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**DATE:** March 11, 2011  
**SUBJECT:** Chromium Emissions Speciation for Selected Source Categories

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## **I. Purpose**

This document provides a summary of the available chromium speciation data for selected source categories addressed in 2005 NATA and the rationale for the chromium speciation values used in the preliminary inhalation risk analyses.

## **II. Background**

Chromium compounds occur in nature and are found primarily in the earth's crust. The largest source of chromium is the ore mineral chromite,  $\text{FeCr}_2\text{O}_4$  or  $\text{MgCr}_2\text{O}_4$ , where magnesium can substitute for iron (Guertin, 2005). Chromium can also be found in small concentrations in certain types of igneous rocks, coal, tar, asphalt, and crude oil (Guertin, 2005). Chromium exists in several different oxidation states, but the most stable and most commonly found are hexavalent chromium (+6 valence state) (or Cr VI) and trivalent chromium (+3 valence state) (Cr III) (ATSDR, 2008).

Chromium compounds are used in a variety of industrial applications and operations. They are used in alloys, such as stainless steel; paint pigments; refractory bricks that line furnaces and kilns; wood preservatives; production and processing of insoluble salts; in leather tanning; as catalysts for halogenation, alkylation, and catalytic cracking of hydrocarbons; as fuel and propellant additives; and more (Guertin, 2005). Many of these applications use substances containing CrVI compounds, including various chromates, dichromates, and chromic acid. In addition, some industrial processes may produce chromium emissions, wherein the hexavalent state is favored in an oxidizing alkaline environment, and the trivalent state is favored in a reducing acidic environment (Guertin, 2005).

Cr VI, including its compounds, is classified by U.S. EPA as "a known human carcinogen by the inhalation route of exposure" because there is sufficient scientific evidence that inhalation exposure to this form of chromium increases the risks of cancer in humans (EPA, 1998). Because carcinogenicity by the oral route of exposure cannot be determined based on the information available, it is not classified as to the human carcinogenicity from this route of exposure (EPA, 1998). Cr VI has an inhalation cancer potency value of 0.012 per microgram per cubic meter ( $\mu\text{g}/\text{m}^3$ ), which means that inhaling Cr VI in air at an average concentration of  $1 \mu\text{g}/\text{m}^3$  daily for a lifetime poses an estimated increased risk of cancer of 12,000 in a million (EPA, 1998). This inhalation cancer potency value is among the highest values of the hazardous air pollutants (HAP)

listed in the Clean Air Act. On the other hand, trivalent chromium (Cr III) is “not classified as to its human carcinogenicity,” as no data are available on the carcinogenic potential of chromium (III) compounds alone (EPA, 1998). Therefore, it has no cancer potency value for inhalation or ingestion exposures and is not evaluated for cancer effects in risk assessments.

For non-carcinogenic effects, Cr VI has a Reference Concentration for Chronic Inhalation Exposure (RfC) inhalation value of 0.0001 per milligram per cubic meter ( $\text{mg}/\text{m}^3$ ), which means that a person inhaling Cr VI in air at an average concentration of 0.0001  $\text{mg}/\text{m}^3$  or less daily is likely to be without an appreciable risk of deleterious effects during a lifetime (EPA, 1998). On the other hand, data are considered to be inadequate for development of an RfC for Cr III due to the lack of a relevant toxicity study addressing respiratory effects of Cr III (EPA, 1998). Therefore, it has no non-cancer dose-response value for inhalation and is not evaluated for non-cancer effects in risk assessments. Thus, when estimating the increased risk of cancer due to chromium emissions, the determination of the percent Cr VI versus Cr III, is a major factor for estimating the extent and magnitude of the risks.

