United States
Environmental Protection Agency

Office of Chemical Safety and
Pollution Prevention

Final Risk Evaluation for

Asbestos

Part 1: Chrysotile Asbestos

Systematic Review Supplemental File:

Data Quality Evaluation of Environmental Releases and Occupational Exposure Data

December 2020

This document is a compilation of tables for the data extraction and evaluation of common sources for environmental releases and occupational exposure of the first 10 chemicals. This document may contain sources that were not used for the risk evaluation of Asbestos. Each table shows the data point or set or information element that was extracted and evaluated from a data source in accordance with Appendix D of the *Application of Systematic Review in TSCA Risk Evaluations*. If the source contains more than one data set or information element, the review provides an overall confidence score for each data set or information element that is found in the source. Therefore, it is possible that a source may have more than one overall quality/ confidence score.

Table of Contents

Explanatory Notes

These explanatory notes provide context to understand the short comments in the data evaluation tables.

Domain	Metric	Description of Comments Field
Reliability	Methodology	Indicates the sampling/analytical methodology, estimation method, or type of publication
Representativeness	Geographic Scope	Indicates the country of the study, publication, or underlying data
	Applicability	Indicates whether the data are for a condition of use within scope of the Risk Evaluation
	Temporal Representativeness	Provides the year of study, publication, or underlying data
	Sample Size	Describes the distribution of the sample or underlying data
Accessibility / Clarity	Metadata Completeness	Describes the completeness of the metadata
Variability and Uncertainty	Metadata Completeness	Indicates if study or publication addresses variability and uncertainty of the data or information

Occupational Exposure

Source Citation:	Mauskopf, J. A.. 1987. Projections of cancer risks attributable to future exposure to asbestos. Risk Analysis.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	338

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Friction products, A/C pipes, coatings and sealants, paper products, V/A floor tile, gaskets and packing, textiles, A/C sheet, plastics
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Exposure expressed in number of fibers people were exposed to per year. For current uses, data ranges from 200 fibers/year (pipe installation) to 1.56B fibers/ year (use of textiles)
Number of Samples:	N/A (fibers/year estimates derived from OSHA data)
Type of Measurement or Method:	N/A (mean level of exposure per year by product category is presented)
Worker Activity:	Activities include installation, use, and repair/disposal for the various product categories.
Number of Workers:	Estimates range from 1265 people who were estimated (in 1983) to be installing "sheet"; to 551,207 people estsimated to be involved in repair/disposal work involving friction products.
Exposure Duration:	Annual/cumulative estimate of number of fibers exposued to per year.

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Low	× 1	3	1983 OSHA Data
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Most applicable condition of use was friction products with no indicator it was for aftermarket auto parts
	Metric 4:	Temporal Representativeness	Low	× 2	6	1983
	Metric 5:	Sample Size	Low	× 1	3	data estimates total number of fibers workers are exposed to per year, based on 1983 OSHA data. No specifics on tasks.

Continued on next page

– continued from previous page

Source Citation:	Mauskopf, J. A.. 1987. Projections of cancer risks attributable to future exposure to asbestos. Risk Analysis.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	338

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	Low	× 1	3	No personal/area sampling data.
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Low	× 1	3	No description of how data is estimated.
Overall Quality Determination†		Low		2.6	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	McKinnery, W. N., Jr.,Moore, R. W.. 1992. Evaluation of airborne asbestos fiber levels during removal and installation of valve gaskets and packing. AIHA Journal.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	28518

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Valve Gaskets and packing
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	PCM: 0.049 to 0.44 f/cc (removal); 0.131 to 0.29 f/cc (installation)TEM: 0.86 to 18.44 structures/cc (removal); 0.40 to 74.32 structures/cc (installation)
Number of Samples:	PCM: 108TEM: 104
Number of Sites:	1 (isolated room for the purpose of experiment)
Type of Measurement or Method:	Short-term during length of task (approx. 30 min. samples)
Worker Activity:	Controlled exposure experiment to determine exposure during valve gasket removal/installation using normal pipefitter techniques.
Number of Workers:	N/A Controlled study
Type of Sampling:	Personal and Area
Sampling Location:	Isolated room for purpose of experiment
Exposure Duration:	Approximately 30 minutes for both removal and installation tasks. Work was repeated several times.
Exposure Frequency:	N/A. experimental conditions
Bulk and Dust Particle Size Distribution:	50-60 percent chyrsotile asbestos gaskets.
Engineering Control & percent Exposure Reduction:	None. Tasks performed under supervision of a pipefitter and representative 1992 work practices implemented, "with little concern for asbestos exposure"
PPE:	Not specified.
Analytic Method:	PCM for f/cc exposure. The data source also presents TEM analysis for structures/cc

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	AIHA, NIOSH, NVLAP accredited lab used for analysis.

Continued on next page

– continued from previous page

Source Citation:	McKinnery, W. N., Jr.,Moore, R. W.. 1992. Evaluation of airborne asbestos fiber levels during removal and installation of valve gaskets and packing. AIHA Journal.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	28518

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Valve fitting on industrial pipes, occupational exposure similar to the primary conditions of use
	Metric 4:	Temporal Representativeness	Low	× 2	6	1992 data; but likely still representative of a potential scenario today.
	Metric 5:	Sample Size	High	× 1	1	Over 100 samples.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Medium	× 1	2	Does not have specific durations by sample. Lists average duration at beginning of article for both removal and installation.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	High	× 1	1	Controlled experiment and large number of samples.
Overall Quality Determination†			Medium		1.8	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Steinsvag, K.,Bratveit, M.,Moen, B. E.. 2007. Exposure to carcinogens for defined job categories in Norway's offshore petroleum industry, 1970 to 2005. Occupational and Environmental Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	524541

EXTRACTION

Parameter	Data
Life Cycle Stage:	Oil field brake blocks
Life Cycle Description (Subcategory of Use):	Brake bands in oil field drilling draw worksGaskets.
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	0.02-0.03 f/cm3; from brake bands.No data on gasket removal exposure.
Number of Samples:	Not specified
Number of Sites:	1
Type of Measurement or Method:	Not specified
Worker Activity:	Ambient asbestos fibers
Number of Workers:	Not specified
Type of Sampling:	Area
Sampling Location:	Drilling floor
Exposure Duration:	Not specified; but since ambient - assume "full shift".
Exposure Frequency:	Not specified
Bulk and Dust Particle Size Distribution:	41 percent asbestos in brake linings
Engineering Control & percent Exposure Reduction:	None. Ambient air.
PPE:	Not specified.
Analytic Method:	"Electron Microscope"

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Low	× 1	3	Not specified methodology.
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD country (Norway)
	Metric 3:	Applicability	High	× 2	2	Applicable to a current use, if brake blocks contain asbestos.
	Metric 4:	Temporal Representativeness	Low	× 2	6	30 year old data (1988).

Continued on next page

– continued from previous page

Source Citation:	Steinsvag, K.,Bratveit, M.,Moen, B. E.. 2007. Exposure to carcinogens for defined job categories in Norway's offshore petroleum industry, 1970 to 2005. Occupational and Environmental Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	524541

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
	Metric 5: Sample Size	Low	× 1	3	Number of measurements not reported and statistical characterization not provided.
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	Low	× 1	3	Only metadata provided is that samples were stationary measurements.
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Low	× 1	3	Variability not discussed.
Overall Quality Determination†		Low		2.4	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Kakooei, H.,Hormozy, M.,Marioryad, H.. 2011. Evaluation of asbestos exposure during brake repair and replacement. Industrial Health.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	1082293

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Brake repair and replacement
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	0.116 to 2.48 f/ml. Range encompasses cars and trucks.
Number of Samples:	60
Number of Sites:	30
Type of Measurement or Method:	TWA's calculated from 45 min short-term samples
Worker Activity:	Brake repair/replacement
Number of Workers:	60
Type of Sampling:	Personal
Sampling Location:	Auto repair shops
Exposure Duration:	Samples were short term; but work continues all day.
Exposure Frequency:	Daily
Bulk and Dust Particle Size Distribution:	> 30 percent of fibers were > 1um in diameter.
Engineering Control & percent Exposure Reduction:	Sources mentions "inadequate LEV"
PPE:	None shown in photo
Analytic Method:	NIOSH 7400, Asbestos International Association

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	NIOSH 7400, Asbestos International Association
Domain 2: Representative						
	Metric 2:	Geographic Scope	Low	× 1	3	Non-OECD country (Iran)
	Metric 3:	Applicability	High	× 2	2	Applicable to maintenance/replacement of brakes (current use)
	Metric 4:	Temporal Representativeness	High	× 2	2	2011
	Metric 5:	Sample Size	Medium	× 1	2	Means with standard deviations and ranges are presented.

Continued on next page

– continued from previous page

Source Citation:	Kakooei, H.,Hormozy, M.,Marioryad, H.. 2011. Evaluation of asbestos exposure during brake repair and replacement. Industrial Health.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	1082293

EVALUATION

Domain	Metric	Rating	MWF⋆	Score	Comments
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	Medium	× 1	2	A few details lacking (e.g. specific activities assocated with each sample)
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	Limited discussion.
Overall Quality Determination†		High		1.6	

⋆ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Bonneterre, V.,Mathern, G.,Pelen, O.,Balthazard, A. L.,Delafosse, P.,Mitton, N.,Colonna, M.. 2012. Cancer incidence in a chlorochemical plant in Is"re, France: an occupational cohort study, 1979-2002. American Journal of Industrial Medicine.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	1788554

EXTRACTION

Parameter	Data
Life Cycle Stage:	Asbestos Diaphragms
Life Cycle Description (Subcategory of Use):	Chlor-alkali Industry
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Epidemiological study, but does not include any measured or estimated asbestos exposure data.

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	AMERICAN JOURNAL OF INDUSTRIAL MEDICINE
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD country (France)
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	Low	× 2	6	Information from ACC indicates that French processes at this time vary greatly from current methods
	Metric 5:	Sample Size	Low	× 1	3	Not specified sample distribution
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Sources, methods, and assumptions discussed
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	Limited discussion.
Overall Quality Determination†			Medium		1.9	

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Madl, A. K.,Gaffney, S. H.,Balzer, J. L.,Paustenbach, D. J.. 2009. Airborne asbestos concentrations associated with heavy equipment brake removal. Annals of Occupational Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2591959

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Heavy equipment /non-passenger vehicles
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	0.024 f/cc (or 0.009 f/cc as 8-hr TWA) for mechanic. Exposure information also available for bystanders.
Number of Samples:	44 personal; 68 area
Number of Sites:	2
Type of Measurement or Method:	Short-term during length of task (consecutive 30-minute samples)
Worker Activity:	Personal sampling during brake removal tasks on heavy-duty construction equipment (10 loader backhoes/2 tractors). Area sampling also conducted in bystander, remote, and ambient air areas.
Number of Workers:	16 (12 brake/bench work employees; 4 clothes handling employees)
Type of Sampling:	Personal and Area
Sampling Location:	Two heavy-duty equipment service centers.
Exposure Duration:	30 - 60 minutes
Exposure Frequency:	3 brake jobs per shift
Bulk and Dust Particle Size Distribution:	Table 3 presents a comprehensive summary of fiber size and morphology of asbestos fibers collected on the workers.
Engineering Control & percent Exposure Reduction:	None. No ventilation. Shop doors closed.
PPE:	Not specified.
Analytic Method:	NIOSH 7400, 7402

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Recognized NIOSH methods; analysis by AIHA-accredited lab
Domain 2: Representative					

Continued on next page

– continued from previous page

Source Citation:	Madl, A. K.,Gaffney, S. H.,Balzer, J. L.,Paustenbach, D. J.. 2009. Airborne asbestos concentrations associated with heavy equipment brake removal. Annals of Occupational Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2591959

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Study focused on brake removal from heavy-duty equipment.
	Metric 4:	Temporal Representativeness	Medium	× 2	4	Data collected between April 2005 and September 2006; but activities are likely similar today.
	Metric 5:	Sample Size	High	× 1	1	Table 1 provides fully characterized statistical distrubution of samples
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Monitoring data is well described.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	High	× 1	1	Exposure and work practice variability between workers and shops is discussed.
Overall Quality Determination†			High		1.4	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Madl, A. K.,Scott, L. L.,Murbach, D. M.,Fehling, K. A.,Finley, B. L.,Paustenbach, D. J.. 2008. Exposure to chrysotile asbestos associated with unpacking and repacking boxes of automobile brake pads and shoes. Annals of Occupational Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2601402

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Brake repair and replacement
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	0.086-0.368 f/cc for unpacking/repacking brake pads; 0.021-0.126 brake shoes.
Number of Samples:	80 personal; 92 area
Number of Sites:	1
Type of Measurement or Method:	Short-term during lenth of task - 15 - 100 minute samples
Worker Activity:	Personal sampling during the unpacking and repacking of vintage auto parts suppliers (used for 1946-1980 vehicles). Area samples in bystander, remote, and ambient air areas.
Number of Workers:	1
Type of Sampling:	Personal and Area
Sampling Location:	Auto repair shop in Santa Rosa, CA
Exposure Duration:	15, 30, and 100 mins (personal); 30 mins (area)
Exposure Frequency:	N/A. Simulated experiment. Lengthy discussion on frequency
Bulk and Dust Particle Size Distribution:	Table 4 presents a comprehensive summary of fiber size and morphology of asbestos fibers collected on the workers.
Engineering Control & percent Exposure Reduction:	None. No ventilation. Shop doors closed.
PPE:	Not specified.
Analytic Method:	NIOSH 7400, 7402

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
Metric 1:	Methodology	High	× 1	1	Recognized NIOSH methods; analysis by AIHA-accredited lab
Domain 2: Representative					
Metric 2:	Geographic Scope	High	× 1	1	United States

Continued on next page

– continued from previous page

Source Citation:	Madl, A. K.,Scott, L. L.,Murbach, D. M.,Fehling, K. A.,Finley, B. L.,Paustenbach, D. J.. 2008. Exposure to chrysotile asbestos associated with unpacking and repacking boxes of automobile brake pads and shoes. Annals of Occupational Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2601402

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 3:	Applicability	Medium	× 2	4	Assigned a 2 since this study is for vintage vehicles; and it only focuses on unpacking/repacking of boxes, not actual brake servicing.
	Metric 4:	Temporal Representativeness	Medium	× 2	4	Data collected during July 2004 (Phase 1) and November 2005 (Phase 2); but activities are likely similar today.
	Metric 5:	Sample Size	High	× 1	1	Table 1 provides fully characterized statistical distrubution of samples
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Monitoring data is well described.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	High	× 1	1	Exposure and work practice variability between workers and shops is addressed. Discussion of how work practices during this experiement based on interviews with career auto mechanics and parts suppliers.
Overall Quality Determination†			High		1.4	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Madl, A. K.,Devlin, K. D.,Perez, A. L.,Hollins, D. M.,Cowan, D. M.,Scott, P. K.,White, K.,Cheng, T. J.,Henshaw, J. L.. 2015. Airborne asbestos exposures associated with gasket and packing replacement: a simulation study of flange and valve repair work and an assessment of exposure variables. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3015760

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Valve Gaskets
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Exposure (as an 8-hr TWA) ranged from 0.010 to 0.062 f/cc.
Number of Samples:	475 samples, during 23 events.
Number of Sites:	1
Type of Measurement or Method:	Short-term (task based) samples and estimated TWA's
Worker Activity:	Personal samples for mechanic and assistant during all tasks associated with the removal and replacement of valve flange gaskets. Area samples in bystander/ distant bystander areas. Also clerance, background, and ambient samples.
Number of Workers:	2 (mechanic and assistant)
Type of Sampling:	Personal and Area
Sampling Location:	Enclosed study chamber in Windsor, CA
Exposure Duration:	14-89 min samples
Exposure Frequency:	Study assumes 1 to 3 gasket/packing replacements per day
Bulk and Dust Particle Size Distribution:	Table 4 presents a comprehensive summary of fiber size and morphology of asbestos fibers collected on the workers.
Engineering Control & percent Exposure Reduction:	Ventilation. Phase I done with passive ventilation (1.4 ACH); Phase II done with active ventilation (13.6-15.6 ACH).
PPE:	Source notes "safety equipment provided"
Analytic Method:	NIOSH 7400, 7402

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Recognized NIOSH methods; analysis by AIHA-accredited lab

Continued on next page

– continued from previous page

Source Citation:	Madl, A. K.,Devlin, K. D.,Perez, A. L.,Hollins, D. M.,Cowan, D. M.,Scott, P. K.,White, K.,Cheng, T. J.,Henshaw, J. L.. 2015. Airborne asbestos exposures associated with gasket and packing replacement: a simulation study of flange and valve repair work and an assessment of exposure variables. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3015760

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Occupational exposure, but not one of the four primary conditions of use
	Metric 4:	Temporal Representativeness	High	× 2	2	Data collected during March 2011 (Phase I) and November 2011 (Phase II).
	Metric 5:	Sample Size	High	× 1	1	Table 1 provides fully characterized statistical distrubution of samples
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Monitoring data is well described.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	Work was performed by an experienced U.S. Navy mechanic. He did the work in the same manner he did througout his career, but no discussion on variability of work practices; and no other workers used. They did vary ventilation between the two Phases.
Overall Quality Determination†			High		1.3	

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Madl, A. K.,Clark, K.,Paustenbach, D. J.. 2007. Exposure to airborne asbestos during removal and installation of gaskets and packings: a review of published and unpublished studies. Journal of Toxicology and Environmental Health, Part B: Critical Reviews.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3079606

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Valve Gaskets
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Seven simulation studies and four work-site industrial hygiene studies of industrial and maritime settings. The average of the long-term exposures during gasket formation was 0.008 f/cc, with data ranging from 0.001 to 0.017 f/cc. The short-term concentrations collected during dry gasket removal and formation ranged from 0.11 to 1.4 f/cc, the onset of the study both of the samples taken during wet gasket removal were below the limit of detection.
Number of Samples:	300+
Number of Sites:	11
Type of Measurement or Method:	Short term and TWA
Worker Activity:	Removal, repair, and cleaning of packing, flanges, and gaskets
Number of Workers:	Varies by study
Type of Sampling:	Personal and area
Sampling Location:	Various workshops /enclosed environments for simulated studies
Exposure Duration:	15 - 480 min
Exposure Frequency:	Various
Bulk and Dust Particle Size Distribution:	Found chrysotile, no amphibole detected in any study
Engineering Control & percent Exposure Reduction:	Not specified
PPE:	Not specified.
Analytic Method:	NIOSH 7400, 7402

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
Metric 1:	Methodology	High	× 1	1	Approved NIOSH methods

Continued on next page

– continued from previous page

Source Citation:	Madl, A. K.,Clark, K.,Paustenbach, D. J.. 2007. Exposure to airborne asbestos during removal and installation of gaskets and packings: a review of published and unpublished studies. Journal of Toxicology and Environmental Health, Part B: Critical Reviews.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3079606

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Occupational exposure, but not one of the four primary conditions of use
	Metric 4:	Temporal Representativeness	Low	× 2	6	Most of the studies looked at in this report are 20 + years old
	Metric 5:	Sample Size	High	× 1	1	Large number of samples compiled from studies, well characterized
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Monitoring data is well described.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	There is variability between exposures and work practices in the diferrent studies, but it is not discussed
Overall Quality Determination†			Medium		1.8	

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Longo, W. E.,Egeland, W. B.,Hatfield, R. L.,Newton, L. R.. 2002. Fiber release during the removal of asbestos-containing gaskets: a work practice simulation. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3080516

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Valve Gaskets
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Worker (non-assistant) Exposure (as an 8-hr TWA) ranged from 1.5 to 3.6 f/cc.
Number of Samples:	Three separate studies: Study 1: 28 worker/assistant, 4 background, 36 area; Study 2: 28 worker/assistant (table v), 4 background, 24 area; Study 3: 15 worker/assistant, 4 background, 16 area.
Number of Sites:	1
Type of Measurement or Method:	Short-term during scraping/hand wire brushing of small and large flange assemblies, and power wire brushing of large flange assembly
Worker Activity:	Gasket removal activities including hand scraping, hand wire brushing, and electric wire brushing.
Number of Workers:	2 (worker and helper)
Type of Sampling:	Personal and Area
Sampling Location:	Exposure Characterization Laboratory (ECL)
Exposure Duration:	15-30 mins (cassettes exchanged)
Exposure Frequency:	N/A. Simulated experiment.
Bulk and Dust Particle Size Distribution:	Size distribution not determined. Results are for fibers > 5 um
Engineering Control & percent Exposure Reduction:	ECL was ventilated to provide 5 ACH
PPE:	Disposable protective suits and supplied air HEPA respirators
Analytic Method:	NIOSH 7400 (air samples). ASTM protocol (bulk samples)

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Approved NIOSH/ASTM methods
Domain 2: Representative					

Continued on next page

– continued from previous page

Source Citation:	Longo, W. E.,Egeland, W. B.,Hatfield, R. L.,Newton, L. R.. 2002. Fiber release during the removal of asbestos-containing gaskets: a work practice simulation. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3080516

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Paper mill powerhouse steam flanges had their gaskets removed. Not in-scope.
	Metric 4:	Temporal Representativeness	Medium	× 2	4	Study is from 2002, but activities are likely similar today.
	Metric 5:	Sample Size	Medium	× 1	2	Only range and averages are presented.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Monitoring data is fairly well described.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	Limited discussion on variability.
Overall Quality Determination†			Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Orlowski, E. wa,Audignon-Durand, S.,Goldberg, M.,Imbernon, E.,Brochard, P.. 2015. EV@LUTIL: An Open Access Database on Occupational Exposures to Asbestos and Man-Made Mineral Fibres. American Journal of Industrial Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3089885

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Auto Brakes, Gaskets, Asbestos Cement
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	This source provides a description of a database (called Evalutil) that has asbestos exposure monitoring data.
Number of Samples:	Table III describes the number of series measurements by task category. Total number of series of measurements in the asbestos database is 1961.
Type of Measurement or Method:	Varies depending on data source in database.
Worker Activity:	Would vary
Number of Workers:	Not specified
Type of Sampling:	Likely personal and area
Sampling Location:	Not specified
Exposure Duration:	Not specified
Exposure Frequency:	Not specified
Bulk and Dust Particle Size Distribution:	Not specified
Engineering Control & percent Exposure Reduction:	Not specified
PPE:	Not specified
Analytic Method:	Not specified

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
Metric 1:	Methodology	Low	× 1	3	Not specified, likely varies.
Domain 2: Representative					
Metric 2:	Geographic Scope	Low	× 1	3	Not specified, likely from U.S., OECD countries, and non-OECD countries.
Metric 3:	Applicability	High	× 2	2	Very possible some data in the database described in this source has occupational scenarios within scope (e.g., gasket work is described as an example)

Continued on next page

– continued from previous page

Source Citation:	Orlowski, E. wa,Audignon-Durand, S.,Goldberg, M.,Imbernon, E.,Brochard, P.. 2015. EV@LUTIL: An Open Access Database on Occupational Exposures to Asbestos and Man-Made Mineral Fibres. American Journal of Industrial Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3089885

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 4:	Temporal Representativeness	Low	× 2	6	Some data in the database is likely older than 20 years.
	Metric 5:	Sample Size	High	× 1	1	Figure 4 is an example output from the database on operations on gaskets containing asbestos. N=121 for that example, and data shown with whisker plot.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Low	× 1	3	Not specified without accessing the database
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	Not specified without accessing the database
Overall Quality Determination†			Low		2.3	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Sahmel, J.,Barlow, C. A.,Simmons, B.,Gaffney, S. H.,Avens, H. J.,Madl, A. K.,Henshaw, J.,Lee, R. J.,Van Orden, D.,Sanchez, M.,Zock, M.,Paustenbach, D. J.. 2014. Evaluation of Take-Home Exposure and Risk Associated with the Handling of Clothing Contaminated with Chrysotile Asbestos. Risk Analysis.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3093967

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Not a current use (Take Home Exposure Associated with Handling of Contaminated Clothes)
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	15-minute means; 0.0140.097 f/cc, 30-minute means; 0.0060.063 f/cc
Number of Samples:	12
Number of Sites:	1
Type of Measurement or Method:	30 minute samples, each with 15 minutes of active handling and 15 minutes of no handling
Worker Activity:	Handling clothes containing asbestos
Number of Workers:	1
Type of Sampling:	Personal and area
Sampling Location:	Enclosed environment
Exposure Duration:	30 minutes
Exposure Frequency:	N/A - Simulated experiment
Bulk and Dust Particle Size Distribution:	Not specified
Engineering Control & percent Exposure Reduction:	N/A - Simulated experiment
PPE:	N/A - Simulated experiment
Analytic Method:	NIOSH 7400, 7402

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
Metric 1:	Methodology	High	× 1	1	Approved NIOSH methods
Domain 2: Representative					
Metric 2:	Geographic Scope	High	× 1	1	United States

Continued on next page

– continued from previous page

Source Citation:	Sahmel, J.,Barlow, C. A.,Simmons, B.,Gaffney, S. H.,Avens, H. J.,Madl, A. K.,Henshaw, J.,Lee, R. J.,Van Orden, D.,Sanchez, M.,Zock, M.,Paustenbach, D. J.. 2014. Evaluation of Take-Home Exposure and Risk Associated with the Handling of Clothing Contaminated with Chrysotile Asbestos. Risk Analysis.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3093967

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 3:	Applicability	Low	× 2	6	Study describes a controlled experiment simulating handling and shake-out of contaminated work clothing. The volume of asbestos in this study isn't realistic for any of our current uses. There"s a photo of someone shaking clothing; and there is visible asbestos in the picture. For our current uses, the only potential to come into contact with such volume of asbestos would be in the chloralkali industry. But folks aren"t really coming into contact with bulk asbestos like this (per the ACC and company responses to questions) .
	Metric 4:	Temporal Representativeness	High	× 2	2	2014
	Metric 5:	Sample Size	Medium	× 1	2	Only 6 sampling events
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Monitoring data is fairly well described.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	Limited discussion on variability.
Overall Quality Determination†			Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Andersson, M.,Selin, F.,Järvholm, B.. 2016. Asbestos exposure and the risk of sinonasal cancer. Occupational Medicine.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3361072

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	No data and not relevant to current uses.
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	N/A - No monitoring data

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Occupational Medicine
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD - Sweden
	Metric 3:	Applicability	Low	× 2	6	This data source does not provide any actual monitoring data. It's a retrospective cohort study of Swedish construction workers, with occupational health exam records stored between 1971 and 1992 used. Additionally, workers born after 1958 were excluded since asbestos use ceased by the time they started working in the mid 1970's.
	Metric 4:	Temporal Representativeness	Low	× 2	6	Pre 1970's-uses very different from current uses. Asbestos is no longer used as it was back then.
	Metric 5:	Sample Size	Low	× 1	3	No sample data provided in article
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	No sample data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	Does not address variability/uncertainty
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.8.

Continued on next page

– continued from previous page

Source Citation:	Andersson, M.,Selin, F.,Järvholm, B.. 2016. Asbestos exposure and the risk of sinonasal cancer. Occupational Medicine.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3361072

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Cely-GarcÃa, M. F.,Curriero, F. C.,Giraldo, M.,MÃ©ndez, L.,Breysse, P. N.,DurÃ¡n, M.,Torres-Duque, C. A.,GonzÃ¡lez-GarcÃa, M.,PÃ©rez, C.,Parada, P.,Ramos-Bonilla, J. P.. 2016. Factors Associated With Non-compliance of Asbestos Occupational Standards in Brake Repair Workers. Annals of Occupational Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3520523

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Auto Brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Out of the one hundred three 8-h TWA PCM-Eq personal asbestos concentrations estimated, 24 percent exceeded the Colombian standard and the US OSHA PEL of 0.1 f/cm3 asbestos occupational limit. Furthermore, 15 percent of the samples were in compliance but above the USA OSHA PEL action level of 0.050 f/cm3.
Number of Samples:	103 (8-hr TWA equivalents). Of those 103, 43 for passenger vehicles, 60 for heavy-duty vehicles. Note, there were more individual samples, this number is for TWA-eq.
Number of Sites:	18
Type of Measurement or Method:	30 minute samples, perhaps consecutive
Worker Activity:	Brake riveting
Number of Workers:	28
Type of Sampling:	PBZ
Sampling Location:	Passenger vehicle and heavy-duty vehicle brake repair shops
Exposure Duration:	Not specified
Exposure Frequency:	Not specified, assumed daily
Bulk and Dust Particle Size Distribution:	Samples ranged between 5-15 percent asbestos
Engineering Control & percent Exposure Reduction:	Not evaluated
PPE:	none described
Analytic Method:	NIOSH 7400 airborne sample counts by PCM with TEM used to determine ratio of asbestos fibers; bulk samples by PLM.

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					

Continued on next page

– continued from previous page

Source Citation:	Cely-GarcÃa, M. F.,Curriero, F. C.,Giraldo, M.,MÃ©ndez, L.,Breysse, P. N.,DurÃ¡n, M.,Torres-Duque, C. A.,GonzÃ¡lez-GarcÃa, M.,PÃ©rez, C.,Parada, P.,Ramos-Bonilla, J. P.. 2016. Factors Associated With Non-compliance of Asbestos Occupational Standards in Brake Repair Workers. Annals of Occupational Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3520523

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 1:	Methodology	High	× 1	1	approved NIOSH methods
Domain 2: Representative						
	Metric 2:	Geographic Scope	Low	× 1	3	Non-OECD country (Colombia)
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	High	× 2	2	2016
	Metric 5:	Sample Size	Low	× 1	3	Well-characterized, 18 brake shopes sampled on 3-6 days, however the actual sample data is not given, only whether or not sample value was above guideline values
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Low	× 1	3	No sample data given
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	Different sites sampled, but limited discussion on variability
Overall Quality Determination†			Medium		1.8	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Liukonen, L. R.,Weir, F. W.. 2005. Asbestos exposure from gaskets during disassembly of a medium duty diesel engine. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531131

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Diesel engine overhaul sheet gasket removal/cleaning
Physical Form:	solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	nondetect - 0.032 f/cm3 (detection limit as high as 0.12 f/cm3, only 2 samples (both personal) exceeded the LOD); bulk samples of gaskets 15 - 65 percent chrysotile
Number of Samples:	14 personal, 15 area, 33 bulk
Number of Sites:	1
Type of Measurement or Method:	Short-term duration of task (12-54 minutes); short term area, bulk
Worker Activity:	removal /cleaning of gaskets, as part of diesel engine disassembly (hand scraping, power buffing, power wire-brushing); area sampled 10 feet downwind from task.
Number of Workers:	1
Type of Sampling:	personal, area, bulk
Sampling Location:	engine repair shop (in Texas)
Exposure Duration:	13 - 54 minutes
Exposure Frequency:	14 asbestos exposed tasks over 3 days in a busy repair shop
Bulk and Dust Particle Size Distribution:	fiber type confirmed by TEM or PLM.
Engineering Control & percent Exposure Reduction:	open shop with fan, August
PPE:	None shown in photo
Analytic Method:	NIOSH 7400 airborne sample counts by PCM with TEM confirmation of fiber type; bulk samples by PLM.

