**Bay Area Air Quality Management District**
**939 Ellis Street**
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# Workshop Report

## BAAQMD Regulation 12, Rule 13: Metal Melting and Processing Operations

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**WORKSHOP REPORT**
**Regulation: Metal Melting and Processing Operations**

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# I. INTRODUCTION

The Bay Area Air Quality Management District (District or BAAQMD) has the authority to regulate emissions of various air pollutants from stationary sources in all of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, and portions of Solano and Sonoma Counties. Types of air pollutants regulated by the District include criteria pollutants, such as particulate matter (PM) and volatile organic compounds (VOC); toxic compounds; and odorous substances that can cause a nuisance to the general public. Table 1 provides examples of the various types of air pollutants that the District regulates and some of the sources.

**Table 1**
**Summary of Pollutants Regulated by the Air District**

| Pollutant Category | Pollutant | Potential Sources |
|---|---|---|
| Criteria | Volatile organic compounds (VOC) | Refineries, chemical plants, gasoline stations, autobody repair facilities, gasoline bulk terminals & cargo tanks, solvent cleaning operations, architectural coatings, solid waste disposal sites. |
| | Oxides of nitrogen (NOx) | Power plants, IC engines & turbines, furnaces, water heaters and boilers. |
| | Oxides of Sulfur | Refineries, combustion of fuel oil, ships. |
| | Particulate Matter (PM) | Wood smoke, agricultural burning, restaurants. |
| Toxic Compounds | Toxic Air Contaminant, HAPs | Gas stations, dry cleaners, diesel generators. |
| Stratospheric Ozone Depleters | Chloroflourocarbons (CFCs) and hydrochloroflourocarbons (HCFCs) | Refrigerants and solvents. |
| Nuisance | Odorous substances, dust | Sewage treatment plants, construction sites, chemical plants, refineries. |

Metal melting and processing facilities are sources of emissions of PM, VOC (including toxic and odorous substances), and other pollutants. Because some of these facilities are located in close proximity to residences and other businesses, there is a potential for them to impact their neighbors and they tend to garner scrutiny from community members and adjacent businesses. Staff has evaluated this industrial sector and determined that while many of these facilities comply with current District rules and regulations applicable to them, their operations have triggered odor nuisance issues. Some of these facilities are also of concern due to emissions of PM or toxic air contaminants, particularly when in close proximity to residential areas (with most being located within or near Community Air Risk Evaluation (CARE) program designated areas). Implementation of metal melting and casting best practices and improved pollution prevention techniques and emission mitigation should reduce emissions of particulate matter and organic compounds, including odorous substances, and reduce risk to nearby residences and businesses.

# II. BACKGROUND

## A. Source Description

Staff has identified approximately 20 facilities that conduct metal melting or metal heating operations in the District that may be affected by the proposed rule. There are also potentially 100 facilities that collect and manage scrap metals throughout the Bay Area. These metal melting and processing facilities fall into at least one of three primary categories of potentially-affected facilities: foundries, forges, and metal recycling operations. Metal melting and processing facilities can process “ferrous” metals, “non-ferrous” metals or a combination of both. Ferrous metals and alloys have iron as the largest metal component. Non-ferrous metals and alloys contain metal(s) other than iron as the major (base) component, e.g.: aluminum (Al), copper (Cu), magnesium (Mg), zinc (Zn), brass, and bronze.[1]

### 1. Foundries and Furnaces

Foundries are metal melting operations that cast molten metals into a wide array of products, such as pipes, connectors, valves, engine parts, pump housings, ski lift and cable car castings, even horse shoes. Foundries melt metal in furnaces, which are large ovens that are heated using coke, electricity, or natural gas. Once the molten metal has obtained the right properties, it is poured or “tapped” and transferred to molds in which the metal casting is formed into the shape of the final product. The molten metal can also be “spun” into pipes using centrifugal force. Molten metal can also be cast into ingots or sows for subsequent transport, storage, or re-melting and casting. Foundries may operate one or more type(s) of furnaces, which include cupola, electric arc, reverberatory and crucible.

*Cupola Furnace*

The cupola furnace is one of the oldest methods of making cast iron and is the most common at iron and steel foundries in the District. A cupola is a cylindrical, water-cooled furnace which appears similar to a squat smoke stack and is lined with refractory brick made from heat resistant material such as oxides of aluminum, magnesium, and silicon, or silicon carbide. In the metal melting process, scrap iron or steel, coke and lime (used as flux) are put into the cupola near the top; this is call the “charge.” The charge is layered – coke, metal, lime. Air, often heated, is blown in near the bottom through tuyeres (nozzles though which air blasts are routed into the furnace to provide oxygen) to improve the combustion and heating of the furnace.

*Electric Arc Furnace*

The electric arc furnace (EAF) is used in secondary steel production (steel made from scrap or ingots – not iron ore). This furnace relies on an electric arc to heat and melt metal rather than a fuel such as coke or natural gas. The furnace is lined with refractory material and is usually water cooled. The vessel is covered with a retractable roof through which typically three cylindrical, graphite electrodes protrude into the furnace. When powered with a very strong current, an electric arc forms between the charged metal and the electrode that heats the metal to its melting point. Once the metal is molten and of the proper metallurgical properties, the electrodes are raised. The furnace is built on a tilting platform so that the liquid steel can be poured into another vessel for transport; this is called "tapping."

*Reverberatory Furnaces*

The reverberatory furnace differs from a cupola furnace because in a reverberatory furnace, the metal is isolated from contact with the fuel. Reverberatory furnaces rely on radiant and convective heating to melt the metal. These furnaces are not as energy efficient as the cupola or electric arc furnaces. Reverberatory furnaces have historically been used for melting bronze, brass, and pig iron (an intermediate product of smelting iron ore with a high carbon content). Currently these furnaces are used for melting secondary aluminum, often from scrap.[2, 3]

The basic design of a reverberatory furnace is a simple steel box lined with aluminum oxide refractory bricks with a flue at one end and a vertically-lifting door at the other. The temperature in the furnace allows the aluminum to melt while leaving solid other metals, such as iron, that have a higher melting point. The floor of the furnace slopes slightly to separate the molten aluminum from the solid metals.[2]

## 2. Forges

Forges are metal processing operations where the metal is worked in the solid state. There are several types of forging: hot, warm, and cold. In hot forging, the metal is heated in a furnace above its recrystallization temperature – often to glowing, but not molten. Forging makes metal more malleable, which makes it more amenable to shaping, stamping, or forming. There is also warm and cold forging. Warm forging occurs between 30 and 100 percent of the metal's recrystallization temperature (on an absolute scale) while cold forging occurs below 30 percent of the recrystallization temperature, usually ambient temperatures. Historically, these types of metalworking were performed by a blacksmith. Currently, industrial forging is done either with presses or hammers powered by compressed air, electricity, hydraulics or steam. The furnaces used in the forging process are heated with natural gas or electricity.[4]

Associated with forging of metal is the quenching process, in which the hot metal is rapidly cooled in a liquid (such as water or oil) or air cooled. Quenching preserves various qualities in the metal that would be lost during a slow cooling process. Quenching retards crystallization of the metal and produces greater hardness.[4]

### 3. Metal Recycling Operations

There are various scrap handlers and metal recycling operations in the Bay Area which vary in size from a few tons to thousands of tons per year with satellite feeder facilities. The metal is never melted or heated during recycling operations. Sources of scrap metal are as varied as metallic products themselves; however, the majority of scrap metal comes from automotive sources, demolitions (buildings, constructions sites, even the Bay and Carquinez Straits Bridges), manufacturing, wiring, and miscellany (cans and other consumer products). The majority of metals recycled are steel and other ferrous metals, aluminum, and copper and copper alloys, such as brass and bronze.

Scrap metal is most often delivered by regular peddlers in trucks which are weighed and sometimes scanned for radioactive materials. The metal is inspected to minimize the presence of unacceptable substances such as wood, paper, dirt, rocks, glass and free liquids. Scrap containing these substances is not accepted. Other substances that may contaminate scrap metal include other metals, insulation, plastics, paints, and oils. Staff at these facilities is trained to recognize types of metals and alloys on sight and when there is doubt, the metal can be analyzed with hand held spectrometers that provide accurate composition.

Once the scrap has been inspected it is sized and sorted. The sizing of the scrap is dependent of the facility, but the segregation is by metal type, ferrous metal and alloys and non-ferrous metals and alloys. Ferrous includes steel and iron and can be separated from non-ferrous metals using magnets. Non-ferrous includes aluminum, copper, brass and bronze and sometimes precious metals.