A preliminary risk assessment was conducted based on data extracted from EPA’s 2005 National-Scale Air Toxics Assessment (NATA) National Emissions Inventory (NEI). While chromium emissions are sometimes reported in the NEI as the specific compound emitted (e.g., potassium dichromate, strontium chromate, etc.) they can also be reported to the NEI as a general category of emissions such as “chromium & compounds,” or “chromium.” As the toxicity of these compounds is largely dependent on the oxidation state, it is an important factor in evaluating the health effects from exposure to chromium compounds. Where the specific compound or oxidation state of chromium is reported, the appropriate dose response value may be applied for the purposes of risk assessment. However, for generically reported chromium emissions, there is no information provided regarding the oxidation state of the chromium. For the source categories with generically reported chromium emissions, available data were examined to determine the proportions of emissions that would likely be in the Cr VI and Cr III oxidation states. Preliminary “speciation profiles” were developed from this effort and applied in the preliminary risk analyses.

### **III. General Approach for Developing Speciation Profiles for Source Categories**

The available chromium speciation data were examined for source categories. The available chromium speciation data ranged from no data available at all for a few source categories, to speciated data for individual emission point types for source categories. For several source categories, speciation data were available at a facility-wide level for one or more facilities in the source category.

In general, the data were examined and evaluated, and the speciation profile determined to be most appropriate for each source category was chosen according to a hierarchy in the quality of the data. Where available, emission point-specific speciation

data from that source category was given the highest weighting. Next in the hierarchy, overall emissions speciation data that represented the profile for an entire facility (as opposed to individual emission points at the facility) were considered. If data for a particular source category were unavailable or very limited, then we reviewed available data and information about chromium emissions from other similar industrial source categories or similar processes. In some cases, we also considered the NEI default chromium speciation values for a source category or emission point type when source category data were not available or limited.

Since the available chromium speciation data are sparse for most source categories, a conservative approach was applied in determining an appropriate profile. For example, if available data indicated a range of percentages for Cr VI, the higher end of the range was generally selected. Also, in general, an overall maximum value (or upper end value) was selected to be applied source category-wide to all emission points and at all facilities with generically reported chromium emissions.

While we believe the conservative approach applied in determining chromium speciation profiles to use for the preliminary risk analyses is appropriate, the chromium speciation profiles will be re-evaluated considering data received from information collection requests (ICR) under CAA Section 114, public comments received in response to proposed rule-making, and any relevant emissions test data that EPA may obtain from other efforts. Depending upon the amount and quality of data available during this re-evaluation, a less conservative approach may be applied. In addition, where available, emission point type-specific chromium speciation profiles may be applied. Any revised chromium speciation values will be applied in the risk analyses performed for the purposes of developing residual risk standards.

The following sections describe the data, analyses, assumptions, and conclusions regarding chromium speciation for selected source categories included in the 2005 NATA with generically reported chromium emissions.

#### **IV. Chromium Speciation for Specific Source Categories**

##### **1. Coal Boilers**

Chromium is naturally present as a trace element in coal. When coal is burned, chromium is released to the atmosphere. The quantity of chromium emitted is dependent on many factors including the concentration of chromium in the coal, control device efficiency and type of boiler. Based on source test data from 7 units, an assumption of 12% hexavalent chromium is used for coal boilers in 2005 NATA modeling. The 7 units included 4 utility boilers and 3 industrial boilers. The average hexavalent chromium for the 4 utility boilers was 11 % and the range for the 4 tests was 0.4 % to 23%. (1998 EPA “Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units – Final Report to Congress. U.S. EPA #453/R-98-004. February 1998). As part of the development of industrial boiler rule in 2000, hexavalent chromium was measured at 3 industrial boiler units. The average hexavalent chromium for the 3 industrial boilers

was 12% (Emissions database compiled November 30, 2000, in support of National Emission Standards for Hazardous Air Pollutants for Industrial/Commercial/Institutional Boilers and process Heaters, Final Rule, 69FR55217 September 13, 2004) Because of the limited number of units tested, the utility and industrial boiler data sets were combined and the more conservative value of 12% was used as a default in the 2005 NATA.

## **2. Ferroalloys Production**

Ferroalloys are alloys of iron and one or more other elements, such as chromium, manganese, and/or silicon. Ferroalloy production occurs when an electric arc furnace (EAF) is charged with raw materials to begin smelting the ores. The molten product is “tapped” or poured from the furnace. Raw material and product handling (e.g., crushing and screening operations) also occur as part of the ferroalloy production process. Emissions of chromium compounds may be caused by chromium present in the EAF feedstocks (coal and ore) and/or the refractory linings of the furnaces.

