

# Application for the Recycling of Hazardous Waste, by Written Determination Revision 3



Figure 1 - AquaRefinery Rendering

21 Jul 2016

Aqua Metals Reno, Inc.

This Permit Application is for a Lead Acid Battery (LAB) recycling facility using Aqua Metals' novel Aqua Refining technology, to be located in the Tahoe Reno Industrial Center (TRIC), in McCarran, Storey County, Nevada.

The property owner and operator is Aqua Metals Reno, Inc., a Delaware corporation, located at the proposed facility.

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## 1. Location and Ownership

This Permit Application is for a Lead Acid Battery (LAB) recycling facility, to be located within the Tahoe Reno Industrial Center (TRIC), in McCarran, Storey County, Nevada.

The proposed facility will operate continuously, 24 hours/day 7 days/week and will recycle approximately 150 metric tons of used LABs per day to produce approximately 80 metric tons of reclaimed lead per day.

The address of the proposed facility is:

Aqua Metals Reno, Inc.  
2500 Peru Drive  
McCarran, NV 89434

The plant has been assigned the EPA ID Number **NVR 000 092 049**.

The activity status is Small Quantity Generator (SQG), Large Quantity Handler of Universal Waste (LQHUW), Destination Facility for Universal Waste, Recycler of Hazardous Waste, Receives Hazardous Waste from Off-site.

The owner and operator of the proposed facility will be Aqua Metals Reno Inc., (AMR) a Delaware Corporation with offices at the above address.

The contact person is **Michael Krickel**, Director of Recycling Technology, phone number: (775) 525-1932.

AMR is a wholly owned subsidiary of Aqua Metals Inc., (AMI) a Delaware corporation which developed and retains exclusive ownership of the AquaRefining technology, and whose offices are located at:

Aqua Metals, Inc.  
1010 Atlantic Ave  
Alameda, CA 94501

The contact person is **Selwyn Mould**, Chief Operating Officer.

## 2. Description and Nature of Recycling

The facility proposes to recycle used lead acid batteries (LAB's) to recover the lead using Aqua Metals proprietary technology, Aqua Refining. LABs are the single most recycled product on the planet. Each year over 7 million tons of lead is reclaimed from recycling LABs, more than 1.2 million tons of lead is recycled in the USA alone. In North America 85% of the lead used in new LABs is recycled lead because recycled lead is of comparable quality to newly mined lead and is less expensive to recover. However, until now, the only way to commercially recycle LABs has been through the high temperature (1300 to 1700°F), energy intensive, and environmentally problematic process of smelting. In this process lead compounds, such as oxides, sulfates and carbonates are reduced to metallic lead. Aqua Metals has developed a novel, room temperature process that recovers metallic lead from the lead compounds using an electro-chemical process called Aqua Refining. Aqua Refining has the potential to significantly reduce the environmental impact of LAB recycling.

At the Aqua Metals Reno facility battery recycling will consist of the following major steps:

- Acid draining which releases the battery (sulfuric) acid from the battery
- Battery breaking and separation. This will shred and separate LABs into:
  - metallic lead chips (primarily from grid and connector materials);
  - active material paste (lead sulfates and lead oxides)
  - plastic chips (for re-use)
- De-sulfurization, which extracts any sulfate ions from the active material paste.
- Aqua Metals lead recovery process which first digests the active material paste in Aqua Metals proprietary electrolyte and then by a process called Aqua Refining converts the digested paste into high purity lead.
- Ingotting, which converts the lead chips into “hard” lead alloy ingots and the Aqua Refined™ lead into “soft” pure lead ingots.

### What Is a Lead Acid Battery (LAB)?

To best understand LAB recycling it is helpful to understand what a LAB is.

Lead acid batteries are essentially made of five basic components:

- A resilient plastic container usually made of polypropylene (PP), polycarbonate (PC) or Acrylonitrile-Butadiene-Styrene (ABS).
- Positive and negative internal plates made of lead. These consist of lead grids made from metallic lead alloys that are filled with a paste of lead oxides and lead sulfates.

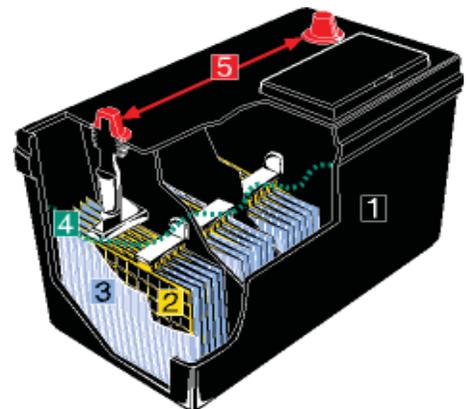


Figure 2 - Plastic Container and Cover

- Plate separators made of porous synthetic material – often polypropylene or fiberglass mat
- Electrolyte, a dilute solution of sulfuric acid and water, better known as battery acid.
- Lead terminals, the connection point between the battery and whatever it powers.

The manufacturing process begins with the production of a plastic container and cover. Most automotive battery containers and their covers are made of polypropylene. For a typical 12-volt car battery, the case is divided into six sections, or cells, shaped somewhat like one row in an ice-cube tray. The cover is dropped on and sealed when the battery is finished.

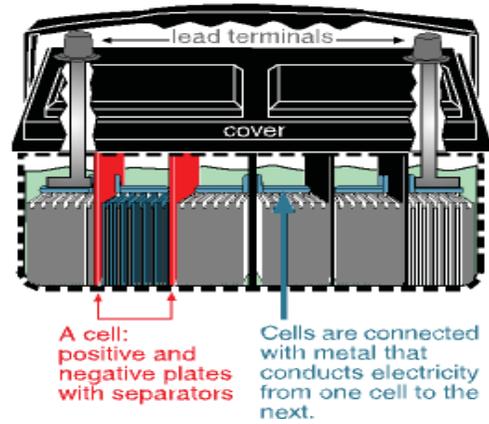


Figure 3 - Inside the Battery

The process continues with the manufacture of grids from lead or an alloy of lead and other metals. A battery must have positive and negative plates to conduct a charge.

Next, a paste mixture of lead oxide -- which is powdered lead and other materials -- sulfuric acid and water is applied to the grids. Expander material made of powdered sulfates is added to the paste to produce negative plates.

Inside the battery, the pasted positive and negative plates must be separated to prevent short circuits. Separators are thin sheets of porous, insulating material used as spacers between the positive and negative plates. Fine pores in the separators allow electrical current to flow between the plates while preventing short circuits.

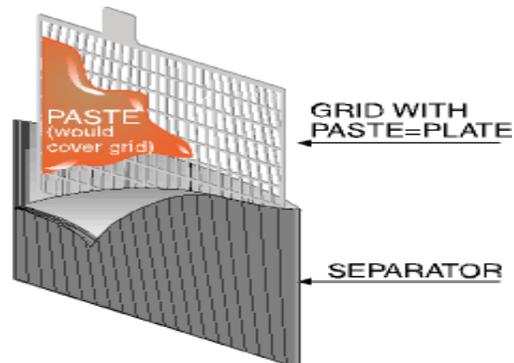


Figure 4 - Element

In the next step, positive plates are paired with negative plates and separators. This unit is called an element, and there is one element per battery cell, or compartment in the container. Elements are dropped into the cells in the battery case. The cells are connected with solid lead metal that conducts electricity. The lead terminals, or posts, are then welded on.

The battery is then filled with electrolyte - or battery acid -- a mixture of sulfuric acid and water, and the cover is attached. The battery is checked for leaks.

The final step is formation. During this step, the battery terminals are connected to a source of electricity and the battery is charged for many hours. When the battery is fully formed, it moves to another line where the case is cleaned, if necessary, and the labels are attached.

The simple structure and composition of a lead acid battery means that it can be recycled with relative ease. As such, in the USA more than 98% of lead acid batteries are recycled and 85% of the lead used to make new batteries is recycled lead. In addition, there is no theoretical limit to the number of times that the lead used to make batteries can be recycled. This leads to lead being the single most recycled product on earth.

## Facility Layout and Construction

The site covers approximately 12 acres on which a ~135,000 ft<sup>2</sup> facility will be constructed. APPENDIX A contains our Facility Layout.

We have engaged Miles Construction, based in Carson City, Nevada, as the General Contractor.

## Building Specifications

All floors in the building are sealed for containment. Containment areas, sloping floors, trench drains and sumps are used to collect spills and ensure no leaks or external discharge. There are no drains to external discharge. The building is separated into 3 areas for containment management.

Area 1: The main factory area. The floor will be sealed with Sikagard Duochem 7500 with PurCem moisture block system (specifications are shown in APPENDIX H Safety Data Sheets). This sealant is widely used in LAB recycling and is compatible with sulfuric acid and the other materials used in this area. The floor area of 66,800 square feet has a primary containment capability of 5,567 cubic feet (or 41,644 gallons) achieved by depressing the area by 1" (66,800sqft x 1in = 5,567cuft). The largest tank in this area is 7,300 gallons. Secondary containment is provided by trench drains and sumps with a capacity of 825 gallons.

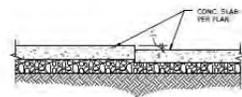
Area 2: The Aqua Refining area. The floor will be sealed with Sikagard CRV 20 with PurCem 20 moisture block system (specifications are shown in APPENDIX H Safety Data Sheets). This sealant is compatible with our proprietary organic acid used in this area. The floor area is 28,500 square feet. The area has a primary containment capability of 4,750 cubic feet (or 35,532 gallons) achieved by raising the perimeter doors by 2" (28,500sqft x 2in = 4,750cuft). The largest tank in this area is 4,250 gallons. Secondary containment is provided by a trench drain and sump with a capacity of 330 gallons.

Area 3: The Water Treatment Plant (WTP). The floor will be sealed with Sikagard Duochem 7500 with Puracem moisture block system (specifications are shown in APPENDIX H Safety Data Sheets). The floor area is 4,800 square feet. This area will have a primary containment capability of 800 cubic feet (or 5,984 gallons) achieved by a 2" bund (4,800sqft x 2in = 800cuft). Secondary containment is provided by a trench drain and sump with a capacity of 130 gallons. The largest tank in this area is 5,000 gallons.

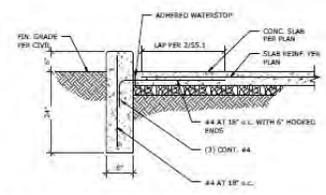
The primary containment in areas 1 and 2 has been designed to comply with IBC Section 415.8.2.4 which follows the 2012 International Fire Code (IFC) Section 5004.2 which details spill control for hazardous materials and requires that containment must be sufficient to control sprinkler fire flow for 20 minutes minimum. The Aqua Metals building has been designed with 3000 square foot zones for fire control. The sprinkler flow meets the requirement of 0.33 gallons per minute per square foot. Therefore, the containment must be a minimum of 0.33gpm/sqft x 20 minutes x 3000sqft = 19,800 gallons or 2,780 cubic feet. As can be seen above, the containment in area 1 is more than 2 times the requirement and the containment in area 2 is more than 1.7 times the requirement.

Figure 5 shows the containment areas, trench drains and sumps. Figure 6 shows design details used for containment.

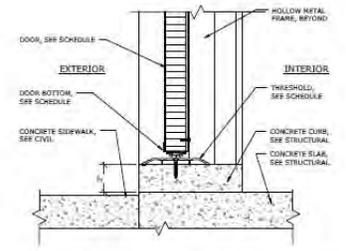




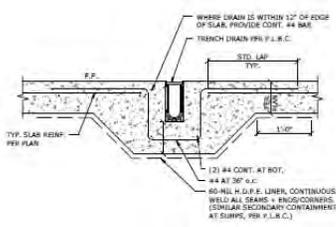
8 SLAB EDGE OFFSET  
SCALE: 3/4" = 1'-0"



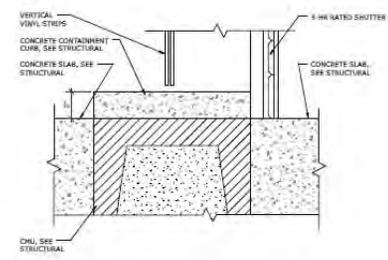
5 SLAB EDGE, TYP.  
SCALE: 3/4" = 1'-0"



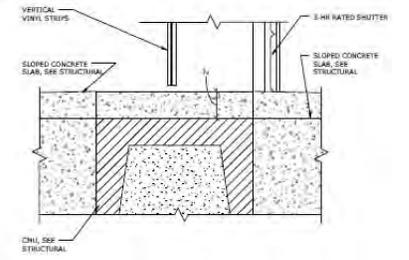
2 H.M. DOOR THRESHOLD AT AQUA REFINING-FIGURE  
SCALE: 3/4" = 1'-0"



7 TRENCH DRAIN SECTION  
SCALE: 3/4" = 1'-0"



4 TYPICAL SHUTTER THRESHOLD AT OPENING  
SCALE: 3/4" = 1'-0"



1 SHUTTER THRESHOLD AT DRIVE-THRU OPENING  
SCALE: 3/4" = 1'-0"

Figure 6 - Design Details of Containment Areas

## Equipment Manufacturer

Supplied by Wirtz Manufacturing Inc.

The equipment for the process steps of Acid Draining, Battery Breaking, De-sulfurization and Ingoting will be supplied by Wirtz Manufacturing, a global leader in equipment design and manufacturing for the lead acid battery market. This is LAB recycling industry best practice equipment and represents about half of the total capital expenditure on plant and equipment.

APPENDIX J Wirtz-Supplied Tanks includes information for all the tanks supplied by Wirtz including location, capacity, material of construction and integrity assessment. As tanks are installed they will be inspected and stamped tank installation certification will be provided by a Nevada Registered Professional Engineer. Copies of certifications will be provided after the tanks are installed.

All process tanks will meet 40CFR 264 Subpart J requirements.

Supplied by Aqua Metals Inc.

The equipment for Aqua Metals Lead Recovery Process (“AquaRefining™”) will be supplied by Aqua Metals. This is Aqua Metals modular and pre-manufactured equipment. All of the AquaRefining™ equipment will be manufactured and supplied by Aqua Metals Operations Inc., (AMO). AMO is a wholly owned subsidiary of Aqua Metals Inc., and a sister company to AMR. AMO has manufacturing facilities located in Alameda, CA and is building additional manufacturing capacity, sufficient to supply all of the AquaRefining™ needs of AMR. Aqua Metals manufacturing process involves the assembly of bought out components that have been manufactured to Aqua Metals proprietary design (for example tanks, frames and cathodes) or commodity components (such as pumps). A small scale, pilot unit, was developed and built in 2013 and has been operated at Aqua Metals California research and development facility since this time to validate the technology and refine operating parameters. In November 2014 a full size unit was built and operated to demonstrate the scalability of the technology and validate manufacturing processes. The expenditure on Aqua Metals proprietary equipment represents less than one quarter of the total capital expenditure for the facility.

### Other Supply

APPENDIX I Aqua Metals Tanks includes information for all the tanks supplied by suppliers other than Wirtz including location, capacity, material of construction and integrity assessment. As tanks are installed they will be inspected and stamped tank installation certification will be provided by a Nevada Registered Professional Engineer. Copies of certifications will be provided after the tanks are installed.

All process tanks will meet 40CFR 264 Subpart J requirements.

Shipping, Despatch, and Receiving will use standard, commonly available equipment such as fork lift trucks, banding machines, etc.

Other capital equipment such as transformers, rectifiers, buss bars, overhead cranes etc. will be supplied by reputable manufacturers such as Eaton and Neeltran.

### 3. Explanation of Recycling

#### Recycling Process

##### *Step 1 - Receiving*

Used LABs are received, sorted and documented. An average of about 150 metric tons each day of used LABs are delivered on a just in time, daily basis into the fully banded receiving area. Each truck will carry up to 25 tons and this will involve between 7 and 15 truck movements per day.

##### *Step 2 - Acid Draining*

The used LABs are put on a belt conveyor which feeds them into the battery draining unit where the battery cases are punctured with two saw blades and then turned on their side to drain. The sulfuric acid contained in the batteries drains through two screens, which remove any plastic shavings, into an acid collecting tray before transfer to the acid collection tank (500 gallon HDPE tank, see APPENDIX J). The battery draining unit is in a stainless steel enclosure. Most of the acid is transferred to be used in the Desulfurization process (Step 4). The rest of the recovered acid is used for pH adjustment in the Water Treatment Plant (WTP) – see [Other Processing, Water Treatment Plant](#). The plastic shavings collected by the screens are returned to the belt conveyor and are fed with the drained batteries into Battery Breaking and Separation.

### Step 3 - *Battery Breaking and Separation*

The drained batteries are then fed into the hammer mill where they are pulverized. The resulting debris (generally fragments of ½" or less) is flowed in recycled water from the water treatment plant through a series of vibrating screens, tank classifiers and an elutriator to separate the mixture into four streams:

- ♻ Plastic chips – from the battery boxes and containers
- ♻ Metallic lead alloy chips – from the battery grid and connector material
- ♻ Battery separator material
- ♻ Paste components

The hammer mill pulverizes the LABs and then discharges the pulverized batteries to the primary screen via an auger. In the primary vibrating screen, the battery components are sprayed with a recycled water stream which removes the majority of the battery paste and the paste passes through the screens and is conveyed to the elutriator via an auger.

The solid components from the primary screen are discharged onto an auger which conveys the components to the lead classification tank. In the lead classification tank a rising water current carries the plastic components, separator materials, and any residual paste not removed in the primary screen over a weir and into the secondary vibrating screen. The metallic lead alloys sink to the bottom of the lead classification tank and is discharged from the tank via an auger. In the secondary vibrating screen, the remaining solid components are washed using a water spray to remove any residual paste. The residual paste and water are pumped back to the hammer mill. The solid components are discharged into the plastic classification tank which is then filled with water, causing the plastic chips to float and the separator material to sink and both are subsequently removed from the tank via an auger.

The plastic fraction can then be further separated into polypropylene, ABS and polycarbonate. The collected plastic chips are bagged, allowed to dry and sold as re-grind for re-use in manufacturing battery containers. Between 5 and 15 tons of plastic chips will be produced each day. The separator material is bagged and sent for disposal.

Initially the metallic lead chips will be re-melted and cast into ingots before being sold to be re-melted, refined and used to make new LAB components. Once the business is established and all processes are working satisfactorily (expected to be within 6 months), Aqua Metals will transition to refining the lead to make specific LAB grid alloys which can be sold at a premium. Between 35 and 45 tons of hard lead grid alloy will be produced each day.

The remaining slurry of active material paste (about 35 to 45 tons per day) is passed through to Step 4.

The Battery Breaking and Separation process described is considered "Best Practice" in the battery recycling industry. We have partnered with Wirtz Manufacturing, Inc., a company based in Michigan, to supply the equipment. Wirtz are considered to be a leading supplier of this equipment.

## Step 4 - De-sulfurization

Conversion of the recovered active material paste to lead carbonate is the LAB recycling industry standard and is achieved by adding sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>) to the recovered active material. The recovered paste material is composed primarily of lead, lead oxides, and lead sulfate. It is removed from the solid components of the battery via the water wash that occurs in the primary vibrating screen as described in the previous section. The paste and water mixture (paste slurry) is then conveyed to the slurry tank before processing in the de-sulfurization unit.

In the slurry tank the paste slurry undergoes a pre-treatment with dilute hydrogen peroxide (~30%) which, in the presence of sulfuric acid (sufficient is present in the paste slurry), converts any lead dioxide (PbO<sub>2</sub>) to lead sulfate (PbSO<sub>4</sub>), see equation below. The process is controlled by continuous monitoring of the concentration of hydrogen peroxide in the slurry. The slurry mix will see a temperature rise of up to 20°F during the pre-treatment. The slurry is then transferred to the desulfurization reaction tanks.



The de-sulfurization unit consists of two desulfurization reaction tanks in series where the lead sulfate (PbSO<sub>4</sub>) is converted to lead carbonate (PbCO<sub>3</sub>) which produces aqueous sodium sulfate (Glauber's Salt, Na<sub>2</sub>SO<sub>4</sub>) according to the equation below. Conversion of the lead sulfate is achieved by adding sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>) to raise the pH, under controlled temperatures, to the paste slurry in the neutralization tanks.



Small amounts of sulfuric acid will be present in the paste slurry which will react with the sodium carbonate and produce a maximum of 2.65 tons per day of CO<sub>2</sub> as indicated in the below equation. The plant has the capability to add sulfuric acid in this step, as required, to manage the efficiency and yield of the conversion.



From the desulfurization reaction tanks, the desulfurized paste slurry is pumped to a filter press where the lead carbonate is removed from the liquid stream. The lead carbonate is transferred by conveyor from the filter press to AMI's lead recovery process. The liquid stream from the filter press is sent to the Water Treatment Plant (WTP) where water is recovered from the stream and the concentrated sodium sulfate is collected as Glauber's Salt (see [Other Processing, Water Treatment Plant](#)).

In a smelting based LAB recycling process, it is advantageous to remove sulfate ions before smelting to avoid the release of sulfur dioxide (the cause of acid rain). The Aqua Metals process does not release sulfur dioxide, however a de-sulfurization step is advantageous to improve digestion of the recovered active material (Step 5).

The de-sulfurization equipment will be supplied by Wirtz. This is a standard and widely used process and Wirtz' equipment is considered industry best available.

## Step 5 - Aqua Metals Lead Recovery Process – AquaRefining™

The lead components from the paste de-sulfurization process are transferred by a conveyor to the Aqua Metals lead recovery process. This is a proprietary and patented process which takes the lead compounds (i.e. lead oxide (PbO)/lead carbonate (PbCO<sub>3</sub>)) and converts them into high purity lead. The Aqua Metals process replaces the smelting processes used at typical LAB recycling facilities.

The Aqua Metals process is a two-step process with the first step being a “digestion” and the second step being an electrolysis process, AquaRefining. In the digestion step the paste from the de-sulfurization process is dissolved in Aqua Metals proprietary and patent pending water based electrolyte which generates a “pregnant” solution. The paste is added to the electrolyte in a mixer (electrolyte digestion tank) before being transferred to one of three parallel digestion reaction tanks. The three tanks are operated so that one is always filling, one is always emptying and one is digesting the paste. The chemical equation for the digestion process is shown below, where HA is the proprietary electrolyte. The CO<sub>2</sub> generated will be collected by extraction ducting and vented outside of the building.



The pregnant solution is then transferred to the electrolysis unit, called an AquaRefiner, where electricity is passed through the “pregnant” solution which causes the dissolved lead ions in the solution to “detach” from the electrolyte and collect on the cathode of the electrolysis unit. The chemical equation for this reaction is shown below. The electrolyte is considered to be “depleted” when most of the lead ions have been collected on the cathode.



The high purity lead collected on the cathode is recovered as a sludge of lead and electrolyte which slides under gravity onto a conveyor which transfers the sludge to one of two high pressure briquetter presses. The sludge is compressed under high pressure into high purity lead bricks. This removes the electrolyte and the lead bricks are then transported by cart to the ingoting process.

The electrolyte pressed out of the lead bricks is recycled back to digestion where it is re-used to dissolve more lead paste. The depleted electrolyte from the electrolysis unit is recycled back to digestion where it is re-used to dissolve more lead paste. This closed loop process means that very little electrolyte is consumed during the lead recovery process.

The equipment used for AquaRefining™ is modular and pre-manufactured, requiring minimal on-site installation and configuration. The photograph below shows a full scale pre-production AquaRefining™ unit. This unit was used to prove the technical viability of the process and produce lead samples for analysis.



Figure 7 - AquaRefining™ Unit

The AquaRefining™ units, or AquaRefiners, are arranged in a bank of 3 assembled together on a 17-foot skid. Two banks, each of 3 units, will be connected together electrically in series to create a module. The two banks of a module are arranged in parallel, facing each other, with a conveyor passing down the center. In the facility, eight modules feed each conveyor and each conveyor feeds one high pressure press. In total the facility will have 16 modules, representing 96 AquaRefining™ units, feeding two conveyors and two presses. The units will run continuously, 24 hours a day, producing lead on the cathode that will be collected before pressing into bricks. The rendering below shows three units assembled together as a bank.



Figure 8 - Bank of AquaRefining™ Units

APPENDIX A contains our layout drawing for the installation of 16 AquaRefining™ modules, 2 conveyors and 2 presses at the Tahoe-Reno Industrial Center facility.

The core technology of AquaRefining™ is considered to be electrowinning and as such is regulated under the Clean Water Act. A “Permit by Rule” submission is being prepared.

In the AquaRefining process it is possible to generate hydrogen as a bi-product of the electrolysis process. Therefore, each AquaRefiner is equipped with its own hood, de-misting unit and exhaust system. The exhaust system vents outside of the building to atmosphere. Hydrogen is an extremely light gas which is non-toxic and disperses quickly. Care has been taken with the design of the operation so that hydrogen does not collect or concentrate in any part of the building or exhaust system. The hydrogen concentration is continually monitored in the exhaust above each AquaRefining unit and the unit is automatically cut off from power if the level of hydrogen reaches 25% of the lower explosion limit (LEL). In addition, as a further safety measure, the concentration of hydrogen is monitored in the highest part of the building and power to all the AquaRefiners is cut off if the concentration reaches 25% of LEL.

After the lead has been compressed into bricks the hazardous waste recovery process is effectively complete. At this stage the used LAB's have been converted into high purity lead which is a marketable product. The next step is to convert the bricks into ingots which is the form of lead most commonly sold to battery manufacturers.

## *Step 6 - Ingotting*

The lead bricks from the AquaRefining process (Step 5) are put in a large (50 ton) kettle and heated until the lead melts (~750°F to 850°F). Similarly, the hard lead chips from the Battery Breaking and Separation process (Step3) are melted in a large kettle. At this stage, the lead can be further refined (at temperatures up to 1050°F), refined into battery grade alloys or cast directly into ingots. To cast ingots, the molten lead is transferred to an automated ingot caster which casts industry standard “pigs” of lead. The ingot caster is widely used in the industry and is cooled with a chiller. An automated stacker will stack the lead “pigs” ready to be moved to shipping and despatch (Step 7).

The lead kettle and ingot caster will be industry best practice equipment supplied by Wirtz. Any emissions will be captured and ducted to a baghouse filtration system with a minimum removal efficiency of 90%. In line after the baghouse will be a HEPA filter with a minimum removal efficiency of 99.97%. The bags will be regularly maintained, inspected and cleaned as necessary, or at least annually. Material collected from the bags will be disposed of as hazardous waste according to 40 CFR 261.3. The maximum emissions of lead are expected to be less than 1 lb per year. A detailed analysis of emissions from the ingoting area is provided in Aqua Metals application for a Class II Air Quality Permit.

Any drosses that are produced in the ingoting process will be collected and returned to Step 5 where they will be added back to the Digestion process.

Initially there will be 2 lead kettles (one for pure “soft” lead and one for “hard” lead). The facility will have space for a further 4 kettles which will be needed when the business moves to refining battery grade alloys. The baghouse is capable of supporting all 6 kettles.

## *Step 7 - Shipping and Despatch*

Stacks of lead will be held in the despatch to allow each batch to be analysed for purity. After analysis lead will be shipped to customers by truck in ~20 ton loads. On average 80 metric tons of lead will be shipped each day generating 4 truck movements. Trucks will be loaded by fork lift.

Plastic chip (polypropylene, ABS and polycarbonate) will be collected in bags in the factory. From here it will be transported to the despatch area before being shipped to customers. Between 5 and 15 metric tons of plastic chip will be produced each day.

Sodium sulfate slurry will be collected and shipped off site for disposal. Approximately 45,000lbs of sodium sulfate will be produced each day.

## Other Processing

### Water Treatment Plant

The water treatment plant (see APPENDIX E) is designed to recover water from the sodium sulfate stream produced in the De-sulfurization process (step 4), remove metals such as lead, antimony and selenium, and return water to the facility to be used in Battery Breaking and Separation (Step 3). In ideal conditions the facility will operate with a neutral water balance because the water content in the incoming used LABs will match the consumption in the plant. However, the amount of dilute acid (and therefore water) contained in the used LABs can vary considerably and so the facility has been designed to accommodate this variance. In some circumstances the facility will operate with a net consumption of water and in others a net discharge of water. The water treatment plant has been designed to ensure that any water discharged will meet applicable Tahoe Reno Industrial General Improvement District (TRI GID) standards. TRI GID has approved the discharge of wastewater from the plant on the condition that it meets the TRI GID discharge standards.

In the Water Treatment Plant the liquid sodium sulfate ( $\text{Na}_2\text{SO}_4$ ) stream from the filter press in the De-sulfurization process (Step 4) has flocculant added to form insoluble flocs of metal contaminants. The flocs are separated in a filter press and disposed of periodically as hazardous waste according to CFR 261.3. The remaining liquid stream is sent to evaporators where the stream is heated under vacuum and clean water is collected as condensate. The clean water is returned to be used as process water in Battery Breaking and Separation (Step 3). Surplus water not required in the process will be discharged to the sewer after analysis to ensure that applicable TRI GID standards are met. The water collected as condensate should be essentially pure and therefore should comfortably meet TRI GID standards.

The remaining slurry of sodium sulfate (Glauber's Salt) is passed through a centrifuge which further dries the sodium sulfate. The water recovered is returned to Battery Breaking and Separation (Step 3) and the sodium sulfate (Glauber's Salt) will be transferred by conveyor to a "roll on – roll off" container which will be removed and replaced daily. Approximately 45,000lbs of sodium sulfate will be collected each day. The Glauber's Salt will be shipped off site daily for sale or disposal.

## Description of Regulated Waste Processed

Used LABs (EPA Waste Code D008 – Lead-Acid Batteries Subcategory RLEAD) are the only reportable hazardous waste recycled by our facility and are regulated under CFR 2012 Title 40, Vol., 28 Part 273.

## Source and Amount of Waste Recycled

### Principle Source

Used LABs are the sole input. The facility will process about 150 metric tons per day representing 7 to 15 truckloads per day.

### Other Sources

The main process materials are listed below. Copies of the MSDSs are included in APPENDIX H.

-  Sodium Carbonate (~35,000lbs/day)
-  Hydrogen Peroxide (~7,000lbs/day)
-  Anionic polymer flocculant (~500lbs/month)
-  Aqua Metals proprietary aqueous based electrolyte (once system is full the closed loop process means consumption will be no more than 3,500 lbs/day, or about 330 gallons/day).

# Output Materials

## Principle Output

This will be in two forms:

- ♻️ Pure (“soft”) lead (~40 metric tons/day)
- ♻️ “Hard” lead, initially (likely the first 6 months) as unrefined lead ingots and later (after the first 6 months) as ingots of refined battery grade alloys (~40 metric tons/day)

## Other, Secondary Outputs

- ♻️ Polypropylene, ABS and polycarbonate chips to be sold to battery companies or other for use as regrind in manufacture of plastic battery boxes (up to 30,000 lbs/day)
- ♻️ Sodium sulfate (~45,000 lbs/day) to be sold or disposed of

## Discharges

- ♻️ Separator material (polypropylene and/or fiberglass mat) for disposal according to solid waste regulations (~10,000 lbs/day)
- ♻️ Surplus water not required in the water treatment plant process will be discharged to the sewer after analysis to check it meets applicable standards. Water within limits for discharge to TRI GID (up to 15,000 gallons/day)
- ♻️ Flue dust collected from the baghouse will be disposed of as hazardous waste according to 40 CFR 261.3
- ♻️ The recycling process involves limited production of hydrogen and carbon dioxide gases. The hydrogen produced is managed as described in the section Step 5 - Aqua Metals Lead Recovery Process - Aqua Refining. Up to 350lbs of hydrogen will be produced per day. The hydrogen produced is exhausted to atmosphere where it will disperse safely and quickly. The carbon dioxide produced is managed as described in the section Step 5 - Aqua Metals Lead Recovery Process - Aqua Refining. Up to 14,000lbs of carbon dioxide will be produced per day. The carbon dioxide produced is vented outside of the building where it will quickly and safely disperse.

## 4. Economic Analysis

### Business Economics

#### Revenue

Initial operation of the plant will be on a “toll” basis where Aqua Metals will charge a cost per pound of lead produced to convert used LABs to lead. This is a common business model in the LAB industry. Based on a daily output of 80 metric tons per day, operation of 340 days per year, and a tolling fee of 30 cents per pound annual revenue will be about \$18 million. Additional revenue from sale of plastic chip (market price of about 1 cent per pound) and Glauber’s Salt (market price of about 1 cent per pound) would be small but could add up to \$200,000 per year. In time the business plans to move to a merchandising model, where Aqua Metals will source used LABs and sell the lead produced. In this model, based on a lead sale price of 80 cents per pound, revenue will increase to about \$50 million.

## Projected Costs

### Building and Equipment Capital Cost

The land, building, construction and equipment cost for the facility is approaching \$30 million. This is made up of approximately:

- ♻️ \$1 million for land
- ♻️ \$14 million for buildings
- ♻️ \$15 million for equipment

### Operating Cost

The operating costs are based on a planned output rate of 80 metric tons per day. Monthly costs will be:

- ♻️ Labor: \$180,000
- ♻️ Materials: \$340,000
- ♻️ Maintenance: \$90,000
- ♻️ Overhead (labor): \$55,000
- ♻️ Overhead (miscellaneous): \$10,000
- ♻️ Disposal of waste: \$60,000
  - Separators (~\$45,000)
  - Flue dust (~5,000)
  - Hazardous waste metal compounds collected at WTP (~\$5,000)
  - Other (~\$5,000)
- ♻️ Utilities: \$320,000
- ♻️ Transport: \$20,000

This gives a total monthly cost of \$1,075,000 which is a conversion cost of just over 21 cents per pound.

### Staffing Levels

Aqua Metals will employ between 65 and 75 people. Seven of these will be office based staff, ten of them for Maintenance, with the rest working a mixture of shifts to support 24-hour/7-day-per-week operation. The average wage rate is planned to be between \$16 and \$22/hour. The monthly labor costs are planned to be:

- ♻️ Overhead (office): \$55,000
- ♻️ Operators: \$180,000
- ♻️ Maintenance: \$40,000

## Projected Earnings

When at planned operating capacity of 80 metric tons per day the facility is projected to make a gross profit of better than 8 cents per pound of lead produced. This equates to a gross profit of roughly \$400,000 per month. The facility is projected to take six months to reach full capacity and is projected to break even in month 4.

## Sources of Finance

AMR's parent company (Aqua Metals Inc.,) closed a private placement of \$6 million in convertible notes on October 31<sup>st</sup> 2014. Following this Aqua Metals completed an initial public offering ("IPO") and listed on the NASDAQ exchange on July 31<sup>st</sup> 2015. The IPO raised a net \$33 million that is being used to fund the recycling facility in Nevada.

Separately, Aqua Metals has secured an additional \$10 million of debt finance from Green Bank. This debt is guaranteed by the US Department of Agriculture.

## Customer Base and Markets

### Aqua Metals Market for Sales of Lead

To reduce market risk in the early years of operation, Aqua Metals has signed a strategic agreement with a locally based battery distributor, Battery Systems Inc. (BSI) to "toll" convert their used LABs into lead. This agreement ensures that Aqua Metals will have a guaranteed supply of used LABs in the first few years of operation and a guaranteed customer for its lead production. BSI will also take the polypropylene, ABS and polycarbonate chips recovered. BSI is capable of supplying Aqua Metals with more than 150 metric tons per day of used LABs and will take all of the lead produced. Aqua Metals has also begun discussions with a number of other battery manufacturers and distributors to "toll" convert their used LABs.

In future years, as Aqua Metals develops its detailed understanding of the lead market and builds its reputation, it will begin to source used LABs itself and sell lead directly to end customers and so reduce its dependence on a single customer. Discussions have already begun with potential customers, including West Coast battery companies. The move to a merchanting model of trading, where Aqua Metals sources its own supply of used LABs and sells the lead produced, will be more profitable, but potentially higher risk.

### Markets for Lead

The primary use for lead is lead acid batteries (LABs). LABs are essential for starting automotive engines, providing motive power and increasingly, providing uninterruptable

power supplies (UPS) for homes, hospitals, offices, telecommunications, trading exchanges and data centers.

Measured by capacity, LABs represent ~98% of all rechargeable batteries produced each year. As such LABs essential raw material - lead - has become a \$24 Billion/year globally traded commodity.

Lead is a traded commodity on the London Metal Exchange (LME). The LME price effectively sets the trading price for lead. In the US different grades of lead are traded at a discount or premium to the LME price. Examples supplied by a leading North American battery manufacturer are:

-  Virgin pure lead (>99.99%): +14 cents per pound premium
-  Specific battery grade alloys: +1 to +9 cents per pound premium
-  Rough lead (unrefined): - 5 cents per pound discount

## Production and Consumption of Lead

The production and consumption of lead has grown steadily for the last 100 years. In the last ten years the rate of growth has accelerated sharply, driven in part by the rapid growth of the lead acid battery (LAB) market and most recently particularly by demand for LABs for Chinese e-bikes.

### Lead Production Volumes

According to the International Lead Association (ILA) official production now stands at over 10.5 million metric tons per annum. This represents over \$20 billion in value.

There are two sources of lead:

- ♻️ Ores and concentrates which are smelted to produce primary lead
- ♻️ Recycled LABs known as secondary lead

The adjacent Figure 10 shows the volume of primary and secondary lead produced since 1970. It can be seen that the proportion of lead output from recycled lead has risen from 25% to over 55% in 2012.

Importantly, the proportion of lead production from recycling varies markedly from region to region. In developed countries the proportion of lead produced from recycling is the highest, in North America it is 83% and in Europe 76%.

Several factors drive this, including: legislation requiring the recycling of lead acid batteries; the chemical properties of lead which allow it to be recycled and reused indefinitely; robust reverse supply chains that cost effectively return used batteries to manufacturers and recyclers; supply and demand economics that make recycled lead cost competitive with lead from mining.