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	approved NIOSH methods with confirmation of fiber type
Domain 2: Representative					

Continued on next page

– continued from previous page

Source Citation:	Liukonen, L. R.,Weir, F. W.. 2005. Asbestos exposure from gaskets during disassembly of a medium duty diesel engine. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531131

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 2:	Geographic Scope	High	× 1	1	United states, applicable to open shop summer time conditions
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2004 data. Note that diesel vehicles tend to remain in service for decades
	Metric 5:	Sample Size	Medium	× 1	2	mostly censored data (below limit of detection, due to short sampling durations)
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Medium	× 1	2	all metadata included. Except for task frequency
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	High	× 1	1	Authors discuss oher data for this sector, state that variability is high in this study due to low fiber counts
Overall Quality Determination†			High		1.4	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Lazar, M.,Carnogurska, M.,Brestovic, T. G.,Jasminska, N.,Kmet'ova, L.,Kapustova, L.,Jezny, T.. 2016. High-Temperature Processing of Asbestos-Cement Roofing Material in a Plasma Reactor. Polish Journal of Environmental Studies.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3585189

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Outside scope - Waste treatment
Physical Form:	Solid
Exposure Concentration (Unit):	N/A - No monitoring data
Number of Sites:	1
Type of Measurement or Method:	chemical analysis of vitrified slag and leachate, e.g. for heavy metals
Worker Activity:	melting of asbestos roofing material in a plasma reactor to produce vitreous slag which can be recycled
Sampling Location:	laboratory scale plasma reactor
Analytic Method:	X-ray fluorescent spectrometryanalysis

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Medium	× 1	2	Pol. J. Environ. Stud.
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	Conducted in Slovakia (Slovak Republic)
	Metric 3:	Applicability	Low	× 2	6	no asbestos exposures reported in this study.
	Metric 4:	Temporal Representativeness	High	× 2	2	2016
	Metric 5:	Sample Size	Low	× 1	3	No sample data provided in article
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	No sample data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	Does not address variability/uncertainty

Continued on next page

– continued from previous page

Source Citation:	Lazar, M.,Carnogurska, M.,Brestovic, T. G.,Jasminska, N.,Kmet'ova, L.,Kapustova, L.,Jezny, T.. 2016. High-Temperature Processing of Asbestos-Cement Roofing Material in a Plasma Reactor. Polish Journal of Environmental Studies.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3585189

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Overall Quality Determination†		Unacceptable		4	Metric Mean Score: 2.4.

** Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Rohl, A. N.,Langer, A. M.,Klimentidis, R.,Wolff, M. S.,Seilikoff, I. J.. 1977. Asbestos content of dust encountered in brake maintenance and repair. Proceedings of the Royal Society of Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3615571

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Brake maintenance and repair truck & auto
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	1.7 - 7.7 fibers/cc air samples during grinding old truck brakes; 23.7 - 72.0 for bevelling new truck brake linings.Auto 6.6 - 29.4 f/cc near compressed air cleaning of brake drums, 0.1 - 4.2 f/cc 1.5 - 22 meters away.In bulk dust samples, 2-15 percent chrysotile in U.S. (NYC), all other countries range was 0.5 - 3.2 percent
Number of Samples:	10 bulk from NY city repair shops, 29 bulk from OECD countries, air samples personal and area (23 truck brake repair, 13 auto)
Number of Sites:	1 truck repair facility; more than one auto repair shop, including a taxi fleet repair shop
Type of Measurement or Method:	OSHA methods as of 1975, which are similar to current methods
Worker Activity:	truck: grinding/beveling of brake padsauto: compressed air cleaning of brake drums
Number of Workers:	Not specified
Type of Sampling:	bulk, area air, personal air
Sampling Location:	City sanitation department truck repair shop in NYC; auto and taxi repair shops
Exposure Duration:	Not specified
Exposure Frequency:	Not specified, but daily assumed
Bulk and Dust Particle Size Distribution:	large percentage of asbestos fibers identified by TEM in this study did/do not meet the historical/current counting rules for PCM
Engineering Control & percent Exposure Reduction:	none
PPE:	none described
Analytic Method:	PCM, with 8 personal air samples analyzed by TEM

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments

Continued on next page

– continued from previous page

Source Citation:	Rohl, A. N.,Langer, A. M.,Klimentidis, R.,Wolff, M. S.,Seilikoff, I. J.. 1977. Asbestos content of dust encountered in brake maintenance and repair. Proceedings of the Royal Society of Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3615571

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Medium	× 1	2	in accordance with 1975 OSHA methods, which appear to be equivalent to current methods in terms of type of microscopy (oly fibers > 5 um are counted, 3:1 aspect ratio).
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	New York City
	Metric 3:	Applicability	Medium	× 2	4	occupational exposures - likely higher than current exposures due to lack of engineering controls, high percent chrysotile in the bulk material, and use of compressed air cleaning in auto shops.
	Metric 4:	Temporal Representativeness	Low	× 2	6	study published in 1977
	Metric 5:	Sample Size	Medium	× 1	2	sample number, means, and ranges reported
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Low	× 1	3	sample durations not stated
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	discusses findings in similar studies
Overall Quality Determination†			Medium		2.2	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Newhouse, M. L.. 1977. Asbestos content of dust encountered in brake maintenance and repair. Proceedings of the Royal Society of Medicine.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3615816

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Brake maintenance and repair
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	NO ACTUAL MONITORING DATA
Worker Activity:	Letter to editor re HERO 3615571. mentions 2 earlier "thorough" British studies on brake repair: Hickish & Knight 1970, Knight & Hickish 1970, Lee 1970
Engineering Control & percent Exposure Reduction:	Vacuum brushes and funnels
PPE:	none described

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	TUC Centenary Institute of Occupational Health
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	Author is from London
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	Low	× 2	6	letter to editor that mentions 2 British studies from 1970.
	Metric 5:	Sample Size	N/A		N/A	Letter to editor referencing other articles; no data provided; not applicable
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	N/A		N/A	Letter to editor referencing other articles; no data provided; not applicable
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	N/A		N/A	Letter to editor referencing other articles; no data provided; not applicable
Overall Quality Determination†			Medium		1.8	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Abundo, M. L.,Almaguer, D.,Driscoll, R.. 1994. Health hazard evaluation report no. HETA 93-1133-2425, Electrode Corporation, Chardon, Ohio.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3970520

EXTRACTION

Parameter	Data
Life Cycle Stage:	Asbestos Diaphragms
Life Cycle Description (Subcategory of Use):	chloralkali Industry, diaphragm anodes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	80-90 percent chrysotile in bulk anodes; settled dust samples all below limit of detection
Number of Samples:	5 bulk, 3 settled dust (vacuum dust collection at 4 l/min)
Number of Sites:	1
Type of Measurement or Method:	bulk and settled dust
Worker Activity:	Receiving anodes from customer that are contaminated from asbestos diaphragm (unpacking crates and placing anodes in washer).
Number of Workers:	Not specified
Type of Sampling:	bulk, settled dust
Sampling Location:	Receiving /parts washing
Exposure Frequency:	Not specified
Bulk and Dust Particle Size Distribution:	not discussed
Engineering Control & percent Exposure Reduction:	none for receiving, parts washer is used to remove asbestos
PPE:	disposable masks rated for non-hazardous nuisance dusts (not rated for asbestos).
Analytic Method:	NIOSH 7400 for settled dust, NIOSH 9002 for bulk

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	NIOSH methods conducted as part of a NIOSH Health Hazard evaluation
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	Ohio
	Metric 3:	Applicability	High	× 2	2	anodes contaminated due to customer use of asbestos diaphragms in chloralkali industry

Continued on next page

– continued from previous page

Source Citation:	Abundo, M. L.,Almaguer, D.,Driscoll, R.. 1994. Health hazard evaluation report no. HETA 93-1133-2425, Electrode Corporation, Chardon, Ohio.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3970520

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
	Metric 4: Temporal Representativeness	Low	× 2	6	1994
	Metric 5: Sample Size	Medium	× 1	2	range is described for bulk sample results.
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	Medium	× 1	2	exposure scenario well-described
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Low	× 1	3	variability of settled dust samples not discussed; limits of detection not specified.
Overall Quality Determination†		Medium		1.9	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Tapp, L.,Sussell, A.. 2008. Health hazard evaluation report no. HETA 2007-0055-3073, Evaluation of employee exposures in a bus maintenance shop, Huntingon Coach Corporation, Huntington Station, New York.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3970528

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Bus maintenance facility
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	all nondetect, with limit of quantification = 1 percent .
Number of Samples:	6 bulk samples (4 brake shoes, 1 brake pad, 1 friction material); 4 settled dust
Number of Sites:	2 (1 body shop, 1 maintenance shop)
Type of Measurement or Method:	bulk and settled dust
Worker Activity:	bus maintenance
Number of Workers:	Not specified
Type of Sampling:	bulk, settled dust
Sampling Location:	settled dust from 2 bus brake drums, a rotor lathe, and a wheel on a van
Exposure Frequency:	Not specified, but daily assumed
Bulk and Dust Particle Size Distribution:	not discussed
Engineering Control & percent Exposure Reduction:	none described
PPE:	none described
Analytic Method:	NIOSH method 9002 (PLM)

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	NIOSH methods conducted as part of a NIOSH Health Hazard evaluation
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	New York State
	Metric 3:	Applicability	High	× 2	2	aftermarket automotive brakes for buses and vans
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2008
	Metric 5:	Sample Size	Medium	× 1	2	all results were non-detect, limit of quantification reported at 1 percent .

Continued on next page

– continued from previous page

Source Citation:	Tapp, L.,Sussell, A.. 2008. Health hazard evaluation report no. HETA 2007-0055-3073, Evaluation of employee exposures in a bus maintenance shop, Huntingon Coach Corporation, Huntington Station, New York.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3970528

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	Medium	× 1	2	exposure scenario well-described
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Low	× 1	3	Variability not discussed.
Overall Quality Determination†		Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	U.S, E. P. A.. 2017. Preliminary information on manufacturing, processing, distribution, use, and disposal: Asbestos. Support document for Docket EPA-HQ-OPPT-2016-0736.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3827275

EXTRACTION

Parameter	**Data**
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Manufacturing, processing, distribution, use, and disposal
Exposure Concentration (Unit):	No discussion of monitoring data

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	EPA document
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Related to occupational exposure
	Metric 4:	Temporal Representativeness	High	× 2	2	2017
	Metric 5:	Sample Size	Low	× 1	3	No sample data provided in article
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	No sample data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	Does not address variability/uncertainty
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.0.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	2014. Annex XV restriction report: Amendment to a restriction: Chrysotile.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3970695

EXTRACTION

Parameter	Data
Life Cycle Stage:	Asbestos Diaphragms
Life Cycle Description (Subcategory of Use):	electrolysis for hydrogen production (Sweden); electrolysis for chloralkali production (Dow Germany)
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	No data for Swedish plant;For Dow plant, dumping fibers in mixing vessel, 90 percent upper confidence limit = 108 fibers per meter cubed (all below limit of detection (LOD, 100 f/m3)); For flushing and decoupling feed lines, geometric mean 100 f/m3; for waste handling, 90 percent upper conf limit = 112 f/m3 (all below LOD); assembly of electrolysis cells, 90 percent upper conf limit 253 f/m3 (4 samples below LOD, 1 at 100 f/m3, one at 300 f/m3); disassembly geometric mean 123 f/m3, 90 percent upper conf limit 235 f/m3 (4 below LOD, 1 at 200 f/m3, 1 at 290 f/m3); washing anodes/cathodes geometric mean 100 f/m3 (one below LOD, 2 at 100 f/m3). Summary table on page 94. (note that the German OEL is 1000 f/m3, and the EU OEL is 100000 f/m3). [see summary table in HERO 397-696 page 27].
Number of Samples:	0 for Swedish plant;For Dow: six for control room operator dumping fibers into mixing vessel; 2 for technician flushing/decoupling feed lines; for maintenance and cleaning, zero exposure samples; for waste handling, six samples. Assembly of electrolysis cells, six samples; dismantling cells, 9 samples; washing anodes/ cathodes, 3 samples.
Number of Sites:	2 (no data from Swedish site)
Type of Measurement or Method:	area samples, duration Not specified, volumetric flow rate Not specified.
Worker Activity:	AAK (Sweden) uses sealed cells imported from Switzerland (not EU and therefor not subject to REACH restrictions).Dow (Germany) uses diaphragms and reconditions them with asbestos containing brine (made on site), all processes are automated except for maintenance. Exposure scenarios include receiving/ storing bulk fiber, dumping fibers into mixing vessel, formation of slurry, filling feed containers, feeding electrolysis cells, flushing feed lines/decoupling hoses, maintenance/cleaning of dry asbestos handling room, and waste handling. Assembly of electrolysis cells; dismantling/cleaning cells, disassembly of cells with cleaning of electrodes.

Continued on next page

– continued from previous page

Source Citation:	2014. Annex XV restriction report: Amendment to a restriction: Chrysotile.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3970695

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
	Number of Workers:				For dumping fibers in mixing vessel, 1 remote operator in control room; For flushing and decoupling feed lines, 1 technician; waste handling 1 technician. Assembly of electrolysis cells, 4 technicians; disassembly/cleaning electrodes, 3 technicians;
	Type of Sampling:				Area samples due to required air volume to achieve LOD <110 f/m3. Sampled in accordance with VDI 3492.
	Sampling Location:				Dow chloralkali plant
	Exposure Duration:				For dumping fibers in mixing vessel, 1 hour per day; for Flushing and decoupling feed lines, half hour /day, 10 seconds per coupling/decoupling; for maintenance and cleaning, 2 hours/day; waste handling 8 hours/day. Assembly of electrolysis cells, 8 hours per day for 20 days; disassembly/cleaning electrodes 8 hours/day
	Exposure Frequency:				For dumping fibers in mixing vessel, 2/week; for flushing and decoupling feed lines, 2/week; for maintenance and cleaning, 6 times per year; waste handling 75 days/year. Assembly of electrolysis cells, 4 times per year (20 days each time); disassembly/cleaning electrodes 75 days/year;
	Bulk and Dust Particle Size Distribution:				not discussed
	Engineering Control & percent Exposure Reduction:				sealed systems at Swedish plant;enclosed systems with remote/mechanical handling at Dow (Germany), wet methods/submersion for open handling: receiving/ storing bulk fiber - fully enclosed/sealed containers; dumping fibers into mixing vessel - robotic/remote operation in negative pressure tunnel; formation of slurry - remote/enclosed negative pressure tunnel; filling feed containers - enclosed; feeding electrolysis cells - enclosed; flushing feed lines/decoupling hoses - after flushing with brine, and wet; maintenance/cleaning of dry asbestos handling room - shower out procedures, with washdown of the exit airlock; and waste handling - collected into enclosed plastic barrells containing wet additive, and sent to rotary oven/kiln, whereas wastewater is fed through enclosed system, with waste water sludge pelletized with manual closing of wet pellet barrells before transfer to kiln (thermal treatment at 1300C). Assembly of electrolysis cells - mostly enclosed with mechanical handling; manual handling during sealing step, with natural ventilation; disassembly/cleaning electrodes - wet methods, mechanical handling, natural ventilation

Continued on next page

– continued from previous page

Source Citation:	2014. Annex XV restriction report: Amendment to a restriction: Chrysotile.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3970695

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
PPE:		for cleaning the dry asbestos handling room, disposable clothing, dedicated shoes, full face PAPR respirator with P3 cartridges (99.95 percent efficient, similar to HEPA). For assembly and disassembly of cells, work clothing.			
Analytic Method:		German VDI 3492 an SEM method for fibrous particles, same 5 um length and 1:3 aspect ratio as NIOSH, only counts fibers < 3um width (NIOSH 7400 does not count fibers less than 2.5 um width). 8-30 liter/min flow rate. [NIOSH flow rate is 0.5 - 16 L/min].			

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	German method modified to use higher flow rate to achieve a lower LOD.
Domain 2: Representative					
	Metric 2: Geographic Scope	Medium	× 1	2	Germany
	Metric 3: Applicability	High	× 2	2	Dow chloralkali plant
	Metric 4: Temporal Representativeness	High	× 2	2	2008-2013
	Metric 5: Sample Size	High	× 1	1	geometric means and upper conf limits presented when possible (cannot calculate an upper conf limit if all sample results identical)
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	Medium	× 1	2	task duration provided, but not sample duration
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	low geometric standard deviation as evidence of low variability, but area samples do not always correlate well with personal samples.
Overall Quality Determination†		High		1.3	

Continued on next page

– continued from previous page

Source Citation:	2014. Annex XV restriction report: Amendment to a restriction: Chrysotile.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3970695

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Abejie, B. A.,Wang, X.,Kales, S. N.,Christiani, D. C.. 2010. Patterns of pulmonary dysfunction in asbestos workers: a cross-sectional study. Journal of Occupational Medicine and Toxicology.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	2079050

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Textile manufacture
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	> 2mg/m3, the Chinese OEL in the 1970s.
Number of Samples:	454
Number of Sites:	Workers from 1 textile plant in China
Type of Measurement or Method:	Not specified
Worker Activity:	Not specified
Number of Workers:	277 asbestos workers and 177 control subjects (non-occupational)
Type of Sampling:	Not specified
Sampling Location:	Not specified
Exposure Duration:	Not specified
Exposure Frequency:	Not specified
Bulk and Dust Particle Size Distribution:	Not specified
Engineering Control & percent Exposure Reduction:	Not specified
PPE:	Not specified
Analytic Method:	Not specified

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Journal of Occupational Medicine and Toxicology
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD (China)
	Metric 3:	Applicability	Medium	× 2	4	Occupational exposure for out of scope use (textiles)
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2010
	Metric 5:	Sample Size	Low	× 1	3	No sample data provided in article

Continued on next page

– continued from previous page

Source Citation:	Abejie, B. A.,Wang, X.,Kales, S. N.,Christiani, D. C.. 2010. Patterns of pulmonary dysfunction in asbestos workers: a cross-sectional study. Journal of Occupational Medicine and Toxicology.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	2079050

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data.
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Low	× 1	3	Does not address variability/uncertainty
Overall Quality Determination†		Unacceptable		4	Metric Mean Score: 2.3.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Mlynarek, S. P.,Van Orden, D. R.. 2012. Asbestos exposure from the overhaul of a Pratt andamp; Whitney R2800 engine. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2561011

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Airplane overhaul - replacement of metal glad nonfriable gaskets, replacement of clutch linings.
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	During disassembly: 0.0013 - 0.1240 f/cc, average 0.0272 f/cc;During reassembly: 0.0055 - 0.0913 f/cc, average 0.0198 f/cc; Clutch rebuild: 0.0129 - 0.0179 f/cc; no visible dust observed. These levels are similar to rural ambient asbestos levels. 40 percent of bulk samples contained chrysotile, 20-70 percent . Only 1 personal sampled contained asbestos confirmed by TEM, only 5 of 79 area samples contained asbestos confirmed by TEM, and these were not close to the work area (there was asbestos in the building insulation).
Number of Samples:	121 area samples (4 locations); 121 personal (workers wore 2 pumps and cassettes, bystanders (i.e., researchers) also sampled); 186 bulk samples (one of each type of gasket or other ACM.)
Number of Sites:	1
Type of Measurement or Method:	task based (average 188 minutes for disassembly, 222 minutes for reassembly)
Worker Activity:	Week 1 disassembly, week 2 painting (no asbestos exposure), week 3 reassembly. Clutch rebuild, cylinder change, ignition system rebuild,[metal clad, nonfriable gaskets]. No power tools used (not an approved protocol), most gaskets came off by hand or with hand tool if needed.All bulk samples from clutch rebuild contained asbestos;
Number of Workers:	Not specified
Type of Sampling:	bulk, area, personal
Sampling Location:	FAA certified Aircraft Repair Station (piston engine service facility).
Exposure Duration:	average 3 hours per task;
Exposure Frequency:	2-3 vintage aircraft per month rebuilt or serviced at this facility
Bulk and Dust Particle Size Distribution:	Approximately 40 percent of the bulk samples collected during this test were found to contain chrysotile.
Engineering Control & percent Exposure Reduction:	natural ventilation (garage doors closed, roof vents closed). Most parts covered with oil during disassembly and reassembly, such that no visible dust observed.

Continued on next page

– continued from previous page

Source Citation:	Mlynarek, S. P.,Van Orden, D. R.. 2012. Asbestos exposure from the overhaul of a Pratt andamp; Whitney R2800 engine. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2561011

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
PPE:		Not specified.			
Analytic Method:		NIOSH 7400 (PCM), 7402 (TEM); for samples positive for asbestos in 7402, then analyzed in accordance with ISO 10312.			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	Medium	× 1	2	The authors do not describe the rationale for using the ISO 10312 TEM method to confirm fiber type, rather than using PLM. The authors do not present the TEM data in table form, and do not provide the limit of detection for the ISO TEM method.
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	Medium	× 2	4	gasket removal, clutch work, although all these gaskets were metal-clad, which was not the case for the diesel truck engine. Aircraft engines.
	Metric 4: Temporal Representativeness	High	× 2	2	2012
	Metric 5: Sample Size	High	× 1	1	excellent description of sample distribution
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	excellent descriptions
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	This study was supported by Pratt & Whitney, which has participated in asbestos product litigation. The authors have also participated in asbestos product litigation.
Overall Quality Determination†		High		1.4	

Continued on next page

– continued from previous page

Source Citation:	Mlynarek, S. P.,Van Orden, D. R.. 2012. Asbestos exposure from the overhaul of a Pratt andamp; Whitney R2800 engine. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2561011

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Iarc,. 2012. ARC Monographs on the evaluation of carcinogenic risks to humans: Asbestos (Chrysotile, amosite, crocidolite, tremolite, actinolite, and anthophyllite).
Type of Data Source	Occupational Exposure; Completed Exposure or Risk Assessments;
Hero ID	3970851

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	N/A (Multiple: brake pad production, cement, gaskets, textiles, insulation)
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	fibers/cc
Number of Samples:	Not specified
Number of Sites:	41 occupational cohort studies shown in Table 2.2, includes standardized mortality ratios and/or risk ratios with confidence limits, at link: http://monographs.iarc.fr/ENG/Monographs/vol100C/100C-06-Table2.2.pdf
Type of Measurement or Method:	varies depending on the study
Worker Activity:	Cohort study design characteristics (12 pages landscape): http://monographs.iarc.fr/ENG/Monographs/vol100C/100C-06-Table2.3.pdfLink to table of case-control studies (12 pages long landscape orientation, includes relative risk and confidence limits): http://monographs.iarc.fr/ENG/Monographs/vol100C/100C-06-Table2.1.pdf
Number of Workers:	Not specified
Type of Sampling:	varies depending on the study
Sampling Location:	Not specified
Exposure Duration:	Not specified
Exposure Frequency:	Not specified
Engineering Control & percent Exposure Reduction:	Not specified
PPE:	Not specified.
Analytic Method:	Not specified.

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
Metric 1:	Methodology	High	× 1	1	IARC monograph

Continued on next page

– continued from previous page

Source Citation:	Iarc,. 2012. ARC Monographs on the evaluation of carcinogenic risks to humans: Asbestos (Chrysotile, amosite, crocidolite, tremolite, actinolite, and anthophyllite).
Type of Data Source	Occupational Exposure; Completed Exposure or Risk Assessments;
Hero ID	3970851

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	a mix of data from multiple countries.
	Metric 3:	Applicability	Medium	× 2	4	a mix of occupational exposure scenarios
	Metric 4:	Temporal Representativeness	High	× 2	2	2012
	Metric 5:	Sample Size	Medium	× 1	2	Statistical distribution of results not described.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Very thorough review of a ton of studies, include epidemiologic studies as recent as 2009.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	High	× 1	1	Confidence limits shown in tables 2.1. and 2.2. Uncertainty discussed in regards to whether chrysotile is less carcinogenic than other forms, also whether cancer of the colorectum is associated with asbestos exposure.
Overall Quality Determination†			High		1.4	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Niosh,. 1972. NIOSH criteria for a recommended standard: Occupational exposure to asbestos.
Type of Data Source	Occupational Exposure; Completed Exposure or Risk Assessments;
Hero ID	3974883

EXTRACTION

Parameter	Data
Life Cycle Description (Subcategory of Use):	N/A (Multiple)
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	fibers/cc
Number of Samples:	various. NIOSH sampling data 1969-71 pages 99 - 124.
Number of Sites:	Not specified
Type of Measurement or Method:	varies depending on the study
Worker Activity:	various. Epi data tables pages 125 - 129.
Number of Workers:	Not specified
Type of Sampling:	air
Sampling Location:	Not specified
Exposure Duration:	Not specified
Exposure Frequency:	Not specified
Engineering Control & percent Exposure Reduction:	Not specified
PPE:	Not specified.
Analytic Method:	Not specified.

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	NIOSH Criteria document
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	a mix of studies from multiple countries.
	Metric 3:	Applicability	Medium	× 2	4	a mix of occupational exposure scenarios
	Metric 4:	Temporal Representativeness	Low	× 2	6	1972
	Metric 5:	Sample Size	Low	× 1	3	findings of health effects in asbestos exposed workers are discussed in narrative form
Domain 3: Accessibility/Clarity						

Continued on next page

– continued from previous page

Source Citation:	Niosh,. 1972. NIOSH criteria for a recommended standard: Occupational exposure to asbestos.
Type of Data Source	Occupational Exposure; Completed Exposure or Risk Assessments;
Hero ID	3974883

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
	Metric 6: Metadata Completeness	Low	× 1	3	findings of health effects in asbestos exposed workers are discussed in narrative form
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	tables on pages 128 - 129 indicate which epi findings are significant at p>0.05, but confidence limits not shown.
Overall Quality Determination†		Low		2.3	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Park, E. K.,Takahashi, K.,Hoshuyama, T.,Cheng, T. J.,Delgermaa, V.,Le, G. V.,Sorahan, T.. 2011. Global magnitude of reported and unreported mesothelioma. Environmental Health Perspectives.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	2575987

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	General asbestos use
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Epid study - national cumulative asbestos use in metric tons

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Institute of Industrial Ecological Sciences
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD (Japan)
	Metric 3:	Applicability	Medium	× 2	4	a mix of occupational exposure scenarios
	Metric 4:	Temporal Representativeness	High	× 2	2	2011
	Metric 5:	Sample Size	Low	× 1	3	findings of health effects in asbestos exposed workers are discussed in narrative form
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.1.

Continued on next page

– continued from previous page

Source Citation:	Park, E. K.,Takahashi, K.,Hoshuyama, T.,Cheng, T. J.,Delgermaa, V.,Le, G. V.,Sorahan, T.. 2011. Global magnitude of reported and unreported mesothelioma. Environmental Health Perspectives.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	2575987

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments

** Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale:
High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Stayner, L.,Welch, L. S.,Lemen, R.. 2013. The worldwide pandemic of asbestos-related diseases. Annual Review of Public Health.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3078375

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	General asbestos use
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Discussion of national asbestos consumption and mesothelioma rates

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Annu. Rev. Public Health 2013
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	a mix of occupational exposure scenarios
	Metric 4:	Temporal Representativeness	High	× 2	2	2013
	Metric 5:	Sample Size	Low	× 1	3	findings of health effects in asbestos exposed workers are discussed in narrative form
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.0.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Nicholson, W. J.. 2001. The carcinogenicity of chrysotile asbestos–a review. Industrial Health.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3080670

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Various (products, wallboards, friction products and textiles)
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Discusses global asbestos consumption and mesothelioma

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Industrial Health
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	a mix of occupational exposure scenarios
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2001
	Metric 5:	Sample Size	Low	× 1	3	findings of health effects in asbestos exposed workers are discussed in narrative form
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.2.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Landrigan, P. J.,Nicholson, W. J.,Suzuki, Y.,Ladou, J.. 1999. The hazards of chrysotile asbestos: a critical review. Industrial Health.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3080988

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Various
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Literature review of health effects related to asbestos exposure - No monitoring data

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Industrial Health
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	Industrial Health
	Metric 3:	Applicability	Medium	× 2	4	a mix of occupational exposure scenarios
	Metric 4:	Temporal Representativeness	Low	× 2	6	1999
	Metric 5:	Sample Size	Low	× 1	3	findings of health effects in asbestos exposed workers are discussed in narrative form
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.4.