The ANPRM data set for the ferroalloys production source category includes one facility with chromium emissions (out of a total of three facilities), which are reported generically as “chromium & compounds” and “chromium” emissions.

During the development of the MACT for ferroalloys, there was a ferrochromium (FeCr) plant (Macalloy) located at Charleston, South Carolina. This facility was a potential major source of HAP, but closed down before the MACT standard was promulgated. A letter addressed to Conrad Chin (Environmental Engineer, U.S. EPA) from the South Carolina Department of Health and Environmental Control (DHEC) dated December 19, 1996, contains a table that provides Cr VI emissions data from electric arc furnaces (EAF) no. 15 and no. 14 of the Macalloy facility (South Carolina DHEC, 1996). Based on these data, Cr VI comprises approximately 2 percent of the total chromium emissions from the EAFs.

We do not have speciated chromium emissions data for other Ferroalloys production processes (e.g., for ferromanganese or silicomanganese). However, we do have some data for EAFs used for steel production. We believe that steel production EAFs, particularly EAF melting processes, are somewhat similar to ferroalloy processes, in that similar feedstocks are used and the EAF would include similar refractory linings. Therefore, we also reviewed the chromium data for the melting process from steel production EAFs for possible application to the ferroalloy category. We have Cr VI data for the baghouse dust from EAF melting for one steelmaking facility. These data include 9 samples of EAF melting baghouse dust that ranged from 0.8 percent to 2.5 percent Cr VI; the average of these data was 1.5 percent; and, the median was 1.4 percent (Consumers Energy, Laboratory Services, 2004). These data, all from a single plant, are not from emissions stack test data but rather are from analyses of EAF baghouse dust (i.e., we assumed that captured baghouse dust concentrations are the same as the dust concentrations emitted from the baghouse). We believe the EAF melting data from the baghouse dust is appropriate for ferroalloy production because the steel production EAF melting is similar to ferroalloys processing.

Based on these data, and assuming that captured baghouse dust concentrations are the same as the dust concentrations emitted from the baghouse, the estimated Cr VI emissions from one closed ferroalloy facility were 2 percent of the total chromium emissions generated by the EAF, and emissions of Cr VI are a maximum of 2.5 percent of EAF total chromium emissions at one steel production facility. Applying a conservative approach, we have assumed that 3 percent of the total chromium emissions from ferroalloys production facilities are Cr VI, and that 97 percent are Cr III, and this speciation profile was used in the preliminary risk analysis for generically reported chromium emissions.

### **3. Oil Boilers**

Chromium is naturally present as a trace element in oil. When oil is burned, chromium is released to the atmosphere. The quantity of chromium emitted is dependent on many factors including the concentration of chromium in the oil, control device efficiency and type of boiler. Based on source test data from 7 units, an assumption of 18% hexavalent chromium is used for coal boilers in 2005 NATA modeling. The average hexavalent chromium for the 7 utility boilers was 18 %, and the range for the 7 tests was 5 % to 34%. (1998 EPA “Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units – Final Report to Congress. U.S. EPA #453/R-98-004. February 1998).

### **4. Pesticide Active Ingredient Production**

Pesticide Active Ingredient (PAI) Production facilities manufacture active ingredients in insecticides, herbicides, fungicides, and related products. Typically, the active ingredients are subsequently formulated with inert ingredients to create end-product pesticides for application.

Emissions of chromium compounds are generally not expected from facilities in this source category. However, chromium emissions are included in the ANPRM data set for one facility (out of a total of 18 facilities), and are reported generically as “chromium & compounds” and “chromium” emissions.

