been observed to increase the levels or activities of the following enzymes: ... lactic dehydrogenase, acid phosphatase, glutamic pyruvate transaminase, lipase, cathepsin D, acid RNAase, B-glucuronidase, B-N-acetyl glucos-aminidase, sucrase, alkaline phosphatase, ATPase, and p-nitrophenyl acetate hydrolase.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.80 (1979) NRCC No. 16452] **PEER REVIEWED**

Absorption, Distribution & Excretion:

Inhaled fibers deposit by sedimentation, diffusion, impaction, and interception in airways of the respiratory system. The mathematical model developed... for the respiratory deposition of ordered cylindrical rods showing periodic motion has been adapted to 3 rod configurations in random orientation. Their results suggest that for aerosols having distributions such as Union Internationale Contre le Cancer **asbestos** samples dispersed by the dispenser... straight uniform fibers may deposit in pulmonary spaces in about twice the number of irregularly shaped fibers which may be judged to be in random orientation.
[Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988., p. 603] **PEER REVIEWED**

Actin, the contractile protein within cells, may be responsible for movement of **asbestos** particles through the epithelium to the lung interstitium where the fibers react with macrophages and fibroblasts.
[Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988., p. 604] **PEER REVIEWED**

Two human studies gave evidence for the penetration and migration of **asbestos**. ...Amphibole **asbestos** /has been detected/ in the urine of Minnesota residents who ingested drinking water contaminated with 5X10+7 fibers/L. ...Amphibole **asbestos** in lung > liver > jejunum of persons exposed to high oral intake of the mineral /has been observed/. /Amphibole **asbestos**/
[Seiler, H.G., H. Sigel and A. Sigel (eds.). Handbook on the Toxicity of Inorganic Compounds. New York, NY: Marcel Dekker, Inc. 1988., p. 604] **PEER REVIEWED**

After intrapleural or subcutaneous inoculation, the only translocation that occurred was of a minute fraction of the finer fibers. ...Occasional **asbestos** fibers or bodies have been reported in other tissues, including pancreas, spleen and thyroid. There is no information on how fibers... reach these sites.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V2 29 (1973)] **PEER REVIEWED**

Following inhalation ...fibers found in ...lung tissue are usually <3 um in diameter and <100 um in

length. Thicker or longer fibers are either not inhaled or are rapidly cleared from the respiratory tract. On weight basis, only a very small proportion of inhaled fiber is retained.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V2 29 (1973)] **PEER REVIEWED**

...**Asbestos** was inoculated intrapleurally, the majority of fiber was cleared during the first 10 days; but subsequently there was a very slow elimination through the gut. In feeding experiments almost all the fiber was eliminated.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V2 29 (1973)] **PEER REVIEWED**

In persons occupationally exposed to **asbestos**, smaller numbers of **asbestos** bodies or fibers than are seen in lung tissue have been found in extra-pulmonary tissue, including tonsils, thoracic and abdominal lymph nodes, pleura, peritoneum, liver, spleen, kidney and small intestine.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V14 74 (1977)] **PEER REVIEWED**

The physical characteristics of **asbestos** fibers that penetrate to lung parenchyma /demonstrate/ fiber respirability was largely a function of fiber diameter. ...5000 **asbestos** fibers from lungs of 10 deceased persons who had been occupationally exposed... showed that... all /were/ <0.5 um in diameter.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V14 72 (1977)] **PEER REVIEWED**

Studies with animals demonstrated that ingested **asbestos** can cross the gastrointestinal mucosa and from there can be transported to other sites in the body. Humans who consumed water containing **asbestos** were found to have **asbestos** fibers in their urine.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.14 (1979) NRCC No. 16452] **PEER REVIEWED**

Shorter fibers are preferentially removed /from the lungs of rats/ after one week following inhalation ... longer fibers reaching the alveolar spaces are trapped.
[Morgan A et al; Br J Ind Med 35: 146-53 (1978) as cited in USEPA; Asbestos Health Assessment Update (Draft) p.74 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

The observation in humans of peritoneal mesothelioma, excess cancer of the stomach, colon, and rectum, and ... cancers at other non-respiratory sites ... could result from the migration of ... fibers to and across the gastrointestinal mucosa. ... Fibers may reach organs in the peritoneal cavity by transdiaphragmatic migration or lymphatic-hematogenous transport.
[USEPA; Asbestos Health Assessment Update (Draft) p.74-76 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

Evidence for the human intestinal uptake ("persorption") of particles as large as 75 um is provided by the observation of starch granules in blood only minutes after ingestion.
[USEPA; Ambient Water Quality Criteria Doc: Asbestos p.C-29 (1980) EPA 440/5-80-022] **PEER REVIEWED**

Most inhaled or directly ingested **asbestos** particles which pass through the gastrointestinal tract are

excreted in feces. As mentioned previously, some fibers are absorbed by the gastrointestinal tract and are eventually eliminated through the urinary tract.
[USEPA; Ambient Water Quality Criteria Doc: Asbestos p.C-32 (1980) EPA 440/5-80-022] **PEER REVIEWED**

Rats were fed a diet supplemented with an **asbestos**/margarine formulation for periods up to 1 yr. UICC standard reference samples of amosite were used. There was no evidence of **asbestos** retention within gut lumen, and no sign of cell penetration or damage to intestinal mucosa were observed.
[Bolton RE, Davis J MG; Ann Occup Hyg 19 (2): 121-8 (1976)] **PEER REVIEWED** PubMed Abstract

Dosages of 1-3 mg (1 mg/mL of water) were injected into the femoral vein of female Wistar rats at 2 day intervals from days 10-14 of gestation. Total dose varied from 4-12 mg of **asbestos**. The fetuses were removed by Caesarean section the day before parturition in a manner that prevented cross-contamination from the mother; the livers and lungs were than analyzed by electron microscopy. **Asbestos** fibers were found to cross the placenta but the extent of this occurrence was highly variable. The livers and lungs analyzed were selected at random and thus could have come from different fetuses in the same uterus. In the first experiment, the highest number of fibers found in fetal liver and lungs came from a dam administered four 3 mg injections (total dose= 12 mg). Numbers of fibers found in liver and lungs were 27.03X10+6 fibers/g and 139.97X10+6 fibers/g, respectively. In a second experiment, the highest number of fibers found in fetal liver and lung came from a dam administered five 2 mg injections (total dose= 10 mg). Numbers of fibers found in the liver and lung were 100.12X10+6 fibers/g and 2.90X10+6 fibers/g, respectively.
[Cunningham HM, Moodie CA; Arch Environ Contam Toxicol 6: 507-13 (1977) as cited in USEPA, Office of Drinking Water; Criteria Document (Draft): Asbestos p.III-10 (1985)] **PEER REVIEWED**

The deposition and clearance of fibers from the lung suggest that most inhaled fibers (approximately 99%) are eventually cleared from the lung by ciliary or phagocytic action.
[USEPA; Asbestos Health Assessment Update (Draft) p.92 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

Fibers were detected in beverages (beer, wine and soft drinks) and were studied to see if such fibers consumed orally can pass through the intestinal wall and enter the bloodstream. A stock solution was made to contain fibers the same length as those found in beverages (0.5-2) and determined to contain 9.4x10+6 fibers/l. An aliquot (assumed to be 350 ml) was then administered intragastrically to rats (number, species and sex not known). **Asbestos** fibers were found to accumulate in the omentum surrounding the small intestine, brain and lung. ... counts could not be made on the liver and kidneys.
[Cunningham HM, Pontefract RD; J Assoc Off Anal Chem 56: 976 (1973) as cited in USEPA; Office of Drinking Water; Criteria Document (Draft): Asbestos p.III-8 (1985)] **PEER REVIEWED**

In the lower respiratory tract, fiber deposition is largely controlled by interception that is controlled by fiber length; **asbestos** fibers tend to be deposited in respiratory bronchioles at airway branch points. The curvature of chrysotile makes this fiber especially vulnerable to interception at bifurcations. In studies of rats using irradiated crocidolite, about 35% alveolar deposition was observed, and following a 1 hr inhalation exposure, electron microscopy demonstrated fiber deposition at bifurcations of alveolar ducts. Evaluation of lung tissue in both animals and humans after mixed **asbestos** exposure reveals that there is preferential clearance of chrysotile and retention of amphiboles over time. Animal models of asbestosis reveal greater retention of chrysotile in those with parenchymal rather than an airways lesion, and there are twice as many fibers longer than 5 um in the former, a finding consistent with host differences in clearance and risk for pulmonary fibrosis. **Asbestos** fibers are cleared by the mucociliary ladder or are transported across the type I alveolar epithelial cells into the interstitium, where their fate may be

transmigration to hilar nodes or pleura or eventual dissolution. The kinetics of dissolution are most rapid for man-made mineral fibers followed in rank order by chrysotile, crocidolite, and erionite.
[Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 271] **PEER REVIEWED**

The thoracic lymph nodes are a part of the clearance system from lung tissue. Accumulation of dust in these nodes are known to occur following some types of exposure. However, no information exists as to **asbestos** content in lymph nodes from the general population. The study cohort consisted of 21 individuals previously defined as nonoccupationally exposed to **asbestos**. Tissue burden of **asbestos** obtained from lung analysis by analytical electron microscopy was compared with burden in the lymph nodes. No **asbestos** fibers were detected in nodes from 8 cases. The majority of the fibers found in lymph nodes were short (<5 um) and most often noncommercial amphiboles. Ferruginous bodies (FBs) were detected in lymph node from only two samples. The total **asbestos** burden in the lung tissue from these individuals was quite low. However, in 12 of the 13 cases that had positive nodes, the tissue burden in the node was appreciably heavier per gram than in the lung. This raises the question as to whether the lymph nodes, though less efficient clearance, may be better indicators of lifetime exposure to dust than lung tissue.
[Dodson RF et al; Am J Ind Med 37 (2): 169-74 (2000)] **PEER REVIEWED** PubMed Abstract

Asbestos fibers have been detected in blood and lymph of rats exposed to oral doses of **asbestos**, suggesting that fibers penetrating the gut might be carried to tissues throughout the body. In support of this, **asbestos** fibers have been detected in the lung, kidney, liver, brain, heart, and spleen of rats that had been exposed to **asbestos** in the diet. Highest levels of fibers were found in the omentum (a fold of the peritoneum connecting abdominal viscera to the stomach), supporting the idea that the fibers were emanating from the gastrointestinal tract. Although the diet fed to the animals was prepared using corn oil to minimize **asbestos fiber** inhalation, the possibility that some fiber inhalation took place cannot be eliminated.
[DHHS/ATSDR; Toxicological Profile for Asbestos p.83 (2001)] **PEER REVIEWED**

The principal pathway by which fibers are removed from the respiratory tract is mucociliary transport. This is mediated by ciliated epithelial cells that produce and move the layer of mucus coating the epithelial tissue upwards toward the throat, where it is swallowed. Fibers deposited in this mucus layer are swallowed into the alimentary canal and most are ultimately excreted in the feces. However, a small number of fibers may penetrate through the epithelial layers of the lung and/or the gastrointestinal tract and are transferred to the blood and eventually to the kidney, where some of them may be excreted in the urine. In addition, some fibers are not cleared from the lung, leading to a gradual accumulation with time.
[DHHS/ATSDR; Toxicological Profile for Asbestos p.86 (2001)] **PEER REVIEWED**

An autopsy study was conducted to investigate whether there is transplacental transfer of **asbestos** in humans. The **asbestos** burden of lung, liver, skeletal muscle, and placenta digests of 40 stillborn infants was determined using a bleach digestion method. The fibers detected in the tissue digests were characterized as to the type of **asbestos**, using electron microscopy, energy-dispersive x-ray analysis, and selected-area diffraction analysis. Placental digests of 45 full-term, liveborn infants were similarly processed as controls. Low levels of small, thin, uncoated **asbestos** fibers were detected in the placentas and organs of 37.5% of the stillborn infants (15 of 40). The fiber sizes ranged from 0.05 to 5.0 microns in length and 0.03 to 0.3 micron in width, with a mean length of 1.15 microns and a mean width of 0.069 micron. Maximum numbers of fibers were found in the lungs (mean 235,400 fibers/g; n = 10), followed by liver (mean 212,833 fibers/g; n = 6), placenta (mean 164,500 fibers/g; n = 4), and skeletal muscle (80,000 fibers/g; n = 1). The fibers were detected at all stages of gestation and showed no association with gestational age. A significant association was found between fiber presence and working mothers,

and positive but nonsignificant associations were found with maternal history of drug abuse, previous abortions, and fetal maceration. No association was found between premature rupture of membranes and fiber presence. No fibers were detected in the 45 placentas of the liveborn control infants. There was a highly significant difference in the **asbestos fiber** counts of the placentas of the stillborn and liveborn infants ($P < .001$).
[Haque AK et al; Pediatr Pathol Lab Med 16 (6): 877-92 (1996)] **PEER REVIEWED**
PubMed Abstract

The retention of different types of **asbestos** in rats following exposure to the same concentration of respirable dusts... /has been described/. For the amphiboles, there was a similar pattern with an almost proportional increase of lung dust with dose. Much less dust was found for the chrysotiles, and no increase of dust content was shown in the lungs. Dust in the lungs of animals with 6 months' exposure had been partially cleared 18 months after the inhalation period. About 74% of the amosite and crocidolite and 41% of the anthophyllite were eliminated.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V14 58 (1977)] **PEER REVIEWED**

Rats fed chrysotile, crocidolite, or amosite exhibited no retention of fibers in the gut lumen and no penetration of the mucosa. The transit time for the majority of fibers was 48 hours, and there was no **asbestos** either in the feces or in the gut after 7-28 days.
[Bolton RE, Davis JMG; Ann Occup Hyg 19: 121-8 (1976) as cited in Nat'l Research Council Canada; Asbestos p.66 (1979) NRCC No. 16452] **PEER REVIEWED**

Twenty female CBA mice were injected subcutaneously in two sites. Each injection contained 10 mg fiber suspended in 0.4 ml saline. Each animal received three injections into each flank. The flank was chosen as a site well distant from the thorax. Three fiber types: crocidolite, amosite, and chrysotile, were tested to study their distribution. All three fiber types were found in the submesothelial tissues of the thorax and abdomen. In addition, extensive inflammatory changes and some sarcomas developed at the injection sites, while transport of fibers to submesothelial tissues culminated in mesothelioma.
[Roe FJC et al; Int J Cancer 2: 628-38 (1967) as cited in USEPA, Office of Drinking Water; Criteria Document (Draft): Asbestos p.III-9 (1985)] **PEER REVIEWED**

There is no evidence that inhaled or ingested **asbestos** is completely cleared from the body. It is likely that some fraction of the **asbestos** in the body is retained for long periods, if not for life.
[Nat'l Research Council Canada; Executive Reports Effects of Chromium, Alkali Halides, Arsenic, Asbestos, Mercury, Cadmium p.54 (1980) NRCC No. 17585] **PEER REVIEWED**

Mechanism of Action:

In an effort to understand the properties of **asbestos** fibers that might contribute to their toxicity, ... three different varieties of **asbestos** /were incubated/ with phospholipid emulsions and ... evidence of lipid peroxidation /were sought/. Although all three types of **asbestos** were able to catalyze lipid peroxidation in the native state, this catalytic activity was inhibited by pre-washing of the **asbestos** with the iron chelator desferroxamine. This suggests that lipid peroxidation may be one of the mechanisms by which **asbestos** produces tissue injury, and treatment with iron chelators might diminish the potential to produce this injury.
[Weitzman SA, Weitberg AB; Biochem J 225 (1): 259-62 (1985)] **PEER REVIEWED**
PubMed Abstract Full text: PMC1144578

Animal experimentation... indicated that the important factor in the carcinogenicity was the dimensionality of the fibers rather than their chemical properties. ...Greatest carcinogenicity was related to fibers that were less than 2.5 um in diameter and longer than 10 um.
[USEPA; Asbestos Health Assessment Update (Draft) p.9 (1984) EPA-600/8-84-003A]
PEER REVIEWED

In terms of carcinogen mechanisms, **asbestos** appears to act like a lung cancer promoting agent ... Promotional effect does not diminish with time after cessation of exposure ... Inhalation of the fibers can precede initiating events because the fibers remain continously available in the lung to act after other necessary carcinogenic processes occur.
[USEPA; Asbestos Health Assessment Update (Draft) p.23 (1984) EPA-600/8-84-003A]
PEER REVIEWED

Following deposition, the initial lesion /in pulmonary asbestosis/ is an accumulation of alveolar macrophages in the alveolar ducts and peribronchiolar regions adjacent to the terminal respiratory bronchiole. These tissues are subsequently thickened by a predominance of interstitial macrophages followed by fibroblasts. The type I alveolar epithelial cells are injured by transepithelial migration of fibers from the air space to the interstitium, and by mediators (likely oxidants) released by alveolar macrophages as they phagocytose free fibers reaching the alveolar air sacs. There is a striking proliferation of alveolar epithelial type II cells to replace the injured alveolar epithelial lining, and ther are areas of cellular denudation. After rats were subjected to 1 months' inhalation of chrysotile the persisting alterations include an increased volume of interstitial macrophages, accumulations of myofibroblasts, and increased volume of interstitial matrix. These changes persisted and increased after 3 months' exposure, and after 12 months' exposure there was a substantial increase in the noncellular interstitial matrix. There was a significant (two-fold) increase in interstitial cells, including fibroblasts. Importantly, the fibrosis progressed over time, and progressive transport of **asbestos** fibers into airway walls and interstitium occurred.
[Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 271] **PEER REVIEWED**

The pathogenesis of pleural plaques probably involves submesothelial cellular events because of the absence of mesothelial cell proliferation and pleural adhesions. Fibers and areas of inflammation can be identified at lymphatic pores of the parietal pleura. The plaques are composed of collagen bundles separated by irregularly arranged spaces in a basketweave pattern.
[Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 273] **PEER REVIEWED**

Asbestos acts as a clastogen in mammalian cell systems, causing chromosome aberrations that may bear directly on **asbestos** carcinogenesis. Circulating lymphocytes of **asbestos** insulators have been shown to have increased numbers of sister chromatid exchanges. Larger chromosomes were more susceptible, and in the largest chromosome group, there was a significant interactive effect of **asbestos** exposure and smoking. By gaining access to the perinuclear region of cells, **asbestos** may cause transformation by binding to microtubules or other cytoskeletal proteins that are important in the disjunction of chromosomes during mitosis, resulting in hypoploidy, aneuploidy, and polyploidy.
[Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 280] **PEER REVIEWED**

Natural killer (NK) lymphocytes, specialized cells that can identify and destroy malignant cells, are inhibited from performing their immune surveillance function when assessed in vitro following exposure to amosite, chrysotile, or crocidolite in a dose-dependent fashion from 1-10 ug/mL up to 100-1,000 ug/mL and is independent of cytotoxicity. NK-cell activity was reconstituted in vitro by adding

recombinant interleukin 2. In 14 of 20 mesothelioma patients there was a reduction in NK-cell activity that could by partially reconstituted with interferon-gamma. Like mesothelioma patients, **asbestos** workers with reduced NK-cell activity had only a partial response when stimulated with interferon-gamma; this observation was consistent with the concept that depressed immune surveillance in **asbestos** workers may be associated with cancer risk.
[Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 280] **PEER REVIEWED**

Tracheal organ cultures incubated with crocidolite **asbestos** with adsorbed 3-methylcholanthrene for 1 month and implanted subcutaneously into syngeneic hamsters produced carcinomas in 12 to 52 weeks, whereas neoplasms did not occur after implantation with organ cultures exposed to crocidolite alone. Both crocidolite and amosite promote epithelial hyperplasia and an increase in the incorporation of [3H] thymidine by tracheal epithelium in vitro. Furthermore, crocidolite **asbestos** with adsorbed polycyclic aromatic hydrocarbon is transported into the cell, where it induces the aryl hydrocarbon hydroxylase (AHH) system. The AHH system produces active metabolites of the hydrocarbon that can interact with DNA facilitating the process of carcinogenesis. Adsorption of polycyclic aromatic hydrocarbons on **asbestos** fibers is probably an indirect process whereby adsorption of surfactant phospholipids onto the fibers creates a continuous lipid phase along the fiber surface within which lipophilic substances such an PAHs can be solubilized. AHH is a ubiquitous enzyme involved in the early metabolism of aromatic hydrocarbons and is inducible by **asbestos** in vitro. Studies of blood lymphocytes from long-term **asbestos** workers reveal increased inducibility by 3-methylcholanthrene and dibenz(a,h)anthracene. Similarly, AHH is inducible in AM, and **asbestos** workers who smoked and had lung cancer had AHH in the range of what was considered high inducibility . Extensive metabolizers of cytochrome P450 debrisoquine have an enhanced risk of lung cancer following exposure to cigarette smoke and **asbestos**.
[Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 280] **PEER REVIEWED**

Within the lung, alveolar macrophage activity has been implicated as playing a significant role in **asbestos**-induced changes in immunocompetence. Fibers of **asbestos** that are deposited in the lung are phagocytized by macrophages, resulting in macrophage lysis and release of lysosomal enzymes and subsequent activation of other macrophages. Recently it has been hypothesized that the development of asbestosis in animal models occurs by the following mechanism. Fibers of **asbestos** deposited in the alveolar space recruit the interstitial space where the complement cascade becomes activated, releasing C5a, a potent macrophage activator and chemoattractant for other inflammatory cells. Recruited interstitial and resident alveolar macrophages phagocytize the fibers and release cytokines, which cause the proliferation of cells within the lung and the release of collagen. A sustained inflammatory response could then contribute to the progressive pattern of fibrosis which is associated with **asbestos** exposure.
[Klaassen, C.D. (ed). Casarett and Doull's Toxicology. The Basic Science of Poisons. 6th ed. New York, NY: McGraw-Hill, 2001., p. 444] **PEER REVIEWED**

Once **asbestos** fibers have been deposited in the lung, they may become phagocytized by alveolar macrophages. Short fibers are completely ingested and subsequently removed via the mucociliary escalator. Longer fibers are incompletely ingested, and the macrophages become unable to leave the alveoli. Activated by the fibers, macrophages release mediators such as lymphokines and growth factors, which in turn attract immunocompetent cells or stimulate collagen production. **Asbestos**-related lung disease thus may be mediated through the triggering of an inflammatory sequence of events or the production of changes that eventually lead to the initiation (DNA damage caused by reactive molecular species) or promotion (increased rate of cell turnover in the lung) of the carcinogenic process. The surface properties of **asbestos** fibers appear to be an important mechanistic element in toxicity. The protection afforded by superoxide dismutase or free radical scavengers in **asbestos**-related cell injury in vitro suggests that the generation of active oxygen species and concomitant lipid peroxidation are important mechanisms in **asbestos** toxicity. The interaction of iron on the surface of **asbestos** fibers with

oxygen may lead to the production of hydrogen peroxide and the highly reactive hydroxyl radical, events that have been associated with **asbestos** toxicity.
[Klaassen, C.D. (ed). Casarett and Doull's Toxicology. The Basic Science of Poisons. 6th ed. New York, NY: McGraw-Hill, 2001., p. 526] **PEER REVIEWED**

The surface properties of **asbestos** fibers appear to be an important mechanistic element in toxicity. The protection afforded by superoxide dismutase or free radical scavengers in **asbestos**-related cell injury in vitro suggests that the generation of active oxygen species and concomitant lipid peroxidation are important mechanisms in **asbestos** toxicity. The interaction of iron on the surface of **asbestos** fibers with oxygen may lead to the production of hydrogen peroxide and the highly reactive hydroxyl radical, events that have been associated with **asbestos** toxicity.
[Klaassen, C.D. (ed). Casarett and Doull's Toxicology. The Basic Science of Poisons. 6th ed. New York, NY: McGraw-Hill, 2001., p. 526] **PEER REVIEWED**

Pleural and pulmonary fibrosis (asbestosis) are ramifications of occupational exposures to **asbestos** fibers, a diverse family of ubiquitous, naturally-occurring minerals. The pathogenesis of **asbestos**-associated fibrosis involves the participation of a number of cell types and is characterized by an early and persistent inflammatory response that involves the generation of oxidants, growth factors, chemokines, and cytokines. These mediators may also contribute directly to cell injury, proliferation, and fibrogenesis. After interaction with cells, **asbestos** fibers trigger a number of signaling cascades involving mitogen-activated protein kinases (MAPK) and nuclear factor kappa-B (NF-kappaB). Activation of transcription factors such as NF-kappaB and activator protein-1 (AP-1) may be linked to increases in early response genes (e.g., c-jun and c-fos) which govern proliferation, apoptosis, and inflammatory changes in the cells of the lung.
[Robledo R, Mossman B; J Cell Physiol 180 (2): 158-66 (1999)] **PEER REVIEWED**
PubMed Abstract

Recent work has suggested potentially important mechanistic roles for a number of nuclear regulatory proteins, oncogenes, proto-oncogenes, and second messenger proteins. Among these are nuclear factor-Kbeta (NF-Kbeta) activator protein-1 (AP-1), including its subunits of c-fos, c-jun, and fra-1, p53, ras, tyrosine kinases, and protein kinase c (PKC). Interestingly, a number of these factors have been shown to influence the production of other cellular factors. Additionally, cellular oxidant status has been shown to influence the behavior of AP-1 and NF-Kbeta . The latter two observations have served to further the view that NF- and AP-1 play roles in **asbestos**-induced lung injury, as they would allow for the integration of several of the mechanisms proposed (i.e., **asbestos**-associated iron could generate oxygen radicals, leading to the increased activity of nuclear factors, which induce cytokine genes, leading to cell infiltration and proliferation).
[DHHS/ATSDR; Toxicological Profile for Asbestos p.99 (2001)] **PEER REVIEWED**

Asbestos causes asbestosis and malignancies by mechanisms that are not fully understood. Alveolar epithelial cell (AEC) injury by iron-derived reactive oxygen species (ROS) is one important mechanism implicated. We previously showed that iron-catalyzed ROS in part mediate **asbestos**-inducedAEC DNA damage and apoptosis. Mitochondria have a critical role in regulating apoptosis after exposure to agents causing DNA damage but their role in regulating **asbestos**-induced apoptosis is unknown. To determine whether **asbestos** causes AEC mitochondrial dysfunction, we exposed A549 cells to amosite **asbestos** and assessed mitochondrial membrane potential changes (delta(psi)m) using a fluorometric technique involving tetremethylrhodamine ethyl ester (TMRE) and mitotracker green. We show that amosite **asbestos**, but not an inert particulate, titanium dioxide, reduces delta(psi)m after a 4 hr exposure period. Further, the delta(psi)m after 4 hr was inversely proportional to the levels of apoptosis noted at 24 hr as assessed by nuclear morphology as well as by DNA nucleosome formation. A role for iron-derived ROS was suggested by the finding that phytic acid, an iron chelator, blocked **asbestos**-induced reductions in A549 cell delta(psi)m and attenuated apoptosis. Finally, overexpression of Bcl-xl, an anti-apoptotic

protein that localizes to the mitochondria, prevented **asbestos**-induced decreases in A549 cell delta(psi) m after 4 hr and diminished apoptosis. We conclude that **asbestos** alters AEC mitochondrial function in part by generating iron-derived ROS, which in turn can result in apoptosis. This suggests that the mitochondrial death pathway is important in regulating pulmonary toxicity from **asbestos**.
[Kamp DW et al; Mol Cell Biochem 234-235 (1-2): 153-60 (2002)] **PEER REVIEWED**