Continued on next page

– continued from previous page

Source Citation:	Landrigan, P. J.,Nicholson, W. J.,Suzuki, Y.,Ladou, J.. 1999. The hazards of chrysotile asbestos: a critical review. Industrial Health.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3080988

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Courtice, M. N.,Berman, D. W.,Yano, E.,Kohyama, N.,Wang, X.. 2016. Size- and type-specific exposure assessment of an asbestos products factory in China. Journal of Exposure Science and Environmental Epidemiology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3088311

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Manufacture of woven and rubber products
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Study focused less on fiber counts and more on determining size /dimensions of fibers. A total of 14 510 fibres were individually sized to two decimal places and checked for chemical composition.
Number of Samples:	52
Number of Sites:	6
Worker Activity:	raw materialsopening, raw materialsbagging, carding, spinning, weaving, and rubber.
Number of Workers:	Unknwon
Type of Sampling:	scanning electron microscopy (SEM) analysis (identifies fibers that would be missed by NIOSH 7400 b/c less than .25 um in width)
Sampling Location:	Workshop area
Exposure Duration:	Samples no more than 2 hours long
Exposure Frequency:	Not mentioned but assumed daily
Bulk and Dust Particle Size Distribution:	Not specified
Engineering Control & percent Exposure Reduction:	Not specified
PPE:	Not specified.
Analytic Method:	scanning electron microscopy (SEM), ISO method 14966

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
Metric 1:	Methodology	Medium	× 1	2	scanning electron microscopy. Describes fiber characteristics, not fiber counts
Domain 2: Representative					
Metric 2:	Geographic Scope	Medium	× 1	2	OECD country (China)

Continued on next page

– continued from previous page

Source Citation:	Courtice, M. N.,Berman, D. W.,Yano, E.,Kohyama, N.,Wang, X.. 2016. Size- and type-specific exposure assessment of an asbestos products factory in China. Journal of Exposure Science and Environmental Epidemiology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3088311

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 3:	Applicability	Low	× 2	6	Data given was occuapational exposure to asbestos that was not in scope and didn't provide data of fibers /mL
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2006 data
	Metric 5:	Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Low	× 1	3	fiber composition, not fiber counts
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	Variabilty between shops sampled and time of day that sampling occurred were briefly addressed
Overall Quality Determination†			Medium		2.2	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Atsdr,. 2001. Toxicological profile for asbestos (update).
Type of Data Source	Occupational Exposure; Published Models for Exposures or Releases;
Hero ID	3098571

EXTRACTION

Parameter	Data
Life Cycle Stage:	Sheet gaskets
Life Cycle Description (Subcategory of Use):	Page 190 describes Fowler (2000) simulation of bandsawing sheet gaskets. Page 191: Strokova (1998) Bulgarian workers engaged in the production of asbestos gaskets and filter materials at two plants were exposed to 0.040.38 and 0.040.43 f/mL of asbestos.
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	2.2 - 4.9 f/ml by PCM for sawing neoprene sheet containing 80 percent chrysotile in a simulation.0.040.38 and 0.040.43 f/mL in Bulgarian gasket production (1998).
Number of Samples:	Not specified
Number of Sites:	Not specified
Type of Measurement or Method:	Not specified
Worker Activity:	cutting gaskets, production of gaskets
Number of Workers:	Not specified
Type of Sampling:	PCM, TEM, also Not specified
Sampling Location:	Not specified
Exposure Duration:	Not specified
Exposure Frequency:	Not specified
Bulk and Dust Particle Size Distribution:	Fowler discusses fiber sizes by TEM.
Engineering Control & percent Exposure Reduction:	Not specified.
PPE:	Not specified.
Analytic Method:	PCM in simulation, Not specified in Bulgarian plant

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	Low	× 1	3	no detail on methodology
Domain 2: Representative					

Continued on next page

– continued from previous page

Source Citation:	Atsdr,. 2001. Toxicological profile for asbestos (update).
Type of Data Source	Occupational Exposure; Published Models for Exposures or Releases;
Hero ID	3098571

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 2:	Geographic Scope	Low	× 1	3	non-OECD country (Bulgaria)
	Metric 3:	Applicability	Medium	× 2	4	Fowler is a simulation rather than actual workplace data
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2001 and 1998 data.
	Metric 5:	Sample Size	Low	× 1	3	No statistical characterization provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Low	× 1	3	limited metadata provided
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	variability discussed in general /qualitative terms
Overall Quality Determination†			Low		2.4	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Niosh,. 2011. Current intelligence bulletin 62: Asbestos fibers and other elongate mineral particles: State of the science and roadmap for research [Revised April 2011]. Current Intelligence.
Type of Data Source	Occupational Exposure; Completed Exposure or Risk Assessments;
Hero ID	3102338

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Mentions 84 percent of asbestos used in roofing products as of 2008 (p10).
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Page 11 Figure 2: geometric mean exposures below 0.1 f/cc in OSHA and NIOSH samples of the construction, manufacturing, mining, and other industries since 1986 (data through 2003).
Type of Measurement or Method:	Not specified
Worker Activity:	Not specified
Number of Workers:	Not specified
Type of Sampling:	Not specified
Sampling Location:	Not specified
Exposure Duration:	Not specified
Exposure Frequency:	Not specified
Bulk and Dust Particle Size Distribution:	"thoracic-size Elongate mineral particles (EMPs) occurring either in an asbestiform habit (e.g., asbestos fibers) or in a nonasbestiform habit (e.g., as needle-like [acicular] or prismatic crystals), as well as EMPs that result from the crushing or fracturing of nonfibrous minerals (e.g., cleavage fragments)." NIOSH commented on MSHA 2005 asbestos rulemaking: "NIOSH remains concerned that the regulatory definition of asbestos should include asbestiform mineral fibers such as winchite and richterite, which were of major importance as contaminants in the Libby, MT, vermiculite"
Engineering Control & percent Exposure Reduction:	Not specified.
PPE:	Not specified.
Analytic Method:	discusses short comings of PCM misses fibers too thin to see. Electron microscopy methods much more costly and less widely available.

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments

Continued on next page

– continued from previous page

Source Citation:	Niosh,. 2011. Current intelligence bulletin 62: Asbestos fibers and other elongate mineral particles: State of the science and roadmap for research [Revised April 2011]. Current Intelligence.
Type of Data Source	Occupational Exposure; Completed Exposure or Risk Assessments;
Hero ID	3102338

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	NIOSH and OSHA sampling data
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	very little actual data. Discusses future research needs.
	Metric 4:	Temporal Representativeness	Medium	× 2	4	NIOSH/OSHA IMIS data through 2003
	Metric 5:	Sample Size	Low	× 1	3	no information provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Low	× 1	3	limited metadata.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	not discussed
Overall Quality Determination†			Medium		2.1	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Hossain, M. dS,Fakhruddin, A. buNM,Chowdhury, M. A. Z.,Gan, S. H. ua. 2016. Impact of ship-Breaking activities on the coastal environment of Bangladesh and a management system for its sustainability. Environmental Science and Policy.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3352103

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Shipbreaking - outside scope.
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	No monitoring data

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Environmental Science & Policy
Domain 2: Representative						
	Metric 2:	Geographic Scope	Low	× 1	3	Non-OECD - Bangladesh
	Metric 3:	Applicability	Low	× 2	6	outside scope - shipbreaking
	Metric 4:	Temporal Representativeness	High	× 2	2	2016
	Metric 5:	Sample Size	Low	× 1	3	no information provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	No monitoring data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.4.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Yoshizumi, K.,Hori, H.,Satoh, T.,Higashi, T.. 2001. The trend in airborne asbestos concentrations at plants manufacturing asbestos-containing products in Japan. Industrial Health.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531608

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Manufacturing asbestos products
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	control classification - 1 through 3; unsure what the translation is to f/cm3
Number of Samples:	Not specified
Number of Sites:	528
Type of Measurement or Method:	Not specified
Worker Activity:	Various
Number of Workers:	2798
Type of Sampling:	Area
Sampling Location:	Not specified
Exposure Duration:	Not specified
Exposure Frequency:	Not specified
Bulk and Dust Particle Size Distribution:	counting rules - WHO fibers (over 5 "m in length, over 3:1 in aspect ratio and less than 3 "m in diameter)
Engineering Control & percent Exposure Reduction:	Not specified
PPE:	Not specified.
Analytic Method:	Not specified.

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Low	× 1	3	Unlcear methodology
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD - Japan
	Metric 3:	Applicability	Medium	× 2	4	Study done on occupational exposure to asbestos
	Metric 4:	Temporal Representativeness	Low	× 2	6	2001 study, data from 1985-1998.

Continued on next page

– continued from previous page

Source Citation:	Yoshizumi, K.,Hori, H.,Satoh, T.,Higashi, T.. 2001. The trend in airborne asbestos concentrations at plants manufacturing asbestos-containing products in Japan. Industrial Health.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531608

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
	Metric 5: Sample Size	Low	× 1	3	no information provided
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	Unacceptable	× 1	4	control classifications in this report cannot be linked to actual airborne concentrations.
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†		Unacceptable		4	Metric Mean Score: 2.8.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Yu, I. J.,Yoo, C. Y.,Chung, Y. H.,Han, J. H.,Yhang, S. Y.,Yu, G. M.,Song, K. S.. 2004. Asbestos exposure among Seoul metropolitan subway workers during renovation of subway air-conditioning systems. Environment International.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531609

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Renovation of ventilaltion system in subway
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	range from LOD to 0.020 f/cc; 9 of 72 air samples above LOD (LOD 0.002 - 0.003 f/cc);
Number of Samples:	72 air samples
Number of Sites:	8
Type of Measurement or Method:	TWA
Worker Activity:	Removal of ceiling panels and ventillation ducts, installation of new ventillation system, and installation of subway station equipment
Number of Workers:	Not specified
Type of Sampling:	bulk, breathing zone
Sampling Location:	subway system in Seoul, Korea
Exposure Duration:	180240 min for night shift and 300360 min for day shift.
Exposure Frequency:	Not specified
Bulk and Dust Particle Size Distribution:	Twelve of the eighteen bulk samples were found to contain asbestos (Table 1), although four samples were less than 0.1 percent that is usual detection limit for most labs. Ten samples contained chrysotile fibers and two samples contained tremolite fibers (Table 1). The original four gaskets used in the duct connections at the Euljiro, Yaksu, and Sindang stations were found to contain asbestos
Engineering Control & percent Exposure Reduction:	Not specified
PPE:	Not specified.
Analytic Method:	NIOSH 7402

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	used NIOSH methods

Continued on next page

– continued from previous page

Source Citation:	Yu, I. J.,Yoo, C. Y.,Chung, Y. H.,Han, J. H.,Yhang, S. Y.,Yu, G. M.,Song, K. S.. 2004. Asbestos exposure among Seoul metropolitan subway workers during renovation of subway air-conditioning systems. Environment International.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531609

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD - Korea
	Metric 3:	Applicability	Medium	× 2	4	Out of scope occupational exposure data
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2003 study; 2001 data
	Metric 5:	Sample Size	Low	× 1	3	no information provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Low	× 1	3	limited metadata.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	limited discussion
Overall Quality Determination†			Medium		2.1	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Osha,. 2017. Occupational exposure to asbestos.
Type of Data Source	Occupational Exposure; Completed Exposure or Risk Assessments;
Hero ID	3978190

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Gasket/packing manufacture, Automotive repair
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	estimated exposures before and after compliance with 1994 PEL of 0.1 f/cc (based on representative data from 1985 rulemaking record): automotive repair: 0.017 f/c, 0.00294 f/cc; gasket manufacture: 0.043 down to 0.00718 (Table 5)
Number of Samples:	Not specified
Number of Sites:	Not specified
Type of Measurement or Method:	Not specified
Worker Activity:	Not specified
Number of Workers:	Not specified
Type of Sampling:	Not specified
Sampling Location:	Not specified
Exposure Duration:	Not specified
Exposure Frequency:	Not specified
Bulk and Dust Particle Size Distribution:	Not specified
Engineering Control & percent Exposure Reduction:	"National Automobile Dealers Association stated that both the enclosure/HEPA vacuum method and the low pressure/wet cleaning method are currently [as of 1994 rulemaking] in use throughout the automotive brake and clutch repair industry," which are feasible methods of achieving the PEL of 0.1 f/cc.
PPE:	in 1986 rulemaking, OSHA concluded that asbestos cement pipe manufacture "dry mechanical process" could not achieve 0.2 f/cc without respiratory protection.
Analytic Method:	describes the 0.1 f/cc PEL as the practical lower limit of feasibility

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	OSHA final rule; expected that underlying data are from literature search and OSHA compliance data

Continued on next page

– continued from previous page

Source Citation:	Osha,. 2017. Occupational exposure to asbestos.
Type of Data Source	Occupational Exposure; Completed Exposure or Risk Assessments;
Hero ID	3978190

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	US
	Metric 3:	Applicability	High	× 2	2	automotive repair, also cement pipe manufacture
	Metric 4:	Temporal Representativeness	Low	× 2	6	1994 OSHA Final Rule
	Metric 5:	Sample Size	Low	× 1	3	Where exposure data are presented, statistical characterization not provided.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Low	× 1	3	Where exposure data are presented, few metadata are provided.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	No discussion provided
Overall Quality Determination†			Medium		2.1	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Osha,. 2007. Standard interpretations: Classification of removal of asbestos-containing gaskets; requirement to conduct removal in a "glove bag".
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3978224

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	gasket removal
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	N/A - No monitoring data
Worker Activity:	letter of intepretation.

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Medium	× 1	2	Correspondance between the president of a company that works with asbestos gaskets and the director of the Directorate of Enforcement Programs
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	US
	Metric 3:	Applicability	Medium	× 2	4	information regarding the removal of asbestos gaskets
	Metric 4:	Temporal Representativeness	High	× 2	2	2011
	Metric 5:	Sample Size	Low	× 1	3	no information provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.1.

Continued on next page

– continued from previous page

Source Citation:	Osha,. 2007. Standard interpretations: Classification of removal of asbestos-containing gaskets; requirement to conduct removal in a "glove bag".
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3978224

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments

** Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale:
High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Osha,. 1995. Work practices and engineering controls for Class I asbestos operations - non-mandatory, Part 2.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3978233

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Class I work = removal of thermal system insulation or surfacing material >1 percent asbestos (surfacing material means sprayed on, troweled on, or otherwise applied, such as acoustical plaster on ceilings or fireproofing on structural members).
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	N/A - No monitoring data
Worker Activity:	1915.1001 Appendix F, nonmandatory, exposure controls for Class I asbestos work.

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	OSHA
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	US
	Metric 3:	Applicability	Medium	× 2	4	Asbestos avoidance instructions for construction and shipyard workers
	Metric 4:	Temporal Representativeness	Low	× 2	6	1993
	Metric 5:	Sample Size	Low	× 1	3	no information provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data, work activities outside scope.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.4.

Continued on next page

– continued from previous page

Source Citation:	Osha,. 1995. Work practices and engineering controls for Class I asbestos operations - non-mandatory, Part 2.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3978233

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Japanese Ministry of, Environment. 2011. Summary of countermeasures against asbestos in Japan.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3980937

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	waste disposal
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	geometric mean concentrations of 0.47 - 0.05 f/Liter, with no particular trends. Shown in table 3-1 on page 21.
Number of Samples:	Not specified
Number of Sites:	Not specified
Type of Measurement or Method:	area samples, duration Not specified
Worker Activity:	asbestos disposal facility
Number of Workers:	Not specified
Type of Sampling:	area sampling at 10 L/min
Sampling Location:	Not specified
Exposure Duration:	Not specified
Exposure Frequency:	Not specified
Bulk and Dust Particle Size Distribution:	not discussed
Engineering Control & percent Exposure Reduction:	not discussed
Analytic Method:	optical microscopy

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
Metric 1:	Methodology	High	× 1	1	sampling methods described in detail in appendix VIII of this report.
Domain 2: Representative					
Metric 2:	Geographic Scope	Medium	× 1	2	Japan
Metric 3:	Applicability	Low	× 2	6	ambient monitoring data from unspecified number of waste disposal facilities. no information on whether the samples were in working areas or at the fenceline
Metric 4:	Temporal Representativeness	Medium	× 2	4	2011 report, 1995-2009 data
Metric 5:	Sample Size	Low	× 1	3	only geometric means reported.

Continued on next page

– continued from previous page

Source Citation:	Japanese Ministry of, Environment. 2011. Summary of countermeasures against asbestos in Japan.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3980937

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	Unacceptable	× 1	4	no information on whether the samples were in working areas or at the fenceline
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Low	× 1	3	not discussed
Overall Quality Determination†		Unacceptable		4	Metric Mean Score: 2.6.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Ctem Publication. 1999. Industrial pollution prevention and abatement in chlor-alkali industry.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3981071

EXTRACTION

Parameter	Data
Life Cycle Stage:	Asbestos Diaphragms
Life Cycle Description (Subcategory of Use):	3 different processes for chloralkali production (one uses mercury instead of asbestos)
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	N/A - No monitoring data

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Low	× 1	3	Document does not specify organization that authored report or what methods were used
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	US
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	Medium	× 2	4	1999 report pulled in 2017.
	Metric 5:	Sample Size	Low	× 1	3	no information provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	Document does not discuss its sources, methods, and assumptions; author and publishing organization is not specified. Document contains no metadata to evaluate quality of information presented.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	No discussion provided
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.2.

Continued on next page

– continued from previous page

Source Citation:	Ctem Publication. 1999. Industrial pollution prevention and abatement in chlor-alkali industry.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3981071

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Donovan, S.,Pickin, J.. 2016. An Australian stocks and flows model for asbestos. Waste Management and Research.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3520603

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	estimates when asbestos containing materials will be disposed to landfill. 90 percent of asbestos consumed in Australia prior to 2003 ban went into cement products.
Exposure Concentration (Unit):	Under the best estimate, asbestos stocks peaked in 1981 and waste quantities in 2014, and in 2016, 44 percent of consumed asbestos remains in use.

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Medium	× 1	2	Waste Management & Research
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	Australia
	Metric 3:	Applicability	Unacceptable	× 2	8	does not relate directly to occupational exposure.
	Metric 4:	Temporal Representativeness	High	× 2	2	2016
	Metric 5:	Sample Size	Low	× 1	3	no information provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.7.

** Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, two of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Kim, S. Y.,Kim, Y. C.,Kim, Y.,Hong, W. H.. 2016. Predicting the mortality from asbestos-related diseases based on the amount of asbestos used and the effects of slate buildings in Korea. Science of the Total Environment.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3531033

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	cement products
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	N/A - No monitoring data

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Medium	× 1	2	Science of the Total Environment
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	Korea
	Metric 3:	Applicability	Unacceptable	× 2	8	not occupational exposure
	Metric 4:	Temporal Representativeness	High	× 2	2	2016
	Metric 5:	Sample Size	Low	× 1	3	no information provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.7.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, two of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Gray, C.,Carey, R. N.,Reid, A.. 2016. Current and future risks of asbestos exposure in the Australian community. International Journal of Occupational and Environmental Health.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3541055

EXTRACTION

Parameter	**Data**
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Asbestos removers and assessors
Exposure Concentration (Unit):	no monitoring data - literature review and interviews

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	International Journal of Occupational and Environmental Health
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	Australia
	Metric 3:	Applicability	Unacceptable	× 2	8	no monitoring data. No occupational exposures discussed.
	Metric 4:	Temporal Representativeness	High	× 2	2	2016
	Metric 5:	Sample Size	Low	× 1	3	no information provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.6.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, two of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Porcu, M.,Orru, R.,Cincotti, A.,Cao, G. C.. 2005. Self-propagating reactions for environmental protection: Treatment of wastes containing asbestos. Industrial and Engineering Chemistry Research.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3581347

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	asbestos waste treatment/thermal conversion
Exposure Concentration (Unit):	no monitoring data - information and experimentation with a process to treat asbestos waste
Worker Activity:	thermal treatment of asbestos containing waste with ferric oxide, magnesium powder, and sepiolite (Mg4Si6)15(OH)26H2O. Self propagating reaction alters the chemical and micro- structure.

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Medium	× 1	2	Ind. Eng. Chem
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	Italy
	Metric 3:	Applicability	Unacceptable	× 2	8	This article does not describe occupational exposure or environmental release
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2005
	Metric 5:	Sample Size	Low	× 1	3	no information provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.9.

Continued on next page

– continued from previous page

Source Citation:	Porcu, M.,Orru, R.,Cincotti, A.,Cao, G. C.. 2005. Self-propagating reactions for environmental protection: Treatment of wastes containing asbestos. Industrial and Engineering Chemistry Research.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3581347

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, two of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Usgs,. 2017. Mineral commodity summaries 2017.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3827270

EXTRACTION

Parameter	Data
Life Cycle Stage:	Asbestos Diaphragms
Life Cycle Description (Subcategory of Use):	Chlor-alkali Industry and others
Exposure Concentration (Unit):	estimates that 100 percent of imported asbestos (340 metric tons, all chrysotile) was used in manufacture of asbestos diaphragms for the chloralkali industry - no monitoring data
Worker Activity:	A non-specified quantity of asbestos was imported within manufactured products, possibly including brake linings and pads, building materials, gaskets, millboard, and yarn and thread, among others.

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	US Geological Survey Report
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	US
	Metric 3:	Applicability	High	× 2	2	Provides asbestos import and consumption volumes and estimate of market share by chloralkali industry.
	Metric 4:	Temporal Representativeness	High	× 2	2	2016
	Metric 5:	Sample Size	Low	× 1	3	Sample size representativeness captured in USGS estimates is unclear
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Low	× 1	3	Data collection methods and assumptions not clearly provided. Appendix C defines data sources and terms used for classification of reserves.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	Variability not discussed.
Overall Quality Determination†			Medium		1.7	

Continued on next page

– continued from previous page

Source Citation:	Usgs,. 2017. Mineral commodity summaries 2017.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3827270

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Flanagan, D. M.. 2016. 2015 Minerals yearbook. Asbestos [advance release].
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3840041

EXTRACTION

Parameter	Data
Life Cycle Stage:	Asbestos Diaphragms
Life Cycle Description (Subcategory of Use):	Chlor-alkali Industry and others
Exposure Concentration (Unit):	estimates that 95 percent of imported asbestos (343 metric tons, all chrysotile) was used in manufacture of asbestos diaphragms for the chloralkali industry.
Worker Activity:	asbestos consumption has declined annually for 30 years. Insufficient data to quantify asbestos use in other industries. The US imported $4.63 million of manufactured products containing asbestos (an18 percent descrease from 2014). The US exported and reexported $26 million of manufactured asbestos products, a 13 percent decrease from 2014. 32 percent of asbestos containing exports were friction products (brake and clutch linings, brake pads), 15 percent of exports were gaskets, packing and seals. These may have been reexports or misclassified items that did not contain asbestos, since there is little or no production of these materials in the US in recent years.

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	USGS Minerals Yearbook
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	US
	Metric 3:	Applicability	High	× 2	2	Provides asbestos import and consumption volumes and estimate of market share by chloralkali industry.
	Metric 4:	Temporal Representativeness	High	× 2	2	2015
	Metric 5:	Sample Size	Low	× 1	3	Sample size representativeness captured in USGS estimates is unclear
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Low	× 1	3	Data collection methods and assumptions not clearly provided.
Domain 4: Variability and Uncertainty						

Continued on next page

– continued from previous page

Source Citation:	Flanagan, D. M.. 2016. 2015 Minerals yearbook. Asbestos [advance release].
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3840041

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
	Metric 7: Metadata Completeness	Low	× 1	3	Variability not discussed.
Overall Quality Determination†		Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Virta, R. L.. 2004. Kirk-Othmer Encyclopedia of Chemical TechnologyAsbestos.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3859385

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Asbestos industry
Exposure Concentration (Unit):	worldwide production by country through 2000. No monitoring data - information on chemical structure of asbestos
Worker Activity:	does not discuss occupational exposures
Analytic Method:	Page 18 a brief discussion of microscopy for fiber identification

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Kirk-Othmer Encyclopedia of Chemical Technology
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	US
	Metric 3:	Applicability	Unacceptable	× 2	8	does not relate directly to occupational exposure.
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2004
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.7.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, two of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	2017. PubChem: Chrysotile.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3860485

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	NLM data dump, outside scope
Exposure Concentration (Unit):	No monitoring data - contains chemical information for asbestos
Type of Measurement or Method:	p 22 describes lab analytical methods
Worker Activity:	p 19 use and mfr info, all too old to use. P. 70: Mentions presence in local water in San Franciso and Seattle, plus areas with aggressive water and asbestos cement pipe.

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	U.S. National Library of Medicine
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	US
	Metric 3:	Applicability	Medium	× 2	4	no recent occupational exposure data.
	Metric 4:	Temporal Representativeness	High	× 2	2	Accessed 2017
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.0.

Continued on next page

– continued from previous page

Source Citation:	2017. PubChem: Chrysotile.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3860485

EVALUATION

Domain	Metric	Rating	MWF⋆	Score	Comments

⋆⋆ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

⋆ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	2017. Safe work practices: Asbestos.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3860565

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	O&M guidance
Exposure Concentration (Unit):	N/A - No monitoring data
Worker Activity:	no exposure data, just work practice guidance for O&M.

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	US EPA
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	US
	Metric 3:	Applicability	Medium	× 2	4	Relates to occupational exposure to asbestos
	Metric 4:	Temporal Representativeness	High	× 2	2	2017
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no actual monitoring data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.0.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	ToxNet Hazardous Substances Data, Bank. 2017. HSDB: Asbestos.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3970271

EXTRACTION

Parameter	**Data**
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Hazardous substances data bank - all old info
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	N/A - No monitoring data
Worker Activity:	no exposure data, no relevant data on use.

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	National Institute of Health, U.S. National Library of Medicine
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	US
	Metric 3:	Applicability	Medium	× 2	4	Relates to occupational exposure to asbestos
	Metric 4:	Temporal Representativeness	High	× 2	2	2017
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.0.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	ToxNet Hazardous Substances Data, Bank. 2017. HSDB: Chrysotile asbestos.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3970272

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Hazardous substances data bank - all old info
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	N/A - No monitoring data
Worker Activity:	no exposure data, no relevant data on use.

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	National Institute of Health, U.S. National Library of Medicine
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	US
	Metric 3:	Applicability	Medium	× 2	4	Relates to occupational exposure to asbestos
	Metric 4:	Temporal Representativeness	High	× 2	2	2017
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.0.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Usgs,. 2002. Asbestos: Geology, mineralogy, mining, and uses.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3975020

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Mining, processing, and use
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	N/A - No monitoring data
Worker Activity:	no exposure data, no relevant data on use.

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	U.S. DEPARTMENT OF THE INTERIOR
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	US
	Metric 3:	Applicability	Medium	× 2	4	Relates to occupational exposure to asbestos
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2002? report #02-xxx; newest entry in bibliography is from 2001.
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.2.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Boelter, F.,Simmons, C.,Hewett, P.. 2011. Exposure data from multi-application, multi-industry maintenance of surfaces and joints sealed with asbestos-containing gaskets and packing. Journal of Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2576853

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	gaskets within heavy equipment (Caterpillar construction equipment)
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Sample data information including the surrogate values for the full-shift,TWA personal sample resultsranged from 0.002 to 0.064 asbestos f/cc. Personal, short-term, 30-min sample results, including the two surrogate values, ranged from 0.038 to 0.561 asbestos f/cc. Full-shift TWA area samples, including the 31 surrogate values, ranged from 0.005 to 0.039 asbestos f/cc. Area air sample results at the end of the project were similar to levels measured before the start of the project. No fiber concentration buildup within the work area was indicated over the 9-day study. All full-shift personal and area TWA sample results were below 0.1 f/cc, and shortterm 30-min personal samples were below 1.0 f/cc. Statistical results of the sample data with and without the surrogate values were consistent. Use of the time-activity model reduced the uncertainty associated with this data analysis and provided a consistent logical process for estimating surrogate values to replace missing data.
Number of Samples:	A total of 444 samples were collectedover 9 days. Despite execution of a carefully planned sampling strategy, approximately 10 percent (47) of the samples collected could not be analyzed due to overloading or filter damage. To include the overloaded samples in the data analysis,surrogate values were estimated following a time-activity model. Twelve long-term personal samples, 2 short-term, 30-min personal samples, and 31 long-term area samples weremodeled. Personal and area time-weighted average(TWA) datawere analyzed both with and without the estimated surrogate values and compared.
Number of Sites:	one site
Type of Measurement or Method:	TWA
Worker Activity:	This study on four pieces of heavy construction equipment was conducted to determine the concentration of airborne asbestos fibers during in-frame maintenance and repair activities,which included aggressive techniques that resulted in visible dust from work involving friction products and gaskets.

Continued on next page

– continued from previous page

Source Citation:	Boelter, F.,Simmons, C.,Hewett, P.. 2011. Exposure data from multi-application, multi-industry maintenance of surfaces and joints sealed with asbestos-containing gaskets and packing. Journal of Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2576853

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
	Number of Workers:				Four experienced heavy equipment mechanicsremoved and replaced friction products and gaskets.
	Type of Sampling:				Personal and area
	Sampling Location:				in a heavy equipment repair facility
	Exposure Duration:				Multiple, see samples infoFull shift ranged from 6.5hr to 9.5hr, with over half of the samples in the 8-hr time period
	Exposure Frequency:				Ten background air samples were collected for approximately 145 min at 2 L/min on the day prior to the start of repair activities. Five samples were collected inside the facility, and five were collected outside the facility to establish background fiber concentrations.Personal and area air samples were collected each day with sample pumps started prior to the initiation of work activities and were stopped at the end of the day after completion of work. Consecutive, long-term samples were collected on each mechanic and at each area sampling location. Samples were combined into TWAs over the whole sampling period to achieve full-shift TWA concentrations.The short-term, personal monitoring periods were for 30 min and were collected during activities when the mechanics were directly impacting the asbestos-containing gasket or friction material. These samples were collected to reflect peak exposure concentrations from activities conducted over a short period of time.
	Bulk and Dust Particle Size Distribution:				The removed and replaced brake materials from all four pieces of equipment contained from 15 percent to 95 percent chrysotile asbestos. Bulk sample analysis for asbestos in brake debris collected from all four machines yielded either nondetectable or less than 1 percent chrysotile asbestos. Removed and replaced gasket materials positive for asbestos ranged from 3 percent to 85 percent chrysotile.

