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Environmental Protection
Agency

Preliminary Review of the Metal Finishing Category

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ABBREVIATIONS

Acronym	Definition
ACPEIP	Administration on the Control of Pollution Caused by Electronic Information Products
BAT	Best Available Technology Economically Achievable
BBP	Benzyl butyl phthalate
BCT	Best Conventional Pollutant Control Technology
BOE	Basis of Estimate
BPT	Best Practicable Control Technology Currently Available
CBI	Confidential Business Information
CFR	Code of Federal Regulations
CRD	Comment Response Document
CWA	Clean Water Act
CWT	Centralized Waste Treatment
DBP	Dibutyl phthalate
DCN	Document Control Number
DIBP	Diisobutyl phthalate
DMR	Discharge Monitoring Report
DTC	Dithiocarbonate
E3	Economy – Energy – Environment
ECHA	European Chemicals Agency
ELGs	Effluent Limitations Guidelines and Standards
EPA	Environmental Protection Agency
ERG	Eastern Research Group, Inc.
ESRC	Environmental Sustainability Resource Center
EU	European Union
FR	Federal Register
GACT	Generally Available Control Technology
GLRPPR	Great Lakes Regional Pollution Prevention Roundtable
HAP	Hazardous Air Pollutant
HEM	n-hexane extractable material
HVOF	High Velocity Oxygen Fuel
IWC	International Water Conference
KTBP	Known to be Present
LTA	Long-term Average
MFDF	Metal Finishers Defense Fund
MMSD	Milwaukee Metropolitan Sewerage District
mg/L	milligrams per Liter
MP&M	Metal Products and Machinery
NACWA	National Association of Clean Water Agencies
Nadcap	National Aerospace and Defense Contractors Accreditation Program
NAICS	North American Industry Classification System
NASF	National Association for Surface Finishing

ABBREVIATIONS

Acronym	Definition
NCMS	National Center for Manufacturing Sciences
NESHAP	National Emission Standards for Hazardous Air Pollutants
NSPS	New Source Performance Standards
ORCR	Office of Resource Conservation and Recovery
OW	Office of Water
P2	Pollution Prevention
P2RIC	Pollution Prevention Regional Information Center
P2Rx	Pollution Prevention Resource Exchange
PBB	Polybrominated biphenyls
PBDE	Polybrominated diphenyl ethers
PFOS	Perfluorooctane sulfonate
POC	Pollutant of Concern
PoHS	Prohibition on Certain Hazardous Substance in Customer Products
POTW	Publicly Owned Treatment Works
PPE	Personal Protective Equipment
PPRC	Pollution Prevention Resource Center
PQAPP	Programmatic Quality Assurance Project Plan
PSES	Pretreatment Standards for Existing Sources
PSNS	Pretreatment Standards for New Sources
QA	Quality Assurance
RBE	River's Bend Engineering
RCRA	Resource Conservation and Recovery Act
REACH	Registration, Evaluation, Authorization and Restriction of Chemical substances
RO	Reverse Osmosis
RoHS	Restriction of Hazardous Substances
SGP	Strategic Goals Program
SIC	Standard Industrial Classification
TDD	Technical Development Document
TOC	Total Organic Compound
TOP	Total Organics Parameter
TRI	Toxics Release Inventory
TSS	Total Suspended Solids
TTO	Total Toxic Organics
TWF	Toxic Weighted Factor
TWPE	Toxic Weighted Pound Equivalent
VOC	Volatile Organic Compounds
WA/FS	Wetting Agents/Fume Suppressants
WEFTEC	Water Environment Federation's Annual Technical Exhibition and Conference
WSPPN	Western Sustainability and Pollution Prevention Network

1. INTRODUCTION

The Clean Water Act (CWA) directs EPA to review the existing effluent guidelines annually, and revise them if appropriate, as well as to identify categories of sources for which ELGs have not been developed. The statute also requires annual review of existing pretreatment standards, and revision, if appropriate. EPA promulgated Effluent Limitations Guidelines and Standards (ELGs) for the Metal Finishing Category (Metal Finishing ELGs), codified at 40 Code of Federal Regulations (CFR) Part 433, in 1983. EPA reevaluated the Metal Finishing ELGs during the development of the Metal Products and Machinery (MP&M) rulemaking in the late 1990s and early 2000s.

In the *Final 2014 Effluent Guidelines Program Plan*, EPA announced plans to conduct a preliminary study of the Metal Finishing Category to assess the current state of the industry, including an updated industry profile, descriptions of new and traditional process technologies and techniques, potential new pollutants of concern, advances in wastewater treatment technologies, and strategies used to achieve zero liquid discharge (U.S. EPA, 2015a, 2015b). As part of the public docket for the Preliminary 2016 Effluent Guidelines Program Plan, EPA included a 2015 Status Report for this effort. In this report, EPA noted that it planned to collect additional information to further assess the current state of the industry, including changes in process operations and wastewater characteristics, availability of improved technologies for pollution prevention and wastewater treatment, and challenges facilities face in applying the Metal Finishing ELGs. This 2017 status report builds on the previous report and describes study activities conducted since the 2015 Status Report.

The remainder of this report is organized as follows:

- Section 2 summarizes the existing metal finishing regulations and describes the findings from the 2015 Status Report.
- Section 3 generally describes the methodology for activities that EPA has conducted since the 2015 Status Report.
- Section 4 provides further details on EPA's study findings for activities EPA has conducted since the 2015 Status Report, including site visits, analysis of available discharge data, pollution prevention (P2) literature and data review, detailed review of select MP&M rulemaking documentation, technical conferences, stakeholder outreach, and review of other existing regulations that may impact metal finishing operations and wastewater generation.
- Section 5 summarizes EPA's conclusions for the study.
- Section 6 summarizes EPA's quality assurance (QA) procedures for reviewing existing information presented in this report.
- Section 7 is the list of references cited in the report.

2. SUMMARY OF 2015 STATUS REPORT

As described above, EPA previously published a report on its study of the Metal Finishing ELGs: *Preliminary Study of the Metal Finishing Category: 2015 Status Report* (2015 Status Report) (U.S. EPA, 2016a). This section provides an overview of the existing Metal Finishing ELGs (regulated unit operations and pollutants, treatment technology basis), as detailed in Section 2 of the 2015 Status Report and summarizes the activities and findings of the 2015 Status Report.

2.1 Existing Metal Finishing ELGs

Wastewater discharges from metal finishing operations are regulated primarily under ELGs for the Metal Finishing Category (40 CFR Part 433).[1,2] The Metal Finishing ELGs regulate wastewater discharges from six primary metal finishing operations. Additionally, at facilities where at least one of these primary operations is being conducted, the ELGs also cover wastewater discharges resulting from 40 additional metal finishing operations. If a facility does not perform any of the six primary metal finishing operations, it is not subject to the Metal Finishing ELGs (U.S. EPA, 1984). Table 2-1 lists the six primary metal finishing operations and 40 additional metal finishing operations. Detailed descriptions of these operations can be found in Section 2.2 of the 2015 Status Report (U.S. EPA, 2016a).

Table 2-1. Unit Operations Regulated by ELGs for the Metal Finishing Category

Six Primary Operations	40 Additional Metal Finishing Unit Operations	
• Electroplating • Electroless plating • Anodizing • Coating • Etching and chemical milling • Printed circuit board manufacturing	• Cleaning • Machining • Grinding • Polishing • Barrel finishing • Burnishing • Impact deformation • Pressure deformation • Shearing • Heat treating • Thermal cutting • Welding • Brazing • Soldering • Flame spraying • Sand blasting • Abrasive jet machining • Electrical discharge machining • Electrochemical machining • Electron beam machining	• Laser beam machining • Plasma arc machining • Ultrasonic machining • Sintering • Laminating • Hot dip coating • Sputtering • Vapor plating • Thermal infusion • Salt bath descaling • Solvent degreasing • Paint stripping • Painting • Electrostatic painting • Electropainting • Vacuum metalizing • Assembly • Calibration • Testing • Mechanical plating

Source: 40 CFR Part 433.

[1] Discharges from facilities performing metal finishing operations may also be regulated under other ELGs (e.g., Aluminum Forming, Iron and Steel) that take precedence over the Metal Finishing ELGs.

[2] Certain electroplating and metal finishing facilities that began operation before July 15, 1983 and discharge wastes to POTWs are covered under the Electroplating Category (40 CFR Part 413).

At promulgation, 78 percent of facilities indirectly discharged metal finishing wastewater to receiving water via POTWs, and 22 percent directly discharged to surface waters (U.S. EPA, 1984). The Metal Finishing ELGs established one set of concentration-based discharge limits that apply across a single subpart (Subpart A: Metal Finishing), summarized in Table 2-2. Direct dischargers comply with best practicable control technology currently available (BPT)/best available technology economically achievable (BAT) discharge limitations and new source performance standards (NSPS), whereas indirect dischargers comply with pretreatment standards for existing sources (PSES) and pretreatment standards for new sources (PSNS). As the table shows, the limitations and standards are the same for new and existing sources of metal finishing wastewater discharges, except for cadmium, which has a lower NSPS and PSNS discharge standard (U.S. EPA, 1983).

Table 2-2. Regulated Pollutants and ELG Limits for the Metal Finishing Category

Unit Operations Covered	Pollutant	BPT/BAT/PSES Daily Max (Monthly Average) (mg/L)	NSPS/PSNS Daily Max (Monthly Average) (mg/L)
See Table 2-1, for the list of 46 unit operations.[a]	Cadmium (T)	0.69 (0.26)	0.11 (0.07)
	Chromium (T)	2.77 (1.71)	2.77 (1.71)
	Copper (T)	3.38 (2.07)	3.38 (2.07)
	Lead (T)	0.69 (0.43)	0.69 (0.43)
	Nickel (T)	3.98 (2.38)	3.98 (2.38)
	Silver (T)	0.43 (0.24)	0.43 (0.24)
	Zinc (T)	2.61 (1.48)	2.61 (1.48)
	Cyanide (T)[b]	1.20 (0.65)	1.20 (0.65)
	Total Toxic Organics (TTO)[c]	2.13	2.13
	Oil and Grease[d]	52 (26)	52 (26)
	Total Suspended Solids (TSS)[d]	60 (31)	60 (31)
	pH[d]	Within 6.0 to 9.0	Within 6.0 to 9.0
For industrial facilities with cyanide treatment, and upon agreement between a source subject to those limits and the pollution control authority, the following amenable cyanide limit may apply in place of the total cyanide limit.	Cyanide amenable to alkaline chlorination	0.86 (0.32)	0.86 (0.32)

Source: 40 CFR Part 433.
(T): Total

[a] The provisions of this subpart apply to discharges from six electroplating operations on any basis material: electroplating, electroless plating, anodizing, coating (chromating, phosphating, and coloring), chemical etching and milling, and printed circuit board manufacturing. If any of these six operations are present, the provisions of this subpart also apply to discharges from 40 additional metal finishing operations, listed in Table 2-1. These limits do not apply to (1) metallic platemaking and gravure cylinder preparation conducted within or for printing and publishing facilities or (2) existing indirect discharging job shops and independent printed circuit board manufacturers, which are covered by 40 CFR Part 413.

[b] Anti-dilution provisions are stipulated in 40 CFR Part 433, which require self-monitoring for cyanide after cyanide treatment and before dilution with other waste streams. In general, the practice of diluting rinse water as a partial or total substitute for adequate treatment to achieve compliance with discharge limits is in violation of the National pretreatment standards: Categorical standards (40 CFR Part 403.6(d)).

[c] No monthly average TTO limitation.

[d] Parameter is regulated for BPT and NSPS only.

EPA based BPT, BAT, and PSES on the treatment of metal finishing wastewater using hydroxide precipitation, clarification, and sludge dewatering for common metals treatment, with pretreatment steps for chromium reduction, cyanide oxidation, complexed metals removal, and oil and grease removal, where the wastewater contains these components. EPA based NSPS and PSNS on the BPT/BAT/PSES technology, adding in-process treatment modifications for controlling the discharge of cadmium. The modifications for controlling cadmium employ evaporative recovery or ion exchange on cadmium-bearing wastewater before it mixes with other wastewater (U.S. EPA, 1983). Section 2.3 of the 2015 Status Report discusses in detail the technology bases for BPT/BAT/PSES and NSPS/PSNS (U.S. EPA, 2016a).

2.2 2015 Status Report Summary of Findings

As described in the 2015 Status Report, EPA initiated a review of the industry by examining existing information that EPA collected through technical conferences, discussions with industry experts and stakeholders, and a literature review. From these activities, EPA found (U.S. EPA, 2016a):

- Some facilities are implementing pollution prevention practices to minimize the volume of wastewater discharged, including countercurrent rinsing systems and replacing evaporative losses in plating baths with both untreated and treated rinsewater.
- Primary sources of wastewater have not changed since promulgation of the Metal Finishing ELGs. Most of the wastewater generated continues to originate from rinsing and cleaning operations. Improvements to coating and plating processes have not been shown to generate additional waste streams and generally aim to minimize process losses associated with the technology.
- Chemical recovery operations are performed by metal finishing facilities that use valuable plating chemicals such as gold and silver.
- At most metal finishing facilities, wastewater management and solid waste disposal are significant components of overall operating costs.
- Most metal finishing facilities continue to use conventional chemical precipitation technologies, although, some facilities have added a polishing step, such as membrane filtration or sorption technologies. EPA also learned that industry has been slow to develop or adopt advanced wastewater treatment technologies, most likely due to the costs of installation and operation. However, EPA has not fully evaluated the extent to which the metal finishing industry is applying technologies beyond the BPT technology basis.

3. RECENT STUDY ACTIVITIES

This section describes EPA's activities for the preliminary study of the Metal Finishing Category, undertaken since the publication of the 2015 Status Report (U.S. EPA, 2016a), including site visits, analysis of available discharge data, P2 literature and data review, detailed review of select MP&M rulemaking documentation, technical conferences, stakeholder outreach, and review of other existing regulations that may impact metal finishing operations and wastewater generation. Section 4 of this report details EPA's findings from these activities. These findings (in addition to those described in the 2015 Status Report) will inform EPA's decisions on how to proceed with the study.

3.1 Site Visits to Metal Finishing Facilities

EPA conducted site visits at 18 facilities to observe metal finishing operations and wastewater management practices. During these visits, EPA collected information on current metal finishing operations and associated wastewater generation; wastewater management including pollution prevention and/or wastewater reduction and associated costs; and historical data on raw and treated wastewater samples. EPA visited facilities near Los Angeles, CA; Salt Lake City, UT; Detroit, MI; and Chicago, IL. These facilities served the following markets:

- Aircraft/aerospace
- Automotive
- Medical devices
- Military
- Electronics (including semiconductors)
- Jewelry and miscellaneous awards (medals, trophies, etc.)
- General, non-specific

EPA also visited one vendor in Indiana that developed an environmentally friendly alternative to hexavalent chromium plating baths. Further details on information gathered during site visits are provided in Section 4.1.

3.2 Discharge Monitoring Report (DMR) and Toxics Release Inventory (TRI) Data Analysis

EPA reviewed DMR and TRI data and conducted follow-up conversations with facilities that reported the data. The objectives of the review were to:

- Determine the types of industries that are subject to Metal Finishing ELGs by Standard Industrial Classification (SIC) and North American Industry Classification System (NAICS) code.[3]
- Gain more knowledge about pollutants discharged from metal finishing operations, with a focus on those that are not regulated by the 1983 Metal Finishing ELGs.

[3] DMR data classifies facilities by SIC code, while TRI data classifies facilities by NAICS code.

- Identify potential changes in wastewater and pollutant discharges from the metal finishing industry since the 1983 ELGs.

EPA reviewed DMR and TRI data in two phases. EPA first analyzed 2014 DMR and TRI data for the 178 SIC codes and 203 NAICS codes with facilities likely to perform operations under the Metal Finishing Category (see Appendix A) and identified four SIC codes and six NAICS codes for further review. Second, EPA reviewed multi-year (2010 through 2014) analyses of DMR and TRI data for the four SIC and six NAICS codes to confirm industries with metal finishing operations and to evaluate whether any regulated or unregulated pollutants warrant additional control.

EPA then compared the TRI and DMR data to the following:

- *Metal Finishing ELGs and Long-Term Average (LTA) Concentrations*. EPA compared DMR and underlying TRI concentration data to the 1983 Metal Finishing ELGs and long-term average concentrations[4] (hereafter "MF ELG LTA"). EPA performed this analysis to understand how current discharges compare to the limitations and limitation bases for the existing ELGs.
- *Metal Products and Machinery (MP&M) Proposed LTA Concentrations***.** EPA compared DMR and underlying TRI concentrations to the 2001 MP&M ELGs lowest pollutant LTA (hereafter "MP&M LTA") across all MP&M proposed subcategories that cover metal finishing facilities (Metal Finishing Job Shops, Printed Wiring Boards, Non-Chromium Anodizing, and General Metals Subcategories).[5] EPA used this comparison to gauge how facility discharges have changed and to understand their current treatability.
- *Analytical Baseline Value*. The *Development Document for the Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment (CWT) Industry – Final* established analytical baseline values for various pollutants under the metals subcategory for CWT wastewater. In general, the baseline values are equal to the nominal quantitation limit identified for the specified pollutant's analytical methods (U.S. EPA, 2000a). When looking at a pollutant's concentration in a wastewater, EPA often compares that concentration to five or ten times the baseline value to gauge its treatability. For unregulated pollutants identified, EPA compared DMR and underlying TRI concentrations to the respective baseline values. For this analysis, EPA considered DMR and underlying TRI concentrations detected above five times the baseline value as treatable.

Table 3-1 summarizes the analyses EPA performed and the scope of those analyses presented in this report. For background information about the methodology for obtaining the DMR/TRI data for this analysis, including a methodology process flow diagram, see the *Metal*

[4] Long term averages are not typically the same as the limitations (or standards). Facilities are required to meet the limitations (or standards) which include variability factors. EPA often compares pollutant concentrations to the LTAs instead of the limitations (or standards) because the LTAs represent the level at which treatment technologies should be targeted to ensure compliance with the limitations (or standards).

[5] Refer to Section 3.4 and 4.4 for more information about the MP&M rulemaking.

Finishing Preliminary Study: Summary of Phase I and Phase II Review of DMR and TRI Data (ERG, 2017a). Section 4.2 of this report presents the results from this analysis.

Table 3-1. Summary of Analyses of the DMR and TRI Data Presented in this Report

Data Source	SIC/NAICS Codes Investigated	Analyses Performed
2014 DMR and TRI Pollutant TWPE Data	All Metal Finishing SIC and NAICS Codes (see Appendix A)	• Evaluated pollutant discharge loads (in pounds per year and toxic weighted pound equivalents (TWPE)), facility counts, and percent unregulated pollutants by SIC/NAICS industry to recommend a subset of SIC/NAICS industries for further review.
Facility Contacts	SIC Codes: • 3731 – Ship Building • 3479 – Metal Coating • 3471 – Electroplating • 3714 - Motor Vehicle • 3624 – Carbon Graphite Corresponding NAICS Codes: • 332813 – Electroplating • 336350; 336340; and 336330 - Motor Vehicle • 336611 – Ship Building • 332812 – Metal Coating • 335991 – Carbon Graphite	• Contacted facilities with the largest TWPE contribution from the subset of SIC/NAICS industries identified in the previous step to confirm that the facility conducts metal finishing operations and discharges metal finishing wastewater. EPA did not pursue further review of Carbon and Graphite Manufacturing facilities (SIC 3624; NAICS 335991) because they do not perform metal finishing operations, as defined in the 1983 regulations.
2010 – 2014 DMR and TRI Pollutant TWPE and Concentration Data[c]	• 3471 – Electroplating • 3714 - Motor Vehicle • 3731 – Ship Building • 3479 – Metal Coating	• Identified for further review a subset of toxic pollutants that contribute greater than 95 percent of the multi-year (2010-2014) TWPE across the industries identified from the step above. • Gathered available outfall and monitoring period concentration data for all facilities within the identified industries discharging the top toxic pollutants. • ***Unregulated Pollutants***.[a] Compared the concentrations for each of the top unregulated pollutants to five times their respective baseline values to assess their general treatability. • ***Regulated Pollutants.***[b] Compared the concentrations of each of the top regulated pollutants to the MF ELGs, MF ELG LTAs and MP&M LTAs to understand how current discharges compare to the ELGs and the most recently evaluated technology performance.

