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Part II

Environmental Protection Agency

40 CFR Part 63

Proposed Standards for Chromium
Emissions From Hard and Decorative
Chromium Electroplating and Chromium
Anodizing Tanks; Proposed Rule

ENVIRONMENTAL PROTECTION AGENCY**40 CFR Part 63**

[AD-FRL-4810-5]

RIN 2860-AC14

National Emission Standards for Hazardous Air Pollutants; Proposed Standards for Chromium Emissions From Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule and notice of public hearing.

SUMMARY: The proposed standards would limit emissions of chromium compounds from new and existing chromium electroplating and anodizing operations; both major and area sources are being regulated. The proposed standards implement section 112 of the Clean Air Act, as amended. The intent of the standards is to protect the public health by minimizing the amount of chromium emitted from new and existing chromium electroplating and anodizing operations. These sources must achieve an emissions level consistent with the installation and operation of maximum achievable control technology (MACT). The EPA is also proposing Methods 306, 306A, and 306B with the standards. These methods would be used to demonstrate compliance with the standards.

DATES: *Comments:* Comments must be received on or before February 14, 1994.

Public Hearing: If anyone contacts EPA requesting to speak at a public hearing by January 6, 1994, a public hearing will be held on January 18, 1994, beginning at 10 a.m.

ADDRESSES: *Comments:* Comments should be submitted (in duplicate if possible) to: Air Docket (LE-131), Attention: Docket Number A-88-02, U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460.

Public Hearing: If anyone contacts EPA requesting a public hearing, the hearing will be held at the EPA Office of Administration Auditorium in Research Triangle Park, North Carolina. Persons interested in attending the hearing or wishing to present oral testimony should notify Mrs. Julia Latta, Standards Development Branch (MD-13), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone number (919) 541-5578.

Background Information Document: The background information document (BID) and other documents supporting the proposed standards may be obtained from the docket or from the U.S. EPA Library (MD-35), Research Triangle Park, North Carolina 27711, telephone number (919) 541-2777. Please refer to "Chromium Electroplating NESHAP—Background Information Document for Proposed Standards" (Volume I: EPA-453/R-93-030a and Volume II: EPA-453/R-93-030b) and to "Chromium Electroplating NESHAP—New Technology Document" (EPA-453/R-93-031).

Docket: Docket No. A-88-02, containing supporting information used in developing the proposed standards, is available for public inspection and copying between 8 a.m. and 4 p.m., Monday through Friday, at EPA's Air Docket Section, West Tower Lobby, Gallery 1, Waterside Mall, 401 M Street, SW., Washington, DC 20460. A reasonable fee may be charged for copying.

FOR FURTHER INFORMATION CONTACT: For information concerning regulatory decisions and the proposed standards, contact Mr. Lalit Banker, Standards Development Branch ((919) 541-5420). For information concerning technical aspects of chromium electroplating and anodizing tanks or control technologies, contact Mr. Phil Mulrine, Industrial Studies Branch ((919) 541-5289). The address for each of these contacts is Emission Standards Division (MD-13), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711.

SUPPLEMENTARY INFORMATION: The information presented in this preamble is organized as follows:

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I. Background

In 1984, the EPA began an investigation of chromium electroplating operations as a source of chromium emissions in conjunction with a notice of intent to list total or hexavalent chromium as a hazardous air pollutant (HAP) under section 112 of the Clean Air Act (50 FR 24317). This study focused on chromium emissions from chromium electroplating and anodizing tanks. (Due to the focus of this study, information was not obtained on HAP emissions from other metal plating processes such as nickel, copper, and cadmium plating. As a result, these processes are not included in today's proposal.) During this study, it was determined that chromium electroplating and anodizing tanks were significant emitters of chromic acid, the principal ingredient in chromium electroplating and anodizing baths. Chromic acid is a hexavalent chromium compound. The EPA has determined that there is strong evidence to conclude that hexavalent chromium compounds cause lung cancer in humans. This conclusion was documented in the notice of intent to list total or hexavalent chromium (50 FR 24317). Trivalent chromium compounds are emitted in low levels from those decorative electroplating tanks that use trivalent chromium electroplating solutions. The data on the carcinogenicity of trivalent chromium are inconclusive at this time; however, it is known that trivalent chromium can accumulate in the lungs and could potentially result in decreased lung

function under extended exposure conditions.

On November 15, 1990, the Clean Air Act was amended. Section 112(b) of the amended Act provides a list of 189 compounds that are considered to be HAP. Chromium compounds are included on this list of pollutants. Under section 112(c) of the Act, the Administrator is required to publish and from time to time revise a list of source categories and subcategories that emit one or more of the HAP listed in section 112(b). On July 16, 1992, EPA published in the *Federal Register* (57 FR 31576) an initial list of major and area source categories to be regulated, which included major and area sources of hard chromium electroplating, decorative chromium electroplating, and chromium anodizing. Emission standards under section 112(d) of the Act are being proposed for all six of these source categories. The study of these source categories that had begun in 1984 continued and became the basis for this proposed rule.

Subcategorization of each of the above categories was studied. The EPA study concluded that major and area sources of emissions from hard chromium electroplating and chromium anodizing tanks should not be subcategorized. However, it was determined that major and area sources of emissions from decorative chromium electroplating tanks should be subcategorized according to whether a trivalent chromium or chromic acid electroplating bath solution is used. The chromic acid and trivalent chromium processes are considered separate source subcategories because the trivalent chromium process differs in several ways from the chromic acid electroplating process. For example, the electroplating bath chemistry for trivalent baths is comprised mostly of trivalent chromium; hexavalent chromium is considered a bath contaminant, whereas it is the main ingredient in a chromic acid bath. In addition, the process line for a trivalent chromium electroplating process differs from that used with a chromic acid electroplating bath. In particular, additional rinse tanks or post dips are added to the electroplating line in the trivalent chromium electroplating processes (for more information, see discussion of trivalent chromium electroplating tanks in section V.A.2 of this preamble).

The Agency's findings indicate that a majority of the sources in the six source categories are not major sources as defined in section 112(a)(1); i.e., they do not emit or have the potential to emit greater than 9.1 Megagrams per year

(Mg/yr) (10 tons per year (tons/yr)) of chromium compounds. Some sources would be considered major if the source is located at a facility that is major. In such cases, the source would be regulated as a major source. Based on the fact that most sources would not be considered major and considering the toxicity of chromium compounds, EPA has chosen to regulate area sources as well as major sources as documented in the area source finding for these six source categories (57 FR 31576). Further, the proposed rule would regulate both major and area sources by applying maximum achievable control technology (MACT).

II. National Emission Standards for Hazardous Air Pollutants Decision Process

A. Source of Authority for NESHAP Development

Section 112 of the 1990 Clean Air Act gives EPA the authority to establish national standards to reduce air toxics from sources that emit one or more HAP. Section 112(b) contains a list of HAP that are the specific air toxics to be regulated by national emission standards for hazardous air pollutants (NESHAP). Section 112(c) directs EPA to use this pollutant list to develop and publish a list of source categories for which NESHAP will be developed. The EPA must list all known categories and subcategories of "major sources" (defined below) which emit one or more of the listed HAP. Area source categories selected by EPA for NESHAP development will be based on the Administrator's judgment that the sources in a category, individually or in aggregate, pose a "threat of adverse effects to health and the environment."

B. Criteria for Development of NESHAP

The NESHAP are to be developed to control HAP emissions from both new and existing sources according to the statutory directives set out in section 112 of the Act. The statute requires the standard to reflect the maximum degree of reduction in emissions of HAP that is achievable for new or existing sources. The NESHAP must reflect consideration of the cost of achieving the emission reduction, any nonair quality health and environmental impacts, and energy requirements for control levels more stringent than the MACT floor (described below). The emission reduction may be accomplished through application of measures, processes, methods, systems or techniques, including, but not limited to, measures which:

(A) Reduce the volume of, or eliminate emissions of, such pollutants through process changes, substitution of materials, or other modifications;

(B) Enclose systems or processes to eliminate emissions;

(C) Collect, capture, or treat such pollutants when released from a process, stack, storage, or fugitive emissions point;

(D) Are design, equipment, work practice, or operational standards including requirements for operator training or certification as provided in section 112(h); or

(E) Are a combination of the above (section 112(d)(2)).

To develop NESHAP, EPA collects information about the industry, including information on emission source characteristics, control technologies, data from HAP emission tests at well-controlled facilities, and information on the costs and other energy and environmental impacts of emission control techniques. The EPA uses this information to analyze possible regulatory approaches.

Although NESHAP are normally structured in terms of numerical emission limits, alternative approaches are sometimes necessary. In some cases, physically measuring emissions from a source may be impossible or at least impracticable due to technological and economic limitations. Section 112(h) authorizes the Administrator to promulgate a design, equipment, work practice, or operational standard, or combination thereof, in those cases where it is not feasible to prescribe or enforce an emissions standard.

If sources in the source category are major sources, then a MACT standard is required. For area sources, the Administrator has the option of establishing either a MACT standard or a standard based on generally available control technologies (GACT) (section 112(d)(5)). To establish a MACT standard, the level of control corresponding to the MACT floor needs to be determined as a starting point for developing the regulatory alternatives.

C. Categorization/Subcategorization: Determining Maximum Achievable Control Technology Floors

Section 112 of the Act provides certain very specific directives to guide EPA in the process of establishing MACT standards. It states that EPA shall establish standards which require "the maximum degree of reduction in emissions of the hazardous air pollutants * * * that the Administrator, taking into consideration the cost of achieving such emission reduction, and any nonair quality health and

environmental impacts and energy requirements, determines is achievable * * * (section 112(d)(2)). In addition, a minimum baseline or "floor" for standards is specified. For new sources, the standards for a source category or subcategory "shall not be less stringent than the emission control that is achieved in practice by the best controlled similar source, as determined by the Administrator" (section 112(d)(3)). Existing source standards shall be no less stringent than the average emission limitation achieved by the best performing 12 percent of the existing sources in the category or subcategory for categories and subcategories with 30 or more sources, or the best performing 5 sources for categories or subcategories with fewer than 30 sources (section 112(d)(3)).

In rules currently under development, EPA is considering two interpretations of the statutory language concerning the MACT floor for existing sources. One interpretation groups the words "average emission limitation achieved by" together in a single phrase and asks what is the "average emission limitation achieved by" the best performing 12 percent. This interpretation places the emphasis on "average". It would correspond to first identifying the best performing 12 percent of the existing sources, then determining the average emission limitation achieved by these sources as a group. Another interpretation groups the words "average emission limitation" into a single phrase and asks what "average emission limitation" is "achieved by" all members of the best performing 12 percent. In this case, the "average emission limitation" might be interpreted as the average reduction across the HAP emitted by an emission point over time. Under this interpretation, EPA would look at the average emission limits achieved by each of the best performing 12 percent of existing sources, and take the lowest. This interpretation would correspond to the level of control achieved by the source at the 88th percentile if all sources were ranked from the most controlled (100th percentile) to the least controlled (1st percentile).

The EPA believes that the first interpretation is appropriate and solicits comment on its interpretation of "the average emission limitation achieved by the best performing 12 percent of the existing sources" (section 112(d)(3)(A) of the Act).

The EPA is also considering two possible meanings for the word "average" as the term is used in section 112(d)(3) (A) and (B) of the Act. First, "average" could be interpreted as the

arithmetic mean. The arithmetic mean of a set of measurements is the sum of the measurements divided by the number of measurements in the set. The EPA has determined that the arithmetic mean of the emissions limitations achieved by the best performing 12 percent of existing sources in some cases would yield an emission limitation that fails to correspond to the limitation achieved by any particular technology. In such cases, EPA would not select this approach. The word "average" could also be interpreted as the median emission limitation value. The median is the value in a set of measurements below and above which there are an equal number of values (when the measurements are arranged in order of magnitude). This approach identifies the emission limitation achieved by those sources within the top 12 percent, arranges those emission limitations by magnitude, and takes the control level achieved by the median source. This is mathematically equivalent to identifying the emission limitation achieved by the source at approximately the observed 94th percentile level of emission control. Either of these two approaches could be used in developing standards for different source categories. The "median" approach was used in these proposed standards.

Once the floor has been determined for new or existing sources for a category or subcategory, the Administrator must set MACT standards that are no less stringent than the floor. Such standards must then be met by all sources within the category or subcategory. However, in establishing standards, the Administrator may distinguish among classes, types, and sizes of sources within a category or subcategory (section 112(d)(1)). Thus, for example, the Administrator could establish two classes of sources within a category or subcategory based on size and establish a different emission standard for each class, provided both standards are at least as stringent as the MACT floor.

In addition, the Act provides the Administrator further flexibility to regulate area sources. Section 112(d)(5) provides that in lieu of establishing MACT standards under section 112(d), the Administrator may promulgate standards which provide for the use of "generally available control technologies or management practices." Area source standards promulgated under this authority (GACT standards) would not be subject to the MACT "floors" described above. Moreover, for source categories subject to standards promulgated under section 112(d)(5),

EPA is not required to conduct a residual risk analysis under section 112(f).

D. Regulatory Approach and Regulatory Alternatives

At the end of the data gathering and analysis, EPA must decide whether it is more appropriate to follow the MACT or the GACT approach for regulating an area source category. In some cases, it may be appropriate to regulate both major and area sources in a source category under MACT. In other cases, it may be more appropriate to establish area source standards based on GACT. In the case of the proposed rulemaking for chromium electroplating and anodizing, the Administrator has decided to regulate both major and area sources by applying MACT.

The next step in establishing standards is the investigation of regulatory alternatives. With MACT standards, only alternatives at least as stringent as the floor may be considered. Information about the industry is analyzed to develop model plant populations for projecting national impacts, including HAP emission reduction levels, costs, energy, and secondary impacts. Several regulatory alternative levels (which may be different levels of emissions control or different levels of applicability or both) are then evaluated to determine the most appropriate regulatory alternative to serve as the basis for the standard.

The regulatory alternatives for new versus existing sources may be different, and separate regulatory decisions must be made for new and existing sources. For both source types, the selected alternative may be more stringent than the MACT floor. However, the control level selected must be technically achievable. In selecting a regulatory alternative, the Agency considers the achievable reduction in emissions of HAP (and possibly other pollutants that are co-controlled), the cost and economic impacts, the energy requirements, and other environmental impacts.

The selected regulatory alternative is then translated into a proposed regulation. The regulation implementing the decision typically includes sections of applicability, standards, test methods and compliance demonstration, monitoring, reporting, and recordkeeping. The preamble to the proposed regulation provides an explanation of the rationale for the decision. The public is invited to comment on the proposed regulation during the public comment period. Based on an evaluation of these

comments, EPA reaches a final decision and promulgates the standard.

III. Overview of Proposed Standards

This section provides an overview of the:

- (1) Applicability of the standards;
- (2) Format of the standards;
- (3) Actual standards and their bases;
- (4) Test methods for compliance;
- (5) Monitoring requirements; and
- (6) Reporting and recordkeeping requirements.

Detailed discussions concerning the statutory basis and the selection rationale for the proposed standards are provided in sections II and VI, respectively, of this preamble.

A. Applicability of the Standards

The source categories to be regulated are major and area sources of HAP emissions from facilities performing hard chromium electroplating, decorative chromium electroplating, and chromium anodizing. As noted in the initial source category list, EPA has identified as a separate source category each of the three different types of chromium electroplating and anodizing operations. In addition, EPA has listed both the major and area sources for each of these categories. Thus, this rule proposes standards for six different source categories identified in the July 16, 1992 source category list.

The specific emission units that are to be regulated within these source categories are electroplating and anodizing tanks. There are approximately 1,500 facilities with hard chromium electroplating tanks, 2,800 facilities with decorative chromium electroplating tanks, and 700 facilities with chromium anodizing tanks in the United States. Approximately 10 percent of the decorative chromium electroplating tanks use a trivalent chromium electroplating process; the remainder use a chromic acid (hexavalent chromium) electroplating process. A more detailed process description of the emission sources being regulated is provided in section V.A of this preamble.

Section 112(b) of the Act lists chromium compounds as HAP; these are the pollutants being regulated by this rulemaking. Chromic acid, a hexavalent chromium compound, is

emitted in significant quantities from all hard chromium electroplating and anodizing tanks and from most decorative chromium electroplating tanks. Hexavalent chromium compounds are highly toxic and are known human carcinogens. Emissions from those decorative electroplating tanks that use trivalent chromium electroplating solutions include trivalent chromium and may include low levels of hexavalent chromium. The data on the carcinogenicity of trivalent chromium are inconclusive at this time; however, it is known that trivalent chromium can accumulate in the lungs and could potentially result in decreased lung function under extended exposure conditions.

B. Format of the Standards

The proposed standards are expressed in terms of emission limits. Specifically, a concentration format was selected for the proposed standards: Mass of total chromium emitted per unit volume of air, expressed as milligrams of chromium per dry standard cubic meter of air (mg/dscm). This format would apply to all chromium electroplating and anodizing tanks and would allow owner/operator flexibility in the selection of technologies or operational practices that achieve equivalent performance to those technologies selected as the basis of the standards. Emissions from hard chromium electroplating and anodizing tanks and those decorative chromium electroplating tanks using a chromic acid electroplating process are comprised of hexavalent chromium. Emissions from decorative chromium electroplating tanks that use a trivalent electroplating process are comprised primarily of trivalent chromium, with low levels of hexavalent chromium possibly present.

An alternative format to reduce emissions is proposed for decorative chromium electroplating tanks and chromium anodizing tanks that use fume suppressants. Such tanks do not typically have ventilation systems; emission testing to determine compliance at these tanks would not be possible (see discussion in section VI.D). The emission limits for decorative chromium electroplating tanks and chromium anodizing tanks using fume

suppressants are expressed in terms of concentration and are based on emission tests performed at sources with ventilation. Another parameter, surface tension, has been measured in conjunction with the emission rate from tanks using wetting-agent-type fume suppressants, and EPA has found that a relationship between surface tension and total chromium emission rates exists. Therefore, the Administrator is proposing that those tanks that use wetting-agent-type fume suppressants (or a wetting agent plus foam blanket) comply with a surface tension requirement rather than the emission limit.

C. Actual Standards and Their Bases

In the proposed rulemaking, standards have been established for major and area sources in each category and subcategory identified for regulation. The Agency's study has indicated that the majority of the sources in each category and subcategory would be area sources, emitting less than 9.1 Mg/yr (10 tons/yr) of any one HAP or 22.7 Mg/yr (25 tons/yr) of multiple HAP by themselves. Some sources are considered major because they are located within the fence line of a source that is major. However, the appropriate control technology is not a function of whether the source is a major or area source. Thus, the standards identified in this section would apply both to major and area sources in each category and subcategory.

The Administrator has determined that different standards are appropriate for new sources as compared to existing sources; this decision is, in part, based on the MACT floor requirements explained in section II.C. The Administrator has also determined that for existing sources in the hard chromium electroplating category, different standards are suitable based on the size of the facility. A less stringent standard is proposed for small facilities in this source category. The size designations identified for this source category are independent of the major and area source designation.

A summary of the total chromium emission limits for each of the categories and subcategories is provided in Table 1.

TABLE 1.—NEW AND EXISTING SOURCES—BASIS OF THE STANDARD (TOTAL CHROMIUM EMISSION LIMIT)

		Hard chromium electroplating	
		Small	Large
New	CMP: (0.013 mg/dscm [5.7×10 ⁻⁶ gr/dscf])		CMP: (0.013 mg/dscm [5.7×10 ⁻⁶ gr/dscf]).

TABLE 1.—NEW AND EXISTING SOURCES—BASIS OF THE STANDARD (TOTAL CHROMIUM EMISSION LIMIT)—Continued

Hard chromium electroplating		
	Small	Large
Existing	PBS ^b : (0.03 mg/dscm [1.3×10^{-5} gr/dscf])	CMP: (0.013 mg/dscm [5.7×10^{-6} gr/dscf]).
Decorative chromium (chromic acid bath); all sizes of operations:		
New and existing	FS ^c : (40 dynes/cm [2.7×10^{-3} lb _f /ft]) or (0.003 mg/dscm [1.3×10^{-6} gr/dscf]).	
Decorative chromium (trivalent chromium bath); all sizes of operations:		
New and existing	TVC ^d : (no action) (55 dynes/cm [3.8×10^{-3} lb _f /ft]) or (0.048 mg/dscm [2.1×10^{-5} gr/dscf]).	
Chromium anodizing; all sizes of operations:		
New and existing	FS: (40 dynes/cm [2.7×10^{-3} lb _f /ft]) or (0.003 mg/dscm [1.3×10^{-6} gr/dscf]).	

^a CMP=Composite mesh pad.

^b PBS=Packed-bed scrubber.

^c FS=Chemical fume suppressant.

^d TVS=Trivalent chromium plating process.

1. Hard Chromium Electroplating Tanks

a. *New Tanks.* All new hard chromium electroplating tanks, regardless of size, would be required to meet a total chromium emission limit of 0.013 mg/dscm (5.7×10^{-6} grain per dry standard cubic foot [gr/dscf]). This emission limit is based on the use of a composite mesh-pad system. Composite mesh-pad systems have been demonstrated to achieve an outlet total chromium concentration of 0.013 mg/dscm (5.7×10^{-6} gr/dscf).

b. *Existing Tanks.* The emission limits for existing hard chromium electroplating tanks that are presented in the following paragraphs differ depending on the size of the facility. Facilities with maximum cumulative potential rectifier capacities less than 60 million Ah/yr are considered small. Other facilities are considered large. A discussion of the calculation of maximum potential rectifier capacity is provided in section VI.A of this preamble.

All existing hard chromium electroplating tanks at large facilities would be required to meet a total chromium emission limit of 0.013 mg/dscm (5.7×10^{-6} gr/dscf), which is based on the composite mesh-pad system.

All existing hard chromium electroplating tanks at small facilities would be required to meet a total chromium emission limit of 0.03 mg/dscm (1.3×10^{-5} gr/dscf). This emission limit is based on the use of a well-maintained and well-operated packed-bed scrubber.

2. Decorative Chromium Electroplating Tanks Using a Chromic Acid Bath

All new and existing decorative chromium electroplating tanks that use a chromic acid electroplating process, regardless of size, would be required to: (1) Meet a total chromium emission limit of 0.003 mg/dscm (1.3×10^{-6} gr/dscf) if an air pollution control device is the sole means to control chromium emissions; or (2) use a wetting-agent-type fume suppressant in the electroplating bath and maintain a bath surface tension no greater than 40 dynes per centimeter (dynes/cm) (2.7×10^{-3} pound force per foot [lb_f/ft]). Chemical fume suppressants in the form of wetting agents, used either alone or with a foam blanket, are expected to achieve outlet concentrations of 0.003 mg/dscm (1.3×10^{-6} gr/dscf) when used in accordance with vendor recommendations.

3. Decorative Chromium Electroplating Tanks Using a Trivalent Chromium Bath

Emission tests conducted on a trivalent chromium electroplating tank indicated that the total chromium outlet concentration from such a bath is 0.048 mg/dscm (2.1×10^{-5} gr/dscf). The maximum value of bath surface tension measured during the test was 55 dynes/cm (3.8×10^{-3} lb_f/ft). Because surface tension is related to emissions, the proposed standard requires that this value not be exceeded. Surface tension monitoring is required to minimize the potential that any new process developments for trivalent chromium baths would result in an increase in emissions from the process. If an air

pollution control device is the sole means of controlling chromium emissions, facilities must meet a total chromium emission limit of 0.048 mg/dscm (2.1×10^{-5} gr/dscf).

4. Chromium Anodizing Tanks

All new and existing chromium anodizing tanks, regardless of size, would be required to meet a total chromium emission limit of 0.003 mg/dscm (1.3×10^{-6} gr/dscf) (if an air pollution device is the sole means of controlling chromium emissions) or maintain a surface tension no greater than 40 dynes/cm (2.7×10^{-3} lb_f/ft) (if wetting agents are used to control chromium emissions).

5. Compliance Schedule

Owners or operators of existing hard chromium electroplating tanks would be required to comply with the proposed standards within 1 year after the effective date of the standards. In accordance with proposed § 63.7(a), the owner or operator would then have 120 days after the compliance date to conduct a performance test.¹ These time periods are necessary to allow the estimated 60 percent of those facilities with tanks currently operating uncontrolled, or with less effective air pollution control devices than those required under the standards, to obtain, install, and test appropriate control systems. The EPA believes this amount of time is adequate and that a longer time is neither necessary nor desirable

¹ The EPA proposed regulations for subpart A of 40 CFR part 63 published in the Federal Register on August 11, 1993 at 58 FR 42760.

given the highly toxic nature of chromium emissions and the proximity of these operations to highly populated areas.

The owner or operator of an existing decorative chromium or chromium anodizing tank would have 3 months to comply after the effective date. A shorter time period is appropriate for these tanks because fume suppressants already are widely used, a large number of vendors supply chemical fume suppressants, and no installation of equipment is needed to comply with the standards.

Owners or operators of new hard chromium or decorative chromium electroplating or anodizing tanks that commence construction or reconstruction after the standards are proposed, and before the final standards are promulgated, would have to comply immediately upon startup unless the promulgated standards are more stringent than the proposed standards. In accordance with § 63.7(a)(2)(ix), if the promulgated standards are more stringent than the proposed standards, the compliance date for tanks built after proposal but before promulgation would be 1 year after the effective date.² The owner or operator would have to comply with the standard as proposed until the compliance date. The owner or operator would then be required to conduct a performance test within 120 days after the compliance date.

The owner or operator of any hard chromium or decorative chromium electroplating or anodizing tank constructed after the effective date of the standards would be required to comply immediately upon startup.

6. Early Reduction Program

An early reduction program for existing sources is set out in section 112(i)(5) of the Act. This is a voluntary program that allows an emission source to qualify for a 6-year extension from the compliance date to comply with the promulgated standard, provided it meets and demonstrates all the program requirements. Those requirements are: (1) The source must achieve a 90 percent or greater reduction in HAP emissions (95 percent for particulate matter); (2) an enforceable commitment for this reduction is made to EPA; (3) the emission reduction must be achieved before the standard's proposal, unless the source qualifies for and makes an enforceable commitment for this reduction before the proposal date that states the reduction will be achieved after proposal but before January 1, 1994; and (4) the early

emission reduction must be determined through a comparison of the reduced emissions levels achieved with the baseline levels in existence no earlier than 1987 (unless data were submitted in response to a Section 114 request and received by the Administrator before November 15, 1990; in which case, 1985 or 1986 baseline data can be used). The early reduction program implementing section 112(i)(5) was promulgated on December 29, 1992 (57 FR 61970). The EPA has explained the early reduction program to affected industry sources and expects some sources to participate in the program. Those most likely to participate would be those that have recently installed effective control measures.

D. Test Methods for Compliance

Test Methods 306 and 306A, "Determination of Chromium Emissions from Decorative and Hard Chromium Electroplating and Anodizing Operations," are the proposed methods for determining compliance with the emission standards. Test Method 306B, "Surface Tension Measurement and Recordkeeping for Tanks used at Chromium Electroplating and Anodizing Facilities," is the proposed method for monitoring surface tension at decorative chromium electroplating and chromic acid anodizing facilities.

E. Monitoring Requirements

Two types of monitoring would be required by this standard: Compliance monitoring and operation and maintenance (O&M) monitoring. Compliance monitoring would be conducted to ensure ongoing compliance with the emission limit. Operation and maintenance monitoring would be required to ensure that the affected source and its emission control system is properly maintained and operated to minimize emissions.

1. Compliance Monitoring

All owners or operators that use an air pollution control device to demonstrate compliance with the specified chromium emission limits would be required by the proposed standards to conduct an initial performance test, in accordance with the requirements of § 63.7.³ During the performance test, the owner or operator would establish values for operating parameters to be monitored to ensure continued compliance with the standard. This section identifies the parameters to be monitored and the frequency of monitoring. The procedures for

monitoring are outlined in § 63.345 of the proposed regulation.

An owner or operator who uses an air pollution control device to comply with the emission limits would be required to monitor and record once each day the gas velocity of the inlet stream to the control device. The value or range of values of gas velocity that correspond to compliance with the emission limit would be established by the owner or operator during the initial performance test. If a packed-bed scrubber is used to comply with the standard, the owner or operator would also be required to measure once each day, using a hydrometer, the concentration of chromic acid in the scrubber water. Gas velocity and scrubber water concentration (for packed-bed scrubbers) have been identified by the Agency as the site-specific operating parameters that would determine compliance or noncompliance with the regulation. Should the gas velocity be outside of the range established during the performance test (i.e., either higher or lower than the pre-established value or range of values) or should the scrubber water concentration exceed 45 grams per liter (g/L) (6 ounces per gallon (oz/gal)), the owner or operator would be in noncompliance with the emission limit.