At larger facilities that resell scrap, the metal is sent through a shredder which uses hammers and screens to ensure the scrap meets specific size criteria. Water is used during the operation to minimize dust emissions and also to help reduce the potential for fires. Scrap that has been properly sized and sorted is often sold and shipped to metal melting facilities in the vicinity or overseas. At some facilities, scrap metal (such as aluminum) is charged to furnaces onsite to produce reclaimed metal that may used as feed stock in other metal-melting processes.

Facilities that both recycle and melt metal may not be able to use water for dust suppression for scrap that is charged to its furnace because wet scrap can result in explosions in a furnace.

## B. Operations Associated with Foundries

There are several operations associated with metal melting that occur at foundries. These operations include temporary mold and core making, metal casting, cooling, shakeout and sand reclamation. These operations contribute to the emissions of particulate matter and VOCs (including odorous substances and toxic compounds). Once metal is heated to become molten in a furnace, it is cast. Metal casting is the process of pouring molten metal into molds to create cast metal products such pipes, engines, tools, pumps, toys, and a myriad of other products. Metal casting requires the making of molds into which the molten metal is poured. These molds must withstand the extreme heat from the molten metal and maintain their shape without collapsing until the metal has cooled and solidified. Once solid and properly cooled, the part can be extracted from the mold. In sand casting, separation of the cooled casted part from the spent mold and core assembly is called shake out. After the part is separated, the spent sand / binder mixture is sent through a sand reclamation process.

### 1. Temporary Mold and Core Making

Temporary molds are made from mixtures of refractory (heat resistant) sand and some type of binder. (There are also a few types permanent casting: centrifugal casting (for casting of pipes), die casting, and ingot and sow casting.)

*Sand Mold and Core Making*

Sand casting is one of the earliest techniques used in metal casting due to the simplicity and availability of materials used. In sand mold making, disposable molds and cores (called the foundry shapes) are produced with a mixture of sand and an organic or inorganic binder. A mold forms the shape that the casted part is to take and cores are used to form internal spaces within the mold. A binder is needed so the mold and core shapes do not disintegrate when they come into contact with the molten metal. There are several general techniques used to produce molds and cores for sand casting: green sand, bake, no-bake, cold box, warm box and hot box.

Bake Molding: With bake sand molding, a shell mold of the pattern is made by covering a heated metal pattern with a mixture of sand and a thermoset plastic binder, usually phenolic urethane. This results a thin layer of a sand and plastic mixture adhering to the pattern and some off-gassing of organic compounds. This skin is removed from the pattern to form the "shell mold." The two halves of the shell mold are secured together in a flask – a container with only sides (no top or bottom) that forms a frame around the mold – and either a casting sand or green sand is poured around the outside of the shell to support it. Once the shell is secured, molten metal is poured in the shell to form the casted part. Contact with the hot molten metal results in vapor off-gassing. When the metal solidifies, the shell is broken and the molding materials recycled. This process can produce complex parts with good surface finish and excellent dimensional tolerance. A good surface finish and good size tolerance reduce the need for machining. Shell molding offers better surface finish, better dimensional tolerances, and higher throughput due to reduced cycle times. The materials that can be used with this process include iron, and aluminum and copper alloys.[5]

No-Bake and Cold Box Molding: In the no bake and cold box techniques, sand is compacted around a master pattern – which is in the shape of the item to be cast – to form a mold cavity, which is sort of a negative of the master pattern and item to be casted. In order to obtain the desired properties for the binder, various solvents and additives are typically used with the reactive components of the binders to enhance the properties needed. This type of mold gets its name from not being baked in an oven like other sand mold types. Like bake casting, molds often form a two-part mold having a top and bottom that can be separated so that the master pattern can be removed.[1, 6, 7]

In the no-bake process, a liquid curing catalyst is mixed with the sand and binder before shaping the mixture in a pattern. The foundry mix is shaped by compacting it in a pattern, and allowing it to cure until it is self-supporting.[6]

Cold box casting uses organic and inorganic binders that strengthen the mold by chemically adhering to the sand. In the cold-box process, a gaseous catalyst is permeated through a shaped mixture of the sand and binder. The gaseous catalyst cures the binder to form a hardened mold. The type of catalyst or co-reactant gas/vapor that is used depends upon the specific chemistry of the binder employed: epoxy-acrylic cold-box uses only sulfur dioxide. Urethane cold-box uses only tertiary amines; alkaline resole cold-box uses methyl formate or carbon dioxide; and sodium silicate cold-box uses carbon dioxide. This type of mold is not baked in an oven like other sand mold types. Because these types of mold making processes use no phenolic binders and are not heated, there is a much lower chance of emissions of odorous substances.[1,6,8]

Green Sand: The most common method for metal casting uses green sand molding, which is considered no-bake casting. Green sand is a mixture of refractory (heat resistant) sand, starch and/or seacoal (pulverized coal), and water. It is call “green” because of the moisture content of the mixture and not due to any coloration. The addition of the hot molten metal causes the starch or coal to partially combust which results in the off-gassing of organic vapors.[5,9,10]

Warm Box Molding: Warm box molding is a recently developed system that produces cores using a furfuryl alcohol-based binder that cures using a latent (heat activated) catalyst. The catalysts are acidic solutions of various salts. The resin, catalyst and release agent are mixed with the sand to form a sand mix with a long shelf life. When used, the mix is blown into a pattern heated to between 300 to 450 °F. The latent heat of the pattern rapidly accelerates the cures of the resin in sand mix to form an insoluble, infusible solid. The mold remains in the box long enough to develop adequate strength to be handled and is then ejected. Curing continues as the mold cools.[11]

Hot Box Molding: Hot box molding is a heat-cured process that produces cores using either a sand, phenolic resin or furfuryl alcohol based binder, and a latent catalyst. Typically hot box casting requires higher curing temperatures than a warm-box process. The sand with the binder is blown (using air pressure) into a heated core box that is at a temperature between 445 and 550°F.[1]

## 2. Cooling

Once a metal part has been cast, it must be allowed to cool before it can be removed from the mold. The duration of cooling is dependent on the size and shape of the cast part. Parts with a large surface area will cool faster than part with a smaller surface area. During cooling, emissions of VOC (including odorous substances) and particulate matter may occur.

## 3. Shakeout

Once the cast metal part cools sufficiently it has to be removed from a sand mold. The process of removing the cast part is called “shakeout.” With an efficient shakeout, the mold is broken up, the castings and sand are separated, and mold lumps are reduced in size. To accomplish this, most modern foundries use a vibratory or rotary shakeout system.[12]

### *Vibratory Shakeout System*

Vibratory decks are commonly used to perform the shakeout operation. The vibrating deck consists of a heavy-duty frame constructed from steel and a perforated grid on the frame's top face. The frame is isolated by springs from the vibrating grid. The action of the vibrating deck is usually to impart high frequency vibrations to the mold to break down the compacted sand. The continuing vibration usually is enough to remove the remaining adhering sand from the casting.[12]

### *Rotary Drum Shakeout System*

A rotary shakeout consists of two concentric drums. The outer unit is supported on rollers and may be gear- or chain-driven, typically at three to eight revolutions a minute. The inner drum is perforated to allow sand to flow into the space between the two drums. This allows the sand and castings to be delivered to fixed points for separation.[12]

## 4. Thermal Sand Reclamation

Many metal melting and processing facilities that cast metal parts with sand molds and cores recycle or reclaim the sand for reuse. A well-operated sand reclamation system can achieve reclamation rates of well over 90 percent. The spent sand is heated to over 1350$^{o}$F in a fluid calcining bed to burn off the organic binding agent, before being cooled and pneumatically scrubbed to remove remaining clay, binder and fines. The exhaust from the reclaimer is usually routed to control devices, typically an afterburner and a baghouse. Reclamation greatly reduces waste and there is usually little to no loss of quality to the reclaimed sand. The reclaimed sand can be recoated with a binder and used for subsequent core or mold making.[13]

## 5. Permanent Mold Casting

There are three primary types of metal casting that use permanent molds: die casting, centrifugal casting, and gravity casting. Unlike sand casting, in which the mold is destroyed with each casting, permanent mold casts are used for more multiple casting.[14]

### *Die Casting*

Die casting is used to produce small- to medium-sized castings at high production rates. Metal molds are coated with a mold release coating and preheated before molten metal is injected into it. Premeasured amounts of molten metal are forced from a shot chamber into the permanent mold or die under extreme pressure (1,450 to 30,500 pounds per square inch (psi)). This allows for high production rates.[15, 16]