Figure 9 - Global Lead Production

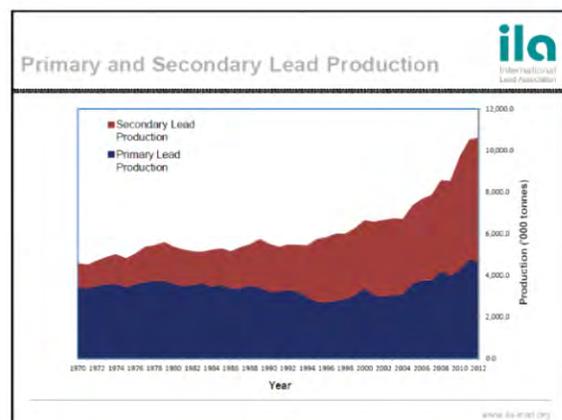


Figure 10 - Primary and Secondary Lead Production

## Lead Consumption Volumes

The growth in lead consumption over the last 50 years has been entirely based on the increased production of lead acid batteries (LAB). Lead acid battery production in 2012 accounted for 85% of the consumption of lead, compared to only 27% in 1960. The adjacent chart shows how the use of lead has evolved since 1960.

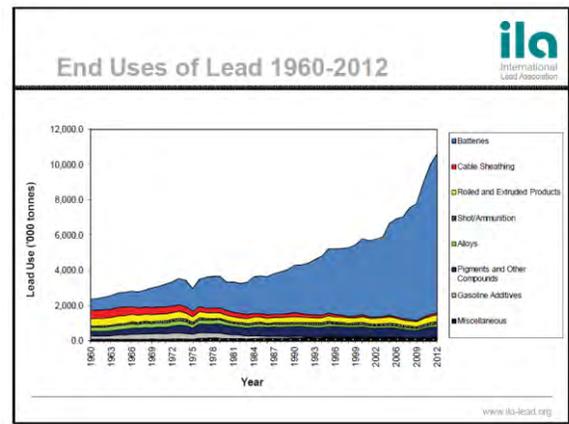


Figure 11 - Growth in Lead Consumption

The production and consumption of lead has grown steadily for the last 100 years. In the last ten years the rate of growth has accelerated sharply, driven in part by the rapid growth of the lead acid battery (LAB) market and most recently particularly by demand for LABs for Chinese e-bikes.

According to the International Lead Association (ILA) official production now stands at over 10.5 million Tons per annum. This represents over \$20 billion in value.

## Uses and Markets

### Uses of Lead

The primary use for lead is lead acid batteries (LABs). LABs are essential for starting automotive engines, providing motive power and increasingly, providing uninterruptable power supplies (UPS) for homes, hospitals, offices, telecommunications, trading exchanges and data centers.

Measured by capacity, LABs represent ~98% of all rechargeable batteries produced each year. As such LABs essential raw material - lead - has become a \$24Billion/year globally traded commodity.

## Customer Base

Lead consumption is dominated by lead acid batteries (LAB) which account for over 85% of all use. The major battery companies on a global basis are shown in Table 1 below.

Company	Home	Consumption T	World share	Home share	Smelting capability	% of own demand
Johnson Controls	US		15%	25%	Yes	50%
Energys	US		7%	10%	No	0%
Exide Technologies	US		8%	15%	Yes	70%
East Penn	US		5%	18%	Yes	65%
Exide Industries	India		4%	65%	Yes	50%
Camel	China		5%	10%	Yes	60%
Baoding Sail	China		3%	7%	No	0%

Table 1 - Largest LAB Producers

Although some of the largest battery companies have their own smelting capabilities it is not economically feasible for smaller companies to have their own recycling capability because of the large scale required for efficient operation. As a result, the percent of lead market supplied through vertically integrated battery companies is less than 25% (i.e. >75% of battery production comes out of LAB factories that do not recycle LABs).

Apart from Johnson Controls, Exide Technologies, East Penn, Exide Industries and Camel nearly all battery companies have to buy their own lead. Even the companies with their own smelters buy some of their lead from lead producers and refiners.

In the United States, the main battery manufacturers who are buyers of lead are: Johnson Controls, Exide Technologies, Energys, East Penn, Trojan, Superior, Crown, and North Star.

## Market Growth

In the long term, demand for lead is expected to continue to grow as vehicle production increases in developing nations, and new markets for batteries in UPS, grid-scale storage and urban electric vehicles open up across the world. CHR Metals forecast total lead output in 2017 to be 20% higher than in 2012. 85% of this increase in output will be met from recycled lead.

## Supply of Used LABs

### Source of Used LABs

Aqua Metals has signed a strategic agreement with a locally based battery distributor, Battery Systems Inc. (BSI) to “toll” convert their used LABs into lead. This agreement ensures that Aqua Metals will have a guaranteed supply of used batteries in the first few years of operation and in addition means that they will have no need to stockpile batteries at the facility. The local distributor is capable of supplying Aqua Metals with more than 150 metric tons per day of used LABs.

In future years Aqua Metals will begin to source used LABs independently and move to a more profitable, but higher risk, merchanting model of trading. This will reduce Aqua Metals dependence on one supplier.

### Percent of ‘Locally Available’ Supply

Well over 7 million metric tons of lead is recycled each year globally (CHR Metals). Of this more than 1.7 million metric tons per year of lead is recycled in NAFTA and 1.2 million metric tons of that is recycled in the US. Aqua Metals research shows that the Reno facility will represent just 1.5% of North American lead production and less than 10% of Western USA lead production. At full capacity Reno will require less than 25% of the used LABs from within a 500-mile radius of Reno.

### Competitors for Feedstock in Reno

The nearest smelter to Reno is RSR’s facility, more than 500 miles away in Los Angeles, CA. The closure of Exide’s Vernon, CA facility (with the subsequent loss of the equivalent capacity to RSR’s facility) has resulted in RSR’s facility becoming the only remaining smelter west of the Rockies. As such it is presumed to be operating at full capacity.

As there is limited smelter capacity on the West coast, used LABs must be transported to East Coast and Mexican smelters for recycling. However, the higher transportation costs effectively lower the value of used LABs collected on the West Coast.

## 5. Comparison of Economic and Environmental Impact

AquaRefining™ is a new, proprietary and patent pending electrochemical process which was developed by Aqua Metals Inc., to replace the highly polluting smelting process used in conventional LAB recycling operations. However, unlike smelting, AquaRefining™ is a room temperature, water-based process that is fundamentally non-polluting. As such, AquaRefining™ delivers multiple advantages including;

- ♻ Higher quality product. AquaRefined™ lead has high purity and meets many standards for pure lead without further refining;
- ♻ Higher yield. Unlike smelting, AquaRefining™ does not generate slag, a waste product that can lower yields by 5% to 10%;
- ♻ Significantly reduced environmental challenges. Importantly, hazardous solid, liquid or airborne emissions are significantly reduced, and in some cases eliminated, and process fluids are re-cycled and re-used;
- ♻ Reduced greenhouse gas emissions. AquaRefining™ uses electricity to convert lead compounds to lead rather than high temperature pyro-metallurgical processes that require the burning of fossil fuels.

## 6. Operating Plan

### Recycling Process

The Operating Plan follows the Recycling Process described in Section 3, Explanation of Recycling. In addition, to ensure safe operation and compliance, the following actions are underway:

- ♻️ Aqua Metals is working closely with Storey County officials during the development and design of the AquaRefining™ facility and continues to keep the Fire Department closely involved in design, construction and operations planning.
- ♻️ Aqua Metals is committed to developing a highly skilled and safety conscious workforce. Employees will undergo extensive training on joining the company. The training to include health and safety awareness, and quality as well as best practice operating procedures.
- ♻️ The facility will develop a strong quality and continuous improvement culture based on the fundamentals of Six Sigma. Employees will be trained in Six Sigma principles.
- ♻️ Detailed operating procedures will be developed in the first 3 months from startup. These will be available at the facility for review. High quality management with experience of the lead recycling industry have been recruited to lead the startup of operations and bring best practice operating procedures to the business.
- ♻️ An initial Integrated Contingency Plan that includes an Emergency Preparedness Plan and a Spill Prevention Control and Countermeasure (SPCC) Plan has been prepared and can be found in APPENDIX K Integrated Contingency Plan.

### Closure and Financial Assurance

A closure plan has been developed and can be found in APPENDIX L Closure Plan and Cost Estimate. The estimated cost of closure set out in this plan is \$582,900 + \$87,435 (15%) Contingency for a total of \$670,335.

A Financial Instrument to cover the potential cost of closure and cleanup will be in place at start of operations. A draft is in APPENDIX M Financial Assurance.

## 7. Signature Page

Submitted and Certified by:

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Selwyn Mould, Chief Operating Officer  
Aqua Metals  
1010 Atlantic Ave STE 101  
Alameda CA 94501  
510.543.0143

---

Date

## 8. Appendices

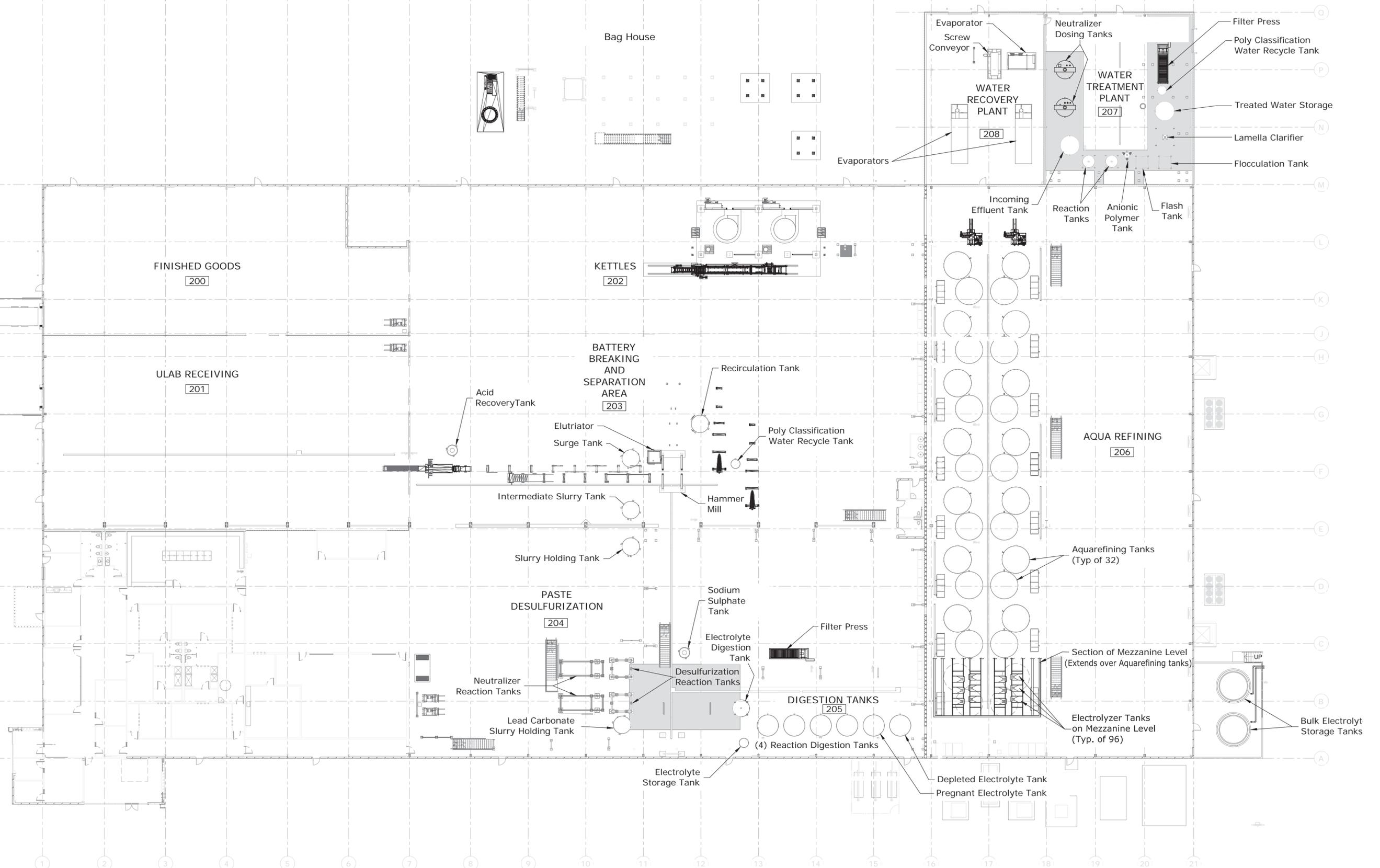
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# APPENDIX A Facility Layout

Figure 12 - Facility Layout

# APPENDIX A Facility Layout 7/22/2016





Wirtz Manufacturing Co., Inc.

## APPENDIX B Wirtz Battery Breaking and De-sulfurization Process

The pallet of whole, used lead acid storage batteries (ULAB) is placed on the **Pallet Loading Roller Conveyor** located in the **ULAB Warehouse**. The pallet of batteries is transferred onto the **Pallet Elevator**. The pallet elevator raises the pallet to the crusher mezzanine and is transferred off the elevator onto the **Lift & Rotate Station #1**. The pallet moves forward off of the Lift & Rotate Station onto **Transfer Roller Conveyor #1**, which loads the pallet onto the **Battery Unload Station**. The batteries are hand unloaded by an operator from the pallet onto the **Acid Draining In-Feed Belt Conveyor** and are fed into the **Acid Draining Unit** where they are punctured and drained of acid. The acid is collected in tanks below the Acid Draining unit. The empty pallet is then transferred to a return loop of roller conveyors, back to the elevator to be returned to the ULAB Warehouse.

The raw acid is collected in a **Settling Tank** to allow large solid to settle out of the solution. The slurry from the bottom of this tank is pumped to the Crusher Discharge Screw Conveyor for processing through the separation process. The remaining acid solution flows into a set of four tanks with filters between each of the tanks to collect the finer solids. The clarified acid is then pumped to the acid tank farm for off-site reprocessing or sent to the ETP for neutralization.

The drained batteries leave the Acid Draining Unit and are loaded onto the **Crusher In-Feed Belt Conveyor**. From the In-Feed Belt Conveyor, the batteries pass through the Battery Crusher receiving hood assembly and into the **Battery Crusher** where they are pulverized. The crushed contents of the batteries are transported via the **Crusher Discharge Screw** to the **Primary Rotary Screen**. The Primary Screen washes all of the materials using an intense spray washing system. This system is comprised of a **Make-Up Water Storage Tanks**, one **Centrifugal Pump** for supplying water to rinse the materials and one **High Pressure Water Pump** for screen cleaning. The paste fraction and fine metallic particles pass through the screen openings.

The slurry of metallic fines and the paste materials is carried from the Primary Rotary Screen by the **Rotary Screen Discharge Screw #1**, located underneath the Primary Rotary Screen, to the **Elutriator Unit**. This unit is specially designed to allow the metallic lead fines to sink while the paste fraction remains in suspension and is overflowed to a **Surge Tank**. From the surge tank, the slurry is pumped to a **Holding Tank** and from the Holding Tank, the slurry is pumped to the **Desulphurization Process**.

The remaining crushed battery components from the Primary Rotary Screen are deposited into **Rotary Screen Discharge Screw #2**, located at the discharge end of the Primary Rotary Screen, and are washed with water sprays before being discharged to the **Lead Metals Classification Tank**. In the Lead Metals Classification Tank, a rising water current generated with fluids from the **Recirculation Tank**, carries the plastics, organics and any remaining paste materials out of the tank, over a weir and into the **Secondary Rotary Screen**. The metallic lead fraction that sinks in the lead metal classification tank is carried by screw conveyor from the bottom of the Lead Metals Classification Tank and discharged to a bunker. This material along with the fine metallic lead recovered from the Elutriator can then be charged into the Refining Kettles for purification.



Wirtz Manufacturing Co., Inc.

The liquid and any remaining lead paste passes through the screen openings of the Secondary Rotary Screen and into the **Recirculation Tank**. The oversize material fraction from the Secondary Rotary Screen is washed using an intense spray washing system and is discharged directly into the **Plastic Classification Tank**. The polypropylene plastics float while other organics, including hard rubber and PVC, will sink. The tank surface is agitated by paddle wheels for partial cleaning Polypropylene and enhance movement of the plastic toward an exit screw conveyor. A final rinse manifold sprays fresh water over the plastic in the **Polypropylene Screw Conveyor**.

This plastic can be bagged or transported to a plastics granulation system for cleaning, granulation, and extrusion to polypropylene pellets. Organics, including hard rubber and PVC, are transported from the bottom by a second screw conveyor. A rinse manifold washes this material while in the screw conveyor. This material can be disposed of.

The liquid and fine solid materials in the Recirculation Tank are pumped by the **Upflow Centrifugal Pump** into the Lead Metals Classification Tank as the source of the rising current while the **Breaker Cooling Water Centrifugal Pump** sends liquids and solids to the breaker for cooling, lubrication and transportation of materials out of the breaker.

In the Desulphurization Area, the slurry pumped from the Holding Tank goes to the first of two Reaction Tanks. In **Reaction Tank #1**, sodium carbonate is mixed with the slurry until the pH of the solution reaches a pH of 4-5. The solution is then transferred to **Reaction Tank #2** where additional sodium carbonate and sodium hydroxide are added to the solution until a pH of 7-8 is achieved. If excess sodium carbonate is present at the end of the reaction time, dilute sulfuric acid from the Clarified Acid Tank may be added to the Reaction Tank. The slurry is pumped from Reaction Tank #2 to the **Filter Press** for dewatering. The solids removed from the Filter Press is loaded into the Digester Tanks of the Aqua Metals System.

# APPENDIX C Proof of Property Ownership

Vanessa Stephens  
 Storey County Treasurer  
 PO Drawer D  
 Virginia City, NV 89440

## STOREY COUNTY REAL PROPERTY TAXES FOR FISCAL YEAR 2015 - 2016 TAXES FROM JULY 1, 2015 THRU JUNE 30, 2016

PARCEL NUMBER	DISTRICT	ROLL NUMBER	PROPERTY LOCATION
005-071-55	12.2	000189	PT S10 T19N,R22E, INDUSTRIAL GID



000093 L2TSTO88  
 AQUA METALS RENO INC  
 501 23RD AVE  
 OAKLAND, CA 94606

MAKE REMITTANCE PAYABLE TO:  
 STOREY COUNTY TREASURER  
 PO Drawer D  
 Virginia City, NV 89440

YOUR CHECK IS YOUR RECEIPT  
 IF ADDITIONAL RECEIPT IS NEEDED, RETURN  
 ENTIRE TAX BILL WITH PAYMENT AND  
 SELF-ADDRESSED STAMPED ENVELOPE.

Office Phone: (775) 847-0969

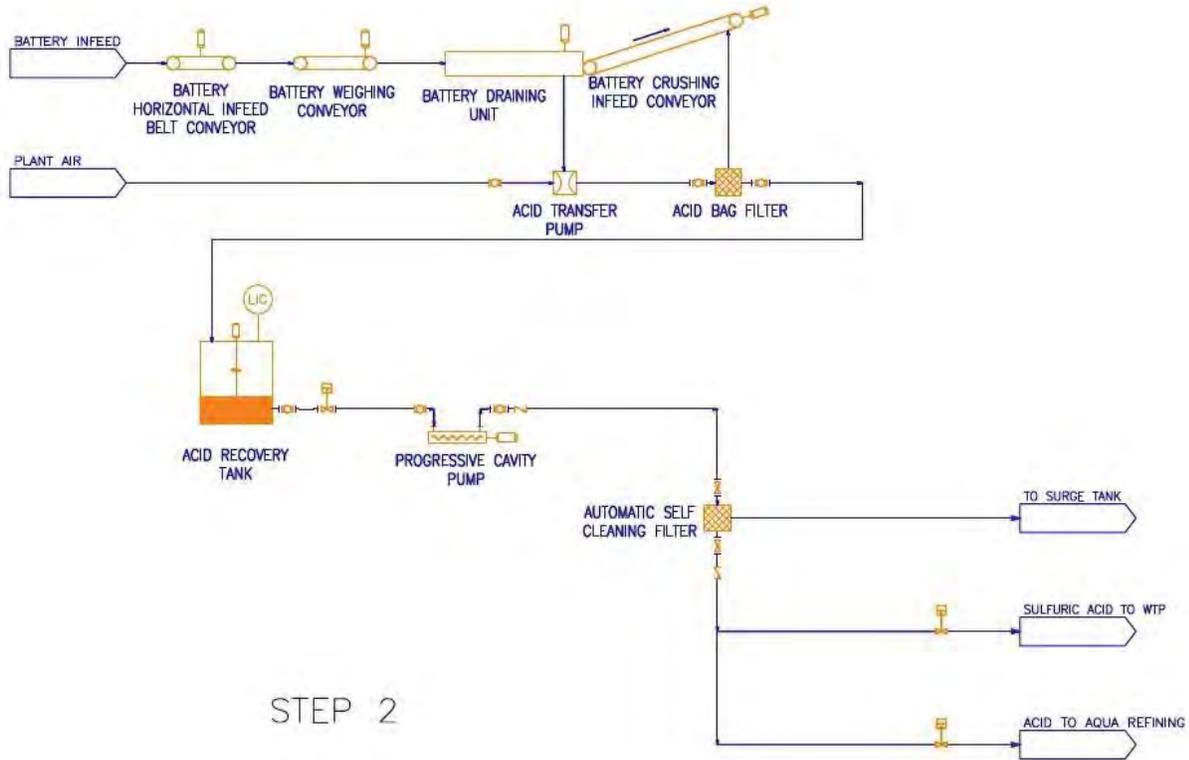
ASSESSED VALUATION		DISTRIBUTION OF TAX AMOUNTS				
DESCRIPTION	VALUE	TAXING AGENCY	RATE	PREABATEMENT AMOUNT	ABATEMENT/RECAPTURE AMOUNT	TAX AMOUNT
Real Estate	\$ 250,581	GENERAL	1.7719	\$ 4,440.04		\$ 4,440.04
		SCHOOL OPER	0.7500	1,879.36		1,879.36
		SCHOOL DEBT	0.1447	362.59		362.59
		CAPITAL AQUIS	0.0500	125.29		125.29
		STATE	0.1700	425.99		425.99
		IND MEDICAL	0.0100	25.06		25.06
		IND ACCIDENT	0.0150	37.59		37.59
		FIRE DISTRICT	0.5446	1,364.66		1,364.66
		YOUTH SERVICE	0.0045	11.28		11.28
		Ad Valorem Totals	3.4607	8,671.86		8,671.86
NET ASSESSED	\$ 250,581					
Information concerning taxing authorization, rates and uses of taxes collected can be found at <a href="http://www.tax.state.nv.us">www.tax.state.nv.us</a> or by calling (775) 847-0969						
<b>TOTAL TAX DUE</b>						<b>\$8,671.86</b>

Please see the reverse side of this tax bill for important information and address change instructions.

Figure 13 - Proof of Property Ownership

# APPENDIX D Piping & Instrumentation Diagrams of Recycling Process

## Step 2 - Acid Draining



STEP 2

Figure 14 - Step 2 - Acid Draining



Step 3B - Battery Breaking and Separation

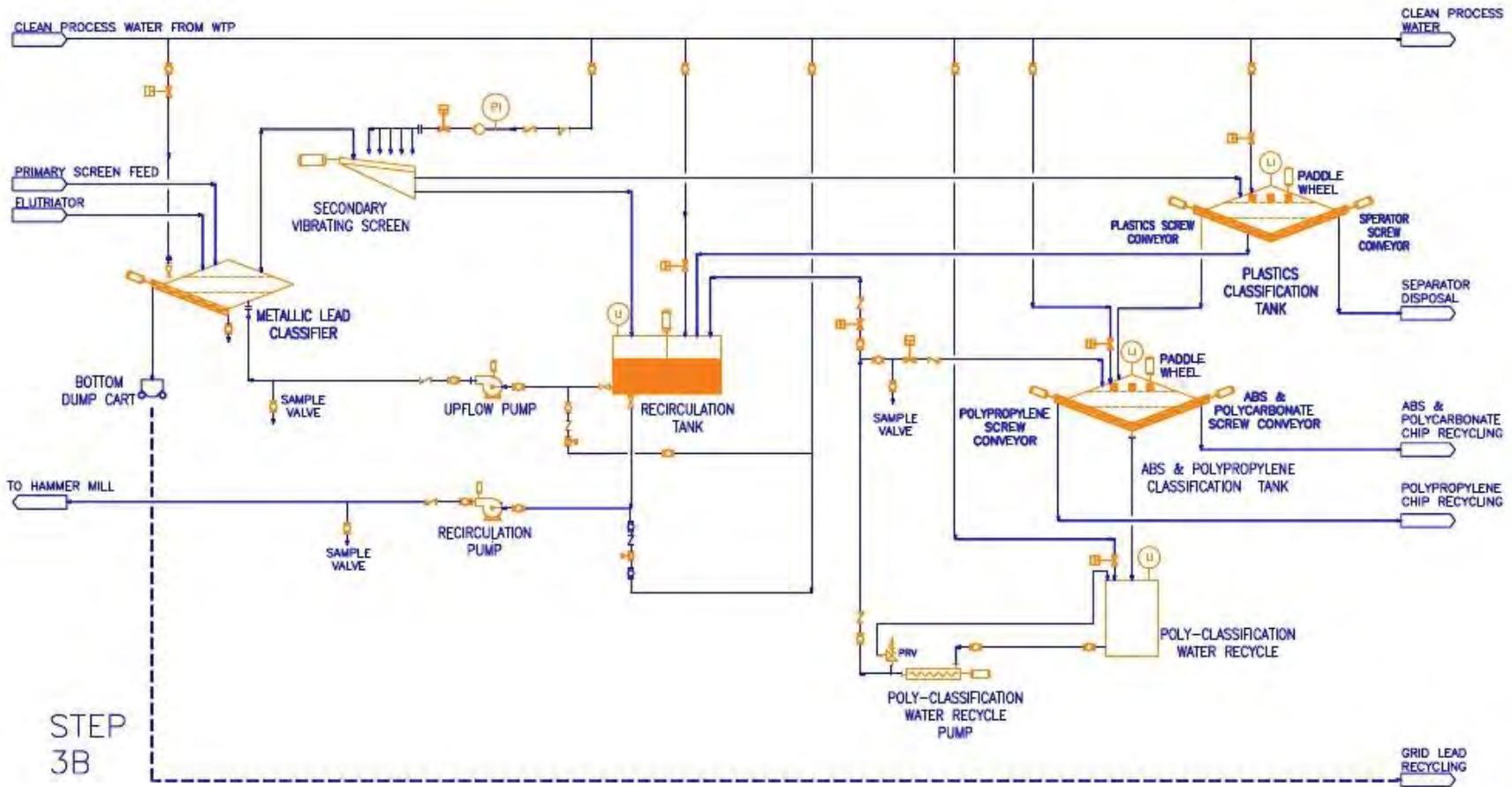


Figure 16 - Step 3B - Battery Breaking and Separation

Step 4 - De-Sulfurization

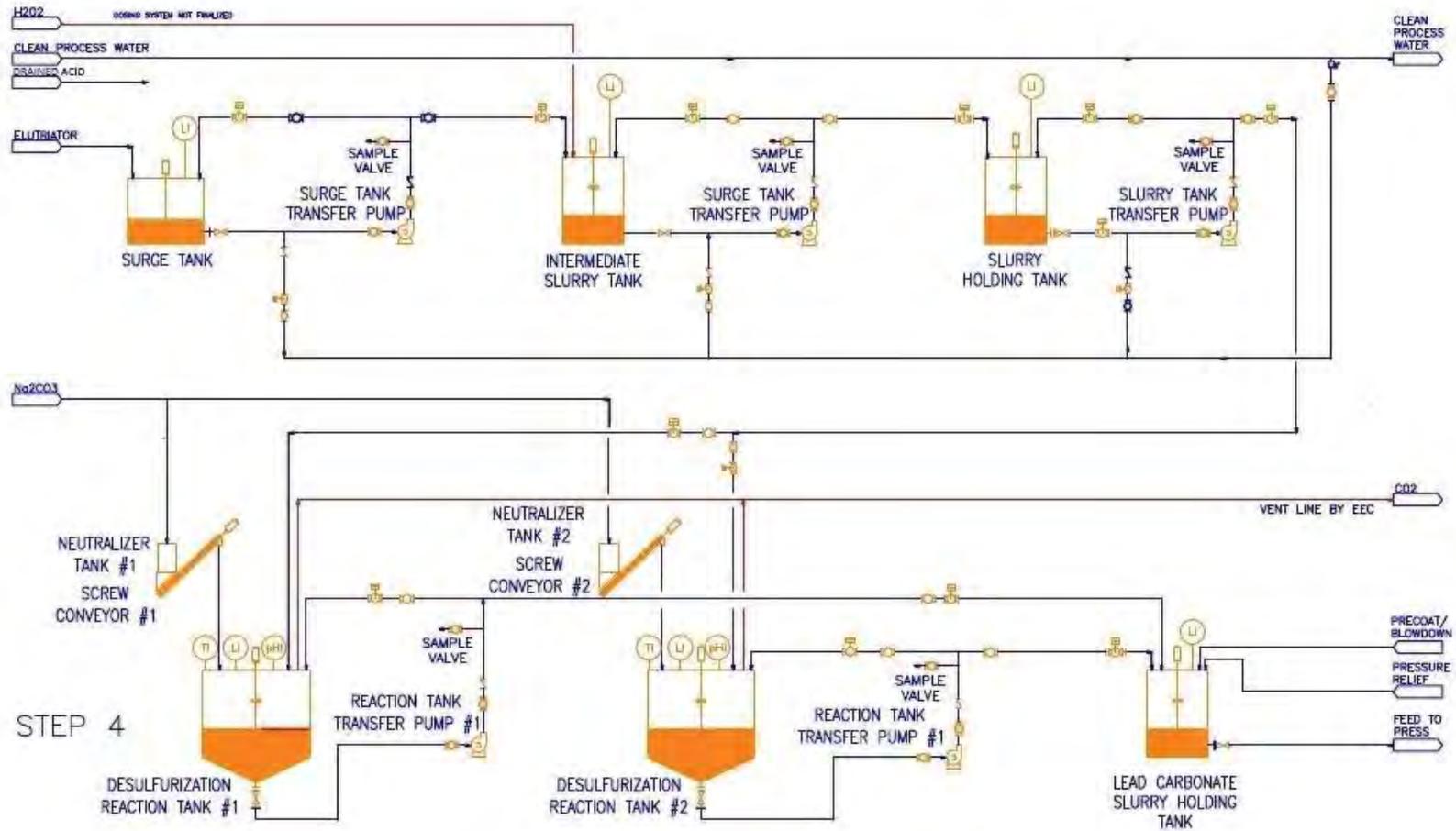
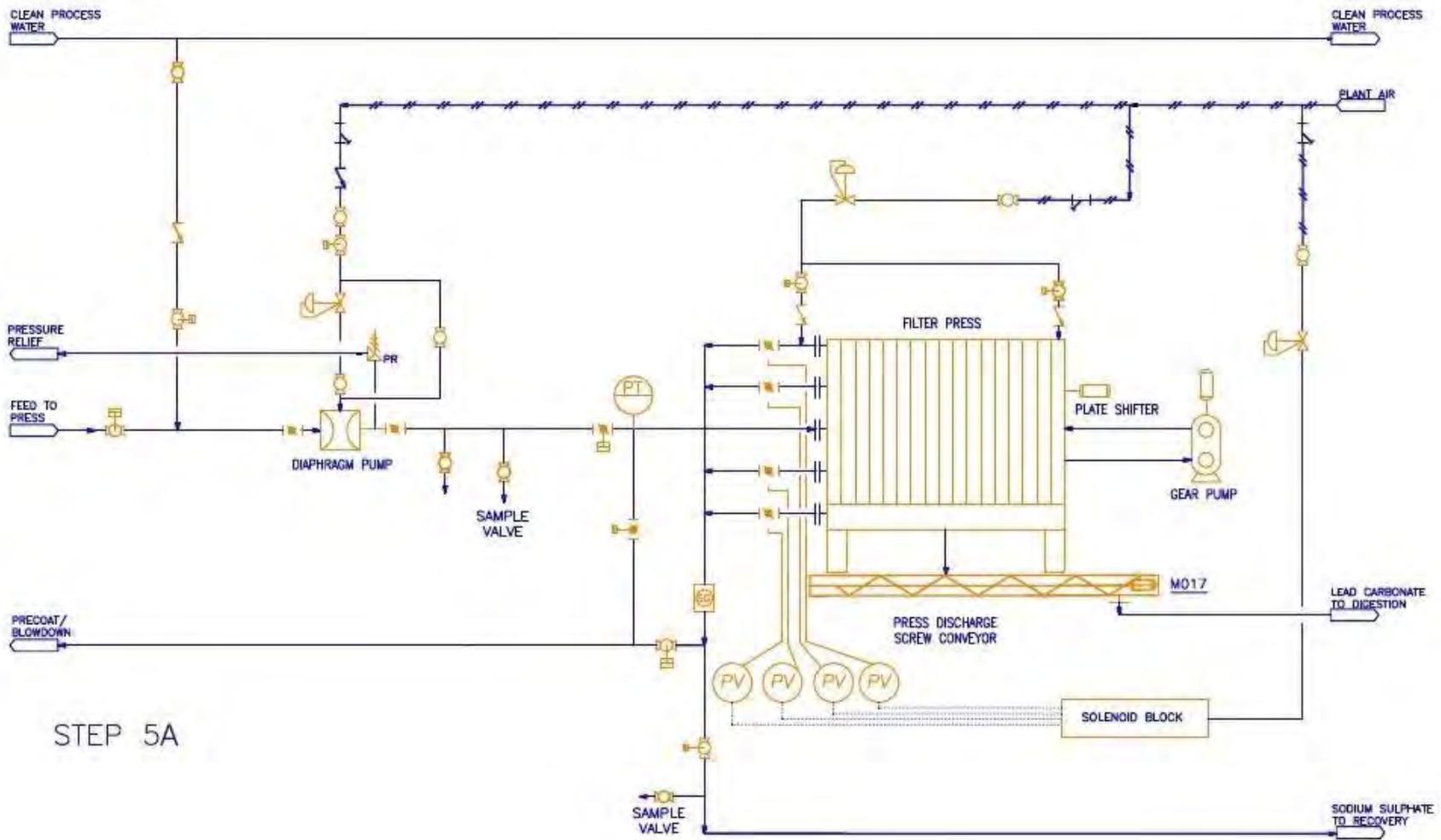


Figure 17 - Step 4 - De-Sulfurization

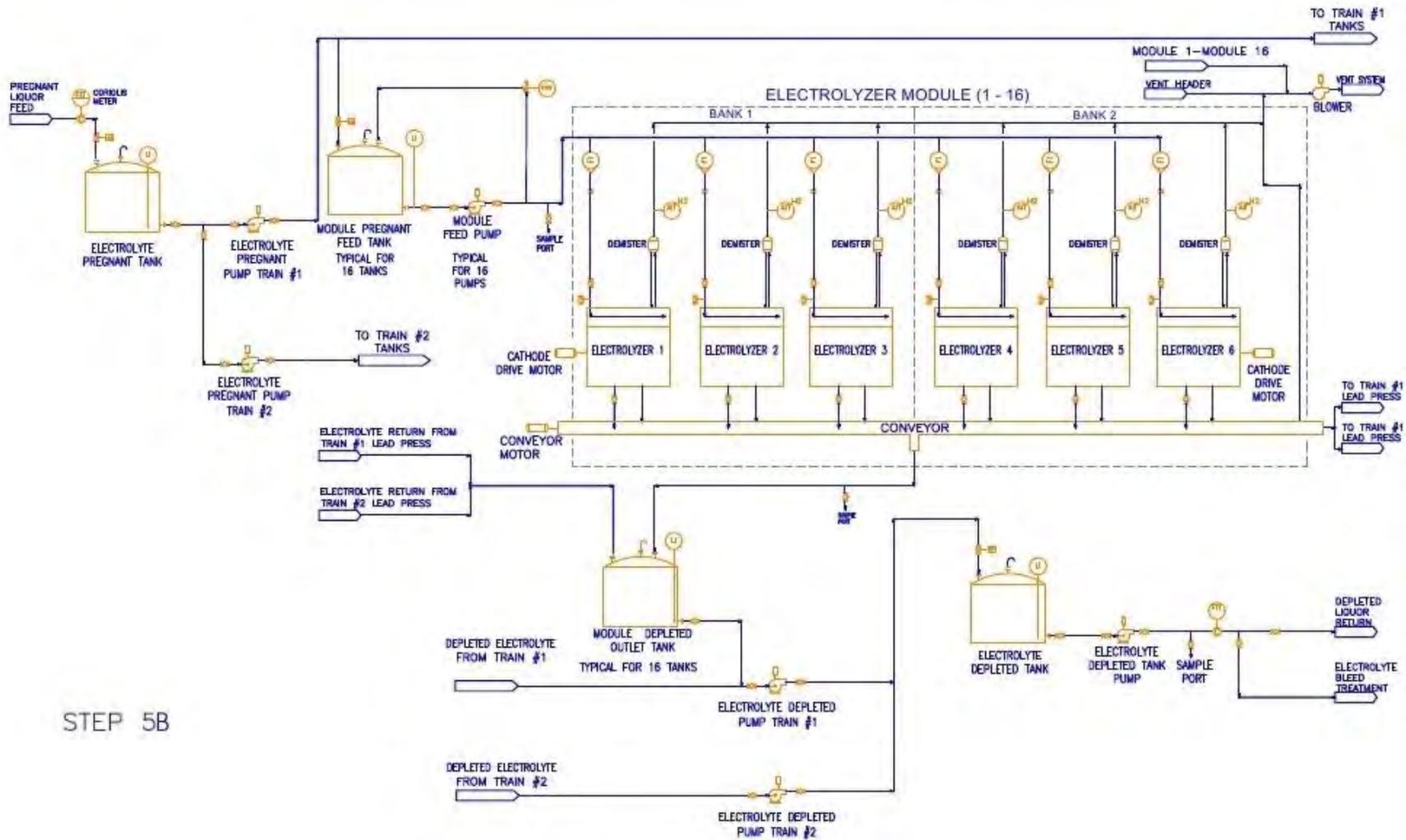
Step 5A - Aqua Metals Lead Recovery Process – AquaRefining™