...The accumulating evidence showing that **asbestos** is directly genotoxic by inducing DNA strand breaks (DNA-SB) and apoptosis in relevant lung target cells /is reviewed/. Although the exact mechanisms by which **asbestos** causes DNA damage and apoptosis are not firmly established, some of the implicated mechanisms include the generation of iron-derived reactive oxygen species (ROS) as well as reactive nitrogen species (RNS), alteration in the mitochondrial function, and activation of the death receptor pathway.
[Upadhyay D et al; Exp Biol Med (Maywood) 228 (6): 650-9 (2003)] **PEER REVIEWED** PubMed Abstract

Interactions:

The cell transforming ability of **asbestos** dusts (amosite and crocidolite **asbestos**) was investigated using C3H10T1/2 murine fibroblast cultures. The dusts were capable of augmenting the oncogenic effect of benzo(a)pyrene. This synergistic effect was evident when fibers and chemicals were added to cultures as simple mixtures and when benzo(a)pyrene was adsorbed to the surface of fibers. /Amosite and Crocidolite/
[Poole A et al; Environ Health Perspect 51: 319-24 (1983)] **PEER REVIEWED** PubMed Abstract Full text: PMC1569293

After inhalation of (222)Ra at equilibrium with radon daughters, male Sprague-Dawley rats were inoculated intrapleurally with 2 mg of unleached or acid-leached **asbestos** fibers. ... The additive co-carcinogenic effects of this type of malignant insult were demonstrated by increased incidence of malignant thoracic tumors. In rats given mineral materials, bronchopulmonary carcinomas and mixed carcinomas were observed, as well as typical mesotheliomas and combined pulmonary pleural tumors, whereas in control rats inhaling radon alone, only bronchopulmonary carcinomas occurred.
[Bignon J et al; Carcinogenesis 4 (5): 621-28 (1983)] **PEER REVIEWED** PubMed Abstract

Asbestosis mortality for workers who smoked 20 or more cigaretes a day was 2.8 times higher than that for workers who never smoked regularly. ... Interactive effects between cigarette smoking and the prevalence of x-ray abnormalities have been reported. ... No relationship between cigarette smoking and the risk of death from mesothelioma or gastrointestinal cancer was found.
[Hammond EC et al; Ann NY Acad Aci 330: 473-90 (1979) as cited in USEPA; Asbestos Health Assessment Update (Draft) p.27 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

Trace metals (beryllium, cadmium, chromium, cobalt, copper, iron, manganese, nickel, thallium) may be present as natural impurities in **asbestos** or may be added inadvertently during milling and handling. The release of these contaminating metals in a biologically active form when the **asbestos** fibers are deposited in soft tissue may be involved in the etiology of some **asbestos**-related diseases.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.21 (1979) NRCC No. 16452] **PEER REVIEWED**

The relationship between **asbestos** exposure and smoking indicates a synergistic effect of smoking with regard to lung cancer. Further evaluations indicate that this synergistic effect is close to a multiplicative

model. ...The risk of mesothelioma appears to be independent of smoking, and a significantly decreasing trend in risk was observed with the amount smoked in 1 study.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. S7 108 (1987)] **PEER REVIEWED**

The in vitro cytotoxicity and oncogenicity of both native and acid-leached **asbestos** fibers were studied using the C3H10T1/2 cell model. Both native and leached fibers induced a dose-dependent toxicity. At high fiber concentrations, acid leached fibers were less toxic than their untreated counterparts. Whereas **asbestos** fibers alone do not induce oncogenic transformation at the concn examined, both leached and native fibers synergistically enhanced the oncogenicity of gamma irradiation. Although no significant chromosomal aberrations or sister chromatid exchanges were found in **asbestos**-treated cultures, a higher number of sister chromatid exchanges was observed in cells treated with both **asbestos** and radiation compared to cells receiving radiation alone. The enhancement in radiation induced oncogenicity by **asbestos** fibers may be attributed to the mere physical presence of the fibers rather than any chemical contaminants the fibers may contain. Furthermore, the carcinogenicity of **asbestos** may be unrelated to genotoxicity.
[Hei TK et al; Br J Cancer 52 (4): 591-97 (1985)] **PEER REVIEWED** PubMed Abstract Full text: PMC1977261

F344 rats were gavaged with a suspension of untreated UICC anthophyllite fibers (50 mg/kg bw) and fibers which had been allowed to adsorb benzo(a)pyrene molecules from aqueous solutions. Whereas anthophyllite fibers failed to induce cytogenetic alterations,fibers pretreated with the polycyclic aromatic solutions caused dose-dependent increase in the sister chromatid exchange frequencies. The observed cytogenetic impact can be explained by a local action of carcinogen molecules accumulated and subsequently transported . The results support the hypothesis that epidemiological evidence of carcinogenicity of **asbestos** in potable water may be explained by the cogenotoxic action of the **asbestos** fibers and biologically active organic micropollutants adsorbed on their surface. /Anthophyllite **asbestos**/
[Sheftel, V.O.; Indirect Food Additives and Polymers. Migration and Toxicology. Lewis Publishers, Boca Raton, FL. 2000., p. 830] **PEER REVIEWED**

Crocidolite **asbestos** plus cigarette smoke synergistically increased DNA strand breaks as measured by fluorescent spectroscopy from 4.3% (crocidolite) and 9.8% (smoking), respectively, to 78 +/- 12% together. Hydroxyl radical release was measured by electron paramagnetic resonance, and oxidant scavengers such as mannitol, catalse, iron chelators, and dimethylsulfoxide prevented the DNA damage. /Crocidolite/
[Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 280] **PEER REVIEWED**

Pharmacology:

Interactions:

The cell transforming ability of **asbestos** dusts (amosite and crocidolite **asbestos**) was investigated using C3H10T1/2 murine fibroblast cultures. The dusts were capable of augmenting the oncogenic effect of benzo(a)pyrene. This synergistic effect was evident when fibers and chemicals were added to cultures as simple mixtures and when benzo(a)pyrene was adsorbed to the surface of fibers. /Amosite and

Crocidolite/
[Poole A et al; Environ Health Perspect 51: 319-24 (1983)] **PEER REVIEWED** PubMed Abstract Full text: PMC1569293

After inhalation of (222)Ra at equilibrium with radon daughters, male Sprague-Dawley rats were inoculated intrapleurally with 2 mg of unleached or acid-leached **asbestos** fibers. ... The additive co-carcinogenic effects of this type of malignant insult were demonstrated by increased incidence of malignant thoracic tumors. In rats given mineral materials, bronchopulmonary carcinomas and mixed carcinomas were observed, as well as typical mesotheliomas and combined pulmonary pleural tumors, whereas in control rats inhaling radon alone, only bronchopulmonary carcinomas occurred.
[Bignon J et al; Carcinogenesis 4 (5): 621-28 (1983)] **PEER REVIEWED** PubMed Abstract

Asbestosis mortality for workers who smoked 20 or more cigaretes a day was 2.8 times higher than that for workers who never smoked regularly. ... Interactive effects between cigarette smoking and the prevalence of x-ray abnormalities have been reported. ... No relationship between cigarette smoking and the risk of death from mesothelioma or gastrointestinal cancer was found.
[Hammond EC et al; Ann NY Acad Aci 330: 473-90 (1979) as cited in USEPA; Asbestos Health Assessment Update (Draft) p.27 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

Trace metals (beryllium, cadmium, chromium, cobalt, copper, iron, manganese, nickel, thallium) may be present as natural impurities in **asbestos** or may be added inadvertently during milling and handling. The release of these contaminating metals in a biologically active form when the **asbestos** fibers are deposited in soft tissue may be involved in the etiology of some **asbestos**-related diseases.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.21 (1979) NRCC No. 16452] **PEER REVIEWED**

The relationship between **asbestos** exposure and smoking indicates a synergistic effect of smoking with regard to lung cancer. Further evaluations indicate that this synergistic effect is close to a multiplicative model. ...The risk of mesothelioma appears to be independent of smoking, and a significantly decreasing trend in risk was observed with the amount smoked in 1 study.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. S7 108 (1987)] **PEER REVIEWED**

The in vitro cytotoxicity and oncogenicity of both native and acid-leached **asbestos** fibers were studied using the C3H10T1/2 cell model. Both native and leached fibers induced a dose-dependent toxicity. At high fiber concentrations, acid leached fibers were less toxic than their untreated counterparts. Whereas **asbestos** fibers alone do not induce oncogenic transformation at the concn examined, both leached and native fibers synergistically enhanced the oncogenicity of gamma irradiation. Although no significant chromosomal aberrations or sister chromatid exchanges were found in **asbestos**-treated cultures, a higher number of sister chromatid exchanges was observed in cells treated with both **asbestos** and radiation compared to cells receiving radiation alone. The enhancement in radiation induced oncogenicity by **asbestos** fibers may be attributed to the mere physical presence of the fibers rather than any chemical contaminants the fibers may contain. Furthermore, the carcinogenicity of **asbestos** may be unrelated to genotoxicity.
[Hei TK et al; Br J Cancer 52 (4): 591-97 (1985)] **PEER REVIEWED** PubMed Abstract Full text: PMC1977261

F344 rats were gavaged with a suspension of untreated UICC anthophyllite fibers (50 mg/kg bw) and fibers which had been allowed to adsorb benzo(a)pyrene molecules from aqueous solutions. Whereas anthophyllite fibers failed to induce cytogenetic alterations,fibers pretreated with the polycyclic aromatic

solutions caused dose-dependent increase in the sister chromatid exchange frequencies. The observed cytogenetic impact can be explained by a local action of carcinogen molecules accumulated and subsequently transported . The results support the hypothesis that epidemiological evidence of carcinogenicity of **asbestos** in potable water may be explained by the cogenotoxic action of the **asbestos** fibers and biologically active organic micropollutants adsorbed on their surface. /Anthophyllite **asbestos**/
[Sheftel, V.O.; Indirect Food Additives and Polymers. Migration and Toxicology. Lewis Publishers, Boca Raton, FL. 2000., p. 830] **PEER REVIEWED**

Crocidolite **asbestos** plus cigarette smoke synergistically increased DNA strand breaks as measured by fluorescent spectroscopy from 4.3% (crocidolite) and 9.8% (smoking), respectively, to 78 +/- 12% together. Hydroxyl radical release was measured by electron paramagnetic resonance, and oxidant scavengers such as mannitol, catalse, iron chelators, and dimethylsulfoxide prevented the DNA damage. /Crocidolite/
[Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 280] **PEER REVIEWED**

Environmental Fate & Exposure:

Environmental Fate/Exposure Summary:

Asbestos is a term for six naturally occurring fibrous silicate minerals that have been mined, milled and used in many commercial products. Today, only one form of **asbestos**, chrysotile, is used in products in the United States. Due to its high tensile strength, low cost, resistence to heat, chemical attack, and biological attack, about 3,000 types of products were previously produced using **asbestos**. In most of these applications, **asbestos** fibers were bonded with some other material such as cement, plastics, pipes, or resins. Due to health concerns, **asbestos** is primarily used today in roofing products, gaskets and friction parts. The mining, milling and fabrication of **asbestos** containing products has resulted in its release to the environment through various waste streams. The last operating US **asbestos** mine closed in 2002. If released to air, **asbestos** fibers will eventually return to soil or water through gravitational settling and wet and dry deposition. Mean airborne concentrations of **asbestos** in US cities are roughly 2-4 ng/cu m, but much higher levels are typically observed near source dominated areas. Movement of **asbestos** fibers through soils only occur during runoff or erosion. **Asbestos** fibers will not volatilize or degrade in soils although they may be resuspended to the air by vehicular traffic or mining operations. **Asbestos** may be released to water from waste water in **asbestos** related industries, erosion of natural deposits or waste piles, corrosion of **asbestos**-cemented pipes, disintegration of **asbestos** containing roofing materials followed by subsequent runoff. **Asbestos** does not volatilize or degrade from water surfaces, nor does it appear to bioconcentrate in aquatic organisms. Occupational exposure occurs through inhalation and dermal contact in workplaces where **asbestos** is mined, milled, and products are manufactured or used. Monitoring data suggest that the general population is exposed to **asbestos** through inhalation of ambient air, ingestion of drinking water, and ingestion of food sources containing **asbestos**. In the past, filters made from **asbestos** were employed in the preparation of wines, beers, cigarette filters and other consumer products; however, these practices have been discontinued and intake of **asbestos** through foods and drugs is now unlikely. Low levels of **asbestos** are present in some talc powders, but the level of exposure from this source is considered low. (SRC)
PEER REVIEWED

Probable Routes of Human Exposure:

Asbestos /enters the human body/ from gastrointestinal and respiratory tract exposure.
[Nat'l Research Council Canada; Asbestos p.14 (1979) NRCC No. 16452] **PEER REVIEWED**

Asbestos is usually taken into the body by inhalation or ingestion and it is then distributed to most organs via the blood or lymphatic systems.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.23 (1979) NRCC No. 16452] **PEER REVIEWED**

ASBESTOS FIBERS MAY BE LIBERATED INTO AIR ... IN MINING, MILLING, PROCESSING, OF **ASBESTOS** CONTAINING PRODUCTS & DUMPING WASTE. ... FIBERS LESS THAN 3 UM IN DIAM & FROM 10-200 UM IN LENGTH ARE MOST IMPORTANT CAUSE OF ASBESTOSIS.
[International Labour Office. Encyclopedia of Occupational Health and Safety. Volumes I and II. New York: McGraw-Hill Book Co., 1971., p. 123] **PEER REVIEWED**

CONTENTS & TYPES OF **ASBESTOS** IN FIREPROOFING INSULATION MATERIALS SPRAYED ON CEILINGS OF 127 BUILDINGS THROUGHOUT THE USA WERE STUDIED. DURING REMOVAL OF SPRAYED MATERIALS, WORKERS WERE EXPOSED TO EXTREMELY HIGH CONCENTRATIONS (AVG 16.4 FIBERS/CC) WHEN DRY METHODS WERE USED. WHEN WET METHODS WERE USED DURING REMOVAL, THE AIRBORNE FIBER CONCENTRATIONS WERE REDUCED TO LESS THAN 2 FIBERS/CC.
[PAIK NW ET AL; AM IND HYG ASSOC J 44 (6): 428-32 (1983)] **PEER REVIEWED** PubMed Abstract

... EXPOSURES OCCUR DURING END-PRODUCT USE, AMONG **ASBESTOS** INSULATION WORKERS, AMONG BRAKE REPAIR & BRAKE MAINTENANCE WORKERS, & AS RESULT OF INDIRECT OCCUPATIONAL EXPOSURES, PARTICULARLY IN SHIP BUILDING & SHIP REPAIR, & IN CONSTRUCTION INDUSTRY. OTHER EXPOSURES OCCUR IN RELATION TO INSPECTION & MAINTENANCE WORK ON **ASBESTOS** CONTAINING STRUCTURES & EQUIPMENT, IN REFINERIES & CHEMICAL PLANTS, BUILDINGS, RAILWAY LOCOMOTIVES & WAGONS, SHIPYARDS & POWER PLANTS. ... BUILDING DEMOLITION & WASTE DISPOSAL. ... EXPOSURE MAY OCCUR DURING WEARING OF **ASBESTOS** SAFETY GARMENTS.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php, p. V14 37 (1977)] **PEER REVIEWED**

Talc /which is often contaminated with **asbestos**/ is used in the following products: cosmetics, spray and dusting powder, insecticides, white shoe polishes, as a filler for soap, dusting powders for toy balloons, condoms, and contraceptive diaphragms.
[Nat'l Research Council Canada; Asbestos p.51 (1979) NRCC No. 16452] **PEER REVIEWED**

Insulation workers using **asbestos** materials and automotive brake repairmen have been exposed to airborne **asbestos** levels up to 133 and 72 fibers/cu m, respectively.
[Nat'l Research Council Canada; Asbestos p.13 (1979) NRCC No. 16452] **PEER REVIEWED**

Exposure to airborne **asbestos** in the home may /result from use of/ spackling compounds, certain types

of insulation, and some workers may bring home some material ... on their work clothing.
[Nat'l Research Council Canada; Asbestos p.13 (1979) NRCC No. 16452] **PEER REVIEWED**

Exposure profiles for respirable silica dust in 15 mining industry groups that were prepared from the 1977-1981 Mine Safety and Health Administration (MSHA) MIDAS files are presented as probability distribution graphs. The dust exposure data have been organized into data sets according to industry group, operation category, and location (surface and underground) as discussed in this report. There are 15 industry groups: copper, gold and silver, iron, lead and zinc, molybdenum, uranium, other metals, limestone, other stone, clay and shale, **asbestos**, talc, oil shale, sand and gravel, and other nonmetals. Operation and location are classified into 14 categories: surface drilling; underground drilling, blasting, cutting and boring; surface production; surface mobile transport; surface haulageway maintenance; underground production; underground haulageway maintenance; crushing or grinding, and sizing; concentrating and finishing; non specific surface; and non specific underground.
[Chen CK et al; Technological Feasibility of Controlling Asbestos and Silica at Mines and Mills. 248 pp (1983) NIOSH Contract No. PHS-NIOSH-210-81-4101] **PEER REVIEWED**

Occupational settings in which individuals who may be at risk from indirect exposure to **asbestos** include: gold mining, cigarette filter manufacture, automobile transmission parts manufacture, dentistry, and agriculture.
[Nat'l Research Council Canada; Asbestos p.46 (1979) NRCC No. 16452] **PEER REVIEWED**

Asbestos is present in the soil, water and air, and may be added to these media from mining, wearing of automobile brake linings, **asbestos** textile manufacturing, **asbestos** spraying for fireproofing, and the use of **asbestos** in construction materials. The multitude of uses for this non-combustible insulating material means that exposure may be both occupational and non-occupational (environmental); for most people, exposure to at least a low level of **asbestos** ocurs on a daily basis.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.23 (1979) NRCC No. 16452] **PEER REVIEWED**

... Dietary materials that have been reported to contain, or are likely to contain, **asbestos** include foods such as vegetable oil, lard, mayonnaise, ketchup and meats ... and beverages such as beers, sherries, ports, vermouth and soft drinks.
[USEPA, Office of Drinking Water; Criteria Document (Draft): Asbestos p.IV-8 (1985)] **PEER REVIEWED**

Currently, all major commercial **asbestos** varieties, chrysotile, amosite, and crocidolite, have been found to produce a significant incidence of **asbestos**-related disease among workers ocupationally exposed in mining and milling, in manufacturing, and in the use of materials containing the fiber. The predominant route of exposure has been inhalation, although some **asbestos** may be swallowed directly or after being brought up from the rspiratory tract. Not only has **asbestos** disease been found among individuals exposed to the fiber directly as a result of excessive work exposures in decades past, but **asbestos**-associated cancer has also been identified, albeit less frequently, among those with inhalation exposures of lesser intensity, including those who had worked near the application or removal of **asbestos** material, those with history or residing in the vicinity of **asbestos** plants, and those who had lived in the household of an **asbestos** worker.
[USEPA; Ambient Water Quality Criteria Doc: Asbestos p.63 (1980) EPA 440/5-80-022] **PEER REVIEWED**

DOMESTIC EXPOSURE OF HOUSEHOLD CONTACTS TO **ASBESTOS** MAY OCCUR FROM DUSTS BROUGHT HOME ON WORKERS' CLOTHES, SHOES, HAIR, EQUIPMENT, ETC. ...

ASBESTOS LEVELS /WERE FOUND/ RANGING FROM 100-500 NG/CU M IN THE HOUSES OF WORKMEN.
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V14 38 (1977)] **PEER REVIEWED**

Certain beverages are either made from water already containing **asbestos** fibers or are clarified (beer, wine) by filtration through **asbestos** filter pads from which fibers may be released. The **asbestos fiber** levels in other foods are largely unknown.
[Nat'l Research Council Canada; Effects of Asbestos in the Canadian Environ p.14 (1979) NRCC No. 16452] **PEER REVIEWED**

The hazard from environmental **asbestos** exposure showed that mesothelioma could occur among individuals whose potential **asbestos** exposure consisted of having resided near an **asbestos** factory or in the household of an **asbestos** worker. Twenty of 76 cases from the files of the London hospital were the result of such exposures.
[Newhouse ML, Thompson H; Br J Ind Med 22: 261 (1965) as cited in USEPA; Asbestos Health Assessment Update (Draft) p.114 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

A field study was conducted to measure **asbestos fiber** concentrations during brake repair for mechanics in the Federal Republic of Germany. In addition to **asbestos** air sampling, 210 occupational histories describing working conditions under which brake maintenance is carried out were evaluated. Ninety dust concentration measurements in 76 service stations with static and personal samplers during brake maintenance operations. Sampling times varied from less than 3 min to more than 1 hr depending on the duration of the work operation. Samples were analyzed by phase contrast microscopy and scanning transmission electron microscopy. Fiber concentrations during brake service operations were 0.1X10+6/cu m (0.1 fiber per cc) on average. Average fiber dosages (fiber concentration X sampling time) ranged from 4X10+6 fiber/cu m/min for dry brushing and grinding to 10X10+6 fibers/cu m/min for machine grinding. Electron microscopy of brake drum dust indicated very high concentrations of short fibers; fibers with lengths > 5 um constituted less than 1% of all the chrysotile fibers counted.
[Rodelsperger K et al; Am J Ind Med 10: 63-72 (1986)] **PEER REVIEWED** PubMed Abstract

Average Daily Intake:

Assuming that **asbestos** is present at the highest accurate concentration, ie, > 9999.99 million fibers/liter the daily intake for a 70 kg adult male consuming 2 liters of drinking water/day would be > 20 billion fibers/day.
[Millette JR et al; Environ Health Perspect 53: 91-98 (1983) as cited in USEPA; Office of Drinking Water; Criteria Document (Draft): Asbestos p.IV-8 (1985)] **PEER REVIEWED**

Natural Pollution Sources:

Asbestos is a term for six naturally occurring fibrous silicate minerals that are mined and used in many commercial products(1).
[(1) ATSDR; Toxicological Profile for Asbestos. Sept 2001. US Dep of Health and Human Services Agency of Toxic Substances and Disease Registry. Available at

http://www.atsdr.cdc.gov/toxprofiles/tp61.html as of Feb 18, 2004.] **PEER REVIEWED**

Asbestos is a natural contaminant of talc. ... **Asbestos** represents less than 1% of the samples of cosmetic talcs tested.
[Luckewitz W; J Soc Cosmet Chem 26: 431-37 (1975) as cited in Nat'l Research Council Canada; Asbestos p.51 (1979) NRCC No. 16452] **PEER REVIEWED**

Artificial Pollution Sources:

The mining and milling of **asbestos** for end use in insulating products, friction parts, roofing materials and many other applications(1), has led to its release to the environment through various waste streams (SRC).
[(1) ATSDR; Toxicological Profile for Asbestos. Sept 2001. US Dep of Health and Human Services Agency of Toxic Substances and Disease Registry. Available at http://www.atsdr.cdc.gov/toxprofiles/tp61.html as of Feb 18, 2004.] **PEER REVIEWED**

Environmental Fate:

TERRESTRIAL FATE: Movement of **asbestos** fibers only occur during runoff or erosion. **Asbestos** fibers will not volatilize or degrade although they may be resuspended to the air by vehicular traffic over unpaved soil surfaces containing **asbestos** or through mining and milling operations.
[Callahan, M.A., M.W. Slimak, N.W. Gabel, et al. Water-Related Environmental Fate of 129 Priority Pollutants. Volume I. EPA-440/4 79-029a. Washington, DC: U.S. Environmental Protection Agency, December 1979., p. 7-9] **PEER REVIEWED**

AQUATIC FATE: The importance of the transport of **asbestos** from the surface of aquatic environments by wind-activated aerosol formation is presently indeterminate. **Asbestos** will not volatilize or degrade in water.
[Callahan, M.A., M.W. Slimak, N.W. Gabel, et al. Water-Related Environmental Fate of 129 Priority Pollutants. Volume I. EPA-440/4 79-029a. Washington, DC: U.S. Environmental Protection Agency, December 1979., p. 7-9] **PEER REVIEWED**

ATMOSPHERIC FATE: **Asbestos** released to the air will eventually settle out by gravitational settling and dry deposition.
PEER REVIEWED

Environmental Biodegradation:

Asbestos is considered to be non-biodegradable by aquatic organisms.
[Callahan, M.A., M.W. Slimak, N.W. Gabel, et al. Water-Related Environmental Fate of 129 Priority Pollutants. Volume I. EPA-440/4 79-029a. Washington, DC: U.S. Environmental Protection Agency, December 1979., p. 7-13] **PEER REVIEWED**

Environmental Abiotic Degradation:

Certain forms of **asbestos** may undergo dissolution under acidic conditions. This should not be confused with solubility, which is the amount of material that dissolves in solution before it reaches chemical equilibrium. Under acidic conditions, magnesium hydroxide may leach from the outer brucite layer of amosite and chrysotile, but the basic silicate structure of the fiber remains intact (1). The other forms of **asbestos** are generally resistant to dissolution under acidic or alkaline conditions(1).
[(1) ATSDR; Toxicological Profile for Asbestos. Sept 2001. US Dep of Health and Human Services Agency of Toxic Substances and Disease Registry. Available at http://www.atsdr.cdc.gov/toxprofiles/tp61.html as of Feb 18, 2004.] **PEER REVIEWED**

Environmental Bioconcentration:

No evidence was found regarding the bioaccumulation of **asbestos** in aquatic organisms.
[Callahan, M.A., M.W. Slimak, N.W. Gabel, et al. Water-Related Environmental Fate of 129 Priority Pollutants. Volume I. EPA-440/4 79-029a. Washington, DC: U.S. Environmental Protection Agency, December 1979., p. 7-13] **PEER REVIEWED**

Soil Adsorption/Mobility:

It appears that **asbestos** does not have an adsorptive affinity for the solids normally found in natural water systems; however, some materials, notably trace metals and organic cmpd, have an affinity for **asbestos** minerals.
[Callahan, M.A., M.W. Slimak, N.W. Gabel, et al. Water-Related Environmental Fate of 129 Priority Pollutants. Volume I. EPA-440/4 79-029a. Washington, DC: U.S. Environmental Protection Agency, December 1979., p. 7-10] **PEER REVIEWED**

Volatilization from Water/Soil:

Asbestos fibers will not volatilize from water or soil surfaces. (SRC)
PEER REVIEWED

Environmental Water Concentrations:

