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June 17, 2025

Department of Environmental Quality
Cleaner Air Oregon (CAO)
700 NE Multnomah Street, Suite 600
Portland, OR 97232
Attn: Amy DeVita-McBride, Project Engineer

RE: Response to CAO Comments on Emission Inventory
Orchid Orthopedic Solutions Oregon, Inc., 13963 S Fir St., Oregon City, OR 97045
ENW Project 1827-23001-06

Thank you for your comments on our Orchid Orthopedic Solutions Oregon, Inc.'s emission inventory, submitted November 22, 2024. Cleaner Air Oregon's (CAO) comments are outlined below (shaded) and ENW's responses are presented in italics following each of ODEQ's general and specific comments.

General Comments

1. Baghouse Control Efficiencies: DEQ will not accept 99.9 percent control efficiency of particulate matter (PM) for activities controlled by a baghouse. Vendor specifications for the filters used at Orchid Orthopedics' baghouses state a 99.9 percent control of PM sized between 2.5 and 10 microns. Fabric filters typically have a lower control efficiency for PM less than 2.5 microns. The activities controlled by the baghouses at Orchid Orthopedics are understood to produce PM sized less than 2.5 microns (PM2.5) therefore a control efficiency of 99.9 percent overestimates the removal efficiency of the baghouses for smaller particulates. DEQ has addressed specific instances and required updates to the Inventory or supporting calculations in the proceeding section.

   ENW will respond to this comment in the specific comments below.

2. Crystalline Silica: The CAS registry number (CASRN) of 7631-86-9 is for silica of both amorphous and crystalline form. However, at this time only crystalline silica (of respirable size) is a listed toxic air contaminant (TAC). The following silica materials are of the crystalline form: quartz (CASRN 14808-60-7), cristobalite (CASRN 14464-46-1), and tridymite (CASRN 15468-32-3). Materials under these CASRNs should be evaluated as crystalline silica and are potentially reportable as "silica, crystalline (respirable)" (CASRN 7631-86-9) for CAO. DEQ has reviewed Safety Data Sheets (SDSs) for materials used at Orchid Orthopedics and found that in multiple instances amorphous silica compounds have been reported as crystalline silica. DEQ has addressed these specific instances and required updates to the Inventory or supporting calculations in the proceeding "Specific Comments" section.

   Thank you for this clarification. ENW will respond to this comment in specific comments below.

3. Hexavalent Chromium: DEQ has reviewed Orchid Orthopedics' industrial hygiene report on hexavalent chromium exposure conducted for employees performing welding, casting, cutoff, and barrel change activities. DEQ has determined that the analysis presented is inadequate to support the assumption of zero hexavalent chromium emissions from foundry activities. DEQ has provided acceptable values to use in estimating hexavalent chromium as percentage of total chromium in the proceeding section.

   ENW will respond to this comment in the specific comments below.

4. Short-term variability: DEQ recommends accounting for some safety factor in estimating short-term (maximum daily) throughputs and usage rates. This safety factor will help account for short-term variability in production and add conservatism to the acute risk assessment.

   Orchid Orthopedics has reconsidered short-term variability and increased the general safety factor used in AQ520 from 1.25 to 2 for estimating maximum daily usage at capacity.

Specific Comments

1. **Process Flow Diagram:** Provide a copy of the facility's process flow diagram which meets the requirements of OAR 340-245-0040(4)(b)(C)(i). The process flow submitted with the Inventory is a text-based flow document which, while useful, does not fulfill the requirements.

   On May 16, 2025, the file "1827-23001-06_Fig4ProcessFlowDiagram(v07).pdf" was provided to CAO via email. This file contained detailed process flow diagrams for all emissions producing activities, including expected points of all fugitive and non-fugitive emissions and air pollution control devices, consistent with the requirements of OAR 340-245-0040(4)(b)(C)(i).

2. **Alloy Composition Data:** DEQ requests that more refined alloy compositional information be provided for the purposes of developing the Inventory. Batch sheets or alloy specification sheets provided by the supplier should be used over SDS sheets for the alloys.
   a. Provide DEQ copies of this compositional information for review. If this information is considered Confidential Business Information (CBI), follow appropriate CBI protocols when submitting these documents.

      On May 15, 2025, Orchid's Proprietary Material Specification sheets for alloys F-75 and 17-4 were provided to CAO via email following appropriate CBI protocols.

   b. Update TAC emission estimates for all TEUs which use alloy compositional data. Specific instances are identified below in Specific Comment 3.

      TAC emission estimates which use alloy compositional data have been updated for applicable TEUs, as identified in Specific Comment 3.

3. **Revised Inventory:** Submit to DEQ a revised Inventory (AQ520), along with all supporting calculations in Excel format, as well as all information required under OAR 340-245-0040(4).

The following information is being submitted concurrent with this letter via YDO:

- *Revised inventory (AQ520) excel file.*
- *Revised supporting calculation excel file*
- *Revised Process Flow word file that shows deleted and added text for clarity*
- *Revised Figures 2 and 3 (reflective of removal of Kolene TEU and Scrubber)*

Include the following updates to the AQ520:

a. NATURAL GAS TEU:

i. Review of previous year's annual reports show that the annual Requested PTE from the Inventory has been exceeded in recent years (see 2017 and 2018). Review and revise the Requested PTE as needed to ensure it is reflective of the facility's future operations.

The annual Requested PTE was based on information from the last three years of operation and an indicator at the time of preparation that production may be on a downward trend. Annual Requested PTE has been reconsidered based on natural gas use in 2017 and 2018 and an approach of being able to expand production if needed. The annual Requested PTE has been updated to 30 MMSCF.

ii. Incorporate the following updates to the emission factors in Worksheet 3:

1. Use the emission factor of 3.2 lb/MMscf for ammonia (CASRN 7664-41-7). The emission factor used is for units equipped with an SCR.[1]
2. Include emissions estimates for benzo[a]pyrene (CASRN 50-32-8) using an emission factor of 0.0000012 lb/MMscf.[2]

These updates have been incorporated into AQ520, Worksheet 3.

b. **17-4 Alloy TEUs:**

i. For the 17-4 alloy, confirm the estimate of maximum daily production/processing throughputs are reflective of worst-case daily activities at the facility. The Inventory calculates maximum daily production and metal processing throughputs as a split of annual usage across 250 days. However, supplemental information provided with the Inventory notes that "work with the 17-4 alloy comes in batches. … Some months may have a couple small batches; most months there will be zero use." This comment is included with supplemental information pertaining specifically to TIG

[1] DEQ. March 1, 2024. "AQ104B Toxics Reporting and Air Toxics Emissions Inventory: Combustion Emission Factor Search Tool." https://www.oregon.gov/deq/aq/air-toxics/Pages/Air-Toxics-Emissions-Inventory.aspx

[2] EPA. September 1998. AP-42 Chapter 1, Table 1.4-3 "Emission Factors for Speciated Organic Compounds from Natural Gas Combustion." https://www.epa.gov/sites/production/files/2020-09/documents/1.4_natural_gas_combustion.pdf

production welding, but DEQ assumes it applies more generally to production using the 17-4 alloy.

Orchid Orthopedics reviewed 2023 casting records and determined that the maximum amount of 17-4 ally poured in one day was 468 pounds. AQ520 has been updated accordingly.

ii. **Refine the maximum daily assumptions across all 17-4 alloy specific TEUs as appropriate.**

These updates have been incorporated into AQ520, Worksheet 2.

c. WELD (F-75) TEU:

i. Update alloy content based on refined compositional information for the F-75 alloy (see Specific Comment 2.b).

Alloy compositional information has been updated in the "Orchid CAO - UPDATED Supporting Calcs for Emissions (Rev01)" excel file, worksheet "TIG Weld (Production)". Based on the results of this update, compositional emission factors have been updated in AQ520, Worksheet 3, as appropriate.

ii. Per General Comment 1, DEQ will not accept a PM control efficiency of 99.9 percent for processes captured by a baghouse. DEQ will accept the following control efficiencies:[3]
    1. 100 percent control of PM that is greater than 10 microns; and
    2. 99 percent control of PM less than 10 microns (PM10).

The baghouse control efficiency has been updated on AQ520, Worksheet 3 using the DEQ-accepted control efficiency of 99%.

iii. Include emission estimates for hexavalent chromium (CASRN 18540-29-9) as 5 percent of total chromium emissions based on guidance from San Diego County Air Pollution Control District.[4]

Alloy compositional concentrations have been updated in the "Orchid CAO - UPDATED Supporting Calcs for Emissions (Rev01)" excel file, Worksheet "TIG Weld (Production)" to include 5 percent of total chromium emissions as hexavalent chromium. Then hexavalent chromium was added to AQ520, Worksheet 3 using the resultant emission factor.

iv. Include emissions estimates for molybdenum trioxide (CASRN 1313-27-5). In the absence of data specific to molybdenum trioxide, account for 100 percent

[3] DEQ will consider other more refined emission estimate approaches for PM emissions with supporting representative information.

[4] San Diego County Air Pollution Control District. October 16, 1998 (revised July 11, 2022). "Welding Operations." (https://www.sdapcd.org/content/dam/sdapcd/documents/permits/emissions-calculation/welding/APCD-Welding-Operations.pdf).

conversion to molybdenum trioxide by multiplying molybdenum emissions by 1.5 (the ratio of the molecular weight of molybdenum trioxide and the atomic weight of molybdenum).

Alloy compositional concentrations have been updated in the "Orchid CAO - UPDATED Supporting Calcs for Emissions (Rev01)" excel file, Worksheet "TIG Weld (Production)" to include calculations of molybdenum trioxide using:

- *The methodology of San Diego APCD and the category of "Metals w/o Emission Factors" as confirmed acceptable in an April 2, 2025 email from CAO.*
- *Application of a ratio of 1.5 applied to the concentration of molybdenum in the emission factor concentration.*

The AQ520, Worksheet 3 was then updated to include molybdenum trioxide.

v. Unless more refined alloy specifications are available (see Specific Comment 2.b), include emission estimates for compounds listed under the SARA Title III subsection of the Regulatory Information section of the SDS.
    1. Nickel (CASRN 7440-02-0): Assume the de minimis concentration of 0.1 percent.[5]
    2. Beryllium (CASRN 7440-41-7): Assume the de minimis concentration of 0.1 percent.[5]

CAO has been provided with more refined alloy material specification sheets. Accordingly:

- *Alloy compositional concentration for nickel has been updated in the "Orchid CAO -UPDATED Supporting Calcs for Emissions (Rev01)" excel file, Worksheet 3 "TIG Weld (Production)" and the nickel emission factor was updated on AQ520, Worksheet 3.*
- *Beryllium is excluded from the alloy based on the material specification sheets.*

d. WELD (17-4) TEU:

i. Update the maximum daily (actual and Requested PTE) usage rates per response to Specific Comment 3.b.

The maximum daily (actual and Requested PTE) usage rates have been updated in AQ520 in response to Specific Comment 3.b.

[5] EPA. "EPCRA Section 313 Chemical List for Reporting Year 2010." (https://www.epa.gov/sites/default/files/documents/RY2010ChemicalList.pdf)

ii. Per General Comment 1, DEQ will not accept a PM control efficiency of 99.9 percent for processes captured by a baghouse. DEQ will accept the following control efficiencies:[3]
    1. 100 percent control of PM that is greater than 10 microns; and
    2. 99 percent control of PM10.

The baghouse control efficiency has been updated on AQ520, Tab 3 using the DEQ-accepted control efficiency of 99%.

iii. Update alloy content based on refined compositional information for the 17-4 alloy (see Specific Comment 2.b).

Alloy compositional information has been updated in the "Orchid CAO - UPDATED Supporting Calcs for Emissions (Rev01)" excel file, Worksheet "TIG Weld (Production)". Based on the results of this update:

- *Colbalt and aluminum were removed from AQ520 because they are not present in this material (as indicated by Orchid's material specification sheet).*
- *Emission factors for TACs have been updated in AQ520, Worksheet 3.*

iv. Include emission estimates for hexavalent chromium (CASRN 18540-29-9) as 5 percent of total chromium emissions based on guidance from San Diego County Air Pollution Control District.[4]

Alloy compositional concentrations have been updated in the "Orchid CAO - UPDATED Supporting Calcs for Emissions (Rev01)" excel file, Worksheet "TIG Weld (Production)" to include 5 percent of total chromium emissions as hexavalent chromium. Then hexavalent chromium was added to AQ520, Worksheet 3 using the resultant emission factor.

v. Include emissions estimates for molybdenum trioxide (CASRN 1313-27-5). In the absence of data specific to molybdenum trioxide, account for 100 percent conversion to molybdenum trioxide by multiplying molybdenum emissions by 1.5 (the ratio of the molecular weight of molybdenum trioxide and the atomic weight of molybdenum).

Orchid's material specification sheet for the alloy 17-4 excluded molybdenum or compounds in the composition requirements. Therefore, estimates for molybdenum trioxide have not been included.

e. WELD (MIG) TEU: The maximum daily usage rate for the MIG welding rod presented in Worksheet 2 differs from information presented in supporting workbook "2024.11.21 Orchid Ortho CAO - Supporting Calcs for Emissions.xlsx." Review and revise throughputs as appropriate to resolve the discrepancy.

AQ520 has been revised using the value presented in the supporting workbook.

f. F-75 CAST TEU:

i. Review of 2023 actual annual metal poured against information submitted in both the 2023 Annual Report and the Air Toxics Emissions Inventory (ATEI) show discrepancies. Review and revise throughputs as appropriate to resolve the discrepancy.

AQ520 has been revised to reflect the amount of F-75 alloy poured in 2023, consistent with the 2023 Annual Report.

ii. The Inventory uses both AP-42 and RTI International (RTI) emission factors for casting operations. RTI's "Emission Estimation Protocol for Iron and Steel Foundries" document (RTI document) is DEQ's preferred source for emission factors for foundry sources.[6] Update emission factors to reference only the RTI document. Use the following particulate matter (PM) emission factors from RTI, which represent the sum of both filterable PM (PM-FIL) and condensable PM (PM-CON), for casting operations at Orchid Orthopedics:

1. Induction melting uncontrolled (RTI, Table 3-3): 1.55 lb/ton metal poured;
2. Induction charging & tapping uncontrolled (RTI, Table 3-3): 0.51 lb/ton metal poured;
3. Pouring, captured, uncontrolled (RTI, Table 5-4): 0.317 lb/ton metal poured; and
4. Cooling, captured, uncontrolled (RTI, Table 5-4): 1.06 lb/ton metal poured.

The emission factors have been updated to 1) only reference the RTI document, and 2) to reflect the sum of both filterable PM (PM-FIL) and condensable PM (PM-CON). The Process Flow document and AQ520 have been revised. The combined emission factor is now 3.437 lb. PM / ton metal poured.

iii. DEQ will not accept a building control efficiency of 99 percent for casting activities as set forth in the Inventory. The justification provided is inadequate to support such a high degree of control for PM generated from casting activities. Either substantiate the requested control efficiency or remove entirely.

Orchid Orthopedics further investigated the air handling of the room where casting activities occur. In summary:

- *Casting activities occur during early morning shifts.*
- *Casting protocol (for product purity) requires all doors to be kept closed.*
- *Five air-intake fans in the roof push air into the room.*
- *Dust control devices DC#1, DC#2 and DC#3 are operated 24-7 and create a vacuum in the casting room with DC#3 having the closest proximity to casting activities and the strongest vacuum. The doors to the rooms controlled by DC#2 and DC#3 are tarp-type material roll-up doors (see photos).*

Photos: Tarp-type doors into areas controlled by DC#2 and DC#3 showing response (deformation) to vacuum for dust control equipment.

The preferential pathway for casting emissions to leave the building will be through dust control equipment, preferentially to DC#3. Therefore, a 99% control efficiency reflective of baghouse filters is appropriate for casting emissions.

iv. Update alloy content based on refined compositional information for the F-75 alloy (see Specific Comment 2.b).

Alloy compositional information has been updated in AQ520.

v. Include emission estimates for hexavalent chromium (CASRN 18540-29-9). The percent of total chromium as hexavalent chromium varies across casting activities. Use the following defaults from Table B-9 in Appendix B of the RTI document:[6]

1. Induction melting (steel foundry, electric induction furnace [EIF]): 12 percent;
2. Charging & tapping (steel foundry, charge handling): 3 percent;
3. Pouring (steel foundry, pouring and casting): 3 percent; and
4. Cooling (steel foundry, casting cooling): 3 percent.

AQ520 has been updated to include emission estimates for CrVI. The CAO-required percentages have been applied to the emission factors provided in 3.f.ii as follows:

- *Melting: 12% x (RTI Table 3-3): 1.55 lb. PM / ton metal poured = 0.186 lb. CrVI PM / ton metal poured*
- *Charging/Tapping: 3% x (RTI Table 3-3): 0.51 lb. PM / ton metal poured = 0.0153 lb. CrVI PM / ton metal poured*
- *Pouring and Casting: 3% x (RTI Table 5-4): 0.317 lb. PM / ton metal poured*
  = 0.00951 lb. CrVI PM / ton metal poured
- *Cooling: 3% x (RTI Table 5-4): 1.06 lb. PM / ton metal poured = 0.0318 lb. CrVI PM / ton metal poured*

Summarizing the emission factors across casting activities results in a total emission factor of 0.24261 lb. CrVI PM / ton metal poured. This emission factor is applied to the average concentration of total chromium in AQ520.

vi. Include emissions estimates for molybdenum trioxide (CASRN 1313-27-5). In the absence of data specific to molybdenum trioxide, account for 100 percent conversion to molybdenum trioxide by multiplying molybdenum emissions by 1.5 (the ratio of the molecular weight of molybdenum trioxide and the atomic weight of molybdenum).

AQ520 has been updated to include estimates of molybdenum trioxide using the above conversion factor.

vii. Unless more refined alloy specifications are available (see Specific Comment 2.b), include emission estimates for compounds listed under the SARA Title III subsection of the Regulatory Information section of the SDS.

[6] RTI International. 2012. "Emission Estimation Protocol for Iron and Steel Foundries."

1. Nickel (CASRN 7440-02-0): Assume the de minimis concentration of 0.1 percent.[5]
2. Beryllium (CASRN 7440-41-7): Assume the de minimis concentration of 0.1 percent.[5]

CAO has been provided with more refined alloy material specification sheets. Accordingly:

- *Alloy compositional concentration for nickel has been updated on AQ520, Tab 3.*
- *Beryllium is excluded from the alloy based on the material specification sheets.*

g. 17-4 CAST TEU:

i. Review of 2023 actual annual metal poured against information submitted in both the 2023 Annual Report and the ATEI show discrepancies. Review and revise throughputs as appropriate to resolve the discrepancy.

AQ520 has been revised to reflect the amount of 17-4 alloy poured in 2023, consistent with the 2023 Annual Report.

ii. Update the maximum daily (actual and Requested PTE) metal poured per response to Specific Comment 3.b.

The maximum daily (actual and Requested PTE) usage rates have been updated in AQ520 in response to Specific Comment 3.b.

iii. The Inventory uses both AP-42 and RTI emission factors for casting operations. The RTI document is DEQ's preferred source for emission factors for foundry sources.[6] Update emission factors to reference only the RTI document. Use the following PM emission factors from RTI, which represent the sum of both filterable PM (PM-FIL) and condensable PM (PM-CON), for casting operations at Orchid Orthopedics:

1. Induction melting uncontrolled (RTI, Table 3-3): 1.55 lb/ton metal poured;
2. Induction charging & tapping uncontrolled (RTI, Table 3-3): 0.51 lb/ton metal poured;
3. Pouring, captured, uncontrolled (RTI, Table 5-4): 0.317 lb/ton metal poured; and
4. Cooling, captured, uncontrolled (RTI, Table 5-4): 1.06 lb/ton metal poured.

The emission factors have been updated to 1) only reference the RTI document, and 2) to reflect the sum of both filterable PM (PM-FIL) and condensable PM (PM-CON). The Process Flow document and AQ520 have been revised.

iv. DEQ will not accept a building control efficiency of 99 percent for casting activities as set forth in the Inventory. The justification provided is inadequate

to support such a high degree of control for PM generated from casting activities. Either substantiate the requested control efficiency or remove entirely.

See response to Specific Comment 3.f.iii.

v. Update alloy content based on refined compositional information for the 17-4 alloy (see Specific Comment 2.b).

Alloy compositional information has been updated in AQ520.

vi. Include emission estimates for hexavalent chromium (CASRN 18540-29-9). The percent of total chromium as hexavalent chromium varies across casting activities. Use the following defaults from Table B-9 in Appendix B of the RTI document:[6]
    1. Induction melting (steel foundry, electric induction furnace [EIF]): 12 percent;
    2. Charging & tapping (steel foundry, charge handling): 3 percent;
    3. Pouring (steel foundry, pouring and casting): 3 percent; and
    4. Cooling (steel foundry, casting cooling): 3 percent.

Consistent with response to 3.f.v., AQ520 has been updated to include emission estimates for CrVI.

vii. Include emissions estimates for molybdenum trioxide (CASRN 1313-27-5). In the absence of data specific to molybdenum trioxide, account for 100 percent conversion to molybdenum trioxide by multiplying molybdenum emissions by 1.5 (the ratio of the molecular weight of molybdenum trioxide and the atomic weight of molybdenum).

Orchid's material specification sheet for the alloy 17-4 excluded molybdenum or compounds in the composition requirements. Therefore, estimates for molybdenum trioxide have not been included.

h. F-75 CUT TEU:

i. Review of 2023 actual annual metal poured against information submitted in both the 2023 Annual Report and the ATEI show discrepancies. Review and revise throughputs as appropriate to resolve the discrepancy.

AQ520 has been revised to reflect the amount of F-75 alloy poured in 2023, consistent with the 2023 Annual Report.

ii. Update alloy content based on refined compositional information for the F-75 alloy (see Specific Comment 2.b).

Alloy compositional information has been updated in AQ520.

iii. Per General Comment 1, DEQ will not accept a PM control efficiency of 99.9 percent for processes captured by a baghouse. DEQ will accept the use of the PM10 emission factor of 3.0 lb/ton metal poured for "cutting, captured and uncontrolled" (RTI, Table 6-2)6 as representing PM emissions and the following control efficiencies for activities controlled by baghouses:[3]
    1. 100 percent control of PM that is greater than 10 microns; and
    2. 99 percent control of PM10 (PM less than 10 microns).

The baghouse control efficiency has been updated on AQ520, Tab 3 using the DEQ-accepted control efficiency of 99%.

iv. Include emission estimates for hexavalent chromium (CASRN 18540-29-9) as 3 percent of total chromium emissions.[7]

Emission estimates for hexavalent chromium have been included on AQ520 as 3 percent of total chromium emissions.

v. Include emissions estimates for molybdenum trioxide (CASRN 1313-27-5). In the absence of data specific to molybdenum trioxide, account for 100 percent conversion to molybdenum trioxide by multiplying molybdenum emissions by 1.5 (the ratio of the molecular weight of molybdenum trioxide and the atomic weight of molybdenum).

AQ520 has been updated to include estimates of molybdenum trioxide using the above conversion factor.

vi. Unless more refined alloy specifications are available (see Specific Comment 2.b), include emission estimates for compounds listed under the SARA Title III subsection of the Regulatory Information section of the SDS.
    1. Nickel (CASRN 7440-02-0): Assume the de minimis concentration of 0.1 percent.[5]
    2. Beryllium (CASRN 7440-41-7): Assume the de minimis concentration of 0.1 percent.[5]

CAO has been provided with more refined alloy material specification sheets. Accordingly:

- *Alloy compositional concentration for nickel has been updated on AQ520, Tab 3.*
- *Beryllium is excluded from the alloy based on the material specification sheets.*

[7] RTI International. 2012. Appendix B, "Development of Chromium Hexavalent Distribution of Total Chromium." Assume hexavalent chromium is 3 percent of total chromium for finishing activities.

i. 17-4 CUT TEU:

i. Review of 2023 actual annual metal poured against information submitted in both the 2023 Annual Report and the ATEI show discrepancies. Review and revise throughputs as appropriate to resolve the discrepancy.

AQ520 has been revised to reflect the amount of 17-4 alloy poured in 2023, consistent with the 2023 Annual Report.

ii. Update the maximum daily (actual and Requested PTE) metal poured per response to Specific Comment 3.b.

The maximum daily (actual and Requested PTE) usage rates have been updated in AQ520 in response to Specific Comment 3.b.

iii. Per General Comment 1, DEQ will not accept a PM control efficiency of 99.9 percent for processes captured by a baghouse. DEQ will accept the use of the PM10 emission factor of 3.0 lb/ton metal poured for "cutting, captured and uncontrolled" (RTI, Table 6-2)6 as representing PM emissions and the following control efficiencies for activities controlled by baghouses:[3]
    1. 100 percent control of PM that is greater than 10 microns; and
    2. 99 percent control of PM10 (PM less than 10 microns).

The baghouse control efficiency has been updated on AQ520, Worksheet 3 using the DEQ-accepted control efficiency of 99%.

iv. Update alloy content based on refined compositional information for the 17-4 alloy (see Specific Comment 2.b).

Alloy compositional information has been updated in AQ520.

v. Include emission estimates for hexavalent chromium (CASRN 18540-29-9) as 3 percent of total chromium emissions.[7]

Emission estimates for hexavalent chromium have been included on AQ520 as 3 percent of total chromium emissions.

vi. Include emissions estimates for molybdenum trioxide (CASRN 1313-27-5). In the absence of data specific to molybdenum trioxide, account for 100 percent conversion to molybdenum trioxide by multiplying molybdenum emissions by 1.5 (the ratio of the molecular weight of molybdenum trioxide and the atomic weight of molybdenum).

Orchid's material specification sheet for the alloy 17-4 excluded molybdenum or compounds in the composition requirements. Therefore, estimates for molybdenum trioxide have not been included.

j. KNOCK OUT TEU:

i. DEQ will also approve use of the PM emission factor or Shakeout at Gray Iron Foundries of 3.2 lb/ton metal poured.[8] Orchid Orthopedics has used the emission factor from the RTI document, which, while conservative, likely presents an overestimate of PM emissions from the knockout activities at an investment foundry.

We appreciate this additional reference option and have updated AQ520 accordingly.

ii. Ceramic Mold Composition Development:

1. Provide additional details on the ceramic mold weight analysis conducted by Orchid Orthopedics. Describe when molds were weighed (such as before or after curing) and provide justification for the representativeness of the mold used in the evaluation.

Ceramic mold weight analysis was conducted to better understand the final composition of the molds to support emission estimates. The mold selected for the analysis was based on the product in production at that time. This product is considered representative because Orchid's products are all similarly sized, circular gates with the same number of pieces (individual parts molds) that result in a similar overall surface area.

Details of this analysis were provided in the Supporting Calcs for Emissions excel file, tab "Ceramic Molds – STEP 2." A total of five weights were taken during the process:

#1 – Weight of wax mold prior to investing process
#2 – After the first slurry dip
#3 – After the first slurry dip and sand application
#4 – After the second slurry dip and sand application
#5 – At the end of process, after dewax

Weights #2, #3 and #4 were taken approximately one hour after the indicated process, but before going through the final drying/curing process that occurs in Tunnel 1, Tunnel 2 and Final Dry rooms. Moisture loss at the time of weight measurement would be minimal.

Weight #5 would represent a mold that is completely cured/dried and devoid of moisture. This is further considered in the next response.

2. Provide justification for the assumption that the relative weight of the slurry layer and the sand layer is consistent across all dips. The information collected for the first slurry dip and first sand application

[8] EPA. January 1995. AP-42 Chapter 12, Table 12.10-7 "Particulate Emission Factors for Ancillary Operations and Fugitive Sources at Gray Iron Foundries." https://www3.epa.gov/ttnchie1/ap42/ch12/final/c12s10.pdf

show that for Dip #1 the slurry layer and sand layer are of equal weights. Based on this, the same weight ratio was applied across all slurry dips and sand applications despite different compositions of both the slurries and sands.

Determining the ceramic mold composition was inherently challenging due to the semi-automation (robotics) portions of the investing process and we acknowledge that using the 1:1 ratio for slurry to sand determined from the first application of both has an inherent level of uncertainty.

Technical factors that support using the 1:1 ratio assumption:

1) Physical Process Consistency:

- *Each slurry dip should coat the existing surface with a relatively uniform thickness, governed by the slurry's rheological properties (viscosity, thixotropy)*
- *The sand stuccoing process relies on gravitational settling and adhesion to the wet slurry surface*
- *If process parameters remain constant (dip time, withdrawal speed, sand particle size distribution), the coating mechanisms should be reproducible*

2) Surface Area Scaling:

- *As layers build up, the surface area increases, but this affects both slurry and sand deposition proportionally*
- *The slurry forms the binding matrix, and sand particles pack into available surface area with similar efficiency each layer*

Technical factors that create uncertainty:

- *Surface roughness change – Each layer may create a rougher surface, potentially holding more sand*
- *Slurry penetration – Later slurry coats may penetrate less into previous layers as porosity decreases, potentially creating a thinner effective slurry coat*
- *Drainage effects – Thicker shells may have different drainage characteristics during the drying process; the outcome could go either way regarding the ratio*
- *Net Expectation – The surface roughness and slurry penetration effects somewhat counteract each other, but surface roughness is likely to dominate in practice. Based on this line of reasoning there may be a slight increase in sand-to-slurry ratio in outer layers, though this is often controlled by adjusting slurry viscosity or dip parameters.*

Even though there is a level of uncertainty regarding the 1:1 slurry to sand ratio assumption, the mechanics of both the physical process and surface area scaling present a strong line of logic for use of this assumption.

Continuing the discussion from the above response, the loss of moisture associated with the slurry components through the drying and dewaxing process will also result in a net increase of sand component in the final weight (#5). A review of the percentage of ingredients in each slurry+sand applications shows that sand is approximately 75% by weight for all applications except #2 where it is 82%. Therefore, the loss of moisture through the drying process should be under 25% by weight.

Further consideration of TAC emissions from ceramic mold ingredients:

- *Slurry Ingredients: Only one TAC (1,3-Butadiene) is present in the ceramic material from the slurry ingredients at an extremely low concentration (0.01% of the product). While this TAC is known for having a low boiling point resulting in high volatility, this particular slurry ingredient is a mixture that includes low concentrations of 1,3-butadiene, which greatly effects the boiling point of the mixture. At low concentrations, the partial pressure of 1,3-butadiene is likely too low to allow for significant vaporization and subsequent distillation from the mixture.*
- *Sand Products: Remaining TACs in the ceramic material are associated with the sand products.*

In consideration of the uncertainty regarding 1) the sand-slurry ratio for each sequence of dip/sand application and 2) the amount of moisture lost from the slurry ingredients through the drying process, a safety factor of 1.5 will be applied to the sand products. This is a conservative safety factor because it is likely the sand-slurry ratio is closer to 1:1 for most dip/sand applications and the weight of moisture loss will be less than 25%. This approach is conservative from a risk perspective.

A safety factor of 1.5 has been applied to the emission factors of Knockout TEU sand products in AQ520.

3. Dow Corning Antifoam Y-30 Emulsion (M-1971): Review content of this material in the recipe for Dips 3 through 8. The recipe description says the content is 62 millimeters per batch, but the calculation uses 120 millimeters.

Updated in Supporting Calcs for Emissions (Rev01) – "Ceramic Mold -STEP 1" Worksheet. Note that updated information is shown in red font. Changed cells (including dependents) are yellow-highlighted. Cells that

previously used red font and yellow highlighting were re-formatted for clarity.

4. Account for emissions of the volatile components of the ceramic mold in a separate TEU as these would likely be emitted during the mold curing process. See Specific Comment 4.b for additional guidance. Also note that fabric filters provide negligible removal of gaseous compounds such as 1,3-butadiene (CASRN 106-99-0).

The mold curing process occurs progressively in the Investing Room, Tunnel 1, Tunnel 2, and Final Dry. All four of these rooms are climate controlled to specific temperatures and humidity, with no exterior vents. There are no identified stacks or fugitive emissions and therefore the mold curing process doesn't represent a separate TEU.

Additionally, the only 'volatile' TAC in the ceramic mold is 1,3-butadiene which is present as part of a mixture. 1,3-butadiene is accounted for as particulate matter in the Knockout TEU (see response to comment J.ii.2).

5. Nalco Esp-Prime (M-385): Update silica content of the ceramic molds to include only crystalline silica. This material contains only amorphous silica. No crystalline silica is listed in SDS.

Updated in Supporting Calcs for Emissions (Rev01) Worksheet "Ceramic Molds – STEP 4" and propagated through emission calculations.

6. Mulgrain 47/Remasil 48/Ez-Cast, all grades (M-396):
    a. Update calculations to reference content of Cristobalite (CASRN 14464-46-1) which is the crystalline form of silica in the material. Current calculations reference the amorphous silica content.

    Updated in Supporting Calcs for Emissions (Rev01) Worksheet "Ceramic Molds – STEP 4" and propagated through emission calculations.

    b. Account for the aluminum (CASRN 7429-90-5) content of kaolin ($Al2Si2O5(OH)4$) by multiplying the weight percentage of kaolin by 0.209 (the ratio of the atomic weight of two aluminum atoms and the molecular weight of kaolin).

    Updated in Supporting Calcs for Emissions (Rev01) Worksheet "Ceramic Molds – STEP 4" and AQ520.

7. Biocide MC 68 MW, bleach (M-406): This material contains a copper salt (cupric nitrate, CASRN 3251-23-8). Account for the copper (CASRN 7440-50-8) content of cupric nitrate ($Cu(NO3)2$) by multiplying the weight percentage of cupric nitrate by 0.339 (the

ratio of the atomic weight of the copper atom and the molecular weight of cupric nitrate).

Updated in Supporting Calcs for Emissions (Rev01) Worksheet "Ceramic Molds – STEP 4" and AQ520.

8. Remasil 48 RG20, RG23, RG25, RG30, RG40, RG50, RG70 (M-415):
    a. Update calculations to reference content of Cristobalite (CASRN 14464-46-1) which is the crystalline form of silica in the material. Current calculations reference the amorphous silica content.

    Updated in Supporting Calcs for Emissions (Rev01) Worksheet "Ceramic Molds – STEP 4" and AQ520.

    b. Account for the aluminum (CASRN 7429-90-5) content of kaolin ($Al_2Si_2O_5(OH)_4$) by multiplying the weight percentage of kaolin by 0.209 (the ratio of the atomic weight of two aluminum atoms and the molecular weight of kaolin).

    Updated in Supporting Calcs for Emissions (Rev01) Worksheet "Ceramic Molds – STEP 4" and AQ520.

9. Zircon – all grades (M-425): Account for the aluminum (CASRN 7429-90-5) content of aluminum silicate (CASRN 1302-76-7, $Al_2H_6O_5Si$) by multiplying the weight percentage of aluminum silicate by 0.321 (the ratio of the atomic weight of two aluminum atoms and the molecular weight of aluminum silicate).

Updated in Supporting Calcs for Emissions (Rev01) Worksheet "Ceramic Molds – STEP 4" and AQ520.

10. NALCO 1130 (M-429): Update silica content of the ceramic molds to include only crystalline silica. Colloidal silica is amorphous. No crystalline silica listed in SDS.

Updated in Supporting Calcs for Emissions (Rev01) Worksheet "Ceramic Molds – STEP 4" and AQ520.

11. GZM TZM EZM Zircon flour Sand A (M-1837): Account for the aluminum (CASRN 7429-90-5) content of kyanite (CASRN 1302-76-7, $Al_2H_6O_5Si$) by multiplying the weight percentage of kyanite by 0.321 (the ratio of the atomic weight of two aluminum atoms and the molecular weight of kyanite).

Updated in Supporting Calcs for Emissions (Rev01) Worksheet "Ceramic Molds – STEP 4" and AQ520.

12. Cobalt aluminate blue spinel (M-2045): Current calculations assume 100 percent of material as cobalt. Update emission calculations to account for both the cobalt (CASRN 7440-48-4) and aluminum (CASRN 7429-90-5) content of the cobalt aluminate blue spinel ($CoAl_2O_4$).
    a. Calculate the cobalt content of by multiplying the weight percentage of cobalt aluminate blue spinel by 0.333 (the ratio of the atomic weight of the cobalt atom and the molecular weight of cobalt aluminate blue spinel).
    b. Calculate the aluminum content of by multiplying the weight percentage of cobalt aluminate blue spinel by 0.305 (the ratio of the atomic weight of two aluminum atoms and the molecular weight of cobalt aluminate blue spinel).

Both items updated in Supporting Calcs for Emissions (Rev01) Worksheet "Ceramic Molds – STEP 4" and AQ520.

iii. Update calculations in Worksheet 3 of the AQ520 form (Column J) to reference the correct throughput from Worksheet 2 for annual emission calculations.

The indicated reference has been updated in AQ520.

k. Grinding TEUs (CELL 1 GATE GRIND, CELL 2 HAND GRIND, REWORK GRIND):

i. Split each of the grinding TEUs into two TEUs, one for each alloy type, consistent with other TEUs which use alloy composition as the emissions basis for metal TACs (such as the Weld, Cast, and Cut TEUs).

The grinding TEUs have been split as requested in AQ520.

ii. Comments in the AQ520 workbook suggest that the current grinding throughput basis is total mass of metal shipped. The basis for finishing operations emission factors presented in Table 6-2 of the RTI document is the total mass of metal cast, not the mass of the final metal product (see Example 6-1).6 Grinding throughputs can account for portion of metal gating removed at the cut-off stage. Update grinding throughputs in Worksheet 2 to reflect total metal poured for parts.

The basis has been changed to reflect total metal poured in AQ520.

iii. Per General Comment 1, DEQ will not accept a PM control efficiency of 99.9 percent for processes captured by a baghouse. DEQ will accept the use of the PM10 emission factor of 8.0 lb/ton metal produced for "grinding, captured and uncontrolled" (RTI, Table 6-2)6 as representing PM emissions and the following control efficiencies for activities controlled by baghouses:[3]
    1. 100 percent control of PM that is greater than 10 microns; and
    2. 99 percent control of PM10 (PM less than 10 microns).

AQ520 has been updated to reflect the PM10 emission factor and filter control efficiencies noted above.

iv. Currently both the grinding throughputs in Worksheet 2 and emission factors in Worksheet 3 are apportioned to account for a split of emissions across the three grinding TEUs. Based on information provided, this split (95/2.5/2.5 percent) should not be incorporated into both throughputs and emission factors. Therefore, update the Inventory in one of the following ways. If none of the below is appropriate, provide justification for an alternate approach.
    1. If not all parts are processed through each grinding TEU, update throughputs for individual grinding TEUs to reflect appropriate estimates of parts and alloys through each process. Use the full grinding emission factor (8 lb/ton metal produced) without accounting for any additional reduction.
    2. If all parts are processed through each grinding TEU, present as a single TEU for each alloy (such as "F-25 GRIND" and "17-4 GRIND") and account for total throughput of parts for each alloy through their respective grinding TEU. Use the full grinding emission factor (8 lb/ton metal produced) for each TEU. The distribution of emissions from the different grinding stations and/or control devices can be accounted for in the Modeling Protocol. Update Worksheet 2 to reflect all appropriate control devices (Column C) and stack IDs (Column E).
    3. If all parts are processed through each Grinding TEU, update throughputs for Grinding TEUs to estimate of total throughput of parts and alloys through grinding. Account for split of emissions by apportioning the grinding emission factor (8 lb/ton metal produced).

Previously presented grinding TEUs are now presented as a single TEU for each alloy consistent with option 2. The distribution of emissions from the different control devices will be accounted for in the modeling protocol. AQ520 has been updated accordingly.

v. Include emission estimates for hexavalent chromium (CASRN 18540-29-9) as 3 percent of total chromium emissions.[7]

Emission estimates for hexavalent chromium have been included on AQ520 as 3 percent of total chromium emissions.

vi. Include emissions estimates for molybdenum trioxide (CASRN 1313-27-5). In the absence of data specific to molybdenum trioxide, account for 100 percent conversion to molybdenum trioxide by multiplying molybdenum emissions by 1.5 (the ratio of the molecular weight of molybdenum trioxide and the atomic weight of molybdenum).

AQ520 has been updated to include estimates of molybdenum trioxide using the above conversion factor for F-75 alloy. The material specification sheet for 17-4 excludes molybdenum.

vii. 17-4 Alloy TEUs: Develop the maximum daily (actual and Requested PTE) metal produced per response to Specific Comment 3.b.

Done. Please see response to Specific Comment 3.b.ii.

viii. F-75 Alloy TEUs: Unless more refined alloy specifications are available (see Specific Comment 2.b), include emission estimates for compounds listed under the SARA Title III subsection of the Regulatory Information section of the SDS.

1. Nickel (CASRN 7440-02-0): Assume the de minimis concentration of 0.1 percent.[5]
2. Beryllium (CASRN 7440-41-7): Assume the de minimis concentration of 0.1 percent.[5]

CAO has been provided with more refined alloy material specification sheets. Accordingly:

- *Alloy compositional concentration for nickel has been updated on AQ520, Tab 3.*
- *Beryllium is excluded from the alloy on the material specification sheets.*

l. **PARTS CLEANING TEU:** Include a reference for the source of compositional information for the "Isopropyl Alcohol" material in Column H of Worksheet 5.