As an alternative to the above requirements, an owner or operator who uses an air pollution control device in conjunction with fume suppressants to control emissions from a decorative chromium or chromium anodizing operation may monitor surface tension of the electroplating bath to demonstrate ongoing compliance (gas velocity and scrubber water concentration would not have to be monitored). The maximum value for surface tension may be determined by the owner or operator during the initial performance test, or the owner or operator may adhere to the surface tension limits set by this standard. (If the surface tension limits set by this standard are used to indicate compliance, an initial performance test would not be required.) The owner or operator would be required to measure and record the surface tension of the bath using a stalagmometer or a tensiometer at least once every 4 hours during operation of the tank. Operation of the electroplating tank at surface tensions above the acceptable value would constitute noncompliance with the standard.

An owner or operator of a tank that uses a wetting-agent-type fume suppressant or a combination wetting-agent/foam-blanket-type suppressant to comply with the standard would be required to measure and record the

² Ibid.

³ Ibid.

surface tension of the bath using a stalagmometer or a tensiometer at least once every 4 hours during operation of the tank. Operation of the electroplating tank at surface tensions above the acceptable value would constitute noncompliance with the standard.

An owner or operator of a tank that uses a foam blanket alone to comply with the standard would be required to conduct an initial performance test to confirm that the emission limit of 0.003 mg/dscm (1.3×10^{-6} gr/dscf) is being met. For ongoing compliance, the owner or operator would be required to maintain the foam blanket thickness at 2.5 centimeters (cm) (1 inch (in.)), and measure and record the foam blanket thickness at least once every hour during operation of the tank. Operation of the electroplating tank at a foam blanket thickness below the acceptable value would constitute noncompliance with the standard.

An owner or operator of a trivalent chromium electroplating tank would be required by the standard to monitor the surface tension using a stalagmometer or tensiometer every 4 hours. Operation of the electroplating tank at surface tensions above the acceptable value would constitute noncompliance with the standard.

2. Operation and Maintenance Monitoring

To ensure proper operation of the air pollution control device, the proposed standards require the owner or operator to prepare an operation and maintenance plan for the device. The plan would be incorporated into the startup, shutdown, malfunction plan required by § 63.6(e),⁴ and would include a standardized checklist to document the operation and maintenance of the equipment, a systematic procedure for identifying malfunctions and for reporting them to supervisory personnel, and procedures to be followed to ensure that equipment or process malfunctions due to poor maintenance or other preventable conditions do not occur.

As an indication of good maintenance procedures, the owner or operator would be required to record once each day the performance of washdown of the packed bed or mesh pad and to measure and record the pressure drop across the device. As with the gas velocity, the acceptable pressure drop range would be established by the owner or operator during the initial performance test. Unlike gas velocity and scrubber water concentration, the pressure drop readings would be used

only as an indication of adherence to the operation and maintenance plan. Operation outside of the pre-established pressure drop range would not alone indicate noncompliance with the emission limit.

F. Reporting and Recordkeeping Requirements

The owner or operator of any tank subject to these standards would be required to fulfill the reporting and recordkeeping requirements outlined in § 63.10(e)(3)(v).⁵ These requirements include those associated with startup, shutdown, or malfunctions; operation and maintenance records; compliance monitoring system records; performance test reporting; quarterly reports of no excess emissions for a year and semi-annual reporting subsequently, if there are no excess emissions; and quarterly reports of exceedances of the emission limits. The owner or operator of any tank subject to these standards would be required to submit quarterly reports of any exceedances of monitored operating parameter values required under this subpart. These quarterly reports must contain the monitored operating parameter value readings for the periods constituting exceedances, and a description and timing of steps taken to address the cause of the exceedances.

In addition to the above requirements, the owner or operator of a tank that uses an add-on air pollution control device to meet an emission standard would also be required to maintain records of daily and monthly inspections, daily gas velocity readings, daily washdowns, daily pressure drop readings, and any emission tests at the facility. Facilities using packed-bed scrubbers to comply with the standards would also be required to maintain records of daily scrubber water concentrations. All records must be maintained for a minimum of 5 years. Each inspection record would identify the device inspected and include the following (see further discussion in section VI.I): the date and approximate time of inspection, a brief description of the working condition of the device during the inspection, the gas velocity, the scrubber water concentration (if applicable), the pressure drop, and any actions taken to correct deficiencies found during the inspection. Each record of washdown would identify the device and include the date, approximate time, and duration of the washdown.

An owner or operator of a tank that uses a fume suppressant or foam blanket to comply with the standard would be

required to maintain the following records at the facility for at least 5 years: the amounts of fume suppressants purchased (invoices); the surface tension or foam blanket thickness measurements; the frequency of maintenance additions; the amount of material added during each maintenance addition; the surface tension of the bath; measurements of foam blanket thickness; and any emission tests to assure compliance with the standard. Each record of a surface tension measurement would identify the tank and include the date, approximate time, measured surface tension, and whether any additions were made to the bath. Each record of a foam blanket thickness measurement would identify the tank and include the date, approximate time, measured thickness, and whether any additions were made to the bath. If an addition was made, the amount of material added would also be recorded.

An owner or operator of a tank that uses a trivalent chromium electroplating process would be required to maintain at the facility for at least 5 years records of the surface tension measurements; the amount of bath additive (containing fume suppressant) that is purchased (invoices); and any emission tests conducted. Each record of a surface tension measurement would identify the tank and include the date, approximate time, and measured surface tension.

IV. Impacts of the Standards

The nationwide impacts presented below are the impacts the proposed standards would have on existing facilities in each category or subcategory identified. No net growth is projected for the source categories covered by these standards although new facilities may be constructed to replace existing, obsolete facilities. Because no information is available for projecting numbers of new facilities or electroplating tanks, nationwide impacts beyond baseline are presented here for existing facilities only. For informational purposes, model plant impacts are presented for new facilities in section VI.C.4. More detailed discussion on how these impacts were calculated can be found in section V.I.C of this preamble, Chapters 6 through 8 of the BID, and in the New Technology Document (see ADDRESSES section).

A. Hard Chromium Electroplating Tanks

Existing hard chromium electroplating tanks at facilities with maximum cumulative potential rectifier capacities greater than or equal to 60 million Ah/yr (large facilities) would be required to meet a total chromium

⁴ Ibid.

⁵ Ibid.

emission limit of 0.013 mg/dscm (5.7×10^{-6} gr/dscf), which is based on the application of composite mesh pads. The aggregated nationwide emission reduction from baseline which would be achieved by these sources would be approximately 126 megagrams per year (Mg/yr) (139 tons per year (tons/yr)). Nationwide aggregated annual costs beyond baseline would be approximately \$17 million.

Existing hard chromium electroplating tanks at facilities with maximum cumulative potential rectifier capacities less than 60 million Ah/yr (small facilities) would be required to meet a total chromium emission limit of 0.03 mg/dscm (1.3×10^{-5} gr/dscf), which is based on the application of packed-bed scrubbers. The aggregated nationwide emission reduction from baseline which would be achieved by these sources would be approximately 18 Mg/yr (20 tons/yr). Nationwide aggregated annual costs beyond baseline would be approximately \$5 million.

The total emission reduction for the hard chromium electroplating source category would be 144 Mg/yr (159 tons/yr) with an associated total annual cost for control of \$22 million. The total annual reporting and recordkeeping costs of the proposed standards would be approximately \$8.6 million.

The annual cost for control would increase the electroplating cost for hard-chromium-plated products. It is assumed that the majority of these costs can be passed on to the customer because the capital investment the customer has in the part, in most cases, far outweighs the increased electroplating cost. In addition, the actual product price increase resulting from compliance with the emission standard would be less than 1 percent of the current product price. The relatively minor effect on end product price results because, most often, hard chromium electroplating is not performed on an entire end product. Instead, electroplating is performed on components (e.g., hydraulic cylinders) of the end product (e.g., backhoe), and the cost increase for this service (that would result from compliance with the standard) is small compared to the price of the end product. It is conservatively estimated that fewer than 30 facilities with hard chromium electroplating tanks, or less than 2 percent of the industry (largely those that are presently uncontrolled), would close because of their inability to absorb the cost of meeting the standard.

The nationwide aggregate energy impact (mainly for additional fan horsepower) beyond baseline would be approximately 102,900 megawatt hours

per year (MWh/yr) for large facilities and 6,300 MWh/yr for small facilities. The nationwide solid waste impact beyond baseline from the periodic disposal of packing material would be 130 cubic meters per year (m^3/yr) (4,590 cubic feet per year (ft^3/yr)) for large facilities and 26 m^3/yr (910 ft^3/yr) for small facilities.

The use of composite mesh-pads and packed-bed scrubbers results in the generation of wastewater requiring reuse, treatment, or disposal. However, it is assumed that all wastewater would eventually be drained to the electroplating tanks to make up for evaporative losses, as is the current industry practice. Thus, no wastewater impacts would be associated with this standard. If, for some reason, the wastewater were not recycled, it would need to be treated and disposed of in accordance with requirements under the Resource Conservation and Recovery Act.

B. Decorative Chromium Electroplating Tanks

Existing decorative chromium electroplating tanks using a chromic acid bath would be required to meet a total chromium emission limit of 0.003 mg/dscm (1.3×10^{-6} gr/dscf) if an air pollution control device is the sole means of controlling emissions or use wetting-agent-type fume suppressants and maintain a surface tension of less than 40 dynes/cm (2.7×10^{-3} lb_f/ft). Impacts are estimated based on the use of chemical fume suppressants. The aggregate nationwide impact of the standards on decorative chromium electroplaters using chromic acid baths is estimated to be 10 Mg/yr (11 tons/yr) in emission reductions. No additional cost of control beyond that incurred at baseline would accrue because there are no capital costs associated with chemical fume suppressants. (The costs projected for baseline conditions result from the assumption that 42 percent of the facilities will elect to use packed-bed scrubbers in conjunction with fume suppressants.) (See further discussion in section VI.C.) The total annual reporting and recordkeeping costs of the proposed standards would be approximately \$14 million. No closures are anticipated as a result of compliance because there is no additional cost of control. No energy or solid waste impacts are attributable to the use of chemical fume suppressants.

There are no control requirements in this proposed rulemaking for existing decorative chromium electroplating tanks using a trivalent chromium electroplating process. Therefore, there are no cost, economic, energy, or solid waste impacts. These facilities would be

required to maintain a surface tension of the electroplating bath of 55 dynes/cm (3.8×10^{-3} lb_f/ft) or to meet a total chromium emission limit of 0.048 mg/dscm (2.1×10^{-5} gr/dscf). The total annual reporting and recordkeeping costs of the proposed standards would be approximately \$1.6 million.

C. Chromium Anodizing Tanks

Existing chromium anodizing tanks would be required to meet an emission limit of 0.003 mg/dscm (1.3×10^{-6} gr/dscf) or maintain a surface tension of less than 40 dynes/cm (2.7×10^{-3} lb_f/ft). This is based on the use of chemical fume suppressants. The nationwide aggregate emission reduction beyond baseline would be 4 Mg/yr (4.4 tons/yr). As with decorative chromium electroplating facilities using a chromic acid electroplating process, there would be no nationwide cost impact beyond baseline. No closures are anticipated as a result of compliance with the proposed standards because there is no additional cost of control. There are also no energy or solid waste impacts attributable to the use of chemical fume suppressants. The total annual reporting and recordkeeping costs of the proposed standards would be approximately \$3.8 million.

V. Process Description and Description of Control Technologies

This section describes the chromium electroplating and anodizing processes and the technologies that can be used to control chromium emissions from these processes. This section is provided to supplement the rationale for selection of the proposed standards presented in section VI. For more detailed process and control technology descriptions, consult the BID for the proposed standards (see ADDRESSES) and the New Technology Document (see ADDRESSES).

A. Process Descriptions

The source categories that would be regulated by this standard are those performing hard chromium electroplating, decorative chromium electroplating, and chromium anodizing. (Area and major sources of each would be regulated for a total of six source categories.) The specific emission sources that would be regulated are the electroplating and anodizing tanks. Three distinct processes can be performed in these tanks: chromic acid electroplating, trivalent chromium electroplating, and chromium anodizing. Each process is described below.

1. Chromic Acid Electroplating

Chromic acid electroplating is the most widely used procedure for depositing chromium on metal. Chromium anhydride (CrO_3), commonly referred to in the industry as chromic acid, is the hexavalent chromium compound used to formulate the electroplating bath. Chromic acid electroplating baths typically contain approximately 240 g/L (32 oz/gal) of chromic acid and 2.4 g/L (0.32 oz/gal) of sulfuric acid, which acts as a bath catalyst.

Emissions of hexavalent chromium from the electrodeposition of chromium in chromic acid electroplating baths occur primarily because of the inefficiency of the chromic acid electroplating process. Eighty to 90 percent of the electrical current applied is consumed by the evolution of oxygen and hydrogen gases at the electrodes. As the bubbles burst at the surface of the electroplating solution, a fine chromic acid mist is formed. The rate of mist formation is a function of the chemical or electrochemical activity in the tank and increases directly with the amount of current (amperage) applied to the tank, which is determined by the amount and type of parts plated or surface area plated in the tank and the current densities needed to effectively plate the parts.

In hard chromium electroplating, a relatively thick layer of chromium is deposited directly on a base metal (usually steel) to provide functional or engineering characteristics such as hardness, a low coefficient of friction, and wear and corrosion resistance. Hard chromium electroplating is used for items such as hydraulic cylinders and rods, industrial rolls, zinc die castings, plastic molds, engine components, and marine hardware. Current densities for hard chromium electroplating tanks range from 1,600 to 6,500 amperes per square meter of surface area plated (A/m^2) (150 to 600 amperes per square foot [A/ft^2]). Electroplating times range from one-half hour to 36 hours, and electroplating thicknesses range from a few to several hundred microns (μm).

In decorative chromium electroplating, the base material (e.g., brass, steel, aluminum, or plastic) generally is plated with layers of copper and nickel followed by a relatively thin layer of chromium to provide a bright surface with wear and tarnish resistance. Decorative chromium electroplating is used for items such as automotive trim, metal furniture, bicycles, hand tools, and plumbing fixtures. Current densities for decorative chromium electroplating tanks range

from 540 to 2,400 A/m^2 of surface area plated (50 to 220 A/ft^2). Electroplating times range from less than 1 minute to 5 minutes, and electroplating thicknesses range from 0.003 to 2.5 μm (0.0001 to 0.1 mil).

Hard chromium electroplating tanks emit significantly more chromic acid emissions than decorative chromium electroplating tanks because of the higher current densities and longer electroplating times required to achieve the desired plate thickness. Emissions from both hard chromium and decorative chromium electroplating are comprised almost entirely of hexavalent chromium because a chromic acid electroplating process is used.

2. Trivalent Chromium Electroplating

Trivalent chromium processes are used at less than 10 percent of the 2,800 facilities with decorative chromium electroplating tanks. This process is not used for hard chromium electroplating because the trivalent chromium process, as currently formulated, cannot achieve the full range of plate thicknesses necessary for most hard chromium electroplating applications.

Trivalent chromium processes are applicable for the full range of decorative chromium electroplating applications. However, because the process is relatively new, it does not have widespread use. Also, special precautions must be taken when a trivalent chromium process is used for electroplating brass, zinc, and tubular (hollow) steel parts. If there is insufficient coverage of nickel on the part, the exposed base metals may dissolve in the trivalent chromium electroplating solution, resulting in contamination of the bath. Contamination problems can be overcome through the application of a thicker layer of nickel, the use of ion exchange columns to purify the bath, and several other methods. At present, there are several trivalent chromium tanks at which these types of parts are successfully plated.

Two types of trivalent chromium processes are commercially available: The single-cell and the double-cell. The single-cell process is a halogen-based system using graphite anodes and additives to prevent oxidation of trivalent chromium at the anode. In this system, the anodes are in direct contact with the electroplating solution. The double-cell process is a sulfate-based system in which lead anodes are encased in boxes that are lined with a permeable (ion-selective) membrane and that contain a dilute solution of sulfuric acid. This system eliminates contact and oxidation of the trivalent chromium

electrolyte at the anode. The double-cell process requires fewer additives.

The main difference between the trivalent chromium processes and chromic acid electroplating processes is in the chromium electroplating step. The electroplating bath chemistry is different for trivalent baths; the bath is comprised mostly of trivalent chromium with hexavalent chromium considered as a bath contaminant. Trivalent chromium electroplating solutions typically contain between 22 to 30 g/L (3 to 4 oz/gal) of trivalent chromium. The exact compositions of trivalent chromium electroplating solutions are proprietary. The process lines for trivalent chromium electroplating processes also differ from those used with a chromic acid electroplating bath. For example, additional rinse tanks or post dips are added to the electroplating line in the trivalent chromium electroplating processes.

Tests indicate that emissions from trivalent chromium tanks have total chromium concentrations of 0.048 mg/dscm (2.1×10^{-5} gr/dscf) and hexavalent chromium emissions of 0.004 mg/dscm (1.75×10^{-6} gr/dscf). Additional advantages of using a trivalent chromium bath, from a pollution prevention standpoint, are discussed in section V.B.5.

3. Chromium Anodizing

In the chromium anodizing process, chromic acid is used to form an oxide layer on aluminum that provides corrosion resistance. The chromium anodizing process is used primarily to coat aircraft parts and architectural structures that are subject to high stress and corrosive conditions. The Department of Defense (Naval Air Systems Command) is conducting research on alternatives to chromic acid anodizing for military aircraft. This research focuses on the use of a sulfuric/boric acid anodizing process. If the research results impact the current rulemaking, they will be made available for comment.

The chromic acid concentration in anodizing baths is approximately 50 to 100 g/L (7 to 13 oz/gal). The current densities applied range from 1,550 to 7,750 A/m^2 (144 to 720 A/ft^2) of surface area anodized. The anodizing time ranges from one-half to 1 hour. The anodizing process is a voltage-controlled process. Voltage is applied step-wise (in 5 V increments per minute) from 0 to 20 or 40 V and maintained at the desired voltage for the remainder of the anodizing period. When current is applied, chromic acid breaks down in the anodizing bath resulting in the liberation of oxygen and

hydrogen. The oxygen evolves at the surface of the aluminum part where it reacts with the substrate to form an aluminum oxide layer. At the same time, chromic and dichromic acids contained in the bath react with the aluminum oxide film in a dissolving action, which results in the formation of very fine pores that enhance the continuation of current flow to the metal surface. About half of the oxidized aluminum is retained as anodic film, and the remainder goes into solution to form alumina-chromic acid compounds. The liberation of hydrogen and oxygen gas results in the formation of a fine chromic acid mist at the surface of the anodizing solution. Misting is more pronounced at the beginning of the anodizing cycle when there is minimal resistance to current flow. As the oxide film develops on the surface of the part, the resistance to current flow is higher, and less mist is formed.

B. Description of Control Techniques

This section presents descriptions of the techniques typically used to control emissions of chromic acid mist from chromium electroplating and anodizing tanks. All of these control technologies are effective regardless of the size of the operation. In particular, the use of a given technology is not a function of whether a source is considered major or area. A more complete description of these control technologies is presented in the BID for the proposed standards (see ADDRESSES) and in the New Technology Report (see ADDRESSES). Control technologies (e.g., chevron-blade mist eliminators) that were considered less stringent than the MACT floor are not included in the following discussion. However, information on less-stringent control technologies is presented in the BID for the proposed standards.

The discussions below present information concerning the achievable emission levels and percent reductions (efficiencies) for the various demonstrated control measures. Percent reduction provides a convenient basis on which to compare various control techniques. Percent reduction is determined from the control device inlet and outlet mass emission rates. However, the available test data strongly indicate that outlet chromium concentrations within each class of control device type are relatively constant and are not influenced by the inlet chromium concentration to the control device. Thus, the "control efficiency" actually achieved by a given control device would vary depending on inlet loading. For this reason, the level of control assigned to each control

technique in the discussion below is based on the percent reduction achievable by well-maintained units at representative inlet loadings (refer to chapters 4 and 5 of the BID) and is used here only for the purpose of estimating emission reduction impacts associated with alternative control techniques.

1. Packed-Bed Scrubbers

Packed-bed scrubbers are typically used by hard and decorative chromium electroplating and chromic acid anodizing tanks to control emissions of chromic acid mist. Both single and double packed-bed designs are used. Chromic acid mist is removed from the gas stream primarily by impaction of droplets on packing media.

First, the gas stream is wetted by spraying water countercurrent to the gas flow to enlarge the droplet size. The gas stream then passes through the packed bed(s) where the droplets impinge on the packing media. The packing media used to control chromic acid mist typically are made of polypropylene and are configured to have a high surface-area-to-volume ratio. Packing depth is typically about 0.3 to 0.6 m (1 to 2 ft). In most cases, the packed-bed section of the scrubber is followed by a mist eliminator section comprised of a single chevron-blade mist eliminator. The mist eliminator removes any water entrained from the packed-bed section. Treated gases then pass through an induced draft fan and out a stack or exhaust vent. The scrubber water is usually recirculated and periodically tapped and discharged to the electroplating tanks as makeup solution.

The operating parameters that most greatly affect the performance of packed-bed scrubbers include the gas velocity entering the packed bed and the liquid-to-gas ratio. Removal of chromic acid mist is accomplished by reducing the velocity of the gas stream in an expansion chamber at the inlet of the scrubber. The velocity must be maintained at a rate such that the droplets possess sufficient energy to collide with the packing media. Operation of packed-bed units at greater than the design gas velocity will decrease gravitational settling of chromic acid droplets upstream of the packed bed. An increase of the gas velocity above optimal levels will also cause reentrainment of chromic acid droplets from the packed bed and contribute to an overall decrease in collection efficiency. If the liquid-to-gas ratio is too high, the packed bed will become flooded and the gas flow will be restricted. A liquid-to-gas ratio that is too low will result in insufficient wetting of the packed bed, leaving

portions of the bed dry. This inhibits interception of particles by the fluid boundaries on the packing material. Also, the inlet gas stream will not be wetted enough to allow enlargement of the chromic acid droplets. Therefore, a liquid-to-gas ratio that is too low will result in lower collection efficiencies.

Other factors that affect performance include the surface contact area and distribution of the packing media. Inadequate surface contact area results in less impingement and, thus, less removal of chromic acid mist. Nonuniform distribution or settling of the packing media in its frame results in channeling or bypass, which adversely affects scrubber performance. Also, plugging of the spray nozzles used for packing media washdown can result in excessive buildup of chromic acid on the packing media leading to reentrainment or plugging of the bed.

Two independent studies were conducted by the Agency to determine the effects of: (1) Chromic acid concentrations in the scrubber water; and (2) overhead washdown on scrubber performance. The results of the recirculation study indicate that the chromic acid concentration of the scrubber water does not significantly affect scrubber performance. However, a slight increase in emissions was noted at scrubber water concentrations above 45 g/L (6 oz/gal). Therefore, the Agency is requiring that chromic acid concentrations in the scrubber be maintained below 45 g/L (6 oz/gal). Most plants typically have scrubber water concentrations less than 15 g/L (2 oz/gal). Results from the washdown study indicated that periodic flooding of the packed bed with clean water helps to clean packing media and prevent degradation in the performance of the unit. However, continuous washdown of the packing media does not significantly improve performance beyond that achieved with periodic washdown. Emission test results also suggest that double packed-bed designs do not improve the performance level beyond that achieved with single packed-bed designs. The EPA requests comments on the appropriateness of the scrubber water concentration value or any data to indicate the significance of increase in chromium emissions relative to the scrubber water concentration.

As discussed previously, the inlet loading to packed-bed scrubbers does not affect the outlet concentration achieved; therefore, the percent reduction achieved by the control device is dependent upon the inlet concentration level. Hard chromium electroplating tanks typically have high inlet concentrations (above

approximately 3 mg/dscm [0.001 gr/dscf]). Decorative chromium electroplating and anodizing tanks, which operate with lower current densities, produce lower emissions, about one-third that encountered at representative hard chromium electroplating tanks.

Control device vendors estimate that removal efficiencies for packed-bed scrubbers range from 95 to 99 percent. The control efficiencies achieved by existing chromium electroplating and anodizing tanks using packed-bed scrubbers are often on the low end of this range because of the less-than-optimum operating and maintenance practices prevalent in the industry. Based on data obtained during EPA's emission test program, packed-bed scrubbers with periodic washdown can achieve outlet hexavalent chromium concentrations of 0.03 mg/dscm (1.3×10^{-5} gr/dscf). Assuming performance of the control device at proper conditions, a 99 percent control efficiency for packed-bed scrubbers is achievable at the higher inlet concentrations typically found in hard chromium electroplating tanks; 97 percent efficiency is achievable at the lower inlet concentrations found at decorative chromium electroplating and anodizing tanks.

Operating costs for packed-bed scrubbers depend on unit size. The size is a function of the airflow rate, which is determined by the surface area and configuration of the electroplating or anodizing tank(s).

2. Composite Mesh-Pads

Composite mesh-pads consist of layers of interlocked fibers densely packed between two supporting grids. The composite mesh pad was developed to remove small particles (<5 μm [0.2 mils]) that were not effectively controlled by conventional technologies. The layers of material in composite pads are arranged with the smallest diameter fiber layer located in the center of the pad and progressively larger diameter layers located on both sides of the center. The fiber diameters used in these pads range from 0.005 to 0.08 cm [2 to 32 mils]. Particles larger than 1 μm (0.025 mil), traveling with sufficient velocity, collide with the fibers in the first portion of the pad and adhere to their surfaces. These captured particles coalesce into larger droplets as they travel through the small-diameter fiber layers in the center of the pad. These enlarged particles either drain to the bottom of the unit or are reentrained in the gas stream. The reentrained particles are then captured by the large-

diameter fiber layers in the back of the pad.

Factors that affect the performance of mesh-pad mist eliminators include the pad cleaning frequency, the velocity of the gas stream, and the particle size of the entrained pollutant. Pad cleaning frequency is related to the tendency of mesh pads to plug if chromic acid is allowed to build up on the pad material. The mesh pads should be washed down with water at least daily to reduce the chance of plugging.

Gas stream velocity and particle size affect performance because as velocity increases, collection of particles through the mechanism of inertial impaction increases. Thus, gas velocities that are too low can result in reduced performance. However, gas velocities that are too high also can reduce performance because particles may become reentrained in the gas stream.

Based on emission test results, a composite mesh-pad system can achieve outlet hexavalent chromium concentrations of 0.013 mg/dscm (5.7×10^{-6} gr/dscf). At representative inlet loadings, the percent reduction achieved by a composite mesh-pad system is greater than 99.5 percent at the higher inlet loadings typical for a hard chromium electroplating operation.

Operating costs for composite mesh-pad systems depend on the size and the type of control equipment that is used in conjunction with the composite pads (e.g., packed-bed scrubbers or a series of mesh pads). The size of the unit is a function of the airflow rate, which is determined by the surface area and configuration of the electroplating or anodizing tank(s).

3. Fiber-Bed Mist Eliminators

Fiber-bed mist eliminators have been used predominantly to control acid mists from sulfuric, phosphoric, and nitric acid plants. One system, however, is known to be in place to control chromium emissions from electroplating tanks. Fiber-bed mist eliminators remove contaminants from a gas stream through the mechanisms of inertial impaction and Brownian diffusion. Fiber-bed mist eliminators that are designed based on inertial impaction as the principal control mechanism are more efficient than other control devices that use this mechanism (e.g., packed-bed scrubbers) because of the higher surface area-to-volume ratios. These higher ratios result in greater obstruction of the gas flow, which provides additional opportunities for impaction. Fiber beds designed for contaminant removal by Brownian diffusion as well as inertial impaction

are the most efficient mist eliminators currently available. These units are typically installed downstream of an existing control system. Fiber-bed mist eliminators are not recommended as the first stage of a control system because of their tendency to plug. An existing control system, such as mesh pads or a packed-bed scrubber, should precede the fiber-bed mist eliminator to remove the majority of the emissions and thus prevent plugging of the fiber bed.