Continued on next page

– continued from previous page

Source Citation:	Boelter, F.,Simmons, C.,Hewett, P.. 2011. Exposure data from multi-application, multi-industry maintenance of surfaces and joints sealed with asbestos-containing gaskets and packing. Journal of Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2576853

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Engineering Control & percent Exposure Reduction:		The repair facility was not equipped with a mechanical ventilation system. The study was conducted under routine conditions with doors being opened only for entry and exitof personnel. The overhead doors were opened only to move equipment and supplies in and out of the repair facility or fora few minutes following work activities, such as operating the diesel engines, welding, and grinding or other activities that generated dense smoke or fume. A pedestal-mounted fan was used by the mechanics at various times to provide airmovement inside the repair facility.Prior to and following work activities, the effective ventilation rate (reported as the number of air changes per hour) of thefacility was determined by using carbon dioxide (CO2) tracer gas.			
PPE:		no discussion /none?			
Analytic Method:		Samples were analyzed using NIOSH Method 7400 Phase ContrastMicroscopy followed by NIOSH Method 7402 TransmissionElectron Microscopy.			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Approved NIOSH methods
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	Medium	× 2	4	This study on four pieces of heavy construction equipment was conducted to determine the concentration of airborne asbestos fibers during in-frame maintenance and repair activities, which included aggressive techniques that resulted in visible dust from work involving friction products and gaskets. Friction products were not for automotive use
	Metric 4: Temporal Representativeness	Medium	× 2	4	2007
	Metric 5: Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics

Continued on next page

– continued from previous page

Source Citation:	Boelter, F.,Simmons, C.,Hewett, P.. 2011. Exposure data from multi-application, multi-industry maintenance of surfaces and joints sealed with asbestos-containing gaskets and packing. Journal of Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2576853

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	Discuss variability between different worker activities
Overall Quality Determination†		High		1.6	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Madl, A. K.,Hollins, D. M.,Devlin, K. D.,Donovan, E. P.,Dopart, P. J.,Scott, P. K.,Perez, A. L.. 2014. Airborne asbestos exposures associated with gasket and packing replacement: a simulation study and meta-analysis. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3077980

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	valve gaskets and packing
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Shortterm mechanic and assistant airborne asbestos concentrations during valve work averaged 0.013 f/cc and 0.008 f/cc (PCME), respectively. Area samples averaged 0.008 f/cc, 0.005 f/cc, and 0.003 f/cc (PCME) for center, bystander, and remote background, respectively. Assuming a tradesman conservatively performs 13 gasket and/or packing replacements daily, an average 8-h TWA was estimated to be 0.002 0.010 f/cc (PCME).
Number of Samples:	A total of 228 airborne asbestos samples were collected over the course of the 3-day study, including 78 worker samples, 40 assistant samples, 57 area samples, 18 clearance samples, six background samples, nine ambient samples, and 20 field blanks. Of these samples, a total of 58 worker samples, 26 assistant samples, and 52 area samples were used in the analysis since they were collected during activities involving asbestos-containing components. In addition, a total of 59 bulk samples were collected on the associated packing and gasket material, as well as on miscellaneous dust created during valve work.
Number of Sites:	Complete valve overhauls were performed inside an enclosed room by two retired mechanics with 50 combined years of training and experience in the U.S. Navy, servicing and repairing equipment.
Type of Measurement or Method:	Short term and 8-hr TWA estimates obtained from short term samples
Worker Activity:	Exposures to airborne asbestos during the removal and installation of internal gaskets and packing associatedwith a valve overhaul were characterized and compared to published data according to different variables (e.g., product, equipment, task, tool, setting, duration).
Number of Workers:	two
Type of Sampling:	Personal breathing zone and area samples were collected during twelve events simulating gasket and packing replacement, clean-up and clothinghandling.
Sampling Location:	maritime?
Exposure Duration:	16-84 min

Continued on next page

– continued from previous page

Source Citation:	Madl, A. K.,Hollins, D. M.,Devlin, K. D.,Donovan, E. P.,Dopart, P. J.,Scott, P. K.,Perez, A. L.. 2014. Airborne asbestos exposures associated with gasket and packing replacement: a simulation study and meta-analysis. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3077980

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
	Exposure Frequency:				Airborne asbestos concentrations were measured during activities conducted during twelve sampling events. Ten of these events characterized exposures during valve overhaul work which included the removal and installation of asbestos-containing packing and/or gaskets contained within ten vintage valves (Event 1, 311), one characterized exposures associated with post-valve overhaul clean-up work (Event 2), and one characterized exposures during the handling of coveralls worn during the study (Event 12).See study for additional details
	Bulk and Dust Particle Size Distribution:				The asbestos bulk content of the packing material removed from the valves was ND-<1 percent chrysotile (1 valve) and 4070 percent chrysotile (3 valves); no asbestos was detected in the packingmaterial removed from the remaining six valves. The bulk content of the packing material installed in the valves ranged from 25 percent to 70 percent chrysotile asbestos. The asbestos bulk content of the gasket material removed from the valves was ND-<1 percent chrysotile (4 valves), <1 percent chrysotile (1 valve), and 5055 percent chrysotile (2 valves); no asbestos was detected in the gasket material removed from the remaining two valves. The bulk content of the gasket material installed in the valves ranged from 45 percent to 65 percent chrysotile asbestos. No amphibole fibers were detected in any of the gasket or packing materials removed or installed into the valves.
	Engineering Control & percent Exposure Reduction:				The air exchange in the room (passive ventilation) was found to be approximately 23 air changes per hour (ACH).
	PPE:				Clothes handling (i.e., shaking and folding of coveralls worn during valve overhaul work) was also studied. In total, six coveralls worn by the worker and the assistant (one pair each per day) were collected and sealed separately in plastic-lined bags. At the conclusion of the study, coveralls worn by the mechanic and assistant and collected each day of the testing (new coveralls were worn each day) were shaken, folded, and turned inside out for approximately13 min by a volunteer, simulating the handling of these potentiallycontaminated work clothes (Event 12).

Continued on next page

– continued from previous page

Source Citation:	Madl, A. K.,Hollins, D. M.,Devlin, K. D.,Donovan, E. P.,Dopart, P. J.,Scott, P. K.,Perez, A. L.. 2014. Airborne asbestos exposures associated with gasket and packing replacement: a simulation study and meta-analysis. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3077980

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Analytic Method:		These samples were analyzed using PCM and TEM methods and PCM-equivalent (PCME) airborne asbestos concentrations were calculated. A meta-analysis was performed to compare these data with airborne asbestos concentrations measured in other studies involving gaskets and packing.			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Approved NIOSH methods
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	Medium	× 2	4	Airborne asbestos exposures associated with gasket and packing replacement
	Metric 4: Temporal Representativeness	High	× 2	2	2014
	Metric 5: Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	High	× 1	1	well described within document
Overall Quality Determination†		High		1.2	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Fowler, D. P.. 2000. Exposures to asbestos arising from bandsawing gasket material. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3080855

EXTRACTION

Parameter	Data
Life Cycle Stage:	Sheet gaskets
Life Cycle Description (Subcategory of Use):	bandsawing gasket material
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	The results are shown in Table I. The personal exposures to fibers longer than 5 micrometers (l m) during bandsawing were between 2.2 and 4.9 fibers per milliliter (f/mL) by PCM where the current OSHA eight-hour TWA standard is 0.1 f/mL, and the 30-minute excursion limit is 1.0 f/mL. The personal results by TEM were higher; 22.249.3 asbestos structures per milliliter...
Number of Samples:	nine samples, see Table 1 for details
Number of Sites:	one site
Type of Measurement or Method:	Short-term
Worker Activity:	A simulation of bandsawing sheet asbestos gasket material was performed as part of a retrospective exposure evaluationundertaken to assist in determining causation of a case of mesothelioma. The work was performed by bandsawing a chrysotile asbestos (80 percent)/neoprene gasket sheet with a conventional 16-inch woodworking bandsaw inside a chamber.
Number of Workers:	one worker, simulation study
Type of Sampling:	personal breathing and area
Sampling Location:	The work was done inside a specially constructed chamber - see report for details
Exposure Duration:	6-30 min
Exposure Frequency:	Three sets of samples were taken. During the saber saw cutting to reduce the sheet to manageable-size pieces for bandsawing, a single personal sample (A) was taken from the right side of the operator"s breathing zone. The second set of samples was taken during the cutting of the two large pieces to smaller pieces (approximately 12 cm " 15 cm). (samples B to E.) That cutting was interrupted by a power failure for a few minutes, as indicated on Table I. The third set of samples was taken during the cutting (for a few minutes) of the 12 cm " 15 cm pieces into halves. (samples F to J, no G used.)
Bulk and Dust Particle Size Distribution:	The material examined was a neoprene-impregnated sheet gasket, 0.3175 cm (1/8 inch) thick. The asbestos content of the gasket as stated by the manufacturer was 80 percent chrysotile.

Continued on next page

– continued from previous page

Source Citation:	Fowler, D. P.. 2000. Exposures to asbestos arising from bandsawing gasket material. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3080855

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Engineering Control & percent Exposure Reduction:		The entire chamber was ventilated during all sawing by drawing air into the entry of the clean room with a Nil" sk Model GS 80 HEPA-filtered vacuum cleaner placed at the end of the chamber farthest from the entry. The air " flow rate was approximately 0.991.13 cubic meters per minute (3540 cubic feet per minute), for an air exchange rate of 3.23.7 air changes per hour (ACH).			
PPE:		All sawing work was done by theauthor, wearing disposable garments over street clothes, and a properly " fitted half-mask respirator with HEPA "filter cartridges.			
Analytic Method:		with analysis of collected samples by transmission electronmicroscopy(TEM) and phase contrast microscopy (PCM). These were supplemented by qualitative scanning electron microscopy (SEM) examinations of some of the airborne particles collectedon the filters			

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Approved NIOSH methods
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	High	× 2	2	In-scope use
	Metric 4: Temporal Representativeness	Medium	× 2	4	2000
	Metric 5: Sample Size	High	× 1	1	Individual samples provided, so distribution can be fully characterized.
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty, which could be determined from underlying methods

Continued on next page

– continued from previous page

Source Citation:	Fowler, D. P.. 2000. Exposures to asbestos arising from bandsawing gasket material. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3080855

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Overall Quality Determination†		High		1.3	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Boelter, F. W.,Crawford, G. N.,Podraza, D. M.. 2002. Airborne fiber exposure assessment of dry asbestos-containing gaskets and packings found in intact industrial and maritime fittings. AIHA Journal.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3520465

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Asbestos-Containing Gaskets and Packings Found in Intact Industrial and Maritime Fittings
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Results for every area and personal sample showed the 8-hour TWAs were well below the current Occupational Safety and Health Administration permissible exposure limit of 0.1 f/cc.
Number of Samples:	80 total samples - see Table 1
Number of Sites:	The fittings used during this study were obtained intact from a decommissioned industrial power plant and U.S. Navy destroyers
Type of Measurement or Method:	8-hr TWA
Worker Activity:	The activities tested included flat blade scraping, hand wire brushing, power wire brushing, making gaskets with a ball-peen hammer, and stem packing removal and replacement. All activities were performed dry.
Number of Workers:	Personal samples were collected from the breathing zones of thetwo individuals performing the work for the duration of the 8-hour test cycle.
Type of Sampling:	personal sampling
Sampling Location:	An isolation test chamber shown in Figure 1 was constructedin which to conduct the study.
Exposure Duration:	8-hour test cycle
Exposure Frequency:	The study was conducted as 10 separate cycles in an isolation chamber to eliminate outside influences. Each cycle was conducted at the rate of one fitting per hour over an 8-hour period. The frequency of one fitting per hour was based on the activity rates observed by the authors, reported in previous published field gasket studies, and those in reerence estimating manuals.(18,19) or reference text books.

Continued on next page

– continued from previous page

Source Citation:	Boelter, F. W.,Crawford, G. N.,Podraza, D. M.. 2002. Airborne fiber exposure assessment of dry asbestos-containing gaskets and packings found in intact industrial and maritime fittings. AIHA Journal.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3520465

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Bulk and Dust Particle Size Distribution:		The old packing material was all fibrous, and when it contained asbestos, it varied from 40 to 80 percent chrysotile. The "new" asbestos-containing packing material used for the event cycles was from unused new old stock (NOS). This material was Garlock style 733, which is a graphite impregnated 80 percent chrysotile square braided packing. The 16 valves were packed using new valve packing tools purchased from a catalog.			
Engineering Control & percent Exposure Reduction:		The chamber was designed and constructed to be a static environment. During the test there was no air movement into or out of the chamber.			
PPE:		simulation			
Analytic Method:		Samples were collected and analyzed by PCM following OSHA ID-160, which is essentially the same as NIOSH method 7400, A Rule			

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	OSHA ID-160, same as NIOSH 7400
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	Medium	× 2	4	gasket and packing activities in industrial and maritime environments
	Metric 4: Temporal Representativeness	Medium	× 2	4	2002
	Metric 5: Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					

Continued on next page

– continued from previous page

Source Citation:	Boelter, F. W.,Crawford, G. N.,Podraza, D. M.. 2002. Airborne fiber exposure assessment of dry asbestos-containing gaskets and packings found in intact industrial and maritime fittings. AIHA Journal.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3520465

EVALUATION

Domain	Metric	Rating	MWF⋆	Score	Comments
	Metric 7: Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty which could be determined from underlying methods
Overall Quality Determination†		High		1.6	

⋆ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Mangold, C.,Clark, K.,Madl, A.,Paustenbach, D.. 2006. An exposure study of bystanders and workers during the installation and removal of asbestos gaskets and packing. Journal of Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531143

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	gaskets and packing, naval equipment
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	8-hour TWA exposures of pipefitters and other tradesmen who perfermoed thes activities were below the current PEL and all previous PELs - highest average 8-hr TWA was 0.030 f/cc. 8-hour TWA breathing zone concentrations did not exceed 0.016 f/cc
Number of Samples:	multiple datasets for different worker activities - 100+ samples taken
Number of Sites:	one site, recreated Navy's work practices in a contaminant-free enviornment during an 8-hour workday
Type of Measurement or Method:	4 and 8-hr TWA
Worker Activity:	replacing gaskets and packing materials - formation, removal, and storage of gaskets, as well as the scraping of flanges and the replacemetn of valve packing
Number of Workers:	simulation - not relevant
Type of Sampling:	personal and area
Sampling Location:	enclosure (27 cubic meters)
Exposure Duration:	8-hour test cycle
Exposure Frequency:	N/A - simulation
Bulk and Dust Particle Size Distribution:	removed gaskets contained 60-80 percent chrysotile asbestos, and the installed gaskets contained 70-80 percent chrysotile asbestos.
Engineering Control & percent Exposure Reduction:	n/a - simulation
PPE:	simulation
Analytic Method:	phase contrast microscopy (PCM) analysis

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Approved NIOSH methods

Continued on next page

– continued from previous page

Source Citation:	Mangold, C.,Clark, K.,Madl, A.,Paustenbach, D.. 2006. An exposure study of bystanders and workers during the installation and removal of asbestos gaskets and packing. Journal of Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531143

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	gasket and packing activities
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2006
	Metric 5:	Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty which could be determined from underlying methods
Overall Quality Determination†			High		1.6	

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Spence, S. K.,Rocchi, P. S. J.. 1996. Exposure to asbestos fibres during gasket removal. Annals of Occupational Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3580451

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	gaskets used in the chemical industry to prevent leakage between solid surfaces
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	The average exposure to fibres for group A, averaged over the work period, was 0.04-0.242 fibres/ml as determined by phase-contrast microscopy.Group B - ranged between below the detection limit and 0.02 fibres/ml
Number of Samples:	21 samples total - 11 for group A, 10 for Group B
Number of Sites:	one - ARCO Chemical in Netherlands
Type of Measurement or Method:	Short term and 8-hr TWA
Worker Activity:	Two groups were studied: group A, who only removed gaskets if they could be removed easily and without breaking; and group B, who removed gaskets which were left by the first group. For both groups, the gasket was first made wet before removal.
Number of Workers:	unspecified
Type of Sampling:	personal
Sampling Location:	chemical site
Exposure Duration:	69-432 min
Exposure Frequency:	Not stated, implied removal of gaskets is not done often (once a year?)
Bulk and Dust Particle Size Distribution:	Not specified
Engineering Control & percent Exposure Reduction:	Not mentioned
PPE:	HEPA filter full-face mask respiratory, hooded coveralls, gloves, boots
Analytic Method:	PCM and transmission electron microscopy

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Approved NIOSH methods
Domain 2: Representative					

Continued on next page

– continued from previous page

Source Citation:	Spence, S. K.,Rocchi, P. S. J.. 1996. Exposure to asbestos fibres during gasket removal. Annals of Occupational Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3580451

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD, Netherlands
	Metric 3:	Applicability	Medium	× 2	4	gasket removal in chemical industry
	Metric 4:	Temporal Representativeness	Low	× 2	6	1996
	Metric 5:	Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty which could be determined from underlying methods
Overall Quality Determination†			Medium		1.9	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Rohl, A. N.,Langer, A. M.,Wolff, M. S.,Weisman, I.. 1976. Asbestos exposure during brake lining maintenance and repair. Environmental Research.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	176

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	automotive brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Data obtained on asbestos exposure of garage mechanics during brake lining maintenance and repair work show that fiber concentrations frequently in excess of regulated limits are common.
Number of Samples:	ten samples
Number of Sites:	multiple, exact number unclear
Type of Measurement or Method:	short-term, bulk
Worker Activity:	Data obtained on asbestos exposure of garage mechanics during brake lining maintenanceand repair work
Number of Workers:	unspecified
Type of Sampling:	personal air samples
Sampling Location:	franchised auto dealer garages, taxi fleet repair shops, and a municipal truck repair shop. all located in New York Cit
Exposure Duration:	0-14 min
Bulk and Dust Particle Size Distribution:	presence of chrysotile, ranging from 2 to 15 percent , in brake drum dusts,particle size distribution discussed in article
Engineering Control & percent Exposure Reduction:	States engineering controls were not used
PPE:	States workers didn't use PPE
Analytic Method:	The presence of chrysotile, ranging from 2 to 15 percent , in brake drum dusts, was demonstrated by X-ray diffraction, transmission electron microscopy. selected area electron diffraction, and electron microprobe analyses

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Approved NIOSH methods

Continued on next page

– continued from previous page

Source Citation:	Rohl, A. N.,Langer, A. M.,Wolff, M. S.,Weisman, I.. 1976. Asbestos exposure during brake lining maintenance and repair. Environmental Research.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	176

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	in scope use
	Metric 4:	Temporal Representativeness	Low	× 2	6	1976
	Metric 5:	Sample Size	Medium	× 1	2	Only mean and ranges provided for most of the data
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty, which could be determined from underlying methods
Overall Quality Determination†			Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Freeman, M. D.,Kohles, S. S.. 2012. Assessing specific causation of mesothelioma following exposure to chrysotile asbestos-containing brake dust. International Journal of Occupational and Environmental Health.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	2554714

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	automotive brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	note - document has good information/background for brake linings industrysee referenced studies for exposure details. Need to track down underlying studies for this document to be useful

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	US University study, published in International Journal of Occup and Env Health
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	In-scope use - automotive brakes
	Metric 4:	Temporal Representativeness	High	× 2	2	2012
	Metric 5:	Sample Size	N/A		N/A	Not applicable; no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	N/A		N/A	Not applicable; no data provided
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	N/A		N/A	Not applicable; no data provided
Overall Quality Determination†			High		1.0	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Blake, C. L.,Johnson, G. T.,Harbison, R. D.. 2009. Airborne asbestos exposure during light aircraft brake replacement. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2594497

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	aircraft brake pad replacement
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Personal air samples did not detect any measurable amount of asbestos fibers during the brake changing or subsequent cleanup procedures. Analysis of personal samples (n = 9) using phase contrast microscopy indicated airborne fiber concentrations at or below 0.003 f/ml as 8-h time weighted averages (TWAs) and less than 0.069 f/ml averaged over 2830 min sampling periods. Airborne chrysotile fibers were detected by two area air samples with fiber concentrations remaining at or below0.0013 f/ml over an 8-h TWA.
Number of Samples:	9 personal samples, 2 area
Number of Sites:	one site
Type of Measurement or Method:	28-30 min short term and 8-hr TWA estimated from 1-hr samples
Worker Activity:	an aircraft fitted with asbestos containing brake pads had brake changes performed
Number of Workers:	one worker, simulation study
Type of Sampling:	personal and area
Sampling Location:	The brake changing process took place in a closed, unventilated aircraft hanger and all operations were performed according to the manufacturer"srecommended procedure.
Exposure Duration:	28 - 63 min samples
Exposure Frequency:	Two complete brake changes were performed during two airsampling sessions, one for each of the aircraft"s main wheels.
Bulk and Dust Particle Size Distribution:	Following removal of the test brake pads from the aircraft, 2 of the 4 pads were submitted for analysis of asbestos content. This analysis, performed using Polarized Light Microscopy (PLM) indicated the presence of 10 percent (by area) chrysotile asbestos in each pad.
Engineering Control & percent Exposure Reduction:	n/a - simulation
PPE:	not discussed
Analytic Method:	PCM /TEM

Continued on next page

– continued from previous page

Source Citation:	Blake, C. L.,Johnson, G. T.,Harbison, R. D.. 2009. Airborne asbestos exposure during light aircraft brake replacement. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2594497

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Approved NIOSH methods
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	Medium	× 2	4	not automotive
	Metric 4: Temporal Representativeness	High	× 2	2	2009
	Metric 5: Sample Size	Medium	× 1	2	Statistical distribution of results not described.
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty which could be determined from underlying methods
Overall Quality Determination†		High		1.4	

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Blake, C. L.,Dotson, G. S.,Harbison, R. D.. 2008. Evaluation of asbestos exposure within the automotive repair industry: a study involving removal of asbestos-containing body sealants and drive clutch replacement. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2599024

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	removal of asbestos-containing body sealants and drive clutch replacement
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	the average asbestos concentration for personal breathing zone (PBZ) samples during seam sealant removal was 0.006 f/cc (fibers/cubic centimeter of air). Many other air samples contained asbestos at or below the analytical limit of detection (LOD).The highest asbestos corrected airborne fiber concentration observed during clutch installation was 0.0028 f/cc. This value is approximately 100 times lower than Occupational Safety and Health Administration"s (OSHA) permissible exposure limit (PEL) of 0.1 f/cc.
Number of Samples:	84 area samples, 14 PBZ samples
Number of Sites:	one site
Type of Measurement or Method:	Short-term and 8-hr TWA
Worker Activity:	Two independent assessments were performed of airborne asbestos concentrations generated during automotive repair work on vintage vehicles . The first involved removal of asbestos-containing seam sealant, and the second involved servicing of a drive clutch.
Number of Workers:	one professional mechanic
Type of Sampling:	PBZ, area
Sampling Location:	This study was conducted in an operational automotive repair facility located in Ypsilanti, Michigan. The specific workspace used for this testing was a three bay garage.
Exposure Duration:	126 - 321 min

Continued on next page

– continued from previous page

Source Citation:	Blake, C. L.,Dotson, G. S.,Harbison, R. D.. 2008. Evaluation of asbestos exposure within the automotive repair industry: a study involving removal of asbestos-containing body sealants and drive clutch replacement. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2599024

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Exposure Frequency:		In total, fourteen individual test sessions were conducted during removal of asbestos-containing seam sealant. In the first test cycle, the mechanic removed the mastic material with a hand scraper. Subsequently a pneumatic chisel was used in removing sealant from alternative sites of the same wheel well. Seam sealant was removed during 15 min test intervals. During the first day of testing, the mechanic performed eight, 15 min-duration removal exercises on the Mustang Coupe (two within each of four wheel wells), and one 15 min-duration removal exercise on the Mustang Fastback. On the following day, five additional 15 minduration removal exercises were performed on the Mustang Fastback. All outside doors to the service facility were closed during each test session. Following each 15 min sampling period, the bay and pedestrian doors were opened for approximately 30 min to facilitate "airing-out" of the automotive service facility. Additional activities were performed during the clean-up phase including removal of debris, wet-mopping of the floor and replacing/repositioning of the air samplers.			
Bulk and Dust Particle Size Distribution:		Despite the relatively high concentrations (5.628 percent) of chrysotile fibers detected within bulk samples of seam sealant			
Engineering Control & percent Exposure Reduction:		The automotive service facility had no ventilation system representing "the worst case" scenario for a mechanic engaged in the servicing of vehicles.			
PPE:		not discussed			
Analytic Method:		Samples were analyzed using phase contrast microscopy (PCM)and transmission electron microscopy (TEM)			

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Approved NIOSH methods
Domain 2: Representative					

Continued on next page

– continued from previous page

Source Citation:	Blake, C. L.,Dotson, G. S.,Harbison, R. D.. 2008. Evaluation of asbestos exposure within the automotive repair industry: a study involving removal of asbestos-containing body sealants and drive clutch replacement. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2599024

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	in scope use
	Metric 4:	Temporal Representativeness	High	× 2	2	2008
	Metric 5:	Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	High	× 1	1	well described within document
Overall Quality Determination†			High		1.0	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Paustenbach, D. J.,Finley, B. L.,Lu, E. T.,Brorby, G. P.,Sheehan, P. J.. 2004. Environmental and occupational health hazards associated with the presence of asbestos in brake linings and pads (1900 to present): a andquot;state-of-the-artandquot; review. Journal of Toxicology and Environmental Health, Part B: Critical Reviews.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3080278

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	asbestsos in brake linings and pads (1900 to present)
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Between 1960 and 1974, five epidemiology studies of friction product manufacturing workers were conducted. During this same time period, the initial studies of brake lining wear (dust or debris) emissions were conducted showing that automobile braking was not a substantial contributor of asbestos fibers greater than 5?m in length to ambient air.During the post-1974 time period, most of the information on exposure of brake mechanics to airborne asbestos during brake repair was gathered, primarily from a series of sampling surveys conducted by the National Institute of Occupational Safety and Health in the United States. These surveys indicated that the time-weighted average asbestos concentrations (about 16 h in duration) during brake servicing were between 0.004 and 0.28 fibers per cubic centimeter, and the mean time-weighted average concentration was about 0.05 fibers per cubic centimeter. The data also showed that brake mechanics were not exposed to time-weighted average concentrations above workplace exposure limits in effect at the time of the study.Finally, there were 20 studies published during this time period evaluating asbestos exposure or asbestos-related health effects in friction product manufacturing workers. These studies indicated that these workers were historically exposed to concentrations of chrysotile fibers perhaps 10 to 50 times greater than those of brake mechanics, but the risk of asbestosis, mesothelioma, and lung cancer, if any, was not apparent, except for those workers who had some degree of exposure to amphibole asbestos during their careers.
Number of Samples:	Between 1930 and 1959, eight studies were conducted for which friction product manufacturing workers were part of the population assessed. These studies provided evidence of asbestosis among highly exposed workers, but provided little information on the magnitude of exposure. The U.S. Public Health Service proposed the first occupational guideline for asbestos exposure in 1938.

Continued on next page

– continued from previous page

Source Citation:	Paustenbach, D. J.,Finley, B. L.,Lu, E. T.,Brorby, G. P.,Sheehan, P. J.. 2004. Environmental and occupational health hazards associated with the presence of asbestos in brake linings and pads (1900 to present): a andquot;state-of-the-artandquot; review. Journal of Toxicology and Environmental Health, Part B: Critical Reviews.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3080278

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Number of Sites:		Multiple - see details in literature review			
Type of Measurement or Method:		Literature review - This article presents a "state-of-the-art" analysis of what was known over time about the potential environmental and occupational health hazards associated with the presence of chrysotile asbestos in brake linings and pads. As part of this analysis, the evolution of automobile brakes and brake friction materials, beginning with the early 1900s, is described.			
Worker Activity:		"This analysis is divided into three time periods: 1900 to 1959, 1960 to 1974, and 1975 to 2002. These were selected based on what were perceived to be seminal events." SEE CONTINUATION OF THIS PARAGRAPH IN STUDYbrake linings and pad repair, friction product manufacturing			
Number of Workers:		Multiple - see details in literature review			
Type of Sampling:		Multiple - see details in literature review			
Sampling Location:		Multiple - see details in literature review			
Exposure Duration:		Multiple - see details in literature review			
Exposure Frequency:		Multiple - see details in literature review			
Engineering Control & percent Exposure Reduction:		Not mentioned			
PPE:		Not mentioned			
Analytic Method:		Multiple - see details in literature review			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Published in peer reviewed scientific journal: Journal of Toxicology and Environmental Health
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States

Continued on next page

– continued from previous page

Source Citation:	Paustenbach, D. J.,Finley, B. L.,Lu, E. T.,Brorby, G. P.,Sheehan, P. J.. 2004. Environmental and occupational health hazards associated with the presence of asbestos in brake linings and pads (1900 to present): a andquot;state-of-the-artandquot; review. Journal of Toxicology and Environmental Health, Part B: Critical Reviews.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3080278

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 3:	Applicability	High	× 2	2	in scope use
	Metric 4:	Temporal Representativeness	Medium	× 2	4	Spans multiple time periods, with the most recent data being from 1975 to 2002
	Metric 5:	Sample Size	Low	× 1	3	Statistical distribution of results not described.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty, which could be determined from underlying methods
Overall Quality Determination†			High		1.6	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Yeung, P.,Patience, K.,Apthorpe, L.,Willcocks, D.. 1999. An Australian study to evaluate worker exposure to chrysotile in the automotive service industry. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3080975

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	automotive /multiple
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Chrysotile exposure of car mechanics measured by PCM was typically below the reportable detection limit of 0.05 f /mL, irrespective of whether disc brake, drum brake,or clutch was being serviced.In the three brake shoe relining workshops, task specific exposure reached up to 0.16 f /mL in the processesof cutting and radius grinding.TEM results were generally higher, due to its higher resolution power. The median diameter on samples taken from the servic e garages (passenger c ars), as determined by TEM, was 0.5" 1.0 micro-m; and was between 0.2" 0.5 micro-m for the brake bonding and gasket proc essing workshops, while that for the bus servic e depot was 0.1" 0.2 micro-m. Most of the respirable fibers (84 percent , mainly forsterite) from the bus servic e depot were below 0.2 micro-m in diameter whic h is the resolution limit of PCM. In the brake bonding and gasket c utting workshops, 34 perc ent and 44 perc ent of the chrysotile fibers were below 0.2 micro-m in diameter.
Number of Samples:	A total of 68 (11 personal and 57 area) air samples were collected
Number of Sites:	A study was conducted in Sydney, Australia, in 1996 to investigate the current exposure levels, control technologies, and work practices in five service garages (four car and one bus), three brake bonding workshops, and one gasket processing workshop.
Type of Measurement or Method:	Short-term: less than 2 hours
Worker Activity:	Summarized in Table I
Number of Workers:	Summarized in Table I - depends on worker activity
Type of Sampling:	personal and area
Sampling Location:	Area samples were taken at fixed locations in the vicinity of the work tasks, and between one and two meters above floor level.