[a] "Unregulated Pollutants" are considered any pollutants that do not have limits under the Metal Finishing ELGs (U.S. EPA, 1983).

[b] "Regulated Pollutants" are considered any pollutants with limits under the Metal Finishing ELGs or proposed MP&M ELGs (U.S. EPA, 1983, 2000b).

[c] Because EPA lacks pollutant discharge concentration data for indirect discharges in the DMR and TRI data, EPA contacted facilities that indirectly discharge metal finishing wastewater and report to TRI a basis of estimate (BOE) of M1 or M2 to obtain underlying concentration data. For further information on facility contacts, see Section 3.4 of the *Metal Finishing Preliminary Study: Summary of Phase I and Phase II Review of DMR and TRI Data* (ERG, 2017a).

3.3 Pollution Prevention (P2) Review

EPA reviewed several publicly available data sources to identify P2 practices performed by Metal Finishing facilities and the prevalence of these practices across the industry. The data sources used in this review included:

- *TRI P2 Data*. TRI P2 data are reported voluntarily by facilities to the TRI Program each year. EPA analyzed 2011 through 2015 TRI P2 data for NAICS codes that fall under the Metal Finishing Category and performed a targeted keyword search of P2 descriptions to understand the P2 practices metal finishing facilities are currently implementing. EPA used the keywords provided in Table 3-2 to flag relevant records for further review (U.S. EPA, 2017).

Table 3-2. Keywords Used for Identifying Metal Finishing TRI P2 Practices

Flag Type	Keywords	
Metal Finishing/Electroplating	Metal finish*	Electroplat*
Recycle	recover* recyc*	reus*
Alternative	alternative	replac*
Zero Liquid Discharge	zero discharge zero liquid discharge	no discharge complete recycle
Wastewater Treatment	treatment	
Pilot-Scale	pilot	
Secondary Keywords	coat* chromat* phosphat* color*	printed circuit* anodiz* electroless* etch*

Note: An asterisk within a keyword searches for all forms of the word containing the portion of the word or phrase prior to the asterisk.

- *Targeted literature search.* EPA performed a targeted literature review to identify in-process and resource recovery P2 technologies, either emerging or prevalent in the metal finishing industry, and to determine the purpose of the identified technologies. This literature search builds on previous EPA literature reviews, described in the 2015 Status Report, that focused on recent technological advances in removing metals in metal finishing wastewater. EPA searched for peer-reviewed journal articles using keywords listed in Table 3-3. EPA identified and reviewed eight journal articles in the targeted search.

Table 3-3. Keywords Used for Literature Search of Metal Finishing P2 Practices

Primary Keywords		Secondary Keywords	Tertiary Keywords
Metal finish*	Pollution Prevention	Wastewater treatment	Cadmium
Electroplat*	P2	Hazardous waste	Chromium
	Recover*	Pilot scale	(hexavalent/trivalent)
	Recyc*	Full scale	Lead
	Reduc*	Electroless	Nickel
	Reuse	Coat*	Copper
	BMP	Chromat*	Cyanide
	Zero discharge	Phosphat*	Toxic Organics
		Color*	Fluoride
		Printed circuit*	

Search Engine: Google Scholar

Note: An asterisk within a keyword searches for all forms of the word containing the portion of the word or phrase prior to the asterisk.

- *Response to Comments for the Final Effluent Limitations Guidelines and Standards for the Metal Products and Machinery Point Source Category (MP&M CRD) (U.S. EPA, 2003a).* As part of the MP&M rulemaking, EPA solicited comments on the proposed MP&M ELGs, which included proposed limitations and guidelines for facilities covered under the Metal Finishing Point Source Category. EPA searched the MP&M CRD (U.S. EPA, 2003a) for comments that used the term "pollution prevention" and reviewed comments relevant to metal finishing facilities to identify P2 practices and technologies they were using at the time of the MP&M rulemaking.
- *Economy – Energy – Environment (E3).* E3 is a federal technical assistance framework comprising six federal government agencies, including EPA. The technical assessments strive to reduce energy consumption, minimize carbon footprints, prevent pollution, increase productivity, and drive innovation. Typically, E3 projects are financed by sources such as federal grants, sustainability funds, and manufacturer's investments. EPA reviewed E3 success stories to identify any innovative P2 practices implemented at metal finishing facilities under this initiative.
- *Regional P2 contacts.* EPA reviewed regional EPA websites to identify any recently active P2 initiatives that targeted the metal finishing industry, as well as resources available to metal finishers looking to implement P2 practices (e.g., guidance documents).

Section 4.3 of this report presents the results of these reviews, including a summary of P2 practices common in the metal finishing industry and resources available to metal finishers.

3.4 Metal Products and Machinery (MP&M) Rulemaking

EPA reviewed supporting documentation from the 2001 MP&M proposed rulemaking, which evaluated facilities covered under the Metal Finishing Category. While EPA decided not to promulgate limits or standards for any metal-bearing wastewater discharges under MP&M, including discharges from metal finishing processes, the MP&M Rulemaking documentation contains information and data related to the Metal Finishing Category that may be useful for the current study. More specifically, EPA reviewed the metal finishing industry profile, metal

finishing process and wastewater technology improvements, and metal finishing wastewater characteristics. EPA also reviewed supporting materials, including correspondence with trade organizations, treatment technology studies, site visit and sampling reports, and databases containing data from information gathering activities, such as questionnaires and sampling episodes.

EPA reviewed the MP&M Rulemaking documentation in two phases: an initial screening review followed by a more detailed review and extraction of information. EPA initially screened more than 1,000 documents associated with the rulemaking to gain perspective on the type of information and data collected and the challenges EPA may have previously encountered in revisiting ELGs applicable to metal finishing facilities. For more information on the initial screening and approach, see *Approach for the Review of Metal Products and Machinery (MP&M) Rulemaking Documentation* (ERG, 2016a) and *Metal Products and Machinery (MP&M) Rulemaking Documentation: Screening Review Results and Proposed Approach for Detailed Review* (ERG, 2016b).

Ultimately, EPA reviewed the Technical Development Document for the 2001 Proposed Rule (MP&M TDD) (U.S. EPA, 2000b), the Preamble to the 2001 proposed rule (U.S. EPA, 2001), and the Preamble for the 2003 final rule (U.S. EPA, 2003b), in addition to the targeted review of the MP&M CRD discussed in Section 3.3 (U.S. EPA, 2003a). EPA reviewed information in the MP&M TDD to identify changes in the metal finishing industry that occurred from the development of the 1983 Metal Finishing ELGs up to the development of the 2001 proposed MP&M ELGs, including pollutants of concern (POCs), metal-bearing wastewater generation (e.g., operations and rinses), and P2 practices. EPA also compared the proposed technology options for metal-bearing wastewater subcategories in the MP&M proposed rule to wastewater treatment operations identified during the development of the Metal Finishing ELGs. EPA reviewed the 2001 proposed rule Preamble and 2003 final rule Preamble to identify information relevant to the metal finishing industry, including major comments from stakeholders and rationale for EPA's decision not to revise the ELGs for the Metal Finishing Category (40 CFR Part 433) in the final MP&M ELGs. For additional information on the detailed reviews of the MP&M documentation, see *Metal Products and Machinery (MP&M) Rulemaking Preamble: Summary of Industry Comments and EPA Decisions Related to the Metal Finishing Category* (ERG, 2017b) and *Metal Products and Machinery (MP&M) Rulemaking TDD: Review and Comparison of Wastewater Technologies, Pollutants of Concern, and Pollution Prevention (P2) Practices Considered in the MP&M and Metal Finishing Rulemakings* (ERG, 2017c).

Section 4.4 of this report summarizes the results of the review of the MP&M Rulemaking.

3.5 Technical Conferences

EPA attended the following industry-specific and general wastewater treatment technical conferences to further inform the Agency on current industry practices:

- National Association for Surface Finishing (NASF) SUR/FIN® Manufacturing & Technology Trade Show & Conference.

- National Association of Clean Water Agencies (NACWA) 2016 and 2017 Pretreatment & Pollution Prevention Workshops.
- Water Environment Federation's Annual Technical Exhibition and Conference (WEFTEC).
- Engineers' Society of Western Pennsylvania's International Water Conference (IWC).

EPA attended the 2016 NASF SUR/FIN® Manufacturing & Technology Trade Show & Conference from June 6-8, 2016, specifically to gather information for the preliminary study of the Metal Finishing Category. This event included vendor booths, paper presentations, and keynote presentations on surface finishing process advancements, novel technologies, and waste management. Presenters and attendees include vendors, engineers, business executives, regulators, and trade association leaders.

EPA attended the NACWA 2016 Pretreatment & Pollution Prevention Workshop from May 17-20, 2016, and the 2017 Pretreatment & Pollution Prevention Workshop from May 16-19, 2017, specifically to gather information for the preliminary study of the Metal Finishing Category. The conference gathers pretreatment professionals, regulators, and vendors to attend workshops and participate in roundtable discussions.

EPA attended WEFTEC on September 24-28, 2016, as part of its annual effluent guideline review process. WEFTEC provides water quality education and training by offering technical sessions and workshops on a variety of topics and provides access to information from exhibitors on water management technologies and services. EPA attended presentations and obtained papers from proceedings relevant to process technologies, alternative chemistries, and wastewater treatment technologies. For the preliminary study of the Metal Finishing Category, EPA reviewed publications from WEFTEC to identify those regarding the treatment of metal finishing wastewater.

EPA also attended the Engineers' Society of Western Pennsylvania's IWC on November 7-9, 2016, as part of its annual effluent guideline review process. IWC discusses the most recent scientific advances and practical applications for treatment, use, and reuse of water for engineering purposes, industry, or otherwise. Presenters and attendees of the IWC include researchers, practicing engineers, managers, educators, suppliers, contractors, government workers, and end users. Most of the publications presented at the conference pertained to the steam electric generating industry; however, EPA also reviewed the publications and identified those relevant to treatment of metal finishing wastewater.

Section 4.5 provides a summary of the conference presentations and topics most relevant to the preliminary study of the Metal Finishing Category.

3.6 Stakeholder Outreach

EPA contacted a variety of stakeholders to improve its understanding of the metal finishing industry and to gain different perspectives on the implementation of the 1983 regulations and current industry operations, discussed below. Further information on the findings of EPA's stakeholder outreach is presented in Section 4.6.

3.6.1 Pretreatment Coordinators

As discussed in Section 2, most metal finishing facilities are indirect dischargers subject to pretreatment standards under the Metal Finishing ELGs. As part of its annual effluent guideline review, EPA continued its conversations with its regional pretreatment coordinators who have direct experience with metal finishing wastewater issues at POTWs. As the scope of the Metal Finishing ELGs is specific to "operations" such as electroplating, etching, and cleaning rather than a specific type of manufacturing, the primary issue raised by the pretreatment coordinators regarded the applicability of this rule, particularly at facilities for which metal finishing operations are ancillary. The pretreatment coordinators also assisted EPA in further understanding the industry's current profile and identifying metal finishing scenarios for which the applicability of the regulations is unclear.

3.6.2 Industry and Trade Organizations

EPA continued discussions with the NASF, a trade association representing the interests of metal finishers (among others). At their invitation, EPA spoke at the NASF Washington Forum in April 2016, to discuss the Agency's metal finishing industry study. EPA also met with NASF in February 2016, November 2016, and April 2017 to discuss the preliminary study of the Metal Finishing Category and information collection requirements. In addition to these meetings, EPA attended a project kickoff meeting for the P2 Research and Implementation for Michigan Metal Finishers and reviewed the "NASF Milwaukee Area Surface Finishing Industry Metal Loadings Study," provided by NASF.

3.6.3 Other Stakeholders

EPA met with the NACWA in November 2016 to understand their perspective on the implementation of the 1983 regulations. EPA also met with NACWA members (Control Authorities) at the 2016 and 2017 national pretreatment conference. NACWA members indicated that the regulations are sufficient but noted that in some cases applicability determinations continue to be challenging. They noted inconsistent determinations and, like the EPA pretreatment coordinators, raised questions concerning the applicability of the regulations particularly at facilities where the metal finishing operations are ancillary.

3.7 Other Regulation Review

EPA performed a comprehensive search of federal regulations which potentially affect the Metal Finishing Category. This search included reviewing environmental regulations on government websites and environmental compliance information on metal finishing trade organization websites. A summary of other regulations most relevant to the preliminary study of the Metal Finishing Category appears in Section 4.7.

4. RECENT STUDY FINDINGS

This section describes the findings of EPA's analyses of the data and information gathered during the 2016 and 2017 activities described in Section 3, including:

- Site Visits to Metal Finishing Facilities (Section 4.1)
- DMR and TRI Data Analysis (Section 4.2)
- P2 Review (Section 4.3)
- MP&M Rulemaking (Section 4.4)
- Technical Conferences (Section 4.5)
- Stakeholder Outreach (Section 4.6)
- Other Regulation Review (Section 4.7)

The findings discussed in this section focus on the following topics:

- Changes to the scope of facilities, including geographic distribution, facility size, distribution of captive and job shop operations, discharge practice, and downstream markets.
- Advances in process technologies.
- Use of alternative process chemicals and formulations.
- Use of pollution prevention and wastewater treatment technologies.
- Existing regulatory issues and industry standards for consideration.

4.1 Site Visits to Metal Finishing Facilities

In 2016, EPA conducted site visits at 18 facilities to observe and collect information on metal finishing operations and wastewater management practices. EPA selected the facilities by reviewing publicly available discharge data, wastewater treatment processes, TRI P2 data, and through recommendations from Control Authorities. During these visits, EPA received information on general process design, typical operating conditions, wastewater treatment and/or management technologies and approaches, data on raw and treated wastewater samples, and plating metal usage rates. EPA also visited one vendor in Indiana that had developed (at lab scale) an environmentally friendly alternative to hexavalent chromium plating baths, using trivalent chromium and an ionic liquid chemistry. EPA prepared individual site visit reports documenting each visit and providing detailed, facility-specific information. Table 4-1 lists the metal finishing facilities where EPA conducted site visits and cites the Document Control Numbers (DCNs) of all the site visit reports in the docket.

Table 4-1. List of Metal Finishing Site Visits

Facility Name	Facility Location	40 CFR 413/433	Website	Site Visit Date	Site Visit Report DCN[a]
Carlisle Interconnect	El Segundo, CA	433	http://www.carlisleit.com/	May 16, 2016	MF00111CBI, MF00161
PB Fasteners	Gardena, CA	433	http://www.pccfasteners.com/companies/pcc-fasteners/pb-fasteners.html	May 17, 2016	MF00113CBI, MF00158

Table 4-1. List of Metal Finishing Site Visits

Facility Name	Facility Location	40 CFR 413/433	Website	Site Visit Date	Site Visit Report DCN[a]
Northrop Grumman	Redondo Beach, CA	433	http://www.northropgrumman.com	May 19, 2016	MF00114
Hill Air Force Base	Ogden, UT	433	http://www.hill.af.mil/	July 11, 2016	MF00119CBI, MF00184
Williams International	Ogden, UT	433	http://www.williams-int.com/	July 12, 2016	MF00120CBI, MF00185
Blanchard Metal Processing	Salt Lake City, UT	413	http://www.bmproc.com/	July 13, 2016	MF00121CBI, MF00186
Pilkington Metal Finishing LLC	Salt Lake City, UT	433	http://pilkingtonmetalfinishing.com/	July 13, 2016	MF00122CBI, MF00187
O.C. Tanner Manufacturing Company	Salt Lake City, UT	433	http://www.octanner.com/about-us/manufacturing-excellence.html	July 14, 2016	MF00123CBI, MF00188
Varian Metal Systems X-Ray Products	Salt Lake City, UT	433	https://www.varian.com/about-varian/varian-technologies	July 14, 2016	MF00124
Plymouth Plating Works	Plymouth, MI	413	http://www.plymouthplating.com/	August 15, 2016	MF00126
KC Jones	Hazel Park, MI	433	http://www.kcjplating.com/	August 15, 2016	MF00127CBI, MF00189
AJAX Metal Processing	Detroit, MI	413	https://www.ajaxmetal.com/	August 16, 2016	MF00128CBI, MF00190
Ford Flat Rock	Flat Rock, MI	433	https://corporate.ford.com/company/plant-detail-pages/flat-rock-assembly-plant.html	August 16, 2016	MF00129CBI, MF00191
Elm Plating	Jackson, MI	433	http://www.elmplating.com/	August 17, 2016	MF00130
Trion Coatings, LLC (vendor)	South Bend, IN	NA	http://www.trioncoatings.com/	August 17, 2016	MF00131
Methode Electronics, Inc.	Rolling Meadows, IL	433	http://www.methode.com/	August 18, 2016	MF00132
Eagle Electronics	Schaumburg, IL	433	http://www.eagle-elec.com/	August 18, 2016	MF00133
Metal Impact LLC	Elk Grove Village, IL	433	http://metalimpact.com/	August 19, 2016	MF00134CBI, MF00196
Magnetic Inspection Laboratory	Elk Grove Village, IL	433	http://www.milinc.com/	August 19, 2016	MF00135CBI, MF00195

DCN: Document Control Number; NA: Not Applicable.

[a] Some facilities have a Confidential Business Information (CBI) version of the site visit report, listed as its own DCN, separate from the sanitized version of the site visit report.

The remainder of this section provides a general summary of EPA's findings from the site visits to protect Confidential Business Information (CBI) claims made by facilities.

As described in the 2015 Status Report, during the promulgation of the Metal Finishing ELGs, EPA categorized facilities as captive facilities or job shops, as defined in the 1983 Metal Finishing ELGs and described below (U.S. EPA, 1984):

- *Captive facility.* A facility that in a calendar year owns more than 50 percent (by surface area) of the materials undergoing metal finishing. Captive facilities were categorized as integrated or non-integrated to characterize the wastewater discharges generated. Integrated facilities are those which, prior to treatment, combine electroplating waste streams with significant process waste streams not covered by the Electroplating Category (40 CFR Part 413). Non-integrated facilities are those which have significant wastewater discharges only from operations addressed by the Electroplating Category.
- *Job shop.* A facility that in a calendar year owns less than 50 percent (by surface area) of the materials undergoing metal finishing. During development of the regulation, approximately 97 percent of job shops were found to be non-integrated.

Of the 18 facilities visited in the 2016 site visits, nine are integrated, captive facilities and one facility is a non-integrated captive facility; two facilities are integrated job shops, and the remaining six facilities are non-integrated job shops. All facilities discharged indirectly to POTWs.

