State of California
California Environmental Protection Agency
Air Resources Board

2003 Thermal Spraying Materials Survey

Final Report

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Acknowledgements

The Air Resources Board would like to thank the companies that responded to our 2003 survey.

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LIST OF ACRONYMS

ATCM	Airborne Toxic Control Measure
ARB	Air Resources Board
CAS#	Chemical Abstract Service number
HVOF	High Velocity Oxy-Fuel
PD	Protected Data
SWA	Sales-Weighted Average

I. INTRODUCTION

Thermal spraying (or metallizing) is a process in which metals are deposited in a molten or nearly molten condition to form a coating. Coating materials can include pure metals, metal alloys, carbides, oxides, ceramics, and ceramic metals (cermets). Some of the ingredients found in thermal spraying materials are classified as toxic air contaminants that can result in adverse health impacts. The Air Resources Board (ARB/Board) staff is investigating the potential health risks associated with thermal metal spraying activities.

As part of this investigation, ARB staff conducted a survey of thermal spraying materials manufacturers to identify the quantity of thermal spraying products that were sold in California during 2002. In May 2003, ARB staff mailed a survey to thermal spraying manufacturers throughout the United States and Canada. A copy of the survey form is contained in the Appendix. The 2003 survey only gathered data on thermal spraying materials containing chromium, nickel, and other specified chemicals of concern. The 2003 survey requested data on sales, chemical composition, type of thermal spraying process, customer industry identification, and customer location. This report summarizes the results of that survey.

In addition to surveying manufacturers, ARB staff has gathered basic data on thermal spraying facilities that have obtained air permits from local air districts. This effort is being followed up by a more detailed survey of all potential thermal metal spraying facilities in California, including those without air permits.

II. BACKGROUND

Hard chromium electroplating (chrome plating) has played an essential part in the managing, manufacturing, repair and maintenance operations for the military and industry. However, the chrome plating process generates hexavalent chromium, which has been identified by the United States Environmental Protection Agency and ARB as a toxic air contaminant. Due to the health risk to employees and the cost to comply with State and federal environmental laws, industry and the military are seeking alternatives to hard chromium electroplating. One potential alternative is thermal metal spraying. Some thermal metal spraying materials contain chromium, which can generate hexavalent chromium emissions when heated. As a result, a Board member requested that staff examine the potential health risk associated with thermal metal spraying activities.

III. OVERVIEW OF THERMAL METAL SPRAYING PROCESS OPERATIONS

ARB's survey gathered data on materials used in the following processes: (1) flame spraying; (2) plasma spraying; (3) twin-wire electric arc spraying; and (4) high velocity oxy-fuel (HVOF). All of these processes use thermal and kinetic energy to deposit material onto a surface. Material is fed into a thermal spray gun, melted and applied to the surface in molten or semi-molten droplets, using compressed air or another gas.

Generally, the quality of the coating is dependent upon the velocity of the processing gases and the generation of a high degree of kinetic energy. A brief description of each process is provided below.

Flame Spraying

Flame spraying can be accomplished using materials in either a powder form or a wire/rod form. The flame can be produced using acetylene, propane, or another flammable gas. Flame spraying can achieve particle velocities from 40 m/sec to 350 m/sec, depending on the type of material and equipment being used. Flame spraying can achieve deposition rates from 10 kg/hr to 60 kg/hr.

Plasma Spraying

A plasma jet is generated by feeding a gas (e.g., hydrogen, nitrogen, argon, helium) through an electric arc which ionizes the gas. At the core of the plasma the temperature can reach as high as 30,000 F. Therefore, plasma spraying can be used for ceramics and other materials that cannot be melted in other thermal spraying processes. The plasma process can generate particle velocities greater than 500 m/sec and deposition rates of 5 kg/hr.

Twin-Wire Electric Arc Spraying

In this process, wires of opposite polarity are used to create an electric arc, which melts the two wires at the tips and creates molten droplets. Twin-wire electric arc processes can deposit up to 60 kg/hr of coating material with particle velocities as high as 250 m/sec.