A reference (the SDS) has been added as the source of compositional information for Isopropyl Alcohol in Column H of Worksheet 5.

m. FLASHFIRE DEWAX TEU:

i. 2023 actual maximum daily material usage for both wax materials presented in Worksheet 4 differs from information presented in the supporting workbook "2024.11.21 Orchid Ortho CAO - Supporting Calcs for Emissions.xlsx." This workbook states usage of 994-1-1002 Green Cerita Casting Wax (M-711) as 38.9 lb/yr and usage of 2-R736 Mod-A Reclaim Wax (M-476) as 73.4 lb/yr. Review and revise throughputs as appropriate to resolve the discrepancy.

AQ520 actual maximum daily material usage for both wax materials have been updated to be consistent with the Supporting Calcs for Emissions excel file.

ii. Provide manufacturer documentation to support assumption that 10 to 20 percent of wax is lost as smoke.

The manufacturer of the Flash Fire Dewax System is Pacific Kiln. Information presented on their website[9] states, "80-90% of the wax is recovered without moisture." This is located on the Flash Fire Dewax System page, under the section, "Advantages of Flashfire Dewax System." A printout of this page is included as Attachment A. Our approach conservatively assumes that any wax not recovered is sent through the afterburner as smoke.

This approach is conservative; this is supported through an email conversation with the wax manufacturer Paramelt, who indicated, "If they really mean burn out (after dewax), you would not be losing 10-20% in combustion/smoke. This should be 1-4% depending upon how well you drain the parts on the molds."[10]

iii. DEQ requires that Orchid Orthopedics reach out to the wax manufacturer (Paramelt) for information on products of combustion for their materials. Of particular interest is any data available on the combustion products of paraffin wax (CASRN 8002-74-2).

Orchid Orthopedics reached out to Paramelt for information on products of combustion for their materials. During an email conversation the following information was shared:

- *"The product of combustion would basically be carbon. If you have 10-20% excess air in the combustion chamber and a good afterburner, there would not be much carbon discharge."[10]*
- *"So, the unanswered question is what is going out your stack. The attached SDS states the following in section 5.2: In case of fire hazardous decomposition products may be produced such as: Carbon dioxide, carbon monoxide and complex hydrocarbons. This statement refers mostly to an uncontrolled fire, and not a flashfire & afterburner situation."[11] Note: the SDS provided was for the wax "994-I-1002 Green Cerita Casting Wax" which was previously provided to CAO.*

Paramelt did not provide any further information. No updates were made to the Emissions Inventory based on the above information.

iv. 2-W07F-3 Pink Water Soluble Wax (M-524): This material contains multiple TACs. If this material is melted at the dewax furnace, include emission estimates for the below TACs. If otherwise, provide an explanation of how this wax is used.

1. Potassium aluminum silicate, mica (12001-26-2): Account for the aluminum (CASRN 7429-90-5) content of mica (Al2K2O6Si) by

[9] https://www.pacifickiln.com/investment-casting-products/flash-fire-dewax-system/
[10] March 21, 2025, email from Mark Post (Paramelt) to Lisa Hogan (Orchid Ortho).
[11] April 15, 2025, email from Mark Post (Paramelt) to Lisa Hogan (Orchid Ortho).

multiplying the weight percentage of mica by 0.211 (the ratio of the atomic weight of two aluminum atoms and the molecular weight of mica).

2. Aluminum silicate, kaolin (CASRN 1332-58-7): Account for aluminum (CASRN 7429-90-5) content of kaolin (Al2Si2O5(OH)4) by multiplying the weight percentage of kaolin by 0.209 (the ratio of the atomic weight of two aluminum atoms and the molecular weight of kaolin).
3. Sodium aluminum silicate, feldspar (CASRN 68476-25-5): Account for aluminum (CASRN 7429-90-5) content of feldspar (AlO8Si3Na) by multiplying the weight percentage of feldspar by 0.103 (the ratio of the atomic weight of aluminum and the molecular weight of feldspar).
4. Quartz (CASRN 14808-60-7): Quartz is a form of crystalline silica (CASRN 7631-86-9).

Orchid Orthopedics has confirmed that this specific wax "2-W07F-3 Pink Water Soluble" is not used at the Oregon City facility and that it was inadvertently included in the original list of wax products. No changes to AQ520 have been made regarding this material as it was not previously included.

n. Sandblast TEUs (CELL 1 SANDBLAST, CELL 2 SANDBLAST, FINISH SANDBLAST):

i. Include emission estimates for metal TACs from sandblasting activities.

Emission estimates for metal TACs from sandblasting activities have been included. Similar to the Grind TEU, the distribution of emissions for metal TACs from the different control devices will be accounted for in the modeling protocol. AQ520 has been updated accordingly.

ii. Split each of the sandblast TEUs into two TEUs, one for each alloy type, consistent with other TEUs which use alloy composition as the emissions basis for metal TACs (such as the Weld, Cast, and Cut TEUs).

Done. AQ520 has been updated accordingly.

iii. Per General Comment 1, DEQ will not accept a PM control efficiency of 99.9 percent for processes captured by a baghouse. DEQ will accept the use of the PM10 emission factor of 8.0 lb/ton metal produced for "shot blasting or sand blasting, captured and uncontrolled" (RTI, Table 6-2)6 as representing PM emissions and the following control efficiencies for activities controlled by baghouses:[3]

1. 100 percent control of PM that is greater than 10 microns; and
2. 99 percent control of PM10 (PM less than 10 microns).

The baghouse control efficiency has been updated on AQ520, Worksheets 3 and 5 using the DEQ-accepted control efficiency of 99%.

iv. Speciate PM emissions using alloy composition consistent with the method used for the other alloy-specific TEUs.
    1. Include emission estimates for hexavalent chromium (CASRN 18540-29-9) as 3 percent of total chromium emissions.[7]
    2. Include emissions estimates for molybdenum trioxide (CASRN 1313-27-5). In the absence of data specific to molybdenum trioxide, account for 100 percent conversion to molybdenum trioxide by multiplying molybdenum emissions by 1.5 (the ratio of the molecular weight of molybdenum trioxide and the atomic weight of molybdenum).

Done. AQ520 has been updated accordingly.

v. 17-4 Alloy TEUs: Develop the maximum daily (actual and Requested PTE) metal produced per response to Specific Comment 3.b.

Done. Please see response to Specific Comment 3.b.ii.

vi. F-75 Alloy TEUs: Unless more refined alloy specifications are available (see Specific Comment 2.b), include emission estimates for compounds listed under the SARA Title III subsection of the Regulatory Information section of the SDS.
    1. Nickel (CASRN 7440-02-0): Assume the de minimis concentration of 0.1 percent.[5]
    2. Beryllium (CASRN 7440-41-7): Assume the de minimis concentration of 0.1 percent.[5]

CAO has been provided with more refined alloy material specification sheets. Accordingly:

- *Alloy compositional concentration for nickel has been updated on AQ520, Tab 3.*
- *Beryllium is excluded from the alloy based on the material specification sheets.*

vii. Washington mills Duralum 60 Grit, aka Brown Aluminum oxide 60 grit (M-2012): Confirm this material contains aluminum oxide of fibrous forms. Currently the DEQ pollutant list only has aluminum oxide of fibrous forms listed as a TAC, though all forms of aluminum oxide share the CASRN of 1344-28-1. Non-fibrous forms of aluminum oxide should be reported as aluminum (CASRN 7429-90-5). Account for aluminum content of aluminum oxide (Al2O3) by multiplying the weight percentage of aluminum oxide by 0.529 (the ratio of the atomic weight of two aluminum atoms and the molecular weight of aluminum oxide).

Washington Mills would not provide information directly to Orchid Orthopedics, but only upon the request of the supplier.[12] Accordingly, the supplier (Surface Prep) was engaged to obtain the information. Repeated follow-up communications have only resulted in the following information being obtained: "The product is NOT fibrous and in no way 'hazardous'." Therefore, aluminum oxide will be reported as aluminum using the atomic weight percentage provided above. AQ520 has been updated with this emission estimate.

viii. Duralum Special White 24 Grit (U-013): Confirm this material contains aluminum oxide of fibrous forms. Currently the DEQ pollutant list only has aluminum oxide of fibrous forms listed as a TAC, though all forms of aluminum oxide share the CASRN of 1344-28-1. Non-fibrous forms of aluminum oxide should be reported as aluminum (CASRN 7429-90-5). Account for aluminum content of aluminum oxide (Al2O3) by multiplying the weight percentage of aluminum oxide by 0.529 (the ratio of the atomic weight of two aluminum atoms and the molecular weight of aluminum oxide).

Same answer as directly above.

o. ROBOT POLISH TEU:

i. P-255 Liquid Compound (U-014): Confirm this material contains aluminum oxide of fibrous forms. Currently the DEQ pollutant list only has aluminum oxide of fibrous forms listed as a TAC, though all forms of aluminum oxide share the CASRN of 1344-28-1. Non-fibrous forms of aluminum oxide should be reported as aluminum (CASRN 7429-90-5). Account for aluminum content of aluminum oxide (Al2O3) by multiplying the weight percentage of aluminum oxide by 0.529 (the ratio of the atomic weight of two aluminum atoms and the molecular weight of aluminum oxide).

Information provided by email by Pinnacle Technologies, the manufacturer of P-255 Liquid Compound, demonstrates that their product uses a non-fibrous form of aluminum oxide. This email was forwarded to DEQ on May 23, 2025, and is also included as Attachment B. Form AQ520 has been revised to account for aluminum emissions, using the information provided by DEQ above.

ii. Update removal efficiency of the BH9 filters to reflect the MERV 10 equivalency rating stated by the manufacturer. The Inventory uses the manufacturer's stated removal efficiency for PM of size 20 microns or greater. However, in the absence of size distribution data, DEQ will accept a removal efficiency of 50 percent based on the EPA's minimum stated control efficiency for MERV 10 filters.[13]

[12] May 5, 2025. Phone conversation between Lisa Simmons, PE and Washington Mills.
[13] EPA. Indoor Air Quality. Updated March 5, 2024. "What is a MERV rating?" (https://www.epa.gov/indoor-air-quality-iaq/what-merv-rating)

Orchid Orthopedics contacted the BH9 filter supplier which provided removal efficiency test information for the filters (see Attachment C). Provided information demonstrates that the filters have a 99.9981866 removal efficiency at PM 2.5. The control efficiency of these filters have been updated in AQ520, Worksheet 5 to 99% to be consistent with CAO guidance provided previously in these comments regarding baghouse filters.

p. KOLENE TEU:

In a May 1, 2025 email, CAO stated: DEQ understands from the extension request letter that the Kolene line and scrubber is being decommissioned and will not be operated in the future. Therefore, no PTE basis will be included for this source. Note that DEQ requires existing sources to provide activity data for the calendar year preceding source call-in [OAR 340-245-0040(4)(a)(B)(i)]. Therefore, please address Specific Comment 3.p from DEQ's March 18, 2025 letter, as pertains to calendar year 2023, by the June 18, 2025 deadline.

i. Review of 2023 actual annual usage of the Caustic Soda Beads material against information submitted in the ATEI show discrepancies. Review and revise throughputs as appropriate to resolve the discrepancy.

AQ520 was updated to reflect the information presented in the 2023 ATEI.

ii. Provide additional information on the hydrochloric acid (CASRN 7647-01-0) bath at the Kolene system. Including whether emissions from this tank are captured and controlled by the Viron Scrubber.

The Kolene system is a very old installation without manufacturers literature available. The purpose of the Kolene system was to remove small amounts of residual ceramic shell that are lodged in hard-to-reach nooks and crannies of parts. The process took parts through a series of baths: a sodium hydroxide bath heated to 1,000°F, a water bath, and then a hydrochloric acid bath to neutralize. The Viron Scrubber captured and controlled emissions from the hydrochloric acid bath.

iii. Provide additional information on the nitric acid (CASRN 7697-37-2) used for passivation in the Kolene process. Emissions estimates for nitric acid from the Kolene TEU were included in both the 2020 and 2023 ATEI. In the 2023 ATEI it was noted that use of this material was discontinued during 2023. If this material was used in 2023 and the Kolene process resulted in emissions of nitric acid (CASRN 7697-37-2), include 2023 actual annual and maximum daily throughput or usages for this material in the Inventory. Emissions do not need to be estimated if this material will not be included in Orchid Orthopedics' Requested PTE.

Use of nitric acid in the Kolene process was discontinued around March 2023 based on best available information. For 'maximum daily use', the nitric acid bath was kept heated 24/7; we have assumed that the bath was in operation

for 90 days during 2023. AQ520 has been updated to include 2023 actual annual and the estimated maximum daily use of nitric acid in the Kolene process.

4. Investing: DEQ has identified two materials containing potentially volatile TACs from review of SDS for materials used in the Investing Department. Include emission estimates for these TACs or provide justification for excluding.
    a. REMET Citriwash (M-384): SDS shows 2-Butoxyethanol (CASRN 111-76-2) content of 15 percent.

REMET Citriwash is used in the Investing room to wash/clean the wax molds prior to being dipped in slurry. As previously described, the Investing Room is climate controlled to specific temperatures and humidity, with no exterior vents. As there are no emission points from this room (fugitive or point) it does not present a TEU.

    b. Latrix 6300 (M-421): Orchid Orthopedics included emissions of 1,3-butadiene (CASRN 106-99-0) from this material at the KNOCK OUT TEU (see Specific Comment 3.j.i.4). The SDS lists 1,3-butadiene in the Regulatory Information section under CERCLA Reportable Quantity. Based on information in this section Orchid Orthopedics should use a minimum concentration of 0.01 percent.

1,3-Butadiene in Latrix 6300 is present within a mixture at a concentration of 0.01% and is unlikely to readily volatilize in the Investing Room (see response to comment J.ii.2). Further, as described above, there are no emission points from the Investing Room and therefore it does not present a TEU. Orchid Orthopedics had previously presented this TAC at the KNOCK OUT TEU at concentration of 0.5%; this has been Updated in Supporting Calcs for Emissions (Rev01) Worksheet "Ceramic Molds – STEP 4" and AQ520 to reflect the 0.01% concentration stated above.

5. Casting: Provide additional information on the use of hexamethylenetetramine powder during casting of the 17-4 alloy. Supplemental material provided with the Inventory indicates that the hexamethylenetetramine undergoes a reaction with the molten metal.
    a. Review the reaction mechanics to identify if this is a source of TAC emissions. Revise the Inventory as needed to include TAC emission estimates from this activity.
    b. Provide DEQ additional information on this reaction and the hexamethylenetetramine SDS.

During internal research for this comment it became known that the use of hexamethylenetetramine powder during casting of the 17-4 alloy was terminated in September 2023. The replacement material is table sugar. A SDS for the table sugar being used is provided in Attachment D.

Immediately after molten metal (17-4 alloy) is poured into a mold, the sugar is placed on top of the hot mold and covered with a steel drum. The sugar ignites, resulting in the burning off of oxygen inside the drum, creating an oxygen free environment for the metal to solidify in, reducing oxide-related defects in the castings.

The steel drums are left in place for a minimum of 30 minutes. When the steel drum is removed, the primary emissions will be carbon monoxide and carbon dioxide. This is confirmed

by the following Orchid Orthopedics observation: "When they [steel drums] are removed, we are not observing any airborne emissions being released —only solid residues such as soot and ash remain on the interior surfaces of the drums.

6. Machining: Review of SDSs identified a number of materials used at the facility contain TACs but were not included in the Inventory. Information included in supporting documents note that these materials are used for equipment maintenance and that total use is minimal (less than 2 ounces per year). DEQ conducted an Exempt TEU analysis following guidance presented in the "Cleaner Air Oregon Exempt TEU Reporting" document and has approved use of these materials as an Exempt TEU for the purposes of CAO.[14] DEQ conducted the analysis assuming conservative usage rates of 12 ounces per year and 100 percent volatilization of the TACs.

   Emission rates for TACs were below thresholds presented in Appendix A-1 of the guidance.[10] Exempt TEUs must be listed in Worksheet 4, but there is no requirement to include usage and/or waste rates for the materials and they can be excluded from Worksheet 5 as you do not need to estimate emissions for Exempt TEUs. Include the following materials under the MACHINING TEU on Worksheet 4 but note as exempt:
   a. Granite Surface Plate Cleaner (U-010);
   b. LPS Force 842 (U-011);
   c. Quicker Clean (U-012); and
   d. Gel Lube (U-023).

   AQ520 has been updated accordingly.

7. Compound ZF 113-1 (M-2261): This material, which is used in both the Finishing-Polishing and Polishing Water Pre-Treatment processes, contains two potentially volatile TACs. Include emission estimates for the following TACs or provide justification for excluding:

   Orchid Orthopedics has obtained a more current SDS dated 2024 (included in Attachment E). Please note that the product name is now "Compound ZF 113." While the mixture components and ratios have changed, identification of only the two TACs listed below remains the same.

   a. 2,2'-iminodiethanol (diethanolamine, CASRN 111-42-2). Weight percentage of 1-10 (average 5.5 percent); and

      In the 2024 SDS, 2,2'iminodiethanol's weight percentage is 1-5 (average 3.5 percent).

      Diethanolamine (DEA) has been excluded from emission estimates due to physical process and chemical properties. Both processes that Compound ZF 113 is used in are water based. Specifically, Compound ZF 113 is used in 1) Rosler drag finish units and 2) the process water recycling unit (a water-based material removal process). The combination of DEA's relatively low volatility and high solubility (it forms strong hydrogen bonds) results in minimal if any evaporation. Further, DEA vapors have a characteristic fishy, ammonia-like

[14] Oregon DEQ. March 21, 2022. "Cleaner Air Oregon Exempt TEU Reporting." (https://www.oregon.gov/deq/aq/cao/Documents/ExemptTEUReporting-Appendices.pdf)

odor detectable at low concentrations. This odor has not been reported at either process location.

b. Propan-2-ol (isopropyl alcohol, CASRN 67-63-0). Isopropyl alcohol is listed in the Regulatory Information section under SARA Section 313. Unless more refined compositional information is available, assume a content of 1 percent for this TAC. This is the de minimis concentration in the EPCRA Section 313 Chemical List For Reporting Year 2005 (the calendar year of the provided SDS).[15]

In the 2024 SDS, propan-2-ol is listed in the regulatory information section consistent with the earlier SDS. AQ520 has been updated to include emission estimates from this TAC assuming a 1 percent content.

8. Cooling Tower: Confirm if Orchid Orthopedics operates a cooling tower. If so, provide copies SDSs for all cooling tower chemicals. If these chemicals contain TACs, include emission estimates for the cooling tower TEU in the revised Inventory. Alternatively, provide DEQ with an Exempt TEU analysis. [OAR 340-245-0060(3)(a)]

Orchid Orthopedics operates a 500 gallon per minute hybrid closed-loop furnace cooling system with air cooler and closed-circuit cooling tower. Cooling tower solution is comprised of:

- *Water (70-75%)*
- *Food-grade propylene glycol (25-30%)*
- *Molybdate inhibitor (0.005%)*

Orchid Orthopedics kindly requests DEQ consider the Cooling Tower system an Exempt TEU. According to OAR 340-245-0060(3)(a)], this requires that "The owner or operator of the TEU has demonstrated that the TEU is not likely to emit toxic air contaminants and DEQ approves such demonstration. The demonstration may include any information the owner or operator considers relevant. . ."

Orchid Orthopedics presents the following information for DEQ's consideration towards approving the cooling tower system as an Exempt TEU:

- *Manufacturer's (Dry Cooler) Installation and Operation Instruction Manual for the cooling system. The schematics demonstrate the closed-loop and sealed nature of the system without opportunity for emissions. See Attachment F.*
- *SDSs (provided in Attachment G) for:*
  - *Propylene glycol (food grade)*
    - *No TACs identified*
  - *CLT-100 Molybdate Corrosion Inhibitor for Closed Recirculating Systems*
    - *No TACs identified*

[15] EPA, EPCRA Section 313 Chemical List for Reporting Year 2005. Reporting Year 2005 referenced as SDS was for product was published in 2005. (https://www.epa.gov/sites/default/files/documents/RY2005ChemicalList.pdf)

The provided information demonstrates that the TEU is unlikely to emit TACs by design of both the equipment and chemicals selected for use in the system.

9. Safety Data Sheets: The SDSs for some materials were either missing or the copies provided were incomplete in the initial submittal. Provide SDSs for the following materials:
    a. P-255 Liquid Compound (U-014) – incomplete in initial submittal;
    b. Caustic Potash (M-1136) – missing in initial submittal; and
    c. ER70S-6 MIG Welding rod – missing in initial submittal.

    On May 16, 2025, SDSs for the above three materials were provided to CAO via email.

Please let me know if you have any additional questions or comments related to any of the CAO submittal documents for this project or related to this project in general. We appreciate your assistance with this project.

Sincerely,

EVREN Northwest, Inc.

Lisa K. Simmons

Lisa Kelly Simmons, P.E.
Senior Engineer

Lisa K. Simmons for

Lynn D. Green, C.E.G.
Principal Engineering Geologist

CC: Nathan Holwege, Orchid Orthopedic Solutions Oregon, Inc.

Attachments:

A – Flash Fire Dewax System, Manufacturer's Information from Website
B – P-255 Liquid Compound, Manufacturer's Email
C – BH9 Filter, Manufacturer's Literature
D – SDS for Table Sugar
E – SDS for Compound ZF 113
F – Cooling Tower O&M Manual
G – SDSs for Products used in Cooling Tower

APPENDIX A

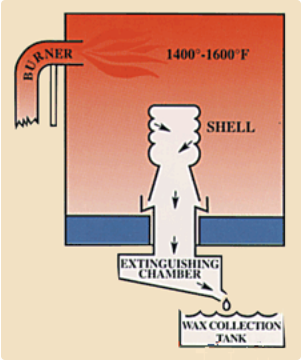
Flash Fire Dewax System, Manufacturer's Information from Website

(https://www.pacifickiln.com/)

Flash Fire Dewax System

FlashFire Dewax can be traced back to the beginning of Investment Casting. But smoke was ever present and in the early 1960's the autoclave solved the problem and became the standard in shell dewax. As shell size increased however, interest in FlashFire Dewax also increased. Then in the early 1990's Rapid Prototyping emerged as a significant new technology and FlashFire became a necessary part of the process. In early 1994 Pacific Kiln introduced the FlashFire Dewax SYSTEM and quickly challenged dewax standards and filled the Rapid Prototyping need. Today this Patented SYSTEM is proving its worth all over the world in the most sophisticated applications.

Innovative Design



Based on a shuttle car design, the load end of the car is positioned outside the furnace chamber while the other end of the car keeps the hot idling load chamber sealed from outside air.

Shell molds are set in designated cup locations on the load bed. The operator then activates the process-controlled system, which opens the furnace door, pulls the load car into position, and closes the door. Because of the quick sequence, all shells are treated equally.

The 1400°F to 1600°F heat quickly penetrates the ceramic shell and melts the wax pattern from the outside in, eliminating the potential shell cracking from wax expansion. The wax drains through a tube in the floor into an extinguishing/cooling chamber and is allowed to collect in a holding tank.

Wax is normally removed within 10 minutes and complete burnout within 20 minutes. Shells may then be taken to a higher temperature for pouring or removed for inspection and reheat. Since there is no residual wax, reheat furnaces need not have an afterburner.

The downdraft burner system yields an even highly oxidized atmosphere and exhausts into a chimney section that incorporates an afterburner which thermally degrades any hydrocarbon smoke created in the process.

Why Choose a Flash Fire Dewax System?

ADVANTAGES OF FLASHFIRE DEWAX SYSTEM

- Dewax and Burnout are combined into one process.
- All shells are processed identically with perfect repeatability.
- 80-90% of the wax is recovered without moisture.
- Low maintenance needs.
- Meets all environmental requirements.
- Totally automated system means operator safety and accurate, repeatable product processing.
- Can be designed to meet any production need, from single door single load bed, to double door double load bed, to continuous car types.

COST ADVANTAGES OF FLASHFIRE DEWAX SYSTEM

- Energy costs are minimal since the furnace is holding at 1600°F and not cycling into high fire.
- Can eliminate the burnout furnace and/or reheat furnace.
- Eliminates the need for afterburners on reheat furnaces.
- Eliminates the autoclave system.
- The wax does not need to be sent out for reclaim processing.
- Reheat furnaces don't need environmental permit because they are no longer burning out anything.

Rapid Prototyping

FlashFire is the system that solved pattern removal for the Rapid Prototyping industry. FlashFire burns away the pattern without expansion, eliminating problems with molc cracking while wax runners and sprues are drained and recovered. FlashFire works with all SLA, SLS, FDM, OR LOM Rapid Prototype patterns

APPENDIX B

P-255 Liquid Compound, Manufacturer's Email

Orchid Orthopedics Info to Support Response to Specific Comment 3.o.i

Lisa K. Simmons, PE <lisa.simmons.pe@gmail.com> Fri, May 23, 2025 at 1:09 PM
To: DEVITA-MCBRIDE Amy * DEQ <Amy.DeVita-McBride@deq.oregon.gov>
Cc: "Holwege, Nathan" <Nathan.Holwege@orchid-ortho.com>, Lynn Green <lynng@evren-nw.com>

Dear Amy, In regards to Specific Comment #3.o.i (Robot Polish TEU), please see below and attached for the response from Pinnacle Technologies, the manufacturer of P-255 Liquid Compound which demonstrates that the aluminum oxide used in their product is of non-fibrous forms. Therefore, we will update the emissions inventory to report aluminum using the molecular weights as you indicated in the comment.

Kind regards,
Lisa Simmons

****
Lisa K. Simmons, PE
c. 503-330-0829

---------- Forwarded message ---------
From: **Debbie Foy** <debbie@pinnacletechnologies.com>
Date: Fri, May 23, 2025 at 11:35 AM
Subject: RE: Orchid Orthopedics Aluminum Oxide Question
To: Lisa K. Simmons, PE <lisa.simmons.pe@gmail.com>
Cc: Holwege, Nathan <Nathan.Holwege@orchid-ortho.com>, Huddleston, Erik <Erik.Huddleston@orchid-ortho.com>, Lynn Green <lynng@evren-nw.com>, Michael Penque <mpenque@pinnacletechnologies.com>

Hello Lisa

Attached please find the SDS for the Calcined Alumina that is used in our P-255L formula. It is non-fibrous.

Please advise what other information is required.

Let me know

Thank you

Debbie

PINNACLE TECHNOLOGIES

681 Lawlins Road Unit 15

Wyckoff, NJ 07481

www.pinnacletechnologies.com

Debbie Foy

Operations Manager

201-891-7049 Ext 306

201-310-6921 Mobile

From: Lisa K. Simmons, PE <lisa.simmons.pe@gmail.com>
Sent: Thursday, May 22, 2025 3:22 PM
To: Debbie Foy <debbie@pinnacletechnologies.com>
Cc: Holwege, Nathan <Nathan.Holwege@orchid-ortho.com>; Huddleston, Erik <Erik.Huddleston@orchid-ortho.com>; Lynn Green <lynng@evren-nw.com>
Subject: Orchid Orthopedics Aluminum Oxide Question

Hi Debbie, thank you for your assistance!

With regards to the product "P-255 Liquid Compound" (SDS attached) and the ingredient Calcined Alumina (aka Aluminum Oxide):

- Is the aluminum oxide of fibrous forms or non-fibrous forms?
- If both are present, what is the ratio or product % of each?

These questions are being prompted by a toxic air contaminant emissions inventory being required of Orchid by the Oregon Department of Quality - Cleaner Air Oregon division. Fibrous forms are to be reported as aluminum oxide. Non-fibrous forms are to be reported as aluminum (after applying a molecular weight percentage).

Please confirm receipt to ensure I entered your email correctly.

Kind regards,

Lisa Simmons

****

Lisa K. Simmons, PE

c. 503-330-0829

Please consider the environment before printing this email.

Aluminum Oxide SDS.pdf
197K

Date of Preparation: 1 JUN 2015
SDS No. 105

Review Date: 21 JUN 2018
Revision 6

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND THE COMPANY/UNDERTAKING

1.1 PRODUCT IDENTIFIER

Product Name	**THERMALLY REACTIVE ALUMINA**
Technical Name	Aluminum Oxide, Alumina
Synonyms	All AC-*** Thermally Reactive Aluminas
REACH Registration No.	Registered – Registration number may be requested

1.2 RELEVANT IDENTIFIED USES OF THE SUBSTANCE OR MIXTURE AND USES ADVISED AGAINST

Recommended Uses
Ceramics, Refractories, Polishing Agents, Fillers

Uses not recommended
Avoid use with ethylene oxide or chlorine trifluoride

1.3 DETAILS OF THE SUPPLIER OF THE SAFETY DATA SHEET

AluChem, Inc.	AluChem of Jackson, Inc.	AluChem of Little Rock, LLC
1 Landy Lane	14782 Beaver Pike	10500 Arch Street Pike
Reading, OH 45215	Jackson, OH 45640	Little Rock, AR 72206
USA	USA	USA
+1 513 733 8519	+1 740 286 2455	+1 501 486 9106

1.4 EMERGENCY TELEPHONE NUMBER

AluChem, Inc. +1 513 733 8519 (Monday – Friday; 8AM – 5PM EST)

2. HAZARDS IDENTIFICATION

2.1 CLASSIFICATION OF THE SUBSTANCE OR MIXTURE

These products are ***not*** classified as dangerous according to Regulation (EC) No. 1272/2008
These products are ***not*** classified according to EU Directives 67/548/EEC or 1999/45/EC
These products are ***not*** listed by NTP, IARC or regulated by OHSA as a carcinogen
These products are ***not*** classified as a dangerous substances or mixtures according to the Globally Harmonized System (GHS)

2.2 LABEL ELEMENTS

Symbol(s)	None
Signal Word	None
Hazard Statements	None
Precautionary Statements	P261 – Avoid breathing dust / fumes / gas / mist / vapors / spray P280 - Wear eye protection / face protection P285 - In case of inadequate ventilation wear respiratory protection P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, If present and easy to do. Continue rinsing. P302 + P352 – IF ON SKIN – Wash with soap and water

2.3 OTHER INFORMATION

Prolonged or excessive contact may cause irritation of the respiratory tract.

3 COMPOSITION/INFORMATION ON INGREDIENTS

3.1 SUBSTANCES

Chemical Name	CAS No	EINECS	Weight(%)	REACH
Aluminum Oxide (Non-Fibrous)	1344-28-1	215-691-6	>99	Registered

4 FIRST AID MEASURES

4.1 DESCRIPTION OF FIRST AID MEASURES

EYE CONTACT	Intensive rinsing with water. Consult physician if necessary
SKIN CONTACT	Wash skin with soap and water
INHALATION	Move to fresh air. Consult a physician if necessary
INGESTION	Rinse mouth with plenty of water. Seek medical advice.

4.2 MOST IMPORTANT SYMPTOMS AND EFFECTS, BOTH ACUTE AND DELAYED

No information is currently available

4.3 INDICATION OF IMMEDIATE MEDICAL ATTENTION AND SPECIAL TREATMENT NEEDED

Treat symptomatically

5 FIRE-FIGHTING MEASURES

5.1 EXTINGUISHING MEDIA

Suitable Extinguishing Media	Product itself is non-combustible. Use extinguishing media appropriate to the source of the fire.
Unsafe Extinguishing Media	None

5.2 SPECIAL HAZARDS ARISING FROM THE SUBSTANCE OR MIXTURE

None

5.3 ADVICE FOR FIREFIGHTERS
Firefighters should use self-contained breathing apparatus (SCBA) and full protective gear

6 ACCIDENTAL RELEASE MEASURES

6.1 PERSONAL PREAUTIONS, PROTECTIVE EQUIPMENT AND EMERGENCY PROCEDURES
Avoid dust formation. In case of exposure to high levels of airborne dust, wear a personal respirator in compliance with and approved by appropriate governmental regulations and authorities.

6.2 ENVIRONMENTAL PRECAUTIONS
No special environmental precautions are required.

6.3 METHODS AND MATERIALS FOR CONTAINMENT AND CLEANING UP
Recover product and place into appropriate containers for disposal or recycling.
Preferable method is by using a vacuum device, if available, otherwise by broom and shovel.

7 HANDLING AND STORAGE

7.1 PRECAUTIONS FOR SAFE HANDLING
Avoid dust formation. Use adequate ventilation when dust is present.

7.2 CONDITIONS FOR SAFE STORAGE, INCLUDING ANY COMPATABILITIES
Keep material dry and in closed containers when possible
Material is incompatible with ethylene oxide and chlorine trifluoride

7.3 SPECIFIC END USE(S)
See section 1.2

8 EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 CONTROL PARAMETERS

Chemical Name	OSHA PEL	ACGIH (TLV-TWA)	MEXICO
Aluminum Oxide (non-fibrous) (1344-28-1)	=15 mg/m^3 TWA total dust = 5 mg/m^3 TWA respirable fraction	=1 mg/m^3 respirable fraction as Aluminum	=10 mg/m3 TWA LMPE-PPT
Derived No Effect Level (DNEL)		3mg/m^3, respirable, 8 hour TWA	
Predicted No Effect Concentration (PNEC)		No information available	

8.2 EXPOSURE CONTROLS

Engineering Controls: Use adequate ventilation in confined spaces.

Personal Protective Equipment

Eye Protection Safety glasses with full side shields. When air turbulence may be present, safety goggles should be worn.

Skin Protection	Wear long sleeve shirts to avoid skin irritation or injury.
Hand Protection	Protective gloves are recommended.
Respiratory Protection	Avoid inhaling the dust. In case of concentrations above the exposure limits, suitable certified respirator must be worn.
Hygiene Measures	Do not eat, drink or smoke when handling
Environmental Exposure Controls	Avoid dust formation.

9 PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Granular, powder
Color	White
Odor	None
pH (20°C)(10g/100ml)	8 – 10
Solubility in Water	0.00002 g/l at 20°C
Density	3.4 – 3.9 g/cm^3
Bulk Density	600 – 1250 kg/m^3
Vapor Pressure	Not applicable
Boiling Point	2980° C
Melting Point	2050° C
Flash Point	None
Flammability	Not flammable
Auto Ignition	Does not ignite
Explosive Properties	Non explosive
Thermal decomposition	Does not occur

10 STABILITY AND REACTIVITY

10.1	*Reactivity*	None under normal processing
10.2	*Chemical Stability*	Stable under normal conditions
10.3	*Possibility of Hazardous Reactions*	None under normal processing
10.4	*Conditions to Avoid*	None under normal processing
10.5	*Incompatible Materials*	Ethylene oxide and chlorine trifluoride
10.6	*Hazardous Decomposition*	None under normal processing

11 TOXICOLOGICAL DATA

11.1 INFORMATION ON TOXICOLOGICAL EFFECTS

Acute Toxicity

Oral	LD50 => 5000mg/kg bw (rat)
Dermal	Conclusive but not sufficient for classification
Inhalation	LC50 = 7.6mg/l (rat)

Skin Corrosion	Not corrosive (rabbit)
Skin Irritation	Not irritating (rabbit)

Chronic Toxicity

Irritation	Conclusive but not sufficient for classification
Corrosivity	Conclusive but not sufficient for classification
Sensitization	Conclusive but not sufficient for classification
Mutagenic Effects	Conclusive but not sufficient for classification
Carcinogenic Effects	Not classified as a human carcinogen – ACGIH – A4
Reproduction Effects	Conclusive but not sufficient for classification
Developmental Effects	Conclusive but not sufficient for classification
Aspiration Hazards	Conclusive but not sufficient for classification

11.2 ADDITIONAL INFORMATION

RTECS NO. BD1200000

12 ECOLOGICAL INFORMATION

12.1 TOXICITY

	Value	*Species*	*Type*	*Test Substance*
Fish Toxicity	LC50= >100 mg/l	Salmo trutta	acute	aluminum oxide
Invertebrate Toxicity	EC50 = >100 mg/l	Daphnia Magna	acute	aluminum oxide
Algae Toxicity	EC50 = >100 mg/l	Selenastrum Capricornutum	acute	aluminum oxide

12.2 PERSISTANCE AND DEGRADABILITY
Not applicable for inorganic substances.

12.3 BIOCUMULATIVE POTENTIAL
No relevant information available

12.4 MOBILITY IN SOIL
No relevant information available

12.5 RESULTS OF PBT AND vPvB ASSESSMENT
As a result of the PBT/vPvB assessment it was determined that this product does not meet the criteria for classification as PBT/vPvB

12.6 OTHER ADVERSE EFFECTS
None known.

13 DISPOSAL CONSIDERATIONS

13.1 WASTE TREATMENT METHODS
Collect in containers or covered dumpsters. If reuse or recycling is not possible material may be disposed of in an industrial landfill in accordance with local regulations and restrictions.

Empty containers should be emptied entirely and taken for recycling, recovery or waste disposal in accordance with local regulations and restrictions.

13.2 RCRA STATUS

If discarded in its purchased form, this product would not be a hazardous waste either by listing or characteristic nor is it federally (USA) regulated. However, under RCRA, it is the responsibility of the product user to determine at the time of disposal whether a material containing the product or derived from the product should be classified as a hazardous waste (40 CFR 261.20-24 or state equivalent in the USA).

14 TRANSPORT INFORMATION

14.1	**UN NUMBER**	Not Regulated
14.2	**UN PROPER SHIPPING NAME**	Not Regulated
14.3	**TRANSPORT REGULATIONS**	
	DOT (US)	Not regulated
	IMDG/IMO	Not regulated
	RID	Not regulated
	ADR	Not regulated
	ICAO	Not Regulated
	IATA	Not Regulated
14.4	**HTSUS CODE**	2818.20.0000 (US)

15 REGULATORY INFORMATION

15.1 SAFETY, HEALTH AND ENVIRONMENTAL REGULATIONS/LEGISLATION SPECIFIC FOR THE SUBSTANCE

International Inventories

TSCA	Listed
DSL	Listed
NDSL	Not Listed
EINECS	Listed
ELINCS	Not Listed
IECSC	Listed
KECL	KE-01012
PICCS	Listed
AICS	Listed
MITI	Listed
ENCS	1-23
IECSC	Listed

Legend

TSCA – United States Toxic Substances Control Act Section 8(b) Inventory
DSL – Canadian Domestic Substances List
NDSL – Canadian Non-Domestic Substances List
EINECS – European Inventory of Existing Commercial Chemical Substances
ELINCS – European List of Notified Chemical Substances
IECSC – China Inventory of Existing Chemical Substances
KECL – Korean Existing and Evaluated Chemical Substances
PICCS – Philippines Inventory of Chemicals and Chemical Substances
AICS – Australian Inventory of Chemical Substances

MITI – Japanese Ministry of Trade and Industry
ENCS – Japanese Existing and New Chemical Substances
IECSC – Chinese Inventory of Existing Chemical Substances

15.2 COUNTRY/LOCAL SPECIFIC REGULATIONS

US Federal Regulations:
OSHA Classification – Nonhazardous
TSCA Chemical Inventory Status: All components of this product are listed.
CERCLA Reportable Quantity: None.
SARA Title III:
Section 302 Extremely Hazardous Substances: None.
Section 304 Emergency Release Reporting: None.
Section 311/312 Hazardous Categories: Immediate (acute).
Section 313 Toxic Categories: None.
Clean Air Act of 1990 – Title VI: This material does not contain nor was it manufactured using ozone depleting chemicals.

US State and Regional Regulations:
California Proposition 65: Not listed.
Cal-OSHA Workplace Airborne Contaminant: Listed.
Coalition of Northeast Governors (CONEG) – Toxics in Packaging Clearinghouse (TPCH): Compliant
Idaho Air Contaminant: Listed.
Illinois Toxic Substances Disclosure to Employees List: Listed.
Massachusetts Right to Know List: Listed.
Massachusetts Hazardous Substance Code: F9
Minnesota Hazardous Substance List: Listed. Code: A Carcinogen: No
New Jersey Right to Know List: Listed – Substance No. 2891
Pennsylvania Right to Know List: Listed.
Pennsylvania Hazardous Substance List (Chapter 323 Appendix A): Listed Code: E
Rhode Island Hazardous Substance List: Listed.
Texas Air Contaminant with Health Effects Screening Level: Listed (as a synonym)
Washington Air Contaminant: Listed – limit TWA 10 mg/m^3

Canadian Regulations:
WHMIS Classification: Not a controlled product.
DSL (Domestic Substance List): All components of this product are listed on the DSL.
NPRI (National Pollutant Release Inventory): Not subject to mandatory reporting requirements.
IDL (Ingredient Disclosure List): All components of this product are listed on the IDL.
Canadian Hazard Symbol: Not applicable.
Note: This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (Canada) and this SDS contains all the information required by the Controlled Products Regulations (Canada).

European Union

Regulation (EC) No 2037/2000 (Ozone Depleting Substances)	Not listed
Regulation (EC) No 850/2004 (Persistant Organic Pollutants)	Not listed
Regulation (EC) No 689/2008 (Export and Import of Dangerous Substances)	Not listed
Directive 2002/95/EC (RoHS)	Compliant
Restrictions according to Title VIII of the Regulation (EC) No 1907/2008 (REACH)	None

15.3 CHEMICAL SAFETY ASSESMENT
A chemical safety assessment has been carried out

16 OTHER INFORMATION

16.1 HAZARD RATINGS

NFPA® Ratings:	Health: **1**	Flammability: **0**	Reactivity: **0**
HMIS® III Codes:	Health: **1**	Flammability: **0**	Physical Hazard: **0**

This safety data sheet complies with the requirements of the United Nations' (UN) Globally Harmonized System of Classification and Labeling of Chemicals (GHS) as defined in Annex 4 and the United States Occupational Health and Safety Administration (OSHA) Hazard Communication Standard (HCS)

Prepared By: Technical Services Department
AluChem, Inc.
1 Landy Lane
Reading, OH 45215
USA
+1-513-354-3667

Preparation Date: 1-Jun-2015
Revision Date/Review: 21-Jun-2016

Revision Summary: Revision 6, Jul 2013
All Sections revised and re-written to conform to GHS and HCS guidelines

Disclaimer:

Information presented herein has been compiled from sources considered to be dependable and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. It is the user's responsibility to determine for themselves the suitability of any material for a specific purpose whether alone or in combination with any other products, and to adopt such safety precautions as may be necessary. This shall in no way establish a legally valid contractual relationship.