The site visit facilities ranged in size from less than 10 employees to over 10,000 employees, with most facilities having between 100 and 500 employees. The facilities serve a broad range of markets, including:

- Aircraft/aerospace
- Automotive
- Medical devices
- Military
- Electronics (including semiconductors)
- Jewelry and miscellaneous awards (medals, trophies, etc.)
- General, non-specific

EPA observed several facilities that operated multiple surface cleaning and preparation steps (such as etching, pickling, bright dipping, media blasting, and passivation), plating, hot and cold rinsing, and post-treatment steps (such as coloring, heat treatment, and parts finishing). Additionally, EPA observed that most of the metal finishing facilities listed in Table 4-1 perform single or multi-layer plating processes using a barrel or rack line.[6] Some facilities automated their operations to perform a series of steps based on desired product specifications, while others manually operated their plating lines for more versatility. EPA observed other common surface finishing operations during the site visits, including aluminum anodizing, chromating,

[6] On a barrel line, facilities place parts inside a slowly-rotating barrel immersed in a plating solution, causing the parts to tumble and coating them uniformly. On a rack line, facilities place parts on stationary metal racks that are then immersed in a plating solution, thus protecting delicate parts from damage.

phosphating, and powder coating. A few facilities performed more specialized operations, such as ion vapor deposition, high velocity oxygenated fuel (HVOF) spray coating, or zirconization. The facilities used a range of different base materials, including brass, copper, aluminum, stainless steel, carbon steel, and Inconel. They also plated a variety of metals, including:

- Bronze
- Cadmium
- Chromium
- Copper
- Gold
- Nickel
- Rhodium
- Silver
- Tin
- Titanium
- Zinc
- Zinc-nickel

From the site visits, EPA confirmed that most metal finishing facilities performed pre-treatment of segregated waste streams before combining the pretreated wastewaters for primary wastewater treatment. These pre-treatment steps typically include cyanide destruction and hexavalent chromium reduction. Facilities also generally have similar wastewater treatment steps such as equalization, neutralization, metals precipitation, flocculation, clarification, and sludge thickening. Facilities sent the solids from the sludge thickening and filter press offsite for disposal as hazardous waste. A few metal finishing facilities also employ ion exchange or microfiltration to treat rinsewater for reuse.

Facility-specific site visit reports (CBI and sanitized versions) with further details on facility processes and wastewater treatment can be found in EPA's docket for the study (EPA-HQ-OW-2015-0665).

4.2 DMR/TRI Data Analysis

Section 3.2 provides the methodology for this DMR/TRI analysis, including an explanation of EPA's comparisons of observed pollutant concentrations to the analytical baseline value (baseline values established in the *Development Document for the Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment (CWT) Industry* (U.S. EPA, 2000a), 1983 Metal Finishing ELGs and long-term average concentrations (MF ELG LTA), and 2001 MP&M ELGs lowest pollutant LTA (MP&M LTA). This section presents the results and conclusions of these analyses.

4.2.1 Industries under the Metal Finishing Category Contributing Top Pollutant Discharges in 2014

EPA analyzed 2014 pollutant discharge data reported to TRI and on DMRs for facilities within SIC/NAICS codes that it had previously determined fall within the Metal Finishing Category (listed in Appendix A). EPA calculated an aggregated toxic weighted pound equivalents (TWPE) for each facility based on the reported pollutant discharges and previously established toxic weighting factors (TWFs) (U.S. EPA, 2016b). EPA summed the TWPE across facilities in each SIC/NAICS code to identify the top industries by SIC/NAICS code contributing toxic pollutant discharges within the Metal Finishing Category. Table 4-2 lists the top five industries by SIC code and corresponding NAICS code. These five SIC codes represent 67 percent of the total direct discharge load by TWPE in the 2014 DMR data. The seven

corresponding NAICS codes represent 81 percent of the total direct discharge load and 27 percent of the total indirect discharge load by TWPE in 2014 TRI data (ERG, 2016c).

EPA then contacted facilities that discharged the largest percentage of TWPE within the SIC/NAICS codes to confirm that the facilities conduct metal finishing operations and discharge metal finishing wastewater. From the facility contacts, EPA determined that four of the five SIC codes have facilities that generate metal finishing wastewater; therefore, EPA reviewed these industries further. EPA did not further review of the fifth SIC Code, Carbon and Graphite Manufacturing facilities (SIC: 3624 – Carbon and Graphite Products; NAICS: 335991 – Carbon and Graphite Product Manufacturing), because the top pollutant dischargers within this industry (comprising 99 percent of total industry-specific TWPE for 2014 DMR data and 72 percent of total industry-specific TWPE for 2014 TRI data) do not perform metal finishing operations as defined in the 1983 regulations.

Table 4-2. Top Metal Finishing Dischargers by SIC and NAICS Codes Identified from 2014 DMR and TRI Data

SIC Code	SIC Code Description	NAICS Code	NAICS Code Description	Perform Metal Finishing Operations that Generate Metal Finishing Wastewater?
3471	Electroplating, Plating, Polishing, Anodizing, and Coloring	332813	Electroplating, Plating, Polishing, Anodizing, and Coloring	Yes
3714	Motor Vehicle Parts and Accessories	336350	Motor Vehicle Transmission and Power Train Parts Manufacturing	Yes
		336340	Motor Vehicle Brake System Manufacturing	
		336330	Motor Vehicle Steering and Suspension Components (except Spring) Manufacturing	
3731	Ship Building and Repairing	336611	Ship Building and Repairing	Yes
3624	Carbon and Graphite Products	335991	Carbon and Graphite Product Manufacturing	No
3479	Coating, Engraving, and Allied Services, Not Elsewhere Classified	332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers	Yes

4.2.2 Pollutant Analyses

For the SIC and NAICS codes listed in Table 4-2 that perform metal finishing operations that generate metal finishing wastewater, EPA evaluated 2010 through 2014 DMR and TRI pollutant discharge data to identify the top pollutants discharged, in terms of aggregate 2010 through 2014 TWPE. EPA further analyzed reported concentrations of the top pollutants across the DMR and TRI data sets, depending on whether the Metal Finishing ELGs have established limitations for the pollutants. As described in Section 3.2, EPA downloaded DMR concentration data for the top pollutants from the Water Pollutant Loading Tool. Because facilities do not report concentration or flow data to TRI, EPA contacted a small subset of facilities reporting releases of the pollutants to TRI to obtain underlying concentration data as described in Section 3.4 of the *Metal Finishing Preliminary Study: Summary of Phase I and Phase II Review of DMR and TRI Data* (ERG, 2017a).

4.2.2.1 Top DMR Pollutants

Table 4-3 presents the pollutants contributing greater than 95 percent of the cumulative DMR TWPE for the targeted SIC codes for reporting years 2010 through 2014 (ERG, 2018). The table also indicates whether the pollutants are regulated under the Metal Finishing ELGs.

EPA also ranked the DMR pollutants discharged by facilities in the targeted SIC codes by pounds for reporting years 2010 through 2014. EPA found that over 80 percent of the cumulative pounds discharged are attributed to conventional pollutants including total suspended solids (TSS), total dissolved solids (TDS), chemical oxygen demand (COD), and biochemical oxygen demand (BOD); therefore, EPA continued to focus its analyses on pollutants listed in Table 4-3 that contribute a majority of the toxic discharges.

Table 4-3. Top Pollutants by TWPE Based on Reported DMR Data, 2010 – 2014

Pollutant	Total DMR TWPE for All Five Years (lb/eq)	Percent of Total DMR TWPE for All Five Years	Regulated Pollutant?
Silver	732,000	66.9%	Yes
Lead	127,000	11.6%	Yes
Nickel	87,500	8.0%	Yes
Copper	39,700	3.6%	Yes
Total Residual Chlorine	25,500	2.3%	No
Chromium	24,000	2.2%	Yes
Mercury	18,400	1.7%	No
All Other Pollutants	40,200	3.7%	-
Total Across All Pollutants	**1,090,000**	**100%**	**-**

Source: (ERG, 2018)

4.2.2.2 Top TRI Pollutants

Table 4-4 presents the pollutants contributing greater than 95 percent of the cumulative TRI TWPE for the targeted NAICS codes for reporting years 2010 through 2014 (ERG, 2018). The table also indicates whether the pollutants are regulated under the Metal Finishing ELGs. Several of the pollutants are also top pollutants from the DMR analysis shown above.

Table 4-4. Top Pollutants by TWPE Based on Reported TRI Data, 2010 – 2014

Pollutant	Total TRI TWPE for All Five Years (lb/eq)	Percent of TRI TWPE for all Five years[a]	Regulated Pollutant?
Copper	16,100	32.9%	Yes
Lead	9,350	19.1%	Yes
Zinc	5,280	10.8%	Yes
Nitrate	5,190	10.6%	No
Nickel	4,580	9.4%	Yes
Manganese	4,140	8.5%	No
Cadmium	2,370	4.8%	Yes
All Other Pollutants	1,880	3.8%	
Total Across All Pollutants	**48,900**	**100%**	**-**

Source: (ERG, 2018)

From the collective analysis of the top pollutants reported to DMR and TRI for 2010-2014, EPA identified for further review the following list of pollutants that contribute greater than 95 percent of the toxic discharges within the targeted SIC/NAICS codes. For each of the pollutants listed below, EPA downloaded from the Water Pollutant Loading Tool all available outfall and monitoring period concentration data reported on DMRs for facilities within the four targeted SIC codes. EPA obtained underlying concentration data from a subset of facilities in the targeted NACIS codes that reported the pollutants to TRI (see Section 3.4 of (ERG, 2017a) for information on EPA's methodology for obtaining pollutant concentration data). As described in Section 4.2.4 and 4.2.3 below, EPA performed comparisons of concentrations of the pollutants to various benchmarks to further understand the potential significance and treatability of their discharge.

Top Regulated Pollutants

- Cadmium
- Chromium
- Copper
- Lead
- Nickel
- Silver
- Zinc

Top Unregulated Pollutants

- Manganese
- Mercury
- Nitrate
- Total Residual Chlorine

4.2.3 Unregulated Pollutant Analysis

When looking at a pollutant's concentration in wastewater, EPA often compares that concentration to a threshold of five or ten times the analytical baseline value to gauge its treatability. For this analysis, EPA considered DMR and underlying TRI concentrations detected above five times the baseline value as treatable. Table 4-5 presents the range and median concentrations for each pollutant across the targeted SIC/NAICS codes as well as the pollutants' respective baseline values (ERG, 2018). As shown, the median concentrations for mercury and total residual chlorine are below five times the baseline value, suggesting that these pollutants

are not generally present in the wastewater at treatable levels. However, EPA notes that the data for unregulated pollutants is limited because many facilities do not have permit limits or monitoring requirements for these pollutants. Although the median concentration for nitrate is above five times the baseline value, the data represent only five facilities and may not be an indication of nitrate discharges across the metal finishing industry. Similarly, the median concentration for manganese from the TRI data set is above five times the baseline value, however, the TRI data represent only one facility.

Table 4-5. Summary of DMR and TRI Concentration Data for Unregulated Pollutants Compared to Baseline Values

Metric	Manganese[a]	Mercury	Nitrate[b]	Total Residual Chlorine[c]
DMR Data				
Minimum Concentration (mg/L)	0.005	1×10^{-11}	0.305	0.000018
Median Concentration (mg/L)	0.005	6.0×10^{-6}	23.43	0.05
Maximum Concentration (mg/L)	0.005	0.0008	386	8.3
Number of Data Points	60	471	138	908
TRI Data				
Minimum Concentration (mg/L)	0.005	-	-	-
Median Concentration (mg/L)	0.24	-	-	-
Maximum Concentration (mg/L)	1	-	-	-
Number of Data Points	29	0	0	0
Analytical Baseline Value (mg/L)	0.015	0.0002	0.05	1
5x Analytical Baseline Value (mg/L)	0.075	0.001	0.25	5

Source: (ERG, 2018)

[a] All DMR manganese concentrations are from one facility and all concentrations are equal.

[b] DMR nitrate concentrations are from 5 facilities, all in the Electroplating, Plating, Polishing, Anodizing, and Coloring SIC Code (SIC 3471).

[c] EPA used the analytical baseline value for chloride to compare to the total residual chlorine concentrations.

4.2.4 Regulated Pollutant Analysis

For the regulated pollutants, EPA compared the concentration data to the Metal Finishing (MF) limitations as well as the MF LTAs and the MP&M LTAs. As shown in Table 4-6, the median of the concentrations for each of the regulated pollutants are an order of magnitude or more lower than the comparable limitations and LTAs relevant to the metal finishing industry, including the LTAs identified for metal finishing processes during the development of the MP&M ELGs (ERG, 2018). As described further in Section 4.4, EPA ultimately decided not to promulgate limitations and standards for any metal-bearing wastewater discharges under the final MP&M rule. [7]

[7] As described in Section 4.4, during development of the MP&M rulemaking EPA evaluated additional controls for five metal-bearing wastewater subcategories, four of which included metal finishing facilities.

Table 4-6. Summary of DMR and TRI Concentration Data for Regulated Pollutants Compared to Metal Finishing ELGs and Relevant LTAs

Metric	Cadmium	Chromium	Copper	Lead	Nickel	Silver	Zinc
DMR Data							
Minimum Concentration (mg/L)	0.000002	0.0002	0.000001	0.00007	0.00004	0.00001	0.00003
Median Concentration (mg/L)	0.001	0.01	0.0245	0.0079	0.06	0.004	0.0869
Maximum Concentration (mg/L)	0.065	1.00	100.5	1.00	37.2	12.5	95.1
Number of Data Points	702	1,032	2,889	944	1,371	757	2,746
TRI Data							
Minimum Concentration (mg/L)	0.00005	0.0025	0.0025	0.0002	0.0025	0.001	0
Median Concentration (mg/L)	0.0005	0.025	0.005	0.025	0.005	0.001	0.129
Maximum Concentration (mg/L)	0.004	0.025	0.687	0.085	0.014	0.002	3.73
Number of Data Points	21	50	332	50	50	21	285
ELG Monthly Average (mg/L)	0.26[a]	1.71	2.07	0.43	2.38	0.24	1.48
ELG Daily Maximum (mg/L)	0.69[a]	2.77	3.38	0.69	3.98	0.43	2.61
MF LTA (mg/L)	0.13	0.572	0.815	0.2	0.942	0.096	0.549
MP&M LTA (mg/L)	0.05	0.1	0.17	0.02	0.08	0.04	0.11

Source: (ERG, 2018)

[a] ELG monthly average and daily maximum values shown for cadmium are for BPT. NSPS/PSES limitations are 0.07 mg/L monthly average and 0.11 mg/L daily maximum.

4.2.5 Summary of Results and Conclusions

For the DMR/TRI data analysis, EPA identified and focused its evaluation on discharges from a subset of the metal finishing industry that falls within four SIC and six corresponding NAICS codes. These top industry sectors, which EPA confirmed perform metal finishing operations and discharge wastewater, contribute a majority of the toxic pollutant discharges within the Metal Finishing Category, based on 2014 DMR and TRI data.

Across the top industry sectors, EPA identified four unregulated and seven regulated pollutants that collectively account for greater than 95 percent of the TWPE. For these top 11 toxic pollutants EPA obtained and evaluated reported facility outfall and monitoring period concentration data to understand the significance and potential treatability of their discharge. For the four unregulated pollutants, EPA compared the range and median of the concentrations to the respective baseline values and found that only the median nitrate concentration exceeded five times the baseline value, suggesting that most of the unregulated pollutants may not generally be present in the wastewater at treatable levels. However, EPA notes that the available data for unregulated pollutants are limited. Specific to nitrate and manganese, though the data suggest the concentrations may be present at treatable levels, the data represent only a few facilities and may not represent discharges across the metal finishing industry. For the seven regulated pollutants, EPA compared the median of the concentrations to the Metal Finishing ELGs as well as the MF

LTA and the MP&M LTA concentrations and found that the concentrations for each of the regulated pollutants are an order of magnitude or more lower than the comparable limitations and LTAs, suggesting that the discharges of these pollutants are adequately controlled. As described further in Section 4.4, EPA ultimately decided not to promulgate limitations and standards for any metal-bearing wastewater discharges under the final MP&M rule due to technological or economic achievability concerns and changes to datasets and methodologies in response to public comments.

4.3 Pollution Prevention (P2) Review

EPA identified P2 practices and their prevalence at metal finishing facilities through the review of the following data sources (detailed in Section 3.3):

- TRI P2 data[8]
- Literature review[9]
- MP&M Comment Response Document (CRD) [10]
- Economy – Energy – Environment (E3) Success Stories[13]
- Regional P2 contacts[11]

This section summarizes the P2 practices for metal finishing facilities, including process technology controls and alternatives, alternative process chemistries, wastewater recycling and materials recovery, and other resources available to metal finishers. Refer to Appendix B for a full listing of P2 practices found during EPA's review.

4.3.1 Process Technology Controls and Alternatives

EPA identified metal finishing facilities implementing process controls or altering existing process operations to minimize waste generation, including:

- *Water conservation practices.* Facilities frequently reported using alternative rinsing and control practices to conserve in-process water. Metal finishing facilities reported using countercurrent rinsing, an alternative rinse-tank configuration in which rinsewater flows opposite the direction of finished parts, with the cleanest rinsewater used as the final rinse. Facilities also reported using spray rinses in place of dip rinses to reduce the volume of water used per rinse. In addition, EPA identified conductivity and flow controls used to conserve rinsewater at metal finishing facilities mentioned in P2 data sources.

[8] For full results from the TRI P2 data review, see memorandum *Toxic Release Inventory (TRI) Pollution Prevention (P2) Data Summary* (ERG, 2017g).

[9] For full results from the literature review, see memorandum *Results of the Pollution Prevention Targeted Literature Review for the Metal Finishing Industry* (ERG, 2017f).

[10] For full results from the MP&M CRD review, see memorandum *Results of the Targeted Review of the MP&M Comment Response Document: Pollution Prevention and Wastewater Treatment Practices* (ERG, 2017h).

[11] For full results from the E3 success stories review and regional P2 contacts review, see the memorandum *Results of the Pollution Prevention Data Collection using E3 Sources and Regional Contacts in the Metal Finishing Industry* (ERG, 2017d).

- *Process changes.* EPA identified practices that involve altering existing metal finishing process operations to reduce waste generation, including installing in-tank filtration of process fluids, installing air emissions controls, and optimizing process tank volumes. Although less frequently reported than water conservation practices EPA identified greener alternative operations that can replace existing processes, such as replacing liquid coatings with powder coatings, and implementing more advanced plating technologies, such as HVOF[12] spray application for chromium plating.
- *Recycle scrap materials.* Metal finishing facilities reported recycling materials, such as defective parts and solder, to reduce facility waste generation.
- *Methods to reduce dragout.*[13] EPA identified methods to reduce the amount of dragout transferred from process tanks to rinse tanks. These include methods that remove dragout from parts, such as sponge rollers or air knives that use a sponge or air, respectively, to force dragout off the part, or techniques to capture dragout so it may be directed back into process tanks.
- *Methods to increase throughput efficiency.* Metal finishing facilities also reduce pollution generation and discharge by increasing efficiency in their manufacturing processes. Reported examples include modifying process schedules and tank layouts. Increasing throughput efficiency may also add the benefit of cost savings.

4.3.2 Alternative Process Chemistries

EPA found that some facilities have modified process chemistries for their metal finishing operations and have considered chemical alternatives that are more environmentally friendly for solvents/cleaners, plating solutions, and anodes. Facilities reported replacing chemical solvents with water-based coatings or cleaners, converting to lead-free electroplating anodes, replacing processes that produce cyanide-bearing wastewater, and adopting low-volatile organic compound (VOC) coating chemical alternatives. Facilities are also currently investigating replacements for cadmium and hexavalent chromium plating baths that are less toxic but can achieve equivalent plating specifications. EPA identified alternative process chemistries as an active area of P2 innovation through review of TRI P2, literature review, and regional P2 data (see Appendix B).