High Velocity Oxy-Fuel (HVOF)

HVOF uses a unique nozzle design and extremely high velocity gas to propel molten drops to a part surface. Particle velocities can reach 1000 m/sec with deposition rates up to 5 kg/hr.

IV. SURVEY RESULTS

The 2003 survey was distributed to 42 companies identified by the ARB as potential manufacturers of thermal spraying materials. A copy of the survey package is contained in the Appendix. The survey had a response rate of 90%, with 15 companies reporting sales and 23 companies stating they had no California sales of the targeted materials. The four companies that did not respond to the survey represent a small percentage of the market, based on discussions with an industry working group. Table 1 is a listing of companies that responded to the survey. Table 2 is a listing of companies that did not respond to the survey. Table 3 contains a summary of key survey results, and Tables 4 through 6 summarize other survey results.

Table 1: List of Companies that Responded to the Survey

1.	Alloy Sales
2.	Ametek Inc.
3.	Branford Wire
4.	Carpenter Powder Products Inc.
5.	Durum Inc., USA
6.	Eutectic Corporation
7.	F. J. Brodmann and Company, L.L.C.
8.	F. W. Winter Inc. and Company
9.	Flame Spray Technologies Inc.
10.	Genie Products Inc.
11.	H.C. Starck Inc.
12.	Heany Industries Inc.
13	Homogeneous Metals Inc.
14.	LiquidMetal Technologies
15.	Montreal Carbide Company, Ltd.
16.	Nano Steel Company
17.	North American Hoganas
18.	Northwest Mettech Corporation
19.	Osram Sylvania – Chemical and Metallurgical Products
20.	Plasma Powders and Systems Inc.
21.	Plasmatec Inc.
22.	Platt Brother and Company Inc.
23.	Polymet Corporation
24.	Postle Industries, Inc.
25.	Powder Alloy Corporation
26.	Powdermet Inc.
27.	Praxair Surface Technologies
28.	Precursor International Technologies Company
29.	Progressive Technologies Inc.
30.	Special Metals Welding Products Company
31.	Stellite Coatings
32.	Stoody Company
33.	Sulzer Metco
34.	Superior Shot Peening Inc.
35.	Thermach Incorporated
36.	UltraFine Powder Technology Inc.
37.	Wall Colmonoy Corporation
38.	Westaim Ambeon

Table 2: List of Companies that Did Not Respond to the Survey

1.	AIM Inc.
2.	Lineage Alloys
3.	Saint Gobain Ceramic Materials
4.	WOKA, North America

Table 3: Key Survey Results

Number of manufacturers that were surveyed	42
Number of manufacturers that responded	38
Number of manufacturers that reported 2002 sales in California	15
Number of manufacturers that reported products with chromium or chromium compounds	14
Reported sales of materials that contained chemicals of concern*	103 tons
Reported sales of materials that contained chromium or chromium compounds	72 tons
Reported quantity of chemicals of concern in thermal spraying materials	64 tons
Reported quantity of chromium in thermal spraying materials	18 tons

** Chemicals of concern include Toxic Air Contaminants and Copper (which may present an acute health risk).*

The ARB treats a company's reported sales data as confidential information. To maintain confidentiality in publishing the survey results, the ARB implemented the historical practice of concealing sales data that did not represent at least three companies, otherwise known as the "Three Company Rule." In addition, this report contains summarized survey data, rather than lists of individual survey responses to further protect confidentiality. Every effort was made to reveal as much of the survey data as possible without compromising the "Three Company Rule." However, instances did arise where it was necessary to conceal certain portions of the survey results. Throughout this report the term "Protected Data" (or PD) is used to reflect that compliance with the "Three Company Rule" could not be satisfied and the data were concealed.

Table 4 provides sales totals based on the material form (powder or wire) and the type of process. If a product was identified as being suitable for more than one process, all of the processes are listed.

Included with the survey was a list of compounds that were of particular interest. Table 5 provides the survey results for the targeted compounds.