Castings of varying weights and sizes can be produced. Nearly all die castings are produced in nonferrous alloys (aluminum, zinc and copper alloys), with limited amounts of cast iron and steel castings produced in special applications. The die casting process is suitable for a wide variety of applications for which high volume production is needed. Die casting provides excellent mechanical properties, surface finish, precise dimensional tolerances and can produce thin-section castings.[16]

### *Centrifugal Casting*

In centrifugal casting, a permanent mold is rotated about its axis at high speeds (300 to 3000 revolutions per minute) as the molten metal is poured. The molten metal is centrifugally thrown towards the inside mold wall, where it solidifies while cooling. Typical materials that can be cast with this process are iron, steel, stainless steels, and alloys of aluminum, copper and nickel. Typical parts made by this process are pipes, boilers, pressure vessels, flywheels, cylinder liners and other parts that are symmetric around an axis.[17]

*Ingot, Pigs and Sow Casting*

Many metal melting operations produce metals and alloys to be processed as raw material in other metal melting operations. In these operations, the metal is usually made into ingots, pigs, or sows, which are masses of metal shaped for convenient transport and storage, such as in rectangular bars or blocks. The three terms, ingot, pig and sow, are often used interchangeably and the difference between them depends greatly on the context. Ingots are typically the smallest of the three often weighing up to 20 pounds; pigs are usually larger than ingots and smaller than sows; and sows are usually the largest of the three and can weigh well over a ton. Ingots, pigs and sows are produced using the mold chill method. In mold chill, a permanent mold is cooled using a water spray or an internal cooling system. Once molten metal is poured into the mold it cools and contracts, which causes it to pull from the surface of the mold. The molds are usually arranged in a continuous loop conveyor system that continuously fills the molds with molten metal and sprays them with water to cool after the ingots are ejected.

## C. Regulatory History

Metal melting and processing facilities in the Bay Area are subject to many air pollution control regulations which largely depend on the types of metals processed and the pollutants emitted. Included in these regulations are District rules, a State airborne toxic control measure (ATCM), and at least five national emissions standards for hazardous air pollutants (NESHAP).

### 1. District Regulations

The District currently regulates metal melting and processing facilities under the following rules:

- Regulation 1: General Provisions & Definitions;
- Regulation 2, Rule 1: General Requirements;
- Regulation 2, Rule 2: New Source Review;
- Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants;
- Regulation 2, Rule 6: Major Facility Review;
- Regulation 6, Rule 1: Particulate Matter General Requirements; and
- Regulation 7: Odorous Substances.

*Regulation 1: General Provisions and Definitions*

The provisions and definitions in this regulation are applicable to all District Regulations and are in addition to the provisions and definitions in individual rules and regulations. Regulation 1 includes sections on nuisance, exclusions, breakdown procedures, definition of terms, registration, right-of-access, sampling facilities, record maintenance, and other provisions.

*Regulation 2, Rule 1: General Requirements*

This rule includes criteria for issuance or denial of permits, exemptions, appeals against decisions of the APCO and District actions on applications. Under the general requirements, any facility that operates equipment that causes or reduces air pollutants must have a permit to operate that provides details on how the equipment is to be operated and/or the levels to which the emissions are to be mitigated. Any equipment emitting air pollutants used in metal melting and processing facilities is required to have permits.

*Regulation 2, Rule 2: New Source Review*

Regulation 2, Rule 2 (Rule 2) applies to new or modified sources. Rule 2 contains requirements for Best Available Control Technology (BACT) and emission offsets. Rule 2 also implements federal New Source Review and Prevention of Significant Deterioration requirements. Any metal melting and processing facility that installs a new source or modifies an existing source of air pollutants that emits ten pounds per day of a criteria pollutant must obtain permits under this rule and install District-approved BACT.

*Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants*

Regulation 2, Rule 5 (Rule 2-5) requires preconstruction permit review for new and modified sources of toxic air contaminants; contains project health risk limits and requirements for Toxics Best Available Control Technology (TBACT). Any metal melting and processing facility that installs a new source or modifies an existing source of air pollutants must install District-approved TBACT.

*Regulation 2, Rule 6: Major Facility Review*

Regulation 2, Rule 6 establishes procedures for large facilities to obtain federal Title V permits.[i] This rule applies to any metal melting and processing facility that is major source or operates under a Synthetic Minor Operating Permit, which limits production to keep facilities from emitting pollutants at major source amounts.

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[i] Title V operating permits are federally-enforceable permits issued by the District as required by the 1990 federal Clean Air Act amendments, and in accordance with District Regulation 2, Rule 6: Major Facility Review. Title V permits are required for "major facilities" that have the potential to emit regulated air pollutants or hazardous air pollutants above specific thresholds. Title V permits list every federally-enforceable air pollution requirement applicable at a major facility, including BAAQMD rules that have been incorporated into the state implementation plan (SIP) and include either a certification of compliance with these requirements or a schedule to comply. Title V permits must be renewed every five years, and renewals, as well as original permits, are subject to public notice requirements and EPA review.

*Regulation 6, Rule 1: Particulate Matter General Requirements*

Regulation 6, Rule 1 limits the quantity of particulate matter in the atmosphere by controlling emission rates, concentration, visible emissions and opacity.

*Regulation 7: Odorous Substances.*

Regulation 7 (Reg. 7) establishes general limitations on odorous substances and specific emission limitations on certain odorous compounds. The provisions of the regulation do not apply to a facility unless the District receives ten or more confirmed odor complaints about a facility within 90 days. Compounds with specific emissions limits regulated under Reg. 7 include dimethylsulfide, ammonia, mercaptans, phenols, and trimethylamine.

### 2. California State Regulations

The Non-Ferrous Metal Melting Airborne Toxic Control Measure (ATCM) applies to facilities that melt non-ferrous metals such as aluminum, copper, zinc, lead, cadmium, arsenic and their alloys.[ii] The ATCM limits emissions of PM and dust. The ATCM contains emission standards, equipment and operating requirements and specifications. All emission points equipped with an emission collection system must meet the specifications of the "Industrial Ventilation, Manual of Recommended Practices," 20th Edition, 1988.

Any particulate matter control device must achieve a control effectiveness of at least 99 percent along with specific operating conditions. Further, the ATCM prohibits visible emissions that exceed an opacity limit of ten percent for three minutes or longer in any hour.

The District also implements the California Air Toxic "Hot Spots" Program (AB2588). This program identifies facilities that emit toxic air contaminants, prioritizes them, assesses the health risk, notifies local populations, and requires risk reduction.

### 3. Federal MACT Standards

Federal Maximum Achievable Control Technology (MACT) Standards are set by the US Environmental Protection Agency (EPA) to control emissions of hazardous air pollutants (HAP). Hazardous air pollutants are 187 compounds that have been determined by the US EPA to be toxic. There are five MACT Standards that are specific to certain types of metal melting facilities. They are:

- The National Emission Standard for Hazardous Air Pollutants (NESHAP) for Iron and Steel Foundries: 40 CFR Part 63, Subpart EEEEE (E5);

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[ii] Although the ATCM regulates facilities that melt lead, cadmium, or arsenic, there are no such facilities in the Bay Area.

- NESHAP for Secondary Aluminum Production:  40 CFR Part 63, Subpart RRR (R3);
- NESHAP for Electric Arc Furnace Steelmaking Facilities:  40 CFR Part 63, Subpart YYYYY (Y5);
- NESHAP for Iron and Steel Foundries: 40 CFR Part 63, Subpart ZZZZZ (Z5); and
- NESHAP for Aluminum, Copper, and Other Nonferrous Foundries: 40 CFR Part 63, Subpart ZZZZZZ (Z6).

*NESHAP for Iron and Steel Foundries, 40 CFR Part 63, Subpart EEEEE*

The NESHAP for Iron and Steel Foundries (40 CFR Part 63, Subpart EEEEE (E5)) was originally promulgated in April 2004 and was amended in May 2005 and again in February 2008.  It affects iron and steel foundries (NAICS code numbers 331511, 331512, 331513) that are major sources of hazardous air pollutant (HAP) emissions.  A major source is a facility with the potential to emit a total of ten tons per year of a single HAP or 25 tons per year of a combination of HAPs.  E5 addresses emissions from metal melting furnaces, including electric arc furnaces (EAF), electric induction furnaces (EIF), and cupola metal melting furnaces; scrap preheaters; pouring areas and stations; automated conveyors, pallet cooling lines, and automated shakeout lines that use a sand mold system; and mold and core-making lines.  This MACT standard also covers fugitive emissions from foundry operations.  This regulation affects at least ten metal melting and processing facilities in the District.