Fiber-bed mist eliminators typically consist of one or more fiber beds. Each bed consists of a hollow cylinder formed from two concentric screens attached to a top flange and a bottom drain plate (fiber cage). The fiber packed into the annular space between the two screens forms a bed with a radial thickness of 5 to 8 centimeters (cm) (2 to 3 inches (in.)). The cages are typically fabricated from either metal- or fiberglass-reinforced plastic. The fibers are fabricated from glass, ceramic, plastic, or metal in bulk (loose) or roving (rope) form. The individual fibers are usually less than 25 μm (1 mil) in diameter.

A typical impaction cylinder has an outside screen diameter of 66 cm (26 in.), a bed thickness of 5 cm (2 in.), and an overall length of 180 cm (72 in.). Pressure drops for impaction units range from 0.12 to 2.0 kiloPascals (kPa) (0.5 to 8 inches of water column [in. w.c.]).

Fiber-bed mist eliminators are also equipped with two spray nozzles. One nozzle is located at the top of the unit and is used to wash down any large particles that may clog the mist eliminator. The other nozzle is located at the bottom of the unit and is used as an aerosol spray to remove any contaminants in the mist eliminator that may cause plugging or improper drainage.

Fiber-bed units are designed for horizontal, concurrent gas-liquid flow through the bed. The contaminated gas stream and water flow to the downstream face of the bed, and the acid mist in the gas stream impacts on the surface of the fibers and drains down the outer face of the bed to the sump, while the cleaned gas flows up and out the top of the unit.

The major factors affecting the performance of the fiber-bed mist eliminator are the gas velocity and pressure drop. As with mesh-pad mist eliminators, gas flow rates with impaction-type, fiber-bed units must be maintained above a certain lower limit because of the decrease in efficiency of inertial impaction at low flow rates. The maximum gas flow rate in fiber-bed mist eliminators is limited by either: (1) A decrease in efficiency with increasing

gas flow rate or (2) a gas-phase pressure drop limitation.

Fiber-bed mist eliminators, using impaction-type cylinders, have recently been employed at a Naval depot that performs chromium electroplating and anodizing. Prior to entering the fiber-bed mist eliminators, each chromic acid stream is controlled with a vertical-flow, single packed-bed scrubber unit with chevron-blade mist eliminators preceding and following the scrubber. As previously discussed, this configuration is designed to prevent plugging of the fiberbed unit.

Emissions test results on fiber-bed mist eliminators suggest that these systems are capable of achieving outlet total chromium concentrations of 1.0×10^{-4} mg/dscm (4.4×10^{-8} gr/dscf) with corresponding removal efficiencies greater than 99.9 percent.

Operating costs for fiber-bed mist eliminators depend on the size and the design pressure drop. The size of the unit is a function of the airflow rate, which is determined by the surface area and configuration of the electroplating or anodizing tank(s). The design pressure drop is a function of the density of the fiber bed. The higher the bed density, the higher the pressure drop. Net annualized costs for fiber-bed mist eliminators are approximately 200 percent higher than the costs for single packed-bed scrubbers at both new and existing facilities, and approximately 90 percent higher than composite mesh-pad systems. These costs account for the additional control device, such as a packed-bed scrubber, that is required prior to the fiber-bed mist eliminator to prevent plugging. The only fiber-bed mist eliminator system known to be controlling chromic acid emissions from electroplating tanks is located at a government, not a commercial, facility, and is not considered a similar source. Because of this fact and the high costs associated with this control device, EPA has determined that fiber-bed mist eliminators are not MACT for new sources but are considered an emerging technology for the source categories being regulated.

4. Chemical Fume Suppressants

Chemical fume suppressants are compounds that are added directly to chromium electroplating and anodizing baths to reduce or inhibit misting. Fume suppressants include three types: wetting agents, foam blankets, and combinations that include both a wetting agent and a foam blanket. Trivalent chromium electroplating solutions also contain wetting agents. In the trivalent chromium bath, however, a wetting agent is used to enhance the

uniformity of electroplating thickness, not as a fume suppressant. Therefore, the following discussion of fume suppressants as a control technology is specific to hexavalent chromium baths. Information on trivalent chromium baths can be found in sections V.A.2 and V.B.5.

An important distinction between wetting agents and foam blankets is in the mechanism by which they reduce emissions. Wetting agents reduce or inhibit misting by lowering the surface tension of the electroplating or anodizing bath. When the surface tension of the solution is reduced, gases escape at the surface of the electroplating solution with less of a "bursting" effect, forming less mist. Fume suppressants that produce a foam blanket do not preclude the formation of chromic acid mist, but rather trap the mist formed under a blanket of foam.

Fume suppressants are used widely by decorative chromium electroplaters. Hard chromium platers seldom use fume suppressants because the wetting agents used aggravate pitting, which affects the quality of the hard chromium plate. Also, when foam blankets are used, there is a potential for explosion of the entrapped hydrogen gas. These tendencies are more pronounced in hard chromium electroplating than in decorative chromium electroplating because of the higher current densities, longer electroplating times, and thicker deposits associated with hard chromium electroplating tanks.

a. *Wetting Agents.* The most common types of wetting agents used are fluorinated wetting agents, which are very stable throughout a wide range of operating temperatures, current densities, chromic acid concentrations, and oxidation-reduction reactions. A number of fume suppressant formulators indicate that wetting agents that are fluorocarbon-based may aggravate pitting and defects in base metals when electroplating thickness exceeds 13 to 25 μm (0.5 to 1 mil). Some fume suppressant vendor literature recommends caution regarding use of these compounds as the chromium thickness increases beyond 25 to 100 μm (1 to 4 mils) (depending on the product). However, some manufacturers now state that certain base metals have a tendency to pit and that this tendency is not aggravated by the use of fume suppressant additives.

Chromic acid electroplating baths typically have a surface tension of about 70 dynes/cm (4.8×10^{-3} lb_f/ft). The addition of a wetting agent can effectively lower the surface tension of these baths to about 40 dynes/cm (2.7×10^{-3} lb_f/ft). Further additions of

the wetting agent will not lower the surface tension of the electroplating solution appreciably beyond this point. Surface tensions between 30 to 40 dynes/cm (2.0×10^{-3} to 2.7×10^{-3} lb_f/ft) minimize chromic acid mist formation because the hydrogen and oxygen gas bubbles generated during electroplating do not burst at the surface of the electroplating tank as they do at higher bath surface tensions.

The initial makeup volume of wetting agents is determined by the volume of electroplating or anodizing solution and the temperature of the bath. They are depleted from electroplating and anodizing baths by dragout. Dragout is the solution carried out of the electroplating or anodizing tank by parts as the parts are transferred between tanks. Monitoring the surface tension of the electroplating or anodizing bath is the most effective method for determining when to add wetting agent to the bath. The surface tension of the bath can be determined by using an easy-to-use, relatively inexpensive device called a stalagmometer.

b. *Foam Blankets.* Foam blankets are formed by agitation produced by the hydrogen and oxygen gas bubbles generated during electroplating. Once formed, the foam blanket is usually maintained at a thickness of 1.3 to 2.5 cm (0.5 to 1.0 in.) and covers the entire surface of the electroplating bath. Foam blankets trap the hydrogen gas and chromic acid mist in the foam layer. In order to maintain the desired foam thickness around the cathode, a heavy foam layer can develop in other areas (corners) of the tank. In these heavy foam areas, hydrogen gases will build up and if a spark is generated (e.g., from the contacting equipment) a hydrogen explosion can occur. As a result of this explosion, the foam layer, along with a portion of the electroplating solution, is blown out of the tank, and the chromium plate on the part may be damaged. If the foam layer is not maintained at a minimum reasonable thickness, the ability of the foam layer to inhibit misting is reduced.

Initial makeup volumes of foam blanket solutions are determined by the surface area of the electroplating bath, amount of current applied, and temperature and chromic acid concentration of the electroplating bath. Generally, the lower the temperature, the less product is needed.

Foam blankets are depleted primarily by decomposition; however, dragout of the foam may also be a factor. Also, foam blankets may be pulled into ventilation hoods if the solution level is too close to the hoods. Some types may also be depleted by excessive air

agitation of the bath. Appreciable concentrations of alkali metal ions, especially potassium, tend to reduce the solubility of some foam blankets.

Visual monitoring of the thickness of the foam blanket is the most common method for determining when to add foam blanket solution to the bath. The frequency of the maintenance additions depends on the amount of work processed through the electroplating tank and the dragout rate of the solution.

c. *Combination Fume Suppressants.* Combination fume suppressants (wetting agent plus a foam blanket) reduce the surface tension of the electroplating bath while forming a foam blanket over the surface. Because of the synergistic effects of the two components, less product is required than if either the wetting agent or the foam blanket were used alone.

d. *Factors Affecting Performance and Cost of Fume Suppressants.* The main factor affecting the performance of chemical fume suppressants is the amount of fume suppressant present in the electroplating or anodizing bath. If insufficient wetting agent is present in the bath, the surface tension of the solution will not be maintained below 40 dynes/cm (2.7×10^{-3} lb_f/ft) and, therefore, the effectiveness of the wetting agent in inhibiting misting will be substantially reduced. If a foam blanket is used, proper care must be taken to maintain the foam blanket at the specified thickness because a thin foam layer will not entrap the chromic acid mist efficiently, and areas of heavy foam may cause a hydrogen gas buildup and explosion potential.

Emission tests were conducted on a decorative chromium electroplating line with and without fume suppressants. Two types of fume suppressants were evaluated during the test program: (1) A foam blanket; and (2) a combination foam blanket and wetting agent. Test results indicate that fume suppressants are extremely effective in inhibiting the release of chromic acid mist. Hexavalent chromium concentrations range from 0.001 to 0.007 mg/dscm (4.4×10^{-7} to 3.1×10^{-6} gr/dscf) when a foam blanket or a combination foam blanket and fume suppressant is used in the electroplating bath. The hexavalent chromium concentrations measured when the combination foam blanket and wetting agent were used ranged from 0.001 to 0.003 mg/dscm (4.4×10^{-7} to 1.3×10^{-6} gr/dscf). These results indicated that the combination fume suppressant might be marginally more effective than the foam blanket type suppressant. Both types of fume suppressants reduced chromium

emissions by more than 99.5 percent compared to uncontrolled levels.

The costs of using chemical fume suppressants depend upon the tank capacity, the amount of current applied, and the number of parts processed.

5. Source Reduction and Recycling

The Pollution Prevention Act of 1990 establishes the following environmental management hierarchy as national policy:

a. Pollution should be prevented or reduced at the source wherever feasible;

b. Pollution that cannot be prevented should be recycled in an environmentally safe manner wherever feasible;

c. Pollution that cannot be prevented or recycled should be treated in an environmentally safe manner wherever feasible; and

d. Disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.

Although the Act does not specifically define "pollution prevention," it states that source reduction is fundamentally different and more desirable than waste management and pollution control. Source reduction is defined as any practice that reduces the amount of any hazardous substance entering the waste stream or otherwise released into the environment prior to recycling, treatment, or disposal.

There are two source reduction alternatives available for decorative chromium electroplating tanks. The first involves the use of a trivalent chromium electroplating process instead of a chromic acid process. This alternative has two primary benefits. First, trivalent chromium may be less toxic than hexavalent chromium and is not presently classified as a known human carcinogen, as is hexavalent chromium. A second benefit is that these processes also result in less total chromium in process wastewaters because of the lower total chromium concentrations in the electroplating baths as compared to chromic acid electroplating baths. The total chromium concentration of trivalent chromium solutions is approximately one-fifth that of hexavalent chromium solutions. In addition, less sludge is generated because of the lower total chromium content in the wastewater. As discussed in section VI.K. of this preamble, EPA specifically requests comment on whether the trivalent chromium electroplating process should be required for all new decorative chromium electroplaters.

The addition of chemical fume suppressants is also considered to be a

source reduction technique because fume suppressants inhibit emissions at the source. As mentioned previously, chemical fume suppressants are extremely effective (greater than 99.5 percent) in reducing emissions from decorative chromium electroplating and anodizing tanks.

In addition, each of the add-on pollution control techniques being considered for this source category has a recycling element; they allow for recycling of all collected chromium and/or reductions in the total wastewater treatment burden of a facility. All of the effluent generated from the control devices at hard chromium electroplating and anodizing tanks is recycled back to the electroplating tank to make up for evaporative losses. At decorative chromium electroplating tanks, where large quantities of rinse water are generated, scrubbers are often used as evaporators that reduce the total wastewater treatment burden by concentrating the process rinse waters prior to treatment. For this reason, a large majority of decorative chromium electroplaters continue to operate scrubbers in conjunction with fume suppressants. As discussed in section VI.K. of this preamble, EPA specifically requests comment on whether the final standards should require recycling of the wastewater.

Unlike decorative chromium electroplating tanks, hard chromium electroplating tanks typically do not use fume suppressants either alone or in conjunction with an add-on control device. As discussed earlier, wetting agents can cause pitting in the hard chromium plate and, historically, foam blankets have been viewed as explosion hazards. However, EPA obtained data from a test at a hard chromium electroplating operation using a fume suppressant (a combination wetting agent/foam blanket) in conjunction with an add-on control device, a mesh-pad mist eliminator. The EPA also performed a test to measure emissions from a system involving the use of a foam blanket and polypropylene balls in conjunction with a packed-bed scrubber to control emissions at a hard chromium electroplating operation. These data indicate that chromium removal efficiencies averaged 97.7 percent when a foam blanket was used and only 60.1 percent with the use of a combination fume suppressant. (These control efficiencies do not include control associated with the add-on control device, only the control associated with the foam blanket or fume suppressant. Outlet concentrations, considering

control, are provided in the paragraph below.)

The significant difference in the performance of the foam blanket compared to that of the combination fume suppressant at the hard chromium electroplating tanks cannot be explained by information obtained at the time of testing. Possible explanations for this inconsistency include differences in the maintenance of foam blankets, characteristics of the parts being plated, and the transportation and handling of the parts in the electroplating bath. The data do indicate that the use of foam blankets and combination fume suppressants in hard chromium electroplating tanks is less effective than the use of these compounds in decorative chromium electroplating tanks.

The above tests also indicated that overall emissions from a fume suppressant or foam blanket/control device system were lower than emission rates achieved solely with a control device. The emissions from the fume suppressant/mist eliminator were measured as 0.008 mg/dscm (3.5×10^{-6} gr/dscf), a 30 percent improvement in emission control over that obtained with the mist eliminator system alone. Emissions from the foam blanket/packed-bed scrubber system were also measured as 0.008 mg/dscm (3.5×10^{-6} gr/dscf), an 86 percent increase in emission control over that obtained with the packed-bed scrubber system alone. However, as previously stated, wetting agents can cause pitting in the hard chromium plate, and foam blankets have a potential explosion hazard. Therefore, the use of foam blankets and/or wetting agents in conjunction with add-on control devices was not considered feasible for the entire range of hard chromium electroplating tanks and is not included as a regulatory alternative. This does not preclude the use of these methods by some facilities, such as those tested, which may be able to comply with the standard by using wetting agents or foam blankets in conjunction with an add-on control device.

VI. Rationale for Selection of the Proposed Standards

This section describes the rationale for the decisions made by the Administrator in selecting the proposed standards.

A. Selection of Pollutant and Source Categories To Be Regulated

Section 112 requires EPA to establish national standards to reduce HAP emissions from source categories that emit these pollutants. Section 112(b)

provides a list of 189 compounds that are considered to be HAP. Chromium compounds are included on this list of pollutants. Section 112(c) directs EPA to use this pollutant list to develop and publish a list of source categories for which NESHAP will be developed. This list of source categories, which was published in the *Federal Register* on July 16, 1992, includes major and area sources performing hard chromium electroplating, decorative chromium electroplating, and chromium anodizing. Thus, emissions of chromium compounds from these six source categories are being regulated by this proposed rulemaking.

The preamble to the list of source categories (57 FR 31588) presents the rationale for listing the chromium electroplating and anodizing area source categories. That discussion is repeated in the following paragraphs, and EPA requests comment on whether there is a basis for removing from the source categories list any of the categories or subcategories covered by the proposed standards. Specific information is requested concerning whether the delisting criteria of section 112(c)(9) would be met, or whether, in the alternative, it would be appropriate, in the case of any proposed subcategory (such as decorative electroplating using the trivalent chromium process), to conduct an assessment under section 112(c)(3) of the effect on human health or the environment before finally creating such subcategory and adding it to the source category list.

Chromium electroplaters can present an adverse health threat to populations living near the source of emissions. Chromium electroplaters mostly emit the hexavalent form of chromium, Cr(+6), as chromic acid mist, and lesser amounts of trivalent chromium Cr(+3). Current health effects data suggest that the hexavalent form of chromium is the most toxic of all chromium compounds. Both human case studies and epidemiological studies attest to the adverse health effects from inhalation of hexavalent chromium. Acute exposure to hexavalent chromium has been shown to cause nasal irritation in workers and other individuals. Intermediate and chronic inhalation exposure to chromium has been reported to cause adverse respiratory tract effects, including irritation and perforation of the nasal mucosa, decreases in lung function, and renal proteinuria. Animal studies of acute organ toxicity also suggest that chromium compounds may produce kidney and liver damage.

The carcinogenic health effects from chromium are also well documented.

Hexavalent chromium is considered a Group A carcinogen because there is adequate evidence for its carcinogenicity in humans. Specifically, chronic occupational exposure to chromium has been associated with increased incidence of respiratory cancer in workers. The association of exposure to chromium and the induction of lung cancer is strengthened by the high lung cancer mortality ratios found in various epidemiological studies, the consistency of results across several studies, the increased tumors found in association with increasing doses, and the specificity of the tumor site. The role of trivalent chromium in carcinogenesis is presently unclear.

Reproductive studies on animals also suggest that chromium compounds may have some fetal and maternal toxicity effects. Although conclusive results can not be drawn from the available data, studies suggest that chromium compounds can adversely affect fetal development and male reproduction in experimental animals.

Recognizing the considerable uncertainties associated with cancer risk assessment, the Agency has developed nationwide emission and population exposure estimates associated with chrome platers and anodizers. Based on this analysis, the Agency estimates that chrome platers and anodizers contribute significantly to the total increased cancer incidence in the U.S. from airborne toxics. Hard chrome platers, decorative chrome platers, and acid anodizers may cause as many as 110 increased cancer cases per year in the U.S. In addition to significant population risks, chrome platers and anodizers contribute significantly to maximum individual cancer risks in the proximity of particular facilities. The Agency estimates that maximum, upper-bound individual risks range from two chances in 100,000 (2×10^{-5}) for small acid anodizing plants to five chances in 1,000 (5×10^{-3}) for large hard plating operations. All estimates of risk in this analysis are based on hexavalent chromium only, and not on trivalent chromium.

An Agency study of Southeast Chicago estimates that chrome platers contribute about one sixth of the total cancer incidence due to all sources of airborne toxics in the study area, including steel mills, road vehicles, and other industrial sources.

An Agency analysis of cancer incidence from air toxic emissions in five large U.S. cities shows that chrome platers contribute about one tenth of the total increased cancer incidence due to all sources of airborne toxics. Extrapolating the cancer rate in the five

cities to the U.S. yields an estimate of as high as 90 increased cases per year.

Currently, the only Federal emission regulations for electroplaters are limited to OSHA workplace emission standards, designed specifically to limit worker exposure. Fourteen States have adopted or proposed regulations for controlling chromium emissions from electroplaters.

The Agency finds that the overall emissions, exposures, and known and suspected health impacts associated with chromium electroplaters and anodizers present a threat of adverse effects to human health. Based on the finding above, the Agency has included chromium electroplaters and anodizers on the initial list of categories of area sources.

The six source categories subject to the proposed rulemaking were evaluated to determine if subcategorization of the source categories was justified. The Agency's analysis indicates that the decorative chromium electroplating source category should be subcategorized based on whether a chromic acid or trivalent chromium electroplating process is used. No subcategorization is recommended for the hard chromium electroplating and chromium anodizing source categories.

The decorative chromium electroplating source category has been subcategorized depending on whether a chromic acid (hexavalent chromium) or trivalent chromium electroplating process is used. These two subcategories are being considered separately because the trivalent chromium electroplating process is very different from the hexavalent chromium electroplating process. Trivalent chromium electroplating solutions typically contain between 22 to 30 g/L (3 to 4 oz/gal) of trivalent chromium. Chromic acid is considered a bath contaminant, and the total chromium concentration in trivalent baths is four times lower than that in chromic acid baths. Also, the trivalent chromium solutions contain wetting agents; these are used primarily to provide a uniform plate thickness across the entire surface area of the parts. While the wetting agents may also inhibit misting, this is a secondary purpose. In contrast, in chromic acid baths, wetting agents are specifically used to inhibit misting. Also, in a trivalent chromium process, the wetting agents are not added separately during the electroplating process.

Electroplating solution composition is maintained through the use of automatic controllers that add specified amounts of a material on an Ampere-hour basis. Addition of wetting agents alone may

jeopardize the trivalent chromium bath chemistry. Because some emissions control is inherent in the trivalent chromium electroplating process, tanks using this process are only required to monitor the process, whereas those tanks with a chromic acid electroplating process are required to add wetting agent to the electroplating solution.

Another consideration is that the trivalent chromium electroplating process, while suitable for the full range of decorative chromium electroplating tanks, has unique operating considerations. For example, the trivalent chromium electroplating process is more sensitive to contamination than hexavalent chromium electroplating baths. Certain materials such as copper, zinc, and lead, which are commonly found in the metal parts being plated, may contaminate the trivalent chromium bath solution. Also, the finish color achieved with the trivalent electroplating process may differ from that traditionally obtained with chromic acid baths, and the difference in color may be unacceptable to the end user. Finally, with the trivalent chromium bath, additional posttreatment and rinsing tanks may be needed.

Although the Agency did not find any basis for subcategorizing the hard chromium electroplating source category, it was determined that distinct size classes of facilities existed in the source category. The rationale for selecting these sizes is based primarily on control costs, which are discussed in sections VI.C.4 and VI.C.5; the size distinctions are presented here because sections of this preamble that precede section VI.C.4. contain discussion using the size distinctions.

For the purposes of this rulemaking, the distinction between small and large hard chromium electroplating facilities within the source category is based on the maximum cumulative potential rectifier capacity at a facility. A tank's rectifier capacity determines the amount of current (amperes) that can flow through the plating solution (from the anode to the cathode). Maximum cumulative potential rectifier capacity is calculated as:

$$\left(\sum RC_i\right) \times 8,400 \text{ hr/yr} \times 0.7$$

where:

RC_i = the rectifier capacity rating of an individual tank

8,400 hr/yr = operating schedule based on 24 hr/d, 7 d/wk, 50 wk/yr

0.7 = the percent time the electrodes are energized

Based on the model plant parameters used for this analysis, a small model plant would have one plating tank, with a maximum rectifier capacity of 10,000 Amperes. The maximum rated capacity would be approximately 60 million Ah/yr. Therefore, the cutoff between small and large facilities has been established as 60 million Ah/yr. Existing facilities would follow the same procedure in calculating their total maximum rectifier capacity.

B. Selection of Emission Points To Be Covered by the Standard

The primary sources of HAP within the chromium electroplating and anodizing source categories are the electroplating and anodizing tanks, which emit chromium compounds. These are the emission points that would be covered by the proposed rule. Other processes located at facilities that perform chromium electroplating and anodizing that emit small quantities of other HAP include surface preparation steps such as acid dipping and vapor degreasing are not covered by this NESHAP. The HAP emitted from these processes are acid mists and solvent vapors. Hazardous air pollutant emissions from other metal plating processes such as nickel, copper, and cadmium plating are also not included in the scope of this rule. The reasons for excluding these emission points are provided below.

The Agency's study of chromium emissions from chromium electroplating and anodizing tanks was begun prior to the 1990 amendments to the Act. The study focused on chromium compounds only; information on sources emitting HAP other than chromium compounds had not been obtained. Therefore, only those sources emitting chromium compounds (i.e., the chromium electroplating and anodizing tanks) are included in this proposed rulemaking.

The additional time that would be required to develop the necessary background information to regulate the associated surface preparation steps could unnecessarily delay regulation of the electroplating and anodizing tanks. The EPA is in the process of developing NESHAP for emissions from degreasing tanks that would cover such operations located at facilities performing chromium electroplating and anodizing. Metal finishing processes that produce acid mists are found in a variety of source categories, and EPA will consider these sources in a forthcoming 5-year area source study.

C. Selection of Basis and Level of Proposed Standards for Existing and New Sources

1. Selection of MACT/GACT Approach

Section 112 of the amended Act directs the Administrator to promulgate standards that:

require the maximum degree of reduction in emissions of the hazardous air pollutants . . . that the Administrator, taking into consideration the cost of achieving such emission reductions, and any nonair quality health and environmental impacts and energy requirements, determines is achievable * * *

This control level is referred to as MACT. Section 112(d)(3) of the amended Act specifies the requirements for determining MACT for new and existing sources. The MACT level is required for all major sources. However, the Administrator may elect to promulgate standards or requirements applicable to sources in categories or subcategories of area sources that provide for the use of generally available control technologies (GACT) or management practices by such sources to reduce emissions of HAP. The GACT approach can be less stringent than the MACT floor, and it considers the availability of the emission control systems, their costs and economic impacts, and the technical capabilities of owners/operators to operate and maintain emission control systems. Under the GACT approach, a "floor" evaluation is not conducted for each category or subcategory to assess the minimum allowable control. Also, the Administrator is not required to conduct a residual risk analysis to determine if more stringent standards are necessary to protect public health under section 112(f), although the Administrator may conduct such a residual risk analysis as appropriate. Such an analysis is required for source categories for which MACT is required.

The criteria for distinguishing major from area sources are included in the definitions of major and area sources in section 112(a). A major source is one that emits or has the potential to emit, considering control, 9.1 Mg/yr (10 tons/yr) or more of any HAP or 22.7 Mg/yr (25 tons/yr) or more of any combination of HAP. An area source is, by definition, any stationary source of HAP that is not a major source. It is expected that for each of the six source categories covered by this proposed rulemaking, the majority of sources in each category will be area sources. Chromium emissions from an electroplating or anodizing operation alone are unlikely to exceed the major source cutoffs. However, if the

chromium electroplating or anodizing operation is located at a facility that meets the criteria for a major source due to HAP emissions from other operations, then it would be considered a major source for purposes of the proposed rule.

The Administrator is proposing to regulate area sources performing chromium electroplating and anodizing under section 112(c)(3), based on a finding that they present a threat of adverse effects to human health or the environment (see section VI. A.). This proposal is based on data that show that a significant amount of hexavalent chromium, a known human carcinogen, is emitted to the atmosphere from the chromium electroplating and anodizing tanks at the levels of chromium emissions that present a threat of adverse effects to human health.

In determining whether to regulate area sources by applying MACT or GACT, the Administrator also considered the availability of control technologies and the cost of compliance for area sources. The control technologies on which this proposed rulemaking is based include packed-bed scrubbers and composite mesh-pad systems for hard chromium electroplating operations and fume suppressants for decorative chromium electroplating and anodizing operations. Packed-bed scrubbers are currently used widely in the hard chromium electroplating industry; composite mesh-pad systems are also being installed at all sizes of facilities although their use is not yet as widespread as packed-bed scrubbers. Fume suppressants are used widely for decorative chromium electroplating and anodizing operations. Because of the availability of these control technologies, they would be considered appropriate bases for GACT as well as MACT. Also, the cost of applying these control technologies has been found to be reasonable for most sources in these source categories (see section VI.C.4).

Because of the high toxicity of chromium compounds and the availability and reasonable cost of control technologies, the Administrator is proposing to apply MACT to both major and area sources of chromium electroplating and anodizing. The application of MACT to both area and major sources ensures that a residual risk analysis of emissions associated with these sources will be conducted by the Agency, as required by section 112(f) of the Act, to determine whether additional regulation is warranted in the future to protect public health. The agency solicits comments on the proposal to establish MACT standards

for area sources instead of adopting GACT standards.

