



Standing on the MACT Floor

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ABSTRACT

Three MACT standards have impacted manufacturing operations at the Boeing Philadelphia site. These standards apply to Aerospace Manufacturing and Rework, Halogenated Solvent Cleaning, and Chromium Anodizing.

In order to meet the requirements imposed by the standards, qualifications programs were established and conducted by the Materials and Process Engineering group to approve several candidate compliant materials and processes. Engineering specifications were revised to include qualified alternatives, primarily for cleaning and surface treatment of aerospace hardware. Operation and maintenance plans; startup, shutdown, and malfunction plans; work practice standards; housekeeping methods; and training procedures specified in the standards had to be implemented by the effective dates of the regulations. In addition, periodic monitoring of procedures, methods, and processes is required to document due diligence and support compliance certifications in the mandatory reports submitted to the EPA and the Pennsylvania environmental regulatory agency. Boeing utilizes its Hazardous Materials Management System (HMMS) and Material Safety Data Sheet (MSDS) databases as aids in providing accountability for material usage, characteristics, and emissions, to comply with recordkeeping requirements contained in the MACT standards.

Boeing has converted fifteen waterwash paint booths to dry filters for particulate control to facilitate compliance with the inorganic MACT standards of the Aerospace NESHAP. Cross-functional coordination of MACT requirements has been critical not only for ensuring compliance with those requirements, but also for identifying and implementing suitable alternatives not subject to any MACT standards. For instance, the applicability of the Chromium MACT standard at the Boeing Philadelphia facility was eliminated by replacing a chromic acid anodizing process with a boric/sulfuric acid anodizing process in 1998. Chromium electroplating at the Boeing Philadelphia facility was out-sourced prior to the effective date of the MACT standard. Ongoing research and development efforts seek alternatives to the two remaining trichloroethylene vapor degreasers on site. Viable alternatives will not utilize halogenated solvent cleaners subject to the Subpart T NESHAP. Currently, the majority of the batch cleaning is performed using either spray or immersion aqueous cleaning.

INTRODUCTION

National Emission Standards for Hazardous Air Pollutants (NESHAP) are promulgated by the U.S. Environmental Protection Agency (USEPA) pursuant to Section 112 of the Clean Air Act. Recently promulgated NESHAP pursuant to Section 112(b) impose maximum achievable control technology (MACT) requirements to limit emissions of hazardous air pollutants (HAP) from identified sources (40 CFR Part 63 – NESHAP for Source Categories). Salient aspects of the Boeing Philadelphia facility's experience with three of the NESHAP are presented in this paper.

The Boeing Philadelphia facility primarily manufactures military rotorcraft, including the Chinook, Apache, and Comanche helicopters and the V-22 Osprey, a vertical takeoff and landing aircraft. In addition, a limited amount of commercial jet airliner component manufacturing is performed at the facility. The site is relatively large, encompassing 400 acres with over twenty buildings and employing more than 5,000 workers. However, from an air emissions standpoint, the site can be considered rather moderate in size, having emitted an estimated average quantity of volatile organic compounds (VOC) of about 125 tons per year over the past several years. Furthermore, the actual quantity of HAP emitted from aerospace NESHAP operations for the semiannual period covered by the Initial Notice of Compliance Status was only 2.5 tons.

The following sections share Boeing Philadelphia's experience in complying with the following NESHAP regulations:

- Subpart A, National Emission Standards for Hazardous Air Pollutants, General Provisions.¹
- Subpart N, National Emission Standards for Chromium Emissions from Hard and Decorative Electroplating and Chromium Anodizing Tanks.²
- Subpart T, National Emission Standards for Halogenated Solvent Cleaning.³
- Subpart GG, National Emission Standards for Aerospace manufacturing and Rework Facilities.⁴

SUBPART N NESHAP – CHROMIUM ANODIZING

Anodizing aluminum components imparts the surface of the metal with a protective aluminum oxide layer. A process previously used at the facility required a chromic acid solution to function as the electrolyte while the aluminum part served as the anode. Since this process is regulated by the Subpart N NESHAP, specific emission standards together with monitoring, recordkeeping, and reporting requirements are imposed by this regulation. One of the more onerous requirements is to develop and maintain an up-to-date operation and maintenance plan meeting numerous criteria listed in the regulation [40 CFR 63.342(f)]. This plan is in lieu of a startup, shutdown, and malfunction plan as specified in the general provisions of Subpart A.

