Proposed Rule 1435 – Control of Toxic Emissions from Metal Heat Treating Processes

WORKING GROUP MEETING #1

August 6, 2019

Call-in Number: (866) 705-2554
Passcode: 412104

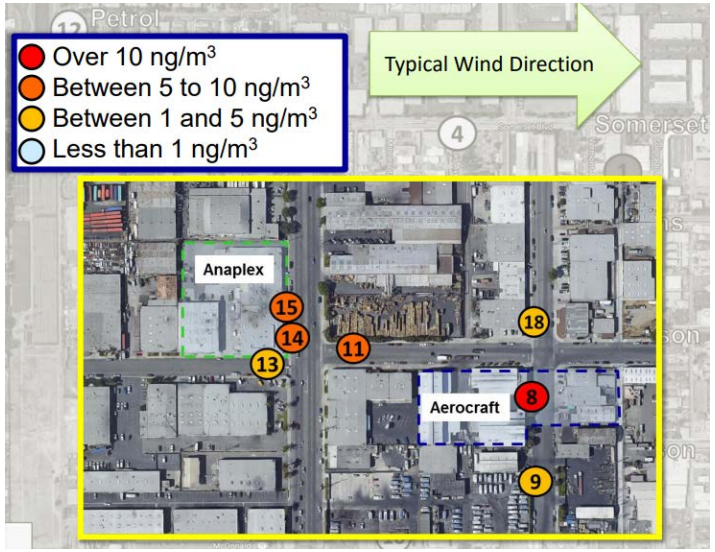
AGENDA

- Background
- Emissions Testing and Sampling at Aerocraft
- Emissions Testing and Sampling at Forging Facilities
- Additional Testing
- Proposed Rule 1435 Initial Concepts and the Rule Development Process

BACKGROUND

Background

- In 2016 the South Coast AQMD began ambient monitoring in the industrial areas of Paramount
  - October 2016 elevated levels of hexavalent chromium were found near Madison and Garfield
- Further investigation identified two facilities that were contributing to the elevated levels:
  - Aerocraft Heat Treating Company, Inc. (Aerocraft) - Heat Treating Facility
  - Anaplex Corporation (Anaplex) - Plating and Anodizing Facility
- Proposed Rule 1435 is designed to address toxic air contaminant emissions sources, similar to those identified at Aerocraft



Aerocraft Heat Treating Company

- Emissions testing at Aerocraft showed hexavalent chromium from
  - Furnaces
  - Quenching and cooling operations, and
  - Fugitive dust on surfaces in and around facility
- Heat treating operations were not previously known as source of hexavalent chromium emissions
- Aerocraft has since enacted several mitigation measures to reduce emissions

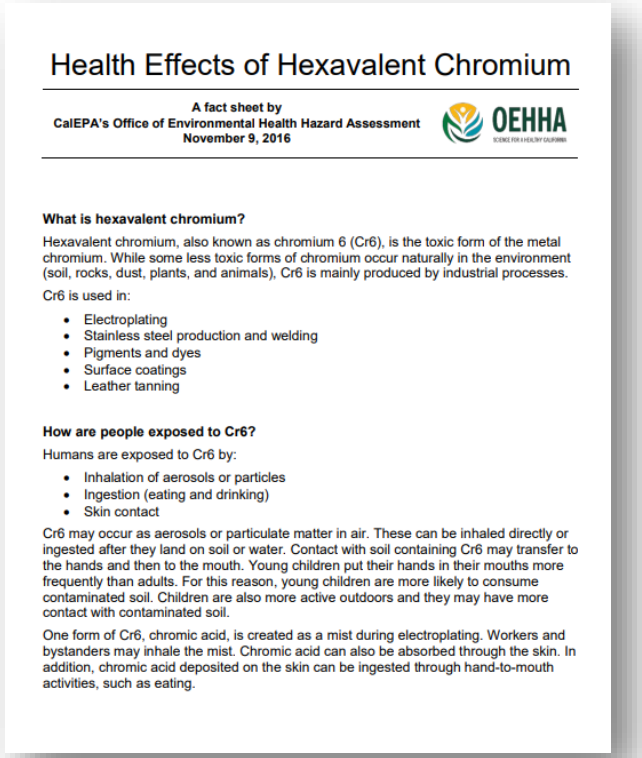
Heat Treating Furnaces

Water Quench Tank & Cooling Tower

Sources of hexavalent chromium emissions

Hexavalent Chromium

- Hexavalent chromium is a toxic air contaminant that is a potent carcinogen
- Mainly produced by industrial processes
- Long-term inhalation of hexavalent chromium over a lifetime can:
  - Increase the risk of developing lung and nasal cancers
  - Cause or worsen certain health conditions such as respiratory tract irritation, wheezing, shortness of breath etc.