2. Selection of the MACT Floor

As discussed in section II.C, Categorization/Subcategorization: Determining Maximum Achievable Control Technology "Floors," EPA develops and considers regulatory alternatives that are at least as stringent as the MACT floor as defined in the Act. The MACT floor is determined from information on various control levels within each of the categories and subcategories (baseline conditions). The baseline conditions that led to the development of the MACT floors are discussed below. Additional information on baseline conditions is found in Chapter 5 of the BID.

a. *Hard Chromium Electroplating MACT Floor.* Baseline conditions that were originally established for facilities operating hard chromium electroplating tanks were based on an industry survey of 44 hard chromium electroplating operations that was conducted in 1987. Based on this survey and industry census data, it was estimated that baseline conditions for facilities operating hard chromium electroplating tanks included a total population of 1,540 facilities. Of these tanks, 30 percent were uncontrolled, 30 percent were controlled by chevron-blade mist eliminators, and 40 percent were controlled by packed-bed scrubbers. Chevron-blade mist eliminators represent a control device efficiency of approximately 95 percent at representative inlet loadings for hard chromium electroplating tanks. The associated outlet concentration is 0.15 mg/dscm (6.6×10^{-6} gr/dscf). Alternatively, well-maintained and -operated packed-bed scrubbers that incorporate periodic washdown of the packing can achieve an emission reduction of 99 percent, with an associated outlet concentration of 0.03 mg/dscm (1.3×10^{-5} gr/dscf) considered feasible. Although EPA believes that an undetermined number of existing facilities are operating packed-bed scrubbers under less-than-ideal operating and maintenance conditions, if proper operation and maintenance procedures are implemented, existing units will readily achieve an emission limit of 0.03 mg/dscm (1.3×10^{-5} gr/dscf).

More recent information obtained from control device vendors confirms that composite mesh-pads are being used at approximately 5 percent of hard chromium electroplating facilities and that the growth in use is expected to continue. The vendor survey also indicated that these control devices are

being installed at all sizes of facilities. Based on emission test results from three facilities, a composite mesh-pad system can achieve an average outlet concentration of 0.013 mg/dscm (5.7×10^{-6} gr/dscf). Based on a representative inlet loading, the percent reduction achieved by the composite mesh-pad system is greater than 99.8 percent. The current use of this system in the industry as well as the fact that it represents the "maximum degree of reduction in emissions" (section 112(d)(3) of the Act) resulted in the selection of 0.013 mg/dscm (5.7×10^{-6} gr/dscf) as the MACT floor for new sources.

Some uncertainty surrounds the exact effect that the increasing use of composite mesh-pads has on the original existing source baseline. The EPA has no information on whether the composite mesh-pad systems were installed to replace or augment existing packed-bed scrubbers or if they were installed at facilities that were either uncontrolled or were using chevron-blade mist eliminators. This uncertainty, however, does not affect the existing source MACT floor; the same level of control would represent the MACT floor whether the original or modified baseline conditions are assumed. A discussion of how the existing source MACT floor is calculated under either circumstance is provided below.

In the first MACT floor analysis, it is assumed that composite mesh-pads are not included in the baseline conditions. The existing source MACT floor is determined by calculating the average emission limitation achieved by the best performing 12 percent of sources. Because it is estimated that 40 percent of the industry is currently using packed-bed scrubbers, and that a well-maintained and -operated packed-bed scrubber that incorporates periodic washdown of the packing can achieve outlet concentrations of 0.03 mg/dscm (1.3×10^{-5} gr/dscf), this emission limit (0.03 mg/dscm [1.3×10^{-5} gr/dscf]) is the MACT floor for existing sources.

In the second MACT floor analysis, the baseline conditions are adjusted to account for the 5 percent of facilities using composite mesh-pads. In this scenario, the average emission limitation associated with 5 percent of facilities performing at 0.013 mg/dscm (5.7×10^{-6} gr/dscf) and 7 percent performing at the next highest level of control (0.03 mg/dscm [1.3×10^{-5} gr/dscf]) results in an emission limitation (0.023 mg/dscm [1.0×10^{-5} gr/dscf]) that

does not correspond to any specific control technique.

As noted earlier (in section II.C), when the average emission limitation does not correspond to an emission limitation achievable with a specific type of control technique, EPA may use the emission limitation achieved by the facility at the 94th percentile (the median of the best performing 12 percent), which is equivalent to 0.03 mg/dscm (1.3×10^{-5} gr/dscf) in this case. This approach would result in an emission limitation of 0.03 mg/dscm (1.3×10^{-5} gr/dscf) as the MACT floor for existing hard chromium electroplating tanks. Either of the approaches to determining the MACT floor described above results in the same level of control.

b. *Decorative Chromium Electroplating—Chromic Acid Bath—MACT Floor.* Baseline conditions that were originally established for facilities with decorative chromium electroplating tanks were based on an industry survey of 63 decorative chromium electroplating operations that was conducted in 1987. Baseline conditions for decorative chromium electroplaters using chromic acid baths include a total facility population of 2,800 facilities of which 15 percent of facilities are uncontrolled, 40 percent use fume suppressants, 40 percent use packed-bed scrubbers, and 5 percent use packed-bed scrubbers. Because the inlet concentrations in decorative chromium electroplating are lower than those in hard chromium electroplating, the overall efficiency of packed-bed scrubbers is also lower (approximately 97 percent compared to 99 percent for hard chromium electroplating tanks). Alternatively, test results show that the use of chemical fume suppressants inhibit greater than 99.5 percent of the chromium from being released from an electroplating bath and are capable of achieving an outlet concentration of 0.003 mg/dscm (1.3×10^{-6} gr/dscf). Because more than 12 percent of the facilities in this source category use fume suppressants and no more effective control technique is available, the MACT floor for both new and existing decorative chromium electroplating tanks using a chromic acid bath is an emission limitation of 0.003 mg/dscm (1.3×10^{-6} gr/dscf).

c. *Decorative Chromium Electroplating—Trivalent Chromium Bath—MACT Floor.* Approximately 10 percent of decorative electroplaters use trivalent chromium baths. As discussed in section VI.A., EPA has determined

that decorative chromium electroplating tanks using a trivalent chromium bath are a separate subcategory. Tests conducted on tanks using trivalent chromium electroplating baths indicate that the total chromium concentration in emissions from these baths is 0.048 mg/dscm (2.1×10^{-5} gr/dscf). Hexavalent chromium concentrations from these baths have been measured as 0.004 mg/dscm (1.7×10^{-6} gr/dscf).

Most trivalent chromium electroplating baths do not have ventilation systems such that the chromium concentration in emissions from these baths could be measured. Therefore, another parameter, surface tension, was measured during the emission tests; the tests indicated that trivalent chromium baths that meet the above emission levels should have surface tensions no greater than 55 dynes/cm (3.8×10^{-3} lb/ft). Based on these test data, the MACT floor for new and existing trivalent chromium electroplating tanks is operation of the bath consistent with the above concentrations (0.048 mg/dscm [2.1×10^{-5} gr/dscf]), as demonstrated through surface tension measurement.

d. *Chromium Anodizing Tanks MACT Floor.* Baseline conditions that were originally established for facilities with chromium anodizing tanks were based on an industry survey of 25 chromium anodizing operations that was conducted in 1987. Baseline conditions for chromium anodizing tanks include a total facility population of 680 facilities, of which 40 percent are uncontrolled, 10 percent use chevron-blade mist eliminators, 20 percent use packed-bed scrubbers, and 30 percent use fume suppressants. Once again, the average emission limits achieved by the best-performing 12 percent of the facilities in this category are associated with the use of fume suppressants. Also, a more efficient control technique is not available. Therefore, the MACT floor for both new and existing chromium anodizing sources is an emission limit of 0.003 mg/dscm (1.3×10^{-6} gr/dscf).

3. Regulatory Alternatives Considered

The existing source regulatory alternatives developed to select existing source MACT for each of the categories and subcategories are presented in Table 2. A brief discussion of the alternatives is presented below. More stringent control techniques beyond what would be required by the new source MACT floor are not available; therefore, no additional regulatory alternatives beyond the MACT floor were considered for new sources.

TABLE 2.—SUMMARY OF REGULATORY ALTERNATIVES FOR EXISTING SOURCES

Type of operation/regulatory alternative (RA)		
Hard chromium plating		
	Size of operation*	
	Small (<60 million Ah/yr)	Large (≥60 million Ah/yr)
RA I (MACT floor)	PBS ^b	PBS.
RA II	PBS	CMP ^c —Existing PBS exempt.
RA III	PBS	CMP.
RA IV	CMP—Existing PBS exempt	CMP.
RA V	CMP	CMP.
Decorative chromium plating—chromic acid bath		
RA I (MACT floor)	FS ^d	
Decorative chromium plating—trivalent chromium bath		
RA I (MACT floor)	TVC ^e (no action)	
Chromium anodizing		
RA I (MACT floor)	FS	

*Based on the maximum cumulative potential rectifier capacity of tanks at a facility.
^bPBS=Packed Bed Scrubber.
^cCMP=Composite Mesh Pad.
^dFS=Chemical Fume Suppressant.
^eTVC=Trivalent Chromium Plating Process.

a. *Hard Chromium Electroplating Regulatory Alternatives.* For hard chromium electroplating, the EPA evaluated five regulatory alternatives as shown in Table 2. The alternatives increase in control stringency from Regulatory Alternative (RA) I, the existing source MACT floor control level, to RA V. The alternatives are structured to determine whether a size or class distinction is appropriate in selection of MACT. Such a distinction is authorized by section 112(d)(1), which provides that the MACT standard may distinguish among classes, types, and sizes of sources within a category or subcategory.

Regulatory Alternative I would require the control level achieved by packed-bed scrubbers for both small and large hard chromium electroplaters. Regulatory Alternative II would increase the stringency for large hard chromium electroplaters by requiring the control level achievable by composite mesh-pads unless the source is already controlled with a packed-bed scrubber. Regulatory Alternative III would further increase the stringency for large hard chromium electroplaters by requiring the control level achievable by composite mesh-pads for all sources, even those already controlled with packed-bed scrubbers. Regulatory Alternative IV would increase the stringency for small hard chromium electroplaters by requiring the control

level achievable by composite mesh-pads, except for those already controlled by packed-bed scrubbers. Regulatory Alternative V would require the control level achievable by composite mesh-pads for all small and large hard chromium electroplaters, with no exceptions.

b. *Decorative Chromium Electroplating—Chromic Acid Bath—Regulatory Alternative.* The control technology that represents the MACT floor, i.e., the use of fume suppressants, is the highest level of control achievable by the subcategory. Therefore, only one regulatory alternative is possible.

c. *Decorative Chromium Electroplating—Trivalent Chromium Bath—Regulatory Alternative.* There are no regulatory alternatives other than the no-action alternative for trivalent chromium processes. Because of the presence of a wetting agent as an integral part of the bath chemistry, and the low emission potential, no controls are currently in use for this process.

d. *Chromium Anodizing Tanks Regulatory Alternative.* The control technology that represents the MACT floor, i.e., the use of fume suppressants, is the highest level of control achievable by the category. Therefore, only one regulatory alternative is possible.

4. Nationwide Impacts of the Regulatory Alternatives

This section presents the nationwide environmental, energy, cost, and

economic impacts of the RA's presented in Table 2. For purposes of assessing impacts, each RA is compared to the baseline or no-action alternative. The baseline levels of control were obtained from responses to an industry survey conducted by EPA in 1985. The survey provided information on control techniques at 44 hard chromium electroplating facilities, 63 decorative chromium electroplating facilities, and 25 chromium anodizing facilities. A more recent follow-up survey of vendors supplying composite mesh-pads was also conducted after the initial survey to assess any changes in the control level used in the industry. This survey demonstrated that composite mesh-pads were being installed on new and existing hard chromium electroplating tanks, regardless of facility size.

As explained in section VI.C.2, the baseline conditions for this industry are constantly changing as existing facilities replace old control equipment with new, more efficient control devices such as composite mesh-pads. The impacts presented here, however, are based on baseline conditions as established through the initial industry survey. This is because the follow-up vendor survey did not provide specific information on whether the composite mesh-pads were replacing previously uncontrolled tanks, or tanks that had been controlled with a less efficient control device. As stated in section VI.C.2, results of the vendor

survey indicate that approximately 5 percent of the facilities within the hard chromium electroplating source category are using composite mesh-pads. Assuming that each composite mesh-pad was installed at a different facility, the maximum number of facilities with these devices would be approximately 80 out of an estimated 1,540 facilities. Given the relatively small number of composite mesh-pads being used, the nationwide impacts that would result if these facilities were accounted for in the baseline conditions would not differ significantly from those presented here.

a. *Baseline Conditions.* For the purposes of this analysis, the baseline conditions presented in the following paragraphs were used.

For hard chromium electroplating, it was estimated that, at baseline, 30 percent of the tanks are uncontrolled, 30 percent are controlled by chevron-blade mist eliminators, and 40 percent are controlled by packed-bed scrubbers.

For decorative chromium electroplating, it was estimated that, at baseline, 15 percent are uncontrolled, 40 percent are controlled by chemical fume suppressants, 40 percent are controlled by chemical fume suppressants in conjunction with packed-bed scrubbers, and 5 percent are

controlled by packed-bed scrubbers. In calculating aggregate nationwide impacts for decorative chromium electroplating tanks, the following control scenario was assumed for RA I: 58 percent of the existing tanks will operate with chemical fume suppressants alone, and 42 percent of the existing tanks will operate with chemical fume suppressants in conjunction with packed-bed scrubbers. The combined use of techniques is common because packed-bed scrubbers serve a dual purpose. In addition to controlling air pollution, the scrubbers serve as atmospheric evaporators that concentrate the process rinse waters requiring treatment. Therefore, it is assumed that existing tanks currently using chemical fume suppressants in conjunction with packed-bed scrubbers will continue this practice and that half of the tanks that currently use packed-bed scrubbers alone will opt to operate the scrubber in conjunction with fume suppressants.

For chromium anodizing, it was estimated that, at baseline, 40 percent are uncontrolled, 10 percent are controlled by chevron-blade mist eliminators, 20 percent are controlled by packed-bed scrubbers, and 30 percent are controlled by chemical fume suppressants.

No net growth is projected for the chromium electroplating and anodizing industry. Contacts with equipment suppliers indicate that the majority of new equipment installations occur at existing facilities as a result of replacement of obsolete capacity or expansion of the existing capacity. The equipment suppliers indicated that very few new facilities have been constructed in the last 5 years. Consequently, the nationwide impacts presented below are the impacts beyond baseline of the RA's on existing tanks only. Impacts on new facilities are presented at the end of this section for typical, new model plant configurations only.

b. *Environmental Impacts.* Estimates of nationwide emission reductions and energy and solid waste impacts associated with each regulatory alternative are presented in Table 3. The RA's correspond to those that were presented in Table 2. To determine impacts beyond baseline using the numbers on Table 3, subtract the baseline number from the total number for a given alternative. To determine incremental impacts between regulatory alternatives, subtract the value for the less stringent of the two alternatives from the value for the more stringent.

TABLE 3.—ENVIRONMENTAL IMPACTS OF THE REGULATORY ALTERNATIVES

Type of operation	RA	Nationwide emission estimate, Mg/yr (tons/yr) ^a		Nationwide energy impacts, MWh/yr ^b		Nationwide solid waste impacts, m ³ /yr (ft ³ /yr) ^c	
		Small (<60 million Ah/yr)	Large (≥60 million Ah/yr)	Small (<60 million Ah/yr)	Large (≥60 million Ah/yr)	Small (<60 million Ah/yr)	Large (≥60 million Ah/yr)
Hard chromium plating	Baseline ...	18.5 (20.3)	126.6 (139.3)	20,300	112,300	18 (640)	26 (920)
	RA I	0.54 (0.59)	3.7 (4)	26,600	136,000	44 (1,550)	64 (2,260)
	RA II	0.54 (0.59)	1.93 (2.12)	26,600	183,370	44 (1,550)	118 (4,170)
	RA III	0.54 (0.59)	0.74 (0.81)	26,600	215,220	44 (1,550)	156 (5,510)
	RA IV	0.28 (0.3)	0.74 (0.81)	34,797	215,220	78 (2,750)	156 (5,510)
	RA V	0.11 (0.12)	0.74 (0.81)	40,284	215,220	103 (3,640)	156 (5,510)
Decorative chromium plating—chromic acid plating process.	Baseline ...	.....	10.5 (11.5)	.....	106,000	.....	67 (2,400)
	RA I .....	.....	0.3 (0.3)	.....	105,000	.....	63 (2,200)
Chromium anodizing	Baseline ...	.....	3.6 (3.9)	.....	48,000	.....	8 (280)
	RA I .....	.....	0.04 (0.05)	.....	45,000	.....	0 (0)

^a For the nationwide emission estimate calculations, refer to Chapter 6, Section 6.2 of the BID for Proposed Standards.
^b For the nationwide energy impact calculations, refer to Chapter 6, Section 6.3 of the BID for Proposed Standards.
^c For the nationwide solid waste impact calculations, refer to Chapter 6, Section 6.5 of the BID for Proposed Standards.

Impacts on wastewater treatment or discharges were considered negligible because of the industry practice to recirculate control device effluent back to the electroplating tanks as makeup to compensate for evaporative losses. Solid waste is generated as a result of the need to periodically replace packing and mesh material used in the control systems. The nationwide solid waste

impact is based on the frequency of replacement, the volume of material per control device, a compaction factor of 50 percent prior to disposal, and the estimated number of tanks nationwide.

i. *Hard Chromium Electroplating Tanks—RA I.* For hard chromium electroplating tanks, RA I represents a 97 percent reduction in the nationwide baseline emissions. The total

nationwide emission reduction associated with this alternative is 140 Mg/yr (155 tons/yr).

The total nationwide energy impact beyond baseline of RA I is approximately 30,000 MWh/yr. This increase and the incremental increases in energy impacts between RA's are due to increases in the pressure drop across control systems and their corresponding

increase in the fan horsepower requirements.

The total nationwide solid waste impact beyond baseline is 64 m³/yr (2,260 ft³/yr). The increase in solid waste over baseline is due to increases in the number of tanks using control systems that require periodic disposal of packing material.

Regulatory Alternative II. The total nationwide emission reduction associated with RA II is 143 Mg/yr (157 tons/yr). The total nationwide energy impact beyond baseline of RA II is approximately 77,000 MWh/yr. The total nationwide solid waste impact beyond baseline is 118 m³/yr (4,170 ft³/yr).

Regulatory Alternative III. The nationwide emission reduction beyond baseline associated with RA III is 144 Mg/yr (159 tons/yr). The total nationwide energy impact beyond baseline of RA III is approximately 109,200 MWh/yr. The total nationwide solid waste impact beyond baseline is 156 m³/yr (5,500 ft³/yr).

Regulatory Alternative IV. The nationwide emission reduction beyond baseline associated with RA IV is 144 Mg/yr (159 tons/yr). The total nationwide energy impact beyond baseline of RA IV is approximately

117,400 MWh/yr. The total nationwide solid waste impact beyond baseline is 190 m³/yr (6,700 ft³/yr).

Regulatory Alternative V. The nationwide emission reduction beyond baseline associated with RA V is 144 Mg/yr (159 tons/yr). The total nationwide energy impact beyond baseline of RA V is approximately 122,900 MWh/yr. The total nationwide solid waste impact beyond baseline is 215 m³/yr (7,590 ft³/yr).

ii. **Decorative chromium electroplating tanks—chromic acid bath.** Regulatory Alternative I corresponds to a 97-percent reduction against nationwide baseline emission levels. The nationwide emission reduction associated with this alternative is 10 Mg/yr (11 tons/yr). There is no energy impact associated with RA I. In fact, the nationwide energy requirement for RA I is projected to be lower than that at baseline because of the discontinuation of add-on control systems on some decorative chromium tanks. There is no increase in the amount of solid waste generated under RA I because there is no solid waste associated with the use of chemical fume suppressants. The solid waste generated under this alternative is

associated with those tanks that continue to operate packed-bed scrubbers in conjunction with fume suppressants.

iii. **Decorative chromium electroplating tanks—trivalent chromium bath.** Regulatory Alternative I, which is a no-action alternative, represents no additional emission reduction from baseline. There are also no energy or solid waste impacts.

iv. **Chromium anodizing tanks.** Regulatory Alternative I corresponds to an emissions reduction of 99 percent or 3.5 Mg/yr (4 tons/yr). The energy impacts associated with RA I represent a decrease of 6 percent from baseline. This decrease is due to the discontinuation of packed-bed scrubbers and chevron-blade mist eliminators at those tanks that currently use these control systems. Regulatory Alternative I would also reduce the amount of solid waste generated by 100 percent. Solid waste is generated at baseline conditions due to the use of packed-bed scrubbers. No solid waste is generated from the use of chemical fume suppressants.

c. **Cost Impacts.** Aggregate nationwide capital and net annualized costs for each RA are presented in Table 4.

TABLE 4.—COST IMPACTS OF THE REGULATORY ALTERNATIVES

Type of operation	RA	Nationwide capital costs, millions ^a		Nationwide annualized costs, millions ^a		Nationwide emission reduction Mg/yr ^b (ton/yr)	Incremental cost-effectiveness, \$/Mg (\$/ton) ^c
		Small (<60 million Ah/yr)	Large (≥60 million Ah/yr)	Small (<60 million Ah/yr)	Large (≥60 million Ah/yr)		
Hard chromium plating.	RA I	19.5	22.3	5.2	6.1	140.86(155)	80,000 (73,000)
	RA II	19.5	21.3	5.2	12.2	142.66 (156.9)	3,400,000 (3,100,000)
	RA III	19.5	25.1	5.2	17.1	143.82 (158.2)	4,200,000 (3,800,000)
	RA IV	12.6	25.1	7.6	17.1	144.08 (158.5)	9,200,000 (8,400,000)
	RA V	11.4	25.1	9.8	17.1	144.25 (158.7)	12,900,000 (11,700,000)
Decorative chromium plating. Chromium anodizing.	RA I .....	.....	.....	.....	.....	10.2 (11.2)	0 (0)
	RA I .....	.....	.....	.....	.....	3.56 (3.9)	0 (0)

^a For further description of the nationwide cost impacts refer to Chapter 7, Section 7.6 of the BID for Proposed Standards.

^b Nationwide emission estimates are provided in Table 3: Emission reductions are calculated by subtracting the emissions associated with a given alternative from the baseline emission estimate.

^c Incremental cost-effectiveness is calculated by dividing the incremental cost of two alternatives by the incremental emission reduction. In this Table, the incremental cost-effectiveness of an alternative is calculated by comparing it to the previous alternative. Estimates calculated from the costs and emission reductions presented in this table may not match the actual estimates presented in this column due to rounding.

i. **Hard Chromium Electroplating Tanks—RA I.** Regulatory Alternative I would result in nationwide increases in capital and annualized costs beyond baseline of \$42 million and \$11 million per year, respectively. The incremental cost of RA I compared to baseline is approximately \$80,000/Mg (\$73,000/ton).

Regulatory Alternative II. With RA II, nationwide capital and annualized cost

increases beyond baseline are \$41 million and \$17 million per year, respectively. The capital costs for large facilities are actually lower than they were for RA I even though a more stringent control technology is required. This is because composite mesh-pads have a lower capital cost, but higher annual cost, than packed-bed scrubbers. The incremental cost effectiveness of RA II compared to RA I is

approximately \$3.4 million/Mg (\$3.1 million/ton).

Regulatory Alternative III. For RA III, the nationwide capital cost increase beyond baseline that would result from RA III is \$45 million, and the annualized cost increase beyond baseline is \$22 million. The incremental cost effectiveness of RA III compared to RA II is \$4.2 million/Mg (\$3.7 million/ton).

Regulatory Alternative IV. Regulatory Alternative IV results in nationwide capital and annualized cost increases beyond baseline of \$38 million and \$25 million per year, respectively. Once again, the requirements for composite mesh-pads, this time at small hard chromium electroplating facilities, result in decreases in capital costs and increases in annual operating costs. The incremental cost effectiveness of RA IV compared to RA III is approximately \$9.2 million/Mg (\$8.4 million/ton).

Regulatory Alternative V. Regulatory Alternative V results in nationwide capital and annualized cost increases beyond baseline of \$37 million and \$27 million per year, respectively. The capital cost decrease (and annualized cost increase) compared to RA IV is due to the addition of the small hard chromium electroplating facilities that are required to replace existing packed-bed scrubbers with composite mesh-pads. The incremental cost effectiveness of RA V compared to RA IV is approximately \$12.9 million/Mg (\$11.8 million/ton).

The total annual reporting and recordkeeping costs would be approximately \$8.6 million. These costs are the same for all the regulatory alternatives.

ii. *Decorative chromium electroplating tanks—chromic acid electroplating solution.* For decorative chromium tanks using a chromic acid electroplating process, there is no nationwide capital cost increase beyond baseline associated with RA I because there are no capital costs associated with the use of chemical fume suppressants. The capital and annualized costs projected under RA I are driven by the assumption that 42 percent of the facilities will elect to use packed-bed scrubbers in conjunction with chemical fume suppressants. In fact, a slight decrease in nationwide baseline costs are expected under RA I because of the discontinuation of some add-on pollution control equipment at some decorative chromium electroplating facilities. However, the total annual reporting and recordkeeping costs would be approximately \$14 million.

iii. *Decorative chromium electroplating tanks—trivalent chromium electroplating solution.* As previously stated, RA I for those decorative chromium electroplating facilities using a trivalent chromium bath is a no-action alternative. Thus, there are no control cost impacts. However, the total annual reporting and recordkeeping costs would be approximately \$1.6 million.

iv. *Chromium anodizing tanks.* Regulatory Alternative I for anodizing tanks has no capital costs because fume suppressants require no equipment purchases. There is no annualized control cost impact beyond baseline for RA I. In fact, nationwide annualized costs are expected to decrease under RA I due to the discontinuation of add-on pollution control systems that are less effective and are more costly than fume suppressants. However, the total annual reporting and recordkeeping costs would be approximately \$3.8 million.

d. *Economic Impacts.* The following section presents the economic impacts associated with each RA. Economic impacts were assessed by examining the effect of the RA's on the cost of electroplating and on the final end-product prices. In addition, the effect of each RA on small businesses was estimated in a small businesses impact analysis. This analysis used EPA's Office of Policy, Planning, and Evaluation's 1982 Regulatory Flexibility Act guidelines to determine if there were significant impacts on a substantial number of small businesses. According to those guidelines, the following criteria constitute a significant adverse economic impact: (1) Annual compliance costs increase the total cost of production for small entities by more than 5 percent; (2) compliance costs as a percentage of sales for small entities are at least 10 percent higher than compliance costs as a percentage of sales for large entities; (3) capital costs of compliance represent a significant portion of capital available to small entities, considering internal cash flow plus external financing capabilities; and (4) the requirements of the regulation are likely to result in closures of small entities.

i. *Hard chromium electroplating operations—Regulatory Alternative I.* The economic impacts associated with RA I for hard chromium electroplating operations are not significant. End product price increases are well below 1 percent. The estimated number of small business closures for RA I ranges from 14 to 20 of the 1,170 small hard plating operations. Based on an analysis of the common financial ratios used by banks to assess loan applications for typical small facilities, there are no capital availability problems under RA I. All operations should be able to acquire the capital necessary to install a packed-bed scrubber system if they do not already have one.

Regulatory Alternative II. Regulatory Alternative II does not result in significant economic impacts. Once again the end product price increases are less than 1 percent. For RA II, the

estimated number of closures ranges from 20 to 23. Capital availability problems are also avoided under RA II for the following reasons. First, small operations are required to use packed-bed scrubbers for which the capital costs should not be prohibitive. Second, large facilities that currently use packed-bed scrubbers may continue to use these devices and thus will have little or no capital requirements to meet the regulation. Finally, because the capital cost of composite mesh-pad systems is actually lower than that of packed-bed scrubbers, large facilities required to use composite mesh-pads will not have problems obtaining the necessary capital.

Regulatory Alternative III. The estimated number of closures under RA III ranges from 20 to 28. However, the end product price increases resulting from this alternative are still insignificant (below 1 percent). Also, because RA III requires a control level equivalent to that of composite mesh-pad systems for all large facilities, while the required control level for small facilities continues to be equivalent to the use of packed-bed scrubbers, there are no capital availability problems because larger facilities should be able to obtain the necessary capital.

Regulatory Alternative IV. The end product price increases remain below 1 percent, and the estimated number of closures ranges from 33 to 39 under RA IV. In addition, capital availability problems are avoided because RA IV allows small facilities that currently use packed-bed scrubbers to continue using those systems. Other small facilities may have to purchase a composite mesh-pad system, but because the capital cost of this type of system is lower than that of a packed-bed scrubber, small facilities should be able to obtain the required capital.