We have no data for the PAI facility reporting chromium emissions that would provide a chromium speciation profile or information to develop such a profile. Consequently, we considered using chromium speciation data from source categories with similar processes. However, as chromium emissions appear to be unique to one PAI facility and are not necessarily emitted by a specific process used within this industry or other industries, a process-type comparison between facilities or industries was not appropriate in this case. We next considered the NEI default chromium speciation profiles. The NEI does not have a default chromium speciation profile specific to the MACT code for PAI production (0911), but there is a NEI default chromium speciation profile specific to the SCC for these emissions (30190013) of 4 percent Cr VI and 96

percent Cr III. Considering that all the chromium emissions for this source category are from one facility and one emissions point classified by this SCC, we applied the NEI default chromium speciation profile to these generically reported chromium emissions. Therefore the speciation profile used in the preliminary risk analysis was 4 percent Cr VI and 96 percent Cr III.

## **5. Phosphoric Acid and Phosphate Fertilizer Production**

Phosphoric acid production facilities produce phosphoric acid by reacting phosphate rock with sulfuric acid. Phosphate fertilizer production facilities react phosphoric acid or phosphate rock with other materials to create a fertilizer product. These operations are generally co-located, as phosphoric acid manufacturing facilities provide feedstock for phosphate fertilizer production facilities, and much of the phosphoric acid produced in the U.S. is consumed in the manufacture of fertilizers. Chromium emissions from these source categories originate from native chromium that is present in the phosphate rock ore.

The ANPRM data set for these facilities includes emissions for both source categories together. Of the 15 facilities in the ANPRM data set for the phosphoric acid and phosphate fertilizer production source categories, 2 facilities report “chromium” emissions.

We have no emissions data specific the facilities reporting these chromium emissions or to the phosphoric acid or phosphate fertilizer production industries that would provide a chromium speciation profile or information to develop such a profile for these processes. As such, we considered using chromium speciation data from source categories with similar processes. Another facility type that produces inorganic chemicals and that also processes ore containing chromium compounds are chromium chemicals production facilities. We have emissions tests from 1996 and 2000 for two facilities that manufacture chromium chemicals, which include chromium speciation measurements. The estimates of chromium speciation were 20 percent Cr VI and 80 percent Cr III for one facility and 21 percent Cr VI and 79 percent Cr III for the other facility (METCO 1996 and 2000). We expect that ores used for chromium chemicals manufacturing would have much higher levels of total chromium than phosphate rock ores. However, the speciation of the chromium that is in the ores used by these industries and that is emitted through the ore processing and production of the inorganic chemicals could be similar.

In the absence of chromium speciation data specific to phosphoric acid and phosphate fertilizer production facilities, we applied a conservative approach and assumed that the proportion of Cr VI emissions from phosphate fertilizer and phosphoric acid production facilities is similar to the upper end of the proportion of Cr VI emissions from chromium chemical production facilities. As the proportion of Cr VI measured at two of these facilities was 20 percent and 21 percent, and considering the possible differences in the ores used in by the chromium chemical production facilities and the ores used by phosphoric acid and phosphate fertilizer production facilities, we

conservatively assumed a value of 25 percent of the total chromium emissions from phosphoric acid and phosphate fertilizer production facilities are Cr VI, and that 75 percent are Cr III. This speciation profile was used in the preliminary risk analysis for generically reported chromium emissions for these source categories.

## 6. Pulp and Paper Production

The pulp and paper production source category includes any facility engaged in the production of pulp and/or paper, including integrated mills (where pulp alone or pulp and paper or paperboard are manufactured on-site), non-integrated mills (where paper or paperboard are manufactured, but no pulp is manufactured on-site), and secondary fiber mills (where waste paper is used as the primary raw material). The pulp and paper production operations (e.g., pulping, bleaching, and chemical recovery) are addressed in three MACT standards as follows:

- **MACT I** (40 CFR 63, subpart S) - regulates hazardous air pollutant (HAP) emissions from the pulp production areas and bleaching operations at chemical pulp mills (Kraft, sulfite, semi-chemical, and soda wood pulping processes)
- **MACT II** (40 CFR 63, subpart MM) - regulates HAP emissions from the chemical recovery combustion areas of chemical pulp mills (kraft, sulfite, semi-chemical, and soda pulping processes)
- **MACT III** (40 CFR 63, subpart S) - regulates HAP emissions from pulp and paper production areas of pulp mills using mechanical, secondary fiber, and non-wood pulping, and papermaking systems at all mills

Emissions of chromium and other metallic HAP are not expected from MACT I and III sources (other than for supplemental or in-process fuel use), but are expected from many of the MACT II chemical recovery combustion sources (e.g., direct contact evaporator (DCE) and nondirect contact evaporator (NDCE) recovery furnaces) at kraft, soda, sulfite, and stand-alone semichemical pulp mills; and lime kilns and smelt dissolving tanks at kraft and soda pulp mills.

