



California Air Resources Board Thermal Spray Regulations

25th Program Review

Greensboro, NC

March 2005

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The CARB ACTM

- ❑ Airborne Toxic Control Measure (ACTM) to Reduce Emissions of Hexavalent Chromium and Nickel from Thermal Spraying
 - California Air Resources Board (statewide) Air Toxics Control Measure
 - Adopted 12/9/04, final passage 3/4/05
 - Also adopted February 4, 2005, by the South Coast Air Quality Management District (SCAQMD)
 - Compliance dates
 - New or modified facilities, Jan 1 2005
 - Existing facilities, Jan 1 2006
- ❑ Information locations
 - Background <http://www.arb.ca.gov/coatings/thermal/thermal.htm>
 - Rulemaking <http://www.arb.ca.gov/regact/thermspr/thermalspr.htm>
 - Proposed regulatory language and methods of “calculating” emissions <http://www.arb.ca.gov/coatings/thermal/docs.htm>
 - HCAT site
<http://www.materialoptions.com/w2g/cgi/kmcgi.exe?O=DIR0000000MDR&V=0>

CARB meeting Dec 12 2004

- ❑ Meeting at which rules were adopted that was open to public comment
- ❑ Only thermal spray industry member present was Plasma Technology and consultant Barbara Kanegsberg
- ❑ A lot of hyperbole and uninformed statements from environmentalists
- ❑ Tendency of public to equate thermal spray with chrome plating

Latest update – March 1 2005

Thermal Spraying ATCM Update - March 1, 2005

The Air Resources Board approved the Thermal Spraying ATCM at their hearing on December 9, 2004. During the hearing, ARB staff also obtained approval to make additional changes to address stakeholder comments. In March 2005, we will make available these proposed changes for a 15-day public comment period. After these 15-day changes are incorporated, the regulatory documents must be submitted to the Office of Administrative Law and the Secretary of the State for final approval.

Regulatory Process

- ✍ Board Approved Thermal Spraying ATCM on December 9, 2004
- ✍ Draft changes are made available for 15-day public review in March 2005
- ✍ 15-day changes are incorporated and regulatory package is submitted to the Office of Administrative Law
- ✍ Office of Administrative Law has 30 days to review and approve regulatory package
- ✍ Secretary of State has 30 days to review and approve regulatory package
- ✍ Regulation becomes legally effective

If you're interested in reviewing the 15-day changes, please sign up for the list serve on this website. You will be notified by e-mail when the proposed changes are available and when the regulation is formally approved.

For more information please contact:
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- ❑ Last chance (15 day period) to put in comments
 - ❑ Must sign up to list serve

Provisions

- ❑ All new or modified operations must install maximum control efficiency technology – e.g. HEPA filters or equivalent devices.
- ❑ Largest sources – control efficiency must increase to 99.97% for $0.3\mu\text{m}$ particles
- ❑ Small sources – Lower control efficiency requirement for BACT; control device efficiency of 90%
 - Exemption: existing thermal spray operations with low emissions (based on whether the facility is a point or volume source); however such operations must still comply with all permitting, monitoring and recordkeeping requirements.
- ❑ Remotely located operations – The ATCM allows for 90% control efficiency for any facility located at least 1 640' (500 m) from a sensitive receptor. However the facility must conduct a site-specific analysis to confirm its low health risk status.

Provisions (cont)

- ❑ No new facilities within 500' of a residential or mixed use area
- ❑ All new operations must undergo site-specific analysis conducted by the district even if the facility has HEPA filters and meets the 500' criteria
- ❑ Standards for enclosures and ventilation systems
- ❑ Permit required by Oct 1, 2005

Allowable emissions – point sources

- Rules vary by emission volume
 - Point sources emit up stacks or pipes

Tier	Annual Hexavalent Chromium Emissions from Thermal Spraying	Annual Nickel Emissions from Thermal Spraying	Minimum Control Efficiency Requirements
1	≥ 0.004 lbs/yr and ≤ 0.04 lbs/yr	≥ 2.1 lbs/yr and ≤ 20.8 lbs/yr	90% by weight (e.g., a water curtain)
2	> 0.04 lbs/yr and ≤ 0.4 lbs/yr	> 20.8 lbs/yr and ≤ 208 lbs/yr	99.999% @ 0.5 microns (e.g., a high-efficiency dry filter)
3	> 0.4 lbs/yr	> 208 lbs/yr	99.97% @ 0.3 microns (e.g., a HEPA filter)

Allowable emissions – volume sources

- Emit through door and windows – no stacks

Tier	Annual Hexavalent Chromium Emissions from Thermal Spraying	Annual Nickel Emissions from Thermal Spraying	Minimum Control Efficiency Requirements
1	≥ 0.001 lbs/yr and ≤ 0.01 lbs/yr	≥ 0.3 lbs/yr and ≤ 3.1 lbs/yr	99% by weight (e.g., a dry filter)
2	> 0.01 lbs/yr and ≤ 0.1 lbs/yr	> 3.1 lbs/yr and ≤ 31 lbs/yr	99.999% @ 0.5 microns (e.g., a high-efficiency dry filter)
3	> 0.1 lbs/yr	> 31 lbs/yr	99.97% @ 0.3 microns (e.g., a HEPA filter)

How did they come up with Cr⁶⁺ emissions?