Regulatory Alternative V. Under RA V, end product price increases are below 1 percent, and the number of estimated closures ranges from 37 to 51. However, because RA V requires all hard chromium electroplating operations to use composite mesh-pads regardless of whether they currently operate a packed-bed scrubber, some small facilities currently using packed-bed scrubbers may have a difficult time acquiring the necessary capital to purchase a composite mesh-pad system. Financial institutions may not be willing to lend the necessary capital to retrofit or replace an existing packed-bed scrubber to a small facility that is still paying for those existing systems.

ii. *Decorative chromium electroplating and chromium anodizing operations.* The economic impacts

associated with the regulatory alternatives for both decorative chromium electroplating and chromium anodizing operations are not significant. For decorative chromium operations using the chromic acid plating process and for chromium anodizing operations, this results from the extremely low annual control cost. Small increases in both the electroplating costs (less than 5 percent) and the anodizing costs (less than 7 percent) are estimated in the economic analysis. As a result, end product price increases are also very small (less than 1 percent). The RA for decorative chromium operations using the trivalent chromium plating process is no action; thus, there is no economic

impact. No small business closures are expected for either decorative chromium electroplating or chromium anodizing operations due to the low cost of control.

e. *Environmental and Cost Impacts for New Tanks.* This section presents environmental and cost impacts for new tanks. These impacts are provided on an individual model plant basis and are calculated against a baseline of no control. No aggregate nationwide impacts for new facilities are presented because there are no reliable estimates for totally "new" facilities.

Environmental and cost impacts for new hard and decorative chromium electroplating tanks are presented in

Tables 5 and 6, respectively. For hard chromium electroplating tanks, the proposed standard requires the application of composite mesh-pad systems, which corresponds to a 99.8-percent reduction in uncontrolled emissions. Energy impacts for composite mesh-pad systems vary from 37,300 to 895,200 kwh/yr. The solid waste impact resulting from the application of composite mesh-pad systems is low, ranging from 0.19 to 1 m³/yr (7 to 35 ft³/yr). The capital costs for composite mesh-pad systems range from \$27,200 to \$143,600; the annual operating costs range from \$13,500 to \$76,700.

TABLE 5.—ENVIRONMENTAL AND COST IMPACTS OF CONTROL TECHNIQUES AT NEW HARD CHROMIUM PLATING OPERATIONS

Control technique/model plant size	Emission reduction, kg/yr (lb/yr)	Energy impact, kWh/yr	Solid waste impact, m ³ /yr (ft ³ /yr)	Capital costs, (dollars)	Net annual cost, \$/yr
Composite mesh-pad systems:					
Small	50 (110)	37,300	0.19 (6.7)	27,200	13,500
Medium	420 (924)	261,000	0.52 (18)	71,800	32,800
Large	1,600 (3,520)	895,200	1.0 (35)	143,600	76,700

TABLE 6.—ENVIRONMENTAL AND COST IMPACTS OF CONTROL TECHNIQUES AT NEW DECORATIVE CHROMIUM PLATING OPERATIONS

Control technique/model plant size	Emission reduction, kg/yr (lb/yr)	Energy impact, kWh/yr	Solid waste impact, m ³ /yr (ft ³ /yr)	Capital costs, (dollars)	Net annual cost, \$/yr
Chemical fume suppressants:					
Small	6.0 (13)	14,900	0 (0)	0	1,000
Medium	23.9 (52.6)	59,700	0 (0)	0	3,300
Large	239 (526)	156,700	0 (0)	0	17,200

For decorative chromium tanks using a chromic acid electroplating process, the use of chemical fume suppressants represents a 99.5-percent reduction in uncontrolled emission levels. No energy or solid waste impacts are associated with chemical fume suppressants. Also, no capital investment is associated with chemical fume suppressants, and the annual control costs are low, varying from \$1,000/yr for a small operation to \$17,200/yr for a large operation.

New decorative chromium tanks that use a trivalent chromium process would have no cost or energy impacts because it is assumed they would comply with the standard simply by using the trivalent chromium bath.

The only control technique examined for new chromium anodizing tanks was the use of chemical fume suppressants. The use of chemical fume suppressants represents a 99.5-percent reduction in uncontrolled emission levels. The annual operating costs associated with fume suppressants range from \$1,600 for

small tanks to \$4,300 for large tanks. No energy or solid waste impacts are associated with fume suppressant usage. Also, no capital investment is associated with fume suppressant usage.

5. Selection of MACT

a. *New Source MACT.* In all cases, MACT for new sources is based on the MACT floor for new sources presented in section VI.C.2., Selection of the MACT floor, above. For hard chromium electroplating sources, new source MACT is a total chromium emission limit of 0.013 mg/dscm (5.7×10⁻⁶ gr/dscf), which is based on the use of composite mesh pads. An emission limit of 0.003 mg/dscm (1.3×10⁻⁶ gr/dscf), which is based on the use of fume suppressants, represents new source MACT for decorative chromium electroplaters using chromic acid baths and for chromium anodizing tanks. For those decorative chromium electroplating tanks that use a trivalent chromium electroplating process, new

source MACT is the continued operation of the trivalent chromium electroplating process, with monitoring of the surface tension required. In each case, the new source MACT floor represents the "emission control that is achieved in practice by the best controlled similar source." The EPA considered whether there were any classes within the categories where the MACT floor did not represent the level associated with the "best controlled similar source" but did not find any such classes.

b. *Existing Hard Chromium Electroplating MACT.* To determine MACT for hard chromium electroplating, EPA evaluated the emission reductions, costs, economic impacts, and other environmental and energy impacts of the MACT floor control level (achievable with packed-bed scrubbers) and levels of control more stringent than the floor (achievable with composite mesh pad systems). These impacts were evaluated

separately for small and large platers and for platers already well-controlled (with packed bed scrubbers). These size and class distinctions were made for analytical purposes as authorized by section 112(d)(1) of the Act which provides that the Administrator may distinguish among classes, types, and sizes of sources within a category or subcategory in establishing standards. Section VI.C.3 of this preamble describes the regulatory alternatives (RA's). For small platers, RA's I, II, and III would all require the floor level of control. Regulatory Alternative IV is more stringent, and RA V would require the most stringent control. For large platers, RA I would require the floor level of control, RA II is more stringent, and RA's III, IV, and V would all require the most stringent control.

The following discussion of the primary factors EPA considered in determining MACT provides separate rationales for small and large platers. The primary factors that affected the decision are the emission reductions achievable, the cost of control, and the economic impacts. As described in section VI.C.4 of this preamble, the other environmental (solid waste and water) and energy impacts of various alternatives would not be significant. Therefore, they were not primary factors in the MACT decision and are not discussed in this section.

The regulatory analysis discussed below indicates what appear to be very high costs of control compared to the associated chromium emission reductions for all the regulatory alternatives. However, when the high toxicity of chromium and the proximity of exposed populations to electroplating facilities are considered, the costs of control are found to be as reasonable as those for other pollutants in other source categories. One pound of chromium is roughly equivalent in cancer potency to 1500 pounds of benzene. Specifically, the factor of 1,500 results from a quantitative comparison of the unit risk estimates for benzene and chromium. While quantitative comparisons of potencies of carcinogens carry with them considerable uncertainties, the highly toxic nature of chromium means that very small quantities of emissions can cause air pollution with very serious adverse health impacts on the surrounding population. For this reason, higher costs of controlling a given quantity of these emissions would be more acceptable than for a less toxic pollutant.

c. *Small hard chromium electroplaters.* As shown in Tables 3 and 4, for small platers a significant emission reduction (18 Mg/yr (19.7

tons/yr)) beyond baseline would be achieved by RA's I, II, and III (packed-bed scrubbers) at an incremental annualized cost of \$5.2 million per year. This results in an incremental cost effectiveness of \$290,000 per Mg (\$260,000 per ton). This is equivalent to \$130/lb of chromium emission reduction, which is comparable to approximately \$200/ton of benzene emission reduction, if relative cancer potency is factored in. The economic impact of requiring packed-bed scrubbers on small platers would not be significant. The EPA's economic impact analysis found that most small platers could obtain funds to install and operate the scrubbers without serious adverse impacts. A typical small plater has sales revenue of \$1 million, and for an uncontrolled facility the capital and annualized costs of packed-bed scrubber control would be \$36,700 and \$9,800, respectively. However, the retrofit costs of installing packed-bed scrubbers for facilities with less efficient control systems would be higher. The nationwide incremental capital cost increase would be \$20 million.

Regulatory Alternative IV is more stringent than RA III for small platers in that it would require the use of composite mesh pads for all facilities except those already controlled with packed-bed scrubbers. The nationwide incremental emission reduction of RA IV compared to RA III would be 0.26 Mg/yr (0.29 ton/yr) at an incremental annualized cost of \$2.4 million per year. This results in an incremental cost effectiveness of \$9.2 million/Mg (\$8.4 million/ton) of chromium emission reduction. This is equivalent to \$4,180/lb of chromium emission reduction, which is comparable to approximately \$6,000/ton of benzene emission reduction, if relative cancer potency is factored in. Thus, a small incremental emission reduction would be achieved at a significant increase in annualized cost. The economic impact of RA IV would not be significant because small platers could obtain capital for composite mesh pads as readily as they could for packed-bed scrubbers, and replacement of existing packed-bed scrubbers would not be required under this alternative. For a typical uncontrolled small plater, the capital cost for a composite mesh-pad system would be \$27,200, which is lower than that for a packed-bed scrubber; however, the annualized cost would be \$13,500 which is higher than that for the packed-bed scrubber. The nationwide capital costs for RA IV compared to RA III would be \$7 million less than for RA III because the capital costs for

composite mesh-pad systems are lower than for packed-bed scrubbers.

Regulatory Alternative V is more stringent than RA IV for small platers in that it would require the use of composite mesh pads for all facilities. This means that those currently controlled with packed-bed scrubbers would be required to replace them with composite mesh pads or retrofit them to achieve the more stringent control level. The nationwide incremental emission reduction of 0.17 Mg/yr (0.19 ton/yr) would be achieved at an incremental annualized cost of \$2.2 million per year. This is a significant cost increase compared to the associated emission reduction. This results in an incremental cost effectiveness of \$12.9 million/Mg (\$11.7 million/ton) of chromium emission reduction. This is equivalent to \$5,900/lb of chromium emission reduction, which is comparable to approximately \$8,000/ton of benzene emission reduction, if relative cancer potency is factored in. The incremental cost effectiveness of RA V compared to RA III is \$10.7 million/Mg (\$9.7 million/ton) of chromium emission reduction. This is equivalent to \$4,900/lb of chromium emission reduction, which is comparable to approximately \$7,000/ton of benzene emission reduction, if relative cancer potency is factored in. The incremental impacts of RA V compared to RA IV or RA III are considerably higher than those of RA III compared to RA I or II. Small platers would find it difficult or impossible to obtain the necessary capital to replace or retrofit existing packed-bed scrubbers with composite mesh-pad systems.

The Administrator has selected RA III, the MACT floor level of control, as the basis for the proposed MACT standard for small hard chromium electroplaters. This selection is based on consideration of the significant emission reductions achievable at reasonable costs and other environmental, energy and economic impacts. The more stringent RA's IV and V were rejected because the incremental costs of control and economic impacts would be unreasonable when compared to the small incremental emission reduction that would be achieved. However, comments are specifically requested on this decision and whether a different control level should be required in the final standard. Commenters on this issue should provide supporting rationale for their positions.

d. *Large hard chromium electroplaters.* As shown in Tables 3 and 4, for large hard platers, the nationwide emission reduction that would be achieved by requiring packed-bed

scrubbers under RA I, the MACT floor level of control, would be about 123 Mg/yr (136 tons/yr) at an annualized cost of \$6.1 million per year. This results in an incremental cost effectiveness of \$49,600/Mg (\$45,100/ton) of chromium emission reduction, equivalent to \$22/lb of chromium emission reduction, which is comparable to approximately \$30/ton of benzene emission reduction if relative cancer potency is factored in. The nationwide capital costs would increase by \$22 million. There would not be a significant adverse economic impact on large platers under this alternative and facilities could afford the installation and operation of packed-bed scrubbers.

Regulatory Alternative II is more stringent than RA I for hard platers in that it would require the use of composite mesh pads for all facilities except those already controlled with packed-bed scrubbers. The incremental emission reduction of RA II compared to RA I would be 1.8 Mg/yr (1.9 tons/yr) at an incremental annualized cost of \$6.1 million per year. This results in an incremental cost effectiveness of \$3.4 million/Mg (\$3.1 million/ton) of chromium emission reduction, equivalent to \$1,600/lb of chromium emission reduction, which is comparable to approximately \$2,000/ton of benzene emission reduction if relative cancer potency is factored in. The nationwide incremental capital costs would decrease by \$1 million rather than increase because the capital cost for a composite mesh-pad system is lower than for a packed-bed scrubber. The economic impact of RA II on large hard platers would not be significant; they could afford the cost of installation and operation of the required controls.

Regulatory Alternative III is the most stringent alternative for large hard platers (RA's IV and V would require the same level of control) in that composite mesh-pads would be required for all facilities. The incremental emission reduction of RA III compared to RA II would be 1.2 Mg/yr (1.3 tons/yr) at an incremental annualized cost of \$4.9 million per year. This results in an incremental cost effectiveness of \$4.2 million/Mg (\$3.8 million/ton) of chromium emission reduction, equivalent to \$1,850/lb of chromium emission reduction, which is comparable to approximately \$2,000/ton of benzene emission reduction if relative cancer potency is factored in. (The incremental cost effectiveness of RA III compared to RA I is \$3.7 million/Mg, \$3.4 million/ton, \$1,700/lb of chromium, or approximately \$2,000/ton of benzene reduction.) The nationwide incremental capital costs would

increase by \$3 million. Unlike small hard platers, large facilities would not encounter significant difficulties in obtaining funds to purchase and operate composite mesh-pad systems to replace existing packed-bed scrubbers. Thus, the cost of control for RA III for large platers would be affordable and would not result in facility closures.

Considering all these factors, the Administrator has selected RA III as the basis for the proposed MACT standard for large hard chromium electroplaters. This selection is based on consideration of the significant incremental reductions of chromium emissions that are achievable, the control costs, economic, and other environmental and energy impacts, all of which are reasonable. As discussed previously, the control cost is considered to be reasonable given the high toxicity of chromium emissions and the proximity of exposed populations to electroplating facilities.

The cumulative impacts of RA III on all hard chromium electroplaters provide further support for the decisions that were made separately for small and large platers. The economic impacts on small businesses are considered reasonable since the number of facilities that might close under RA III is estimated to be less than 2 percent (20 to 28 out of 1,540 facilities). An estimated 99 percent emission reduction from all hard chromium electroplaters is estimated nationwide by requiring use of composite mesh-pad systems on all existing large hard chromium electroplaters and packed-bed scrubbers on small platers under RA III. If RA II were required, this number would be reduced to 98 percent reduction, and if RA I were required this estimate would be further reduced to 97 percent reduction.

As discussed in section VI.A. of this preamble, the EPA developed nationwide emission and population exposure estimates associated with chromium electroplaters. EPA recognizes that there are a variety of factors that contribute to the uncertainties associated with the cancer risk assessments. However, despite these uncertainties, the estimates provide a frame of reference that is useful for judging the risk reduction associated with the proposed standard. It is in this context that the following discussion is presented.

Under baseline conditions (current control levels), hard chromium electroplaters could cause as many as 100 increased cancer cases per year in the U.S. In addition, the EPA estimates that maximum, upper-bound individual risks could range from 4 chances in 10,000 (4×10^{-4}) for small platers to one

chance in 100 (1×10^{-2}) for large platers. The alternative selected for proposal, RA III, would reduce these estimates to 1 cancer case per year and risks of 4 chances in 1,000,000 (4×10^{-6}) for small platers and 3 chances in 100,000 (3×10^{-5}) for large platers. These estimates are provided to give perspective to the potential impact of the proposed standards. For the complete picture of risk, one would also want to consider non-cancer risks, which are discussed in section VI.6.

e. Existing Decorative Chromium Electroplating—Chromic Acid Bath—MACT. The control technology that represents the MACT floor, i.e., the use of fume suppressants, is the highest level of control achievable by the subcategory and is the predominant form of control being used in the industry. Therefore, all existing decorative chromium electroplating sources using chromic acid baths would be required to meet an emission limit of 0.003 mg/dscm (1.3×10^{-6} gr/dscf), which corresponds to the use of a fume suppressant, if an add-on air pollution device alone is used, or maintain a surface tension of no greater than 40 dynes/cm (2.7×10^{-3} lb_f/ft) (if wetting agents are used to control chromium emissions).

f. Existing Decorative Chromium Electroplating—Trivalent Chromium Bath—MACT. There are no regulatory alternatives above the MACT floor. Due to the low emission potential and the absence of any existing control for these tanks, MACT for new and existing sources is the use of the trivalent chromium process, with monitoring of surface tension. All sources would be required to maintain a surface tension of no greater than 55 dynes/cm (3.8×10^{-3} lb_f/ft) or, if an air pollution control device alone is used, meet an emission limit of 0.048 mg/dscm (2.1×10^{-5} gr/dscf).

g. Existing Chromium Anodizing Tanks MACT. The control technology that represents the MACT floor, i.e., the use of fume suppressants, is the highest level of control achievable by the subcategory and is currently being used extensively at existing facilities to reduce chromium emissions. Therefore, all existing chromium anodizing tanks would be required to meet an emission limit of 0.003 mg/dscm (1.3×10^{-6} gr/dscf) (if an add-on air pollution device alone is used) or maintain a surface tension of 40 dynes/cm (2.7×10^{-3} lb_f/ft) (if wetting agents are used to control chromium emissions.)

D. Selection of the Format of the Proposed Standards

Concentration, in terms of mass of chromium emitted per unit volume of air, was determined to be the most appropriate format for the standards. In selecting the format for the proposed standards, the following factors were considered: (1) The ability to ensure that the technology used to comply with the standard is at least as effective as the technology upon which the standards are based; (2) the ability to ensure that the technology selected as the basis of the standard can demonstrate compliance in all cases, if the systems are operated properly; and (3) the cost of determining compliance.

Based on the available emission test data, it was determined that the inlet hexavalent chromium concentration levels increased as the current supplied to the electroplating bath increased, but the outlet concentrations (within a given control level) did not vary significantly. Since the outlet chromium concentration within each class of control devices is relatively constant, a determination on this basis regarding a control system's performance can be readily made. A format based on concentration would also ensure that the technology selected as the basis of the standards would be required to meet the emissions limit since no data overlaps exist between classes of control devices. In addition, the outlet chromium concentration level is easy to measure, and the compliance test cost is equal to or less than that of the other formats considered. Therefore, a format based on outlet concentration was chosen to be the most appropriate format of the standard.

One concern with using concentration as a format is that dilution of the exhaust gases can be used to circumvent the standards. Dilution of the gas stream at the outlet of the control system is more of a concern than any dilution taking place at the inlet to the control systems since the control systems operate as constant outlet devices. However, this concern can be addressed by a review of the test data and permit data from a given facility. The air flow rate measured during testing should approximate the design air flow rate for the control system reported on the permit application. If the two values differ significantly, then an inspection of the control system can be made to determine if dilution air is being introduced to the system.

Another concern with using concentration as the format for the standard was that many decorative chromium and chromium anodizing

tanks do not have ventilation systems available. Thus, it would be impossible to determine the concentration of the emission stream. This issue has been resolved by allowing such facilities to demonstrate compliance by measuring surface tension. The Agency has determined that a relationship exists between the emission concentration that results from applying fume suppressants and the surface tension of the electroplating solution. A chromic acid electroplating solution with a surface tension less than or equal to 40 dynes/cm is in compliance with the emission limit. A trivalent chromium electroplating solution with a surface tension less than or equal to 55 dynes/cm (3.8×10^{-3} lb/ft) is in compliance with the emission limit.

Other format options considered were: (1) The percent reduction; (2) the process emission rate (mass of chromium emitted per unit of production (as measured by the current input to the electroplating tank); and (3) the mass emission rate (the mass of chromium emitted per unit of time).

Percent reduction is determined from the inlet and outlet mass emission rates. As stated previously, the outlet chromium concentration is relatively constant for a given class of control equipment. Therefore, percent reduction is not a good indicator of performance because of its dependency on the inlet loading to the control device. The use of percent reduction as the format of the standards would not ensure the use of the technology selected as the basis for the standards because of the data overlaps that exist between classes of control devices. These data overlaps exist because of variations in the inlet loadings among facilities. In addition, inlet testing of the control device is not always feasible, especially at existing facilities, and the compliance cost is substantially higher than that for the other formats because testing of the control device inlet and outlet is required. Therefore, the dependency on inlet loadings, the higher compliance cost, and potential inlet testing problems make percent reduction unacceptable as the format of the standards.

The process emission rate is based on the outlet mass emission rate and the current supplied to the electroplating tank. As noted above, the outlet mass emission rate varies depending on the chromium concentration and the exhaust gas flow rate. Since the outlet concentration levels do not vary with the current loading to the electroplating tank, facilities that operate at high current loadings would have a much lower process emission rate than

facilities that operate at low current loadings even though both facilities have applied the same technology and may be controlled to the same emissions level. Conversely, facilities that have a low process emission rate could have higher emissions than intended by the standards because of a high inlet loading (high current loading) to the control device. Even though the cost of compliance is equal to or less than that for other format options, the process emission rate was not selected as the format of the standards.

The mass emission rate varies depending upon the chromium concentration and the exhaust gas flow rate. The mass emission rate is easy to measure, and the compliance costs are equal to or less than that for the other format options. However, since the outlet chromium concentration is fairly independent of the production rate (inlet current loading) of the facility, the mass emission rate varies according to the exhaust gas flow rate which is a function of the size of the facility (number of electroplating tanks). This dependency results in data overlaps between the classes of control devices. To eliminate these overlaps, multiple emission limits would be required to accommodate the size variation among the facilities. Therefore, a mass emission rate limitation was not selected as the format of the standard.

E. Selection of the Emission Limits

This section presents the emissions data used to determine the emission limits for the technologies selected as the basis of the standards. For hard chromium tanks, packed-bed scrubbers and composite mesh-pad systems were selected as the basis of the standards. For decorative chromium tanks, chemical fume suppressants or the trivalent chromium process form the basis of the standards. Chemical fume suppressants also form the basis for the standard for anodizing tanks.

All of the emission limits presented below are in terms of mg of total chromium per dscm of exhaust air. During the early part of the emission test program, both hexavalent and total chromium were measured at each site. The results of these tests indicate that, considering the precision of the sampling and analytical methods used, the hexavalent and total chromium levels were essentially the same (for all tanks using a chromic acid electroplating bath solution). Therefore, it can be presumed that all of the chromium was in the hexavalent form, which would be expected, given the fact that chromic acid is a hexavalent compound of chromium. For these

reasons, total chromium analyses were discontinued for the remainder of the tests. The hexavalent chromium concentrations, however, were assumed to equal the total chromium concentrations, and all of the emission limits are expressed in terms of total chromium. In addition to the reasons cited above, the analytical method for total chromium is less expensive than that for hexavalent chromium, and most laboratories can perform total chromium analyses, but fewer laboratories perform hexavalent chromium analyses.

The numerical emission limit associated with packed-bed scrubbers is 0.03 milligram of total chromium per dry standard cubic meter (1.3×10^{-5} gr/dscf) of exhaust air. The numerical emission limit associated with composite mesh pad systems is 0.013 mg/dscm (5.7×10^{-6} gr/dscf) of exhaust air. A numerical limit of 0.003 mg/dscm (1.3×10^{-6} gr/dscf) of exhaust air was selected for chemical fume suppressants usage. A total chromium emission limit of 0.048 mg/dscm (2.1×10^{-5} gr/dscf) of exhaust air was established for the trivalent chromium process.

Based on available emissions test data and considering factors relevant to the level of controlled emissions, the Administrator has determined that the proposed emission limits are achievable in all circumstances that can be reasonably foreseen. A summary of the factors considered in the selection of the emission limits is presented in the discussion of emission test data below. Complete discussions are presented in chapter 4 of the BID and in the New Technology Report (see ADDRESSES).

Emission tests were conducted at 13 hard chromium electroplating facilities and 3 decorative chromium electroplating facilities. Of the 13 hard chromium electroplating facilities where tests were conducted, 3 used chevron-blade eliminators, 3 used mesh-pad mist eliminators, three used packed-bed scrubbers, 3 used composite mesh-pads in series, and 1 used a packed-bed scrubber in conjunction with a composite mesh-pad. At two of the decorative chromium facilities tested, uncontrolled emission levels were quantified, and the performance of chemical fume suppressants was evaluated. At the third decorative chromium facility, the chromium emissions from a trivalent chromium electroplating process were evaluated.

Additional data were collected from hard and decorative chromium electroplating facilities but were excluded from the data base because of process upset conditions, control equipment malfunctions, or procedural discrepancies with EPA test methods.

The rationale for excluding these data is presented in Appendix D of the BID.

No chromium anodizing facilities were tested. However, a mass balance was performed to quantify uncontrolled emission levels from a scrubber used to control chromium emissions from a chromic acid anodizing tank. (For further information on this estimating procedure and the calculations involved, refer to Chapter 3 and Appendix C of the BID.)

The emissions data obtained on packed-bed scrubbers operating with periodic or continuous washdown and typical chromic acid concentrations in the scrubber water (0 to 29.9 g/L (0 to 4 oz/gal)) indicated chromium emissions ranging from 0.020 to 0.028 mg/dscm (8.7×10^{-6} to 1.2×10^{-5} gr/dscf) with an average concentration of 0.024 mg/dscm (1.1×10^{-5} gr/dscf). Using the methodology presented in section III of this preamble, packed-bed scrubbers were determined to be the MACT floor for hard chromium electroplating tanks. For packed-bed scrubbers, a total chromium emission limit of 0.03 mg/dscm (1.3×10^{-5} gr/dscf) was selected because this was the highest value obtained during any of the test runs (0.028 mg/dscm rounded to 0.03 mg/dscm). Based on tests the Agency has conducted on mesh-pad mist eliminators used at some hard chromium electroplating tanks, this emission limit could probably also be achieved by those devices.

The emissions data obtained on composite mesh-pads, either used in series or in conjunction with a packed-bed scrubber, indicated total chromium emissions ranging from 0.004 to 0.013 mg/dscm (1.7×10^{-6} to 5.7×10^{-6} gr/dscf), with an average concentration of 0.009 mg/dscm (3.9×10^{-6} gr/dscf). A total chromium emission limit of 0.013 mg/dscm (5.7×10^{-6} gr/dscf) was selected for composite mesh-pads because this value was the highest obtained during any of the test runs.

Two types of chemical fume suppressants were tested at decorative chromium electroplating facilities using a chromic acid bath—a foam blanket and a combination foam blanket and wetting agent. The only data considered in establishing the emission limit were those for the combination foam blanket and wetting agent. The emissions data based on the use of a foam blanket alone were excluded because this control technique was considered to be less effective than the combination foam blanket and wetting agent, as stated in section VI.B.5. The test data for chemical fume suppressants indicated chromium emissions ranging from 0.001 to 0.003 mg/dscm (4.4×10^{-7} to 1.3×10^{-6}

gr/dscf), with an average concentration of 0.002 mg/dscm (8.7×10^{-7} gr/dscf). The total chromium emission limit selected for chemical fume suppressants is 0.003 mg/dscm (1.3×10^{-6} gr/dscf), which was the highest value obtained during the test runs.

Source testing of a decorative chromium electroplating operation that uses a trivalent chromium electroplating process was also conducted by EPA. Total chromium emissions from this operation ranged from 0.013 to 0.048 mg/dscm (5.7×10^{-6} to 2.1×10^{-5} gr/dscf), with an average total chromium concentration of 0.027 mg/dscm (1.2×10^{-5} gr/dscf). The emission limit that was selected for these tanks is 0.048 mg/dscm (2.1×10^{-5} gr/dscf), which was the highest value obtained during any of the test runs.

Some facilities that use chemical fume suppressants in their electroplating or anodizing baths do not have ventilation systems; thus, emission testing of these systems is not possible. The Agency has determined that another parameter, surface tension, can be measured to determine compliance with the emission limits. This alternate parameter can be used when wetting-agent-type fume suppressants or combination foam-blanket/wetting-agent-type fume suppressants are used and a ventilation system is not present. If a wetting agent or a combination foam blanket/wetting agent is used to control emissions, then the surface tension of the electroplating or anodizing bath must be monitored by using a stalagmometer to ensure that the surface tension is at or below 40 dynes/cm (2.7×10^{-3} lb_f/ft).