Continued on next page

– continued from previous page

Source Citation:	Yeung, P.,Patience, K.,Apthorpe, L.,Willcocks, D.. 1999. An Australian study to evaluate worker exposure to chrysotile in the automotive service industry. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3080975

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Exposure Duration:		Single sample durations wereselec ted not to exc eed two hours, such that only a maximum of 240 liters of air would be collec ted. This approach has resultedin a prac tic al detec tion limit of around 0.05 f/mL (or 10 " bers/100 graticule areas) by phase contrast mic roscopy (PCM).			
Exposure Frequency:		Summarized in Table I - depends on worker activity			
Bulk and Dust Particle Size Distribution:		On bulk - see intro excerpt: "Chrysotile is still used in the manufac ture of motor vehic le brake and c lutch materials in Australia, although inc reasingly other materials (for example, metal oxides, synthetic mineral and organic " bers) have been substituted for asbestos in the fabric ation of fric tion materials. Fric tion materials commonlyfound in brake and c lutch systems c ontain about 40-60 percent (drum brakes and c lutc hes) and 20 perc ent (disc brakes) chrysotile asbestos (together with phenolic -type resins as binder and various other additives to improve performanc e). Amosite, c roc idolite, or other amphibole asbestos varieties are not used bec ause they are too harsh and tend to sc ore the brake drums or disc s.(1)The actual size distributions of the fibers sampled from the four types of establishment, as determined by TEM, are presented in Figures 3"6.			
Engineering Control & percent Exposure Reduction:		Summarized in Table I - depends on worker activity			
PPE:		Summarized in Table I - depends on worker activity			
Analytic Method:		Fiber concentrationswere determined by the traditional phase contrast microscopy (PCM) method and 16 selected samples were analyzedby the more powerful transmission electron microscopy (TEM)			

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	PCM and TEM
Domain 2: Representative					

Continued on next page

– continued from previous page

Source Citation:	Yeung, P.,Patience, K.,Apthorpe, L.,Willcocks, D.. 1999. An Australian study to evaluate worker exposure to chrysotile in the automotive service industry. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3080975

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD, Australia
	Metric 3:	Applicability	High	× 2	2	in scope use
	Metric 4:	Temporal Representativeness	Low	× 2	6	1996
	Metric 5:	Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	High	× 1	1	well described within document
Overall Quality Determination†			High		1.6	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Roedelsperger, K.,Jahn, H.,Brueckel, B.,Manke, J.,Paur, R.,Woitowitz, H. J.. 1986. ASBESTOS DUST EXPOSURE DURING BRAKE REPAIR. American Journal of Industrial Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3093764

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	automotive brake repair
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Short-term asbestos dust exposures were measured by light microscopy in 101 personal samples during blowing out of brakes, and grinding and turning of brake linings. During blowing out of car brakes, as well as during grinding of brake linings, the product of fiber concentration with length > 5 micro-m and sampling time amounted to about 4-5 fibers/ml-min corresponding to a concentration of 10ĝ fibers/m3 over 4-5 min. For trucks and buses higher amounts of 5-10 * 10ĝ fibers/m3 min were observed during these operations.
Number of Samples:	Ninety dust measurements in 76 service stations were made by phase contrast microscopy and by scanning transmission electron microscopy.101 personal samples
Number of Sites:	76 service stations
Type of Measurement or Method:	Short-term
Worker Activity:	The number of working operations which were registered in 76 automobile garages during dust sampling can be seen in Table I.The use of exhaust ventilation is also indicated.
Number of Workers:	210 vehicle mechanics
Type of Sampling:	Personal, area
Sampling Location:	Automobile maintenance shops
Exposure Duration:	In general, personal sampling was extended over the whole service operation which lasted 1 h or more, but in some cases personal sampling was limited to certain dust-generating work operations. Therefore, depending on the duration of the work operation, sampling time varied from less than 3 min to more than 1 h.
Exposure Frequency:	From occupational histories of 210 vehicle mechanics, an average duration of employment of X f s = 21 f 10 years and a mean cumulative fiber dose of X f s = (0.54 1.1) - lo6 fibers/m3 - years were calculated.
Bulk and Dust Particle Size Distribution:	By electron microscopy, extremely fine chrysotile fibers with lengths < 5 micro-m were identified in brake drum dust. Fibers with lengths >= 5 micro-m constituted less than 1 percent of all chrysotile fibers counted in brake drum dust.

Continued on next page

– continued from previous page

Source Citation:	Roedelsperger, K.,Jahn, H.,Brueckel, B.,Manke, J.,Paur, R.,Woitowitz, H. J.. 1986. ASBESTOS DUST EXPOSURE DURING BRAKE REPAIR. American Journal of Industrial Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3093764

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Engineering Control & percent Exposure Reduction:		Compressed air was used to blow out loose dust in 15 of 36 garages servicing cars and in 19 of 40 garages servicing trucks or buses. Special exhaust ventilation systems were used during blowing-out operations in 8 of the car garages and in 10 of the bus and truck garages. In addition to compressed air blowing, brushing and the use of solvents were observed. Only brake systems heavily contaminated with oil and dirt were cleaned with hot water.			
PPE:		Not discussed			
Analytic Method:		Fiber concentrations were determined by light and electron microscopy. Fibers with lengths > 5 micro-m were counted with phase contrast light microscopy using the reference method of the AIA [Asbestos International Association, 1979]			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	Medium	× 1	2	PCM and TEM in accordance with the AIA
Domain 2: Representative					
	Metric 2: Geographic Scope	Medium	× 1	2	OECD, Germany
	Metric 3: Applicability	High	× 2	2	in scope use
	Metric 4: Temporal Representativeness	Low	× 2	6	study ranges from 1975 to 1983
	Metric 5: Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	High	× 1	1	well described within document

Continued on next page

– continued from previous page

Source Citation:	Roedelsperger, K.,Jahn, H.,Brueckel, B.,Manke, J.,Paur, R.,Woitowitz, H. J.. 1986. ASBESTOS DUST EXPOSURE DURING BRAKE REPAIR. American Journal of Industrial Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3093764

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Overall Quality Determination†		Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Godbey, F. W.. 1988. Preliminary Survey Report: Evaluation of Brake Drum Service Controls at U.S. Army Armor Center, Fort Knox, Kentucky, Report No. CT-152-15A.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3099099

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	brake drums in automobiles, jeeps, trucks, trailers, and buses
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	The author concludes that this facility did not appear to have asbestos controls that were sufficient to protect the workers from asbestos dust arising from service operations. The advisability of conducting an in depth evaluation of the controls at this facility will be made in the future, after all the preliminary surveys and finalization of the protocol for the project has been reached. - No monitoring data
Number of Sites:	A visit was made to the U.S. Army Armor Center (SIC-9711), Fort Knox, Kentucky, as part of a study of asbestos (1332214) hazards encountered during the maintenance and repair of vehicular brakes.
Worker Activity:	Exposure to asbestos may occur during cleaning, maintenance, and repair of brakes. Vehicular brakes are serviced at this facility utilizing a H.B. Fuller Multi-Clean wet and dry power vacuum cleaner supplemented by wet bristle brushing. Once the wheel has been removed, the hub is vacuumed prior to any attempt to remove it. If force is needed, the back of the hub is vacuumed several times during the removal process. Once the hub is removed, it is placed gently on the floor and the hub and surrounding areas vacuumed. The brake shoe area is vacuumed in conjunction with wet bristle brushing and water rinsing. Once the brake area is free of all accumulated dust, the brakes are serviced.
Number of Workers:	Not specified
Exposure Duration:	Not discussed
Exposure Frequency:	Approximately 800 vehicles were maintained at this center each year with about 100 brake jobs being needed during that course of time.

Continued on next page

– continued from previous page

Source Citation:	Godbey, F. W.. 1988. Preliminary Survey Report: Evaluation of Brake Drum Service Controls at U.S. Army Armor Center, Fort Knox, Kentucky, Report No. CT-152-15A.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3099099

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Engineering Control & percent Exposure Reduction:		Workers were encouraged to use good work practices including the complete water rinsing and wet bristle brushing of all exposed parts prior to handling, gently removing and handling all parts, consistently using all required personal protective equipment, and following instructions for use of asbestos control devices.This U.S. Army Armor Center uses a H.B. Fuller Multi-Clean wet and dry power vacuum cleaner supplemented by wet bristle brushing and water rinsing in an attempt to control asbestos fibers generated during the servicing of vehicular brakes. The vacuum cleaner is not equipped with a HEPA filter which is necessary to entrap the asbestos dust inside the collector and prevent re-entry into the working environment. The wet bristle brushing and water rinsing may control asbestos dust not already disseminated into the workingenvironment by the vacuuming action.			
PPE:		NIOSH/MSHA-approved asbestos dust masks are provided and their use required during brake servicing (see Attachment A).			

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	NIOSH
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	High	× 2	2	in scope use - vehicular brakes
	Metric 4: Temporal Representativeness	Low	× 2	6	survey is from 1985
	Metric 5: Sample Size	N/A		N/A	Not applicable; no data provided
Domain 3: Accessibility/Clarity					

Continued on next page

– continued from previous page

Source Citation:	Godbey, F. W.. 1988. Preliminary Survey Report: Evaluation of Brake Drum Service Controls at U.S. Army Armor Center, Fort Knox, Kentucky, Report No. CT-152-15A.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3099099

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
	Metric 6: Metadata Completeness	N/A		N/A	Not applicable; no data provided
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	N/A		N/A	Not applicable; no data provided
Overall Quality Determination†		Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Godbey, F. W.,Cooper, T. C.,Sheehy, J. W.,O'Brien, D. M.,Van Wagenen, H. D.,McGlothlin, J. D.,Todd, W. F.. 1987. In-Depth Survey Report: Evaluation of Brake Drum Service Controls at United States Postal Service, Vehicle Maintenance Facility, Nashville, Tennessee, Report No. CT-152-20B.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3099476

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	brake drums for jeep delivery vehicles, thirteen seven ton internation trucks, three mack and two white tractors, seven trailers
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Personal and Area - see Tables 1 and 2Nineteen of the 20 personal samples taken during 10 brake jobs were below the deteet10n llrn1t of 0 004 fibers/cc Beeause personal sample concentrat10ns represented exposures whlle serv1clng brakes, and thlS usually takes no more than 2 to 5 hours per sh1ft, the meehan1cs t1IDe-welghted averages exposure would be even lower than the measured levels. Only 1 of the 76 samples analyzed by PCH was above the detectable lim1t, thus, analyses eomparing brake mechanLcs, type of veh1cle, and d1fferences between brake inspectlon and brake replacements were not done
Number of Samples:	60+ samplesReal-tlme data collection was durlng actual brake maintenance oper-atlons, approximately an hour 1n duratlon, and was obtalned durln all 10 brake malntenance jobs Nlne different operators performed the brake maintenance jobs on these 10 vehicles
Number of Sites:	One site - postal site
Type of Measurement or Method:	Personal air samples for asbestos were collected in duplicate on 0 8-um pore slze, 25 mm-dlameter cellulose ester membrane filters at 3 0 lpm for the duration of a slngle brake job, or 2 hours, whlchever was longer The total volume collected (360 llterS) allowed a limit of detection of approXlmately o 004 flbers/cc by Phase Contrast Microscopy (PCM) analysls

Continued on next page

– continued from previous page

Source Citation:	Godbey, F. W.,Cooper, T. C.,Sheehy, J. W.,O'Brien, D. M.,Van Wagenen, H. D.,McGlothlin, J. D.,Todd, W. F.. 1987. In-Depth Survey Report: Evaluation of Brake Drum Service Controls at United States Postal Service, Vehicle Maintenance Facility, Nashville, Tennessee, Report No. CT-152-20B.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3099476

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
	Worker Activity:				Wheels are elevated, removed, and the brakes inspected. Loose dust is cleaned from the drums and brake assemblies by vauuming, wet or dry wiping/brushing, using compressed air, or a combination of these methods. Parts are tehn replaced or repaired as needed and the brake system is reassembled and adjusted.This facility 1S currently replacing asbestos brake shoes with the nonasbestos type when vehicle brakes are repa1red OUr control evaluatlon at this fac llty concent ated on Jeep vehlcle ma1ntenance to determlne the variabllity of control effectlveness ln the same model vehlcle dU lng 10 separate vehlcle brake repa1r or inspecll0ns
	Number of Workers:				The garage is staffed with nlne mechanics, one lead mechanlc, four garagemen, one body man and two superv1sors.
	Type of Sampling:				personal and area
	Sampling Location:				Vehicle maintenance garage
	Exposure Duration:				SlX mechanics work from 6'00 a m to 2'30 p m. and four mechanlcs work fram 9'30 a,m to 6'00 pm. wlth all 10 mechanics on duty from 9 30 a m to 2'30 p m
	Exposure Frequency:				Unsure, assumed daily
	Bulk and Dust Particle Size Distribution:				A bulk brake dust samples for each vehicle and a bulk rafter sample for the site were collected and analyzed for asbestos by TEM
	Engineering Control & percent Exposure Reduction:				Ventllatlon of the garage is mlnxmal There is a serles of roof mounted fans on each slde of the garage These are operated 10 summer to remove hot alr from under the roof area In the cooler months, these fans are not used and the nlet dampers are kept closed There 19 no provision for provldlng fresh, heated air from the outslde When the 14 bay doors can be left open during mild weather, they provlde a lot of useful ventllation DuCLOS colder weather, the garage alr temperature 19 kept at 60 65 F at the mechanlC9working level
	PPE:				Not specified.
	Analytic Method:				PCM /TEM

EVALUATION

Continued on next page

– continued from previous page

Source Citation:	Godbey, F. W.,Cooper, T. C.,Sheehy, J. W.,O'Brien, D. M.,Van Wagenen, H. D.,McGlothlin, J. D.,Todd, W. F.. 1987. In-Depth Survey Report: Evaluation of Brake Drum Service Controls at United States Postal Service, Vehicle Maintenance Facility, Nashville, Tennessee, Report No. CT-152-20B.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3099476

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	NIOSH
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	High	× 2	2	in scope use
	Metric 4: Temporal Representativeness	Low	× 2	6	1987
	Metric 5: Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	High	× 1	1	well described within document
Overall Quality Determination†		High		1.4	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Sheehy, J. W.,Todd, W. F.,Cooper, T. C.,Van Wagenen, H. D.. 1987. In-Depth Survey Report: Evaluation of Brake Drum Service Controls at Cincinnati Bell Maintenance Facility, Fairfax, Ohio, Report No. CT-152-21B.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3099480

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	brake repair for vans, automobiles, and a scooter - see Table 1
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Individual fllter sample results for alrborne asbestos fibers are presented in Table 1 of Appendix A and are summar1zed in Tables 2 and 3 The results for samples analyzed by Phase Contrast Mlcroscopy (PCM) are presented in Table 2The use of the vacuum (wlth a HEPA fllter) for vehlcles such as vans and automobiles, resulted in very low exposures to flbers (PCM) and very low asbestos exposures (TEM) based on personal samples, lndlcatlng effective control of the asbestos dust. Personal exposures (PCM) were low compared to the OSHA standard of 0.2 fibers/cc, the NIOSH recommended standard of 0.1 fibers/cc.
Number of Samples:	60+ see table 2 and 3 for breakdown of # of samples per sampling type and per activity
Number of Sites:	Fairfax maintenance garage - one site
Type of Measurement or Method:	Short-term: 2-3 hour samples
Worker Activity:	brake maintenance and repair - see breakdown of exposure results by activity
Number of Workers:	2 mechanics
Type of Sampling:	personal, area, real time monitoring, bulk sampling
Sampling Location:	Maintenance garage
Exposure Duration:	2-3 hour samples
Exposure Frequency:	This Falrfax sattelite garage has two mechanics on its staff and they are assigned to the second shift only. During the latter part of the 2nd shift, they were the only Bell employees actually present and worklng in the garage. The mechanics and other garage employees are members of the Communlcation Workers of America
Bulk and Dust Particle Size Distribution:	Bulk samples were collected from the rear wheel drums of six of the seven vehicles tested. In addltlon, a rafter sample from the garage was collected and analyzed.Less than one percent of the mater1al in the brake drum bulk samples was asbestos, but from 24 to 100 percent of the f bers in the brake drum bulk samples were chrysoti1e, and in fivve of the S1X samples at least 96 percent of the fibers were chrysot11e.

Continued on next page

– continued from previous page

Source Citation:	Sheehy, J. W.,Todd, W. F.,Cooper, T. C.,Van Wagenen, H. D.. 1987. In-Depth Survey Report: Evaluation of Brake Drum Service Controls at Cincinnati Bell Maintenance Facility, Fairfax, Ohio, Report No. CT-152-21B.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3099480

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Engineering Control & percent Exposure Reduction:		Several work practices employed by the brake rnechanlCs were (I) to always use the Nilfisk vacuum, (2) If dust is created, try to avoid breath1ng 1t by mov1ng away untll lt clears, and (3) clean up as soon as the job is completeGenerally, the mechanics vacuumed each indiv1dual part removed from the b ake assemblyKurz Model No 480 and TSI Model No 1630 air veloclty meters were used to measure air velocltles to determ1ne alr flow rates ln the garage			
PPE:		See "Company Asbestos Exposure Guidelines" paragraph on pg. 7			
Analytic Method:		PCM /TEM			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	NIOSH
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	High	× 2	2	in scope use
	Metric 4: Temporal Representativeness	Low	× 2	6	1987
	Metric 5: Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	High	× 1	1	well described within document
Overall Quality Determination†		High		1.4	

Continued on next page

– continued from previous page

Source Citation:	Sheehy, J. W.,Todd, W. F.,Cooper, T. C.,Van Wagenen, H. D.. 1987. In-Depth Survey Report: Evaluation of Brake Drum Service Controls at Cincinnati Bell Maintenance Facility, Fairfax, Ohio, Report No. CT-152-21B.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3099480

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Kauppinen, T.,Korhonen, K.. 1987. Exposure to Asbestos During Brake Maintenance of Automotive Vehicles by Different Methods. American Industrial Hygiene Association Journal.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3100008

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	brake repair for automobiles - passenger cars, trucks and buses
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	The estimated average asbestos exposure during the workday (8-hr time-weighted average) was 0.1-0.2 fibers/cm3 during brake repair of trucks or buses, and under 0.05 f/cm3 during repair of passenger car brakes when the background concentration was not included in the calculations. The background concentration was estimated to be less than 0.1 f/cm3 " During brake maintenance of buses and trucks, heavy exposure, 0.3-125 (mean 56) f/cm3 , was observed during machine grinding of new brake linings if localexhaust was not in use. Other short-term operations during which the concentration exceeded 1 f/cm3 were the cleaning of brakes with a brush, wet cloth or compressed air jet. During brake servicing of passenger cars, the concentration of asbestos exceeded 1 f/cm3 only during compressed air blowing without local exhaust. The different methods of decreasing the exposure and the risk of asbestos-related diseases among car mechanics are discussed.
Number of Samples:	100+ - see Table I for number of samples per operation
Number of Sites:	24 Finnish workplaces - The authors carried out measurements in 7 out of 24 workplaces under study
Type of Measurement or Method:	Short-term and 8-hr TWA
Worker Activity:	brake repair of trucks, buses, passenger cars
Number of Workers:	Not specified
Type of Sampling:	personal and area
Sampling Location:	breathing zones, unclear where respirable dust measurements were made (stated measurements were taken "in working area")
Exposure Duration:	Eight-hour time-weighted average (TW A) concentrations of asbestos were estimated for different work procedures.
Exposure Frequency:	Mechanic will maintain the brakes of an average of 12 trucks or buses in a year
Bulk and Dust Particle Size Distribution:	Not discussed
Engineering Control & percent Exposure Reduction:	not discussed

Continued on next page

– continued from previous page

Source Citation:	Kauppinen, T.,Korhonen, K.. 1987. Exposure to Asbestos During Brake Maintenance of Automotive Vehicles by Different Methods. American Industrial Hygiene Association Journal.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3100008

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
PPE:		Not discussed			
Analytic Method:		Asbestos fibers (length over 5 um, diameter under 3 um and the aspect ratio over 3: I) were counted by a phase contrast-optical microscope according to the standardized method (Finnish Standard SFS 3868).			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	PCM according to standardized Finnish method
Domain 2: Representative					
	Metric 2: Geographic Scope	Medium	× 1	2	OECD, Finland
	Metric 3: Applicability	High	× 2	2	in scope use
	Metric 4: Temporal Representativeness	Low	× 2	6	1987
	Metric 5: Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	High	× 1	1	well described within document
Overall Quality Determination†		High		1.6	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Anonymous,. 1975. Information Indicating a Potential Health Hazard for Persons Exposed to Asbestos during the Servicing of Motor Vehicle Brake and Clutch Assemblies.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3100991

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	brake servicing for automobiles
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	This is a NIOSH communication alert - no monitoring data included. Contains alerts on best practices for minimizing asbestos dust during servicing of motor vehicle brake and clutch assemblies - evaluate if needed, but likely irrelevant to report considering other sources

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	NIOSH
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	in scope use - vehicular brakes
	Metric 4:	Temporal Representativeness	Low	× 2	6	1975
	Metric 5:	Sample Size	N/A		N/A	Not applicable; no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	N/A		N/A	Not applicable; no data provided
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	N/A		N/A	Not applicable; no data provided
Overall Quality Determination†			Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Paustenbach, D. J.,Richter, R. O.,Finley, B. L.,Sheehan, P. J.. 2003. An evaluation of the historical exposures of mechanics to asbestos in brake dust. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531297

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	brake servicing for automobiles
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Estimated and measured 8-hour TWAs for mechanics servicing automobiles and light trucks ranged from<0.002 to 0.68 f/cc, with a mean of 0.04 f/cc. In contrast, the 8-hour TWAs for mechanics servicing heavy trucks and buses ranged from 0.002 to 1.75 f/cc, with a mean of 0.2 f/cc, suggesting that these mechanics experienced higher daily asbestos exposures than automobile and light truck mechanics. Brake job and 8-hourTWAs for brake mechanicsworldwide were found to be similar during the same time periods, and they were consistently belowcontemporaneous occupational health standards in the United States. The increased use of brake-dust control measures in some garages resulted in at least a 10-fold decrease in the TWA airborne concentrations of asbestos from the 1970s to the late 1980s.
Number of Samples:	Nearly 200 brake job and 8-hour TWA airborne asbestos samples were analyzed to assess how asbestos concentrations varied by type of vehicle serviced, country in which mechanics worked, time period, and brake-cleaning method. To facilitate comparisons, brake job TWAs were converted to estimated 8-hour TWAs using the durations and number of brake jobs performed per mechanic each day.
Number of Sites:	Unsure, study combines large number of other studies
Type of Measurement or Method:	This analysis focuses on 30 years of data collected during the brake repair event (e.g., a brake job) and 8-hour time-weighted average (TWA) personal samples. A brake job TWA represents the average concentration a mechanic experienced during brake servicing, rather than throughout theworkday, and an 8-hour TWA represents the average airborne concentration of asbestos for the entire workday (which would involve brake work and other activities).
Worker Activity:	This article presents a historical analysis of published data regarding the exposure of brake mechanics to asbestos as a result of doing brake work.
Number of Workers:	Unsure, study combines large number of other studies - see study
Type of Sampling:	Personal, area

Continued on next page

– continued from previous page

Source Citation:	Paustenbach, D. J.,Richter, R. O.,Finley, B. L.,Sheehan, P. J.. 2003. An evaluation of the historical exposures of mechanics to asbestos in brake dust. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531297

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Sampling Location:		Various, study combines large number of other studies - see study			
Exposure Duration:		Various, study combines large number of other studies - see study			
Exposure Frequency:		Unsure			
Bulk and Dust Particle Size Distribution:		Various, study combines large number of other studies - see study			
Engineering Control & percent Exposure Reduction:		Various, study combines large number of other studies - see study			
PPE:		Not mentioned			
Analytic Method:		Various			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Most studies used NIOSH methods
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	High	× 2	2	In-scope use
	Metric 4: Temporal Representativeness	Low	× 2	6	study published in 2003, but data collected is from 1970s to late 1980s
	Metric 5: Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Low	× 1	3	Variability and uncertainty not discussed.
Overall Quality Determination†		Medium		1.7	

Continued on next page

– continued from previous page

Source Citation:	Paustenbach, D. J.,Richter, R. O.,Finley, B. L.,Sheehan, P. J.. 2003. An evaluation of the historical exposures of mechanics to asbestos in brake dust. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531297

EVALUATION

Domain	Metric	Rating	MWF⋆	Score	Comments

⋆ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Salazar, N.,Cely-GarcÃa, M. F.,Breysse, P. N.,Ramos-Bonilla, J. P.. 2015. Asbestos exposure among transmission mechanics in automotive repair shops. Annals of Occupational Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531407

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	automotive transmission repair
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	On at least one of the days sampled, all riveters were exposed to asbestos concentrations that exceeded the US OSHA permissible exposure limit or the Colombian permissible limit value.Additionally, from the forty-seven 30-min short-term personal samples collected, two (4.3 percent) exceeded the US OSHA excursion limit of 1 f cm?3
Number of Samples:	150
Number of Sites:	2
Type of Measurement or Method:	8-hr TWA
Worker Activity:	Manipulating clutch facings (removing rivets and attaching facings to new clutch plate)
Number of Workers:	3 riveters and 1 supervisor
Type of Sampling:	Personal, area
Sampling Location:	Unsure where area samples were taken
Exposure Duration:	263-553
Exposure Frequency:	Unsure
Bulk and Dust Particle Size Distribution:	The asbestos content bulk analysis showed that the two brands reported by the workers as asbestos-containing products had a 20 percent content of chrysotile. There was no variation in asbestos content between the four clutch facings analyzed per brand. The four clutch facings of the brand reported by workers as asbestos free, had a 25 percent content of fibrous glass and asbestos were "non-detected".
Engineering Control & percent Exposure Reduction:	One shop had a self-made extractor hood located above the countersink and rivet machines, which was rarely operated. There are two skylights in the roof, one located above the manipulation area, which remained open during the sampling days. Two exit doors remained open during the entire work-shift. The other shop had no ventilation.
PPE:	Both shops used inappropriate respiratory equipment

Continued on next page

– continued from previous page

Source Citation:	Salazar, N.,Cely-GarcÃa, M. F.,Breysse, P. N.,Ramos-Bonilla, J. P.. 2015. Asbestos exposure among transmission mechanics in automotive repair shops. Annals of Occupational Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531407

EVALUATION

Domain	Metric	Rating	MWF⋆	Score	Comments
Analytic Method:		PCM and TEM			

EVALUATION

Domain	Metric		Rating	MWF⋆	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Approved NIOSH methods
Domain 2: Representative						
	Metric 2:	Geographic Scope	Low	× 1	3	Non-OECD (Colombia)
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	High	× 2	2	2014
	Metric 5:	Sample Size	Medium	× 1	2	Only PCME results displayed, without showing the PCM and TEM results
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	Discussion of variability, uncertainty not accounted for in presented results
Overall Quality Determination†			High		1.4	

⋆ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Weir, F. W.,Tolar, G.,Meraz, L. B.. 2001. Characterization of vehicular brake service personnel exposure to airborne asbestos and particulate. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531556

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	brake servicing for automobiles
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Area and personal monitoring of fiber levels demonstrated counts (without compressed air) that ranged from 0.05 to 0.2 f/cc. Fiber counts when using compressed air averaged from 0.05 to 0.9 f/cc."Brake service monitoring in these tests demonstrates that asbestos fiber concentrations, considered on a time weighted average basis, should not exceed currently acceptable workplace standards whether or not the worker uses compressed air, nor during the arc grinding process when arcing is conducted in accord with the design of the equipment."
Number of Samples:	Phase I - 36 samplesPhase II - four runs, continuous sampling? Ask for second opinion
Number of Sites:	two - one for Phase I, one for Phase II
Type of Measurement or Method:	area and personal monitoring of fiber levels
Worker Activity:	Evaluation of fibers and total particulate generated during the servicing of drum brakes on motor vehicles as well as during the resurfacing (arcing) of brake shoes was conducted. Conditions for the studies were based on review of contemporary (" 19501980) working practices in the industry.This work was conducted in two parts. Phase 1 estimatedthe release of asbestos fibers and total particulate during brake inspection and replacement of light-duty vehicle rear drum brakes at an auto/truck repair facility. Two distinctwork practices were evaluated: One rear wheel from each vehicle was serviced using compressed air to remove dust while the second rear wheel was serviced without compressed air.The Phase 2 series evaluated the release of fibers and other particulate from arc grinding. For operations conducted under conditions simulating a workplace, a mean of 0.19 f/cc +/- 0.16 was determined.

Continued on next page

– continued from previous page

Source Citation:	Weir, F. W.,Tolar, G.,Meraz, L. B.. 2001. Characterization of vehicular brake service personnel exposure to airborne asbestos and particulate. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531556

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
	Number of Workers:				An experienced, factory-trained person operated the arcing machine for all tests in this series. This person had been the owner-operator of an after-market automotive parts supply facility located in a suburb of a major U.S. city during the interval when arc grinding was prevalent. His facility incorporated a full service drum turning/brake-shoe arcing shop on the premises
	Type of Sampling:				PBZ and area
	Sampling Location:				Phase I - The site for this study was a public service organization auto/truck repair facility.Phase II - The first test sequence of Phase 2 (identified as Run 1) was conducted in a suburban garage setting
	Exposure Duration:				See study for exact length of each procedureFor purposes of the experiments described in Phase 2, it was assumed that a worker would conduct twice as many brake jobs in a day as would occur in a typical shop. If a worker did nothing but turn drums and arc grind the brake shoes, he could complete work on 8 vehicles within an 8-hour workday.(15
	Exposure Frequency:				N/A - simulation study
	Bulk and Dust Particle Size Distribution:				For asbestos content verification, a bulk sample was collected from each of the 6 pairs of shoes used in this study. Samples were submitted to a certified independent laboratory.(20) The laboratory utilized a standard Polarized Light Microscopy (PLM) method for analysis of these samples,(21) indicating that chrysotile was the only asbestiform material present. Concentrations ranged from 5065 percent chrysotile.
	Engineering Control & percent Exposure Reduction:				n/a - simulation
	PPE:				In addition to the four sequences of testing presented above, the operator"s one-piece suit was carefully removed and then evaluated for the presence of fibers potentially generated during his arcing work.
	Analytic Method:				See page 5 for more details, but generally PCM and TEM for fibers

EVALUATION

Continued on next page

– continued from previous page

Source Citation:	Weir, F. W.,Tolar, G.,Meraz, L. B.. 2001. Characterization of vehicular brake service personnel exposure to airborne asbestos and particulate. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531556

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	NIOSH
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	High	× 2	2	In-scope use
	Metric 4: Temporal Representativeness	Medium	× 2	4	2001
	Metric 5: Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	High	× 1	1	well described within document
Overall Quality Determination†		High		1.2	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Williams, R. L.,Muhlbaier, J. L.. 1982. Asbestos brake emissions. Environmental Research.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3582125

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	automobiles brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	not relevant - measures asbestos braking emissions, not exposure from worker activities
Number of Samples:	17 for disc brakes and 12 for drum brakes
Number of Sites:	1
Worker Activity:	N/A - Not occupational exposure
Engineering Control & percent Exposure Reduction:	N/A - simulation
PPE:	N/A - simulation

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Optical microscopy using OSHA methods
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Unacceptable	× 2	8	Emissions during braking - not an occupational scenario within scope
	Metric 4:	Temporal Representativeness	Low	× 2	6	1981
	Metric 5:	Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	High	× 1	1	well described within document

Continued on next page

– continued from previous page

Source Citation:	Williams, R. L.,Muhlbaier, J. L.. 1982. Asbestos brake emissions. Environmental Research.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3582125

EVALUATION

Domain	Metric	Rating	MWF⋆	Score	Comments
Overall Quality Determination†		Unacceptable		4	Metric Mean Score: 2.1.