DRINKING WATER: IN 1973, AMPHIBOLE **ASBESTOS** FIBERS WERE DISCOVERED IN THE MUNICIPAL WATER SUPPLY OF DULUTH, MINNESOTA. THE ENTIRE CITY POPULATION OF APPROX 100,000 WAS EXPOSED FROM THE LATE 1950S THROUGH 1976 AT LEVELS OF 1-65 MILLION FIBERS/L OF WATER.
[SIGURDSON EE; ENVIRON HEALTH PERSPECT 53: 61-7 (1983)] **PEER REVIEWED** PubMed Abstract Full text: PMC1569083

DRINKING WATER: **Asbestos** (millions of fibers/l) in Canadian drinking water: Belleville: Bay of Quinte: 0.533; Brantford: Grand River: 0.570; Brockville: St. Lawrence River: 0.446 (no filtration plant) Chatham: Thames River: 0.595; Cornwall: St. Lawrence River: 2.11; Hamilton: Lake Ontario: 0.456;

Niagara Falls: Niagara River: 2.58; North Bay: Trout Lake: 0.384 (no filtration plant); Oshawa: Lake Ontario: 0.557; Ottawa: Ottawa River: 0.136; Pembroke: Ottawa River: 2.85; Peterborough: Otonabee River: 1.86; Port Colborne: Welland Ship Canal: 0.608; Sarnia: Lake Huron: 3.87 (no filtration plant); Sault St. Marie: St. Marys River: 0.248; St. Catharines: Welland Ship Canal: 1.03; St. Thomas: Lake Erie: 1.60; Sudbury: Ramsey Lake: 0.297 (no filtration plant); Toronto: Lake Ontario: 1.90; Welland: Welland Ship Canal: 0.820. /Data derived from table/
[Kay GH; J Am Water Works Assoc 65: 513-14 (1974) as cited in Nat'l Research Council Canada; Asbestos p.41 (1979) NRCC No. 16452] **PEER REVIEWED**

DRINKING WATER: **Asbestos** content from Canadian rivers and lakes, and in drinking water /is as follows/: Ottawa, Ottawa River, tap water: 2.0x10+6 fibers/l; Toronto, Lake Ontario, tap water: 4.4x10+6 fibers/l; Montreal, St. Lawrence River, tap water: 2.4x10+6 fibers/l; Hull, Ottawa River, tap water: 9.5x10+6 fibers/l (water supply unfiltered); Beauport, St. Lawrence River, tap water: 8.1x10+6 fibers/l (water supply unfiltered); Drummondville, St. Francais River, tap water: 2.9x10+6 fibers/l; Thetford Mines, Lac a la Truite, tap water, 172.7x10+6 fibers/l (water supply unfiltered); Ottawa top 30 cm melted snow, 33.5x10+6 fibers/l; Ottawa, Ottawa River, river water, 9.5x10+6 fibers/l. /Data derived from table/
[Cunningham HM, Pontefract RD; Nature 232: 332-3 (1971) as cited in Nat'l Research Council Canada; Asbestos p.40 (1979) NRCC No. 16452] **PEER REVIEWED**

DRINKING WATER: Drinking waters from Thetford mines, Quebec, site of a major **asbestos** deposit and mine, contained up to 170x10+6 fibers of **asbestos** per l.
[Nat'l Research Council Canada; Asbestos p.14 (1979) NRCC No. 16452] **PEER REVIEWED**

DRINKING WATER: Water concentrations of **asbestos** are usually less than 1x10+6 fibers of all sizes per liter although significantly higher values (1x10+8 fibers/l) have been found in circumstances where water systems have been in contact with asbestiform minerals or where contamination of water supply exists. Fiber mass concentrations corresponding to fiber concentrations are usually less than 0.01 ug/l. Thus, direct water ingestion usually leads to exposure of less than 0.02 ug/day.
[USEPA; Ambient Water Quality Criteria Doc: Asbestos p.98-99 (1980) EPA 440/5-80-022] **PEER REVIEWED**

DRINKING WATER: ... Data suggest that 1x10+6 fibers corresponds to from 2x10-4 to 2x10-3 ug in water systems. Data on **asbestos** concentrations from erosion of fibers from **asbestos**/cement cooling tower panels indicate that the mass of 1x10+6 fibers is from 0.01 to 0.2 ug.
[USEPA; Ambient Water Quality Criteria Doc: Asbestos p.C-19 (1980) EPA 440/5-80-022] **PEER REVIEWED**

Samples from 365 cities have been collected and analyzed by electron microscopy by the USEPA. Of these, 45% had detectable levels of **asbestos**, usually of the chrysotile variety.
[Millette JR; Environmental Health Effects Reseach Report (1979) EPA 600/1-79- 150 as cited in USEPA; Ambient Water Quality Criteria Doc: Asbestos p.C-13 (1980) EPA 440/5-80-022] **PEER REVIEWED**

Effluent Concentrations:

In 1992, EPA estimated that air emissions from **asbestos** processing, including mining, milling, manufacturing, and fabrication were about 2,240 pounds annually(1). Estimated air emissions from waste disposal is about 499,000 pounds per year(1). The total amount of **asbestos** released to water in the US is estimated as 110,000 to 220,000 pounds per year(1). Most of these releases arise from waste

water in **asbestos** related industries, but other sources are erosion of natural deposits and waste piles, corrosion of **asbestos**-cemented pipes, disintegration of **asbestos** containing roofing materials with subsequent runoff into cisterns sewers etc(1). Currently friable **asbestos** containing waste may only be deposited in landfills that are approved by the federal government. In 1999, 13,573,783 pounds of **asbestos** (friable) were deposited in land by 87 US facilities that produced, processed or used **asbestos** products(1).
[(1) ATSDR; Toxicological Profile for Asbestos. Sept 2001. US Dep of Health and Human Services Agency of Toxic Substances and Disease Registry. Available at http://www.atsdr.cdc.gov/toxprofiles/tp61.html as of Feb 18, 2004.] **PEER REVIEWED**

Sediment/Soil Concentrations:

Although the serpentine and amphibole mineral groups occur over a wide range geological environments, the preponderance of these minerals are non fibrous(1). No studies were located regarding the concentration of **asbestos** fibers that occur in soil, however, **asbestos** was detected in about 80% of the samples of street dirt studied at concentrations ranging from 100 million to 1 billion fibers/g (1).
[(1) ATSDR; Toxicological Profile for Asbestos. Sept 2001. US Dep of Health and Human Services Agency of Toxic Substances and Disease Registry. Available at http://www.atsdr.cdc.gov/toxprofiles/tp61.html as of Feb 18, 2004.] **PEER REVIEWED**

Atmospheric Concentrations:

URBAN/SUBURBAN: Mean airborne concentrations of **asbestos** in US cities are 2.1-4.3 ng/cu m(1). Measurements using electron microscopic techniques have established the presence of **asbestos** in the urban ambient air, usually at concentrations less than 10 ng/cu m(2). Concentrations of 100 ng/cu m to 1000 ng/cu m have been measured near specific **asbestos** emission sources, in schools where **asbestos** containing materials are used for sound control, and in office buildings where similar materials are used for fire control(2).
[(1) Carter LJ; Science 197: 237-40 (1977) as cited in Nat'l Research Council Canada; Asbestos. NRCC No. 16452 p.42 (1979) (2) USEPA; Asbestos Health Assessment Update (Draft). USEPA-600/8-84-003A p. 109 (1984)] **PEER REVIEWED**

SOURCE DOMINATED: During 1973, the dust levels from Canadian **asbestos** mines and mills were as high as 83 fibers/cu m. Average airborne **asbestos** concentrations in chrysotile mining towns in Quebec were 80,000 fibers/cu m in 1973-1974, but were reduced to 7,000 fibers/cu m in 1982(1). The geometric mean concentration of **asbestos** 200 meters from cement, friction parts, textile, ground tile, insulation and refractory factories in Taiwan were 6,000, 8,000, 12,000, 33,000, 12,000, and <100 fibers/cu m, respectively as measured by transmission electron microscopy(2). These levels generally declined as a function of the distance the measurements were made from the factory.
[(1) Nat'l Research Council Canada; Asbestos p.13 (1979) NRCC No. 16452 (2) ATSDR; Toxicological Profile for Asbestos. Sept 2001. US Dep of Health and Human Services Agency of Toxic Substances and Disease Registry. Available at http://www.atsdr.cdc.gov/toxprofiles/tp61.html as of Feb 18, 2004.] **PEER REVIEWED**

MEAN AIR CONCN OF AMPHIBOLE FIBERS IN COMMUNITIES SURROUNDING MILLING

OPERATIONS HAVE BEEN REPORTED TO RANGE FROM 2.6-8.9X1X10+3 FIBERS/CU M. ... CONCN OF AS HIGH AS 11X1X10+6 AMPHIBOLE FIBERS/CU M OF AIR WERE REPORTED NEAR SPECIFIC POINT EMISSION SOURCES. /AMPHIBOLE FIBERS/
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V14 71] **PEER REVIEWED**

SOURCE DOMINATED: The ambient air concentrations near the Union Carbide mill and waste pile in King City, CA and near the Johns-Manville mill and water dump in Coalinga, CA were 1.03 million fibers/cu m and 593 million fibers/cu m, respectively.
[USEPA; Office of Toxic Substances Summary Report of Asbestos Monitoring Data (1982) as cited in USEPA; Office of Drinking Water; Criteria Document (Draft): Asbestos p.IV-12 (1985)] **PEER REVIEWED**

Air concentrations over 24 hours in metropolitan areas usually are less than 5 ng/cu m but can range up to 20 ng/cu m. Values up to 50 ng/cu m are found during daytime hours in locations were construction activities and traffic can be contributing sources. A significant fraction of the fibers inhaled can be brought up from the respiratory tract and swallowed. This leads to an ingestion exposure from air sources of up to 0.1 ug/day, although most of the population exposure is from 0.01 to 0.05 ug/day.
[USEPA; Ambient Water Quality Criteria Doc: Asbestos p.C-98 (1980) EPA 440/5-80-022] **PEER REVIEWED**

3 different /USA/ laboratories ... found that the average fiber concn of **asbestos** dust in insulation work between 1968 and 1971 ranged from about 3 to 6 fibers/ml. ... In the Devonport Naval Dockyard in Great Britain ... 8.9 fibers/ml /was obtained/ for the average of long-term samples of **asbestos** concn. ... Peak exposures could ... exceed 100 fibers/ml /for 2 to 5 minute concn of **asbestos**/ during the mixing of cement.
[USEPA; Asbestos Health Assessment Update (Draft) p.36-37 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

Food Survey Values:

Asbestos content is specified for the following: Canadian beer: 4.3-6.6x10+6 fibers/l; USA beer: 1.1-2.0x10+6 fibers/l; Spanish sherry: 2.0x10+6 fibers/l; Canadian sherry: 4.0x10+6 fibers/l; South African sherry: 2.6x10+6 fibers/l; Canadian port: 2.1x10+6 fibers/l; French vermouth: 1.8x10+6 fibers/l; Italian vermouth: 11.7x10+6 fibers/l; French wine: 64.0x10+6 fibers/l; Ginger ale: 12.2x10+6 fibers/l; Tonic water: 1.7x10+6 fibers/l; Orange (softdrink): 2.5x10+6 fibers/l. /Data derived from table/
[Nat'l Research Council Canada; Asbestos p.38 (1979) NRCC No. 16452] **PEER REVIEWED**

Fish/Seafood Concentrations:

Asbestos mine tailings from a mill in Germany were dumped in a region containing large numbers of mussel beds. Mussels were examined after exposure to water containing **asbestos** in concentrations up to 100 mg/l. Fibers penetrated the epithelial tissue of the stomach and the intestinal tract and were present even when the mussels were kept for several weeks in unpolluted water.
[Halsband E; The Effects of Asbestos Waste Products on Mussels (Myilus edulis). Int Council Exploration of the Seas, Fisheries Improvement Comm (1974) as cited in Nat'l

Research Council Canada; Asbestos p.67 (1979) NRCC No. 16452] **PEER REVIEWED**

Other Environmental Concentrations:

Measurements using electron microscopic techniques have established the presence of **asbestos** in the urban ambient air, usually at concentrations less than 10 ng/cu m. Concentrations of 100 ng/cu m to 1000 ng/cu m have been measured near specific **asbestos** emission sources, in schools where **asbestos** containing materials are used for sound control, and in office buildings where similar materials are used for fire control.
[USEPA; Asbestos Health Assessment Update (Draft) p.109 (1984) EPA-600/8-84-003A] **PEER REVIEWED**

Environmental Standards & Regulations:

TSCA Requirements:

The **Asbestos**-in-Schools Identification and Notification Rule effective June 28, 1982, required all public and private local education agencies (LEAs) to (1) inspect for friable materials; (2) sample and analyze these materials when found; (3) post notice of inspection results and notify employees and parents in schools with **asbestos** containing friable materials (ACFM); and (4) maintain records of the findings at the local education agencies and schools. A stratified systematic sample of 1,800 public and 800 private local education agencies was randomly selected proportionate to the square root of enrollment. A telephone survey found that 83% of the local education agencies have begun or completed inspections and 94% of all schools have been inspected. Of the schools inspected, 35% found **asbestos** containing friable materials. Almost all local education agencies **asbestos** containing friable materials have abatement programs (93%), about 1/3 of which (31%) are operations/maintenance only. Only 9% of the local education agencies were in compliance with the rule by June 28, 1983, the rule's compliance date; and 11% were by January 1984, the date of the survey. Record-keeping and notification were the major problem areas of noncompliance. QA site visits were made to 38 local education agencies and 94 schools within these local education agencies were inspected. The local education agencies data collected during the site visits agreed substantially with the telephone survey data.
[Greenblatt J; Evaluation of the Asbestos-in-Schools Identification and Notification Rule 245 pp (1985) EPA Contract No. 68-01-6721] **PEER REVIEWED**

Pursuant to section 8(d) of TSCA, EPA promulgated a model Health and Safety Data Reporting Rule. The section 8(d) model rule requires manufacturers, importers, and processors of listed chemical substances and mixtures to submit to EPA copies and lists of unpublished health and safety studies. **Asbestos** is included on this list.
[40 CFR 716.120; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

CERCLA Reportable Quantities:

Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately, when there is a release of this designated hazardous substance, in an amount equal to or greater than its reportable quantity of 1lb or 0.454 kg. The toll free number of the NRC is (800) 424-8802; In the Washington D.C. metropolitan area (202) 426-2675. The rule for determining when notification is required is stated in 40 CFR 302.4 (section IV. D.3.b). /The RQ for **asbestos** is limited to friable forms only./
[40 CFR 302.4; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Atmospheric Standards:

Asbestos has been designated as a hazardous air pollutant under section 112 of the Clean Air Act.
[40 CFR 61.01; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

National Emission Standards for Hazardous Air Pollutants. **Asbestos** air emission standards are described for asbestosmills; roadways; manufacturing; demolition and renovation; spraying; fabricating; insulating materials; waste disposal for **asbestos** mills; waste disposal for manufacturing, fabricating, demolition, renovation and spraying operations; inactive waste disposal sites for **asbestos** mills and manufacturing and fabricating operations; air-cleaning; reporting; active waste disposal sites; operations that convert **asbestos**-containing waste material into nonasbestos (**asbestos** free) material.
[40 CFR 61.140 through 61.155; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Listed as a hazardous air pollutant (HAP) generally known or suspected to cause serious health problems. The Clean Air Act, as amended in 1990, directs EPA to set standards requiring major sources to sharply reduce routine emissions of toxic pollutants. EPA is required to establish and phase in specific performance based standards for all air emission sources that emit one or more of the listed pollutants. **Asbestos** is included on this list.
[Clean Air Act as amended in 1990, Sect. 112 (b) (1) Public Law 101-549 Nov. 15, 1990] **PEER REVIEWED**

Clean Water Act Requirements:

Toxic pollutant designated pursuant to section 307(a)(1) of the Federal Water Pollution Control Act and is subject to effluent limitations.
[40 CFR 401.15; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **QC REVIEWED**

Federal Drinking Water Standards:

EPA 7 mf/l (million fibers/l)

[USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93) To Present] **QC REVIEWED**

FDA Requirements:

Asbestos is an indirect food additive for use only as a component of adhesives
[21 CFR 175.105; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Polyester resins, cross-linked. Optional adjuvant substances employed to facilitate the production of the resins or added thereto to impart desired technical or physical properties include the following, provided that the quantity used does not exceed that reasonably required to accomplish the intended physical or technical effect and does ot exceed any limitations prescribed in this section. **Asbestos** use as a reinforcement in included on this list.
[21 CFR 177.2420(b); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Phenolic resins in molded articles. Optional adjuvant substances employed in the production of the phenolic resins or added thereto to impart desired technical or physical properties. **Asbestos fiber** is included on this list.
[21 CFR 177.2410(b); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2003: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Chemical/Physical Properties:

Molecular Formula:

UVCB
PEER REVIEWED

Color/Form:

FINE, SLENDER, FLAXY FIBERS
[The Merck Index. 9th ed. Rahway, New Jersey: Merck & Co., Inc., 1976., p. 110]
PEER REVIEWED

Odor:

... Odorless ...

[NIOSH. NIOSH Pocket Guide to Chemical Hazards & Other Databases. U.S. Department of Health & Human Services, Public Health Service, Center for Disease Control & Prevention. DHHS (NIOSH) Publication No. 2001-145 (CD-ROM) August 2001.] **PEER REVIEWED**

Other Chemical/Physical Properties:

Blue... fibrous ... solids. /Crocidolite/
[NIOSH. NIOSH Pocket Guide to Chemical Hazards & Other Databases. U.S. Department of Health & Human Services, Public Health Service, Center for Disease Control & Prevention. DHHS (NIOSH) Publication No. 2001-145 (CD-ROM) August 2001.] **PEER REVIEWED**

Magnesium ... which occurs naturally in **asbestos** ... contributes to the surface charge of the **asbestos** fibers.
[Nat'l Research Council Canada; Asbestos p.21 (1979) NRCC No. 16452] **PEER REVIEWED**

Cobalt blue to lavender blue /Crocidolite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V3 (1992) 680] **PEER REVIEWED**

Decomposition point: 950 deg C /Anthophylite/. 800 deg C /Crocidolite/.
[ATSDR; Toxicological Profile for Asbestos. Sept 2001. US Dep of Health and Human Services Agency of Toxic Substances and Disease Registry. Available from, as of Feb 18, 2004: http://www.atsdr.cdc.gov/toxprofiles/to61.html **PEER REVIEWED**

Index of refraction: 1.65-1.72 /Crocidolite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V3 (1992) 671] **PEER REVIEWED**

Tensile strength: 1400-4600 Mpa /Crocidolite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V3 (1992) 671] **PEER REVIEWED**

Of mineral origin, **asbestos** does not burn, does not rot, and, dependent on the variety, possesses extremely high tensile strength as well as resistance to acids, bases, and heat. Similarly, when processed into long, thin fibers, **asbestos** is sufficiently soft and flexible to be woven into fire resistant fabrics.
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 (1978) 267] **PEER REVIEWED**

Chemical composition, ((Mg,Fe)7Si8O22(OH)2)n /Anthophyllite/
[ATSDR; Toxicological Profile for Asbestos. Sept 2001. US Dep of Health and Human Services Agency of Toxic Substances and Disease Registry. Available from, as of Feb 18, 2004: http://www.atsdr.cdc.gov/toxprofiles/tp61.html **PEER REVIEWED**

Chemical composition, (Ca2(Mg,Fe)5Si8O22(OH)2)n /Actinolite/
[ATSDR; Toxicological Profile for Asbestos. Sept 2001. US Dep of Health and Human Services Agency of Toxic Substances and Disease Registry. Available from, as of Feb 18, 2004: http://www.atsdr.cdc.gov/toxprofiles/tp61.html **PEER REVIEWED**

Chemical composition, (NaFe3(2+)Fe2(3+)Si8O22(OH)2)n /Crocidolite/
[ATSDR; Toxicological Profile for Asbestos. Sept 2001. US Dep of Health and Human

Services Agency of Toxic Substances and Disease Registry. Available from, as of Feb 18, 2004: http://www.atsdr.cdc.gov/toxprofiles/tp61.html **PEER REVIEWED**

Tensile strength of the **asbestos fiber** is an important and highly significant physical property. The tensile strength values for the different **asbestos** varieties should be considered as relative for the different variety rather than specific, since all these measured values are far less than the theoretical value of over 10,000 MPa (1.45X10+6 psi) attributable to silicate chain structures. Physical strengths of **asbestos** are adversely affected by elevated temperatures.
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 (1978) 273] **PEER REVIEWED**

The typical tensile strengths of **asbestos** fibers have the order: crocidolite > chrysotile > amosite > anthophyllite > tremolite > actinolite
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 (1978) 278] **PEER REVIEWED**

Commercial amphiboles are harsh fibers. They are relatively stiff, brittle, and coarser in diameter than crysotile, and rodlike in appearance under the microscope. /Amphiboles/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 (1978) 276] **PEER REVIEWED**

The structure of all the amphiboles consists of two chains or ribbons based on Si4O11 units separated by a band of cations. Seven cations form the basal unit. Two hydroxyl groups are attached to the central cation in each unit cell. These hydroxyls ... are contained entirely within the amphibole structure. The final structure is composed of stacks of these sandwich ribbons. The bonding between these ribbons is rather weak & the crystals are easily cleaved parallel to the ribbons ... If the cleavage is very facile, the result is an asbestiform mineral. /Amphiboles/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 (1978) 276] **PEER REVIEWED**

... The amphibole **asbestos** fibers dehydroxylate and decompose at elevated temperatures. The presence of large quantities of iron (particularly ferrous iron) makes the decomposition or thermal analysis determinations particularly complex and very dependent on the composition of the atmosphere. ... Compared to crysotile, the amphibole fibers are relatively acid resistant. However, under boiling conditions and high acid concn the amphiboles can exhibit wt losses of approx 2-20%. ... Amphiboles fibers have a negative charge ... The magnitude of the charge exhibited by the amphiboles is substantially lower than chrysotile's. /Amphiboles/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 (1978) 277] **PEER REVIEWED**

Relative order of acid resistance is: tremolite > anthophyllite > crocidolite > actinolite > amosite > chrysotile.
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 (1978) 278] **PEER REVIEWED**

Amphibole fibers do not divide into fibrils as fine in diameter or as symmetrical as the chrysotile variety. Ultimate diameter of amphiboles have been reported to be about 0.1 um and the surface areas of amphibole **asbestos** are considerably smaller than chrysotile. /Amphiboles/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 (1978) 278] **PEER REVIEWED**

Fully fiberized commercial grades of crocidolite have surface areas by gas adsorption of 3-15 sq m/g. /Crocidolite/

[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 (1978) 278] **PEER REVIEWED**

Structure: lamellar, fibrous asbestiform; mineral association: in crystalline schists and gneisses; origin: metamorphic, usually from olivine; veining: slip, mass fiber unoriented and interlacing; essential composition: magnesium silicate with iron; crystal structure: prismatic, lamellar to fibrous; crystal system: orthorhombic; color: gray white, brown, gray, or green; luster: viterous to pearly; Mohs hardness: 5.5-6.0; specific gravity: 2.85-3.1; cleavage: 110%; optical properties: biaxial positive extinction parallel; index of refraction: about 1.61; Seger cones fusibility: infusible or difficult to fuse; flexibility: very brittle, nonflexible; length: short; texture: harsh; acid resistance: fairly resistant to acids; spinnability: poor; specific heat: 879 J/kg deg K or 0.210 Btu/lb deg F. /Anthophyllite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 (1978) 274] **PEER REVIEWED**

Structure: fibrous in iron stones; mineral association: in iron rich silicious argillite in quartzose schists; origin: regional metamorphism; veining: cross fiber; essential composition: silicate of sodium and iron water; crystal structure: fibrous; crystal system: monoclinic; color: lavender, blue; luster: silky to dull; Mohs hardness: 4; specific gravity: 3.2-3.3; cleavage: 110%; optical properties: biaxial extinction inclined; index of refraction: 1.7 pleochroic; Seger cones fusibility: fusible at 3, 1145-1170 deg C; flexibility: fair to good; length: short to long; texture: soft to harsh; acid resistance: fairly resistant to acids; spinnability: fair; specific heat: 841 J/kg deg K or 0.201 Btu/lb deg F. /Crocidolite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 (1978) 274] **PEER REVIEWED**

Structure: reticulated long prismatic crystals & fibers; mineral association: in limestone & in crystalline schists; origin: results of contact metamorphism; veining: slip or mass fiber; essential composition: calcium, magnesium, and iron silicates, water up to 5%; crystal structure: long & thin columnar to fibrous; crystal system: monoclinic; color: green; luster: silky; Mohs hardness: about 6; specific gravity: 3.0-3.2; cleavage: 110%; optical properties: biaxial negative extinction inclined; index of refraction: 1.63 weakly pleochroic; Seger cones fusibility: fusible at 4, 1165-1190 deg C; flexibility: brittle and nonflexible; length: short to long; texture: harsh; acid resistance: relatively insol in hydrochloric acid; spinnability: poor; specific heat: 908 J/kg deg K or 0.217 Btu/lb deg F. /Actinolite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 (1978) 274] **PEER REVIEWED**

Asbestos minerals, despite a relatively high fusion temperature, are completely decomposed at temperatures of 1000 deg C. Both the dehydroxylation temperature and decompostion temperature increase with increased magnesium oxide content among the various amphibole species. ... Most materials have a negative surface charge in aqueous systems. However, since chrysotile has a positive charge, it will attract, or be attracted to, most dispersed materials. The highly reactive surface of **asbestos** causes many surface reactions which are intermediate between simple absorption and a true chemical reaction. The absorption of various materials on the surface of chrysotile has a greater affinity for polar molecules (eg water, ammonia) than for non-polar molecules.
[Speil S, Leineweber JP; Environ Res 2: 166 (1969) as cited in USEPA; Health and Environmental Effects Profile for Asbestos p.12-6 (1969)] **PEER REVIEWED**

Amphiboles can ... occur in nonfibrous forms which may result because of structural disorder. The dominant cations are magnesium, ferrous, ferric, sodium, and calcium. Minor isomorphic substitutions of aluminum, titanium, potassium, and lithium also occur. Because of the wide compositional range, the amphiboles are often assigned to three generic series; ie, the anthophyllite cummingtonite series, the calcic amphiboles and the soda amphiboles. /Amphiboles/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 (1978) 276] **PEER REVIEWED**

Chemical Safety & Handling:

DOT Emergency Guidelines:

/GUIDE 171: SUBSTANCES (LOW TO MODERATE HAZARD)/ Fire or Explosion: Some may burn but none ignite readily. Containers may explode when heated. Some may be transported hot. /**Asbestos**; **Asbestos**, blue; **Asbestos**, brown; **Asbestos**, white/
[U.S. Department of Transportation. 2004 Emergency Response Guidebook. A Guide book for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Incident. Washington, D.C. 2004] **QC REVIEWED**