If a trivalent chromium electroplating process is used to control emissions, then the surface tension of the electroplating bath must be monitored by using a stalagmometer or tensiometer to ensure that the surface tension is at or below 55 dynes/cm (3.8×10^{-3} lb_f/ft). In both cases, the surface tension should be measured at least once every 4 hours.

F. Selection of Definition of Source

The choice of an affected source influences possible reconstruction and modification impacts of the standards. It also determines the point at which the addition or replacement of individual emission sources (i.e., electroplating or anodizing tanks) results in a "new" source. Section 112(a)(3) of the Act defines "stationary source" as having the same meaning as that given in section 111(a) of the Act, where "stationary source" is defined as "any building, structure, facility, or installation which emits or may emit any air pollutant." Most industrial

plants consist of numerous pieces or groups of equipment that emit HAP and that may be viewed as "sources." The EPA, therefore, uses the term "affected source" to designate the equipment within a particular kind of plant that is chosen as the "source" covered by a given standard.

1. Reconstruction Considerations

In designating the affected source, EPA determines which piece or group of equipment is the appropriate unit (the affected source) for emission standards in the particular context involved. The determination is made in light of the terms and purpose of section 112. One major consideration is that a narrow designation of source usually brings replacement equipment under new source MACT sooner.

If, for example, an entire plant is designated as the affected source, the new source MACT would cover no part of the plant unless the replacement causes the entire plant to be "reconstructed." Reconstruction, as defined in the proposed § 63.5, means the replacement of the components of an affected source to such an extent that: (1) The fixed capital cost of the new components exceeds 50 percent of the fixed capital cost that would be required to construct a comparable new source, and (2) it is technologically and economically feasible for the reconstructed source to meet the promulgated emission standards established by the Administrator pursuant to section 112 of the Act.⁶ Upon reconstruction, an affected major source is subject to relevant standards for new sources, including compliance dates, irrespective of any change in emissions of HAP from that source. Major sources are also subject to the preconstruction and review requirements provided in § 63.5, provided the source commenced reconstruction after proposal but does not start operation before promulgation of the final standards.

On the other hand, if each piece of equipment (i.e., each electroplating or anodizing tank) is designated as an affected source, then any single tank can be subject to the reconstruction provision (if the tank is located at a major source). A narrow designation of the affected source would ensure that the standards would cover reconstructed emissions sources (i.e., individual tanks) with new source MACT with each replacement or reconstruction of a tank. A broader designation of the affected source may be appropriate if it would: (1) Result in

equal or greater emission reduction than would a narrow designation or (2) avoid inordinate costs or other adverse impacts.

2. Modification Considerations

According to section 112(a)(5), "modification" means any physical change in, or change in the method of operation of, a major source which increases the actual emissions of any hazardous air pollutant emitted by such source by more than a de minimis amount or which results in the emission of any hazardous air pollutant not previously emitted by more than a de minimis amount. Modified sources are subject to section 112(g) provisions, which prevent any person from modifying a major source of HAP unless the MACT emission limitation for existing sources will be met. If modifications of major sources occur prior to the establishment of final rules under section 112(d), the States are required to establish MACT for the modified sources on a case-by-case basis. Therefore, until promulgation, the source designation will be determined on a case-by-case basis by the permitting authority.

The EPA has reserved space within the proposed General Provisions for provisions related to section 112(g) that will be added in a separate rulemaking. Until EPA guidance on this issue is available, it is difficult to project the potential impact an affected source designation could have on the industry that is the subject of today's rulemaking. However, since only major sources are affected under section 112(g), the impact is probably limited because the majority of electroplating facilities will be considered area sources.

3. Affected Source Definitions

There are three alternative designations that could be applied to the source category. The narrowest designation would be each individual electroplating or anodizing tank. The broadest designation would be the group of electroplating or anodizing tanks at each facility that are covered by the standards. A third possibility is the designation of groups of electroplating tanks by category or subcategory; in other words, affected sources would be: (1) All hard chromium electroplating tanks, (2) all decorative chromium electroplating tanks using chromic acid baths, (3) all decorative chromium electroplating tanks using trivalent chromium baths, and (4) all chromic acid anodizing tanks.

With the exception of hard chromium electroplating tanks, the new and existing source MACT is the same for

the remaining sources. In addition, the preconstruction review requirements for decorative platers and anodizers should be relatively easy to meet because of the relative simplicity and availability of the means of control, i.e., the use of fume suppressants or, as applicable, the use of a trivalent chromium electroplating bath. However, because new source MACT is more stringent than existing source MACT for small hard chromium electroplaters and because the emission limits assume the use of add-on control devices, the impact of an affected source designation is more significant to hard chromium electroplaters. Therefore, EPA based the designation decision on the potential impacts to this source category.

The EPA is proposing to define the affected source in terms of individual tanks. The narrow designation maximizes the potential emission reduction from the source categories. Defining the affected source as an individual tank ensures that new source MACT is applied to new hard chromium electroplating tanks. However, if a new tank is added at an existing source, emissions from the new tank could be ducted to an existing control device on site as long as the emissions from the new tank do not exceed the required emission levels. If the tank is added at a major source, the preconstruction review provisions would be triggered. The preconstruction review requirements are extensive in that the source would be required to perform an emission test to establish the emission rate expected. However, because these provisions only apply to major sources and this industry is comprised largely of area sources, the potential impact of this scenario is small.

As indicated by the discussion above, EPA believes that a narrow definition of source based on individual tanks represents the most reasonable approach given typical plant design and that the additional costs of this approach are generally minimal. EPA requests comments on the effect of adopting a narrow definition of source and on its proposal to define the affected source as each individual tank.

G. Selection of Monitoring Requirements

The amended Act added paragraph (3) to section 114(c). This paragraph requires enhanced monitoring of stationary sources (or possibly other sources) to indicate the compliance status of the source, and whether compliance is continuous or intermittent. Today's rulemaking also identifies monitoring parameters that indicate proper operation and

⁶ Ibid.

maintenance (O&M) of the control device. The following paragraphs describe the enhanced compliance monitoring and the O&M monitoring, and the bases for their selection.

1. Enhanced Compliance Monitoring

In accordance with § 63.7 of the General Provisions for this part, each source subject to these standards would be required to conduct an initial performance test.⁷ The Act requires that after the initial performance test, the compliance status of the source must be demonstrated. For this source category, EPA has decided that certain operating parameters should be monitored to indicate ongoing compliance with the emission limit.

For packed-bed scrubbers and composite mesh-pads used in conjunction with packed-bed scrubbers, the gas velocity at the inlet of the device and the chromium concentration of the scrubber-water have been selected as those operating parameters that are most indicative of control device performance. (The importance of these parameters was discussed in section V.B.) Therefore, during the initial performance test, the owner or operator would be required to set the range of values for gas velocity at the inlet to the control device that corresponds to compliance with the emission limit set by the proposed standards. These standards would require daily measurement of gas velocity to ensure compliance with the emission limit. Operation of the control device outside of the gas velocity range established during the performance test would constitute noncompliance with the emission limit. Additionally, facilities using packed-bed scrubbers would be required to measure the scrubber water concentration once daily. If the scrubber water concentration exceeds 45 g/L (6 oz/gal), the owner or operator would not be in compliance with the emission limit. As an alternative to compliance with this scrubber water concentration, the owner or operator may establish a maximum scrubber water concentration that corresponds to compliance with the emission limit during the initial performance test. Because gas velocity and scrubber water concentration are not highly variable when the add-on control device is properly operated and maintained, the EPA believes that a daily measurement of gas velocity and scrubber water concentration is sufficient to indicate continued compliance with the emission limit. Violation of either of these operating

parameters would constitute noncompliance with the emission limit.

For mesh-pad mist eliminators (that meet the total chromium emission limit of 0.03 mg/dscm (1.3×10^{-5} gr/dscf)), and for composite mesh-pads, the daily measurement of gas velocity alone would indicate compliance or noncompliance with the emission limit. The operating parameter value for gas velocity that corresponds to compliance with the emission limit would be established during the initial performance test.

2. Alternate Compliance Monitoring for Sources Using Fume Suppressants

For tanks that comply with the standards through the use of chemical fume suppressants, the measurement of surface tension every 4 hours would indicate compliance or noncompliance with the standards. Decorative chromium tanks using a chromic acid electroplating process would be required to maintain a surface tension no greater than 40 dynes/cm (2.7×10^{-3} lb_f/ft); those using a trivalent chromium electroplating process would be required to maintain a surface tension no greater than 55 dynes/cm (3.8×10^{-3} lb_f/ft). Operation of the electroplating baths at surface tensions greater than the values identified in these standards would indicate noncompliance with the emission limit. Owners or operators who choose to comply with these surface tension limits would not be required to conduct an initial performance test. Those decorative chromium tanks that use a chemical fume suppressant in conjunction with a control device may conduct an initial performance test to establish an alternative surface tension value that corresponds to compliance with the emission limit.

The Agency has determined that measurement of the surface tension of the bath (using a stalagmometer or tensiometer) at least once every 4 hours during operation of the tank would be sufficient to ensure continuous compliance with the emission limit. The time interval specified for measuring the surface tension is based on the time interval at which additions of wetting agent were required during the emission test program conducted to develop these standards. The time intervals for addition requirements would vary with each operation (e.g., size of tank, current density, configuration of parts, etc.).

The owner or operator of a tank that uses a foam blanket alone to comply with the standards would be required to conduct an initial performance test to confirm that the emission limit of 0.003 mg/dscm (1.3×10^{-6} gr/dscf) is being

met. For ongoing compliance, the owner or operator would be required to measure and record the foam blanket thickness at least once every hour during operation of the tank. Operation of the electroplating tank at a foam blanket thickness less than the level established during the performance test or 2.54 cm (1 in.) (whichever is greater), would constitute noncompliance with the standards.

The owner or operator of a tank that uses a trivalent chromium electroplating bath would be required by the standard to monitor the surface tension using a stalagmometer every 4 hours. Operation of the electroplating tank at surface tensions above 55 dynes/cm (3.8×10^{-3} lb_f/ft) would constitute noncompliance with the standards.

3. Operation and Maintenance Monitoring

Section 63.6(e) of the proposed General Provisions identifies operation and maintenance requirements, which include the preparation of a startup, shutdown, and malfunction plan.⁸ In addition, specific operation and maintenance monitoring would be required by the proposed standards.

An owner or operator who operates a control device to ensure compliance with the standards would be required to prepare an operation and maintenance plan that must include, at a minimum, a standardized checklist to document the operation and maintenance of the equipment, a systematic procedure for identifying and reporting malfunctions, and procedures to ensure that equipment or process malfunctions due to poor maintenance or other preventable conditions do not occur. Owners or operators of decorative chromium electroplating tanks who choose to demonstrate compliance by adhering to the surface tension limits required by these standards (not those established during an initial performance test) would not be subject to the operation and maintenance monitoring requirements. Specific requirements for the operation and maintenance plan are in § 63.115 of the proposed standards.

H. Selection of Test Methods

Test Methods 306 and 306A, "Determination of Chromium Emissions from Decorative and Hard Chromium Electroplating and Anodizing Operations," are the proposed methods for determining compliance with the emission standards. Test Method 306B, "Surface Tension Measurement and Recordkeeping for Tanks used at

⁷ Ibid.

⁸ Ibid.

Chromium Electroplating and Anodizing Facilities," is the proposed method for monitoring surface tension at decorative chromium electroplating and chromic acid anodizing facilities. All three methods are proposed for addition to Appendix A of 40 CFR part 63.

Methods 306 and 306A were developed for measurement of chromium emissions from chromium electroplating facilities. Method 306 is based on Method 5 (40 CFR part 60, Appendix A) and utilizes isokinetic sampling. The major modifications to Method 5 to yield Method 306 include elimination of the filter, use of an alkaline impinger reagent for sample collection, and sample analysis by the tester's choice of graphite furnace atomic absorption spectrometry or inductively-coupled argon plasma emission spectrometry. Both analytical techniques produce results for the total chromium concentration of the emission sample.

Method 306A is a simplified, constant sampling rate method for measurement of chromium emission from electroplating facilities, which offers owners and operators a less expensive means to demonstrate compliance than Method 306. Collection of a representative sample without isokinetic sampling is achieved by varying the sampling time at each traverse point and limiting the particle size of the sampled emissions to 10 micrometers. Sample analysis for Method 306A is identical to that for Method 306. When correctly applied, the precision and bias of Method 306A have been demonstrated to be comparable to those of Method 306.

Method 306B provides procedures for measuring the surface tension of plating or anodizing tank baths when a wetting agent is used for emission control. The method offers the option for use of two generally accepted surface tension measurement devices, a stalagmometer or a tensiometer.

I. Selection of Reporting and Recordkeeping Requirements

The owner or operator of any source subject to these standards would be required to fulfill all reporting requirements outlined in 40 CFR 63.10.⁹

An owner or operator of a source who uses an add-on air pollution control device to meet these standards would also be required to maintain records of daily and monthly inspections, daily gas velocity readings, daily scrubber water concentrations, daily washdowns, daily pressure drop readings, and any

emission tests at the facility. These records should be maintained for a minimum of 5 years. Each inspection record would identify the device inspected and include the following: the date and approximate time of inspection, a brief description of the working condition of the device during the inspection, the gas velocity, the scrubber water concentration, the pressure drop, and any actions taken to correct deficiencies found during the inspection. Each record of washdown would identify the device and include the date, approximate time, and duration of the washdown.

An owner or operator of a source who uses a fume suppressant to comply with these standards would be required to maintain the following records at the facility for at least 5 years: (1) The amounts of fume suppressants purchased (invoices); (2) the frequency of maintenance additions; (3) the amount of material added during each maintenance addition; (4) the surface tension of the bath or the foam blanket thickness; and (5) any emission tests to assure compliance with the standard. Each record of a surface tension measurement would identify the tank and include the date, approximate time, measured surface tension, and whether any additions were made to the bath. Each record of a foam blanket thickness measurement would be required to identify the tank and include the date, approximate time, measured thickness, and whether any additions were made to the bath. If an addition was made, the amount of material added would also be recorded.

An owner or operator of a source who uses a trivalent chromium electroplating process would be required to maintain the following records at the facility for at least 5 years: (1) The amount of bath additive containing wetting agent purchased (invoices); (2) the surface tension of the bath; and (3) any emission tests to assure compliance with the standard. Each record of a surface tension measurement would identify the tank and include the date, approximate time, measured surface tension, and whether any additions were made to the bath.

All records of inspections, washdowns, pressure drop readings, emission tests, foam blanket and surface tension measurements, frequency of fume suppressant maintenance additions, the amount of fume suppressant added during each maintenance addition, and purchases of fume suppressants would be maintained at the facility for a minimum of 5 years. The operation and maintenance plan (associated with add-on pollution

control devices) would be maintained at the facility for the life of the device. The Administrator believes that the above reporting and recordkeeping requirements are adequate to ensure that owners or operators are complying with the provisions of the proposed standards.

J. Operating Permit Program

Under the operating permit regulations codified at 40 CFR part 70, any source that is a major source under the Act or any nonmajor source subject to a standard under sections 111 or 112 of the Act must obtain an operating permit. (See § 70.3(a)(1).) The part 70 regulations also provide that a State may, at its discretion, defer all nonmajor sources from the obligation to obtain a part 70 permit until such time as the EPA finishes a rulemaking regarding the applicability of the part 70 program to nonmajor sources. Part 70 further provides that, for nonmajor sources subject to a future standard promulgated under section 111 or 112, " * * * the Administrator will determine whether to exempt any or all such applicable sources from the requirements to obtain a part 70 permit at the time that the new standard is promulgated." (See § 70.3(b)(1) and (2).)

The proposed rule for chromium electroplating and anodizing tanks would not exempt area sources from permitting requirements. The EPA believes that permitting these nonmajor sources will enhance the implementation and enforcement of the rule by clarifying how the rule applies to a particular source, and how relevant parts of the to be promulgated general provisions apply to chromium electroplating and anodizing tanks. The proposed general provisions are generic requirements that sources subject to section 112 standards must meet.¹⁰

However, under the existing provisions of part 70, States may choose to defer the obligation of all nonmajor sources to obtain a permit until the EPA "completes a rulemaking to determine how the program should be structured for nonmajor sources and the appropriateness of any permanent exemptions * * *." In promulgating the permits rule, the EPA committed to complete that rulemaking within 5 years after the approval of the first State part 70 program that defers permitting of nonmajor sources.

The EPA believes, for the same reasons stated in the preamble to the operating permits rule, that the benefits to be gained from the permitting of nonmajor sources subject to this

⁹Ibid.

¹⁰Ibid.

proposed rule are not likely to accrue during the early stages of the permit program when permitting authorities will be occupied with the task of issuing permits to major sources. Once this task is complete, however, permitting authorities should be able to process permits for nonmajor sources subject to this rule on a relatively expedited basis. This expedited review should be the case, in part, because of the presumptive suitability of these sources for general permits.

K. Solicitation of Comments

The Administrator specifically requests comments on the topics discussed in this section. Commenters should provide available data and rationale to support their comments on each topic.

1. Surface Tension Limit for Decorative Chromium Electroplating Tanks Using a Trivalent Chromium Electroplating Process

The EPA specifically requests comments on the proposed surface tension limit of 55 dynes/cm (3.8×10^{-3} lb_f/ft) for those decorative chromium electroplating tanks using a trivalent chromium electroplating process. This limit was selected by EPA based on the test data available (see section IV.C.2.c), which indicate that the value of surface tension achievable in a trivalent chromium electroplating bath is a maximum of 55 dynes/cm (3.8×10^{-3} lb_f/ft). The surface tension achievable in a given trivalent chromium bath will be dependent on the specific chemistry of that bath. Therefore, a lower surface tension may be achievable. Alternatively, a source may have difficulty lowering the surface tension of its trivalent chromium electroplating bath to 55 dynes/cm (3.8×10^{-3} lb_f/ft). Although the available data indicate that a value of 55 dynes/cm (3.8×10^{-3} lb_f/ft) is the most reasonable to select as the maximum surface tension of a trivalent chromium electroplating bath, the Administrator welcomes data that indicate that an alternate surface tension limit is more appropriate.

2. Use of Trivalent Chromium Electroplating Process

As discussed in sections V.A.2 and V.B.5, the trivalent chromium electroplating process is considered an effective pollution prevention technique. The use of a trivalent chromium electroplating process results in less total chromium in process wastewaters and less sludge generation than would result from a chromic acid electroplating process. Also, hexavalent chromium emissions are reduced by

greater than 99 percent when the trivalent chromium electroplating process is used instead of an uncontrolled chromic acid bath.

During development of the proposed standards, EPA considered requiring the trivalent chromium electroplating process as a control technique for new decorative chromium electroplating tanks because of its pollution prevention aspects and its low hexavalent chromium emissions. However, results of a source test indicated that total chromium emissions were greater than those from a well-controlled chromic acid bath even though hexavalent chromium emissions were much lower. These limited source test data do not support requiring the trivalent chromium electroplating process for all new decorative chromium electroplating tanks. Therefore, new decorative chromium electroplating sources would be allowed by the proposed rule to use either the chromic acid process with fume suppressants and bath surface tension monitoring or the trivalent process with bath surface tension measuring. However, the EPA encourages new decorative chromium electroplating sources to use the trivalent process because of its overall multi-media benefits. The Administrator requests comments on whether the trivalent process should be required for new sources in the final rule and welcomes any data related to emissions of total and hexavalent chromium from the use of a trivalent chromium electroplating process.

3. Proposed Standards for Small Hard Chromium Electroplaters

Comments are specifically requested on the level of the proposed standards for small hard chromium electroplaters [0.03 mg/dscm (1.3×10^{-5} gr/dscf)]. Comments should indicate whether the proposed level is appropriate given the consideration of factors discussed in section VI.C.5 of this preamble and why.

4. Requirements for Recirculating Scrubber Water

In considering the cross-media impacts of the proposed standards, EPA identified a potential need for further regulation: the wastewater from packed-bed scrubbers and composite mesh pads used to comply with the emission limits. To minimize the water pollution impact from these control devices, it may be appropriate to require that the wastewater be routed back to the chromium bath in one of two ways before its eventual discharge: (1) The rule could require that packed-bed scrubber water be recirculated within

the control device until the chromium concentration reaches a certain level (pursuant to the concentration limits in the proposed rule) and then the water could be reused in the bath or discharged; or (2) the rule could require that scrubber water be recirculated and routed back to the bath as makeup water (in the case of composite mesh pads, there is only washdown water; this would have to be sent back to the bath). Under the latter option, discharge of the wastewater would not be allowed.

The Agency has identified several issues associated with these requirements. First, there is some uncertainty as to whether EPA has authority under section 112(d) of the Act to set a zero discharge requirement for wastewater from control devices. This uncertainty exists because a zero wastewater discharge requirement would not result in an air emission reduction (chromium in wastewater will not become airborne) even though it will ensure minimal water pollution impacts. Second, some sources have indicated that they cannot route scrubber or washdown water back to the plating tanks because there is too much metal contamination. This is especially the case with older control devices; the materials of construction could lead to increased concentrations of iron and lead in the water. Third, sources will already have an incentive to recycle and reuse wastewater as much as possible to avoid costly treatment of wastewater prior to discharge.

Due to these issues, the proposed rule does not address wastewater discharges. However, EPA specifically requests comments on limiting or prohibiting wastewater discharges in the standard and any data on why this is or is not reasonable.

VII. Administrative Requirements

A. Public Hearing

A public hearing will be held, if requested, to discuss the proposed standards in accordance with section 307(d)(5) of the Act. Persons wishing to make oral presentation on the proposed standards for chromium emissions from hard and decorative chromium electroplating and chromium anodizing tanks should contact EPA at the address given in the ADDRESSES section of this preamble. Oral presentations will be limited to 15 minutes each. Any member of the public may file a written statement before, during, or within 30 days after the hearing. Written statements should be addressed to the Air Docket Section address given in the ADDRESSES section of this preamble, and should refer to Docket No. A-88-02.

A verbatim transcript of the hearing and written statements will be available for public inspection and copying during normal working hours at EPA's Air Docket Section in Washington, DC (see ADDRESSES section of this preamble).

B. Docket

The docket is an organized and complete file of all the information submitted to or otherwise considered by EPA in the development of this proposed rulemaking. The principal purposes of the docket are: (1) To allow interested parties to readily identify and locate documents so that they can intelligently and effectively participate in the rulemaking process, and (2) to serve as the record in case of judicial review [except for interagency review materials (section 307(d)(7)(A))].

C. Executive Order 12866

Under Executive Order 12866 (58 FR 51736 (October 4, 1993)), the Agency must determine whether the regulatory action is "significant" and therefore subject to Office of Management and Budget (OMB) review and the requirements of the Executive Order. The Order defines "significant regulatory action" as one that is likely to result in a rule that may:

(1) Have an annual effect on the economy of \$100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities,

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency,

(3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

(4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

Pursuant to the terms of Executive Order 12866, OMB has notified EPA that this action is a "significant regulatory action" within the meaning of the Executive Order. For this reason, this action was submitted to OMB for review. Changes made in response to OMB suggestions or recommendations will be documented in the public record.

D. Paperwork Reduction Act

The information collection requirements in this proposed rule have been submitted for approval to OMB under the Paperwork Reduction Act, 44

U.S.C. 3501 *et seq.* An Information Collection Request document has been prepared by EPA (ICR No. 1611) and a copy may be obtained from Sandy Farmer, Information Policy Branch, U. S. Environmental Protection Agency, 401 M Street SW., (2136), Washington, DC 20460 or by calling (202) 260-2740. The public reporting burden for this collection of information is estimated to average 103 hours per source for reporting annually over the first 3 years and 253 hours per source for recordkeeping annually. This includes time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Chief, Information Policy Branch, 2136, U. S. Environmental Protection Agency, 401 M Street SW., Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503, marked "Attention: Desk Officer for EPA." The final rule will respond to any OMB or public comments on the information collection requirements contained in this proposal.

E. Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires EPA to consider potential impacts of proposed regulations on small business "entities." If a preliminary analysis indicates that a proposed regulation would have a significant economic impact on 20 percent or more of small entities, then a regulatory flexibility analysis must be prepared.

The EPA's 1982 Regulatory Flexibility Act guidelines indicate that an economic impact should be considered significant if it meets one of the following criteria:

(1) Annual compliance costs increase the total cost of production for small entities by more than 5 percent;

(2) Compliance costs as a percentage of sales for small entities are at least 10 percent more than compliance costs as a percentage of sales for large entities;

(3) Capital costs of compliance represent a significant portion of capital available to small entities, considering internal cash flow plus external financial capabilities; and

(4) The requirements of the regulation are likely to result in closures of small entities.

Using the Small Business Administration's definition of a small business for SIC Code 3471 of less than

500 employees, it has been determined that none of the above criteria are triggered. In the hard electroplating source category the number of small businesses is estimated to be 1,170. None of the regulatory alternatives considered will significantly impact 20 percent of this population. For example, the estimated number of small entity closures ranges from less than 2 percent for RA I to less than 5 percent for RA IV. As for decorative electroplating and anodizing tanks, the low annualized compliance costs associated with the RA's would not cause any of the criteria for a significant impact to be triggered.

Pursuant to the provisions of 5 U.S.C. 605(b), I hereby certify that this proposed rule, if promulgated, will not have a significant economic impact on a substantial number of small business entities.

F. Miscellaneous

In accordance with section 117 of the Act, publication of this proposal was preceded by consultation with appropriate advisory committees, independent experts, and Federal departments and agencies. The Administrator will welcome comments on all aspects of the proposed regulation, including economic and technological issues, and on the proposed test methods.

This regulation will be reviewed 8 years from the date of promulgation. This review will include an assessment of such factors as evaluation of the residual health risks, any overlap with other programs, the existence of alternative methods, enforceability, improvements in emission control technology and health data, and reporting and recordkeeping requirements.

List of Subjects in 40 CFR Part 63

Environmental protection, Air pollution control, Hazardous substances, Reporting and recordkeeping requirements.

Dated: November 30, 1993

Carol M. Browner,
Administrator.

It is proposed that part 63, chapter I, title 40 of the Code of Federal Regulations be amended as follows:

PART 63—[AMENDED]

1. The authority citation for part 63 continues to read as follows:

Authority: 42 U.S.C. 7401 *et seq.*

2. By adding a new subpart N, consisting of §§ 63.340-63.347, to read as follows:

Subpart N—National Emission Standards for Chromium Emissions From Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks

Sec.

- 63.340 Applicability and designation of sources.
 63.341 Definitions.
 63.342 Standards.
 63.343 Compliance and performance testing.
 63.344 Test methods and procedures.
 63.345 Monitoring requirements.
 63.346 Recordkeeping requirements.
 63.347 Reporting requirements.

Subpart N—National Emission Standards for Chromium Emissions From Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks

§ 63.340 Applicability and designation of sources.

The affected source to which the provisions of this subpart apply is each electroplating or anodizing tank at facilities performing hard chromium electroplating, decorative chromium electroplating, or chromium anodizing.

§ 63.341 Definitions.

Terms used in this subpart are defined in the Clean Air Act, in subpart A of part 63, or in this section as follows:¹

Affected source means the chromium electroplating or anodizing tank.

Air pollution control device means equipment used to collect and contain chromium emissions from chromium electroplating and anodizing tanks.

Anodizing means the surface treatment of metals, particularly aluminum, where the part to be anodized serves as the anode and an oxide film is produced on the surface of the base metal.

Base metal means the metal or metal alloy the workpiece is composed of.

Chemical fume suppressant means any chemical agent that reduces or suppresses fumes at the surface of an electroplating or anodizing bath.

Chromic acid means the common name for chromium anhydride (CrO₃).

Chromium anodizing means the process by which an oxide layer is produced on the surface of a base metal using a chromic acid solution.

Chromium electroplating means the process by which a layer of chromium metal is electrodeposited on a base metal or plastic.

Composite mesh-pad system means an air pollution control device typically consisting of several stages. The purpose

of the first stage is to remove large particles. Smaller particles are removed in the second stage, which consists of the composite mesh-pad. A final stage may remove any reentrained particles not collected by the composite mesh-pad.

Decorative chromium electroplating means the process by which a thin layer of chromium is electrodeposited on a base metal or plastic to provide a bright surface with wear and tarnish resistance.