STEP 5A

Figure 18 - Step 5A - AquaRefining™

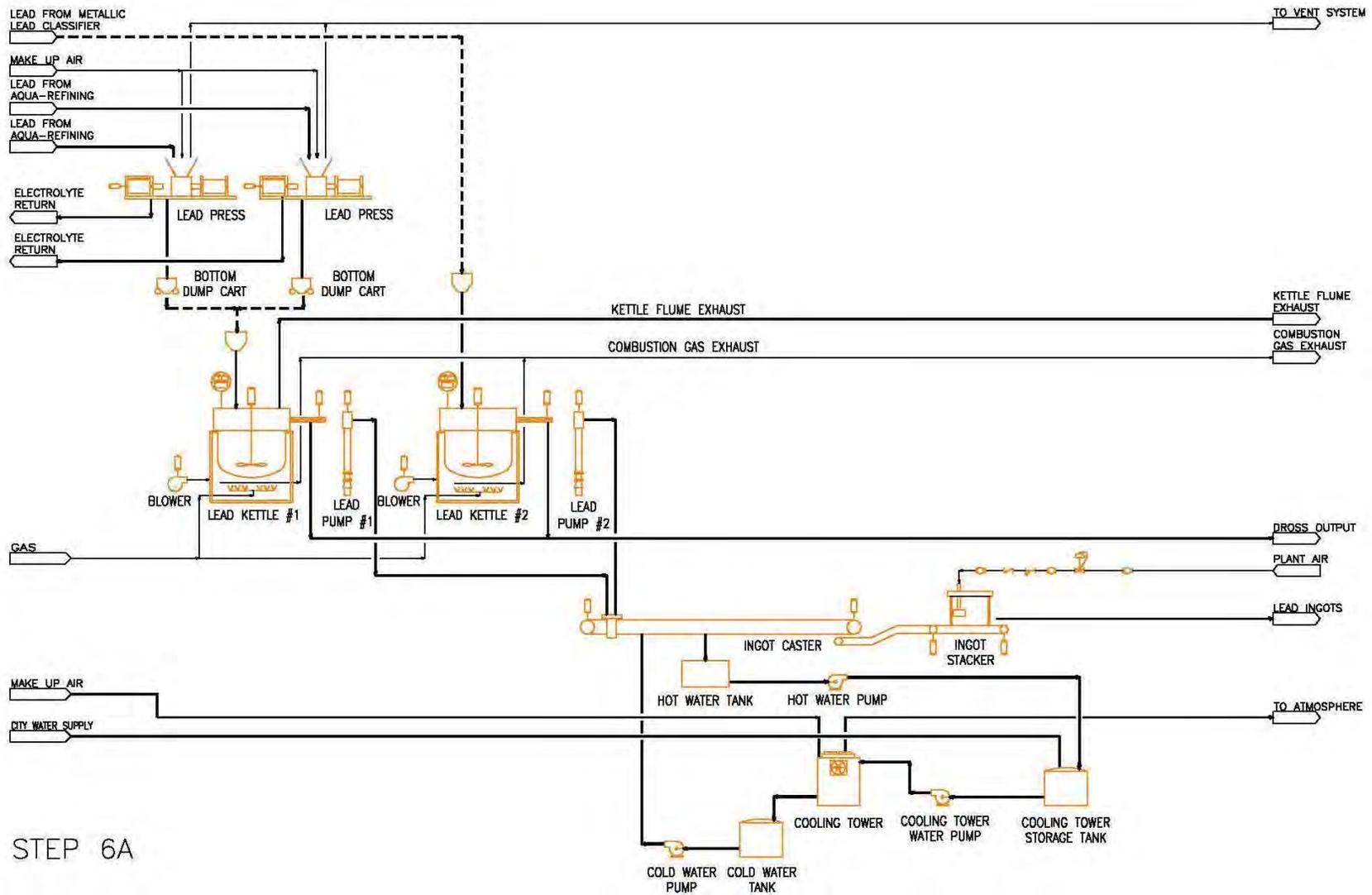
Step 5B - Aqua Metals Lead Recovery Process – AquaRefining™



STEP 5B

Figure 19 - Step 5B - AquaRefining™

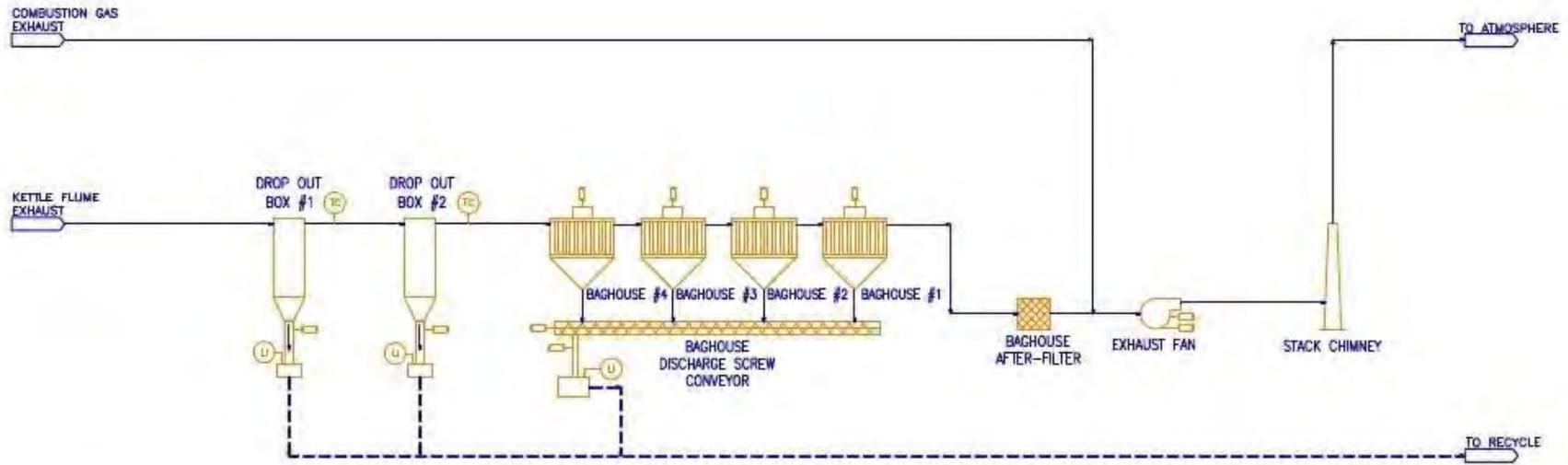
Step 6A - Ingoting



STEP 6A

Figure 20 - Step 6A - Ingoting

Step 6B - Ingoting

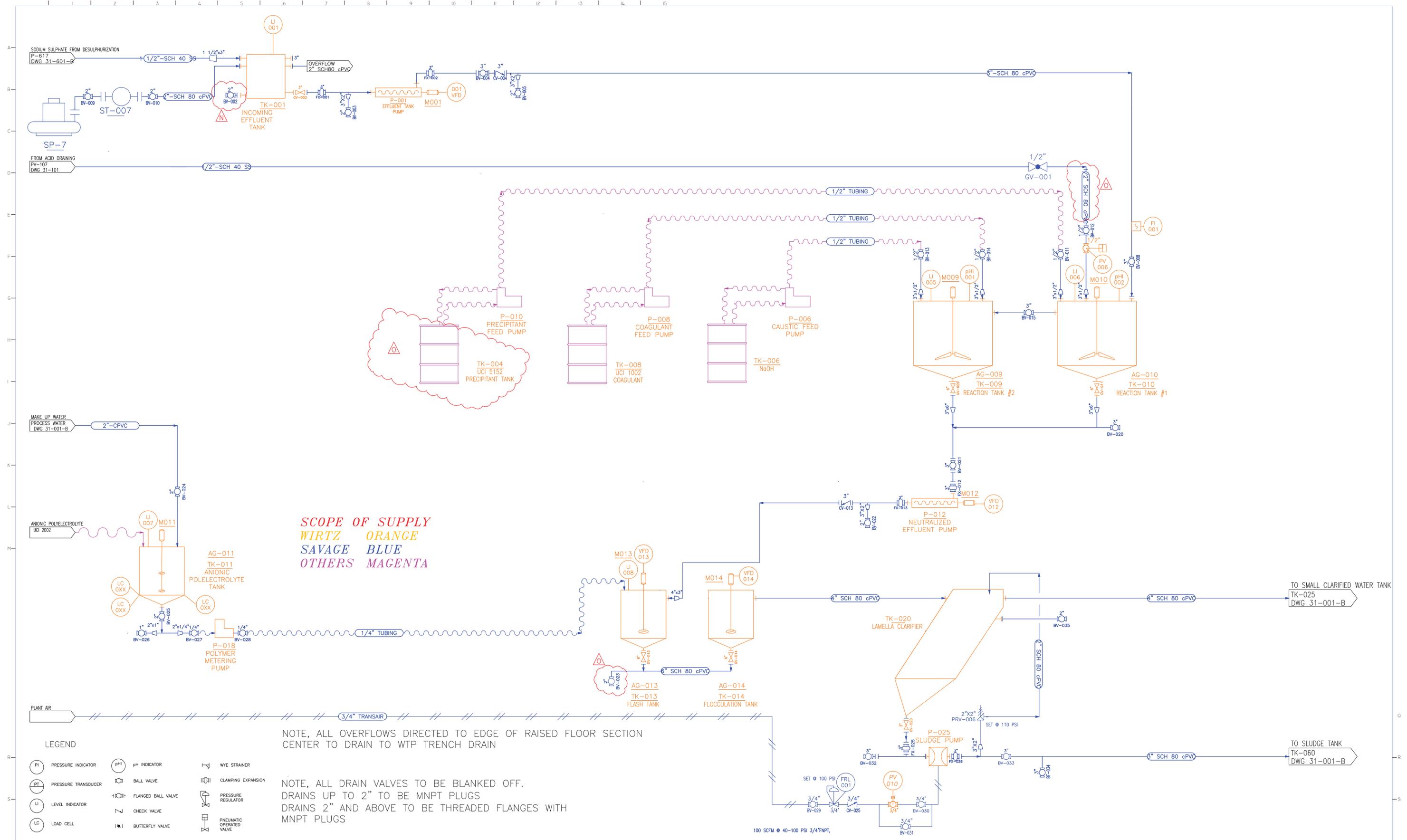


STEP 6B

Figure 21 - Step 6B – Ingoting

# APPENDIX E Water Treatment Plant Process

Figures 22a/b - Water Treatment Plant Process



**SCOPE OF SUPPLY**  
**WIRTZ ORANGE**  
**SAVAGE BLUE**  
**OTHERS MAGENTA**

NOTE, ALL OVERFLOWS DIRECTED TO EDGE OF RAISED FLOOR SECTION  
 CENTER TO DRAIN TO WTP TRENCH DRAIN

NOTE, ALL DRAIN VALVES TO BE BLANKED OFF.  
 DRAINS UP TO 2" TO BE MNPT PLUGS  
 DRAINS 2" AND ABOVE TO BE THREADED FLANGES WITH  
 MNPT PLUGS

LEGEND

PI	PRESSURE INDICATOR	pH	pH INDICATOR	W	WYE STRAINER
PT	PRESSURE TRANSDUCER	BV	BALL VALVE	CE	CLAMPING EXPANSION
LI	LEVEL INDICATOR	FBV	FLANGED BALL VALVE	PR	PRESSURE REGULATOR
LC	LOAD CELL	CV	CHECK VALVE	POV	PNEUMATIC OPERATED VALVE
		BFV	BUTTERFLY VALVE		

REFERENCE DWGS

DRAWING NO.	TITLE
31-101	BATTERY DRAINING P&ID
31-201	BATTERY CRUSHING P&ID
31-301	GRID LEAD RECOVERY & PLASTICS RECOVERY P&ID
31-601	DESULFURIZATION
31-701	DIGESTION P&ID
31-801	ELECTROLYTE DISTRIBUTION P&ID
31-901	INGOTTING P&ID

DRAWING NO.	TITLE

REV.	DESCRIPTION	DATE	REV.	DESCRIPTION	DATE
J	VALVES REMOVES, SUMP PUMP ADDED	6/30/15	A	ISSUED FOR REVIEW	6/30/15
K	RELEASED FOR PIPING DESIGN	5/15/16	B	ADD VALVES & INSTRUMENTS	08/28/15
L	FEED TO TK-001 REDIRECTED	5/15/16	C	UPDATE BUTTERFLY VALVES	09/11/15
M	CALCIUM HYDROXIDE SYSTEM REPLACED WITH NEW SYSTEM	5/23/16	D	ADD FLOC TANK, CHANGE PUMPS, UPDATE VALVES	10/06/15
N	UPDATE DETAILS AFTER PIPING REVIEW	6/23/16	E	UPDATE EQUIPMENT NAMES, CHANGE FILTER PRESS PUMP	10/13/15
O	UPDATE DETAILS AFTER PIPING REVIEW	6/29/16	F	UPDATE EQUIPMENT NAMES, ADD TK-017	10/30/15
			G	UPDATE VALVE NO'S & PRESS DETAILS	2/28/16
			H	FEED LINES TO TK-001 CHANGED	3/21/16
			J	FILTER PRESS MOVED TO 31-001-B COMMENTS ADDED	4/23/16

PROJECT NO.	RENO 1	DATE	6/30/15
DRAWN	MK	DESIGNED	SB
CHECKED		APPROVED	
APPROVED			

**BATTERY RECYCLING SYSTEMS** □□□□ M □□□□□

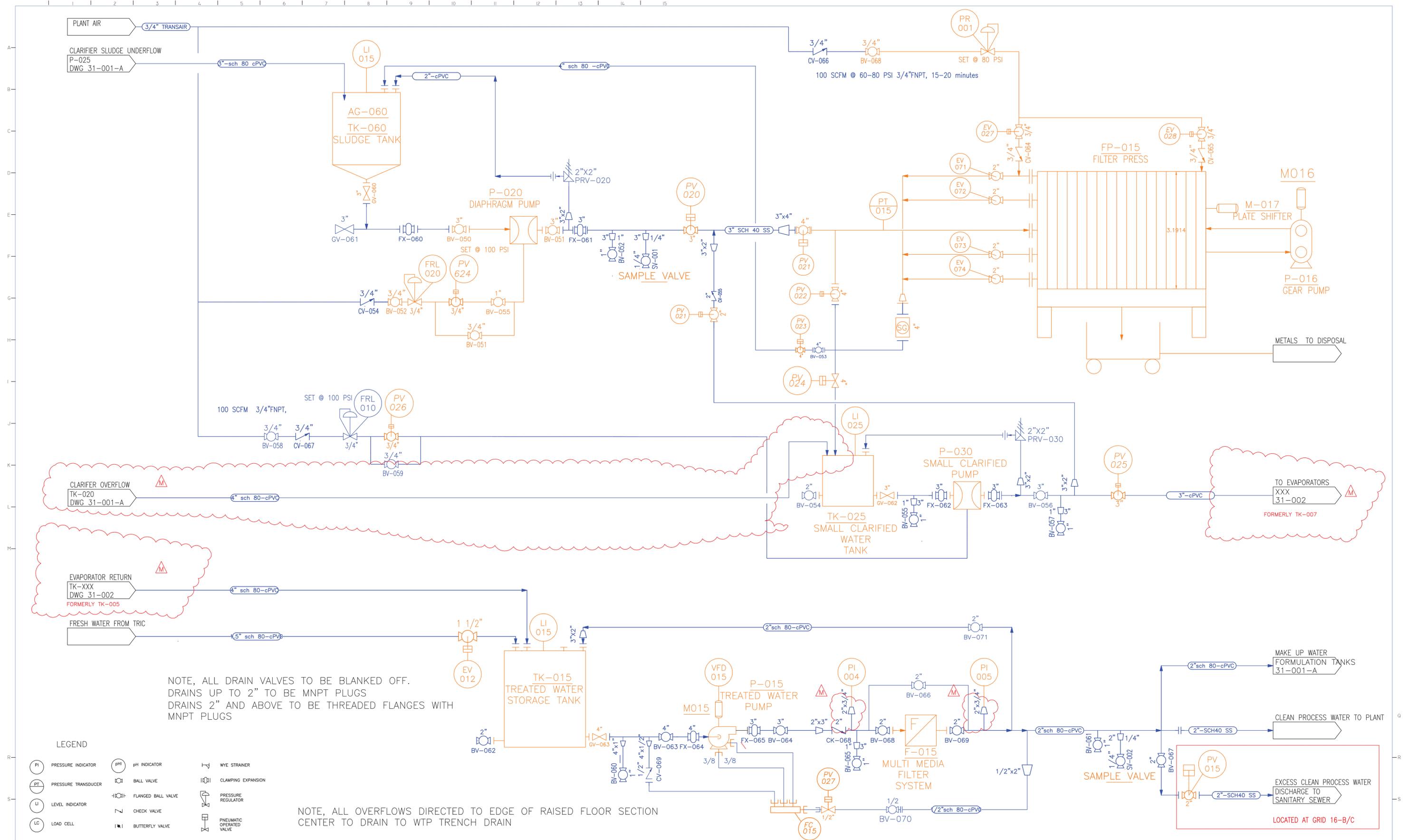
PROJECT NO. **RENO 1** DATE **6/30/15**

DRAWN **MK** DESIGNED **SB**

**WIRTZ WATER TREATMENT PLANT**

CHECKED \_\_\_\_\_ APPROVED \_\_\_\_\_

SCALE: **N.T.S.** SHEET **1 OF 1** DRAWING No. **31-001-A** REV. **0**



NOTE, ALL DRAIN VALVES TO BE BLANKED OFF.  
DRAINS UP TO 2" TO BE MNPT PLUGS  
DRAINS 2" AND ABOVE TO BE THREADED FLANGES WITH MNPT PLUGS

NOTE, ALL OVERFLOWS DIRECTED TO EDGE OF RAISED FLOOR SECTION  
CENTER TO DRAIN TO WTP TRENCH DRAIN

**LEGEND**

PI	PRESSURE INDICATOR	pH	pH INDICATOR	W	WYE STRAINER
PT	PRESSURE TRANSDUCER	BV	BALL VALVE	CE	CLAMPING EXPANSION
LI	LEVEL INDICATOR	FBV	FLANGED BALL VALVE	PR	PRESSURE REGULATOR
LC	LOAD CELL	CV	CHECK VALVE	POV	PNEUMATIC OPERATED VALVE
		SV	BUTTERFLY VALVE		

REFERENCE DWGS	DRAWING NO.	TITLE	DRAWING NO.	TITLE	REV.	DESCRIPTION	DATE	REV.	DESCRIPTION	DATE	PROJECT NO.	RENO 1	DATE	SCALE:	SHEET	1 OF 1	DRAWING No.	31-001-B	REV.	M
	31-101	BATTERY DRAINING P&ID			K	ISSUED FOR FABRICATION	5/17/16	A	ISSUED FOR REVIEW	6/30/15			6/30/15	N.T.S.						
	31-201	BATTERY CRUSHING P&ID			L	EVAPORATOR CONNECTIONS ADDED	5/30/16	B	ADD VALVES & INSTRUMENTS	08/28/15			7/14/15							
	31-301	GRID LEAD RECOVERY & PLASTICS RECOVERY P&ID			M	UPDATED AFTER PIPING REVIEW	6/24/16	C	UPDATE BUTTERFLY VALVES	09/11/15										
	31-601	DESULFURIZATION						D	ADD FLOC TANK, CHANGE PUMPS, UPDATE VALVES	10/06/15										
	31-701	DIGESTION P&ID						E	UPDATE EQUIPMENT NAMES, CHANGE FILTER PRESS PUMP	10/13/15										
	31-801	ELECTROLYTE DISTRIBUTION P&ID						F	UPDATE EQUIPMENT NAMES, ADD TK-017	10/30/15										
	31-901	INGOTTING P&ID						G	UPDATE VALVE NO'S & PRESS DETAILS	2/28/16										
					H	FEED LINES TO TK-001 CHANGED	3/21/16													
					J	FILTER PRESS FROM 31-001-A	4/23/16													

PROJECT NO. RENO 1  
DRAWN MK  
DESIGNED SB  
CHECKED  
APPROVED

WIRTZ WATER TREATMENT PLANT

SCALE: N.T.S. SHEET 1 OF 1 DRAWING No. 31-001-B REV. M

APPENDIX F Industry Standard for Lead  
*BS EN 12659:1999 – Lead and Lead Alloys*

## APPENDIX G Other Permits Required to Operate in Jurisdiction

In addition to this Permit Application, we have, or are seeking, the following regulations and permits before the commencement of operations:

Permit	Regulating Agency	Status
Class II Air Quality Operating Permit.	State of Nevada, Division of Environmental Protection, Bureau of Air Pollution Control	Issued (included in the following pages)
Water/Sewer Service	Tahoe Reno Industrial General Improvement District (TRI GID)	"Will Serve" Letter Ready for Pickup and Fee Checks Submitted
Clean Water Act: Permit by Rule (Permit for Discharge into TRI GID wastewater system)	USEPA, Region 9	NOTE: If the <i>neutralization</i> process will be covered under the WD. If it is, then the need for applying to TRIC GID is not necessary.
Business License	Storey County	Issued prior to construction
Building Permits	Storey County	Issued prior to construction (included in the following pages)



**Bureau of Air Pollution Control**

901 SOUTH STEWART STREET SUITE 4001

CARSON CITY, NEVADA 89701-5249

p: 775-687-9350 • [www.ndep.nv.gov/bapc](http://www.ndep.nv.gov/bapc) • f: 775-687-6396

**Facility ID No. A1917**

**Draft Permit No. AP5051-3711**

**CLASS II AIR QUALITY OPERATING PERMIT**

**Issued to:** AQUA METALS, INC. (HEREINAFTER REFERRED TO AS PERMITTEE)

**Mailing Address:** 1010 ATLANTIC AVENUE, ALAMEDA, CALIFORNIA 94501

**Physical Address:** 2500 PERU DRIVE, MCCARRAN, NEVADA 89434

**General Facility Location:** TAHOE-RENO INDUSTRIAL CENTER, 2500 PERU DRIVE, MCCARRAN, NEVADA

SECTION 10, T 19N, R 23E, MDB&M

HA 83 – TRACY SEGMENT, TRUCKEE RIVER BASIN; STOREY COUNTY

NORTH 4,378.30 KM, EAST 285.40 KM, UTM ZONE 11 – NAD 83

**Emission Unit List:**

**A. System 01 – Battery Draining Unit**

PF 1.001 Battery Draining Unit (mfd by Battery Recycling Systems, mdl# BD-15)

**B. System 02 – Battery Breaking Unit**

S 2.001 Battery Breaking Unit (mfd by Battery Recycling Systems, mdl# BC-15)

**C. System 03 – Bulk Material Conveyance**

S 2.002 Sodium Carbonate Bulk Material Conveyance

S 2.003 Calcium Hydroxide Bulk Material Conveyance

**D. System 04 – Lead Ingotting Kettles and Casting**

S 2.004 Ingotting Kettle #1

S 2.005 Ingotting Kettle #2

S 2.006 Ingot Casting Unit

**E. System 05 – Cooling Tower for Ingot Casting**

S 2.007 Cooling Tower

**F. System 06 – 200 HP Emergency Diesel Generator**

S 2.008 200 HP Emergency Diesel Generator



**Bureau of Air Pollution Control**

**Facility ID No. A1917**

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**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section I. General Conditions**

- A. Severability (Nevada Administrative Code (NAC) 445B.315.3(c))  
Each of the conditions and requirements of this Operating Permit is severable and, if any are held invalid, the remaining conditions and requirements continue in effect.
- B. Prohibited Acts (Nevada Revised Statute (NRS) 445B.470))  
Permittee shall not knowingly:
1. Violate any applicable provision, the terms or conditions of any permit or any provision for the filing of information;
  2. Fail to pay any fee;
  3. Falsify any material statement, representation or certification in any notice or report; or
  4. Render inaccurate any monitoring device or method, required pursuant to the provisions of NRS 445B.100 to 445B.450, inclusive, or 445B.470 to 445B.640, inclusive, or any regulation adopted pursuant to those provisions.
- C. Prohibited Conduct: Concealment of Emissions (NAC 445B.225)  
Permittee shall not install, construct, or use any device which conceals any emission without reducing the total release of regulated air pollutants to the atmosphere.
- D. Compliance/Noncompliance (NAC 445B.315.3(d))  
Permittee shall comply with all conditions of this Operating Permit. Any noncompliance constitutes a violation and is grounds for:
1. An action for noncompliance;
  2. Revising, revoking, reopening and revising, or terminating the Operating Permit; or
  3. Denial of an application for a renewal of the Operating Permit.
- E. NAC 445B.315.3(e)  
The need to halt or reduce activity to maintain compliance with the conditions of this Operating Permit is not a defense to noncompliance with any conditions of this Operating Permit.
- F. NAC 445B.315.3(f)  
The director may revise, revoke and reissue, reopen and revise, or terminate the operating permit for cause.
- G. NAC 445B.315.3(g)  
This Operating Permit does not convey any property rights or any exclusive privilege.
- H. NAC 445B.315.3(h)  
Permittee shall provide the Bureau of Air Pollution Control, within a reasonable time, with any information that the Bureau of Air Pollution Control requests in writing to determine whether cause exists for revising, revoking and reissuing, reopening and revising or terminating this Operating Permit or to determine compliance with the conditions of this Operating Permit.
- I. Fees (NAC 445B.315.3(i))  
Permittee shall pay fees to the Bureau of Air Pollution Control in accordance with the provisions set forth in NAC 445B.327 and 445B.331.
- J. Right to Entry (NAC 445B.315.3(j))  
Permittee shall allow the Bureau of Air Pollution Control personnel, upon the presentation of credentials, to:
1. Enter upon the premises of Permittee where:
    - a. The stationary source is located;
    - b. Activity related to emissions is conducted; or
    - c. Records are kept pursuant to the conditions of this Operating Permit;
  2. Have access to and copy, during normal business hours, any records that are kept pursuant to the conditions of this Operating Permit;
  3. Inspect, at reasonable times, any facilities, practices, operations, or equipment, including any equipment for monitoring or controlling air pollution, that are regulated or required pursuant to this Operating Permit; and
  4. Sample or monitor, at reasonable times, substances or parameters to determine compliance with the conditions of this Operating Permit or applicable requirements.



**Bureau of Air Pollution Control**

**Facility ID No. A1917**

**Draft Permit No. AP5051-3711**

**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section I. General Conditions (continued)**

**K. Certification (NAC 445B.315.3(k))**

A responsible official of Permittee shall certify that, based on information and belief formed after reasonable inquiry, the statements made in any document required to be submitted by any condition of this Operating Permit are true, accurate and complete.

**L. Testing and Sampling (NAC 445B.252)**

1. To determine compliance with NAC 445B.001 to 445B.3689, inclusive, before the approval or the continuance of an operating permit or similar class of permits, the director may either conduct or order the owner of any stationary source to conduct or have conducted such testing and sampling as the director determines necessary. Testing and sampling or either of them must be conducted and the results submitted to the director within 60 days after achieving the maximum rate of production at which the affected facility will be operated, but not later than 180 days after initial startup of the facility and at such times as may be required by the director.
2. Tests of performance must be conducted and data reduced in accordance with the methods and procedures of the test contained in each applicable subsection of this section unless the director:
  - a. Specifies or approves, in specific cases, the use of a method of reference with minor changes in methodology;
  - b. Approves the use of an equivalent method;
  - c. Approves the use of an alternative method, the results of which he has determined to be adequate for indicating whether a specific stationary source is in compliance; or
  - d. Waives the requirement for tests of performance because the owner or operator of a stationary source has demonstrated by other means to the director's satisfaction that the affected facility is in compliance with the standard.
3. Tests of performance must be conducted under such conditions as the director specifies to the operator of the plant based on representative performance of the affected facility. The owner or operator shall make available to the director such records as may be necessary to determine the conditions of the performance test. Operations during periods of startup, shutdown and malfunction must not constitute representative conditions of a performance test unless otherwise specified in the applicable standard.
4. Permittee shall give notice to the director 30 days before the test of performance to allow the director to have an observer present. A written testing procedure for the test of performance must be submitted to the director at least 30 days before the test of performance to allow the director to review the proposed testing procedures.
5. Each test of performance must consist of at least three separate runs using the applicable method for that test. Each run must be conducted for the time and under the conditions specified in the applicable standard. For the purpose of determining compliance with an applicable standard, the arithmetic means of results of the runs apply. In the event of forced shutdown, failure of an irreplaceable portion of the sampling train, extreme meteorological conditions or other circumstances with less than three valid samples being obtained, compliance may be determined using the arithmetic mean of the results of the other two runs upon the director's approval.
6. All testing and sampling will be performed in accordance with recognized methods and as specified by the director.
7. The cost of all testing and sampling and the cost of all sampling holes, scaffolding, electric power and other pertinent allied facilities as may be required and specified in writing by the director must be provided and paid for by the owner of the stationary source.
8. All information and analytical results of testing and sampling must be certified as to their truth and accuracy and as to their compliance with all provisions of NAC 445B.001 to 445B.3689, inclusive, and copies of these results must be provided to the director no later than 60 days after the testing or sampling, or both.
9. Notwithstanding the provisions of subsection 2, the Director shall not approve an alternative method or equivalent method to determine compliance with a standard or emission limitation contained in Part 60, 61 or 63 of Title 40 of the Code of Federal Regulations for:
  - a. An emission unit that is subject to a testing requirement pursuant to Part 60, 61 or 63 of Title 40 of the Code of Federal Regulations; or
  - b. An affected source.



**Bureau of Air Pollution Control**

**Facility ID No. A1917**

**Draft Permit No. AP5051-3711**

**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section I. General Conditions (continued)**

**M. Maximum Opacity of Emissions (NAC 445B.22017)**

1. Except as otherwise provided in this section and NAC 445B.2202, Permittee may not cause or permit the discharge into the atmosphere from any emission unit opacity equal to or greater than 20 percent. Opacity must be determined by one of the following methods:
  - a. If opacity is determined by a visual measurement, it must be determined as set forth in Reference Method 9 in Appendix A of 40 C.F.R. Part 60.
  - b. If a source uses a continuous monitoring system for the measurement of opacity, the data must be reduced to 6-minute averages as set forth in 40 CFR § 60.13(h).
2. The provisions of this section and NAC 445B.2202 do not apply to that part of the opacity that consists of uncombined water. The burden of proof to establish the application of this exemption is upon the person seeking to come within the exemption.

**N. Exceptions for Stationary Sources (NAC 445B.2202)**

The provisions of NAC 445B.22017 do not apply to:

1. Smoke from the open burning described in NAC 445B.22067;
2. Smoke discharged in the course of training air pollution control inspectors to observe visible emissions, if the facility has written approval of the commission;
3. Emissions from an incinerator as set forth in NAC 445B.2207;
4. Emissions of stationary diesel-powered engines during warm-up for not longer than 15 minutes to achieve operating temperatures.

**O. Odors (NAC 445B.22087)**

Permittee may not discharge or cause to be discharged, from any stationary source, any material or regulated air pollutant which is or tends to be offensive to the senses, injurious or detrimental to health and safety, or which in any way interferes with or prevents comfortable enjoyment of life or property.

**P. Assertion of Emergency as Affirmative Defense to Action for Noncompliance (NAC 445B.326.1)**

Permittee may assert an affirmative defense to an action brought for noncompliance with a technology-based emission limitation contained in the Operating Permit if the holder of the Operating Permit demonstrates through signed, contemporaneous operating logs or other relevant evidence that:

1. An emergency (as defined in NAC 445B.056) occurred and the holder of the Operating Permit can identify the cause of the emergency;
2. The facility was being properly operated at the time of the emergency;
3. During the emergency, the holder of the Operating Permit took all reasonable steps to minimize excess emissions; and
4. Permittee submitted notice of the emergency to the director within 2 working days after the emergency. The notice must contain a description of the emergency, any steps taken to mitigate emissions, and any corrective actions taken to restore the normal operation of the facility.
5. In any action for noncompliance, Permittee, by asserting the affirmative defense of any emergency, has the burden of proof.

**Q. Revocation and reissuance (NAC 445B.3265)**

1. This Operating Permit may be revoked if the control equipment is not operating.
2. This Operating Permit may be revoked by the director upon determination that there has been a violation of NAC 445B.001 to 445B.3689, inclusive, or the provisions of 40 CFR § 52.21, or 40 C.F.R. Part 60 or 61, Prevention of Significant Deterioration, New Source Performance Standards, and National Emission Standards for Hazardous Air Pollutants adopted by reference in NAC 445B.221.
3. The revocation is effective 10 days after the service of a written notice, unless a hearing is requested.

**\*\*\*\*End of General Conditions\*\*\*\***



**Bureau of Air Pollution Control**

**Facility ID No. A1917**

**Draft Permit No. AP5051-3711**

**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section II. General Construction Conditions**

The following provisions apply to PF1.001 and S2.001 through S2.008.

A. NAC 445B.250 (State Only Requirement)

Notification

The Director will be notified in writing of the following:

1. The date construction (or reconstruction as defined under NAC 445B.247) of the affected facility is commenced, postmarked no later than 30 days after such date.
2. The anticipated date of initial startup of an affected facility, postmarked no more than 60 days and no less than 30 days prior to such date.
3. The actual date of initial startup of the affected facility, postmarked within 15 days after such date.

B. Construction (NAC 445.3457)

1. If construction shall occur in one phase, a Class II operating permit or the revision of a Class II operating permit for a new or modified stationary source expires if construction is not commenced within 18 months after the date of issuance thereof or construction of the facility is delayed for 18 months or more after the construction begins. The Director may extend the date on which the construction may be commenced upon a showing that the extension is justified.
2. If construction shall occur in more than one phase, the projected date of commencement of construction of each phase must be approved by the Director. A Class II operating permit or the revision of a Class II operating permit for a new or modified stationary source expires if the initial phase of construction is not commenced within 18 months after the projected date of the commencement of construction approved by the Director. The Director may extend only the date on which the initial phase of construction may be commenced upon a showing that the extension is justified.

**\*\*\*End of General Construction Conditions\*\*\***



**Bureau of Air Pollution Control**

**Facility ID No. A1917**

**Draft Permit No. AP5051-3711**

**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section IIA. Specific Construction Requirements**

A. Initial Performance Tests (NAC 445B.252; NAC 445B.22017; NAC 445B.346.2)

- The Permittee, upon issuance of this operating permit, shall conduct initial performance tests within 60 days after achieving the maximum production rate at which the affected facility will be operated, but not later than 180 days after initial startup. The Permitting shall follow the tests methods and procedures referenced in Table IIA-1 below:

**Table IIA-1: Initial Performance Tests**

System	Emission Unit(s)	Pollutants To Be Tested	Testing Methods/Procedures
<p>System 04</p> <p>Note: Testing on the single stack for S2.004, S2.005, and S2.006, will include emissions from S2.004, S2.005, S2.006, and the associated Natural Gas Burners for the Kettles. Alternatively, the Permittee may elect to test prior to the burner exhaust connection to the single stack for S2.004, S2.005, and S2.006, and consider only emissions from S2.004, S2.005, and S2.006.</p>	<p>S2.004 S2.005 S2.006</p>	Metals	Reference Method 29 test in Appendix A of 40 CFR Part 60 to determine the antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, and selenium concentrations. The minimum sample volume must be 2.0 dscm (70 dscf) for each run. The performance tests will be conducted for two operating scenarios. Operating scenario one will involve "hard" lead processing with emission units S2.004 (or S2.005) and S2.006 in operation. Operating scenario two will involve "soft" lead processing with emission units S2.004 (or S2.005) and S2.006 in operation.
		PM/PM <sub>10</sub> /PM <sub>2.5</sub>	Reference Method 5 test in Appendix A of 40 CFR Part 60 and a Method 202 test in Appendix M of 40 CFR Part 51, shall be used to determine total particulate matter (PM) emissions. The sample volume for each test run shall be at least 1.7 dscm (60 dscf). Test runs must be conducted for up to two hours in an effort to collect this minimum sample.  Reference Method 201A and Method 202 tests in Appendix M of 40 CFR Part 51 shall be used to determine PM <sub>10</sub> and PM <sub>2.5</sub> emissions. The sample time and sample volume collected for each test run shall be sufficient to collect enough mass to weigh accurately. The Method 201A and 202 test required in this section may be replaced by a Method 5 in Appendix A of 40 CFR Part 60 and Method 202 in Appendix M of 40 CFR Part 51 test. All particulate captured in the Method 5 and Method 202 test performed under this provision shall be considered PM <sub>2.5</sub> for determination of compliance.
		VOC	Reference Method 25A test in Appendix A of 40 CFR Part 60 shall be used to determine the volatile organic compound concentration. A Method 18 test in Appendix A of 40 CFR Part 60 or a Method 320 test in Appendix A of CFR Part 63 may be used in conjunction with the Method 25A test to break out the organic compounds that are not considered volatile organic compounds by definition per 40 CFR 51.100(s). Each Method 25A test will be run for a minimum of 1-hour.



**Bureau of Air Pollution Control**

**Facility ID No. A1917**

**Draft Permit No. AP5051-3711**

**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section IIA. Specific Construction Requirements (continued)**

A. Initial Performance Tests (NAC 445B.252; NAC 445B.22017; NAC 445B.346.2) (continued)

1. The Permittee, upon issuance of this operating permit, shall conduct initial performance tests within 60 days after achieving the maximum production rate at which the affected facility will be operated, but not later than 180 days after initial startup. The Permitting shall follow the tests methods and procedures referenced in Table IIA-1 below:

**Table IIA-1: Initial Performance Tests (continued)**

System	Emission Unit(s)	Pollutants To Be Tested	Testing Methods/Procedures
System 04 (continued)	S2.004 S2.005 S2.006	Opacity	Reference Method 9 in Appendix A of 40 CFR Part 60, concurrent with one of the three required Method 29 performance tests for each operating scenario. The minimum total time of observations must be six minutes (24 consecutive observations recorded at 15-second intervals).
System 05	S2.007	TDS	Sample and analyze the circulating water for total dissolved solids (TDS). Record the TDS value in ppm.
System 06	S2.008	Opacity	Reference Method 9 in Appendix A of 40 CFR Part 60. The minimum total time of observations must be six minutes (24 consecutive observations recorded at 15-second intervals).