Table 4: Sales Summary

Material/Process Description*		CA Sales in 2002 (Lbs)	CA Sales in 2002 (Tons)
Powder:	Flame Spray	9,967	5.0
	Flame Spray/Other	PD	PD
	Flame Spray/Plasma Spray	PD	PD
	HVOF	10,827	5.4
	HVOF/Flame Spray/ Plasma Spray	PD	PD
	HVOF/Plasma Spray	20,654	10.3
	Plasma Spray	17,382	8.7
	Plasma Spray/Other	PD	PD
	Powder Subtotal =	**103,980**	**52.0**
Wire:	Single-Wire Flame Spray	PD	PD
	Twin-Wire Electric Arc	PD	PD
	Wire Subtotal =	**102,249**	**51.1**
	GRAND TOTAL =	**206,230**	**103.1**

** If a product was designated for more than one process, all process descriptions are listed.*
***"PD":** Protected data (fewer than three companies reported sales).*

Table 5: Chemicals of Concern

Chemical Name	CAS	Form	Weight Percent			Quantity of Chemical Sold (lbs)
			Min.	Max.	SWA	
Antimony	7440-36-0	Wire	7.5	7.5	7.5	66
Chromium	7440-47-3	Powder	0.1	70.3	30.7	17,163
Chromium	7440-47-3	Wire	8.0	27.0	20.1	11,376
Chromium^{3+} (trivalent)	16065-83-1	Wire	13.0	13.0	13.0	2,991
Chromium Oxide (Cr_2O_3)	1308-38-9	Powder	91.0	99.3	99.1	7,551
Cobalt	7440-48-4	Powder	0.3	66.4	30.2	13,080
Cobalt	7440-48-4	Wire	1.0	1.0	1.0	4
Copper	7440-50-8	Powder	0.1	99.0	35.1	1,777
Copper	7440-50-8	Wire	3.5	99.0	81.3	5,099
Lead	7439-92-1	Wire	0.1	0.3	0.2	2
Manganese	7439-96-5	Powder	0.3	2.0	0.9	56
Manganese	7439-96-5	Wire	0.5	8.5	1.8	673
Nickel	7440-02-0	Powder	0.3	99.8	54.1	36,736
Nickel	7440-02-0	Wire	0.3	99.0	53.1	30,580
					TOTAL (lbs) =	**127,153**
					TOTAL (tons) =	**63.6**

Figure 1 illustrates the thermal spraying material sales breakdown by industry, based on total sales in California during 2002.