Three ANPRM data sets were created for pulp and paper facilities. The contents of the data sets are based on the process MACT codes assigned to NEI records: (1) emissions regulated by MACT I and MACT III, (2) emissions regulated by MACT II, and (3) emissions from other pulp and paper sources at pulp and paper mills that are not specifically identified as being regulated by MACTs I, II, or III or other MACTs. Of the 168 facilities in the MACT I and III pulp and paper ANPRM data set, six facilities report “chromium & compounds” emissions, six report emissions of “chromium,” and one reports emissions of Cr VI; of the 141 facilities in the MACT II pulp and paper ANPRM data set, 22 facilities report “chromium & compounds” emissions, 23 report emissions of “chromium,” 30 report emissions of Cr VI, 21 report emissions of Cr III, two report emissions of chromic acid (VI), one reports emissions of calcium chromate, one reports emissions of sodium chromate, and one reports emissions of sodium dichromate; and of the 107 facilities in the “other sources” pulp and paper ANPRM data set, one facility reports “chromium & compounds” emissions, 3 report emissions of “chromium,” one

reports emissions of Cr VI, and one reports emissions of Cr III. The generically reported “chromium” and “chromium & compounds” emissions comprise over 99 percent of all the reported chromium emissions in the MACT I and III data set; approximately 38 percent of all the reported chromium emissions from the MACT II data set; and over 99 percent of all the reported chromium emissions from the “other sources” data set.

Some data were available from the industry to characterize emissions from MACT II emissions sources at pulp and paper facilities. The National Council for Air and Stream Improvement (NCASI) has produced a technical bulletin, *Technical Bulletin (TB) 858*, that contains emissions factors and summaries of emission test results for total chromium and Cr VI for some MACT II emissions sources (NCASI, 2003). For emissions sources in which several total chromium and Cr VI emission test results were presented, we selected the median value for each, based upon assuming all non-detects were half of the detection limits, which is a common approach used to estimate emissions when samples are below detection limit. We then divided the Cr VI emissions by the total chromium emissions to determine the approximate percentage of Cr VI. In other instances, only total chromium emissions data were presented, and we could not determine chromium speciation from this information. For these emissions sources, the general NEI default chromium speciation was assigned (34 percent Cr VI and 66 percent Cr III). We have no emissions data specific to the MACT I and III or “other” sources at pulp and paper facilities that could be used to develop a chromium speciation profile for the generically reported “chromium” or “chromium & compounds” emissions. However, the NEI has default chromium speciation profiles specific to many of the SCCs for these emissions sources, and we applied these NEI default chromium speciation profiles to these emissions. Table 1 shows the chromium speciation applied to each type of emission point at pulp and paper facilities and the source of the speciation data. These speciation profiles were used in the preliminary risk analysis for generically reported chromium emissions.

**Table 1. Pulp and Paper Chromium Speciation**

<b>Pulp and Paper Process Units</b>	<b>Emissions Source(s)</b>	<b>SCC</b>	<b>Estimated % Cr VI</b>	<b>Basis</b>
MACT I and III - Pulp and bleach systems at kraft, soda, sulfite, and semichemical pulping mills	unknown operations, fuel use – unknown fuel, and pulping not classified operations	30700X99	100	NEI default
	fuel use - unknown fuel	3079XXXX	34	General NEI default
	Fuel Fired Equipment: Natural Gas: Process Heaters, Fuel Fired Equipment: Natural Gas: Incinerators, In-Process Fuel Use: Natural Gas, General	30790003 30790013 39000699	4	NEI default
	wastewater	30700121	19	NEI