- ❑ Sawatari and Serita, *Industrial Health*, 24, pp 51-61 (1986)
 - Study of welding fumes carried out by using a plasma spray gun running on **pure Cr** powder – spray conditions not known
 - Fumes collected and measured by wet chemistry
- ❑ CARB study
 - Plasma spray of pure Cr – spray conditions not known
 - Measurement by uv-vis atomic absorption spectrophotometer

Conclusion
1/3 of spray
is Cr⁶⁺

Chromium Compounds in Plasma Spraying Fumes

Name of Compound	CAS #	MW*	% of Total
Dichromium Trioxide (Cr ₂ O ₃) [corundum structure]	1308-38-9	152	25%
Chromium (VI) Trioxide (CrO ₃)	1333-82-0	100	3%
Mixed Oxide Fraction Containing:			
Dichromium (III) Trioxide (Cr ₂ O ₃)	1308-38-9	152	45%
Chromium (VI) Trioxide (CrO ₃)	1333-82-0	100	27%
Total =			100%

*MW = Molecular Weight, grams/mole

**Note: No Cr metal in
spray!**

Equivalent methodology for chrome plating air emission calculations



Assumed Cr⁶⁺ air emissions from thermal spray

- ❑ Measuring stack emissions costs ~\$100,000
- ❑ CARB “helpfully” supplies a method for calculating Cr⁶⁺ emissions instead of spending all that money
 - Based on idea that all thermal spray processes turn **30% of all** Cr sprayed by any method into Cr⁶⁺

Emission Factor Summary – Hexavalent Chromium

Process	Emission Factors (lbs Cr ⁶⁺ /lb Cr sprayed)			
	0% Ctl. Eff. (Uncontrolled)	90% Ctl. Eff. ¹ (e.g. Water Curtain)	99% Ctl. Eff. (e.g. Dry Filter)	99.97% Ctl. Eff. (e.g., HEPA Filter)
Single-Wire Flame Spray ²	4.68E-03	4.68E-04	4.68E-05	1.40E-06
Twin-Wire Electric Arc Spray ²	6.96E-03	6.96E-04	6.96E-05	2.09E-06
Flame Spray ³	6.20E-03	1.17E-03	6.20E-05	1.86E-06
HVOF ³	6.20E-03	1.17E-03	6.20E-05	1.86E-06
Plasma Spray ⁴	1.18E-02	6.73E-03	2.61E-03	2.86E-06
Other Thermal Spraying ⁵	7.17E-03	2.05E-03	5.70E-04	2.01E-06

Assumed Ni air emissions from thermal spray

Maximum Hourly Emissions, 0% Control Efficiency – Nickel

Process	Material	Emission Factor (g Ni/g Ni)	Estimated Emissions (grams Ni/sec)		
			Low Spray Rate @ 0.083 g/s	Medium Spray Rate @ 0.63 g/s	High Spray Rate @ 1.89 g/s
Flame Spray	Powder	1.10E-01	6.93E-03	6.93E-02	2.08E-01
Flame Spray/Other	Powder	1.02E-01	6.43E-03	6.43E-02	1.93E-01
Flame Spray/Plasma Spray	Powder	1.30E-01	8.19E-03	8.19E-02	2.46E-01
HVOF	Powder	1.10E-01	6.93E-03	6.93E-02	2.08E-01
HVOF/Flame Spray/Plasma Spray	Powder	1.23E-01	7.77E-03	7.77E-02	2.33E-01
HVOF/Plasma Spray	Powder	1.30E-01	8.19E-03	8.19E-02	2.46E-01
Plasma Spray	Powder	1.50E-01	9.45E-03	9.45E-02	2.83E-01
Plasma Spray/Other	Powder	1.22E-01	7.69E-03	7.69E-02	2.31E-01
Single-Wire Flame Spray	Wire	1.10E-01	6.93E-03	6.93E-02	2.08E-01
			Low @ 0.083 g/s	Medium @ 0.63 g/s	High @ 3.15 g/s
Twin-Wire Electric Arc	Wire	6.00E-03	3.78E-04	3.78E-03	1.89E-02

Outcome of rules

- ❑ Spraying will become more difficult in CA
- ❑ A lot of manufacturers will probably choose to stay with chrome plate rather than switch to cleaner thermal spray
 - Leading to increased Cr⁶⁺ emissions, of course
- ❑ Similar rules may be adopted in other states
- ❑ Some sprayers have already adopted HEPA filters
- ❑ Even though they know Cr⁶⁺ emissions are well below assumed levels some are adding controls because it is no more expensive than measuring the emissions