Health Effects of Hexavalent Chromium

A fact sheet by
CalEPA's Office of Environmental Health Hazard Assessment
November 9, 2016

OEHHA

What is hexavalent chromium?

Hexavalent chromium, also known as chromium 6 (Cr6), is the toxic form of the metal chromium. While some less toxic forms of chromium occur naturally in the environment (soil, rocks, dust, plants, and animals), Cr6 is mainly produced by industrial processes.

Cr6 is used in:

- Electroplating
- Stainless steel production and welding
- Pigments and dyes
- Surface coatings
- Leather tanning

How are people exposed to Cr6?

Humans are exposed to Cr6 by:

- Inhalation of aerosols or particles
- Ingestion (eating and drinking)
- Skin contact

Cr6 may occur as aerosols or particulate matter in air. These can be inhaled directly or ingested after they land on soil or water. Contact with soil containing Cr6 may transfer to the hands and then to the mouth. Young children put their hands in their mouths more frequently than adults. For this reason, young children are more likely to consume contaminated soil. Children are also more active outdoors and they may have more contact with contaminated soil.

One form of Cr6, chromic acid, is created as a mist during electroplating. Workers and bystanders may inhale the mist. Chromic acid can also be absorbed through the skin. In addition, chromic acid deposited on the skin can be ingested through hand-to-mouth activities, such as eating.

Emissions Testing and Sampling at Aerocraft

Emission Sources of Hexavalent Chromium at Aerocraft

Furnaces Conducting Heat Treating

Quench Tanks

Fugitive Dust Emissions

Overview of Heat Treating Furnaces

Furnaces Conducting Heat Treating

- Workpieces are heated in furnaces to attain desired properties such as hardness, durability, strength, ductility, etc.
- Temperatures can range from 240°F to >2250°F
- Residency time in furnaces can range from hours to days and are generally dictated by:
  - Metal alloys and workpieces being treated
  - Properties desired in the workpiece
- Workpieces may be placed on racks or stands constructed of chromium alloys such as stainless steel
- Furnace types, dimensions, and heating capacities can vary greatly

Overview of Quenching and Cooling

Quench Tanks

- Workpieces may be rapidly cooled (quenched) to obtain desired properties
  - Quench media includes freshwater, oil, polymer, or brine
- Workpieces may also be cooled at slower rates:
  - With forced or ambient air (inside or outside a building)
  - Cooled within furnaces

Overview of Areas with Accumulation of Fugitive Dust

Fugitive Dust Emissions

- Ambient dust was observed in areas throughout the facility
- Large amount of dust accumulated in the intermediate storage area
- Some heat treated workpieces were cooled in the open with fans (forced air cooling) or in ambient air
  - Staff observed a substantial amount of dust from the workpieces suspended in the air during a forced air cooling event
- Other means of causing airborne dust may have been wind, forklift traffic, or sweeping

Testing and Sampling at Aerocraft

- South Coast AQMD conducted tests to identify operations contributing to the elevated hexavalent chromium levels
- Emissions tests of 3 furnaces showed elevated hexavalent chromium concentrations
- Liquid and bulk samples collected at various points throughout the operation also detected the presence of hexavalent chromium:
  - Water quench tank and associated cooling tower
  - Oil quench tank
  - Metal dust accumulated in an outdoor storage area

Testing and Sampling Results for Heat Treating Furnaces at Aerocraft

Furnaces Conducting Heat Treating

- Emissions tests were conducted on three (3) furnaces
- Data shows high emissions of hexavalent chromium
  - Source of emissions not conclusive
  - Additional information needed to understand at what temperature hexavalent chromium is forming

Emission Screening Test				
Furnace	**Alloy**	**% Chromium Content**	**Temperature (°F)**	**Cr^{+6} Emission Concentrations (ng/m^3)**
#3	Inconel	14 - 31	2100	**376**

Source Tests					
Furnaces	**Alloy**	**% Chromium Content**	**Temp (°F)**	**Cr^{+6} Emission Concentrations (ng/m^3)**	**Cr^{+6} Mass Emissions (mg/hr)**
#11	Chromium alloy	% not given	1250	**9564**	**8.0**
	Titanium	N/A	1250	**3224**	**4.2**
#14	Chromium alloy	% not given	1800	**1670**	**6.6**
	Titanium	N/A	1800	**Indeterminate**	**N/A**
	Empty	N/A	1800	**Indeterminate**	**N/A**