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				default
	causticizing	30700122	25	NEI default
MACT II - Chemical recovery combustion sources at kraft, soda, sulfite, and stand-alone semichemical pulping mills	smelt dissolving tank	30700105	100	NCASI
	unknown operations, neutral sulfite semichemical pulping, and pulping not classified	30700X99	100	NEI default
	recovery furnace/indirect contact evaporator	30700110	75	NCASI
	lime kiln (with ESP), MgO recovery system, NH3 recovery system, Na recovery system, and fluid bed reactor	30700106,30700221,30700222,30700223,30700303	34	General NEI default
	recovery furnace/direct contact evaporator	30700104	25	NCASI
	incineration of sludge	50300506	19	NEI default
	process heater – oil, incinerator – oil, lime kiln burning oil	30790001,30790002,30790011,30790012,39000403,39000503	18	NEI default
	lime kiln (with wet scrubber)	30700106	10	NCASI
	process heater – natural gas, incinerator - natural gas, incinerator - process gas, lime kiln burning natural gas, in process fuel use – natural gas	30790003,30790013,30790014,39000603,39000699	4	NEI default
	unknown operations	39999999	100	NEI default
Other, non-MACT processes	incineration and incineration of sludge	50300107,50300506	19	
	fuel use – natural gas and in process fuel use – natural gas	39000699	4	

### 7. Secondary Aluminum Production

Secondary aluminum production facilities recover aluminum from scrap materials such as beverage cans, foundry returns, dross, and other aluminum scrap. These facilities conduct the following operations: (1) preprocessing of scrap aluminum, including size reduction and removal of oils, coatings, and other contaminants, (2) furnace operations including melting, in-furnace refining, fluxing, and tapping, (3) additional refining, by means of in-line fluxing, and (4) cooling of dross.

Emissions of chromium compounds may be caused by chromium present in the furnace feedstock ((i.e., the scrap aluminum) and/or the refractory linings of the furnaces. Secondary aluminum feedstock may contain chromium from impurities in the scrap metal (such as auto parts) and from contamination of oils, grease, paints and lubricants on the aluminum scrap being fed into the furnace. Additionally, refractory linings of various parts of the furnace and its appendages contain chromium compounds or chromium ore, which is emitted from the furnace along with the other metal HAP emissions.

Of the 180 facilities in the ANPRM data set for the secondary aluminum production source category, 70 facilities report “chromium” emissions, 9 report emissions of “chromium & compounds,” 5 report emissions of Cr VI, and 2 report emissions of Cr III. The generically reported “chromium” and “chromium & compounds” emissions comprise over 99 percent of all the reported chromium emissions from the source category.

We have no emissions data specific to the secondary aluminum industry that could be used to develop a chromium speciation profile for the generically reported “chromium” or “chromium & compounds” emissions from secondary aluminum production processes. We have reports from tests conducted at secondary aluminum facilities for which total chromium emissions were measured, but these tests did not measure the Cr VI fraction of the total chromium emissions. Because the types of metal being recycled vary significantly from one facility to another, and because of lack of data for these facilities, it is not possible, at this time, to use industry-specific data to estimate chromium speciation for the overall industry. We considered using chromium speciation data from facilities in source categories that have similar processes or equipment, such as wool fiberglass facilities. Facilities in both the wool fiberglass and the secondary aluminum source categories use furnaces that have linings made of refractory material containing chromium. Due to these refractory materials, melt furnaces have been identified as one of the primary sources of chromium emissions from wool fiberglass production. While chromium emissions for these furnaces may be similar for both source categories, there is uncertainty about the amount of Cr VI that is in the scrap aluminum feed, and this speciation could vary depending on the specific characteristics of the scrap material. Considering the Cr VI speciation profile for wool fiberglass melt furnaces ranges from 5 percent to 95 percent (see the wool fiberglass section for more information about this speciation range), the uncertainty of the chromium speciation of the scrap feed material, and in applying a conservative approach, we have assumed that 100 percent of the total chromium emissions from secondary aluminum production facilities are Cr VI, and that 0 percent are Cr III. This speciation profile was used in the preliminary risk analysis for generically reported chromium emissions.