*NESHAP for Secondary Aluminum Production:  40 CFR Part 63, Subpart RRR (R3)*

The NESHAP for Secondary Aluminum Production (40 CFR Part 63, Subpart RRR (R3)) was promulgated in March 2000 and was amended in December 2002 and again in December 2005.  This MACT standard affects new and existing sources at secondary aluminum production facilities with the following NAICS Code numbers:  331312, 331314, 331315, 331316, 331319, 331521, and 331524.  R3 regulates emissions of PM, total hydrocarbons (THC), and hydrochloric acid (HCl) from the following sources:  aluminum scrap shredder, thermal chip dryer, scrap dryer, delacquering or decoating kiln, group 2 (i.e., processing clean charge only and no reactive fluxing) furnace, sweat furnace, dross-only furnace, and rotary dross cooler; secondary aluminum processing unit at major-source facilities.  R3 also limits emissions of dioxin and furans (D/F) from thermal chip dryers, scrap dryer/delacquering kiln/decorating kiln, and sweat furnace; and from secondary aluminum processing units from area source facilities.  This regulation affects at least 11 metal melting and processing facilities in the District.

*NESHAP for Electric Arc Furnace Steelmaking Facilities: 40 CFR Part 63, Subpart YYYYY*

The NESHAP for Electric Arc Furnace Steelmaking Facilities: 40 CFR Part 63, Subpart YYYYY (Y5) was promulgated on December 28, 2007, and addresses emissions from area source steelmaking facilities using electric arc furnaces (EAF). The Y5 requirements are additional to those of other NESHAPs that affect ferrous metal melting operations. This MACT standard has requirements for large and small facilities. A large facility is defined as having a production rate of at least 150,000 tons per year of stainless or specialty steel. A small facility produces less than 150,000 tons of steel annually. This regulation affects at least six metal melting and processing facilities in the District.

*NESHAP for Iron and Steel Foundries: 40 CFR Part 63, Subpart ZZZZZ*

The NESHAP for Iron and Steel Foundries: 40 CFR Part 63, Subpart ZZZZZ (Z5) was promulgated January 2, 2008, and affects all area source iron and steel foundries. This MACT standard has requirements for large and small facilities that are non-major sources. There are different criteria defining large and small facilities, depending on whether the facility is new or existing. A large, existing facility is defined as one with a production rate of at least 20,000 tons per year of stainless or specialty steel. A small, existing facility produces less than 20,000 tons of steel annually. For new facilities, a large facility produces at least 10,000 tons annually and small, less than 10,000 tons. This regulation affects at least ten metal melting and processing facilities in the District.

*NESHAP for Area Source Aluminum, Copper, and Other Nonferrous Foundries: 40 CFR Part 63, Subpart ZZZZZZ*

The NESHAP for Area Source Aluminum, Copper, and Other Nonferrous Foundries: 40 CFR Part 63, Subpart ZZZZZZ (Z6) was promulgated on June 25, 2009 and addresses emissions of HAPs from area source aluminum, copper and other nonferrous foundries (NAICS Codes: 331524, 331525, and 331528). Under this MACT standard, an affected area source:

1. Emits less than 10 tons per year of a single HAP or less than 25 tons of any combination of HAPs;
2. Has an annual metal melt production of 600 tons or more; and
3. Uses material that contains, as appropriate:
    - <u>Aluminum foundry HAP</u>: any material containing greater than 0.1 percent by weight beryllium, cadmium, lead, or nickel or greater than 1.0 percent by weight manganese;
    - <u>Copper foundry HAP</u>: any material containing greater than 0.1 percent by weight lead or nickel or greater than 1.0 percent by weight manganese; or
    - <u>Other nonferrous foundry HAP</u>: any material containing greater than 0.1 percent by weight chromium, lead, or nickel.

This regulation affects at least two metal melting and processing facilities in the District.

# III. TECHNICAL REVIEW

## A. Emissions and Risk from Metal Melting and Processing Facilities

The District has identified numerous metal melting and processing facilities in the Bay Area. There are at least 19 facilities that actively engage in metal melting and processing activities, such as metal melting and casting (foundries) and heat treatment of metals (forges). There are an additional 100 facilities that engage in scrap metal recycling. All of these operations have associated with them some degree of emissions, such as particulate matter, including metals; VOCs (including odorous compounds, such as phenols and cresols); and/or toxics compounds. These emissions data and other compliance information allow these facilities to be segregated into three types of emissions sources:

- Criteria pollutants and precursors generation:
  - VOCs
  - PM
- Toxic risks posed to the surrounding community:
  - Cancer risk
  - Chronic non-cancer risk
  - Acute non-cancer hazard
- Nuisance / Odors
  - Phenol and associated compounds
  - Creosol and associated compounds

The casting of molten metals is the primary emission source of PM, VOCs, and odorous substances, such as phenolic compounds at metal melting facilities. These emissions occur when the hot molten metals contact the molds and cores that are often formulated with binders that contain organic compounds, including phenols, urethane, furan or other organics. Table 2 lists the most common stages of production at metal melting and processing facilities and the types of emissions associated with those stages.

**Table 2**
**Metal Melting Process Stages, Description and Emissions**

| Process* | Description | Emissions |
|---|---|---|
| Metal Management | Compilation, collection, storage and sorting of metals for metal management. | PM (metals) |
| Charging | Preheating the furnace and adding metal, flux, fuel and other compounds to furnace | PM (metals) |
| Metal Melting | Heating until the metal mixture is molten and reaches the proper temperature and metallurgic properties. | PM (metals), VOCs, CO, NOx |
| Tapping | Molten metal is poured from furnace into a ladle for transfer to the casting area. | PM (metals) |
| Casting / Pouring | The tapped metal is transferred to the casting area and poured into the molds to form castings. | PM (metals), VOCs, |
| Cooling | The cast metal is allowed to cool to close to ambient temperatures. While cooling, the metal cast shrinks often pulling away from the mold. | PM (metals), VOCs, |
| Shake Out | Removing the casting from the mold – which can often involve destruction of mold. | PM (metals), VOCs, |
| Grinding / Finishing | Once the casting is removed from the mold, it may have to be finished by grinding excesses of metal | PM (metals) |
| Mold / Core Making | Making the mold / core from sand and binders and other substances such as clay, starch, charcoal. | PM (silica), VOCs, TACs |

* The listed metal melting processes – metal management through grinding / finishing – are sequential steps in the production of cast metal parts. Mold / core making, however, is an essential parallel process that is not specifically a sequential step in the production of cast metal parts.

## B. Air Pollution Control Measures

As mentioned earlier in this report, metal melting and process facilities have emissions, such as particulate matter, including metals; VOCs (including odorous compounds, such as phenols and cresols); and/or toxics compounds. There are various mitigation measures that are currently used to capture, reduce, and/or eliminate these emissions. At metal melting facilities in the Bay Area, particulate matter can be mitigated using fabric filters or baghouses; emissions of VOC, including odorous organic compounds, are controlled using incineration (afterburners) or carbon adsorption units. Emissions of odorous compounds can also be addressed through pollution prevention measures such as switching to binder formulations with a lower potential to emit odorous compounds. A significant fraction of the emissions from these facilities is fugitive emissions; these emissions can be reduced using ventilated enclosures ducted to an appropriate control device. Metal recycling facilities.

1. Baghouses

Particulate matter can be controlled using fabric filters, which are more commonly known as baghouses. Baghouses are used to filter dust and particulate matter from exhaust streams and can achieve efficiencies of more than 99 percent for very fine particulates. Most baghouses use felted cotton, woven synthetic- or glass-fiber material shaped into elongated tubular bags to filter particulate matter and may be primed with calcium carbonate or a fine, pulverized clay. Dust-laden gases enter the baghouse from the bottom and pass through the fabric bags that act as filters. The high efficiency of the baghouse is due to the formation of a cake of dust on the surface of the filter that captures the fine particles in the gas stream. As more material is filtered and builds up on the fabric surface, the change in pressure (pressure drop) across the filter increases. At a certain point, usually determined by the pressure drop, the filter must be cleaned of the caked-on material. This is done typically using a mechanical shaker that knocks the caked material off of the filters that then falls to the bottom of the baghouse where it is collected.