4.3.3 Wastewater Recycling, Materials Recovery, and Treatment Alternatives

Metal finishing facilities can reduce wastewater discharge and reduce water costs by implementing practices such as segregating metal finishing wastewater for reuse, metals recovery, and near zero liquid discharge treatment systems, as described below.

- *Segregation of wastewater for recycle/reuse.* Metal finishing facilities reported segregating wastewater during collection and treatment for recycle and reuse. For

[12] HVOF is a type of thermal spray coating that can replace hard chrome plating for certain parts. Refer to the *Preliminary Study of the Metal Finishing Category: 2015 Status Report* for additional information on this technology (U.S. EPA, 2016a).

[13] Dragout is the water carried out of the plating bath with a part and into succeeding tanks.

example, metal finishing facilities reported the capture and segregated treatment of chromium-bearing wastewater for reuse in chromium electroplating baths.

- *Recycle/reuse spent cleaners and solvent.* Facilities reported recycling cleaners and solvents, such as ethylene glycol, hydraulic oil, and coolants, with recovery systems prior to reuse. The treatment technology used is dependent on the type of the solution; however, EPA identified filtration systems as a common treatment method for solvent recycling at metal finishing facilities.
- *Recover materials from wastewater.* EPA identified the recovery of metals from spent plating baths and metal finishing process solutions using advanced technologies, such as electrowinning, and the recovery of metals from metal finishing sludge as potential metal finishing P2 practices. Gold and silver are candidates for recovery via electrodialysis (McLay, 2001).
- *Regenerate spent plating baths.* P2 data sources identify the regeneration of spent plating baths using advanced treatments such as electrowinning, crystallization, evaporation, and/or microfiltration for metal finishers (see Appendix B). However, bath regeneration is not frequently used because chemical suppliers and customers require strict specifications for bath plating formulas.
- *Use alternative wastewater treatment chemicals.* Facilities reported using alternative chemicals (e.g., ferrous sulfate, caustic soda) to reduce the volume of sludge generated during metal finishing wastewater treatment by chemical precipitation.
- *Additional wastewater treatment beyond the metal finishing BAT.* Metal finishing facilities reported implementing wastewater treatment technologies more advanced than the Metal Finishing BAT to treat metal finishing process wastewater. These technologies include ion exchange, ultrafiltration, dissolved air flotation, reverse osmosis, evaporation/distillation, and electrowinning. EPA also identified zero discharge or near-zero liquid treatment technologies for metal finishers in the literature (see Appendix B).

4.3.4 P2 Initiatives and Resources for the Metal Finishing Industry

EPA reviewed the regional P2 and E3 data sources described in Section 3.3, as well as additional state, regional, and federal websites, to identify active P2 initiatives and P2 resources, such as guidance documents, available to the metal finishing industry. From this review, EPA identified the Pollution Prevention Resource Exchange (P2Rx), a national partnership of eight regional pollution prevention information centers funded in part through grants from EPA, and searched programs within P2Rx for more information about regional activities. Table 4-7 provides the name, a summary of the program, a reference for each regional program and the respective EPA region it targets. The P2Rx website does not offer guidance materials specific to metal finishing, but general P2 information, as well as links to regional resources.

EPA also identified the National Metal Finishers Strategic Goals Program (SGP) as an inactive metal finishing P2 program. SGP, which stemmed from EPA's Common Sense Initiative, was a voluntary, performance-based program that committed industry participants to reducing discharges from process operations beyond that required by law. SGP committed other

stakeholders to aiding industry in meeting their environmental goals.[14] The program ended in 2002.

EPA performed a cursory review of state websites and determined that many individual state governments or a collaboration of state governments maintain P2 programs that offer some level of technical assistance to manufacturers, including metal finishers, to voluntarily implement P2 practices. This assistance may include technology fact sheets, P2 manuals, links to available EPA P2 funding sources, workshops, or non-regulatory walk-through audits. EPA also determined that some states offer minimal or no technical assistance for P2 implementation.

Additionally, metal finishers can take advantage of E3 programs and services to reduce energy usage, decrease carbon footprint, prevent pollution, and increase efficiency and cost savings at their facilities.[15] Metal finishers may use several E3 programs and resources to support customized technical assessments designed to identify practical, sustainable procedures that can be integrated throughout a facility or group of facilities. For more information about E3 and regional P2 support see *Results of the Pollution Prevention Data Collection using E3 Sources and Regional Contacts in the Metal Finishing Industry* (ERG, 2017d).

[14] The Metal Finishing Strategic Goals Program and P2 alternative were detailed in the MP&M 2001 Proposed Rule (EPA-HQ-OW-2002-0033-0001).

[15] Refer to Section 3.3 for an overview of E3.

Table 4-7. Major Regional P2 Technical Assistance Websites

Program Name	EPA Region(s) Served by Program	Program Summary	Reference
Northeast States Pollution Prevention Roundtable/ P2 Information Center	1, 2	Serves state and local environmental assistance programs by managing a regional roundtable of state and local environmental programs, managing a resource center for information, conducting training sessions for state officials, researching innovative and source reduction strategies and techniques, coordinating joint policy, and supporting program development. Includes resources associated with the National Metal Finishers Strategic Goals Program.[a] This site links to P2Rx resources and the New York State Dept. of Environmental Conservation P2 Unit outreach program for the metal finishing industry.	(NEWMOA, 2013)
Environmental Sustainability Resource Center (ESRC)	3, 4	Provides comprehensive online resources, news, and information about pollution prevention to state environmental agencies, businesses, technical assistance providers, and the public. Does not include guidance P2 documents or programs specific to the metal finishing industry. This site links to P2Rx site and EPA E3 program information.	(ESRC, 2017)
Great Lakes Regional Pollution Prevention Roundtable (GLRPPR)	2, 3, 5	Promotes information exchange and networking to P2 professionals in the Great Lakes region. Includes resources for many industry sectors, including metal finishing, and provides various technical guidance documents. This site links to resources on Ohio, Illinois, Massachusetts, and Washington state websites, federal websites, and vendor websites. Resource network serves Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, and Ontario.	(GLRPPR, 2017)
Zero Waste Network	6	Provides tools and resources to help industry identify money-saving options to reduce pollution. P2 resources include workshops and guidance for general P2 planning. Also included are common alternatives or P2 practices for process operations, including those often performed at metal finishing facilities (e.g., acid pickle, dragout rinsing).	(ZWN, 2017)
Pollution Prevention Regional Information Center (P2RIC)	7	Enhances resource sharing among programs, businesses, and agencies that provide waste reduction services and expertise to business and industry in the region. Does not provide current P2 resources specific to metal finishing. Site links to Iowa, Kansas, Missouri, and Nebraska state P2 programs. This site also links to P2Rx resources.	(P2RIC, 2017)

Table 4-7. Major Regional P2 Technical Assistance Websites

Program Name	EPA Region(s) Served by Program	Program Summary	Reference
Peak to Prairies Pollution Prevention Information Center	8	Encourages adoption of P2 practices by businesses and works with technical assistance providers to promote P2 and environmental management. Offers access to current P2 information and contacts, encourages collaboration and leveraging of resources between states and programs, and distributes P2 information through websites and presentations. This site links to P2 programs in Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming and P2Rx resources. Website does not provide P2 technical guidance specific to metal finishers.	(Peak to Prairies, 2017)
Western Sustainability and Pollution Prevention Network (WSPPN)	9	Serves as a technical resource for regional P2 issues through researching, consolidating, and disseminating P2 information. This website includes numerous P2 resources for metal finishers. Links to EPA Region 9 website.	(WSPPN, 2017)
Pacific Northwest Pollution Prevention Resource Center (PPRC)	10	Works collaboratively with business, government, and non-governments organizations to promote P2 and offer high quality, unbiased P2 information (not specific to metal finishers).	(PPRC, 2017)

[a] The National Metal Finishers SGP began in 2001 as a voluntary incentive program that committed metal finishers to reduce discharges from process operations beyond that required by law. For more information regarding the SGP, see the MP&M 2001 Proposed Rule (EPA-HQ-OW-2002-0033-0001). The technical documents associated with this initiative may be outdated.

4.4 Metal Products and Machinery (MP&M) Rulemaking

EPA conducted a review of materials generated during the development of the 2003 MP&M ELGs (40 CFR Part 438) to identify information relevant to facilities covered under the Metal Finishing Category, as described in Section 3.4. Although EPA decided not to promulgate limits or standards for any metal-bearing wastewater discharges under MP&M for the final rule, including discharges from metal finishing processes, the MP&M Rulemaking documentation contains useful information and data relevant to the Metal Finishing Category. This section summarizes the findings of detailed MP&M documentation reviews and includes:

- Descriptions of MP&M subcategories containing metal finishing facilities.
- Pollutants of concern.
- P2 and wastewater treatment technologies identified between the development of the 1983 Metal Finishing ELGs and the 2001 MP&M proposed ELGs.
- Technology bases considered for the MP&M ELGs.
- Key MP&M findings regarding the metal finishing industry.

4.4.1 Subcategories Containing Metal Finishers

In 2001, EPA published the MP&M proposed ELGs which would have established more stringent limitations and standards for the MP&M industry (facilities that manufacture, rebuild, or maintain finished metal products, parts, or machines that fall within sixteen identified industrial sectors), which included facilities covered by the Metal Finishing ELGs. The 2001 proposed ELGs divided MP&M facilities into eight subcategories grouped by manufacturing, maintenance, or rebuilding operations, as follows:

- Metal-bearing wastewater subcategories:
  - General Metals
  - Metal Finishing Job Shops
  - Printed Wiring Board
  - Non-Chromium Anodizing
  - Steel Forming and Finishing

- Oil-bearing wastewater subcategories:
  - Oily Wastes
  - Railroad Line Maintenance
  - Shipbuilding Dry Docks

Ultimately, EPA decided not to promulgate ELGs for seven of the eight subcategories. This was largely due to technological or economic achievability concerns and changes to datasets and methodologies in response to public comments. The remaining subcategory, Oily Wastes, did not include any metal finishers; therefore, no metal finishing facilities were subject to the final MP&M ELGs (U.S. EPA, 2003b).

Of the five proposed metal-bearing wastewater subcategories, four included metal finishing facilities. The four proposed MP&M subcategories that contain metal finishing

facilities (Metal Finishing Job Shops, Printed Wiring Board, Non-Chromium Anodizing, and General Metal) and the additional proposed metal-bearing wastewater subcategory (Steel Forming and Finishing) are further described below (U.S. EPA, 2000b).

- *Metal Finishing Job Shops.* Facilities in the proposed Metal Finishing Job Shops Subcategory perform at least one of the six core metal finishing operations (electroplating; electroless plating; anodizing; coating, including chromating, phosphating, passivation, and coloring; chemical etching and milling; and printed circuit board manufacturing) and own not more than 50 percent (on an annual basis) of the materials undergoing metal finishing. All facilities in this subcategory are regulated under the Metal Finishing ELGs or Electroplating ELGs. EPA estimated that the proposed Metal Finishing Job Shops Subcategory consisted of approximately 1,500 indirect dischargers and 15 direct dischargers.
- *Printed Wiring Board.* Facilities in this proposed subcategory discharge wastewater from the manufacture or repair of printed wiring boards (i.e., circuit boards). All facilities in the Printed Wiring Board Subcategory are regulated under the Metal Finishing or Electroplating ELGs. EPA estimated that approximately 620 indirect dischargers and 11 direct dischargers were in the Printed Wiring Board Subcategory.

  Facilities in this subcategory were unique in that they generally worked with copper-clad laminate material, allowing them to target copper for removal in their wastewater treatment systems or recover the copper using in-process ion exchange. Printed Wiring Board facilities apply, develop, and strip photo resist, a set of unit operations that is unique to this subcategory and generate higher concentrations of a more consistent group of organic constituents than other facilities. The nature of the wastewater generated by these facilities may also be different because these facilities perform more lead-bearing operations (e.g., lead/tin electroplating wave soldering) than other MP&M facilities (U.S. EPA, 2000b).
- *Non-Chromium Anodizing.* Facilities in this proposed subcategory perform aluminum anodizing without using chromic acid or dichromate sealants. EPA estimated that this subcategory consisted of approximately 190 indirect dischargers and did not identify any direct dischargers that would fall under this subcategory. The *Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Metal Products & Machinery Point Source Category* (proposed MP&M TDD) (U.S. EPA, 2000b) did not include an estimate of the number of facilities in this subcategory that were regulated by the Metal Finishing ELGs; however, since the Metal Finishing ELGs include facilities that anodize and does not include an exclusion for non-chromium anodizers, all facilities in this subcategory were likely regulated by the Metal Finishing ELGs.
- *Steel Forming and Finishing.* Facilities in the proposed Steel Forming and Finishing Subcategory perform MP&M operations on steel. All facilities in this subcategory had permits or other control mechanisms under the Iron and Steel Manufacturing ELGs (40 CFR Part 420). Therefore, none of these facilities were subject to Metal Finishing ELGs.

- *General Metals.* EPA referred to this proposed subcategory as a "catch-all" for remaining facilities that discharge metal-bearing wastewater and do not fall within the other four metal-bearing wastewater subcategories described above. EPA estimated about 26,000 indirect and 3,800 direct dischargers were in this subcategory at the time of the proposed MP&M rulemaking. EPA also estimated that 16 percent of the facilities in this subcategory were covered under the Metal Finishing ELGs at the time of the proposed MP&M rulemaking.

4.4.2 Pollutants of Concern

During development of the 2001 proposed MP&M ELGs development, EPA considered limitations for all 64 pollutants listed in Table 4-8 for the metal-bearing wastewater subcategories. EPA proposed limitations for all 64 pollutants for the Metal Finishing Job Shops and General Metals Subcategories and a subset of these pollutants for the Printed Wiring Board Subcategory (all except cadmium, molybdenum, and silver).[16] For the Non-Chromium Anodizing Subcategory, EPA proposed limits only for total suspended solids (TSS), oil and grease, aluminum, manganese, zinc, and nickel. The proposed MP&M ELGs for subcategories that included metal finishers expanded on the list of pollutants regulated by the Metal Finishing ELGs by including limitations and standards for additional organics,[17] metals (aluminum, molybdenum, zinc), and nonconventional pollutants (sulfide, amendable cyanide) (U.S. EPA, 2000b).

Table 4-8. Pollutants Considered for the Proposed MP&M Regulation for Metal-Bearing Subcategories

Priority Metals		
Cadmium	Cyanide	Silver
Chromium	Lead	Zinc
Copper	Nickel	
Nonconventional Metals		
Manganese	Molybdenum	Tin
Conventional Pollutants		
Oil and Grease (as HEM)	Total Suspended Solids (TSS)	
Other Nonconventional Pollutants		
Amenable Cyanide	Total Organic Carbon	Total Sulfide

[16] Not all the wastewater generated by these subcategories is generated by metal finishing facilities. EPA determines pollutants of concern based on the characteristics of the wastewater for the overall subcategory, not only the metal finishing wastewater component. Refer to the memorandum *Metal Products and Machinery (MP&M) Rulemaking Preamble: Summary of Industry Comments and EPA Decisions Related to the Metal Finishing Category* for a list of MP&M process operations that generate wastewater considered for regulation (ERG, 2017b).

[17] The proposed MP&M ELGs included limitations for a Total Organics Parameter (TOP). EPA determined the value of this limitation based on the contribution of the organic pollutants listed in Table 4-8 (U.S. EPA, 2000b). The Metal Finishing ELGs include a limitation for TTO, but do not regulate the discharge of TOP or any of the specific organic pollutants listed in Table 4-8 (U.S. EPA, 1983).

Table 4-8. Pollutants Considered for the Proposed MP&M Regulation for Metal-Bearing Subcategories

Priority Organic Pollutants		
1,1,1-Trichloroethane	Chlorobenzene	Methylene Chloride
1,1-Dichloroethane	Chloroethane	n-Nitrosodimethylamine
1,1-Dichloroethylene	Chloroform	n-Nitrosodiphenylamine
2,4-Dimethylphenol	1-Methylfluorene	Naphthalene
2,4-Dinitrophenol	1-Methylphenanthrene	Phenanthrene
2,6-Dinitrotoluene	2-Isopropylnaphthalene	Phenol
2-Nitrophenol	2-Methylnaphthalene	Pyrene
4-Chloro-m-cresol	Di-n-Butyl Phthalate	Tetrachloroethene
4-Nitrophenol	Di-n-Octyl Phthalate	Toluene
Acenaphthene	Dimethyl Phthalate	Trichloroethylene
Acrolein	Ethylbenzene	Biphenyl
Anthracene	Fluoranthene	Carbon Disulfide
Benzyl Butyl Phthalate	Fluorene	Dibenzofuran
Bis(2-Ethylhexyl) Phthalate	Isophorone	Dibenzothiophene
Nonconventional Organic Pollutants		
3,6-Dimethylphenanthrene	Benzoic Acid	n-Tetradecane
Aniline	n-Hexadecane	p-Cymene

Source: (U.S. EPA, 2000b)

As discussed in Section 4.6, during this preliminary study of the Metal Finishing Category, pretreatment coordinators raised concerns to EPA about two pollutants on the MP&M pollutant of concern (POC) list that are currently discharged by metal finishing facilities: 1,4-dioxane and N-nitrosodimethylamine (U.S. EPA, 2000b, 2018d). EPA did not consider 1,4-dioxane for proposed regulation as part of the MP&M ELGs because it is controlled through the regulation of Total Organics Parameter (TOP), a total organics control parameter. However, EPA proposed to regulate N-nitrosodimethylamine under the proposed MP&M ELGs (see Table 4-8). The *Development Document for Effluent Limitations Guidelines New Source Performance Standards for the Metal Finishing Point Source Category* (Metal Finishing TDD) identified N-nitrosodimethylamine as a known to be present (KTBP) pollutant but did not note the presence of 1,4-dioxane in metal finishing process wastewater (U.S. EPA, 1983).

4.4.3 P2 Practices and Wastewater Treatment Technologies Identified Between the Metal Finishing and MP&M Rulemakings

From review of the proposed MP&M TDD (U.S. EPA, 2000b) and the Metal Finishing TDD (U.S. EPA, 1983), EPA identified wastewater treatment technologies and P2 practices, including flow reduction practices and in-process P2 technologies, that were described in the MP&M rulemaking, but were not discussed in the Metal Finishing Rulemaking documentation. Table 4-9 describes these technologies. Refer to the memorandum *Metal Products and Machinery (MP&M) Rulemaking TDD: Review and Comparison of Wastewater Technologies, Pollutants of Concern, and Pollution Prevention (P2) Practices Considered in the MP&M and*

Metal Finishing Rulemakings for additional details on these technologies, as described in the MP&M TDD (ERG, 2017c).

Table 4-9. Practices and Technologies Identified in the 2001 MP&M TDD and Not Discussed in the 1983 Metal Finishing TDD

Technology/Practice Type	Technology Descriptions
Flow Reduction Practices	• Air knives use forced air to remove dragout from part. • Drip shields capture dragout and direct it back to process tanks. • Rinse timers reduce unnecessary rinsewater generation by turning off flow of fresh rinsewater after a set time. • Bath concentrations can be lowered, when feasible, to lower viscosity and reduce the volume of rinsewater required to adequately rinse a part.
In-Process P2 Technologies	• Recycle/reuse process solutions by removing impurities by carbon adsorption, filtration, or reverse osmosis (RO). • Carbonate "freezing" removes carbonates that build up in some process chemicals by lowering the operating temperature to 26°F. Crystallized hydrated salts can then be removed via filtration or decanting. • Recycle machine coolant following regeneration by a centrifugal separator and pasteurization.
Wastewater Treatment	• Treatment of chelated wastewater; electrolytic recovery; sodium borohydride, hydrazine, and sodium hydrosulfide reduction; dithiocarbonate (DTC) precipitation. • Sodium borohydride precipitation for metals removal.