⋆⋆ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

⋆ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Hickish, D. E.,Knight, K. L.. 1970. Exposure to asbestos during brake maintenance. Annals of Occupational Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3610801

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	automobiles brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	the personal exposure of the operators was below the limit corresponding to 50-year exposure (from 1970). TWA average of personal samples was 0.79 f/ cm3.
Number of Samples:	Unsure
Number of Sites:	1
Type of Measurement or Method:	Short-term and TWA
Worker Activity:	Blowing out of brake dust
Number of Workers:	2 men studied for personal samples
Type of Sampling:	personal, area
Sampling Location:	Area samples taken by side of car, in the dust cloud, the adjacent bay, 2 bays away, and the center of the garage
Exposure Duration:	Two 45-min sampling periods for personal samples, static samples were approximately 3-hrs in duration
Exposure Frequency:	Blowing out of brakes is not part of routine
Bulk and Dust Particle Size Distribution:	Not specified in study
Engineering Control & percent Exposure Reduction:	Not specified in study
PPE:	Not specified in study
Analytic Method:	Air sampling using membrane filters. Technique described in the Hygiene Standard for Chrysotile Asbestos Dust, published by the British Occupational Hygiene Society(1968).

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					

Continued on next page

– continued from previous page

Source Citation:	Hickish, D. E.,Knight, K. L.. 1970. Exposure to asbestos during brake maintenance. Annals of Occupational Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3610801

EVALUATION

Domain	Metric		Rating	MWF⋆	Score	Comments
	Metric 1:	Methodology	Medium	× 1	2	Out of date sampling and assessment techniques: "the sampling and subsequent assessment being in accordance with the technique described in the Hygiene Standard for Chrysotile Asbestos Dust, published by the British Occupational Hygiene Society (1968)"
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD - Great Britain
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	Low	× 2	6	monitoring data is from 1970, out of date with respect to current products/ practices
	Metric 5:	Sample Size	Medium	× 1	2	Only 6 personal samples during car brake service
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Medium	× 1	2	Does not have specific durations by sample
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	not discussed
Overall Quality Determination†			Medium		2.1	

⋆ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Spencer, J. W.,Plisko, M. J.,Balzer, J. L.. 1999. Asbestos fiber release from the brake pads of overhead industrial cranes. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3615974

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Asbestos Fiber Release from the Brake Pads of Overhead Industrial Cranes, during use in industrial setting
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Eight hour time-weighted average (TWA) asbestos fiber concentrations ranged from <0.005 to 0.011 f/cc (PCM), and <0.0026 to <0.0094 f/cc (TEM). There were no asbestos fibers detected by the TEM method from air samples collected during the operation of the cranes.
Number of Samples:	Forty-four personal and area air sampleswere collected during the assessment
Number of Sites:	One site
Type of Measurement or Method:	TWA
Worker Activity:	The purpose of this study was to determine the actualcontribution of optically (phase contrast microscopy (PCM)) visible airborne asbestos " bers to the work environment from the operation of overhead cranes and hoists which use asbestoscomposition brake pads.
Number of Workers:	N/A - simulation study
Type of Sampling:	personal and area
Sampling Location:	Crane working area and on crane
Exposure Duration:	An overhead crane assembly comprised of a trolley and two hoists was employed for this study. The crane was operated for two consecutive eight-hour shifts representative of a heavy-duty cycle.
Exposure Frequency:	N/A - simulation study
Bulk and Dust Particle Size Distribution:	Bulk samples of the brake pad material were obtained and analyzed prior to initiating the duty cycle evaluation. One bulk sample each was obtained from the bridge, trolley, and the mainand auxiliary hoist brake padsAnalysis was performed using Polarized Light Microscopy (PLM) with dispersion staining. The results of laboratory analysis indicated that each brake shoe material contained 12 percent chrysotile asbestos by weight.
Engineering Control & percent Exposure Reduction:	N/A - simulation study
PPE:	N/A - simulation study

Continued on next page

– continued from previous page

Source Citation:	Spencer, J. W.,Plisko, M. J.,Balzer, J. L.. 1999. Asbestos fiber release from the brake pads of overhead industrial cranes. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3615974

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Analytic Method:		Asbestos fibers were analyzed for by phase contrast (NIOSH 7400) , and transmission electron (NIOSH 7402) microscopy methods.			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Approved NIOSH methods
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	Medium	× 2	4	Occupational exposure, not in-scope
	Metric 4: Temporal Representativeness	Low	× 2	6	1999
	Metric 5: Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	High	× 1	1	well described within document
Overall Quality Determination†		Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Lorimer, W. V.,Rohl, A. N.,Miller, A.,Nicholson, W. J.,Selikoff, I. J.. 1976. ASBESTOS EXPOSURE OF BRAKE REPAIR WORKERS IN UNITED-STATES. Mount Sinai Journal of Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3646036

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	brake repair
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	In addition, Boillat and Lob (8) reported values for various manipulations of the brake-lining material including punching holes for rivets, and grinding. Sampling interval is not given. Fiber counts ranged from 0.3 to 29.2 fibers/ml; four of the nine values were over 5 fibers/ml (5,000,000/m 3).PRESENT STUDY: Fiber concentrations for personal and background samples during blowing dust from drum brakes on automobiles are presented in Table II. The values show extensive variation, but the values at 3-5 feet are bY far the highest, with a mean of 15.9 fibers/ml. Fiber concentrations for personal and background samples during renewing used linings by grinding truck brakes are presented in Table III. The mean concentration for the personal sampler was 3.8 fibers/ml. Fiber concentrations for personal and background samples during beveling new linings for trucksare given in Table IV. The mean concentrations were 37 .5 fibers/ml.
Number of Samples:	20+ - see table II, III, IV, and V
Number of Sites:	In order to provide additional information on this subject, we have investigated asbestos exposure among brake repair maintenance workers in New York City and have initiated a clinical survey of workers employed in the workshops studied.
Type of Measurement or Method:	Personal air samples were taken during brake-lining maintenance work both on automobiles and trucks. These were peak samples taken over 2-10 minutes during which the workers were performing certain tasks, such as blowing dust from drum brakes, renewing used linings by grinding, and beveling new linings. Background samples were also taken at varying distances and times

Continued on next page

– continued from previous page

Source Citation:	Lorimer, W. V.,Rohl, A. N.,Miller, A.,Nicholson, W. J.,Selikoff, I. J.. 1976. ASBESTOS EXPOSURE OF BRAKE REPAIR WORKERS IN UNITED-STATES. Mount Sinai Journal of Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3646036

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Worker Activity:					"During brake-lining servicing the wheel is removed and all loose dust is removed from the drums and backplates. Compressed air jets are usually used (Fig. 1). In a two-city survey in the USA, Castleman et al (5) found that 175 out of 220 establishments used this procedure. Alternates include vacuuming and wet brushing. The brake lining itself may require grinding to remove irregularities or removal and replacement. The new lining may require considerable manipulation to fit the brake shoe-beveling edges and punching holes in the material, for example. As an alternative, the brake shoe and lining may be replaced as a unit. A number of studies have measured exposure in such work, and fiber counts reported are summarized in Table I.
Number of Workers:					"At least 900,000 people in the United States are employed as auto mechanics or garage workers"
Type of Sampling:					Personal and background sampling of workers engaged in brake maintenancework
Sampling Location:					Various, multiple studies
Exposure Duration:					60 - 450 minutes
Bulk and Dust Particle Size Distribution:					Brake linings pose a potential hazard for asbestos exposure because they contain 33-73 percent asbestos.Environ release: "Jacko and Ducharme (2) have estimated that 70 million pounds of asbestos (32 million Kg) are worn away from brake linings each year in the United States. Much of the asbestos worn away (around 80 percent -90 percent) drops to the road or is emitted intothe atmosphere."Several investigators (2-4). have analyzed bulk brake-drum dust for chrysotile and have found weight percentages of between 0.3 percent (2) to "at most 1 percent " (3). Lynch (4) reported percentages of 10 percent and 15 percent free fiber in two of fifteen samples. Most of the rest were below 1 percent ."PRESENT STUDY: Bulk samples of brake-drum dust were collected and analyzed by electron microscopy. One hundred fibers were sized in each sample. Qualitative morphologic comparisons of the fibers with standard chrysotile morphology were made.
Engineering Control & percent Exposure Reduction:					Not specified
PPE:					Not specified

Continued on next page

– continued from previous page

Source Citation:	Lorimer, W. V.,Rohl, A. N.,Miller, A.,Nicholson, W. J.,Selikoff, I. J.. 1976. ASBESTOS EXPOSURE OF BRAKE REPAIR WORKERS IN UNITED-STATES. Mount Sinai Journal of Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3646036

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Analytic Method:		"The standard techniques for filter processing and fiber counting which have been adopted by the Occupational Safety and Health Administration of the US Department of Labor were used (13). Samples of dust collected in the standard manner were examined both by standard optical techniques (fibers/ml > 5?) and by electron microscopy to give ?g/m3 of air, and the results compared."			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	Medium	× 1	2	Older methods used (OSHA)
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	High	× 2	2	In-scope use
	Metric 4: Temporal Representativeness	Low	× 2	6	exposure data from 1976
	Metric 5: Sample Size	Medium	× 1	2	Statistical distribution of results not described.
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty which could be determined from underlying methods
Overall Quality Determination†		Medium		1.8	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Sheehy, J. W.,Godbey, F. W.,Cooper, T. C.,Lenihan, K. L.,Van Wagenen, H. D.,McGlothlin, J. D.. 1987. In-Depth Survey Report: Control Technology for Brake Drum Service Operations at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, CT-152-18b.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3648228

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Automobile brake servicing
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	In this study, eight smaller vehicles and one large dump truck were evaluated. The smaller vehicles, all with rear drum brakes, included two automobiles, one passenger van, and five half-ton pickup trucks. The nine vehicles ranged in age from 1977 to 1985 with total vehicle mileage ranging from 16,000 to 106,000personal samples - averaged less than 0.004 f/ccsource samples - averaged less than 0.002 f/ccsee more details in Results section on page 14
Number of Samples:	18 personal samples, 9 fender source samples, 9 axle, 10 background, 12 ambient - see Table I and II for details
Number of Sites:	one site
Type of Measurement or Method:	personal and area samples; real-time air sampling every four seconds
Worker Activity:	brake drum servicing for 180 large trucks, 250 pickup trucks, 90 passenger cars, 25 vans, 25 loaders, and a number of other specialized road maintenance units"most of the approximately 300 to 500 brake jobs performed yearly are handled by 5 to 6 mechanics"
Number of Workers:	11 veteran mechanics, 2 body men, and 3 welders
Type of Sampling:	See page 12 for details
Sampling Location:	See page 12 for details
Exposure Duration:	personal - single brake job, or 2 hours, whichever was longerarea - 8-hr period
Exposure Frequency:	Not stated, assumed daily
Bulk and Dust Particle Size Distribution:	bulk brake dust samples for each sample - collected and analyzed for asbestos by TEM
Engineering Control & percent Exposure Reduction:	general ventilation system - see page 6also using a vacuum/enclosure unit to minimize exposure during brake servicing - see bottom of page 6
PPE:	Not specified
Analytic Method:	PCM/TEM

Continued on next page

– continued from previous page

Source Citation:	Sheehy, J. W.,Godbey, F. W.,Cooper, T. C.,Lenihan, K. L.,Van Wagenen, H. D.,McGlothlin, J. D.. 1987. In-Depth Survey Report: Control Technology for Brake Drum Service Operations at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, CT-152-18b.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3648228

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	NIOSH
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	High	× 2	2	in scope use
	Metric 4: Temporal Representativeness	Low	× 2	6	monitoring data is from 1987
	Metric 5: Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty which could be determined from underlying methods
Overall Quality Determination†		High		1.6	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Van Wagenen, H. D.. 1987. Preliminary Survey Report: Evaluation of Brake Drum Service Controls at Pennsylvania Bureau of Vehicle Management, Vehicle Maintenance Division, Harrisburg, Pennsylvania, Report No. CT-152-19a.
Type of Data Source	Occupational Exposure; Completed Exposure or Risk Assessments;
Hero ID	3648316

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	brake drum service controls (automobiles)
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	With readings taken every two seconds, the observed readings over the entire testing period of approximately 15 minutes lay in a 0.08-0.12 mg/m3 range. There were essentially no differences in the averaged readings over the different periods (1) before brake cleaning, (2) during brake cleaning, and (3) after conclusion of brake cleaning.If only nuisance dust were present, these 0.08-0.12 mg/m3 values are way below the OSHA PEL (permissible exposure level) limit of 10 mg/m3 for 8-hour TWA (time-weighted average) airborne concentrations. However, there is an Not specified amount of asbestos present and the OSHA PEL limit for asbestos fibers, at the time of this survey, was 2 fibers per cubic centimeter (2 f/cc) of air. The present OSHA PEL limit is 0.2 f/cc of air. Results from prior NIOSH investigations demonstrate that the brake dust taken from Clayton bag and prefilter surfaces should contain a low proportion of asbestos fibers (possibly 5-10 percent).
Number of Samples:	real-time monitoring
Number of Sites:	One site - This garage facility occupies an entire floor of a very large two-story Pennsylvania state building located adjacent to the main business district of the state's capitol, Harrisburg
Type of Measurement or Method:	Short-term
Worker Activity:	A crew of seven veteran mechanics are full time employees of the garage. Both overhead hoists and floor based hydraulic lifts are employed in a series of bays to raise the vehicles off the floor . The number of brake jobs varies considerably with time, but generally is in a range of 5 to 10 weekly . Housekeeping in the garage is good and there was no dust in the air on visual inspection.
Number of Workers:	seven
Type of Sampling:	real time air monitoring
Sampling Location:	adjacent to the Clayton unit
Exposure Duration:	15 minute test cycle

Continued on next page

– continued from previous page

Source Citation:	Van Wagenen, H. D.. 1987. Preliminary Survey Report: Evaluation of Brake Drum Service Controls at Pennsylvania Bureau of Vehicle Management, Vehicle Maintenance Division, Harrisburg, Pennsylvania, Report No. CT-152-19a.
Type of Data Source	Occupational Exposure; Completed Exposure or Risk Assessments;
Hero ID	3648316

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Bulk and Dust Particle Size Distribution:		Not specified in study			
Engineering Control & percent Exposure Reduction:		This Pennsylvania state garage uses the BCE-IOOO Clayton unit, comprising a transparent enclosure hood and an HEPA vacuum filter dust collector, for servicing of all vehicular brakes during their cleaning, maintenance, repair, and particularly replacement.			
PPE:		briefly mentions PPE, but does not seem to include PPE used at facility			
Analytic Method:		Real time air monitoring			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	NIOSH
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	High	× 2	2	in scope use
	Metric 4: Temporal Representativeness	Low	× 2	6	1987 study
	Metric 5: Sample Size	Low	× 1	3	Sample size and distribution not clearly characterized
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	Low	× 1	3	Samples presented in mg/m3
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty which could be determined from underlying methods
Overall Quality Determination†		Medium		2.0	

Continued on next page

– continued from previous page

Source Citation:	Van Wagenen, H. D.. 1987. Preliminary Survey Report: Evaluation of Brake Drum Service Controls at Pennsylvania Bureau of Vehicle Management, Vehicle Maintenance Division, Harrisburg, Pennsylvania, Report No. CT-152-19a.
Type of Data Source	Occupational Exposure; Completed Exposure or Risk Assessments;
Hero ID	3648316

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Donovan, E. P.,Donovan, B. L.,Sahmel, J.,Scott, P. K.,Paustenbach, D. J.. 2011. Evaluation of bystander exposures to asbestos in occupational settings: a review of the literature and application of a simple eddy diffusion model. Critical Reviews in Toxicology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2581697

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	brake repair and other categories
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Based on the available data and our modeling results, the authors propose the following approach as a rule of thumb: for persons 15 feet from the source, airborne asbestos concentrations can be roughly approximated at 50 percent of the source concentration; 35 percent at >510 feet, 10 percent for >1030 feet, and less than 1 percent at distances greater than 30 feet. This approach should be helpful for bracketing the range of likely exposures to bystanders being evaluated in asbestos-related dose-reconstruction analyses.
Number of Samples:	See Table 1, 2 and 3 - copy to sample tracking spreadsheet
Number of Sites:	See Table 1, 2 and 3 - copy to sample tracking spreadsheet
Type of Measurement or Method:	This article presents a review of the publicly available information as it relates to airborne asbestos concentrations at varying distances from a source in an occupational environment. Personal and area samples collected 575 feet from the primary worker from workplace surveys conducted in the 1970s and area samples collected 550 feet from the primary worker during more recent simulation studies were identified, compiled, and analyzed. As expected, airborne asbestos concentrations generally decreased with distance from the worker who performed a given task. Based on this review, however, the authors found that no systematic research to quantitatively relate fiber concentration with distance from the source (including consideration of fiber length, dilution ventilation, and initial momentum of the particle) has been conducted to date. A simple mathematical model was therefore used, and the results were considered, along with available published data comparing exposure data for both workers and persons/areas near workers. From this analysis, the authors offer guidance for estimating airborne asbestos concentrations at distance from a source.
Worker Activity:	Multiple - see Table summaries
Number of Workers:	Multiple - see Table summaries
Type of Sampling:	Multiple - see Table summaries

Continued on next page

– continued from previous page

Source Citation:	Donovan, E. P.,Donovan, B. L.,Sahmel, J.,Scott, P. K.,Paustenbach, D. J.. 2011. Evaluation of bystander exposures to asbestos in occupational settings: a review of the literature and application of a simple eddy diffusion model. Critical Reviews in Toxicology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2581697

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Sampling Location:		Multiple - see Table summaries			
Exposure Duration:		Multiple - see Table summaries			
Exposure Frequency:		Multiple - see Table summaries			
Bulk and Dust Particle Size Distribution:		Not specified in study			
Engineering Control & percent Exposure Reduction:		Not specified			
PPE:		Not specified			
Analytic Method:		Multiple - see Table summaries			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	PCM and TEM used for air samples
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	High	× 2	2	In-scope use
	Metric 4: Temporal Representativeness	Medium	× 2	4	multiple time periods, up to 2006
	Metric 5: Sample Size	Medium	× 1	2	Statistical distribution of results not described.
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty which could be determined from underlying methods
Overall Quality Determination†		High		1.4	

Continued on next page

– continued from previous page

Source Citation:	Donovan, E. P.,Donovan, B. L.,Sahmel, J.,Scott, P. K.,Paustenbach, D. J.. 2011. Evaluation of bystander exposures to asbestos in occupational settings: a review of the literature and application of a simple eddy diffusion model. Critical Reviews in Toxicology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2581697

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Strokova, B.,Evstatieva, S.,Dimitrova, S.,Mavrodieva, E.,Lukanova, R.. 1998. Study of asbestos exposure in some applications of asbestos materials in the chemical industry. International Archives of Occupational and Environmental Health.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3081101

EXTRACTION

Parameter	Data
Life Cycle Stage:	Asbestos Diaphragms
Life Cycle Description (Subcategory of Use):	production of asbestos gaskets and filter materials for technological equipment in the chemical industry.
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	The level of asbestos exposure registered was in the range 0,04 to 0,38 f/cm3 for the operators in the "Diaphragm electrolysis" shop and for the staff in the "Mechanical" shop of "Nephtochim" Co. - from 0.04 to 0.43 f/cm3.
Number of Samples:	Not specified
Number of Sites:	two
Type of Measurement or Method:	The sampling was performed observingall requirements of BSS 2200-85 [2], BSS 16909-89 131, BSS 172402-78 [4 I and EN 689/I 995 [5]. Personal and stationary dust sampling devices of "Higitcst" and "Guilian" types were used.
Worker Activity:	The workers from the "Cathode workshop", "Diaphragm electrolysis", "Polymers" Co., Devnja (12 operators) who operate the installation of asbestos diaphragms manufacture and installation of electrolysis cells, and the staff of the "Mechanical" shop of "Nephtochim" Co., Burgas, engaged in the cutting of gaskets made of pressed asbestos - polymer boards (6 workers), were studied.
Number of Workers:	18 workers total
Type of Sampling:	personal breathing zone
Sampling Location:	two sites
Exposure Duration:	Duration seems unclear from article - revisit
Exposure Frequency:	1 to 2 working shifts, but working shift length not defined
Bulk and Dust Particle Size Distribution:	not discussed (sheet gasket cutting summarized in ATSDR tox profile, HERO ID 3098571)
Engineering Control & percent Exposure Reduction:	The statements made increase the necessity of dust control by technical preventive means and the medical control of the workers exposed to asbestos-related injuries.
PPE:	The workers werc provided with suitable personal protection equipment for respiratory organs.

Continued on next page

– continued from previous page

Source Citation:	Strokova, B.,Evstatieva, S.,Dimitrova, S.,Mavrodieva, E.,Lukanova, R.. 1998. Study of asbestos exposure in some applications of asbestos materials in the chemical industry. International Archives of Occupational and Environmental Health.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3081101

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Analytic Method:		The hygienic normative standardsand methodology for measuring and assessment of the asbestos exposure, used all over the world were applied: mean shift count concentration of respirable asbestos fibres; entire shift personal sampling (BSS 2200-85), PCOM light microscopy (BSS 16909-89).			

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	Medium	× 1	2	BSS 2200-85 [2], BSS 16909-89 131, BSS 172402-78 [4 I and EN 689/I 995
Domain 2: Representative					
	Metric 2: Geographic Scope	Low	× 1	3	Non-OECD - Bulgaria
	Metric 3: Applicability	High	× 2	2	In scope use
	Metric 4: Temporal Representativeness	Medium	× 2	4	1998
	Metric 5: Sample Size	Medium	× 1	2	Statistical distribution of results not described.
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	Medium	× 1	2	Limited discussion of metadata
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty which could be determined from underlying methods
Overall Quality Determination†		Medium		1.9	

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Mlynarek, S. P.,Van Orden, D. R.. 2012. Assessment of potential asbestos exposures from jet engine overhaul work. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2565742

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Engine gaskets - jet engine overhaul
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	This study has demonstrated that the disturbance of asbestos-containing gaskets, o-rings, and other types of asbestos-containing components, while performing overhaul work to a jet engine produces very few airborne fibers, and that virtually none of these aerosolized fibers is asbestos. The overhaul work was observed to be dirty and oily. The exposures to the mechanics and bystanders were several orders of magnitude below OSHA exposure regulations, both current and historic. The data presented underscore the lack of risk to the health of persons conducting this work and to other persons in proximity to it from airborne asbestos.See results section for details /summary
Number of Samples:	A total of 425 bulk samples, 197 area air samples, 189 personal air samples, and 72 blank samples were collected. Personal air samples were collected in duplicate and 78 of these duplicate personal air samples collected were archived and not analyzed. All anticipated personal samples were collected from the mechanics performing the work and the bystander. Regarding phase contrast microscopy (PCM) and transmission electron microscopy (TEM) analyses, only 2 of the 458 (0.4 percent) personal and area air samples were not able to be analyzed, and both of these voided samples were area air samples. In both cases the filter was damaged and/or obstructed.
Number of Sites:	This study was conducted at JB Power LTD, an established jet engine service facility located in Miami, Florida.
Type of Measurement or Method:	Separate personal air samples were collected during the rebuild of the gear box and other components from the mechanics that performed the work. Area air samples were collected in proximity to this work in conjunction with the overhaul, as were samples from the two outdoor locations.Air sampling equipment adhered to the requirements of the National Institute of Occupational Safety and Health (NIOSH) Method 7400 (NIOSH, 1994a) and the Asbestos Hazard Emergency Response Act (AHERA) (USEPA, 1987).

Continued on next page

– continued from previous page

Source Citation:	Mlynarek, S. P.,Van Orden, D. R.. 2012. Assessment of potential asbestos exposures from jet engine overhaul work. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2565742

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Worker Activity:					Jet engines contained various components (gaskets, clamps, o-rings and insulation) that contained asbestos that potentially could release airborne fibers during routine maintenance or during an engine overhaul. To evaluate the potential exposures to aircraft mechanics, a Pratt & Whitney JT3D jet engine was obtained and overhauled by experienced mechanics using tools and work practices similar to those used since the time this engine was manufactured.
Number of Workers:					Exact number Not specified
Type of Sampling:					bulk, area, personal air
Sampling Location:					Air sampling was conducted to determine the airborne fiber concentrations in during the overhaul. Area sampling was conducted at four locations centered on the engine overhaul. The area samples were initiated at approximately the same time as work began, and were terminated at the end of the work day. Sampling was also conducted outside the buildings to allow comparison between outdoor and indoor fiber levels.Personal air sampling was conducted to provide information regarding the airborne asbestos fiber exposure of persons performing the engine overhaul or service work. The personal air samples used to assess potential asbestos fiber exposure were collected in duplicate, i.e., using side-by-side personal sampling pumps and collection media. One set of these personal samples was submitted for analyses, and the other set was archived.
Exposure Duration:					Task-based sample times, see Table I
Exposure Frequency:					Not discussed

Continued on next page

– continued from previous page

Source Citation:	Mlynarek, S. P.,Van Orden, D. R.. 2012. Assessment of potential asbestos exposures from jet engine overhaul work. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2565742

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
	Bulk and Dust Particle Size Distribution:				During the overhaul work, representative bulk samples of all types of parts removed and parts installed that could have contained asbestos were collected.A total of 425 bulk samples were collected, 420 were collected from the overhaul work and 5 from the facility or its contents. Of the 420 analyses of samples associated with the overhaul work, 403 of these were of Pratt & Whitney engine parts, and 17 of these were from parts designated as Quick Engine Change (QEC). These QEC parts are not Pratt & Whitney products. Of the Pratt & Whitney parts, 37 (9 percent) were positive for the presence of asbestos. In all cases the type of asbestos was chrysotile, and the percent asbestos present in these samples ranged from 30 percent to 90 percent . Of the QEC parts, 5 (33 percent) were positive for the presence of asbestos. In all cases the type of asbestos was chrysotile, and the percent asbestos present in these samples ranged from 40 percent to 90 percent . Of the 5 analyses of samples associated with the facility, none were positive for the presence of asbestos.
	Engineering Control & percent Exposure Reduction:				All work performed for the disassembly and reassembly of the engine was done in an open area within this building. The only exception to this was the rebuilding of the gearbox. There is a special room within the building where this work was performed. This room adjoins the offices, and it is 140 long 100 wide 80 high. It, like the offices, is air conditioned. While the office space and gear box room were air conditioned, there was no mechanical ventilation system for the work area for either heating or cooling. The building relies solely on natural convection... Due to these operating conditions, no attempt was made to determine the air changes per hour (ACH) in the building. Local ventilation problems may exist in some areas, but there were no obstruction to airflow at the location of the work done during this study.
	PPE:				Not discussed

Continued on next page

– continued from previous page

Source Citation:	Mlynarek, S. P.,Van Orden, D. R.. 2012. Assessment of potential asbestos exposures from jet engine overhaul work. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2565742

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Analytic Method:		All bulk samples were analyzed in accordance with published protocols (Perkins and Harvey, 1993).Air samples were analyzed in accordance with NIOSH 7400 (NIOSH, 1994a) and NIOSH 7402 (NIOSH, 1994b). When asbestos was observed during the NIOSH 7402 analysis, that sample was also prepared and analyzed in accordance with ISO 10312 (ISO, 1995).			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	NIOSH methods
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	Medium	× 2	4	Occupational exposure - not in-scope
	Metric 4: Temporal Representativeness	High	× 2	2	2012
	Metric 5: Sample Size	Medium	× 1	2	Samples presented as a range with statistics
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	Metadata provided
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	Discuss variability between different worker activities
Overall Quality Determination†		High		1.4	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Park, D.,Choi, S.,Ryu, K.,Park, J.,Paik, N.. 2008. Trends in occupational asbestos exposure and asbestos consumption over recent decades in Korea. International Journal of Occupational and Environmental Health.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3079461

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Multiple
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Data from Korean occupational health-related journals. Auto repair shop ranges: <0.02-8.0, 0.01-7.28 f/cc with mean of 0.27 f/cc, and 0.16-5.64 f/cc with geometric mean of 0.35 f/cc
Number of Samples:	204 samples of auto repair shops taken from 3 studies
Number of Sites:	10 auto repair shops
Type of Measurement or Method:	Not specified
Worker Activity:	Not specified
Number of Workers:	Not specified
Type of Sampling:	Personal
Sampling Location:	Not specified
Exposure Duration:	Not specified
Exposure Frequency:	Not specified
Bulk and Dust Particle Size Distribution:	Not specified
Engineering Control & percent Exposure Reduction:	Not specified
PPE:	Not specified
Analytic Method:	PCM

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	NIOSH 7400
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD, Korea
	Metric 3:	Applicability	High	× 2	2	Data from auto repair shops

Continued on next page

– continued from previous page

Source Citation:	Park, D.,Choi, S.,Ryu, K.,Park, J.,Paik, N.. 2008. Trends in occupational asbestos exposure and asbestos consumption over recent decades in Korea. International Journal of Occupational and Environmental Health.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3079461

EVALUATION

Domain	Metric		Rating	MWF⋆	Score	Comments
	Metric 4:	Temporal Representativeness	Low	× 2	6	1989-1991
	Metric 5:	Sample Size	Low	× 1	3	Not specified sample distribution
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Low	× 1	3	No description of metadata
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	Does not address variability/uncertainty
Overall Quality Determination†			Medium		2.2	

⋆ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Boelter, F. W.,Spencer, J. W.,Simmons, C. E.. 2007. Heavy equipment maintenance exposure assessment: using a time-activity model to estimate surrogate values for replacement of missing data. Journal of Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3079629

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	gaskets and packing
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	All three sets of statistics suggest that the mean and median exposures were less than 25 percent of 0.1 f/cc 8-hr TWA sample or 1.0 f/cc 30-min samples, and that there is at least 95 percent confidence that the true 95th percentile exposures are less than 0.1 f/cc as an 8-hr TWA.
Number of Samples:	A total of 782 samples were analyzed by phase contrast microscopy, and 499 samples were analyzed by transmission electron microscopy.
Number of Sites:	Mutliple per industry - see details within study
Type of Measurement or Method:	Full shift TWAs, personal 30-minexposures, and area full-shift TWA values
Worker Activity:	Removal with flat blade scraper, cleaning of flange with die grinder fitted with abrasive pad, compressed air, and emery cloth
Number of Workers:	Not specified
Type of Sampling:	Personal, area, bulk
Sampling Location:	PBZ and areas around vehicle service shop
Exposure Duration:	Half shift
Exposure Frequency:	Not specified
Bulk and Dust Particle Size Distribution:	Full shift TWAs, personal 30-minexposures, and area full-shift TWA values
Engineering Control & percent Exposure Reduction:	Not specified
PPE:	Not specified
Analytic Method:	PCM, PLM for bulk

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Well-described methodology

Continued on next page

– continued from previous page

Source Citation:	Boelter, F. W.,Spencer, J. W.,Simmons, C. E.. 2007. Heavy equipment maintenance exposure assessment: using a time-activity model to estimate surrogate values for replacement of missing data. Journal of Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3079629

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	in scope use
	Metric 4:	Temporal Representativeness	High	× 2	2	2011
	Metric 5:	Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	Discusses variability between different worker activities and analytical methods
Overall Quality Determination†			High		1.1	

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	del Piano, M.,Palagiano, C.,Rimatori, V.. 1989. Asbestos hazards in the city of Rome, Italy. Social Science and Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3615595

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	automobile brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Most values found are below the limits suggested for chrysotile by the American Conference of Government Industrial Hygienists and by the EEC which is 1 ff/ml for 8 working hours. It needs emphasis that the highest values found refer to short-term operationsand the weighted mean values over 8 working hours are below the limits. It follows that it is possible to lower the chrysotile concentrations in the work place air to insignificant levels, comparable to those of the exterior environment, if only the indoor conditionsare suitable. It is essential that there is appropriate motivation at the work place and also that the work pieces are kept wet at the point of work. In this way concentrations of asbestos fibres in the air drop considerably, probably to insignificant levels.Figure 2 and Table 1 show the percentage frequency distribution of the chrysotile concentration values in ff/ml in various departments during operations in the depots.
Number of Samples:	unclear
Number of Sites:	14 workplaces throughout Rome
Type of Measurement or Method:	Samples were collected on 25 mm dia membrane filters at flow rate of 2 l/min or higher (AIA and NIOSH methods) [13, 141, depending on both the duration of the operations and the expected dust concentration.
Worker Activity:	The exposure to asbestos of workers of the ATAC company (the public concern of urban passenger transport of Rome) is examined. This is particularly dangerous for workers who repair equipment with asbestos components. such as brake linings.
Number of Workers:	Not specified
Type of Sampling:	Chrysotile asbestos was found in the breathing zone (W) of workers and in fixed positions (AA) in the industrial areas and in fixed positions at a height of 1.5 m in urban areas of Rome.
Sampling Location:	fixed positions at a height of 1.5 m in urban areas of Rome.
Exposure Duration:	Not specified
Exposure Frequency:	Not specified

Continued on next page

– continued from previous page

Source Citation:	del Piano, M.,Palagiano, C.,Rimatori, V.. 1989. Asbestos hazards in the city of Rome, Italy. Social Science and Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3615595

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Bulk and Dust Particle Size Distribution:		Those employed in workshops servicing the urban passenger transportation company of Rome may be exposed to asbestos contained both in covering materials and in brake linings. The latter are fastened to the aluminium support with aluminium rivets. The asbestos content of such elements is about 28 percent , in various mixtures with other compounds. Asbestos used in brake linings is chrysotile, but over 99 percent of it is turned into forsterite, a dehydrated amorphous material, which is much less toxic and dangerous thanasbestos.			
Engineering Control & percent Exposure Reduction:		not discussed			
PPE:		not discussed			
Analytic Method:		Asbestos fibres were counted by PCOM (Phase Contrast Optical Microscopy) according to the AIA and NIOSH methods. The counting procedure generally used a Walton-Becket (WB) eyepiece graticule (100 field of 0.00785 mm") but, if necessary, the full viewing field was employed to ensure a minimum count of fibres. By the WB method fibre counts can be increased by a factor of 1.37 f 0.64, this effect being attributed to human error in full-field counting.			