The most effective type of filter currently in use is Gore-Tex® bags, which are made of woven Teflon® material, and have been demonstrated to achieve an extremely low emission rate of 0.0013 grains per dry standard cubic feet (gr/dscf) for $PM_{10}$. The District has determined this emission rate to be Best Available Control Technology (BACT) for baghouses.[18]

2. Afterburners

Afterburners are used to control VOCs, including toxic compounds such as dioxins and furans and odorous substances such as phenolic compounds in the exhaust from furnaces. The afterburner controls VOCs by burning a mixture of air (oxygen), fuel and the VOCs in the exhaust stream in a combustion chamber. Complete combustion oxides the pollutants to carbon dioxide and water vapor. The controlling parameters for the combustion reaction are the temperature and the residence time (the duration the mixture of air, fuel, and pollutants are maintained at the necessary temperature). Typically, afterburners, when properly designed and operated, can achieve destruction rates of 98 percent or higher.[19]

3. Carbon Adsorption

Carbon adsorption is often used as a method to control VOCs in low to medium concentration gas streams when a stringent level of control is required. Carbon adsorption utilizes activated carbon, which is a form of carbon that has been processed to make it extremely porous. Its porosity results in a very large internal surface which enables it to adsorb gases within its structure. During adsorption, a gas molecule migrates from the gas stream and adheres to the surface of the activated carbon. The adsorptive capacity of the activated carbon is dependent on many parameters and tends to increase with the concentration, molecular weight, and diffusivity, polarity, and boiling point of the compound. Activated carbon can adsorb up to 50 percent of its weight in VOCs.[20, 21]

Carbon adsorption is effective as long as the adsorptive capacity of the activated carbon is not exceeded. Once the activated carbon bed has become saturated and can no longer adsorb any more material, the pollutants “breakthrough” or pass through the saturated activated carbon bed unabated. For effective control, carbon adsorption units need to be either replaced or regenerated well before breakthrough occurs. To avoid breakthrough, a carbon adsorption unit should be replaced or regenerated when no more than 50 percent of the carrying capacity has been reached. For this reason, they are often operated in tandem so one unit can be regenerated while the other is adsorbing.

The regeneration of carbon adsorption units can be accomplished by heating the carbon bed to a sufficiently high temperature, usually via steam or hot combustion gases or by reducing the pressure to a sufficiently low value (vacuum desorption). The desorbed VOCs are either collected using a refrigerated condenser or burned using a flare or incinerator. Regeneration of virgin activated carbon can leave residue of approximately three to five percent of the adsorbed organics.[22]

A well designed adsorber system can achieve 95 to 98 percent VOC control efficiency when the inlet VOC concentrations range between 500 and 2000 ppm.[23]

### 4. Low VOC and Inorganic Binder Technology

Numerous binder systems are used in the metals casting industry for making cores and molds. These binder system types can be divided into organic (high and low VOC) and inorganic formulae. The system formulation and intended use can have significant impacts on the amount and type of emissions of VOCs, toxic compounds and particulate matter that result from metal casting operations. Emission testing data indicate that all types of binder systems emit various VOCs (including toxic compounds such as phenols, creosols, and furans), PM, and other compounds to some degree during the pouring, casting and shakeout phases. Table 3 lists these binder systems, their uses, and comparative VOC contents.

**Table 3**
**Summary of Binder Systems Formulations, Use, and Emissions**

| Binder System | Use | High, Low VOC or Inorganic |
|---|---|---|
| Phenolic – Urethane | Cold Box, No-Bake | High VOC |
| Epoxy – Acrylic | Cold Box | Low VOC |
| Furfurlyl Alcohol | No-Bake, Warm Box | Low VOC |
| Sodium Silicate | Cold Box | Inorganic |

Staff has reviewed studies conducted over the last decade by the Casting Emission Reduction Program (CERP) at McClellan, California CERP reports that the studies demonstrate that some binder systems have far lower VOC emissions rates than others. The CERP studies show that when compared to phenolic – urethane binder systems, the inorganic sodium silicate-based binder system can achieve up to 88 percent reduction in VOCs, a furan no-bake binder system can achieve an 81 percent VOC reduction, and low VOC epoxy – acrylic binder systems can achieve a 22 percent reduction in VOCs on a pound of VOC emitted per ton of metal process basis.[24, 25, 26]

Although these comparative test results appear to offer great promise, it must be noted that casting operations vary greatly and often product parameters change between each casting. Because of the variable nature of the industry and its processes, the efficacy of any alternative binder system would be highly dependent on the specific nature of the casting operation. It is believed that alternative (low-VOC and inorganic) binder systems do offer the potential to greatly reduce the amounts of VOCs (including odorous substances), toxic compounds, and PM emitted from various metal casting operations.

## 5. Enclosures and Ventilation

A large fraction of the emissions from metal melting and processing operations can be due to fugitive emissions escaping from a facility building's or structure's open doors, windows, vents and other openings where these operations occur and from uncontained storage of metal melting and processing materials. Unless these emissions are properly captured and ducted to abatement equipment, they can impact not only the surrounding community, but also the employees of the facility. To properly capture and control fugitive emissions metal melting and casting operations located within building, or other structures, should be enclosed with proper ventilation. Five primary criteria developed by the US EPA for proper design of ventilation systems are listed below in Table 4.[27]

**Table 4**
**Criteria for a Permanent Total Enclosure[27]**

| No. | Criterion | Requirement |
|---|---|---|
| 1 | Location of openings | Any natural draft opening (NDO) shall be at least four equivalent opening diameters from each emission point. |
| 2 | Areas of openings | The total area of all NDOs shall not exceed five percent of the surface area of the enclosure's four walls, floor, and ceiling. |
| 3 | Flow rate into enclosure | The average facial velocity (FV) of air through all NDOs shall be at least 3,600 m/hr [200 ft/min (this equates to a negative pressure difference of 0.007 inches of water or 0.013 mm Hg)]. The direction of air flow through all NDOs must be into the enclosure. |
| 4 | Access doors/windows | All access doors and windows whose areas are not included in item 2 and are not included in the calculation in item 3 shall be closed during routine operation of the process. |
| 5 | Emission capture | All emissions must be captured and contained for discharge through a control device. |

To properly design an effective enclosure with ventilation to address workplace standards and meet air pollution emission limits, the Industrial Ventilation, A Manual of Recommended Practice for Design, should be used.[28]

# IV. PROPOSED RULE

The District is proposing a new rule that would address emissions of PM, VOCs, toxic compounds, and odorous substances from metal melting and processing facilities in the Bay Area. The proposed rule would address stack and fugitive emissions, from several general processes of metal melting and casting:

1. Furnace / Oven (including tapping),
2. Mold and Core making,
3. Pouring and Casting,
4. Cooling and Shake out,
5. Sand Reclamation,
6. Slag and Dross Handling and Processing.

The proposal also contains provisions for metal recycling and scrap handling to ensure best management practices are incorporated and adhered to.

## A. Applicability

The proposal would address the largest emitters in these categories; and would address those facilities with a significant toxic risk. A metal throughput of 1000 tons per year is proposed for any metal melting and processing facility. In addition, a facility cancer risk of 10 in one million or a hazard index of 1.0 as determined by the District's Health Risk Screening Analysis Guidelines is proposed as an applicability trigger. Table 4 lists metal melting facilities and their annual metal throughput, pollutants emitted, and the facilities location relative to impacted Community Air Risk Evaluation (CARE) areas.[iii]

**Table 5**
**Metal Melting Facilities 2009 Annual Throughput, Emissions, and Proximity to a CARE Area Summary***

| Facility Name | City | Annual Metal Through Put (tons) | PM (lb/day) | VOC (lb/day) | CARE Area |
|---|---|---|---|---|---|
| A B & I Foundry | Oakland | 94,474 | 3.3 | 20.4 | yes |
| United States Pipe & Foundry | Fremont | 54,701 | 36.3 | 294.4 | near |
| CASS | Oakland | 7,472 | 0.5 | 0.01 | yes |
| Pacific Steel Casting | Berkeley | 19,770 | 207.2 | 144.3 | yes |
| PCC Structurals | San Leandro | 175 | 2.9 | 0.1 | yes |
| Ridge Foundry | San Leandro | 239 | 0.8 | 3.1 | yes |
| Tyco Thermal Controls | Redwood City | n/a | 14.5 | 60.7 | yes |
| Berkeley Forge & Tool | Berkeley | 265 | 2.7 | 0.3 | yes |
| ECS Refining | Santa Clara | 331 | 0.8 | 0.05 | yes |
| USS-POSCO Industries | Pittsburg | 2,890,000 | 250.1 | 118.4 | no |
| California Casting | Richmond | 0 | 0.03 | 0.00 | yes |
| Aalba Dent | Fairfield | 84 | 0.01 | 0.02 | no |
| Memry Corporation | Menlo Park | n/a | 0.03 | 0.1 | no |
| J & B Enterprises | Santa Clara | 1 | 0.7 | 0.1 | yes |
| Metech International | Gilroy | n/a | 0.02 | 0.05 | no |
| Napa Redevelopment Partners | Napa | n/a | 0.00 | 0.3 | no |
| United Spiral Pipe | Pittsburg | n/a | n/a | n/a | no |
| Xstrata Copper | San Jose | 128 | 0.4 | 45.3 | no |
| Castco | San Leandro | n/a | 4.2 | 0.9 | yes |

* This information presented in this table comes from a variety of sources, including facility-reported permit data on annual throughput and estimated emissions.