2. Tests of performance, as specified in Table IIA-1 above, must be conducted under such conditions as the Director specifies to the operator of the plant based on representative performance of the affected facility. The owner or operator shall make available to the Director such records as may be necessary to determine the conditions of the test of performance. Operations during periods of startup, shutdown and malfunction must not constitute representative conditions of a test of performance unless otherwise specified in the applicable standard (NAC 445B.252.3).
3. Permittee shall provide notification of the anticipated date for conducting the initial performance tests required in Table IIA-1 above. The notification shall be postmarked not less than 30 days prior to such date.
4. Within 60 days after completing the initial performance tests required in Table IIA-1 above, Permittee shall furnish the Director a written report of the results of the performance tests. All information and analytical results of testing and sampling must be certified as to the truth and accuracy and as to their compliance with NAC 445B.001 to 445B.3689, inclusive (NAC 445B.252.8).
5. The Permittee shall comply with the requirements of Sections I.L.3 through I.L.8 for all performance testing.

**\*\*\*End of Specific Construction Requirements\*\*\***



**Bureau of Air Pollution Control**

**Facility ID No. A1917**

**Draft Permit No. AP5051-3711**

**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section III. General Operating Conditions**

**A. Facilities Operation (NAC 445B.227)**

Permittee may not:

1. Operate a stationary source of air pollution unless the control equipment for air pollution which is required by applicable requirements or conditions of this Operating Permit is installed and operating.
2. Disconnect, alter, modify or remove any of the control equipment for air pollution or modify any procedure required by an applicable requirement or condition of this Operating Permit.

**B. Excess Emissions (NAC 445B.232; NAC 445B.346.2)**

1. Scheduled maintenance or testing or scheduled repairs which may result in excess emissions of regulated air pollutants prohibited by NAC 445B.001 to 445B.3689, inclusive, must be approved by the director and performed during a time designated by the director as being favorable for atmospheric ventilation.
2. The director must be notified in writing of the time and expected duration at least 24 hours in advance of any scheduled maintenance which may result in excess emissions of regulated air pollutants prohibited by NAC 445B.001 to 445B.3689, inclusive.
3. The director must be notified in writing or by telephone of the time and expected duration at least 24 hours in advance of any scheduled repairs which may result in excess emissions of regulated air pollutants prohibited by NAC 445B.001 to 445B.3689, inclusive.
4. The director must be notified of any excess emissions within 24 hours after any malfunction or upset of the process equipment or equipment for controlling pollution or during startup or shutdown of such equipment. E-mail to: [eenotify@ndep.nv.gov](mailto:eenotify@ndep.nv.gov).
5. Permittee, as the owner or operator of an affected facility, shall provide the director, within 15 days after any malfunction, upset, startup, shutdown, or human error which results in excess emissions, sufficient information to enable the director to determine the seriousness of the excess emissions. The information must include at least the following:
  - a. The identity of the stack or other point of emission, or both, where the excess emissions occurred.
  - b. The estimated magnitude of the excess emissions expressed in opacity or in units of the applicable limitation on emission and the operating data and methods used in estimating the magnitude of the excess emissions.
  - c. The time and duration of the excess emissions.
  - d. The identity of the equipment causing the excess emissions.
  - e. If the excess emissions were the result of a malfunction, the steps taken to remedy the malfunction and the steps taken or planned to prevent the recurrence of the malfunction.
  - f. The steps taken to limit the excess emissions.
  - g. Documentation that the equipment for controlling air pollution, process equipment, or processes were at all times maintained and operated, to a maximum extent practicable, in a manner consistent with good practice for minimizing emissions.

**C. Permit Revision (NAC 445B.287.1.b)**

A revision of this operating permit is required pursuant to the requirements of NAC 445B.3465 before the stationary source may be modified.

**\*\*\*End of General Operating Conditions\*\*\***



**Bureau of Air Pollution Control**

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**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section IV. General Monitoring and Recordkeeping**

- A. Records Retention (NAC 445B.315.3(b))  
Permittee shall retain records of all required monitoring data and supporting information for 5 years from the date of the sample collection, measurement, report or analysis. Supporting information includes, but is not limited to, all records regarding calibration and maintenance of the monitoring equipment and all original strip-chart recordings for continuous monitoring instrumentation.
- B. Reporting (NAC 445B.346.3)  
Permittee will promptly report to the director any deviations from the requirements of this Operating Permit. The report to the director will include the probable cause of all deviations and any action taken to correct the deviations. For this Operating Permit, prompt is defined as submittal of a report within 15 days of the deviation. This definition does not alter any reporting requirements as established for reporting of excess emissions as required under NAC 445B.232 and under condition III.B of this permit.
- C. Yearly Reports (NAC 445B.315.3(h), NAC 445B.346.2)  
Permittee will submit yearly reports including, but not limited to, throughput, production, fuel consumption, hours of operation, and emissions. These reports will be submitted on the form provided by the Bureau of Air Pollution Control for all emission units/systems specified on the form. The completed form must be submitted to the Bureau of Air Pollution Control no later than March 1 annually for the preceding calendar year.

**\*\*\*\*End of General Monitoring and Recordkeeping Conditions\*\*\*\***



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**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section V. Specific Operating Conditions**

A. **Emission Unit PF1.001** Location North 4,378.32 km, East 285.80 km, UTM (Zone 11, NAD 83)

**System 01 – Battery Draining Unit**

**PF 1.001 Battery Draining Unit (mfd by Battery Recycling Systems, mdl# BD-15)**

1. Air Pollution Control Equipment (NAC 445B.346.1)
  - a. PF1.001 has no add-on controls. Emissions from PF1.001 exhaust inside the building followed by discharge to the atmosphere through the general building ventilation exhaust.
  
2. Operating Parameters (NAC 445B.346.1)
  - a. The maximum allowable throughput rate for PF1.001 shall not exceed 200.0 tons of used lead acid batteries per day, nor more than 73,000.0 tons per year.
  - b. Hours  
PF1.001 may operate a total of 8,760 hours per year.
  
3. Emission Limits (NAC 445B.305; NAC 445B.346.1)
  - a. The Permittee, upon issuance of this operating permit, shall not discharge or cause the discharge into the atmosphere from PF1.001 the following pollutants in excess of the following specified limits:
    - (1) The discharge of H<sub>2</sub>SO<sub>4</sub> Mist (sulfuric acid mist) to the atmosphere shall not exceed 0.00079 ton per year.
    - (2) The opacity from PF1.001 shall not equal or exceed 20 percent in accordance with NAC 445B.22017.
  
4. Monitoring, Testing, Recordkeeping, and Reporting (NAC 445B.346.2)
  - a. Monitoring and Recordkeeping  
The Permittee, upon the issuance date of this operating permit, shall:
    - (1) Monitor the throughput in tons for PF1.001 on a daily basis.
    - (2) Monitor the hours of operation for PF1.001 on a daily basis.
    - (3) The required monitoring established in (1) and (2) of this section, shall be maintained in a contemporaneous log containing, at a minimum, the following recordkeeping:
      - (a) The calendar date of any required monitoring.
      - (b) The total daily throughput in tons for the corresponding date.
      - (c) The total daily hours of operation for the corresponding date.
      - (d) The corresponding monthly throughput rate in tons per month, and the corresponding annual throughput rate in tons per year. The monthly throughput rate shall be determined at the end of each month as the sum of each total daily throughput for each day of the month. The annual throughput rate will be determined at the end of each month as the sum of the monthly throughput for each month of the year.



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**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section V. Specific Operating Conditions (continued)**

B. **Emission Unit S2.001** Location North 4,378.35 km, East 285.78 km, UTM (Zone 11, NAD 83)

**System 02 – Battery Breaking Unit**

**S 2.001 Battery Breaking Unit (mfd by Battery Recycling Systems, mdl# BC-15)**

1. Air Pollution Control Equipment (NAC 445B.346.1)
  - a. Emissions from S2.001 shall be collected in an enclosure, captured under negative pressure, and ducted to a **Wet Scrubber** with a maximum volume flow rate of 500 actual cubic feet per minute (acfm). The exhaust from the **Wet Scrubber** will be vented inside the building, followed by discharge to the atmosphere through the general building ventilation exhaust. The **Wet Scrubber** will be manufactured by **Tir-Mer Corporation** that is designed for capturing sulfuric acid mist with 98% removal efficiency.
  - b. Descriptive Stack Parameters for Wet Scrubber  
Height: exhausts into facility building  
Diameter: 0.92 feet  
Temperature: indoor ambient
2. Operating Parameters (NAC 445B.346.1)
  - a. The maximum allowable throughput rate for S2.001 shall not exceed **200.0 tons of used lead acid batteries per day**, nor more than **73,000.0 tons per calendar year**.
  - b. The enclosure shall be free of significant cracks, gaps, corrosion or other deterioration that could cause lead bearing material to be released from the primary barrier. Measures shall be in place to prevent the tracking of lead bearing material out of the unit by personnel or by equipment used in handling the material. An area shall be designated to decontaminate equipment and any rinsate must be collected and properly managed.
  - c. The Permittee shall ventilate the enclosure continuously to ensure negative pressure values of at least **0.013 mm of mercury** (0.007 inches of water); and maintain an inward flow of air through all natural draft openings.
  - d. The Permittee shall operate and maintain any affected source, including associated air pollution control equipment and monitoring equipment, in a manner consistent with safety and good air pollution control practices for minimizing emissions.
  - e. Hours  
S2.001 may operate a total of **8,760 hours per year**.
3. Emission Limits (NAC 445B.305; NAC 445B.346.1)
  - a. The Permittee, upon issuance of this operating permit, shall not discharge or cause the discharge into the atmosphere from S2.001 the following pollutants in excess of the following specified limits:
    - (1) The discharge of H<sub>2</sub>SO<sub>4</sub> Mist (sulfuric acid mist) to the atmosphere shall not exceed **0.00041 ton per year**.
    - (2) The opacity from S2.001 shall not equal or exceed **20 percent** in accordance with NAC 445B.22017.
4. Monitoring, Testing, Recordkeeping, and Reporting (NAC 445B.346.2)
  - a. Monitoring and Recordkeeping  
The Permittee, upon the issuance date of this operating permit, shall:
    - (1) Monitor the throughput in tons for S2.001 on a daily basis.
    - (2) Monitor the hours of operation for S2.001 on a daily basis.
    - (3) Install, calibrate, operate, and maintain a differential pressure monitoring system to continuously monitor the enclosure.
    - (4) Inspect the enclosure and facility structures that contain any lead-bearing materials at least once per month; and repair any gaps, breaks, separations, leak points or other possible routes for emissions of lead to the atmosphere within one week of identification.
    - (5) Follow the manufacture recommended operating and monitoring procedures for the **Wet Scrubber**.
    - (6) Monitor the pressure drop and water flow rate values for the **Wet Scrubber** at least once every hour.



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**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section V. Specific Operating Conditions (continued)**

**A. Emission Unit S2.001 (continued)**

**4. Monitoring, Testing, Recordkeeping, and Reporting (NAC 445B.346.2) (continued)**

**a. Monitoring and Recordkeeping**

The Permittee, upon the issuance date of this operating permit, shall:

- (7) The required monitoring established in (1) through (6) of this section, shall be maintained in a contemporaneous log containing, at a minimum, the following recordkeeping:
  - (a) The calendar date of any required monitoring.
  - (b) The total daily throughput in tons for the corresponding date.
  - (c) The total daily hours of operation for the corresponding date.
  - (d) The corresponding monthly throughput rate in tons per month, and the corresponding annual throughput rate in tons per year. The monthly throughput rate shall be determined at the end of each month as the sum of each total daily throughput for each day of the month. The annual throughput rate will be determined at the end of each month as the sum of the monthly throughput for each month of the year.
  - (e) The continuous differential pressure of the enclosure.
  - (f) The results of the monthly inspection of the enclosures and facility structures; and any corrective actions taken.
  - (g) The records of the manufacture recommended operating and monitoring procedures for the **Wet Scrubber**.
  - (h) The hourly pressure drop and water flow rate values for the **Wet Scrubber**.



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**Section V. Specific Operating Conditions (continued)**

C. Emission Unit S2.002 Location North 4,378.36 km, East 285.81 km, UTM (Zone 11, NAD 83)  
Emission Unit S2.003 Location North 4,378.39 km, East 285.71 km, UTM (Zone 11, NAD 83)

**System 03 – Bulk Material Conveyance**

S	2.002	Sodium Carbonate Bulk Material Conveyance
S	2.003	Calcium Hydroxide Bulk Material Conveyance

1. Air Pollution Control Equipment (NAC 445B.346.1)
  - a. Emissions from S2.002 and S2.003, each, shall be ducted to a control system consisting of a **Particulate Filter** with a maximum flow rate of 290 actual standard cubic feet per minute (acfm). Exhaust from each **Particulate Filter** discharges inside the building.
2. Operating Parameters (NAC 445B.346.1)
  - a. The maximum allowable throughput rate for S2.002 shall not exceed **1.5 tons of sodium carbonate per any one-hour period**, nor more than **13,140.0 tons per year**.
  - b. The maximum allowable throughput rate for S2.003 shall not exceed **1.5 tons of calcium hydroxide per any one-hour period**, nor more than **13,140.0 tons per year**.
  - c. Hours  
S2.002 and S2.003, each, may operate a total of **8,760 hours per year**.
3. Emission Limits (NAC 445B.305; NAC 445B.346.1)
  - a. The Permittee, upon issuance of this operating permit, shall not discharge or cause the discharge into the atmosphere from S2.002 and S2.003, each, the following pollutants in excess of the following specified limits:
    - (1) The discharge of PM (particulate matter) to the atmosphere shall not exceed **0.012 pound per hour**, nor more than **0.054 ton per year**.
    - (2) The discharge of PM<sub>10</sub> (particulate matter less than 10 microns in diameter) to the atmosphere shall not exceed **0.012 pound per hour**, nor more than **0.054 ton per year**.
    - (3) The discharge of PM<sub>2.5</sub> (particulate matter less than 2.5 microns in diameter) to the atmosphere shall not exceed **0.012 pound per hour**, nor more than **0.054 ton per year**.
    - (4) The opacity from S2.002 and S2.003, each, shall not equal or exceed **20 percent** in accordance with NAC 445B.22017.
4. Monitoring, Testing, Recordkeeping, and Reporting (NAC 445B.346.2)
  - a. Monitoring and Recordkeeping  
The Permittee, upon the issuance date of this operating permit, shall:
    - (1) Monitor the throughput in tons for S2.002 and S2.003, each, on a daily basis.
    - (2) Monitor the hours of operation for S2.002 and S2.003, each, on a daily basis.
    - (3) The required monitoring established in (1) and (2) of this section, shall be maintained in a contemporaneous log containing, at a minimum, the following recordkeeping:
      - (a) The calendar date of any required monitoring.
      - (b) The total daily throughput in tons for the corresponding date.
      - (c) The total daily hours of operation for the corresponding date.
      - (d) The corresponding average throughput rate in tons per hour. The average throughput rate shall be determined from the total daily throughput and total daily hours of operation recorded in (b) and (c) above.
      - (e) The corresponding monthly throughput rate in tons per month, and the corresponding annual throughput rate in tons per year. The monthly throughput rate shall be determined at the end of each month as the sum of each total daily throughput for each day of the month. The annual throughput rate will be determined at the end of each month as the sum of the monthly throughput for each month of the year.



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**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section V. Specific Operating Conditions (continued)**

D. **Emission Units S2.004, S2.005, and S2.006** Location North 4,378.32 km, East 285.75 km, UTM (Zone 11, NAD 83)

**System 04 – Lead Ingotting Kettles and Casting**

S	2.004	Ingotting Kettle #1
S	2.005	Ingotting Kettle #2
S	2.006	Ingot Casting Unit

1. Air Pollution Control Equipment (NAC 445B.346.1)

- a. Emissions from S2.004, S2.005, and S2.006, each, shall be collected in an enclosure, captured under negative pressure, and ducted to a common control system with a maximum volume flow rate of 41,000 dry standard cubic feet per minute (dscfm) and vented to the atmosphere through a single stack. The common control system shall consist of a **Wirtz Manufacturing Baghouse** with a 90% control manufacture guarantee followed in series by an **American Air Filter HEPA Filter** with a 99.97% control manufacturer guarantee.
- b. Descriptive Stack Parameters for Single Stack  
Height: 70.5 feet  
Diameter: 5.3 feet  
Temperature: 100 to 140 °F

2. Operating Parameters (NAC 445B.346.1)

- a. The maximum allowable throughput rate for S2.004 and S2.005, each, shall not exceed **10.0 tons of recycled lead per any one-hour period**, nor more than **43,800.0 tons per year**.
- b. The maximum allowable throughput rate for S2.006 shall not exceed **20.0 tons of recycled lead per any one-hour period**, nor more than **87,600.0 tons per year**.
- c. The maximum allowable temperature of S2.004 and S2.005, each, shall not exceed **1,050 °F**.
- d. The enclosure shall be free of significant cracks, gaps, corrosion or other deterioration that could cause lead bearing material to be released from the primary barrier. Measures shall be in place to prevent the tracking of lead bearing material out of the unit by personnel or by equipment used in handling the material. An area shall be designated to decontaminate equipment and any rinsate must be collected and properly managed.
- e. The Permittee shall ventilate the enclosure continuously to ensure negative pressure values of at least **0.013 mm of mercury (0.007 inches of water)**; and maintain an inward flow of air through all natural draft openings.
- f. The Permittee shall operate and maintain any affected source, including associated air pollution control equipment and monitoring equipment, in a manner consistent with safety and good air pollution control practices for minimizing emissions.
- g. Hours  
S2.004, S2.005, and S2.006, each, shall not operate in excess of **12.0 hours per day**, nor more than **4,380 hours per year**.

3. Emission Limits (NAC 445B.305; NAC 445B.346.1)

- a. The Permittee, upon issuance of this operating permit, shall not discharge or cause the discharge into the atmosphere from S2.004 and S2.005, each, the following pollutants in excess of the following specified limits:
  - (1) The discharge of PM (particulate matter) to the atmosphere shall not exceed **0.00009 pound per hour**.
  - (2) The discharge of PM<sub>10</sub> (particulate matter less than 10 microns in diameter) to the atmosphere shall not exceed **0.00009 pound per hour**.
  - (3) The discharge of PM<sub>2.5</sub> (particulate matter less than 2.5 microns in diameter) to the atmosphere shall not exceed **0.00009 pound per hour**.
  - (4) The discharge of lead (Pb) to the atmosphere shall not exceed **0.00003 pound per hour**.



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Issued to: AQUA METALS, INC.

**Section V. Specific Operating Conditions (continued)**

**D. Emission Units S2.004, S2.005, and S2.006 (continued)**

3. Emission Limits (NAC 445B.305; NAC 445B.346.1) (continued)

- b. The Permittee, upon issuance of this operating permit, shall not discharge or cause the discharge into the atmosphere from S2.006 the following pollutants in excess of the following specified limits:
- (1) The discharge of PM (particulate matter) to the atmosphere shall not exceed **0.00024 pound per hour**.
  - (2) The discharge of PM<sub>10</sub> (particulate matter less than 10 microns in diameter) to the atmosphere shall not exceed **0.00024 pound per hour**.
  - (3) The discharge of PM<sub>2.5</sub> (particulate matter less than 2.5 microns in diameter) to the atmosphere shall not exceed **0.00024 pound per hour**.
  - (4) The discharge of lead (Pb) to the atmosphere shall not exceed **0.00006 pound per hour**.
- c. The Permittee, upon issuance of this operating permit, shall not discharge or cause the discharge into the atmosphere from S2.004, S2.005, and S2.006, combined, the following pollutants in excess of the following specified limits:
- (1) The discharge of PM (particulate matter) to the atmosphere shall not exceed **0.00092 ton per year**.
  - (2) The discharge of PM<sub>10</sub> (particulate matter less than 10 microns in diameter) to the atmosphere shall not exceed **0.00092 ton per year**.
  - (3) The discharge of PM<sub>2.5</sub> (particulate matter less than 2.5 microns in diameter) to the atmosphere shall not exceed **0.00092 ton per year**.
  - (4) The discharge of lead (Pb) to the atmosphere shall not exceed **0.00026 ton per year**.
  - (5) The opacity from the single stack for S2.004, S2.005, and S2.006, shall not equal or exceed **20 percent** in accordance with NAC 445B.22017.

4. Monitoring, Testing, Recordkeeping, and Reporting (NAC 445B.346.2)

a. Monitoring and Recordkeeping

The Permittee, upon the issuance date of this operating permit, shall:

- (1) Monitor the throughput in tons for S2.004, S2.005, and S2.006, each, on a daily basis.
- (2) Monitor the hours of operation for S2.004, S2.005, and S2.006, each, on a daily basis.
- (3) Install, calibrate, operate, and maintain a differential pressure monitoring system to continuously monitor the enclosure.
- (4) Inspect the enclosure and facility structures that contain any lead-bearing materials at least once per month; and repair any gaps, breaks, separations, leak points or other possible routes for emissions of lead to the atmosphere within one week of identification.
- (5) Follow the manufacture recommended operating and monitoring procedures for the **Baghouse**; including:
  - (a) Daily monitoring of pressure drop across each baghouse cell.
  - (b) Weekly confirmation that dust is being removed from hoppers through visual inspection, or equivalent means of ensuring the proper functioning of removal mechanisms.
  - (c) Daily check of compressed air supply for pulse-jet baghouses.
  - (d) An appropriate methodology for monitoring cleaning cycles to ensure proper operation.
  - (e) Monthly check of bag cleaning mechanisms for proper functioning through visual inspection or equivalent means.
  - (f) Monthly check of bag tension on reverse air and shaker-type baghouses. Such checks are not required for shaker-type baghouses using self-tensioning (spring loaded) devices.
  - (g) Quarterly confirmation of the physical integrity of the baghouse through visual inspection of the baghouse interior for air leaks.
  - (h) Quarterly inspection of fans for wear, material buildup, and corrosion through visual inspection, vibration detectors, or equivalent means.



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**Section V. Specific Operating Conditions (continued)**

**D. Emission Units S2.004, S2.005, and S2.006 (continued)**

**4. Monitoring, Testing, Recordkeeping, and Reporting (NAC 445B.346.2) (continued)**

**a. Monitoring and Recordkeeping**

The Permittee, upon the issuance date of this operating permit, shall:

- (6) Monitor and record the pressure drop across each **HEPA Filter** system daily. If the pressure drop is outside the limit(s) specified by the filter manufacturer, take appropriate corrective measures:
  - (a) Inspecting the filter and filter housing for air leaks and torn or broken filters.
  - (b) Replacing defective filter media, or otherwise repairing the control device.
  - (c) Sealing off a defective control device by routing air to other control devices
  - (d) Shutting down the process producing the particulate emissions.
- (7) Install, calibrate, operate, and maintain a continuous temperature monitoring device for **S2.004** and **S2.005**, each.
  - (a) The continuous temperature monitoring device for **S2.004** and **S2.005**, each, will automatically alert the operator if the normal operating temperature parameters are exceeded. The alert should include an alarm that requires the operator to respond. The operator shall investigate the alarm within 1 hour from the time that the alarm notice began and record the alarm event within 24 hours.
- (8) Conduct and record an observation of visible emissions (excluding water vapor) on the exhaust stack of the **HEPA Filter** on a monthly basis while operating. The observer shall stand at a distance sufficient to provide a clear view of the emissions with the sun oriented to their back. If visible emissions are observed, the Permittee shall conduct and record a Method 9 visible emission test. Each Method 9 visible emission test must be conducted by a certified visible emissions reader in accordance with 40 CFR Part 60, Appendix A.
- (9) The required monitoring established in (1) through (8) of this section, shall be maintained in a contemporaneous log containing, at a minimum, the following recordkeeping:
  - (a) The calendar date of any required monitoring.
  - (b) The total daily throughput in tons for the corresponding date.
  - (c) The total daily hours of operation for the corresponding date.
  - (d) The corresponding average throughput rate in tons per hour. The average throughput rate shall be determined from the total daily throughput and total daily hours of operation recorded in (b) and (c) above.
  - (e) The corresponding monthly throughput rate in tons per month, and the corresponding annual throughput rate in tons per year. The monthly throughput rate shall be determined at the end of each month as the sum of each total daily throughput for each day of the month. The annual throughput rate will be determined at the end of each month as the sum of the monthly throughput for each month of the year.
  - (f) The corresponding monthly hours of operation, and the corresponding annual hours of operation per year. The monthly hours of operation shall be determined at the end of each month as the sum of each total daily hours of operation for each day of the month. The annual hours of operation will be determined at the end of each month as the sum of the monthly hours of operation for each month of the year.
  - (g) The continuous differential pressure of the enclosure.
  - (h) The results of the monthly inspection of the enclosures and facility structures; and any corrective actions taken.
  - (i) The records of the manufacture recommended operating and monitoring procedures for the **Baghouse**.
  - (j) The daily pressure drop for the **HEPA Filter**; and any corrective actions taken.
  - (k) The continuous temperature monitoring for **S2.004** and **S2.005**, each. Record any alarm event and include the corresponding alert message, cause of the alarm, date, time and course of remediation.
  - (l) Results of the monthly observation of visible emissions on the exhaust stack of the **HEPA Filter**



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**Section V. Specific Operating Conditions (continued)**

**D. Emission Units S2.004, S2.005, and S2.006 (continued)**

**4. Monitoring, Testing, Recordkeeping, and Reporting (NAC 445B.346.2) (continued)**

**b. Periodic Compliance Testing (NAC 445B.252.1)**

- (1) The Permittee shall conduct and record the following periodic compliance tests on the single stack for S2.004, S2.005, and S2.006. The periodic compliance tests will be conducted on an annual basis with no more than one year and 90 days between compliance tests. The first round of periodic compliance tests will be conducted within 90 days of the one-year anniversary of the completion of the initial compliance testing required under Section IIA, Table IIA-1, of this operating permit. The periodic compliance tests will be conducted for two operating scenarios. Operating scenario one will involve "hard" lead processing with emission units S2.004 (or S2.005) and S2.006 in operation. Operating scenario two will involve "soft" lead processing with emission units S2.004 (or S2.005) and S2.006 in operation. The periodic compliance tests shall consist of three valid runs based on representative performance at the affected facility.
  - (a) A Method 29 test in Appendix A of 40 CFR Part 60 shall be used to determine the lead concentration. The minimum sample volume must be 2.0 dscm (70 dscf) for each run.
  - (b) Testing on the single stack for S2.004, S2.005, and S2.006, will include emissions from S2.004, S2.005, S2.006, and the associated Natural Gas Burners for the Kettles. Alternatively, the Permittee may elect to test prior to the burner exhaust connection to the single stack for S2.004, S2.005, and S2.006, and consider only emissions from S2.004, S2.005, and S2.006.
- (2) Conduct and record a Method 9 visible emissions reading on the single stack for S2.004, S2.005, and S2.006, concurrent with one of the three required Method 29 performance tests for each operating scenario. Visible emissions reading shall use the procedures contained in 40 CFR Part 60, Appendix A, Method 9. The visible emissions reading must be conducted by a certified visible emissions reader for a period of 6-minutes. The opacity readings must be averaged such that compliance with a 6-minute average is determined.
- (3) The Permittee shall comply with the requirements of Sections I.L.3 through I.L.9 of this operating permit for all performance testing.
- (4) The Permittee will monitor and record the throughput in tons for S2.004, S2.005, and S2.006, each, during each test run.

**c. End-of-Permit Compliance Testing (NAC 445B.252.1)**

- (1) The Permittee will conduct and record the following compliance tests on the single stack for S2.004, S2.005, and S2.006. The compliance tests will be conducted at least 90 days prior to the date of expiration of this operating permit, but no earlier than 365 days from the date of expiration of this operating permit. The compliance tests will be conducted for two operating scenarios. Operating scenario one will involve "hard" lead processing with emission units S2.004 (or S2.005) and S2.006 in operation. Operating scenario two will involve "soft" lead processing with emission units S2.004 (or S2.005) and S2.006 in operation.
  - (a) A Method 5 test in Appendix A of 40 CFR Part 60 and a Method 202 test in Appendix M of 40 CFR Part 51; shall be used to determine total particulate matter (PM) emissions. The sample volume for each test run shall be at least 1.7 dscm (60 dscf). Test runs must be conducted for up to two hours in an effort to collect this minimum sample.
  - (b) A Method 201A and Method 202 tests in Appendix M of 40 CFR Part 51 shall be used to determine PM<sub>10</sub> and PM<sub>2.5</sub> emissions. The sample time and sample volume collected for each test run shall be sufficient to collect enough mass to weigh accurately.
  - (c) The Method 201A and 202 test required in this section may be replaced by a Method 5 in Appendix A of 40 CFR Part 60 and Method 202 in Appendix M of 40 CFR Part 51 test. All particulate captured in the Method 5 and Method 202 test performed under this provision shall be considered PM<sub>2.5</sub> for determination of compliance.
  - (d) A Method 25A test in Appendix A of 40 CFR Part 60 shall be used to determine the volatile organic compound concentration. A Method 18 test in Appendix A of 40 CFR Part 60 or a Method 320 test in Appendix A of CFR Part 63 may be used in conjunction with the Method 25A test to break out the organic compounds that are not considered volatile organic compounds by definition per 40 CFR 51.100(s). Each Method 25A test will be run for a minimum of 1-hour.



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**Section V. Specific Operating Conditions (continued)**

**D. Emission Units S2.004, S2.005, and S2.006 (continued)**

4. Monitoring, Testing, Recordkeeping, and Reporting (NAC 445B.346.2) (continued)

c. End-of-Permit Compliance Testing (NAC 445B.252.1) (continued)

- (1) The Permittee will conduct and record the following compliance tests on the **single stack for S2.004, S2.005, and S2.006**. The compliance tests will be conducted at least 90 days prior to the date of expiration of this operating permit, but no earlier than 365 days from the date of expiration of this operating permit. The compliance tests will be conducted for two operating scenarios. Operating scenario one will involve "hard" lead processing with emission units **S2.004 (or S2.005) and S2.006** in operation. Operating scenario two will involve "soft" lead processing with emission units **S2.004 (or S2.005) and S2.006** in operation.
- (e) A Method 29 test in Appendix A of 40 CFR Part 60 shall be used to determine the antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, and selenium concentrations. The minimum sample volume must be 2.0 dscm (70 dscf) for each run.
- (f) Testing on the **single stack for S2.004, S2.005, and S2.006**, will include emissions from **S2.004, S2.005, S2.006**, and the associated Natural Gas Burners for the Kettles. Alternatively, the Permittee may elect to test prior to the burner exhaust connection to the **single stack for S2.004, S2.005, and S2.006**, and consider only emissions from **S2.004, S2.005, and S2.006**.
- (2) Conduct and record a Method 9 visible emissions reading on the **single stack for S2.004, S2.005, and S2.006**, concurrent with one of the three required Method 5 performance tests for each operating scenario. Visible emissions reading shall use the procedures contained in 40 CFR Part 60, Appendix A, Method 9. The visible emissions reading must be conducted by a certified visible emissions reader for a period of 6-minutes. The opacity readings must be averaged such that compliance with a 6-minute average is determined.
- (3) The Permittee shall comply with the requirements of Sections I.L.3 through I.L.9 of this operating permit for all performance testing.
- (4) The Permittee will monitor and record the throughput in tons for **S2.004, S2.005, and S2.006**, each, during each test run.



**Bureau of Air Pollution Control**

**Facility ID No. A1917**

**Draft Permit No. AP5051-3711**

**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section V. Specific Operating Conditions (continued)**

E. **Emission Unit S2.007** Location North 4,378.36 km, East 285.72 km, UTM (Zone 11, NAD 83)

**System 05 – Cooling Tower for Ingot Casting**

**S 2.007 Cooling Tower**

1. Air Pollution Control Equipment (NAC 445B.346.1)
  - a. Emissions from S2.007 shall be controlled by **Drift Eliminators**.
  - b. Descriptive Parameters for Cooling Tower  
Height: 9 ft  
Diameter: 4 ft  
Temperature: slightly above ambient
  
2. Operating Parameters (NAC 445B.346.1)
  - a. The maximum circulating water flow rate for S2.007 shall not exceed **3,000.0 gallons per hour**.
  - b. The maximum total dissolved solids (TDS) content for S2.007 will not exceed **15,000.0 ppm**.
  - c. The use of chromium-based water treatment chemicals is prohibited.
  - d. Hours  
S2.007 may operate a total of **8,760 hours per year**.
  
3. Emission Limits (NAC 445B.305; NAC 445B.346.1)
  - a. The Permittee, upon issuance of this operating permit, shall not discharge or cause the discharge into the atmosphere from S2.007 the following pollutants in excess of the following specified limits:
    - (1) The discharge of PM (particulate matter) to the atmosphere shall not exceed **0.075 pound per hour**, nor more than **0.33 ton per year**.
    - (2) The discharge of PM<sub>10</sub> (particulate matter less than 10 microns in diameter) to the atmosphere shall not exceed **0.075 pound per hour**, nor more than **0.33 ton per year**.
    - (3) The discharge of PM<sub>2.5</sub> (particulate matter less than 2.5 microns in diameter) to the atmosphere shall not exceed **0.075 pound per hour**, nor more than **0.33 ton per year**.
    - (4) The opacity from the cooling tower stack discharge of S2.004 shall not equal or exceed **20 percent** in accordance with NAC 445B.22017.
  
4. Monitoring, Testing, Recordkeeping, and Reporting (NAC 445B.346.2)
  - a. Monitoring and Recordkeeping  
The Permittee, upon the issuance date of this operating permit, shall:
    - (1) Monitor the circulating water flow in gallons for S2.007 on a daily basis.
    - (2) Monitor the hours of operation for S2.007 on a daily basis.
    - (3) The required monitoring established in (1) and (2) of this section, shall be maintained in a contemporaneous log containing, at a minimum, the following recordkeeping:
      - (a) The calendar date of any required monitoring.
      - (b) The total daily circulating water flow in gallons for the corresponding date.
      - (c) The total daily hours of operation for the corresponding date.
      - (d) The corresponding average circulating water flow rate in gallons per hour. The average circulating water flow rate shall be determined from the total daily flow and total daily hours of operation recorded in (b) and (c) above.
  - b. Performance/Compliance Testing (NAC 445B.252.1)  
The Permittee, upon the issuance date of this operating permit, shall:
    - (1) Sample and analyze the circulating water for total dissolved solids (TDS) at six-month intervals, beginning with the initial TDS analysis conducted in **Section IIA, Table IIA-1**, of this operating permit. Record the TDS value in ppm in a contemporaneous log for each six-month testing interval.



Bureau of Air Pollution Control

Facility ID No. A1917

Draft Permit No. AP5051-3711

CLASS II AIR QUALITY OPERATING PERMIT

Issued to: AQUA METALS, INC.

Section V. Specific Operating Conditions (continued)

F. Emission Unit S2.008 Location North 4,378.42 km, East 285.80 km, UTM (Zone 11, NAD 83)

System 06 – 200 HP Emergency Diesel Generator

S 2.008 200 HP Emergency Diesel Generator

1. Air Pollution Control Equipment (NAC 445B.346.1)
  - a. S2.008 has no add-on controls.
  - b. Descriptive Stack Parameters for Generator  
Height: 5 to 10 feet  
Diameter: to be determined  
Temperature: to be determined
2. Operating Parameters (NAC 445B.346.1)
  - a. The maximum allowable fuel consumption for S2.008 shall not exceed 3.6 gallons of ultra-low sulfur (15 ppm S) #2 diesel fuel oil per any one-hour period.
  - b. Hours  
S2.008 may operate 24 hours per day, but no more than 100 hours per year for testing and maintenance operations. There is no time limit for operation of S2.008 during emergency situations.
3. Emission Limits (NAC 445B.305; NAC 445B.346.1)
  - a. The Permittee, upon issuance of this operating permit, shall not discharge or cause the discharge into the atmosphere from S2.008 the following pollutants in excess of the following specified limits:
    - (1) The discharge of PM (particulate matter) to the atmosphere will not exceed 0.44 pound per hour, nor more than 0.022 ton per year.
    - (2) The discharge of PM<sub>10</sub> (particulate matter less than 10 microns in diameter) to the atmosphere shall not exceed 0.44 pound per hour, nor more than 0.022 ton per year.
    - (3) The discharge of PM<sub>2.5</sub> (particulate matter less than 2.5 microns in diameter) to the atmosphere shall not exceed 0.44 pound per hour, nor more than 0.022 ton per year.
    - (4) The discharge of SO<sub>2</sub> (sulfur dioxide) to the atmosphere shall not exceed 0.41 pound per hour, nor more than 0.021 ton per year.
    - (5) The discharge of NO<sub>x</sub> (nitrogen oxides) to the atmosphere shall not exceed 6.20 pounds per hour, nor more than 0.31 ton per year.
    - (6) The discharge of CO (carbon monoxide) to the atmosphere shall not exceed 1.34 pounds per hour, nor more than 0.067 ton per year.
    - (7) The discharge of VOC (volatile organic compounds) to the atmosphere shall not exceed 0.50 pound per hour, nor more than 0.025 ton per year.
    - (8) The opacity from S2.008 shall not equal or exceed 20 percent in accordance with NAC 445B.22017.
4. Monitoring, Testing, Recordkeeping, and Reporting (NAC 445B.346.2)
  - a. Monitoring and Recordkeeping  
The Permittee, upon the issuance date of this operating permit, shall:
    - (1) Monitor the hours of operation for testing and maintenance use for S2.008 on a monthly basis.
    - (2) Monitor the hours of operation for emergency use for S2.008 on a monthly basis.
    - (3) The required monitoring established in (1) and (2) of this section, shall be maintained in a contemporaneous log containing, at a minimum, the following recordkeeping:
      - (a) The calendar date of any required monitoring.
      - (b) The total monthly hours of operation for testing and maintenance use for the corresponding date.
      - (c) The corresponding annual hours of operation for testing and maintenance use per year. The annual hours of operation for testing and maintenance use shall be determined at the end of each month as the sum of the monthly hours of operation for testing and maintenance use for each month of the year.
      - (d) The corresponding monthly fuel consumption. The monthly fuel consumption shall be determined by multiplying the maximum allowable fuel consumption as listed in this section by the total monthly hours of operation.