LEGEND:

ACGIH	American Conference of Governmental Industrial Hygienists
ADR	European Agreement Concerning the International Carriage of Dangerous Goods by Road
CAS	Chemical Abstract Service
CEPA	Canadian Environmental Protection Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	United States Code of Federal Regulations
CPR	Cardio-pulmonary Resuscitation
DOT	United States Department of Transportation
DSL	Canadian Domestic Substances List
EINECS	European Inventory of Existing Commercial Chemical Substances
EPA	United States Environmental Protection Agency
GHS	United Nations' Globally Harmonized System of Classification and Labeling of Chemicals
HCS	United States Occupational Safety and Health Administration's (OSHA) Hazard Communication Standard
IDL	Canadian Ingredient Disclosure List
IARC	International Agency for Research on Cancer
IATA	International Air Transport Association
IATA-DRG	International Air Transport Association – Dangerous Goods Regulations
ICAO	International Civil Aviation Organization
ICAO-TI	International Civil Aviation Organization – Technical Instructions on the Safe Transport of Dangerous Goods by Air
IMDG	International Maritime Dangerous Goods Code
IMO	International Maritime Organization
LMPE-PPT	Limite Maximo Permisible de Exposicion Promedio Ponderado en Tiempo
NDSL	Canadian Non-domestic Substances List
NIOSH	National Institute for Occupational Safety and Health (USA)
NTP	National Toxicology Program (USA)
OEL	Occupational Exposure Limit
OSHA	United States Occupational Health and Safety Administration
PBT/vPvB	Persistant, Bioaccumulative and Toxic / Very Persistant and Very Bioaccumulative
PEL	Permissive Exposure Limits
PIN	Product Identification Number
PPE	Personal Protective Equipment
RCRA	Resource Conservation and Recovery Act (USA)
REACH	Registration, Evaluation, Authorization and Restriction of Chemicals (EU)
RID	European Agreement Concerning the International Carriage of Dangerous Goods by Rail
RTECS	The Registry of Toxic Effects of Chemical Substances
SARA	Superfund Amendments and Reauthorization Act (USA)
TDGR	Transportation of Dangerous Goods Regulations
TLV	Threshold Limit Values
TSCA	Toxic Substances Control Act (USA)
TWA	Time Weighted Average

cm = centimeter, m = meter, g = gram, kg = kilogram, ml = milliliter, l = liter, > = greater than, < = less than, bw = body weight

END OF SDS SHEET

APPENDIX C

BH9 Filter, Manufacturer's Literature

Southern Felt

FELT SPECIFICATION SHEET

PRODUCT SPECIFICATION SHEET: 4212 **DATE : 4/29/2015**

PRODUCT DESCRIPTION

STYLE : PE-16-US CUSTOMER CODE:

DESCRIPTION :

16 OZ/YD2 SELF SUPPORTED POLYESTER NEEDLEFELT WITH A SINGE ONE SIDE FINISH.

CONSTRUCTION: UNSUPPORTED NEEDLEFELT.

FINISH: HEATSET, SINGED ONE SIDE.

CRITERIA

WEIGHT (OPSY)	THICKNESS (INCHES)	AIR FLOW RANGE (CFM)
15.00 - 17.00	0.065 - 0.085	20 - 40

STRENGTH : MULLEN : 400 PSI. MIN.
WARP TENSILE : 75 LBS. MIN.
FILL TENSILE : 150 LBS. MIN.
ELONGATION : BOTH DIRECTIONS : 10 % MAX. (10 LBS. - 2")

SHRINKAGE : BOTH DIRECTIONS : 3 % MAX. @ 300 DEGREES F FOR 2 HOURS

RESISTIVITY: < 0 @ 0 VOLTS

Lydall®
Industrial Filtration Americas

TESTING OF BAGHOUSE FILTRATION PRODUCTS

SOUTHERN FELT SUMMARY OF RESULTS AT 6.6/1

DATE: 11/01/04

RUN ID.	**134-R2**
FABRIC DESIGNATION	**NX-13.5/5-US-1**
MANUFACTURER	**Southern Felt**
DUST FEED	**Pural NF**

VERIFICATION TEST RESULTS

Mean Outlet Particle Conc. PM 2.5 (gr/dscf)	0.0000582
Mean Outlet Particle Conc. Total mass (gr/dscf)	0.0000582
Initial Residual Pressure Drop (in. w.g.)	1.07
Change in Residual Pressure Drop (in. w.g.)	0.24
Average Residual Pressure Drop (in. w.g.)	1.22
Mass Gain of Filter Sample (g)	1.81
Average Filtration Cycle Time (s)	112
Number of Pulses	193

RESIDUAL PRESSURE DROP

At Start of:	
Conditioning Period (in. w.g.)	0.06
Recovery Period (in. w.g.)	0.96
Performance Test Period (in. w.g.)	1.07

REMOVAL EFFICIENCY (%)

Dust Conc (gr/dscf)	7.95	
PM 2.5	99.99905	*
Total Mass	99.99927	**

* (Dust Concentration * 0.7735) - PM 2
Dust Concentr

** Dust Concentration - Tota
Dust Concentration

ING OF BAGHOUSE FILTRATION PRODUCTS

HERN FELT SUMMARY OF RESULTS AT [illegible]

$$* \quad \frac{\text{(Dust Concentration * 0.7735) - PM 2.5 Outlet Concentration}}{\text{Dust Concentration * 0.7735}} * 100$$

$$** \quad \frac{\text{Dust Concentration - Total Mass Outlet Concentration}}{\text{Dust Concentration}} * 100$$

RUN ID.	**934-1-1**
FABRIC DESIGNATION	**PE-16-US**
MANUFACTURER	**Southern Felt**
DUST FEED	**Pural NF**

VERIFICATION TEST RESULTS

Mean Outlet Particle Conc. PM 2.5 (gr/dscf)	0.0001146
Mean Outlet Particle Conc. Total mass (gr/dscf)	0.0001153
Initial Residual Pressure Drop (in. w.g.)	1.48
Change in Residual Pressure Drop (in. w.g.)	0.42
Average Residual Pressure Drop (in. w.g.)	1.74
Mass Gain of Filter Sample (g)	1.43
Average Filtration Cycle Time (s)	48
Number of Pulses	448

RESIDUAL PRESSURE DROP

At Start of:

Conditioning Period (in. w.g.)	0.05
Recovery Period (in. w.g.)	1.39
Performance Test Period (in. w.g.)	1.48

REMOVAL EFFICIENCY (%)

Dust Conc (gr/dscf)		8.17
PM 2.5	*	99.9981866
Total Mass	**	99.9985893

APPENDIX D

SDS for Table Sugar

Safety Data Sheet
All White Granulated Sugars

Revision Date 12/22/2016 Version 1.0

Domino Foods, Inc.

According To Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations and According t the Hazardous Products Regulation (February 11, 2015)

SECTION 1: IDENTIFICATION

1.1. Product Identifier

Product Form: Substance

Product Name(s): Domino® Extra Fine Granulated, Fruit Granulated, Bakers Special Granulated, Standard Granulated, Medium Granulated, Medium Fine Granulated, LCMT Granulated Sugar, Sanding No. 2, Superfine, Bottlers' Granulated Sugar, Canners' Extra Fine Granulated and Con AA Sugar; C&H® Con A Sugar, Con AA Sugar, Coarse Sanding Sugar, Special Sanding Sugar, Con Sanding Sugar, Special Coarse Sugar, Manufacturers Sugar, Special Grain Sugar, Extra Fine Granulated Sugar, Gel/Fruit Granulated Sugar, Bottlers Extra Fine Granulated Sugar, Cube Sugar, and Bakers Special Sugar and 35/50 Granulated Sugar; USP/NF and EP grade of any preceding product.

CAS No: 57-50-1

1.2. Intended Use of the Product

Sweetener

1.3. Name, Address, and Telephone of the Responsible Party

Company

American Sugar Refining Inc.
1 Federal Street
Yonkers, NY 10705
914-963-2400

1.4. Emergency Telephone Number

Emergency Number : 914-963-2400

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the Substance or Mixture

GHS-US/CA Classification

Comb. Dust

2.2. Label Elements

GHS-US/CA Labeling

Signal Word (GHS-US/CA) : Warning

Hazard Statements (GHS-US/CA) : May form combustible dust concentrations in air.

Supplemental Information : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Proper grounding procedures to avoid static electricity should be followed. Avoid generating dust. Prevent dust accumulation (to minimize explosion hazard).

2.3. Other Hazards

Exposure may aggravate pre-existing eye, skin, or respiratory conditions.

2.4. Unknown Acute Toxicity (GHS-US/CA)

No data available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1. Substance

Name : Extra Fine Granulated Sugar

CAS No : 57-50-1

Name	Product Identifier	% *
Sucrose	(CAS No) 57-50-1	100

3.2. Mixture

Not applicable

*Percentages are listed in weight by weight percentage (w/w%) for liquid and solid ingredients. Gas ingredients are listed in volume by volume percentage (v/v%).

SECTION 4: FIRST AID MEASURES

4.1. Description of First-aid Measures

General: Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible).

Inhalation: Using proper respiratory protection, immediately move the exposed person to fresh air. Obtain medical attention if breathing difficulty persists.

Skin Contact: Rinse immediately with plenty of water for 5 minutes. Obtain medical attention if irritation develops or persists.

Eye Contact: Rinse cautiously with water for at least 5 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Obtain medical attention if redness, pain, or irritation occurs.

Ingestion: Rinse mouth. Do not induce vomiting. Get medical advice and attention if you feel unwell.

4.2. Most Important Symptoms and Effects Both Acute and Delayed

General: Not expected to present a significant hazard under anticipated conditions of normal use. Prolonged contact with large amounts of dust may cause mechanical irritation.

Inhalation: Dust may be harmful or cause irritation.

Skin Contact: Prolonged exposure may cause skin irritation.

Eye Contact: May cause slight irritation to eyes.

Ingestion: Ingestion is not likely to be harmful or have adverse effects.

Chronic Symptoms: Repeated or prolonged contact with skin may cause dermatitis.

4.3. Indication of Any Immediate Medical Attention and Special Treatment Needed

If exposed or concerned, get medical advice and attention. If medical advice is needed, have product container or label at hand.

SECTION 5: FIRE-FIGHTING MEASURES

5.1. Extinguishing Media

Suitable Extinguishing Media: Use extinguishing media appropriate for surrounding fire.

Unsuitable Extinguishing Media: Do not use a heavy water stream. Use of heavy stream of water may spread fire.

5.2. Special Hazards Arising From the Substance or Mixture

Fire Hazard: Combustible Dust.

Explosion Hazard: Dust explosion hazard in air.

Reactivity: Hazardous reactions will not occur under normal conditions.

5.3. Advice for Firefighters

Precautionary Measures Fire: Exercise caution when fighting any chemical fire.

Firefighting Instructions: Use water spray or fog for cooling exposed containers.

Protection During Firefighting: Do not enter fire area without proper protective equipment, including respiratory protection.

Hazardous Combustion Products: Thermal decomposition generates: Carbon oxides (CO, CO_2).

Other Information: Risk of dust explosion.

Reference to Other Sections

Refer to Section 9 for flammability properties.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal Precautions, Protective Equipment and Emergency Procedures

General Measures: Avoid prolonged contact with eyes, skin and clothing. Avoid generating dust. Avoid breathing dust. Remove ignition sources. Keep away from heat, hot surfaces, sparks, open flames, and other ignition sources. No smoking.

6.1.1. For Non-Emergency Personnel

Protective Equipment: Use appropriate personal protective equipment (PPE).

Emergency Procedures: Evacuate unnecessary personnel.

6.1.2. For Emergency Personnel

Protective Equipment: Equip cleanup crew with proper protection.

Emergency Procedures: Upon arrival at the scene, a first responder is expected to recognize the presence of dangerous goods, protect oneself and the public, secure the area, and call for the assistance of trained personnel as soon as conditions permit. Ventilate area.

6.2. Environmental Precautions

Prevent entry to sewers and public waters.

6.3. Methods and Materials for Containment and Cleaning Up

For Containment: Contain solid spills with appropriate barriers and prevent migration and entry into sewers or streams. Avoid generation of dust during clean-up of spills.

Methods for Cleaning Up: Clean up spills immediately and dispose of waste safely. Vacuum clean-up is preferred. If sweeping is required use a dust suppressant. Use explosion proof vacuum during cleanup, with appropriate filter. Do not mix with other materials. Use only non-sparking tools. Contact competent authorities after a spill.

6.4. Reference to Other Sections

See Section 8 for exposure controls and personal protection and Section 13 for disposal considerations.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for Safe Handling

Additional Hazards When Processed: Accumulation and dispersion of dust with an ignition source can cause a combustible dust explosion. Keep dust levels to a minimum and follow applicable regulations.

Precautions for Safe Handling: Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Avoid prolonged contact with eyes, skin and clothing. Avoid creating or spreading dust. Avoid breathing dust. Keep away from heat, sparks, open flames, hot surfaces. – No smoking.

Hygiene Measures: Handle in accordance with good industrial hygiene and safety procedures.

7.2. Conditions for Safe Storage, Including Any Incompatibilities

Technical Measures: Comply with applicable regulations. Avoid creating or spreading dust. Use explosion-proof electrical, ventilating, lighting equipment. Proper grounding procedures to avoid static electricity should be followed.

Storage Conditions: Keep container closed when not in use. Store in a dry, cool place. Keep/Store away from direct sunlight, extremely high or low temperatures and incompatible materials.

Incompatible Materials: Strong acids, strong bases, strong oxidizers. Sulfuric acid. Nitric acid.

7.3. Specific End Use(s)

Sweetener

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control Parameters

For substances listed in section 3 that are not listed here, there are no established Exposure limits from the manufacturer, supplier, importer, or the appropriate advisory agency including: ACGIH (TLV), AIHA (WEEL), NIOSH (REL), OSHA (PEL), Canadian provincial governments, or the Mexican government.

Sucrose (57-50-1)		
Mexico	OEL TWA (mg/m³)	10 mg/m³
Mexico	OEL STEL (mg/m³)	20 mg/m³
USA ACGIH	ACGIH TWA (mg/m³)	10 mg/m³
USA ACGIH	ACGIH chemical category	Not Classifiable as a Human Carcinogen
USA OSHA	OSHA PEL (TWA) (mg/m³)	15 mg/m³ (total dust) 5 mg/m³ (respirable fraction)
USA NIOSH	NIOSH REL (TWA) (mg/m³)	10 mg/m³ (total dust) 5 mg/m³ (respirable dust)
Alberta	OEL TWA (mg/m³)	10 mg/m³
British Columbia	OEL TWA (mg/m³)	10 mg/m³ (total dust) 3 mg/m³ (respirable fraction)
Manitoba	OEL TWA (mg/m³)	10 mg/m³
New Brunswick	OEL TWA (mg/m³)	10 mg/m³
Newfoundland & Labrador	OEL TWA (mg/m³)	10 mg/m³
Nova Scotia	OEL TWA (mg/m³)	10 mg/m³
Nunavut	OEL STEL (mg/m³)	20 mg/m³
Nunavut	OEL TWA (mg/m³)	10 mg/m³
Northwest Territories	OEL STEL (mg/m³)	20 mg/m³
Northwest Territories	OEL TWA (mg/m³)	10 mg/m³
Ontario	OEL TWA (mg/m³)	10 mg/m³
Prince Edward Island	OEL TWA (mg/m³)	10 mg/m³
Québec	VEMP (mg/m³)	10 mg/m³
Saskatchewan	OEL STEL (mg/m³)	20 mg/m³
Saskatchewan	OEL TWA (mg/m³)	10 mg/m³

Yukon	OEL STEL (mg/m³)	20 mg/m³
Yukon	OEL TWA (mg/m³)	30 mppcf 10 mg/m³

8.2. Exposure Controls

Appropriate Engineering Controls: Emergency eye wash fountain capability should be available in the immediate vicinity of any potential exposure. Ensure adequate ventilation, especially in confined areas. Ensure all national/local regulations are observed. Proper grounding procedures to avoid static electricity should be followed. Use explosion-proof equipment. Use local exhaust or general dilution ventilation or other suppression methods to maintain dust levels below exposure limits. Power equipment should be equipped with proper dust collection devices. It is recommended that all dust control equipment such as local exhaust ventilation and material transport systems involved in handling of this product contain explosion relief vents or an explosion suppression system or an oxygen-deficient environment.

Personal Protective Equipment: Gloves. Protective clothing. Protective goggles. Insufficient ventilation: wear respiratory protection.

Materials for Protective Clothing: Chemically resistant materials and fabrics.

Hand Protection: Wear protective gloves.

Eye Protection: Chemical safety goggles.

Skin and Body Protection: Wear suitable protective clothing.

Respiratory Protection: If exposure limits are exceeded or irritation is experienced, approved respiratory protection should be worn. In case of inadequate ventilation, oxygen deficient atmosphere, or where exposure levels are not known wear approved respiratory protection.

Other Information: When using, do not eat, drink or smoke

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on Basic Physical and Chemical Properties

Physical State	:	Solid
Appearance	:	Dry powder, granules
Odor	:	Not available
Odor Threshold	:	Not available
pH	:	Not available
Evaporation Rate	:	Not available
Melting Point	:	Not available
Freezing Point	:	Not available
Boiling Point	:	Not available
Flash Point	:	Not available
Auto-ignition Temperature	:	Not available
Decomposition Temperature	:	Not available
Flammability (solid, gas)	:	Not available
Lower Flammable Limit	:	Not available
Upper Flammable Limit	:	Not available
Vapor Pressure	:	Not available
Relative Vapor Density at 20°C	:	Not available
Relative Density	:	Not available
Specific Gravity	:	Not available
Solubility	:	Not available
Partition Coefficient: N-Octanol/Water	:	Not available
Viscosity	:	Not available

SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity: Hazardous reactions will not occur under normal conditions.

10.2. Chemical Stability: Stable under recommended handling and storage conditions (see section 7).

10.3. Possibility of Hazardous Reactions: Hazardous polymerization will not occur.

10.4. Conditions to Avoid: Direct sunlight, extremely high or low temperatures, and incompatible materials. Sparks, heat, open flame and other sources of ignition. Dust accumulation (to minimize explosion hazard).

10.5. Incompatible Materials: Strong acids, strong bases, strong oxidizers. Sulfuric acid. Nitric acid.

10.6. Hazardous Decomposition Products: None known.

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on Toxicological Effects - Product

Acute Toxicity (Oral): Not classified
Acute Toxicity (Dermal): Not classified
Acute Toxicity (Inhalation): Not classified
LD50 and LC50 Data: Not available
Skin Corrosion/Irritation: Not classified
Eye Damage/Irritation: Not classified
Respiratory or Skin Sensitization: Not classified
Germ Cell Mutagenicity: Not classified
Carcinogenicity: Not classified
Specific Target Organ Toxicity (Repeated Exposure): Not classified
Reproductive Toxicity: Not classified
Specific Target Organ Toxicity (Single Exposure): Not classified
Aspiration Hazard: Not classified
Symptoms/Injuries After Inhalation: Dust may be harmful or cause irritation.
Symptoms/Injuries After Skin Contact: Prolonged exposure may cause skin irritation.
Symptoms/Injuries After Eye Contact: May cause slight irritation to eyes.
Symptoms/Injuries After Ingestion: Ingestion is not likely to be harmful or have adverse effects.
Chronic Symptoms: Repeated or prolonged contact with skin may cause dermatitis.

11.2. Information on Toxicological Effects - Ingredient(s)

LD50 and LC50 Data:

Sucrose (57-50-1)	
LD50 Oral Rat	29700 mg/kg

SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity

Ecology - General: Not classified.

12.2. Persistence and Degradability

Extra Fine Granulated Sugar (57-50-1)	
Persistence and Degradability	Not established.

12.3. Bioaccumulative Potential

Extra Fine Granulated Sugar (57-50-1)	
Bioaccumulative Potential	Not established.

12.4. Mobility in Soil Not available

12.5. Other Adverse Effects

Other Information: Avoid release to the environment.

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Waste Disposal Recommendations: Dispose of contents/container in accordance with local, regional, provincial, territorial, national, and international regulations
Additional Information: Container may remain hazardous when empty. Continue to observe all precautions.
Ecology - Waste Materials: Avoid release to the environment.

SECTION 14: TRANSPORT INFORMATION

The shipping description(s) stated herein were prepared in accordance with certain assumptions at the time the SDS was authored, and can vary based on a number of variables that may or may not have been known at the time the SDS was issued.

14.1. In Accordance with DOT Not regulated for transport

14.2. In Accordance with IMDG Not regulated for transport

14.3. In Accordance with IATA Not regulated for transport

14.4. In Accordance with TDG Not regulated for transport

SECTION 15: REGULATORY INFORMATION

15.1. US Federal Regulations

Extra Fine Granulated Sugar (57-50-1)	
SARA Section 311/312 Hazard Classes	Fire hazard Sudden release of pressure hazard

Sucrose (57-50-1)
Listed on the United States TSCA (Toxic Substances Control Act) inventory

15.2. US State Regulations

Sucrose (57-50-1)
U.S. - Massachusetts - Right To Know List U.S. - Pennsylvania - RTK (Right to Know) List

15.3. Canadian Regulations

Sucrose (57-50-1)
Listed on the Canadian DSL (Domestic Substances List)

SECTION 16: OTHER INFORMATION, INCLUDING DATE OF PREPARATION OR LAST REVISION

Revision Date : 12/22/2016

Other Information : This document has been prepared in accordance with the SDS requirements of the OSHA Hazard Communication Standard 29 CFR 1910.1200 and Canada's Hazardous Products Regulations (HPR).

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

NA GHS SDS 2015 (US, Can, Mex)

APPENDIX E

SDS for Compound ZF 113

Safety Data Sheet

acc. to OSHA HCS

Printing date 05/21/2024 Version 31 Reviewed on 05/21/2024

1 Identification

- **Product identifier**

- **Trade name: Compound ZF 113**

- **Article number:** 05160001130

- **Application of the substance / the mixture**
Process auxiliary for surface finishing
Industrial use

- **Details of the supplier of the safety data sheet**

- **Manufacturer/ Supplier:**
Rösler Oberflächentechnik GmbH
Hausen 1
D-96231 Bad Staffelstein
www.rosler.com
Tel.: +49/9533/924-0
Fax : +49/9533/924-300
info@rosler.com

- **Supplier:**
Rösler Metal Finishing USA, L.L.C.
1551 Denso Road
Battle Creek, MI 49037
USA
Phone: +1(269)441-3000
Fax: +1(269)441-3001
rosler-us@rosler.com
www.rosler.us

- **Information department:** Department of Product Control

- **Emergency telephone number:** Emergency Number (24h emergency contact): CHEMTREC Phone: (800)-424-9300

2 Hazard(s) identification

- **Classification of the substance or mixture**


GHS08 Health hazard

Carcinogenicity 2	H351 Suspected of causing cancer.
Toxic to Reproduction 2	H361 Suspected of damaging fertility or the unborn child.
Specific Target Organ Toxicity - Repeated Exposure 2	H373 May cause damage to organs through prolonged or repeated exposure. Route of exposure: Oral.


GHS05 Corrosion

Eye Damage 1	H318 Causes serious eye damage.


GHS07

Skin Irritation 2	H315 Causes skin irritation.

- **Label elements**
- **GHS label elements** The product is classified and labeled according to the Globally Harmonized System (GHS).

(Contd. on page 2)

Safety Data Sheet

acc. to OSHA HCS

Trade name: Compound ZF 113

(Contd. of page 1)

- **Hazard pictograms**

GHS05 GHS08

- **Signal word** Danger

- **Hazard-determining components of labeling:**
octanoic acid
2,2'-iminodiethanol
Amides, C8-18 (even numbered) and C18-unsatd., N,N-bis(hydroxyethyl)
2-aminoethanol
- **Hazard statements**
Causes skin irritation.
Causes serious eye damage.
Suspected of causing cancer.
Suspected of damaging fertility or the unborn child.
May cause damage to organs through prolonged or repeated exposure. Route of exposure: Oral.
- **Precautionary statements**
Do not handle until all safety precautions have been read and understood.
Wear protective gloves / eye protection.
If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
IF exposed or concerned: Get medical advice/attention.

- **Classification system:**
- **Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.

3 Composition/information on ingredients

- **Chemical characterization: Mixtures**
- **Description:** Mixture of the substances listed below with nonhazardous additions.

- **Dangerous components:**		
124-07-2	octanoic acid Skin Corrosion 1C, H314	5-10%
68155-07-7	Amides, C8-18 (even numbered) and C18-unsatd., N,N-bis(hydroxyethyl) Eye Damage 1, H318; Skin Irritation 2, H315	5-10%
141-43-5	2-aminoethanol Skin Corrosion 1B, H314; Acute Toxicity - Oral 4, H302; Acute Toxicity - Dermal 4, H312; Acute Toxicity - Inhalation 4, H332; Specific Target Organ Toxicity - Single Exposure 3, H335; Flammable Liquids 4, H227 Specific concentration limit: STOT SE 3; H335: C ≥ 5 %	1-5%
111-42-2	2,2'-iminodiethanol Carcinogenicity 2, H351; Toxic to Reproduction 2, H361; Specific Target Organ Toxicity - Repeated Exposure 2, H373; Eye Damage 1, H318; Acute Toxicity - Oral 4, H302; Skin Irritation 2, H315	1-5%

(Contd. on page 3)

Safety Data Sheet

acc. to OSHA HCS

Trade name: Compound ZF 113

(Contd. of page 2)

67701-05-7	Fatty acids, C8-18 and C18-unsatd. Eye Damage 1, H318; Skin Irritation 2, H315	1-5%

4 First-aid measures

- **Description of first aid measures**
- **General information:**
  Take affected persons out of danger area and lay down.
  Personal protection for the First Aider.
  Immediately remove any clothing soiled by the product.
- **After inhalation:** In case of unconsciousness place patient stably in side position for transportation.
- **After skin contact:** If skin irritation continues, consult a doctor.
- **After eye contact:** Rinse opened eye for several minutes under running water. Then consult a doctor.
- **After swallowing:**
  Rinse out mouth with plenty of water.
  Do not induce vomiting; immediately call for medical help.
- **Information for doctor:**
- **Most important symptoms and effects, both acute and delayed** No further relevant information available.
- **Indication of any immediate medical attention and special treatment needed**
  No further relevant information available.

5 Fire-fighting measures

- **Extinguishing media**
- **Suitable extinguishing agents:**
  CO2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
- **For safety reasons unsuitable extinguishing agents:** Water with full jet
- **Special hazards arising from the substance or mixture** No further relevant information available.
- **Advice for firefighters**
- **Protective equipment:** Wear self-contained respiratory protective device.
- **Additional information**
  Dispose of fire debris and contaminated fire fighting water in accordance with official regulations.

6 Accidental release measures

- **Personal precautions, protective equipment and emergency procedures**
  Wear protective equipment. Keep unprotected persons away.
  Particular danger of slipping on leaked/spilled product.
- **Environmental precautions:**
  Inform respective authorities in case of seepage into water course or sewage system.
  Do not allow product to enter sewers/ surface or ground water.
  Do not allow product to penetrate the ground/soil.
- **Methods and material for containment and cleaning up:**
  Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
  Dispose of the collected material according to regulations.
- **Reference to other sections**
  See Section 7 for information on safe handling.
  See Section 8 for information on personal protection equipment.
  See Section 13 for disposal information.

(Contd. on page 4)

Safety Data Sheet

acc. to OSHA HCS

Trade name: Compound ZF 113

(Contd. of page 3)

- **Protective Action Criteria for Chemicals**

- **PAC-1:**		
141-43-5	2-aminoethanol	6 ppm
111-42-2	2,2'-iminodiethanol	3 mg/m³
67-63-0	propan-2-ol	400 ppm

- **PAC-2:**		
141-43-5	2-aminoethanol	170 ppm
111-42-2	2,2'-iminodiethanol	28 mg/m³
67-63-0	propan-2-ol	2000* ppm

- **PAC-3:**		
141-43-5	2-aminoethanol	1,000 ppm
111-42-2	2,2'-iminodiethanol	130 mg/m³
67-63-0	propan-2-ol	12000** ppm

7 Handling and storage

- **Handling:**
- **Precautions for safe handling** No special measures required.
- **Information about protection against explosions and fires:** No special measures required.

- **Conditions for safe storage, including any incompatibilities**
- **Storage:**
- **Requirements to be met by storerooms and receptacles:** No special requirements.
- **Information about storage in one common storage facility:** Not required.
- **Further information about storage conditions:**
  Keep receptacle tightly sealed.
  Store at 41°F to 104°F
  Can be stored for at least 2 years.
- **Specific end use(s)** No further relevant information available.

8 Exposure controls/personal protection

- **Additional information about design of technical systems:** No further data; see section 7.

- **Control parameters**
- **Components with limit values that require monitoring at the workplace:**
  The following constituents are the only constituents of the product which have a PEL, TLV or other recommended exposure limit.
  At this time, the other constituents have no known exposure limits.

141-43-5 2-aminoethanol	
PEL	Long-term value: 6 mg/m³, 3 ppm
REL	Short-term value: 15 mg/m³, 6 ppm Long-term value: 8 mg/m³, 3 ppm
TLV	Short-term value: 6 ppm Long-term value: 3 ppm

(Contd. on page 5)

Safety Data Sheet

acc. to OSHA HCS

Trade name: Compound ZF 113

(Contd. of page 4)

111-42-2 2,2'-iminodiethanol	
REL	Long-term value: 15 mg/m³, 3 ppm
TLV	Long-term value: 1* mg/m³ Skin; *inhalable fraction and vapor, A3

- **Additional information:** The lists that were valid during the creation were used as basis.

- **Exposure controls**
- **Personal protective equipment:**
- **General protective and hygienic measures:**
The usual precautionary measures for handling chemicals should be followed.
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Do not inhale gases / fumes / aerosols.
Avoid contact with the eyes and skin.
Do not eat, drink, smoke or sniff while working.
- **Breathing equipment:**
Not necessary in case of intended use.
Use suitable respiratory protective device if vapors occur or aerosol is formed.
Filter A/P2
- **Protection of hands:**

Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation
After use of gloves apply skin-cleaning agents and skin cosmetics.
- **Material of gloves**
e.g.
Nitrile rubber, NBR
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.
- **Penetration time of glove material**
The exact break trough time has to be found out by the manufacturer of the protective gloves and has to be observed.
- **For the permanent contact gloves made of the following materials are suitable:**
Butyl rubber with 0.7 mm layer thickness or nitrile rubber with 0.4 mm layer thickness, (recommended: Protection index 6, corresponding to over 480 minutes permeation time according to EN 374).
Attention. Due to the special conditions at the workplace (mechanical load, temperature), the daily service life of a chemical protective glove may be considerably shorter than
the permeation time determined according to EN 374.
- **Eye protection:**

Tightly sealed goggles

- **Body protection:** Protective work clothing

(Contd. on page 6)

Safety Data Sheet

acc. to OSHA HCS

(Contd. of page 5)

9 Physical and chemical properties

- **Information on basic physical and chemical properties**
- **General Information**
- **Appearance:**
  Form: Liquid
  Color: Blue
- **Odor:** Characteristic

- **pH-value at 20°C (68°F):** 9.5 (± 0.3)
- **pH-Value; 5g/l at 20°C (68°F):** 8.9 (± 0.3)
- **Melting point/Melting range:** Undetermined.
- **Boiling point/Boiling range:** Undetermined.

- **Flash point:** Not applicable.

- **Flammability (solid, gaseous):** Not applicable.

- **Auto igniting:** Not applicable.

- **Decomposition temperature:** Not determined.

- **Ignition temperature:** Product is not selfigniting.

- **Danger of explosion:** Product does not present an explosion hazard.

- **Explosion limits:**
  Lower: Not determined.
  Upper: Not determined.

- **Vapor pressure at 20 °C (68 °F) at 20 °C (68 °F):** 23 hPa (17.3 mm Hg)

- **Density at 20°C (68°F):** 1.008 (± 0.010) g/cm³ (8.412 (± 0.083) lbs/gal)

- **Relative density** Not determined.
- **Vapor density** Not determined.
- **Evaporation rate** Not determined.

- **Solubility in / Miscibility with**
  Water: Fully miscible.

- **Partition coefficient (n-octanol/water):** Not determined.

- **Viscosity:**
  Kinematic: Not determined.
  Kinematic at 20 °C (68 °F): -
  Dynamic at 22°C (72°F): 14.8 - 22.2 mPa.s

- **Other information** No further relevant information available.

(Contd. on page 7)

Safety Data Sheet

acc. to OSHA HCS

(Contd. of page 6)

10 Stability and reactivity

- **Reactivity** No dangerous reactions in case of intended use.
- **Chemical stability**
- **Thermal decomposition / conditions to be avoided:**
  No decomposition if used and stored according to specifications.
- **Possibility of hazardous reactions** No dangerous reactions in case of intended use.
- **Conditions to avoid** No further relevant information available.
- **Incompatible materials:** No further relevant information available.
- **Hazardous decomposition products:** None in case of intended use and storage.

11 Toxicological information

- **Information on toxicological effects**

- **LD/LC50 values that are relevant for classification:**		
68155-07-7 Amides, C8-18 (even numbered) and C18-unsatd., N,N-bis(hydroxyethyl)		
Oral	LD50	>5,000 mg/kg (rat)
Dermal	LD50	>2,000 mg/kg (rabbit)
141-43-5 2-aminoethanol		
Oral	LD50	1,089 mg/kg (rat)
Dermal	LD50	2,504 mg/kg (rabbit)
Inhalative	LC50	1.3 mg/l (rat)
	LC0	1.3 mg/l (rat)
111-42-2 2,2'-iminodiethanol		
Oral	LD50	1,600 mg/kg (rat)
Dermal	LD50	13,079 mg/kg (rabbit)
92129-33-4 Quaternary ammonium compounds, di-C16-18-alkyldimethyl, chlorides		
Dermal	LD50	>2,000 mg/kg (rat)

- **Primary irritant effect:**
- **on the skin:**
  Caustic effect on skin and mucous membranes.
  Determination of Skin Corrosion Potential
  Method : OECD 431
  Result: Not corrosive

  According to GHS regulation:
  Causes skin irritation.
- **on the eye:**
  Strong caustic effect.
  This product has to be classified using the calculation set out according to GHS regulation.
- **Additional toxicological information:** Corrosive

- **Carcinogenic categories**

- **IARC (International Agency for Research on Cancer)**		
111-42-2	2,2'-iminodiethanol	2B

(Contd. on page 8)

Safety Data Sheet

acc. to OSHA HCS

(Contd. of page 7)

67-63-0	propan-2-ol	3

- **NTP (National Toxicology Program)**

None of the ingredients is listed.

- **OSHA-Ca (Occupational Safety & Health Administration)**

None of the ingredients is listed.

12 Ecological information

- **Toxicity**

- **Aquatic toxicity:**	
111-42-2 2,2'-iminodiethanol	
EC10 (72h)	1.4 mg/l (Pseudokirchneriella subcapitata)

- **Persistence and degradability** No further relevant information available.
- **Behavior in environmental systems:**
- **Bioaccumulative potential** No further relevant information available.
- **Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **COD-value (solution of 0.5% in water):** 3735 mg/L
- **General notes:**
  Must not reach bodies of water or drainage ditch undiluted or unneutralized.
  Danger to drinking water if even small quantities of product leak into the ground.
  Do not allow product to reach ground water, water course or sewage system.
  Avoid transfer of product into the environment.
- **Results of PBT and vPvB assessment**
  The product contains no substance which is considered to be persistent, bioaccumulative or toxic (PBT) or as very persistent and very bioaccumulative (vPvB).
- **PBT:** Not applicable.
- **vPvB:** Not applicable.

13 Disposal considerations

- **Waste treatment methods**
- **Recommendation:**
  Dispose of in accordance with all applicable federal, state and local regulations.
  Disposal must be made according to official regulations.

- **Uncleaned packagings:**
- **Recommendation:** Disposal must be made according to official regulations.

14 Transport information

- **UN-Number**
- **DOT, ADR, ADN, IMDG, IATA** Void
- **UN proper shipping name**
- **DOT, ADR, ADN, IMDG, IATA** Void

(Contd. on page 9)

Safety Data Sheet

acc. to OSHA HCS

(Contd. of page 8)

- **Transport hazard class(es)**

- **DOT, ADR, ADN, IMDG, IATA**
- **Class** Void
- **Packing group**
- **DOT, ADR, IMDG, IATA** Void
- **Environmental hazards:** Not applicable.

- **Special precautions for user** Not applicable.
- **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code** Not applicable.

- **Transport/Additional information:** Not dangerous according to the above specifications.

- **UN "Model Regulation":** Void

15 Regulatory information

- **Safety, health and environmental regulations/legislation specific for the substance or mixture**
- **Sara**

- **Section 355 (extremely hazardous substances):**
None of the ingredient is listed.

- **Section 313 (Specific toxic chemical listings):**	
111-42-2	2,2'-iminodiethanol
67-63-0	propan-2-ol

- **TSCA (Toxic Substances Control Act):**		
68155-07-7	Amides, C8-18 (even numbered) and C18-unsatd., N,N-bis(hydroxyethyl)	ACTIVE
141-43-5	2-aminoethanol	ACTIVE
111-42-2	2,2'-iminodiethanol	ACTIVE
67701-05-7	Fatty acids, C8-18 and C18-unsatd.	ACTIVE

- **Hazardous Air Pollutants**	
111-42-2	2,2'-iminodiethanol

- **Proposition 65**

- **Chemicals known to cause cancer:**	
111-42-2	2,2'-iminodiethanol

- **Chemicals known to cause reproductive toxicity for females:**
None of the ingredients is listed.

- **Chemicals known to cause reproductive toxicity for males:**
None of the ingredients is listed.

- **Chemicals known to cause developmental toxicity:**
None of the ingredients is listed.

- **Cancerogenity categories**

- **EPA (Environmental Protection Agency)**
None of the ingredients is listed.

(Contd. on page 10)

Safety Data Sheet

acc. to OSHA HCS

Trade name: Compound ZF 113

(Contd. of page 9)

- **TLV (Threshold Limit Value)**		
111-42-2	2,2'-iminodiethanol	A3
67-63-0	propan-2-ol	A4

- **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients is listed.

- **GHS label elements** GHS label elements

- **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee or warranty for any specific product features and shall not establish a legally valid contractual relationship. The user is responsible for determing wether the product is suitable for its intendes conditions of use.