Table 6 lists metal recycling facilities and their annual metal throughput based on production rates.

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iii Under the Community Air Risk Evaluation (CARE) program, the District has identified six most at-risk communities in the Bay Area based on maps of toxic air emissions and sensitive populations. These six communities are deemed CARE areas.

**Table 6**
**Metal Melting Facilities Potentially Subject to the Proposed Rule Based on Annual Metal Throughput**

| Facility Name | City |
|---|---|
| A B & I Foundry | Oakland |
| United States Pipe & Foundry | Fremont |
| CASS | Oakland |
| Pacific Steel Casting | Berkeley |
| USS-POSCO Industries | Pittsburg |

Table 7 lists metal melting facilities that would not trigger the metal throughput applicability requirements of the proposed rule, but may be subject based on risk.

**Table 7**
**Metal Melting Facilities Potentially Subject to the Proposed Rule Due Solely to the Results of an Initial Risk Screening**

| Facility Name | City |
|---|---|
| PCC Structurals[a] | San Leandro |
| Ridge Foundry[b] | San Leandro |
| J & B Enterprises[b] | Santa Clara |

a. Initial staff estimates indicate that PCC Structurals would be subject to the requirements of the proposal.
b. It is likely that Ridge Foundry and J&B Enterprises would not be subject to the proposal based on current estimates; however, more detailed risk analyses are needed to determine whether these facilities would be subject to the requirements under the current proposal.

Current analyses indicate the facilities that would be subject to the emission limits of the rule are ABI, US Pipe & Foundry, CASS, Pacific Steel Casting, USS-POSCO, PCC Structurals, Schnitzer Steel, and Sims Metals in Redwood City and Richmond.

## B. Emission Limits

The proposal contains emissions standard and control efficiency requirements for particulate matter ($PM_{10}$), dust in the form of an opacity standard, VOCs, and odorous substances. These limits would be enforced with a combination of inspections, monitoring requirements (including parametric and continuous emissions monitoring), source tests, and recordkeeping provisions.

### 1. PM Limit

The proposal includes emissions limits for $PM_{10}$. The proposed $PM_{10}$ limit for furnaces and PM abatement devices with flow rates of 25,000 cubic feet per minute (cfm) is 0.0020 grain per dry standard cubic feet (gr/dscf). This limit is based on the District BACT standard and reflects the most effective level of control achieved by fabric filters.[18] For PM abatement devices with flow rates less than 25,000 cfm, the proposed PM10 limit is 0.0040 gr/dscf.

2. Opacity Standard

The proposal contains a limit for visible emissions (opacity standard) of ten percent for a maximum of three minutes per hour. This standard is contained in current permit conditions for some metal melting facilities and the Non-Ferrous Metal Melting ATCM.[29]

3. VOC Abatement Requirement

The proposal requires that VOCs be reduced by an abatement device by at least 95 percent (95 percent reduction of VOCs between inlet and outlet concentrations). This level of control is consistent with the levels of control achievable for afterburners and carbon adsorption units which are used in metal melting and processing facilities.[19, 22]

4. Odorous Substances

The proposal requires that emissions of odorous substances meet the limits derived from analysis of specific odorous compounds associated with metal melting and processing facilities. The analysis was used to promulgate compound-specific standards in District Regulation 7, Odorous Substances, Section 7-303. The compounds specifically to be regulated under the proposal are dimethyl sulfide ($(CH_3)_2S$), mercaptans measured as methylmercaptan ($CH_3SH$), phenolic compounds measures as phenol ($C_6H_5OH$), and trimethylamine ($(CH_3)_3N$). This provision would require affected facilities to measure their emissions of odorous substances from exhaust stacks and fugitive emission points to verify compliance with these limits. Owners and operators who demonstrate that the facility operations do not result in the emissions of these odorous substances would not be subject to these emission limits or to the preparation of odor management plans.

## C. Operations Required to Be Collected and Abated

The proposal would require that the emissions of pollutants from certain operations be collected and abated. This section defines the operations that must meet the emission limits described above. The following operations are proposed to be collected and abated:

- Tapping, transporting, pouring or casting molten metal;
- Cooling and shakeout of metal parts;
- Mold and core assemblies making;
- Processing, reprossessing, sorting, recycling, and preparing for transport of solid slag;
- Reclaiming of sand;

- Welding or grinding of metal; or
- Crushing or shredding of metal.

These operations are to be conducted in areas that are equipped with an emission collection system that conforms to the specifications for design and operations of the Industrial Ventilation, Manual of Recommended Practices, 27th edition, 2010, published by the American Conference of Government and Industrial Hygienists. The emission collection system must achieve a collection efficiency of at least 85 percent; this efficiency would be determined by US EPA Methods 204 and 204E.[30]

## D. Comprehensive Compliance Plan

The proposal contains requirements for the development, approval, and implementation of a Comprehensive Compliance Plan (CCP) that addresses three primary areas: metal melting and processing; operation, maintenance and monitoring; metal management; and odor management. The types of operations and processes at an affected facility would determine which sections of the CCP would apply. A facility that use scrap metal to charge a furnace and phenolic binders to create mold assemblies would be required to complete all three segments of the CCP. However, a scrap metal facility at which there are no metal melting or casting operation would only be required to develop the metal management section.

### <u>1. Operation, Maintenance and Monitoring Plan Section</u>

The proposed rule would require affected metal melting facilities to develop, submit, have approved, and implement an Operation, Maintenance and Monitoring (OM&M) Plan section of the CCP. Affected facilities would need to examine the equipment and operations that are associated with emissions and abatement to determine where there are potential areas for improvement and emission reductions. Because the District must review and approve the OM&M Plan section utilizing experience gathered from other affected facilities and in house expertise, each facility would be able to benefit from best practices performed at other affected facilities.

*Technical Information*

The OM&M Plan section must include technical information on each source of pollutants (e.g., PM, VOCs, and odorous substances), such as furnaces, ovens, mold and core making equipment and areas, sand reclamation equipment and areas, ventilation and collection equipment, and abatement and monitoring equipment. The technical information must include detailed process diagrams that show equipment location(s), ventilation ducting, walls and partitions, building dimensions, and opening (doors and windows, openings for ducting and inlets).

*Operating Parameters, Procedures, and Monitoring*

The OM&M Plan section must also include a detailed listing of the operating parameters and procedures including proper startup, operating, shutdown, and emergency shutdown procedures for each abatement device. These include:

- Baghouse: maximum pressure drop, maximum inlet temperature, and leak detection system operation parameters;
- Afterburner: Operating temperature, volumetric flow rate, residence time, and quench volume;
- Carbon Adsorption: Operating temperature, mass of activated carbon, volumetric flow rate, activated carbon recharge schedule (based on metal throughput or other appropriate parameters), and breakthrough detection system operating parameters.

2. Metal Management Plan Section

The proposal would require that metal melting and processing facilities that receive or produce scrap or recycled metal prepare a Metal Management Plan (MMP) section of the CCP that outlines the practices that would minimize visible emissions (dust), PM and the potential for toxic metals emissions. The MMP section would detail the equipment and procedures that are currently used or would be used to reduce the emissions of various pollutants enough to comply with the emissions limits of the proposed rule.

*Best Management Practices*

Best practices for managing scrap metal would be required to be listed in the MMP Section and may include employing water, dust palliatives, berms, bins, tarps, screens, and enclosures for the storage and handling of scrap / recycled metals. Also included would be methods to minimize the contamination of scrap metal used for charge in a furnace or recycled and sold. The facility would be required to develop a Comprehensive Compliance Plan (CCP) section (see below) that would detail how the best management practices would be put in place.