4.4.4 Technology Bases and Proposed ELGs

In support of the preliminary study of the Metal Finishing Category, EPA reviewed the regulatory options considered for the proposed MP&M ELGs and compared the technology bases and associated limitations with the Metal Finishing ELGs. EPA also reviewed a compliance alternative considered for indirect dischargers in the proposed Metal Finishing Jobs Shops Subcategory as part of the MP&M proposed ELGs.

4.4.4.1 Technology Options

EPA considered four technology options for the MP&M metal-bearing wastewater subcategories, and ultimately selected regulatory Options 2 and 4 as the basis for the proposed rule, described below.

- *Option 1* includes the pretreatment of segregated waste streams followed by chemical precipitation and gravity clarification for metal hydroxide removal. EPA specified pretreatment of the following segregated waste streams: oil-bearing wastewater (emulsion breaking and gravity separation), cyanide-bearing wastewater (alkaline chlorination), hexavalent chromium-bearing wastewater (reduction), chelated metal-bearing wastewater (reduction/precipitation), an organic solvent-bearing wastewater (contract hauling).
- *Option 2* built on Option 1 by adding in-process P2. Option 2 P2 methods include countercurrent cascade rinsing for all flowing rinses, centrifugation and recycling of

painting water curtains, and centrifugation and pasteurization to extend the life of water-soluble machining coolants. EPA selected Option 2 as the basis for:

  - — BPT, Best Conventional Pollutant Control Technology (BCT), BAT, and PSES for the five metal-bearing wastewater subcategories.
  - — NSPS for the Non-Chromium Anodizing Subcategory.

- *Option 3* replaced gravity clarification for metal hydroxide removal and emulsion breaking for oil removal in Option 1 with microfiltration for metal hydroxide removal and ultrafiltration for oil removal. Option 3 did not include the in-process P2 controls proposed for Option 2.
- *Option 4* combined the wastewater treatment technologies of Option 3 with the in-process flow controls and P2 practices included in Option 2. EPA selected Option 4 as the basis for:
  - — NSPS for the General Metals, Metal Finishing Job Shops, Printed Wiring Board, and Steel Forming and Finishing Subcategories; and
  - — PSNS for the General Metals, Metal Finishing Job Shops, Printed Wiring Board, and Steel Forming and Finishing Subcategories.

The technology that forms the basis for Metal Finishing BAT, BPT, and PSES is similar to MP&M technology Option 1 and includes chemical precipitation, clarification, and sludge dewatering for the treatment of common metals. The Metal Finishing technology basis also includes the pretreatment of segregated wastes, such as chromium reduction, cyanide oxidation, complexed metals removal by high pH precipitation, and emulsion breaking for oil and grease removal. The Metal Finishing NSPS/PSNS technology basis also includes additional cadmium reduction. None of the technology bases for the Metal Finishing ELGs incorporate in-process flow control or P2 or advanced filtration (U.S. EPA, 1983).

4.4.4.2 Proposed Limits for Existing Direct Dischargers

Table 4-10 compares the proposed BPT/BAT limits for the MP&M subcategories that contained metal finishing facilities to the metal finishing limitations under 40 CFR Part 433. In general, the limitations for TSS and n-hexane extractable material (HEM) are comparable, while the proposed MP&M limitations for metals and cyanide are lower than those of the Metal Finishing ELGs.

Table 4-10. Proposed MP&M BPT/BAT Limits and Promulgated Metal Finishing BPT and BAT Limits

Pollutant	MP&M Proposed BPT/BAT Limits (mg/l) [a]								Part 433 BPT/BAT Limits (mg/l) [a]	
	Metal Finishing Job Shops Subcategory		General Metals Subcategory		Printed Wiring Board Subcategory		Non-Chromium Anodizing Subcategory			
	Daily Max.	Monthly Avg.	Daily Max.	Monthly Avg.	Daily Max.	Monthly Avg.	Daily Max	Monthly Avg.	Daily Max.	Monthly Avg.
Total Suspended Solids (TSS)	60	31	34	18	60	31	60	31	60	31
Oil and Grease (as HEM)	52	26	15	12	52	26	52	26	52	26
Total Organic Carbon (TOC)	78	59	87	50	101	67				
Total Organics Parameter (TOP)	9	4.3	9	4.3	9	4.3				
Total Toxic Organics (TTO)									2.13	NA
Aluminum							8.2	4		
Cadmium	0.21	0.09	0.14	0.09					0.69	0.26
Chromium	1.3	0.55	0.25	0.14	0.25	0.14			2.77	1.71
Copper	1.3	0.57	0.55	0.28	0.55	0.28			3.38	2.07
Total Cyanide	0.21	0.13	0.21	0.13	0.21	0.13			1.2	0.65
Amenable Cyanide	0.14	0.07	0.14	0.07	0.14	0.07			0.86	0.32
Lead	0.12	0.09	0.04	0.03	0.04	0.03			0.69	0.43
Manganese	0.25	0.1	0.13	0.09	1.3	0.64	0.13	0.09		
Molybdenum	0.79	0.49	0.79	0.49						
Nickel	1.5	0.64	0.5	0.31	0.3	0.14	0.5	0.31	3.98	2.38
Silver	0.15	0.06	0.22	0.09					0.43	0.24
Sulfide, Total	31	13	31	13	31	13				
Tin	1.8	1.4	1.4	0.67	0.31	0.14				
Zinc	0.35	0.17	0.38	0.22	0.38	0.22	0.38	0.22	2.61	1.48
pH									6.0 - 9.0	6.0 – 9.0

Source: (U.S. EPA, 1983, 2000b)

[a] Gray shaded cells with numeric values indicate that a BPT-only limitation applies (i.e., no BAT limitation). Gray shaded cells without numeric values indicate no BAT or BPT limitation applies. All other cells indicate applicable BAT/BPT limitations.

4.4.4.3 Proposed P2 Alternative for Metal Finishing Job Shops Subcategory

As part of the proposed MP&M rulemaking, EPA considered a P2 alternative for existing indirect dischargers in the Metal Finishing Job Shops Subcategory. Under this alternative, participating facilities could choose to meet Metal Finishing limitations and standards in lieu of MP&M ELGs by implementing P2 and water conservation practices in ten P2 practice categories, described in Table 4-11. Many of the operations listed in the P2 alternative for the Metal Finishing Job Shops Subcategory were also discussed during the development of the Metal Finishing ELGs but were not incorporated.

The participation of many metal finishing job shops in the National Metal Finishing SGP by 2001, described in Section 4.3.4, formed the basis for the proposed alternative PSES compliance option for the Metal Finishing Job Shops Subcategory. EPA noted in the preamble to the final MP&M ELGs that many metal finishing job shops were already employing best management practices outlined in the proposed P2 alternative as part of the SGP initiative. Ultimately, the P2 alternative was not included in the final MP&M ELGs because EPA did not promulgate new limits for Metal Finishing Job Shops Subcategory.

Table 4-11. Proposed P2 Alternatives for Metal Finishing Job Shop Subcategory

Category	Requirement	Technology Options
Category 1. Must use practices that reduce and/or recover drag-out	To satisfy this requirement, facilities must implement three or more drag-out reduction practices or use at least one drag-out recovery technology option (*i.e.,* chemical recovery) listed under technology options on all electroplating or surface finishing lines.	**Drag-out Reduction Practices:** • Lower process solution viscosity and/or surface tension by lowering chemical concentration, increasing bath temperature, or use wetting agents. • Reduce drag-out volume by modifying rack/barrel design and performing rack maintenance to avoid solution trapping under insulation. • Position parts on racks in a manner that avoids trapping solution. • Reduce speed of rack/barrel withdraw from process solution and/or increase dwell time over process tank. • Rotate barrels over process tank to improve drainage. • Use spray/fog rinsing over the process tank (limited applicability). • Use drip boards and return process solution to the process tank. • Use dragout tanks, where applicable, and return process solution to the process tank. • Work with customers to ensure that part design maximizes drainage. **Drag-out Recovery Technology Options:** • Evaporators • Ion exchange • Electrowinning • Electrodialysis • Reverse osmosis

Table 4-11. Proposed P2 Alternatives for Metal Finishing Job Shop Subcategory

Category	Requirement	Technology Options
Category 2. Must use good rinse system design for water conservation	To satisfy this requirement, facilities must implement three or more elements of good rinse system design listed under technology options on all electroplating or surface finishing lines.	**Good Rinse System Design Elements:** • Select the minimum size rinse tank in which the parts can be rinsed and use the same size for the entire plating line, where practical. • Locate the water inlet and discharge points of the tank at opposite positions in the tank to avoid short-circuiting or use a flow distributor to feed the rinsewater evenly. • Use air agitation, mechanical mixing or other means of turbulence. • Use spray/fog rinsing (less effective with hidden surfaces). • Use multiple rinse tanks in a counter-flow configuration (*i.e.,* counter-current cascade rinsing). • Reuse rinsewater multiple times in different rinse tanks for succeeding less critical rinsing.
Category 3. Must use water flow control for water conservation	To satisfy this requirement, facilities must implement at least one effective method of water use control on all electroplating or surface finishing lines. Effective water use controls include but are not limited to those listed under technology options.	**Water Use Control Methods:** • Flow restrictors (Flow restrictors as a stand-alone method of rinsewater control are only effective with plating lines that have constant production rates, such as automatic plating machines. For other operations, there must also be a mechanism or procedure for stopping water flow during idle periods.) • Conductivity controls • Timer rinse controls • Production activated control (*e.g.,* spray systems activated when a rack or barrel enters/exits a rinse station)
Category 4. Must segregate non-process water from process water	To satisfy this requirement, facilities must not combine non-process water such as non-contact cooling water with process wastewater prior to wastewater treatment.	NA
Category 5. Must use water conservation practices with air pollution control devices	To satisfy this requirement, facilities operating air pollution control devices with wet scrubbers must recirculate the scrubber water as appropriate (periodic blowdown is allowed, as needed). Where feasible, reuse scrubber water in process baths.	NA

Table 4-11. Proposed P2 Alternatives for Metal Finishing Job Shop Subcategory

Category	Requirement	Technology Options
Category 6. Must practice good housekeeping	To satisfy this requirement, facilities must demonstrate compliance with each of the requirements listed under technology options.	**Good Housekeeping Practices:** • Perform preventative maintenance on all valves and fittings (*i.e.,* check for leaks and damage) and repair leak valves and fittings in a timely manner. • Inspect tanks and liners and repair or replace equipment as necessary to prevent ruptures and leaks. Use tank and liner materials that are appropriate for associated process solutions. • Perform quick cleanup of leaks and spills in chemical storage and process areas. • Remove metal buildup from racks and fixtures.
Category 7. Minimize the entry of oil into rinse systems	To satisfy this requirement, facilities must do at least one of the practices listed under technology options.	**Oil Entry Minimization into Rinse Systems:** • Minimize the entry of oil into cleaning baths or use oil skimmers or other oil removal devices in cleaning baths when needed to prevent oil from entering rinse tanks. • Work with customers to degrease parts prior to shipment to the plating facility to minimize the amount of oils on incoming materials.
Category 8. Must sweep or vacuum dry production areas prior to rinsing with water	To satisfy this requirement, facilities must sweep or vacuum dry production area floors prior to rinsing with water.	NA
Category 9. Must reuse drum/shipping container rinsate directly in process tanks	To satisfy this requirement, when performing rinsing of raw material drums, storage drums, and/or shipping containers that contain pollutants regulated under the MP&M regulation, facilities must reuse the rinsate directly into process tanks or save for use in future production.	NA
Category 10. Must implement environmental management and record keeping system	To satisfy this requirement, facilities must meet the requirements listed under technology options.	**Environmental Management Program Elements:** • Pollution prevention policy statement • Environmental performance goals • Pollution prevention assessment • Pollution prevention plan • Environmental tracking and record keeping system • Procedures to optimize control parameter settings (*e.g., o*xidation-reduction potential (ORP) set point in cyanide destruction systems, optimum pH for chemical precipitation systems, etc.) • Statement delineating minimum training levels for wastewater treatment operators

Source: (U.S. EPA, 2000b)

NA: Not Applicable.

4.4.5 Key MP&M Findings for the Metal Finishing Industry

EPA ultimately decided not to promulgate limitations and standards for the MP&M subcategories that would have incorporated facilities covered under the Metal Finishing ELGs. In response to public comments on the proposed rule, EPA re-evaluated in-place treatment technologies and adjusted the datasets and methodology used to conduct the incremental cost and loadings analyses. Due to these changes, EPA determined that the newly calculated limits for metal-bearing wastewater subcategories were not technologically achievable, not economically achievable, or the costs to achieve the limits were disproportionate to the estimated toxic pollutant removals (U.S. EPA, 2003b). Refer to the memorandum *Metal Products and Machinery (MP&M) Rulemaking Preamble: Summary of Industry Comments and EPA Decisions Related to the Metal Finishing Category* for additional details on the changes made to EPA's datasets and methodologies and summaries of stakeholder comments relevant to the Metal Finishing Category (ERG, 2017b).

EPA's key findings for metal bearing wastewater subcategories (including the four MP&M subcategories containing metal finishing facilities: General Metals, Metal Finishing Job Shops, Non-chromium Anodizing, and Printed Wiring Board) are summarized below.

- Overall, the cost of achieving limits under Option 2 was considered disproportionate to the estimated toxic pollutant removals for the subcategories.
- EPA determined that limitations based on the Option 4 technology were not proven to be technologically achievable based on EPA's dataset. EPA also considered establishing the Option 2 technology as the bases for PSES and NSPS, but determined the limitations and standards created a barrier to entry for new dischargers.
- EPA determined that Option 2 created high closure rates for existing direct and indirect dischargers (50 and 46 percent, respectively) in the proposed Metal Finishing Job Shops Subcategory, which consisted entirely of facilities covered under the Metal Finishing and Electroplating ELGs.

EPA considered incorporating PSES low-flow exclusions for the Metal Finishing Job Shops, Printed Wiring Board, and General Metals Subcategories, and considered upgrading all facilities in these subcategories covered under 40 CFR Part 413 to the PSES of 40 CFR Part 433. Ultimately, EPA determined the closure rates for these two PSES options would be greater than 10 percent for existing dischargers not covered by 40 CFR Part 433 (U.S. EPA, 2003b).

4.5 Technical Conferences

As discussed in Section 3.5, EPA attended the NASF SUR/FIN® conference in 2016 and the NACWA National Pretreatment and Pollution Prevention Workshop in 2016 and 2017, which are further discussed in the following subsections. EPA also attended WEFTEC and Engineer's Society of Western Pennsylvania's IWC conferences in 2016; however, EPA did not identify any information from those conference proceedings relevant to the preliminary study of the Metal Finishing Category.

4.5.1 NASF SUR/FIN® Conference

Since the NASF SUR/FIN® conference was focused on the surface finishing industry, there were several presentations, vendor booths, and papers relevant to the preliminary study of the Metal Finishing Category. Major industries presenting at the conference included the aerospace/defense, automotive, and electronics industries. There were multiple vendors advertising wastewater treatment technologies and metal finishing technologies.

The aerospace/defense industry presented several advances in metal finishing processes, waste reduction strategies, chemical alternatives, and wastewater treatment technologies. For example, several presentations discussed the National Aerospace and Defense Contractors Accreditation Program (Nadcap) as a driver for process changes and metal finishing improvements. Nadcap specifications are required by many customers and increase product uniformity in the aerospace/defense industry. In addition, the aerospace/defense industry reduced the amount of chromium used in etching and plating process steps and identified several process chemical alternatives, such as zirconium, manganese, phosphate, titanium, and cold-spray surface finishing processes. Other aerospace/defense industry research indicates that zinc-nickel plating is a more effective coating than cadmium and anticipates that the industry will move away from cadmium plating. Finally, Water Innovations, Inc. presented an ion exchange recycling system that has been implemented at several aerospace metal finishing facilities. The treatment technology costs about $8-$16 per 1,000 gallons of wastewater and saves facilities money on treatment chemicals and sludge disposal. This system is also designed to maximize the amount of recyclable rinsewater.

NASF SUR/FIN® presentations about the automotive industry mostly discussed methods to improve surface finishing. For example, several presentations talked about different software models and simulations that shorten and improve the design of coating processes to optimize product uniformity (e.g., tray design, coating thickness). Other presentations discussed replacements for traditional coating chemistries, include one-coat systems (to replace two-coat systems), tungsten/iron, iron/phosphorus, and silver/zinc chemistries.

Representatives from the electronics industry presented several chemical alternatives in surface finishing. Traditionally, electroless nickel solutions are blended with additives containing regulated heavy metals to stabilize and brighten the metal coating. However, a new process using an organo-metallic complex as the additive provides a Restriction of Hazardous Substances Directive (RoHS)-compliant chemical that improves metal coating brightness, leveling, surface roughness, porosity, deposit stress, and corrosion resistance. Also, substitutes for lead alloys (due to environmental lead restrictions) have been developed (e.g., Sn-Ag-Cu alloy).

EPA also visited vendor booths on the NASF SUR/FIN® show floor. There was a booth operated by Precious Metals Processing Consultants, Inc. (PMPC) that demonstrated the removal potential of their electro-winning system, which is in full operation at several sites to remove precious metals. More research needs to be performed to determine whether this wastewater treatment technology is applicable to other heavy metals.

4.5.2 NACWA Conferences

At the 2016 and 2017 NACWA conference, EPA attended roundtable discussions on concerns and problems facing Control Authorities pertaining to categorical dischargers. Attendees expressed concern over the applicability of metal finishing regulations. One area of discussion involved the confusion surrounding process operations that use weak acids. Some states interpret weak acids, such as citric acid, as not covered under the Metal Finishing ELGs. Citric acid is often used for cleaning and to satisfy customers who desire a greener process. Attendees urged EPA to look at the intent of the metal finishing regulation regarding weak acids. Some attendees also asked for clarification on the applicability of the Metal Finishing ELGs to specific manufacturing industries and process operations, such as the manufacture of germanium crystals for night vision goggles. Another area of discussion involved the appropriateness of applying the Metal Finishing ELGs to wastewater generated at facilities primarily engaged in other industrial activities.

Members also expressed the desire to consolidate the metal finishing (40 CFR Part 433) and electroplating (40 CFR Part 413) regulations. Certain electroplating and metal finishing facilities that began operation before July 15, 1983 are covered under the Electroplating Category and, therefore, must comply with the less stringent Electroplating ELGs. All other facilities performing electroplating or metal finishing operations are subject to regulations under the Metal Finishing Category.

4.6 Stakeholder Outreach

EPA contacted stakeholders to better understand the metal finishing industry and to gain different perspectives on the implementation of the 1983 regulations and current industry operations. The following sections discuss EPA's conversations with pretreatment coordinators, industry and trade organizations, and other stakeholders.

4.6.1 Local Control Authorities and EPA Regional Pretreatment Coordinators

EPA continued discussions with local Control Authorities and EPA Regional pretreatment coordinators who have direct experience with metal finishing wastewater issues at POTWs to identify metal finishing scenarios for which the applicability of the regulations is unclear, and to further their understanding of the metal finishing industry profile. Specifically, EPA met with local Control Authorities from POTWs receiving metal finishing wastewater from facilities EPA visited in Utah. From this discussion, EPA learned that the POTWs generally have not had issues with receiving metal finishing wastewater streams. While the region is not a water-stressed area, local Control Authorities may encourage smaller metal finishers to consider zero discharge practices (i.e., collect and evaporate wastewater) because the generated wastewater volumes are more easily managed through evaporation ponds or tanks than pretreatment to send to a POTW. Of the regulated pollutants, the local Control Authorities noted that TTO is the costliest to manage and monitor for both the facilities and the POTWs. Lastly, local Control Authorities indicated gray areas of applicability related to transportation polishing and brightening, and cleaning activities involving acids and metals (ERG, 2017e).