- **Relevant phrases**
H227 Combustible liquid.
H302 Harmful if swallowed.
H312 Harmful in contact with skin.
H314 Causes severe skin burns and eye damage.
H315 Causes skin irritation.
H318 Causes serious eye damage.
H332 Harmful if inhaled.
H335 May cause respiratory irritation.
H351 Suspected of causing cancer.
H361 Suspected of damaging fertility or the unborn child.
H373 May cause damage to organs through prolonged or repeated exposure.
- **Classification according to Regulation (EC) No 1272/2008**
Determination of Skin Corrosion Potential
Method : OECD 431
Result: does not cause severe skin burns

- **Department issuing SDS:**
Rösler Oberflächentechnik GmbH
Department of Product Control
- **Contact:** SDS Coordinator

- **Abbreviations and acronyms:**
ADR: Accord relatif au transport international des marchandises dangereuses par route (European Agreement Concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
PBT: Persistent, Bioaccumulative and Toxic
vPvB: very Persistent and very Bioaccumulative
NIOSH: National Institute for Occupational Safety
OSHA: Occupational Safety & Health
TLV: Threshold Limit Value
PEL: Permissible Exposure Limit
REL: Recommended Exposure Limit
Flammable Liquids 4: Flammable liquids – Category 4
Acute Toxicity - Oral 4: Acute toxicity – Category 4

(Contd. on page 11)

Safety Data Sheet

acc. to OSHA HCS

Trade name: Compound ZF 113

(Contd. of page 10)

Skin Corrosion 1B: Skin corrosion/irritation – Category 1B
Skin Corrosion 1C: Skin corrosion/irritation – Category 1C
Skin Irritation 2: Skin corrosion/irritation – Category 2
Eye Damage 1: Serious eye damage/eye irritation – Category 1
Carcinogenicity 2: Carcinogenicity – Category 2
Toxic to Reproduction 2: Reproductive toxicity – Category 2
Specific Target Organ Toxicity - Single Exposure 3: Specific target organ toxicity (single exposure) – Category 3
Specific Target Organ Toxicity - Repeated Exposure 2: Specific target organ toxicity (repeated exposure) – Category 2

- **Sources**
For the preparation of this SDS information from our suppliers, information on chemicals from the European Chemicals Agency (ECHA) and data from the GESTIS database were used.
- *** Data compared to the previous version altered.**

APPENDIX F

Cooling Tower O&M Manual

Installation & Operation Instruction Manual

500 GPM Hybrid Closed-Loop Furnace Cooling System with Air-Cooler and Closed-Circuit Cooling Tower

Dry Coolers Serial No: J-6233
Nov 11, 2015

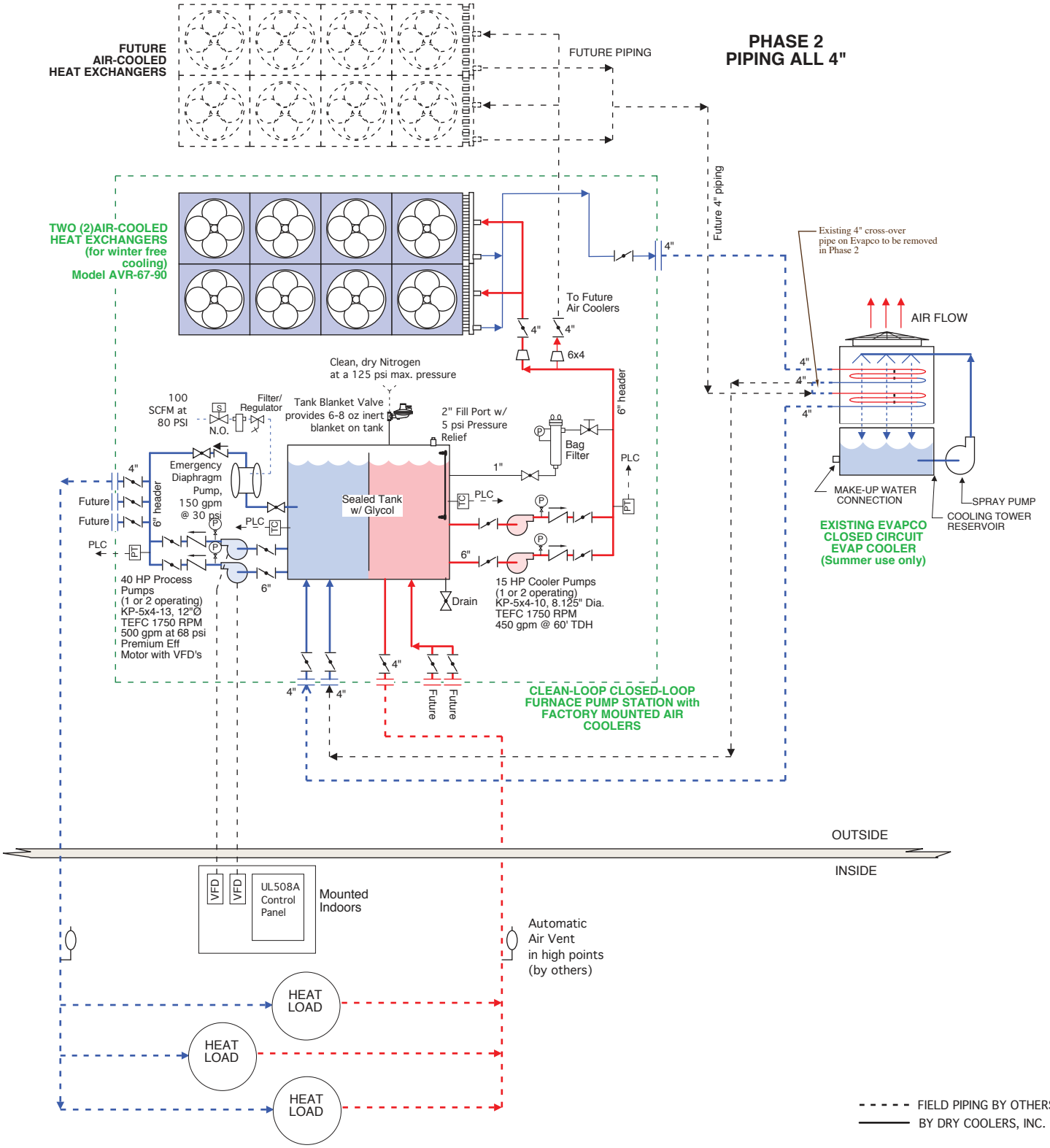
Orchid Orthopedic

Oregon City, OR
PO 88367

Dry Coolers Inc.

ISO 9001:2008
CERTIFIED

575 S. Glaspie St.
Oxford, MI 48371 USA
Phone: 248-969-3400
Fax: 248-969-3401
www.drycoolers.com



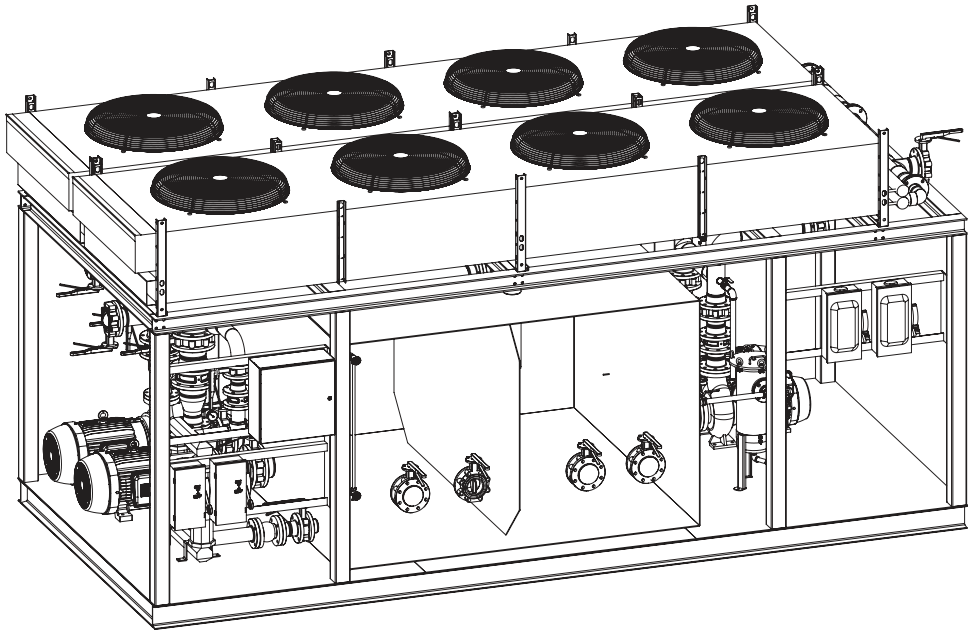
Dry Coolers Inc.
3232 Adventure Lane
Oxford, MI 48371
Phone (248) 969-3400
Fax (248) 969-3401
www.drycoolers.com

PROCESS COOLING DIAGRAM

REF:	PO: 88367	BY/DATE:	mjr 9/17/2015
CUSTOMER:	ORCHID ORTHOPEDIC	DRW #	J-6233 PID R5

J-6233
Orchid Orthopedic
Closed Loop Furnace Cooling System

STANDARD APPROVAL PACKAGE



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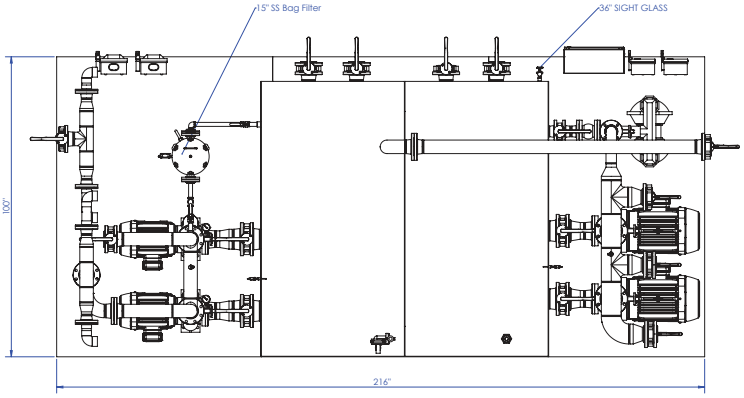
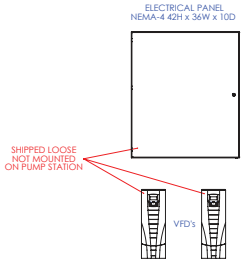
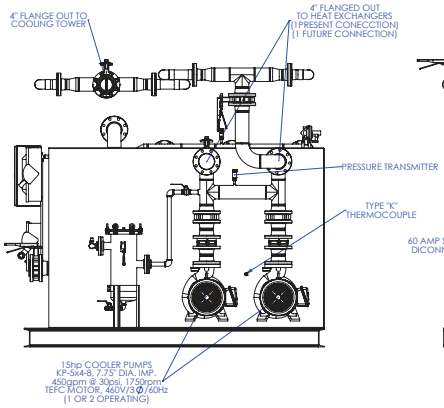
575 S. GLASPIE ST.
Oxford, MI 48371 USA
248.969.3400
www.drycoolers.com

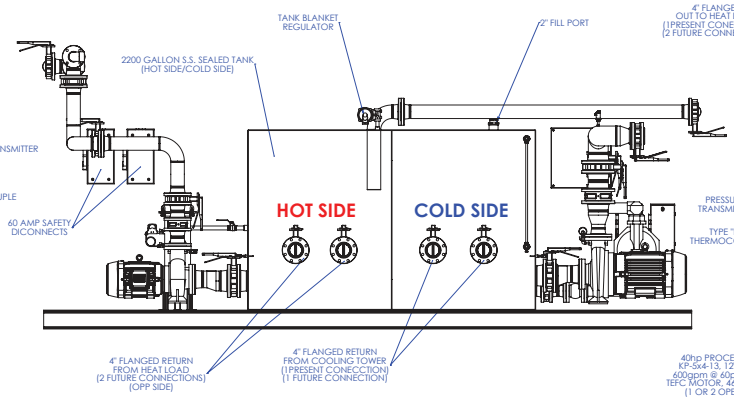
DDX-600-2200-EEP-ST-MP

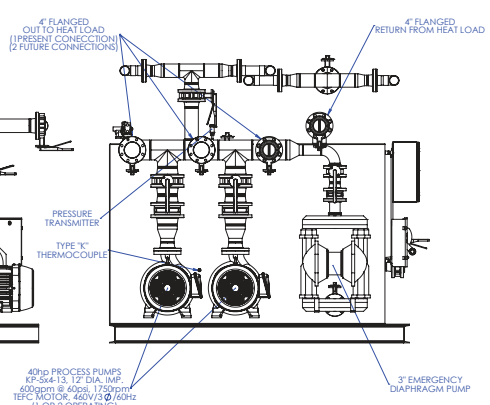
INSTALLATION NOTES:
1) Carefully read the installation and Operating manual that comes with this systm prior to installation.
2) Dimensions may vary due to manufacturing tolerances. Do not complete field piping until system is properly installed.
3) Do not rig from system piping.
4) Level and shim base before anchoring.
5) Do not bind system connections.
6) Field piping must be supported independent of system piping.
7) Manual valves should be installed in all high points of the system to assist in venting air during fill.







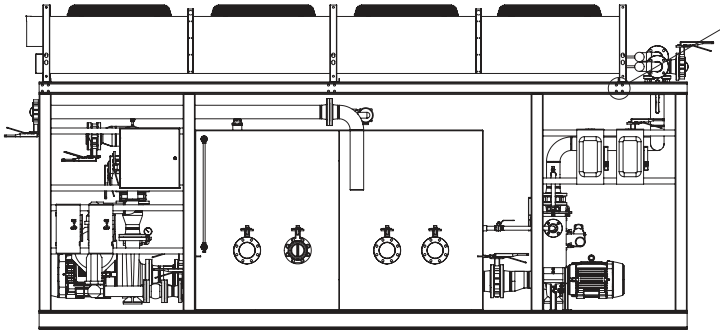


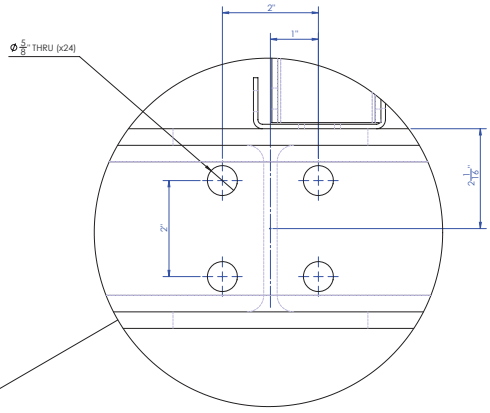


REV.	DATE	BY	DESCRIPTION
0	09/02/15	MDG	Original (PIDr0)
1	09/11/15	MDG	Rotated skid 180deg., changed location of outlets and returns.
2	09/17/15	MDG	Replaced electric back-up pump with 3" Emergency Diaphragm Pump, reoriented returns.
3	09/22/15	MDG	Added 15" SS Bag Filter

Dry Coolers
575 S. GLASPIE ST.
Oxford, MI 48371 USA
248.969.3400
www.drycoolers.com

DRAWING TITLE: GENERAL LAYOUT 1	PAINT COLOR:	
EQUIPMENT: DDX-600-2200-EEP-ST-MP	SHEET NO.: 2 OF 3	REV.
CUSTOMER: Orchid Orthopedic	DRAWING NO.: J-6233-GL-01	





DETAIL A
SCALE 1 : 1

REV.	DATE	BY	DESCRIPTION
0	09/02/15	MDG	Original (PIDr0)
1	09/11/15	MDG	Rotated skid 180deg., changed location of outlets and returns.
2	09/17/15	MDG	Replaced electric back-up pump with 3" Emergency Diaphragm Pump, reoriented returns.
3	09/22/15	MDG	Added 15" SS Bag Filter

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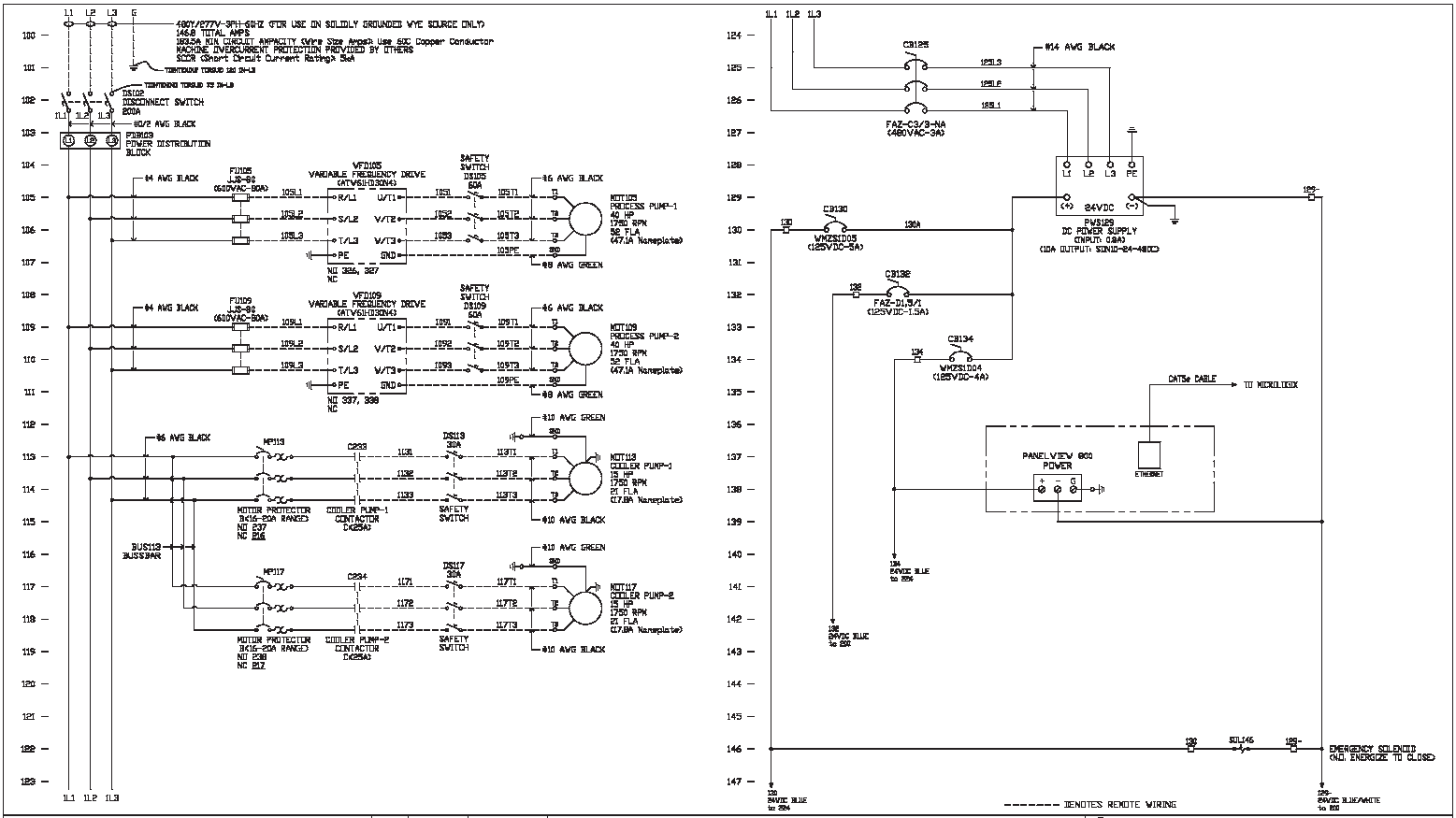
575 S. GLASPIE ST.
Oxford, MI 48371 USA
248.969.3400
www.drycoolers.com

DRAWING TITLE: GENERAL LAYOUT 2
PAINT COLOR:
EQUIPMENT: DDX-600-2200-EEP-ST-MP
SHEET NO.: 3 OF 3
REV.:
CUSTOMER: Orchid Orthopedic
DRAWING NO.: J-6233-GL-02



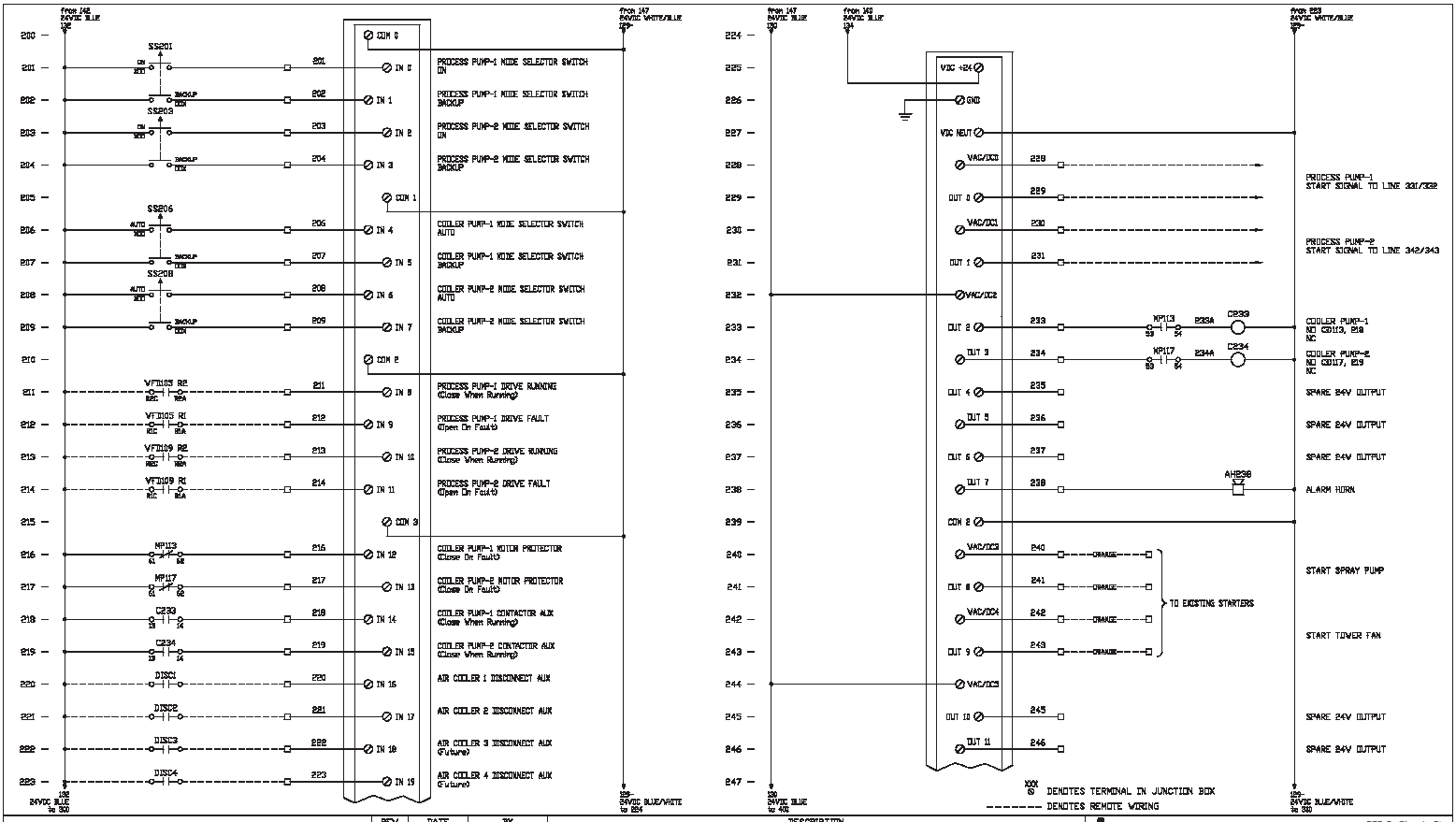
REV	DATE	BY	DESCRIPTION
0	08/28/15	MJS	ORIGINAL
1	09/08/15	MJS	REQUESTED UPDATES
2	09/16/15	MJS	ADDED EMERGENCY DIAPHRAGM PUMP SOLENOID

Dry Coolers
575 S. Glaspie Street
Oxford, MI 48371 USA
248.969.3400
www.drycoolers.com

DRAWING TITLE: ELECTRICAL WIRING SCHEMATIC

EQUIPMENT	SHEET NO.	REV.
PROCESS COOLING SYSTEM	1 OF 5	2

CUSTOMER	DRAWING NO.
ORCHID ORTHOPEDIC	J-6233EL



REV	DATE	BY	DESCRIPTION
0	08/28/15	MJS	ORIGINAL
1	09/08/15	MJS	REQUESTED UPDATES
2	11/11/15	MJS	ADDED AIR COOLER DISCONNECT INPUTS

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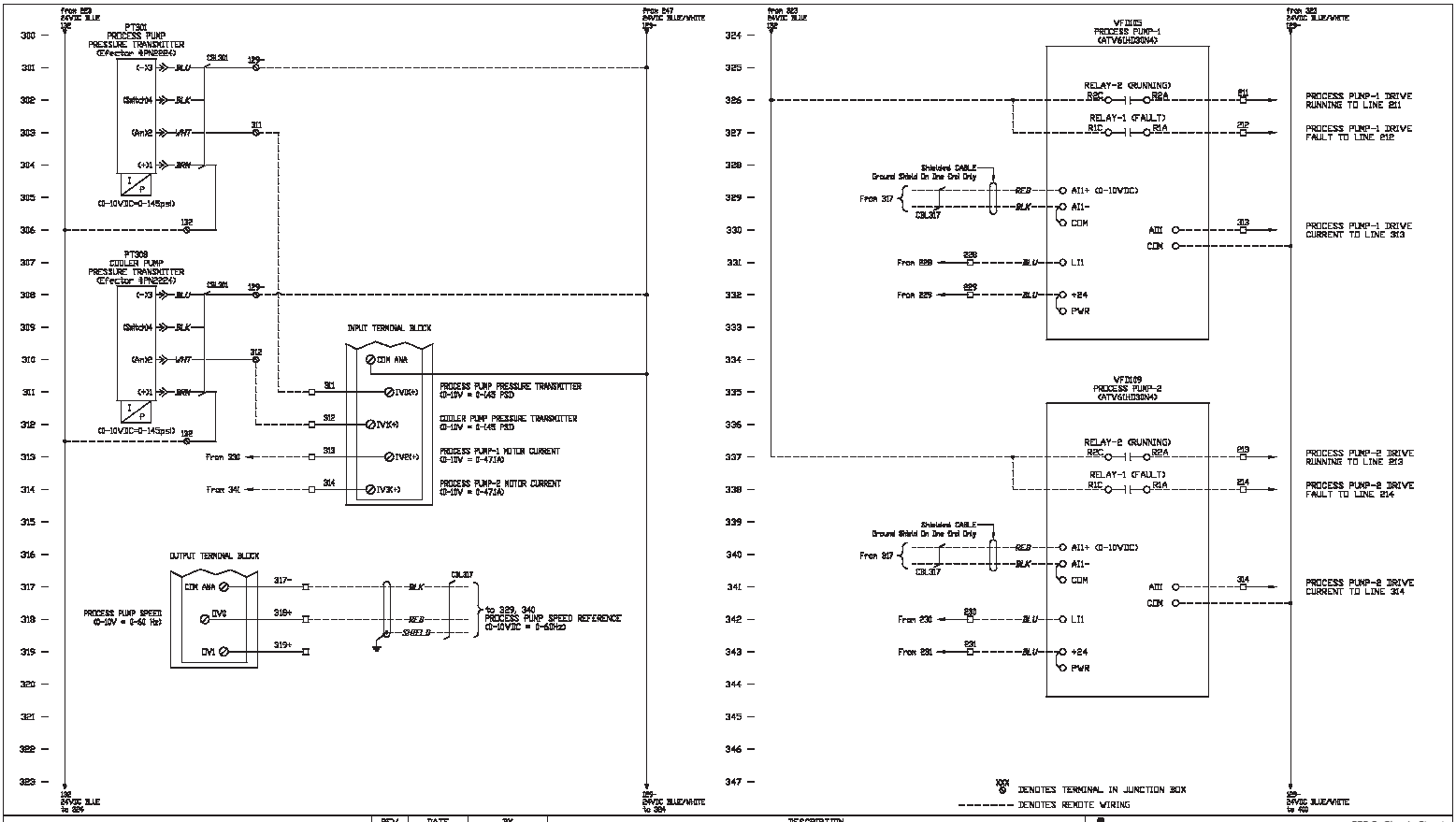
DRAWING TITLE: ELECTRICAL WIRING SCHEMATIC

EQUIPMENT	SHEET NO.	REV.
PROCESS COOLING SYSTEM	2 OF 5	2

CUSTOMER	DRAWING NO.
ORCHID ORTHOPEDIC	J-6233EL



REV	DATE	BY	DESCRIPTION
0	08/31/15	MJS	ORIGINAL
1	09/08/15	MJS	REQUESTED UPDATES
2	09/28/15	MJS	ADDED COOLER PUMP PRESSURE TRANSMITTER

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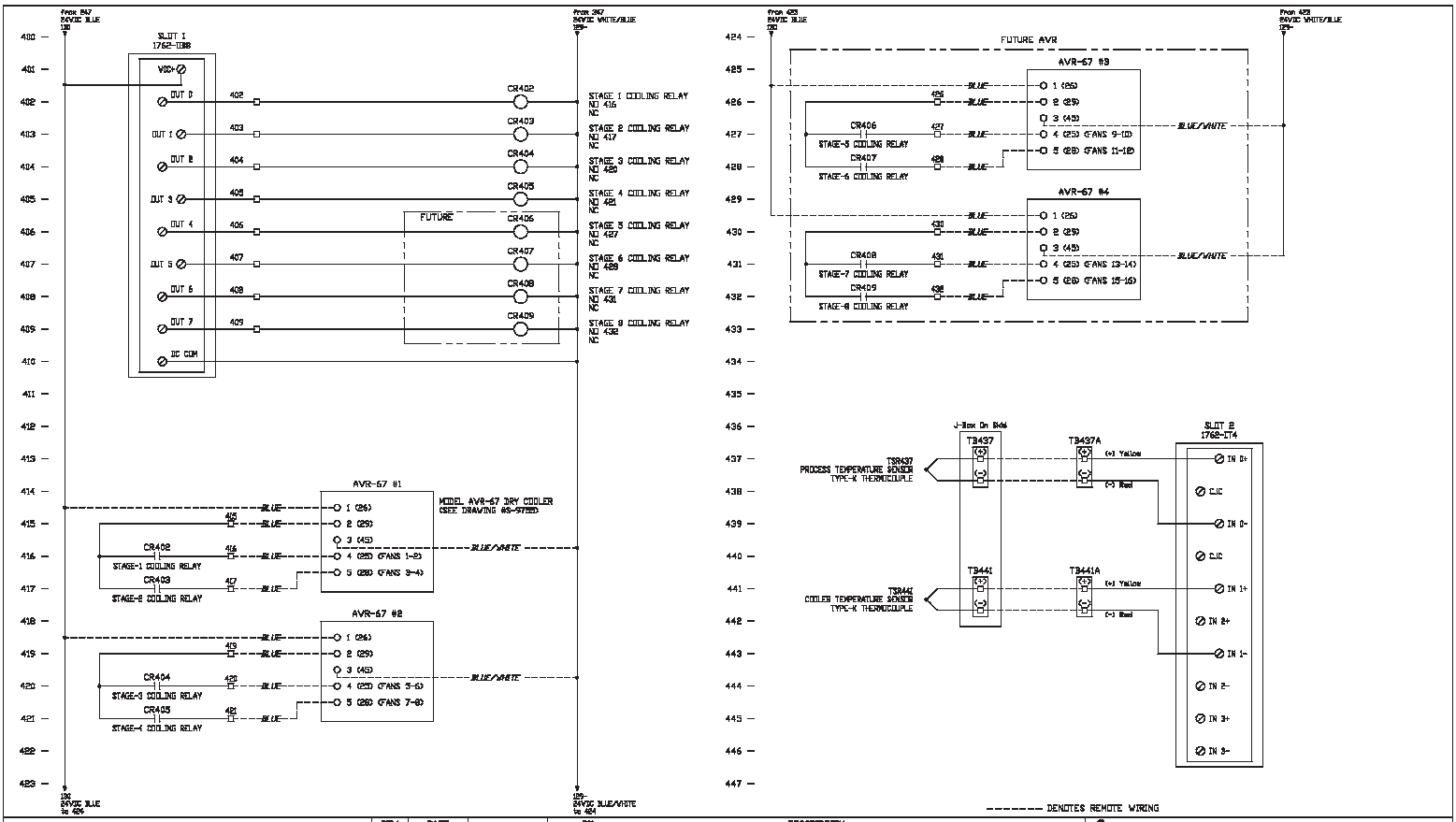
DRAWING TITLE: ELECTRICAL WIRING SCHEMATIC

EQUIPMENT	SHEET NO.	REV.
PROCESS COOLING SYSTEM	3 OF 5	2

CUSTOMER	DRAWING NO.
ORCHID ORTHOPEDIC	J-6233EL



REV	DATE		BY	DESCRIPTION
0	08/31/15		MJS	ORIGINAL
1	09/08/15		MJS	REQUESTED UPDATES

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575 S. Glaspie St.
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DRAWING TITLE: ELECTRICAL WIRING SCHEMATIC

EQUIPMENT	SHEET NO.	REV.
PROCESS COOLING SYSTEM	4 OF 5	1
CUSTOMER	DRAWING NO.	
ORCHID ORTHOPEDIC	J-6233EL	

SCHNEIDER ATV61 PROCESS PUMP DRIVE CONFIGURATION

(S IN-) SIMPLY START MENU

CODE	SETTING	NAME/DESCRIPTION
tCC	2C	2/3 WIRE CONTROL
CFG	FnF	MACRO CONFIGURATION (Pumps/Fans)
bFr	60	STANDARD MOT. FREQ (60Hz)
IPL	yES	INPUT PHASE LOSS
nPr	40	RATED MOTOR POWER (MOTOR NAMEPLATE Hp)
Uns	480	RATED MOTOR VOLT (MOTOR NAMEPLATE V)
nCr	47.1	RATED MOT CURRENT (MOTOR NAMEPLATE FLA)
FrS	60	RATED MOTOR FREQ. (MOTOR NAMEPLATE Hz)
nSP	1750	RATED MOTOR SPEED (MOTOR NAMEPLATE RPM)
tFr	60	MAX FREQUENCY (Hz)
ItH	47.1	MOT. THERM. CURRENT (MOTOR NAMEPLATE FLA)
ACC	10	ACCELERATION (SECONDS)
dEC	10	DECELERATION (SECONDS)
LSP	20	LOW SPEED (MOTOR FREQUENCY AT MINIMUM REFERENCE Hz)
HSP	60	HIGH SPEED (MOTOR FREQUENCY AT MAXIMUM REFERENCE Hz)

(I-O-) INPUTS/OUTPUTS CFG

CODE	SETTING	NAME/DESCRIPTION
AI1t	IAU	AI TYPE (0-10V)
UIL1	0	AI MIN VALUE (0V)
UIH1	10	AI MAX VALUE (10V)
AI1F	1.0	AI FILTER (Seconds)
r1	FLt	R1 ASSIGNMENT (No Drive Fault)
r2	rUn	R2 ASSIGNMENT (Drive Running)
AOI	OCr	I MOTOR (Current To The Motor)
AO1t	IAU	AOI TYPE (Voltage)
UOL1	0	AOI MIN OUTPUT (0V)
UOH1	10	AOI MAX OUTPUT (10V)

PT301 PRESSURE TRANSMITTER CONFIGURATION

Press [Mode/Enter] until requested parameter is displayed.
Press and hold [Set] until requested parameter flashes.

PARAMETER	SETTING	DESCRIPTION
OU1	HnO	HYSTERSIS FUNCTION / NORMALLY OPEN
OU2	U	VOLTAGE SIGNAL (0-10V)
ASP	0	ANALOG START POINT
AEP	100	ANALOG END POINT
HI	145	MAX VALUE (SYSTEM PRESSURE)
LO	0	MIN VALUE (SYSTEM PRESSURE)
P-n	PNP	OUTPUT POLARITY
Uni	psi	UNITS OF MEASURE
dIS	d2	DISPLAY CONFIGURATION (200ms Update)

-------- DENOTES REMOTE WIRING

REV	DATE	BY	DESCRIPTION
0	09/08/15	MJS	ORIGINAL
1	09/16/15	MJS	REMOVED EMERGENCY PUMP PANEL

Dry Coolers
575 S. Glaspie Street
Oxford, MI 48371 USA
248.969.3400
www.drycoolers.com

DRAWING TITLE: ELECTRICAL WIRING SCHEMATIC

EQUIPMENT	SHEET NO.	REV.
PROCESS COOLING SYSTEM	5 OF 5	1

CUSTOMER	DRAWING NO.
ORCHID ORTHOPEDICS	J-6233EL

Dry Coolers Inc.

ISO 9001:2008
CERTIFIED

575 S. Glaspie St.
Oxford, MI 48371 USA
Phone: 248-969-3400
Fax: 248-969-3401
www.drycoolers.com

Installation & Operation Instruction Manual for the Aqua-Vent Closed-Loop Air-Cooled Heat Exchange System with Emergency Diaphragm Pump

INTRODUCTION

As with any equipment, proper installation and maintenance will improve performance and extend service life. The following suggestions are designed to assist you in installing and operating your Aqua-Vent Closed-Loop Air-Cooled Heat Exchange System.

INSPECTION

Inspect the unit as soon as is received from the shipper. Any shipping damage MUST be immediately identified and claimed with the shipper. Also, make sure that the contents of any loose shipped boxes or crates are identified. Missing parts should be identified at the outset thereby preventing installation delays and unnecessary expense. Electrical nameplate characteristics of motors, controls, etc., should be checked promptly to make sure they are consistent with your electrical service.

All of the Aqua-Vent Closed-Loop Air-Cooled Heat Exchange Systems are fully pressure tested, run-tested, and inspected prior to shipment. A small amount of water or propylene glycol may be left in the tank and piping from the run-off. The glycol is used in run-off at the factory so that there is no potential for freeze damage during shipment.

APPLICATION

The Aqua-Vent Cooling System is designed for the year round cooling of process liquids with air. The standard Aqua-Vent heat exchanger has the fluid circulating inside a finned tube coil over which air is drawn to provide cooling. As shown in the process diagram, the circulating pump draws water from the tank and pumps it through an air-cooled heat exchanger ("Dry Cooler"). The cooled water then flows to your equipment and returns to the tank. The basic components of an Aqua-Vent cooling system are described below.

EQUIPMENT DESCRIPTION

Following are the basic components of the Aqua-Vent Closed-Loop Air-Cooled Heat Exchange System:

RECIRCULATING PUMP – closed-coupled centrifugal pumps operating at 3500 RPM and typically rated for 60 psi or higher. A pump curve and maintenance manual is provided.

TANK – accepts the expansion and contraction of the liquid as it is heated and cooled and also provides a means for air to be removed from the system. Large tanks (over 2000 gallons) are often shipped separate from the pump station and require field installation of the tank accessories (i.e. sight glass, tank blanket valve, drain, thermometer with well, thermocouple with well, and pressure relief). These items will be shipped loose for field installation.

EMERGENCY DIAPHRAGM PUMP – This cooling system is supplied with a diaphragm backup pump that will automatically start upon loss of commercial power. Plant nitrogen is typically piped to a Fail Open (Normally Open) pneumatic valve located upstream of the diaphragm pump. On loss of power, this valve will open allowing nitrogen to flow to the pump. The pump is factory mounted to the pump station and is pre-piped with the fail-open valve and a filter/regulator. The regulator can be adjusted to regulate the speed of the pump. Vendor literature is provided. *CAUTION: The diaphragm pump will automatically start on loss of commercial power and will continue to operate until power is restored. This could deplete your nitrogen supply if power is out for an extended period of time.*

PRESSURE RELIEF – All tanks are supplied with a safety pressure relief. A 7 psi or 15 psi ASME pressure relief valve is typically used for tanks smaller than 240 gallons. On larger tanks, a 2" drum vent (with 5 psi relief) or 8" diameter fill port (with 1 psi relief) is used. The latter serve as both fill ports and pressure relief.

(Optional) TANK BLANKET VALVE – An 3/4" tank blanket valve has been shipped loose for installation on top of the tank. The valve will maintain a constant nitrogen blanket on the coolant. This eliminates the presence of oxygen in the system and greatly reduces corrosion. The valve requires a maximum of 125 psi pressure and will reduce the nitrogen pressure down to 6-8 ounces in the tank. The valve includes an inherent pressure relief at about 12 oz.

INDICATORS – pressure gauge and sight flow indicator for monitoring system performance.

LOCATION GUIDELINES

The Aqua-Vent Pump Station should be located close to the equipment requiring cooling. The unit should be located so that gauges are clearly visible to operators and maintenance personnel.

Locate the heat exchangers so that an adequate supply of unrestricted air is available. Unit must not be installed in the path of air currents from discharge vents or exhaust fans of any type and should be oriented so as to be unaffected by adverse prevailing winds.

Level mounting of the Aqua-Vent heat exchanger is necessary to assure proper fluid distribution in the coil. Level mounting of the pumping station is necessary to assure flooded pump suction.

The pumping station should be located indoors in a convenient place. Gauges should be clearly visible to operators and maintenance personnel.

FREEZE PROTECTION

WARNING: Aqua-Vent heat exchangers located outside **are subject to freeze damage at 32°F.** Adequate anti-freeze concentration must be monitored and maintained on a routine basis.

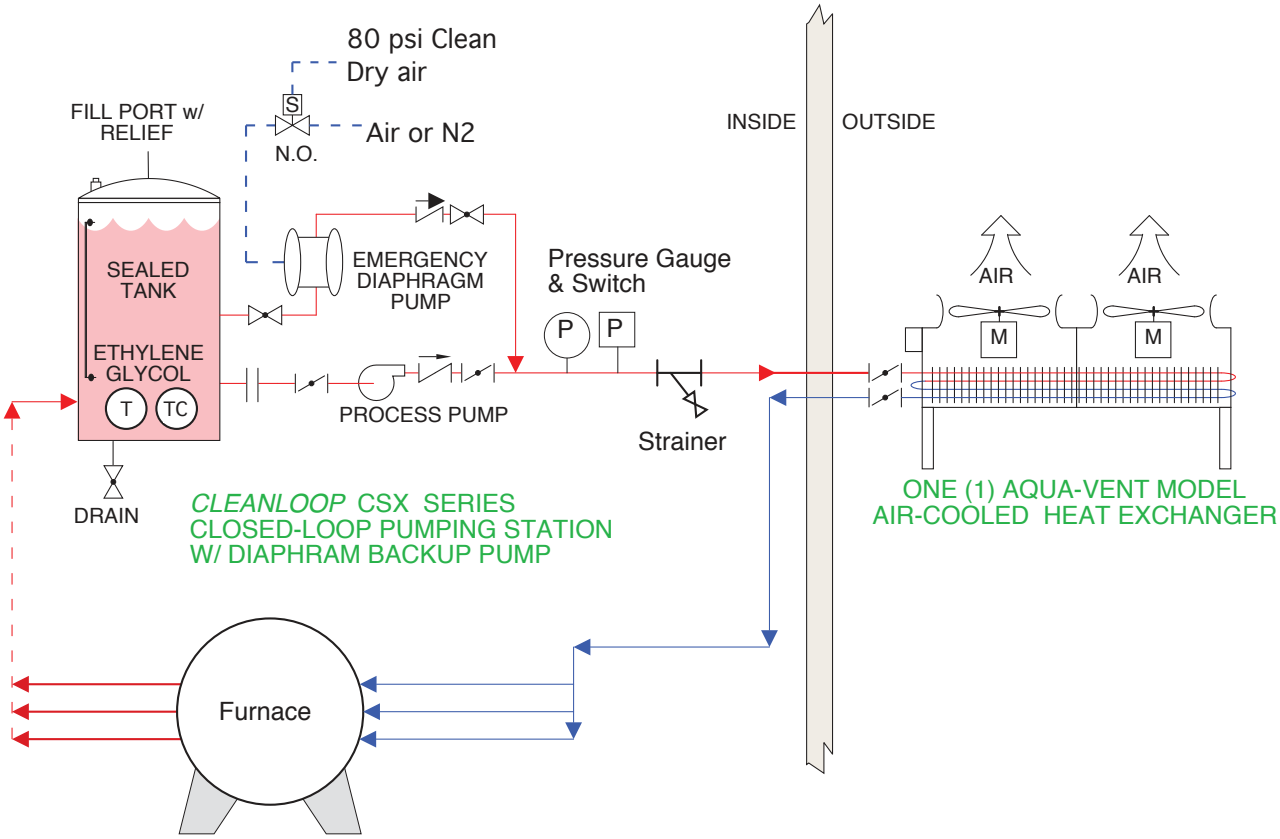

Figure 1. Typical Process Diagram

PIPE SIZING

Typically, the piping going to and from your equipment should be sized large enough to minimize the pressure losses caused by pipe fittings, valves, and pipe friction. Pressure losses in a piping system can be readily determined using the "equivalent length" method that is detailed out in most piping handbooks. Use the following htable for systems requiring less than 200' length of pipe and that has a minimum number of valves and bends. Larger and more complex systems may need special consideration. Consult Dry Coolers for recommendations.