*Minimization of Contaminants*

The proposal also requires facilities to include in the MMP section a process to ensure that scrap or recycled metals received and used as charge for an onsite furnace be a free as possible of contaminants such as oils, organic liquids, PCBs, mercury and lead contamination (e.g., from engine blocks), oil filters, plastics, rubber and other contaminants.

3. Odor Management Plan Section

One of the purposes of this rule development effort is to address potential public nuisances that result from the emissions of odorous substances from metal melting processes. Some metal melting facilities continue to pose odor-based nuisances to their surrounding communities. To address this issue of nuisance odors in an objective manner, the proposal contains a requirement for metal melting and processing facilities that melt at least 1000 tons of metal annually to develop an Odor Management Plan (OMP) section of the CCP.

*Development of the OMP Section*

The OMP section would detail the actions to be taken to minimize the potential for odorous impacts to the surrounding community and would include a list of all potential sources of odorous substances, focusing on materials used in mold and core making. The list should include:

- The types and amounts of odorous substances used, including the binders, resins, activators, releasing agents and catalysts, etc. and the associated MSDS or manufacturers' product information sheets that indicate the product formulations;
- The equipment, processes, or operations from which odorous emissions may occur. These may include furnaces, heaters, tapping, transporting, pouring, casting, cooling, breakout, core and mold making equipment and areas, sand reclamation processes.

The OMP section would also detail mitigation measures employed to reduce the emissions of odorous substances. Potential mitigation measures include:

- Improved partitioning and ventilation;
- Reduction of fugitive emissions;
- Improved management of odorous sources such as:
    - Practices for cooling and shake out of castings, and
    - Use of low odor binders;
- Additional abatement equipment.

4. Review and Approval of the Comprehensive Compliance Plan

A draft CCP, containing the appropriate sections, would have to be submitted to the District for review and approval within six months of the adoption of the rule or six months following a facility becoming subject to the rule. Within 30 days of receiving a draft CCP, the District will determine if the plan is complete. If the plan is not complete, the District would notify the facility in writing with the basis for the determination. Upon receipt of notification of an incomplete plan, the facility would have 30 days to correct any deficiencies and resubmit the draft CCP. If the District determines that the deficiencies are not corrected, the District would disapprove the CCP. If the plan is deemed complete, the District would make it available for 30 days for public comment. Within 30 days of the close of the public comment period, the District would approve or disapprove the CCP. If the CCP is disapproved, the facility would have 30 days to correct identified deficiencies. Within 90 days of the approval of a CCP, the facility must apply for the necessary permit modification and/or authority(ies) to construct. Once approved, the facility must follow the provisions of the approved plan or be in violation of the rule.

## E. Review and Modification of the Comprehensive Compliance Plan

The proposal would require the review and modification of any of the required CCP sections: Metal Management, OM&M, or Odor Management, if any of following occurs:

- Any of the emissions limits of the proposal are exceeded;
- Changes at the facility trigger or require a modification of the Permit to Operate of any affected equipment, such as equipment replacements or throughput changes; or

The proposal would also require that the Plans be updated and resubmitted to the District once every three years for review and approval. This would allow best practices implemented at one facility to be required in plans at other facilities, where they are applicable. This exchange of information would result in continuous improvement in the management of emissions of pollutants at all the affected facilities.

## F. Recordkeeping

The proposal requires affected facilities to maintain records on the monthly throughput of each type of metal processed, which includes metal melted, heated, scrapped or recycled; an estimate of the amounts of the following contaminants contained in the metals process: manganese, cadmium, mercury, lead, and nickel; the monthly throughputs of the type of binder systems and sand used; and for those that qualify for the clean aluminum exemption, the certification on the quality of aluminum.

## G. Exemptions

The proposal contains certain exemptions for facilities or operations that should not contribute significantly to the emissions of criteria or toxic pollutants or odorous substances.

### 1. Clean Aluminum Exemption

Die casting facilities that melt only aluminum that certifiably contains less than 0.004 percent cadmium and 0.002 percent arsenic would be exempt from the emissions, equipment / air movement, metal management, odor, and plan development requirements of the proposal. However, to retain this exemption, the facilities must maintain records certifying the cleanliness of the aluminum used. This exemption parallels an exemption in the Non-Ferrous Metal Melting ATCM.

2. Low Metal Throughput Exemption

Facilities that have a metal processing throughput of 1000 tons or less per year would also be exempt from the emissions, air movement, and ventilation system standards, and Comprehensive Compliance Plan requirements of the rule. These facilities would need to maintain records on their annual throughput and make those records available upon District request.

3. Non-Odorous Materials and Processes

A facility would be exempt from the odorous substances limits of the proposal provided the facility could demonstrate to the District that no materials or processes are employed at the facility that would result in the emissions of odorous substances.

## H. Eliminate the Permit Exemption for Mold Making Equipment

Staff also proposes to eliminate the permit exemption for heated shell core and shell mold manufacturing machines in District Regulation 2, Rule 1: General Requirements (Rule 2-1). Currently, shell core and shell mold manufacturing machines are exempt from permits under Section 2-1-122.3. Because these machines are sources of emissions of PM and VOCs including odorous substances and would be regulated under proposed Rule 12-13, their exemption from permit requirements should be removed. The proposed amendment to Rule 2-1 would read as follows:

**2-1-122** Exemption, Casting and Molding Equipment: The following equipment is exempt from the requirements of Sections 2-1-301 and 302, provided that the source does not require permitting pursuant to Section 2-1-319.

**122.1** Molds used for the casting of metals.
**122.2** Foundry sand mold and core forming equipment, including shell core and shell-mold manufacturing machines, to which no heat is applied, except processes utilizing organic binders yielding in excess of 0.25% free phenol by weight of sand.
~~**122.3** Shell core and shell-mold manufacturing machines~~.
**122.~~4~~3** Equipment used for extrusion, compression molding and injection molding of plastics. The use of mold release products or lubricants is not exempt unless the VOC content of these materials is less than or equal to 1 percent, by weight, or unless the total facility-wide uncontrolled VOC emissions from the use of these materials are less than 150 lb/yr.
**122.~~5~~4** Die casting machines.

When a source becomes subject to permit requirements by a change in District rules, the operator of that source has 90 days to submit a permit application. Unlike a new source, an Authority to Construct is not required.

# V. EMISSIONS AND EMISSIONS REDUCTIONS

There are two primary types of pollutants that are addressed by this proposal: emissions of particulate matter and VOCs, including odorous substances. A review of the potentially affected facilities indicates that there are six metal melting facilities that would be affected by the emissions limits and the abatement, enclosure and emission collection requirements of the proposal. These facilities are responsible for over 95 percent of the PM emissions and generate the vast majority of the odor complaints for this sector. There are also three metal recycling facilities that would be subject to the PM and opacity standards and Compliance Plan requirements.

Staff anticipates the facilities would realize higher capture efficiency for all pollutants addressed by the proposal due to the implementation of the enclosure and emission collection requirements. This increase in capture efficiency – although resulting in greater emission reductions – would not lend itself to quantification because of the variable nature of the ability of each facility to capture and route emissions to control.

## A. Particulate Matter

The five largest metal melting facilities by metal throughput emit, collectively, about 329 pounds of particulate matter per day or 60 tons/year. Particulate matter, or PM, is a mixture of suspended particles and liquid droplets. PM includes elements such as carbon and metals; compounds such as nitrates, organics and sulfates and complex mixtures such as diesel exhaust and wood smoke. PM is a leading health concern. A large body of evidence suggests that exposure to PM, particularly fine PM, can cause a wide range of health effects, including aggravation of asthma and bronchitis, an increase in visits to the hospital respiratory and cardio-vascular symptoms, and a contribution to heart attacks and deaths. The Bay Area is not in attainment of the California standards for either PM of 10 microns or less aerodynamic diameter (PM10) or PM of 2.5 microns or less aerodynamic diameter (PM2.5); or of the national 24-hour PM2.5 ambient air quality standard.