/GUIDE 171: SUBSTANCES (LOW TO MODERATE HAZARD)/ Health: Inhalation of material may be harmful. Contact may cause burns to skin and eyes. Inhalation of **asbestos** dust may have a damaging effect on the lungs. Fire may produce irritating, corrosive and/or toxic gases. some liquids produce vapors that may cause dizziness or suffocation. Runoff from fire control may cause pollution. /**Asbestos**; **Asbestos**, blue; **Asbestos**, brown; **Asbestos**, white/
[U.S. Department of Transportation. 2004 Emergency Response Guidebook. A Guide book for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Incident. Washington, D.C. 2004] **QC REVIEWED**

/GUIDE 171: SUBSTANCES (LOW TO MODERATE HAZARD)/ Public Safety: CALL Emergency Response Telephone Number ... . As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters (150 feet) for liquids and at least 25 meters (75 feet) for solids. Keep unauthorized personnel away. Stay upwind. /**Asbestos**; **Asbestos**, blue; **Asbestos**, brown; **Asbestos**, white/
[U.S. Department of Transportation. 2004 Emergency Response Guidebook. A Guide book for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Incident. Washington, D.C. 2004] **QC REVIEWED**

/GUIDE 171: SUBSTANCES (LOW TO MODERATE HAZARD)/ Protective Clothing: Wear positive pressure self-contained breathing apparatus (SCBA). Structural firefighters' protective clothing will only provide limited protection. /**Asbestos**; **Asbestos**, blue; **Asbestos**, brown; **Asbestos**, white/
[U.S. Department of Transportation. 2004 Emergency Response Guidebook. A Guide book for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Incident. Washington, D.C. 2004] **QC REVIEWED**

/GUIDE 171: SUBSTANCES (LOW TO MODERATE HAZARD)/ Evacuation: ... Fire: If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. /**Asbestos**; **Asbestos**, blue; **Asbestos**, brown; **Asbestos**, white/
[U.S. Department of Transportation. 2004 Emergency Response Guidebook. A Guide book for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Incident. Washington, D.C. 2004] **QC REVIEWED**

/GUIDE 171: SUBSTANCES (LOW TO MODERATE HAZARD)/ Fire: Small fires: Dry chemical, CO2, water spray or regular foam. Large fires: Water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Do not scatter spilled material with high pressure water streams. Dike fire-control water for later disposal. Fire involving tanks: Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety

devices or discoloration of tank. ALWAYS stay away from tanks engulfed in fire. /**Asbestos**; **Asbestos**, blue; **Asbestos**, brown; **Asbestos**, white/
[U.S. Department of Transportation. 2004 Emergency Response Guidebook. A Guide book for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Incident. Washington, D.C. 2004] **QC REVIEWED**

/GUIDE 171: SUBSTANCES (LOW TO MODERATE HAZARD)/ Spill or Leak: Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent dust cloud. Avoid inhalation of **asbestos** dust. Small dry spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area. Small spills: Take up with sand or other non-combustible absorbent material and place into containers for later disposal. Large spills: Dike far ahead of liquid spill for later disposal. Cover powder spill with plastic sheet or tarp to minimize spreading. Prevent entry into waterways, sewers, basements or confined areas. /**Asbestos**; **Asbestos**, blue; **Asbestos**, brown; **Asbestos**, white/
[U.S. Department of Transportation. 2004 Emergency Response Guidebook. A Guide book for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Incident. Washington, D.C. 2004] **QC REVIEWED**

/GUIDE 171: SUBSTANCES (LOW TO MODERATE HAZARD)/ First Aid: Move victim to fresh air. Call 911 or emergency medical service. Give artificial respiration if victim is not breathing. Administer oxygen if breathing is difficult. Remove and isolate contaminated clothing and shoes. In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves. /**Asbestos**; **Asbestos**, blue; **Asbestos**, brown; **Asbestos**, white/
[U.S. Department of Transportation. 2004 Emergency Response Guidebook. A Guide book for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Incident. Washington, D.C. 2004] **QC REVIEWED**

Fire Fighting Procedures:

If material involved in fire: Extinguish fire using agent suitable for type of surrounding fire. (Material itself does not burn or burns with difficulty.) Keep run-off water out of sewers and water sources.
[Association of American Railroads/Bureau of Explosives; Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads. Pueblo, CO. 2002., p. 110] **PEER REVIEWED**

Hazardous Decomposition:

Asbestos minerals, despite a relatively high fusion temperature, are completely decomposed at temperatures of 1,000 deg C.
[USEPA; Ambient Water Quality Criteria Doc: Asbestos p.A-3 (1980) EPA 440/5-80-022] **PEER REVIEWED**

The resistance of the **asbestos** fibers to attack by reagents other than acid is excellent up to temperatures of approximately 100 deg C with rapid deterioration observed at higher temperatures.
[USEPA; Ambient Water Quality Criteria Doc: Asbestos p.A-5 (1980) EPA 440/5-80-022] **PEER REVIEWED**

Immediately Dangerous to Life or Health:

NIOSH considers **asbestos** to be a potential occupational carcinogen.
[NIOSH. NIOSH Pocket Guide to Chemical Hazards & Other Databases. U.S. Department of Health & Human Services, Public Health Service, Center for Disease Control & Prevention. DHHS (NIOSH) Publication No. 2001-145 (CD-ROM) August 2001.] **PEER REVIEWED**

Protective Equipment & Clothing:

If an employee is exposed to **asbestos** above the /OSHA/ TWA and/or excursion limit, or where the possibility of eye irritation exists, the employer /is required to/ provide at no cost to the employee and ensure that the employee uses appropriate protective work clothing and equipment such as, but not limited to: Coverall or similar full-body work clothing; Gloves, head coverings, and foot coverings; and Face shield, vented goggles, or other appropriate protective equipment which complies with /the OSHA **Asbestos** standard/.
[29 CFR 1910.1001(h)(1); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 20, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Basic protection ... coveralls ... made of cotton polyester material. Cotton alone cannot be used because static build-up causes fibers to adhere to cloth. ... Provide head covering /such as/ surgical caps.
[USDHEW/NCI; Asbestos: An Information Resource p.79 (1978) DHEW Pub No. NIH 79-1681] **PEER REVIEWED**

Foot coverings, /such as/ canvas booties, rubber galoshes, or safety shoes /should be used/.
[USDHEW/NCI; Asbestos: An Information Resource p.79 (1978) DHEW Pub No. NIH 79-1681] **PEER REVIEWED**

Airborne concentration of **asbestos** or conditions of use: not in excess of 1 fibers/cc (10 times PEL); Required respirator: half-mask air-purifying respirator other than a disposable respirator, equipped with high efficiency filters.
[29 CFR 1910.1001(g)(3); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Airborne concentration of **asbestos** or condition of use: not in excess of 5 fibers/cc (50 times PEL); Required respirator: full facepiece air-purifying respirator equipped with high efficiency filters.
[29 CFR 1910.1001(g)(3); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Airborne concentration of **asbestos** or condition of use: not in excess of 10 fibers/cc (100 times PEL); Required respirator: any powered air-purifying respirator equipped with high efficiency filters or any supplied air respirator operated in continuous flow mode.
[29 CFR 1910.1001(g)(3); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Airborne concentration of **asbestos** or condition of use: not in excess of 100 fibers/cc (1,000 times PEL); Required respirator: full facepiece supplied air respirator operated in pressure demand mode.

[20 CFR 1910.1001(g)(3); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Airborne concentration of **asbestos** or condition of use: greater than 100 fibers/cc (1,000 times PEL) or unknown concentration; Required respirator: full facepiece supplied air respirator operated in pressure demand mode, equipped with an auxiliary positive pressure self-contained breathing apparatus.
[20 CFR 1910.1001(g)(3); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Respirator Recommendations: Escape: (Assigned protection factor = 50) Any air-purifying, full-facepiece respirator with a high-efficiency particulate filter/Any appropriate escape-type, self-contained breathing apparatus.
[NIOSH. NIOSH Pocket Guide to Chemical Hazards & Other Databases. U.S. Department of Health & Human Services, Public Health Service, Center for Disease Control & Prevention. DHHS (NIOSH) Publication No. 2001-145 (CD-ROM) August 2001.] **PEER REVIEWED**

Wear appropriate personal protective clothing to prevent skin contact.
[NIOSH. NIOSH Pocket Guide to Chemical Hazards & Other Databases. U.S. Department of Health & Human Services, Public Health Service, Center for Disease Control & Prevention. DHHS (NIOSH) Publication No. 2001-145 (CD-ROM) August 2001.] **PEER REVIEWED**

Wear appropriate eye protection to prevent eye contact.
[NIOSH. NIOSH Pocket Guide to Chemical Hazards & Other Databases. U.S. Department of Health & Human Services, Public Health Service, Center for Disease Control & Prevention. DHHS (NIOSH) Publication No. 2001-145 (CD-ROM) August 2001.] **PEER REVIEWED**

The employer shall institute engineering controls and work practices to reduce and maintain employee exposure to or below the TWA and/or excursion limit prescribed in paragraph (c) of /the OSHA **asbestos** standards/, except to the extent that such controls are not feasible.
[29 CFR 1910.1001(f)(1)(i); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Wherever the feasible engineering controls and work practices that can be instituted are not sufficient to reduce employee exposure to or below the TWA and/or excursion limit prescribed in paragraph (c) of /the OSHA **asbestos** standard/, the employer shall use them to reduce employee exposure to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protection that complies with the requirements of paragraph (g) of /the OSHA standard/.
[29 CFR 1910.1001(f)(1)(ii); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

For the following operations, wherever feasible engineering controls and work practices that can be instituted are not sufficient to reduce the employee exposure to or below the TWA and/or excursion limit prescribed in paragraph (c) of /the OSHA **asbestos** standard/, the employer shall use them to reduce employee exposure to or below 0.5 fiber/cu cm of air (as an 8-hr time-weighted average) or 2.5 fibers/cc for 30 minutes (short-term exposure) and shall supplement them by the use of any combination of respiratory protection that complies with the requirements of paragraph (g) of /the OSHA **asbestos** standard/, work practices and feasible engineering controls that will reduce employee exposure to or below the TWA and to or below the excursion limit permissible prescribed in paragraph (c) of /the

OSHA **asbestos** standard/: Coupling cutoff in primary **asbestos** cement pipe manufacturing; sanding in primary and secondary **asbestos** cement sheet manufacturing; grinding in primary and secondary friction product manufacturing; carding and spinning in dry textile processes; and grinding and sanding in primary plastics manufacturing.
[29 CFR 1910.1001(f)(1)(iii); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Respirators may always be necessary during the cleaning or repair of exhaust ductwork or during manual shakedown of collection bags in baghouses. ... This form of protection may be the only feasible method of controlling **asbestos** exposure during the removal of thermal insulation or the application of some **asbestos** products. ... The type of respirator needed ... will be indicated by the concn of airborne **asbestos fiber.** ... Respirators require proper fitting, maintenance, and cleaning to be effective.
[USDHEW/NCI; Asbestos: An Information Resource p.78 (1978) DHEW Pub No. NIH 79-1681] **PEER REVIEWED**

Local exhaust ventilation and dust collection systems shall be designed, constructed, installed, and maintained in accordance with good practices such as those found in the American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, ANSI Z9.2□1979.
[29 CFR 1910.1001(f)(1)(iv); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

All hand-operated and power-operated tools which would produce or release fibers of **asbestos**, such as, but not limited to, saws, scorers, abrasive wheels, and drills, shall be provided with local exhaust ventilation systems which comply with paragraph (f)(1)(iv) of /the OSHA **asbestos** standard/.
[29 CFR 1910.1001(f)(1)(v); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Insofar as practicable, **asbestos** shall be handled, mixed, applied, removed, cut, scored, or otherwise worked in a wet state sufficient to prevent the emission of airborne fibers so as to expose employees to levels in excess of the TWA and/or excursion limit, prescribed in paragraph (c) of /the OSHA **asbestos** standard/, unless the usefulness of the product would be diminished thereby.
[29 CFR 1910.1001(f)(1)(vi); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

No **asbestos** cement, mortar, coating, grout, plaster, or similar material containing **asbestos**, shall be removed from bags, cartons, or other containers in which they are shipped, without being either wetted, or enclosed, or ventilated so as to prevent effectively the release of airborne fibers.
[29 CFR 1910.1001(f)(1)(viii); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Compressed air shall not be used to remove **asbestos** or materials containing **asbestos** unless the compressed air is used in conjunction with a ventilation system which effectively captures the dust cloud created by the compressed air.
[29 CFR 1910.1001(f)(1)(ix); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Sanding of **asbestos**-containing flooring material is prohibited.
[29 CFR 1910.1001(f)(1)(x); U.S. National Archives and Records Administration's

Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

/Workers/ are required to wear a respirator when performing tasks that result in **asbestos** exposure that exceeds the permissible exposure limit (PEL) of 0.1 f/cc. ...Air-purifying respirators equipped with a high-efficiency particulate air (HEPA) filter can be used where airborne **asbestos fiber** concentrations do not exceed 2 f/cc; otherwise, air-supplied, positive-pressure, full facepiece respirators must be used. Disposable respirators or dust masks are not permitted to be used for **asbestos** work. For effective protection, respirators must fit your face and head snugly. ...Employers /are/ required to conduct fit tests when /employees/ are first assigned a respirator and every 6 months thereafter. Respirators should not be loosened or removed in work situations where their use is required.
[29 CFR 1910.1001(App G); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 20, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Preventive Measures:

SRP: The scientific literature for the use of contact lenses in industry is conflicting. The benefit or detrimental effects of wearing contact lenses depend not only upon the substance, but also on factors including the form of the substance, characteristics and duration of the exposure, the uses of other eye protection equipment, and the hygiene of the lenses. However, there may be individual substances whose irritating or corrosive properties are such that the wearing of contact lenses would be harmful to the eye. In those specific cases, contact lenses should not be worn. In any event, the usual eye protection equipment should be worn even when contact lenses are in place.
PEER REVIEWED

SRP: Local exhaust ventilation should be applied wherever there is an incidence of point source emissions or dispersion of regulated contaminants in the work area. Ventilation control of the contaminant as close to its point of generation is both the most economical and safest method to minimize personnel exposure to airborne contaminants.
PEER REVIEWED

Prevention of dust prodn & its effective control at the site of prodn is the basis of technical control. Once the dust is airborne in the general atmosphere, its elimination & control become expensive & relatively ineffective. Thus, successful technical control starts with enclosing machines & applying local exhaust ventilation at points where the equipment has to be opened, for example where bags of fiber are fed into mixers or the fiber comes out of the machine at the bagging end of the mills. Damping of the fiber before mixing with other products & during spinning & weaving can greatly assist the elimination of dust prodn. ... Exhaust ventilation is required where **asbestos**-containing products are ground, sawn, drilled, or turned, & the cleaning up should be done by vacuum cleaners rather than brushes.
[International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983., p. 187] **PEER REVIEWED**

The employer shall ensure that employees remove work clothing contaminated with **asbestos** only in /clean/ change rooms... . The employer shall provide clean change rooms for employees who work in areas where their airborne exposure to **asbestos** is above the TWA and/or excursion limit. The employer shall ensure that change rooms are... equipped with two separate lockers or storage facilities, so separated as to prevent contamination of the employee's street clothes from his protective work clothing and equipment. The employer shall ensure that employees who work in areas where their airborne

exposure is above the TWA and/or excursion limit, shower at the end of the work shift. The employer shall provide shower facilities.../and/ ensure that employees who are required to shower... do not leave the workplace wearing any clothing or equipment worn during the work shift. The employer shall ensure that no employee takes contaminated work clothing out of the change room, except those employees authorized to do so for the purpose of laundering, maintenance, or disposal. Contaminated work clothing shall be placed and stored in closed containers which prevent dispersion of the **asbestos** outside the container. Containers of contaminated protective devices or work clothing which are to be taken out of change rooms or the workplace for cleaning, maintenance or disposal, shall bear labels... /including the following information: DANGER; CONTAINS **ASBESTOS** FIBERS; AVOID CREATING DUST; CANCER AND LUNG DISEASE HAZARD/. ...The employer shall clean, launder, repair, or replace protective clothing and equipment required by /OSHA's **asbestos** standard/ to maintain their effectiveness. The employer shall provide clean protective clothing and equipment at least weekly to each affected employee. The employer shall prohibit the removal of **asbestos** from protective clothing and equipment by blowing or shaking. Laundering of contaminated clothing shall be done so as to prevent the release of airborne fibers of **asbestos** in excess of the permissible exposure limits prescribed /by OSHA/. ...Contaminated clothing shall be transported in sealed impermeable bags, or other closed, impermeable containers, and labeled... .
[29 CFR 1910.1001(h)(2-3), (i)(1-4); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 20, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

The employer shall provide lunchroom facilities for employees who work in areas where their airborne exposure is above the TWA and/or excursion limit. The employer shall ensure that lunchroom facilities have a positive pressure, filtered air supply, and are readily accessible to employees. The employer shall ensure that employees who work in areas where their airborne exposure is above the PEL and/or excursion limit wash their hands and faces prior to eating, drinking or smoking. The employer shall ensure that employees do not enter lunchroom facilities with protective work clothing or equipment unless surface **asbestos** fibers have been removed from the clothing or equipment by vacuuming or other method that removes dust without causing the **asbestos** to become airborne.
[29 CFR 1910.1001(i)(3); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 20, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

The employer shall ensure that employees do not smoke in work areas where they are occupationally exposed to **asbestos** because of activities in that work area.
[29 CFR 1910.1001(i)(4); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 20, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

The employer shall ensure that employees do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in the regulated area /where airborne concentrations of **asbestos** exceed, or there is a reasonable possibility they may exceed a PEL/.
[29 CFR 1915.1001(e)(5) ; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 20, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

... A strong corporate /policy/ should be established against the practice of eating, drinking, or smoking on the job. These activities should be restricted to a designated, clean location visited only after established decontamination procedures have been followed.
[USDHEW/NCI; Asbestos: An Information Resource p.76 (1978) DHEW Pub No. NIH 79-1681]
PEER REVIEWED

Although individual **asbestos** removal projects vary in terms of the equipment required to accomplish

the removal of the materials, some equipment and materials are common to most **asbestos** removal operations. Plastic sheeting used to protect horizontal surfaces, seal HVAC openings or to seal vertical openings and ceilings should have a minimum thickness of 6 mils. Tape or other adhesive used to attach plastic sheeting should be of sufficient adhesive strength to support the weight of the material plus all stresses encountered during the entire duration of the project without becoming detached from the surface. Other equipment and materials which should be available at the beginning of each project are: HEPA Filtered Vacuum is essential for cleaning the work area after the **asbestos** has been removed. It should have a long hose capable of reaching out-of-the-way places, such as areas above ceiling tiles, behind pipes, etc. Portable air ventilation systems installed to provide the negative air pressure and air removal from the enclosure must be equipped with a HEPA filter. ...Water spray... used to keep the **asbestos** material as saturated as possible during removal... . ...Water used to saturate the **asbestos** containing material can be amended by adding at least 15 mL (1/4 ounce) of wetting agent in 1 L (1 pint) of water. An example of a wetting agent is a 50/50 mixture of polyoxyethylene ether and polyoxyethylene polyglycol ester. Backup power supplies are recommended... . Shower and bath water should be with mixed hot and cold water faucets. Water that has been used to clean personnel or equipment should either be filtered or be collected and discarded as **asbestos** waste. Soap and shampoo should be provided to aid in removing dust from the workers' skin and hair.
[29 CFR 1915.1001(App F) ; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 20, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Warning labels shall be affixed to all raw materials, mixtures, scrap, waste, debris, and other products containing **asbestos** fibers, or to their containers. ...The labels shall comply with the requirements of 29 CFR 1910.1200(f) of OSHA's Hazard Communication standard, and shall include the following information: DANGER; CONTAINS **ASBESTOS** FIBERS; AVOID CREATING DUST; CANCER AND LUNG DISEASE HAZARD.
[29 CFR 1910.1001(j)(4); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 20, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Pollution control technology in Canadian **asbestos** mines and mills ... the industry has taken several steps to improve worker safety ... the amount of airborne dust in the workplace has been reduced by: 1) wet processing of fibers during textile manufacture, and 2) encapsulation of the yarn by chemical dispersing agents which inhibited small **asbestos** fibrils from breaking away.
[Curtis RA, Bierbaum PJ; Am Ind Hyg Assoc J 36 (2): 115-25 (1975) as cited in Nat'l Research Council Canada; Asbestos p.52 (1979) NRCC No. 16452] **PEER REVIEWED**

Sealants /are now available/ which help prevent the release of **asbestos** from surfaces which are flaking.
[Nat'l Research Council Canada; Asbestos p.53 (1979) NRCC No. 16452] **PEER REVIEWED**

Do not wear work clothing outside the work area ... this will curtail exposure of other individuals. Use a vacuum to remove **asbestos** fibers from work clothing.
[USDHEW/NCI; Asbestos: An Information Resource p.79 (1978) DHEW Pub No. NIH 79-1681] **PEER REVIEWED**

If material not involved in fire: Keep material out of water sources and sewers.
[Association of American Railroads/Bureau of Explosives; Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads. Pueblo, CO. 2002., p. 110] **PEER REVIEWED**

Personnel protection: Avoid breathing dusts. ... Do not handle broken packages unless wearing appropriate personal protective equipment. Wash away any material which may have contacted the body

with copious amounts of water or soap and water.
[Association of American Railroads/Bureau of Explosives; Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads. Pueblo, CO. 2002., p. 110] **PEER REVIEWED**

Shipment Methods and Regulations:

No person may /transport,/ offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177)./
[49 CFR 171.2; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 15, 2006: http://www.gpoaccess.gov/ecfr/ **QC REVIEWED**

The International Air Transport Association (IATA) Dangerous Goods Regulations are published by the IATA Dangerous Goods Board pursuant to IATA Resolutions 618 and 619 and constitute a manual of industry carrier regulations to be followed by all IATA Member airlines when transporting hazardous materials.
[International Air Transport Association. Dangerous Goods Regulations. 47th Edition. Montreal, Quebec Canada. 2006., p. 151, 153, 272] **QC REVIEWED**

The International Maritime Dangerous Goods Code lays down basic principles for transporting hazardous chemicals. Detailed recommendations for individual substances and a number of recommendations for good practice are included in the classes dealing with such substances. A general index of technical names has also been compiled. This index should always be consulted when attempting to locate the appropriate procedures to be used when shipping any substance or article.
[International Maritime Organization. International Maritime Dangerous Goods Code. London, UK. 2004., p. 103, 124] **QC REVIEWED**

Cleanup Methods:

Techniques are available to minimize the concentration of **asbestos** fibers in drinking water. Filtration research conducted at locations on lake superior and in the cascade mountains in Washington has shown that amphibole and chrysotile fibers can be removed by granular media filtration. Pilot scale and distribution system research projects have shown that **asbestos** cement (AC) pipes can be protected from dissolution and leaching effects that can result in release of **asbestos** fibers into drinking water. Suggested techniques include modifying low pH, low alkalinity water so they are not aggressive; coating the pipe wall with a chemical precipitate; and applying a cement mortar lining to the pipe wall.
[Logsdon GS; Environ Health Perspect 53: 169-76 (1983)] **PEER REVIEWED** PubMed Abstract Full text: PMC1569079

Environmental considerations: Land spill: Cover solids with a plastic sheet to prevent dissolving in rain or fire fighting water. Dike surface flow using soil, sand bags, foamed polyurethane, or foamed concrete.
[Association of American Railroads/Bureau of Explosives; Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads. Pueblo, CO. 2002., p. 110] **PEER REVIEWED**

Environmental considerations: Water spill: Use natural barriers or oil spill control booms to limit spill

travel.
[Association of American Railroads/Bureau of Explosives; Emergency Handling of Hazardous Materials in Surface Transportation. Association of American Railroads. Pueblo, CO. 2002., p. 110] **PEER REVIEWED**

Disposal Methods:

SRP: The most favorable course of action is to use an alternative chemical product with less inherent propensity for occupational exposure or environmental contamination. Recycle any unused portion of the material for its approved use or return it to the manufacturer or supplier. Ultimate disposal of the chemical must consider: the material's impact on air quality; potential migration in soil or water; effects on animal, aquatic, and plant life; and conformance with environmental and public health regulations.
PEER REVIEWED

Recommendable method: Landfill. Peer-review: No one should handle fibrous or dusty **asbestos** waste without a suitable ... /NIOSH approved respirator/. **Asbestos** waste should be put into good quality plastic bags and sealed as it is produced. These bags should then be buried at the landfill without opening, and immediately covered with 1.5-2 m of non-**asbestos** waste. (Peer-review conclusions of an IRPTC expert consultation (May 1985))
[United Nations. Treatment and Disposal Methods for Waste Chemicals (IRPTC File). Data Profile Series No. 5. Geneva, Switzerland: United Nations Environmental Programme, Dec. 1985., p. 96] **PEER REVIEWED**

Asbestos is a poor candidate for incineration.
[USEPA; Engineering Handbook for Hazardous Waste Incineration p.3-11 (1981) EPA 68-03-3025] **PEER REVIEWED**

Empty shipping bags can be flattened under exhaust hoods and packed into airtight containers for disposal. Empty shipping drums are difficult to clean and should be sealed. Vacuum bags or disposable paper filters should not be cleaned, but should be sprayed with a fine water mist and placed into a labeled waste container. Process waste and housekeeping waste should be wetted with water or a mixture of water and surfactant prior to packaging in disposable containers. Material containing **asbestos** that is removed from buildings must be disposed of in leak-tight 6-mil thick plastic bags, plastic-lined cardboard containers, or plastic-lined metal containers. These wastes, which are removed while wet, should be sealed in containers before they dry out to minimize the release of **asbestos** fibers during handling.
[29 CFR 1910.1001(App G); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 20, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Occupational Exposure Standards:

OSHA Standards:

The employer shall ensure that no employee is exposed to an airborne concentration of **asbestos** in excess of 0.1 fiber/cu cm of air as an 8-hr TWA as determined by the method prescribed in Appendix A to this section, or by an equivalent method.