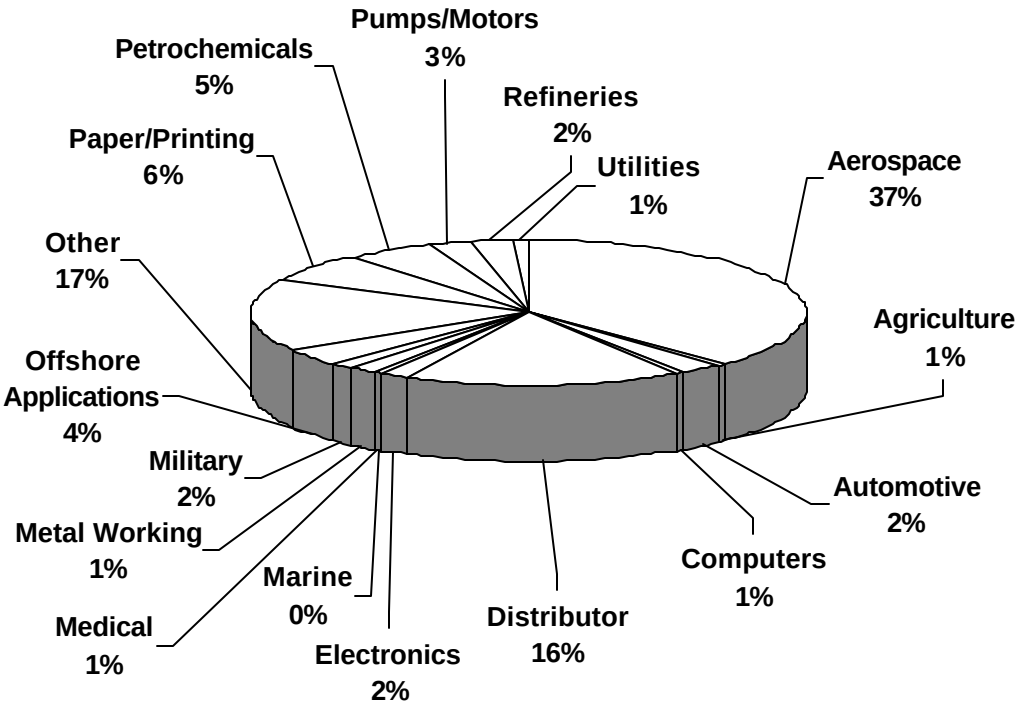

Figure 1: Industry Breakdown

For each product that was reported in the survey, manufacturers provided data on customer locations. For the sake of simplicity, California was divided into three regions along county lines, and manufacturers reported the number of customers in each region. Table 6 lists the sales-weighted average percent of customers for each region.

Table 6: Sales-Weighted Average Percent of Customers

Region		Air Districts		Percent of Reported Customers
	1	Amador Butte Colusa El Dorado Feather River Glenn Lake Lassen Mendocino Modoc	North Coast Unified Northern Sierra Northern Sonoma Placer Sacramento Shasta Siskiyou Tehama Yolo-Solano	4.5%
	2	Calaveras Great Basin Unified Monterey Bay Unified (San Benito & Santa Cruz Counties only)	San Francisco Bay Area San Joaquin Valley Unified (except Kern County) Tuolumne	16.3%
	3	Antelope Valley Imperial Kern Mojave Desert Monterey Bay Unified (Monterey County only) San Diego	San Joaquin Valley Unified (Kern County portion only) San Luis Obispo Santa Barbara South Coast Ventura	79.2%

V. FUTURE EFFORTS

ARB plans to use the data from the thermal spraying materials manufacturer survey to improve emission inventory estimates and to support our investigation into the potential health risks associated with thermal spraying facilities in California. To date, the investigation has included a survey of thermal spraying materials manufacturers, as well as a survey of the thermal spray facilities throughout California. The next phase of the investigation will include refined air dispersion modeling and health risk assessments. Based on the results of the health risk assessments, ARB will determine whether it is necessary to develop a statewide airborne toxic control measure (ATCM). Development of an ATCM will involve extensive consultation with stakeholders, including an industry working group and a working group for air districts. For additional information regarding ARB's thermal spray activities please visit our website at *www.arb.ca.gov/coating/thermal/thermal.htm.*

APPENDIX

2003 Thermal Spraying Materials Survey Package

Winston H. Hickox
Agency Secretary

Air Resources Board

Alan C. Lloyd, Ph.D.
Chairman
1001 I Street • P.O. Box 2815 • Sacramento, California 95812 • www.arb.ca.gov

Gray Davis
Governor

May 15, 2003

Re: Survey For Sales Of Thermal Spray Materials In California

The California Air Resources Board (ARB) is conducting a survey regarding thermal spray materials sold in California in 2002. The purpose of the survey is to gather data on thermal spraying products and processes that potentially emit toxic metals or compounds which could result in acute health risks (see enclosed list of targeted compounds). The information that you supply will be used to help develop estimates of health risks associated with thermal spraying in California.

Legal Authority And Confidentiality: This request for information is made pursuant to sections 39607, 39701, and 41511 of the California Health and Safety Code, and Title 17, California Code of Regulations, section 91100. These sections authorize the ARB to require the submission of information needed to estimate atmospheric emissions and to carry out its other statutory responsibilities. *All survey data will be protected as confidential information, in accordance with Title 17, California Code of Regulations, sections 91000 to 91022 and the California Public Records Act (Government Code section 6250 et seq.) (see enclosed confidentiality form).*

Due Date: The survey information is ***due no later than July 18, 2003***. The mailing address is: California Air Resources Board, Stationary Source Division, Measures Assessment Branch, P.O. Box 2815, Sacramento, California 95812. *Attention: Monique Davis. The information may also be provided via e-mail to Monique Davis – mdavis@arb.ca.gov.*

Survey Instructions: The enclosed survey consists of two forms: Form I: requests general information regarding HC Stark, and the percentage, by industry type, of annual product sales. Form II: collects specific product information including annual sales, composition, applicable processes, and industries.