Additionally, EPA held a meeting with EPA Regional pretreatment coordinators in December 2016 and asked about the number of electroplating and metal finishing facilities in

each Region, and whether brightening and tank cleaning operations performed at wineries, dairies, breweries, and truck stops were being considered as metal finishing operations. EPA also asked about applicability issues with cleaning vs. etching, citric acid, or new chemicals and processes (U.S. EPA, 2018a). From this discussion, EPA learned that the number of electroplating and metal finishing facilities varies widely (from 4 to over 1,300) between Regions (that specifically track the number of electroplating or metal finishing facilities). For facility classification, regions may classify a winery, dairy, or brewery as a metal finishing facility if it performs passivation, but this practice is uncommon. Regions may classify a truck stop as a metal finishing facility if it has brightening operations, but this practice is also uncommon (U.S. EPA, 2018a).

EPA also learned that Regions have defined a cleaning step as etching or coating if an acid is used in the process; however, this is an area where additional clarification would be useful for all Regions. Regions differ in handling the classification of citric acid operations. Some Regions consider any process that is removing the metal basis material, regardless of the acid used, as a metal finishing process. Others consider a process strictly of citric acid cleaning a non-metal finishing process because citric acid is a very light acid (U.S. EPA, 2018a).

4.6.2 Industry and Trade Organizations

EPA continued discussions with the NASF, a trade association representing the interests of the North American surface finishing industry, including metal finishing. EPA spoke at the NASF Washington Forum in 2016 and met with NASF in February 2016, November 2016, and April 2017 to discuss the preliminary study of the Metal Finishing Category (U.S. EPA, 2018b).

In addition to the meetings above, EPA also attended the project kickoff meeting on November 29, 2016 for the P2 Research and Implementation for Michigan Metal Finishers, a joint project with NASF, the National Center for Manufacturing Sciences (NCMS), and other stakeholders. The project objective is to demonstrate how to reduce pollution from metal finishing facilities through new and innovative source reduction P2 methods and technologies. The phases of the project include researching P2 technologies for metal finishers, surveying the metal finishers located in Region 5, auditing select Detroit area metal finishing facilities (four to six facilities), implementing agreed-to P2 initiatives at these metal finishing facilities, and developing case studies based on the implemented technologies (U.S. EPA, 2016c).

EPA also reviewed the "NASF Milwaukee Area Surface Finishing Industry Metal Loadings Study," published in March 2017. From 1989 through 1992, the Metal Finishers Defense Fund (MFDF) conducted a study to calculate the percentage of influent loadings from metal finishing facility wastewater discharges (categorical industrial users) to the Milwaukee Metropolitan Sewerage District (MMSD), which consists of two water reclamation facilities (Jones Island and South Shore). The pollutants of concern were cadmium, chromium, copper, cyanide, lead, nickel, silver, and zinc. NASF with contractor River's Bend Engineering (RBE) conducted a similar study evaluating MMSD influent characteristics from 2014 through 2016. NASF compared the results of its study with the study conducted by MFDF and showed a decrease in influent loadings from metal finishing facility wastewater discharges sent to the MMSD over the years (NASF, 2017).

4.6.3 Other Stakeholders

EPA held meetings with the NACWA in 2016 and in 2017 to understand their perspective on the implementation of the 1983 regulations (U.S. EPA, 2018). Additionally, EPA attended the NACWA 2016 and 2017 Pretreatment & Pollution Prevention Workshops, discussed in Section 4.5.

4.7 Other Regulations and Initiatives Affecting the Metal Finishing Industry

In the 2015 Status Report (U.S. EPA, 2016a), EPA discussed environmental regulations outside of the Metal Finishing ELGs that may impact the industry. As part of continuing efforts, EPA performed an in-depth review of available online resources, including government and trade organization websites, to identify additional environmental regulations, international environmental initiatives, and customer certifications that may impact metal finishing facility process operations, process chemistries, and wastewater treatment operations.

4.7.1 Federal Regulations

Metal finishing facilities are subject to multiple federal environmental air emissions and hazardous waste disposal regulations. Plating tanks and other process operations that emit metals and toxic materials into the air are regulated by the U.S. EPA Office of Air and Radiation. Air emission controls installed by metal finishing facilities to comply with air regulations impact wastewater characteristics at those facilities. Additionally, metal finishing process solutions and wastewater are highly toxic in nature, requiring facilities to consider hazardous waste regulations when disposing of spent solutions and wastewater treatment wastes (e.g., sludge, filter cake). The subsections below describe U.S. air and hazardous waste regulations that may cover metal finishing facilities.

4.7.1.1 National Emission Standards for Hazardous Air Pollutants (NESHAPs), U.S. EPA Office of Air and Radiation

EPA explored NESHAPs that may require metal finishing facilities to incorporate air control technologies to mitigate air emissions, such as wet scrubbers, to understand if the resulting generated wastewater can impact metal finishing wastewater discharges. Several NESHAPs (listed below) apply to metal finishing operations.

- *NESHAPs for Chromium Emissions from Hard and Decorative Chromium Electroplating and Chromium Anodizing (40 CFR Part 63, Subpart N), 2012*. EPA promulgated the original NESHAP in 1995 affecting all facilities using chromium electroplating tanks. In 2012, EPA amended the rule to tighten emission standards for chromium electroplating and anodizing operations, which included revised emission and surface tension limits for hard chrome electroplating, decorative chrome electroplating, and anodizing tanks, and a ban on the use of perfluorooctane sulfonate (PFOS)-based fume suppressants in air pollution control devices (40 CFR Part 63, Subpart N). Based on discussions with some metal finishing facilities, EPA learned that wastewater generated from emission control devices used to control chromium emissions are typically combined with other metal finishing wastewater for wastewater treatment because their wastewater characteristics make them amenable to the same treatment steps.

- *NESHAP for Plating and Polishing Operations (40 CFR Part 63, Subpart WWWWWW), 2008.* EPA's 2008 NESHAP required use of generally available control technology (GACT) standards at facilities with plating, polishing or thermal spray processes that contain cadmium, nickel, lead, manganese and/or chromium (excluding chromium electroplating and anodizing operations). The rule does not establish emission limits for these operations but requires platers to implement management practices that reduce the generation of airborne chemicals. Facilities have several compliance alternatives, including the use of wetting agents/fume suppressants (WA/FS), air pollution control devices, or tank covers. At the time of the rule, EPA determined that the regulation would not interfere with the ability of facilities in the plating and polishing area source category to comply with the Clean Water Act requirements (e.g., Metal Finishing Effluent Guidelines, 40 CFR Part 433) (73 FR 37728).
- *NESHAP for Metal Fabrication and Finishing Area Source (40 CFR Part 63, Subpart XXXXXX), 2008.* In 2008, EPA promulgated requirements to reduce air pollution of compounds of metals such as cadmium, chromium, lead, manganese, and nickel in nine metal fabrication and finishing source categories. This rule applies to facilities "primarily engaged" in one of these nine source categories. The rule covers the following operations: dry abrasive blasting, dry grinding and dry polishing with machines, dry machining, spray painting, and welding. At the time of the rule, EPA determined that none of the control measures considered for the final rule generate a wastewater stream (73 FR 42978).

4.7.1.2 Resource Conservation and Recovery Act (RCRA) Hazardous Waste Regulations, Office of Resource Conservation and Recovery (ORCR)

Metal finishing facilities generate hazardous waste, including spent process solutions (e.g., alkaline cleaners, plating baths) and metal finishing wastewater treatment residuals (e.g., sludge and filter cake). The handling and disposal of these hazardous wastes is regulated under RCRA. EPA identified RCRA regulations that may impact how facilities in the metal finishing industry handle hazardous waste and treat process wastewater.

As defined under RCRA, wastewater treatment sludge from electroplating operations[18] is a F006 hazardous waste and, therefore, costlier for waste generators to dispose of than nonhazardous wastes. In the 2015 Status Report, EPA described discussions with wastewater treatment vendors, during which EPA learned that this hazardous waste regulation can inhibit industry advances in wastewater treatment technologies. Specifically, vendors noted the difficulty of applying more advanced technologies, such as ion exchange or RO, due to the costs of offsite resin or membrane reclamation and/or disposal. The resins and membranes may be classified as hazardous waste, most commonly under F006. Technologies such as ion exchange and RO can treat wastewaters to a quality enabling their reuse in metal finishing processes, thereby significantly reducing the amount of wastewater discharged. However, the added cost of

[18] Wastewater treatment sludges from the following processes are not F006 hazardous wastes under RCRA: (1) sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc, and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum (40 CFR Part 261).

managing the hazardous wastes generated by these technologies may render them economically infeasible for many metal finishing facilities (particularly job shops). EPA visited at least one metal finishing facility in 2016 that noted the higher cost of disposing sludge and filter cake classified as hazardous (versus non-hazardous) waste.

In addition to F006 hazardous wastes, corrosive wastes generated by metal finishing facilities, such as spent acid or alkaline cleaning baths, are considered "characteristic wastes" due to corrosivity (RCRA waste codes D002) and must be managed as hazardous waste. Other common metal finishing hazardous wastes include spent process solutions containing lead (RCRA waste code D008) and spent solvents (F001, F002, F003, F004, F005). On January 13, 2015, EPA published in the Federal Register a revised definition of solid waste under RCRA (80 FR 1694). The objective was to encourage reclamation of hazardous secondary materials, without increasing the risk to human health and the environment posed by improperly discarded hazardous secondary material. The revised solid waste definition excludes high-value solvents transferred from one manufacturer to another for the purpose of extending the useful life of the solvents by remanufacturing the solvent back to the commercial grade solvent (remanufacturing exclusion). Regulators believed this exclusion would encourage waste generators, such as metal finishers, to recycle high-value solvents rather than pay a RCRA permitted waste handler a considerable fee for waste disposal. This new definition may help advance adoption of P2 in the metal finishing industry (U.S. EPA, 2015c).

On November 28, 2016, EPA published the Hazardous Waste Generator Improvements Rule (81 FR 85808) to revise the Resource Conservation and Recovery Act (RCRA) hazardous waste regulatory program. EPA revised the existing regulatory program to make hazardous waste generator regulations easier to understand, facilitate better compliance, provide greater flexibility in managing hazardous waste, and close important gaps in the regulations. Updates to the regulatory program may further facilitate the disposal of wastewater treatment wastes for metal finishers by:

- Allowing hazardous waste generators to avoid the increased burden of high generator status when generating episodic waste, provided the hazardous waste generator properly manages the episodic waste. These facilities are generally limited to one episodic waste event per year.
- Allowing a very small quantity generator to send its hazardous waste to a large quantity generator under control of the same person (81 FR 85808).

4.7.2 Other Environmental Directives

Metal Finishing facilities looking to sell their products throughout the U.S. and abroad need to comply with state and international environmental directives specific to those markets. The European Union (EU), additional countries, and at least one U.S. state (California) have developed environmental initiatives to limit the quantity and concentration of certain chemicals that are manufactured in or imported to their regions. For example, in 2000, the EU published the End of Life Vehicles Directive to address the recycling and/or disposal of automobiles at the end of their useful lives to reduce waste containing lead, mercury, cadmium, and hexavalent chromium. The directive bans lead, mercury, and cadmium, and limits hexavalent chromium to minimal amounts for corrosion protection only.

In 2007, the European Community Regulation (EC 1907/2006) Registration, Evaluation, Authorization and Restriction of Chemical substances (REACH), became effective and was most recently revised in 2017. REACH requires special registration for all substances manufactured or imported to the EU at certain threshold quantities. Special registration is also required for substances incorporated into certain articles (e.g., automobiles, electronic chips, jewelry, etc.). Metal finishers importing to the EU must notify the European Chemicals Agency (ECHA) if the imported article contains concentrations above 0.1 percent by weight of a chemical on the REACH candidate list or if the chemical exceeds a total one metric tonne per year in articles imported by the facility. REACH candidate list chemicals include substances common in metal finishing operations, such as cadmium, chromium, and lead compounds (ECHA, 2017).

In 2002, the Restriction of Hazardous Substances (RoHS) directive was established in the EU and set maximum levels for six restricted materials used in electronic and electrical products, including cadmium, hexavalent chromium, mercury, lead, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE). The EU RoHS was updated in 2015 to include restrictions on four different phthalates bis(2-ethylhexyl) phthalate (DEHP), benzyl butyl phthalate (BBP), dibutyl phthalate (DBP), and diisobutyl phthalate (DIBP)). Metal finishing facilities that import products or finish parts into the EU for customers covered by RoHS must meet these requirements (NASF, 2012). The RoHS requirement most relevant to the metal finishing industry is the limit on the percentage of chromium and chromate in any material or coating (0.1 percent and 0.01 percent by weight, respectively). Efforts in the metal finishing industry are underway to find replacements for cadmium and chrome in plating due to the European REACH and RoHS regulations (NASF, 2012).

EPA identified the following additional environmental directives similar to RoHS that may impact how metal finishers importing to these markets select plating and coating constituents:

- The California Electronics Recycling Act (2003) (SB 20 as amended by SB 50) limits the use of hazardous substances in certain electronic products sold in California (CalRecycle, 2017).
- China Administration on the Control of Pollution Caused by Electronic Information Products (ACPEIP) (2006) establishes product-marking requirements for the original six EU RoHS chemicals.
- Korea Act of Resources Recycling of Electrical and Electronic Equipment and Vehicles (2007) promotes improvement in product design and recycling technology as they become technologically and economically feasible. The regulation established chemical concentration standards for lead, mercury, hexavalent chromium, and cadmium in electrical and electronic equipment and vehicles.
- Norway Prohibition on Certain Hazardous Substance in Customer Products (PoHS) (2008) prohibits the use of 18 substances, including lead and cadmium, in consumer goods.

4.7.3 Customer Specifications and Certifications

Customers in the automotive, aerospace, and defense industries often require strict manufacturing and product specifications for their plated parts. Metal finishing facilities may be restricted to certain chemicals and plating processes to meet these customer specifications. For example, job shops that finish parts for certain automotive companies may be required to meet strict customer specifications for these parts. EPA also identified two industry-specific programs that affect how facilities operate their plating processes, described below.

The National Aerospace and Defense Contractors Accreditation Program (Nadcap) is a cooperative program managed by companies in the aerospace and defense industries. The program was designed to establish cost-effective, standardized approaches for process operations and products and aims to provide continual improvement within the aerospace and defense industries. Metal finishing facilities that supply parts to these companies become Nadcap accredited for certain processes (e.g., electroplating, anodizing, coating, and stripping), which can dictate aspects of finishing procedures.

In addition to meeting Nadcap criteria, metal finishing facilities that supply parts for the U.S. military must finish parts in accordance with strict military specifications. These specifications dictate the temperatures, plating times, plating thickness, hardness, plating bath concentrations, and other specifications during metal finishing process operations, leaving little room for manufacturing variation. Some military specifications allow for alternative coatings for traditional cadmium plating, including pure aluminum, zinc-nickel, and nickel fluorocarbon. However, military specifications for some parts require the use of cadmium plating (NASF, 2012).

5. PRELIMINARY REVIEW CONCLUSIONS

Our preliminary review indicates that processes that generate wastewater in metal finishing operations have not changed substantially since EPA first promulgated the Metal Finishing ELGs. Additionally, most metal finishing facilities continue to use conventional chemical precipitation and clarification wastewater treatment technologies (the technology basis for the existing ELGs); however, some facilities have installed advanced treatment technologies, such as a membrane filtration polishing step.

At this time, EPA does not have, nor have stakeholders provided, any data to demonstrate that pollutants in metal finishing discharges are leading to environmental problems or causing issues for POTWs. As the scope of the Metal Finishing ELGs is specific to "operations" such as electroplating, etching, and cleaning, rather than to a specific type of manufacturing, some stakeholders continue to have questions regarding the applicability of this rule, particularly at facilities for which metal finishing operations are ancillary. The main applicability issues identified include:

- Misapplication of the metal finishing ELGs when a facility's operations do not fall under SIC and NAICS codes for the Metal Finishing Category (e.g., assigning the metal finishing ELGs to a facility that is not performing metal finishing operations or not assigning the metal finishing ELGs to a facility that is performing metal finishing operations).
- Applicability of the metal finishing ELGs to specific scenarios (e.g., transportation polishing and brightening).
- Definitions of the 46 metal finishing unit operations, leading to misapplication of permit limits (e.g., cleaning vs. etching).

Therefore, EPA plans to focus its future efforts on the resolution of applicability questions. As noted in Sections 3.6.2 and 3.6.3, EPA will continue discussions with outside stakeholders, such as the NASF and NACWA, as it resolves these applicability questions.

6. QUALITY ASSURANCE

In gathering information to support EPA's preliminary study of the Metal Finishing Category, EPA evaluated and documented the usefulness and quality of the data collected to date in accordance with the criteria specified in the *Environmental Engineering Support for Clean Water Regulations Programmatic Quality Assurance Project Plan* (PQAPP) (ERG, 2013). EPA also applied specific criteria discussed below in Section 6.3. This section describes the data sources used and data quality evaluations performed for EPA's 2016-2017 study activities.

6.1 Project Objectives

As discussed in Section 1, one of EPA's primary objectives for the preliminary study of the Metal Finishing Category was to assess the current state of the industry to better understand how metal finishing operations, wastewater characteristics, and wastewater treatment technologies have changed since EPA promulgated the 1983 ELGs. This assessment will help EPA to determine whether additional data collection efforts are needed and how best to address the 1983 Metal Finishing ELGs. Specifically, the study seeks to answer the key questions listed in Section 1 of this report.

6.2 Data Sources

To support its preliminary study of the Metal Finishing Category, in 2016 - 2017 EPA collected information from the following activities and data sources:

- Site visits to metal finishing facilities.
- Government databases containing discharge data, specifically, DMR and TRI data.
- Conference proceedings, peer-reviewed journals, and other literature.
- Government publications and supporting information.
- Interviews with industry personnel, vendors, trade association representatives, and pretreatment coordinators.

6.3 Data Quality Objectives and Criteria

As described in the PQAPP, EPA ensured that the data collection, processing, and analyses performed for the preliminary study met the data quality standards of objectivity, integrity, utility, and transparency, as described below:

- *Objectivity*. The information must be accurate, reliable, and unbiased, and the manner in which the information is presented must be accurate, clear, complete, and unbiased.
- *Integrity*. The information may not be compromised through corruption or falsification, either by accident or by unauthorized access or revision.
- *Utility*. The information must be useful for the intended users.
- *Transparency.* The sources of the data used must also have been made transparent. EPA describes the various assumptions made, analytical methods used, and statistical procedures applied throughout the study report.

EPA prioritized the review of the data sources described in Section 6.2 to address the key study questions listed in Section 1 of this report. EPA evaluated the quality of data using the criteria of accuracy, relevance, reliability, and representativeness. These criteria are described in Section 4.3.1 and in Table 4-2 of the PQAPP (ERG, 2013), and summarized below:

Accuracy. EPA assumed that the underlying data and information contained in state and federal reports, peer-reviewed journal articles, and industry publications are accurate. Although industry publications are not usually peer-reviewed, this resource provides useful information for understanding metal finishing processes and wastes generated. EPA considered data from industry, including discussions with trade associations and correspondence with individual facilities, to be sufficiently accurate to characterize the metal finishing industry, its process operations, and anticipated waste streams.

Relevance. Selected data sources must describe process operations, pollutants, or waste streams that are representative of the metal finishing industry. Data sources that most closely provide answers to the key questions listed in Section 1 are the most relevant.