**Bureau of Air Pollution Control**

**Facility ID No. A1917**

**Draft Permit No. AP5051-3711**

**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section V. Specific Operating Conditions (continued)**

**F. Emission Unit 2.008 (continued)**

**5. 40 CFR Part 60 Subpart IIII – NSPS for Emergency Stationary Diesel Internal Combustion Engines**

The Permittee must comply with the following applicable requirements for S2.008 (a stationary compression ignition internal combustion engine at an area source of HAP emissions, manufactured after April 1, 2006) (40 CFR 60.4200 et. seq.):

**a. Operating Limitations – 40 CFR 60.4205**

- (1) The Permittee must comply with the emission standards for new CI engines in 40 CFR Part 60 Subpart IIII (40 CFR Part 60.4205(b); 40 CFR Part 60.4202(a)(2); 40 CFR Part 89.112).

**b. Demonstration of Continuous Compliance with Operating Limitations – 40 CFR 60.4206:**

- (1) The Permittee must operate and maintain the stationary CI ICE to achieve the emission standards as required in 40 CFR Part 60.4205 over the entire life of the engine.

**c. Fuel Requirements – 40 CFR 60.4207:**

- (1) The Permittee must use diesel fuel that meets the requirements of 40 CFR 80.510(b) for non-road diesel fuel:
- (a) Sulfur content – 15 ppm (0.0015 wt%) maximum for nonroad diesel fuel.
  - (b) Cetane index or aromatic content – minimum cetane index of 40 or maximum aromatic content of 35 volume percent.

**d. Monitoring, Installation, Collection, Operation, and Maintenance Requirements – 40 CFR 60.4209(a):**

- (1) The Permittee must install a non-resettable hour meter if one is not already installed.

**e. Compliance Requirements – 40 CFR 60.4211:**

- (1) The Permittee must comply with the emission standards specified in 40 CFR Part 60, Subpart IIII. The Permittee must operate and maintain the stationary CI internal combustion engine and control device according to the manufacturer's written instructions or procedures developed by the owner or operator that are approved by the engine manufacturer. In addition, owners and operators may only change those settings that are permitted by the manufacturer (40 CFR 60.4211(a)).
- (2) The Permittee must comply with the emission standards specified in 40 CFR 60.4205(b). The Permittee must comply by purchasing an engine certified to the emission standards in 40 CFR 60.4205(b), as applicable, for the same model year and maximum engine power. The engine must be installed and configured according to the manufacturer's specifications (40 CFR 60.4211(c)).
- (3) Emergency stationary ICE may be operated for the purpose of maintenance checks and readiness testing, provided that the tests are recommended by Federal, State or local government, the manufacturer, the vendor, or the insurance company associated with the engine. Maintenance checks and readiness testing of such units is limited to 100 hours per year. There is no time limit on the use of emergency stationary ICE in emergency situations. The Permittee may petition the Administrator for approval of additional hours to be used for maintenance checks and readiness testing, but a petition is not required if the Permittee maintains records indicating that Federal, State, or local standards require maintenance and testing of emergency ICE beyond 100 hours per year. Emergency stationary ICE may operate up to 50 hours per year in non-emergency situations, but those 50 hours are counted towards the 100 hours per year provided for maintenance and testing. The 50 hours per year for non-emergency situations cannot be used for peak shaving or to generate income for a facility to supply power to an electric grid or otherwise supply non-emergency power as part of a financial arrangement with another entity. Any operation other than emergency operation, maintenance and testing, and operation in non-emergency situations for 50 hours per year, as permitted in this section, is prohibited (40 CFR 60.4211(f)).

**f. Notification, Reporting, and Recordkeeping Requirements – 40 CFR 60.4214:**

If the stationary CI internal combustion engine is an emergency stationary internal combustion engine, the Permittee is not required to submit an initial notification. Starting with the model years in Table 5 to 40 CFR Part 60, Subpart IIII, if the emergency engine does not meet the standards applicable to non-emergency engines in the applicable model year, the Permittee must keep records of the operation of the engine in emergency and non-emergency service that are recorded through the non-resettable hour meter. The Permittee must record the time of operation of the engine and the reason the engine was in operation during that time (40 CFR 60.4214(b)).

**6. 40 CFR Part 63.6590 – Subpart ZZZZ, NESHAP for Stationary Reciprocating Internal Combustion Engines (RICE)(40 CFR Part 63.6590 (c))**

An affected source that is a new or reconstructed stationary RICE located at an area source, must meet the requirements of this part by meeting the requirements of 40 CFR part 60 subpart IIII, for compression ignition engines. No further requirements apply for such engines under this part.



**Bureau of Air Pollution Control**

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**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section V. Specific Operating Conditions (continued)**

**\*\*\*\*End of Specific Operating Conditions\*\*\*\***



**Bureau of Air Pollution Control**

**Facility ID No. A1917**

**Draft Permit No. AP5051-3711**

**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section VI. Emission Caps**

A. Not Applicable.

**\*\*\*\*End of Emission Caps\*\*\*\***



**Bureau of Air Pollution Control**

**Facility ID No. A1917**

**Draft Permit No. AP5051-3711**

**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section VII. Fugitive Dust and Surface Area Disturbance Conditions**

**A. Emission of Hazardous Air Pollutant: Fugitive Dust (NAC 445B.22037)**

The Permittee shall prepare a standard operating procedure that describes in detail the measures that will be put in place and implemented to control the fugitive dust emissions as follows:

1. Cleaning. Where a cleaning practice is specified, you shall clean by wet wash or a vacuum equipped with a filter rated by the manufacturer to achieve 99.97 percent capture efficiency for 0.3 micron particles in a manner that does not generate fugitive lead dust.
2. Accidental releases. The Permittee shall initiate cleaning of all affected areas within one hour after detection of any accidental release of lead dust that exceeds 10 pounds (the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) reportable quantity for lead at 40 CFR 302.4).
3. Battery storage areas. The Permittee shall inspect any batteries that are not stored in a total enclosure once each week and move any broken batteries to an enclosure within 72 hours of identification. The Permittee shall clean residue from broken batteries within 72 hours of identification. Batteries shall not be stored outside of the building.
4. Materials storage and handling areas. The Permittee shall wash each vehicle at each exit of the material storage and handling areas. The vehicle wash must include washing of tires, undercarriage and exterior surface of the vehicle followed by vehicle inspection.
5. Equipment maintenance. The Permittee shall perform all maintenance activities that could generate lead dust in a manner that minimizes emissions of fugitive dust. This must include one or more of the following:
  - (a) Performing maintenance inside a total permanent enclosure maintained at negative pressure.
  - (b) Performing maintenance inside a temporary enclosure and use a vacuum system either equipped with a filter rated by the manufacturer to achieve a capture efficiency of 99.97 percent for 0.3 micron particles or routed to an existing control device permitted for this activity.
  - (c) Performing maintenance inside a partial enclosure and use of wet suppression sufficient to prevent dust formation.
  - (d) Decontamination of equipment prior to removal from an enclosure.
  - (e) Immediate repair of ductwork or structure leaks without an enclosure if the time to construct a temporary enclosure would exceed the time to make a temporary or permanent repair, or if construction of an enclosure would cause a higher level of emissions than if an enclosure were not constructed.
  - (f) Activities required for inspection of fabric filters and maintenance of filters that are in need of removal and replacement are not required to be conducted inside of total enclosures. Used fabric filters must be placed in sealed plastic bags or containers prior to removal from a baghouse.
6. Material transport. The Permittee shall collect and transport all lead bearing dust (i.e. lead bearing material which is a dust) within closed conveyor systems or in sealed, leak-proof containers unless the collection and transport activities are contained within a total enclosure. All other lead bearing material shall be contained and covered for transport outside of a total enclosure in a manner that prevents spillage or dust formation. Intact batteries and lead ingot product are exempt from the requirement to be covered for transport.

**B. Emission of Particulate Matter: Fugitive Dust (NAC 445B.22037)**

Surface area disturbance less than 5 acres:

1. Permittee may not cause or permit the handling, transporting, or storing of any material in a manner which allows or may allow controllable particulate matter to become airborne.
2. Except as otherwise provided in subsection 3, Permittee person may not cause or permit the construction, repair, demolition, or use of unpaved or untreated areas without first putting into effect an ongoing program using the best practical methods to prevent particulate matter from becoming airborne. As used in this subsection, "best practical methods" includes, but is not limited to, paving, chemical stabilization, watering, phased construction, and revegetation.
3. The provisions of subsection 2 do not apply to:
  - a. Agricultural activities occurring on agricultural land; or
  - b. Surface disturbances authorized by a permit issued pursuant to NRS 519A.180 which occur on land which is not less than 5 acres or more than 20 acres.

**\*\*\*End of Surface Area Disturbance Conditions\*\*\***



**Bureau of Air Pollution Control**

**Facility ID No. A1917**

**Draft Permit No. AP5051-3711**

**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section VIII. Schedules of Compliance**

A. Not Applicable.

**\*\*\*\*End of Schedule of Compliance Conditions\*\*\*\***



**Bureau of Air Pollution Control**

**Facility ID No. A1917**

**Draft Permit No. AP5051-3711**

**CLASS II AIR QUALITY OPERATING PERMIT**

Issued to: AQUA METALS, INC.

**Section IX. Amendments**

June 14, 2016 – Air Case 8620 - New Class II Air Quality Operating Permit AP5051-3711.

**This permit:**

1. Is non-transferable. NAC 445B.287(4)
2. Shall be posted conspicuously at or near the stationary source. NAC 445B.318(5)
3. Carries a term of five years beginning on the date of: June 14, 2016  
NAC 445B(315)(3)(a).
4. A completed application for renewal of an operating permit must be submitted to the director on the form provided by him with the appropriate fee at least 70 calendar days before the expiration date of this operating permit. NAC 445B.3473(2)
5. Any party aggrieved by the Department's decision to issue this permit may appeal to the State Environmental Commission (SEC) within ten days after the date of notice of the Department's action. NRS 445B.340.

**THIS PERMIT EXPIRES ON:**

June 14, 2021

Signature

Issued by: Jeffrey Kinder, P.E.  
Chief, Bureau of Air Pollution Control  
Nevada Division of Environmental Protection

Phone: (775) 687-9475

Date: June 14, 2016

rsp  
06/2016

## CLASS II NON-PERMIT EQUIPMENT LIST

Appended to Permit #AP5051-3711

Emission Unit #	Emission Unit Description
IA1.001	1.20 MMBtu/hour Natural Gas Fired Kettle #1 Burner (NAC 445B.288.2(e))
IA1.002	1.20 MMBtu/hour Natural Gas Fired Kettle #2 Burner (NAC 445B.288.2(e))
IA1.003	0.20 MMBtu/hour Natural Gas Fired Casting Unit Burner (NAC 445B.288.2(e))
IA1.004	1.21 MMBtu/hour Natural Gas Fired Roof Top Heating Unit 1 (NAC 445B.288.2(e))
IA1.005	1.44 MMBtu/hour Natural Gas Fired Roof Top Heating Unit 2 (NAC 445B.288.2(e))
IA1.006	3.66 MMBtu/hour Natural Gas Fired Roof Top Heating Unit 3 (NAC 445B.288.2(e))
IA1.007	3.66 MMBtu/hour Natural Gas Fired Roof Top Heating Unit 4 (NAC 445B.288.2(e))
IA1.008	3.52 MMBtu/hour Natural Gas Fired Roof Top Heating Unit 5 (NAC 445B.288.2(e))
IA1.009	2.27 MMBtu/hour Natural Gas Fired Roof Top Heating Unit 6 (NAC 445B.288.2(e))
IA1.010	2.27 MMBtu/hour Natural Gas Fired Roof Top Heating Unit 7 (NAC 445B.288.2(e))
IA1.011	12,500 Gallon Organic Acid AST Tank 1 (NAC 445B.288.2(d))
IA1.012	12,500 Gallon Organic Acid AST Tank 2 (NAC 445B.288.2(d))
IA1.013	Paste Desulfurization (only emits CO <sub>2</sub> )
IA1.014	AMI Lead Recovery Process (only emits CO <sub>2</sub> )



## Water and Sanitary Sewer Will Serve Letter

February 25, 2016

### AquaMetals

2500 Peru Drive a 11.47 ac acre site

From permit number 57120 (subject to application #63884)

Dear Applicant:

This letter constitutes a commitment by TRI General Improvement District ("TRIGID") to allocate groundwater rights in the amount of 9.61 acre feet for potable uses and 0.05 acre feet for landscaping in order to serve the above-referenced project from the community water system owned and operated by TRIGID. This letter also constitutes a commitment to provide sanitary sewer service from the TRIGID's community sewer system, including treatment capacity in the TRIGID Sewer Treatment Plant I.

This commitment of resource and system capacity shall not be valid if the approval for this project expires or is terminated by the local governing body. At that time this commitment to provide service shall be automatically revoked.

The necessary water and sewer infrastructure extension to serve this development shall be made from the nearest source of adequate capacity in accordance with approved TRIGID plans and specifications. Upon completion, the improvements not on the parcel being served will be owned and maintained by TRIGID. All water and sewer service shall be supplied pursuant to the rules, rates and regulations of the TRIGID.

This water and sewer commitment is based on information and plans submitted to TRIGID by the applicant. Review of the information submitted does not constitute an application for service nor imply completed processing of design and construction drawings for approval of these services by TRIGID or the master developer.

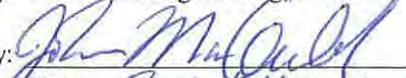
**#VALUE!**

Sincerely,

**TRI GENERAL IMPROVEMENT DISTRICT,**  
a political subdivision of the State of Nevada

By: TRI Water and Sewer Company, a Delaware Corporation, Its Operator

By: Farr West Engineering, District Engineer

By:   
Name/Title: Project Managers

cc. Storey County Community Development Department

Permit No. <b>09587 02</b>	<b>Storey County Building Dept.</b> P O Box 526 Virginia City NV 89440	Date <b>12/21/15</b>
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<input type="checkbox"/> <b>Commercial</b>	<b>PERMIT</b>	<input checked="" type="checkbox"/> <b>Industrial</b>
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WORK DESCRIPTION: SHELL ONLY (STEEL BUILDING - 136,750SF)			
WORK LOCATION ADDRESS: 2500 PERU DRIVE			AREA: TRI
LOT(S):	APN(S): 005-071-55	ZONE: I-2	FLOOD:
OCCUPANCY or INTENDED USE:			
ESTIMATED WORK COMMENCEMENT DATE: 12/21/15		ESTIMATED COMPLETION DATE: 6/21/16	

SPECIAL CONDITIONS:			
CONTRACTOR: MILES CONSTRUCTION			PHONE: 775-246-3722
ADDRESS: 61 INDUSTRIAL PARKWAY CARSON CITY, NV	NV LIC #: 0065971	Exp: 9/30/16	Limit: \$ 2500000
	SC LIC #: 015615		
SUB-Contractor:			PHONE:
ADDRESS:	NV LIC #:	Exp:	Limit: \$
	SC LIC #:		
SUB-Contractor:			PHONE:
ADDRESS:	NV LIC #:	Exp:	Limit: \$
	SC LIC #:		

ALL MATERIALS and EQUIPMENT PURCHASED FOR THIS PROJECT SHOULD BE RECEIVED IN STOREY COUNTY AND THE VALUE REPORTED AS 'County-of-Delivery' ON THE NEVADA DEPT. OF TAXATION FORM TPI-02.01 "Combined Sales and Use Tax Return".  
If you require further information, please call (775) 847-0966.

OWNER / Permittee (Print): AQUA METALS RENO INC	PHONE:
ADDRESS (Mailing): 501 23RD AVE OAKLAND, CA 94606	
OWNER <i>Signature</i> :	Authorized <i>Signature</i> :
	BUILDER / AGENT:

OCCUPANCY	SQ. FT.	VALUATION AMOUNT	~ FEES ~	~ REQUIRED ~
	0@ .00	9,893,000.00	<b>Building:</b> 38,068.20	(2 Sets) Plans Recd on 12/10/15
	0@ .00	.00	<b>Plan Review:</b> 24,744.33	Sewer & Water Will Serve
	0@ .00	.00	<b>Electric:</b> 194.50	Received on
	0@ .00	.00	<b>Plumbing:</b> 130.00	Architectural Approval
	0@ .00	.00	<b>Mechanical:</b> 189.00	Received on 12/14/15
	0@ .00	.00	<b>Temp Trailer</b> .00	<b>TOTAL DUE: \$63,326.03</b>

TOTAL VALUATION: \$ <b>9,893,000.00</b>		<input type="checkbox"/> PLAN REVIEW ONLY	Check #: 10009
<input type="checkbox"/> Est. Cost	<input type="checkbox"/> Actual Contract	<input checked="" type="checkbox"/> FULL PERMIT	Receipt #: 12471

Permission is hereby granted to do the work described in this application and ONLY in accordance with the Rules, Regulations, and Ordinances of the County of Storey. Inspection MUST be called for within 180 days of issuance of permit or permit is void. Permit may be renewed for 50% of the original "Permit Fee".

By:   
Storey County Building Department

Permit No. <b>09587 01</b>	<b>Storey County Building Dept.</b> P O Box 526 Virginia City NV 89440	Date <b>10/26/15</b>
-------------------------------	---	-------------------------

<input type="checkbox"/> <b>Commercial</b>	<b>PERMIT</b>	<input checked="" type="checkbox"/> <b>Industrial</b>
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WORK DESCRIPTION: <b>STRUCTURAL FOOTINGS/FOUNDATION/SLAB ONLY</b>			
WORK LOCATION ADDRESS: <b>2500 PERU DRIVE</b>			AREA: <b>TRI</b>
LOT(S):	APN(S): <b>005-071-55</b>	ZONE: <b>I-2</b>	FLOOD:
OCCUPANCY or INTENDED USE:			
ESTIMATED WORK COMMENCEMENT DATE: <b>10/26/15</b>		ESTIMATED COMPLETION DATE: <b>4/26/16</b>	

SPECIAL CONDITIONS:			
CONTRACTOR: <b>MILES CONSTRUCTION</b>			PHONE: <b>775-246-3722</b>
ADDRESS: <b>61 INDUSTRIAL PARKWAY CARSON CITY, NV</b>		NV LIC #: <b>0065971</b>	Exp: <b>9/30/16</b> Limit: \$ <b>2500000</b>
		SC LIC #: <b>015615</b>	
SUB-Contractor:			PHONE:
ADDRESS:		NV LIC #:	Exp:    Limit: \$
		SC LIC #:	
SUB-Contractor:			PHONE:
ADDRESS:		NV LIC #:	Exp:    Limit: \$
		SC LIC #:	

ALL MATERIALS and EQUIPMENT PURCHASED FOR THIS PROJECT SHOULD BE RECEIVED IN STOREY COUNTY AND THE VALUE REPORTED AS 'County-of-Delivery' ON THE NEVADA DEPT. OF TAXATION FORM TPI-02.01 "Combined Sales and Use Tax Return".  
If you require further information, please call (775) 847-0966.

OWNER / Permittee (Print): <b>AQUA METALS RENO INC</b>		PHONE:
ADDRESS (Mailing): <b>501 23RD AVE OAKLAND, CA 94606</b>		

OWNER <i>Signature</i> :	Authorized <i>Signature</i> : <i>on file</i>
BUILDER / AGENT:	

OCCUPANCY	SQ. FT.	VALUATION AMOUNT	~ FEES ~	~ REQUIRED ~
	0@ .00	1,150,000.00	<b>Building:</b> 6,156.25	(2 Sets) <b>Plans Recd on</b> 10/19/15
	0@ .00	.00	<b>Plan Review:</b> 4,001.56	<b>Sewer &amp; Water Will Serve</b>
	0@ .00	.00	<b>Electric:</b> .00	<b>Received on</b>
	0@ .00	.00	<b>Plumbing:</b> .00	<b>Architectural Approval</b>
	0@ .00	.00	<b>Mechanical:</b> .00	<b>Received on</b>
	0@ .00	.00	<b>Temp Trailer</b> .00	<b>TOTAL DUE: \$10,157.81</b>

TOTAL VALUATION \$ <b>1,150,000.00</b>		<input type="checkbox"/> PLAN REVIEW ONLY	Check #: <i>11622</i>
<input type="checkbox"/> Est. Cost <input type="checkbox"/> Actual Contract		<input checked="" type="checkbox"/> FULL PERMIT	Receipt #: <i>12426</i>

Permission is hereby granted to do the work described in this application and ONLY in accordance with the Rules, Regulations, and Ordinances of the County of Storey. Inspection MUST be called for within 180 days of issuance of permit or permit is void. Permit may be renewed for 50% of the original "Permit Fee".

By: *Stacey Guochianeri*  
Storey County Building Department



## APPENDIX H Safety Data Sheets

SDS for the following materials are attached:

-  Methane Sulfonic Acid 70%
-  Dissolvine NA2
-  Sodium Carbonate
-  Lead Carbonate, Basic
-  Lead Dioxide
-  Sodium Hydroxide
-  Lead Oxide
-  Lead Metal
-  Lead Sulfate
-  Sulfuric Acid (30-50%), (95-100%)
-  Lead Methanesulfonate 50-70%
-  AETFLOC C-5005 Precipitant
-  TerraBond Stabilizer
-  Sikagard Duochem 7500
-  Sikagard CRV 20

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Methanesulfonic acid solution

Product Number : 471348

Brand : Sigma-Aldrich

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

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

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832

Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

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**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Corrosive to metals (Category 1), H290  
Acute toxicity, Oral (Category 4), H302  
Acute toxicity, Dermal (Category 4), H312  
Skin corrosion (Category 1B), H314  
Serious eye damage (Category 1), H318  
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335  
Acute aquatic toxicity (Category 2), H401

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Danger

Hazard statement(s)

H290 May be corrosive to metals.  
H302 + H312 Harmful if swallowed or in contact with skin  
H314 Causes severe skin burns and eye damage.  
H318 Causes serious eye damage.  
H335 May cause respiratory irritation.  
H401 Toxic to aquatic life.

Precautionary statement(s)

P234 Keep only in original container.  
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.

P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P301 + P330 + P331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.
P363	Wash contaminated clothing before reuse.
P390	Absorb spillage to prevent material damage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P406	Store in corrosive resistant stainless steel container with a resistant inner liner.
P501	Dispose of contents/ container to an approved waste disposal plant.

### 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.2 Mixtures

Formula	:	CH <sub>4</sub> O <sub>3</sub> S
Molecular weight	:	96.11 g/mol

#### Hazardous components

Component	Classification	Concentration
<b>Methanesulphonic acid</b>		
CAS-No.	75-75-2	>= 70 - < 90 %
EC-No.	200-898-6	
Index-No.	607-145-00-4	
		Met. Corr. 1; Acute Tox. 4; Skin Corr. 1B; Eye Dam. 1; STOT SE 3; Aquatic Acute 2; H290, H302 + H312, H314, H318, H335, H401

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Move out of dangerous area. Consult a physician. Show this safety data sheet to the doctor in attendance.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician. Continue rinsing eyes during transport to hospital.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

- 4.2 Most important symptoms and effects, both acute and delayed**  
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11
- 4.3 Indication of any immediate medical attention and special treatment needed**  
No data available
- 

## 5. FIREFIGHTING MEASURES

- 5.1 Extinguishing media**  
**Suitable extinguishing media**  
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
- 5.2 Special hazards arising from the substance or mixture**  
Carbon oxides, Sulphur oxides
- 5.3 Advice for firefighters**  
Wear self-contained breathing apparatus for firefighting if necessary.
- 5.4 Further information**  
No data available
- 

## 6. ACCIDENTAL RELEASE MEASURES

- 6.1 Personal precautions, protective equipment and emergency procedures**  
Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.  
For personal protection see section 8.
- 6.2 Environmental precautions**  
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.
- 6.3 Methods and materials for containment and cleaning up**  
Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.
- 6.4 Reference to other sections**  
For disposal see section 13.
- 

## 7. HANDLING AND STORAGE

- 7.1 Precautions for safe handling**  
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.  
For precautions see section 2.2.
- 7.2 Conditions for safe storage, including any incompatibilities**  
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.  
Storage class (TRGS 510): Non-combustible, corrosive hazardous materials
- 7.3 Specific end use(s)**  
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated
- 

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

- 8.1 Control parameters**  
**Components with workplace control parameters**  
Contains no substances with occupational exposure limit values.
- 8.2 Exposure controls**  
**Appropriate engineering controls**  
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

## Personal protective equipment

### Eye/face protection

Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nature latex/chloroprene

Minimum layer thickness: 0.6 mm

Break through time: 480 min

Material tested:Lapren® (KCL 706 / Aldrich Z677558, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm

Break through time: 30 min

Material tested:Dermatril® P (KCL 743 / Aldrich Z677388, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |  |                                      |
|--|--------------------------------------|
| a) Appearance                              | Form: liquid                         |
| b) Odour                                   | No data available                    |
| c) Odour Threshold                         | No data available                    |
| d) pH                                      | No data available                    |
| e) Melting point/freezing point            | Melting point/range: -60 °C (-76 °F) |
| f) Initial boiling point and boiling range | No data available                    |
| g) Flash point                             | Not applicable                       |
| h) Evaporation rate                        | No data available                    |
| i) Flammability (solid, gas)               | No data available                    |
| j) Upper/lower flammability or             | No data available                    |

explosive limits

- |   |  |
|---|--|
| k) Vapour pressure                        | No data available                                |
| l) Vapour density                         | No data available                                |
| m) Relative density                       | 1.345 - 1.360 g/cm <sup>3</sup> at 20 °C (68 °F) |
| n) Water solubility                       | No data available                                |
| o) Partition coefficient: n-octanol/water | log Pow: -4.98                                   |
| p) Auto-ignition temperature              | No data available                                |
| q) Decomposition temperature              | No data available                                |
| r) Viscosity                              | No data available                                |
| s) Explosive properties                   | No data available                                |
| t) Oxidizing properties                   | No data available                                |

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Bases, Strong oxidizing agents, Amines, Strong reducing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

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## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

## **Carcinogenicity**

- IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
- ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
- NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
- OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

## **Reproductive toxicity**

No data available  
No data available

## **Specific target organ toxicity - single exposure**

No data available

## **Specific target organ toxicity - repeated exposure**

No data available

## **Aspiration hazard**

No data available

## **Additional Information**

RTECS: Not available

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin., spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea

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## **12. ECOLOGICAL INFORMATION**

### **12.1 Toxicity**

No data available

### **12.2 Persistence and degradability**

No data available

### **12.3 Bioaccumulative potential**

No data available

### **12.4 Mobility in soil**

No data available

### **12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### **12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Toxic to aquatic life.

---

## **13. DISPOSAL CONSIDERATIONS**

### **13.1 Waste treatment methods**

#### **Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### **Contaminated packaging**

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3265      Class: 8      Packing group: II  
Proper shipping name: Corrosive liquid, acidic, organic, n.o.s. (Methanesulphonic acid)  
Reportable Quantity (RQ):

Poison Inhalation Hazard: No

### IMDG

UN number: 3265      Class: 8      Packing group: II      EMS-No: F-A, S-B  
Proper shipping name: CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S. (Methanesulphonic acid)

### IATA

UN number: 3265      Class: 8      Packing group: II  
Proper shipping name: Corrosive liquid, acidic, organic, n.o.s. (Methanesulphonic acid)

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## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

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.

### SARA 311/312 Hazards

Acute Health Hazard

### Massachusetts Right To Know Components

No components are subject to the Massachusetts Right to Know Act.

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Methanesulphonic acid	75-75-2	2007-03-01
Water	7732-18-5	

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Methanesulphonic acid	75-75-2	2007-03-01
Water	7732-18-5	

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

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## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Eye Dam.	Serious eye damage
H290	May be corrosive to metals.
H302	Harmful if swallowed.
H302 + H312	Harmful if swallowed or in contact with skin
H312	Harmful in contact with skin.
H314	Causes severe skin burns and eye damage.
H318	Causes serious eye damage.
H335	May cause respiratory irritation.
H401	Toxic to aquatic life.
Met. Corr.	Corrosive to metals

Skin Corr. Skin corrosion  
STOT SE Specific target organ toxicity - single exposure

**HMIS Rating**

Health hazard: 3  
Chronic Health Hazard:  
Flammability: 0  
Physical Hazard 0

**NFPA Rating**

Health hazard: 3  
Fire Hazard: 0  
Reactivity Hazard: 0

**Further information**

Copyright 2015 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only. The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.3

Revision Date: 07/09/2015

Print Date: 02/22/2016

## 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

<b>Product Name</b>	<b>Dissolvine® NA2-S</b>
<b>Chemical Name</b>	Ethylenediaminetetraacetic acid, disodium salt, dihydrate
<b>Synonym(s)</b>	Disodium EDTA dihydrate
<b>Product Use</b>	Chelating agent
<b>Manufacturer / Supplier</b>	Akzo Nobel Functional Chemicals LLC Chelates Americas 525 West Van Buren St., Chicago, IL 60607 Tel. 1-800-906-7979 <a href="http://www.dissolvine.com">www.dissolvine.com</a>
<b>Emergency Telephone Numbers</b>	
<b>CHEMICAL EMERGENCY</b> (Spill, Leak, Fire, Exposure or Accident)	CHEMTREC (800) 424-9300 (Toll-free in the U.S., Canada, and the U.S. Virgin Islands) (24-hr) (703) 527-3887 (For calls originating elsewhere / collect calls are accepted) CANUTEC (613) 996-6666 (Canada)
<b>MEDICAL / HANDLING EMERGENCIES</b>	(914) 693-6946 [AkzoNobel – USA]

## 2. HAZARDS IDENTIFICATION

### EMERGENCY OVERVIEW

<b>CAUTION !</b>	<b>Contact with dust may cause skin, eye and respiratory tract irritation.</b>
<b>Appearance and odor</b>	Odorless white free-flowing powder.
<b>Fire &amp; Explosion Hazards</b>	Although this product is not defined as flammable or combustible, potential for dust explosion may exist. Depending upon conditions, dust may be sensitive to static discharge. Avoid possibility of dry powder and friction causing static electricity in presence of flammable materials (See NFPA-77, Chap.6).

### **POTENTIAL HEALTH EFFECTS** [See Section 11 for additional information]

<b>Primary Route(s) of Exposure</b>	Eye contact, skin contact and inhalation
<b>Acute Exposure</b>	
<b>Inhalation</b>	Exposure to an excessive concentration of dust may cause respiratory tract discomfort and/or mild irritation.
<b>Skin Contact</b>	Disodium EDTA dihydrate was moderately irritating to rabbit skin, causing reversible effects such as redness, slight edema, scabbing and scarring after repeated application.
<b>Eye Contact</b>	Eye contact with dust may cause mild physical irritation.
<b>Ingestion</b>	This product is expected to have a low order of acute toxicity.
<b>Carcinogenicity</b>	IARC, NTP, ACGIH and OSHA do not classify this material as a carcinogen or suspect carcinogen.
<b>Reproduction</b>	EDTA and its sodium salts caused birth defects in some animal studies in the presence of maternal toxicity
<b>Medical Conditions Aggravated by Exposure</b>	There are no data available that address medical conditions that are generally recognized as being aggravated by exposure to this product.

## 2. HAZARDS IDENTIFICATION (CONTINUED)

### POTENTIAL ENVIRONMENTAL EFFECTS [See Section 12 for additional information]

**Aquatic Toxicity** This product is not expected to be harmful to aquatic life, based on available data.

## 3. COMPOSITION / INFORMATION ON INGREDIENTS

INGREDIENTS	CAS Number	% (w/w)
EDTA disodium salt	139-33-3	89 – 91
Water	7732-18-5	9 – 11

## 4. FIRST AID MEASURES

**Inhalation** Dust may be irritating to the respiratory tract and cause symptoms of bronchitis. Remove victim to fresh air. If irritation occurs or if breathing becomes difficult, get medical attention.

**Skin Contact** Remove contaminated clothing, shoes and equipment. Wash all affected areas with soap and plenty of water. Wash contaminated clothing and shoes before reuse. Get medical attention if irritation occurs or persists.

**Eye Contact** Flush eyes with large quantities of running water for a minimum of 15 minutes. If the victim is wearing contact lenses, remove them. Hold the eyelids apart during the flushing to ensure rinsing of the entire surface of the eye and lids with water. Do not let victim rub eye(s). Do not attempt to neutralize with chemical agents. Get medical attention if eye irritation occurs.

**Ingestion** Give several glasses of water. DO NOT induce vomiting. If vomiting occurs, keep head below hips to reduce risk of aspiration. Give fluids again. Never give anything by mouth to a person who is unconscious or convulsing. Get medical attention if health effects occur.

**Note to Physician** Attending physician should treat exposed patients symptomatically.

## 5. FIRE FIGHTING MEASURES

**Flammable Properties** not flammable or combustible

**Extinguishing Media** Use water fog or spray, dry chemical, foam or carbon dioxide extinguishing agents.

**Fire Fighting Procedures** As in any fire, prevent human exposure to fire, smoke, fumes or products of combustion. Evacuate all non-essential personnel from the fire area. Fire fighters should wear full-face, self-contained breathing apparatus and impervious protective clothing.

**Fire & Explosion Hazards** Although this product is not defined as flammable or combustible, potential for dust explosion may exist. Depending upon conditions, dust may be sensitive to static discharge. Avoid possibility of dry powder and friction causing static electricity in presence of flammable materials (See NFPA-77, Chap.6).

**Hazardous Combustion Products** Thermal decomposition products may release toxic and/or hazardous fumes and gases, including nitrogen oxides and carbon oxides.

**NFPA Hazard Rating** **Health:** 1 / **Fire:** 1 / **Instability:** 0 / **Other:** None  
[0 – Minimal / 1 – Slight / 2 – Moderate / 3 – High / 4 – Extreme]

## 6. ACCIDENTAL RELEASE MEASURES

**Personal Precautions** All personnel involved in spill cleanup should avoid skin and eye contact by wearing appropriate personal protective equipment.

**Methods for Containment** Safely stop source of spill. Restrict non-essential personnel from area.

## 6. ACCIDENTAL RELEASE MEASURES

<b>Environmental Precautions</b>	Sweep up spilled solid material, being careful not to create dust. Return sweepings to stock or, if contaminated, place into a chemical waste container for disposal. Flush remainder with water.
<b>Methods for Clean-up</b>	Using a stiff brush, work the slurry into cracks and crevices. Allow to stand for 2-3 minutes. Then flush again with water. Repeat if necessary. Dike water for later disposal. Do not allow contaminated water to enter waterways. CAUTION – The spill area may be slippery.
<b>Other Information</b>	See also Section 13 for disposal information.

## 7. HANDLING AND STORAGE

<b>Handling</b>	Avoid inhalation of dust as well as prolonged and/or repeated skin and eye contact.
<b>Storage</b>	Keep containers closed and dry. This material is suitable for any general chemical storage area. Store in PVC, PE, stainless steel or bituminized tanks. Avoid contact with aluminum, copper, copper alloys, nickel and zinc.
<b>Recommended Storage Temperature</b>	Store in a cool and dry place at ambient temperature (below 25°C / 77°F).
<b>General Comments</b>	Containers should not be opened until ready for use. Opened containers must be closed again properly. It is advised to re-test the product after three years of storage. In certain concentrations, the product may form an explosive dust-air mixture. Protect product from moisture and wet air.

## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

### Exposure Guidelines

Chemical Name	OSHA – PELs (mg / m <sup>3</sup> )		ACGIH – TLVs (mg / m <sup>3</sup> )		NIOSH – RELs (mg / m <sup>3</sup> )		AIHA – WEELs (mg / m <sup>3</sup> )	
	TWA	STEL / CEIL(C)	TWA	STEL / CEIL(C)	TWA	STEL / CEIL(C)	TWA	STEL / CEIL(C)
EDTA, disodium salt	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D
Water	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D

[Ref: ACGIH Guide to Occupational Exposure Values, 2008 Edition]

#### Legend:

CEIL:	Ceiling Exposure Limit	PEL:	Permissible Exposure Limit	REL:	Recommended Exposure Limit
STEL:	Short Term Exposure Limit	TLV:	Threshold Limit Value	TWA:	Time-Weighted Average
N/D:	Not Determined	WEEL:	Workplace Environmental Exposure Level		
ACGIH:	American Conference of Governmental Industrial Hygienists				
AIHA:	American Industrial Hygiene Association				
NIOSH:	National Institute for Occupational Safety and Health				
OSHA:	Occupational Safety and Health Administration				

**Engineering Controls & Ventilation** Special ventilation is usually not required under normal use conditions. Ensure that existing ventilation is sufficient to prevent the circulation and/or accumulation of dust in the air.

### Personal Protective Equipment (PPE)

**Respiratory** Use of respiratory protection is generally not required. However, if use conditions generate dust and adequate ventilation (e.g., outdoor or well-ventilated area) is not available, use a NIOSH-approved organic vapor respirator with dust, mist and fume filters to reduce potential for inhalation exposure. When using respirator cartridges or canisters, they must be changed frequently (following each use or at the end of the work shift) to assure breakthrough exposure does not occur.

## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION (CONTINUED)

<b>Skin</b>	Skin contact with the product should be minimized or prevented through the use of suitable protective clothing, gloves and footwear selected according to use condition exposure potential. For permanent (>8 hours) full contact use, 100% Viton gloves are recommended.
<b>Eyes/Face</b>	Since eye contact with dust may cause irritation, chemical goggles and/or a face shield should be worn when handling this product.
<b>Hygiene Measures</b>	All food and smoking materials should be kept in a separate area away from the storage/use location. Eating, drinking and smoking should be prohibited in areas where there is a potential for significant exposure to this material. Before eating, drinking and smoking, hands and face should be thoroughly washed.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### Appearance

<b>Form</b>	powder
<b>Color</b>	white
<b>Odor</b>	odorless
<b>Boiling Point</b>	not applicable
<b>Bulk Density</b>	~ 700 kg/m <sup>3</sup>
<b>Evaporation Rate</b> (Butyl Acetate=1)	not determined
<b>Melting Point</b>	110°C (230°F) / loss of crystallization
<b>Odor Threshold</b>	not determined
<b>pH</b>	~ 4.0 – 6.0 (5% solution)
<b>Partition Coefficient</b> (n-octanol/water)	Log P <sub>ow</sub> < 0
<b>Solubility in Water</b>	~ 100 mg/L (at 20°C / 68°F)
<b>Solubility in Other Solvents</b>	not determined
<b>Specific Gravity</b>	not determined
<b>Vapor Density (Air = 1)</b>	not applicable
<b>Vapor Pressure</b>	not applicable
<b>Viscosity</b>	not applicable
<b>Volatiles (% by weight)</b>	not determined
<b>Other</b>	decomposition temperature = 255°C (491°F)
<b>Flammability</b>	not flammable or combustible
<b>Flash Point (Method)</b>	not applicable
<b>Upper Flammable Limit</b> (% by volume)	not applicable
<b>Lower Flammable Limit</b> (% by volume)	not applicable
<b>Auto-Ignition Temperature</b>	not applicable

< : less than    > : greater than    ≈ : approximately

## 10. STABILITY AND REACTIVITY

<b>Chemical Stability</b>	This product is stable under recommended storage and handling conditions (see section 7). It is not self-reactive and is not sensitive to physical impact.
<b>Conditions to Avoid</b>	Avoid contact with aluminum, nickel, zinc, copper and copper alloys in combination with humidity/water (formation of hydrogen). Avoid prolonged storage at elevated temperatures.
<b>Incompatible Materials</b>	This product is incompatible with strong oxidizers.

## 10. STABILITY AND REACTIVITY (CONTINUED)

<b>Hazardous Decomposition Products</b>	Under fire conditions the product may support combustion and decomposes to give off carbon oxides fumes (CO, CO <sub>2</sub> ) and nitrogen oxides.
<b>Possibility of Hazardous Reactions</b>	Hazardous polymerization is not expected to occur under normal temperatures and pressures.

## 11. TOXICOLOGICAL INFORMATION

<b>Inhalation - Acute</b>	The acute LC <sub>50</sub> for this product is not available. There were no mortalities when rats were exposed to a saturated dust atmosphere (nominal concentration of 1.13 mg/L) for 7 hours. Exposure to an excessive concentration of dust may cause respiratory tract discomfort and/or mild irritation.
<b>Inhalation - Chronic</b>	No known effects for this product.
<b>Skin - Acute</b>	Dermal toxicity for this product is not available. A 4-hour human exposure to 0.2 g of 99% pure Disodium EDTA showed no irritation. Disodium EDTA dihydrate was moderately irritating to rabbit skin causing reversible effects such as redness, slight edema, scabbing and scarring after repeated application.
<b>Skin - Chronic</b>	No known effects for this product.
<b>Eyes</b>	This product is slightly irritating to rabbit eyes.
<b>Ingestion - Acute</b>	The oral LD <sub>50</sub> is greater than 2,000 mg/kg (rat).
<b>Ingestion - Chronic</b>	Disodium EDTA was administered in the feed of male rats for 4 weeks and female rats for 31 days. There were no adverse effects at the lowest tested dose of 692 mg/kg/day for male rats and 237 mg/kg/day for female rats (NOAEL). As well, in a 2-year study, rats were fed diets containing 0.5, 1 or 5% Disodium EDTA. There were no mortalities attributed to the treatment.
<b>Sensitization</b>	No known effects for this product.
<b>Carcinogenicity</b>	IARC, NTP, ACGIH and OSHA do not classify this material as a carcinogen or suspect carcinogen.
<b>Mutagenicity</b>	Disodium EDTA dihydrate gave negative results in numerous tests (such as Ames Assay, Mouse Lymphoma Assay, Micronucleus Assay). Disodium EDTA dihydrate did induce a dose-dependent increase in chromosome aberrations in CHL fibroblast cells with metabolic activation.
<b>Reproductive Toxicity</b>	EDTA and its sodium salts have been reported, in some studies, to cause birth defects in laboratory animals only at exaggerated doses that were toxic to the mother. These effects are likely associated with zinc deficiency due to chelation. Exposures having no effect on the mother should have no effect on the fetus. Disodium EDTA had no effect on mouse sperm morphology.
<b>Other Effects</b>	None known.
<b>Target Organs</b>	Eyes, skin and developmental (in the presence of maternal toxicity).

## 12. ECOLOGICAL INFORMATION

**Ecotoxicity** No data available for this product. However, the following information is available for a structurally related product:

Test	Exposure / Duration	Test Results
Algae ( <i>green algae</i> )	96-h	EC <sub>50</sub> = 1.14E8 mg/L (calculated by EPIWIN model)
Fish ( <i>guppy</i> )	96-h	LC <sub>50</sub> = 320 mg/L
Bacteria ( <i>Pseudomonas putida</i> )	8-h	EC <sub>50</sub> = 56 mg/L

## 12. ECOLOGICAL INFORMATION (CONTINUED)

<b>Biodegradation</b>	This product is not readily biodegradable (based on tests with structurally related products).
<b>Bioaccumulation</b>	It is not expected to bioaccumulate. The calculated Log Pow is – 11.7 (EPIWIN/KOWWIN models).
<b>Other Ecotoxicity information</b>	Disodium EDTA did not undergo photodegradation under laboratory conditions.

## 13. DISPOSAL CONSIDERATIONS

<b>Waste Disposal</b>	In its unused condition, this product is not considered to be a RCRA-defined hazardous waste by characteristics or listings. It is the responsibility of the waste generator to evaluate whether his wastes are hazardous by characteristic or listing. Dispose in accordance with all local, state and federal regulations. NOTE – State and local regulations may be more stringent than federal regulations.
<b>Container Disposal</b>	Containers should be cleaned of residual product before disposal or return. Since emptied containers retain product residue, follow label warnings even after container is emptied. Empty containers should be disposed of or shipped in accordance with all applicable laws and regulations.

## 14. TRANSPORT INFORMATION

Regulatory Information	UN Number	Proper Shipping Name	Class	PG	Label	Additional Information
US DOT TDG – Canada IMDG IATA/ICAO	N/R	N/R	N/R	N/R	N/R	Not regulated for transport.

**Emergency Response Guidebook (2008 ERG)** Not applicable

**Environmentally Hazardous Substances** None known  
[49 CFR 172.101, Appendix A]

## 15. REGULATORY INFORMATION

Regulatory Lists / Inventories: The components are subject to the following regulatory lists and inventories:

Substance Name	CAA	CERCLA	IARC	US STATE RIGHT-TO-KNOW LISTS	CA PROP 65	SARA
EDTA, disodium salt	N/R	N/R	N/R	N/R	N/R	N/R
Water	N/R	N/R	N/R	N/R	N/R	N/R

### National Chemical Inventories Status:

Substance Name	US TSCA	Canada		EU EINECS	Australia AICS	New Zealand NZIoC	Japan ENCS	Korea KECI	Philippines PICCS	China IECSC
		DSL	NDSL							
EDTA, disodium salt	X	X		X	X	X	X	X	X	X
Water	X	X		X	X	X	X	X	X	X

## 15. REGULATORY INFORMATION (CONTINUED)

### Legend

AICS	Australian Inventory of Chemical Substances
CA LIST	California – Directors List of Hazardous Substances
CA PROP 65	California Proposition 65
CAA	Clean Air Act, Section 112
CERCLA	CERCLA Hazardous Substances
DSL	Domestic Substances List – Canada
EINECS	European Inventory of Existing Commercial Chemical Substances
ENCS	Japan Existing and New Chemical Substances
FL LIST	Florida – Substance List
IARC	International Agency for Research on Cancer – Carcinogens – Groups 1, 2A or 2B
IECSC	China – Inventory of Existing Chemical Substances
IL LIST	Illinois Toxic Substances Disclosure to Employees Act
KECI	Korea Existing Chemicals Inventory
LA LIST	Louisiana Right-to-Know Reporting List
MA LIST	Massachusetts – R-T-K Substance List
MN LIST	Minnesota – Hazardous Substance List
NDSL	Non-Domestic Substances List – Canada
NJ R-T-K	New Jersey – R-T-K Hazard List
N/R	Non Regulated
NZIoC	New Zealand Inventory of Chemicals
PA LIST	Pennsylvania Hazardous Substance List
PICCS	Philippines Inventory of Chemicals and Chemical Substances
RI LIST	Rhode Island – Hazardous Substance List
SARA	SARA Title III, Section 302 / 313
TSCA	Toxic Substances Control Act – USA
X	Listed and/or Regulated

### CANADA – WHMIS (Workplace Hazardous Materials Information System)

#### Not controlled

This product has been classified in accordance with the hazard criteria of the *Controlled Products Regulations* (CPR) and the MSDS contains all the information required by the CPR.

#### Other Regulatory Information

The Cosmetic Ingredient Review (CIR) Expert Panel determined that EDTA and its salts are safe as used in cosmetic formulations.

## 16. OTHER INFORMATION

### HMIS RATING

**Health:** 1 / **Flammability:** 1 / **Physical Hazard:** 0 / **Other:** none  
[0 – Minimal / 1 – Slight / 2 – Moderate / 3 – High / 4 – Extreme / \* - Chronic Health Hazard (see Section 11)]

### Trademark

Dissolvine® is a registered trademark of Akzo Nobel Chemicals B.V.

### Date of Issue / Revision

November 24, 2008

### Revision #

10.0

### Changes

Section 16 / Logo

### Prepared by

AkzoNobel [Technology & Engineering, SHERA - Regulatory Toxicology]  
Tel. 613.273.8095

### Disclaimer

The information in this Material Safety Data Sheet should be provided to all who will use, handle, store, transport or otherwise be exposed to this product. Akzo Nobel Functional Chemicals LLC makes no warranty, express or implied as to the product's merchantability or fitness for any particular purpose, or that any suggested use will not infringe any patent. Nothing contained herein shall be construed as granting or extending any license under any patent. Buyer shall determine for himself, by preliminary tests or otherwise, the suitability of this product for his purposes, including mixing with other products. The information contained herein supersedes all previously issued bulletins on the subject matter covered. If the date of this document is more than three years old, please call to ensure that this sheet is current.

[00707\_061108]

## SAFETY DATA SHEET

Version 4.10  
Revision Date 11/06/2014  
Print Date 12/02/2015

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Sodium carbonate

Product Number : S7795  
Brand : Sigma-Aldrich  
Index-No. : 011-005-00-2

CAS-No. : 497-19-8

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

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

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Eye irritation (Category 2A), H319

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word : Warning

Hazard statement(s)  
H319 : Causes serious eye irritation.

Precautionary statement(s)  
P264 : Wash skin thoroughly after handling.  
P280 : Wear eye protection/ face 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.  
P337 + P313 : If eye irritation persists: Get medical advice/ attention.

**2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none**

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**3. COMPOSITION/INFORMATION ON INGREDIENTS****3.1 Substances**

Synonyms : Soda ash

Formula :  $\text{CNa}_2\text{O}_3$   
Molecular weight : 105.99 g/mol  
CAS-No. : 497-19-8  
EC-No. : 207-838-8  
Index-No. : 011-005-00-2  
Registration number : 01-2119485498-19-XXXX

#### Hazardous components

Component	Classification	Concentration
<b>Sodium carbonate</b>		
	Eye Irrit. 2A; H319	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

---

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Carbon oxides, Sodium oxides

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Avoid breathing dust.

For personal protection see section 8.

### 6.2 Environmental precautions

Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

## 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

hygroscopic Keep in a dry place.

Storage class (TRGS 510): Non Combustible Solids

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Contains no substances with occupational exposure limit values.

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

#### Personal protective equipment

##### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

##### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

##### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

##### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

##### Body Protection

impervious clothing, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator. For higher level protection use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Do not let product enter drains.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: powder Colour: white
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	12 at 106 g/l at 25 °C (77 °F)
e) Melting point/freezing point	Melting point/range: 851 °C (1,564 °F) - lit.
f) Initial boiling point and boiling range	1,600 °C (2,912 °F)
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	2.532 g/cm <sup>3</sup>
n) Water solubility	217 g/l at 20 °C (68 °F) - completely soluble
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	400 °C (752 °F) -
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

hygroscopic

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

#### 10.4 Conditions to avoid

Exposure to moisture.

#### 10.5 Incompatible materials

Strong acids

#### 10.6 Hazardous decomposition products

Other decomposition products - No data available  
In the event of fire: see section 5

---

### 11. TOXICOLOGICAL INFORMATION

#### 11.1 Information on toxicological effects

##### Acute toxicity

LD50 Oral - Rat - 4,090 mg/kg

LC50 Inhalation - Rat - 2 h - 5,750 mg/l

Dermal: No data available

No data available

##### Skin corrosion/irritation

Skin - Rabbit

Result: Mild skin irritation - 24 h

##### Serious eye damage/eye irritation

Eyes - Rabbit

Result: Eye irritation - 24 h

##### Respiratory or skin sensitisation

No data available

##### Germ cell mutagenicity

No data available

##### Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

##### Reproductive toxicity

No data available

No data available

##### Specific target organ toxicity - single exposure

No data available

##### Specific target organ toxicity - repeated exposure

No data available

##### Aspiration hazard

No data available

##### Additional Information

RTECS: VZ4050000

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish LC50 - Lepomis macrochirus (Bluegill) - 300 mg/l - 96 h

Toxicity to daphnia and other aquatic invertebrates EC50 - Daphnia magna (Water flea) - 265 mg/l - 48 h

### 12.2 Persistence and degradability

No data available

### 12.3 Bioaccumulative potential

No data available

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

Not dangerous goods

### IMDG

Not dangerous goods

### IATA

Not dangerous goods

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

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.

### SARA 311/312 Hazards

Acute Health Hazard

### Massachusetts Right To Know Components

No components are subject to the Massachusetts Right to Know Act.

### Pennsylvania Right To Know Components

Sodium carbonate

CAS-No.  
497-19-8

Revision Date

### New Jersey Right To Know Components

CAS-No.

Revision Date

**California Prop. 65 Components**

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

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**16. OTHER INFORMATION**

**Full text of H-Statements referred to under sections 2 and 3.**

Eye Irrit. H319	Eye irritation Causes serious eye irritation.
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**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.10

Revision Date: 11/06/2014

Print Date: 12/02/2015

## SAFETY DATA SHEET

Version 4.7  
Revision Date 03/12/2015  
Print Date 12/02/2015

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Lead(II) carbonate

Product Number : 336378  
Brand : Sigma-Aldrich  
Index-No. : 082-001-00-6

CAS-No. : 598-63-0

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

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

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 4), H302  
Acute toxicity, Inhalation (Category 4), H332  
Carcinogenicity (Category 1B), H350  
Reproductive toxicity (Category 1A), H360  
Specific target organ toxicity - repeated exposure (Category 2), H373  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word : Danger

Hazard statement(s)

H302 + H332 : Harmful if swallowed or if inhaled  
H350 : May cause cancer.  
H360 : May damage fertility or the unborn child.  
H373 : May cause damage to organs through prolonged or repeated exposure.  
H410 : Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201 : Obtain special instructions before use.

P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

### 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: CO <sub>3</sub> Pb
Molecular weight	: 267.21 g/mol
CAS-No.	: 598-63-0
EC-No.	: 209-943-4
Index-No.	: 082-001-00-6

#### Hazardous components

Component	Classification	Concentration
<b>Lead(II) carbonate</b>	Acute Tox. 4; Carc. 1B; Repr. 1A; STOT RE 2; Aquatic Acute 1; Aquatic Chronic 1; H302 + H332, H350, H360, H373, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

Cobalt/cobalt oxides, Lead oxides

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Keep in a dry place.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Lead(II) carbonate	598-63-0	TWA	0.05 mg/m <sup>3</sup>	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Hematologic effects Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices		

		(see BEI® section) Confirmed animal carcinogen with unknown relevance to humans varies		
		TWA	0.050000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Hematologic effects Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans varies		
		TWA	0.050000 mg/m3	USA. NIOSH Recommended Exposure Limits
		See Appendix C		
		PEL	0.05 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1025 If an employee is exposed to lead for more than 8 hours in any work day, the permissible exposure limit, as a time weighted average (TWA) for that day, shall be reduced according to the following formula: Maximum permissible limit (in µg/m3 )=400÷hours worked in the day This section applies to all occupational exposure to lead, except as provided in paragraph (a)(2). It does not apply to the construction industry or to agricultural operations covered by 29 CFR part 1928. OSHA specifically regulated carcinogen		
		TWA	0.05 mg/m3	USA. NIOSH Recommended Exposure Limits
		See Appendix C		

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an

industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### **Body Protection**

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### **Respiratory protection**

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### **Control of environmental exposure**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## **9. PHYSICAL AND CHEMICAL PROPERTIES**

### **9.1 Information on basic physical and chemical properties**

a) Appearance	Form: powder Colour: white
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 400 °C (752 °F)
f) Initial boiling point and boiling range	No data available
g) Flash point	Not applicable
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	6.140 g/cm <sup>3</sup>
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### **9.2 Other safety information**

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong acids, Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

Possible human carcinogen

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Lead(II) carbonate)

2A - Group 2A: Probably carcinogenic to humans (Lead(II) carbonate)

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Lead(II) carbonate)

2A - Group 2A: Probably carcinogenic to humans (Lead(II) carbonate)

NTP: Reasonably anticipated to be a human carcinogen The reference note has been added by TD based on the background information of the NTP. (Lead(II) carbonate)

OSHA: OSHA specifically regulated carcinogen (Lead(II) carbonate)

#### Reproductive toxicity

No data available

Known human reproductive toxicant

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

May cause damage to organs through prolonged or repeated exposure.

**Aspiration hazard**

No data available

**Additional Information**

RTECS: Not available

Lead salts have been reported to cross the placenta and to induce embryo- and feto- mortality. They also have teratogenic effect in some animal species. No teratogenic effects have been reported with exposure to organometallic lead compounds. Adverse effects of lead on human reproduction, embryonic and fetal development, and postnatal (e.g., mental) development have been reported. Excessive exposure can affect blood, nervous, and digestive systems. The synthesis of hemoglobin is inhibited and results in anemia. If left untreated, neuromuscular dysfunction, possible paralysis, and encephalopathy can result. Additional symptoms of overexposure include: joint and muscle pain, weakness of the extensor muscles (frequently the hand and wrist), headache, dizziness, abdominal pain, diarrhea, constipation, nausea, vomiting, blue line on the gums, insomnia, and metallic taste. High body levels produce increased cerebrospinal pressure, brain damage, and stupor leading to coma and often death., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish LC50 - Pimephales promelas (fathead minnow) - > 5.000 mg/l - 96.0 h

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

Very toxic to aquatic life with long lasting effects.

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

Not dangerous goods

**IMDG**

UN number: 3077

Class: 9

Packing group: III

EMS-No: F-A, S-F

Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Lead(II) carbonate)

Marine pollutant:yes

**IATA**

UN number: 3077

Class: 9

Packing group: III

Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Lead(II) carbonate)

**Further information**

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

---

**15. REGULATORY INFORMATION**

**SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

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.

**SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Lead(II) carbonate	598-63-0	1993-04-24

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Lead(II) carbonate	598-63-0	1993-04-24

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Lead(II) carbonate	598-63-0	1993-04-24

**California Prop. 65 Components**

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer. Lead(II) carbonate	598-63-0	2007-09-28

---

**16. OTHER INFORMATION**

**Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H302	Harmful if swallowed.
H302 + H332	Harmful if swallowed or if inhaled
H332	Harmful if inhaled.
H350	May cause cancer.
H360	May damage fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure.

**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	2
Fire Hazard:	0

Reactivity Hazard: 0

**Further information**

Copyright 2015 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only. The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.7

Revision Date: 03/12/2015

Print Date: 12/02/2015

## SAFETY DATA SHEET

Version 4.9  
Revision Date 05/27/2015  
Print Date 12/02/2015

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Lead(IV) oxide

Product Number : 237140  
Brand : Sigma-Aldrich  
Index-No. : 082-001-00-6

CAS-No. : 1309-60-0

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

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

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

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**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Oxidizing solids (Category 3), H272  
Acute toxicity, Oral (Category 4), H302  
Acute toxicity, Inhalation (Category 4), H332  
Carcinogenicity (Category 1B), H350  
Reproductive toxicity (Category 1A), H360  
Specific target organ toxicity - repeated exposure (Category 2), H373  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word : Danger

Hazard statement(s)

H272 : May intensify fire; oxidiser.  
H302 + H332 : Harmful if swallowed or if inhaled  
H350 : May cause cancer.  
H360 : May damage fertility or the unborn child.  
H373 : May cause damage to organs through prolonged or repeated exposure.  
H410 : Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P210	Keep away from heat.
P220	Keep/Store away from clothing/ combustible materials.
P221	Take any precaution to avoid mixing with combustibles.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Synonyms : Lead (su)peroxide  
Lead dioxide  
Lead peroxide

Formula : O<sub>2</sub>Pb  
Molecular weight : 239.20 g/mol  
CAS-No. : 1309-60-0  
EC-No. : 215-174-5  
Index-No. : 082-001-00-6

#### Hazardous components

Component	Classification	Concentration
<b>Lead dioxide</b>	Ox. Sol. 3; Acute Tox. 4; Carc. 1B; Repr. 1A; STOT RE 2; Aquatic Acute 1; Aquatic Chronic 1; H272, H302 + H332, H350, H360, H373, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

**In case of skin contact**

Wash off with soap and plenty of water. Consult a physician.

**In case of eye contact**

Flush eyes with water as a precaution.

**If swallowed**

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

**5. FIREFIGHTING MEASURES****5.1 Extinguishing media****Suitable extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

**5.2 Special hazards arising from the substance or mixture**

Lead oxides

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

Use water spray to cool unopened containers.

---

**6. ACCIDENTAL RELEASE MEASURES****6.1 Personal precautions, protective equipment and emergency procedures**

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

**6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

**6.3 Methods and materials for containment and cleaning up**

Sweep up and shovel. Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13). Keep in suitable, closed containers for disposal.

**6.4 Reference to other sections**

For disposal see section 13.

---

**7. HANDLING AND STORAGE****7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed. Keep away from sources of ignition - No smoking. Keep away from heat and sources of ignition.

For precautions see section 2.2.

**7.2 Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place.

Keep in a dry place.

Storage class (TRGS 510): Oxidizing hazardous materials

**7.3 Specific end use(s)**

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Lead dioxide	1309-60-0	TWA	0.05 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Hematologic effects Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans varies		
		TWA	0.050000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Hematologic effects Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans varies		
		TWA	0.050000 mg/m3	USA. NIOSH Recommended Exposure Limits
		See Appendix C		
		PEL	0.050000 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1025 If an employee is exposed to lead for more than 8 hours in any work day, the permissible exposure limit, as a time weighted average (TWA) for that day, shall be reduced according to the following formula: Maximum permissible limit (in µg/m3 )=400÷hours worked in the day This section applies to all occupational exposure to lead, except as provided in paragraph (a)(2). It does not apply to the construction industry or to agricultural operations covered by 29 CFR part 1928. OSHA specifically regulated carcinogen		
		PEL	0.050000 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1025 If an employee is exposed to lead for more than 8 hours in any work day, the permissible exposure limit, as a time weighted average (TWA) for that day, shall be reduced according to the following formula: Maximum permissible limit (in µg/m3 )=400÷hours worked in the day This section applies to all occupational exposure to lead, except as provided in paragraph (a)(2). It does not apply to the construction industry or to agricultural operations covered by 29 CFR part 1928. OSHA specifically regulated carcinogen		

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

## Personal protective equipment

### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |  |                                    |
|--|------------------------------------|
| a) Appearance                              | Form: powder<br>Colour: dark brown |
| b) Odour                                   | No data available                  |
| c) Odour Threshold                         | No data available                  |
| d) pH                                      | No data available                  |
| e) Melting point/freezing point            | No data available                  |
| f) Initial boiling point and boiling range | No data available                  |
| g) Flash point                             | Not applicable                     |
| h) Evaporation rate                        | No data available                  |
| i) Flammability (solid, gas)               | No data available                  |
| j) Upper/lower                             | No data available                  |

flammability or  
explosive limits

- |   |  |
|---|--|
| k) Vapour pressure                        | No data available  |
| l) Vapour density                         | No data available  |
| m) Relative density                       | No data available  |
| n) Water solubility                       | No data available  |
| o) Partition coefficient: n-octanol/water | No data available  |
| p) Auto-ignition temperature              | No data available  |
| q) Decomposition temperature              | No data available  |
| r) Viscosity                              | No data available  |
| s) Explosive properties                   | No data available  |
| t) Oxidizing properties                   | The substance or mixture is classified as oxidizing with the category 3. |

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong reducing agents, Powdered metals

### 10.6 Hazardous decomposition products

Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

LD50 Intraperitoneal - Guinea pig - 220 mg/kg

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

IARC: 2A - Group 2A: Probably carcinogenic to humans (Lead dioxide)

2A - Group 2A: Probably carcinogenic to humans (Lead dioxide)

NTP: Reasonably anticipated to be a human carcinogenThe reference note has been added by TD based on the background information of the NTP. (Lead dioxide)

OSHA: OSHA specifically regulated carcinogen (Lead dioxide)

**Reproductive toxicity**

May cause congenital malformation in the fetus.

Known human reproductive toxicant

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: OG0700000

Lead salts have been reported to cross the placenta and to induce embryo- and fet- mortality. They also have teratogenic effect in some animal species. No teratogenic effects have been reported with exposure to organometallic lead compounds. Adverse effects of lead on human reproduction, embryonic and fetal development, and postnatal (e.g., mental) development have been reported. Excessive exposure can affect blood, nervous, and digestive systems. The synthesis of hemoglobin is inhibited and results in anemia. If left untreated, neuromuscular dysfunction, possible paralysis, and encephalopathy can result. Additional symptoms of overexposure include: joint and muscle pain, weakness of the extensor muscles (frequently the hand and wrist), headache, dizziness, abdominal pain, diarrhea, constipation, nausea, vomiting, blue line on the gums, insomnia, and metallic taste. High body levels produce increased cerebrospinal pressure, brain damage, and stupor leading to coma and often death., Anorexia., Vomiting, Convulsions, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

No data available

**12.2 Persistence and degradability**

Biodegradability Result: - Not readily biodegradable.

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal. Very toxic to aquatic life with long lasting effects.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1872      Class: 5.1      Packing group: III  
Proper shipping name: Lead dioxide  
Reportable Quantity (RQ):

Poison Inhalation Hazard: No

### IMDG

UN number: 1872      Class: 5.1      Packing group: III      EMS-No: F-A, S-Q  
Proper shipping name: LEAD DIOXIDE  
Marine pollutant:yes

### IATA

UN number: 1872      Class: 5.1      Packing group: III  
Proper shipping name: Lead dioxide

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

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.

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Lead dioxide	1309-60-0	1993-04-24

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Lead dioxide	1309-60-0	1993-04-24

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Lead dioxide	1309-60-0	1993-04-24

### California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer. Lead dioxide	1309-60-0	2007-09-28

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## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity

Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H272	May intensify fire; oxidiser.
H302	Harmful if swallowed.
H302 + H332	Harmful if swallowed or if inhaled
H332	Harmful if inhaled.
H350	May cause cancer.
H360	May damage fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure.
H400	Very toxic to aquatic life.

**HMIS Rating**

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	1

**NFPA Rating**

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	1
Special hazard.I:	OX

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
 Product Safety – Americas Region  
 1-800-521-8956

Version: 4.9

Revision Date: 05/27/2015

Print Date: 12/02/2015

## SAFETY DATA SHEET

Version 5.7  
Revision Date 06/18/2015  
Print Date 12/02/2015

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Sodium hydroxide solution

Product Number : 13171  
Brand : Fluka  
Index-No. : 011-002-00-6

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

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

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

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**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Corrosive to metals (Category 1), H290  
Skin corrosion (Category 1A), H314  
Serious eye damage (Category 1), H318  
Acute aquatic toxicity (Category 3), H402

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Danger

Hazard statement(s)

H290 : May be corrosive to metals.  
H314 : Causes severe skin burns and eye damage.  
H318 : Causes serious eye damage.  
H402 : Harmful to aquatic life.

Precautionary statement(s)

P234 : Keep only in original container.  
P264 : Wash skin thoroughly after handling.  
P273 : Avoid release to the environment.  
P280 : Wear protective gloves/ protective clothing/ eye protection/ face protection.  
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.
P304 + P340 + P310	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.
P363	Wash contaminated clothing before reuse.
P390	Absorb spillage to prevent material damage.
P405	Store locked up.
P406	Store in corrosive resistant stainless steel container with a resistant inner liner.
P501	Dispose of contents/ container to an approved waste disposal plant.

### 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.2 Mixtures

Formula	:	HNaO
Molecular weight	:	40.00 g/mol

#### Hazardous components

Component	Classification	Concentration
<b>Sodium hydroxide</b>		
CAS-No.	1310-73-2	>= 90 - <= 100 %
EC-No.	215-185-5	
Index-No.	011-002-00-6	
Registration number	01-2119457892-27-XXXX	

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician. Continue rinsing eyes during transport to hospital.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

## 5.2 Special hazards arising from the substance or mixture

Sodium oxides

## 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

## 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid inhalation of vapour or mist.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Storage class (TRGS 510): Non-combustible, corrosive hazardous materials

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Sodium hydroxide	1310-73-2	TWA	2.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		C	2.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Upper Respiratory Tract irritation Eye irritation Skin irritation		
		C	2 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Upper Respiratory Tract irritation Eye irritation Skin irritation		

		C	2.000000 mg/m <sup>3</sup>	USA. NIOSH Recommended Exposure Limits
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## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatrill® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |                                 |                                    |
|---------------------------------|------------------------------------|
| a) Appearance                   | Form: liquid<br>Colour: colourless |
| b) Odour                        | No data available                  |
| c) Odour Threshold              | No data available                  |
| d) pH                           | 14.0                               |
| e) Melting point/freezing point | -12 - 10 °C (10 - 50 °F)           |
| f) Initial boiling point and    | 105 - 140 °C (221 - 284 °F)        |

	boiling range	
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	< 24 hPa (< 18 mmHg) at 20 °C (68 °F)
l)	Vapour density	1.38 - (Air = 1.0)
m)	Relative density	1.335 g/mL at 20 °C (68 °F)
n)	Water solubility	completely miscible, soluble
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

## 9.2 Other safety information

Relative vapour density 1.38 - (Air = 1.0)

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Water, acids, Organic materials, Chlorinated solvents, Aluminum, Phosphorus, Tin/tin oxides, Zinc

### 10.6 Hazardous decomposition products

Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

**Skin corrosion/irritation**

No data available

**Serious eye damage/eye irritation**

No data available

**Respiratory or skin sensitisation**

No data available

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: Not available

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin.

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

No data available

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.  
Harmful to aquatic life.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 1824      Class: 8      Packing group: II  
Proper shipping name: Sodium hydroxide solution  
Reportable Quantity (RQ): 1000 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 1824      Class: 8      Packing group: II      EMS-No: F-A, S-B  
Proper shipping name: SODIUM HYDROXIDE SOLUTION

### IATA

UN number: 1824      Class: 8      Packing group: II  
Proper shipping name: Sodium hydroxide solution

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

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.

### SARA 311/312 Hazards

Acute Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Sodium hydroxide	1310-73-2	2007-03-01

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Sodium hydroxide	1310-73-2	2007-03-01
Water	7732-18-5	

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Sodium hydroxide	1310-73-2	2007-03-01
Water	7732-18-5	

### California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

---

## 16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Eye Dam.	Serious eye damage
H290	May be corrosive to metals.
H314	Causes severe skin burns and eye damage.
H318	Causes serious eye damage.
H402	Harmful to aquatic life.
Met. Corr.	Corrosive to metals
Skin Corr.	Skin corrosion

**HMIS Rating**

Health hazard:	3
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

**NFPA Rating**

Health hazard:	3
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.7

Revision Date: 06/18/2015

Print Date: 12/02/2015

## SAFETY DATA SHEET

Version 4.6  
Revision Date 05/19/2015  
Print Date 12/02/2015

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Lead(II) oxide

Product Number : 203610  
Brand : Aldrich  
Index-No. : 082-001-00-6

CAS-No. : 1317-36-8

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

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

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 4), H302  
Acute toxicity, Inhalation (Category 4), H332  
Carcinogenicity, Oral (Category 2), H351  
Reproductive toxicity (Category 1A), H360  
Specific target organ toxicity - repeated exposure (Category 2), H373  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word : Danger

Hazard statement(s)

H302 + H332 : Harmful if swallowed or if inhaled  
H351 : Suspected of causing cancer if swallowed.  
H360 : May damage fertility or the unborn child.  
H373 : May cause damage to organs through prolonged or repeated exposure.  
H410 : Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201 : Obtain special instructions before use.

P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

### 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: OPb
Molecular weight	: 223.2 g/mol
CAS-No.	: 1317-36-8
EC-No.	: 215-267-0
Index-No.	: 082-001-00-6

#### Hazardous components

Component	Classification	Concentration
<b>Lead monoxide</b> Included in the Candidate List of Substances of Very High Concern (SVHC) according to Regulation (EC) No. 1907/2006 (REACH)		
	Acute Tox. 4; Carc. 2; Repr. 1A; STOT RE 2; Aquatic Acute 1; Aquatic Chronic 1; H302 + H332, H351, H360, H373, H410	<= 100 %

No components need to be disclosed according to the applicable regulations.  
For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

### 5. FIREFIGHTING MEASURES

#### 5.1 Extinguishing media

##### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### 5.2 Special hazards arising from the substance or mixture

Lead oxides

#### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

#### 5.4 Further information

No data available

---

### 6. ACCIDENTAL RELEASE MEASURES

#### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

#### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

#### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

#### 6.4 Reference to other sections

For disposal see section 13.

---

### 7. HANDLING AND STORAGE

#### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

#### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Keep in a dry place.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

#### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

#### 8.1 Control parameters

##### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Lead monoxide	1317-36-8	TWA	0.05 mg/m <sup>3</sup>	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Hematologic effects		

		Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans varies		
		TWA	0.050000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Hematologic effects Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans varies		
		TWA	0.050000 mg/m3	USA. NIOSH Recommended Exposure Limits
		See Appendix C		
		PEL	0.050000 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1025 If an employee is exposed to lead for more than 8 hours in any work day, the permissible exposure limit, as a time weighted average (TWA) for that day, shall be reduced according to the following formula: Maximum permissible limit (in µg/m3 )=400÷hours worked in the day This section applies to all occupational exposure to lead, except as provided in paragraph (a)(2). It does not apply to the construction industry or to agricultural operations covered by 29 CFR part 1928. OSHA specifically regulated carcinogen		
		PEL	0.050000 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1025 If an employee is exposed to lead for more than 8 hours in any work day, the permissible exposure limit, as a time weighted average (TWA) for that day, shall be reduced according to the following formula: Maximum permissible limit (in µg/m3 )=400÷hours worked in the day This section applies to all occupational exposure to lead, except as provided in paragraph (a)(2). It does not apply to the construction industry or to agricultural operations covered by 29 CFR part 1928. OSHA specifically regulated carcinogen		

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |   |  |
|---|--|
| a) Appearance                                   | Form: powder<br>Colour: light yellow                                     |
| b) Odour  | No data available  |
| c) Odour Threshold                              | No data available  |
| d) pH   | 9.9 at 100 g/l at 20 °C (68 °F)  |
| e) Melting point/freezing point                 | Melting point/range: 886 °C (1,627 °F) - lit.                            |
| f) Initial boiling point and boiling range      | No data available  |
| g) Flash point                                  | Not applicable   |
| h) Evaporation rate                             | No data available  |
| i) Flammability (solid, gas)                    | No data available  |
| j) Upper/lower flammability or explosive limits | No data available  |
| k) Vapour pressure                              | No data available  |
| l) Vapour density                               | No data available  |
| m) Relative density                             | 9.530 g/cm <sup>3</sup>  |
| n) Water solubility                             | 0.0702 g/l at 20 °C (68 °F) - OECD Test Guideline 105 - slightly soluble |
| o) Partition coefficient: n-octanol/water       | No data available  |
| p) Auto-ignition temperature                    | No data available  |
| q) Decomposition                                | No data available  |

temperature

- r) Viscosity No data available
- s) Explosive properties No data available
- t) Oxidizing properties No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Hydrogen peroxide, Strong oxidizing agents, acids

### 10.6 Hazardous decomposition products

Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

Skin - Rabbit

Result: Mild skin irritation - 24 h

#### Serious eye damage/eye irritation

Eyes - Rabbit

Result: No eye irritation

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

Hamster

Embryo

Morphological transformation.

#### Carcinogenicity

This product is or contains a component that has been reported to be probably carcinogenic based on its IARC, OSHA, ACGIH, NTP, or EPA classification.

Limited evidence of carcinogenicity in animal studies (oral)

IARC: 2A - Group 2A: Probably carcinogenic to humans (Lead monoxide)

2A - Group 2A: Probably carcinogenic to humans (Lead monoxide)

NTP: Reasonably anticipated to be a human carcinogenThe reference note has been added by TD based on the background information of the NTP. (Lead monoxide)

OSHA: OSHA specifically regulated carcinogen (Lead monoxide)

**Reproductive toxicity**

May cause congenital malformation in the fetus.

Known human reproductive toxicant

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

May cause damage to organs through prolonged or repeated exposure.

**Aspiration hazard**

No data available

**Additional Information**

RTECS: OG1750000

Lead salts have been reported to cross the placenta and to induce embryo- and feto- mortality. They also have teratogenic effect in some animal species. No teratogenic effects have been reported with exposure to organometallic lead compounds. Adverse effects of lead on human reproduction, embryonic and fetal development, and postnatal (e.g., mental) development have been reported. Excessive exposure can affect blood, nervous, and digestive systems. The synthesis of hemoglobin is inhibited and results in anemia. If left untreated, neuromuscular dysfunction, possible paralysis, and encephalopathy can result. Additional symptoms of overexposure include: joint and muscle pain, weakness of the extensor muscles (frequently the hand and wrist), headache, dizziness, abdominal pain, diarrhea, constipation, nausea, vomiting, blue line on the gums, insomnia, and metallic taste. High body levels produce increased cerebrospinal pressure, brain damage, and stupor leading to coma and often death., Anorexia., Vomiting, Convulsions, Nausea, Headache, Weakness, anemia, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION**

**12.1 Toxicity**

Toxicity to fish LC50 - Pimephales promelas (fathead minnow) - 0.298 mg/l - 96 h

Toxicity to daphnia and other aquatic invertebrates EC50 - Daphnia magna (Water flea) - 0.132 mg/l - 48 h

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

Very toxic to aquatic life with long lasting effects.