Pipe Dia (inches)	Max. Flow Supply (gpm)	Max. Flow Return for Furnaces (1) (gpm)
1	10	6
1.5	35	20
2	75	40
2.5	120	70
3	200	120
4	350	250
5	550	450
6	800	750
8	1500	1500
10	2500	2500
12	4000	4000

(1) Typically, the back pressure on a furnace must be minimized, so the return water piping for a furnace is usually one size larger than the supply pipe. For example, if a furnace requires a 3" supply, then a 4" return.

Example: An Aqua-Vent Closed-Loop Pumping Station is sized to cool several furnaces requiring a total flow of 150 gpm. A minimum pipe size of 3" is recommended for the supply and 4" for the return piping.

PIPING INSTALLATION

The following are some general piping guidelines and recommendations that should be considered when installing your equipment:

1) Qualified contractors who are familiar with your local codes should install your piping system.

2) Do not use galvanized piping as it reacts with some inhibitors in glycol's and can cause precipitation and deposits in your equipment.

3) All piping must be supported independently from the pump station.

4) Install control valves upstream of each piece of equipment to be cooled so that the flow can be balanced among them.

5) Install shut-off valves on each piece of equipment so that it can be isolated for maintenance.

6) Install manual vent valves in the high points of all the process piping to assist in removing air during the initial system start up.

PIPING CLEANING

After installation, the system piping should be thoroughly cleaned and flushed with 1 lb of pure tri-sodium phosphate (TSP) for each 200-400 gallons of water. The TSP should be pre-mixed with hot water and then poured into the tank or alternatively added slowly over time to prevent collection along the bottom of the tank. This cleaning procedure will remove cutting oils, lubricants and dirt commonly found in piping systems. TSP can typically be found and your local hardware store.

Alternatively you may use a liquid cleaner, such as Nu-Calgon's Liquid System Cleaner #4370-08. Using 1 gallon of product for every 75 gallons of water, circulate the system for approximately 8 hours. Be sure to vent the system from highest elevation to prevent gas build-up. If at all possible heat the cleaning solution to 120-130° F and flush the system continually until flush water runs clear. Then add fresh water. This product is available through Dry Coolers Inc. or any Nu-Calgon distributor.

FREEZE WARNING: If the system is installed during freezing weather, it is very important to isolate the air cooler from the cleaning and flushing procedure so that water does NOT accumulate and freeze in the coil. This will permanently damage the heat exchanger. Under these conditions, it may be necessary to clean the indoor piping separate from the air cooler or forgo the cleaning process and charge the system directly with glycol. Please contact Dry Coolers to discuss.

ESTIMATING FLUID VOLUMES

It is often necessary to determine the volume of water held in a cooling system so that appropriate concentrations of corrosion inhibitor and/or glycol can be added.

The volume of water in your system is determined by adding the volume of water in your pipes, tanks, cooling equipment, and your process equipment. At your request, Dry Coolers can provide the cooling equipment volumes.

The following table may be used as a guide for determining the volume within pipes.

Pipe Dia (inches)	Gallons per 100 ft of Pipe
1	4.5
1.5	10.6
2	17
2.5	25
3	38
4	66
5	104
6	147
8	260
10	410
12	587

SYSTEM VOLUME CALCULATIONS

Volume in Piping _____

Volume in Tanks _____

Volume in HX Equip. _____

Volume in Process Equip. _____

TOTAL VOLUME (GAL) _____

SYSTEM STARTUP

After the piping system has been installed, cleaned, and flushed, it can then be started.

1) Make sure that all shutoff valves in the entire cooling system are fully open.

2) Open the fill port located on top of the reservoir and add water/glycol to the reservoir. The final liquid level in the expansion tank should be 2/3rd's full.

3) Check for correct pump rotation. This can be done by quickly jogging the pump motor. NOTE: Never run the pump dry! This will damage the mechanical seal.

4) Monitor the level in the tank to make sure the tank doesn't run dry. Add water/glycol as needed to maintain the tank about 3/4 full.

5) Allow the system to slowly fill with water/glycol. Most difficulties in starting a system come from air being trapped in the piping. **All high points in the piping system must be vented during the filling operation.**

6) Check the piping system for any leaks.

7) TEST THE AIR-COOLED HEAT EXCHANGERS: Check for correct Aqua-Vent fan rotation. This can be done by jogging the "DRY COOLER" selector switches to the HAND position. Be sure that the fans run freely. The air should be blowing upward. In AUTO mode, the fans will automatically cycle ON & OFF by the temperature controller set points. The setpoints are adjustable. See the enclosed information.

8) TEST THE EMERGENCY BACKUP SYSTEM: Make sure 80 psi air (or nitrogen) is connected to both the pneumatic actuator that operates the valve and to the valve itself. Blow out the air-line before connecting it to the diaphragm pump. Please read the enclosed instruction manual.

9. Adjust the in-line regulator to obtain the desired supply pressure to the pump.

10. When the valve is energized and supplied with house air, the valve will remain closed. By disconnecting power from the main panel, the valve will OPEN allowing nitrogen to flow through the diaphragm pump. Note: The electric pumps need to be OFF to start the diaphragm pump. The pressure created by the electric pumps will prevent the diaphragm from operating.

11. Normal operation may now be started at any time.

SYSTEM CONTROLS

This pumping station is provided with a NEMA 12 electrical control panel for operating the cooling system. An electrical ladder diagram is attached.

The thermocouple located in the process tank should be connected to the temperature controller in the control panel. This controller is used to cycle the air-cooled heat exchanger fans ON/OFF. The temperature set points are field adjustable. See the attached temperature controller configuration sheet and operation manual.

Alarms are typically provided for low process pump pressure and/or high temperature. An alarm silence and an alarm reset pushbuttons are provided.

GLYCOL CHARGE

Charge your closed-loop cooling system with glycol Immediately!

Draining your piping system from water is not a sure method of preventing freeze damage. No matter how carefully the system is drained, water will almost always collect in low spots in the system where it is hard to detect and remove. Even blowing the system out with compressed air does not always ensure complete water removal. Furthermore, blowing more oxygen into damp pipes just compounds the corrosion problem.

Glycol solutions provide the best freeze protection for cooling systems because they significantly lower the freezing point of water.

The amount of ethylene glycol required depends upon the system holding volume (calculated previously) and the design minimum outside temperature.

Percent of ethylene glycol required:

Percent Glycol (%)	Minimum Outside Temp (°F)
20%	+15
30%	-3
40%	-14
45%	-23
50%	-38

Note: This table is intended as a guide only. Consult your glycol supplier for recommendations for freeze protection for your area.

GLYCOL PRECAUTIONS

1. NEVER use automotive type ethylene glycol. These have inhibitors designed for protecting aluminum, not steel and copper. Tell your glycol supplier the material of construction of your system to insure the correct inhibitors are provided with the glycol. Most systems are constructed with carbon steel piping, cast iron pumps, and copper heat exchanger tubes.
2. NEVER use pure (100%) glycol in your cooling system. Pure ethylene glycol is very corrosive and is more susceptible to freezing than when mixed with water.
3. If possible, NEVER use galvanized steel piping as it can react with the glycol inhibitors and cause sludging. If galvanized piping is used, be sure to discuss it with your glycol supplier.

GLYCOL SLUDGE PREVENTION

Glycol systems may be subject to sludge formation in coils, due to one or more of the following causes:

1. Reaction of the corrosion inhibitor with galvanized piping (zinc).
2. Reaction of the glycol with chromate type water additives.
3. Reaction of the glycol with pipe dope, cutting oils, solder flux, and other system dirt.

Glycol manufacturers offer a specially inhibited glycol (formulated for snow melting systems) which does not react with zinc. This glycol is also suitable for heat transfer systems. Glycol manufactures also provide inhibitor check services on a regular basis.

Consequently, good glycol system design requires the following precautions:
1. No galvanized piping is to be used.
2. System piping must be thoroughly cleaned and flushed with a heated trisodium phosphate solution before filling with the water/glycol mixture.
3. No chromate inhibitor treatment must be used.
4. The glycol manufacture should provide inhibitor check service and supply additional inhibitor as required.

SUGGESTED GLYCOL SUPPLIERS

Dow Chemical	800-447-4369
Houghton Chemical	617-254-1010
Interstate Chemical	800-422-2436
Noble Company	800-678-6625
Union Carbide	800-331-6451
Chem Central	800-482-7757

Tell your supplier to include corrosion inhibitors to protect the materials in your system (usually copper and iron). Also, make sure to add a colorant to the glycol so that any leakage / spillage can be detected.
Consult with the supplier relative to your specific needs.

ROUTINE MAINTENANCE

DAILY

After the system is operating normally, the user should log typical system pressures and temperatures for future reference. These should be checked daily to determine any significant deviation which may indicate malfunction in the pumping system, heat exchanger or heat source.

MONTHLY

The pump motor should be lubricated with lithium base grease every three months. Pump maintenance instructions are attached

IMPORTANT REMINDERS

Support all piping independently from the Aqua-Vent pump station and air-cooled heat exchanger.

Add air vents in high points of process piping.

Clean and flush your system with tri-sodium phosphate (TSP).

NEVER run the pumps dry.

Install wiring in accordance with National Electrical Code and local codes.

Never subject the cooling system to freezing temperatures without adequate protection.

Charge the system with the appropriate concentration of glycol immediately. NEVER use chromate inhibitors. NEVER use automotive antifreeze.

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INSTALLATION & MAINTENANCE MANUAL

AVR SERIES AIR COOLED HEAT EXCHANGERS

Bulletin No. IOM 101a
June 2012

General Safety Information

- Installation and maintenance are to be performed only by qualified personnel who are familiar with this type of equipment.
- Make sure that all field wiring conforms to the requirements of the equipment and all applicable national and local codes.
- Avoid contact with sharp edges and coil surfaces. They are a potential injury hazard.
- Make sure all power sources are disconnected before any service work is done on the units.

Inspection

Check all items against the bill of lading to make sure all crates and cartons have been received. If there is any damage, report it immediately to the carrier and file a claim. Make sure the voltage on the unit nameplate agrees with the power supply available.

IMPORTANT: The coils are shipped with a nitrogen charge. Upon receipt, verify the pressure in the coil via the Schrader valve at the end of the header connection. If the pressure is 2 psi or less, notify Dry Coolers, Inc. immediately as the coil may have been damaged during transit.

Rigging and Handling

All AVR fluid coolers are shipped on their sides and come shipped on a skid with a wooden skeleton frame to prevent damage in transit. Leave all framing attached until the unit is as close as possible to its final installed location.

All units have built in lifting lugs, see Figure 1 below for recommended rigging procedure and lifting procedures. Use spreader bar(s) when necessary, failure to do so will damage the air cooled exchanger. Never use the coil headers or return bends for moving or lifting the cooler.

Unit Location

Do not locate any unit so as to be bordered by tall obstructions on three or more sides. See Figure 2 for minimum clearance from obstructions and between units. Short circuiting of the air flow or the intake of warmer air from another unit will seriously degrade the performance of the air cooled heat exchanger. Noise consideration should also be considered when locating an air cooled heat exchanger. Proximity to windows, walls and surrounding structures can cause objections by the occupants. An acoustical expert should be consulted when noise is of a particular concern.

CAUTION: VENT PRESSURE FROM COIL BEFORE REMOVING END CAPS

Start-Up

Prior to start-up check the following items:

- Check fans for freedom of movement.
- Check all fan blade set screws, motor mounts, and mounting leg fasteners.
- Check that the nameplate voltage matches the power supply voltage.

On start-up check the rotation of all fans to insure that air is being discharged up out of the fan discharges. If discharge is wrong, correct by reversing two of the motor leads in the junction box.

Maintenance

Maintenance of the air cooled heat exchanger is extremely important for extended life and peak performance. The following is a recommended maintenance schedule. Site conditions will dictate the frequency of this maintenance plan.

1. Shut off all power to the air cooled heat exchanger and pumping system at the closest disconnect switch and use a lock to prevent others from turning power back on to the unit.

2. Remove fan guards.

3. Remove all large debris (leaves, paper, cardboard, plastic film, *etc*.) from both the top as well as beneath the unit. Keep the area clean around the cooler by removing loose debris around the air cooled heat exchanger.

4. Inspect the unit for damaged fins caused by the debris. Comb out any bent fins with a fin comb. Inspect the unit for signs of corrosion. Note the area and amount of corrosion in your maintenance reports.

5. Should the heat transfer surface require cleaning us the following procedure. Use a cleaning solution that is compatible with the finned material and any protective coating that may have been applied to the heat transfer surface. Follow the cleaning instructions exactly as described by the manufacturer of the cleaning agent. It is extremely important that a proper rinse be applied to the core once the cleaning process is completed. Use a hose with a spray wand and rinse from the top of the unit only. Do not rinse from the underside as this will not properly flush the cleaning agent from the core. Any residue of cleaner left for any extended period will begin to corrode the heat transfer surface. It is recommended to use a detergent type cleaner like Cal-Clean as a cleaning solution.

6. Inspect all fan and motor fasteners for tightness before installing the fan guards.

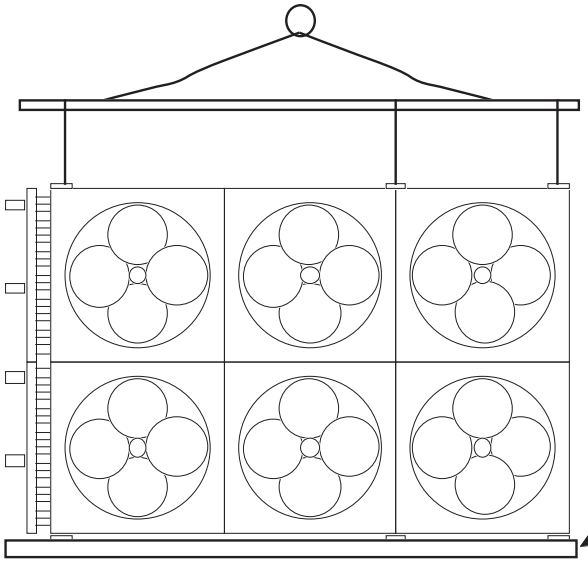
7. Turn power back on to the system.

For inland installations (30 miles from any body of salt water): Visual inspection of the heat transfer surface and unit once every 6 months. Clean the heat transfer surface should it show signs of significant dirt accumulation. Recommended minimum cleaning cycle is once every 12 months.

For sea coast installations (up to 30 miles from any body of salt water): Schedule visual inspections of the heat transfer surface and unit once every 3 months. Clean the heat transfer surface thoroughly every 3 to 6 months with water to remove accumulated layers of salt. Every 12 months clean the heat transfer surface with an approved cleaning solution.

Replacement Parts List

Model No.	Description	Part No.
AVR-5 thru 9	Capacitor, all motors, 5 MFD, 208-230/460V 1Ø 60 Hz	202163-007
	Fan Blades, 24" dia, 32° pitch, CW rotation, 1/2" bore	213455-000
	Fan Guard, wire, epoxy coated (blue), 24"	202136-001
	Motor, PSC, 3/4 HP, 1075 RPM, 208-230V 1Ø 60 Hz	205051-009
	Motor, PSC, 3/4 HP, 1075 RPM, 460V 1Ø 60 Hz	205051-002
	Motor Mount	205269-000
AVR-14 thru 216	Fan Blades, 30" dia, 24° pitch, CW rotation, 5/8" bore	210385-000
	Fan Guard, wire, epoxy coated (blue), 24"	102136-006
	Motor, 1-1/2 HP, 1140 RPM	110204-000
	Motor Mount, 30"	210203-000

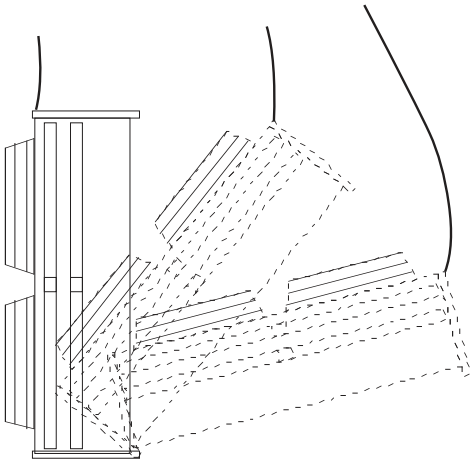


Removing Cooler From Skid

1) Using a spreader bar connect the slings to the cooler.

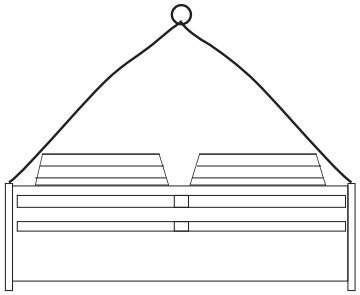
2) Loosen the skid.

3) Raise cooler then set on the ground.



Rotate Unit Flat

1) Gently pull top of unit over maintaining cable tension as unit is rotated from vertical to horizontal



Rig To Lower Legs Into Position

1) Using a spreader bar connect the slings to the cooler (one set of hooks at each leg position).

2) Remove the 1/2" bolts that hold the legs in the telescoped position.

3) Raise the cooler about 18". Drop the legs into position and install bolts removed in step two.

4) Continue to lift and position unit to its new home.

Figure 1

PLAN VIEW MINIMUM CLEARANCES

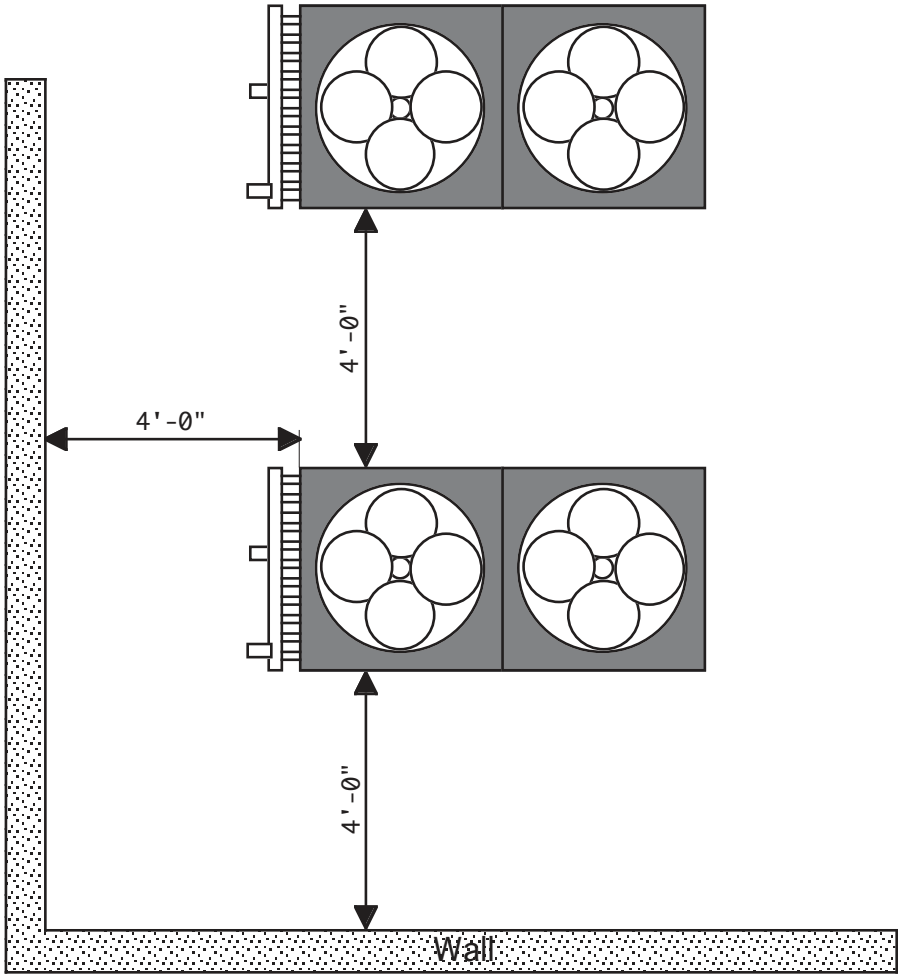


Figure 2

PREVENTING FREEZING AND CORROSION PROBLEMS

Freeze Protection

Draining is a common preventive action for water-based systems. It's a time-consuming method that requires labor in the fall - and again in the spring. Of course, it's feasible only for cooling systems that don't need to be operated in the winter.

But draining is not a sure method of preventing freeze damage. Because no matter how carefully the system is drained, water will almost always collect in low spots in the system where it is hard to detect and remove. Even blowing the system out with compressed air does not always ensure complete water removal. Furthermore, blowing more oxygen into damp pipes just compounds the corrosion problem.

Glycol solutions provide the best freeze protection for cooling systems because they significantly lower the freezing point of water. But care must be taken in choosing a glycol.

1) Use with galvanized steel is not recommended in most cases because the zinc will react with the inhibitor in glycols, causing precipitation of components, possible fouling, and a decrease in heat transfer efficiency.
2) Glycols, without corrosion inhibitors can cause extensive corrosion damage.
3) Glycols with corrosion inhibitors designed for other applications. such as automotive antifreeze, have short fluid life and can gel and clog your system.

Your best choice is a glycol solution that provides a lower freezing point and contains corrosion inhibitors that have been specially formulated for cooling systems.

Freeze Protection vs Burst Protection

There are two levels of protection provided by a glycol-based fluid.

Freeze Protection requires a glycol concentration level sufficient to prevent the formation of ice crystals at the lowest temperature experienced by the fluid. Freeze protection is imperative when the system requires pumping.

Burst Protection only requires a glycol concentration high enough to prevent bursting and other mechanical damage from freezing, but not necessarily high enough to keep the fluid pumpable. Burst protection requires less glycol than freeze protection and is suitable for chilled water systems that are dormant in the winter.

As the temperature drops below the freezing point of the fluid in a system with burst protection, ice crystals begin to form and the solution becomes a slush. The fluid expands as ice is formed. This mixture may or may not be pumpable, but it is fluid enough so that the excess volume flows into an expansion tank without damage to the system. As the temperature drops further and all the water freezes, the glycol will begin to freeze and contract.

Fluid Concentration

For freeze protection, the required concentration of inhibited glycol fluid in a system depends on the operating conditions of the system and the lowest expected ambient temperature. For corrosion protection, it's also important to consider the materials of construction, the age of the system and other variables. Your local glycol supplier representative can help you analyze the specific requirements for your system.

Table 1 shows the protection from freeze damage provided by various concentrations of DOWFROST glycol inhibited fluids. To determine the concentration required, select the lowest expected ambient temperature and decide whether the cooling system requires freeze protection to keep it pumpable, or burst protection to simply prevent damage from fluid expansion (see explanation above).

As a further measure of protection against dilution error, or unexpected cold temperatures, select a temperature that is at least 5°F colder than the lowest expected ambient temperature. If, for example, the lowest expected temperature is -15°F, select the line in Table 1 for -20°F. The table shows that at this temperature, a solution of 45% DOWFROST is required for freeze protection. A concentration of 30% to provide burst protection at this temperature.

PERCENT VOLUME GLYCOL CONCENTRATION REQUIRED

	Freeze Protection	Burst Protection
Temperature °F	DOWFROST	DOWFROST
20	17.%	11.%
10	26.%	18.%
0	34.%	23.%
-10	41.%	28.%
-20	45.%	30.%
-30	49.%	33.%
-40	51.%	35.%
-50	53.%	35.%
-60	55.%	35.%

Table 1: Concentrations of DOWFROST required to provide freeze protection and burst protection at various temperatures.

CORROSION RESISTANCE

Water And Air Are Corrosive

Unless it breaks, loses pressure, or clogs, we seldom think about the piping system that delivers the water we use everyday. So, we don't realize the extent of the corrosion caused by plain water is extremely damaging. It will corrode many metals and could severely damage your Cooling system components over time.

And, as noted earlier, draining does not provide adequate corrosion protection. In fact, the potential for corrosion increases each time you drain because more oxygen is introduced into the damp pipes in your system. Each refill can add more corrosives and impurities.

Plain Glycols Are Even More Corrosive

Even though they lower the freeze point of water, plain glycols are even more corrosive than water. As shown in Table 2 the corrosive rate of plain ethylene glycol on iron, for example, is more than 2.5 times faster than plain water. On steel, it's 4.5 times faster.

	Water	Ethylene Glycol	Dowtherm SR-1	Dowtherm 4000	Propylene Glycol
Copper	0.08	0.16	0.12	0.08	0.16
Solder	3.14	56.5	0.13	0.13	34.7
Brass	0.23	0.46	0.12	0.08	0.20
Mild Steel	9.69	44.5	0.04	0.04	9.80
Cast Iron	21.2	55.7	0.13	0.23	16.2
Aluminum	13.2	19.8	0.44	+0.12	1.80

Table 2: Corrosion test results in mills penetration per year

Automotive Antifreeze Has The Wrong Inhibitors For Cooling Systems

Automotive antifreeze usually contains silicate-based inhibitors which work best in automobile engines where aluminum is present. In cooling systems, these same components will coat heat exchange surfaces and reduce energy efficiency. Not only can the silicates gel and foul or plug the system, but they've also been shown to significantly reduce the lifetime of pump seals.

The manufacturer's recommended fluid life for automotive antifreeze is only 2 to 3 years, so the initial cost advantage rapidly disappears.

IMPORTANT COIL CLEANING INSTRUCTIONS

Dry Coolers, Inc. recommends that the finned surface of this unit be cleaned approximately
every 6 months; more frequent cleaning may be required if extreme conditions cause clogging or fouling of air passages through the finned surface.

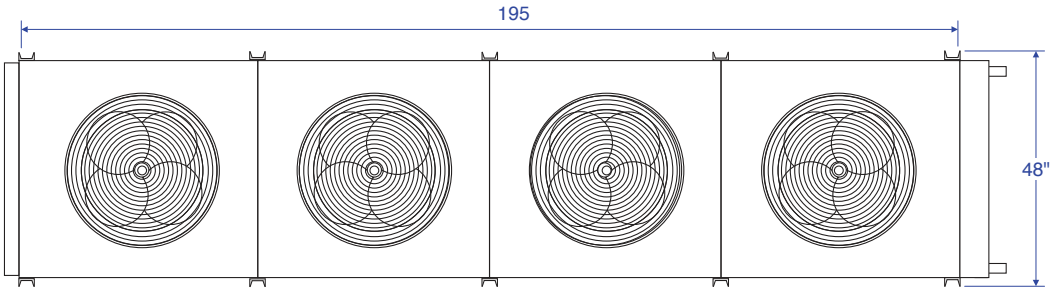
Calgon Vestals CalClean 4135-P2 (or equal) is acceptable for cleaning this unit. CalClean should be applied liberally to the entering air and leaving air surfaces of the finned area in accordance with the directions below:

Directions for Use:

On heavily soiled coils or filters, the CalClean should be mixed with four parts of water and sprayed on both sides of soil or filter. Permit the detergent solution to remain in contact with the dirty surfaces for about 5 minutes, then flush off with water from a hose. Be careful not to damage the finned surface of the coil if using a pressure sprayer.

CalClean is a concentrated detergent and can be diluted with up to 10 parts of water. It can be used effectively in many instances where there is a build up of grease or other heavy soil.

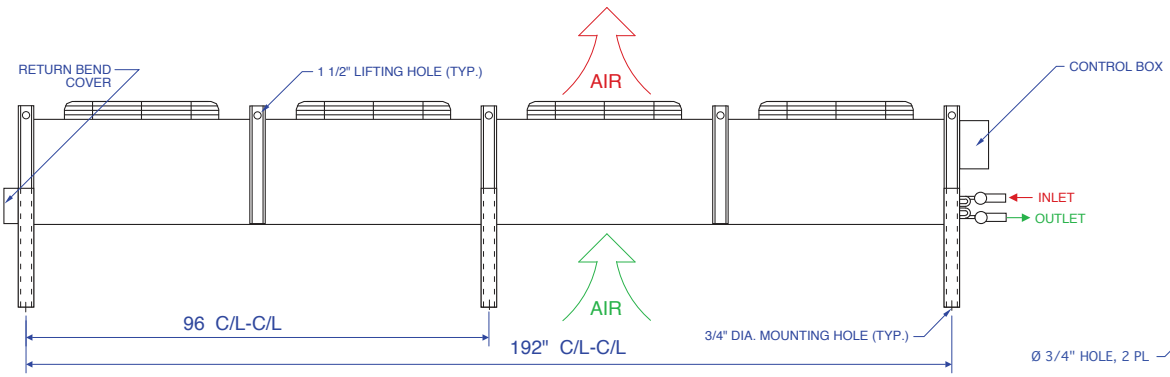
Caution: Under no circumstances should this unit be cleaned with an acid-based cleaner.

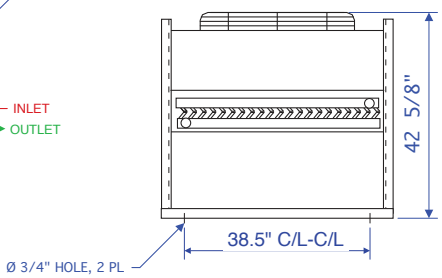


NOTES:
(1) MOUNTING LEGS ARE RETRACTED FOR SHIPPING PURPOSES AND MUST BE LOWERED IN POSITION FOR UNIT INSTALLATION
(2) UNIT MUST BE FREEZE PROTECTED
(3) COILS SHIPPED SEALED & PRESSURIZED w/5-15psi NITROGEN
(4) COOLER MUST BE LOCATED FAR ENOUGH AWAY FROM ANY OBSTRUCTION(S) TO AVOID AIR FLOW RESTRICTION OR RECIRCULATION OF WARM AIR
(5) SEE DRY COOLERS BULLETIN FOR DETAILED INSTALLATION INFORMATION

CONNECTION NOTES:
(1) ALL CONNECTIONS ARE ODS UNLESS OTHERWISE NOTED
(2) SUPPLY AND RETURN CONNECTIONS ARE SAME SIZE
(3) CONNECTION SIZES DO NOT NECESSARILY REFLECT THE REQD PIPE SIZE TO AND FROM THE COOLER. PROPER PIPE SIZE MUST BE CALCULATED USING RECOGNIZED PIPE SIZING PRACTICE

CONNECTION CHART	
ODS SIZES	gpm
1.125"	1-10
1.625"	11-35
2.125"	36-75
2.625"	76-120
3.125"	121 & ^





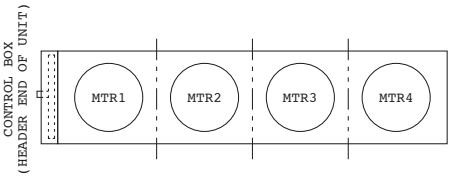
ALL DIMENSIONS ARE SUBJECT TO CHANGE. CONSULT FACTORY FOR CERTIFIED DRAWINGS.

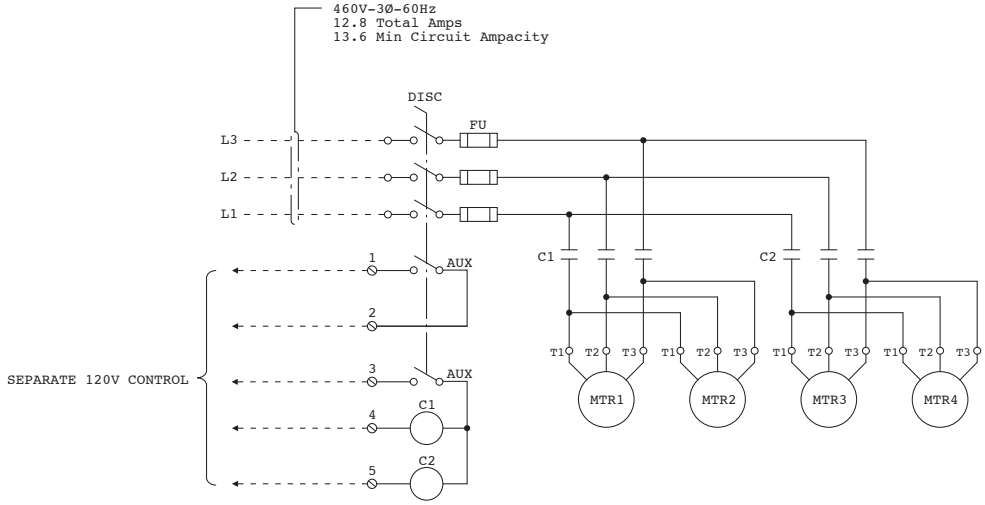
MODEL NO.	FAN DATA			APPROX. NET WEIGHT	VOLUME (GALLONS)
	QTY	DIAMETER	TOTAL CFM		
AVR-58	4	30"	42,000	1050 LBS	14.5
AVR-62	4	30"	41,000	1100 LBS	19.1
AVR-67	4	30"	40,500	1150 LBS	23.7
AVR-72	4	30"	40,000	1200 LBS	23.7
FAN MOTORS ARE 1 1/2 HP 1140 RPM 3Ø 3.2 FLA @ 460V					

Dry Coolers Inc.
575 S. Glaspie St.
Oxford, MI 48371
Phone (248) 969-3400
Fax (248) 969-3401

AQUA-VENT MODEL AVR-58 THROUGH AVR-72

DWG #: AVR-58-72 r5	DWG BY: hhh	DATE: 3/01	REV DATE: 3/01	SCALE: NONE
CUSTOMER:			JOB / PROP #:	





Fan Motors:
1.5 Hp, 1140 RPM, 3.2 FLA Each

NOTE:
1. All wire #16 AWG except as noted.
2. Use copper conductors only.
3. All field wiring to be 75°C minimum.

REVISIONS	DR.	DATE	CHK.
Rev 2 -			
Rev 1 -			
original	ger	4/19/00	mjr

Dry Coolers Inc.
3232 Adventure Lane
Oxford, MI 48371
Phone (248) 969-3400
Fax (248) 969-3401

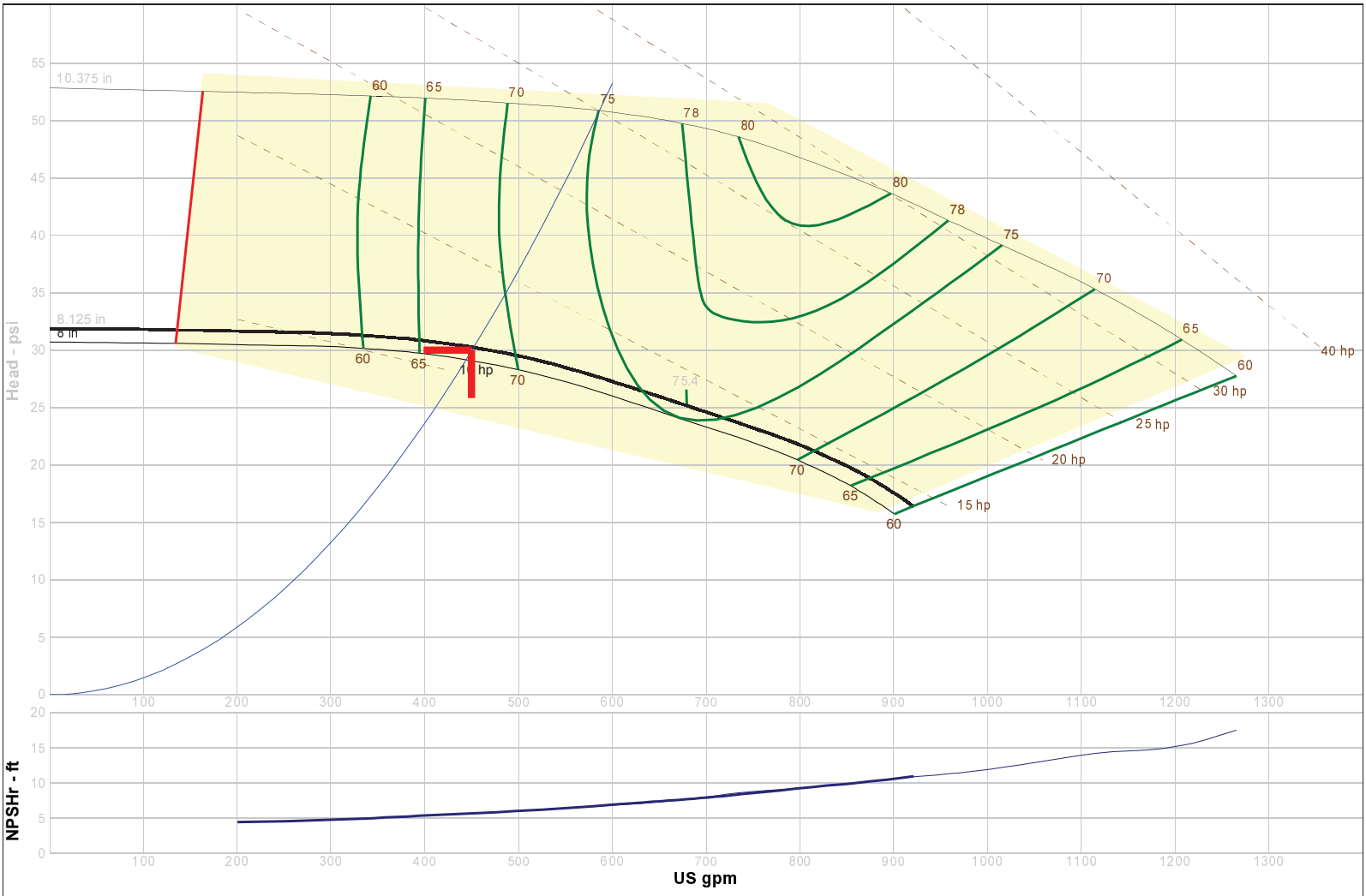
Wiring Schematic for Aqua-Vent for Model AVR-58,62,67,72 Dry Coolers

REF: PO:	BY / DATE: ger, 4/19/00
CUSTOMER:	DRAWING NO. S-9755

Customer:	Orchid	ACHE Performance Data Sheet R14.1	
Ref. No.	J-6233	Dry Coolers Inc.	
Date:	1-Oct-15	800-525-8173	