[29 CFR 1910.1001(c)(1); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

The employer shall ensure that no employee is exposed to an airborne concentration of **asbestos** in excess of 1.0 fiber/cu cm of air as averaged over a sampling period of 30 min as determined by the method prescribed in Appendix A to this section, or by an equivalent method.
[29 CFR 1910.1001(c)(2); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Occupational safety and health standard for **asbestos**. Defines conditions, or the adoption or use of one or more practices, means, methods, operations, or processes, reasonably necessary or appropriate to produce safe or healthful employment and places of employment.
[29 CFR 1910.1001; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 10, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Threshold Limit Values:

8 hr Time Weighted Avg (TWA): 0.1 fibers/cc. Respirable fibers: length greater than 5 um; aspect ratio greater than or equal to 3:1, as determined by the membrane filter method at 400-450X magnification (4-mm objective), using phase-contrast illumination. /**Asbestos**, all forms/
[American Conference of Governmental Industrial Hygienists TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH, 2008, p. 13] **QC REVIEWED**

Excursion Limit Recommendation: Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than a total of 30 minutes during a work day, and under no circumstances should they exceed 5 times the TLV-TWA, provided that the TLV-TWA is not exceeded. /**Asbestos**, all forms/
[American Conference of Governmental Industrial Hygienists TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH, 2008, p. 5] **QC REVIEWED**

A1; Confirmed human carcinogen. /**Asbestos**, all forms/
[American Conference of Governmental Industrial Hygienists TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH, 2008, p. 13] **QC REVIEWED**

NIOSH Recommendations:

NIOSH considers **asbestos** to be a potential occupational carcinogen and recommends that exposures be reduced to the lowest feasible concentration. For **asbestos** fibers >5 micrometers in length, NIOSH recommends a REL of 100,000 fibers per cubic meter of air (100,000 fibers/m3), which is equal to 0.1 fiber per cubic centimeter of air (0.1 fiber/cm3), as determined by a 400-liter air sample collected over 100 minutes in accordance with NIOSH Analytical Method #7400. Airborne **asbestos** fibers are defined as those particles having (1) an aspect ratio of 3 to 1 or greater and (2) the mineralogic characteristics (that is, the crystal structure and elemental composition) of the **asbestos** minerals and their nonasbestiform analogs. The **asbestos** minerals are defined as chrysotile, crocidolite, amosite

(cummingtonite-grunerite), anthophyllite, tremolite, and actinolite. In addition, airborne cleavage fragments from the nonasbestiform habits of the serpentine minerals antigorite and lizardite, and the amphibole minerals contained in the series cummingtonite-grunerite, tremolite-ferroactinolite, and glaucophane-riebeckite should also be counted as fibers provided they meet the criteria for a fiber when viewed microscopically.
[NIOSH. NIOSH Pocket Guide to Chemical Hazards & Other Databases. U.S. Department of Health & Human Services, Public Health Service, Center for Disease Control & Prevention. DHHS (NIOSH) Publication No. 2001-145 (CD-ROM) August 2001.] **PEER REVIEWED**

Immediately Dangerous to Life or Health:

NIOSH considers **asbestos** to be a potential occupational carcinogen.
[NIOSH. NIOSH Pocket Guide to Chemical Hazards & Other Databases. U.S. Department of Health & Human Services, Public Health Service, Center for Disease Control & Prevention. DHHS (NIOSH) Publication No. 2001-145 (CD-ROM) August 2001.] **PEER REVIEWED**

Other Standards Regulations and Guidelines:

Regulations regarding **asbestos** levels in air in the workplace, ... United Kingdom: 2 fibers/cu m average over 4 hr for chrysotile, amosite, and anthophyllite also 12 fibers/cu m average over 10 min (for above mentioned fibers), crocidolite 0.2 fibers/cu m average over 10 minutes; Federal Republic of Germany: Chrysotile: 0.15 mg/cu m; Italy: 5 fibers/cu m; Denmark: 2 fibers/cu m, (ban **asbestos** for insulation work; special permission required to use crocidolite); USSR: 2 mg/cu m (if **asbestos** content > 10% of total dust; German Democratic Republic: 100 particles/cu m if **asbestos** content > 40%; South Africa: 2 fibers/cu m; Finland: 5 fibers/cu m (to be lowered to 2 fibers/cu m (ban crocidolite and ban spraying); Norway: 5 fibers/cu m (to be lowered to 2 fibers/cu m); Sweden: 2 fibers/cu m (special permission required to use crocidolite). /Data derived from table/
[Zielhuis RL; Public Health Risks of Exposure to Asbestos. Comm Eur Commun Report No. LCC 76-5 1964 149 pp. (1977) as cited in Nat'l Research Council Canada; Asbestos p.56 (1979) NRCC No. 16452] **PEER REVIEWED**

Manufacturing/Use Information:

Uses:

The largest former use of **asbestos** was in **asbestos** cement for products such as pipes, ducts, and flat and corrugated sheets. While **asbestos** containing corrugated sheets are still available, fiberglass or other materials have now been substituted in place of **asbestos** in most of these applications. Fiberglass has now been substituted in place of **asbestos** in most of these applications. **Asbestos** cement sheets were used in a wide variety of construction applications. Other uses of **asbestos** include fire resistant textiles, friction materials (i.e., brake linings), underlayment and roofing papers, and floor tiles. **Asbestos** has been widely used for thermal and electrical insulating purposes.
[Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY.

John Wiley and Sons, 1991-Present., p. V3 (1992) 680] **PEER REVIEWED**

The main characteristic properties of **asbestos** fibers that can be exploited in industrial applications are their thermal, electrical, and sound insulation; nonflammability; matrix reinforcement (cement, plastic, and resins); adsorption capacity (filtration, liquid sterilization); wear and friction properties (friction materials); and chemical inertia (except in acids).
[Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V3 680 (1992)] **PEER REVIEWED**

... **Asbestos**-cement products mostly for the construction industry and sanitation (sheets, pipes).
[Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V3 680 (1992)] **PEER REVIEWED**

Crocidolite can be spun & woven using modified cotton industry machinery; the **asbestos** cloth is used for fireproof clothing & curtains.
[International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983., p. 187] **PEER REVIEWED**

Inert filler medium (lab and commercial)
[The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983., p. 117] **PEER REVIEWED**

Reinforcing material in vinyl and asphalt flooring products /former use/
[SRI] **PEER REVIEWED**

Reinforcing pigment in surface coatings and sealants
[SRI] **PEER REVIEWED**

Reinforcing filler in elastomers for packing and gaskets
[SRI] **PEER REVIEWED**

Fire and rot resisting material in felts (eg, for roofing)
[SRI] **PEER REVIEWED**

Raw material for **asbestos** based paper
[SRI] **PEER REVIEWED**

Component of textiles (eg, for use in fireproof clothing)
[SRI] **PEER REVIEWED**

Thermal and electrical insulation medium
[SRI] **PEER REVIEWED**

Component of industrial talcs
[SRI] **PEER REVIEWED**

~~Filler in industrial~~ greases
[SRI] **PEER REVIEWED**

Component of taping compounds
[SRI] **PEER REVIEWED**

Heat resisting additive to metals (eg, for spacecraft)

[SRI] **PEER REVIEWED**

Selected **asbestos** products and their end uses: Valve, flange, and pump components; clutch/transmission components; industrial friction components; automotive/truck body coatings; electronic motor components; chemical process piping; water supply piping; conduits for electric wire; commercial/industrial dryer felts; theater curtains and fireproof draperies; gas vapor ducts for corrosive compounds; table pads and heat protective mats; molten glass handling equipment; underlayment for sheet flooring; hoods, vents for corrosive chemicals; chemical tanks and vessel manufacturing; portable construction buildings; electrical switchboards and components; laboratory furniture; and cooling tower components. /Data derived from table/
[USDHEW/NCI; Asbestos: An Information Resource p.14 (1978) DHEW Pub No. NIH 79-1681] **PEER REVIEWED**

About 98% of the crocidolite is used in the production of **asbestos** cement pipe, because of its hardness, brittleness, and high tensile strength, which add to the ridigity of the end product, and its superior filtration qualities, which enhance the drainage of water, permitting cement to dry more rapidly. ... A very large proportion of total **asbestos** use is accounted for by shorter length fibers. ... /Crocidolite/
[USDHEW/NCI; Asbestos: An Information Resource p.15 (1978) DHEW Pub No. NIH 79-1681] **PEER REVIEWED**

Former use: Spraying of **asbestos fibre** mixed with cement & other binders started in about 1935 & was 1st used for insulation of railway carriages. Later it was used in greatly increased amounts for fire protection & insulation in naval ships & in storage buildings. After the Second World War its use was ... expanded for encasing structural steel in buildings to prevent rapid bending in the event of fire. ... in the late 1960s when the extent of hazards from this use of **asbestos** became apparent spraying decreased & is now banned in many countries.
[International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983., p. 187] **PEER REVIEWED**

Manufacturers:

There are no US manufacturers of **asbestos**. The last US mine was closed in 2002.
[USGS; Mineral Commodity Summaries Database on Asbestos. 2004. Available from, as of Feb 18, 2004: http://minerals.usgs.gov/minerals/pubs/commodity/asbestos/ **PEER REVIEWED**

Methods of Manufacturing:

The mineral is mined or quarried as its ore.
[International Labour Office. Encyclopaedia of Occupational Health and Safety. 4th edition, Volumes 1-4 1998. Geneva, Switzerland: International Labour Office, 1998., p. 74.52] **PEER REVIEWED**

In dry milling operations, which are currently the most widely used, the ore is first crushed to a nominal size and then dried. Fiber extraction then begins through a series of crushing operations, each followed by a vacuum aspiration of the ore running on a vibrating screen. On the latter, the fibers released from the ore have a tendency to move to the surface and, because of their large hydrodynamic volumes (low density), they can be readily collected into a vacuum system. The fibers recovered from consecutive

vibrating screens are brought to cyclone separators, and the air is filtered to remove the finer suspended fibers.
[Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V3 677 (1992)] **PEER REVIEWED**

... Wet milling operations have been initiated with obvious advantages in dust control and potential advantages in the separation of mineral contaminants from the fiber product.
[Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V3 677 (1992)] **PEER REVIEWED**

General Manufacturing Information:

USEPA/OPP Pesticide Code: 099301
[U.S. Environmental Protection Agency/Office of Pesticide Program's Chemical Ingredients Database on Asbestos (1332-21-4). Available from, as of February 10, 2004: http://ppis.ceris.purdue.edu/htbin/epachem.com **PEER REVIEWED**

The term **asbestos** is a generic designation referring usually to six types of naturally occurring mineral fibers which are or have been commercially exploited. These fibers are extracted from certain varieties of hydrated alkaline silicate minerals comprising two families: serpentines and amphiboles. The serpentine group contains a single fibrous variety: chrysotile; five fibrous forms of amphiboles are known: anthophyllite, amosite, crocidolite, tremolite, and actinolite.
[Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V3 659 (1992)] **PEER REVIEWED**

Blue **asbestos** (crocidolite) was discovered in South Africa about 1803 to 1806, but not until 1893 ... was this variety commercially exploited. /Crocidolite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. 3(78) 267] **PEER REVIEWED**

... Crocidolite and amosite are the only amphiboles with significant industrial uses; ... tremolite, although having no industrial application, may be found as a contaminant in other fibers or in other industrial minerals (eg, talc).
[Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V3 661 (1992)] **PEER REVIEWED**

Tremolite & actinolite are of little commercial value, but may be mixed with true talc (an amorphous magnesium silicate) to make commercial talc. Cosmetic talcs are in general free of fibrous silicates. /Actinolite/
[International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983., p. 185] **PEER REVIEWED**

Crocidolite ... /is/ produced in significant quantities only in South Africa. Main producing areas are at Bosrand, Cornheim, Ouplaas, Owendale, the Kuruman area in the Cape Province, & the Lyndenburg District in the Transvaal. Prodn statistics vary widely with the source of information. In 1976, 178 metric tons were produced in South Africa. /Crocidolite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 280 (1978)] **PEER REVIEWED**

The main prodn of /anthophyllite/ was in the Paakkila area of north East Finland where it has been

mined since 1918. Mining has now ceased. /Anthophyllite/
[International Labour Office. Encyclopaedia of Occupational Health and Safety. 4th edition, Volumes 1-4 1998. Geneva, Switzerland: International Labour Office, 1998., p. 10.50] **PEER REVIEWED**

The major properties of concern are length, granular content, degree of openness or effective surface area, drainage or filtration rate, color, absorption, electrical resistivity, bulk density, & strength giving properties.
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. 3(78) 280] **PEER REVIEWED**

Materials which may serve as **asbestos** substitutes are: 1) polypropylene: reinforcement of cement; 2) glass: reinforcement of cement, friction materials; 3) carbon: friction materials; 4) steel: friction materials; 5) mineral wool: insulation board; 6) vermiculite: fire protection, friction materials; 7) silicon nitride: friction materials; 8) ceramic paper: dental castings; 9) alumina and zirconia: high temperature insulation, filtration. /Data derived from table/
[Nat'l Research Council Canada; Asbestos p.55 (1979) NRCC No. 16452] **PEER REVIEWED**

The US Navy tested shipboard transformers, one with **asbestos** and one without. Among the tests conducted, the transformer containing **asbestos** surpassed all others by 300 deg F in the determination of failure temperature on various overloads. Also, air emission tests demonstrated that little, if any, **asbestos fiber** was emitted during actual operating conditions.
[Bureau of Mines. Minerals Yearbook 1983 V1 p.118] **PEER REVIEWED**

A neoprene spray process was developed for coating **asbestos** fibers to prevent their escape from construction components used in building interiors.
[Bureau of Mines. Minerals Yearbook 1983 V1 p.118] **PEER REVIEWED**

A promising substitute for **asbestos** for cement reinforcement is glass fiber made from slate & limestone.
[Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 95] **PEER REVIEWED**

/SRP 60: Former/ **Asbestos** /was/ commercially mined and milled in... states of California, Arizona, and Vermont.
[USDHEW/NCI; Asbestos: An Information Resource p.5 (1978) DHEW Pub No. NIH 79-1681] **PEER REVIEWED**

The Consumer Product Safety Commission has banned general use garments containing **asbestos**. The use of **asbestos** in special garments such as fire fighting suits is permitted, ...only if they are constructed so that **asbestos** fibers will not become airborne under normal conditions of use.
[USDHEW/NCI; Asbestos: An Information Resource p.7 (1978) DHEW Pub No. NIH 79-1681] **PEER REVIEWED**

In Beshada vs Johns-Manville Products Corp, the Supreme Court of New Jersey held that a state of art defense is unavailable in cases brought under a theory of strict liability for failure to warn. The court indicated that **asbestos** producers may be held liable for their products' harm even if the health hazards of **asbestos** were unknown and not discoverable when the products were /sold/.
[Berman J; Am J Law Med 10 (1): 93-114 (1984)] **PEER REVIEWED** PubMed Abstract

The material from the separating mill was largely unopened bundles of fibers. For many purposes it was necessary to open the fiber by separating the bundles into their constituent fibers, which greatly

increases the bulk of the material.
[International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983., p. 186] **PEER REVIEWED**

... Parenteral drugs may be contaminated during their manufacture if **asbestos** is used as a filtration medium.
[Nicholson WJ et al; Science 177: 171-3 (1972) as cited in Nat'l Research Council Canada; Asbestos p.51 (1979) NRCC No. 16452] **PEER REVIEWED**

Asbestos content of product is not necessarily indication of its relative health risk, for in many products fibers are tightly bound to matrix or encapsulated. Potential health risk arises when **asbestos** fibers are set free, eg, during drilling or sawing of **asbestos** cement sheets. /**Asbestos** products/
[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php p. V14 30 (1978)] **PEER REVIEWED**

... only chrysolite is used in or imported into the United States today, and only in a few products in which the fibers are firmly encapsulated in a matrix.
[Pigg BJ; in Chrysolite in the United States. The Asbestos Institute Newsletter. Number 5, October 2003.] **PEER REVIEWED**

Canadian chrysotile crudes are classified as follows: crude #1: 1.9 cm staple & longer; crude #2: 0.95 cm to 1.9 cm staple; crude run of mine: unsorted crudes. Milled Canadian fibers sold from Quebec are classified by a dry screen technique known as the Quebec Standard **Asbestos** Test. This test method grades fibers roughly by fiber or staple length. Minimum test values are guaranteed for each grade & a numerical classification system has been estabilished for fibers ranging from Group 3, the longest grade, to Group 7, the shortest grade. Chrysotile fibers produced outside Quebec are graded or controlled by screening test methods differing from the Quebec Screen Test; however, these basically identify grade by staple length.
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. 3(78) 280] **PEER REVIEWED**

Formulations/Preparations:

Typical chemical compositions of amphibole **asbestos**: silicon dioxide, 49-53%; magnesium oxide, 0-3%; ferrous oxide, 13-20%; ferric oxide, 17-20%; aluminum oxide, 0 to 0.2%; calcium oxide, 0.3-2.7%; potassium oxide, 0 to 0.4%; sodium oxide, 4 to 8.5%; & water, 2.5-4.5%. /Crocidolite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 277 (1978)] **PEER REVIEWED**

Typical chemical compositions of amphibole **asbestos**: silicon oxide, 56-58%; magnesium oxide, 28-34%; ferrous oxide, 3-12%; aluminum oxide, 0.5-1.5%; & water, 1-6%. /Anthophyllite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 277 (1978)] **PEER REVIEWED**

Typical chemical compositions of amphibole **asbestos**: silicon oxide, 51-52%; magnesium oxide, 15-20%; ferrous oxide, 5-15%; ferric oxide, 0-3%; aluminum oxide, 1.5 to 3%; calcium oxide, 10-12%; potassium oxide, 0 to 0.5%; sodium oxide, 0.5-1.5%; & water, 1.5-2.5%. /Actinolite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 277 (1978)] **PEER REVIEWED**

Impurities:

... During preparation of the fiber by the separation of the bundles, contamination by oils & other substances can readily occur. Virgin **asbestos** may also contain small amounts of oils & waxes. Trace amounts of a number of metals, including nickel, chromium, cobalt & manganese are present in many samples.
[International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983., p. 186] **PEER REVIEWED**

Samples of commercially used **asbestos**, especially chrysotile, are frequently contaminated by small amounts of other fibrous minerals. Among these are tremolite and brucite.
[Davis JM et al; Carcinogenesis 6 (5): 667-74 (1985)] **PEER REVIEWED** PubMed Abstract

Trace metals (beryllium, cadmium, chromium, cobalt, copper, ... manganese, nickel, and thallium) may be present as natural impurities in **asbestos**.
[Nat'l Research Council Canada; Asbestos p.21 (1979) NRCC No. 16452] **PEER REVIEWED**

Consumption Patterns:

(1983) COMPONENT OF FRICTION MATERIALS, 21%; REINFORCING MATERIAL IN FLOORING PRODUCTS, 20%; REINFORCING MATERIAL IN CEMENT FOR PIPES, 15%; FOR SHEETS, 4%; REINFORCING PIGMENT IN SURFACE COATINGS & SEALANTS, 10%; REINFORCING FILLER IN ELASTOMERS FOR PACKING & GASKETS, 6%; FIRE & ROT RESISTING MATERIAL IN FELTS, 3%; RAW MATERIAL FOR **ASBESTOS**-BASED PAPER, 1%; OTHER USES, 20%
[SRI] **PEER REVIEWED**

(1973) Construction materials: 30%; floor tiles: 21%; friction products: 8%; paper: 10% asphalt felts: 5%; packing and gaskets: 3%; insulation: 1.5%; textiles: 1.5%; others: 20%.
[Vagt GO; Asbestos 1973 Canadian Minerals Yearbook p.41-49 (1974) as cited in Nat'l Research Council Canada; Asbestos p.30 (1979) NRCC No. 16452] **PEER REVIEWED**

(1975) 550,900 metric tons
[USEPA; Ambient Water Quality Criteria Doc: Asbestos p.A-1 (1980) EPA 440/5-80-022] **PEER REVIEWED**

Between 1974 and 1975 **asbestos** consumption declined 27% from 856,000 to 629,000 tons.
[USDHEW/NCI; Asbestos: An Information Resource p.9 (1978) DHEW Pub No. NIH 79-1681] **PEER REVIEWED**

Replacement of **asbestos** by other materials believed to be safer has been widespread since the mid 1970s. Man-made mineral fibers & other insulating materials are rapidly replacing **asbestos** for heat insulation. But for other uses ... /such as/ **asbestos** cement, friction materials & some felts & gaskets, substitution is not ... /yet/ practicable.
[International Labour Office. Encyclopedia of Occupational Health and Safety. Vols.

I&II. Geneva, Switzerland: International Labour Office, 1983., p. 190] **PEER REVIEWED**

(1986) Friction products, 22%; **asbestos** cement pipe, 18%; coatings and compounds, 15%; packing and gaskets, 9%; **asbestos** cement sheet, 8%; and other, 28%
[BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1987 p.14] **PEER REVIEWED**

(1985) FRICTION PRODUCTS, 22%; FLOORING PRODUCTS, 21%; **ASBESTOS** CEMENT PIPE, 16%; COATINGS AND COMPOUNDS, 10%; PACKING AND GASKETS, 6%; **ASBESTOS** CEMENT SHEET, 5%; ROOFING PRODUCTS, 3%; PAPER AND TEXTILES, 1%; AND OTHER, 16% /FOR **ASBESTOS**/
[BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1986 p.14] **PEER REVIEWED**

(1988) **Asbestos** was consumed in roofing products, 28%; friction products, 26%; **asbestos** cement pipe, 14%; packing and gaskets, 13%; paper, 6%; and other 13%.
[BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 P.18] **PEER REVIEWED**

(1999) 16,000 metric tons, estimated
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2000) 15,000 metric tons, estimated
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2001) 13,000 metric tons, estimated
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2002) 7,000 metric tons, estimated
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2003) 6,000 metric tons, estimated
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2003) **Asbestos** was consumed in roofing product, 80%; gaskets, 8%; friction products, 4%; and other, 8%.
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

U. S. Production:

(1977) 9.26X10+10 G
[SRI] **PEER REVIEWED**

(1982) 6.36X10+10 G
[SRI] **PEER REVIEWED**

(1985) 5.7X10+4 metric tons
[BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 P.18] **PEER REVIEWED**

(1986) 5.1X10+4 metric tons
[BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 P.18] **PEER REVIEWED**

(1987) 5.1X10+4 metric tons
[BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 P.18] **PEER REVIEWED**

(1999) Production (sales), mine: 7,000 metric tons
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2000) Production (sales), mine: 5,000 metric tons
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2001) Production (sales), mine: 5,000 metric tons
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2002) Production (sales), mine: 3,000 metric tons
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2003) There was no **asbestos** production in the United States.
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

U. S. Imports:

(1977) 5.51X10+11 G
[SRI] **PEER REVIEWED**

(1982) 2.42X10+11 G
[SRI] **PEER REVIEWED**

In 1974, 96.5% of the **asbestos** imported ... was from Canada.
[USDHEW/NCI; Asbestos: An Information Resource p.9 DHEW Pub No. NIH 79-1681 (1978)] **PEER REVIEWED**

(1985) 1.42X10+5 metric tons
[BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 P.18] **PEER REVIEWED**

(1986) 1.08X10+5 metric tons
[BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 P.18] **PEER REVIEWED**

(1987) 9.4X10+4 metric tons
[BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 P.18] **PEER REVIEWED**

(1999) 16,000 metric tons
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2000) 15,000 metric tons
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2001) 13,000 metric tons
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2002) 7,000 metric tons
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2003) 6,000 metric tons, estimated
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

U. S. Exports:

(1977) 3.45X10+10 G
[SRI] **PEER REVIEWED**

(1982) 5.90X10+10 G
[SRI] **PEER REVIEWED**

(1985) 4.6X10+4 metric tons
[BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 p.18] **PEER REVIEWED**

(1986) 4.7X10+4 metric tons
[BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 p.18] **PEER REVIEWED**

(1987) 6.0X10+4 metric tons
[BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1989 P.18] **PEER REVIEWED**

(1999) 22,000 metric tons (probably includes nonasbestos materials and reexports)
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER

REVIEWED**

(2000) 19,000 metric tons (probably includes nonasbestos materials and reexports)
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2001) 22,000 metric tons (probably includes nonasbestos materials and reexports)
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2002) 8,000 metric tons (probably includes nonasbestos materials and reexports)
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

(2003) 4,000 metric tons, estimated (probably includes nonasbestos materials and reexports)
[USGS; Mineral Commodity Summaries 2004 (Asbestos). Available from, as of February 10, 2004: http://minerals.usgs.gov/minerals/pubs/mcs/2004/mcs2004.pdf **PEER REVIEWED**

Laboratory Methods:

Clinical Laboratory Methods:

Method: Transmission Electron Microscopy; Analyte: **asbestos**; Matrix: urine; Sample Detection Limit: 0.1-0.3X10-6 fibers per liter. /From table/
[DHHS/ATSDR; Toxicological Profile for Asbestos p.191 PB/2001/109101 (2001)] **PEER REVIEWED**

Method: Transmission Electron Microscopy; Analyte: **asbestos**; Matrix: feces; Sample Detection Limit: 0.15X10+6 fibers per gram. /From table/
[DHHS/ATSDR; Toxicological Profile for Asbestos p.191 PB/2001/109101 (2001)] **PEER REVIEWED**

Method: Transmission Electron Microscopy; Analyte: **asbestos**; Matrix: lung tissue; Sample Detection Limit: 0.1X10+6 fibers per gram. /From table/
[DHHS/ATSDR; Toxicological Profile for Asbestos p.191 PB/2001/109101 (2001)] **PEER REVIEWED**

Method: Phase Contrast Electron Microscopy; Analyte: **asbestos**; Matrix: lung tissue; Sample Detection Limit: 5,000 fibers per gram. /From table/
[DHHS/ATSDR; Toxicological Profile for Asbestos p.191 PB/2001/109101 (2001)] **PEER REVIEWED**

Analytic Laboratory Methods:

METHODS OF CONFIRMING **ASBESTOS** CAN INCLUDE OPTICAL TESTING USING POLARIZED LIGHT, FIRST ORDER RED OR OTHER RETARDATION PLATES, ANGLES OF EXTINCTION, DISPERSION STAINING. BULK SAMPLES MAY BE ANALYZED BY X-RAY DIFFRACTION OR IR ABSORPTION OF DIFFERENTIAL THERMAL ANALYSIS.
[DIXON W; MICROSCOPE 26 (4TH QUARTER): 183 (1978)] **PEER REVIEWED**

Method: NIOSH 7402, **Asbestos** by TEM (Transmission Electron Microscopy); Analyte: **asbestos** fibers; Matrix: air; Estimated Limit of Detection: 1 confirmed **asbestos fiber** above 95% of expected mean blank value.
[CDC; NIOSH Manual of Analytical Methods, 4th ed. Asbestos. Available from, as of February 10, 2004: http://www.cdc.gov/niosh/docs/2003-154/ **PEER REVIEWED**

Method: NIOSH 7400, Issue 2, **Asbestos** and Other Fibers by PCM (Phase Contrast Microscopy); Analyte: fibers (manual count); Matrix: air; Estimated Limit of Detection: 7 fibers/sq mm filter area.
[CDC; NIOSH Manual of Analytical Methods, 4th ed. Asbestos. Available from, as of February 10, 2004: http://www.cdc.gov/niosh/docs/2003-154/ **PEER REVIEWED**

Method: NIOSH 9002, Issue 2, **Asbestos** (bulk) by PLM (Polarized Light Microscopy); Analyte: **asbestos**; Matrix: bulk samples; Estimated Limit of Detection: less than 1% **asbestos**.
[CDC; NIOSH Manual of Analytical Methods, 4th ed. Asbestos. Available from, as of February 10, 2004: http://www.cdc.gov/niosh/docs/2003-154/ **PEER REVIEWED**

Method: OSHA ID-160, **Asbestos** in Air (phase contrast microscopy at 400X); Analyte: **asbestos**; Matrix: air; Detection Limit: 5.5 fibers/sq mm or 0.001 fibers/cc (2,400 L air volume).
[U.S. Department of Labor/Occupational Safety and Health Administration's Index of Sampling and Analytical Methods. Available from: http://www.osha.gov/dts/slтc/methods/toc.html on Asbestos as of February 10, 2004] **PEER REVIEWED**

Method: OSHA ID-191, Polarized Light Microscopy of **Asbestos**; Analyte: **asbestos**; Matrix: bulk; Detection Limit: less than 1% by area.
[U.S. Department of Labor/Occupational Safety and Health Administration's Index of Sampling and Analytical Methods. Available from: http://www.osha.gov/dts/slтc/methods/toc.html on Asbestos as of February 10, 2004] **PEER REVIEWED**

... The number and size distribution of fibers in a sample can only be determined by direct microscopic examination. This may be performed using either light or electron microscopy.
[DHHS/ATSDR; Toxicological Profile for Asbestos p.187 PB/2001/109101 (2001)] **PEER REVIEWED**

Sampling Procedures:

Matrix Air: Collection procedure: A known volume of air is drawn through a 25-mm diameter cassette containing a mixed-cellulose ester filter. The cassette must be equipped with an electrically conductive 50-mm extension cowl. The sampling time and rate are chosen to give a fiber density of between 100 to 1,300 fibers/sq mm on the filter. Recommended sampling rate: 05 to 5.0 liters/minute (L/min). Recommended air volumes: minimun - 25 L; maximum - 2,400 L.
[29 CFR 1910.1001, Appendix B; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of August 23, 2004: http://www.gpoaccess.gov/ecfr **PEER REVIEWED**

Special References:

Special Reports:

40 CFR 1910.1001. Occupational safety and health standard for **asbestos**. U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from: http://www.gpoaccess.gov/ecfr as of February 10, 2004. Defines conditions, or the adoption or use of one or more practices, means, methods, operations, or processes, reasonably necessary or appropriate to produce safe or healthful employment and places of employment.