## **8. Secondary Lead Smelting**

Secondary lead smelting facilities use blast, rotary, reverberatory, and/or electric furnaces to recover lead metal from lead-bearing scrap materials, primarily lead-acid batteries. Processes at these facilities include: (1) breaking lead acid batteries and

separating the lead-bearing materials from the other materials, including the plastic case material and acid electrolyte, (2) melting lead metal and reducing lead compounds to lead metal in the smelting furnace, and (3) refining and alloying the lead to customer specifications. While it has been established that emissions of chromium from these facilities occur, the source of these emissions is not known.

The ANPRM data set for the secondary lead smelting source category includes 15 facilities with chromium emissions (out of a total of 15 facilities). The dataset includes records for “chromium” emissions for these facilities.

The data available on speciated chromium emissions from secondary lead smelters is limited to test data from one facility in California (Exide). However, as operations at this facility are considered typical for the source category, chromium emissions are expected to be similar at other smelters. In October 1991 and February 1992, Exide sampled baghouse dusts from multiple emissions points (EC/R, 2006). In the four emissions source types examined at the facility - a blast furnace, material storage unit, reverberatory furnace, and rotary dryer, total chromium and Cr VI were measured. The concentration of total chromium in the sampled dust ranged from 20 to 120 mg/kg. The concentration of Cr VI was below the detection limit of 0.25 mg/kg in each of the samples. If we assume Cr VI is one-half the detection limit (0.125 mg/kg), which is a common approach used to estimate emissions when samples are below detection limit, the range of the percent of Cr VI would be 0.1 percent ( $0.125 \text{ mg/kg} \div 120 = 0.001$ ) to 0.6 percent ( $0.125 \text{ mg/kg} \div 20 \text{ mg/kg} = 0.00625$ ), depending on the amount of total chromium assumed (EC/R, 2006).

Based on these data, and assuming that captured baghouse dust concentrations are the same as the dust concentrations emitted from the baghouse, the estimated range of Cr VI emissions for secondary lead smelters are from 0.1 percent to 0.6 percent of the total chromium emissions generated. Applying a conservative approach, we have assumed that 1 percent of the total chromium emissions from secondary lead smelters are Cr VI, and that 99 percent are Cr III. This speciation profile was used in the preliminary risk analysis for generically reported chromium emissions.

## **9. Wood Furniture (Surface Coating)**

The Wood Furniture Manufacturing industry encompasses the manufacture of a range of wood and wood-based products, including kitchen cabinets, residential furniture, office furniture and fixtures, partitions, shelving, lockers, and other wood furniture. The MACT standard for this source category covers the finishing, gluing, cleaning, and wash off operations at wood furniture manufacturing facilities. Emissions of chromium compounds from these facilities may be caused by the use of varnishes, glazes, paints, and other coatings that contain chromium.

Of the 644 facilities in the ANPRM data set for the wood furniture surface coating source category, 48 facilities report “chromium & compounds” emissions, 13 report emissions of “chromium,” and 10 report emissions of Cr III. The generically reported

“chromium” and “chromium & compounds” emissions comprise approximately 22 percent of all the reported chromium emissions from the source category.

To determine whether there could be Cr VI emissions from these facilities, EPA contacted representatives from the industry trade association (American Furniture Manufacturers Association) and two of the primary coating suppliers (Kazoo Nobel and Valspar). Based on these oral communications, we conclude that no product formulations for coatings used in the wood furniture industry contain Cr VI compounds. Therefore, we have assumed that 0 percent of the total chromium emissions from wood furniture manufacturing (surface coating) facilities are Cr VI, and that 100 percent are Cr III. This speciation profile was used in the preliminary risk analysis for generically reported chromium emissions.