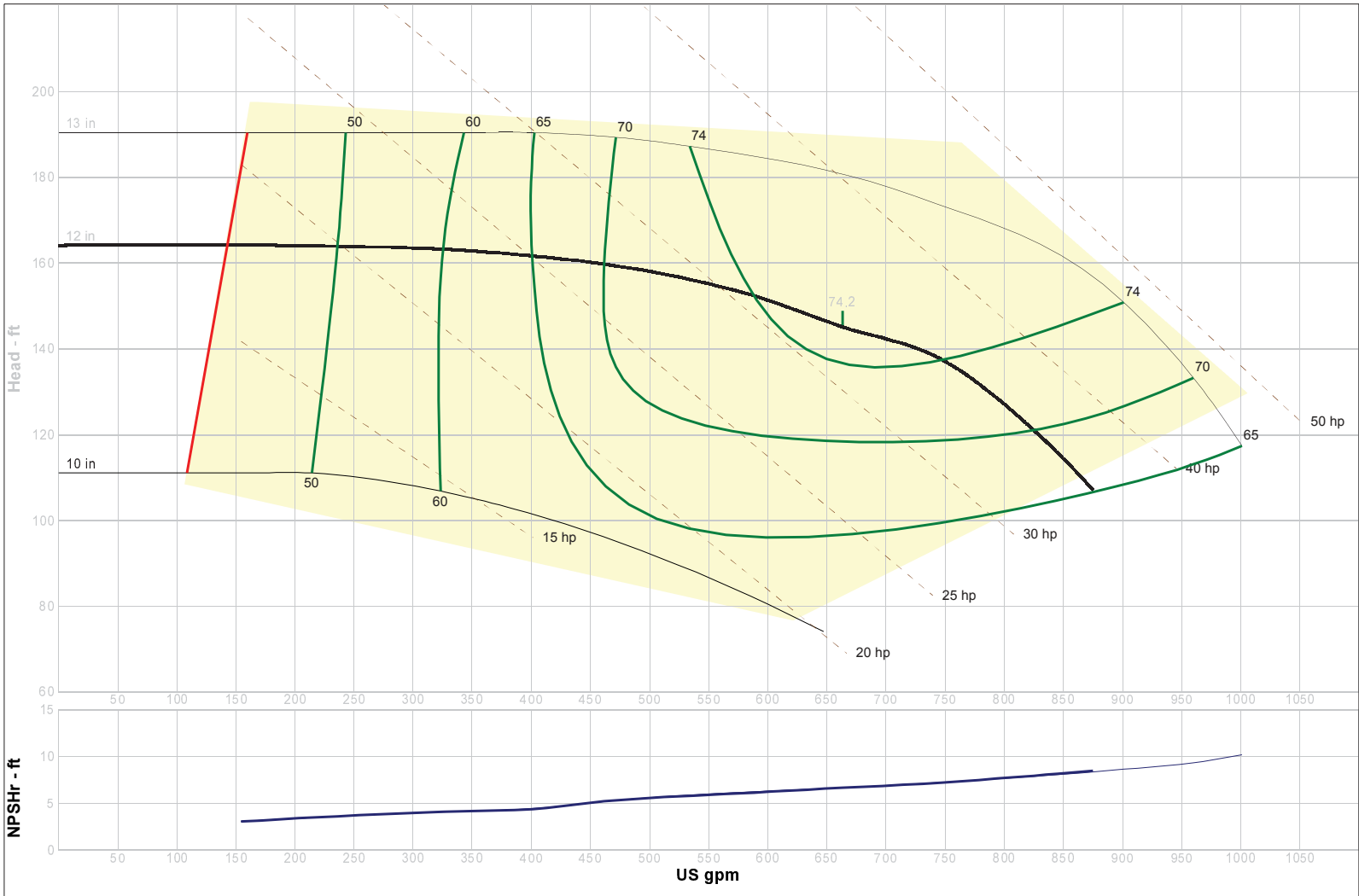
Heat Exchanger Performance Data:			
Heat Exchanger Model:	AVR 67 -90		
Number of Units in Parallel:	2		
Fluid Circulated:	20% Ethylene Glycol		
Heat Exchanged (Total):	2474300 BTU/hr	725 kW	
Flow Rate per Unit:	250 gpm	946 l/min	
Flow Rate (Total):	500 gpm	1893 l/min	
Fluid Inlet Temperature:	95 °F	35 °C	
Fluid Outlet Temperature:	84.7 °F	29.3 °C	
Fluid Pressure Drop:	4.6 psi	32 kPa	
Design Ambient Air (Dry Bulb):	55 °F	12.8 °C	
Elevation:	0 ft	0 m	

Heat Exchanger Structural Data (per unit):			
Length:	16.13 ft	4.91 m	
Width:	4.25 ft	1.3 m	
Weight (shipping):	1750 lbs	794 kg	
Tubes:			
• Material:	Copper		
• OD:	0.5 in	12.7 mm	
Fins:			
• Material:	Aluminum		
• Spacing:	10 fins/inch	394 fins/m	
Fans:			
• Quantity (per unit):	4		
• Diameter:	30 in	762 mm	
• Type:	Direct Drive - Induced Draft		
• Total Air Flow (per unit):	39300 ACFM	18.53 m3/sec	
Motors:			
• Size (each):	1.5 hp	1.1 kW	
• Speed:	1,140	RPM	
• Total FLA/unit @ 460 V:	12.8	amps	
• Total FLA/unit @ 230 V:	25.6	amps	



Company:	Kinetic Pump	Size: 5x4-10
Name:	Catalog: kinetic.60, Vers 1	Speed: 1750 rpm
9/23/2015	Close Couple EndSuct - 1800	Dia: 8.125 in
	Design Point: 450 US gpm, 30 psi	

KINETIC PUMP



Company:	Kinetic Pump	Size: 5x4-13
Name:	Catalog: kinetic.60, Vers 1	Speed: 1800 rpm
7/31/2015	Close Couple EndSuct - 1800	Dia: 12 in

KINETIC PUMP

KINETIC PUMP

KP-C Series

Close Coupled End Suction Centrifugal Pumps

Installation, Operation and Maintenance

PUMP MODEL NOMENCLATURE

KP - 8 x 6 x 16 - E C - AI - BCM

Pump Series

Suction Pipe Size (in)

Discharge Pipe Size (in)

Max Impeller Dia. (in)

Type of Pump
E - End Suction
V - Vertical

Drive Style
C - Close Coupled
F - Flexible Coupling

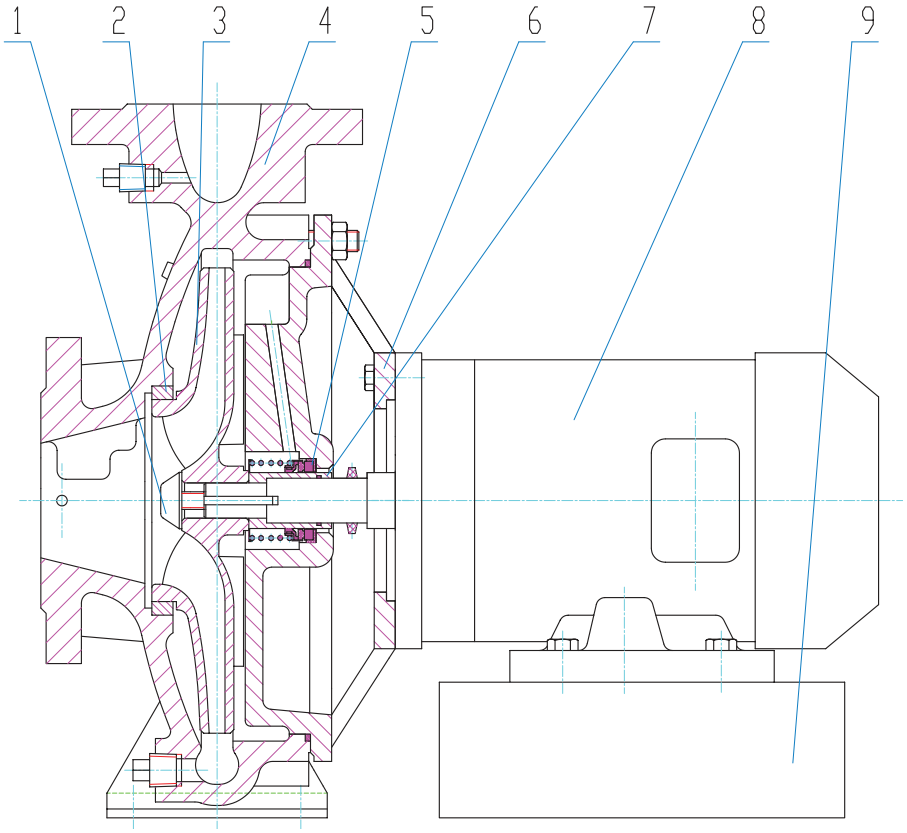
Pump Materials
AI - All Iron
BF - Bronze Fitted
AB - All Bronze
SS - All Stainless Steel

Elastomer
B - Buna Rubber E - EPDM V - Viton

Mechanical Seal Construction

Seal Faces
C - Carbon
M - Ceramic
S - Silicon Carbide
T -Tungsten

PUMP PARTS NOMENCLATURE



1. Impeller nut
2. Wear ring
3. Impeller
4. Pump Casing
5. Mechanical seal
6. Motor Adaptor
7. Shaft sleeve
8. Motor

Kinetic Pump IOM Manual JM Frame Motors

Inspection

Check your pump order for shortage and damage immediately upon arrival. Note damage or shortage on freight bill (bill of lading); immediately file claim with carrier.

EXTERIOR – Pay particular attention to conduit box, external hardware and accessories. Touch up abrasions or scratches with approved paint.

INTERNAL – If extensive or serious external damage is noted, if impeller is damaged (look in ports), or if shaft binds or sticks, disassemble as required to permit internal inspection.

Handling

Handle with care. Dropping or jarring can seriously damage motor bearings or break pump parts. Lift with device having capacity for pump weight, and use lifting hooks or eye bolts (if provided) or rig double sling around motor frame and pump casing. Do not use sling through pump motor adapter nor around suction and discharge flanges.

Installation

Location – Pump location should provide the following:

1. Install as close to suction supply as possible.
2. Use the shortest and most direct suction pipe practical. Suction head must not exceed limit for pump. Net Positive Suction Head (NPSH) available must equal or exceed pump requirement.
3. Suction port below pumping level to provide priming. Ensure a flooded suction.
4. Room for inspection and maintenance.
5. Correct power supply to motor; all wiring should meet National Electrical and Local Codes and Regulations.
6. If outdoors, protection from the elements, freezing, and water damage due to flooding.

Piping – Suction and discharge gauges are useful to check pump operation and are excellent trouble indicators. Install gauges in the piping or use the ports provided on the pump casing. Observe these precautions when installing piping:

1. Support close to, but independently of pump.
2. Use the next larger pipe size for suction and discharge.
3. Keep as straight as possible. Avoid bends and fittings.
4. Remove burrs, sharp edges, ream pipe cuts, and make joints air-tight.
5. Do not spring pipe to make connections. Strain must not be transmitted to pump.
6. Allow for pipe expansion with hot fluids.

Suction – Size and install suction piping to keep pressure loss at minimum and to provide correct NPSH by observing the following:

1. The suction pipe should be equal in size or preferably one size larger than the suction connection of the pump. If pipe is larger than the pump suction, an eccentric pipe reducer should be used at the pump.
2. Pipe should slope upward to pump, even for horizontal run.
3. Use 45-degree or long-sweep 90-degree elbows.
4. A valve in the suction is necessary only on positive suction head installation and must not be used to throttle the pump. The suction valve should be installed for maintenance purposes only.

Discharge – Pumps permit discharge port location at any of four positions, 90 degrees apart. Change by removing cover bolts, rotate casing, and replace bolts. Do not slice O-ring. Kinetic does not recommend bottom vertical discharge due to erratic pump performance. Ensure there is adequate clearance with selected position between wall or tank, motor conduit box, and grease fittings. Casing may extend beyond base or feet.

1. Short discharge lines may be the same size as the discharge port.

2. Long horizontal runs require a grade as even as possible. Avoid high spots and loops. Trapped air will throttle flow and may result in erratic pumping. Vent all high points in the piping

3. Install check and gate valves in discharge line; check valve (if used) between pump and gate valve.

Operation

Pre-Start – Before initial start of the pump, check as follows:

1. Check voltage, phase and frequency of line circuit with motor nameplate.

2. The rotation must be checked upon installation. Close, then break the contacts quickly and observe the rotation of the exposed portion of the rotating parts. Rotation must agree with the rotation arrow on the motor. For all pumps, the standard rotation is counterclockwise when viewed from the suction end. Motor wiring is easily changed in the field. Observe the wiring diagram on the inside of the terminal box cover, or on the motor nameplate

3. Check suction and discharge piping and pressure gauges for proper operation.

4. Assure that pump is full of liquid (primed). Never run the pump dry!

Starting – Proceed as follows to start pump:

1. Close drain valves and valve in discharge line.

2. Open fully all valves in the suction line.

3. Prime the pump. If pump does not prime properly, or loses prime during start-up, shut down and correct condition before repeating procedure.

4. For pumps moving high temperature liquids, open warm-up valve to circulate liquid for preheating. Close valve after pump is warmed up.

5. Start the motor (pump).

6. When pump is operating at full speed, open discharge valve slowly.

Running – Periodically inspect the pump while running, but especially after first start and following repair.

1. Check pump and piping for leaks. Repair immediately.

2. Record pressure gauge readings for future reference.

3. Record voltage, amperage per phase, and kW (if an indicating wattmeter is available).

4. Adjust pump output capacity with discharge valve. DO NOT throttle suction line.

Freezing Protection – Protect pumps shut down during freezing conditions by one of the following methods:

1. Drain pump; remove all liquid from the casing.

2. Keep fluid moving in pump and insulate or heat the pump to prevent freezing. If heated, do not let temperature go above 150 degrees F.

3. Fill pump completely with antifreeze solution.

Maintenance

Cleaning – Remove oil, dust, dirt, water, and chemicals from exterior of motor and pump. Keep motor air inlet and outlet open. Blow out interior of open motors with clean compressed air at low pressure. Regularly drain moisture from TEFC motors.

Temperature – Total temperature, not the rise, is the measure of safe operation for a motor. If temperature by thermometer exceeds limits for insulation class, investigate and change operating conditions.

Labeled Motors – It is imperative for repair of a motor with Underwriters' Laboratories label that original clearances be held; that all plugs, screws, other hardware be fastened securely, and that parts replacements be exact duplicates or approved equals. Violation of any of the above invalidates Underwriters' label.

Lubrication – Pumps should require no maintenance, other than the motor bearings, according to the following instructions:

DOUBLE SHIELDED. When double shielded prelubricated bearings are furnished, no lubrication is required for the life of the bearings. Inspect bearings periodically to determine the condition of the grease and replace the bearings if necessary.

SINGLE SHIELDED WITH GREASE FITTING PROVISIONS. When single shielded bearings are furnished, periodic inspection, cleaning and relubrication is required. See motor manufacturer's specific instructions for lubrication.

Mechanical Seal Replacement

JM FRAME MOTOR

A.) **Disassembly**:

1. Turn off power.

2. Close suction and discharge valves.

3. Drain pump.

4. Remove bolts holding base to foundation.

5. Remove casing bolts.

6. Remove motor and rotating element from casing, leaving casing and piping undisturbed.

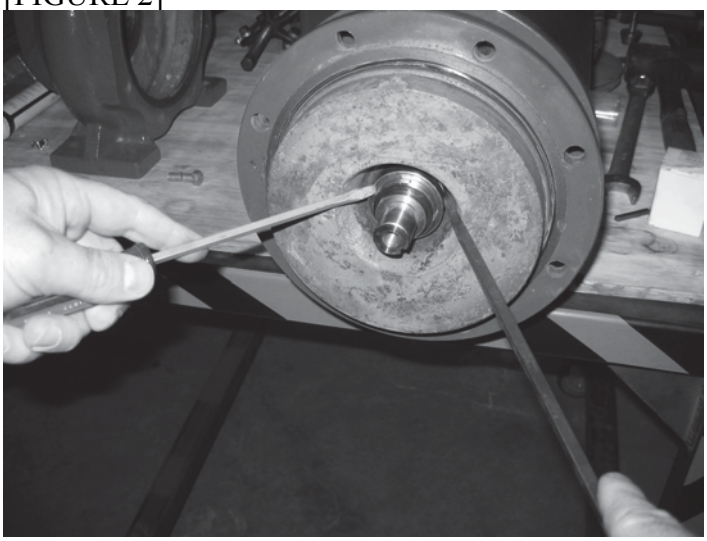
7. Insert a screwdriver in one of the impeller waterway passages and back off the impeller retaining assembly with an allen wrench, as shown in figure 1.

[FIGURE 1]

8. Remove impeller from shaft, being careful not to lose the impeller key, spring and seal retainer. If impeller is difficult to remove, it may be necessary to use a bearing puller to pull off the impeller.

9. Pry off rotating member of mechanical seal from sleeve by using two (2) screwdrivers. (Figure 2).

[FIGURE 2]



10. Remove bolts holding adapter to motor and take off adapter.

11. Place adapter on a flat surface with case rabbet facing down, and push out stationary part of mechanical seal.

12. Inspect the shaft sleeve, shaft O-ring and slinger. If damaged or worn, remove and replace with a new one.

B.) **Reassembly**:

CAUTION: The mechanical seal is a precision product and should be handled accordingly. Use care when handling the lapped running surfaces of the mechanical seal to ensure they remain clean and free of chips or scratches. Do not touch the seal faces.

1. Clean gasket and flange faces, seal seat cavity, shaft sleeve, and motor shaft.

2. Lubricate the seal seat cavity of the adapter and the rubber cup or O-ring of seal seat with the lubricating fluid that comes with the mechanical seal or repair kit. Press the stationary seat in seal seat cavity of the adapter squarely and evenly using an arbor press if possible. Be certain that the lapped face (shiny side) is facing you.

3. Install the slinger on the motor shaft until it bottoms on the motor shaft.

4. Slide the shaft O-ring on the motor shaft until it is tight against the slinger. Make sure that the shaft O-ring does not get damaged during this procedure.

5. Position shaft sleeve chamfer towards motor and slide on motor shaft.

6. With motor preferably in vertical position, remount the adapter on motor, making sure the motor shaft does not dislocate or chip the stationary seat of the seal.

7. Apply the lubricating fluid that comes with the mechanical seal or repair kit to the shaft sleeve and the rubber bellows of the rotary seal. Slide the seal head on the sleeve; press the rubber drive band on the rotary head until the lapped face on the head seats firmly against the lapped face of the stationary seat. Do not chip or scratch faces during installation. Take extra care to make sure the lapped faces are clean. Install seal spring on seal head and retainer on spring.

8. Place key in key seat. Line up keyway in impeller with key on motor shaft, and slide impeller on motor shaft. Be certain that the key is positioned in the keyway of the motor and impeller. Slightly compress seal spring with impeller and hold impeller while installing impeller retaining assembly in motor shaft.

9. Insert a screwdriver in a waterway passage of the impeller holding it against rotation and tighten the retaining assembly as discussed in paragraph 7 of disassembly instructions. The impeller will compress the seal spring to the proper length assuring the correct pressure on the lapped surfaces.

10 Remove any burrs caused by a screwdriver on the vane of the impeller in waterway passage.

11 Slide motor and rotating element in casing. Be sure that any damaged O-ring or gasket is replaced.

12. Tighten casing bolts alternately and evenly.

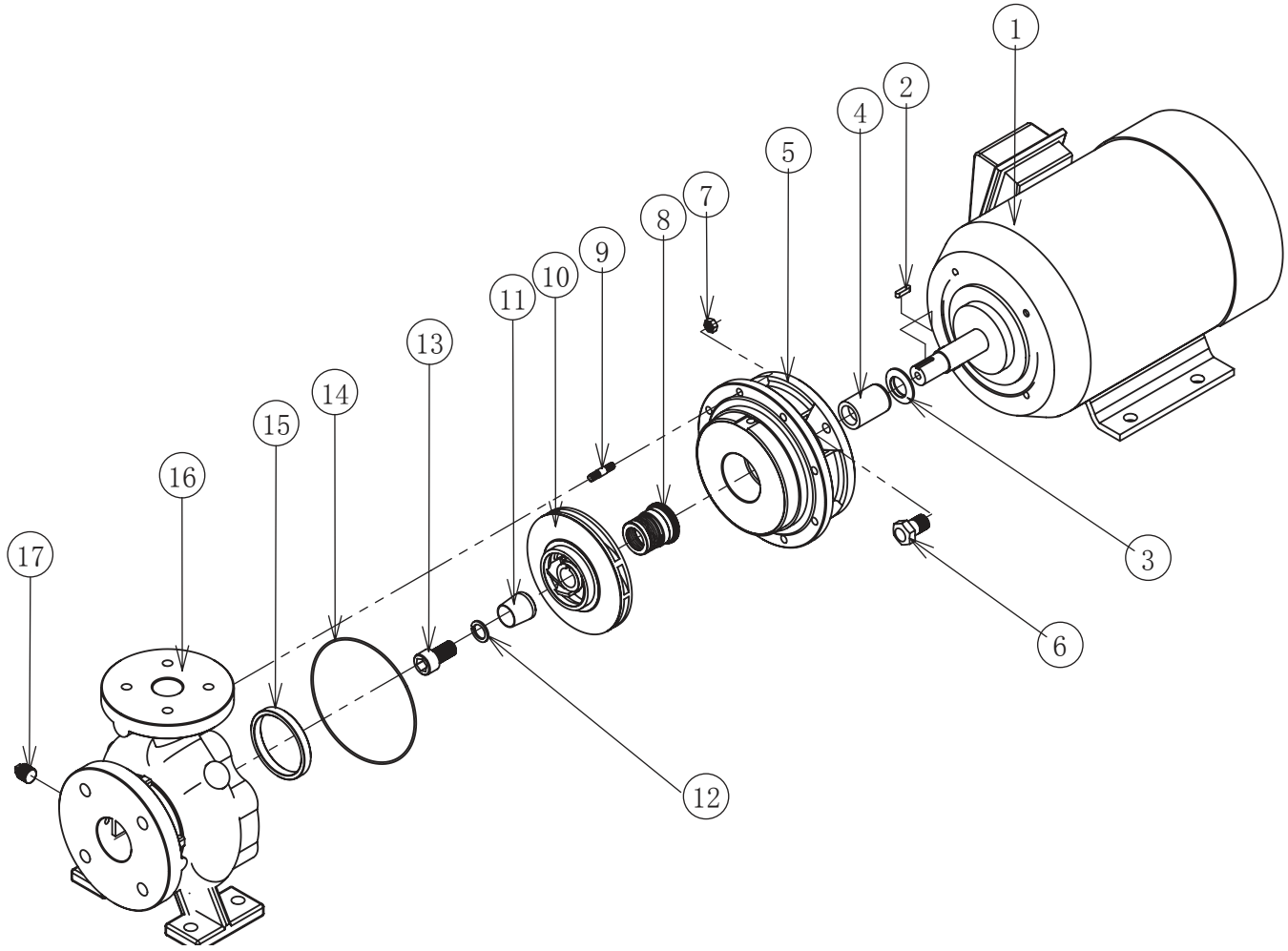
13. Replace hold-down bolts.

14. Check for free rotation after assembly is completed.

15. Seal all drain openings using pipe sealant on threads.

16. Reprime before starting. Do not start until pump is completely filled with water.

EC - Close Coupled Pump Exploded View



1. JM Motor
2. Key shaft *
3. Slinger
4. Shaft sleeve *
5. Motor adaptor
6. Hex bolt
7. Hex nut
8. Mechanical seal *
9. Stud
10. Impeller
11. Impeller nut *
12. Spring washer *
13. Socket hex head bolt
14. Casing O-ring
15. Wear ring
16. Pump casing
17. Plug

** Part included in Replacement Seal Kit*

ACTARIS
metering systems

DRY COOLERS
TANK BLANKET
REGULATOR
MODEL B42 R

125 PSI MAX
INLET PRESSURE

6-8 IN W.C. OUTLET
PRESSURE
(BROWN SPRING)

INTERNAL RELIEF
PRESSURE SET AT 1
PSI

B42 Series Regulator

Advanced Metering
and Regulation
Technolgy at Work

Features

- Interchangeable aluminum orifice
- 12.6 in² of diaphragm area
- Molded deep convolution diaphragm with o-ring seal
- Plated steel diaphragm plate
- Stainless steel lever pin
- Plated steel 6:1 lever
- One piece molded Buna-N valve seat
- Die cast zinc valve stem
- Delrin® vent valve with Buna-N seat
- Spring loaded internal relief valve assembly
- 1" and 3/4" threaded vent with stainless steel screen
- Fiberglass reinforced polethelyne seal cap with integral relief valve stop
- Field interchangeable adjustment spring
- CSA 6-18 Approved
- Measurement Canada Approved - G108
- B109.4 Compliant

Benefits

- Increased Safety
- Long Service Life
- Easier Installation
- Easier Transport

Application

Consistent pressure reduction of gas for typical domestic and light commercial applications.

Model B42 Series regulators exceed all AGA/ANSI B109.4 & CSA 6-18 specifications

Designed to Increase Your Customer's Satisfaction and Reduce Your Total Costs

The model B42 is uniquely constructed to give utilities the edge they need in an increasingly complex and competitive marketplace. The model B42 excels with benefits of size, safety, performance, and cost. The B42 also offers three connection versions providing the greatest flexibility for your regulation needs. In addition, due to inventory and manufacturing enhancements this product can be delivered with unparalleled speed and scheduling dependability.

Compact Size

While the model B42 is more compact than traditional regulators, it was also designed to meet customer expectations for safety and long field life. The B42 is designed to consolidate product usage for both residential and light commercial applications.

Description

The B-42 is a spring loaded self operated regulator with internal relief. The B42 features a molded diaphragm, 6:1 lever ratio and a one inch vent. The benefit is a lighter more compact unit that provides the power, capacity and relief performance of larger regulators

B42N – The B42N is a spring loaded self-operated regulator with no internal relief (N) valve. This model can be used on low or intermediate inlet pressures where an internal relief, or other type of over-pressure protection device is not required.

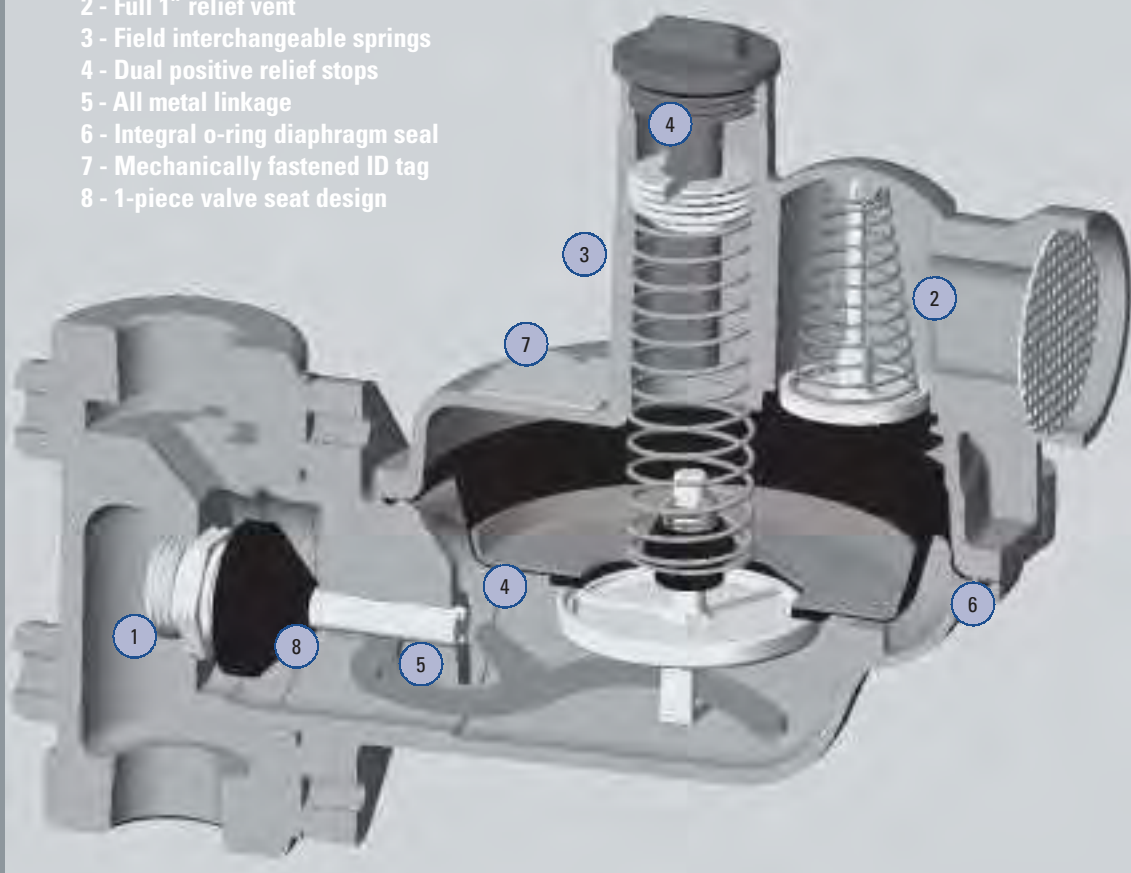
B42R - The B42R is the internal relief (R) version of the B42 Series. The large 1" internal relief valve provides exceptional relief capacity.

Option Designations

N — No Internal Relief
R — Internal Relief

Actaris takes pride in delivering American made products with the utmost concern for safety, quality and customer satisfaction.

1 - All metal restricting orifice
2 - Full 1" relief vent
3 - Field interchangeable springs
4 - Dual positive relief stops
5 - All metal linkage
6 - Integral o-ring diaphragm seal
7 - Mechanically fastened ID tag
8 - 1-piece valve seat design



Specifications

Material Construction:

Valve Body:	High tensile strength cast iron (ASTM A-126, Class A)
Orifice	Aluminum
Valve Seat:	Buna-N or silicone
Valve Stem:	Die cast zinc
Lever Pin:	Stainless steel (Type 303)
Lever:	Zinc and dichromate plated steel (AISI C1010)
Upper Diaphragm Plate:	Zinc and dichromate plated steel (14 gauge steel)
Lower Diaphragm Plate:	Isoplast
Diaphragm:	Buna-N on Dacron reinforcing fabric
Vent Valve/Seat:	Neoprene
Vent Screen:	Stainless Steel (16 mesh)
Adjustment Ferrule:	Delrin
Seal Cap:	Fiberglass reinforced polyethlene
Diaphragm Case:	Die cast aluminum (ASTM B85 –Alloy SC84A)
Fastener Plating:	Dacromet with Plus Black

Shipping Weight:

12 per box:	48 lbs.

Correction factors for non-natural gas applications:

The B42 may be used to control gases other than natural gas. To determine the capacity of the B42 for gases other than natural gas, it will be necessary to multiply the values within the capacity tables by a correction factor. The table below lists the correction factors for some of the more common gases:

Gas Type	Specific Gravity	Correction Factor (CF)
Air	1.0	0.77
Butane	2.01	0.55
Carbon Dioxide (Dry)	1.52	0.63
Carbon Monoxide (Dry)	0.97	0.79
Natural Gas	0.60	1.00
Nitrogen	0.97	0.79
Propane	1.53	0.63
Propane-Air-Mix	1.20	0.71

To calculate the correction factor for gases not listed on the table above, it will be necessary to know the specific gravity of the gas and use it in the formula listed below:

Correction Factor (CF) = $\sqrt{\frac{SG_1}{SG_2}}$

Where:

SG_1 = Specific Gravity of the gas in which the capacity is published.

SG_2 = Specific Gravity of the gas to be controlled.

Standard Spring Data - B42	Spring Color	Outlet Pressure Range**
	Green (p/n 762649)	5 - 7" w.c.
	Brown (p/n 762645)	6 - 8" w.c.
	Blue (p/n 762646)	8 - 14" w.c.
	Silver (p/n 762647)	12 - 28" w.c.
	Yellow/Black (p/n 762650)	1 - 2 PSIG
Alternate Spring Data - B42		
	Orange (p/n 762002)	5.5 - 9" w.c.
	Dark Green (p/n 762003)	4 - 9" w.c.
High Pressure Spring Data - B42		
	Yellow (p/n 762131)	2 - 4 PSIG
	White (p/n 762137)	4 - 5 PSIG
Relief Spring Data - B42		
	Purple (p/n 762653)	7" w.c. Above Set Point
	Red (p/n 762655)	5" w.c. Above Set Point

***Note: Ranges are approximations, please contact manufacture to obtain the best spring for application.*

Orifice Data	Size	K-Factor	MAOP	Emergency	Emergency Outlet	
				Inlet	No Damage	Containment
	1/8"	30	125 PSIG	300 PSIG	60 PSIG	30 PSIG
	1/8" x 3/16"	30	125 PSIG	300 PSIG	60 PSIG	30 PSIG
	3/16"	71	125 PSIG	200 PSIG	60 PSIG	30 PSIG
	1/4"	127	60 PSIG	150 PSIG	60 PSIG	30 PSIG
	5/16"	193	35 PSIG	100 PSIG	60 PSIG	30 PSIG
	3/8"	290	20 PSIG	75 PSIG	60 PSIG	30 PSIG
	1/2"	416	10 PSIG	40 PSIG	60 PSIG	30 PSIG
	1/2" x 9/16"	416	10 PSIG	40 PSIG	60 PSIG	30 PSIG

Wide-Open Flow Calculations

For wide-open orifice flow calculations use the following equations:

For $P_1/P_2 < 1.89$ use: $Q = K\sqrt{P_2(P_1 - P_2)}$

For $P_1/P_2 > 1.89$ use: $Q = \frac{KP_1}{2}$

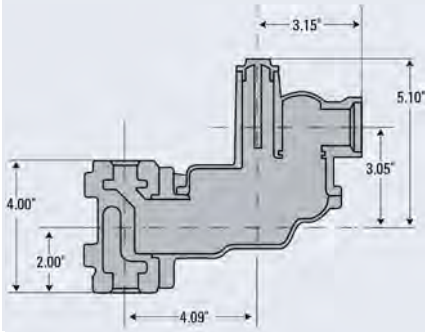
Where: P_1 = absolute inlet pressure (psia)

P_2 = absolute outlet pressure (psia)

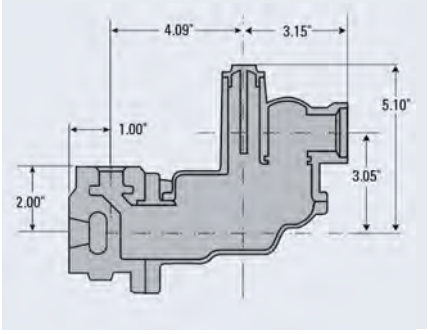
Q = flow rate (scfh)

K = orifice coefficient (scfh/psi)

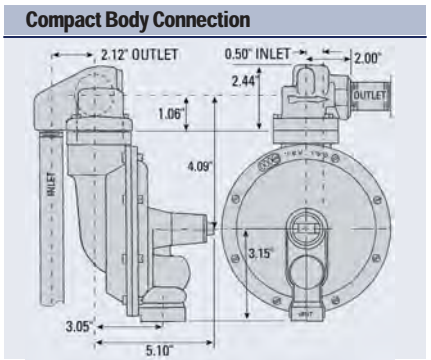
Straight Body Connection



90 Angle Body Connection



Compact Body Connection



Connection Sizes

Inlet	Outlet	Compact	90 Angle	Straight
1/2"	1/2"	-	X	X
1/2"	3/4	-	X	X
1/2"	1"	-	X	-
3/4"	3/4"	X	X	X
3/4"	1"	X	X	X
3/4"	1-1/4"	-	-	X
1"	1"	-	X	X
1"	1-1/4"	-	-	X
1-1/4"	1-1/4"	-	-	X

7" w.c. (17 mbar) - B42 Residential Regulator Capacity Table (1" Droop) - Models N, R

Green Spring (762649)
Position 5
1" NPT Oulet

Capacities in scfh (m^3/hr) - Orifice Size																					
Inlet Pressure		1/8"		1/8 x 3/16"		3/16"		1/4"		5/16"		3/8"		1/2"		1/2 x 9/16"					
PSIG	Bar	3.2 mm		3.2 x 4.8 mm		4.8 mm		6.4 mm		7.9 mm		9.5 mm		12.7 mm		12.7 x 14.3 mm					
0.5	38 mbar	65	(1.8)	70	(2.0)	90	(2.5)	140	(3.9)	175	(4.9)	210	(5.9)	270	(7.6)	280	(7.9)				
1	69 mbar	80	(2.3)	110	(3.1)	140	(3.9)	200	(5.7)	275	(7.8)	300	(8.5)	400	(11.3)	450	(12.7)				
2	0.138	100	(2.8)	180	(5.1)	225(6.4)		250		(7.1)		375		(10.6)		425		(1			
3	0.207	170	(4.8)	225	(6.4)	310	(8.8)	350	(9.9)	500	(14.2)	575	(16.3)	800	(22.7)	910	(25.8)				
5	0.345	215	(6.1)	280	(7.9)	400	(11.3)	500	(14.2)	725	(20.5)	825	(23.4)	1100	(31.1)	1230	(34.8)				
10	0.69	340	(9.6)	390	(11.0)	625	(17.7)	850	(24.1)	1100	(31.1)	1300	(36.8)								
15	1.03	425	(12.0)	470	(13.3)	850	(24.1)	1200	(34.0)	1550	(43.9)	1650	(46.7)								
20	1.38	550	(15.6)	550	(15.6)	1100	(31.1)	1450	(41.1)	1850	(52.4)										
30	2.07	700	(19.8)	700	(19.8)	1400	(39.6)	2000	(56.6)												
40	2.76	850	(24.1)	870	(24.6)	1750	(49.6)	2200	(62.3)												
50	3.45	1000	(28.3)	1020	(28.9)	2150	(60.9)	2500	(70.8)												
60	4.13	1150	(32.6)	1190	(33.7)	2300	(65.1)	2500	(70.8)												
80	5.51	1500	(42.5)	1590	(45.0)	2400	(68.0)														
100	6.89	1800	(51.0)	1870	(53.0)	2500	(70.8)														
125	8.61	2200	(62.3)	2280	(63.0)	2500	(70.8)														

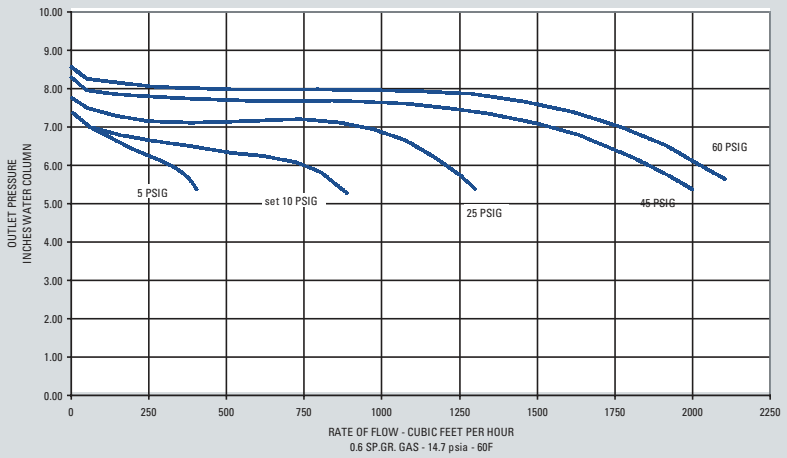
Orifice Inlet Pressure Rating Exceeded

Inlet Effect [B]	0.13" w.c.	0.13" w.c.	0.20" w.c.	0.36" w.c.	0.67" w.c.	0.77" w.c.	2.20" w.c.	2.20" w.c.
Lock Up [C]	0.5" w.c.	0.5" w.c.	0.6" w.c.	0.7" w.c.	0.8" w.c.	0.9" w.c.	1.2" w.c.	1.2" w.c.

Typical Performance Curves

Manufacturer.....Actaris
Type and Model.....B42 R
Regulator:
Inlet Size. .....3/4" NPT
Outlet Size.....1" NPT
Orifice Size .....3/16"
Spring .....Green (p/n 762649)
Set Point 7.0" w.c. with 10 psig inlet @ 50 scfh. All test results are reported at a base of 14.7 psia and 60 F.

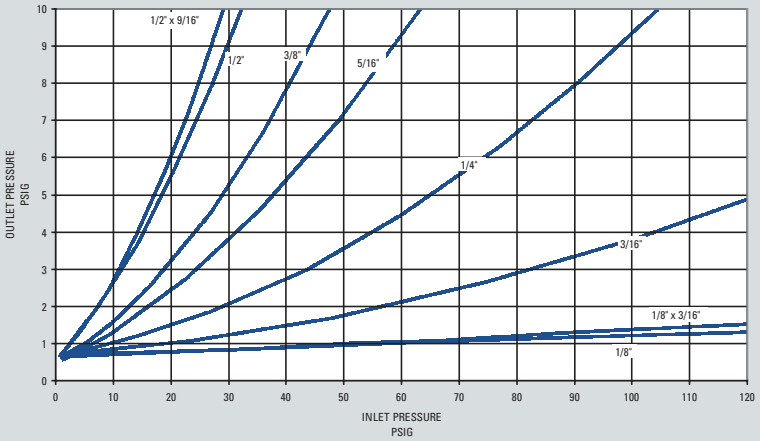
B42R REGULATOR PERFORMANCE
7" w.c. SET POINT



Relief Characteristic Curves R Model Only

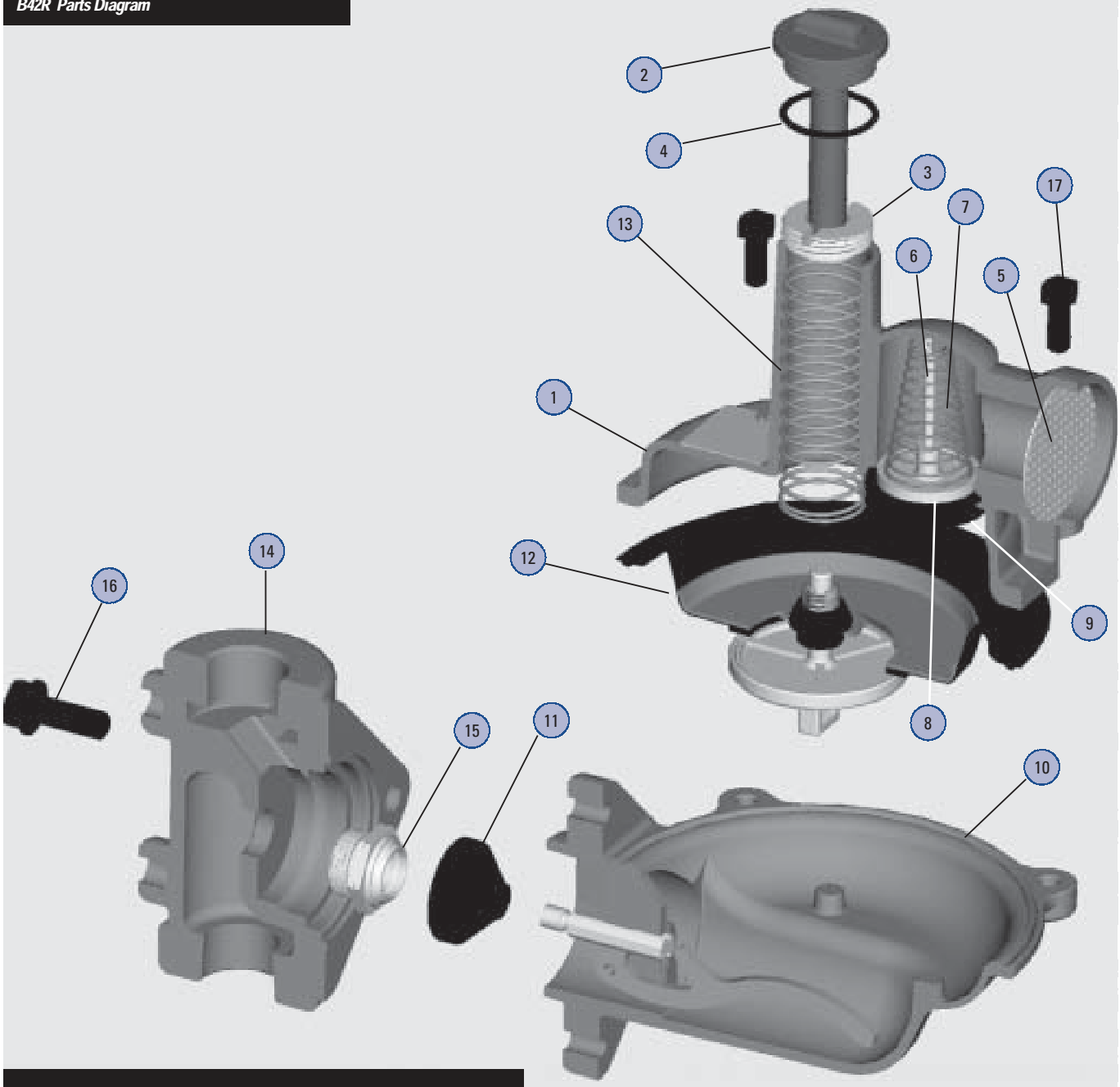
Manufacturer.....Actaris
Type and Model.....B42 R
Regulator:
Inlet Size .....3/4" NPT
Outlet Size.....1" NPT
Vent Size .....1" NPT
Set Point 7.0" w.c. with 10 psig inlet @ 50 scfh. All test results are reported at a base of 14.7 psia and 60 F.