In development of the 2010 Clean Air Plan, District staff developed a methodology for calculating the health impacts of pollution and the monetized benefits of reducing concentrations of pollution. To compare the effects of different pollutants, staff developed a multi-pollutant evaluation method, or MPEM.[31, 32] The methodology used in the MPEM proceeds from an estimate of emissions reductions obtainable from a control measure. The estimate of emissions reductions is related to a change in the ambient concentration of pollutants, which in turn is related to a change in the exposure of the Bay Area population to those pollutants. The change in exposure is related to a change in health effects based on epidemiological studies and finally to a monetized value associated with that health benefit or adverse impacts. This is graphically illustrated as follows:

$\Delta$ Emissions $\rightarrow$ $\Delta$ Concentration $\rightarrow$ $\Delta$ Exposure $\rightarrow$ $\Delta$ Health Effects $\rightarrow$ $\Delta$ $ Value

The monetized health value of reducing one ton of PM2.5 per year was established at $456,400. Not all of the PM emitted by metal melting facilities is PM2.5, however, estimates for PM2.5 are available based on the type of equipment at the facility. PM2.5 at the five largest facilities by throughput from sources targeted by the rule as proposed is estimated to be 195 pounds/day or more than 35 tons/year based on 250. This equates to a health cost of $16,285,000/year. A reduction in PM2.5 emissions will have a commensurate benefit. This value of a given reduction can be compared to the expected costs of the proposal to provide a cost/benefit ratio.

In addition, all of the five largest facilities are located in or near BAAQMD Community Air Risk Evaluation (CARE) communities. Although not a toxic air contaminant, reducing PM2.5 emissions in these communities will contribute toward improved health and air quality for nearby residents.

Fabric filters or baghouses are the primary control option used to control emissions of PM; however, some of the baghouses are old and do not use the latest technology. Although in some cases, baghouses may need to be replaced; in others, upgraded bags may be able to be installed. Staff estimates an 80 percent reduction in PM emissions (0.22 tpd) with the replacement of less efficient baghouses with ones that meet the proposed limit of 0.0020 gr/dscf and a substantial increase in the capture efficiency of fugitive emissions.[iv]

## B. VOCs, Including Odorous Substances

The rule would result in a reduction of emissions of VOCs, including odorous substances, due to improved capture and control and improved monitoring of abatement devices. The rule should also reduce odorous emissions from a facility.

The proposal would result in better capture and control of VOC emissions, including odorous substances, thereby having the added potential benefit of reduced odorous substance emissions off-site.

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[iv] The 80 percent reduction is based on the combination of a substantial increase in the capture efficiency of fugitive emissions, the difference in effectiveness between the types of fabric filters in use at metal melting facilities and the type that would be required by the proposal, and the number of baghouses at the potentially affected facilities.

### C. Associated Risk

The health risks associated with metal melting and processing facilities are proportionate to the amount of toxic and heavy metals contained in the particulate matter emitted from various processes. These metals include arsenic, cadmium, hexavalent chromium, lead, manganese, mercury, and nickel. Any reduction in the emissions of particulate matter would result in a proportionate reduction in associated risk from a particular source of emissions. Implementation of enclosures with highly effective capture efficiencies and more efficient baghouses as required by the proposal would greatly reduce not only the emissions of particulate matter, but these associated heavy metals as well. Staff estimates that the proposal would achieve at least an 80 percent reduction in the amount of particulate matter emitted from metal melting and processing facilities which would translate to at least an 80 percent reduction in risk.

# VI. SUMMARY OF ECONOMIC IMPACTS

There are six metal melting facilities that would be affected by the emission limits and equipment standards of the proposal. These facilities may need to upgrade their particulate matter filtration abatement devices (baghouses) and may need to enclose / partition and ventilate areas where emissions and odors are generated to meet the emission standards and limits of the proposal. The following summarizes the potential capital costs that are associated with the proposal.

1. Baghouses

Baghouses are the primary form of control used at metal melting and processing facilities to reduce $PM_{10}$ exhaust from furnaces, ovens and other combustion sources. Currently, these baghouses reduce $PM_{10}$ emissions to approximately 0.01 gr/dscf.[v] However, newer filtration technology can achieve a PM emission rate of 0.0013 gr/dscf. This emissions rate is currently the District best available control technology (BACT) limit for baghouses and has been achieved in practice.[18]

Sizes of baghouses are based on the airflow rates that they are expected to manage and the expected grain loading to be controlled. There are about 50 baghouses at the six facilities that would be affected, with the number of baghouses per facility ranging from one to nineteen. These baghouses are typically fitted with polyester felt filters and have an average airflow rate of 15,000 cubic feet per minute (cfm). To meet the proposed $PM_{10}$ limit of 0.0020 gr/dscf, the baghouses would have to be upgraded Gore-Tex® bags or a similar material. The polyester felt filters cost approximately \$10 to \$12 per bag; while the Gore-Tex® bags cost approximately \$30 to \$35 per bag. The cost to upgrade

[v] Current $PM_{10}$ emission limits established in permits on these baghouses range from 0.003 to 0.4 gr/dscf, with the majority at 0.01 gr/dscf.

translates to an additional cost of approximately $1 per cfm, for a total capital cost of $750,000 industry-wide.[33] Other cost estimates that will have to be developed may include potential upgrades to the baghouse ventilation system to address potential increases in pressure drops across the filters, and the cost of installing automated systems for cleaning the bags.

Additionally, the proposal requires continuous pressure monitoring of baghouses to ensure that pressure drops indicating either holes developing in the bags or plugging are detected and an alarm is triggered. These pressure monitoring systems cost approximately $500 per baghouse, including installation. Because about 50 baghouses may be affected, the maximum cost would be about $25,000.[34]

2. Emissions Collection and Abatement

The proposal requires that the emissions from furnaces and areas where tapping, pouring or casting; or molds and cores are made and allowed to cool; metal is ground or welded; or slag or dross is recovered and/or processed to be collected and abated. All furnaces (cupolas, electric arc, reverberator, sweat) are fully enclosed and ducted to abatement devices such as an incinerator or carbon adsorption system, and baghouse. Most of the facilities to which the proposal would apply have enclosed areas for mold and core making. However, the other sources, such as tapping, pouring or casting areas, welding and grinding, or slag and dross processing, may not be located in areas where their emissions are adequately captured. This can result in excessive fugitive emissions. For these areas that do not meet the proposed 85 percent capture efficiency requirement, it may be necessary for the facility to add partial or full enclosures to comply. In addition, crushing and shredding operations at scrap metal recycling facilities would also be required to meet the 85 percent capture efficiency and the emissions limits for PM and visible emissions.

Staff has assumed that an enclosure 20 feet long, ten feet wide and ten feet tall would be the minimum needed to address mold and core making operations. It is also assumed that at least two walls of the enclosure would already exist;[vi] therefore, the enclosure would require two panels (ten by ten feet; ten by 20 feet) with a ceiling (ten x 20 feet) and with ventilation sufficient to achieve one volume change every three minutes. An enclosure of this size would cost about $25,000 based on an approximate cost of $50 per square foot of installed material.[35] Site-specific evaluations at each facility would be required to improve cost estimates associated with this proposal.

A volumetric flow rate of at least 700 cubic feet per minute (cfm) is needed to ventilate this volume to meet the criterion of one volume change per three minutes. The equipment and installation cost for an incinerator / afterburner

[vi] These are the approximate dimensions and conditions of the cooling areas for several of the metal melting facilities visited by District staff.

sized for 1000 cfm is approximately $120,000.[19] However, most facilities already operate incinerators / afterburners. It is likely that they will not have to install an additional incinerator. An engineering analysis would have to be conducted at each affected facility to ensure existing equipment could handle any additional volume of air.

# VII. RULE DEVELOPMENT / PUBLIC CONSULTATION PROCESS

In the development of this workshop proposal, staff engaged in an extensive public consultation process. The process involved:

- Multiple meetings with stakeholders, including:
  - Facility owners / operators and industry association representatives,
  - Community groups,
  - Public officials and their staff members;
- Attendance at multiple community meetings;
- Correspondence and telephone conferences with the following governmental agencies:
  - US EPA,
  - SCAQMD
  - ARB,
  - Maricopa County Air Quality Department, Arizona,
  - Regional Water Quality Control Boards, and
  - Bay Area Certified United Program Agencies;
- Facility visits (number of visits):
  - PSC – Berkeley (3),
  - CASS – Oakland (3),
  - AB&I – Oakland (2) ,
  - US Pipe – Union City (1),
  - A&B Die Casting, Rodeo (1),
  - USS / POSCO, Pittsburg (1),
  - Schnitzer Steel, Oakland (1),
  - Sims Metals, Richmond (1),
  - Sims Metals, Redwood City (1)
- Conference calls;
  - Binder manufacturers
  - Industry association representatives

The next step in the process is to conduct one or more public workshops to receive input on the proposal. During the workshop, staff will describe information presented in this Workshop Report and the draft regulatory language for the proposed rule, respond to questions, and receive public comments. Based on the input received at the workshop and during the associated public comment period, staff will assess whether changes to the proposal are necessary prior to preparing final proposed amendments for consideration at a public hearing before the District's Board of Directors.

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