Electroplating means the electrodeposition of an adherent metallic coating upon an electrode (workpiece) to secure a surface with properties different from those of the base metal.

Electroplating or anodizing bath means the electrolytic solution used as the conducting medium in which the flow of current is accompanied by movement of metal ions for the purposes of electroplating metal out of the solution onto a base metal or plastic or for oxidizing the base metal.

Electroplating or anodizing tank means the receptacle or container in which electroplating or anodizing occurs.

Facility means all contiguous or adjoining property that is under common ownership or control, including properties that are separated only by a road or other public right-of-way, in which hard chromium electroplating or chromium anodizing is performed.

Foam blanket means the type of chemical fume suppressant that generates a layer of foam across the surface of a solution when current is applied to that solution.

Gas velocity means the velocity of the inlet gas stream to the air pollution control device.

Hard chromium electroplating means a process by which a thick layer of chromium is electrodeposited on a base metal to provide a surface with wear resistance, a low coefficient of friction, hardness, and corrosion resistance.

Hexavalent chromium means the form of chromium in a valence state of +6.

Large hard chromium electroplating facility means a facility that performs hard chromium electroplating and has a maximum cumulative potential rectifier capacity greater than or equal to 60 million ampere-hours per year (Ah/yr).

Maximum cumulative potential rectifier capacity means the summation of the total installed rectifier capacity at a facility, expressed in amperes, multiplied by an operating schedule of 8,400 hours per year and 0.7, which assumes that electrodes are energized 70 percent of the total operating time.

Operating parameter value means a minimum or maximum value established for a control device or process parameter which, if achieved by itself or in combination with one or more other operating parameter values, determines that an owner or operator has complied with an applicable emission limitation or standard.

Packed-bed scrubber means an air pollution control device consisting of a single or double packed-bed that contains packing media on which the chromic acid droplets impinge. The packed-bed section of the scrubber is followed by a mist eliminator to remove any water entrained from the packed-bed section.

Small hard chromium electroplating facility means a facility that performs hard chromium electroplating and has a maximum cumulative potential rectifier capacity less than 60 million Ah/yr.

Stalagmometer means the device used to measure the surface tension of a solution. A tensiometer may also be used.

Surface active agent means any soluble or colloidal substance that, even when present in very low concentrations, affects markedly the surface tension of solutions.

Surface tension means the property, due to molecular forces, that exists in the surface film of all liquids and tends to prevent liquid from spreading.

Trivalent chromium means the form of chromium in a valence state of +3.

Trivalent chromium process means the process used for electrodeposition of a thin layer of chromium onto a base metal using a trivalent chromium solution instead of a chromic acid solution.

Wetting agent means any substance that reduces the surface tension of a liquid.

Workload means the amount of material or parts processed in the electroplating or anodizing tank at a given time.

Workpiece means the material being plated, anodized, or otherwise finished.

§ 63.342 Standards.

(a) *Standards for hard chromium electroplating tanks.* On and after the date on which the initial performance test is completed or is required to be completed under § 63.7, whichever date is earlier, no owner or operator of an existing or new affected source shall cause to be discharged into the atmosphere from that affected source any gases that contain chromium emissions in excess of:

(1) 0.013 milligrams of total chromium per dry standard cubic meter (mg/dscm) of ventilation air (5.7×10⁻⁶

¹ The EPA proposed regulations for subpart A of 40 CFR part 63 published in the Federal Register on August 11, 1993 at 58 FR 42760.

grains per dry standard cubic foot [gr/dscf]); or

(2) 0.03 mg/dscm (1.3×10^{-5} gr/dscf) if the electroplating tank is an existing source and is located at a small hard chromium electroplating facility.

(b) *Standards for decorative chromium electroplating tanks using a chromic acid bath.* On and after the compliance date identified in § 63.343, no owner or operator of an existing or new affected source shall allow:

(1) The concentration of chromium in the exhaust gas stream discharged to the atmosphere to exceed 0.003 mg/dscm (1.3×10^{-6} gr/dscf) if an air pollution control device is the sole means of reducing emissions; or

(2) The surface tension of the electroplating bath to exceed 40 dynes per centimeter (dynes/cm) (2.7×10^{-3} pound-force per foot (lb_f/ft)) at any time during operation of the tank if fume suppressants are used in the plating bath.

(c) *Standard for decorative chromium electroplating tanks using a trivalent chromium bath.* On and after the compliance date identified in § 63.343, no owner or operator of an existing or new affected source shall allow:

(1) The concentration of chromium in the exhaust gas stream discharged to the atmosphere to exceed 0.048 mg/dscm (2.1×10^{-3} gr/dscf) if an air pollution control device is the sole means of reducing emissions; or

(2) The surface tension of the electroplating bath to exceed 55 dynes/cm (3.8×10^{-3} lb_f/ft) at any time during operation of the tank if fume suppressants are used in the plating bath.

(d) *Standards for chromium anodizing tanks.* On and after the compliance date identified in § 63.343, no owner or operator of an existing or new affected source shall allow:

(1) The concentration of chromium in the exhaust gas stream-discharged to the atmosphere to exceed 0.003 mg/dscm (1.3×10^{-6} gr/dscf) if an air pollution control device is the sole means of reducing emissions; or

(2) The surface tension of the chromium anodizing bath to exceed 40 dynes/cm (2.7×10^{-3} lb_f/ft) at any time during operation of the tank if fume suppressants are used in the plating bath.

(e) *Operation and maintenance plan.* The owner or operator of an affected source that uses an air pollution control device to control emissions of chromium from the electroplating or anodizing tank shall prepare a startup, shutdown, malfunction plan in accordance with § 63.6 of subpart A. The plan shall be implemented within

90 days after the effective date of this subpart and shall also include the following provisions:

(1) The plan shall specify the operation and maintenance criteria for the air pollution control device and shall include a standardized checklist to document the operation and maintenance of the equipment;

(2) The plan shall include a systematic procedure for identifying malfunctions and for reporting them immediately to supervisory personnel; and

(3) The plan shall specify procedures to be followed to ensure that equipment or process malfunctions due to poor maintenance or other preventable conditions do not occur.

(f) The provisions of paragraph (e) of this section do not apply to an owner or operator who complies with these standards by meeting the surface tension limits in paragraphs (b)(2), (c)(2), and (d)(2) of this section.

§ 63.343 Compliance and performance testing.

(a) *Compliance dates.* (1) Hard chromium electroplating tanks. An owner or operator of an existing source shall comply with the standards within 1 year after the effective date of the standards. An owner or operator of a new source shall comply with the standards immediately upon startup.

(2) Decorative chromium electroplating tanks. An owner or operator of an existing source shall comply with the standards within 3 months after the effective date of the standards. An owner or operator of a new source shall comply with the standards immediately upon startup.

(3) Chromium anodizing tanks. An owner or operator of an existing source shall comply with the standards within 3 months after the effective date of the standards. An owner or operator of a new source shall comply with the standards immediately upon startup.

(b) The following procedures shall be used to determine compliance with the emission limits under § 63.342 (a), (b)(1), (c)(1), and (d)(1):

(1) The owner or operator shall conduct an initial performance test as required under § 63.7 using the procedures and test methods listed in §§ 63.7 and 63.344. During this performance test, the owner or operator shall determine the outlet chromium concentration as well as the following:

(i) For sources complying with § 63.342(a) through the use of a composite mesh-pad system or a packed-bed scrubber system, the owner or operator shall establish as a site-specific operating parameter the

acceptable gas velocity value or range of gas velocity values using the procedures in § 63.344.

(ii) For sources complying with § 63.342(a) through the use of a packed-bed scrubber system, the owner or operator shall establish as a site-specific operating parameter the concentration of chromium in the scrubber water using a hydrometer and following manufacturer's instructions.

(iii) As an alternative to the requirement in paragraph (b)(1)(ii) of this section, the owner or operator may accept 45 grams per liter (g/L) (6 ounces per gallon (oz/gal)) as the value of the site-specific operating parameter for the concentration of chromium in the scrubber water.

(2) On and after the date on which the initial performance test is completed or is required to be completed under § 63.7, the owner or operator of an affected source shall:

(i) For sources complying with § 63.342 (a), (b)(1), (c)(1), or (d)(1) through the use of a composite mesh-pad or packed-bed scrubber system, monitor the gas velocity in accordance with the requirements in § 63.345. Operation of the affected source at a gas velocity outside of the range of gas velocity established during the initial performance test shall constitute noncompliance with the standards.

(ii) For sources complying with § 63.342 (a), (b)(1), (c)(1), or (d)(1) through the use of a packed-bed scrubber system, monitor the chromium concentration in the scrubber water in accordance with the requirements in § 63.345. Operation of the affected source at a scrubber water chromium concentration in excess of either 45 g/L (6 oz./gal) or the value established during the initial performance test shall constitute noncompliance with the standards.

(c) The following procedures shall be used to determine compliance with the surface tension limits under § 63.342 (b)(2), (c)(2), and (d)(2):

(1) The owner or operator shall measure the surface tension of the electroplating or anodizing bath using the test methods identified in § 63.344.

(2) On and after the compliance date identified in § 63.343(a), the owner or operator of an affected source shall monitor the surface tension in accordance with the requirements in Method 306B in appendix A to this part. Operation of the affected source at a surface tension in excess of those required by § 63.342 (b)(2), (c)(2), and (d)(2) shall constitute noncompliance with the standards.

(3) As an alternative to meeting the surface tension limits identified in

§ 63.342 (b)(2), (c)(2), and (d)(2), the owner or operator of an affected source may:

(i) Conduct a performance test using the procedures and test methods listed in § 63.7 and § 63.344. During this performance test, the owner or operator shall determine the outlet chromium concentration and shall establish as a site-specific operating parameter the surface tension of the electroplating or anodizing bath that corresponds to compliance with the emission limits under § 63.342 (b)(1), (c)(1), or (d)(1); and

(ii) On and after the date on which the initial performance test is completed or is required to be completed under § 63.7, the owner or operator of an affected source shall monitor the surface tension in accordance with the requirements in Method 306B in appendix A of this part. Operation of the affected source at a surface tension in excess of the value established during the initial performance test shall constitute noncompliance with the standards.

(d) An owner or operator who uses an air pollution control device not listed in § 63.343 shall submit a description of the device, test data verifying the performance of the device for reducing chromium emissions to the atmosphere, a copy of the operation and maintenance plan referenced in § 63.342(e), and appropriate operating parameters that will be monitored to establish compliance with the standards, subject to the Administrator's approval.

§ 63.344 Test methods and procedures.

(a) Each owner or operator subject to the provisions of this subpart concerning the use of air pollution control devices to control chromium emissions shall use the test methods identified in this section to demonstrate compliance with the standards in § 63.342.

(b) Method 306 or Method 306A, "Determination of Chromium Emissions from Decorative and Hard Chromium Electroplating and Anodizing Operations" shall be used to determine the concentration of total chromium in emissions from hard or decorative chromium electroplating tanks or chromium anodizing tanks. The sampling time and sample volume for each run of Method 306 shall be at least 60 minutes and 0.85 dscm (30 dscf), respectively. The sampling time and sample volume for each run of Method 306A shall be 120 minutes and 1.70 dscm (60 dscf), respectively.

(c) Method 306B, "Surface Tension Measurement and Recordkeeping for

Tanks used at Decorative Chromium Electroplating and Anodizing Facilities," shall be used to measure the surface tension of electroplating and anodizing baths.

§ 63.345 Monitoring requirements.

(a) During the initial performance test required by § 63.7 and § 63.343, the owner or operator of a tank that uses an air pollution control device shall establish the range of the pressure drop across the air pollution control device as a site-specific operating parameter according to the procedures in paragraphs (a)(1) through (a)(3) of this section.

(1) Locate a velocity traverse port in a section of straight duct that connects the hooding on the plating tank with the control device. The port shall be located as close to the plating tank as possible, and shall be placed a minimum of 2 duct diameters downstream and 0.5 diameter upstream of any flow disturbance such as a bend, expansion, or contraction (see Method 1, 40 CFR part 60, appendix A). If 2.5 diameters of straight duct work does not exist, locate the port 0.8 of the duct diameter downstream and 0.2 of the duct diameter upstream from any flow disturbance. If the control device serves multiple tanks, locate a port on the straight duct work of each tank.

(2) A 12-point velocity traverse of the duct leading from each tank shall be conducted along a single axis according to Method 2 (40 CFR part 60, appendix A) using an S-type pitot tube; measurement of the barometric pressure and duct temperature at each traverse point is not required, but is suggested. Mark the S-type pitot tube as specified in Method 1 (40 CFR part 60, appendix A) with 12 points. Measure the Δp values for the velocity points and record. Stack temperature should be 70° F plus or minus 5° F at the time that the measurements are made. Determine the square root values of the individual velocity points and average. The point with the square root value that comes closest to the average square root value is the point of average velocity. The range of Δp values measured for this point during the performance test will be used as the reference for future monitoring.

(3) If one control device serves several plating tanks, a reference range for the Δp must be established during the performance test for the duct work from each tank. If flow through the ducts of one or more tanks is shut off during certain process operations, a separate reference range for the Δp must be established for those ducts that are left operating. Reference Δp values must be

established during the performance test for all combinations of tank operation and duct flows that can occur.

(b) The owner or operator of a tank with a conventional packed-bed scrubber shall adhere to, at a minimum, the following maintenance practices in accordance with the operation and maintenance plan required by § 63.342(e):

(1) At least once each month, visually inspect the device to ensure there is proper drainage, no chromic acid buildup on the packed bed, and no evidence of chemical attack on the structural integrity of the device;

(2) At least once each day, visually inspect the back portion of the chevron-blade mist eliminator to ensure it is dry and there is no breakthrough of chromic acid mist;

(3) When makeup additions occur, ensure that all makeup water is fresh and supplied to the unit at the top of the packed bed;

(4) At least once each day, determine the gas velocity prior to the control device. The gas velocity shall be determined at the point of average velocity identified during the performance test in accordance with paragraph (a) of this section. Periodically determine that both openings of the pitot tube are clear; clean chromic acid residue from the pitot, when necessary.

(5) At least once each day, determine the concentration of chromic acid in the scrubber water by using a hydrometer; and

(6) At least once each day, determine the pressure drop across the packed bed(s). If the pressure drop exceeds the value established in accordance with paragraph (a) of this section, this is to be documented and operation and maintenance procedures are to be reviewed. Any corrective action that is taken must also be documented.

(c) The owner or operator of a tank with a composite mesh-pad system shall adhere to, at a minimum, the following maintenance practices in accordance with the operation and maintenance plan required by § 63.342(d):

(1) At least once each month, visually inspect the device to ensure there is proper drainage, no chromic acid buildup on the packed bed, and no evidence of chemical attack on the structural integrity of the device;

(2) At least once each day, visually inspect the back portion of the mesh pad closest to the fan to ensure there is no breakthrough of chromic acid mist;

(3) When makeup additions occur, ensure that all makeup water is fresh and supplied to the unit at the top of the packed bed;

(4) At least once each day, shut the fan and the plating tank off and wash down the composite mesh pads for at least 10 minutes;

(5) At least once each day, determine the gas velocity prior to the control devices in accordance with the requirements of paragraph (b)(4) of this section.

(6) If a packed-bed scrubber is used in conjunction with the composite mesh-pad system, at least once each day, determine the concentration of chromic acid in the scrubber water by using a hydrometer; and

(7) At least once each day, determine the pressure drop across the device. If the pressure drop exceeds the value established in accordance with paragraph (a) of this section, the exceedance shall be documented and the operation and maintenance procedures shall be reviewed. Any corrective action that is taken must also be documented.

(d) Each owner or operator of a tank that uses a wetting agent or a combination wetting agent and foam blanket shall monitor the bath to maintain the surface tension values established in § 63.342(b)(2), (c), and (d)(2). The surface tension shall be measured every 4 hours during operation of the tank with a stalagmometer or a tensiometer as specified in Method 306B, appendix A of this part.

(e) Each owner or operator of a tank that uses a foam blanket to comply with the requirements of § 63.342(a), (b)(1), or (d)(1) shall maintain a foam thickness greater than or equal to the level established during the performance test or 2.54 cm (1 inch) (whichever is greater) at all times. The foam thickness shall be measured once each hour.

§ 63.346 Recordkeeping requirements.

(a) The owner or operator of each electroplating tank that uses an add-on air pollution control device to meet the emission limit shall maintain records of daily and monthly inspections, daily gas velocity readings, daily scrubber water chromium concentrations (if applicable), daily washdowns, daily pressure drop readings, and any emission tests at the facility for a minimum of 5 years.

(1) Each inspection record shall identify the device inspected and include the following: The date and approximate time of inspection, a brief description of the working condition of the device during the inspection, the gas velocity, the scrubber water chromium concentration (if applicable), the pressure drop, and any actions taken to

correct deficiencies found during the inspection.

(2) Each record of washdown shall identify the device and include the date, approximate time, and duration of the washdown.

(b) The owner or operator of each electroplating tank that uses a chromic acid solution and that uses a fume suppressant to comply with the standard shall maintain the following records at the facility for at least 5 years:

(1) The amount of fume suppressants purchased (invoices).

(2) Measurements of the surface tension of the bath.

(3) The frequency of maintenance additions.

(4) The amount of material added during each maintenance addition.

(5) If foam blankets are used, measurements of foam blanket thickness.

(6) Any emission tests to assure compliance with the standard.

(c) Each record of a foam blanket thickness measurement shall identify the electroplating tank and include the date, approximate time, measured thickness, and whether any additions were made to the bath. If an addition was made, the amount of material added would also be recorded.

(d) Each record of a surface tension measurement shall identify the electroplating tank and include the date, approximate time, measured surface tension, and whether any additions were made to the bath.

(e) The owner or operator of each electroplating tank that uses a trivalent chromium solution shall maintain the following records at the facility for at least 5 years:

(1) Measurements of the surface tension of the bath;

(2) The amount of bath additive containing wetting agents purchased (invoices); and

(3) Any emission tests to assure compliance with the standard.

(f) The owner or operator of each electroplating tank that uses a chromic acid solution and that operates an air pollution control device is not required to maintain the records required by paragraph (a) of this section if the owner or operator is complying with § 63.342(b)(2), (c)(2), or (d)(2). If the owner or operator is complying with § 63.342(b)(2), (c)(2), or (d)(2), the recordkeeping requirements of paragraphs (b), (c), and (d) of this section apply.

§ 63.347 Reporting requirements.

(a) The owner or operator of each affected source subject to these standards shall fulfill all reporting

requirements outlined in the General Provisions to 40 CFR part 63, subpart A, §§ 63.7 through 63.10. These reports shall be made to the Administrator or delegated State authority.

(b) The owner or operator of each existing hard chromium electroplating tank shall include the maximum cumulative potential rectifier capacity of the facility in which the tank is located in the initial notification report required by § 63.9(h).

(c) The owner or operator of each affected source subject to these standards shall include the monitored operating parameter value reading required by § 63.343 in the quarterly excess emissions and continuous monitoring system performance report and summary report required by § 63.10(e). In the case of exceedances, the report must also contain a description and timing of the steps taken to address the cause of the exceedance.

3. By adding methods 306, 306A, and 306B in numerical order to read as follows.

Appendix A to Part 63—Test Methods

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Method 306—Determination of Chromium Emissions From Decorative and Hard Chromium Electroplating and Anodizing Operations

1. Applicability and Principle

1.1 Applicability. This method applies to the determination of chromium (Cr) in emissions from decorative and hard chrome electroplating facilities and anodizing operations.

1.2 Principle. Emissions are collected from the source by using a Method 5 sampling train (40 CFR part 60, Appendix A), with the filter omitted and a glass nozzle and probe liner. The chromium emissions are collected in an alkaline solution: 0.1 N sodium hydroxide (NaOH) or 0.1 N sodium bicarbonate (NaHCO₃). The collected samples remain in the alkaline solution until analysis. The chromium sample is analyzed using inductively coupled plasma emission spectrometry (ICP) at 267.72 nm. Alternatively, if improved detection limits are required, a portion of the alkaline impinger solution is digested with nitric acid and analyzed by graphite furnace atomic absorption spectroscopy (GFAAS) at 357.9 nm.

2. Range, Sensitivity, Precision, and Interferences

2.1 Range. A linear response curve for ICP can be obtained in the range 10 µg Cr/liter to at least 500 µg Cr/liter. A linear response curve for GFAAS can be obtained in the range 5 µg Cr/liter to 150 µg Cr/liter. The upper limit of both techniques can be extended by appropriate dilution.

2.2 Sensitivity. Minimum detection limits of 7 µg Cr/liter for ICP and 1 µg Cr/liter for GFAAS have been observed.

2.3 Precision. To be determined.

2.4 GFAAS Interferences. Low concentrations of calcium and/or phosphate may cause interferences; at concentrations above 200 µg/L, calcium's effect is constant and eliminates the effect of phosphate. Calcium nitrate is therefore added to ensure a known constant effect. Other matrix modifiers recommended by the instrument manufacturer may also be suitable. Nitrogen should not be used as the purge gas due to cyanide band interference. Background correction may be required because of possible significant levels of nonspecific absorption and scattering at the 357.9 nm analytical wavelength. Zeeman or Smith-Hieftje background correction is recommended to correct for interferences due to high levels of dissolved solids in the alkaline impinger solutions.

2.5 ICP Interferences.

2.5.1 Spectral Interferences. Spectral interferences are caused by: (1) Overlap of a spectral line from another element; (2) unresolved overlap of molecular band spectra; (3) background contribution from continuous or recombination phenomena; and (4) stray light from the line emission of high-concentration elements. Spectral overlap may be compensated for by computer correcting the raw data after monitoring and measuring the interfering element. At the 267.72 nm Cr analytical wavelength, iron, manganese and uranium are potential interfering elements. Background and stray light interferences can usually be compensated for by a background correction adjacent to the analytical line. Unresolved overlap requires the selection of an alternative chromium wavelength. Consult the instrument manufacturer's operation manual for interference correction procedures.

2.5.2 Physical Interferences. High levels of dissolved solids in the samples may cause significant inaccuracies due to salt buildup at the nebulizer and torch tips. This problem can be controlled by diluting the sample or providing for extended rinse times between sample analyses. Standards are prepared in the same matrix as the samples (i.e., 0.1 N NaOH).

2.5.3 Chemical Interferences. These include molecular compound formation, ionization effects and solute vaporization effects, and are usually not significant in ICP, especially if the standards and samples are matrix matched.

3. Apparatus

3.1 Sampling Train. Same as Method 5, Section 2.1, but omit filter, and use quartz or glass for probe and liner in place of stainless steel. Use 0.1 N NaOH or 0.1 N NaHCO₃ in the impingers in place of water.

3.2 Sample Recovery. Same as Method 5, Section 2.2, but use 0.1 N NaOH or 0.1 N NaHCO₃ in place of acetone. Rinse probe nozzle, probe liner, impingers and connecting glassware into a single sample container.

3.3 Analysis. For analysis, the following equipment is needed.

3.3.1 General.

3.3.1.1 Phillips Beakers.

3.3.1.2 Hot Plate.

3.3.1.3 Volumetric Flasks. Class A 100 ml and other appropriate volumes.

3.3.1.4 Assorted Pipettes.

3.3.2 Analysis by GFAAS.

3.3.2.1 Chromium Hollow Cathode Lamp or Electrodeless Discharge Lamp.

3.3.2.2 Graphite Furnace Atomic Absorption Spectrophotometer.

3.3.3 Analysis by ICP.

3.3.3.1 ICP Spectrometer. Computer-controlled emission spectrometer with background correction and radio frequency generator.

3.3.3.2 Argon Gas Supply. Welding grade or better.

4. Reagents

Unless otherwise indicated, all reagents shall conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society (ACS reagent grade). Where such specifications are not available, use the best available grade.

4.1 Sampling.

4.1.1 Water. Deionized, distilled, that conforms to ASTM Type II water for analysis.

4.1.2 Sodium Hydroxide (NaOH) Absorbing Reagent, 0.1 N or Sodium Bicarbonate (NaHCO₃) Absorbing Reagent, 0.1 N. Dissolve 4.0 gm of sodium hydroxide in 1 L of water, or dissolve 8.5 gm of sodium bicarbonate in 1 L of water.

4.2 Sample Recovery.

4.2.1 0.1 N NaOH or 0.1 N NaHCO₃. See Section 4.1.2. Use the same reagent for recovery that was used in the impingers.

4.3 Sample Preparation and Analysis.

4.3.1 Concentrated Nitric Acid (HNO₃). Trace metals or better grade HNO₃ must be used for reagent preparation; ACS reagent grade HNO₃ is acceptable for cleaning glassware.

4.3.2 Matrix Modifier. See instrument manufacturer's manual for suggested matrix modifier.

4.3.3 Total Chromium Standard Stock Solution (1000 mg/L). Procure a certified aqueous standard or dissolve 2.829 g of potassium dichromate (K₂Cr₂O₇) in water and dilute to 1 L.

4.3.4 Total Chromium Standards for GFAAS. Chromium solutions for GFAAS calibration shall be prepared to contain 1.0% (v/v) HNO₃. The zero standard shall be 1.0% (v/v) HNO₃.

4.3.5 Calibration Standards. Prepare by diluting the chromium stock solution (6.2.5) in 0.1 N NaOH at the following suggested levels: 2 ml of the stock solution in 1000 ml, 250 ml, and 50 ml to provide 2, 8 and 40 µg Cr⁺⁺/ml, respectively.

4.3.6 Calcium Nitrate Ca(NO₃)₂ Solution (10 µg Ca/ml). Prepare the solution by weighing 36 mg of Ca(NO₃)₂ into a 1-liter volumetric flask. Dilute with water to 1 liter.

5. Procedure

5.1 Sampling. Same as Method 5, Section 4.1, except omit the filter and filter holder from the sampling train. Use glass nozzle and probe liner. Clean all glassware in hot soapy water designed for laboratory cleaning of glassware. Follow the cleaning with a deionized water rinse. Place 100 ml of 0.1 N NaOH or 0.1 N NaHCO₃ in each of the first two impingers.

5.2 Sample Recovery. Follow the basic procedures of Method 5, Section 4.2, with the exceptions noted below; a filter is not recovered from this train.

5.2.1 Container No. 1. Measure the volume of the liquid in the first, second, and third impingers and quantitatively transfer into a labeled sample container. Use 200 ml of 0.1 N NaOH or 0.1 N NaHCO₃ to rinse the nozzle, probe liner, three impingers, and connecting glassware; add this wash to the same container.

5.2.2 Container No. 2 (Reagent Blank). Place 400 ml of 0.1 N NaOH or 0.1 N NaHCO₃ in a labeled sample container.

5.2.3 Sample Preservation. Refrigerate samples upon receipt. (Containers Nos. 1 and 2).

5.3 Sample Preparation and Analysis. For GFAAS measurement, an acid digestion of the alkaline impinger solution is required. Two types of blanks are required for the analysis. The calibration blank is used in establishing the analytical curve, and the reagent blank is used to correct for possible contamination resulting from the sample processing. The 0.1 N NaOH solution or the 0.1 N NaHCO₃ from 4.1.2 is used as the calibration blank. The reagent blank must contain all the reagents and be in the same volume as used in the processing of the samples. The reagent blank must be carried through the complete procedure and contain the same acid concentration in the final solution as the sample solutions analyzed.

5.3.1 Acid Digestion for GFAAS. In a beaker, add 10 ml of concentrated nitric acid to the sample aliquot of 300 ml taken for analysis. Cover the beaker with a watch glass. Place the beaker on a hot plate and reflux the sample down to near dryness. Add another 5 ml of concentrated HNO₃ to complete the digestion. Carefully reflux the sample volume down to near dryness. Wash down the beaker walls and watch glass with distilled water. Adjust the final volume to 50 ml or a predetermined volume based on the expected Cr concentration. The final concentration of HNO₃ in the solution should be 1% (v/v). Transfer the digested sample to a 50 ml volumetric flask. Add 0.5 ml of concentrated HNO₃, 1 ml of the 10 µg/ml of Ca(NO₃)₂. Dilute to 50 ml with water.

5.3.2 Sample Analysis by GFAAS. The 357.9-nm wavelength line shall be used. Follow the manufacturer's operating instructions for all other spectrophotometer parameters.