Thank you for your valuable assistance in this effort. If you have any questions regarding this matter, or if you would like to participate in the working group, please call Mr. Jose Gomez, Manager, Technical Development Section, at (916) 324-8033, or e-mail (jgomez@arb.ca.gov) or Ms. Monique Davis at (916) 324-8182, or e-mail (mdavis@arb.ca.gov).

Sincerely,

Barbara Fry, Chief
Measures Assessment Branch

Enclosures

cc: Jose Gomez, Manager
Technical Development Section

Monique Davis
Strategy Evaluation Section

Survey for Sales of Thermal Spray Materials in California

PLEASE PROVIDE REQUESTED DATA BY JULY 18, 2003:

CALIFORNIA AIR RESOURCES BOARD
STATIONARY SOURCE DIVISION
MEASURES ASSESSMENT BRANCH
P.O. BOX 2815
SACRAMENTO, CA 95812

?QUESTIONS?
CONTACT: MONIQUE DAVIS
(916) 324-8182
E-MAIL: mdavis@arb.ca.gov
FAX: (916) 324-8026

FORM I: GENERAL INFORMATION

Step 1: Please provide general company contact information.

Company Name: _____

Company Address: _____

Point of Contact: _____

Telephone Number: _____

Fax Number: _____

E-mail Address: _____

Step 2: Did you sell thermal spraying materials in California during 2002? ❑ YES ❑ NO
If "NO", please stop here and FAX this page to (916) 324-8026, Attn: Monique Davis.

Step 3: If you require the data submitted for this survey to be kept confidential, please complete the enclosed "Confidentiality Form". Clearly label all data submitted as confidential.

Step 4: Please provide an estimated breakdown, by category, for your annual thermal spraying materials sales in California (calendar year 2002).

____ % Aerospace	____ % Agriculture	____ % Automotive
____ % Computers	____ % Electronics	____ % Marine
____ % Medical	____ % Metal Working	____ % Military Working
____ % Offshore Applications	____ % Paper/Printing	____ % Petrochemicals
____ % Pumps/Motors	____ % Railroad	____ % Refineries
____ % Utilities	____ % Other _____	

Legal authority and confidentiality. *This request for information is made pursuant to* sections 39607, 39701, and 41511 of the California Health and Safety Code, and Title 17, California Code of Regulations, section 91100. *These sections authorize the ARB to require the submission of information needed to estimate atmospheric emissions and to carry out its other statutory responsibilities. All survey data will be protected as confidential information, in accordance with* Title 17, California Code of Regulations, sections 91000 to 91022 and the California Public Records Act (Government Code section 6250 et seq.).

Survey for Sales of Thermal Spray Materials in California

FORM II: PRODUCT SALES DATA

*Step 5: Please report 2002 annual sales for all thermal spraying materials sold in California. Only include those products that contain at least **0.1%** (by weight) of the targeted compounds in the attached list (e.g., chromium, nickel, cobalt, copper). Make additional copies of this page, as needed, to submit data for additional products.*

Product Name: _____

Product Code: _____

Annual Sales In California: (by weight) CY 2002 ❑ ***Lbs*** ❑ ***Tons*** ❑ ***Kgs*** _____

Chemical Constituents: (Name, wt%)

Chemical Name	Weight Percentage (%)

SOLD TO:

Step 6: Please describe the customers for this product, by industry category. Check all that apply.

___ Aerospace
___ Agriculture
___ Automotive
___ Computers
___ Electronics
___ Marine
___ Medical
___ Metal Working
___ Military
___ Offshore Applications
___ Paper/Printing
___ Petrochemicals
___ Pumps/Motors
___ Railroad
___ Refineries
___ Utilities
Other: _____

Step 7: Please identify the thermal spraying processes for this product. Check all that apply.