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

---

**13. DISPOSAL CONSIDERATIONS**

**13.1 Waste treatment methods**

**Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 2291      Class: 6.1      Packing group: III  
 Proper shipping name: Lead compounds, soluble, n.o.s. (Lead monoxide)  
 Reportable Quantity (RQ):

Poison Inhalation Hazard: No

**IMDG**

UN number: 2291      Class: 6.1      Packing group: III      EMS-No: F-A, S-A  
 Proper shipping name: LEAD COMPOUND, SOLUBLE, N.O.S. (Lead monoxide)  
 Marine pollutant: yes

**IATA**

UN number: 2291      Class: 6.1      Packing group: III  
 Proper shipping name: Lead compound, soluble, n.o.s. (Lead monoxide)

---

**15. REGULATORY INFORMATION****SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

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.

**SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Lead monoxide	1317-36-8	1993-04-24

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Lead monoxide	1317-36-8	1993-04-24

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Lead monoxide	1317-36-8	1993-04-24

**California Prop. 65 Components**

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer. Lead monoxide	1317-36-8	2007-09-28

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H302	Harmful if swallowed.
H302 + H332	Harmful if swallowed or if inhaled
H332	Harmful if inhaled.
H351	Suspected of causing cancer if swallowed.
H360	May damage fertility or the unborn child.

H373

May cause damage to organs through prolonged or repeated exposure.

**HMIS Rating**

Health hazard: 2  
Chronic Health Hazard: \*  
Flammability: 0  
Physical Hazard 0

**NFPA Rating**

Health hazard: 2  
Fire Hazard: 0  
Reactivity Hazard: 0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.6

Revision Date: 05/19/2015

Print Date: 12/02/2015

## SAFETY DATA SHEET

Version 4.8  
Revision Date 05/27/2015  
Print Date 06/22/2015

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Lead  
  
Product Number : 396117  
Brand : Aldrich  
  
CAS-No. : 7439-92-1

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

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

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA  
  
Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 4), H302  
Carcinogenicity (Category 2), H351  
Reproductive toxicity (Category 2), H361  
Specific target organ toxicity - repeated exposure (Category 2), H373  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Warning

Hazard statement(s)

H302 Harmful if swallowed.  
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.  
H410 Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201 Obtain special instructions before use.  
P202 Do not handle until all safety precautions have been read and understood.

P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	:	Pb
Molecular weight	:	207.2 g/mol
CAS-No.	:	7439-92-1
EC-No.	:	231-100-4

#### Hazardous components

Component	Classification	Concentration
<b>Lead</b>		
	Acute Tox. 4; Carc. 2; Repr. 2; STOT RE 2; Aquatic Acute 1; Aquatic Chronic 1; H302, H351, H361, H373, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Flush eyes with water as a precaution.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

### 5.2 Special hazards arising from the substance or mixture

No data available

### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

### 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
	Remarks	See 1910.1025		
Lead	7439-92-1	TWA	0.05 mg/m <sup>3</sup>	USA. ACGIH Threshold Limit Values (TLV)
		Confirmed animal carcinogen with unknown relevance to humans		
		TWA	0.05 mg/m <sup>3</sup>	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Hematologic effects Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		
		TWA	0.05 mg/m <sup>3</sup>	USA. NIOSH Recommended Exposure Limits
		See Appendix C		

### Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Lead	7439-92-1	Lead	30µg/ 100 ml	In blood	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Not critical			
		Lead	30µg/ 100 ml	In blood	ACGIH - Biological Exposure Indices (BEI)
		Not critical			

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: Shot
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 327.4 °C (621.3 °F) - lit.
f) Initial boiling point and boiling range	1,740 °C (3,164 °F) - lit.
g) Flash point	Not applicable
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

### 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong acids

### 10.6 Hazardous decomposition products

Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

Rat

Cytogenetic analysis

#### Carcinogenicity

Limited evidence of carcinogenicity in animal studies

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Lead)

NTP: Reasonably anticipated to be a human carcinogen (Lead)

Reasonably anticipated to be a human carcinogenThe reference note has been added by TD based on the background information of the NTP. (Lead)

OSHA: 1910.1025 (Lead)

OSHA specifically regulated carcinogen (Lead)

#### Reproductive toxicity

Suspected human reproductive toxicant

Reproductive toxicity - Rat - Inhalation

Effects on Newborn: Biochemical and metabolic.

Reproductive toxicity - Rat - Oral

Effects on Newborn: Behavioral.

Reproductive toxicity - Mouse - Oral

Effects on Fertility: Female fertility index (e.g., # females pregnant per # sperm positive females; # females pregnant per # females mated ). Effects on Fertility: Pre-implantation mortality (e.g., reduction in number of implants per female; total number of implants per corpora lutea).

Developmental Toxicity - Rat - Inhalation

Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Specific Developmental Abnormalities: Blood and lymphatic system (including spleen and marrow).

Developmental Toxicity - Rat - Oral

Specific Developmental Abnormalities: Blood and lymphatic system (including spleen and marrow). Effects on Newborn: Growth statistics (e.g., reduced weight gain).

Developmental Toxicity - Rat - Oral

Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Effects on Embryo or Fetus: Fetal death.

Developmental Toxicity - Mouse - Oral

Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Effects on Embryo or Fetus: Fetal death.

#### Specific target organ toxicity - single exposure

No data available

**Specific target organ toxicity - repeated exposure**

May cause damage to organs through prolonged or repeated exposure.

**Aspiration hazard**

No data available

**Additional Information**

RTECS: OF7525000

anemia

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

**12. ECOLOGICAL INFORMATION****12.1 Toxicity**

Toxicity to fish mortality LOEC - Oncorhynchus mykiss (rainbow trout) - 1.19 mg/l - 96.0 h

LC50 - Micropterus dolomieu - 2.2 mg/l - 96.0 h

mortality NOEC - Salvelinus fontinalis - 1.7 mg/l - 10.0 d

Toxicity to daphnia and other aquatic invertebrates mortality LOEC - Daphnia (water flea) - 0.17 mg/l - 24 h

mortality NOEC - Daphnia (water flea) - 0.099 mg/l - 24 h

Toxicity to algae mortality EC50 - Skeletonema costatum - 7.94 mg/l - 10 d

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

Bioaccumulation Oncorhynchus kisutch - 2 Weeks  
- 150 µg/l

Bioconcentration factor (BCF): 12

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal. Very toxic to aquatic life with long lasting effects.

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 3077 Class: 9

Packing group: III

Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Lead)

Reportable Quantity (RQ): 10 lbs

Poison Inhalation Hazard: No

**IMDG**

UN number: 3077      Class: 9      Packing group: III      EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Lead)  
Marine pollutant:yes

**IATA**

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Lead)

**Further information**

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

---

**15. REGULATORY INFORMATION**

**SARA 302 Components**

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

**SARA 313 Components**

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

**SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

**California Prop. 65 Components**

WARNING! This product contains a chemical known to the State of California to cause cancer.

CAS-No.	Revision Date
7439-92-1	1989-07-10

Lead

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

CAS-No.	Revision Date
7439-92-1	1989-07-10

Lead

---

**16. OTHER INFORMATION**

**Full text of H-Statements referred to under sections 2 and 3.**

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H302	Harmful if swallowed.
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.

H400 Very toxic to aquatic life.  
H410 Very toxic to aquatic life with long lasting effects.

**HMIS Rating**

Health hazard: 1  
Chronic Health Hazard: \*  
Flammability: 0  
Physical Hazard 0

**NFPA Rating**

Health hazard: 1  
Fire Hazard: 0  
Reactivity Hazard: 0

**Further information**

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**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.8

Revision Date: 05/27/2015

Print Date: 06/22/2015

## SAFETY DATA SHEET

Version 4.10  
Revision Date 11/12/2015  
Print Date 02/22/2016

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Lead(II) sulfate

Product Number : 307734  
Brand : Aldrich  
Index-No. : 082-001-00-6

CAS-No. : 7446-14-2

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

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

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 4), H302  
Acute toxicity, Inhalation (Category 4), H332  
Carcinogenicity (Category 1B), H350  
Reproductive toxicity (Category 1A), H360  
Specific target organ toxicity - repeated exposure (Category 2), H373  
Acute aquatic toxicity (Category 1), H400  
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word : Danger

Hazard statement(s)

H302 + H332 : Harmful if swallowed or if inhaled  
H350 : May cause cancer.  
H360 : May damage fertility or the unborn child.  
H373 : May cause damage to organs through prolonged or repeated exposure.  
H410 : Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/ physician if you feel unwell.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

#### 3.1 Substances

Formula	: O <sub>4</sub> PbS
Molecular weight	: 303.26 g/mol
CAS-No.	: 7446-14-2
EC-No.	: 231-198-9
Index-No.	: 082-001-00-6

#### Hazardous components

Component	Classification	Concentration
<b>Lead sulphate</b>	Acute Tox. 4; Carc. 1B; Repr. 1A; STOT RE 2; Aquatic Acute 1; Aquatic Chronic 1; H302 + H332, H350, H360, H373, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

### 4. FIRST AID MEASURES

#### 4.1 Description of first aid measures

##### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

##### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

##### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

##### In case of eye contact

Flush eyes with water as a precaution.

##### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

#### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

#### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

---

### 5. FIREFIGHTING MEASURES

#### 5.1 Extinguishing media

##### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

#### 5.2 Special hazards arising from the substance or mixture

Sulphur oxides, Lead oxides

#### 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

#### 5.4 Further information

No data available

---

### 6. ACCIDENTAL RELEASE MEASURES

#### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

#### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

#### 6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

#### 6.4 Reference to other sections

For disposal see section 13.

---

### 7. HANDLING AND STORAGE

#### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

#### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Keep in a dry place.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

#### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

#### 8.1 Control parameters

##### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Lead sulphate	7446-14-2	TWA	0.050000 mg/m <sup>3</sup>	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Hematologic effects		

		Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans varies		
		TWA	0.050000 mg/m3	USA. NIOSH Recommended Exposure Limits
		See Appendix C		
		PEL	0.050000 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1025 If an employee is exposed to lead for more than 8 hours in any work day, the permissible exposure limit, as a time weighted average (TWA) for that day, shall be reduced according to the following formula: Maximum permissible limit (in µg/m3 )=400÷hours worked in the day This section applies to all occupational exposure to lead, except as provided in paragraph (a)(2). It does not apply to the construction industry or to agricultural operations covered by 29 CFR part 1928. OSHA specifically regulated carcinogen		
		PEL	0.050000 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1025 If an employee is exposed to lead for more than 8 hours in any work day, the permissible exposure limit, as a time weighted average (TWA) for that day, shall be reduced according to the following formula: Maximum permissible limit (in µg/m3 )=400÷hours worked in the day This section applies to all occupational exposure to lead, except as provided in paragraph (a)(2). It does not apply to the construction industry or to agricultural operations covered by 29 CFR part 1928. OSHA specifically regulated carcinogen		
		TWA	0.05 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Hematologic effects Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans varies		
		PEL	0.05 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1025 If an employee is exposed to lead for more than 8 hours in any work day, the permissible exposure limit, as a time weighted average (TWA) for that day, shall be reduced according to the following formula: Maximum permissible limit (in µg/m3 )=400÷hours worked in the day This section applies to all occupational exposure to lead, except as provided in paragraph (a)(2). It does not apply to the construction industry or to agricultural operations covered by 29 CFR part 1928. OSHA specifically regulated carcinogen		
		TWA	0.05 mg/m3	USA. NIOSH Recommended Exposure Limits
		See Appendix C		

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |  |                               |
|--|-------------------------------|
| a) Appearance                              | Form: powder<br>Colour: beige |
| b) Odour                                   | No data available             |
| c) Odour Threshold                         | No data available             |
| d) pH                                      | No data available             |
| e) Melting point/freezing point            | No data available             |
| f) Initial boiling point and boiling range | No data available             |
| g) Flash point                             | Not applicable                |

- |   |  |
|---|--|
| h) Evaporation rate                             | No data available                      |
| i) Flammability (solid, gas)                    | No data available                      |
| j) Upper/lower flammability or explosive limits | No data available                      |
| k) Vapour pressure                              | No data available                      |
| l) Vapour density                               | No data available                      |
| m) Relative density                             | 6.2 g/cm <sup>3</sup> at 25 °C (77 °F) |
| n) Water solubility                             | No data available                      |
| o) Partition coefficient: n-octanol/water       | No data available                      |
| p) Auto-ignition temperature                    | No data available                      |
| q) Decomposition temperature                    | No data available                      |
| r) Viscosity                                    | No data available                      |
| s) Explosive properties                         | No data available                      |
| t) Oxidizing properties                         | No data available                      |

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Potassium, Strong bases

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

### Respiratory or skin sensitisation

No data available

### Germ cell mutagenicity

Human

leukocyte

Sister chromatid exchange

Hamster

ovary

Sister chromatid exchange

### Carcinogenicity

IARC: 2A - Group 2A: Probably carcinogenic to humans (Lead sulphate)

2A - Group 2A: Probably carcinogenic to humans (Lead sulphate)

NTP: Reasonably anticipated to be a human carcinogen The reference note has been added by TD based on the background information of the NTP. (Lead sulphate)

OSHA: OSHA specifically regulated carcinogen (Lead sulphate)

### Reproductive toxicity

No data available

Known human reproductive toxicant

### Specific target organ toxicity - single exposure

No data available

### Specific target organ toxicity - repeated exposure

May cause damage to organs through prolonged or repeated exposure.

### Aspiration hazard

No data available

### Additional Information

RTECS: OG4375000

Lead salts have been reported to cross the placenta and to induce embryo- and feto- mortality. They also have teratogenic effect in some animal species. No teratogenic effects have been reported with exposure to organometallic lead compounds. Adverse effects of lead on human reproduction, embryonic and fetal development, and postnatal (e.g., mental) development have been reported. Excessive exposure can affect blood, nervous, and digestive systems. The synthesis of hemoglobin is inhibited and results in anemia. If left untreated, neuromuscular dysfunction, possible paralysis, and encephalopathy can result. Additional symptoms of overexposure include: joint and muscle pain, weakness of the extensor muscles (frequently the hand and wrist), headache, dizziness, abdominal pain, diarrhea, constipation, nausea, vomiting, blue line on the gums, insomnia, and metallic taste. High body levels produce increased cerebrospinal pressure, brain damage, and stupor leading to coma and often death.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

Toxicity to fish LC50 - *Cynoglossus joyneri* - 0.75 mg/l - 96 h

Toxicity to daphnia and other aquatic invertebrates EC50 - *Daphnia magna* (Water flea) - 0.36 mg/l - 48 h

### 12.2 Persistence and degradability

Biodegradability Result: - Not readily biodegradable.

### 12.3 Bioaccumulative potential

No data available

### 12.4 Mobility in soil

No data available

## 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

## 12.6 Other adverse effects

Very toxic to aquatic life with long lasting effects.

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Lead sulphate)  
Reportable Quantity (RQ): 10 lbs

Poison Inhalation Hazard: No

### IMDG

UN number: 3077      Class: 9      Packing group: III      EMS-No: F-A, S-F  
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Lead sulphate)  
Marine pollutant:yes

### IATA

UN number: 3077      Class: 9      Packing group: III  
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Lead sulphate)

### Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

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.

### SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

	CAS-No.	Revision Date
Lead sulphate	7446-14-2	1993-04-24

### Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Lead sulphate	7446-14-2	1993-04-24

### New Jersey Right To Know Components

	CAS-No.	Revision Date
Lead sulphate	7446-14-2	1993-04-24

### California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the		

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H302	Harmful if swallowed.
H302 + H332	Harmful if swallowed or if inhaled
H332	Harmful if inhaled.
H350	May cause cancer.
H360	May damage fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure.

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

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### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 4.10

Revision Date: 11/12/2015

Print Date: 02/22/2016

## SAFETY DATA SHEET

Version 5.9  
Revision Date 02/26/2015  
Print Date 12/02/2015

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**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Sulfuric acid

Product Number : 320501  
Brand : Sigma-Aldrich  
Index-No. : 016-020-00-8

CAS-No. : 7664-93-9

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

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

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832  
Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

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**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Corrosive to metals (Category 1), H290  
Skin corrosion (Category 1A), H314  
Serious eye damage (Category 1), H318

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Danger

Hazard statement(s)

H290

May be corrosive to metals.

H314

Causes severe skin burns and eye damage.

H318

Causes serious eye damage.

Precautionary statement(s)

P234

Keep only in original container.

P264

Wash skin thoroughly after handling.

P280

Wear protective gloves/ protective clothing/ eye protection/ face protection.

P301 + P330 + P331

IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.

P303 + P361 + P353

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.

P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.
P363	Wash contaminated clothing before reuse.
P390	Absorb spillage to prevent material damage.
P405	Store locked up.
P406	Store in corrosive resistant stainless steel container with a resistant inner liner.
P501	Dispose of contents/ container to an approved waste disposal plant.

### 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1 Substances

Formula	: H <sub>2</sub> O <sub>4</sub> S
Molecular weight	: 98.08 g/mol
CAS-No.	: 7664-93-9
EC-No.	: 231-639-5
Index-No.	: 016-020-00-8
Registration number	: 01-2119458838-20-XXXX

#### Hazardous components

Component	Classification	Concentration
<b>Sulfuric acid</b>		
	Met. Corr. 1; Skin Corr. 1A; Eye Dam. 1; H290, H314, H318	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Move out of dangerous area. Consult a physician. Show this safety data sheet to the doctor in attendance.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Continue rinsing eyes during transport to hospital. Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

## 5.2 Special hazards arising from the substance or mixture

Sulphur oxides

## 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

## 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid inhalation of vapour or mist.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Storage class (TRGS 510): Non-combustible, corrosive hazardous materials

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Sulfuric acid	7664-93-9	TWA	0.2 mg/m <sup>3</sup>	USA. ACGIH Threshold Limit Values (TLV)
		TWA	1 mg/m <sup>3</sup>	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		TWA	1 mg/m <sup>3</sup>	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants

#### Derived No Effect Level (DNEL)

Application Area	Exposure routes	Health effect	Value
Workers	Inhalation	Acute local effects	0.1 mg/m <sup>3</sup>
Workers	Inhalation	Long-term local effects	0.05 mg/m <sup>3</sup>

#### Predicted No Effect Concentration (PNEC)

Compartment	Value
Marine water	0.00025 mg/l
Fresh water	0.0025 mg/l

Marine sediment	0.002 mg/kg
Fresh water sediment	0.002 mg/kg
Onsite sewage treatment plant	8.8 mg/l

## 8.2 Exposure controls

### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

### Personal protective equipment

#### Eye/face protection

Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

#### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

#### Full contact

Material: Fluorinated rubber

Minimum layer thickness: 0.7 mm

Break through time: 480 min

Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

#### Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.2 mm

Break through time: 30 min

Material tested: Dermatrill® P (KCL 743 / Aldrich Z677388, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

#### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

#### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

#### Control of environmental exposure

Do not let product enter drains.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

- |  |                     |
|--|---------------------|
| a) Appearance                              | Form: clear, liquid |
| b) Odour                                   | No data available   |
| c) Odour Threshold                         | No data available   |
| d) pH                                      | 1.2 at 5 g/l        |
| e) Melting point/freezing point            | 3 °C (37 °F)        |
| f) Initial boiling point and boiling range | No data available   |

g) Flash point	Not applicable
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	1.33 hPa (1.00 mmHg) at 145.8 °C (294.4 °F)
l) Vapour density	3.39 - (Air = 1.0)
m) Relative density	1.80 - 1.84 g/cm <sup>3</sup>
n) Water solubility	soluble
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

## 9.2 Other safety information

Surface tension	55.1 mN/m at 20 °C (68 °F)
Relative vapour density	3.39 - (Air = 1.0)

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Bases, Halides, Organic materials, Carbides, fulminates, Nitrates, picrates, Cyanides, Chlorates, alkali halides, Zinc salts, permanganates, e.g. potassium permanganate, Hydrogen peroxide, Azides, Perchlorates., Nitromethane, phosphorous, Reacts violently with: cyclopentadiene, cyclopentanone oxime, nitroaryl amines, hexalithium disilicide, phosphorous(III) oxide, Powdered metals

### 10.6 Hazardous decomposition products

Other decomposition products - No data available  
In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

LD50 Oral - Rat - 2,140 mg/kg

LC50 Inhalation - Rat - 2 h - 510 mg/m<sup>3</sup>

Dermal: No data available

No data available

#### **Skin corrosion/irritation**

Skin - Rabbit

Result: Extremely corrosive and destructive to tissue.

#### **Serious eye damage/eye irritation**

Eyes - Rabbit

Result: Corrosive to eyes

#### **Respiratory or skin sensitisation**

No data available

#### **Germ cell mutagenicity**

No data available

#### **Carcinogenicity**

The International Agency for Research on Cancer (IARC) has determined that occupational exposure to strong-inorganic-acid mists containing sulfuric acid is carcinogenic to humans (group 1).

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### **Reproductive toxicity**

No data available

#### **Specific target organ toxicity - single exposure**

No data available

#### **Specific target organ toxicity - repeated exposure**

No data available

#### **Aspiration hazard**

No data available

#### **Additional Information**

RTECS: WS5600000

Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin., spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting, Pulmonary edema. Effects may be delayed., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

## **12. ECOLOGICAL INFORMATION**

### **12.1 Toxicity**

Toxicity to fish LC50 - Gambusia affinis (Mosquito fish) - 42 mg/l - 96 h

Toxicity to daphnia and other aquatic invertebrates EC50 - Daphnia magna (Water flea) - 29 mg/l - 24 h

### **12.2 Persistence and degradability**

The methods for determining the biological degradability are not applicable to inorganic substances.

**12.3 Bioaccumulative potential**

No data available

**12.4 Mobility in soil**

No data available

**12.5 Results of PBT and vPvB assessment**

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

**12.6 Other adverse effects**

---

**13. DISPOSAL CONSIDERATIONS****13.1 Waste treatment methods****Product**

Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Offer surplus and non-recyclable solutions to a licensed disposal company.

**Contaminated packaging**

Dispose of as unused product.

---

**14. TRANSPORT INFORMATION****DOT (US)**

UN number: 1830      Class: 8      Packing group: II  
 Proper shipping name: Sulfuric acid  
 Reportable Quantity (RQ): 100 lbs

Poison Inhalation Hazard: No

**IMDG**

UN number: 1830      Class: 8      Packing group: II      EMS-No: F-A, S-B  
 Proper shipping name: SULPHURIC ACID

**IATA**

UN number: 1830      Class: 8      Packing group: II  
 Proper shipping name: Sulphuric acid

---

**15. REGULATORY INFORMATION****SARA 302 Components**

The following components are subject to reporting levels established by SARA Title III, Section 302:

	CAS-No.	Revision Date
Sulfuric acid	7664-93-9	2007-07-01

**SARA 313 Components**

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Sulfuric acid	7664-93-9	2007-07-01

**SARA 311/312 Hazards**

Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

	CAS-No.	Revision Date
Sulfuric acid	7664-93-9	2007-07-01

**Pennsylvania Right To Know Components**

	CAS-No.	Revision Date
Sulfuric acid	7664-93-9	2007-07-01

**New Jersey Right To Know Components**

	CAS-No.	Revision Date
Sulfuric acid	7664-93-9	2007-07-01

**California Prop. 65 Components**

WARNING! This product contains a chemical known to the State of California to cause cancer.  
Sulfuric acid

CAS-No.  
7664-93-9

Revision Date  
2007-09-28

---

**16. OTHER INFORMATION****Full text of H-Statements referred to under sections 2 and 3.**

Eye Dam.	Serious eye damage
H290	May be corrosive to metals.
H314	Causes severe skin burns and eye damage.
H318	Causes serious eye damage.
Met. Corr.	Corrosive to metals
Skin Corr.	Skin corrosion

**HMIS Rating**

Health hazard:	4
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	2

**NFPA Rating**

Health hazard:	3
Fire Hazard:	0
Reactivity Hazard:	0

**Further information**

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See [www.sigma-aldrich.com](http://www.sigma-aldrich.com) and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

**Preparation Information**

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.9

Revision Date: 02/26/2015

Print Date: 12/02/2015

## SAFETY DATA SHEET

Version 5.3  
Revision Date 08/29/2014  
Print Date 02/22/2016

---

**1. PRODUCT AND COMPANY IDENTIFICATION****1.1 Product identifiers**

Product name : Lead(II) methanesulfonate solution

Product Number : 462667

Brand : Aldrich

CAS-No. : 17570-76-2

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Manufacture of substances

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

Company : Sigma-Aldrich  
3050 Spruce Street  
SAINT LOUIS MO 63103  
USA

Telephone : +1 800-325-5832

Fax : +1 800-325-5052

**1.4 Emergency telephone number**

Emergency Phone # : (314) 776-6555

---

**2. HAZARDS IDENTIFICATION****2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 4), H302

Skin irritation (Category 2), H315

Serious eye damage (Category 1), H318

Reproductive toxicity (Category 1A), H360

Specific target organ toxicity - repeated exposure (Category 2), H373

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Danger

Hazard statement(s)

H302

Harmful if swallowed.

H315

Causes skin irritation.

H318

Causes serious eye damage.

H360

May damage fertility or the unborn child.

H373

May cause damage to organs through prolonged or repeated exposure.

Precautionary statement(s)

P201

Obtain special instructions before use.

P202

Do not handle until all safety precautions have been read and understood.

P260

Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.

P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P280	Wear protective gloves/ eye protection/ face protection.
P301 + P312	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310	Immediately call a POISON CENTER or doctor/ physician.
P321	Specific treatment (see supplemental first aid instructions on this label).
P330	Rinse mouth.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

### 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.2 Mixtures

Molecular weight : 397.40 g/mol

#### Hazardous components

Component	Classification	Concentration
<b>Lead(II) methanesulfonate</b>		
CAS-No. 17570-76-2	Acute Tox. 4; Skin Irrit. 2; Eye Dam. 1; Repr. 1A; STOT RE 2; H302 + H332, H315, H318, H360, H373	50 - 70 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

#### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

#### In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

#### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

#### If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

### 4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

### 4.3 Indication of any immediate medical attention and special treatment needed

No data available

## 5. FIREFIGHTING MEASURES

### 5.1 Extinguishing media

#### Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

## 5.2 Special hazards arising from the substance or mixture

Carbon oxides, Sulphur oxides, Lead oxides

## 5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

## 5.4 Further information

No data available

---

## 6. ACCIDENTAL RELEASE MEASURES

### 6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

For personal protection see section 8.

### 6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

### 6.3 Methods and materials for containment and cleaning up

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

### 6.4 Reference to other sections

For disposal see section 13.

---

## 7. HANDLING AND STORAGE

### 7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

### 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1 Control parameters

#### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Lead(II) methanesulfonate	17570-76-2	TWA	0.05 mg/m <sup>3</sup>	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Hematologic effects Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans varies		
		See 1910.1025		
		TWA	0.05 mg/m <sup>3</sup>	USA. NIOSH Recommended Exposure Limits
		See Appendix C		

### 8.2 Exposure controls

#### Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

## Personal protective equipment

### Eye/face protection

Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

### Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

### Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

### Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

### Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

---

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1 Information on basic physical and chemical properties

a) Appearance	Form: liquid
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	No data available
f) Initial boiling point and boiling range	No data available
g) Flash point	No data available
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

## 9.2 Other safety information

No data available

---

## 10. STABILITY AND REACTIVITY

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

No data available

### 10.5 Incompatible materials

Strong oxidizing agents

### 10.6 Hazardous decomposition products

Other decomposition products - No data available

In the event of fire: see section 5

---

## 11. TOXICOLOGICAL INFORMATION

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

#### Skin corrosion/irritation

No data available

#### Serious eye damage/eye irritation

No data available

#### Respiratory or skin sensitisation

No data available

#### Germ cell mutagenicity

No data available

#### Carcinogenicity

IARC: 2A - Group 2A: Probably carcinogenic to humans (Lead(II) methanesulfonate)

NTP: Reasonably anticipated to be a human carcinogen. The reference note has been added by TD based on the background information of the NTP. (Lead(II) methanesulfonate)

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

#### Reproductive toxicity

No data available

No data available

#### Specific target organ toxicity - single exposure

No data available

#### Specific target organ toxicity - repeated exposure

No data available

#### Aspiration hazard

No data available

## Additional Information

RTECS: Not available

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

---

## 12. ECOLOGICAL INFORMATION

### 12.1 Toxicity

No data available

### 12.2 Persistence and degradability

No data available

### 12.3 Bioaccumulative potential

No data available

### 12.4 Mobility in soil

No data available

### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

### 12.6 Other adverse effects

No data available

---

## 13. DISPOSAL CONSIDERATIONS

### 13.1 Waste treatment methods

#### Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

#### Contaminated packaging

Dispose of as unused product.

---

## 14. TRANSPORT INFORMATION

### DOT (US)

Not dangerous goods

### IMDG

Not dangerous goods

### IATA

Not dangerous goods

---

## 15. REGULATORY INFORMATION

### SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

### SARA 313 Components

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.

### SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

### Massachusetts Right To Know Components

No components are subject to the Massachusetts Right to Know Act.

### Pennsylvania Right To Know Components

Water

Lead(II) methanesulfonate

CAS-No.

7732-18-5

17570-76-2

Revision Date

2009-07-17

## New Jersey Right To Know Components

Water  
Lead(II) methanesulfonate

CAS-No.  
7732-18-5  
17570-76-2

Revision Date  
2009-07-17

## California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.  
Lead(II) methanesulfonate

CAS-No.  
17570-76-2

Revision Date  
2007-09-28

---

## 16. OTHER INFORMATION

### Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Eye Dam.	Serious eye damage
H302	Harmful if swallowed.
H302 + H332	Harmful if swallowed or if inhaled
H315	Causes skin irritation.
H318	Causes serious eye damage.
H360	May damage fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure.
Repr.	Reproductive toxicity
Skin Irrit.	Skin irritation
STOT RE	Specific target organ toxicity - repeated exposure

### HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

### NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

### Further information

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### Preparation Information

Sigma-Aldrich Corporation  
Product Safety – Americas Region  
1-800-521-8956

Version: 5.3

Revision Date: 08/29/2014

Print Date: 02/22/2016

**1. Identification**

**Product identifier**                    **AETFLOC C-5005**  
**Other means of identification**    None.  
**Recommended use**                    ALL PROPER AND LEGAL PURPOSES  
**Recommended restrictions**        None known.

**Manufacturer/Importer/Supplier/Distributor information**

**Manufacturer**

**Company name**                    Brenntag Mid-South, Inc.  
**Address**                                1405 Highway 136, West  
    Henderson, KY 42420  
**Telephone**                            270-830-1222  
**E-mail**                                 Not available.  
**Emergency phone number**        800-424-9300                                CHEMTREC

**2. Hazard(s) identification**

**Physical hazards**                    Not classified.  
**Health hazards**                    Skin corrosion/irritation                    Category 1B  
    Serious eye damage/eye irritation        Category 1  
**Environmental hazards**            Not classified.  
**OSHA defined hazards**            Not classified.

**Label elements**



**Signal word**                            Danger  
**Hazard statement**                    Causes severe skin burns and eye damage. Causes serious eye damage.  
**Precautionary statement**  
     **Prevention**                            Do not breathe mist or vapor. Wash thoroughly after handling. Wear eye protection/face protection. Wear protective gloves/protective clothing/eye protection/face protection.  
     **Response**                              If swallowed: Rinse mouth. Do NOT induce vomiting. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. If inhaled: Remove person to fresh air and keep comfortable for breathing. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center/doctor. Wash contaminated clothing before reuse.  
     **Storage**                                 Store locked up.  
     **Disposal**                                 Dispose of contents/container in accordance with local/regional/national/international regulations.  
**Hazard(s) not otherwise classified (HNOC)**    None known.  
**Supplemental information**        None.

**3. Composition/information on ingredients**

**Mixtures**

Chemical name	Common name and synonyms	CAS number	%
TRADE SECRET*		Proprietary*	10.5
Other components below reportable levels			89.5

\*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

## 4. First-aid measures

<b>Inhalation</b>	Move to fresh air. Call a physician if symptoms develop or persist.
<b>Skin contact</b>	Take off immediately all contaminated clothing. Rinse skin with water/shower. Call a physician or poison control center immediately. Chemical burns must be treated by a physician. Wash contaminated clothing before reuse.
<b>Eye contact</b>	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Call a physician or poison control center immediately.
<b>Ingestion</b>	Call a physician or poison control center immediately. Rinse mouth. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs.
<b>Most important symptoms/effects, acute and delayed</b>	Burning pain and severe corrosive skin damage. Causes serious eye damage. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Permanent eye damage including blindness could result.
<b>Indication of immediate medical attention and special treatment needed</b>	Provide general supportive measures and treat symptomatically. Chemical burns: Flush with water immediately. While flushing, remove clothes which do not adhere to affected area. Call an ambulance. Continue flushing during transport to hospital. Keep victim under observation. Symptoms may be delayed.
<b>General information</b>	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

## 5. Fire-fighting measures

<b>Suitable extinguishing media</b>	Water fog. Foam. Dry chemical powder. Carbon dioxide (CO <sub>2</sub> ).
<b>Unsuitable extinguishing media</b>	Do not use water jet as an extinguisher, as this will spread the fire.
<b>Specific hazards arising from the chemical</b>	During fire, gases hazardous to health may be formed.
<b>Special protective equipment and precautions for firefighters</b>	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
<b>Fire fighting equipment/instructions</b>	Move containers from fire area if you can do so without risk.
<b>Specific methods</b>	Use standard firefighting procedures and consider the hazards of other involved materials.
<b>General fire hazards</b>	No unusual fire or explosion hazards noted.

## 6. Accidental release measures

<b>Personal precautions, protective equipment and emergency procedures</b>	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Wear appropriate protective equipment and clothing during clean-up. Do not breathe the mist or vapor. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.
<b>Methods and materials for containment and cleaning up</b>	<p>Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water.</p> <p>Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.</p> <p>Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.</p>
<b>Environmental precautions</b>	Avoid discharge into drains, water courses or onto the ground.

## 7. Handling and storage

<b>Precautions for safe handling</b>	Provide adequate ventilation. Do not breathe the mist or vapor. Do not get in eyes, on skin, or on clothing. Wear appropriate personal protective equipment. Observe good industrial hygiene practices.
<b>Conditions for safe storage, including any incompatibilities</b>	Store locked up. Store in original tightly closed container. Store away from incompatible materials (see Section 10 of the SDS).

## 8. Exposure controls/personal protection

<b>Occupational exposure limits</b>	No exposure limits noted for ingredient(s).
<b>Biological limit values</b>	No biological exposure limits noted for the ingredient(s).

<b>Appropriate engineering controls</b>	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Eye wash facilities and emergency shower must be available when handling this product.
<b>Individual protection measures, such as personal protective equipment</b>	
<b>Eye/face protection</b>	Wear safety glasses with side shields (or goggles) and a face shield.
<b>Skin protection</b>	
<b>Hand protection</b>	Wear appropriate chemical resistant gloves. Suitable gloves can be recommended by the glove supplier.
<b>Other</b>	Wear appropriate chemical resistant clothing.
<b>Respiratory protection</b>	In case of insufficient ventilation, wear suitable respiratory equipment.
<b>Thermal hazards</b>	Wear appropriate thermal protective clothing, when necessary.
<b>General hygiene considerations</b>	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

## 9. Physical and chemical properties

### Appearance

<b>Physical state</b>	Liquid.
<b>Form</b>	Liquid.
<b>Color</b>	CLEAR TO PINK
<b>Odor</b>	SULFUR
<b>Odor threshold</b>	Not available.
<b>pH</b>	Not available.
<b>Melting point/freezing point</b>	1563.8 °F (851 °C) estimated / 999 °F (537.22 °C)
<b>Initial boiling point and boiling range</b>	Not available.
<b>Flash point</b>	999.0 °F (537.2 °C)
<b>Evaporation rate</b>	Not available.
<b>Flammability (solid, gas)</b>	Not applicable.
<b>Upper/lower flammability or explosive limits</b>	
<b>Flammability limit - lower (%)</b>	Not available.
<b>Flammability limit - upper (%)</b>	Not available.
<b>Explosive limit - lower (%)</b>	Not available.
<b>Explosive limit - upper (%)</b>	Not available.
<b>Vapor pressure</b>	0.00001 hPa estimated
<b>Vapor density</b>	Not available.
<b>Relative density</b>	Not available.
<b>Solubility(ies)</b>	
<b>Solubility (water)</b>	Not available.
<b>Partition coefficient (n-octanol/water)</b>	Not available.
<b>Auto-ignition temperature</b>	Not available.
<b>Decomposition temperature</b>	Not available.
<b>Viscosity</b>	Not available.
<b>Other information</b>	
<b>Density</b>	21.11 lbs/gal estimated
<b>Explosive properties</b>	Not explosive.
<b>Flammability class</b>	Combustible III B estimated
<b>Oxidizing properties</b>	Not oxidizing.

Specific gravity 2.53 estimated

## 10. Stability and reactivity

**Reactivity** The product is stable and non-reactive under normal conditions of use, storage and transport.

**Chemical stability** Material is stable under normal conditions.

**Possibility of hazardous reactions** Hazardous polymerization does not occur.

**Conditions to avoid** Contact with incompatible materials.

**Incompatible materials** Strong oxidizing agents.

**Hazardous decomposition products** No hazardous decomposition products are known.

## 11. Toxicological information

### Information on likely routes of exposure

**Inhalation** May cause irritation to the respiratory system.

**Skin contact** Causes severe skin burns.

**Eye contact** Causes serious eye damage.

**Ingestion** Causes digestive tract burns.

**Symptoms related to the physical, chemical and toxicological characteristics** Burning pain and severe corrosive skin damage. Causes serious eye damage. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Permanent eye damage including blindness could result.