MARSH GM; ENVIRON HEALTH PERSPECT 53: 49-56 (1983). REVIEW: THIRTEEN EPIDEMIOLOGIC STUDIES OF INGESTED **ASBESTOS** CONDUCTED IN 5 AREAS OF THE USA & CANADA WERE REVIEWED & EVALUATED FOR THE DEFINITIVENESS & APPLICABILITY REGARDING THE DEVELOPMENT OF AMBIENT WATER QUALITY STANDARDS.

USDHEW/NIOSH; Revised Recommended **Asbestos** Standard (1976) DHEW (NIOSH) Pub No. 77-169

USDHEW/NIOSH; Occupational Exposure to Talc Containing **Asbestos** (1980) DHEW (NIOSH) Pub No. 80-115

USEPA; Ambient Water Quality Criteria Doc: **Asbestos** (1980) EPA 440/5-80-022

Nat'l Research Council Canada; Effect of Chromium, Alkali Halides, Arsenic, **Asbestos**, Mercury in the Canadian Environment (1980) NRCC No. 17585

Nat'l Research Council Canada; **Asbestos** (1979) NRCC No. 16452

USEPA/ECAO; **Asbestos** Health Update (1984) EPA 600/8-84-003A

Becklake MR; Amer Rev Resp Dis 126 (2): 187-94 (1982). **Asbestos**-related diseases of the lungs and pleura /are reviewed along with/ current clinical issues.

Canadian Center for Occupational Health and Safety; A Review of Four Major Reports on the Health Hazards of **Asbestos** 93 pp. (1981)

Bishop K et al; Bull Environ Contam Toxicol 34 (3): 301-8 (1985). Identification of **asbestos** and glass fibers in municipal sewage sludges.

WHO; Environ Health Criteria: **Asbestos** and Other Natural Mineral Fibers (1986)

USEPA; Health and Environmental Effects Profile for **Asbestos** (1979)

U.S. Dept Health & Human Services/Agency for Toxic Substances Disease Registry; Toxicological Profile for **Asbestos** (Update) (1995) NTIS # PB/95-264305

DHHS/NTP; Toxicology & Carcinogenesis Studies of Crocidolite **Asbestos** in F344/N Rats (Feed

Studies) Technical Report Series No. 280 (1988) NIH Publication No. 89-2536

National Toxicology Program. Eleventh Report on Carcinogens (2005). The Report on Carcinogens is an informational scientific and public health document that identifies and discusses substances (including agents, mixtures, or exposure circumstances) that may pose a carcinogenic hazard to human health. **Asbestos** (1332-21-4) is listed as known to be a human carcinogen.
[Available from, as of July 31, 2009:
http://ntp.niehs.nih.gov/ntp/roc/eleventh/profiles/s016asbe.pdf

DHHS/ATSDR; Toxicological Profile for **Asbestos** PB/2001/109101 (2001)

Synonyms and Identifiers:

Related HSDB Records:

2957 [AMOSITE] (mineral class)

2966 [CHRYSOTILE **ASBESTOS**] (mineral class)

4212 [TREMOLITE **ASBESTOS**] (mineral class)

Synonyms:

ASBESTOSE (GERMAN)
PEER REVIEWED

ASBESTOS FIBER
PEER REVIEWED

ASBESTOS FIBRE
PEER REVIEWED

ASCARITE
PEER REVIEWED

Associated Chemicals:

Anthophyllite;17068-78-9
Actinolite;13768-00-8
Crocidolite;12001-28-4

Formulations/Preparations:

Typical chemical compositions of amphibole **asbestos**: silicon dioxide, 49-53%; magnesium oxide, 0-3%; ferrous oxide, 13-20%; ferric oxide, 17-20%; aluminum oxide, 0 to 0.2%; calcium oxide, 0.3-2.7%; potassium oxide, 0 to 0.4%; sodium oxide, 4 to 8.5%; & water, 2.5-4.5%. /Crocidolite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 277 (1978)] **PEER REVIEWED**

Typical chemical compositions of amphibole **asbestos**: silicon oxide, 56-58%; magnesium oxide, 28-34%; ferrous oxide, 3-12%; aluminum oxide, 0.5-1.5%; & water, 1-6%. /Anthophyllite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 277 (1978)] **PEER REVIEWED**

Typical chemical compositions of amphibole **asbestos**: silicon oxide, 51-52%; magnesium oxide, 15-20%; ferrous oxide, 5-15%; ferric oxide, 0-3%; aluminum oxide, 1.5 to 3%; calcium oxide, 10-12%; potassium oxide, 0 to 0.5%; sodium oxide, 0.5-1.5%; & water, 1.5-2.5%. /Actinolite/
[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V3 277 (1978)] **PEER REVIEWED**

Shipping Name/ Number DOT/UN/NA/IMO:

UN 2590; White **asbestos** (chrysotile, actinolite, anthophyllite, tremolite)

UN 2212; Blue **asbestos** (crocidolite); Brown **asbestos** (amosite, mysorite)

IMO 9.0; Blue **asbestos** (crocidolite); Brown **asbestos** (amosite, mysorite); White **asbestos** (chrysotile, actinolite, anthophyllite, tremolite)

NA 2212; **Asbestos**

Administrative Information:

Hazardous Substances Databank Number:

511

Last Revision Date:

20050624

Last Review Date:

Reviewed by SRP on 5/13/2004

Update History:

Field Update on 2010-04-27, 1 fields added/edited/deleted
Field Update on 2009-08-12, 2 fields added/edited/deleted

Field Update on 2008-10-01, 1 fields added/edited/deleted
Field Update on 2008-09-02, 2 fields added/edited/deleted
Field Update on 2008-08-25, 1 fields added/edited/deleted
Field Update on 2008-08-15, 25 fields added/edited/deleted
Field Update on 2007-06-07, 1 fields added/edited/deleted
Field Update on 2006-04-18, 2 fields added/edited/deleted
Field Update on 2006-04-17, 2 fields added/edited/deleted
Complete Update on 2005-06-24, 2 fields added/edited/deleted
Field Update on 2005-01-29, 2 fields added/edited/deleted
Complete Update on 2004-09-10, 58 fields added/edited/deleted
Complete Update on 2003-08-29, 1 fields added/edited/deleted
Complete Update on 02/14/2003, 1 field added/edited/deleted.
Complete Update on 10/16/2002, 1 field added/edited/deleted.
Complete Update on 07/22/2002, 2 fields added/edited/deleted.
Complete Update on 05/31/2002, 1 field added/edited/deleted.
Complete Update on 05/13/2002, 1 field added/edited/deleted.
Complete Update on 03/22/2000, 1 field added/edited/deleted.
Complete Update on 02/11/2000, 1 field added/edited/deleted.
Complete Update on 08/26/1999, 1 field added/edited/deleted.
Complete Update on 07/20/1999, 7 fields added/edited/deleted.
Complete Update on 03/29/1999, 1 field added/edited/deleted.
Complete Update on 02/11/1999, 1 field added/edited/deleted.
Complete Update on 11/12/1998, 2 fields added/edited/deleted.
Complete Update on 09/11/1998, 1 field added/edited/deleted.
Complete Update on 11/26/1997, 3 fields added/edited/deleted.
Complete Update on 10/17/1997, 1 field added/edited/deleted.
Complete Update on 08/11/1997, 1 field added/edited/deleted.
Complete Update on 04/01/1997, 2 fields added/edited/deleted.
Complete Update on 02/28/1997, 1 field added/edited/deleted.
Complete Update on 02/26/1997, 1 field added/edited/deleted.
Complete Update on 04/12/1996, 2 fields added/edited/deleted.
Complete Update on 04/09/1996, 1 field added/edited/deleted.
Complete Update on 03/29/1996, 1 field added/edited/deleted.
Complete Update on 03/01/1996, 6 fields added/edited/deleted.
Complete Update on 01/19/1996, 1 field added/edited/deleted.
Complete Update on 02/16/1995, 1 field added/edited/deleted.
Complete Update on 01/18/1995, 1 field added/edited/deleted.
Complete Update on 12/21/1994, 1 field added/edited/deleted.
Complete Update on 11/03/1994, 1 field added/edited/deleted.
Complete Update on 09/23/1994, 1 field added/edited/deleted.
Complete Update on 06/30/1994, 1 field added/edited/deleted.
Complete Update on 05/05/1994, 1 field added/edited/deleted.
Complete Update on 03/25/1994, 1 field added/edited/deleted.
Complete Update on 09/08/1993, 1 field added/edited/deleted.
Complete Update on 08/17/1993, 1 field added/edited/deleted.
Complete Update on 08/07/1993, 1 field added/edited/deleted.
Complete Update on 08/04/1993, 1 field added/edited/deleted.
Field update on 12/13/1992, 1 field added/edited/deleted.
Complete Update on 12/03/1992, 1 field added/edited/deleted.
Complete Update on 11/26/1992, 1 field added/edited/deleted.
Complete Update on 11/09/1992, 1 field added/edited/deleted.

Complete Update on 10/27/1992, 1 field added/edited/deleted.
Complete Update on 04/27/1992, 1 field added/edited/deleted.
Complete Update on 04/01/1992, 1 field added/edited/deleted.
Complete Update on 01/30/1992, 1 field added/edited/deleted.
Complete Update on 07/09/1991, 1 field added/edited/deleted.
Complete Update on 08/30/1990, 78 fields added/edited/deleted.
Field Update on 01/15/1990, 1 field added/edited/deleted.
Field Update on 05/05/1989, 1 field added/edited/deleted.
Field Update on 03/01/1989, 1 field added/edited/deleted.
Field Update on 10/31/1988, 1 field added/edited/deleted.
Complete Update on 02/26/1988, 67 fields added/edited/deleted.
Complete Update on 05/02/1985
Created 19830401 by DS

RICHARD D. PONAK
Environmental Scientist
U.S. EPA Region III
Land and Chemicals Division
Pesticides/Asbestos Branch
1650 Arch Street
Philadelphia, PA 19103-2029
work-215-814-2044

EDUCATION/TRAINING

B.S. Environmental Studies, May 1987, East Stroudsburg University,
East Stroudsburg, PA

1988: Asbestos Abatement Worker/Supervisor - Asbestos Training Academy
Asbestos Inspectors Course - Kaselan and D'Angelo Training Division
1989: AHERA Inspector Refresher - Robert Wood Johnson Medical School
Sampling and Evaluating Asbestos Dust - University of Utah
Bulk Analysis For Asbestos - University of Utah
1990: Philadelphia Asbestos Project Inspector - City of Philadelphia
1991: Asbestos Building Inspector Refresher - Drexel University
EPA Fundamental Inspector Training - EPA Region III
Industrial Hygiene - Temple University Graduate School
Occupational Health and Safety Training - EPA Region III
EPA Contract Administration Course - EPA Region III
1992: Hazardous Waste Management - Temple University Graduate School
Enforcement Negotiation Skills Training - EPA Region III
Building Inspector Recertification Course - Temple University
EPA Project Officer Certification Course - EPA Region III
1993: National Asbestos Registry System Training - EPA Region III
Analytical Instrumentation - Temple University Graduate School
Building Inspector Recertification Course - Temple University
Asbestos NESHAP Demolition and Renovation Inspection Procedures –
R.W.J. Medical School
1994: Asbestos Building Inspector Refresher - Temple University
1995: Asbestos Building Inspector Refresher - Temple University
1996: Asbestos Building Inspector Refresher - Temple University
Technical Personnel Training - Federal Law Enforcement Training Center
1998: Asbestos Building Inspector Refresher - Criterion Labs
1999: EPA Administrative Hearing and Trials - EPA Region III
EPA Litigating Civil Penalties - EPA Region III
Asbestos Building Inspector Refresher - Criterion Labs
2000: Asbestos Building Inspector Refresher - Criterion Labs
EPA Respirator Fit Test Training Program - EPA Region III
2001: Asbestos Building Inspector Refresher - Criterion Labs
Evidence Legal Aspects and Practical Concerns - EPA-CID Region III
2002-2014: Health And Safety Eight Hour Training - EPA Region III
Asbestos Building Inspector Refresher - Criterion Labs

EXPERIENCE

(5/6/91 to present)
Environmental Scientist, United States Environmental Protection Agency, Philadelphia, PA

Conducts Clean Air Act and Toxic Substance Control Act Inspections:

I am responsible for identifying sources and/or facilities in violation of Clean Air Act, TSCA, FIFRA, and other applicable statutory source and facility compliance regulatory requirements, standards and practices. I have conducted over 1000 inspections and investigations while at the EPA. These inspections have involved collecting samples, documents and photographing other evidence at the facility. Many of the inspections have led to EPA enforcement actions being issued.

Assists EPA Criminal Investigation Division:

Since 1991 I have assisted the Philadelphia, Washington Area, Wheeling, and New York CID Offices during search Warrants and field investigations. During the investigations I have acted as a field health and safety technician by assessing hazardous conditions and recommending the proper personal protective equipment to the agents. I have conducted sampling for CID during many search warrants and investigations. The methodology, labeling and photographing all samples, and maintaining the chain of custody from the field throughout the entire case. I have also reviewed many technical documents for CID, including laboratory analysis reports, site surveys, waste manifests, and field data logs. Some of the criminal cases I have provided technical assistance for include, Phillip Banks, Howard Parsons, Christopher Arader, Thomas Chau, David Farley, Kenneth McDonald, and DeVold Partnership.

Serves as an expert and fact witness in civil and criminal trials:

I provide program support to CID by explaining the asbestos regulatory program, obtaining and explaining headquarters interpretations of the regulations and by testifying as a fact and expert witness at Grand Juries, Trials, and sentencings. I have testified in numerous criminal proceedings, program hearings, depositions, and state courts. I have also been involved in several criminal cases that have reached successful plea agreements.

Case development in accordance with agency's enforcement policies:

Serves as a senior staff specialist with responsibility for imitating enforcement/compliance actions, in the absence of appropriate and timely state and local enforcement and compliance actions, particularly in cases where a high degree of technical knowledge is necessary. Prepares Notice of Violation and develop technical support documents to support federal negotiations. Use EPA developed penalty computerized models, to determine noncompliance penalties based on amounts of money saved by noncompliance with applicable regulations and standards.

Conducts seminars and workshops, provides technical assistance and outreach programs for EPA, state, national offices, local agencies, schools, and the general public:

Responds to inquires from state and local officials, environmental groups, the regulated community or the public concerning the interpretation and application of policy directives and regulations pertinent to the agency's national enforcement/compliance programs and requirements.

Responsible for training new inspectors, senior Environmental Employees, interns, and state inspectors.

Provides oversight and technical direction for contractor performance to ensure receipt of products and services purchased, serving as a project officer and work assignment manager. Responsible for laboratory service contracts for the branch also responsible for purchasing all personal protective equipment and supplies for the branch.

Serves as the Region III asbestos/pesticide enforcement coordinator. Responsible for targeting and assigning all Region III asbestos/pesticide inspections and investigations. Reviews all enforcement documents issued by Pesticide and Asbestos Branch. Coordinates enforcement with other regions, states, and other EPA programs.

(5/88 to 4/91)
Environmental Scientist, JACA Corporation, Fort Washington, PA

While at JACA Corporation I conducted environmental Audits, NESHAP Inspections-EPA Region II and Asbestos Hazard Emergency Act Inspections. I also was involved with water sampling, lakes, streams, rivers, quarries and monitoring wells. I was trained in and utilized NIOSH 582, Phase Contrast Microscopy, and Polarized Light Microscopy. I developed and utilized laboratory quality control criteria. I developed and reviewed environmental bid proposals for school districts.

I was on the AHERA Quality Assurance Team of the Philadelphia School District.

(8/87 to 5/88)
Environmental Technician, Applied Environmental Technology, Pennsauken, NJ

OSHA-EPA Quality Assurance Air Monitoring
Environmental Audits/Building Inspections

(5/87 to 8/87)
Environmental Technician, North East Environmental, Inc., Allentown, PA

OSHA-EPA Quality Assurance Air Monitoring

(5/86 to 8/86)
Environmental Technician, Allentown Testing Laboratories, Inc., Bethlehem, PA

Hazardous Waste Site Safety Technician
Asbestos Monitoring and Sampling
Analytical Laboratory Analysis

JAMES A. WELTZ, CIH
President

Professional History:

1986 ï
Present — *President and Founder*

Founded this consulting firm in response to growing environmental needs. Direct a 15-person staff of technicians, laboratory and administrative support personnel servicing a diverse base of clients in city, government, industrial, institutional and commercial environments. Recruited as expert witness to evaluate, identify and support finding sin violation of various environmental regulatory agencies. Assured contractor specifications and blueprint compliance; conducted environmental monitoring for EPA and contract compliance, performed visual inspections; evaluated and authorized final clearance tests. Interacted with fire safety, ergonomics safety and electrical safety engineers. Toured plants, gold mines, operating rooms, schools and corporate settings. Successfully expanded client base 300% from 1990 to 1991 through repeat/referral business based on quality of work performance.

Profile:

An industrial hygiene professional offering over twenty years of demonstrated experience servicing Municipal, Industrial, Educational, Cultural and Commercial clients. Specialist in the identification, evaluation and control of occupational health hazards. Recognized for expertise in ñsick building,ò including asbestos, lead and indoor air quality. Full comprehension of OSHA and EPA regulations and threshold limit values.

Areas of Experience:

- Asbestos Abatement
- Industrial Hygiene Surveys
- Occupational Disease Evaluation
- Laboratory Testing
- Labor Relations
- Supervisory Training
- Public Speaking
- OSHA Compliance
- Indoor Air Quality
- Employee Training
- Technician Training
- Corporate Hazardous Waste Management
- Environmental Audits

Education:

WEST CHESTER UNIVERSITY, West Chester, Pennsylvania
Bachelor of Science in *Chemistry,* 1975
Minor in Biology

Certification — By American Board of Industrial Hygiene, Comprehensive Practice, 1983

Client List:

- Philadelphia Museum of Art
- The City of Philadelphia
- Presbyterian Medical Center
- Episcopal Hospital
- Orleans Homebuilders
- Our Lady of Lourdes
- WCAU NBC-TV 10
- Prudential Insurance Company
- US Postal Service
- Philadelphia Stock Exchange
- University City Science Center
- Verizon Communications, Inc.
- GlaxoSmithKline
- Wachovia Bank
- Upper Darby School District
- Academy of Natural Sciences
- Thomas Jefferson University
- St. Josephôs University
- Graduate Health System
- Toll Brothers, Inc.
- Federal Occupational Health
- Rohm & Haas Company
- PECO Energy Company (Exelon)
- Army Corps of Engineers
- Campbell Soup Company
- Cooper Hospital
- Philadelphia College of Textiles & Science
- McGraw Hill, Inc.
- Abramson Center
- Cheltenham and Chester School Districts

Selected Highlights include:

- Asbestos surveys and abatement monitoring for PECO Energy Co., Thomas Jefferson Hospital and Medical College, St. Josephôs University and the U.S. Postal Service.
- Coordinated with law firm representing the City of Philadelphia in identifying hazardous environmental exposures for employees; analyzed files and reviewed evidence; participated in deposition. Acted as expert witness in case presentation.
- Completed Indoor Air Quality Surveys for the Philadelphia Museum of Art, Campbell Soup Company and University City Science Center.
- Conducted environmental monitoring for EPA and contract compliance for: RCA, Temple University and Philadelphia Museum of Art.
- Provided technical oversight to asbestos and lead abatement design teams on commercial, educational and institutional engagements. His expertise encompasses all asbestos and lead activities including laboratory analysis and air and bulk sampling per EPA/AHERA methodologies. He is an expert on all PADER, NESHAPS and OSHA regulations pertaining to asbestos and lead.

1978 ï 1986 **Aetna Life & Casualty Company**
Senior Industrial hygienist (1979 ï 86)

- Assisted in implementing Federal Hazard Communication Standard (ñRight to Knowò) procedures at VF Corporation, Can Corporation of America and Textron.
- Established necessary procedures to conduct exposure monitoring for Textron, Baker International and Bangor Punta.
- Conducted exposure monitoring for Shriners Hospital for Children, Boeing and Rorer Group.

Aetna Life & Casualty Company
Engineering Representative (1976 ï 78)

AFFILIATIONS:

American Industrial Hygiene Association (AIHA)
American Society of Safety Engineers (ASSE)
American Society of Testing and Materials (ASTM)
American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

PRESENTATIONS:

American Institute of Architects
Hospital Engineers Association
Philadelphia Building Superintendent Association

Elizabeth A. Quinn

US Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103
215-814-3388

EMPLOYMENT

Toxicologist **7/92 - Present**
US Environmental Protection Agency, Region III Philadelphia, PA

Provide expert technical support in the investigation and evaluation of human health and environmental risks posed by hazardous waste sites under the authority of the Resource Conservation and Recovery Act (RCRA).

Senior Toxicologist **1/83 - 7/92**
Halliburton NUS Environmental Corporation Wayne, PA

Prepared and reviewed risk assessments of hazardous waste sites. Trained and provided peer review and oversight for staff toxicologists. Planned site sampling strategy. Developed and presented training materials in toxicology and health and safety.

Teacher **9/74-8/81**
Lower Merion School District Ardmore, PA

Planned and taught lectures and laboratories for academic and advanced chemistry, biology, and general science classes.

Adjunct Assistant Professor **9/90-5/91**
Drexel University **9/97-5/98**
Philadelphia, PA

Prepared and presented selected lectures for *Toxicology* and *Human Physiology and Toxicology* courses. .

EDUCATION

MS, Environmental Toxicology
Drexel University

MS, Science Education
University of Pennsylvania

AB, Biology
Immaculata University

CERTIFICATIONS

Diplomate of the American Board of Toxicology, 1990. Recertified in 1995, 2000, 2005, and 2010.

Pennsylvania Department of Education, Secondary School Teaching Certificate in Chemistry Biology, and General Science.

PROFESSIONAL AFFILIATIONS

EPA Region 3 Toxicology Quality Circle

South River Science Team

REPRESENTATIVE PROJECT EXPERIENCE

- Prepared over 300 formally written, peer-reviewed risk assessments of hazardous waste sites.
- Review risk assessments prepared by facilities for hazardous waste and RCRA permit facilities.
- Review work plans, analytical data, corrective measures studies, and scope of work reports to determine compliance with EPA risk assessment requirements.
- Participate in technical negotiations/oversight activities for hazardous waste facilities.
- Qualified as an expert witness. Provides expert testimony and litigation support for corrective action and multimedia enforcement cases.
- Developed safe concentrations of PCBs in indoor air on board a US Navy battleship undergoing conversion to a static museum.
- Evaluated exposure and developed concentrations of non-liquid PCBs on surfaces that are safe for human exposure in a residential setting.
- Participate in regional and national workgroups, providing expert review and comment on toxicologic issues and pending regulations and guidance.
- Developed and presented training courses on risk assessment vapor intrusion, and solid and hazardous waste site investigation. Audiences included state and local regulators, as well as multinational environmental professionals and regulators in overseas locations including Poland, India, Jordan, Qatar, and Morocco.

PUBLICATIONS

Evaluation of Garden Crop Mercury Uptake and Potential Exposure from Consumption of Garden Crops Grown on Floodplain Soils. 2013. Human and Ecological Risk Assessment: An International Journal. Volume 19, Issue 1, pp 215-231.

Rapid Site Characterization at an Underground Storage Tank Site in Poland: Proceedings of The Third International Symposium and Exhibition on Environmental Contamination in Central and Eastern Europe, September 10-13, 1996, with C. Atkinson and J. Hennessy.

Role of mitochondria in the mercury resistance of cryptococcus albidus *var* albidus. 1982. Master's thesis.

Nearhood, Jennifer

From: Kimberly Krupka <KKrupka@grossmcginley.com>
Sent: Wednesday, December 03, 2014 4:14 PM
To: Nearhood, Jennifer
Subject: Whitehall Township - EPA: Madonna Information
Attachments: Madonna Bid Tabulations & Reference Checks.pdf; 896 Third Street Demolition - Contract 13-03.pdf

Hi Jennifer,

Attached are the Bid Specifications, Bid Tabulations and Reference Checks for the demolition projects. As you will see, the next lowest bidder was only $100 higher than the Madonna bid.

Kimberly G. Krupka
Attorney at Law
GROSS MCGINLEY, LLP

Nearhood, Jennifer

From: Kimberly Krupka <KKrupka@grossmcginley.com>
Sent: Thursday, December 04, 2014 8:55 AM
To: Nearhood, Jennifer
Subject: Whitehall Township - EPA: Madonna Information
Attachments: 896 Third Street Demolition Bid Proposals.pdf

Jennifer,

Attached are the actual bids received regarding the subject project.