Boeing determined that an alternative aluminum anodizing process with a boric and sulfuric acid electrolyte yielded acceptable results, which met all engineering specifications. Hence, the chromium anodizing process was discontinued, and Boeing is no longer subject to Subpart N at the Philadelphia site.

SUBPART T NESHAP – HALOGENATED SOLVENT CLEANING

In past years the Boeing Philadelphia facility employed a number of halogenated solvent vapor degreasers in its manufacturing operations. Concerted research and development efforts have resulted in substitution of aqueous cleaning for many of the halogenated solvent degreasing operations. Currently, only two small (less than 13 square feet solvent/air interface) batch vapor degreasers are in operation. These units are utilized in the facility's transmission shop and use trichloroethylene to clean critical bearing assemblies and detail rotor and transmission components.

To comply with Subpart T, Boeing selected Control Combination No. 8 from the options listed in the regulation (40 CFR 63.463 – Table 1). This option specifies that reduced room draft, a minimum dwell time, and a minimum freeboard ratio of 1.0 shall be employed in the design and operation of the batch vapor degreasers. Pursuant to the regulatory provisions for this control option, Boeing monitors specified parameters, keeps records, and files the requisite reports. Boeing also trains the degreaser operators on how to adhere to the required operating procedures.

SUBPART GG NESHAP – AEROSPACE MANUFACTURING AND REWORK

The Aerospace NESHAP has imposed significant environmental management obligations on the Boeing Philadelphia facility. The fundamental standards imposed by the regulations are basically straightforward. Nonetheless, Boeing expended considerable effort ascertaining which processes and operations are subject to the standards, and, if so, determining whether or not any of the numerous exemptions in the regulation limit the scope of applicable standards.

An example of such a situation is a paint employed predominantly as an uncontrolled topcoat. Pursuant to Subpart GG, the HAP content limit is 420 grams per liter (3.5 lb/gal) less water, and the VOC content limit is 420 grams per liter (3.5 lb/gal) less water and exempt solvents. Furthermore, only specific methods are permissible for applying the topcoat [40 CFR 63.745(f)]. However, the same paint, when functionally applied to mark parts, not to perform as a topcoat, is considered to be a specialty coating. As such, it is not subject to the HAP/VOC content limits, the specified application methods, or any provision whatsoever in Subpart GG.

The example presented above demonstrates only one of the complexities an environmental manager faces when determining facility compliance with the Aerospace NESHAP requirements. Some other challenges the Boeing Philadelphia facility faced in complying with the Aerospace NESHAP are discussed in the following subsections.

Cleaning Solvents

Boeing meets the hand-wipe cleaning solvent requirements of the Aerospace NESHAP by using low vapor pressure solvents such as isopropyl alcohol, and methyl propyl ketone. In addition, Boeing uses acetone for the majority of the hand-wipe solvent cleaning applications plant-wide, to further reduce the regulatory burden, since Acetone is delisted as a HAP and VOC, and not covered by the Aerospace NESHAP.

Spray gun cleaning is performed using a combination of several of the approved methods listed in the regulation. After considerable research and consultation with equipment vendors, Boeing determined that only one of its spray gun cleaners is the enclosed type that must be monitored for leaks on a monthly basis.