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Well-described methodology
Domain 2: Representative					
	Metric 2: Geographic Scope	Medium	× 1	2	OECD, Italy
	Metric 3: Applicability	High	× 2	2	in scope use
	Metric 4: Temporal Representativeness	Low	× 2	6	1989
	Metric 5: Sample Size	Medium	× 1	2	Statistical distribution of results not described.
Domain 3: Accessibility/Clarity					

Continued on next page

– continued from previous page

Source Citation:	del Piano, M.,Palagiano, C.,Rimatori, V.. 1989. Asbestos hazards in the city of Rome, Italy. Social Science and Medicine.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3615595

EVALUATION

Domain	Metric	Rating	MWF⋆	Score	Comments
	Metric 6: Metadata Completeness	Low	× 1	3	sample durations not stated
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty which could be determined from underlying methods
Overall Quality Determination†		Medium		2.0	

⋆ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Johnson, P. L.. 1978. Industrial Hygiene Study of Tuffy Service Center.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3645784

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	automobile brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	No monitoring data provided in NIOSH survey
Number of Sites:	1

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	NIOSH
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	in scope use - vehicular brakes
	Metric 4:	Temporal Representativeness	Low	× 2	6	NIOSH survey conducted in 1976
	Metric 5:	Sample Size	N/A		N/A	Not applicable; no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	N/A		N/A	Not applicable; no data provided
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	N/A		N/A	Not applicable; no data provided
Overall Quality Determination†			Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Johnson, P. L.. 1976. Preliminary Industrial Hygiene Survey at Auto Brake Clinic, Cincinnati, Ohio.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3645882

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	automobile brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Personal breathing zone samples contained 0.16 to 1.82 fibers of asbestos greater than 5 microns per cubic centimeter (f/cc), and general area air samples" contained 0.008 to 0.169 f/cc.
Number of Samples:	Seven general area, five personal air samples, and three bulk brake drum dust samples were obtained during the visit
Number of Sites:	1
Type of Measurement or Method:	8-hr TWA
Worker Activity:	During the survey the brakes on four vehicles were serviced
Number of Workers:	3
Type of Sampling:	Personal, bulk, and area
Sampling Location:	PBZ
Exposure Duration:	Personal: 3-243 min Area: 61-282 min
Exposure Frequency:	Not specified
Bulk and Dust Particle Size Distribution:	Not specified
Engineering Control & percent Exposure Reduction:	Not specified
PPE:	Not specified
Analytic Method:	PCM, electron microscopy

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Well-described methodology
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	In-scope use

Continued on next page

– continued from previous page

Source Citation:	Johnson, P. L.. 1976. Preliminary Industrial Hygiene Survey at Auto Brake Clinic, Cincinnati, Ohio.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3645882

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
	Metric 4:	Temporal Representativeness	Low	× 2	6	1976
	Metric 5:	Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Medium	× 1	2	Most critical data included, but missing details like exposure frequency
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	The monitoring study does not address variability or uncertainty.
Overall Quality Determination†			Medium		1.8	

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Gorman, R. W.. 1979. Hazard Evaluation and Technical Assistance, Report No. TA-79-2, Department of Transportation Vehicle Inspection Stations, Washington, D.C.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3651762

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	automobile brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	No detectable levels of asbestos, hydrogen sulfide, or sulfur dioxide were found at either inspection station
Number of Samples:	6
Number of Sites:	1
Type of Measurement or Method:	8-hr TWA
Worker Activity:	Vehicle inspections
Number of Workers:	2 supervisors and 9 workers
Type of Sampling:	Area
Sampling Location:	Each work lane, about 4.5 ft above floor
Exposure Duration:	Not specified
Exposure Frequency:	The number of vehicles inspected can vary from 200 to 1000 per day for each station
Bulk and Dust Particle Size Distribution:	Not specified
Engineering Control & percent Exposure Reduction:	A project to upgrade the ventilation system in both inspection stations was completed- in the spring of 1977. The project included new, larger exhaust fans mounted on the roof, new ceiling duct work, and new ducts down the outside of the center pillars in the SW station.
PPE:	Not specified
Analytic Method:	PCM

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Well-described methodology

Continued on next page

– continued from previous page

Source Citation:	Gorman, R. W.. 1979. Hazard Evaluation and Technical Assistance, Report No. TA-79-2, Department of Transportation Vehicle Inspection Stations, Washington, D.C.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3651762

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	Low	× 2	6	1979
	Metric 5:	Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Medium	× 1	2	Most critical data included, but missing details like exposure frequency
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	Includes discussion of variability but not uncertainty, which could be determined from underlying methods
Overall Quality Determination†			Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Sheehy, J. W.. 1986. Preliminary Survey Report: Evaluation of Brake Drum Service Controls at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, Report No. CT-152-18a.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3659890

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	automobile brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	No monitoring data, just a description of the facility and the engineering controls that are employed
Number of Sites:	one
Engineering Control & percent Exposure Reduction:	Clayton (CAI) brake cleaning unit, brake enclosure hood and HEPA-filtered dust collector
PPE:	Protective masks

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	NIOSH
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	in scope use - vehicular brakes
	Metric 4:	Temporal Representativeness	Low	× 2	6	1986
	Metric 5:	Sample Size	N/A		N/A	Not applicable; no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	N/A		N/A	Not applicable; no data provided
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	N/A		N/A	Not applicable; no data provided

Continued on next page

– continued from previous page

Source Citation:	Sheehy, J. W.. 1986. Preliminary Survey Report: Evaluation of Brake Drum Service Controls at Ohio Department of Transportation, Maintenance Facility, Lebanon, Ohio, Report No. CT-152-18a.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3659890

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Overall Quality Determination†		Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Sussell, A.,Shults, R.. 1993. Health hazard evaluation report no. HETA 91-053-2320, Union Tank Car, Cleveland, Texas.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3970487

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Valve gaskets
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	The gasket buffing process generated large amounts of dust, which necessitated short-term sampling for asbestos to reduce the overloading of filters with particulate matter. Three to eight samples of 8 to 98 minutes duration were collected for each worker sampled. A total of 32 air samples were submitted for asbestos analysis by PCM, and if appropriate TEM. None of the samples contained detectable levels of fibers (limit of detection 7 fibers/mm2). However, the sampling results were inconclusive (and may include "false negatives"); high total dust levels necessitated short-term sampling, and nine of the 32 samples were so heavily overloaded with particulate matter that fibers could not be counted.
Number of Samples:	32 air samples
Number of Sites:	one site
Type of Measurement or Method:	Short-term samples taken
Worker Activity:	During the first site visit on February 20-21, 1991, personal breathing zone (PBZ) and area air samples were collected during the first shift, primarily during periods of highest work activity. During the sampling periods, work practices were observed. Processes sampled were (analytes in parentheses): valve gasket replacement and fiber insulation handling (asbestos, fibers)During the followup visit, on January 30, 1992, PBZ and area air samples were collected during the first and second shifts to measure full-shift and short-term (15-min) exposures to selected contaminants. (ASBESTOS NOT INCLUDED IN 2ND ROUND)
Number of Workers:	three
Type of Sampling:	PBZ and area air samples

Continued on next page

– continued from previous page

Source Citation:	Sussell, A.,Shults, R.. 1993. Health hazard evaluation report no. HETA 91-053-2320, Union Tank Car, Cleveland, Texas.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3970487

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
	Sampling Location:				PBZ and area samples were collected with the specified sampling media connected via plastic tubing to portable battery-operated personal sampling pumps. The pumps were calibrated immediately before and after sampling with a mass flowmeter which had been calibrated with a primary standard (bubble flowmeter). The means of the measured pre- and post-sampling flow rates were used to calculate sample volumes. PBZ samples were collected in workers' breathing zones by attaching the media on the workers' shirt collars; except that for workers wearing welding facemasks the samples were collected in the facemasks. Area air samples for asbestos were collected with electric-powered high-flow pumps connected to a laboratory-calibrated critical orifices (flow rates of 8.25 and 8.9 liters per minute (L/min))
	Exposure Duration:				50 - 100 min
	Exposure Frequency:				Not specified, assumed daily since facility will often deal with "large batches" of train cars at a time
	Bulk and Dust Particle Size Distribution:				Bulk materials were sampled to determine potential worker exposures to hazardous materials. Processes sampled were (analytes in parentheses): valve gaskets, fibrous glass (asbestos)Bulk samples were collected on the first site visit of valve gaskets and gasket dust in the buffing area; and of fiberglass insulation to determine potential sources of asbestos exposure. After ensuring homogeneity of the samples, representative portions of each sample were immersed in Cargille liquids and analyzed for percent asbestos by polarized light microscope (PLM) at a magnification of 100X.Five valve gasket bulk samples were collected from different sizes of gaskets and submitted for asbestos analysis by PLM. All were found to be 90 percent chrysotile asbestos, indicating a potential health hazard due to airborne asbestos exposure during gasket buffing and valve cleaning. Two samples of dust collected on the desk top in the buffing area were 1 percent chrysotile asbestos; the remainder of the samples was primarily rubber and metal fragments.
	Engineering Control & percent Exposure Reduction:				Not specified
	PPE:				On the day of the survey the valve repairman wore a supplied air respirator during the periods ofgasket buffing.

Continued on next page

– continued from previous page

Source Citation:	Sussell, A.,Shults, R.. 1993. Health hazard evaluation report no. HETA 91-053-2320, Union Tank Car, Cleveland, Texas.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3970487

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Analytic Method:		A total of 32 air samples were submitted for asbestos analysis by PCM, and if appropriate TEM.			

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	NIOSH HHE
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Occupational exposure
	Metric 4:	Temporal Representativeness	Low	× 2	6	1991
	Metric 5:	Sample Size	Medium	× 1	2	Statistical distribution of results not described.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	well described within document
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	Variability and uncertainty not discussed.
Overall Quality Determination†			Medium		2.0	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Belanger, P. L.,Coye, M. J.. 1981. Health hazard evaluation report no. HHE 80-185-842, Department of Munipal Railway Woods Division, San Francisco, California.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3970531

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	railroad tank car repair
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	No useful information in this study other than generic asbestos warnings

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	NIOSH HHE
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Occupational use - not in scope
	Metric 4:	Temporal Representativeness	Low	× 2	6	1980
	Metric 5:	Sample Size	Low	× 1	3	No sample data provided in article
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	No monitoring data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	The monitoring study does not address variability or uncertainty.
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.4.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Echa,. 2014. Committee for Risk Assessment (RAC) opinion on an Annex XV dossier proposing restrictions on chrysotile.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3970699

EXTRACTION

Parameter	**Data**
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Multiple uses
Exposure Concentration (Unit):	No monitoring data, document just states dangers associated with asbestos and reasons why its use should be restricted

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Medium	× 1	2	European Chemicals Agency (ECHA)
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD - Finland
	Metric 3:	Applicability	Medium	× 2	4	Related to occupational exposure
	Metric 4:	Temporal Representativeness	High	× 2	2	2014
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.2.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Wages, R. obert,Markowitz, S. teven,Kieding, S. ylvia,Griffon, M. ark,Ellenbecker, M. ichael. 1998. Former worker medical surveillance program at Idaho National Engineering and Environmental Laboratory (INEEL) Phase I: Needs assessment.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3974967

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	brake work on buses and other site vehicles
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	"Asbestos insulation was used extensively in the 1950's when many facilities at the INEEL were initially constructed. Asbestos-containing materials are found in roofmg, pipe and vessel insulation, building insulation, gaskets, packing, siding and other building materials. Asbestos exposure may also have occurred in relation to work with asbestos blankets and asbestos gloves. In addition, mechanics working at the CFA Big Shop were exposed to asbestos during brake work on buses and other site vehicles." - No monitoring data, risk mapping assessment

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Work performed under DOE contract expected to meet reliable methods
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Uses include occupational uses, but not uses within scope
	Metric 4:	Temporal Representativeness	Medium	× 2	4	1998
	Metric 5:	Sample Size	N/A		N/A	Not applicable; no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	N/A		N/A	Not applicable; no data provided
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	N/A		N/A	Not applicable; no data provided

Continued on next page

– continued from previous page

Source Citation:	Wages, R. obert,Markowitz, S. teven,Kieding, S. ylvia,Griffon, M. ark,Ellenbecker, M. ichael. 1998. Former worker medical surveillance program at Idaho National Engineering and Environmental Laboratory (INEEL) Phase I: Needs assessment.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3974967

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Overall Quality Determination†		Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Markowitz, S. teven,Scarbrough, C. arl,Kieding, S. ylvia,Griffon, M. ark. 2004. Y-12 and Oak Ridge National Laboratory medical surveillance program, Phase I: Needs assessment.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3974971

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	building materials
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	"We report the results and analysis of a one year needs assessment study evaluating whether a medical monitoring and risk communication program is justified for former and current workers at the Y-12 and Oak Ridge National Laboratory (ORNL)" - No monitoring data, risk mapping assessment

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Medium	× 1	2	Queens College, City University of New York
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Related to occupational exposure
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2004
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.3.

Continued on next page

– continued from previous page

Source Citation:	Markowitz, S. teven,Scarbrough, C. arl,Kieding, S. ylvia,Griffon, M. ark. 2004. Y-12 and Oak Ridge National Laboratory medical surveillance program, Phase I: Needs assessment.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3974971

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments

** Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Cdc,. 2003. NIOSH Recommendations for limiting potential exposures of workers to asbestos associated with vermiculite form Libby, Montana.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3978124

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Mining, processing, and use
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	No monitoring data - Source provides information on vermiculite asbestos and precautions to take to avoid inhalation

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	NIOSH
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Related to occupational exposure
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2003
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.2.

Continued on next page

– continued from previous page

Source Citation:	Cdc,. 2003. NIOSH Recommendations for limiting potential exposures of workers to asbestos associated with vermiculite form Libby, Montana.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3978124

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments

** Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale:
High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Osha,. 1995. Asbestos standard for general industry.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3978184

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	OSHA standards for multiple uses
Exposure Concentration (Unit):	Asbestos standard for general industry. No relevant information for report

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	OSHA
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Related to occupational exposure
	Metric 4:	Temporal Representativeness	Low	× 2	6	1995
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.4.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Osha,. 2008. Shipbreaking: Module 6: Workplace and chemical hazards: 6.1 Asbestos.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3978208

EXTRACTION

Parameter	**Data**
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Shipbreaking
Exposure Concentration (Unit):	No monitoring data - Source is a training powerpoint presentation that provides information on asbestos and precautions to take to avoid inhalation

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	OSHA
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Related to occupational exposure
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2008
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.2.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Carex, Canada. 2016. Substance profile: Asbestos.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3978366

EXTRACTION

Parameter	**Data**
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Substance profile: Asbestos
Exposure Concentration (Unit):	Generic general info for asbestos - no monitoring data

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Medium	× 1	2	CAREX Canada
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD - Canada
	Metric 3:	Applicability	Low	× 2	6	Not related to occupational exposure
	Metric 4:	Temporal Representativeness	High	× 2	2	2016
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.4.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Carex, Canada. 2008. Priority occupational carcinogens for surveillance in Canada: Preliminary Priority List.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3978369

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	General asbestos information
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Provides information on chemicals workers are exposed to in various occupations - no monitoring data

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Medium	× 1	2	CAREX Canada
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD - Canada
	Metric 3:	Applicability	Medium	× 2	4	Related to occupational exposure
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2008
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.4.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Ncdol,. 2013. A guide to asbestos for industry.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3982247

EXTRACTION

Parameter	**Data**
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	A guide to asbestos for industry
Exposure Concentration (Unit):	Guide to working safely around asbestos - no monitoring information

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	N.C. Department of Labor
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	Medium	× 2	4	Related to occupational exposure
	Metric 4:	Temporal Representativeness	High	× 2	2	2013
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.0.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Senior Labour Inspectors, Committee. 2006. A practical guide on best practices to prevent or minimise asbestos risks in work that involves (or may involve) asbestos: for the employer, the workers, and the labour inspector.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3982341

EXTRACTION

Parameter	**Data**
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	General information
Exposure Concentration (Unit):	Guide to minimize asbestos exposure in industry - no monitoring data

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	European Commission
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD - Belgium
	Metric 3:	Applicability	Medium	× 2	4	Related to occupational exposure
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2006
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.3.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Osha,. 2006. Asbestos-automotive brake and clutch repair work, Part 2.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3978218

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Automotive brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Personal sample results for the brake mechanics show that concentrations using PCM analysis ranged from less than 0.004 to 0.016 f/cc. All exposures were below the NIOSH recommended exposure limit of 0.1 f/cc using PCM.
Number of Samples:	83 personal samples, 68 area samples
Number of Sites:	12
Type of Measurement or Method:	Brake job TWA
Worker Activity:	Brake repair
Type of Sampling:	Personal, area, bulk
Sampling Location:	Personal samples collected in worker PBZ, area samples collected at car's fender, axle, 10+ feet away from vehicle (background), and outdoors (ambient)
Exposure Duration:	2 hours or brake job length, whichever is longer
Exposure Frequency:	Workers typically only perform one brake job a day
Bulk and Dust Particle Size Distribution:	Fibers in the wheel drum bulk samples represented less than 1 percent of the brake dust, but were generally 60 to 100 percent chrysotile
Engineering Control & percent Exposure Reduction:	HEPA filter-equipped enclosure device, HEPA vacuum, wet brush/recycle system, aerosol spray
Analytic Method:	PCM, TEM

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Well-described methodology
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	In-scope use

Continued on next page

– continued from previous page

Source Citation:	Osha,. 2006. Asbestos-automotive brake and clutch repair work, Part 2.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3978218

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 4:	Temporal Representativeness	Low	× 2	6	1989
	Metric 5:	Sample Size	Medium	× 1	2	Sample size and distribution clearly characterized, along with statistics but samples presented mostly in ranges with means and standard deviation
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Metadata provided
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	Discusses variability between different worker activities and use of engineering controls
Overall Quality Determination†			Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Blake, C. L.,Van Orden, D. R.,Banasik, M.,Harbison, R. D.. 2003. Airborne asbestos concentration from brake changing does not exceed permissible exposure limit. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3080338

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Automotive brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	The results indicated a presence in the air of only chrysotile asbestos and an absence of other types of asbestos. Airborne chrysotile fiber exposures for each test remained below currentlyapplicable limit of 0.1 fiber/ml (eight-hour time-weighted average).
Number of Samples:	4
Number of Sites:	1
Type of Measurement or Method:	Full shift TWA
Worker Activity:	Brake replacement incluing filing, sanding, and arc grinding of brakes
Number of Workers:	1
Type of Sampling:	Personal, area
Sampling Location:	PBZ, vehicle service area
Exposure Duration:	30-103 minutes for personal samples 262-425 min for outdoor samples
Engineering Control & percent Exposure Reduction:	All tests were performed with allseven building outside overhead doors closed
Analytic Method:	PCM and TEM

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Well-described methodology
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2003
	Metric 5:	Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics

Continued on next page

– continued from previous page

Source Citation:	Blake, C. L.,Van Orden, D. R.,Banasik, M.,Harbison, R. D.. 2003. Airborne asbestos concentration from brake changing does not exceed permissible exposure limit. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3080338

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	Metadata provided
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	Discusses variability between different worker activities
Overall Quality Determination†		High		1.3	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Richter, R. O.,Finley, B. L.,Paustenbach, D. J.,Williams, P. R. D.,Sheehan, P. J.. 2009. An evaluation of short-term exposures of brake mechanics to asbestos during automotive and truck brake cleaning and machining activities. Journal of Exposure Science and Environmental Epidemiology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2548725

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Automotive brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	An average 8-h TWA of approximately 0.10 f/cc was estimated for auto brake mechanics that performed arc grinding of linings during automobile brake repair (in the1960s or earlier). In the 1970s and early 1980s, a decline in machining activities led to a decrease in the 8-h TWA to approximately 0.063 f/cc. Improved cleaning methods in the late 1980s further reduced the 8-h TWA for most brake mechanics to about 0.0021 f/cc
Number of Samples:	300+
Number of Sites:	Various (data sourced from multiple studies)
Type of Measurement or Method:	Full shift TWA and short term
Worker Activity:	Brake cleaning and machining activities
Type of Sampling:	Personal, area
Sampling Location:	Personal samples taken in worker PBZ
Exposure Duration:	2-60 min
Analytic Method:	PCM

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Low	× 1	3	Cites other sources for exposure data and methodology
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	High	× 2	2	2009

Continued on next page

– continued from previous page

Source Citation:	Richter, R. O.,Finley, B. L.,Paustenbach, D. J.,Williams, P. R. D.,Sheehan, P. J.. 2009. An evaluation of short-term exposures of brake mechanics to asbestos during automotive and truck brake cleaning and machining activities. Journal of Exposure Science and Environmental Epidemiology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2548725

EVALUATION

Domain	Metric	Rating	MWF⋆	Score	Comments
	Metric 5: Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	Medium	× 1	2	Most critical metadata included
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	Discuss variability between different worker activities
Overall Quality Determination†		High		1.4	

⋆ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Jiang, G. C.,Madl, A. K.,Ingmundson, K. J.,Murbach, D. M.,Fehling, K. A.,Paustenbach, D. J.,Finley, B. L.. 2008. A study of airborne chrysotile concentrations associated with handling, unpacking, and repacking boxes of automobile clutch discs. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2602094

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Automotive clutches
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	It was found that 30-min average airborne chrysotile concentrations (PCM adjusted) were 0.026 " 0.004 f/cc or 0.100 " 0.017 f/cc for a worker unpacking and repacking 1 or 2 boxes of clutches, respectively. The 30-min PCM adjusted average airborne asbestos concentrations at bystander locations ranged from 0.002 " 0.001 f/cc and 0.004 " 0.002 f/cc when 1 or 2 boxes of clutches were handled, respectively. Estimated 8-h TWA asbestos exposures for a worker handling 1 or 2 boxes of clutches over a workday ranged from 0.002 to 0.006 f/cc. The 30-min PCM adjusted average airborne asbestos concentration for a worker continuously stacking unopened boxes of clutches was 0.212 " 0.014 f/cc; the 8-h TWA was 0.013 f/cc. Additionally, 30-min PCM adjusted average airborne asbestos concentrations following cleanup and clothing handling were 0.002 " 0.001 f/cc and 0.002 " 0.002 f/cc, respectively, both resulting in estimated 8-h TWA asbestos exposures of 0.0001 f/cc.
Number of Samples:	Breathing zone samples on the lapel of a volunteer worker (n = 100) and area samples atbystander (n = 50), remote area (n = 25), and ambient (n = 9) locations
Number of Sites:	1
Type of Measurement or Method:	Full shift TWA and short term
Worker Activity:	Unpacking, repacking, and handling boxes of clutch disks
Number of Workers:	1
Type of Sampling:	Personal, area, bulk
Sampling Location:	PBZ, bystander (5 ft from worker) and remote (50 ft from worker)
Exposure Duration:	15 min - 4 hr. Full shift TWA's based off 1-hr samples

Continued on next page

– continued from previous page

Source Citation:	Jiang, G. C.,Madl, A. K.,Ingmundson, K. J.,Murbach, D. M.,Fehling, K. A.,Paustenbach, D. J.,Finley, B. L.. 2008. A study of airborne chrysotile concentrations associated with handling, unpacking, and repacking boxes of automobile clutch discs. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2602094

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Bulk and Dust Particle Size Distribution:		The clutches contained asbestos and the mean chrysotileasbestos content was 33.7 percent " 2.0, with a range of 2052 percent . PLM analysis (LOD 1 percent) did not indicate the presence of amphibole asbestos fibers in any of the clutches. Bulk sample analysis (XRD) of dust which had accumulated on the countertop during the unpacking and repacking of boxes of clutches indicated an average chrysotile asbestos concentration of 6.8 percent " 2.2, and a range of 114 percent			
Analytic Method:		PCM and TEM			

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Well-described methodology
Domain 2: Representative					
	Metric 2: Geographic Scope	High	× 1	1	United States
	Metric 3: Applicability	High	× 2	2	In-scope use
	Metric 4: Temporal Representativeness	High	× 2	2	2008
	Metric 5: Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	High	× 1	1	Metadata provided
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	High	× 1	1	well described within document
Overall Quality Determination†		High		1.0	

Continued on next page

– continued from previous page

Source Citation:	Jiang, G. C.,Madl, A. K.,Ingmundson, K. J.,Murbach, D. M.,Fehling, K. A.,Paustenbach, D. J.,Finley, B. L.. 2008. A study of airborne chrysotile concentrations associated with handling, unpacking, and repacking boxes of automobile clutch discs. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2602094

EVALUATION

Domain	Metric	Rating	MWF⋆	Score	Comments

⋆ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Cohen, H. J.,Van Orden, D. R.. 2008. Asbestos exposures of mechanics performing clutch service on motor vehicles. Journal of Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2603896

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Automotive clutches
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Asbestos air sampling data collected averaged 0.047 f/cc. Using the range of data inputs that were obtained, the authors calculated a range of TWA exposures of 3.75 " 10?5 f/cc to 0.03 f/cc. The mean value of 0.0016 f/cc is below background levels of asbestos that have been reported in garages during this time and below the current OSHA PEL of 0.1 f/cc.
Number of Samples:	104
Number of Sites:	1
Type of Measurement or Method:	Full shift
Worker Activity:	Clutch assembly removal
Number of Workers:	1
Type of Sampling:	Personal, area, bulk
Sampling Location:	PBZ, area samples taken 5-10 feet from mechanic
Exposure Duration:	26-161 min
Bulk and Dust Particle Size Distribution:	Wear debris in the bell housing surrounding clutcheshad an average of 0.1 percent chrysotile asbestos by weight, avalue consistent with similar reports of brake debris
Engineering Control & percent Exposure Reduction:	Control techniques varied and included using water to clean brakes, dry wiping, and compressed air
Analytic Method:	PCM and TEM

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Well-described methodology

Continued on next page

– continued from previous page

Source Citation:	Cohen, H. J.,Van Orden, D. R.. 2008. Asbestos exposures of mechanics performing clutch service on motor vehicles. Journal of Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	2603896

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	High	× 2	2	2008
	Metric 5:	Sample Size	Medium	× 1	2	Distribution of samples is characterized by a range with uncertain statistics
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Medium	× 1	2	Monitoring data include most critical metadata, but lacks some details
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	Does not address variability/uncertainty
Overall Quality Determination†			High		1.4	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Cowan, D. M.,Cheng, T. J.,Ground, M.,Sahmel, J.,Varughese, A.,Madl, A. K.. 2015. Analysis of workplace compliance measurements of asbestos by the U.S. Occupational Safety and Health Administration (1984-2011). Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3520562

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Automotive brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	From 1984 to 2011, personal air samples ranged from 0.001 to 175 f/cc across a variety of industries where asbestos is used (e.g., construction, manufacturing, mining, automotive repair)
Number of Samples:	394 personal, 55 area, and 258 bulk samples for automotive repair, services, and parking
Type of Measurement or Method:	8-hr TWA
Worker Activity:	Unspecified
Type of Sampling:	Personal, area, bulk
Sampling Location:	PBZ of workers for personal samples
Bulk and Dust Particle Size Distribution:	Bulk sampling analysis in this industry yielded asbestos concentrations ranging from 0 percent to 100 percent ; however, information related to the specific product type that was analyzed for asbestos content was rarely provided in the database (i.e., 7 samples included information on product type).
Analytic Method:	PCM

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	OSHA inspection data
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	Medium	× 2	4	Data ranges between 1984-2011
	Metric 5:	Sample Size	Low	× 1	3	Samples presented as a range, with no statistics