Testing and Sampling Results for Quench Tanks

Quench Tanks

- Quench water contained hexavalent chromium
  - Open circuit cooling tower was directly circulating the quench water and releasing airborne water droplets
- Quench oil solution contained very small amounts of hexavalent chromium
  - Sampling above tank surface showed high concentrations of hexavalent chromium – staff believes it was influenced by ambient dust in the facility

Sampling Location	Sampled Material	Cr^{+6} Concentrations
Water Quench Tank	Quench solution	**46 mg/L**
• 1 ft above surface	Fugitive emissions	**638 ng/m^3**
Oil Quench Tank	Quench solution	**0.005 mg/L**
• 1 ft above surface	Fugitive emissions	**130 ng/m^3**

Staff Concerns on Water Quench Tanks

Quench Tanks

- Staff observed quench tank water, that contained hexavalent chromium, circulating through cooling tower
  - Fugitive emissions sampling from cooling tower measured elevated levels of hexavalent chromium
  - Other heat treating facilities with water quench tanks have similar designs
- Rule 1404 – Hexavalent Chromium Emissions from Cooling Towers limits hexavalent chromium concentration to 0.15 mg/L
- Cooling towers or quench tanks containing chromium compounds require a permit (e.g., not exempt per Rule 219 – Equipment Not Requiring a Written Permit)

Testing and Sampling Results for Bulk Sampling

Fugitive Dust Emissions

- Metal dust sample collected in storage area
- Potential sources of hexavalent chromium include:
  - Insufficient housekeeping
  - Air or forced cooling of workpieces
- Sampled titanium workpiece confirmed very little hexavalent chromium

Sampling Location	Sampled Materials	Cr^{+6} Concentrations
Outdoor Storage Area	Metal dust	**190 ppm**
Treated Titanium Workpiece	Scale scraping	**0.018 ppm**

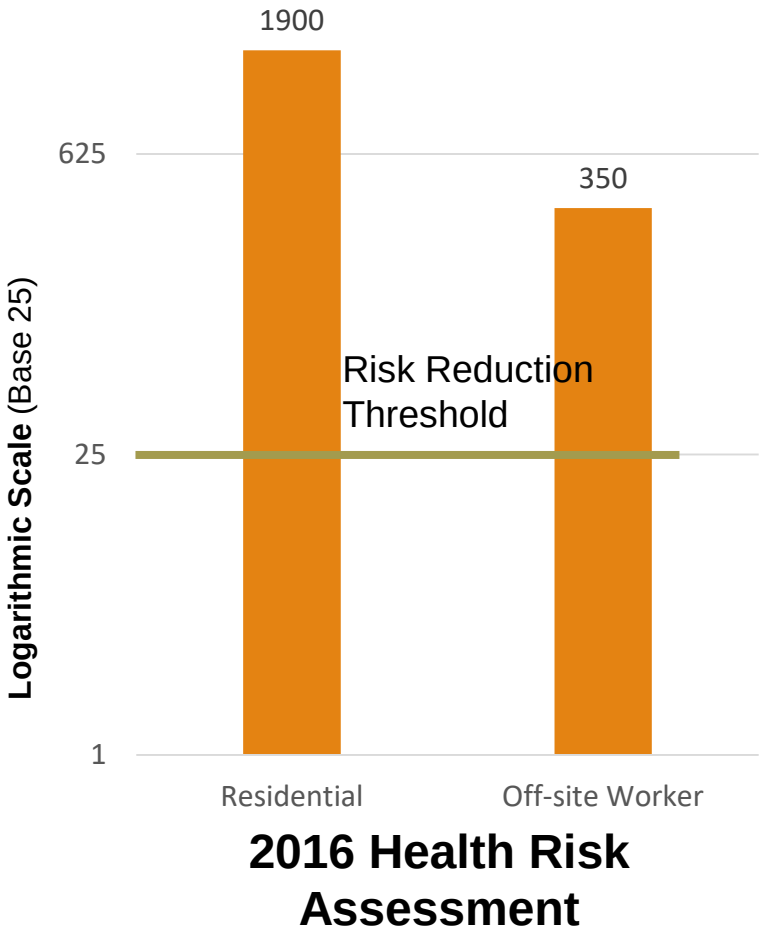
Summary of Testing and Sampling at Aerocraft

- Multiple emissions tests measured hexavalent chromium emissions from furnaces when heat treating alloys with chromium
- Higher furnace temperatures did not always result in higher emissions
- Hexavalent chromium detected in furnaces heat treating materials known not to contain chromium
  - There may be other sources of chromium within the furnaces such as refractory, racks, tables, etc.
- Hexavalent chromium was present in quench water and was being released as fugitive emissions from the open circuit cooling tower

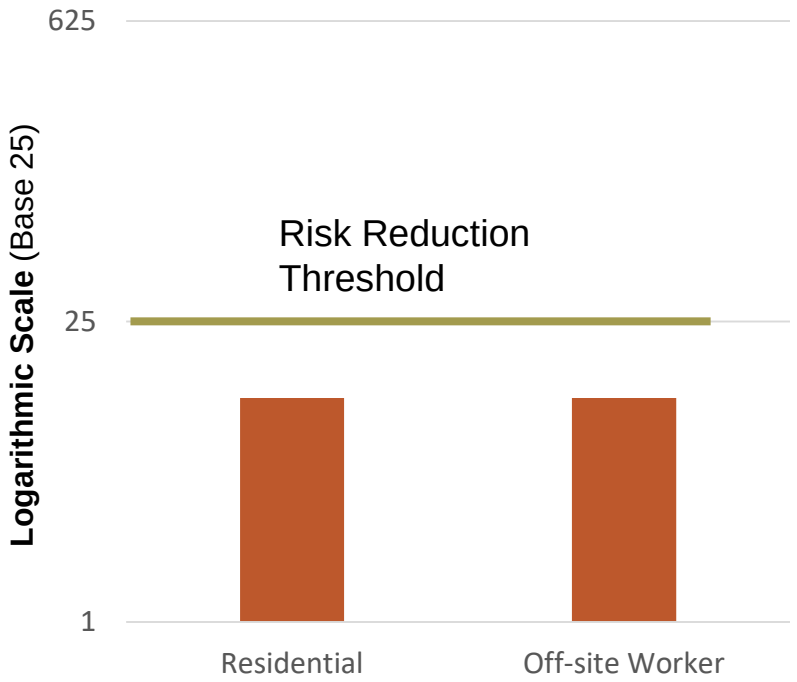
Mitigation Efforts at Aerocraft

- Enclosed buildings to create permanent total enclosures (PTEs) and installed baghouse controls on building ventilation exhaust
  - All furnaces and quenching now operate within PTEs
- Aerocraft installed ultra-low particulate air (ULPA) filters at PTEs
- Quench tank modifications
  - Cooling tower removed – quench water is now naturally cooled
  - Quench water is regularly monitored and ferrous sulfate is periodically added to reduce hexavalent chromium
- Discontinued fan cooling
- Enhanced housekeeping – facility is regularly vacuumed and swept

Estimated Cancer Risk from Hexavalent Chromium - 2016 and 2018



2016 Health Risk Assessment



2018 Estimated Cancer Risk

- 2016 estimated cancer risk from hexavalent chromium emissions well above Significant and Risk Reduction Thresholds in Rule 1402
- Mitigation measures reduced cancer risks below Risk Reduction Threshold

Emissions Testing and Sampling at Forging Facilities

Similar Operations at Other Metal Working Facilities

Based on test results, staff concluded metal heat treating were sources of hexavalent chromium

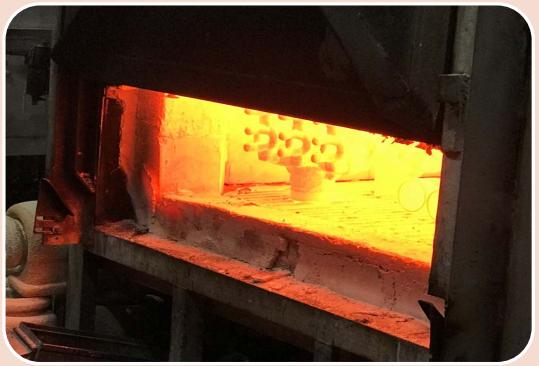
Forging facilities and other hot metal working facilities also use furnaces to heat metal

South Coast AQMD conducted additional screening tests at furnaces located at 4 forging facilities in Paramount

Other Metal Working Furnaces

- Staff found furnaces similar to those at Aerocraft
  - Conducting hot metal work such as pre-heating metals for melting and forging
  - Work with a variety of alloys, including chromium alloys similar to Aerocraft
- Pre-Heat or Re-Heat Furnaces
  - Used to heat billets, ingots, and other raw metal stock
    - At hot working facilities – to increase malleability for subsequent mechanical working
    - At foundries – to heat metal in preparation for melting

Metal Heating Operations Under Consideration

	Heat Treating	Pre-Heating for Mechanical Working	Pre-Heating for Metal Melting
			
	Heat treat various metals and alloys	Heat metals prior to mechanical working	Heat metals prior to melting
Approximate Temp. Range	~ 240 to >2250°F	~ 600 to >2300°F	Depending on melting point
Furnace Residency Time	Hours to days	Up to several hours	Up to several hours

Emissions Testing at Forging Facilities

- Conducted emissions screening tests to quantify hexavalent chromium from seven (7) forging furnaces
- Forging furnaces are used to heat metals to a temperature below the melting point at which the metals are malleable
  - The heated metals are then forged and manipulated to the desired shapes and sizes
- Operating temperature ranges may be hotter than those of heat treating furnaces

Test Results from Forging Furnaces

Facility	Furnaces	Alloy	% Chromium	Temperature (°F)	Cr^{+6} (ng/m^3)
Facility A	Furnace 1A	Waspaloy	18-21	1900	137
Facility B	Furnace 1B	300/400 series stainless steel	10-30	2192	34.6
	Furnace 2B	300/400 series stainless steel	10-30	2252	49.3
	Furnace 3B	Titanium	N/A	1750	82.3
Facility C	Furnace 1C	Titanium	N/A	1725	Non-Detectable & 7.04 *(at 2 separate stacks)*
	Furnace 2C	Titanium	N/A	1725	24,500 *
Facility D	Furnace 1D	Workpieces w/ 15.5% chromium	15.5	2050	2,080

* Furnace used a large stainless steel rotating table to rotate workpieces

Summary of Test Results from Forging Furnaces

- Very high hexavalent chromium emissions from Furnace 2C
  - Titanium workpieces were not expected to have significant levels of chromium
  - Large stainless steel (chromium-containing alloy) rotating table was present in the furnace

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Facility D	Furnace 1D	Workpieces w/ 15.5% chromium	15.5	2050	2,080

- Staff believes the stainless steel rotating table was the source of chromium

Summary of Test Results from Forging Furnaces *(con't)*

- Levels of hexavalent chromium did not directly correlate with workpiece chromium content or temperature
- Furnaces with similar percent chromium had varying levels of hexavalent chromium emissions

Facility	Furnaces	Alloy	% Chromium	Temperature (°F)	Cr^{+6} (ng/m^3)
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Facility D	Furnace 1D	Workpieces w/ 15.5% chromium	15.5	2050	2,080

- Information such as residence time of workpieces, presence of stainless steel baskets or stands, size of workpieces were not documented

Additional Testing

Additional Data Needs

- Additional information needed to better understand how certain operating parameters increase hexavalent chromium emissions
  - Staff believes temperature, residency time, and chromium containing materials affect hexavalent chromium emissions
- Levels of hexavalent chromium emissions are expected to vary based on:
  - Refractory material and/or cement
  - Metal piece that is being heated or treated
  - Racks or stands that support workpieces in the furnace
  - Accumulated metal dust from previous rounds of heating
- In 2018, staff contracted with CE-CERT at UC Riverside to conduct a study of hexavalent chromium formation

CE-CERT Study

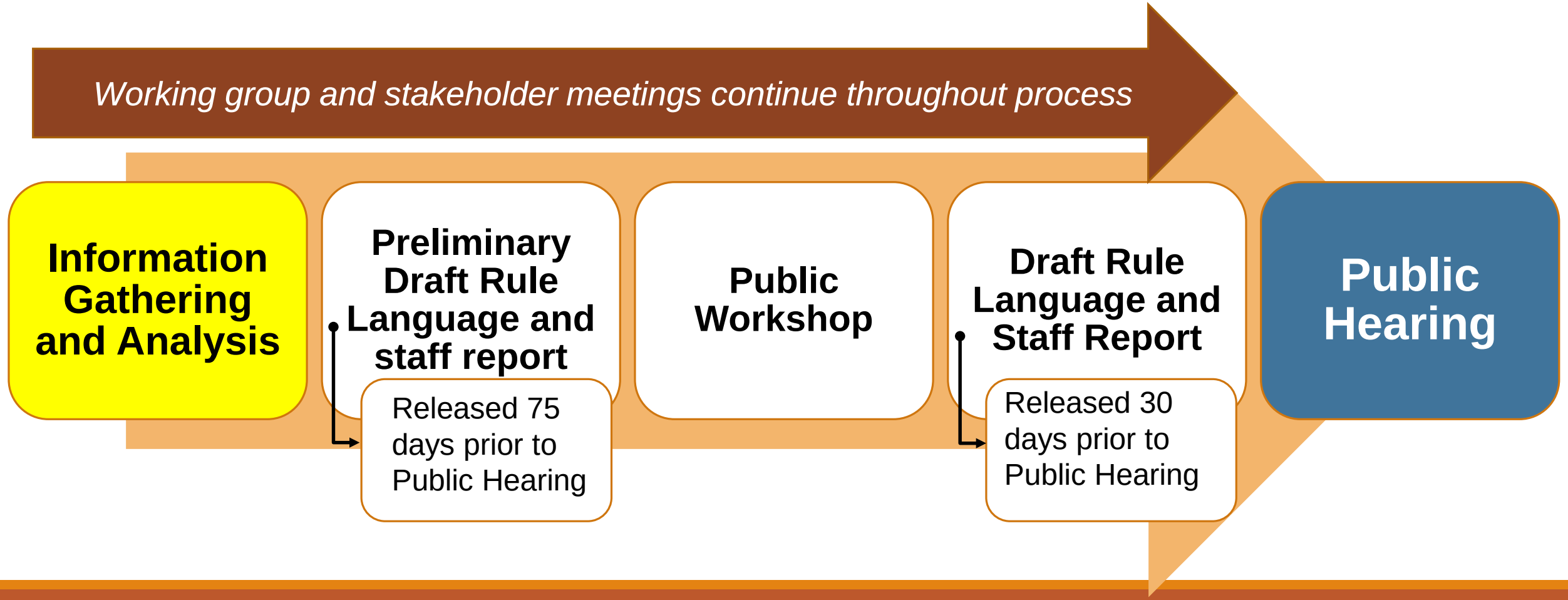
- Objective: to study the formation of hexavalent chromium in heat treating furnaces
- Study will, in part, examine emissions resulting from heating metal to different temperatures for sustained periods of time
- California Metals Coalition is providing testing materials and industry expertise
- Study funded by South Coast AQMD
- Contract signed on June 2018
- Initial kick off meeting held in February 2019

Proposed Rule 1435 Initial Concepts and the Rule Development Process

Proposed Rule 1435

- Proposed Rule 1435 will address toxic air contaminant emissions from metal heating operations
- Still exploring applicability of proposed rule
  - Metal heating operations and processes such as heat treating, pre-heat ovens and furnaces for foundries, hot metal working, and forging facilities
  - Alloys such as chromium alloys
  - Associated processes such as cooling, quenching, etc.
  - Metal toxic air contaminants such as hexavalent chromium, nickel, arsenic, etc.

Overview of Rule Development Process

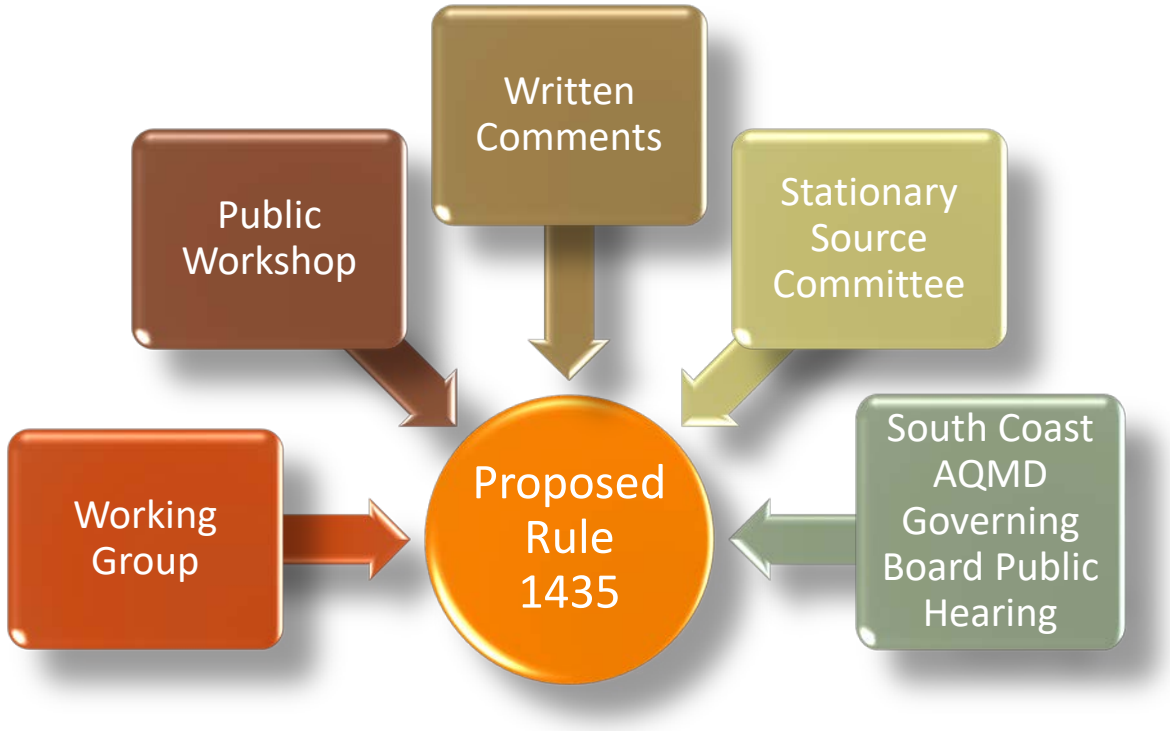


Rule Development Process - Working Group

- Comprised of stakeholders including industry, environmental groups, community members, and public agencies
- Working group meetings are held throughout the rule development process and open to the public
- Objective is to build consensus and work through issues
- Assists staff in understanding:
  - Key issues and concerns
  - Industry terms, industry practices, etc.
  - Applicable technologies

Stakeholder Input

- Stakeholders can provide input during working group meetings and throughout the rulemaking process
- Early input is strongly encouraged to help develop proposed rule and to address issues
- Objective is to build consensus and to have a workable rule



Information Gathering and Analysis

- Information gathering begins well before the first Working Group Meeting
- Primary objectives are to identify:
  - The origin of hexavalent chromium in heat treating furnaces
  - Facilities and equipment to establish the universe of affected sources
  - Other information that may be needed
    - Facility specific information – obtained by surveys, rulemaking team, or inspectors
    - Emissions data
    - Pollution control technologies
    - Cost information

Information Gathering - Site Visits

- Objective: to educate staff on the variety of operations and establish lines of communication with facilities and operators
- Provides opportunity to:
  - Observe actual operations
  - Meet facility operators
  - Learn about unique circumstances
  - Collect operational information from operator
- Staff visits a range of sites to provide a comprehensive overview of the affected sources
- Please contact staff if you want to schedule a site visit

Site Visits Conducted

- Staff has conducted 11 site visits
- Facilities consisted of dedicated heat treaters, forging facilities, a foundry, and a brazing/heat treating facility
- Various types of
  - Equipment
  - Alloys heat treated
  - Workpieces manufactured
- Many of the facilities visited receive much of their work from aerospace or military industries

During site visits and in the course of research, staff encountered various types of heating furnaces

Air Furnace

Workpieces heated in ambient conditions, atmosphere within furnaces are not controlled

Other types used for metal heating?

Electric

Natural Gas

Endothermic Furnaces

Vacuum Furnace

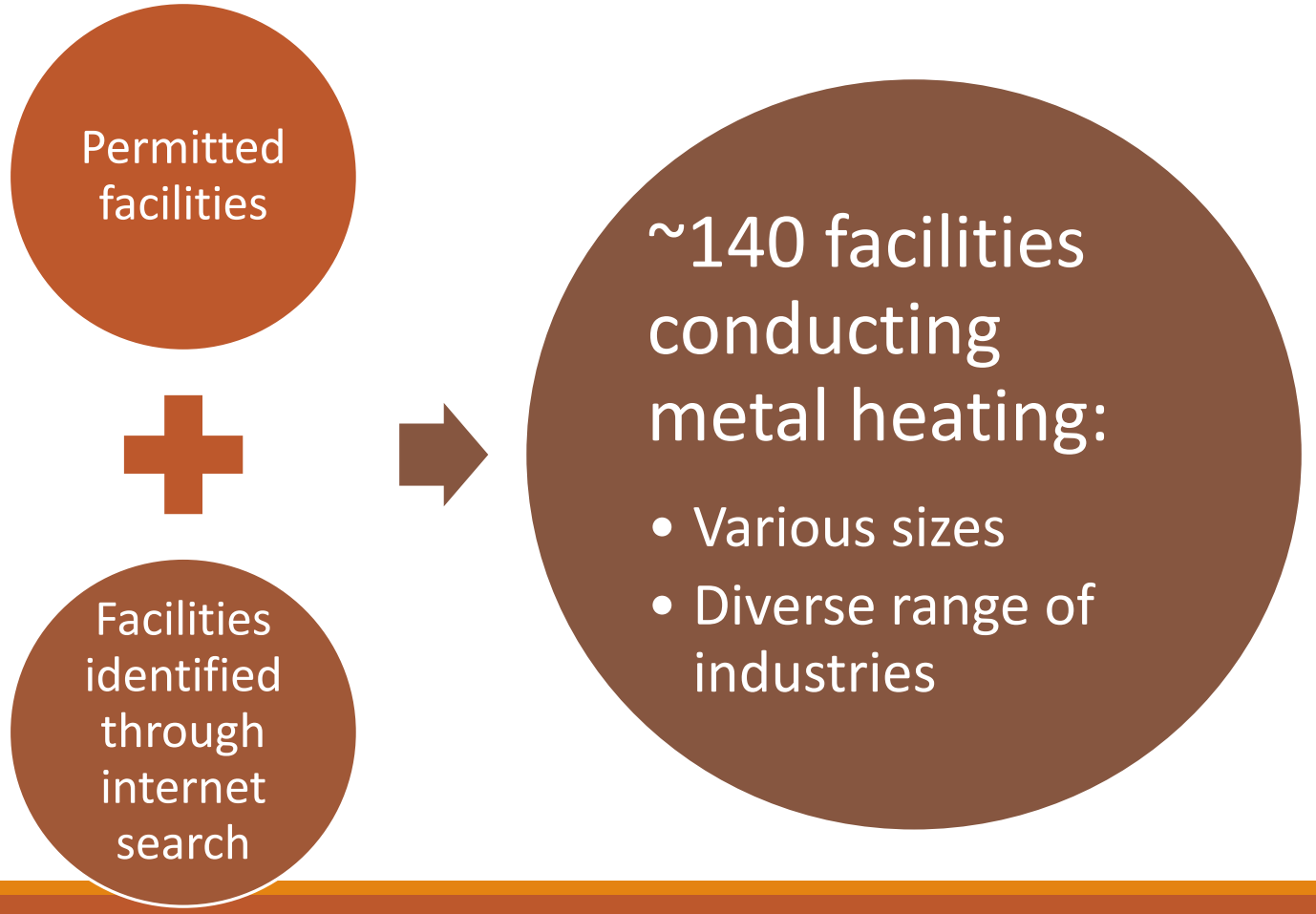
Retort Furnace

Controlled atmosphere furnaces – reduce workpiece oxidation and distortion

Establishing the Universe of Facilities

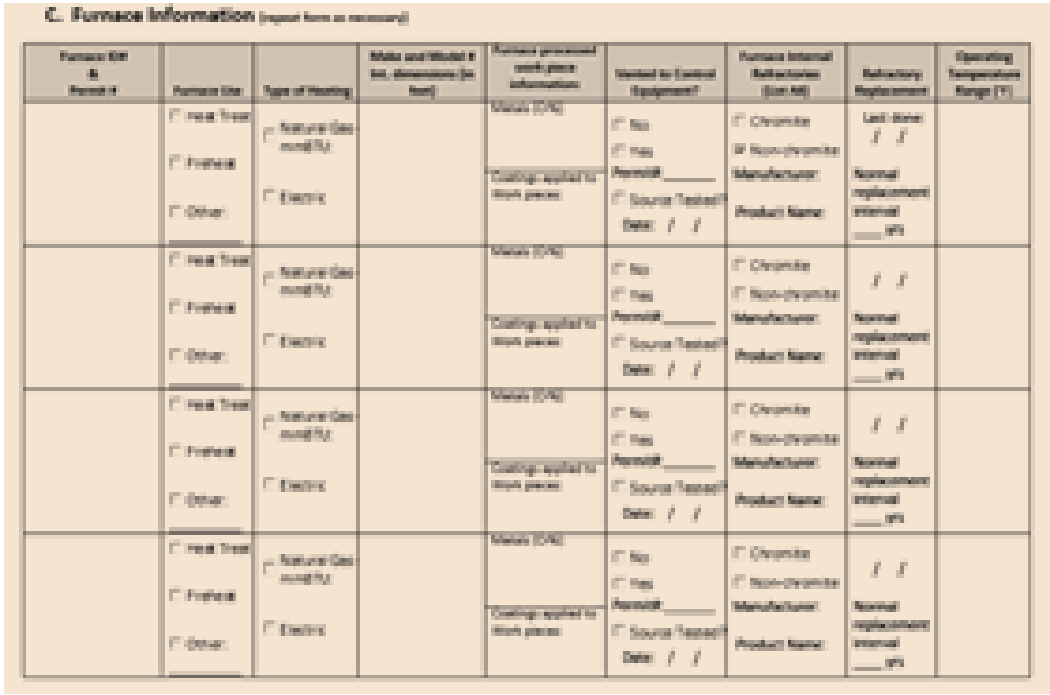
- Establishing a complete universe of metal heating facilities is challenging
  - ➢ Metal heating takes place in various facilities
  - ➢ Some heating operations do not require permits
    - No permits required for:
      - Gaseous fuel-fired furnaces rated at less than 2 MMBTU/hour
      - Electric furnaces
    - Unpermitted facilities not in South Coast AQMD databases
- Staff conducting site visits and outreach to bring facilities into the public process

Establishing Universe of Facilities (*con't*)



Information Gathering – Facility Survey

- Objective: to collect operational information about equipment type, size, materials processed, and housekeeping measures
- Staff is developing a survey for metal heating facilities
  - Information needed to assess number and type of equipment in universe
  - Information is also used to estimate cost impacts associated with proposed rule


C. Furnace Information

Next Steps

- Continue site visits
- Update on CE-CERT study
- Present initial findings at Working Group Meeting #2

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