Reliability. EPA considered the following factors when evaluating the reliability of data sources used to support the study: (1) data that have been generated by government agencies or are otherwise subject to peer review and assessment are considered to be the most reliable and useful for understanding industry process operations, quantitatively characterizing wastewater discharges, and demonstrating treatment system performance; (2) data from entities with established knowledge in the topic area (e.g., studies conducted by industry experts, academic researchers, data generated by an industrial facility using documented and approved methods) are also considered to be reliable and useful for understanding industry process operations, quantitatively characterizing wastewater discharges, demonstrating treatment system performance, and understanding applicability of the regulations; and (3) data from sources that use unknown collection and data review procedures are less reliable, but may be generally useful for qualitative understanding of industry process operations and waste streams. In general, EPA evaluated reliability based on the degree to which sources met the following criteria:

- Scientific work was clearly written, with all assumptions and methodologies identified.
- Variability and uncertainty (quantitative and qualitative) in the information or in the procedures, measures, methods, or models were evaluated and characterized.
- Assumptions and methodologies were consistently applied throughout the analysis as reported in the source.
- Waste streams, parameters, units, and detection limits (when appropriate) were clearly characterized.
- The governmental or facility contact was reputable and had knowledge of the industry, facility, process operation, or waste streams of interest.

Representativeness. EPA evaluated whether data sources described process operations, pollutants, or waste streams that were representative of the metal finishing industry. For the purposes of this study, EPA expanded upon the general criteria set forth in the PQAPP by

establishing data quality acceptance criteria related to the geographic scope and age of the data (described below):

- *Geographic scope*. Data sources must describe the wastewater characteristics for the metal finishing industry in the United States. EPA also collected information from data sources that described how the data were produced, such as the source of the wastewater, sample collection procedures, analytical methods, units, and relevant data qualifiers, to further evaluate the data's usefulness in future analyses. EPA included some international data sources that were relevant for their descriptions of other potential wastewater treatment technologies or chemical processes used in metal finishing.
- *Age*. EPA prioritized data sources published in 2000 or later, as they reflect more recent industry changes. However, information published before 2000 (e.g., 1983 Metal Finishing Technical Development Document, supporting documentation for the MP&M rulemaking) can provide useful qualitative information regarding the temporal status of the industry. In addition, EPA noted the year of the data source referenced in the preliminary study to clearly document the time period.

Table 6-1 summarizes the data quality criteria discussed above.

Table 6-1. Data Quality Criteria Summary

Data Quality Criterion	Description
Accuracy	Underlying data in state and federal reports, peer-reviewed journal articles, and industry publications are assumed accurate. Data collected from industry representatives are assumed sufficiently accurate.
Relevance	Describe process operations, pollutants, or waste streams that are representative of the metal finishing industry.
Reliability	Clearly written; assumptions and methodologies identified.
	Variability and uncertainty in the information are evaluated and characterized.
	Assumptions and methodologies are consistently applied.
Representativeness	Process operations, pollutants, or waste streams that are representative of the metal finishing industry are described.
	Wastewater characteristics of the U.S. metal finishing industry are described. Data sources addressing industry outside of the United States were also included for descriptions of potentially applicable wastewater treatment technologies or chemical processes.
	Data sources published in 2000 or later are prioritized; data sources prior to 2000 were used qualitatively.

6.4 Data Quality Evaluation

This section describes the data sources EPA used and how they met the evaluation criteria listed in Section 6.3. Table 6-2, at the end of this section, summarizes the data sources and acceptance criteria EPA evaluated for each type of data set reviewed during 2016-2017 study activities.

6.4.1 Site Visits to Metal Finishing Facilities

EPA conducted site visits to 18 facilities covered under the Metal Finishing ELGs (see Section 4.1). EPA selected facilities for site visits and data collection in accordance with procedures outlined in the *Environmental Engineering Support for Clean Water Regulations PQAPP* (ERG, 2013) and the *Quality Assurance Activities for the Selection of the Metal Finishing Sites and Existing Data Collection During Site Visits – Revision 1* ("Site Visit QA Memo") (ERG, 2016d).

EPA focused on geographic areas where many metal finishing facilities are located, specifically California, Utah, and EPA Region 5, to develop a prioritized list of facilities of varying size, location, industries, process water usage, and treatment practices. EPA collected DMR and TRI discharge data and pretreatment reports for metal finishing facilities in these regions and ranked sites of interest based on uniform criteria including discharge type, location, process operations performed, wastewater treatment technologies, and P2 practices in place. EPA also contacted pretreatment coordinators in these regions to request recommendations of facilities covered under the Metal Finishing ELGs for site visits.

Before each site visit, EPA documented facility background information obtained from sources such as past facility contacts, DMR or TRI discharge data, and the facility website. EPA identified key elements about each facility, including specific operations or permit limits of interest, and contacted the facility to verify personal protective equipment (PPE) and obtain any additional information needed before the visit. EPA also requested facility discharge permits. After each site visit, EPA prepared a site visit report that documented observations of process chemistries, process operations, and wastewater treatment, as well as conversations about regulatory applicability, technology costs, and other information. If EPA used site visit information to develop profiles, characterize wastewater, or evaluate treatment technologies, EPA applied the site visit data acceptance criteria (outlined in the Site Visit QA Memo, (ERG, 2016d)) to evaluate the acceptability of the information.

6.4.2 Government Databases with Discharge Data (DMR and TRI)

EPA downloaded DMR and TRI data in accordance with the *Environmental Engineering Support for Clean Water Regulations PQAPP*. Specifically, EPA performed quality assurance and quality control (QA/QC) procedures to verify data downloads, check query logic in data analyses, and review data transcriptions between Excel spreadsheets, Access databases, and summary tables presented in memoranda and reports. EPA detailed QA/QC activities on its multi-phase reviews of the DMR and TRI data in the following approach memoranda:

- *Metal Finishing Preliminary Study: Proposed Approach for Phase I Review of DMR and TRI Data* (ERG, 2015).
- *Metal Finishing Preliminary Study: Phase I Review Results and Proposed Approach for Phase II Review of DMR and TRI Data* (ERG, 2016c).

6.4.3 Conference Proceedings, Peer-Reviewed Journal Articles, Other Academic Literature

EPA reviewed conference proceedings, peer-reviewed journal articles, and other academic literature in support of its preliminary study of the Metal Finishing Category. As

described in the 2015 Status Report, EPA identified over 130 documents from peer-reviewed journals and other academic literature. To build on this search, EPA used a second list of key words (see Section 3.3) to perform a targeted literature search to identify P2 practices relevant to the metal finishing industry. As part of the P2 literature search and review, EPA collected 22 relevant peer-reviewed journal articles, recorded them on a quality evaluation tracking spreadsheet, and documented how each data source met (or did not meet) the quality criteria (ERG, 2017f). EPA applied the data quality criteria established in the *Environmental Engineering Support for Clean Water Regulations PQAPP* (ERG, 2013) and determined that the data and information obtained from conference proceedings, peer-reviewed journals, and other academic literature were sufficiently accurate, reliable, and relevant for characterizing metal finishing process operations, chemistries, wastewater, treatment technology performance, and P2 practices relevant to the industry. Refer to the *Quality Assurance Activities for the Collection of Existing Data to Support the Metal Finishing Preliminary Study – Revision 1* (ERG, 2016e) for addition quality assurance procedures applied to the literature search.

6.4.4 Existing Government Publications and Supporting Information

EPA obtained information from government publications and supporting documents, specifically documents supporting the Metal Finishing ELGs and the MP&M proposed rulemaking. During the MP&M proposed rulemaking, EPA evaluated facilities covered under the Metal Finishing ELGs in the 1980s and 1990s. EPA applied the criteria established in the *Environmental Engineering Support for Clean Water Regulations PQAPP* (ERG, 2013) and determined that this information was sufficiently accurate and reliable for characterizing metal finishing process operations, chemistries, wastewater characteristics, and wastewater treatment technologies. However, due to the age of the data, EPA determined that the information may not be representative of current industry practices, and only used the information qualitatively to establish a timeline for changes within the industry. EPA recorded QA determinations for identified MP&M documents in an Excel workbook, which is included as an attachment to the memorandum titled *Metal Products and Machinery (MP&M) Rulemaking Documentation: Screening Review Results and Proposed Approach for Detailed Review* (ERG, 2016b).

6.4.5 Information Obtained from Industry, Vendors, and Trade Associations

EPA contacted personnel at specific facilities, wastewater treatment technology vendors, and trade associations and obtained first-hand information regarding facility-specific process operations and waste streams, treatment technologies, and P2 practices used by the industry. EPA also obtained information from the websites of metal finishing facilities, vendors, and trade associations, including descriptions of process operations, types of products, and services performed. EPA applied the criteria established in the *Environmental Engineering Support for Clean Water Regulations PQAPP* (ERG, 2013) and determined that this information was sufficiently accurate, reliable, and representative of the facilities of interest for use in characterizing industry sector trends and for providing a qualitative understanding of process operations and treatment technologies used.

Table 6-2. Data Acceptance Criteria for the Preliminary Study of the Metal Finishing Category

Data Source	Criteria for Data Usable to Profile Operations and Wastewater Treatment Technologies	Criteria for Data Usable to Characterize In-Process Waste Streams	Criteria for Data Usable to Demonstrate Wastewater Treatment Performance/Efficiency	Criteria for Data Not Usable
Site visits to metal finishing facilities	Metal finishing process operations clearly described. Metal finishing wastewater treatment operations clearly described.	Metal finishing waste stream identified, and analytes, units, analytical methods, and detection limits identified.	(1) Represents full-scale system operated at applicable metal finishing facility. (2) Influent and effluent data show that treatment system is well designed and operated. (3) Detailed description of the treatment system and operating conditions. (4) Analytes identified; units, analytical methods and detection limits included.	(1) Information describing wastewater not generated by or comingled with wastewater covered by the Metal Finishing ELGs.
Government databases containing DMR and TRI discharge data	Metal finishing process operations clearly described.	Metal finishing waste stream identified, and analytes, units, analytical methods, and detection limits identified.	(1) Represents full-scale system operated at applicable metal finishing facility. (2) Influent and effluent data show that treatment system is well designed and operated. (3) Detailed description of the treatment system and operating conditions. (4) Analytes identified; units, analytical methods and detection limits included.	(1) Data collected by an unknown method or units undefined. (2) Data collected during upset conditions. (3) Data represents a process that is not of interest (e.g., sanitary wastewater).
Conference proceedings, peer-reviewed journal articles, other academic literature	Data are current and relevant to the metal finishing facility/industry operations of interest.	Metal finishing waste stream identified, and analytes, units, analytical methods, and detection limits identified. Geographic scope is	(1) Represents full-scale system operated at applicable metal finishing facility. (2) Influent and effluent data show that treatment system is well designed and operated. (3) Detailed description of the treatment system and operating conditions.	Article/paper not peer-reviewed or otherwise deemed sufficient for limited purposes such as identifying incidental and qualitative data.

Table 6-2. Data Acceptance Criteria for the Preliminary Study of the Metal Finishing Category

Data Source	Criteria for Data Usable to Profile Operations and Wastewater Treatment Technologies	Criteria for Data Usable to Characterize In-Process Waste Streams	Criteria for Data Usable to Demonstrate Wastewater Treatment Performance/Efficiency	Criteria for Data Not Usable
		within the United States.	(4) Analytes identified; units, analytical methods and detection limits included.	
Government publications and supporting information (e.g., documents supporting the Metal Finishing ELGs, data collected during the MP&M rulemaking)	Metal finishing process operations clearly described.	Metal finishing waste stream identified, and analytes, units, analytical methods, and detection limits identified.	(1) Represents full-scale system operated at applicable metal finishing facility. (2) Influent and effluent data show that treatment system is well designed and operated. (3) Detailed description of the treatment system and operating conditions. (4) Analytes identified; units, analytical methods and detection limits included.	(1) Data collected by an unknown method or units undefined. (2) Data collected during upset conditions. (3) Represents a process that is not of interest (e.g., sanitary wastewater).
Data and information obtained by directly contacting personnel in industry, vendors, and trade associations	Metal finishing process operations clearly described.	Metal finishing waste stream identified, and analytes, units, analytical methods, and detection limits identified.	(1) Represent full-scale system operated at applicable metal finishing facility. (2) Influent and effluent data or percent removal identified and show that treatment system is well designed and operated. (3) Detailed description of the treatment system and operating conditions. (4) Analytes identified; units, analytical methods and detection limits included.	(1) The plant has since changed operations (e.g., no longer performing metal finishing operations) since the data were collected. (2) Data collected during upset conditions. (3) Represents a process that is not of interest (e.g., sanitary wastewater).

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Appendix A:
SIC and NAICS Codes for the Metal Finishing Industry

Table A-1. List of SIC Codes Assigned to the Metal Finishing Category by the 304(m) Annual Review

Table A-2. List of NAICS Codes Assigned to the Metal Finishing Category by the 304(m) Annual Review

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Table A-1. List of SIC Codes Assigned to the Metal Finishing Category by the 304(m) Annual Review

SIC Code	SIC Code Description
2514	METAL HOUSEHOLD FURNITURE
2522	METAL OFFICE FURNITURE
2531	PUBLIC BUILDING/RELATED FURNIT
2542	METAL PARTI, SHELF, LOCKERS
2591	DRAPE HARDWARE/WINDOW BLINDS
2599	FURNITURE AND FIXTURES, NEC
2796	PLATEMAKING SERVICES
3398	METAL HEAT TREATING
3412	METAL BARRELS, DRUMS AND PAILS
3421	CUTLERY
3423	HAND AND EDGE TOOLS, NEC
3425	HAND SAWS AND SAW BLADES
3429	HARDWARE, NEC
3431	METAL SANITARY WARE
3432	PLUMB FIXTURE FITTINGS & TRIM
3433	HEATING EQUIP, EXCEPT ELECTRIC
3441	FABRICATED STRUCTURAL METAL
3442	METAL DOORS, SASH, AND TRIM
3443	FAB PLATE WORK (BOILER SHOPS)
3444	SHEET METAL WORK
3446	ARCHITECTURAL METAL WORK
3448	PREFABRICATED METAL BUILDINGS
3449	MISC. STRUCTUAL METAL WORK
3451	SCREW MACHINE PRODUCTS
3452	BOLTS, NUTS, RIVETS & WASHERS
3462	IRON AND STEEL FORGINGS
3465	AUTOMOTIVE STAMPINGS
3466	CROWNS AND CLOSURES
3479	METAL COATING & ALLIED SERVIC
3482	SMALL ARMS AMMUNITION
3483	AMMUNIT., EXC. FOR SMALL ARMS
3484	SMALL ARMS
3489	ORDNANCE AND ACCESSORIES, NEC
3491	INDUSTRIAL VALVES
3492	FLUID POWER VALVES & HOSE FITT
3493	STEEL SPRINGS, EXCEPT WIRE
3494	VALVES AND PIPE FITTINGS, NEC
3495	WIRE SPRINGS
3496	MISC. FABRICATED WIRE PRODUCTS
3497	METAL FOIL AND LEAF
3498	FABRICATED PIPE AND FITTINGS
3499	FABRICATED METAL PRODUCTS NEC
3511	TURBINES & TURBINE GENERATOR
3519	INTERNAL COMBUSTION ENGINES,
3523	FARM MACHINERY AND EQUIPMENT
3524	LAWN AND GARDEN EQUIPMENT
3531	CONSTRUCTION MACHINERY
3532	MINING MACHINERY
3533	OIL FIELD MACHINERY

Table A-1. List of SIC Codes Assigned to the Metal Finishing Category by the 304(m) Annual Review

SIC Code	SIC Code Description
3534	ELEVATORS AND MOVING STAIRWAYS
3535	CONVEYORS & CONVEYING EQUIPMEN
3536	CRANES/HOISTS/MONORAIL SYSTEMS
3537	INDUSTRIAL TRUCKS AND TRACTORS
3541	MACHINE TOOLS, METAL CUTTING
3542	MACHINE TOOLS, METAL FORMING
3543	INDUSTRIAL PATTERNS
3544	SPECIAL DIES/TOOLS/JIGS & FIXT
3545	MACHINE TOOL ACCESSORIES
3546	POWER DRIVEN HAND TOOLS
3547	ROLLING MILL MACHINERY
3548	WELDING APPARATUS
3549	METALWORKING MACHINERY, NEC
3552	TEXTILE MACHINERY
3553	WOODWORKING MACHINERY
3554	PAPER INDUSTRIES MACHINERY
3555	PRINTING TRADES MACHINERY
3556	FOOD PRODUCTS MACHINERY
3559	SPECIAL INDUSTRY MACHINERY, NEC
3561	PUMPS AND PUMPING EQUIPMENT
3562	BALL AND ROLLER BEARINGS
3563	AIR AND GAS COMPRESSORS
3564	BLOWER AND FANS
3565	PACKAGING MACHINERY
3566	SPEED CHANGERS, DRIVES & GEARS
3567	INDUSTRIAL FURNACES AND OVENS
3568	POWER TRANSMISSION EQUIPMENT
3569	GENERAL INDUSTRIAL MACHINERY
3571	ELECTRONIC COMPUTERS
3572	COMPUTER STORAGE DEVICES
3575	COMPUTER TERMINALS
3577	COMPUTER PERIPHERAL EQUIP,NEC
3578	CALC & ACCOUNTING EQUIPMENT
3579	OFFICE MACHINES
3581	AUTOMATIC MERCHANDISING MACHIN
3582	COMMERCIAL LAUNDRY EQUIPMENT
3585	REFRIGERATION & HEATING EQUIP
3586	MEASURING & DISPENSING PUMPS
3589	SERVICE INDUSTRY MACHINERY
3592	CARBURETORS, PISTONS, RINGS, VALV
3593	FLUID POWER CYLINDERS & ACTUAT
3594	FLUID POWER PUMPS AND MOTORS
3596	SCALES AND BALANCES, EXC. LAB
3599	INDUSTRIAL MACHINERY, NEC
3612	TRANSFORMERS
3613	SWITCHGEAR & SWITCHBOARD APPAR
3621	MOTORS AND GENERATORS
3624	CARBON AND GRAPHITE PRODUCTS
3625	RELAYS AND INDUSTRIAL CONTROLS

Table A-1. List of SIC Codes Assigned to the Metal Finishing Category by the 304(m) Annual Review