Continued on next page

– continued from previous page

Source Citation:	Cowan, D. M.,Cheng, T. J.,Ground, M.,Sahmel, J.,Varughese, A.,Madl, A. K.. 2015. Analysis of workplace compliance measurements of asbestos by the U.S. Occupational Safety and Health Administration (1984-2011). Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3520562

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
Domain 3: Accessibility/Clarity					
	Metric 6: Metadata Completeness	Low	× 1	3	Monitoring data include sample type but no other metadata.
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Medium	× 1	2	Discussion of variability and uncertainty included, but minimal for the automotive repair industry specifically
Overall Quality Determination†		Medium		1.8	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Cooper, TC; Sheehy, JW; O'Brien, DM; Mcglothlin, JD; Todd, WF. 1987. In-Depth Survey Report: Evaluation of Brake Drum Service Controls at United States Postal Service Vehicle Maintenance Facility, Louisville, Kentucky, Report No. CT-152-11B".
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3099353

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Automotive brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Min <0.004 PCM fibers/cc Max: 0.006 PCM fibers/cc Arithmetic Mean: <0.004 PCM fibers/cc
Number of Samples:	22 personal, 34 area
Number of Sites:	1
Type of Measurement or Method:	Brake job TWA (2-3 hours)
Worker Activity:	Servicing drum brakes on 11 vehicles
Number of Workers:	11
Type of Sampling:	Personal, area, bulk
Sampling Location:	PBZ, garage area
Exposure Duration:	Personal: Duration of brake job or 2 hours, whichever is longer. Area: 4-6 hours
Exposure Frequency:	When performing brake maintenance work (no more than 2-3 hr/day)
Bulk and Dust Particle Size Distribution:	Less than 1 percent of the material in the brake drum bulk samples was asbestos, but from 62 to 100 percent of the fibers in 9 of 11 of the brake drum bulk samples were chrysotile with one of the brake drum samples containing 100 percent chrysotile asbestos fibers. One of the samples contained amphibole fibers. From 0 to 25 percent of asbestos fibers and bundles were longer than 5 microns.
Engineering Control & percent Exposure Reduction:	Vacuum enclosure system used during brake work
PPE:	Work clothing and respirators
Analytic Method:	PCM and TEM

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Well-described methodology

Continued on next page

– continued from previous page

Source Citation:	Cooper, TC; Sheehy, JW; O'Brien, DM; Mcglothlin, JD; Todd, WF. 1987. In-Depth Survey Report: Evaluation of Brake Drum Service Controls at United States Postal Service Vehicle Maintenance Facility, Louisville, Kentucky, Report No. CT-152-11B".
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3099353

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	Low	× 2	6	1987
	Metric 5:	Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics - raw data in appendix
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Metadata provided
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	High	× 1	1	well described within document
Overall Quality Determination†			High		1.4	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Cooper, TC; Sheehy, JW; O'Brien, DM; Mcglothlin, JD; Todd, WF. 1988. In-depth survey report: Evaluation of brake drum service controls at Cincinnati Gas and Electric Garages, Cincinnati, Evanston, and Monroe, Ohio and Covington, Kentucky.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3099264

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Automotive brakes
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Min <0.004 PCM fibers/cc Max: 0.016 PCM fibers/cc Arithmetic Mean: 0.006 PCM fibers/cc
Number of Samples:	10
Number of Sites:	4 garages at 1 site
Type of Measurement or Method:	Brake job TWA (2-3 hours)
Worker Activity:	Servicing drum brakes on 6 vehicles: a sedan, two vans, two pickup trucks, and a larger truck (model years not specified)
Number of Workers:	8
Type of Sampling:	Personal, area, bulk
Sampling Location:	PBZ, garage area
Exposure Frequency:	When performing brake maintenance work (no more than 2-3 hr/day)
Bulk and Dust Particle Size Distribution:	Less than 1 percent of the material in the brake drum bulk samples was asbestos, but from 74 to 100 percent of the fibers in the brake drum bulk samples were chrysotile. None of the brake drum bulk samples contained amphibole fibers. From 1 to 15 percent of asbestos fibers and bundles were longer than 5 microns.
Engineering Control & percent Exposure Reduction:	Mechanics use solvent to minimize dust release, either through spraying solvent or using a parts brush with solvent
Analytic Method:	PCM

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Well-described methodology
Domain 2: Representative					

Continued on next page

– continued from previous page

Source Citation:	Cooper, TC; Sheehy, JW; O'Brien, DM; Mcglothlin, JD; Todd, WF. 1988. In-depth survey report: Evaluation of brake drum service controls at Cincinnati Gas and Electric Garages, Cincinnati, Evanston, and Monroe, Ohio and Covington, Kentucky.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3099264

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	In-scope use
	Metric 4:	Temporal Representativeness	Low	× 2	6	1988
	Metric 5:	Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics - raw data in appendix
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Metadata provided
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	Discuss variability between different worker activities and sampling locations
Overall Quality Determination†			High		1.6	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Nordgren, J. 2017. Comment submitted by Judith Nordgren, Managing Director, Chlorine Chemistry Division (CCD), American Chemistry Council (ACC).
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3986705

EXTRACTION

Parameter	**Data**
Life Cycle Stage:	Asbestos Diaphragms
Life Cycle Description (Subcategory of Use):	Chlor-alkali industry
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Personal monitoring data provided by ACC (unknown number of sites)

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Low	× 1	3	Sampling and analytical methods not provided
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	Data are for the chlor-alkali industry, where asbestos is used in diaphragms. In-scope use.
	Metric 4:	Temporal Representativeness	High	× 2	2	Sample dates range from 1996 to 2016
	Metric 5:	Sample Size	High	× 1	1	Individual samples provided, so distributions can be fully characterized.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Medium	× 1	2	Most sample results include sample duration, worker activity description, sample date, and some data include task frequency, but some data do not include sample duration.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	No discussion provided on if variability in operations is captured in sampled data; uncertainty in measurements not discussed.
Overall Quality Determination†			High		1.6	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Axiall/Westlake. 2018. Information from Axiall/Westlake. Public Comment Docket ID: EPA-HQ-OPPT-2016-0736-0129.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	5352391

EXTRACTION

Parameter	**Data**
Life Cycle Stage:	Asbestos Diaphragms
Life Cycle Description (Subcategory of Use):	Chlor-alkali industry
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Personal monitoring data provided by Axiall-Westlake (1 site)

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Low	× 1	3	Sampling and analytical methods not provided
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	Data are for the chlor-alkali industry, where asbestos is used in diaphragms. In-scope use.
	Metric 4:	Temporal Representativeness	High	× 2	2	Sample dates range from 1996 to 2016
	Metric 5:	Sample Size	High	× 1	1	Individual samples provided, so distributions can be fully characterized.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Medium	× 1	2	Most sample results include sample duration, worker activity description, sample date, and some data include task frequency, but some data do not include sample duration.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	No discussion provided on if variability in operations is captured in sampled data; uncertainty in measurements not discussed.
Overall Quality Determination†			High		1.6	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Occidental Chem Corp. 2017. Comment submitted by Occidental Chemical Corporation. Public Comment Docket ID: EPA-HQ-OPPT-2016-0736-0103..
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	5352389

EXTRACTION

Parameter	Data
Life Cycle Stage:	Asbestos Diaphragms
Life Cycle Description (Subcategory of Use):	Chlor-alkali industry
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Personal monitoring data provided by Occidental (6 sites)

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Low	× 1	3	Sampling and analytical methods not provided
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	Data are for the chlor-alkali industry, where asbestos is used in diaphragms. In-scope use.
	Metric 4:	Temporal Representativeness	High	× 2	2	Sample dates range from 1996 to 2016
	Metric 5:	Sample Size	High	× 1	1	Individual samples provided, so distributions can be fully characterized.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Medium	× 1	2	Most sample results include sample duration, worker activity description, sample date, and some data include task frequency, but some data do not include sample duration.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	No discussion provided on if variability in operations is captured in sampled data; uncertainty in measurements not discussed.
Overall Quality Determination†			High		1.6	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Olin Corp. 2017. Data attached to an email sent to EPA on May 1, 2019. Email Title: Olin: Submission to OCSPP in 2017.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	5352390

EXTRACTION

Parameter	**Data**
Life Cycle Stage:	Asbestos Diaphragms
Life Cycle Description (Subcategory of Use):	Chlor-alkali industry
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Personal monitoring data provided by Olin (4 sites)

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Low	× 1	3	Sampling and analytical methods not provided
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	Data are for the chlor-alkali industry, where asbestos is used in diaphragms. In-scope use.
	Metric 4:	Temporal Representativeness	High	× 2	2	Sample dates range from 1996 to 2016
	Metric 5:	Sample Size	High	× 1	1	Individual samples provided, so distributions can be fully characterized.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Medium	× 1	2	Most sample results include sample duration, worker activity description, sample date, and some data include task frequency, but some data do not include sample duration.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	No discussion provided on if variability in operations is captured in sampled data; uncertainty in measurements not discussed.
Overall Quality Determination†			High		1.6	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Environmental Health Management. 2013. Report for OSHA compliance monitoring at Branham Corporation. Branham Corporation.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	5080210

EXTRACTION

Parameter	Data
Life Cycle Stage:	Sheet gaskets
Life Cycle Description (Subcategory of Use):	Cutting of sheet gaskets
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Personal monitoring data provided for a single Branham Corporation facility.

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	NIOSH 582 equivalency certificate provided
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	Cutting of sheet gaskets; in-scope use.
	Metric 4:	Temporal Representativeness	High	× 2	2	Samples taken in 2012
	Metric 5:	Sample Size	High	× 1	1	Individual samples provided, so distribution can be fully characterized.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Personal samples; air sample data sheet provided with sample times; activity time log provided with worker activities; narrative describes site operations.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	Study does not address if variability in operations is captured in sampled data; uncertainty in measurements could be determined from NIOSH 582.
Overall Quality Determination†			High		1.1	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	ACC. 2017. Use of Non-Friable Asbestos Containing Gaskets in Titanium Dioxide Manufacturing. Information submitted by email to EPA. October 30, 2017.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	5080225

EXTRACTION

Parameter	Data
Life Cycle Stage:	Sheet gaskets
Life Cycle Description (Subcategory of Use):	Use of sheet gaskets in titanium dioxide manufacturing
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Personal monitoring data provided for a single Chemours Titanium Technologies facility.

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	Low	× 1	3	Sampling and analytical methods not provided
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	Removal of asbestos sheet gaskets; in-scope use.
	Metric 4:	Temporal Representativeness	High	× 2	2	Samples taken since 2009
	Metric 5:	Sample Size	Medium	× 1	2	Only number of samples, mean, min, and max provided.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Low	× 1	3	Sample durations and exposure frequency not provided.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	No discussion provided on if variability in operations is captured in sampled data; uncertainty in measurements not discussed.
Overall Quality Determination†			Medium		1.8	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Environmental Protection, Agency. 1985. ASBESTOS WASTE MANAGEMENT GUIDANCE-GENERATION, TRANSPORT, DISPOSAL.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3100906

EXTRACTION

Parameter	**Data**
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Many sources mentioned - including brake linings and brake pads
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Waste management guidance for asbestos - no monitoring data presented

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	EPA document
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	In scope use - addresses aftermarket automotive products
	Metric 4:	Temporal Representativeness	Low	× 2	6	Report published in 1985
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.2.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Chan, Y. M.,Agamuthu, P.,Mahalingam, R.. 2000. Solidification and stabilization of asbestos waste from an automobile brake manufacturing facility using cement. Journal of Hazardous Materials.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3520527

EXTRACTION

Parameter	Data
Life Cycle Stage:	Aftermarket auto parts
Life Cycle Description (Subcategory of Use):	Addresses dusts from brakes - but from the context of a foreign brake manufacturing facility
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Information provided on waste management of asbestos-containing brake dusts - no monitoring data presented

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Peer-reviewed journal article
Domain 2: Representative						
	Metric 2:	Geographic Scope	Low	× 1	3	Non-OECD - Bulgaria
	Metric 3:	Applicability	High	× 2	2	Related to in scope use - addresses manufacturing of aftermarket automotive products
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2000 publication
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.2.

Continued on next page

– continued from previous page

Source Citation:	Chan, Y. M.,Agamuthu, P.,Mahalingam, R.. 2000. Solidification and stabilization of asbestos waste from an automobile brake manufacturing facility using cement. Journal of Hazardous Materials.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3520527

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Ambrosius, S.,Gundlach, H.,Kieser, J.. 1996. Thermal utilization of cement-bound asbestos products in cement kilns.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3580728

EXTRACTION

Parameter	**Data**
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	cement products
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Publication addresses method to manage asbestos fibers in cement products

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Peer-reviewed journal article
Domain 2: Representative						
	Metric 2:	Geographic Scope	Medium	× 1	2	OECD - Germany
	Metric 3:	Applicability	Medium	× 2	4	Occupational use - not in scope
	Metric 4:	Temporal Representativeness	Medium	× 2	4	1996 publication
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.3.

★★ Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Harwood, C. F.,Oestreich, D. K.,Siebert, P.,Stockham, J. D.. 1975. Asbestos emissions from baghouse controlled sources. American Industrial Hygiene Association Journal.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3585625

EXTRACTION

Parameter	Data
Life Cycle Stage:	Other
Life Cycle Description (Subcategory of Use):	Facilities that made cement products, milled products, and textiles
Physical Form:	Solid
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Publication addresses manufacturing activities that have since been completely phased out in the United States

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Peer-reviewed journal article
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	Four facilities in the United States and one facility in Canada
	Metric 3:	Applicability	Medium	× 2	4	Occupational use - not in scope
	Metric 4:	Temporal Representativeness	Low	× 2	6	1975 publication
	Metric 5:	Sample Size	Low	× 1	3	no data provided
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Unacceptable	× 1	4	no recent /relevant exposure or use data
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	N/A - no data
Overall Quality Determination†			Unacceptable		4	Metric Mean Score: 2.4.

Continued on next page

– continued from previous page

Source Citation:	Harwood, C. F.,Oestreich, D. K.,Siebert, P.,Stockham, J. D.. 1975. Asbestos emissions from baghouse controlled sources. American Industrial Hygiene Association Journal.
Type of Data Source	Occupational Exposure; Reports for Data or Information Other than Exposure or Release Data;
Hero ID	3585625

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments

** Consistent with our *Application of Systematic Review in TSCARisk Evaluations* document, if a metric for a data source receives a score of Unacceptable (score = 4), EPA will determine the study to be unacceptable. In this case, one of the metrics were rated as unacceptable. As such, the study is considered unacceptable and the score is presented solely to increase transparency.

* MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale:
High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	NASA. 2020. NASA Operational Uses of Asbestos - Super Guppy Turbine Aircraft.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	6324299

EXTRACTION

Parameter	Data
Life Cycle Stage:	Industrial
Life Cycle Description (Subcategory of Use):	Use of Brakes/Frictional Products for a Single, Large Transport Vehicle (NASA Super-Guppy)
Physical Form:	Dust
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Five worker exposure measurements provided: 8-hour TWA concentrations: <0.003, <0.006, and <0.0089 f/ccExcursion measurements (approx. 30 minutes): <0.044 and <0.045 f/cc
Number of Samples:	5
Number of Sites:	1
Type of Measurement or Method:	PBZ samples tested with NIOSH Method 7400
Worker Activity:	Brake maintenance activity
Number of Workers:	Not reported
Type of Sampling:	PBZ
Sampling Location:	Samples collected during brake repair, which reportedly occurs in a walk-in booth,
Exposure Duration:	The average time spent changing brakes is 3.3 hours.
Exposure Frequency:	Over the last 3 years, NAS reports (on average) changing 3.6 brakes per year.
Bulk and Dust Particle Size Distribution:	Not reported
Engineering Control & percent Exposure Reduction:	Work takes place in a ventilated walk-in booth.
PPE:	"PPE is not required during brake maintenance operations because exposures are below the OSHA PEL and Excursion Limit. Employees may choose to wear PPE voluntarily, including Tyvek suits. Per exposure monitoring results, employees are not required to wear respiratory protection. If they choose to, they wear a half mask air-purifying respirator with P-100 particulate filters (NIOSH Approval Number TC-84A-0086)."
Analytic Method:	NIOSH Method 7400

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					

Continued on next page

– continued from previous page

Source Citation:	NASA. 2020. NASA Operational Uses of Asbestos - Super Guppy Turbine Aircraft.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	6324299

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 1:	Methodology	High	× 1	1	Data are from a presentation by a reliable source (NASA)
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	Information is provided for the one site in the U.S. that houses the Super Guppy aircraft.
	Metric 3:	Applicability	High	× 2	2	All information for the publication are for the Super Guppy condition of use.
	Metric 4:	Temporal Representativeness	High	× 2	2	Data provided from five sampling events - and brake replacement only occurs three to four times per year.
	Metric 5:	Sample Size	High	× 1	1	Very few workers conduct this activity. The few samples cover the few workers.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Medium	× 1	2	A complete account of data are included, but not the full range of information sometimes found in IH sampling reports (e.g., flow rates, laboratory sheets).
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	No discussion is provided on variability, but variability is likely limited for this condition of use due to the fact that all work is conducted at one location and on one aircraft.
Overall Quality Determination†			High		1.2	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Paustenbach, D. J.,Madl, A. K.,Donovan, E.,Clark, K.,Fehling, K.,Lee, T. C.. 2006. Chrysotile asbestos exposure associated with removal of automobile exhaust systems (ca. 1945-1975) by mechanics: results of a simulation study. Journal of Exposure Science and Environmental Epidemiology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531296

EXTRACTION

Parameter	Data
Life Cycle Stage:	Sheet gaskets
Life Cycle Description (Subcategory of Use):	removal of exhaust systems with asbestos-containing gaskets during repair work
Physical Form:	Dust
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Mechanics: 0.022 f/ccBystander: 0.012 f/ccRemote Indoor: 0.005 f/ccBackground Indoor: 0.008 f/ccAmbient Outdoor: 0.003 f/cc
Number of Samples:	170
Number of Sites:	1
Type of Measurement or Method:	8h TWA
Worker Activity:	Removal of the muffler and exhaust pipe up to the flange, removal of the muffler, exhaust pipe, and exhaust manifold, conversion from single to dual exhaust system, and removal of the muffler system up to the exhaust manifold with the installation of an asbestos donut gasket.
Number of Workers:	2
Type of Sampling:	PBZ, area
Sampling Location:	Air samples for asbestos were collected at breathing zone height (5 ft) at four different locations, approximately 4 ft from the vehicle.
Exposure Duration:	A mechanic working on dual exhaust systems all day (two cars per day) was assumed to be potentially exposed to asbestos for 2 h.
PPE:	Mechanics wore no PPE.
Analytic Method:	NIOSH method 7400

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
Metric 1:	Methodology	High	× 1	1	Peer-reviewed journal article
Domain 2: Representative					

Continued on next page

– continued from previous page

Source Citation:	Paustenbach, D. J.,Madl, A. K.,Donovan, E.,Clark, K.,Fehling, K.,Lee, T. C.. 2006. Chrysotile asbestos exposure associated with removal of automobile exhaust systems (ca. 1945-1975) by mechanics: results of a simulation study. Journal of Exposure Science and Environmental Epidemiology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3531296

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	Removal of asbestos sheet gaskets; in-scope use.
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2004 publication.
	Metric 5:	Sample Size	High	× 1	1	Sample size and distribution clearly characterized, along with statistics - raw data in appendix
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Most critical metadata included
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Medium	× 1	2	includes discussion of variability, not uncertainty which could be determined from underlying methods
Overall Quality Determination†			High		1.3	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Blake, C. L.,Dotson, G. S.,Harbison, R. D.. 2006. Assessment of airborne asbestos exposure during the servicing and handling of automobile asbestos-containing gaskets. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3520458

EXTRACTION

Parameter	Data
Life Cycle Stage:	Sheet gaskets
Life Cycle Description (Subcategory of Use):	removal of exhaust systems with asbestos-containing gaskets during repair work
Physical Form:	Dust
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	The highest 8-HR TWA fiber concentration was 0.0079 f/cc, and occurred during the removal of gaskets from the Chevrolet Malibu. All area samples were approximately 100 times lower than the current PEL of 0.1f/cc.The 8-HR TWA PCM fibers concentrations reported for the personal air samples collected during the six test sessions ranged from 0.008 to 0.0937 f/cc.
Number of Samples:	68
Number of Sites:	1
Type of Measurement or Method:	8h TWA
Worker Activity:	Engine disassembly and removal of asbestos-containing gaskets, engine reassembly and installation of asbestos-containing gaskets, and cleanup of service facility.
Number of Workers:	1
Type of Sampling:	PBZ, area
Sampling Location:	Southeast corner (SE corner); 22 feet SE of vehicle Southwest corner (SW corner); 19 feet SW of vehicle Northwest corner (NW corner); 15 feet NW of vehicleNortheast corner (NE corner);18 feet NE of vehicle Intermediate hallway; 30 feet NE of vehicle Distant hallway; 50 NE of vehicle Driver"s side fender Passenger"s side fender Work bench; 9 feet S of vehicle
Exposure Duration:	The length of the tests ranged from 132 to 157min.
Analytic Method:	NIOSH method 7400, USEPA Method 600/R-93/116

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
Metric 1:	Methodology	High	× 1	1	Peer-reviewed journal article

Continued on next page

– continued from previous page

Source Citation:	Blake, C. L.,Dotson, G. S.,Harbison, R. D.. 2006. Assessment of airborne asbestos exposure during the servicing and handling of automobile asbestos-containing gaskets. Regulatory Toxicology and Pharmacology.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	3520458

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	Removal of asbestos sheet gaskets; in-scope use.
	Metric 4:	Temporal Representativeness	Medium	× 2	4	2006 publication.
	Metric 5:	Sample Size	High	× 1	1	Individual samples provided, so distributions can be fully characterized.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Medium	× 1	2	Most critical data included, but missing details like exposure frequency, particle size, and engineering controls.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	High	× 1	1	well described within document
Overall Quality Determination†			High		1.3	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Cheng, RT; McDermott, HJ. 1990. Exposure to asbestos from asbestos gaskets. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	6939370

EXTRACTION

Parameter	Data
Life Cycle Stage:	Sheet gaskets
Life Cycle Description (Subcategory of Use):	handling of gaskets containing asbestos in the oil and chemical industry
Physical Form:	Dust
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Cutting with power shear and hammer punch: 0.015 f/ccCutting with power shear and wheel cutter 0.017 f/ccCutting with knife on a lead surface table 0.012 f/ccCutting with power shear and hammer punch 0.009 f/ccCutting with power shear and scissors 0.001 f/ccCutting with power shear and hammer punch 0.005 f/ccCutting with wheel cutter and hammer punch: 0.003 f/ccCutting with a saber saw: 0.39 f/ccCutting with a saber saw: 0.33 f/ccCutting with power shear and wheel cutter: 0.49 f/ccCutting with power shear and wheel cutter: 0.34 f/ccDry removal: 2 valve gaskets, scraping/brushing: 0.11 f/ccDry removal: 1 pump gasket, scraping/brushing: 0.19 f/ccDry removal: 2 flange gaskets. scraping/brushing: 0.33 f/ccWet removal: 1 pump gasket, scraping/brushing: < 0.06 f/ccWet removal: 2 pipe flange gaskets, brushing: < 0.06 f/cc
Number of Sites:	4
Type of Measurement or Method:	8h TWA
Worker Activity:	Replacement of after-service gaskets, on-site fabrication (cutting) of sheet gaskets, and handling of new and after-service gaskets inside Gasket Trailers.
Type of Sampling:	PBZ, area
Exposure Duration:	Long term samples ranged from 330-470 minutes, and short term samples ranged from 30-55 minutes.
PPE:	Workers should be required to wear a half-face HEPA respirator during dry removal of after-service sheet gaskets

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments
Domain 1: Reliability					
	Metric 1: Methodology	High	× 1	1	Peer-reviewed journal article

Continued on next page

– continued from previous page

Source Citation:	Cheng, RT; McDermott, HJ. 1990. Exposure to asbestos from asbestos gaskets. Applied Occupational and Environmental Hygiene.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	6939370

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	Removal of asbestos sheet gaskets; in-scope use.
	Metric 4:	Temporal Representativeness	Low	× 2	6	1991 Publication
	Metric 5:	Sample Size	High	× 1	1	Individual samples provided, so distributions can be fully characterized.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	Medium	× 1	2	Most critical data included, but missing details like exposure frequency, particle size, sampling location, number of workers, and engineering controls.
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	No discussion provided on if variability in operations is captured in sampled data; uncertainty in measurements not discussed.
Overall Quality Determination†			Medium		1.8	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Millette, JR; Mount, MD; Hays, SM. 1995. Releasability of asbestos fibers from asbestos-containing gaskets. EIA Technical Journal.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	6926060

EXTRACTION

Parameter	Data
Life Cycle Stage:	Sheet gaskets
Life Cycle Description (Subcategory of Use):	removal and replacement of old gaskets
Physical Form:	Dust
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Hand punching: 3.0-5.0 f/ccHand and machine processing: 0.01-1.3 f/ccCutting with knives, power sheers, wheels: 0.001-0.017 f/ccCutting with saber saw and wheel cutter: 0.33-0.49 f/ccInstallation: <0.03 f/ccInstallation after removal: 0.13-0.19 f/ccRemoval: 0.049-0.44 f/ccHand scraping: up to 0.4 f/ccDry removal: 0.11-0.33 f/ccDry polishing: 1.4 f/ccWet removal: <0.06 f/ccCleaning of debris after removal: 0.05 f/ccSheering and punching during cleanup: 1.2 and 1.67 f/ccBackground PBZ: 0.004 f/ccHand scraping PBZ: 0.14 f/ccPower wire brushing PBZ: 6.8 f/ccHand scraping and power wire brushing PBZ: 2.1 f/ccBroom sweeping of area after removal PBZ 5.5 f/ccBackground PBZ (study 2): 0.005 f/ccDuring Gasket Cutting, PBZ (study 2): 11 f/ccBackground before sweeping, PBZ (study 2): 0.13 f/ccDuring Sweeping, PBZ (study 2): 1.7 f/cc
Number of Sites:	2
Type of Measurement or Method:	8h TWA
Worker Activity:	Removal of asbestos-containing sheet gasket material and wire-brushing of the pipe flange.
Type of Sampling:	PBZ, area
Sampling Location:	Near flanges, power brushing equipment.
Bulk and Dust Particle Size Distribution:	All fibers were over 5 um in length and 0.25 um in diameter.
Engineering Control & percent Exposure Reduction:	If a gasket is visibly deteriorated and unlikely to be removed intact, removal shall be undertaken within a glovebag. The gasket shall be thoroughly wetted with amended water prior to removal. The wet gasket shall be immediately placed in a disposal container. Any scraping to remove residue must be performed wet.
PPE:	Respirators and head and body coverings.
Analytic Method:	NIOSH method 7400

EVALUATION

Domain	Metric	Rating	MWF*	Score	Comments

Continued on next page

– continued from previous page

Source Citation:	Millette, JR; Mount, MD; Hays, SM. 1995. Releasability of asbestos fibers from asbestos-containing gaskets. EIA Technical Journal.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	6926060

EVALUATION

Domain	Metric		Rating	MWF★	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Not peer reviewed but utilizes NIOSH method 7400.
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	Removal of asbestos sheet gaskets; in-scope use.
	Metric 4:	Temporal Representativeness	Low	× 2	6	1995 publication
	Metric 5:	Sample Size	Medium	× 1	2	Only ranges provided.
Domain 3: Accessibility/Clarity						
	Metric 6:	Metadata Completeness	High	× 1	1	Most critical metadata included
Domain 4: Variability and Uncertainty						
	Metric 7:	Metadata Completeness	Low	× 1	3	No discussion provided on if variability in operations is captured in sampled data; uncertainty in measurements not discussed.
Overall Quality Determination†			Medium		1.8	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.

Source Citation:	Millette, JR; Mount, MD; Hays, SM. 1996. Chapter 6: Asbestos-containing sheet gaskets and packing. Sourcebook on Asbestos Diseases, Vol. 12: Asbestos Health Risks.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	6915735

EXTRACTION

Parameter	Data
Life Cycle Stage:	Sheet gaskets
Life Cycle Description (Subcategory of Use):	handling of gaskets containing asbestos
Physical Form:	Dust
Route of Exposure:	Inhalation
Exposure Concentration (Unit):	Report summarizes the results of many studies done for asbestos exposure during handling of gaskets, most of which are HEROID's already extracted.
Type of Measurement or Method:	8h TWA, long term, and short term samples.
Worker Activity:	Gasket fabrication, processing, and cutting. Also, cleaning of dusty areas after processing.
Type of Sampling:	PBZ, area
Sampling Location:	Near flanges, power brushing equipment, and in cleanup locations.
Bulk and Dust Particle Size Distribution:	All fibers were over 5 um in length.
PPE:	Respirators and head and body coverings.
Analytic Method:	NIOSH method 7400

EVALUATION

Domain	Metric		Rating	MWF*	Score	Comments
Domain 1: Reliability						
	Metric 1:	Methodology	High	× 1	1	Not peer reviewed but utilizes NIOSH method 7400 in some of the studies summarized.
Domain 2: Representative						
	Metric 2:	Geographic Scope	High	× 1	1	United States
	Metric 3:	Applicability	High	× 2	2	Removal of asbestos sheet gaskets; in-scope use.
	Metric 4:	Temporal Representativeness	Medium	× 2	4	1996 publication
	Metric 5:	Sample Size	Medium	× 1	2	Summaries of study results provided, which include means, maximums, and ranges.
Domain 3: Accessibility/Clarity						

Continued on next page

– continued from previous page

Source Citation:	Millette, JR; Mount, MD; Hays, SM. 1996. Chapter 6: Asbestos-containing sheet gaskets and packing. Sourcebook on Asbestos Diseases, Vol. 12: Asbestos Health Risks.
Type of Data Source	Occupational Exposure; Monitoring Data;
Hero ID	6915735

EVALUATION

Domain	Metric	Rating	MWF★	Score	Comments
	Metric 6: Metadata Completeness	Medium	× 1	2	Critical metadata provided for each study mentioned, but many details not included, like number of samples or workers in each study.
Domain 4: Variability and Uncertainty					
	Metric 7: Metadata Completeness	Low	× 1	3	No discussion provided on if variability in operations is captured in sampled data; uncertainty in measurements not discussed.
Overall Quality Determination†		Medium		1.7	

★ MWF = Metric Weighting Factor

† If any individual metrics are deemed Unacceptable, then the overall rating is also unacceptable. Otherwise, the overall rating is based on the following scale: High: ≥ 1 to < 1.7; Medium: ≥ 1.7 to < 2.3; Low: ≥ 2.3 to ≤ 3.