B42 RELIEF CURVES - LEVER DISCONNECT
7" W.C. SET POINT

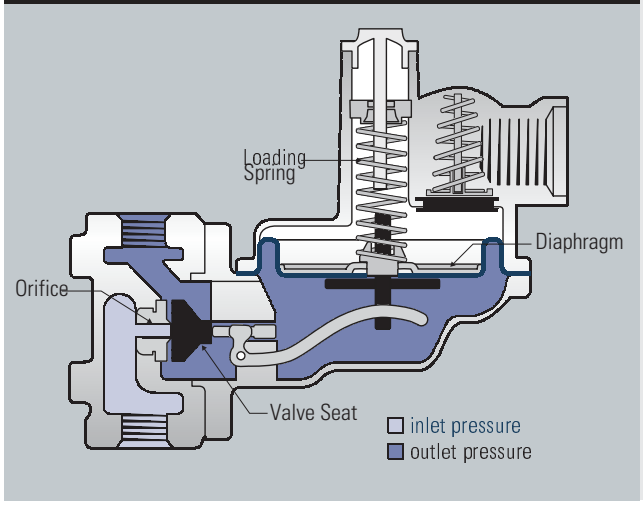


Note:
A- Capacity in grey outline generated with Brown Sprg (762645)
B- Change in outlet pressure for 10 PSIG inlet pressure change
C- Outlet pressure increase required for lock up

B42R Parts Diagram



Operating Principle



NO.	PART#	QTY N	QTY R	DESCRIPTION
1		1	1	Upper Diaphragm Case
	753443			Std. 1" Vent
	753442			Std. ¾" Vent
	753445			HP. 1" Vent
	753444			HP. ¾" Vent
2		1	1	Seal Cap
	760260			Seal Cap - Gray
	760261			Seal Cap - Red
	760262			Seal Cap - Green
3	760215	1	1	Adjustment Screw - Std
	760217	1	1	Adjustment Screw - HP
4	765501	1	1	Seal Cap Gasket
5	762933	1	1	Vent Screen
6	754834	1	1	Vent Valve Disc Pin
7	762651	1	1	Vent Valve Spring
8	765181	1	1	Vent Valve Disc
9	765685	1	1	Vent Valve Seat
10	715075	1	1	Lower Diaphragm Case Assembly
11		1	1	Valve Seat
	765051			Valve Seat - Standard
	765053			Valve Seat - Silicone
				Diaphragm Assembly Complete
12	720085		1	Diaphragm - Standard Relief (R)
	720091	1		Diaphragm - Non-Relief (N)
	761005	1	1	Upper Diaphragm Plate
	75606102		1	Lower Diaphragm Plate (R)
	75606103	1		Lower Diaphragm Plate (N)
	761401		1	Relief Spring Retaining Clip
	755513	1		Nut (N)
	755801	1		Washer (N)
	762653		1	Relief Spring - 7" W.C. - Std.
	762655			Relief Spring - 5" W.C.
	754911	1	1	Stop Stem Guide Bushing
13		1	1	Adjustment Springs - Specify Color
	762649			5-7" W.C. Green
	762645			6-8" W.C. Brown
	762646			8-14" W.C. Blue
	762647			12-28 W.C Silver
	762650			1-2 PSIG Yellow/Black
	762131			2-4 PSIG Yellow* (HP)
	762137			4-5 PSIG White* (HP)
14		1	1	Valve Body - Specify Type and Size
				Straight
	750586			1/2" x 1/2" NPT
	750587			1/2" x 1/2" NPT w/ 1/8" In. PP
	750588			1/2" x 1/2" NPT w/ 1/8" Out. PP
	750527			¾" x ¾" NPT
	750528			¾" x ¾" NPT w/ 1/8" In. PP
	750529			¾" x ¾" NPT w/ 1/8" Out. PP
	750530			¾" x ¾" NPT w/ In/Out PP
	750531			¾" x 1" NPT
	750532			¾" x 1" NPT w/ 1/8" In. PP
	750533			¾" x 1" NPT w/ 1/8" Out. PP
	750534			¾" x 1" NPT w/ In/Out PP
	750567			¾" x 1-1/4" NPT
	750568			¾" x 1-1/4" NPT w/ 1/8" In. PP
	750569			¾" x 1-1/4" NPT w/ 1/8" Out. PP
	750535			1" x 1" NPT
	750536			1" x 1" NPT w/ 1/8" In. PP
	750537			1" x 1" NPT w/ 1/8" Out. PP
	750538			1" x 1" NPT w/ In/Out PP
	750570			1" x 1-1/4" NPT
	750571			1" x 1-1/4" NPT w/ 1/8" In. PP
	750572			1" x 1-1/4" NPT w/ 1/8" Out. PP
	750573			1-1/4" x 1-1/4" NPT
	750574			1-1/4" x 1-1/4" NPT w/ 1/8" In. PP
	750575			1-1/4" x 1-1/4" NPT w/ 1/8" Out. PP
				90º Angle Body
	750541			¾" x ¾" NPT
	750542			¾" x ¾" NPT w/ 1/8" In. PP
	750543			¾" x 1" NPT
	750544			¾" x 1" NPT w/ 1/8" In. PP
	750545			1" x 1" NPT
	750546			1" x 1" NPT w/ In/Out PP Plug
				Compact - Bottom Rear Entry
	750576			¾" x ¾" NPT
	750578			¾" x ¾" NPT w/ 1/8" In. PP
	750577			¾" x 1" NPT
	750579			¾" x 1" NPT w/ 1/8" In. PP
15		1	1	Orifice - Specify size
	757611			1/8" - Aluminum
	757641			1/8" - Brass
	757651			1/8" x 3/16" - Aluminum
	757619			3/16" - Aluminum
	757643			3/16" - Brass
	757623			1/4" - Aluminum
	757645			1/4" - Brass
	757627			5/16" - Aluminum
	757631			3/8" - Aluminum
	757453			1/2" - Aluminum
	75767101			1/2" x 9/16" - Aluminum
	769417	1	1	Legal Warning Label
16	8006701	2	2	Valve Body Screw 5/16 - 18 x 7/8 LG.
17	010323	4	4	Case Screw ¼ - 20 x ¾ LG.
	765605	1	1	Valve Body Gasket

NO.	PART#	DESCRIPTION
	799051	Adjustment Tool

NO.	PART#	TORQUE SPECIFICATIONS
	010322	Case Screws: 35 - 45 in. lb.
	765605	Valve Body Screws: 85 - 115 in. lb
	see above	Orifice: 450 - 600 in. lb.

Installation

A. Make certain all shipping plugs are removed from the inlet, outlet and vent of any regulator before installation.

B. When installing the regulator, the inside of the piping and the regulator inlet and outlet are to be clean, free of dirt, pipe dope and other debris to prevent entry into the regulator which could cause loss of pressure control.

C. The pipe joint sealant should be applied on the male threads of the pipe. Do not use any pipe joint material on the female threads of the regulator or it could become lodged in the regulator causing possible loss of pressure control.

D. Gas must flow through the valve body of the regulator in the same direction as the arrow cast on the body, or the outlet side of the regulator may be overpressured and damaged.

E. The diaphragm casing may be mounted in any position relative to the body through a full 360° angle.

F. When the regulator is installed OUTDOORS, the vent must always be positioned so that rain, snow, moisture or foreign particles cannot enter the vent opening. It is recommended that the vent be positioned to face downward so as to avoid entry of water or other matter which could interfere with the proper operation of the regulator. The vent should be located away from building eves, window openings, building air intakes and above the expected snow level at the site. The vent opening should be inspected periodically to insure it does not become blocked by foreign material.

G. When the regulator is installed INDOORS, the vent must be piped to the outside atmosphere while using the shortest length of pipe, the least number of elbows, and having as large a pipe diameter as the vent size or larger. USING VENT PIPE ANY SIZE SMALLER THAN THE VENT CONNECTION WILL LIMIT THE REGULATOR'S INTERNAL RELIEF VALVE CAPACITY. The outlet end of the pipe must be protected from moisture and the entrance of foreign particles. The regulator should be specified by the user with the size vent and pipe threads desired to make the vent pipe connection.

START-UP PROCEDURE

A. A pressure gauge should be mounted downstream of the regulator to monitor the downstream pressure.

B. With the downstream valve closed, slowly open the inlet valve. The outlet pressure should rise to slightly greater than the set-point.

C. Be sure there are no leaks and all connections are tight.

D. The regulator has been preset at the factory to match specifications given when it was ordered. The outlet pressure may be adjusted by removing the seal cap on top of the spring housing and adjusting the ferrule or screw inside the spring housing using a ratchet with a socket and an extension. With a small amount of gas flowing through the regulator, rotate the ferrule clock-wise to raise the outlet pressure and counter-clockwise to lower the outlet pressure.

E. After the desired outlet pressure is achieved, replace the seal cap, recheck for leaks. The regulator is ready for operation.

SAFETY NOTES:

A. The maximum inlet pressure for this regulator is dependent upon the size of the orifice and model designation. The non-relief models are limited to 60 psig maximum inlet pressure unless addition safety devices are used as outlined in DOT code, OPS, Part 192, section 192.197.

B. When these models are used on liquid petroleum gases, they should be restricted to second-stage pressure reduction in the gaseous phase.

SAFETY WARNING:

This product, as of the date of manufacture, is designed and tested to conform to all governmental or industry safety standards then existing as may apply to the manufacturer.

The purchaser and user of this product are warned that compliance with the manufacturer's instructions and procedures is required in order to avoid the hazards of leaking gas resulting from improper installation, start-up or use of this product, and further, that all area fire control, building codes or other safety regulations established under public laws which regulate or concern the application, installation, operation or general use of this product should be complied with.

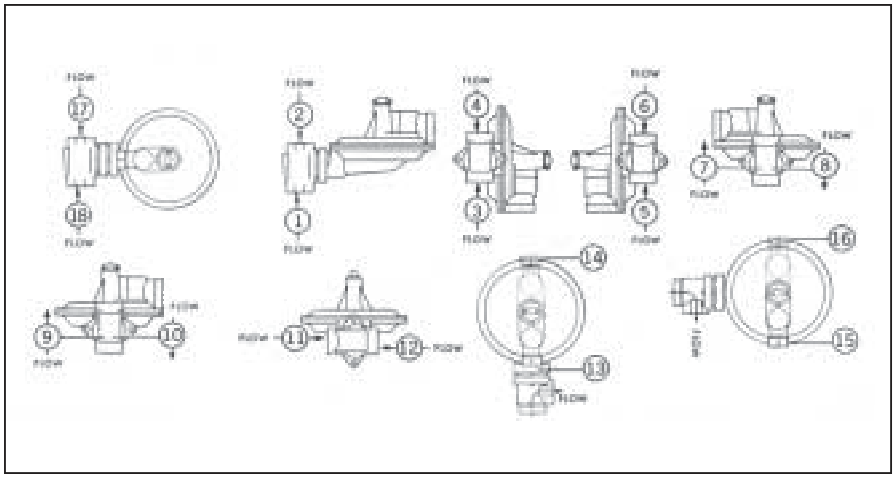
In order to insure the safe and proper operation of this product, the manufacturer recommends that this product be installed by a qualified installer.

Ordering Information

Specify:

1. Inlet and Outlet Connection Size and Type
2. Model Number
3. Outlet pressure desired
4. Inlet pressure range
5. Type of gas and maximum capacity required
6. Assembly position number (see chart at right)
7. Vent size
8. Special requirements such as tagging, 1/8" pipe plug tap, seal wire, etc.

Assembly Positions



Warranty

Actaris Metering System, 970 Highway 127 North, Owenton, Kentucky 40359-9802, warrants this gas product against defects in materials and workmanship for the earlier of one (1) year from the date the product is shipped by Actaris or a period of one year from the date the product is installed by Actaris at the original purchaser's site. During such one-year period, provided that the original purchaser continues to own the product, Actaris will, at its sole option, repair any defects, replace the product or repay the purchase price.

This warranty will be void if the purchaser fails to observe the procedures for installation, operation or service of the product as set forth in the Operating Manual and Specifications for the product or if the defect is caused by tampering, physical abuse or misuse of the product.

Actaris specifically disclaims all implied warranties including those of merchantability or of fitness for a particular purpose. Under no circumstances will Actaris be liable for incidental or consequential damages of any kind whatsoever.

Actaris' liability for any claim of any kind, including negligence and breach of warranty for the sale and use of any product covered by or furnished, shall in no case exceed the price allocable to the product or part thereof which gives rise to the claim.

In the event of a malfunction of the product, consult your Actaris Service Representative or Actaris Metering Systems, 970 Highway 127 North, Owenton, Kentucky 40359-9802.

Reference Information

- Regulator Pressure Ratings - JOT-2
- Regulator Startup - #769402

Actaris Metering Systems
970 Highway 127 North
Owenton, Kentucky 40359-9302, USA
Tel.: +1 800 490 0657
+1 502 484 5747
Fax: +1 502 484 6223

www.ActarisUSgas.com

ACTARIS
metering systems

J1G - 6/02

OPERATOR'S MANUAL

INCLUDING: OPERATION, INSTALLATION & MAINTENANCE

PD30X-X-X-C
PE30X-X-X-C

3" DIAPHRAGM PUMP
1:1 RATIO (METALLIC)

RELEASED: 2-9-05
REVISED: 3-5-07
(REV. 04)

READ THIS MANUAL CAREFULLY BEFORE INSTALLING, OPERATING OR SERVICING THIS EQUIPMENT.

It is the responsibility of the employer to place this information in the hands of the operator. Keep for future reference.

SERVICE KITS

Refer to Model Description Chart to match the pump material options.
637303-XX for fluid section repair (see page 4). Note: This kit also contains several air motor seals which will need to be replaced.
637374-X major air valve assembly (see page 7).
637421 for air section repair (see page 6).

PUMP DATA

Models . . . . . see Model Description Chart for "-XXX".
Pump Type . . . . . Metallic Air Operated Double Diaphragm
Material . . . . . see Model Description Chart.
Weight . . . . PX30A-XAX-XXX-C . . . . . 129.5 lbs (58.8 kgs)
PX30A-XCX-XXX-C . . . . . 216.6 lbs (98.2 kgs)
PX30A-XHX-XXX-C . . . . . 249.8 lbs (113.3 kgs)
PX30A-XSX-XXX-C . . . . . 228.8 lbs (103.8 kgs)
(add 40.0 lbs [18.2 kg] for stainless steel air motor section)
Maximum Air Inlet Pressure . . . . . 120 p.s.i.g. (8.3 bar)
Maximum Material Inlet Pressure . . . . . 10 p.s.i.g. (0.69 bar)
Maximum Outlet Pressure . . . . . 120 p.s.i.g. (8.3 bar)
Maximum Flow Rate . . . . . 237 g.p.m. (897 l.p.m.)
flooded inlet . . . . . 275 g.p.m. (1041 l.p.m.)
Displacement / Cycle @ 100 p.s.i.g. . . . 2.8 gal. (10.6 lit.)
Maximum Particle Size . . . . . 3/8" dia. (9.5 mm)
Maximum Temperature Limits (diaphragm / ball / seal material)
E.P.R. / EPDM . . . . . -60° to 280° F (-51° to 138° C)
Hytrel® . . . . . -20° to 150° F (-29° to 66° C)
Nitrile . . . . . 10° to 180° F (-12° to 82° C)
Kynar® PVDF . . . . . 10° to 200° F (-12° to 93° C)
Santoprene® . . . . . -40° to 225° F (-40° to 107° C)
Teflon® P.T.F.E. . . . . 40° to 225° F (4° to 107° C)
Viton® . . . . . -40° to 350° F (-40° to 177° C)
Dimensional Data . . . . . see page 8
Mounting Dimensions . . . 10-5/32" x 12-1/16" (258 mm x 306 mm)
Noise Level @ 70 p.s.i., 50 c.p.m.① . . . . 83.0 db(A)②

① Tested with 67263 muffler assembly installed.
② The pump sound pressure levels published here have been updated to an Equivalent Continuous Sound Level (L_{Aeq}) to meet the intent of ANSI S1.13-1971, CAGI-PNEUROP S5.1 using four microphone locations.

NOTICE: All possible options are shown in the chart however certain combinations may not be recommended, consult a representative or the factory if you have questions concerning availability.

3" DIAPHRAGM PUMP
PX30X-XXX-XXX-C

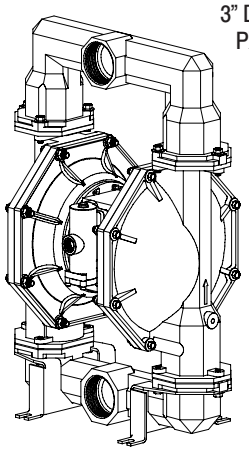
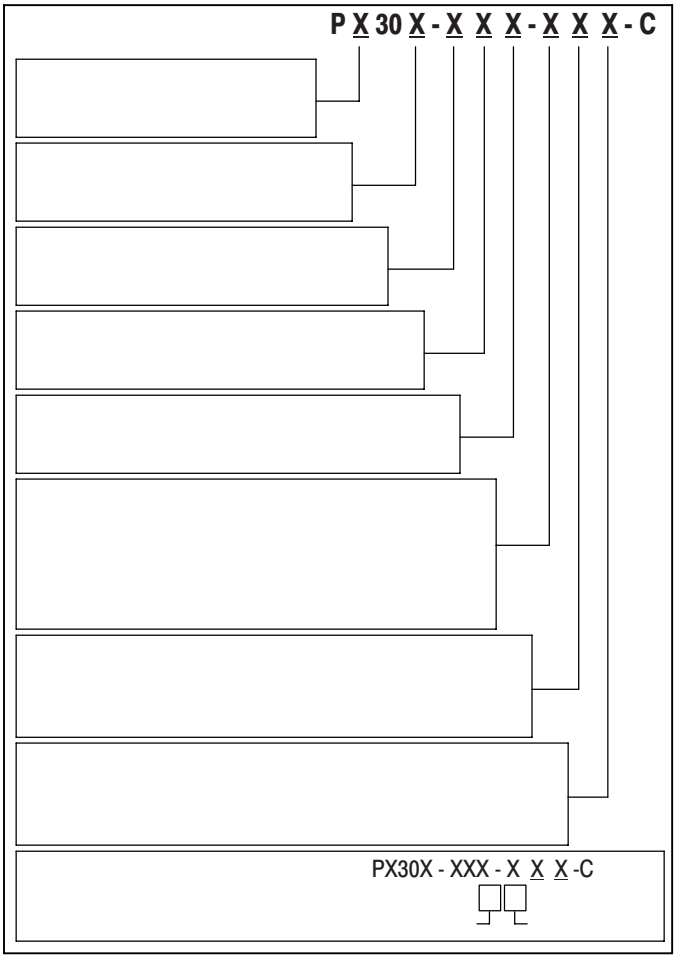


Figure 1

MODEL DESCRIPTION CHART



ARO

Ingersoll Rand
Industrial Technologies

OPERATING AND SAFETY PRECAUTIONS

READ, UNDERSTAND, AND FOLLOW THIS INFORMATION TO AVOID INJURY AND PROPERTY DAMAGE.


EXCESSIVE AIR PRESSURE
STATIC SPARK


HAZARDOUS MATERIALS
HAZARDOUS PRESSURE

⚠ WARNING EXCESSIVE AIR PRESSURE. Can cause personal injury, pump damage or property damage.

- Do not exceed the maximum inlet air pressure as stated on the pump model plate.
- Be sure material hoses and other components are able to withstand fluid pressures developed by this pump. Check all hoses for damage or wear. Be certain dispensing device is clean and in proper working condition.

⚠ WARNING STATIC SPARK. Can cause explosion resulting in severe injury or death. Ground pump and pumping system.

- Use the pump grounding screw terminal provided. Use ARO® part no. 66885-1 ground kit or connect a suitable ground wire (12 ga. min.) to a good earth ground source.
- Secure pump, connections and all contact points to avoid vibration and generation of contact or static spark.
- Consult local building codes and electrical codes for specific grounding requirements.
- After grounding, periodically verify continuity of electrical path to ground. Test with an ohmmeter from each component (e.g., hoses, pump, clamps, container, spray gun, etc.) to ground to insure continuity. Ohmmeter should show 0.1 ohms or less.
- Submerse the outlet hose end, dispensing valve or device in the material being dispensed if possible. (Avoid free streaming of material being dispensed.)
- Use hoses incorporating a static wire.
- Use proper ventilation.
- Keep inflammables away from heat, open flames and sparks.
- Keep containers closed when not in use.

⚠ WARNING Pump exhaust may contain contaminants. Can cause severe injury. Pipe exhaust away from work area and personnel.

- In the event of a diaphragm rupture material can be forced out of the air exhaust muffler.
- Pipe the exhaust to a safe remote location when pumping hazardous or inflammable materials.
- Use a grounded 1” minimum i.d. hose between the pump and the muffler.

⚠ WARNING HAZARDOUS PRESSURE. Can result in serious injury or property damage. Do not service or clean pump, hoses or dispensing valve while the system is pressurized.

- Disconnect air supply line and relieve pressure from the system by opening dispensing valve or device and / or carefully and slowly loosening and removing outlet hose or piping from pump.

⚠ WARNING HAZARDOUS MATERIALS. Can cause serious injury or property damage. Do not attempt to return a pump to the factory or service center that contains hazardous material. Safe handling practices must comply with local and national laws and safety code requirements.

- Obtain Material Safety Data Sheets on all materials from the supplier for proper handling instructions.

⚠ WARNING EXPLOSION HAZARD. Models containing aluminum wetted parts cannot be used with 1,1,1-trichloroethane, methylene chloride or other halogenated hydrocarbon solvents which may react and explode.

- Check pump motor section, fluid caps, manifolds and all wetted parts to assure compatibility before using with solvents of this type.

⚠ WARNING MISAPPLICATION HAZARD. Do not use models containing aluminum wetted parts with food products for human consumption. Plated parts can contain trace amounts of lead.

⚠ CAUTION Verify the chemical compatibility of the pump wetted parts and the substance being pumped, flushed or recirculated. Chemical compatibility may change with temperature and concentration of the chemical(s) within the substances being pumped, flushed or circulated. For specific fluid compatibility, consult the chemical manufacturer.

⚠ CAUTION Maximum temperatures are based on mechanical stress only. Certain chemicals will significantly reduce maximum safe operating temperature. Consult the chemical manufacturer for chemical compatibility and temperature limits. Refer to PUMP DATA on page 1 of this manual.

⚠ CAUTION Be certain all operators of this equipment have been trained for safe working practices, understand it’s limitations, and wear safety goggles / equipment when required.

⚠ CAUTION Do not use the pump for the structural support of the piping system. Be certain the system components are properly supported to prevent stress on the pump parts.

- Suction and discharge connections should be flexible connections (such as hose), not rigid piped, and should be compatible with the substance being pumped.

⚠ CAUTION Prevent unnecessary damage to the pump. Do not allow pump to operate when out of material for long periods of time.

- Disconnect air line from pump when system sits idle for long periods of time.

⚠ CAUTION Use only genuine ARO replacement parts to assure compatible pressure rating and longest service life.

⚠ WARNING

⚠ CAUTION

GENERAL DESCRIPTION

The ARO diaphragm pump offers high volume delivery even at low air pressure and a broad range of material compatibility options available. Refer to the model and option chart. ARO pumps feature stall resistant design, modular air motor / fluid sections.
Air operated double diaphragm pumps utilize a pressure differential in the air chambers to alternately create suction and positive fluid pressure in the fluid chambers, valve checks insure a positive flow of fluid.
Pump cycling will begin as air pressure is applied and it will continue to pump and keep up with the demand. It will build and maintain line pressure and will stop cycling once maximum line pressure is reached (dispensing device closed) and will resume pumping as needed.

AIR AND LUBE REQUIREMENTS

⚠ WARNING EXCESSIVE AIR PRESSURE. Can cause pump damage, personal injury or property damage.

- A filter capable of filtering out particles larger than 50 microns should be used on the air supply. There is no lubrication required other than the "O" ring lubricant which is applied during assembly or repair.
- If lubricated air is present, make sure that it is compatible with the "O" rings and seals in the air motor section of the pump.

OPERATING INSTRUCTIONS

- Always flush the pump with a solvent compatible with the material being pumped if the material being pumped is subject to "setting up" when not in use for a period of time.
- Disconnect the air supply from the pump if it is to be inactive for a few hours.
- The outlet material volume is governed not only by the air supply but also by the material supply available at the inlet. The material supply tubing should not be too small or restrictive. Be sure not to use hose which might collapse.
- When the diaphragm pump is used in a forced-feed (flooded inlet) situation it is recommended that a "Check Valve" be installed at the air inlet.
- Secure the diaphragm pump legs to a suitable surface to insure against damage by vibration.

MAINTENANCE

Refer to the part views and descriptions as provided on page 4 through 7 for parts identification and Service Kit information.

- Certain ARO "Smart Parts" are indicated which should be available for fast repair and reduction of down time.
- Service kits are divided to service two separate diaphragm pump functions: 1. AIR SECTION, 2. FLUID SECTION. The FLUID SECTION is divided further to match typical part MATERIAL OPTIONS.
- Provide a clean work surface to protect sensitive internal moving parts from contamination from dirt and foreign matter during service disassembly and reassembly.
- Keep good records of service activity and include pump in preventive maintenance program.
- Before disassembling empty captured material in the outlet manifold by turning the pump upside down to drain material from the pump.

FLUID SECTION DISASSEMBLY

1. Remove top manifold(s).
2. Remove (22) balls, (19) "O" rings (if applicable) and (21) seats.
3. Remove (15) fluid caps.

NOTE: Only Teflon diaphragm models use a primary (7) diaphragm and a backup (8) diaphragm. Refer to the auxiliary view in figure 1.

4. Remove the (14) screw, (6) diaphragm washer, (7) or (7 / 8) diaphragms, (5) backup washer and (196) cushion.

NOTE: Do not scratch or mar the surface of (1) diaphragm rod.

FLUID SECTION REASSEMBLY

SERVICE NOTE: ARO pn 204214-T diaphragm assembly tool is recommended for use when reassembling the pump.

- Reassemble in reverse order.
- Clean and inspect all parts. Replace worn or damaged parts with new parts as required.
- Lubricate (1) diaphragm rod and (144) "U" cup with Lubriplate® FML-2 grease. (94276 grease packet is included in service kit.)
- Be certain the diaphragm assembly bottoms out on the (1) rod, back off Teflon diaphragm assembly far enough to align holes.
- For models with Teflon diaphragms: Item (8) Santoprene diaphragm is installed with the side marked "AIR SIDE" towards the pump center body. Install the (7) Teflon diaphragm with the side marked "FLUID SIDE" towards the fluid cap.
- Re-check torque settings after pump has been re-started and run a while.

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CLICK HERE TO RETURN TO WEBSITE

★ **637303-XX FLUID SECTION SERVICE KITS INCLUDE: BALLS (see Ball Option, refer to -XX in chart below), DIAPHRAGMS (see Diaphragm Option, refer to -XX in chart below), and items; 3, 19, 70, 144, 175, 196, (listed below) plus (174) and 94276 Lubriplate FML-2 grease (page 6).**

-AXX	94104-A	(4)	[Sp]	-HXX	94114	(4)	[SH]	-XAX	94103-A	(4)	[Sp]	94115	(4)	[E]
-CXX	94104-C	(4)	[H]	-KXX	94621-K	(4)	[K]	-XCX	94103-C	(4)	[H]	Y327-350	(4)	[V]
-EXX	95678	(4)	[C]	-LXX	94939	(4)	[Ha]	-XGX	94103-G	(4)	[B]	Y325-350	(4)	[B]
-FXX	95674	(4)	[A]	-SXX	94113	(4)	[SS]	-XTX	94103-T	(4)	[T]	Y328-350	(4)	[T]
-GXX	94104-G	(4)	[B]					-XVX	94103-V	(4)	[V]	Y327-350	(4)	[V]

MATERIAL CODE

[A] =	Aluminum
[B] =	Nitrile
[C] =	Carbon Steel
[Co] =	Copper
[CI] =	Cast Iron
[E] =	E.P.R.
[H] =	Hytrel
[Ha] =	Hastelloy - C
[K] =	Kynar PVDF
[SH] =	Hard Stainless Steel
[Sp] =	Santoprene
[SS] =	Stainless Steel
[T] =	Teflon P.T.F.E.
[V] =	Viton

5	Backup Washer	(2)	94831-1	[C]	94831-1	[C]	94831-2	[SS]	94831-2	[SS]
68	Air Cap	(1)	94030-1	[A]	94721-1	[A]	94031-1	[SS]	94031-1	[SS]
69	Air Cap	(1)	94030-2	[A]	94721-2	[A]	94031-2	[SS]	94031-2	[SS]
76	Pipe Plug (1/8 - 27 N.P.T. x 0.27")	(1)	------	---	Y17-50-S	[SS]	------	---	Y17-50-S	[SS]
126	Pipe Plug (1/4 - 18 N.P.T. x 7/16")	(2)	------	---	Y17-51-S	[SS]	Y17-51-S	[SS]	Y17-51-S	[SS]
131	Screw (M10 x 1.5 - 6g x 120 mm)	(4)	94531	[C]	94531	[C]	96656	[SS]	96656	[SS]
★✓ 175	"O" Ring (3/32" x 1" o.d.)	(2)	Y325-117	[B]	Y325-117	[B]	------	---	------	---
★✓	(3/32" x 1-1/16" o.d.)	(2)	------	---	------	---	Y325-118	[B]	Y325-118	[B]
181	Roll Pin (5/32" o.d. x 3/4 long")	(4)	------	---	------	---	Y178-56-S	[SS]	Y178-56-S	[SS]

6	Fluid Side Washer	(2)	94802	[A]	94803	[SS]	94947	[Ha]	94803	[SS]
9	Washer (3/16" i.d. x 2" o.d. x 5/32")	(2)	Y13-12-T	[SS]	Y13-12-T	[SS]	94949	[Ha]	Y13-12-T	[SS]
14	Cap Screw (3/4" - 16 x 3-1/4")	(2)	Y5-134-T	[SS]	Y5-134-T	[SS]	94948	[Ha]	Y5-134-T	[SS]
15	Fluid Cap	(2)	94024	[A]	94106	[CI]	94693	[Ha]	94107	[SS]
32	Leg (PX30A-XXX-XXX-C)	(2)	------	---	94701-1	[C]	N / A	N / A	94703-1	[C]
	(PX30S-XXX-XXX-C)	(2)	------	---	94701-2	[SS]	94703-2	[SS]	94703-2	[SS]
60	Inlet Manifold (N.P.T.F.)	(1)	94699-1	[A]	94305-1	[CI]	94691-1	[Ha]	94216-1	[SS]
	(BSP)	(1)	94699-2	[A]	94305-2	[CI]	94691-2	[Ha]	94216-2	[SS]
61	Outlet Manifold (N.P.T.F.)	(1)	94700-1	[A]	94702-1	[CI]	94809-1	[Ha]	94704-1	[SS]
	(BSP)	(1)	94700-2	[A]	94702-2	[CI]	94809-2	[Ha]	94704-2	[SS]

26	Screw (M12 x 1.75 - 6g x 45 mm)	(12)	94412-1	[C]	94412-2	[SS]
27	Screw (M12 x 1.75 - 6g x 60 mm)	(16)	94991-1	[C]	94991	[SS]
29	Nut (M12 x 1.75 - 6g)	(16)	95053-1	[C]	95053	[SS]

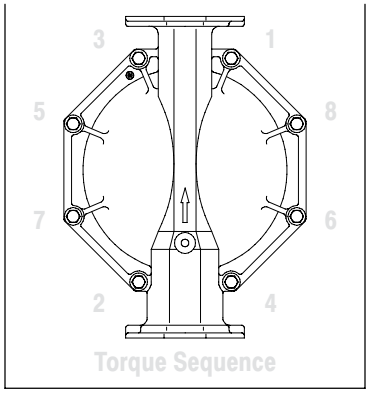
NOTE: Seat options -AXX, -CXX and -GXX do not require item 19 "O" ring.

✓ **Air Motor Kit parts, see page 6.**

1	Rod	(1)	94984	[C]	★✓144	"U" Cup (3/16" x 1-3/8" o.d.)	(2)	Y186-51	[B]
43	Ground Lug (see page 7)	(1)	93004	[Co]	✓ 180	Gasket (0.406" i.d. x 0.031" thick)	(4)	94098	[Co]
★ ✓ 70	Gasket	(2)	94100	[B]	★ 196	Cushion	(2)	94631	[Sp]

MATERIAL	DIAPHRAGM COLOR	BALL COLOR
Hytrel	Cream	Cream
Nitrile	Black	Red (•)
Santoprene	Tan	Tan
Santoprene (Backup)	Green	N/A
Teflon P.T.F.E.	White	White
Viton	Yellow (-) (-) Stripe	Yellow (•) (•) Dot

FOR THE AIR MOTOR SECTION SEE PAGES 6 & 7



Torque Sequence

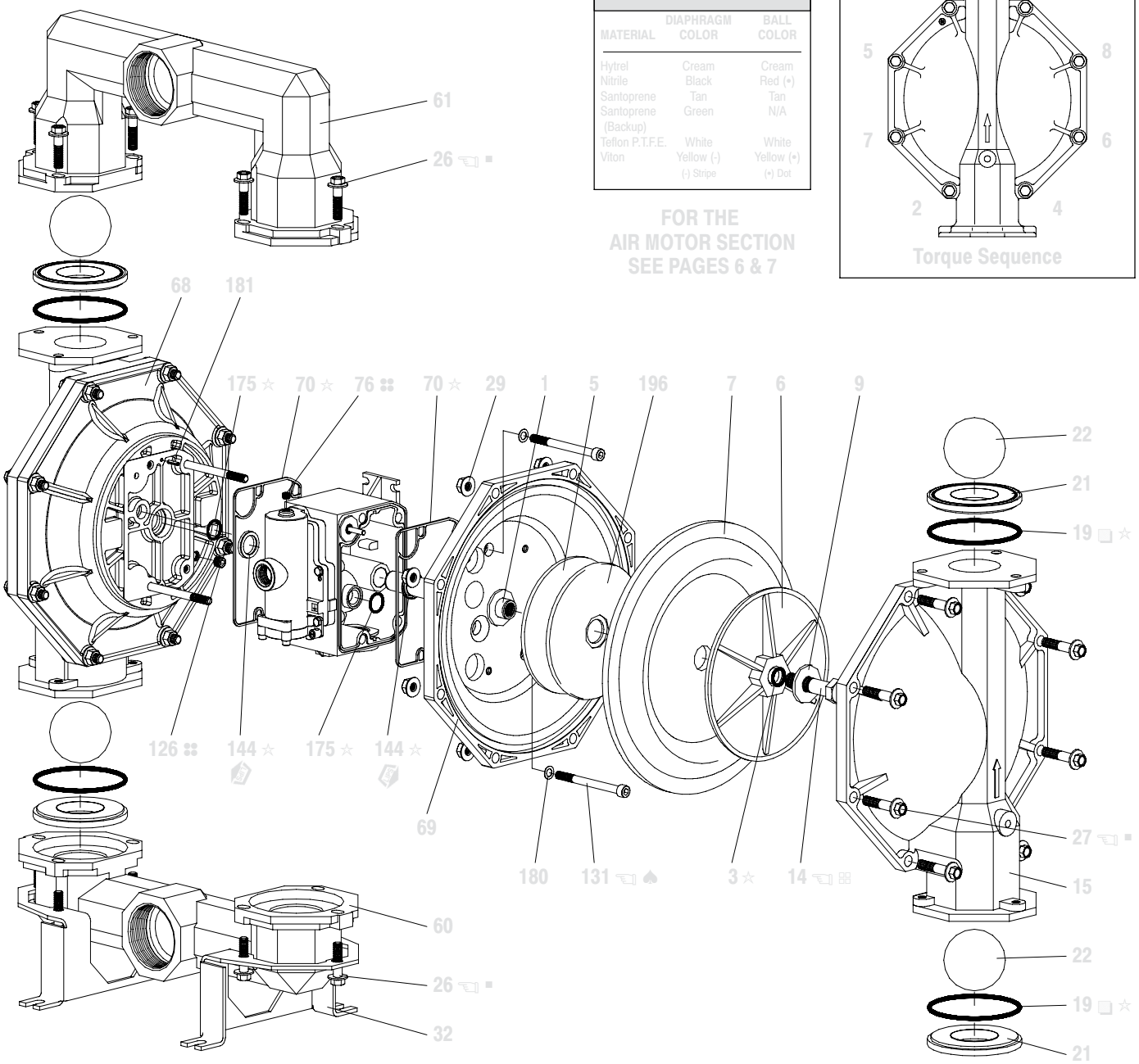


Figure 2

☞ TORQUE REQUIREMENTS ☜

NOTE: DO NOT OVERTIGHTEN FASTENERS.
ALL FASTENERS ARE METRIC.

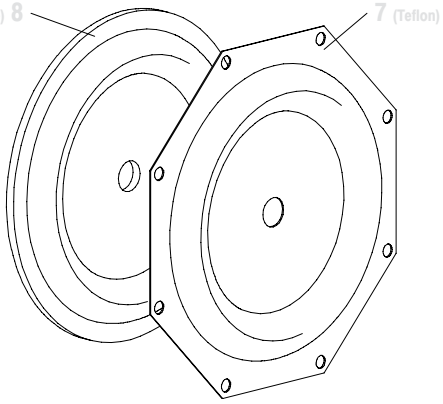
(14) Cap screw, 65 - 70 ft lbs (88.1 - 94.9 Nm).
(26 and 27) Fluid caps / manifold screw, 60 - 70 ft lbs (81.4 - 94.9 Nm).
(131) Screw, 35 - 40 ft lbs (47.5 - 54.2 Nm).

LUBRICATION / SEALANTS

☆ Apply Lubriplate FML-2 grease to all "O" rings, "U" Cups & mating parts.
♠ Apply Loctite® 242 to threads at assembly.
⁘ Apply Teflon tape to threads at assembly.
⊞ Apply Loctite 271 to threads.
▪ Apply anti-seize compound to threads and bolt and nut flange heads which contact pump case when using Stainless steel fasteners.

❑ NOT USED WITH PX30X-XXX-AXX-C, -CXX-C, & -GXX-C.
◇ Lubriplate FML-2 is a white food grade petroleum grease. MSDS available upon request.

VIEW OF TWO PIECE TEFLON DIAPHRAGM



Indicates parts included in 637421 Air Section Service Kit shown below and items (70), (144), (175), (180) shown on page 4.