## 10. Wool Fiberglass Production

Wool fiberglass is manufactured in a process that forms thin fibers from molten glass using raw materials such as sand, feldspar, sodium sulfate, anhydrous borax, boric acid, or other materials. A typical wool fiberglass manufacturing line consists of the following processes: (1) preparation of molten glass; (2) formation of fibers into a wool fiberglass mat; (3) curing the binder-coated fiberglass mat; (4) cooling the mat; and (5) backing, cutting, and packaging the finished product. According to the North American Insulation Manufacturers Association (NAIMA), Cr VI emissions are generated primarily from high temperature erosion and corrosion of refractory materials that contain chromium and some chromium is also generated from tramp chromium materials in the batch (Crane, 2008). Melt furnaces and all riser/channel/conditioner/forehearth systems that are constructed from chromium-bearing refractory materials emit Cr VI (Crane, 2008).

Of the 35 facilities in the ANPRM data set for the wool fiberglass production source category, 24 facilities report “chromium & compounds” emissions, 5 report emissions of “chromium,” 3 report emissions of Cr VI, and 1 reports emissions of Cr III. The generically reported “chromium” and “chromium & compounds” emissions comprise over 95 percent of all the reported chromium emissions from the source category.

Information provided by NAIMA reports estimated percentages of Cr VI relative to total chromium emissions for the equipment that generates chromium emissions at wool fiberglass production facilities. This information is based on stack sampling conducted over the past several years and compiled by NAIMA (Crane, 2008). Table 2 summarizes this information.

**Table 2. Cr VI as a Percent of Total Chromium Emissions for Chromium Emissions Sources at Wool Fiberglass Production Facilities**

Chromium Emissions Source Type	Cr VI Percent of Total Chromium Emissions
Melt furnace - OxyFuel unit with a precipitator	95%

Melt furnace - OxyFuel unit with electric-boost and a precipitator	85%
Melt furnace - electric (TECO, Intech, Western Fiberglass Hot Spot, etc.)	5%
Melt furnace - hot top other than an OxyFuel unit	75%
Channel/forehearth - sealed, un-vented electric	40%
Channel/forehearth - gas fired and vented	60%
Channel/forehearth - hybrid using burner and electric resistance heating	75%
Channel/forehearth - cooled without added heating	30%

In addition to this data, information provided to EPA by the Kansas Department of Health and Environment, indicates that one facility, Owens Corning in Kansas City, KS estimates Cr VI makes up 76 to 77 percent of total chromium emissions from melt furnaces and conditioning processes (Edmiston-Bennett, 2008).

Based on these data, the estimated Cr VI emissions range from 5 percent to 95 percent of the total chromium emissions from melt furnaces and range from 30 percent to 75 percent of the total chromium emissions from channel/forehearths. As our data do not indicate the specific type of equipment used by facilities, and given the wide variation in the estimated chromium speciation, we have applied a conservative approach and assumed that 100 percent of the total chromium emissions from all emission points emitting chromium at wool fiberglass production facilities are Cr VI, and that 0 percent are Cr III. This speciation profile was used in the preliminary risk analysis for generically reported chromium emissions.

#### **D. Summary of Chromium Speciation Profiles for Selected 2005 NATA Categories**

The following table presents a summary of the estimated percent Cr VI and Cr III used in the 2005 NATA preliminary inhalation risk analyses for each source category, along with the data used to support these estimates.

**Table 3. Summary of Chromium Emissions Speciation for Selected Source Categories in the 2005 NATA**

<b>Source Category</b>	<b>% Cr VI</b>	<b>% Cr III</b>	<b>Basis for speciation</b>
Coal Boilers	12	88	Source test data
Ferroalloys Production	3	97	Source category test data, surrogate source category test data
Pesticide Active Ingredient Production	4	96	NEI SCC default
Phosphate Fertilizer and Phosphoric Acid	25	75	Surrogate source category test data

## Chromium Emissions Speciation for Selected Source Categories March, 2011

Source Category	% Cr VI	% Cr III	Basis for speciation
Production			
Pulp and Paper Production	4 to 100 depending on type of process unit	0 to 96 depending on type of process unit	Industry data, NEI SCC defaults
Secondary Aluminum Production	100	0	Surrogate source category test data
Secondary Lead Smelting	1	99	Source category test data
Wood Furniture (Surface Coating)	0	100	Discussion with trade association and coatings suppliers
Wool Fiberglass Production	100	0	Trade association reported estimates

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