SIC Code	SIC Code Description
3629	ELECTRICAL INDUSTRIAL APPARATS
3632	HOUSEHOLD REFRIG. & FREEZERS
3633	HOUSEHOLD LAUNDRY EQUIPMENT
3634	ELECTRIC HOUSEWARES AND FANS
3635	HOUSEHOLD VACUUM CLEANERS
3639	HOUSEHOLD APPLIANCES, NEC
3641	ELECTRIC LAMPS
3643	CURRENT-CARRYING WIRING DEVICE
3644	NONCURRENT-CARRYING WIRING DEV
3645	RESIDENTIAL LIGHTING FIXTURES
3646	COMMERCIAL LIGHTING FIXTURES
3647	VEHICULAR LIGHTING EQUIPMENT
3648	LIGHTING EQUIPMENT, NEC
3651	RADIO AND TV RECEIVING SETS
3652	PHONOGRAPH RECORDS
3661	TELEPHONE/TELEGRAPH APPARATUS
3663	RADIO & TV COMMUNICATION EQUIP
3669	COMMUNICATIONS EQUIPMENT, NEC.
3672	PRINTED CIRCUT BOARD
3675	ELECTRONIC CAPACITORS
3676	RESISTORS FOR ELEC APPLICATION
3677	ELEC COILS, TRANSF. & INDUCTOR
3678	CONNECTORS FOR ELEC APPLICATIO
3679	ELECTRONIC COMPONENTS, NEC
3694	ELEC EQUIP FOR INT COMBUS ENGI
3695	MAG & OPTICAL RECORDING MEDIA
3699	ELEC MACHINERY, EQUIP & SUPPLIE
3711	MOTOR VEHICLES & CAR BODIES
3713	TRUCK & BUS BODIES
3714	MOTOR VEHICLE PARTS & ACCESSOR
3715	TRUCK TRAILERS
3716	MOTOR HOMES
3721	AIRCRAFT
3724	AIRCRAFT ENGINES & ENGINE PART
3728	AIRCRAFT PARTS AND EQUIP, NEC
3731	SHIP BUILDING AND REPAIRING
3732	BOAT BUILDING AND REPAIRING
3743	RAILROAD EQUIPMENT
3751	MOTORCYCLES, BICYCLES AND PART
3761	GUIDED MISSILES & SPACE VEHICL
3764	SPACE PROPULSION UNITS & PARTS
3769	SPACE VEHICLE EQUIPMENT, NEC
3792	TRAVEL TRAILERS AND CAMPERS
3795	TANKS AND TANK COMPONENTS
3799	TRANSPORTATION EQUIPMENT, NEC
3812	SEARCH & NAVIGATION EQUIPMENT
3821	LAB APPARATUS & FURNITURE
3822	ENVIRONMENTAL CONTROLS
3823	PROCESS CONTROL INSTRUMENTS

Table A-1. List of SIC Codes Assigned to the Metal Finishing Category by the 304(m) Annual Review

SIC Code	SIC Code Description
3824	FLUID METERS & COUNTING DEVICE
3825	INSTRUMENTS TO MEASURE ELECTRI
3826	ANALYTICAL INSTRUMENTS
3827	OPTICAL INSTRUMENTS AND LENSES
3829	MEASURING & CONTROLLING DEVICE
3841	SURGICAL & MEDICAL INSTRUMENTS
3842	SURGICAL APPLIANCES & SUPPLIES
3843	DENTAL EQUIPMENT AND SUPPLIES
3844	X-RAY APPARATUS AND TUBES
3845	ELECTROMEDICAL EQUIPMENT
3851	OPHTHALMIC GOODS
3861	PHOTOGRAPHIC EQUIP & SUPPLIES
3873	WATCHES, CLOCKS & WATCHCASES
3911	JEWELRY, PRECIOUS METAL
3914	SILVERWARE AND PLATED WARE
3915	JEWELERS' MATERIALS & LAPIDARY
3931	MUSICAL INSTRUMENTS
3944	GAMES, TOYS & CHILDREN'S VEHIC
3949	SPORTING & ATHLETIC GOODS, NEC
3951	PENS & MECHANICAL PENCILS
3953	MARKING DEVICES
3961	COSTUME JEWELRY
3965	FASTENERS, BUTTONS, NEEDLES
3993	SIGNS AND ADVERTISING DISPLAYS
3995	BURIAL CASKETS
3999	MANUFACTURING INDUSTRIES, NEC
4011	RAILROADS, LINE HAUL OPERATING
4013	RAILROAD SWTCHING & TERM ESTAB
7692	WELDING REPAIR
3469	METAL STAMPINGS, NEC
3471	PLATING AND POLISHING

Table A-2. List of NAICS Codes Assigned to the Metal Finishing Category by the 304(m) Annual Review

NAICS Code	NAICS Code Description
339114	Dental Equipment and Supplies Manufacturing
339115	Ophthalmic Goods Manufacturing
339911	Jewelry (except Costume) Manufacturing
339912	Silverware and Hollowware Manufacturing
339913	Jewelers' Material and Lapidary Work Manufacturing
339914	Costume Jewelry and Novelty Manufacturing
339920	Sporting and Athletic Goods Manufacturing
339941	Pen and Mechanical Pencil Manufacturing
339943	Marking Device Manufacturing
339950	Sign Manufacturing
339992	Musical Instrument Manufacturing
339993	Fastener, Button, Needle, and Pin Manufacturing
339995	Burial Casket Manufacturing
339999	All Other Miscellaneous Manufacturing
482111	Line-Haul Railroads
482112	Short Line Railroads
332112MF	Nonferrous Forging (Metal Finishing)
332993MF	Small Arms Ammunition Manufacturing (Metal Finishing)
332999DC	All Other Miscellaneous Fabricated Metal Product Manufacturing (DC)
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance
512220	Integrated Record Production/Distribution
325510ELEC	Paint and Coating Manufacturing (Electroplating)
326199ELEC	All Other Plastics Product Manufacturing (Electroplating)
331221ELEC	Rolled Steel Shape Manufacturing (Electroplating)
336340ELEC	Motor Vehicle Brake System Manufacturing (Electroplating)
331111MF	Iron and Steel Mills (Metal Finishing)
331314MF	Secondary Smelting and Alloying of Aluminum (Metal Finishing)
331491MF	Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, and Extruding (Metal Finishing)
322225	Laminated Aluminum Foil Manufacturing for Flexible Packaging Uses
323122	Prepress Services
325992	Photographic Film, Paper, Plate, and Chemical Manufacturing
325998MF	All Other Miscellaneous Chemical Product and Preparation Manufacturing (Metal Finishing)
326199MF	All Other Plastics Product Manufacturing (Metal Finishing)
332111	Iron and Steel Forging
332114	Custom Roll Forming
332115	Crown and Closure Manufacturing
332116	Metal Stamping
332117	Powder Metallurgy Part Manufacturing
332211	Cutlery and Flatware (except Precious) Manufacturing
332212	Hand and Edge Tool Manufacturing
332213	Saw Blade and Handsaw Manufacturing
332214	Kitchen Utensil, Pot, and Pan Manufacturing
332311	Prefabricated Metal Building and Component Manufacturing
332312	Fabricated Structural Metal Manufacturing
332313	Plate Work Manufacturing
332321	Metal Window and Door Manufacturing
332322	Sheet Metal Work Manufacturing

Table A-2. List of NAICS Codes Assigned to the Metal Finishing Category by the 304(m) Annual Review

NAICS Code	NAICS Code Description
332323	Ornamental and Architectural Metal Work Manufacturing
332410	Power Boiler and Heat Exchanger Manufacturing
332420	Metal Tank (Heavy Gauge) Manufacturing
332439	Other Metal Container Manufacturing
332510	Hardware Manufacturing
332611	Spring (Heavy Gauge) Manufacturing
332612	Spring (Light Gauge) Manufacturing
332618	Other Fabricated Wire Product Manufacturing
332710	Machine Shops
332721	Precision Turned Product Manufacturing
332722	Bolt, Nut, Screw, Rivet, and Washer Manufacturing
332811	Metal Heat Treating
332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers
332813	Electroplating, Plating, Polishing, Anodizing, and Coloring
332813MF	Electroplating, Plating, Polishing, Anodizing, and Coloring (Metal Finishing)
332911	Industrial Valve Manufacturing
332912	Fluid Power Valve and Hose Fitting Manufacturing
332913	Plumbing Fixture Fitting and Trim Manufacturing
332919	Other Metal Valve and Pipe Fitting Manufacturing
332991	Ball and Roller Bearing Manufacturing
332992	Small Arms Ammunition Manufacturing
332993	Ammunition (except Small Arms) Manufacturing
332994	Small Arms Manufacturing
332995	Other Ordnance and Accessories Manufacturing
332996	Fabricated Pipe and Pipe Fitting Manufacturing
332998	Enameled Iron and Metal Sanitary Ware Manufacturing
332999	All Other Miscellaneous Fabricated Metal Product Manufacturing
333111	Farm Machinery and Equipment Manufacturing
333112	Lawn and Garden Tractor and Home Lawn and Garden Equipment Manufacturing
333120	Construction Machinery Manufacturing
333131	Mining Machinery and Equipment Manufacturing
333132	Oil and Gas Field Machinery and Equipment Manufacturing
333210	Sawmill and Woodworking Machinery Manufacturing
333220	Plastics and Rubber Industry Machinery Manufacturing
333291	Paper Industry Machinery Manufacturing
333292	Textile Machinery Manufacturing
333293	Printing Machinery and Equipment Manufacturing
333294	Food Product Machinery Manufacturing
333295	Semiconductor Machinery Manufacturing
333298	All Other Industrial Machinery Manufacturing
333311	Automatic Vending Machine Manufacturing
333312	Commercial Laundry, Drycleaning, and Pressing Machine Manufacturing
333313	Office Machinery Manufacturing
333314	Optical Instrument and Lens Manufacturing
333315	Photographic and Photocopying Equipment Manufacturing
333319	Other Commercial and Service Industry Machinery Manufacturing
333411	Air Purification Equipment Manufacturing
333412	Industrial and Commercial Fan and Blower Manufacturing

Table A-2. List of NAICS Codes Assigned to the Metal Finishing Category by the 304(m) Annual Review

NAICS Code	NAICS Code Description
333414	Heating Equipment (except Warm Air Furnaces) Manufacturing
333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing
333511	Industrial Mold Manufacturing
333512	Machine Tool (Metal Cutting Types) Manufacturing
333513	Machine Tool (Metal Forming Types) Manufacturing
333514	Special Die and Tool, Die Set, Jig, and Fixture Manufacturing
333515	Cutting Tool and Machine Tool Accessory Manufacturing
333516	Rolling Mill Machinery and Equipment Manufacturing
333518	Other Metalworking Machinery Manufacturing
333611	Turbine and Turbine Generator Set Units Manufacturing
333612	Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing
333613	Mechanical Power Transmission Equipment Manufacturing
333618	Other Engine Equipment Manufacturing
333911	Pump and Pumping Equipment Manufacturing
333912	Air and Gas Compressor Manufacturing
333913	Measuring and Dispensing Pump Manufacturing
333921	Elevator and Moving Stairway Manufacturing
333922	Conveyor and Conveying Equipment Manufacturing
333923	Overhead Traveling Crane, Hoist, and Monorail System Manufacturing
333924	Industrial Truck, Tractor, Trailer, and Stacker Machinery Manufacturing
333991	Power-Driven Handtool Manufacturing
333992	Welding and Soldering Equipment Manufacturing
333993	Packaging Machinery Manufacturing
333994	Industrial Process Furnace and Oven Manufacturing
333995	Fluid Power Cylinder and Actuator Manufacturing
333996	Fluid Power Pump and Motor Manufacturing
333997	Scale and Balance Manufacturing
333999	All Other Miscellaneous General Purpose Machinery Manufacturing
334111	Electronic Computer Manufacturing
334112	Computer Storage Device Manufacturing
334119	Other Computer Peripheral Equipment Manufacturing
334210	Telephone Apparatus Manufacturing
334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing
334290	Other Communications Equipment Manufacturing
334310	Audio and Video Equipment Manufacturing
334412	Bare Printed Circuit Board Manufacturing
334414	Electronic Capacitor Manufacturing
334415	Electronic Resistor Manufacturing
334416	Electronic Coil, Transformer, and Other Inductor Manufacturing
334417	Electronic Connector Manufacturing
334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing
334419	Other Electronic Component Manufacturing
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use

Table A-2. List of NAICS Codes Assigned to the Metal Finishing Category by the 304(m) Annual Review

NAICS Code	NAICS Code Description
334513	Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables
334514	Totalizing Fluid Meter and Counting Device Manufacturing
334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals
334516	Analytical Laboratory Instrument Manufacturing
334517	Irradiation Apparatus Manufacturing
334518	Watch, Clock, and Part Manufacturing
334519	Other Measuring and Controlling Device Manufacturing
334612	Prerecorded Compact Disc (except Software), Tape, and Record Reproducing
334613	Magnetic and Optical Recording Media Manufacturing
335110	Electric Lamp Bulb and Part Manufacturing
335121	Residential Electric Lighting Fixture Manufacturing
335122	Commercial, Industrial, and Institutional Electric Lighting Fixture Manufacturing
335129	Other Lighting Equipment Manufacturing
335211	Electric Housewares and Household Fan Manufacturing
335212	Household Vacuum Cleaner Manufacturing
335222	Household Refrigerator and Home Freezer Manufacturing
335224	Household Laundry Equipment Manufacturing
335228	Other Major Household Appliance Manufacturing
335311	Power, Distribution, and Specialty Transformer Manufacturing
335312	Motor and Generator Manufacturing
335313	Switchgear and Switchboard Apparatus Manufacturing
335314	Relay and Industrial Control Manufacturing
335931	Current-Carrying Wiring Device Manufacturing
335932	Noncurrent-Carrying Wiring Device Manufacturing
335991	Carbon and Graphite Product Manufacturing
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing
336111	Automobile Manufacturing
336112	Light Truck and Utility Vehicle Manufacturing
336120	Heavy Duty Truck Manufacturing
336211	Motor Vehicle Body Manufacturing
336212	Truck Trailer Manufacturing
336213	Motor Home Manufacturing
336214	Travel Trailer and Camper Manufacturing
336311	Carburetor, Piston, Piston Ring, and Valve Manufacturing
336312	Gasoline Engine and Engine Parts Manufacturing
336321	Vehicular Lighting Equipment Manufacturing
336322	Other Motor Vehicle Electrical and Electronic Equipment Manufacturing
336330	Motor Vehicle Steering and Suspension Components (except Spring) Manufacturing
336340	Motor Vehicle Brake System Manufacturing
336350	Motor Vehicle Transmission and Power Train Parts Manufacturing
336360MF	Motor Vehicle Seating and Interior Trim Manufacturing (Metal Finishing)
336370	Motor Vehicle Metal Stamping
336391	Motor Vehicle Air-Conditioning Manufacturing
336399	All Other Motor Vehicle Parts Manufacturing
336411	Aircraft Manufacturing
336412	Aircraft Engine and Engine Parts Manufacturing
336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing
336414	Guided Missile and Space Vehicle Manufacturing

Table A-2. List of NAICS Codes Assigned to the Metal Finishing Category by the 304(m) Annual Review

NAICS Code	NAICS Code Description
336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing
336510	Railroad Rolling Stock Manufacturing
336611	Ship Building and Repairing
336612	Boat Building
336991	Motorcycle, Bicycle, and Parts Manufacturing
336992	Military Armored Vehicle, Tank, and Tank Component Manufacturing
336999	All Other Transportation Equipment Manufacturing
337124	Metal Household Furniture Manufacturing
337127	Institutional Furniture Manufacturing
337214	Office Furniture (except Wood) Manufacturing
337215	Showcase, Partition, Shelving, and Locker Manufacturing
337920	Blind and Shade Manufacturing
339111	Laboratory apparatus and furniture manufacturing
339112	Surgical and Medical Instrument Manufacturing
339113	Surgical Appliance and Supplies Manufacturing

Appendix B:
Pollution Prevention (P2) Practices Identified in EPA's P2 Review

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Table B-1. Pollution Prevention (P2) Practices Identified from EPA's P2 Review

P2 Practice	Description/Frequently Reported Examples	Data Source			
		TRI Data [a]	Literature Search [b]	MP&M CRD [c]	E3/ Regional P2 Resources [d]
Process Technology Controls and Alternatives					
Water conservation practices	Reduce the volume of water required to clean or rinse parts (e.g., countercurrent rinses, conductivity controls, reduced flow processes, in-process flow controls).	✓	✓	✓	✓
Process changes	Alter existing process operations to reduce waste generation (e.g., in-tank filtration of process fluids, conversion of liquid coatings to powder coatings, chromium emission controls).	✓	✓	✓	✓
Recycle scrap materials	Recycle defective parts and solder.	✓			
Methods to reduce dragout	Remove dragout from parts (e.g., air knives, pinch/sponge rollers) or direct dragout back to process tanks (e.g., drip shields) to prevent transfer of dragout to rinse tanks.	✓	✓	✓	
Methods to increase throughput efficiency	Modify process scheduling or tank layout.	✓	✓		✓
Alternative Process Chemistries					
Replace solvent-based coating with water-based coatings	Water-based coatings generally generate less hazardous waste and are more easily treated.	✓		✓	✓
Conversion to lead-free solvents and lead-free anodes	Lead-free solder (e.g., tin, silver/tin), lead-free zinc for galvanizing, lead-free tape (e.g., aluminum), and lead-free finishes.	✓		✓	
Replace cyanide-bearing processes with non-cyanide processes	Convert cyanide base to alkaline base in zinc processing tanks.	✓		✓	✓
Replace hexavalent chromium-bearing process solutions with alternatives	Replace hexavalent chromium plating with trivalent chromium plating, metallic electroplating, or alloy electroplating.	✓	✓		✓

Table B-1. Pollution Prevention (P2) Practices Identified from EPA's P2 Review

P2 Practice	Description/Frequently Reported Examples	Data Source			
		TRI Data [a]	Literature Search [b]	MP&M CRD [c]	E3/ Regional P2 Resources [d]
Replace coating chemicals with low or non-VOC products	Replace coatings containing xylene with low VOC products. Replace methanol in coatings with non-VOC chemicals.	✓			
Wastewater Recycle, Materials Recovery and Treatment Alternatives					
Segregation of wastewater and treatment for recycling/reuse.	Capture chromium-containing wastewater for use in chromium electroplating baths.	✓	✓	✓	
Recycle/reuse spent cleaners and solvent	Recycle/reuse ethylene glycol, methyl isobutyl ketone, isopropyl alcohol, methanol, hydraulic oil, coolant (via centrifuge or ultrafiltration), xylene, and vapor degreasing solvents (containing trichloroethylene).	✓	✓		✓
Recover materials from wastewater	Recycle non-process cooling water, recover precious metals from electrowinning, recover metals from sludge byproducts, and recover copper or chrome in recovery units.	✓	✓	✓	✓
Regenerate spent plating baths	Regenerate spent plating baths using electrowinning systems, crystallization of salts, evaporation, and/or microfiltration. Bath regeneration is infrequent because chemical suppliers and customers require strict specifications for bath plating formulations.		✓	✓	✓
Use of alternative treatment chemicals	Replace ferrous sulfate/caustic soda with sodium bisulfite, which reduces amount of sludge generated. Incorporate clay-based products that absorb oils, surfactants, and many organic compounds from metal finishing wastewater.	✓	✓		

Table B-1. Pollution Prevention (P2) Practices Identified from EPA's P2 Review

P2 Practice	Description/Frequently Reported Examples	Data Source			
		TRI Data [a]	Literature Search [b]	MP&M CRD [c]	E3/ Regional P2 Resources [d]
Additional wastewater treatment beyond the Metal Finishing BAT	Process water recycle, ion exchange, ultrafiltration, dissolved air flotation, sand filtration, reverse osmosis, evaporation/ distillation, electrodialysis, and electrowinning.	✓	✓	✓	✓
Zero discharge through a multi-step approach to wastewater treatment	Evaporation, segregated waste stream treatment, reverse osmosis, ion exchange, carbon filtration, and/or distillation.	✓	✓		

BAT: Best Available Technology Economically Achievable
CRD: Comment Response Document
E3: Economy – Energy – Environment
MP&M: Metal Products & Machinery
TRI: Toxic Release Inventory
VOC: Volatile Organic Compound

[a] Reference: U.S. EPA. (2017). Pollution Prevention (P2) and TRI Webpage. Retrieved from https://www.epa.gov/toxics-release-inventory-tri-program/pollution-prevention-p2-and-tri. Accessed: August 15, 2017. EPA-HQ-OW-2015-0665. MF00271.

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[c] Reference: U.S. EPA. (2003). *Response to Comments for the Final Effluent Limitations Guidelines and Standards for the Metal Products & Machinery Point Source Category*. Washington, D.C. (February). EPA-HQ-OW-2015-0665. MF00263.

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