101	Center Body (PX30A-XXX-XXX-C)	(1)	94028	[A]
	(PX30S-XXX-XXX-C)	(1)	94109	[SS]
103	Bushing	(1)	94092	[D]
105	Screw (M6 x 1 - 6g x 20 mm)	(4)	95887	[SS]
111	Spool	(1)	95651	[D]
118	Actuator Pin (0.250" x 2.276" long)	(2)	94083	[SS]
121	Sleeve	(2)	94084	[D]
○ 127	90 St. Elbow (1-1/2 - 11-1/2 N.P.T.)	(1)	94860	[C / I]
128	Set Screw (1/4" - 20 x 1/4")	(2)	Y29-42-S	[SS]
✓ 132	Gasket	(1)	94099	[B]
133	Lockwasher (1/4") (PX30A-X-X-C)	(3)	Y117-416-C	[C]
	(PX30S-X-X-C)	(3)	Y14-416-T	[SS]
134	Screw (M6 x 1 - 6g x 30 mm)	(4)	96358	[SS]
135	Valve Housing (PD30A-XXX-XXX-C)	(1)	96334-1	[A]
	(PE30A-XXX-XXX-C)	(1)	96334-2	[A]
	(PD30S-XXX-XXX-C)	(1)	96337-1	[SS]
	(PE30S-XXX-XXX-C)	(1)	96337-2	[SS]
136	Plug (PX30A-XXX-XXX-C)	(1)	96335	[A]
	(PX30S-XXX-XXX-C)	(1)	96339	[SS]
✓ 137	"O" Ring (1/16" x 2" o.d.)	(1)	Y325-32	[B]
✓ 138	"U" Cup (3/16" x 1.792" o.d.)	(1)	95966	[B]
✓ 139	"U" Cup (3/16" x 1-1/4" o.d.)	(1)	Y186-50	[B]
140	Valve Insert	(1)	95650	[Ck]
141	Valve Plate	(1)	95659	[Ck]
✓ 146	"O" Ring ◆ (3/32" x 1-1/16" o.d.)	(1)	Y325-118	[B]
✓ 147	"O" Ring ◆ (1/8" x 1/2" o.d.)	(2)	Y325-202	[B]
✓ 166	Track Gasket ●	(1)	94026	[B]
✓ 167	Pilot Piston (includes 168 and 169)	(1)	67164	[D]
168	"O" Ring (3/32" x 5/8" o.d.)	(2)	94433	[U]
169	"U" Cup (1/8" x 7/8" o.d.)	(1)	Y240-9	[B]
170	Piston Sleeve	(1)	94081	[Br]
✓ 171	"O" Ring (3/32" x 1-1/8" o.d.)	(1)	Y325-119	[B]
✓ 172	"O" Ring (1/16" x 1-1/8" o.d.)	(1)	Y325-22	[B]
✓ 173	"O" Ring (1/16" x 1-3/8" o.d.)	(2)	Y325-26	[B]
★✓ 174	"O" Ring (1/8" x 1/2" o.d.)	(2)	Y325-202	[B]
✓ 176	Diaphragm (check valve)	(2)	94102	[Sp]
✓ 199	Track Gasket	(1)	95666	[B]
✓ 200	Gasket	(1)	95665	[B]
○ 201	Muffler	(1)	94810	
233	Adapter Plate (PX30A-XXX-XXX-C)	(1)	96336	[A]
	(PX30S-XXX-XXX-C)	(1)	96338	[SS]
240	Screw (M6 x 1 - 6g x 16 mm)	(2)	95991	[SS]
✓ 241	Track Gasket	(1)	96344	[B]
✓ 242	"O" Ring (1/16" x 7/32" o.d.)	(1)	Y325-5	[B]
✓ 243	"O" Ring (1/8" x 5/8" o.d.)	(1)	Y325-204	[B]
✓ 244	"O" Ring (1/8" x 7/8" o.d.)	(1)	Y325-208	[B]
★ ✓	Lubriplate FML-2 Grease	(1)	94276	
	Lubriplate Grease Packets (10)		637308	

◆ Used on models PX30S-XXX-XXX-C only.
● Used on models PX30A-XXX-XXX-C only.
○ Items not shown

★ Fluid Section Kit parts, see page 4.

AIR MOTOR SECTION SERVICE

Service is divided into two parts – 1. Pilot Valve, 2. Major Valve.
GENERAL REASSEMBLY NOTES:

- Air Motor Section Service is continued from Fluid Section repair.
- Inspect and replace old parts with new parts as necessary. Look for deep scratches on metallic surfaces, and nicks or cuts in "O" rings.
- Take precautions to prevent cutting "O" rings upon installation.
- Lubricate "O" rings with Lubriplate FML-2 grease.
- Do not over-tighten fasteners, refer to torque specification block on view.
- Re-torque fasteners following restart.
- SERVICE TOOLS – To aid in the installation of (168) "O" rings onto the (167) pilot piston, use tool # 204130-T, available from ARO.

PILOT VALVE DISASSEMBLY

1. A light tap on (118) should expose the opposite (121) sleeve, (167) pilot piston and other parts.
2. Remove (170) sleeve, inspect inner bore of sleeve for damage.

PILOT VALVE REASSEMBLY

1. Clean and lubricate parts not being replaced from service kit.
2. Install new (171 and 172) "O" rings, replace (170) sleeve.
3. Install new (168) "O" rings and (169) seal - Note the lip direction. Lubricate and replace (167).
4. Reassemble remaining parts, replace (173 and 174) "O" rings.

MAJOR VALVE DISASSEMBLY

1. Remove (135) valve block and (233) adapter plate, exposing (166 and 132) gaskets and (176) checks.
2. Remove (233) adapter plate, releasing (140) valve insert, (141) valve plate, (199, 200 and 241) gaskets and (243 and 244) "O" rings.
3. Remove (136) plug and (137) "O" ring, releasing (111) spool.

MAJOR VALVE REASSEMBLY

1. Install new (138 and 139) "U" cups on (111) spool – **LIPS MUST FACE EACH OTHER**.
2. Insert (111) spool into (135) valve housing.
3. Install (137 and 242) "O" rings on (136) plug and assemble plug to (135) valve housing, securing with (105) screws.
4. Install (140) valve insert, (141) valve plate, (199) gasket and (243 and 244) "O" rings into (135) valve housing. NOTE: Assemble (140) valve insert with "dished" side toward (141) valve plate. Assemble (141) valve plate with part number identification toward (140) valve insert.
5. Assemble (200 and 241) gaskets and (233) adapter plate to (135) valve housing, securing with (240) screws.
6. Assemble (132 and 166) gaskets and (176) checks to (101) center body.
7. Assemble (135) valve housing and components to (101) center body, securing with (134) screws.

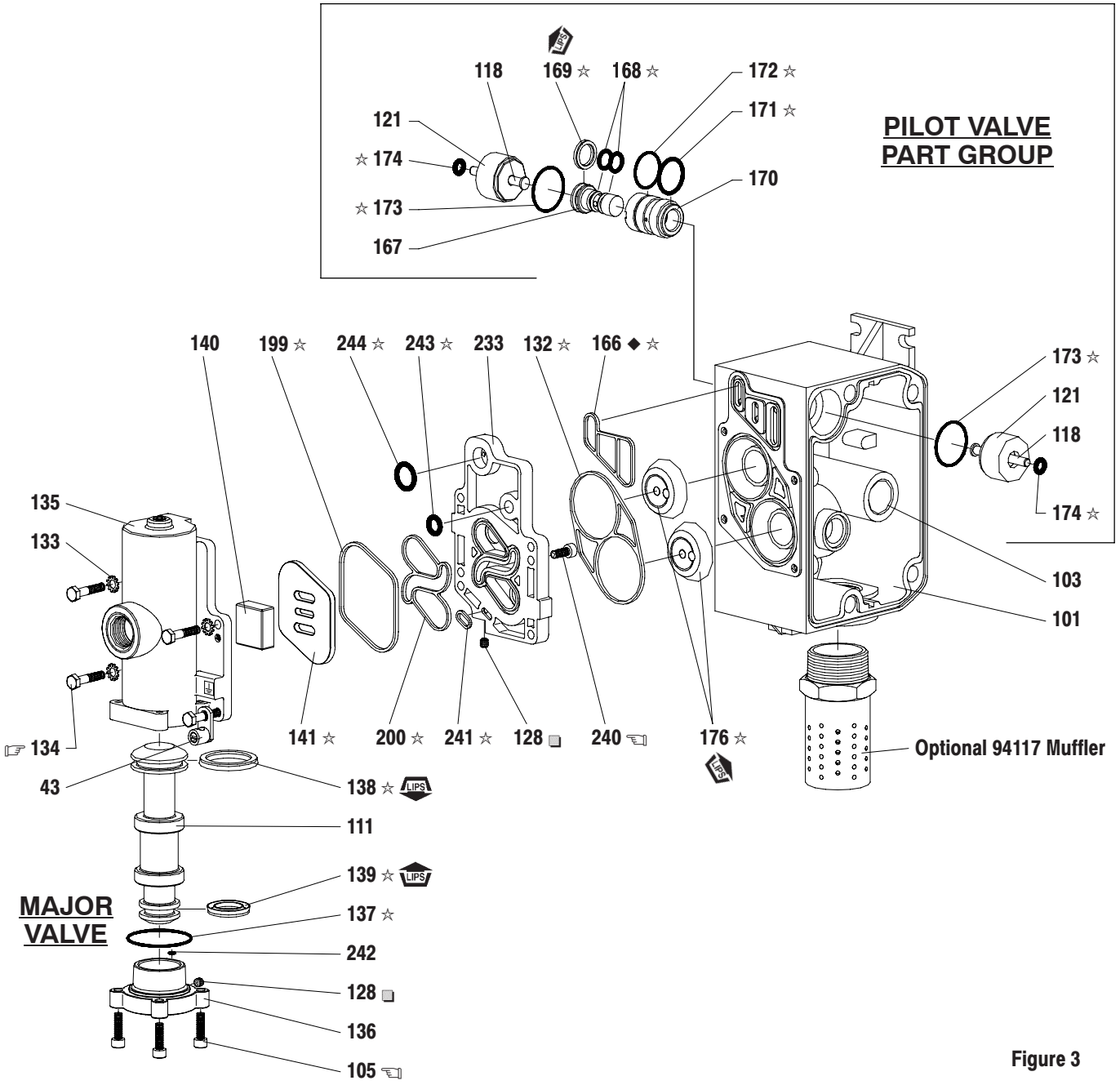


Figure 3

☞ TORQUE REQUIREMENTS ☜

NOTE: DO NOT OVERTIGHTEN FASTENERS.
ALL FASTENERS ARE METRIC.

Torque (105) screw to 40 - 50 in. lbs (4.5 - 5.6 Nm).
Torque (134) screw to 40 - 50 in. lbs (4.5 - 5.6 Nm).
Torque (240) screw to 40 - 50 in. lbs (4.5 - 5.6 Nm).

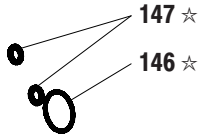
LUBRICATION / SEALANTS

☆ **Apply Lubriplate FML-2 grease to "O" rings, "U" Cups & mating parts.**
❑ **Apply Loctite 271 to threads at assembly.**

MATERIAL CODE

[A] = Aluminum
[B] = Nitrile
[Br] = Brass
[C] = Carbon Steel
[Ck] = Ceramic
[D] = Acetal
[I] = Iron
[Sp] = Santoprene
[SS] = Stainless Steel
[U] = Polyurethane

◆ **Substitute these "O" rings for "166" gasket on models PX30S-XXX-XXX-C.**



A replacement Major Valve Service Assembly is available separately, which includes the following:

637374-2 for models PD30A-X-X-C: 105 (4), 111, 128 (2), 132, 133 (3), 134, 135, 136, 137, 138, 139, 140, 141, 166, 176 (2), 199, 200, 233, 240 (2), 241, 242, 243 and 244.

637374-4 for models PD30S-X-X-C: 105 (4), 111, 128 (2), 132, 133 (3), 134, 135, 136, 137, 138, 139, 140, 141, 146, 147 (2), 176 (2), 199, 200, 233, 240 (2), 241, 242, 243 and 244.

637374-3 for models PE30A-X-X-C: 76, 105 (4), 111, 128 (2), 132, 133 (3), 134, 135, 136, 137, 138, 139, 140, 141, 166, 176 (2), 199, 200, 233, 240 (2), 241, 242, 243 and 244.

637374-5 for models PE30S-X-X-C: 76, 105 (4), 111, 128 (2), 132, 133 (3), 134, 135, 136, 137, 138, 139, 140, 141, 146, 147 (2), 176 (2), 199, 200, 233, 240 (2), 241, 242, 243 and 244.

TROUBLE SHOOTING

Product discharged from exhaust outlet.
- Check for diaphragm rupture.
- Check tightness of (14) cap screw.

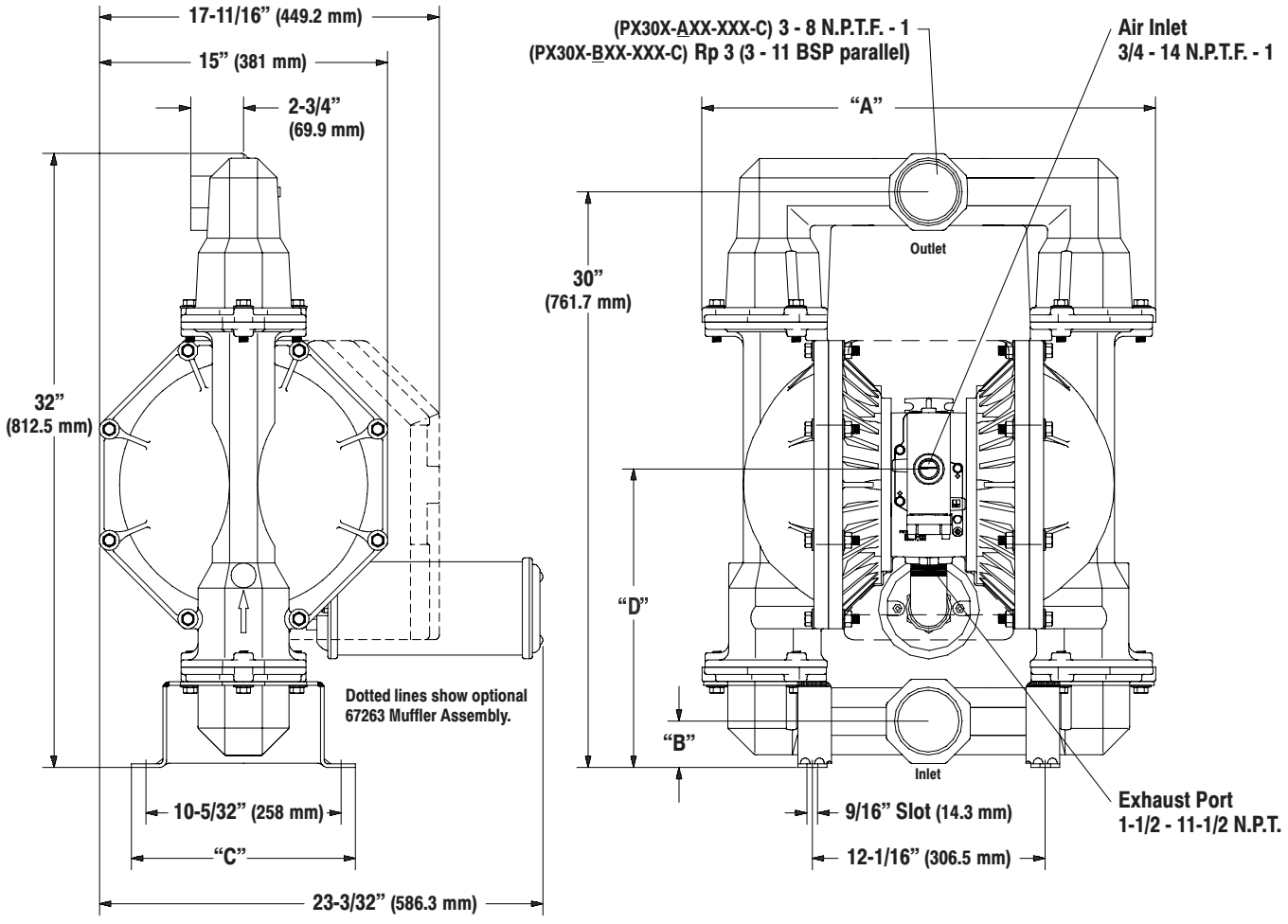
Air bubbles in product discharge.
- Check connections of suction plumbing.
- Check "O" rings between intake manifold and fluid caps.
- Check tightness of (14) cap screw.

Motor blows air or stalls.
- Check (176) check valve for damage or wear.
- Check for restrictions in valve / exhaust.

Low output volume, erratic flow, or no flow.
- Check air supply.
- Check for plugged outlet hose.
- Check for kinked (restrictive) outlet material hose.
- Check for kinked (restrictive) or collapsed inlet material hose.
- Check for pump cavitation - suction pipe should be sized at least as large as the inlet thread diameter of the pump for proper flow if high viscosity fluids are being pumped. Suction hose must be a non-collapsing type, capable of pulling a high vacuum.
- Check all joints on the inlet manifolds and suction connections. These must be air tight.
- Inspect the pump for solid objects lodged in the diaphragm chamber or the seat area.

DIMENSIONAL DATA

(Dimensions shown are for reference only, they are displayed in inches and millimeters (mm).



OPTIONAL ACCESSORY: 66109 Air Line Connection Kit

	"A"	"B"	"C"	"D"
PX30X-XAX-XXX-C	23-5/8" (598.7 mm)	2-3/8" (60.3 mm)	11" (279.4 mm)	15-1/2" (393.7 mm)
PX30X-XCX-XXX-C	23-5/8" (598.7 mm)	2-7/16" (61.1 mm)	11-11/16" (296.1 mm)	15-1/2" (393.7 mm)
PX30X-XHX-XXX-C	23-1/8" (587.3 mm)	2-3/4" (69.9 mm)	11-11/16" (296.1 mm)	16" (406.4 mm)
PX30X-XSX-XXX-C	23-1/8" (587.3 mm)	2-3/4" (69.9 mm)	11-11/16" (296.1 mm)	16" (406.4 mm)

Figure 4

APPENDIX G

SDSs for Products used in Cooling Tower

SAFETY DATA SHEET

Product name: ChemWorld Inhibted Propylene Glycol (Food Grade) **Issue Date:** 04/09/2015
Print Date: 06/15/2015

Chemworld.com encourages and expects you to read and understand the entire (M)SDS, as there are important information throughout the document. We expect you to follow the precautions identified in this document unless your use conditions would necessitate other appropriate methods or actions.

1. IDENTIFICATION

Product name: ChemWorld Inhibted Propylene Glycol (Food Grade)

Recommended use of the chemical and restrictions on use
Identified uses: Intended as a heat transfer fluid for closed-loop systems. This product is acceptable for use where there is possibility of incidental food contact and as a product for use in the immersion or spray freezing of wrapped meat and packaged poultry products. We recommend that you use this product in a manner consistent with the listed use. If your intended use is not consistent with the stated use, please contact your sales or technical service representative.

COMPANY IDENTIFICATION
3939 Royal Drive,
Ste 224 and 226, Kennesaw, GA 30144

Customer Information Number: Phone: (800) 658-7716, Fax: (877) 209-1556
Sales@Chemworld.com

EMERGENCY TELEPHONE NUMBER
24-Hour Emergency Contact: 1 800-255-3924

2. HAZARDS IDENTIFICATION

Hazard classification
This material is not hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29CFR 1910.1200.

Other hazards
no data available

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical nature: Glycol

This product is a mixture.

Component	CASRN	Concentration
Propylene glycol	57-55-6	> 95.0 %
Dipotassium hydrogen phosphate	7758-11-4	< 3.0 %
Water	7732-18-5	< 3.0 %

4. FIRST AID MEASURES

Description of first aid measures
General advice: If potential for exposure exists refer to Section 8 for specific personal protective equipment.

Inhalation: Move person to fresh air; if effects occur, consult a physician.

Skin contact: Wash off with plenty of water.

Eye contact: Flush eyes thoroughly with water for several minutes. Remove contact lenses after the initial 1-2 minutes and continue flushing for several additional minutes. If effects occur, consult a physician, preferably an ophthalmologist.

Ingestion: No emergency medical treatment necessary.

Most important symptoms and effects, both acute and delayed: Aside from the information found under Description of first aid measures (above) and Indication of immediate medical attention and special treatment needed (below), any additional important symptoms and effects are described in Section 11: Toxicology Information.

Indication of any immediate medical attention and special treatment needed
Notes to physician: No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient.

5. FIREFIGHTING MEASURES

Suitable extinguishing media: Water fog or fine spray. Dry chemical fire extinguishers. Carbon dioxide fire extinguishers. Foam. Alcohol resistant foams (ATC type) are preferred. General purpose synthetic foams (including AFFF) or protein foams may function, but will be less effective.

Unsuitable extinguishing media: Do not use direct water stream. May spread fire.

Special hazards arising from the substance or mixture
Hazardous combustion products: During a fire, smoke may contain the original material in addition to combustion products of varying composition which may be toxic and/or irritating. Combustion products may include and are not limited to: Carbon monoxide. Carbon dioxide.

Unusual Fire and Explosion Hazards: Container may rupture from gas generation in a fire situation. Violent steam generation or eruption may occur upon application of direct water stream to hot liquids.

Advice for firefighters
Fire Fighting Procedures: Keep people away. Isolate fire and deny unnecessary entry. Use water spray to cool fire exposed containers and fire affected zone until fire is out and danger of reignition has passed. Fight fire from protected location or safe distance. Consider the use of unmanned hose holders or monitor nozzles. Immediately withdraw all personnel from the area in case of rising sound from venting safety device or discoloration of the container. Burning liquids may be extinguished by dilution with water. Do not use direct water stream. May spread fire. Move container from fire area if this is possible without hazard. Burning liquids may be moved by flushing with water to protect personnel and minimize property damage.

Special protective equipment for firefighters: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, trousers, boots, and gloves). If protective equipment is not available or not used, fight fire from a protected location or safe distance.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures: Use appropriate safety equipment. For additional information, refer to Section 8, Exposure Controls and Personal Protection.

Environmental precautions: Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. See Section 12, Ecological Information.

Methods and materials for containment and cleaning up: Small spills: Absorb with materials such as: Cat litter. Sawdust. Vermiculite. Zorb-all®. Collect in suitable and properly labeled containers. Large spills: Dike area to contain spill. Recover spilled material if possible. See Section 13, Disposal Considerations, for additional information.

7. HANDLING AND STORAGE

Precautions for safe handling: No special precautions required. Keep container closed. See Section 8, EXPOSURE CONTROLS AND PERSONAL PROTECTION.

Spills of these organic materials on hot fibrous insulations may lead to lowering of the autoignition temperatures possibly resulting in spontaneous combustion.

Conditions for safe storage: Do not store in: Galvanized steel. Opened or unlabeled containers. Store in original unopened container. See Section 10 for more specific information. Additional storage and handling information on this product may be obtained by calling your sales or customer service contact.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters
Exposure limits are listed below, if they exist.

Component	Regulation	Type of listing	Value/Notation
Propylene glycol	US WEEL	TWA	10 mg/m3

Exposure controls

Engineering controls: Use local exhaust ventilation, or other engineering controls to maintain airborne levels below exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, general ventilation should be sufficient for most operations. Local exhaust ventilation may be necessary for some operations.

Individual protection measures

Eye/face protection: Use safety glasses (with side shields).

Skin protection

Hand protection: Use gloves chemically resistant to this material when prolonged or frequently repeated contact could occur. Examples of preferred glove barrier materials include: Butyl rubber. Natural rubber ("latex"). Neoprene. Nitrile/butadiene rubber ("nitrile" or "NBR"). Polyethylene. Ethyl vinyl alcohol laminate ("EVAL"). Polyvinyl alcohol ("PVA"). Polyvinyl chloride ("PVC" or "vinyl"). NOTICE: The selection of a specific glove for a particular application and duration of use in a workplace should also take into account all relevant workplace factors such as, but not limited to: Other chemicals which may be handled, physical requirements (cut/puncture protection, dexterity, thermal protection), potential body reactions to glove materials, as well as the instructions/specifications provided by the glove supplier.

Other protection: Wear clean, body-covering clothing.

Respiratory protection: Respiratory protection should be worn when there is a potential to exceed the exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, wear respiratory protection when adverse effects, such as respiratory irritation or discomfort have been experienced, or where indicated by your risk assessment process. In misty atmospheres, use an approved particulate respirator. The following should be effective types of air-purifying respirators: Organic vapor cartridge with a particulate pre-filter.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	
Physical state	Liquid.
Color	Colorless
Odor	Characteristic
Odor Threshold	No test data available
pH	10.0 50% *Literature*
Melting point/range	Not applicable to liquids
Freezing point	supercools
Boiling point (760 mmHg)	152 °C (306 °F) *Literature*
Flash point	**closed cup** 104 °C (219 °F) *Pensky-Martens Closed Cup ASTM D 93* (based on major component), Propylene glycol. **open cup** *Cleveland Open Cup ASTM D92* None
Evaporation Rate (Butyl Acetate = 1)	<0.5 *Estimated.*
Flammability (solid, gas)	Not applicable to liquids
Lower explosion limit	2.6 % vol *Literature* Propylene glycol.
Upper explosion limit	12.5 % vol *Literature* Propylene glycol.

Vapor Pressure	2.2 mmHg *Literature*
Relative Vapor Density (air = 1)	>1.0 *Literature*
Relative Density (water = 1)	1.05 at 20 °C (68 °F) / 20 °C *Literature*
Water solubility	100 % *Literature*
Partition coefficient: n-octanol/water	no data available
Auto-ignition temperature	371 °C (700 °F) *Literature* Propylene glycol.
Decomposition temperature	No test data available
Kinematic Viscosity	43.4 cSt at 20 °C (68 °F) *Literature*
Explosive properties	no data available
Oxidizing properties	no data available
Molecular weight	76.9 g/mol *Literature*

NOTE: The physical data presented above are typical values and should not be construed as a specification.

10. STABILITY AND REACTIVITY

Reactivity: no data available

Chemical stability: Stable under recommended storage conditions. See Storage, Section 7. Hygroscopic

Possibility of hazardous reactions: Polymerization will not occur.

Conditions to avoid: Exposure to elevated temperatures can cause product to decompose. Generation of gas during decomposition can cause pressure in closed systems. Avoid direct sunlight or ultraviolet sources.

Incompatible materials: Avoid contact with: Strong acids. Strong bases. Strong oxidizers.

Hazardous decomposition products: Decomposition products depend upon temperature, air supply and the presence of other materials. Decomposition products can include and are not limited to: Aldehydes. Alcohols. Ethers. Organic acids.

11. TOXICOLOGICAL INFORMATION

Toxicological information on this product or its components appear in this section when such data is available.

Acute toxicity

Acute oral toxicity

Very low toxicity if swallowed. Harmful effects not anticipated from swallowing small amounts.

For the major component(s): Propylene glycol.
LD50, Rat, > 20,000 mg/kg

Acute dermal toxicity
Prolonged skin contact is unlikely to result in absorption of harmful amounts.

For the major component(s): Propylene glycol.
LD50, Rabbit, > 20,000 mg/kg

Acute inhalation toxicity
At room temperature, exposure to vapor is minimal due to low volatility. Mist may cause irritation of upper respiratory tract (nose and throat).

For the major component(s):
LC50, Rat, 4 Hour, vapour, 6.15 mg/l No deaths occurred following exposure to a saturated atmosphere.

Skin corrosion/irritation
Prolonged contact is essentially nonirritating to skin.
Repeated contact may cause flaking and softening of skin.

Serious eye damage/eye irritation
May cause slight temporary eye irritation.
Corneal injury is unlikely.

Sensitization
For the major component(s):
Did not cause allergic skin reactions when tested in humans.

For respiratory sensitization:
No relevant data found.

Specific Target Organ Systemic Toxicity (Single Exposure)
Evaluation of available data suggests that this material is not an STOT-SE toxicant.

Specific Target Organ Systemic Toxicity (Repeated Exposure)
In rare cases, repeated excessive exposure to propylene glycol may cause central nervous system effects.

Carcinogenicity
Similar formulations did not cause cancer in laboratory animals.

Teratogenicity
For the major component(s): Did not cause birth defects or any other fetal effects in laboratory animals.

Reproductive toxicity
For the major component(s): In animal studies, did not interfere with reproduction. In animal studies, did not interfere with fertility.

Mutagenicity
In vitro genetic toxicity studies were negative. For the major component(s): Animal genetic toxicity studies were negative.

Aspiration Hazard

Based on physical properties, not likely to be an aspiration hazard.

12. ECOLOGICAL INFORMATION

Ecotoxicological information on this product or its components appear in this section when such data is available.

Toxicity

Propylene glycol

Acute toxicity to fish
Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).
LC50, Oncorhynchus mykiss (rainbow trout), static test, 96 Hour, 40,613 mg/l, OECD Test Guideline 203

Acute toxicity to aquatic invertebrates
LC50, Ceriodaphnia dubia (water flea), static test, 48 Hour, 18,340 mg/l, OECD Test Guideline 202

Acute toxicity to algae/aquatic plants
ErC50, Pseudokirchneriella subcapitata (green algae), 96 Hour, Growth rate inhibition, 19,000 mg/l, OECD Test Guideline 201

Toxicity to bacteria
NOEC, Pseudomonas putida, 18 Hour, > 20,000 mg/l

Chronic toxicity to aquatic invertebrates
NOEC, Ceriodaphnia dubia (water flea), semi-static test, 7 d, number of offspring, 13,020 mg/l

Dipotassium hydrogen phosphate

Acute toxicity to fish
Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).
LC50, Leuciscus idus (Golden orfe), static test, 48 Hour, > 900 mg/l, Method Not Specified.

Persistence and degradability

Propylene glycol

Biodegradability: Material is readily biodegradable. Passes OECD test(s) for ready biodegradability. Biodegradation may occur under anaerobic conditions (in the absence of oxygen).
10-day Window: Pass
Biodegradation: 81 %
Exposure time: 28 d
Method: OECD Test Guideline 301F or Equivalent
10-day Window: Not applicable
Biodegradation: 96 %
Exposure time: 64 d
Method: OECD Test Guideline 306 or Equivalent

Theoretical Oxygen Demand: 1.68 mg/mg

Chemical Oxygen Demand: 1.53 mg/mg

Biological oxygen demand (BOD)

Incubation Time	BOD
5 d	69.000 %
10 d	70.000 %
20 d	86.000 %

Photodegradation
Atmospheric half-life: 10 Hour
Method: Estimated.

Dipotassium hydrogen phosphate
Biodegradability: Biodegradation is not applicable.

Bioaccumulative potential

Propylene glycol
Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3).
Partition coefficient: n-octanol/water(log Pow): -1.07 Measured
Bioconcentration factor (BCF): 0.09 Estimated.

Dipotassium hydrogen phosphate
Bioaccumulation: No bioconcentration is expected because of the relatively high water solubility.

Mobility in soil

Propylene glycol
Given its very low Henry's constant, volatilization from natural bodies of water or moist soil is not expected to be an important fate process.
Potential for mobility in soil is very high (Koc between 0 and 50).
Partition coefficient(Koc): < 1 Estimated.

Dipotassium hydrogen phosphate
No relevant data found.

13. DISPOSAL CONSIDERATIONS

Disposal methods: DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. All disposal practices must be in compliance with all Federal, State/Provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator. AS YOUR SUPPLIER, WE HAVE NO CONTROL OVER THE MANAGEMENT PRACTICES OR MANUFACTURING PROCESSES OF PARTIES HANDLING OR USING THIS MATERIAL. THE INFORMATION PRESENTED HERE PERTAINS ONLY TO THE PRODUCT AS SHIPPED IN ITS

INTENDED CONDITION AS DESCRIBED IN MSDS SECTION: Composition Information. FOR UNUSED & UNCONTAMINATED PRODUCT, the preferred options include sending to a licensed, permitted: Recycler. Reclaimer. Incinerator or other thermal destruction device.

14. TRANSPORT INFORMATION

DOT

Not regulated for transport

Classification for SEA transport (IMO-IMDG):

Not regulated for transport

Transport in bulk according to Annex I or II of MARPOL 73/78 and the IBC or IGC Code	Consult IMO regulations before transporting ocean bulk

Classification for AIR transport (IATA/ICAO):

Not regulated for transport

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Transportation classifications may vary by container volume and may be influenced by regional or country variations in regulations. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

15. REGULATORY INFORMATION

OSHA Hazard Communication Standard
This product is not a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Sections 311 and 312
This product is not a hazardous chemical under 29CFR 1910.1200, and therefore is not covered by Title III of SARA.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Section 313
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

Pennsylvania Worker and Community Right-To-Know Act:
The following chemicals are listed because of the additional requirements of Pennsylvania law:

Components	**CASRN**
Propylene glycol	57-55-6

California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986)
This product contains no listed substances knownto the State of California to cause cancer, birth defects or other reproductive harm, at levels which would require a warning under the statute.

United States TSCA Inventory (TSCA)
All components of this product are in compliance with the inventory listing requirements of the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

:

16. OTHER INFORMATION

Hazard Rating System
NFPA

Health	Fire	Reactivity
0	1	0

Revision
Identification Number: 101234106 / A001 / Issue Date: 04/09/2015 / Version: 7.0
Most recent revision(s) are noted by the bold, double bars in left-hand margin throughout this document.

Legend

TWA	8-hr TWA
US WEEL	USA. Workplace Environmental Exposure Levels (WEEL)

Information Source and References
This SDS is prepared by Product Regulatory Services and Hazard Communications Groups from information supplied by internal references within our company.

ChemWorld.com urges each customer or recipient of this (M)SDS to study this document carefully and consult appropriate expertise, as necessary or appropriate, to become aware of and understand the data contained in this (M)SDS and any hazards associated with the product. The information herein is provided in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ between various locations. It is the buyer's/user's responsibility to ensure that his activities comply with all federal, state, provincial or local laws. The information presented here pertains only to the product as shipped. Since conditions for use of the product are not under the control of the manufacturer, it is the buyer's/user's duty to determine the conditions necessary for the safe use of this product. Due to the proliferation of sources for information such as manufacturer-specific (M)SDSs, we are not and cannot be responsible for (M)SDSs obtained from any source other than ourselves. If you have obtained an (M)SDS from another source or if you are not sure that the (M)SDS you have is current, please contact us for the most current version.

SAFETY DATA SHEET

CLT-100
Molybdate Corrosion Inhibitor for Closed Systems

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION:

DISTRIBUTOR: **Industrial Treatment of Water, LLC**
10940 SW Barnes Road #212
Portland, OR 97225

USES: Closed Boiler Systems
USE RESTRICTIONS: All other applications

INFORMATION PHONE: (888) 571-6036

EMERGENCY PHONE: **INFOTRAC**: 1-800-535-5053
PRODUCT NAME: CLT-100 Molybdate Corrosion Inhibitor for Closed Recirculating Systems
PRODUCT NUMBER: IT-114
DATE PREPARED: 04/17/2015
LAST REVISION: 10/12/2020

PURE: ☐ LIQUID: ☒
MIXTURE: ☒ SOLID: ☐

2. HAZARDOUS IDENTIFICATION:

EMERGENCY OVERVIEW: Irritant
GHS CLASSIFICATION: Eyes: (Category 2A) Skin: (Category 2) Acute toxicity, Oral (Category 5), Acute Aquatic toxicity (Category 2),

GHS Label elements, including precautionary statements
SIGNAL WORD: **Warning!** **PICTOGRAM(S):**

HAZARD STATEMENT(S):
H303: May be harmful if swallowed
H315: Causes skin irritation
H319: Causes serious eye irritation.
H401: Toxic to aquatic life.

PRECAUTIONARY STATEMENT(S):
P102: Keep Out of Reach of Children.
P262: Do not get in eyes, on skin, or on clothing.
P273: Avoid release to the environment.
P281: Use personal protective equipment as required.
P301+P330+P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303+P361+P353: IF ON SKIN (or hair): Remove/Take off Immediately all contaminated clothing. Rinse SKIN with water/shower.
P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

POTENTIAL HEALTH EFFECTS

EYE CONTACT: Causes eye irritation.
INHALATION: May cause irritation to mucus membranes
INGESTION: Swallowing the liquid can be irritating to mucus membranes, the gastrointestinal tract and cause stomach cramps.
SKIN CONTACT: Severely irritating; may cause skin damage

SIGNS AND SYMPTOMS OF EXPOSURE: Irritation, redness of skin.

3. COMPOSITION/INFORMATION ON INGREDIENTS:

BASIC INGREDIENTS: Surfactants.

Chemical Name	CAS #	Weight %
SODIUM NITRITE	7632-00-0	2 - 4%
POTASSIUM HYDROXIDE	1310583	2 - 4%
SODIUM MOLYBDATE	10102-40-6	3 – 5%

4. FIRST AID MEASURES:

EYE CONTACT: Immediately flush eyes with water for at least 15 minutes. Hold eyelids open while flushing the eyes. Get medical attention.
INHALATION: Remove to fresh air. If not breathing, give artificial respiration. Get medical attention immediately.
INGESTION: If swallowed, do NOT induce vomiting. Give victim plenty of water or milk. Get medical attention immediately. Never give anything by mouth to an unconscious or convulsing person.
SKIN CONTACT: Wash with soap and water. Change contaminated clothing. Get medical attention if irritation develops or persists.
AGGRAVATED MEDICAL CONDITIONS: None known.
SUPPLEMENTAL HEALTH INFORMATION: The effects of long-term, low-level exposure to this product have not been determined. Safe handling of this material on a long-term basis should emphasize the avoidance of all effects from repetitive acute exposures.

5. FIRE FIGHTING MEASURES:

EXTINGUISHING MEDIA: Use extinguishing media appropriate for surrounding fire.
SPECIAL FIRE FIGHTING PROCEDURES: Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece in positive pressure mode. Move containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.
UNUSUAL FIRE AND EXPLOSION HAZARDS: May intensify fire. **COMBUSTION PRODUCTS:** None known.

6. ACCIDENTAL RELEASE MEASURES:

STEPS TO BE TAKEN IN CASE MATERIAL IS SPILLED OR RELEASED: Small spills: Mop up, wipe up or soak up immediately. Large spills: Evacuate area. Contain liquid; transfer to closed poly containers. Or soak up with inert material and shovel into poly drums for disposal.

7. HANDLING AND STORAGE:

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Protect from freezing. Use good personal hygiene when handling this product. Wash hands after use, before smoking, or using the toilet. Wear personal protection as required per safety program. Follow all SDS/label precautions even after container is emptied because it may retain product residues.

OTHER PRECAUTIONS: For industrial and institutional use only. Keep away from children. Keep containers closed while not in use.

8. EXPOSURE CONTROL/PERSONAL PROTECTION:

EXPOSURE CONTROLS:

	OSHA PEL		ACGIH TLV	
Chemical Name	**TWA**	**STEL**	**TWA**	**STEL**
SODIUM NITRITE	n/a	n/a	n/a	n/a
POTASSIUM HYDROXIDE	2mg/m3	n/a	2mg/m3	n/a
SODIUM MOLYBDATE	5mg/m3	n/a	3mg/m3	n/a

PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION: None required.
PROTECTIVE GLOVES: Rubber or other impervious material
VENTILATION: Local exhaust sufficient to keep exposure below TLV.
WORK / HYGENIC PRACTICES: Use good personal hygiene when handling this product. Wash hands after use, before smoking, or using the toilet.
ENGINEERING CONTROLS: None required.
EYE PROTECTION: If splashing is probable safety glasses with side shields (or goggles)
OTHER PROTECTIVE EQUIP: Boots, apron, lab coat or coveralls of impervious material, as appropriate to avoid skin contact.

9. PHYSICAL AND CHEMICAL PROPERTIES:

INFORMATION ON BASIC PHYSICAL AND CHEMICAL PROPERTIES:

a) Appearance: Clear, colorless / pale yellow liquid.	**k) Vapor pressure (mm/Hg):** No data available
b) Odor: No appreciable odor.	**l) Vapor density (Air = 1):** No data available
d) pH: >12	**m) Relative density (Specific Gravity):** 1.09
e) Melting point/freezing point: No data available	**n) Water solubility:** Appreciable
f) Initial boiling point and boiling range: 220ºF	**p) Auto-ignition temperature:** n/a
g) Flash point: n/a **Method Used:** n/a	**r) Viscosity:** No data available
h) Evaporation rate: No data available	**-) Pounds Per Gallon:** 9
j) Upper/lower flammability or explosive limits: n/a	**OTHER:** No other data is available for this product. . . . .

10. STABILITY AND REACTIVITY:

STABLE: Stable
INCOMPATIBILITY: Acids, ammonia, amines
HAZARDOUS DECOMPOSITION OR BY-PRODUCTS: No data available
HAZARDOUS POLYMERIZATION: Will not occur.
CONDITIONS TO AVOID: Do not mix with anything but water.

11. TOXICOLOGICAL INFORMATION: None of the components of this product are listed as carcinogens. No other data available.

12. ECOLOGICAL INFORMATION: Keep out of waterways

13. DISPOSAL CONSIDERATIONS: Dispose of according to local, State, and Federal Regulations.

14. TRANSPORT INFORMATION:

Regulation	UN No.	Proper Shipping Name	Transport Hazard Class	Packing Group
US DOT	- -	Non-Regulated Material, Liquid	- -	- -

ERG No.: 140
REPORTABLE QUANTITY (RQ): Sodium Nitrite 100 Lbs. (306 gallons of liquid mixture)

15. REGULATORY INFORMATION: No data available

16. OTHER INFORMATION:

HMIS INFORMATION: HEALTH: 2 FLAMMABILITY: 0 PHYSICAL HAZARD: 0 PROTECTIVE: C
NFPA INFORMATION: TOXICITY: 2 FIRE: 0 REACTIVITY: 0

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