Powder
___ High Velocity Oxy-Fuel (HVOF)
___ Flame Spray
___ Plasma Spray
___ Detonation Gun

Wire/Rod
___ Twin-Wire Electric Arc
___ Single-Wire Flame

Other: _____

Step 8: Please estimate the number of customers in each region.

Region 1 : _____ **Region 2 :** _____ **Region 3 :** _____

REGION LOCATOR KEY

To better identify the number of facilities within California, we have divided the State into three regions and provided a Region Locator Key that lists all the prefixes for zip codes in the state.

Make additional copies of this page as needed.

Survey for Sales of Thermal Spray Materials in California

Ingredients of Interest

*On Form II, please report 2002 sales of products that contain at least **0.1%** (by weight) of the targeted compounds in the following list:*

	CAS Number
Antimony and Compounds	7440-36-0
Arsenic and Compounds	7440-38-2
Asbestos	1332-21-4
Beryllium and Compounds	7440-41-7
Bromine and Compounds	7726-95-6
Cadmium and Compounds	7440-43-9
Chromium and Compounds	7440-47-3
Chromium 6+ (hexavalent) and Compounds	18540-29-9
Chromium 3+ (trivalent) and Compounds	16065-83-1
Copper and Compounds	7440-50-8
Cyanide Compounds (Inorganic)	57-12-5
Fluoride Compounds (Inorganic)	16984-48-8
Lead and Compounds	7439-92-1
Manganese and Compounds	7439-96-5
Mercury and Compounds	7439-97-6
Nickel	7440-02-0
Phosphorus (white)	7723-14-0
Sodium Hydroxide	1310-73-2
Vanadium and Compounds	7440-62-2

This table is based on the data compiled by the Office of Environmental Health Hazard Assessment (OEHHA) in the "Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values".

CONFIDENTIAL INFORMATION SUBMITTAL FORM

If you wish to designate any information contained in your survey data as **CONFIDENTIAL INFORMATION**, please provide the data requested below and return it with your completed survey forms.

In accordance with Title 17, California Code of Regulations (CCR), sections 91000 to 91022, and the California Public Records Act (Government Code Section 6250 et seq.), the information that a company provides to the Air Resources Board (ARB) may be released: (1) to the public upon request, except trade secrets which are not emissions data or other information which is exempt from disclosure or the disclosure of which is prohibited by law; (2) to the U.S. Environmental Protection Agency (EPA), which protects trade secrets as provided in Section 114(c) of the Clean Air Act and amendments thereto (42 USC 7401 et seq.) and in federal regulation; and (3) to other public agencies provided that those agencies preserve the protections afforded information which is identified as a trade secret, or otherwise exempt from disclosure by law (Section 39660(e)).

Trade secrets as defined in Government Code Section 6254.7 are not public records and therefore will not be released to the public. However, the California Public Records Act provides that air pollution emission data are always public records, even if the data comes within the definition of trade secrets. On the other hand, the information used to calculate emissions is a trade secret.

If any company believes that any of the information it may provide is a trade secret or otherwise exempt from disclosure under any other provision of law, **it must identify the confidential information as such at the time of submission to the ARB and must provide the name, address, and telephone number of the individual to be consulted**, if the ARB receives a request for disclosure or seeks to disclose the data claimed to be confidential. The ARB may ask the company to provide documentation of its claim of trade secret or exemption at a later date. Data identified as confidential will not be disclosed unless the ARB determines, in accordance with the above referenced regulations, that the data do not qualify for a legal exemption from disclosure. The regulations establish substantial safeguards before any such disclosure.

In accordance with the provisions of Title 17, California Code of Regulations, sections 91000 to 91022, and the California Public Records Act (Government Code Sections 6250 et seq.),

Company Name:

_____ declares that only those portions specifically identified and submitted in response to the California Air Resources Board's information request on the survey are confidential "**trade secret**" information, and requests that it be protected as such from public disclosure. All inquiries pertaining to the confidentiality of this information should be directed to the following person:

Name (please print): _____

Signature: _____

Title: _____

Telephone #: _____

Company Address: _____

_____