### Information on toxicological effects

#### Acute toxicity

Components	Species	Test Results
TRADE SECRET		
<u>Acute</u>		
<b>Inhalation</b>		
LC50	Guinea pig	0.8 mg/l, 2 Hours
	Mouse	1.2 mg/l, 2 Hours
	Rat	2.3 mg/l, 2 Hours
<b>Oral</b>		
LD50	Rat	4090 mg/kg

\* Estimates for product may be based on additional component data not shown.

**Skin corrosion/irritation** Causes severe skin burns and eye damage.

**Serious eye damage/eye irritation** Causes serious eye damage.

#### Respiratory or skin sensitization

**Respiratory sensitization** Not a respiratory sensitizer.

**Skin sensitization** This product is not expected to cause skin sensitization.

**Germ cell mutagenicity** No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

**Carcinogenicity** This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

#### OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

**Reproductive toxicity** This product is not expected to cause reproductive or developmental effects.

**Specific target organ toxicity - single exposure** Not classified.

**Specific target organ toxicity - repeated exposure** Not classified.

**Aspiration hazard** Not an aspiration hazard.

## 12. Ecological information

**Ecotoxicity** The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Components		Species	Test Results
TRADE SECRET			
<b>Aquatic</b>			
Crustacea	EC50	Water flea (Ceriodaphnia dubia)	156.6 - 298.9 mg/l, 48 hours
Fish	LC50	Bluegill (Lepomis macrochirus)	300 mg/l, 96 hours

\* Estimates for product may be based on additional component data not shown.

**Persistence and degradability** No data is available on the degradability of this product.  
**Bioaccumulative potential** No data available.  
**Mobility in soil** No data available.  
**Other adverse effects** No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

## 13. Disposal considerations

**Disposal instructions** Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Dispose of contents/container in accordance with local/regional/national/international regulations.  
**Local disposal regulations** Dispose in accordance with all applicable regulations.  
**Hazardous waste code** The waste code should be assigned in discussion between the user, the producer and the waste disposal company.  
**Waste from residues / unused products** Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).  
**Contaminated packaging** Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

## 14. Transport information

**DOT**

**UN number** UN3266  
**UN proper shipping name** CORROSIVE LIQUID, BASIC, INORGANIC, N.O.S.(SODIUM CARBONATE, SODIUM TRITHIOCARBONATE)  
**Transport hazard class(es)**  
**Class** 8  
**Subsidiary risk** -  
**Packing group** II  
**Special precautions for user** Read safety instructions, SDS and emergency procedures before handling.  
**ERG number** 154  
DOT information on packaging may be different from that listed.

**DOT**



## 15. Regulatory information

**US federal regulations** This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.  
One or more components are not listed on TSCA.

**TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)**

Not regulated.

**CERCLA Hazardous Substance List (40 CFR 302.4)**

Not listed.

**SARA 304 Emergency release notification**

Not regulated.

**OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)**

Not listed.

**Superfund Amendments and Reauthorization Act of 1986 (SARA)**

<b>Hazard categories</b>	Immediate Hazard - Yes
	Delayed Hazard - No
	Fire Hazard - No
	Pressure Hazard - No
	Reactivity Hazard - No

**SARA 302 Extremely hazardous substance**

Not listed.

<b>SARA 311/312 Hazardous chemical</b>	No
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**SARA 313 (TRI reporting)**

Not regulated.

**Other federal regulations****Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List**

Not regulated.

**Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)**

Not regulated.

<b>Safe Drinking Water Act (SDWA)</b>	Not regulated.
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**US state regulations****US. California Controlled Substances, CA Department of Justice (California Health and Safety Code Section 11100)**

Not listed.

**US. Massachusetts RTK - Substance List**

Not regulated.

**US. New Jersey Worker and Community Right-to-Know Act**

Not listed.

**US. Pennsylvania Worker and Community Right-to-Know Law**

Not listed.

**US. Rhode Island RTK**

Not regulated.

**US. California Proposition 65**

California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins.

**International Inventories**

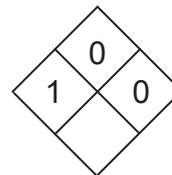
Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	No
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	No
New Zealand	New Zealand Inventory	No
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	No

Country(s) or region	Inventory name	On inventory (yes/no)*
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

\*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)  
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

## 16. Other information, including date of preparation or last revision

Issue date	04-04-2015
Revision date	05-22-2015
Version #	02
HMS® ratings	Health: 3 Flammability: 0 Physical hazard: 0
NFPA ratings	Health: 3 Flammability: 0 Instability: 0
Disclaimer	BNA cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.
Revision Information	This document has undergone significant changes and should be reviewed in its entirety.



NFPA Ratings

# TerraBond<sup>SC</sup>

11550 N. Meridian Street  
Suite 180  
Carmel, IN 46032  
Phone (317) 660-6868

## Material Safety Data Sheet

### Section 1. PRODUCT INFORMATION

PRODUCT NAME: **TERRABOND<sup>SC</sup>**  
 CHEMICAL DESCRIPTION: Alkaline Mixture  
 CHEMICAL NAME: Proprietary Formulation

### Section 2. INFORMATION ON INGREDIENTS

<u>Chemical Name</u>	<u>CAS Number</u>	<u>% by Weight</u>	<u>OSHA PEL (mg/M<sup>3</sup>)</u>	<u>ACGIH TLV (mg/M<sup>3</sup>)</u>
Proprietary Sulfur Blend	N/A	40-60	None Established	None Established
Calcium Hydroxide	1305-62-0	30-40	None Established	None Established
Calcium Carbonate	471-34-1	5-10	None Established	None Established
Inert/Other	N/A	8	None Established	None Established
Calcium Chloride	10035-04-8	1	None Established	None Established

### Section 3. HAZARDS IDENTIFICATION

**EMERGENCY OVERVIEW**

**CAUTION!** – Prolonged contact with the skin may cause irritation.

Eye contact could cause irritation or burning sensation.

Inhalation of dust may irritate the throat or lungs.

**Primary Routes of Entry:** Eye and skin contact. Inhalation of dust.

**Target Organs:** Eyes, skin, mucous membranes, lungs.

**Medical Conditions:** Individuals with pre-existing conditions of emphysema or asthma may experience respiratory irritation from breathing dust. Skin conditions or dermatitis may be aggravated by contact with this material.  
**(Aggravated by Exposure)**

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### Section 3. HAZARDS IDENTIFICATION (Continued)

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#### POTENTIAL HEALTH EFFECTS:

- Eye Contact:** Contact with eyes may cause irritation or abrasive injury.
- Skin Contact:** Prolonged contact may result in minor irritation or skin rash.
- Ingestion:** Ingestion of this product may cause irritation of the mucous membranes of the mouth, throat, esophagus and stomach.
- Inhalation:** Dust may cause respiratory irritation or fibrosing alveolitis (growth of fibrous tissue in the lung).
- Acute, Chronic:** Short-term exposure may cause minor irritation of the skin and mucous membranes.
- Carcinogenicity:** NTP: No IARC: No OSHA: No
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### Section 4. FIRST AID MEASURES

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- Eye Contact:** In case of contact, flush eyes for 15 minutes. Seek medical aid to ensure foreign matter is removed.
- Skin Contact:** Wash off promptly when exposure ceases. Do not allow dried sludge to remain on skin for prolonged periods as this may cause skin rash/irritation.
- Inhalation:** Move victim to a clean, dust-free environment.
- Ingestion:** Do not induce vomiting. Consult a physician.
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### Section 5. FIRE FIGHTING MEASURES

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- Flash Point:** None.
- Lower Flammability Limit:** None.
- Auto-Ignition Temperature:** None.
- Decomposition Products:** Oxides of sulfur (SO<sub>x</sub>), lime (CaO), chlorine, and other irritating gases.
- Extinguishing Media:** Non required; not combustible
- Fire-Fighting Instructions:** None required
- Fire & Explosion Hazards:** None
- NFPA RATINGS: Health = 1 Flammability = 0 Reactivity = 0 Special Hazard = None  
Scale: 0 = Normal material 1 = Slightly hazardous 2 = Hazardous 3 = Extremely dangerous  
4 = Deadly
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### Section 6. ACCIDENTAL RELEASE MEASURES

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- Steps To Be Taken If Material Is Spilled Or Released:** Contain the spill. Dispose of as conventional waste suitable for a municipal landfill.
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### Section 7. HANDLING AND STORAGE

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- Handling:** Handle material wet rather than dry whenever possible.
- Storage:** No special requirements; material is chemically and thermally stable.

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## Section 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

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### PERSONAL PROTECTIVE EQUIPMENT:

- Eye/Face Equipment:** Use safety glasses when handling sludge or safety goggles if handling dry powder.
- Skin Protection:** None required under anticipated handling that requires minimal contact. If gross skin contamination is expected, cover exposed skin to prevent prolonged contact with material.
- Respiratory Protection:** Dust mask for handling dry powder when airborne dust exceeds 10 mg/M<sup>3</sup>.
- Engineering Controls:** None required.
- Work Practices:** Keep material wet to minimize dust generation.
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## Section 9. PHYSICAL AND CHEMICAL PROPERTIES

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<b>Boiling Point:</b>	Not available.	<b>Solubility in Water:</b>	: Slightly soluble.
<b>Vapor Pressure:</b>	Negligible.	<b>Specific Gravity:</b>	30 lbs / CuFt
<b>Vapor Density:</b>	Not applicable.	<b>pH:</b>	10-12
<b>% Volatile by Weight:</b>	None.	<b>Freezing Point::</b>	Not available.
<b>Appearance and Odor:</b>	White powder.		

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## Section 10. STABILITY AND REACTIVITY

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<b>Chemical Stability:</b>	Stable under normal temperature and pressures.	<b>Conditions to Avoid:</b>	Incompatible materials, strong oxidizers heat in the presence of aluminum or phosphorus.
<b>Hazardous Polymerization:</b>	Will not occur.	<b>Incompatibility:</b>	Oxidizing agents, aluminum, phosphorus.
<b>Decomposition Products:</b>	Stable, dries to powder.		

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## Section 11. TOXICOLOGICAL INFORMATION

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**On Product:** Only minor irritation has been observed when skin has had prolonged contact.

**On Ingredients:**

Chemical Name	Oral LD <sub>50</sub> (rat)	Dermal LD <sub>50</sub> (rat)	Inhalation LD <sub>50</sub> (rat)
Proprietary Formulation	not available	not available	not available
Calcium carbonate (CaCO <sub>3</sub> )	6450 mg/kg	not available	not available

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## Section 12. ECOLOGICAL INFORMATION

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**Aquatic Toxicity:** No data found. **Environmental Fate:** No data found. **Environmental Toxicity:** No data found.

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**Section 13. DISPOSAL CONSIDERATIONS**

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**RCRA Status:** This material is not a RCRA listed hazardous waste nor does it exhibit any hazardous waste characteristics.

**Disposal:** Dispose of in a manner consistent with federal, state, or local laws and regulations.

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**Section 14. TRANSPORT INFORMATION**

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**D.O.T. Classification:** Not applicable; not a D.O.T. hazardous material.

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**Section 15. REGULATORY INFORMATION**

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**TSCA:** Calcium carbonate is listed on the TSCA inventory.

**CERCLA:** Not applicable - contains no hazardous substances at or above de minimis concentrations.

**SARA TITLE III:**

**Section 302 Extremely Hazardous Substances:** None at or above de minimis concentrations.

**Section 311/312 Health and Physical Hazards:** Delayed (chronic) health hazard from long-term inhalation of dust.

**Section 313 Toxic Chemicals:** None at or above de minimis concentrations.

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**Section 16. OTHER INFORMATION**

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**HMIS Ratings:** Health = 1 Flammability = 0 Reactivity = 0 Personal Protection = B = Safety glasses + gloves  
Hazard rating scale: 0 = Minimal  
1 = Slight  
2 = Moderate  
3 = Serious  
4 = Severe

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While this information and recommendations set forth herein are believed to be accurate as of the date hereof, Terra Materials LLC makes no warranty with respect hereto and disclaims all liability from reliance thereon.

# Sikagard® Duochem 7500

*(Formerly Duochem 7500 / Supersedes Sikagard® Capchem AR)*

## Chemical-Resistant Epoxy-Novolac Floor Coating and Topping or Containment Lining

<b>Description</b>	Sikagard® Duochem 7500 is a two-component, high solids, epoxy-Novolac coating/topping/lining which possesses outstanding resistance to strong inorganic acids, concentrated sulphuric acid and oxygenated solvents.
<b>Where to Use</b>	<ul style="list-style-type: none"> <li>■ As a smooth, chemical-resistant lining on concrete or steel substrates subject to concentrated acids.</li> <li>■ Protection of containment tanks, machine bases, plant floors and walls exposed to aggressive chemicals.</li> <li>■ Protection against ground water contamination resulting from uncontained chemical spills.</li> <li>■ As a broadcast, build-up system to provide a slip resistant and durable wearing surface in pedestrian areas where aggressive chemicals are present.</li> </ul>
<b>Advantages</b>	<ul style="list-style-type: none"> <li>■ The material is convenient to proportion, 2:1 by volume resin to hardener ratio.</li> <li>■ Sikagard® Duochem 7500 may be applied as a smooth system or a broadcast build-up system incorporating silica sand.</li> <li>■ Sikagard® Duochem 7500 provides a high build and effective barrier for concrete and steel to protect against a wide range of aggressive substances.</li> <li>■ Sikagard® Duochem 7500 exhibits excellent adhesion, hardness, abrasion resistance, and compressive strength values.</li> <li>■ The systems provide excellent protection for steel and concrete against a wide range of chemicals. See product specific Chemical Resistance Guide.</li> </ul>

<b>Technical Data</b>			
<b>Packaging</b>	11.34 L (3 US gal.) and 56.7 L (15 US gal.) units		
<b>Colour</b>	RAL 7046 Telegrey 2, RAL 3009 Oxide Red, Clear		
<b>Yield</b>	<b>Concrete Substrates</b>	<b>Smooth Coating</b>	
	Primer Coat	Sikagard® WDE Primer	4 m <sup>2</sup> /L (160 ft <sup>2</sup> /US gal.) 10 mils w.f.t.
	1st Coat	Sikagard® Duochem 7500	2.6 m <sup>2</sup> /L (106 ft <sup>2</sup> /US gal.) 15 mils w.f.t.
	2nd coat	Sikagard® Duochem 7500	2.6 m <sup>2</sup> /L (106 ft <sup>2</sup> /US gal.) 15 mils w.f.t.
	Maximum build per coat for Sikagard® Duochem 7500 on vertical surfaces: 7 mils w.f.t. Three coats may be required for the smooth coating to be produced vertically.		
	<b>Broadcast Build-Up System</b>		
	Primer Coat	Sikagard® WDE Primer	4 m <sup>2</sup> /L (160 ft <sup>2</sup> /US gal.) 10 mils w.f.t.
	Broadcast Coat	Sikagard® Duochem 7500	2 m <sup>2</sup> /L (80 ft <sup>2</sup> /US gal.) 20 mils w.f.t.
	Aggregate	Oven dried silica sand #32 mesh (spherical) 0.3 - 0.85 mm or #16 mesh (angular) 0.6 - 2.0 mm	3 - 5 kg/m <sup>2</sup> (0.6 - 1 lb/ft <sup>2</sup> )
	Top Coat	Sikagard® Duochem 7500 Coloured or Clear	2 - 2.6 m <sup>2</sup> /L (80 - 106 ft <sup>2</sup> /US gal.) 15 - 20 mils w.f.t.





<b>Steel Substrates</b>	<b>Smooth Coating</b>		
	1st Coat	Sikagard® Duochem 7500	2.6 m <sup>2</sup> /L (106 ft <sup>2</sup> /US gal.) 15 mils w.f.t.
	2nd Coat	Sikagard® Duochem 7500 Coloured or Clear	2.6 m <sup>2</sup> /L (106 ft <sup>2</sup> /US gal.) 15 mils w.f.t.
Maximum build per coat for Sikagard® Duochem 7500 on vertical surfaces: 7 mils. Three coats may be required for the smooth coating to be produced vertically.			
<b>Broadcast Build-Up System</b>			
	Primer Coat	Sikagard® Duochem 7500	2.6 m <sup>2</sup> /L (106 ft <sup>2</sup> /US gal.) 15 mils w.f.t.
	Broadcast Coat	Sikagard® Duochem 7500	2 m <sup>2</sup> /L (80 ft <sup>2</sup> /US gal.) 20 mils w.f.t.
	Aggregate	Oven dried silica sand #32 mesh (spherical) 0.3 - 0.85 mm or #16 mesh (angular) 0.6 - 2.0 mm	3 - 5 kg/m <sup>2</sup> (0.6 - 1 lb/ft <sup>2</sup> )
	Top Coat	Sikagard® Duochem 7500 Coloured or Clear	2 - 2.6 m <sup>2</sup> /L (80 - 106 ft <sup>2</sup> /US gal.) 15 - 20 mils w.f.t.
<b>For Optimum Chemical Resistance for all Systems</b>			
	Optional 3rd / Barrier Coat	Sikagard® Duochem 7500 (Clear)	2.6 m <sup>2</sup> /L (106 ft <sup>2</sup> /US gal.) 15 mils w.f.t.
Actual coverage rates and material consumption will depend upon porosity and profile of substrates. Allowance must be also made for variation in film thickness or number of coats required to achieve opacity with light (ie white) or bright colours (ie reds and yellows) and dark substrates. Test sections are recommended to establish correct coverage.			
<b>Shelf Life</b>			
2 years when stored in original, unopened packaging. Store dry at 5 - 32°C (41 - 90°F). Condition product between 18 - 30° (65 - 86°F) before use.			
<b>Mix Ratio</b>			
A:B= 2:1 by volume			
<b>Waiting Time Between Coats @ 23°C (73°F)</b>			
Minimum		Touch dry	
Maximum		24 hours	
<b>Properties at 25°C (77°F)</b>			
<b>Solids Content</b>			
By volume		Approx. 95 %	
By weight		Approx. 96 %	
<b>Pot Life, 250 g (8.8 oz)</b>		Approx. 60 min	
<b>Drying Times</b>			
Foot traffic		1 day	
Light traffic		2 days	
Full chemical resistance		7 days	
<i>Drying times will vary according to air and substrate temperature and humidity.</i>			
<b>Properties at 28 days</b>			
<b>Tensile Strength ASTM D638, Type IV</b>		<b>SMOOTH COATING</b>	<b>BROADCAST SYSTEM*</b>
<b>Elongation at Break ASTM D638, Type IV</b>		20.4 MPa (2960 psi)	11.0 MPa (1595 psi)
<b>Compressive Strength ASTM D695</b>		28%	8.4%
<b>Water Absorption ASTM D570</b>		57.8 MPa (8380 psi)	23.7 MPa (3435 psi)
24 h		0.42%	0.11%
7 days		1.02%	0.34%
2 h boiling water		-0.57%	-0.10%
<b>Bond Strength to Concrete ASTM D4541</b>		2.8 MPa (406 psi) substrate failure	3.6 MPa (520 psi) substrate failure
<b>Abrasion Resistance ASTM D4060</b>			
Taber Abraser, CS-17 and H-22 Wheels/ 1000 g (2.2 lb)/1000 cycles		170 mg (CS-17)	833 mg ** (H-22)
<b>Impact Resistance ASTM D3029</b>			
Microscopic cracks		5.8 J (51.3 lb/in)	1.5 J (15.2 lb/in)
Major cracks		6.2 J (54.8 lb/in)	10.5 J (91.9 lb/in)
<b>Hardness (Shore D) ASTM D2240</b>		67	72
<b>Water Vapour Transmission ASTM E96</b> (Water method)		0.19 g/hr/m <sup>2</sup> 30 mils film	0.07 g/hr/m <sup>2</sup> 64 mils film
<b>Water Permeance ASTM E96</b> (Water method)		0.48 perm 30 mils film	0.12 perm 64 mils film
<b>Thermal Compatibility with Concrete</b>			
<b>ASTM C884</b> (from -23 to 23°C)		Substrate Failure ***	Substrate Failure ***
<b>Static Coefficient of Friction ASTM C1028</b>			
Dry surface		0.75	1.26
Wet surface		0.55	0.94
<b>Linear Shrinkage ASTM C531</b>		-	0.20
<b>Coefficient of Linear Thermal Expansion</b>			
<b>ASTM C531, cm/cm/°C</b>		-	2.26 x 10 <sup>-5</sup> /°C (1.25 x 10 <sup>-5</sup> /°F)
*24 mesh silica sand used for broadcasting.			
**Standard 28 MPa concrete exhibits 3,872 mg loss when tested as per this procedure.			
***Failure occurs in underlying concrete.			
<i>Product properties are typically averages, obtained under laboratory conditions. Reasonable variations can be expected on-site due to local factors, including environment, preparation, application, curing and test methods.</i>			

## How to Use

### Surface Preparation

**Concrete:** Concrete substrates must be clean and sound. Remove any dust, laitance, grease, oil, dirt, curing agents, impregnations, wax, foreign matter, coatings and detritus from the surface by appropriate mechanical means, in order to achieve a profile equivalent to ICRI-CSP 3-4 for floors and ICRI-CSP 2-3 for walls. The compressive strength of the concrete substrate should be at least 25 MPa (3625 psi) at 28 days and at least 1.5 MPa (218 psi) in tension at the time of application of Sikagard® WDE Primer & Sikagard® Duochem 7500.

**Steel:** All steel to be coated must be dry, clean and stable before applying the coating. Remove all existing treatments such as coatings, sealers, wax, and contaminants i.e. dirt, dust, grease, oils, and foreign matter, which will interfere with the adhesion of Sikagard® Duochem 7500. Prepare steel substrates by appropriate mechanical means, such as abrasive blast-cleaning in order to achieve clean white metal profile equivalent to SSPC-SP10, Near White Metal, 2 to 4 mils anchor profile and apply coating immediately, before oxidation of the steel occurs.

### Mixing

Thoroughly pre-stir each component separately to ensure that all solids are distributed throughout and components are consistent within themselves.

Empty the complete contents of Component B into the part filled Component A unit. Where part mixing a unit, ensure that the components are proportioned in the correct ratio and empty both into a suitably sized, clean mixing vessel.

Mix the combined components for at least 3 minutes, using a low-speed drill (200-300 rpm) to minimize entrapping air. Use an Exomixer type mixing paddle (recommended model) suited to the volume of the mixing container. During the mixing operation, scrape down the sides and bottom of the container with a flat or straight edge trowel at least once, to ensure complete mixing. When completely mixed, Sikagard® Duochem 7500 should be uniform in colour and consistency. Mix only that quantity which can be used within its pot life.

Never use a thickening agent such as Sikafloor® Extender T, Cabosil or any other to increase product viscosity as this will greatly reduce chemical resistance.

### Application

#### Concrete:

##### Smooth Coating:

**Primer Coat:** Apply Sikagard® WDE Primer onto concrete substrates using a brush, roller or squeegee to a uniform coverage without ponding.

**1st Coat:** Once the primer is tack free apply Sikagard® Duochem 7500 using a brush, roller or squeegee to a uniform coverage without ponding.

**2nd Coat:** Once first coat is tack free, apply a second coat of Sikagard® Duochem 7500 using a brush, roller or squeegee to a uniform coverage without ponding.

##### Broadcast Build-Up System:

**Primer Coat:** Apply Sikagard® WDE Primer onto concrete substrates using a brush, roller or squeegee to a uniform coverage without ponding.

**Broadcast Coat:** Once the primer is tack free apply the broadcast coat of Sikagard® Duochem 7500 using a notched squeegee or trowel and backroll to a uniform coverage. Broadcast the selected sand (shape and size to be selected in accordance with required texture/slip resistance) into the wet resin to rejection.

**Top Coat:** Once the broadcast coat has sufficiently cured to allow foot traffic, sweep-up and vacuum-off all loose, unbonded sand. Apply the top coat of Sikagard® Duochem 7500 using a squeegee, followed by back rolling to provide a uniform texture and finish.

#### Steel:

Priming, consolidating or sealing of common steel substrates with Sikagard® WDE Primer is not usually required under typical circumstances. However, due to variations in steel quality, surface condition, surface preparation and ambient conditions, reference test areas are recommended to determine whether priming is required to prevent the possibility of debonding, blisters, pinholes or other defects. Consult Sika Technical Sales for advice.

Application of Sikagard® Duochem 7500 onto properly prepared steel surfaces is typically the same procedure as outlined above for smooth coatings and broadcast build-up systems onto concrete, excluding the use of Sikagard® WDE primer, unless determined otherwise.

See Yield section of this product data sheet above for number of coats, coverage rates, specific application thicknesses and number of coats recommended.



<b>Clean Up</b>	Clean all tools and equipment immediately after use with Sika® Duochem 201 cleaning solvent. Once hardened, material can only be removed mechanically. Wash soiled hands and skin thoroughly in hot water or use Sika® Hand Cleaner towels.
<b>Limitations</b>	<ul style="list-style-type: none"> <li>■ Sikagard® Duochem 7500, as a primary or secondary containment coating system, is best installed by skilled and experienced applicators. Consult Sika Canada Technical Services for advice and recommendations.</li> <li>■ Not suitable for use on exterior, slab-on-grade concrete substrates.</li> <li>■ Minimum / Maximum substrate temperature; 15°C / 30°C (59°F / 86°F).</li> <li>■ Observe minimum application temperature of 15°C (59°F) and product conditioning temperatures of 18 - 30° (65 - 86°F) as high viscosity coatings exhibit reduced smoothing properties and greater tendency to display application marks at low temperatures.</li> <li>■ Substrate temperature must be at least 3°C (5.5°F) above the measured dew point.</li> <li>■ Moisture content of concrete substrates must be &lt; 6% (Tramex meter measurement) before application of Sikagard® WDE Primer otherwise use Sikagard® 75 EpoCem or Sikafloor® 81 EpoCem<sup>CA</sup> as an initial barrier.</li> <li>■ Do not apply onto porous surfaces where moisture vapour transmission will occur during application.</li> <li>■ Maximum relative humidity during application and cure; 85%.</li> <li>■ Do not hand mix Sikagard® materials; mechanically mix only.</li> <li>■ Should maximum waiting time between coats be exceeded, abrade surface of applied material (removing all gloss) vacuum-off all dust and debris, and wipe with Sika® Duochem 201 solvent. Allow solvent to flash off before proceeding with subsequent coats.</li> <li>■ Protect from dampness, condensation and water contact during the initial 24 hour cure period (curing times will be lengthened at cold temperatures and protection should therefore remain for longer).</li> <li>■ Not recommended for areas subject to frequent thermal cycles.</li> <li>■ While the material is supplied in colours, it is not intended and should not be used as a decorative finish, but as a chemical resistant barrier. In addition to discolouration due to ultraviolet light, exposure to some chemicals may result in a change in the appearance of the finish, with loss of gloss values, change in colour and/or staining. This however, does not necessarily constitute a compromise of this protective surfacing.</li> </ul>
<b>Health and Safety Information</b>	<p>For information and advice on the safe handling, storage and disposal of chemical products, users should refer to the <b>most recent Material Safety Data Sheet</b> containing physical, ecological, toxicological and other safety-related data.</p> <p>KEEP OUT OF REACH OF CHILDREN FOR INDUSTRIAL USE ONLY</p>

The information, and in particular, the recommendations relating to the application and end-use of Sika products, are given in good faith based on Sika's current knowledge and experience of the products when properly stored, handled and applied under normal conditions, within their shelf life. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any recommendations, or from any other advice offered. The proprietary rights of third parties must be observed. All orders are accepted subject to our current terms of sale and delivery. Users should always refer to the most recent issue of the Product Data Sheet for the product concerned, copies of which will be supplied on request or can be accessed in the Internet under [www.sika.ca](http://www.sika.ca).



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## Sikagard® CRV 20

### Chemical-Resistant, Novolac Vinyl Ester Resin Coating, Topping and Lining

<b>Description</b>	Sikagard CRV 20 is a coating/topping/lining designed for use where chemical resistance is required on concrete or steel substrates. As the protective component of a system, it is used in conjunction with Sikagard WDE Primer, a two-component epoxy primer providing excellent adhesion to dry or damp concrete substrates and good chemical resistance. The Sikagard® CRV 20 is based upon a modified Novolac Vinyl Ester polymer resin that provides a hard and durable surface. It offers high resistance to a variety of solvents, acids and oxidizing substances and excellent dry heat resistance up to 284°F
<b>Where to Use</b>	<ul style="list-style-type: none"> <li>■ As a smooth, chemical resistant lining on concrete or steel substrates.</li> <li>■ As a broadcast textured floor system to provide a slip resistant, durable wearing surface in pedestrian areas where aggressive chemicals are present.</li> <li>■ Protection of containment tanks, machine bases, plant floors and walls exposed to aggressive chemicals.</li> <li>■ Protection against ground water contamination resulting from uncontained chemical spills.</li> </ul>
<b>Advantages</b>	<ul style="list-style-type: none"> <li>■ The material may be applied as a smooth coating or build-up system incorporating aggregate.</li> <li>■ Suitable for vertical and horizontal surfaces.</li> <li>■ Provides a hard wearing and slip resistant floor finish.</li> <li>■ Will cure down to 14°F and can be formulated to cure down to -4°F.</li> <li>■ Exhibits excellent impact, abrasion and fatigue resistance.</li> <li>■ The systems provide excellent protection for steel and concrete against a wide range of chemicals.</li> </ul>
<b>Chemical Resistance</b>	Before applying for protection against specific chemical environments, consult Sikagard CRV 20 Chemical Resistance Guide or contact Sika Technical Services at 800-933-SIKA (7452).

#### Typical Data

##### Packaging

Resin: 1 gallon in a 1 gallon metal can  
Catalyst (BPO): 120 g (200 mL) plastic container.

##### Color

RAL 7038 Agate Grey

##### Yield

##### Smooth Coating

Primer Coat	Sikadur WDE Primer	(163 ft <sup>2</sup> /gal) 10 mils wft
1st Coat	Sikagard CRV 20	(105 ft <sup>2</sup> /gal) 15 mils wft
2nd Coat	Sikagard CRV 20	(105 ft <sup>2</sup> /gal) 15 mils wft

Maximum build per coat for Sikagard CRV 20 on vertical surfaces: 10 mils wft. Three coats may be required for the smooth coating to be produced vertically.

##### Broadcast Build-Up System

Primer Coat	Sikadur WDE Primer	(160 ft <sup>2</sup> /gal) 10 mils wft
Aggregate	#32 mesh (spherical)	(50 lbs/100ft <sup>2</sup> )
Broadcast Coat	Sikagard CRV 20	105 ft <sup>2</sup> /gal 15 mils wft
Aggregate	#32 mesh (spherical)	(50 lbs/100ft <sup>2</sup> )
Top Coat	Sikagard CRV 20	(105 ft <sup>2</sup> /Gal) 15 mils wft

**Shelf Life:** 6 months in original, undamaged and unopened packaging. Store dry in heated area and off ground on pallets or similar. Protect Sikagard CRV 10 from freezing. If frozen, discard.

## Properties at 23°C (73°F) and 50% R.H.

Component	"A" Resin	"B" Hardener	"A"+"B" Mixed
Specific gravity, kg/L (lb/US gal.)	Vinyl Ester Resin 1.08 (9.0)	Benzoyl Peroxide Powder 0.6 (4.99)	1.08 (9.0)
Viscosity	500 cps	Powder	500 cps
Pot Life 200 g (7.05 oz)	-	-	12 min
Waiting Time Between Coats (CRV - 20 to CRV -20)	Minimum 1.5 hrs	Maximum 24 hrs	
Curing/Drying Times	Tack-free Time	30 -40 mins	
	Traffic exposure	4 hrs	
	Chemical exposure	24 hrs	

### Physical Testing

The following are typical properties of Sikagard CRV 20 as 3 mm (120 mils) clear castings at room temperature.

Tensile Strength	10 150 psi
Tensile Modulus	510 500 psi
Elongation	3%
Flexural Strength	17 985 psi
Flexural Modulus	551 150 psi
Heat Distortion Temperature	284°F
Barcol Hardness	40
VOC (EPA Method 24)	≤ 100 g/l

## How to Use

### Surface Preparation

Surface must be clean, sound and dry. Remove dust, laitance, grease, curing compounds, bond inhibiting impregnations, waxes and any other contaminants. All projections, rough spots, etc. should be dressed off to achieve a level surface prior to the application. Concrete - Should be cleaned and prepared to achieve a laitance and contaminant free, open textured surface by shot blasting or equivalent mechanical means (CSP-3 as per ICRI guidelines). Sweep and vacuum any remaining dirt and dust with a wet/dry vacuum. Removing residual dust will help ensure a tenacious bond between the primer and substrate. Whenever "shot-blasting" is utilized, be careful to leave concrete with a uniform texture. Over "blasting" will result in reduced coverage rates of the primer and/or subsequent topcoats. It is also possible that the texture of the "shot-blast" pattern may show through the last coat. This is known as "tracking". The compressive strength of the concrete substrate should be at least 3500 psi (24 MPa) at 28 days and at least 250 psi (1.7 MPa) in tension at the time of application of Sikagard WDE Primer and Sikagard CRV 20.

### Mixing

The material is supplied as two-components, Part R and catalyst powder. Thoroughly stir Component R to ensure all solids, including pigments, are evenly dispersed. While stirring, periodically check interior of can with stir spatula or similar to again ensure dispersal and distribution of solids throughout resin. Add catalyst powder to pre-mixed Component R and thoroughly mix for 1 minute with a low-speed drill (200-300 rpm) to minimize air entrapment. Use an Exomixer type mixing paddle (recommended model) of suitable size for the mixing vessel. During the mixing operations scrape down the sides and bottom of the container with a flat or straight edge trowel at least once to ensure complete mixing. When completely mixed, Sikagard CRV 20 should be uniform in color and consistency. Mix full units only.

### Application

Concrete Substrates: Smooth coating: This provides a smooth, easy maintenance system. Primer coat: Apply Sikagard WDE Primer onto concrete substrates using a brush, roller or squeegee to a uniform coverage without ponding. Allow primer to cure for a minimum of 6 hours at 20°C (68°F) or 10 hours at 10°C (50°F) before over coating with Sikagard CRV 20. 1st coat: Once the Sikagard WDE Primer has cured apply Sikagard CRV 20 using a brush, roller or squeegee to a uniform coverage without ponding. 2nd coat: Once 1st Coat is tack free apply a second coat of Sikagard CRV 20 using a brush, roller or squeegee to a uniform coverage without ponding. NOTE : If over coating of Sikagard WDE Primer with Sikagard CRV 20 is attempted before the necessary curing time has elapsed, the reactive components in the Sikagard CRV 20 will act as a solvent, softening the Sikagard WDE Primer, causing retardation or stopping the cure of the Sikagard CRV 20. For additional information see Sika Technical Bulletin Sikagard CRV 20 and CRV 20 - Properties and Application Guidelines. Broadcast build- up system: This provides a durable and slip resistant textured finish. Primer coat: Apply Sikagard WDE Primer onto concrete substrates using a brush, roller or squeegee to a uniform coverage without ponding. Broadcast the selected aggregate (selected for texture) into the wet primer to rejection. Broadcast coat: Once the primer coat has sufficiently cured to allow foot traffic, sweep-up and vacuum the loose unbonded aggregate. Apply the broadcast coat of Sikagard CRV 20 using a notched squeegee or trowel and backroll to a uniform coverage. Broadcast the selected aggregate (selected for texture) into the wet resin to rejection. Top coat: Once the broadcast coat has sufficiently cured to allow foot traffic, sweep-up and vacuum the loose unbonded aggregate. Apply the top coat of Sikagard CRV 20 using a squeegee, followed by back rolling to provide a uniform texture and finish.

<b>Limitations</b>	<ul style="list-style-type: none"> <li>■ Sikagard CRV 20, as a primary or secondary containment system, is best installed by skilled and experienced applicators. Consult Sika Technical Service for advice and recommendations.</li> <li>■ As a Vinyl Ester, this material does not bond well to damp substrates. It must be applied over a surface primed with Sikagard WDE Primer as recommended in the Application section.</li> <li>■ Minimum / Maximum ambient and substrate temperature; 14°F / 86°F</li> <li>■ Substrate temperature must be at least 5.5°F above the measured dew point.</li> <li>■ Do not apply onto porous surfaces where moisture vapor transmission will occur during application</li> <li>■ Moisture content of a concrete substrate must be &lt;6% (Tramex method) before application of Sikadur WDE Primer otherwise use Sikagard 75 EpoCem or Sikafloor 81 EpoCem as an initial barrier before applying the required smooth or build-up systems</li> <li>■ Maximum relative humidity during application and cure; 85%</li> <li>■ It is very important to provide efficient ventilation to prevent Sikagard CRV 20 fumes from remaining in the coated area, as this will inhibit proper cure. Ventilation should be provided during application and during the entire cure period.</li> <li>■ Minimum wet film thickness per coat of 10 mils as recommended in the application section.</li> <li>■ Due care should be exercised in applying the system as it is flammable.</li> <li>■ Protect from dampness, condensation and water contact during the initial 24 hour cure period.</li> <li>■ Surface may discolor in areas exposed to ultraviolet light.</li> <li>■ Sikagard CRV 20 is not suitable for use on exterior, slab-on-grade concrete substrates.</li> </ul>
<b>Caution</b>	<p><b>COMPONENT A: DANGER: FLAMMABLE, IRRITANT.</b> Contains Styrene (CAS:100-42-5 ). <b>Keep away from heat, sparks, sunlight, electrical equipment, flame or other sources of ignition. VAPORS MAY IGNITE AND EXPLODE. DO NOT SMOKE.</b> Use only in well ventilated areas. Open doors and windows during use. Eye/skin/respiratory irritant. Inhalation can result in headaches and dizziness. <b>Harmful if swallowed. Intentional misuse by deliberate concentration and inhalation of vapors may be harmful or fatal.</b></p> <p><b>COMPONENT B: DANGER: OXIDIZER, IRRITANT.</b> Contains Peroxide, dibenzoyl (CAS: 94-36-0). <b>CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. Keep from contact with clothing and other combustible materials.</b> Causes eye/skin irritation. May cause respiratory irritation. May cause skin sensitization by skin contact. Harmful if swallowed.</p>
<b>First Aid</b>	<p><b>Eyes</b> – