

REGULATION III – CONTROL OF AIR CONTAMINANTS

**RULE 341
METAL INVESTMENT CASTING**

INDEX

SECTION 100 – GENERAL

- 101 PURPOSE
- 102 APPLICABILITY

SECTION 200 – DEFINITIONS

- 201 BINDER
- 202 BINDER VOC CONTENT
- 203 BINDER-VOC EMISSIONS
- 204 BURNOUT
- 205 BURNOUT CYCLE
- 206 DAY
- 207 EMISSION CONTROL SYSTEM (ECS)
- 208 INVESTMENT CASTING
- 209 KILN

SECTION 300 – STANDARDS

- 301 CONTROLS REQUIRED
- 302 MAINTENANCE
- 303 STORAGE AND DISPOSAL OF VOC
- 304 REQUIREMENTS FOR AIR POLLUTION CONTROL EQUIPMENT

SECTION 400 – ADMINISTRATIVE REQUIREMENTS (NOT APPLICABLE)

SECTION 500 – MONITORING AND RECORDS

- 501 ECS USE
- 502 RECORDKEEPING AND REPORTING
- 503 COMPLIANCE DETERMINATION-TEST METHODS
- 504 AVERAGING

MARICOPA COUNTY
AIR POLLUTION CONTROL REGULATIONS

REGULATION III – CONTROL OF AIR CONTAMINANTS

RULE 341
METAL INVESTMENT CASTING

SECTION 100 – GENERAL

101 PURPOSE: To limit the amount of volatile organic compounds (VOCs) emitted by metal investment casting facilities.

102 APPLICABILITY: This rule applies to any metal investment casting facility.

SECTION 200 – DEFINITIONS: For the purpose of this rule, the following definitions shall apply, in addition to those definitions found in Rule 100 (General Provisions and Definitions) of these rules. In the event of any inconsistency between any of the Maricopa County air pollution control rules, the definitions in this rule take precedence.

201 BINDER: Any material which is used to bind casting sand or other refractory particles into a cohesive mold or part of a mold.

202 BINDER VOC CONTENT:

$$\text{VOC Content of a Binder} = \frac{W_s - W_w - W_{es}}{V_m - V_w - V_{es}}$$

Using consistently either English or metric measures in the calculations

Where:

W_s = weight of all volatile material in the binder, in pounds (or grams), including VOC, water, non-precursor organic compounds and dissolved vapors.

W_w = weight of water in pounds (or grams)

W_{es} = weight of all non-precursor compounds in pounds (or grams)

V_m = volume of total binder material including suspended binder-solids, in gallons (or liters)

V_w = volume of water in gallons (or liters)

V_{es} = volume of all non-precursor compounds in gallons (or liters)

203 BINDER-VOC EMISSIONS: VOC emissions from binder operations which include, but are not limited to, VOC that is emitted during binder formulation and mixing at the casting facility, binder setting, cold-box gassing, metal pouring, mold

burnout, mold cooling, mold storage, and binder/sand recycling. This also includes VOC released through thermal vaporization, combustion, and pyrolysis of binder material.

- 204 BURNOUT:** Firing a mold in a kiln to burn out any remaining fusible-model material and to cure the mold.
- 205 BURNOUT CYCLE:** One of the following:
- 205.1 Into Heated Kiln:** The period between introducing the first mold of a batch of molds into an actively heated kiln until the withdrawal of the last mold of the batch or until the time the cooling kiln reaches 199°F, whichever happens first.
- 205.2 Into Cool Kiln:** For a batch of molds introduced into a cool kiln, the period from the time the kiln reaches 200° F until either the time the last mold of that batch is withdrawn or the time the cooling kiln reaches 199°F, whichever happens first.
- 206 DAY:** A period of 24 consecutive hours beginning at midnight.
- 207 EMISSION CONTROL SYSTEM (ECS):** A system, approved in writing by the Control Officer, designed and operated in accordance with good engineering practice to reduce emissions of volatile organic compounds. Such system consists of an emissions collection subsystem and an emissions processing subsystem.
- 208 INVESTMENT CASTING:** A type of metal casting in which a mold is built up around a fusible model (typically wax), using refractory particles and binder. The model is then melted out and the mold is cured, usually at high temperatures, before casting metal is introduced into the mold.
- 209 KILN:** The oven, retort, or furnace in which molds are fired or cured prior to their receiving molten metal.

SECTION 300 – STANDARDS

- 301 CONTROLS REQUIRED:** After December 16, 1998, no person shall operate a metal investment casting facility emitting, prior to any control device, more than 150 lbs (68 kg) of VOC per day or more than 25 tons (22.7 mg) of VOC per year from investment casting operations unless VOC emissions are controlled by applicable methods in subsections 301.1 and 301.2. VOC emissions from testing, processing, and cleaning procedures that are part of the manufacturing of investment-cast products are included in calculating total emissions.

301.1 VOC Emission from Binders Prior to Burnout:

- a. Use an Emission Control System which, through the capture and processing of emissions, reduces the total, facility-wide binder-VOC

emissions, prior to mold burnout whenever there are pre-burnout binder-VOC emissions, by using one of the following measures:

- (1) Reduce VOC emissions by at least 85 percent as determined by the test methods referred to in Section 503 of this rule; or
 - (2) Use a capture subsystem with an overall capture efficiency of at least 90%, and a processing subsystem that emits no more than 20 mg VOC as organic carbon per standard cubic meter, corrected to 7.0% oxygen for oxidizing systems in accordance with the instructions in subsection 503.5; or
- b. Maintain a limit to binder VOC content of 420 grams VOC per liter (3.5 lb/gal) of binder, less water and non-precursor organic compounds, as determined by methods referred to in Section 503 of this rule; or
 - c. Maintain a daily-weighted average not exceeding 420 grams VOC per liter (3.5 lb/gal) of binder, less water and non-precursor organic compounds, using calculations specified in Section 504 of this Rule 341.

301.2 Burnout VOC-Emissions: VOC emissions from a burnout operation in a kiln shall be controlled by a VOC control system or device that meets all the provisions of either subsection 301.2a or subsection 301.2b, as applicable.

a. Kilns Installed Prior to July 3, 1998: An owner or operator of a VOC control device serving a kiln for which installation was begun before July 3, 1998, shall:

- (1) Operate the device so as to process VOC emissions either:
 - (a) With a reduction-efficiency of at least 90% as determined by the test methods referred to in Section 503, or
 - (b) Process the emissions sufficiently that the average emission during each burnout cycle is less than 30 milligrams of VOC (measured as organic carbon) per standard cubic meter of emissions (as determined by the test methods referred to in Section 503). Results shall be corrected to 7.0% oxygen for oxidizing systems in accordance with the instructions in subsection 503.5.
- (2) During burnout, follow the O&M Plan procedures for proper positioning of the kiln access door, if open, and consistently comply with any other key operating parameters in the Plan.

b. Kilns Installed on or after July 3, 1998: An owner or operator of a kiln of which installation was begun on or after July 3, 1998, shall:

- (1) Operate the device so as to process VOC emissions either:

- (a) With an efficiency of at least 90% as determined by the test methods referred to in Section 503, or
 - (b) Process emissions such that the average emission during each burnout cycle is less than 20 milligrams of VOC (measured as organic carbon) per standard cubic meter of emissions (as determined by the test methods referred to in Section 503). Results shall be corrected to 7.0% oxygen for oxidizing systems in accordance with the instructions in subsection 503.5.
- (2) Provide that the kiln has systems/devices sufficiently effective and of such a design that the door of the kiln does not need to be opened to regulate emissions during the burnout period.
 - (3) The kiln door shall be kept closed after the last unfired mold of a batch is placed in the kiln, except for checking or action on the kiln's contents. The kiln door shall be closed immediately upon completion of checking or action.
 - (4) Consult the O&M Plan if, during burnout, there is visible emission from the kiln.

301.3 Alternative Threshold: The threshold of 150 pounds per day of total VOC from all investment casting operations in Section 301 is raised to 160 pounds per day for a facility to which the following apply:

- a. The 160 lb/day threshold is made a part of the facility's Air Pollution Permit; and
- b. The facility makes molds and/or conducts mold burnout no more than 6 days per week, or
- c. The facility makes molds and/or conducts mold burnout no more than 313 days per year.

302 MAINTENANCE: Any person subject to this rule shall operate and maintain in proper working order all process equipment in which VOC-containing materials are used or stored.

303 STORAGE AND DISPOSAL OF VOC: An owner or operator shall comply with the following provisions:

- 303.1** Store all VOC-emitting materials, including but not limited to waste binders, waste solvents, and their residues, in closed containers which are legibly labeled with their contents.
- 303.2** Use suitable disposal methods. Suitable disposal includes legal deposit into sewers, laundering of wiping materials, collection in closed containers (including impervious bags), and removal by a disposal service.

303.3 Choose one of the following:

- a. Keep adequate records of the disposal/recovery of each VOC-containing material; or
- b. If adequate records of the disposal/recovery of a VOC-containing material are not kept, it is the option of the Control Officer to count as emission to the air the VOC contained in that material, as determined from records of the material's usage.

304 REQUIREMENTS FOR AIR POLLUTION CONTROL EQUIPMENT

304.1 Operation and Maintenance (O&M) Plan Required for ECS:

- a. An owner or operator shall provide and maintain (an) O&M Plan(s) for any ECS, any other emission processing equipment, and any ECS monitoring devices that are used pursuant to this Rule 341 or to an air pollution control permit.
- b. The owner or operator shall submit to the Control Officer for approval the O&M Plans of each ECS and each ECS monitoring device that is used pursuant to this Rule 341.
- c. The owner or operator shall comply with all the identified actions and schedules provided in each O&M Plan.

304.2 Providing and Maintaining ECS Monitoring Devices: Any person incinerating, adsorbing, or otherwise processing VOC emissions pursuant to this rule shall provide, properly install and maintain in calibration, in good working order and in operation, devices described in the facility's O&M Plan that indicate temperatures, pressures, rates of flow, or other operating conditions necessary to determine if air pollution control equipment is functioning properly and is properly maintained.

304.3 O&M Plan Responsibility: An owner or operator of a facility that is required to have an O&M Plan pursuant to subsection 304.1 must fully comply with all O&M Plans that the owner or operator has submitted for approval, but which have not yet been approved, unless notified otherwise by the Control Officer in writing.

SECTION 400 – ADMINISTRATIVE REQUIREMENTS (NOT APPLICABLE)

SECTION 500 – MONITORING AND RECORDS

501 ECS USE:

501.1 On each day an Emission Control System is operated pursuant to this rule, a continuous, permanent record shall be maintained both of the times such

system was used to comply with this rule and of the amount and VOC-content of each binder controlled by the ECS.

501.2 Operation and Maintenance:

- a. On each day that an Emission Control System is used to comply with this rule, a record shall be made of the operating parameters of the key systems described in the O&M Plan.
- b. For each day or period in which the O&M Plan requires that maintenance be performed, a record shall be made of the maintenance actions taken, within 24 hours of maintenance completion.
- c. An explanation shall be entered for scheduled maintenance that is not performed during the period designated in the O&M Plan.

502 RECORDKEEPING AND REPORTING: An owner or operator subject to this rule shall keep the following records and lists in a consistent and complete manner, and shall make them available to the Control Officer upon request. Records of the previous 12 months, requested during normal business hours, shall be made available without delay. Each of the following records shall be maintained for a minimum of five years:

502.1 Current List: A current list shall be maintained of all VOC-containing materials as received by the facility, such as binders and/or binder components, maskants, coatings, cleaning solvents, lubricants and any other VOC-containing substances related to investment casting. Include the VOC content of each in pounds per gallon or grams per liter.

- a. **Type of Material:** The listing for each material shall also include a brief description that indicates the purpose or use of the material, for example: “zirc. binder,” “mold-binder component”, “cleaner”, “wash,” “bearing lube”, “topcoat”, “releasing”, etc.
- b. **Exception:** This rule does not require listing or recording of material arriving at the facility with less than 1.1% organic compound content.

502.2 Use: Records shall be maintained which show the type, amount used, and VOC content, expressed in either pounds of VOC per gallon or grams of VOC per liter, of each VOC-containing material. Records shall be updated according to the following schedule. Materials differing only in brand or manufacturer but having the same composition and formula may be totaled as a single material.

- a. **Monthly:** By the end of the following month, update each month’s usage of all VOC-containing materials except as provided in subsections “b” and “c” following.

- b. **Yearly:** By January 31, update the usage figures for the year just past for the materials of which less than 15 gallons fluid or 100 lb (45 kg) solid are used in any year.
- c. **Daily:** Daily update usage of all binders if any binder(s) used have a VOC content exceeding 3.5 lb VOC/gallon (measured minus water and non-precursor compounds) and are not controlled by an ECS.

503 COMPLIANCE DETERMINATION – TEST METHODS: The test methods as they exist on December 16, 1998, as listed below, are adopted by reference. This adoption by reference includes no future editions or amendments. Copies of test methods referenced in this Section 503 are available at the Maricopa County Air Quality Department, 1001 N. Central Ave., Phoenix, AZ, 85004. When more than one test method is permitted for a determination, an exceedance of the limits established in this rule determined by any of the applicable test methods constitutes a violation of this rule.

- 503.1** Quantification of VOC and solids content of binders, required in order to comply with subsections 301.1b and 301.1c, shall be determined using:
- a. The EPA Reference Method 24 (40 CFR, Part 60, Appendix A), or Method 31 of California’s Bay Area Air Quality Management District as amended April 15, 1992, or by the April 1997 revision of California’s South Coast Air Quality Management District Method 313-9, or by a current Certified Data Sheet, signed by an official of each facility that formulated the binders.
 - b. If an averaging scheme is used pursuant to subsection 301.1c, the owner or operator shall sample each binder formulation at least once per year during the time any binder(s) exceeding 3.5 lb/gal. is being used, and record the VOC content as determined by EPA Method 24 at a testing laboratory.
- 503.2** The control efficiency of an Emission Control System or other control equipment/system used pursuant to subsection 301.1 or subsection 301.2 shall be determined according to EPA Reference Methods 18, 25, or an applicable submethod of Method 25 (Title 40, CFR Part 60, Appendix A).
- 503.3** Capture efficiency of an Emission Control System required by subsection 301.1a shall be determined by mass balance in combination with ventilation/draft rate determinations referenced in subsection 503.4, or by Method 204 and its applicable submethods, Appendix M. 40 CFR 51.
- 503.4** Ventilation/draft rates of an Emission Control System required by subsection 301.1 shall be determined by EPA Reference Methods 2, 2A, 2C, or 2D (40 CFR Part 60, Appendix A).
- 503.5** The following equation is used to correct the VOC concentration to 7.0% oxygen, using the percent oxygen of the emission test:

(VOC concentration) x (20.9 - 7.0) / (20.9 - O₂%) = Adjusted VOC concentration, where:
 “VOC concentration” and “O₂%” are actual emission-test results.