Primer and Topcoat Application Processes

Based on the size, locations, and batch nature of the various primer and topcoat operations at the Boeing Philadelphia facility, add-on controls for organic HAP and VOC removal are not economically feasible. Consequently, Boeing has chosen to comply with the organic HAP and VOC content limitations for uncontrolled coatings [40 CFR 63.745(c)]. To ensure compliance with the applicable 420 grams per liter (3.5 lb/gal) limit for topcoats and the 350 grams per liter (2.9 lb/gal) limit for primers, Boeing thoroughly examined all of its topcoat and primer paints. Information from MSDS was compiled in an electronic database. In a number of instances, MSDS information was not sufficient to ascertain the HAP/VOC content of the coating, typically a two-part coating consisting of a base component and a catalyst component, each with a separate MSDS. When the MSDS information was insufficient to ascertain HAP and VOC content, Boeing contacted the paint vendors directly to obtain certifications regarding such contents. Boeing also revised coating specifications to reflect the amount of thinner that can be added to a purchased coating, as received, without exceeding the regulatory organic HAP/VOC limit in the coating as it is applied to the substrate. The facility HMMS database is relied upon to document primer and topcoat consumption.

The only approved methods for spraying primers and topcoats are high volume low pressure (HVLP) spray guns. Boeing uses only HVLP spraying of Aerospace NESHAP primers and topcoats at the Philadelphia site, with only minor use of other approved methods like brush coating and cotton-tipped swab application.

To comply with inorganic HAP (e.g., cadmium, chromium, cobalt) control requirements, existing primer and topcoat operations must use a booth or hangar in which the exhaust air stream is directed through a two-stage dry particulate filter system, a waterwash system, or an agency-approved alternative that exceeds the removal efficiency of a two-stage dry particulate filter system. Boeing upgraded several of its single stage dry filter paint spray booths to two-stage filters to meet this requirement. Besides these dry filter booths, on the effective date of the Aerospace NESHAP, all of Boeing Philadelphia's other primer and topcoat booths were equipped with waterwashes to control overspray particulate. Startup, shutdown, and malfunction (SSM) plans are required for waterwash booths, but not for dry filter booths operated in accordance with manufacturer specifications [40 CFR 63.743(b)]. Semiannual SSM reports must be submitted for processes and control devices operated pursuant to SSM plans. To relieve these administrative compliance burdens, simplify monitoring requirements (filter pressure drop versus dynamic and static pump pressure head for waterwashes), and minimize waste, Boeing has chosen to replace fifteen of its waterwash systems with approved dry particulate filter systems.

Depainting

At the Philadelphia site, only plastic media blasting (PMB) is used to repaint aircraft components subject to the Aerospace NESHAP requirements. The operation is controlled with a baghouse which is operated and maintained according to an SSM plan. A checklist is used to document process operations. Preventive maintenance system records are also maintained. The only exception to using PMB for repainting

aerospace components subject to the regulation is the use of organic HAP-containing chemical strippers for spot stripping and decal removal. The regulation allows an annual average of no more than 50 gallons (or alternatively, 365 pounds) of organic HAP per military aircraft depainted.

CONCLUSION

Compliance with U.S. EPA NESHAP for source categories requires a significant due diligence effort to support compliance certifications. An organized approach is necessary, together with a strategy for minimizing applicability of requirements whenever feasible without unduly constraining manufacturing operations. Environmental managers must thoroughly review both the specific source category NESHAP and any of the Subpart A General Provisions which are incorporated by reference. Sufficient time and resources must be allocated to ensure that compliance programs are in place by the effective dates of the regulations.

REFERENCES

1. United States Environmental Protection Agency. *40 CFR 63 Subpart A – General Provisions*. 59 FR 12430, March 16, 1994.
2. United States Environmental Protection Agency. *40 CFR 63 Subpart N – National Emission Standards for Chromium Emissions from Hard and Decorative Electroplating and Chromium Anodizing Tanks*. 60 FR 4963, January 25, 1995.
3. United States Environmental Protection Agency. *40 CFR 63 Subpart T – National Emission Standards for Halogenated Solvent Cleaning*. 59 FR 61805, December 2, 1994.
4. United States Environmental Protection Agency. *40 CFR 63 Subpart GG – National Emission Standards for Aerospace Manufacturing and Rework Facilities*. 60 FR 45948, September 1, 1996.

KEYWORDS

NESHAP

HAP

MACT

SSM

Aerospace

Halogenated

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Booth