5.3.2.1 Furnace parameters suggested by the manufacturer should be employed as guidelines. Since temperature-sensing mechanisms and temperature controllers can vary between instruments and/or with time, the validity of the furnace parameters must be periodically confirmed by systematically altering the furnace parameters while analyzing a standard. In this manner, losses of analyte due to higher-than-necessary temperature settings or losses in sensitivity due to less than optimum settings can be minimized. Similar verification of furnace parameters may be required for complex sample matrices.

5.3.2.2 Inject a measured aliquot of digested sample into the furnace and atomize. If the concentration found exceeds

the calibration range, the sample should be diluted with the same acid matrix and reanalyzed. Consult the operator's manual for suggested injection volumes. The use of multiple injections can improve accuracy and help detect furnace pipetting errors.

5.3.2.3 Subtract a sample blank reading from a sample reading to obtain a net reading. (Note that the sample blank is the "reagent blank.") Employ a minimum of one matrix-matched sample blank per sample batch to determine if contamination or any memory effects are occurring.

5.3.2.4 Calculate the chromium concentrations (1) by the method of standard additions (see operator's manual) or (2) from the calibration curve, or (3) directly from the instrument's concentration readout. All dilution or concentration factors must be taken into account.

5.3.2.5 Dilute samples with reagent blank solution if they are more concentrated than the highest standard. Note that the equation in section 8.1 contains a dilution factor to account for any dilution.

5.3.3 Sample Analysis by ICP. The ICP measurement is performed directly on the alkaline impinger reagent; acid digestion is not necessary provided the samples and standards are matrix matched. However, ICP may only be used when the solution analyzed has a Cr concentration greater than 50 µg/l (0.05 µg/ml).

5.3.3.1 Set up the instrument with proper operating parameters including wavelength, background correction settings (if necessary), interfering element correction settings (if necessary). The instrument must be allowed to become thermally stable before beginning performance of measurements (usually requiring at least 30 min of operation prior to calibration). During this warmup period, the optical calibration and torch position optimization may be performed (consult the operator's manual).

5.3.3.2 Before beginning the sample run, analyze the highest calibration standard as if it were a sample. Concentration values obtained should not deviate from the actual values by more than 5% (or the established control limits, whichever is lower). If they do, follow the recommendations of the instrument manufacturer to correct for this condition.

5.3.3.3 Flush the system with the calibration blank solution for at least 1 min before the analysis of each sample. Analyze the calibration standard blank after each 10 samples. Use the average intensity of multiple exposures for both standardization and sample analysis to reduce random error.

5.3.3.4 Dilute and reanalyze samples that are more concentrated than the linear calibration limit or use an alternate, less sensitive Cr wavelength for which quality control data are already established.

5.3.3.5 If dilutions were performed, the appropriate factors must be applied to sample values. All results should be reported in µg/ml with up to three significant figures.

6. Calibration

6.1 Sampling Train Calibration. Perform all of the calibrations described in Method 5, Section 5.

6.2 GFAAS Calibration. Either: (1) Run a series of chromium standards and a

calibration blank and construct a calibration curve by plotting the concentrations of the standards against the absorbencies; or (2) using the method of standard additions, plot added concentration versus absorbance. For instruments that read directly in concentration, set the curve corrector to read out the proper concentration, if applicable. This is customarily performed automatically with most instrument computer based data systems. Calibration standards for total chromium should start with 1% v/v HNO₃ with no chromium for the zero standard and appropriate increases in total chromium concentration in other calibration standards. Prepare at least three (3) standards (not including the zero). The standards should be diluted with 0.1 N NaOH and carried through the sample preparation procedure to ensure that matrix matching is accomplished and to avoid the need for the method of standard additions. Calibration standards should be prepared fresh daily.

6.3 ICP Calibration. Calibrate the instrument according to the instrument manufacturer's recommended procedures, using a calibration blank and three (3) standards for the initial calibration. Be sure that samples and standard calibration matrices are matrix matched. Flush the system with the calibration blank between each standard. (Use the average intensity of multiple exposures for both standardization and sample analysis to reduce random error.)

7. Quality Control

7.1.1 GFAAS Quality Control. Run a check standard after approximately every 10 sample injections. These standards are run, in part, to monitor the life and performance of the graphite tube. Lack of reproducibility or a significant change in the signal for the check standard indicates that the graphite tube should be replaced.

7.1.2 Duplicate Samples. Run one duplicate sample for every 20 samples, (or one per source test, whichever is more frequent) providing there is enough sample for duplicate analysis. Duplicate samples are brought through the whole sample preparation separately.

7.1.3 Matrix Spiking. Spiked samples shall be prepared and analyzed daily to ensure that correct procedures are being followed and that all equipment is operating properly. Spiked sample recovery analyses should indicate a recovery for the Cr spike of between 75 and 125%. Spikes are added prior to any sample preparation. Cr levels in the spiked sample should provide final solution concentrations that fall within the linear portion of the calibration curve.

7.1.4 Method of Standard Additions. Whenever sample matrix problems are suspected and standard/sample matrix matching is not possible or whenever a new sample matrix is being analyzed, the method of standard additions shall be used for the analysis of all extracts. Method 12 specifies a performance test to determine if the method of standard additions is necessary.

7.1.5 Quality Control Check Sample. The concentration of all calibration standards should be verified against a quality control check sample obtained from an outside source. This is done by analyzing the check

sample immediately following calibration. The result should be within 10% of the expected value before sample analysis begins.

7.2 ICP Quality Control.

7.2.1 Interference Check. Prepare an interference check solution to contain known concentrations of interfering elements that will provide an adequate test of the correction factors in the event of potential spectral interferences. Two potential interferences, iron and manganese, may be prepared as 1000 µg/ml and 200 µg/ml solutions, respectively. The solutions should be prepared in dilute HNO₃ (1-5%). Particular care must be taken to ensure that the solutions and/or salts used to prepare the solutions are of ICP grade purity (i.e., that no measurable Cr contamination exists in the salts/solutions). Commercially prepared interfering element check standards are available. Verify the interelement correction factors every 3 months by analyzing the interference check solution. The correction factors are calculated according to the instrument manufacturer's directions. If interelement correction factors are used properly, no false Cr should be detected.

7.2.2 Quality Control Check Sample. Prepare in the same alkaline matrix as the calibration standards; it should be at least 100 times the instrumental detection limit. This sample should be prepared from a different source/supplier (than the calibration standards) and is used to verify the accuracy of the calibration curve. Prior to sample analysis, analyze one check standard prepared from a Cr stock solution source other than that used for preparation of the calibration curve standards (see 7.2.10). The check standard concentration should be at least 100 times the minimum detection limit.

7.2.3 Laboratory Blank. Analyze a minimum of one laboratory blank per sample batch to determine if contamination or any memory effects are occurring.

7.2.4 Duplicates. Analyze one duplicate sample for every 20 samples. A duplicate sample is a sample brought through the whole sample preparation and analytical process.

8. Emission Calculations

Carry out the calculations, retaining one extra decimal figure beyond that of the acquired data. Round off figures after final calculations.

8.1 Total Cr in Sample. Calculate M, the total µg Cr in each sample, as follows:

$$M = V_{ml} \cdot C \cdot F \cdot D \quad \text{Eq. 306-1}$$

where:

V_{ml} = Volume of impinger reagent plus rinses, ml.

C = Concentration of Cr in sample, µg Cr/ml (direct instrument readout).

F = Dilution factor.

= Volume of aliquot after dilution (ml)

Volume of aliquot before dilution (ml)

D = Digestion factor.

= Volume of sample aliquot after digestion (ml)

Volume of sample aliquot submitted to digestion (ml)

8.2 Average Dry Gas Meter Temperature and Average Orifice Pressure Drop. Same as Method 5, Section 6.2.

8.3 Dry Gas Volume, Volume of Water Vapor, Moisture Content. Same as Method 5, Sections 6.3, 6.4, and 6.5, respectively.

8.4 Cr Emission Concentration. Calculate C_s (mg/dscm), the Cr concentration in the stack gas, dry basis, corrected to standard conditions, as follows:

$$C_s = (10^{-3} \text{ mg}/\mu\text{g}) [M/V_{m(\text{std})}] \quad \text{Eq. 306-2}$$

8.5 Isokinetic Variation, Acceptable Results. Same as Method 5, Sections 6.11 and 6.12, respectively.

9. Bibliography

9.1 Test Methods for Evaluating Solid Waste. U.S. Environmental Protection Agency. SW-846, 2nd Edition. July 1982.

9.2 Cox, X.B., R.W. Linton, and F.E. Butler. Determination of Chromium Speciation in Environmental Particles—A Multitechnique Study of Ferrochrome Smelter Dust. Accepted for publication in Environmental Science and Technology.

9.3 Same as Bibliography of Method 5, Citations 2 to 5 and 7.

9.4 California Air Resources Board, "Determination of Total Chromium and Hexavalent Chromium Emissions from Stationary Sources." Method 425, September 12, 1990.

9.5 Test Methods for Evaluating Solid Waste. U. S. Environmental Protection Agency. SW-846, 3rd Edition. November 1986.

Method 306A—Determination of Chromium Emissions From Decorative and Hard Chromium Electroplating and Anodizing Operations

1. Applicability and Principle

1.1 Applicability. This method is used to determine the concentration of chromium emissions from chromium electroplating and anodizing operations that use a chromic acid bath. The method is less expensive and less complex to conduct than Method 306. Correctly applied, the precision and bias of the sample results will be comparable to those obtained with the isokinetic Method 306. This method is applicable under ambient moisture, air, and temperature conditions.

1.2 Principle. The chromium emissions are removed from the duct at a constant sampling rate determined by a critical orifice and collected in a probe and impingers. The sampling time at the sampling traverse points is varied according to the stack gas velocity to obtain a proportional sample. The concentration is determined by the same analytical procedures used in Method 306: inductively-coupled plasma emission spectrometry (ICP) or graphite furnace atomic absorption spectrometry (GFAAS).

2. Range, Sensitivity, Precision, and Interferences

Same as Method 306, Section 2.

3. Apparatus

Note: Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

3.1 Sampling Train. A schematic of the sampling train is shown in Figure 306A-1. The components of the train are available commercially, but some fabrication and assembly are required. If Method 306 equipment is available, the sampling train may be assembled as specified in Method 306 and the sampling rate of the meter box set at the delta H_0 specified for the calibrated orifice; this train is then operated as specified in this method.

3.1.1 Probe Nozzle/Tubing and Sheath. Use approximately ¼ in. inner diameter (ID) glass or rigid plastic tubing about 8 inches long with a short 90 degree bend at one end to form the nozzle. Grind a slight taper on the nozzle end before making the bend. Attach the nozzle to flexible tubing of sufficient length to collect a sample from the stack. Use a straight piece of larger diameter rigid tubing (such as metal conduit or plastic water pipe) to form a sheath that begins about 1 in. from the 90° bend on the nozzle and encases the flexible tubing.

3.1.2 S-Type Pitot. Same as Method 2, Section 3.

3.1.3 Sample Line. Use thick wall flexible plastic tubing (polyethylene, polypropylene, polyvinylchloride) about ¼ in. to ⅜ in. ID to connect the train components. A combination of rigid plastic tubing and thin wall flexible tubing may be used as long as neither tubing collapses when leak-checking the train. Metal tubing cannot be used.

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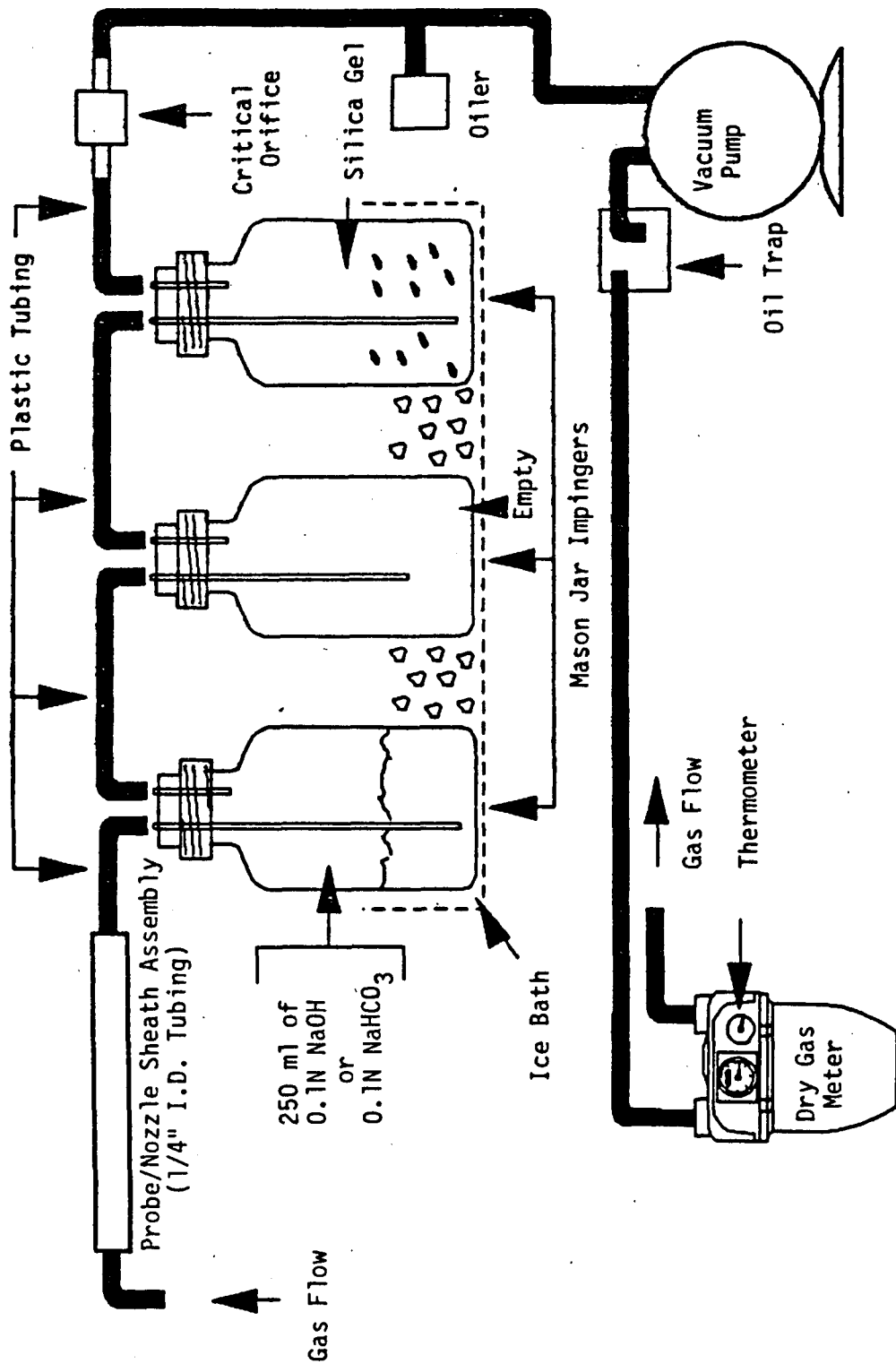


Figure 306-A1 sampling train schematic

3.1.4 Impingers. One quart capacity "Mason" glass canning jars with vacuum seal lids are used. Three impingers are required: the first is for collecting reagent, the second is empty and used to collect any reagent carried over from the first impinger, and the third contains the drying agent. Install leak-tight inlet and outlet tubes for assembly with train. The tubes may be made of approximately 1/4 in. ID glass or rigid plastic tubing. For the inlet tube of the first impinger, heat the glass or plastic tubing and draw until the tubing separates. Cut the tip off until the tip orifice is 3/32 in. in diameter. When fabricating the first impinger, place the tip orifice 3/16 in. above the bottom of the jar when assembled. For the second impinger, the inlet tube need not be drawn and sized, but the tip should be approximately 2 in. above the bottom of the jar. The inlet tube of the third impinger should extend to about 1/2 in. above the bottom of the jar. Locate the outlet tube end of all impingers about 1/2 inch beneath the bottom of the lid.

3.1.5 Manometer. It is inclined, to read water column to 1/100 in. for the first inch and 1/10 inch thereafter. Range 0-6 in.

3.1.6 Critical Orifice. The critical orifice is a small restriction in the sample line that is located upstream of the vacuum pump and sets the sample rate at about 0.75 cubic foot per minute. An orifice meter can be made of 1/8 in. brass tubing approximately 1 in. long sealed inside larger diameter, approximately 3/8 in., brass tubing to serve as a critical orifice giving a constant sample flow. Materials other than brass can be used to construct the critical orifice as long as the

flow through the sampling train is approximately 0.75 cubic foot per minute.

3.1.7 Connecting Hardware. Standard pipe and fittings, 1/4 in. or 1/8 in., are used to install vacuum pump and dry gas meter in train.

3.1.8 Pump Oil. A glass oil reservoir with a wick mounted at pump inlet lubricates pump vanes.

3.1.9 Vacuum Pump. "Cast" sliding vane mechanical pump with fiber vanes suitable to deliver a minimum of 26 in. Hg vacuum and 2.0 cfm are used.

3.1.10 Oil Trap. Empty glass oil reservoir without wick is mounted at pump outlet to prevent oil from reaching the dry gas meter.

3.1.11 Dry Gas Meter. Residential 175 cubic feet per hour (CFH) capacity dry gas meter with thermometer installed monitors meter temperature.

3.2 Sample Recovery.

3.2.1 Wash Bottles. These are glass or inert plastic, 500 or 1000 ml, with spray tube.

3.2.3 Sample Containers. The first mason jar impinger of the sampling train serves as the sample container. A new lid and plastic wrap are substituted for the impinger inlet/outlet assembly.

3.3 Analysis. Same as Method 306, Section 3.3.

4. Reagents

4.1 Sampling. Same as Section 4.1, Method 306.

4.2 Sample Recovery. Same as Section 4.2, Method 306.

5. Procedure

5.1 Sampling.

5.1.1. Pretest Preparation.

5.1.1.1 Port Location. Locate ports as specified in Section 2 of Method 1. Use a total of 24 sampling points for round ducts and 24 or 25 points for rectangular ducts. Mark the pitot and sampling probe with thin strips of tape to permit velocity and sample traversing. For ducts less than 12 inches in diameter, use a total of 16 points.

5.1.1.2 Velocity Traverse. Perform a velocity traverse before obtaining samples. Figure 306A-2 may be used to record velocity traverse data. If testing occurs over several days, perform the traverse at the beginning of each day. At the end of the test effort each day, perform a final traverse. Perform traverses as specified in Section 3 of Method 2, but record the Δp (velocity head) values only. Check the stack temperature before and after recording the Δp values and use the average of the two temperatures for the stack temperature. Enter the Δp values for each point. Check for cyclonic flow during the first traverse to verify that it does not exist; if cyclonic flow does exist, make sure that the absolute average angle of misalignment does not exceed 20 degrees. If the average angle of misalignment exceeds 20 degrees at an outlet location, install straightening vanes to eliminate the cyclonic flow. If it is necessary to test an inlet location where cyclonic flow exists, it may not be possible to install straightening vanes. In this case, a variation of the alignment method must be used. This must be approved by the Administrator.

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5.1.1.3 Point Sampling Times. Since the sampling rate of the train is held constant by the critical orifice, it is necessary to calculate specific sampling times for each point in order to obtain a proportional sample. If all sampling can be completed in a single day,

it is necessary to calculate the point sampling times only once. If sampling occurs over several days, calculate the point sample times for each day using velocity traverse data obtained earlier in the day. Determine the average of the Δp values obtained during

the velocity traverse (Figure 306A-2). Calculate the sampling times for each point using Equation 306A-1. Convert the decimal parts of minutes to seconds. If the stack diameter is less than 12 inches, use 7.5 minutes in place of 5 minutes in the equation and 16 sampling points.

$$\text{Minutes at point} = \sqrt{\frac{\text{Point } \Delta p}{\text{Average } \Delta p}} \times 5 \text{ minutes} \quad \text{Eq. 306A - 1}$$

Where:

n=Total sampling points.

5.1.1.4 Preparation of Sampling Train. Assemble the sampling train as shown in Figure 306A-1. Secure the nozzle-liner assembly to the sheath to prevent slipping when sampling. Before charging, rinse the first mason jar impinger with either 0.1N sodium hydroxide or 0.1N sodium bicarbonate; discard the solution. Put 250 ml of 0.1 N sodium hydroxide or 0.1N sodium bicarbonate sampling solution into the first mason jar. Similarly, rinse the second mason jar impinger and leave empty. Put silica gel into the third mason jar impinger until the

impinger is half full. Place the impingers into an ice bath and check to ensure that the lids are tight.

5.1.1.5 Train Leak Check Procedure. Wait until the ice has cooled the impingers before sampling. Next, seal the nozzle with a finger covered by a piece of clear plastic wrap and turn on the pump. Observe any leak rate on the dry gas meter. The leak rate should not exceed 0.02 cfm.

5.1.2 Sampling Train Operation.

5.1.2.1 Record all pertinent process and sampling data on the data sheet (see Figure 306A-3). Ensure that the process operation is suitable for sample collection.

5.1.2.2 Place the probe/nozzle into the duct at the first sampling point and turn on the pump. A minimum vacuum of 15 in. Hg or 0.47 atmosphere between the critical orifice and pump is required to maintain critical flow. Sample for the time interval previously determined for that point. Move to the second point and sample for the time interval determined for that point; sample all points on the traverse in this manner. Keep ice around the impingers during the run. Complete the traverse and turn off the pump. Move to the next sampling port and repeat. Record the final dry gas meter reading.

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Plant _____ Date _____ Run Number _____
 Sampling Site _____ Operator _____
 Total Micrograms catch(mCr) _____ Stack radius(r) _____
 Avg dry gas meter temp F(Tm) _____ Avg delta p(p avg) _____
 Meter correction factor(Ym) _____ Stack temp F(Ts) _____
 Meter volume - actual cu ft(Vm) _____ Leak rate before run _____
 Barometric pressure in. Hg(Pbar) _____ Leak rate after run _____
 Start clock time _____ Stop meter volume _____
 Stop clock time _____ Start meter volume _____

REMARKS: _____

POINT NO.	SAMPLE (MIN/SEC)	GAS METER TEMP (F)

POINT NO.	SAMPLE (MIN/SEC)	GAS METER TEMP (F)

$Cs = \frac{m \text{ Cr } (Tm+460)}{499.8 (Ym) (Vm) (Pbar)}$

$Kg/Hr = (Cs) 0.0001597 r^2 \sqrt{\frac{p \text{ avg } (Ts+460)}{Pbar (2873)}}$

Mg/Cubic Meter(Cs) _____ (Optional) Kg/Hr _____

Figure 306A-3. Chromium Constant Sampling Rate Field Data

5.1.2.3 Post Test Leak Check. Remove the probe assembly and flexible tubing from the first impinger. Do not cover the nozzle. Seal the inlet tube of the first impinger with a finger covered by clear plastic wrap and turn on the pump. Observe any leak rate on the dry gas meter. If the leak rate exceeds 0.02 cfm, reject the run. If the leak rate is acceptable, take the probe assembly and impinger assembly to the sample recovery area.

5.2 Sample Recovery.

5.2.1 After the train has been moved to the sample recovery area, disconnect the tubing that joins the first impinger with the second.

5.2.2 The first impinger jar is also used as the sample container jar. Unscrew the lid from the first impinger jar. Lift the inlet/outlet tube assembly almost out of the jar, and using the wash bottle, rinse the outside of the impinger tip that was immersed in the impinger jar with extra sampling reagent; rinse the inside of the tip as well.

5.2.3 Recover the second impinger by removing the lid and pouring any contents

from the second impinger into the first impinger. Rinse the second impinger including the inside and outside of the impinger stem as well as any connecting plastic tubing with extra sampling reagent and place the rinse into the first impinger.

5.2.4 Hold the nozzle and connecting plastic tubing in a vertical position so that the tubing forms a "U". Using the wash bottle, partially fill the tubing with sampling reagent. (Keep a minimum of 100 ml of the sampling reagent for a blank analysis). Raise and lower the end of the plastic tubing several times to cause the reagent to contact the major portion of the internal parts of the assembly thoroughly. Do not raise the solution level too high or part of the sample will be lost. Place the nozzle end of the assembly over the mouth of the first impinger jar (sample container) and elevate the plastic tubing so that the solution flows rapidly out of the nozzle. Perform this procedure three times. Next, repeat the recovery procedure but allow the solution to flow rapidly out the open end of the plastic tubing into the first impinger jar.

5.2.5 Place a piece of clear plastic wrap over the mouth of the first impinger jar. Use a standard lid and band assembly to seal the jar. Label the jar with the sample number and mark the liquid level to gauge any losses during handling.

5.3 Analysis. Sample preparation and analysis procedures are identical to Method 306, Section 5.3.

6. Calibration

6.1 Dry Gas Meter. Calibrated by manufacturer or as specified in Method 5.

6.2 GFAA Spectrometer. Same as Method 306, Section 6.2.

6.3 ICP Spectrometer. Same as Method 306, Section 6.3.

7. Quality Control

Same as Method 306, Section 7.

8. Calculations

8.1 Pollutant Concentration. Calculate the concentration (C_s) of chromium in milligrams per dry standard cubic meter (mg/dscm) as follows:

$$C_s = \frac{M_{Cr} \times (T_m + 460)}{499.8 (Y_m)(V_m)(P_{bar})} \text{ Eq. 306A-2}$$

where:

M_{Cr}=Micrograms of Cr in sample from Method 306, Eq. 306-1.

T_m=Dry gas meter temperature in °F.

Y_m=Dry gas meter correction factor.

V_m=Dry gas meter volume in ft³.

P_{bar}=Barometric pressure in inches Hg.

8.2 Approximate Mass Emission Rate (Optional). Calculate an approximate mass emission rate for chromium in kilograms per hour using the following equation:

$$\text{Kg/hr} = 0.0001597 r^2 \sqrt{\frac{\Delta p_{ave} (T_s + 460)}{P_{bar} (28.73)}} \times C_s \text{ Eq. 306A - 3}$$

Where:

r=Radius of stack in inches.

Δp_{ave}=Average of Δp values.

T_s=Stack temperature in °F.

P_{bar}=Barometric pressure in inches Hg.

C_s=Concentration of hexavalent chromium in mg/dscm.

Note: The emission rate is based on an average moisture content of 2 percent.

9. Bibliography

1. F.R. Clay, Memo, Impinger Collection Efficiency—Mason Jars vs. Greenburg-Smith Impingers, Dec. 1989.

2. Robin Segall, Draft Screening Method for Emissions from Chromium Plating Operations, Entropy Environmentalists, Jan. 1988.

3. F.R. Clay, Paper, A Simplified Method for Sampling for Hexavalent Chromium, May 1990.

4. F.R. Clay, Paper, Proposed Sampling Method 306A for the Determination of Hexavalent Chromium Emissions from Electroplating and Anodizing Facilities, May 1992.

Method 306B—Surface Tension Measurement for Tanks Used at Decorative Chromium Electroplating and Anodizing Facilities

1. Applicability and Principle

1.1 Applicability. This method is applicable to all decorative chromium plating and anodizing operations where a wetting agent is used in the tank to reduce emissions from the surface of the plating solution.

1.2 Principle. During an electroplating or anodizing operation, gas bubbles generated during the process rise to the surface of the liquid and burst. Upon bursting, tiny droplets of chromic acid become entrained in ambient air. The addition of a wetting agent to the tank bath reduces the surface tension of the liquid and diminishes the formation of these droplets. This method determines the surface tension of the bath using a stalagmometer or a tensiometer to confirm that there is sufficient wetting agent present.

2. Apparatus

2.1 Stalagmometer or Tensiometer. A commercially available stalagmometer, platinum ring detachment tensiometer or equivalent surface tension measuring device is required.

3. Procedure

3.1 The surface tension of the tank bath may be measured by using a tensiometer or a stalagmometer. If a tensiometer is used, the procedures specified in ASTM Method D 1331-89, Standard Test Methods for Surface and Interfacial Tension of Solution of Surface Active Agents, shall be followed. If a stalagmometer is used, the instructions provided with the measuring device must be followed.

3.2 Measurements of the bath surface tension must be made every 4 hours of tank operation. If the surface tension of the bath exceeds 40 dynes per centimeter for three consecutive four-hour periods, the interval between measurements must be reduced in one-hour increments until two consecutive measurements indicate the surface tension to be at or below 40 dynes per centimeter. If the activity level in the plating or anodizing tank is reduced, the time interval between measurements can be increased to a maximum of four hours as long as two consecutive measurements indicate the surface tension is being maintained at or below 40 dynes per centimeter.

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