Kimberly G. Krupka
Attorney at Law
GROSS MCGINLEY, LLP

TOWNSHIP OF WHITEHALL March 22, 2013

MINUTES OF BID OPENING FOR CONTRACT NO. 13-03
DEMOLITION PROJECT #896 THIRD STREET
BID DUE: March 20, 2013 – 3:00 p.m.
BID OPENING: March 21, 2013 – 3:00 p.m.

Present were: Mary Ann Miller, Purchasing Agent
Pat Sweeney, Secretary to the Mayor

All bids were opened by Mrs. Miller with a qualified bid bond submitted with each in the amount of ten percent (10%).

A Tabulation of Bids is attached.

Township Staff will review proposal and a recommendation will be issued.

Respectfully submitted,

Mary Ann Miller

MARY ANN MILLER
Purchasing Agent

MM/mkd

cc: Board of Commissioners
Edward D. Hozza, Mayor
John D. Meyers, Deputy Mayor
Brian Corrigan, Finance Officer
Diane Lindeman, Accounts Payable Clerk
John F. Rackus, Bureau Chief of Public Works
File

BID TABULATION

RE: "DEMOLITION OF #896 THIRD STREET PROPERTY"

BID NO. 13-03

BID OPENING: THURSDAY, MARCH 21, 2013 – 3:00 P.M.

Whitehall Township
3219 MacArthur Road
Whitehall, PA 18052
610-437-5524
610-437-6096 Fax

ASHWOOD ENTERPRISES, LLC
891 Alpine Drive
Danielsville, PA 18038-9529
484-357-0107
610-837-6249 Fax
E-mail:

TOTAL COST TO RAZE #896 THIRD STREET ***$26,723.00***

NAME OF APPROVED DUMP SITE: **East Penn Transfer Station to I.E.S.I., Bethlehem, PA**

BEATTY CONTRACTORS
P.O. Box 414
Nazareth, PA 18064
610-837-9892
610-837-5162 Fax
E-mail: beattydemo@enter.net

TOTAL COST TO RAZE #896 THIRD STREET ***$24,500.00***

NAME OF APPROVED DUMP SITE: **East Penn Sanitation/Chrin Landfill**

DIRT WORK SOLUTIONS
3755 Main Street
Slatington, PA 18080
610-767-9438
610-767-9438 Fax
E-mail: DirtWorksSolutions1@gmail.com

TOTAL COST TO RAZE #896 THIRD STREET ***$29,950.00***

NAME OF APPROVED DUMP SITE: **I.E.S.I Bethlehem, PA**

HOPKO EXCAVATING
327 Dogwood Drive
Alburtis, PA 18911
610-972-1452
610-845-8584 Fax
E-mail:

TOTAL COST TO RAZE #896 THIRD STREET ***$28,495.00***

NAME OF APPROVED DUMP SITE: **Berkys Transfer**

MADONNA ENTERPRISES INC.
610 Third Street
Port Carbon, PA 17965
1-570-573-2787
1-570-622-5621 Fax
E-mail:

TOTAL COST TO RAZE #896 THIRD STREET ***$15,500.00***

NAME OF APPROVED DUMP SITE: **Commonwealth Environmental**

BID TABULATION

RE: "DEMOLITION OF #896 THIRD STREET PROPERTY"

BID NO. 13-03

BID OPENING: THURSDAY, MARCH 21, 2013 – 3:00 P.M.

Whitehall Township
3219 MacArthur Road
Whitehall, PA 18052
610-437-5524
610-437-6096 Fax

NIMARIS CONSTRUCTION LP
6866 Chrisphalt Drive
Bath, PA 18014
610-837-3900
610-837-9067 Fax
E-mail: gilroy13@hotmail.com

TOTAL COST TO RAZE #896 THIRD STREET ***$21,000.00***

NAME OF APPROVED DUMP SITE: **Minerva Ent.**
Waynesburg, OH

PENMAR SYSTEMS INC.
P.O. Box 370, 700 Savage Road
Northampton, PA 18067
610-261-1700
610-261-9215 Fax
E-mail: penmarrandy@yahoo.com

TOTAL COST TO RAZE #896 THIRD STREET ***$18,400.00***

NAME OF APPROVED DUMP SITE: **East Penn Sanitation**

SDL CONSTRUCTION LLC
325 Eisenhower Drive
Orwigsburg, PA 17961
1-570-366-2960
1-888-727-8460 Fax
E-mail: ray@thelickmangroup.com

TOTAL COST TO RAZE #896 THIRD STREET ***$15,600.00***

NAME OF APPROVED DUMP SITE: **I.E.S.I Landfill**

SHEA INDUSTRIES
39 Fig Avenue
Clarks Summit, PA 18411
1-570-585-0550
1-570-961-2266 Fax
E-mail: Sheademo@epix.net

TOTAL COST TO RAZE #896 THIRD STREET ***$17,313.00***

NAME OF APPROVED DUMP SITE: **Keystone Landfill**

NEUBER ENVIRONMENTAL SERVICES
p.o. Box 541
Phoenixville, PA 19460

Fax
E-mail:

TOTAL COST TO RAZE #896 THIRD STREET **$** Not Opened

NAME OF APPROVED DUMP SITE:

LATE BID REPLY

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

PROPOSAL/SIGNATURE PAGE

TO: WHITEHALL TOWNSHIP
3219 MacArthur Road
Whitehall, PA 18052

DATE: 3-20-13
BID NO.: 13-03
BID NAME: 896 Third St demolition

The Undersigned having examined the Specifications, Standard Requirements and all other documents and being familiar with the various conditions under which these services and/or supplies are to be used, agrees to furnish all labor, material, tools, equipment and services to furnish the requirements called for in the bid, for the prices stated on Proposal Page.

The Undersigned hereby certify that this proposal is genuine and not sham, collusive, or fraudulent or made in the interest of or in behalf of any person, firm or corporation not herein names, and that the undersigned has not, directly or indirectly, induced or solicited any Bidder to submit a sham bid or any other person, firm or corporation from bidding and that the undersigned has not, in any manner, sought by collusion to secure for himself any advantage over any other Bidder.

TOTAL COST TO RAZE 896 THIRD STREET $ 17,313.00

Seventeen thousand three hundred thirteen
(Price as expressed in written form)

NAME OF APPROVED DUMP SITE: Keystone Landfill

Company Name: Shea Industries Inc
Address: 39 Fig Ave
Clarks Summit PA 18411
Zip Code
Signature: Suzanne Shea
Print Name: Suzanne Shea
Title: President
Phone: (570) 585-0550 Fax (570) 585-0550

Years in Business 18 as ( ) Individual ( ) Partner or (✓) Corporation

Federal I.D.# 23-2814099 or Social Security # _____

(Seal)

~~**NO BID REPLY FORM**~~

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

NAME: Shea Industries Inc

ADDRESS 39 Fig Ave Clarks Summit PA 18411

TELEPHONE (570) 585-0550 DATED 3-20-13

EXPLANATORY

Before any bids are deemed to be properly submitted to the Township of Whitehall, Pennsylvania, it will be required that each and every question herein contained be answered, giving specific, definite and detailed information. An answer must not be evasive, indefinite or general.

Qualifications of Bidders: After the bid opening, the Township of Whitehall may make such investigation as it deems necessary to determine the ability of the bidders to perform the work, and the bidders shall furnish to the Township all such information and data for this purpose as the Township may request. The Township reserves the right to reject any bid if the evidence submitted by or investigation of, such bidder fails to satisfy the Township that such bidder is properly qualified and responsible to carry out the obligations of the contract and to complete the work contemplated therein.

If the space provided in this form to answer any question is not large enough, the contractor shall add additional sheets or space.

1. How many years has your organization been in business as a contractor under your present name? 18+ yrs

2. Have you ever failed to complete any work awarded to you? If so when, where and why? NO

3. Has any officer or partner of your organization ever failed to complete a municipal contract handled in his own name? If so, when, where and why? NO

   a. Has any officer or partner of your organization been in business under any other corporate organization or partnership which failed to complete a municipal contract: If so, when, where and why? NO

4. Have liens or lawsuits of any kind been filed against any of your contracts? Give full details. NO

5. If a corporation, state:

   a. Date when organized MAY 1995

   b. Under the laws of what state organized PA

6. List Surety Companies and Bonding Companies which have heretofore bonded you (give name and address of company and name and amount of contract and amount of bond for the same) within the last five (5) years.

Travelers Ins Co (CC Young Ins) 570-346-7021 $ 231,000.00

Service Ins Co $ 350,000.00

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

6. (Cont'd.)

Service Ins Co	(CC Young Ins) (570) 346-2021	$ 500,000.00
Travelers Ins Co		$ 125,000.00
Travelers Ins Co		$ 109,000.00
Travelers Ins Co		$ 126,000.00
Service Ins Co		$ 473,000.00

7. List all contracts which you are now performing, or for which you have signed contracts but not started work. (Give names and amounts of contracts and owners).

All contracts have been completed.

8. State all your banking connections and give banking references:

Pennstar Bank	(570) 718-1632	Joe Migliorino
M+T Bank	(570) 341-1094	Patti Gregg
PNC Bank	(570) 586-2711	Sandy

9. The work, if awarded to you will have the personal supervision of whom?

Norm Artabane

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

PROPOSAL/SIGNATURE PAGE

TO: WHITEHALL TOWNSHIP
3219 MacArthur Road
Whitehall, PA 18052

DATE: 3/20/13
BID NO.: 13-03
BID NAME: Demolition Project

The Undersigned having examined the Specifications, Standard Requirements and all other documents and being familiar with the various conditions under which these services and/or supplies are to be used, agrees to furnish all labor, material, tools, equipment and services to furnish the requirements called for in the bid, for the prices stated on Proposal Page.

The Undersigned hereby certify that this proposal is genuine and not sham, collusive, or fraudulent or made in the interest of or in behalf of any person, firm or corporation not herein names, and that the undersigned has not, directly or indirectly, induced or solicited any Bidder to submit a sham bid or any other person, firm or corporation from bidding and that the undersigned has not, in any manner, sought by collusion to secure for himself any advantage over any other Bidder.

TOTAL COST TO RAZE 896 THIRD STREET $ 15,600.00

Fifteen Thousand Six Hundred w/00
(Price as expressed in written form)

NAME OF APPROVED DUMP SITE: IESI Landfill

Company Name SDL Construction LLC

Address Ms. Lisa Lickman - member
325 Eisenhower Dr.
Orwigsburg, PA 17961-1607

Zip Code

Signature

Print Name Lisa Lickman

Title Member

Phone 570-366-2960 Fax 888-727-8460

Years in Business 6 as ✓ LLC Individual ( ) Partner or ( ) Corporation

Federal I.D.# 20-4719249 or Social Security # _____

(Seal)

NO BID REPLY FORM

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

NAME: SDL Construction LLC

ADDRESS 325 Eisenhower Dr.
Orwigsburg, PA 17961-1607

TELEPHONE 570-366-2960 DATED 3/20/13

EXPLANATORY

Before any bids are deemed to be properly submitted to the Township of Whitehall, Pennsylvania, it will be required that each and every question herein contained be answered, giving specific, definite and detailed information. An answer must not be evasive, indefinite or general.

Qualifications of Bidders: After the bid opening, the Township of Whitehall may make such investigation as it deems necessary to determine the ability of the bidders to perform the work, and the bidders shall furnish to the Township all such information and data for this purpose as the Township may request. The Township reserves the right to reject any bid if the evidence submitted by or investigation of, such bidder fails to satisfy the Township that such bidder is properly qualified and responsible to carry out the obligations of the contract and to complete the work contemplated therein.

If the space provided in this form to answer any question is not large enough, the contractor shall add additional sheets or space.

1. How many years has your organization been in business as a contractor under your present name? 6 yrs

2. Have you ever failed to complete any work awarded to you? If so when, where and why? NO

3. Has any officer or partner of your organization ever failed to complete a municipal contract handled in his own name? If so, when, where and why? NO

   a. Has any officer or partner of your organization beeu in business under any other corporate organization or partnership which failed to complete a municipal contract: If so, when, where and why? NO

4. Have liens or lawsuits of any kind been filed against any of your contracts? Give full details. NO

5. If a corporation, state:

   a. Date when organized _____

   b. Under the laws of what state organized _____

6. List Surety Companies and Bonding Companies which have heretofore bonded you (give name and address of company and name and amount of contract and amount of bond for the same) within the last five (5) years.

Acstar Insurance Company $ 400,000
36 South Rd, Farmington, CT $ _____

over →

CX 39

ACSTAR INSURANCE COMPANY
30 SOUTH ROAD • FARMINGTON, CT 06032 • (860) 415-8400

BOND NO. B29161
BID BOND

KNOW ALL MEN BY THESE PRESENTS, that We SDL CONSTRUCTION, LLC, as Principal, and ACSTAR INSURANCE COMPANY, 30 South Road, Farmington, Connecticut 06032, a corporation duly organized under the State of Illinois as Surety, hereinafter called the Surety, are held and firmly bound unto

TOWNSHIP OF WHITEHALL
3219 MACARTHUR ROAD
WHITEHALL, PA 18052-2900

as Obligee, hereinafter called the Obligee, in the penal sum of TEN PERCENT OF BID AMOUNT Dollars (10% OF AMOUNT BID) for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for CONTRACT NO. 13-03 DEMOLITION PROJECT – 896 THIRD STREET

NOW, THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a Contract with the Obligee, or in the event of the failure of the Principal to enter into such Contract and if the Principal shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said bid, then this obligation shall be null and void. This obligation shall expire and be null and void 90 days from the date executed as set forth below. This obligation shall expire and be null and void 90 days from the date of execution as set forth below. No action may be commenced upon this bond later than 90 days from the date of execution, as set forth below, provided that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof, such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

This bond is null and void unless signed by Principal and Surety.

Signed and sealed this 18th day of March, 2013.

ATTEST:

SDL CONSTRUCTION, LLC
Principal (Seal)

By

ATTEST:

Diane L. Plante

ACSTAR INSURANCE COMPANY
Surety (Seal)

By
Name: Henry W. Nozko, Jr.
Title: President

CX 39 Bond No. B29161

ACSTAR INSURANCE COMPANY
30 South Road
Farmington CT 06032
(860)415-8400

POWER OF ATTORNEY
№ 34880

This Power of Attorney must have original corporate seal, and red and blue ACSTAR logo to be valid.

Know all men by these presents: That ACSTAR Insurance Company, a corporation of the State of Illinois, having its principal office in the Town of Farmington, Connecticut, pursuant to the following Resolution, which was adopted by the Board of Directors of the said Company on June 28, 2012.

RESOLVED, That the following Rules shall govern the execution for the Company of bonds, undertakings, recognizances, contracts and other writings in the nature thereof:

(1) That the Chairman, the President, any Vice President and General Counsel, or any Attorney-in-Fact, may execute for and on behalf of the Company any and all bonds, undertakings, recognizances, contracts and other writings in the nature thereof, the same to be attested when necessary by the Corporate Secretary, or any Assistant Corporate Secretary, and the seal of the Company affixed thereto; and that the Chairman or President may appoint and authorize any other Officer (elected or appointed) of the Company, and Attorneys-in-Fact to so execute or attest to the execution of all such writings on behalf of the Company and to affix the seal of the Company thereto.

(2) Any such writing executed in accordance with these Rules shall be as binding upon the Company in any case as though signed by the President and attested to by the Corporate Secretary.

(3) The signature of the Chairman, the President, or a Vice President of the Company may be affixed by facsimile on any power of attorney granted pursuant to this Resolution, and the signature of a facsimile to any certificate of any such power, and any such power or certificate bearing such facsimile signature and seal shall be valid and binding on the Company.

(4) Such other Officers of the Company, and Attorneys-in-Fact shall have authority to certify or verify copies of this Resolution, the By-Laws of the Company, and any affidavit or record of the Company necessary to the discharge of their duties.

does hereby nominate, constitute and appoint

HENRY W. NOZKO, JR., HENRY W. NOZKO III, GARY M. CASE, CARMEN CARLTON, each individually, its true and lawful Attorney-in-Fact, to make, execute, seal and deliver on its behalf, and as its act and deed any and all bonds, under-takings, recognizances, contracts and other writings in the nature thereof in penalties not exceeding TEN MILLION DOLLARS ($10,000,000.00) each, and the execution of such writings in pursuance of these presents, shall be as binding upon said Company, as fully and amply, as if they had been duly executed and acknowledged by the regularly elected officers of the Company at its principal office.

IN WITNESS WHEREOF, Henry W. Nozko, Jr., President, has hereunto subscribed his name and affixed the corporate seal of **ACSTAR Insurance Company** this 11th day of September 2012.

ACSTAR Insurance Company

by _____
Henry W. Nozko Jr., President

STATE OF CONNECTICUT)
) ss. FARMINGTON
COUNTY OF HARTFORD)

On this 11th day of September A.D. 2012, before me, a Notary Public of the State of Connecticut came, Henry W. Nozko, Jr., President of the **ACSTAR Insurance Company**, to me personally known to be the individual and officer who executed the preceding instrument, and he acknowledged that he executed the same, and the seal affixed to the preceding instrument is the corporate seal of said Company; that the said corporate seal and his signatures were duly affixed by the authority and direction of the said corporation, and the Resolution adopted by the Board of Directors of said Company, referred to in the preceding instrument, is now in force.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal at the Town of Farmington the day and year first above written.

DIANE L. PLANTE NOTARY PUBLIC CONNECTICUT

_____
Diane L. Plante - Notary Public
My Commission Expiration Date: November 30, 2013

I, the undersigned, Secretary or Assistant Secretary of **ACSTAR Insurance Company**, do hereby certify that the original POWER OF ATTORNEY of which the foregoing is a full, true and correct copy, is in full force and effect.

In witness whereof, I have hereunto subscribed my name as Secretary or Assistant Secretary, and affixed the corporate seal of the Corporation, this 18th day of March 2013

_____
Henry W. Nozko III/Maurice C. Shea
Secretary/ Assistant Secretary

Not valid for mortgage, note, loan, letter of credit, bank deposit, currency rate, interest rate or residual value guarantees.

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

PROPOSAL/SIGNATURE PAGE

TO: WHITEHALL TOWNSHIP
3219 MacArthur Road
Whitehall, PA 18052

DATE: March 19, 2013
BID NO.: 13-03
BID NAME: 896 Third St -Demolition

The Undersigned having examined the Specifications, Standard Requirements and all other documents and being familiar with the various conditions under which these services and/or supplies are to be used, agrees to furnish all labor, material, tools, equipment and services to furnish the requirements called for in the bid, for the prices stated on Proposal Page.

The Undersigned hereby certify that this proposal is genuine and not sham, collusive, or fraudulent or made in the interest of or in behalf of any person, firm or corporation not herein names, and that the undersigned has not, directly or indirectly, induced or solicited any Bidder to submit a sham bid or any other person, firm or corporation from bidding and that the undersigned has not, in any manner, sought by collusion to secure for himself any advantage over any other Bidder.

TOTAL COST TO RAZE 896 THIRD STREET $ 18400.00

Eighteen Thousand Four Hundred Dollars
(Price as expressed in written form)

NAME OF APPROVED DUMP SITE: East Penn Sanitation

Company Name: Penmar Systems Inc.
Address: 700 Savage Rd, Suite 2
Northampton PA 18067
Zip Code
Signature: Kay L Kraft Pres
Print Name: Kay L Kraft
Title: President
Phone: 610-261-2700 Fax 610-261-9215

Years in Business 16 yrs as ( ) Individual ( ) Partner or (X) Corporation

Federal I.D.# 23-2856232 or Social Security # _____

(Seal)

NO BID REPLY FORM

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

TO: WHITEHALL TOWNSHIP
3219 MacArthur Road
Whitehall, PA 18052
ATTN: Mary Ann Miller, CPPO

DATE: March 19, 2013
BID NO.: 13-03

To assist us in obtaining good competition on our Request for Bids, we ask that each firm has received an invitation, but does not wish to bid, state their reason(s) below and return to this office. This information will not preclude receipt of future invitations unless you request removal from the Bidders' List by so indicating below, or do not return this form or bonafide bid.

~~Unfortunately, we must offer a "No Bid" at this time because:~~

_____ 1. We do not wish to participate in the bid process.

_____ 2. We do not wish to bid under the terms and conditions of the Request for Bid document. Our objections are:

_____

_____

_____ 3. We do not feel we can be competitive.

_____ 4. We cannot submit a Bid because of the marketing or franchising policies of the manufacturing company.

_____ 5. We do not wish to sell to the Township of Whitehall.
Our objections are:

_____

_____

_____ 6. We do not sell the items/services on which Bids are requested.

X 7. Other: We Are Bidding

_____

Penmar Systems Inc.
FIRM NAME

_____
SIGNATURE

X We wish to remain on the Bidders' List.

_____ We wish to be deleted from the Bidders' List.

CONTRACTORS QUALIFICATION STATEMENT

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

NAME: Penmar Systems Inc.

ADDRESS 700 Savage Rd, Ste 2, Northampton PA 18067

TELEPHONE 610-261-2700 DATED March 19, 2013

EXPLANATORY

Before any bids are deemed to be properly submitted to the Township of Whitehall, Pennsylvania, it will be required that each and every question herein contained be answered, giving specific, definite and detailed information. An answer must not be evasive, indefinite or general.

Qualifications of Bidders: After the bid opening, the Township of Whitehall may make such investigation as it deems necessary to determine the ability of the bidders to perform the work, and the bidders shall furnish to the Township all such information and data for this purpose as the Township may request. The Township reserves the right to reject any bid if the evidence submitted by or investigation of, such bidder fails to satisfy the Township that such bidder is properly qualified and responsible to carry out the obligations of the contract and to complete the work contemplated therein.

If the space provided in this form to answer any question is not large enough, the contractor shall add additional sheets or space.

1. How many years has your organization been in business as a contractor under your present name? 16 yrs.

2. Have you ever failed to complete any work awarded to you? If so when, where and why? No

3. Has any officer or partner of your organization ever failed to complete a municipal contract handled in his own name? If so, when, where and why? No

   a. Has any officer or partner of your organization been in business under any other corporate organization or partnership which failed to complete a municipal contract: If so, when, where and why? No

4. Have liens or lawsuits of any kind been filed against any of your contracts? Give full details. No

5. If a corporation, state:

   a. Date when organized August 1, 1996

   b. Under the laws of what state organized Delaware / Cert of Auth for PA

6. List Surety Companies and Bonding Companies which have heretofore bonded you (give name and address of company and name and amount of contract and amount of bond for the same) within the last five (5) years.

   Please See Attached $

   $

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

6. (Cont'd.)

(Attached List) $ _____

_____ $ _____

_____ $ _____

_____ $ _____

_____ $ _____

7. List all contracts which you are now performing, or for which you have signed contracts but not started work. (Give names and amounts of contracts and owners).

Please See Attached

8. State all your banking connections and give banking references:

First Northern Bank - 102 Commerce Dr, Northampton PA
610-261-9464 Denise Krupka, Manager

KNBT - National Penn - 1962 Main St, Northampton PA
610-262-4484 Robin Lutz, Manager

9. The work, if awarded to you will have the personal supervision of whom?

Stephen Skrapits, General Manager

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

PROPOSAL/SIGNATURE PAGE

TO: WHITEHALL TOWNSHIP
3219 MacArthur Road
Whitehall, PA 18052

DATE: 3/20/13
BID NO.: 13-03
BID NAME: DEMO 896 THIRD ST.

The Undersigned having examined the Specifications, Standard Requirements and all other documents and being familiar with the various conditions under which these services and/or supplies are to be used, agrees to furnish all labor, material, tools, equipment and services to furnish the requirements called for in the bid, for the prices stated on Proposal Page.

The Undersigned hereby certify that this proposal is genuine and not sham, collusive, or fraudulent or made in the interest of or in behalf of any person, firm or corporation not herein names, and that the undersigned has not, directly or indirectly, induced or solicited any Bidder to submit a sham bid or any other person, firm or corporation from bidding and that the undersigned has not, in any manner, sought by collusion to secure for himself any advantage over any other Bidder.

TOTAL COST TO RAZE 896 THIRD STREET $ 21,000.00

TWENTY-ONE THOUSAND 00/100
(Price as expressed in written form)

NAME OF APPROVED DUMP SITE: MINERVA ENT, WAYNESBURG, OH

Company Name: NIMARIS CONSTRUCTION L.P.

Address: 68666 CHRISPHALT DRIVE
BATH, PA 18014
Zip Code

Signature:

Print Name: NICHOLAS F. CICCONE

Title: GENERAL PARTNER

Phone: (610)837-3900 Fax (610) 837-9067

Years in Business 12+ as ( ) Individual (X) Partner or ( ) Corporation

Federal I.D.# 03 0377895 or Social Security # _____

(Seal)

NO BID REPLY FORM

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

TO: WHITEHALL TOWNSHIP
3219 MacArthur Road
Whitehall, PA 18052
ATTN: Mary Ann Miller, CPPO

DATE: 3/20/13
BID NO.: 13-03

To assist us in obtaining good competition on our Request for Bids, we ask that each firm has received an invitation, but does not wish to bid, state their reason(s) below and return to this office. This information will not preclude receipt of future invitations unless you request removal from the Bidders' List by so indicating below, or do not return this form or bonafide bid.

Unfortunately, we must offer a "No Bid" at this time because:

_____ 1. We do not wish to participate in the bid process.

_____ 2. We do not wish to bid under the terms and conditions of the Request for Bid document. Our objections are:

_____

_____

_____ 3. We do not feel we can be competitive.

_____ 4. We cannot submit a Bid because of the marketing or franchising policies of the manufacturing company.

_____ 5. We do not wish to sell to the Township of Whitehall.
Our objections are:

_____

_____

_____ 6. We do not sell the items/services on which Bids are requested.

_____ 7. Other: _____

_____

_____
FIRM NAME

N/A
_____
SIGNATURE

_____ We wish to remain on the Bidders' List.

_____ We wish to be deleted from the Bidders' List.

CONTRACTORS QUALIFICATION STATEMENT

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

NAME: NIMARIS CONSTRUCTION L.P.

ADDRESS 6866 CHRISPHALT DR., BATH, PA 18014

TELEPHONE (610) 837-3900; (610) 837-9067 FAX DATED 3/20/13

EXPLANATORY

Before any bids are deemed to be properly submitted to the Township of Whitehall, Pennsylvania, it will be required that each and every question herein contained be answered, giving specific, definite and detailed information. An answer must not be evasive, indefinite or general.

Qualifications of Bidders: After the bid opening, the Township of Whitehall may make such investigation as it deems necessary to determine the ability of the bidders to perform the work, and the bidders shall furnish to the Township all such information and data for this purpose as the Township may request. The Township reserves the right to reject any bid if the evidence submitted by or investigation of, such bidder fails to satisfy the Township that such bidder is properly qualified and responsible to carry out the obligations of the contract and to complete the work contemplated therein.

If the space provided in this form to answer any question is not large enough, the contractor shall add additional sheets or space.

1. How many years has your organization been in business as a contractor under your present name? 12+ YRS

2. Have you ever failed to complete any work awarded to you? If so when, where and why? NO

3. Has any officer or partner of your organization ever failed to complete a municipal contract handled in his own name? If so, when, where and why? NO

   a. Has any officer or partner of your organization been in business under any other corporate organization or partnership which failed to complete a municipal contract: If so, when, where and why? NO

4. Have liens or lawsuits of any kind been filed against any of your contracts? Give full details. NO

5. If a corporation, state:

   a. Date when organized _____

   b. Under the laws of what state organized _____

6. List Surety Companies and Bonding Companies which have heretofore bonded you (give name and address of company and name and amount of contract and amount of bond for the same) within the last five (5) years.

CINCINATTI INSURANCE $ SEE ATTACHED

HAMPSON, MOWRER, KRIETZ $ _____

6. (Cont'd.)

_____ $ _____

_____ $ _____

_____ $ _____

_____ $ _____

_____ $ _____

7. List all contracts which you are now performing, or for which you have signed contracts but not started work. (Give names and amounts of contracts and owners).

SEE ATTACHED

8. State all your banking connections and give banking references:

SEE ATTACHED

9. The work, if awarded to you will have the personal supervision of whom? _____

NICHOLAS F. CICCONE

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

PROPOSAL/SIGNATURE PAGE

TO: WHITEHALL TOWNSHIP
3219 MacArthur Road
Whitehall, PA 18052

DATE: 3-18-13
BID NO.: 13-03
BID NAME: 896 Third St.

The Undersigned having examined the Specifications, Standard Requirements and all other documents and being familiar with the various conditions under which these services and/or supplies are to be used, agrees to furnish all labor, material, tools, equipment and services to furnish the requirements called for in the bid, for the prices stated on Proposal Page.

The Undersigned hereby certify that this proposal is genuine and not sham, collusive, or fraudulent or made in the interest of or in behalf of any person, firm or corporation not herein names, and that the undersigned has not, directly or indirectly, induced or solicited any Bidder to submit a sham bid or any other person, firm or corporation from bidding and that the undersigned has not, in any manner, sought by collusion to secure for himself any advantage over any other Bidder.

TOTAL COST TO RAZE 896 THIRD STREET $ 28,495.00

Twenty eight thousand four hundred ninety five 00/100
(Price as expressed in written form)

NAME OF APPROVED DUMP SITE: Berks Transfer

Company Name: HOPKO Excavating Inc.

Address: 327 Dogwood Dr.

Albertis PA 18011
Zip Code

Signature: Ben Hopko

Print Name: Ben Hopko

Title: Pres.

Phone: 610 972 1452 Fax 610 845-8581

Years in Business 15 as ( ) Individual ( ) Partner or (✓) Corporation

Federal I.D.# 42-1554060 or Social Security # ———

(Seal)

~~**NO BID REPLY FORM**~~

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

NAME: HOPKO Excavating Inc.

ADDRESS 327 Dogwood Dr. ALBURTIS PA 18011

TELEPHONE 610 9721452 DATED 3-18-13

EXPLANATORY

Before any bids are deemed to be properly submitted to the Township of Whitehall, Pennsylvania, it will be required that each and every question herein contained be answered, giving specific, definite and detailed information. An answer must not be evasive, indefinite or general.

Qualifications of Bidders: After the bid opening, the Township of Whitehall may make such investigation as it deems necessary to determine the ability of the bidders to perform the work, and the bidders shall furnish to the Township all such information and data for this purpose as the Township may request. The Township reserves the right to reject any bid if the evidence submitted by or investigation of, such bidder fails to satisfy the Township that such bidder is properly qualified and responsible to carry out the obligations of the contract and to complete the work contemplated therein.

If the space provided in this form to answer any question is not large enough, the contractor shall add additional sheets or space.

1. How many years has your organization been in business as a contractor under your present name? 15

2. Have you ever failed to complete any work awarded to you? If so when, where and why? NO

3. Has any officer or partner of your organization ever failed to complete a municipal contract handled in his own name? If so, when, where and why? NO

   a. Has any officer or partner of your organization been in business under any other corporate organization or partnership which failed to complete a municipal contract: If so, when, where and why? NO

4. Have liens or lawsuits of any kind been filed against any of your contracts? Give full details. NO

5. If a corporation, state:

   a. Date when organized 3-13-2004

   b. Under the laws of what state organized PA

6. List Surety Companies and Bonding Companies which have heretofore bonded you (give name and address of company and name and amount of contract and amount of bond for the same) within the last five (5) years.

   no Bonded Jobs in last 5 years $ _____

   we didn't need them For work $ _____

   we where doing.

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

NAME: HOPKO Excavating Inc.

ADDRESS 327 Dogwood Dr. ALBURTIS PA 18011

TELEPHONE 610 9721452 DATED 3-18-13

EXPLANATORY

Before any bids are deemed to be properly submitted to the Township of Whitehall, Pennsylvania, it will be required that each and every question herein contained be answered, giving specific, definite and detailed information. An answer must not be evasive, indefinite or general.

Qualifications of Bidders: After the bid opening, the Township of Whitehall may make such investigation as it deems necessary to determine the ability of the bidders to perform the work, and the bidders shall furnish to the Township all such information and data for this purpose as the Township may request. The Township reserves the right to reject any bid if the evidence submitted by or investigation of, such bidder fails to satisfy the Township that such bidder is properly qualified and responsible to carry out the obligations of the contract and to complete the work contemplated therein.

If the space provided in this form to answer any question is not large enough, the contractor shall add additional sheets or space.

1. How many years has your organization been in business as a contractor under your present name? 15

2. Have you ever failed to complete any work awarded to you? If so when, where and why? NO

3. Has any officer or partner of your organization ever failed to complete a municipal contract handled in his own name? If so, when, where and why? NO

   a. Has any officer or partner of your organization been in business under any other corporate organization or partnership which failed to complete a municipal contract: If so, when, where and why? NO

4. Have liens or lawsuits of any kind been filed against any of your contracts? Give full details. NO

5. If a corporation, state:

   a. Date when organized 3-13-2004

   b. Under the laws of what state organized PA

6. List Surety Companies and Bonding Companies which have heretofore bonded you (give name and address of company and name and amount of contract and amount of bond for the same) within the last five (5) years.

   NO Bonded Jobs in last 5 years $

   we didn't need them for work $

   we where doing.

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

6. (Cont'd.)

	$
	$
	$
	$
	$

7. List all contracts which you are now performing, or for which you have signed contracts but not started work. (Give names and amounts of contracts and owners).

Tony Stellar	15000
Pete Everett	35000
Henn ott	35000

8. State all your banking connections and give banking references:

Sovereign Bank — Emmaus Branch

9. The work, if awarded to you will have the personal supervision of whom? Ben Hoffo

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

PROPOSAL/SIGNATURE PAGE

TO: WHITEHALL TOWNSHIP
3219 MacArthur Road
Whitehall, PA 18052

DATE: 3-20-13
BID NO.: 13-03
BID NAME: DEMOLITION OF 896 THIRD STREET

The Undersigned having examined the Specifications, Standard Requirements and all other documents and being familiar with the various conditions under which these services and/or supplies are to be used, agrees to furnish all labor, material, tools, equipment and services to furnish the requirements called for in the bid, for the prices stated on Proposal Page.

The Undersigned hereby certify that this proposal is genuine and not sham, collusive, or fraudulent or made in the interest of or in behalf of any person, firm or corporation not herein names, and that the undersigned has not, directly or indirectly, induced or solicited any Bidder to submit a sham bid or any other person, firm or corporation from bidding and that the undersigned has not, in any manner, sought by collusion to secure for himself any advantage over any other Bidder.

TOTAL COST TO RAZE 896 THIRD STREET $ 29,950.00

TWENTY NINE THOUSAND, NINE HUNDRED FIFTY AND ZERO CENTS
(Price as expressed in written form)

NAME OF APPROVED DUMP SITE: IESI PA BETHLEHEM LANDFILL

Company Name: DIRT WORK SOLUTIONS, LLC
Address: 3755 MAIN STREET
SLATINGTON, PA 18080
Zip Code
Signature: Randi C Bult
Print Name: RANDI C. BULT
Title: MANAGER
Phone: (610) 767-9438 Fax (610) 767-9438

Years in Business 8 as ( ) Individual (X) Partner or ( ) Corporation

Federal I.D.# 56-2533049 or Social Security # —

(Seal)

NO BID REPLY FORM

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

TO: WHITEHALL TOWNSHIP
3219 MacArthur Road
Whitehall, PA 18052
ATTN: Mary Ann Miller, CPPO

DATE: 3-20-13
BID NO.: 13-03

To assist us in obtaining good competition on our Request for Bids, we ask that each firm has received an invitation, but does not wish to bid, state their reason(s) below and return to this office. This information will not preclude receipt of future invitations unless you request removal from the Bidders' List by so indicating below, or do not return this form or bonafide bid.

Unfortunately, we must offer a "No Bid" at this time because:

_____ 1. We do not wish to participate in the bid process.

_____ 2. We do not wish to bid under the terms and conditions of the Request for Bid document. Our objections are:

_____

_____

_____ 3. We do not feel we can be competitive.

_____ 4. We cannot submit a Bid because of the marketing or franchising policies of the manufacturing company.

_____ 5. We do not wish to sell to the Township of Whitehall.
Our objections are:

_____

_____

_____ 6. We do not sell the items/services on which Bids are requested.

_____ 7. Other: _____

_____

DIRT WORK SOLUTIONS, LLC
FIRM NAME

SIGNATURE Randy C. Bull

_____X_____ We wish to remain on the Bidders' List.

_____ We wish to be deleted from the Bidders' List.

CONTRACTORS QUALIFICATION STATEMENT

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

NAME: DIRT WORK SOLUTIONS, LLC

ADDRESS 3755 MAIN STREET, SLATINGTON, PA 18080

TELEPHONE (610) 767-9438 DATED 3-2013

EXPLANATORY

Before any bids are deemed to be properly submitted to the Township of Whitehall, Pennsylvania, it will be required that each and every question herein contained be answered, giving specific, definite and detailed information. An answer must not be evasive, indefinite or general.

Qualifications of Bidders: After the bid opening, the Township of Whitehall may make such investigation as it deems necessary to determine the ability of the bidders to perform the work, and the bidders shall furnish to the Township all such information and data for this purpose as the Township may request. The Township reserves the right to reject any bid if the evidence submitted by or investigation of, such bidder fails to satisfy the Township that such bidder is properly qualified and responsible to carry out the obligations of the contract and to complete the work contemplated therein.

If the space provided in this form to answer any question is not large enough, the contractor shall add additional sheets or space.

1. How many years has your organization been in business as a contractor under your present name? 8 YEARS

2. Have you ever failed to complete any work awarded to you? If so when, where and why? NO

3. Has any officer or partner of your organization ever failed to complete a municipal contract handled in his own name? If so, when, where and why? NO

   a. Has any officer or partner of your organization been in business under any other corporate organization or partnership which failed to complete a municipal contract: If so, when, where and why? NO

4. Have liens or lawsuits of any kind been filed against any of your contracts? Give full details. —

   NO

5. If a corporation, state:

   a. Date when organized N/A

   b. Under the laws of what state organized —

6. List Surety Companies and Bonding Companies which have heretofore bonded you (give name and address of company and name and amount of contract and amount of bond for the same) within the last five (5) years.

   Richard B. Ryon (Western Surety / Penn National) $ SEE ATTACHED

   $

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

6. (Cont'd.)

_____ $ _____

_____ $ _____

_____ $ _____

_____ $ _____

_____ $ _____

7. List all contracts which you are now performing, or for which you have signed contracts but not started work. (Give names and amounts of contracts and owners).

Celebration Fireworks - $50,000.00 / Mike Hefner (IN PROGRESS)

8. State all your banking connections and give banking references:

THE NEFFS NATIONAL BANK, 5629 ROUTE 873 / P.O. BOX 10, NEFFS, PA 18065-0010

9. The work, if awarded to you will have the personal supervision of whom? RANDY C. BUCT AND TRAVIS S. BUCT, DIRT WORK SOLUTIONS, LLC

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

PROPOSAL/SIGNATURE PAGE

TO: WHITEHALL TOWNSHIP
3219 MacArthur Road
Whitehall, PA 18052

DATE: 3/20/13
BID NO.: 13-03
BID NAME: Demolition of 896 Third Street

The Undersigned having examined the Specifications, Standard Requirements and all other documents and being familiar with the various conditions under which these services and/or supplies are to be used, agrees to furnish all labor, material, tools, equipment and services to furnish the requirements called for in the bid, for the prices stated on Proposal Page.

The Undersigned hereby certify that this proposal is genuine and not sham, collusive, or fraudulent or made in the interest of or in behalf of any person, firm or corporation not herein names, and that the undersigned has not, directly or indirectly, induced or solicited any Bidder to submit a sham bid or any other person, firm or corporation from bidding and that the undersigned has not, in any manner, sought by collusion to secure for himself any advantage over any other Bidder.

TOTAL COST TO RAZE 896 THIRD STREET $ 24,500.00

Twenty Four Thousand Five Hundred 00/xx
(Price as expressed in written form)

NAME OF APPROVED DUMP SITE: East Penn Sanitation and/or Ghrist Landfill

Company Name: Beatty Contractors & Wreckers, Ltd.
Address: P.O. Box 414
Nazareth, Pa. 18064
Zip Code

Signature: Russell D Beatty
Print Name: Russell D. Beatty
Title: President
Phone: 610-837-9892 Fax 610-837-5162

Years in Business 40 as ( ) Individual ( ) Partner or (X) Corporation

Federal I.D.# 23-2026569 or Social Security # N/A

(Seal)

NO BID REPLY FORM

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

NAME: Beatty Contractors & Wreckers, Ltd.

ADDRESS P.O. Box 414, Nazareth, Pa 18064

TELEPHONE 610-837-9892 DATED 3/20/13

EXPLANATORY

Before any bids are deemed to be properly submitted to the Township of Whitehall, Pennsylvania, it will be required that each and every question herein contained be answered, giving specific, definite and detailed information. An answer must not be evasive, indefinite or general.

Qualifications of Bidders: After the bid opening, the Township of Whitehall may make such investigation as it deems necessary to determine the ability of the bidders to perform the work, and the bidders shall furnish to the Township all such information and data for this purpose as the Township may request. The Township reserves the right to reject any bid if the evidence submitted by or investigation of, such bidder fails to satisfy the Township that such bidder is properly qualified and responsible to carry out the obligations of the contract and to complete the work contemplated therein.

If the space provided in this form to answer any question is not large enough, the contractor shall add additional sheets or space.

1. How many years has your organization been in business as a contractor under your present name? 60+

2. Have you ever failed to complete any work awarded to you? If so when, where and why? No

3. Has any officer or partner of your organization ever failed to complete a municipal contract handled in his own name? If so, when, where and why? No

   a. Has any officer or partner of your organization been in business under any other corporate organization or partnership which failed to complete a municipal contract: If so, when, where and why? No

4. Have liens or lawsuits of any kind been filed against any of your contracts? Give full details. No

5. If a corporation, state:

   a. Date when organized 1973

   b. Under the laws of what state organized Pennsylvania

6. List Surety Companies and Bonding Companies which have heretofore bonded you (give name and address of company and name and amount of contract and amount of bond for the same) within the last five (5) years.

First Sealord Surety Co. — $ 9,950.00 - Upper
789 E. Lancaster Ave — $ Milford Twsp.
Suite 200
Villanova, Pa 19085

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

6. (Cont'd.)

First Sealord Surety Co.	$ 27,500.00 Stockertown Borough
AEGIS Surety Co.	$ 23,400.00
2407 Park Drive, P.O. Box 3153 Harrisburg, Pa 17110	$ County of Northampton

7. List all contracts which you are now performing, or for which you have signed contracts but not started work. (Give names and amounts of contracts and owners).

East Penn Sanitation - T & M
Tom Braun - T & M

8. State all your banking connections and give banking references:

Lafayette Ambassador Bank
Lisa Luciano 610-332-7161

9. The work, if awarded to you will have the personal supervision of whom?

Russell Stewart Beatty

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

PROPOSAL/SIGNATURE PAGE

TO: WHITEHALL TOWNSHIP
3219 MacArthur Road
Whitehall, PA 18052

DATE: MARCH 19, 2013
BID NO.: 13-03
BID NAME: DEMO. PROJECT
896 THIRD STREET

The Undersigned having examined the Specifications, Standard Requirements and all other documents and being familiar with the various conditions under which these services and/or supplies are to be used, agrees to furnish all labor, material, tools, equipment and services to furnish the requirements called for in the bid, for the prices stated on Proposal Page.

The Undersigned hereby certify that this proposal is genuine and not sham, collusive, or fraudulent or made in the interest of or in behalf of any person, firm or corporation not herein names, and that the undersigned has not, directly or indirectly, induced or solicited any Bidder to submit a sham bid or any other person, firm or corporation from bidding and that the undersigned has not, in any manner, sought by collusion to secure for himself any advantage over any other Bidder.

TOTAL COST TO RAZE 896 THIRD STREET $ 26,723.00
TWENTY-SIX THOUSAND SEVEN-HUNDRED TWENTY THREE DOLLARS
EAST PENN TRANSFER STATION TO I.E.S.I.
~~(Price as expressed in written form)~~ BETHLEHEM, PA.

NAME OF APPROVED DUMP SITE: EAST PENN TRANSFER STATION TO I.E.S.I. BETHLEHEM, PA.

Company Name: ASHWOOD ENTERPRISES LLC

Address: 891 ALPINE DRIVE

DANIELSVILLE, PA. 18038
Zip Code

Signature:

Print Name: CRAIG DEUTSCH

Title: OWNER / VICE. PRES.

Phone: 484-357-0107 Fax (610) 837-6249

Years in Business 9 as ( ) Individual ( ) Partner or (X) Corporation

Federal I.D.# 20-4927332 or Social Security # ———

(Seal)

NO BID REPLY FORM

WORKERS COMPENSATION VERIFICATION FORM

A. The Applicant is a Contractor within the meaning of the Pennsylvania Workers Compensation Law:

☑ Yes ☐ No

If the answer is "YES", complete Sections B and C below as appropriate.

B. INSURANCE INFORMATION:

Name of Applicant ASHWOOD ENT. LLC

Federal or State Employer Identification No. 20-4927332

Applicant is a qualified self-insurer for Workers Compensation.

Name of Workers Compensation Insurer ERIE

Workers Compensation Insurance Policy No. Q8701032975 Q91200610

Policy Expiration Date 3-1-14

C. EXEMPTION

Complete Section C if the Applicant is a contractor claiming exemption from providing Workers Compensation insurance.

The undersigned swears or affirms that he/she is not required to provide Workers Compensation Insurance under the provisions of Pennsylvania's Workers Compensation Law for one of the following reasons, as indicated:

☐ Contractor with no employees. Contractor prohibited by law from employing any individual to perform work pursuant to this building permit unless contractor provides proof of insurance to the Township.

☐ Religious exemption under the Workers Compensation Law.

Applicant Name – *Please Print Clearly*

Address

City, State, Zip

County

Municipality

Signature of Applicant

Subscribed and sworn before me this

_____ day of _____ 20____

Signature of Notary Public

My Commission Expires: _____

(SEAL)

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

NAME: ASHWOOD ENTERPRISES, LLC

ADDRESS 891 ALPINE DR. DANIELSVILLE, PA 18038

TELEPHONE 484-357-0107 DATED 3/19/13

EXPLANATORY

Before any bids are deemed to be properly submitted to the Township of Whitehall, Pennsylvania, it will be required that each and every question herein contained be answered, giving specific, definite and detailed information. An answer must not be evasive, indefinite or general.

Qualifications of Bidders: After the bid opening, the Township of Whitehall may make such investigation as it deems necessary to determine the ability of the bidders to perform the work, and the bidders shall furnish to the Township all such information and data for this purpose as the Township may request. The Township reserves the right to reject any bid if the evidence submitted by or investigation of, such bidder fails to satisfy the Township that such bidder is properly qualified and responsible to carry out the obligations of the contract and to complete the work contemplated therein.

If the space provided in this form to answer any question is not large enough, the contractor shall add additional sheets or space.

1. How many years has your organization been in business as a contractor under your present name? 9 years

2. Have you ever failed to complete any work awarded to you? If so when, where and why? NO

3. Has any officer or partner of your organization ever failed to complete a municipal contract handled in his own name? If so, when, where and why? NO

   a. Has any officer or partner of your organization been in business under any other corporate organization or partnership which failed to complete a municipal contract: If so, when, where and why? NO

4. Have liens or lawsuits of any kind been filed against any of your contracts? Give full details. NO

5. If a corporation, state: N/A

   a. Date when organized —

   b. Under the laws of what state organized —

6. List Surety Companies and Bonding Companies which have heretofore bonded you (give name and address of company and name and amount of contract and amount of bond for the same) within the last five (5) years.

Western Surety 333 S. Wabash Ave. Chicago, IL 60604 — $ 70,000 — Walnutport Bor. Bathroom Ren.

Western Surety 333 S. Wabash Ave. Chicago, IL 60604 — $ 150,000 — Walnutport Bor. Recreation Bldg.

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

6. (Cont'd.)

Western Surety Co. 333 S. Wabash Ave. Chicago, IL 60604	WASHINGTON TWP. FOOD BANK $ 100,000
" " " " "	Nazareth Sch. District $ 50,000
WESTERN SURETY CO. "	$ 120,000.00 WASHINGTON TWP. FOOD BANK PHASE II
	$
	$

7. List all contracts which you are now performing, or for which you have signed contracts but not started work. (Give names and amounts of contracts and owners).

None

8. State all your banking connections and give banking references:

PNC Bank, 1660 Valley Center Pkwy. Bethlehem 18015
Merchants Bank, 44 S. Broad St. Nazareth 18064

9. The work, if awarded to you will have the personal supervision of whom? Craig Deutsch

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

PROPOSAL/SIGNATURE PAGE

TO: WHITEHALL TOWNSHIP
3219 MacArthur Road
Whitehall, PA 18052

DATE: _____
BID NO.: _____
BID NAME: _____

The Undersigned having examined the Specifications, Standard Requirements and all other documents and being familiar with the various conditions under which these services and/or supplies are to be used, agrees to furnish all labor, material, tools, equipment and services to furnish the requirements called for in the bid, for the prices stated on Proposal Page.

The Undersigned hereby certify that this proposal is genuine and not sham, collusive, or fraudulent or made in the interest of or in behalf of any person, firm or corporation not herein names, and that the undersigned has not, directly or indirectly, induced or solicited any Bidder to submit a sham bid or any other person, firm or corporation from bidding and that the undersigned has not, in any manner, sought by collusion to secure for himself any advantage over any other Bidder.

TOTAL COST TO RAZE 896 THIRD STREET $ 15,500.00

fifteen thousand five hundred dollars
(Price as expressed in written form)

NAME OF APPROVED DUMP SITE: Commonwealth Environmental

Company Name: Maconna Ent Inc

Address: 610 3rd St

Port Carbon PA 17965
Zip Code

Signature: _____

Print Name: Vincent Maconna

Title: President

Phone: 570 573 2787 Fax 570 622 5621

Years in Business 10 as ( ) Individual ( ) Partner or (X) Corporation

Federal I.D.# 20-2092933 or Social Security # _____

(Seal)

NO BID REPLY FORM

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

TO: WHITEHALL TOWNSHIP
3219 MacArthur Road
Whitehall, PA 18052
ATTN: Mary Ann Miller, CPPO

DATE: _____
BID NO.: _____

To assist us in obtaining good competition on our Request for Bids, we ask that each firm has received an invitation, but does not wish to bid, state their reason(s) below and return to this office. This information will not preclude receipt of future invitations unless you request removal from the Bidders' List by so indicating below, or do not return this form or bonafide bid.

Unfortunately, we must offer a "No Bid" at this time because:

_____ 1. We do not wish to participate in the bid process.

_____ 2. We do not wish to bid under the terms and conditions of the Request for Bid document. Our objections are:

_____

_____

_____ 3. We do not feel we can be competitive.

_____ 4. We cannot submit a Bid because of the marketing or franchising policies of the manufacturing company.

_____ 5. We do not wish to sell to the Township of Whitehall.
Our objections are:

_____

_____

_____ 6. We do not sell the items/services on which Bids are requested.

_____ 7. Other: _____

_____

_____
FIRM NAME

_____
SIGNATURE

__X__ We wish to remain on the Bidders' List.

_____ We wish to be deleted from the Bidders' List.

CONTRACTORS QUALIFICATION STATEMENT

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

NAME: Madonna Ent Inc

ADDRESS 610 3rd St Port Carbon PA 17965

TELEPHONE 570 573 2787 DATED 3/19/13

EXPLANATORY

Before any bids are deemed to be properly submitted to the Township of Whitehall, Pennsylvania, it will be required that each and every question herein contained be answered, giving specific, definite and detailed information. An answer must not be evasive, indefinite or general.

Qualifications of Bidders: After the bid opening, the Township of Whitehall may make such investigation as it deems necessary to determine the ability of the bidders to perform the work, and the bidders shall furnish to the Township all such information and data for this purpose as the Township may request. The Township reserves the right to reject any bid if the evidence submitted by or investigation of, such bidder fails to satisfy the Township that such bidder is properly qualified and responsible to carry out the obligations of the contract and to complete the work contemplated therein.

If the space provided in this form to answer any question is not large enough, the contractor shall add additional sheets or space.

1. How many years has your organization been in business as a contractor under your present name? 10

2. Have you ever failed to complete any work awarded to you? If so when, where and why? No

3. Has any officer or partner of your organization ever failed to complete a municipal contract handled in his own name? If so, when, where and why? No

   a. Has any officer or partner of your organization been in business under any other corporate organization or partnership which failed to complete a municipal contract: If so, when, where and why? No

4. Have liens or lawsuits of any kind been filed against any of your contracts? Give full details. No

5. If a corporation, state:

   a. Date when organized 2001

   b. Under the laws of what state organized Pennsylvania

6. List Surety Companies and Bonding Companies which have heretofore bonded you (give name and address of company and name and amount of contract and amount of bond for the same) within the last five (5) years.

Western Surety $ 140,000

Western Surety $ 79,800

CONTRACT 13 - 03
DEMOLITION OF 896 THIRD STREET PROPERTY

6. (Cont'd.)

Western Surety	$ 29,900
Western Surety	$ 18,600
Western Surety	$ 74,000
Western Surety	$ 15,600
Western Surety	$ 26,000

7. List all contracts which you are now performing, or for which you have signed contracts but not started work. (Give names and amounts of contracts and owners).

Miller Bros Const. - Demo of Catawissa Lumber
Sheriff's County - Demo of Single Structure home
City of Shamokin - Demo - Clean up of Hazardous Site

8. State all your banking connections and give banking references:

First Watsontown Bank - 570 538-2370

9. The work, if awarded to you will have the personal supervision of whom? Vincent Mannino