504 AVERAGING: For metal investment casting facilities using any binder exceeding 3.5 lbs VOC/gallon less water and non-precursor compounds, daily-weighted averaging shall be performed on each day of such usage that demonstrates compliance with subsection 301.1c. Averaging shall be performed as follows:

504.1 Emission Computation Schedule: Each workday's VOC emissions and the daily-weighted average expressed in grams of VOC per liter of binder (or lb/gal) shall be computed and recorded no later than 12 hours after the end of that workday. Binder used in any day shall have all its emitted VOC ascribed to that day even if evaporation is not complete until a following day. At the end of a day, the numerical quantity of any leftover binder which will not be used again, shall be added to the sum of the total binder used of that same formulation used on that day. However, the amount of leftover binder does not need to be added to the sum of the total binder used on that day if such binder is stored in sealed container(s), and a determination of VOC content is made by Method 24 and recorded in the log, prior to removal from the site.

504.2 Bulk Accounting: A separate account shall be kept and updated as bulk binder ingredients arrive and as such ingredients are used up. This account shall include deliveries of VOC-containing diluents such as alcohol and other make-up solvents. Purchase order and inventory records can suffice for this if they are at all times kept complete, in a form usable for such accounting, and available to the Control Officer.

504.3 Averaging Schedule: A list shall be kept current containing the name/designation of each binder formulation and the amount of each constituent in each formulation, and including the mass of VOC per unit volume of binder, less water and non-precursor organic compounds. The amounts of each binder formulation used, including make-up formulations, shall be recorded at the end of each mold-making shift. The daily-weighted average expressed in grams VOC per liter of binder (or lb/gal), less water and non-precursor organic compounds, shall be computed and recorded no later than 12 hours after the end of each workday.

504.4 MATHEMATICALLY CALCULATING THE DAILY-WEIGHTED AVERAGE: The daily-weighted average VOC content of all the binders used in a day facility-wide, a quantification required in order to comply with subsection 301.1c, shall be calculated using the following equation and be expressed in units of mass of VOC per unit volume of binder excluding any water and any non-precursor organic compounds (non-precursors).

$$\text{VOC}_w = \frac{V_1C_1 + V_2C_2 + \dots + V_nC_n + M_{va}}{V_1 + V_2 + \dots + V_n + V_{va} + V_{sa}}$$

where:

- VOC_w = The daily-weighted average VOC content of all "n" binder formulations ("a" through "n") used during a day throughout the facility expressed in grams of VOC per liter of binder (or lb/gal) after water and non-precursors are excluded.
- C_1 = The VOC content of the first formulation used on a production day in grams per liter of binder (lb/gal), excluding water and non-precursors.
- C_2 = The VOC content of the second binder-formulation used on a production day, in grams per liter of binder (or lb/gal), excluding water and non-precursors.
- C_n = The VOC content of the very last binder formulation used on a production day when a total of "n" formulations were used, and the only formulation remaining to be accounted for. It is expressed in grams VOC per liter of binder-formulation "n" (or lb/gal), excluding water and non-precursors.
- M_{va} = The total mass of VOC added to any previously formulated binder used during the course of the day expressed in grams (or lbs). This includes the VOC portion of added materials which also contain non-VOC components.
- V_1 = The total volume used throughout the day of the first binder formulation used that day, expressed in liters (or gal), excluding the volume of any water and the volume of any non-precursors.
- V_2 = The total volume used throughout the day of the second binder formulation used that day, in liters (or gal), excluding the volume of water and non-precursors.
- V_n = The total volume used throughout the day of the very last binder formulation used that day, when a total of "n" formulations were used. It is expressed in liters (or gal) of formulation "n" not including the volume of any water and non-precursors.
- V_{va} = The total volume of VOC in liters (or gal) added to any and all previously formulated binders during the course of the day for make-up, viscosity reducing, or other purpose(s). If such VOC is used in a mixture containing non-VOC components, the volume of the non-VOC portion is excluded when making calculations.
- V_{sa} = The total volume of solids in liters (or gal) added during the day to any already formulated binders used during that day such solids are added. Such volume shall be equivalent to the volume of solid material remaining after any volatile material has been removed by the drying oven under the conditions specified in a Method 24 test, as referenced in Section 503.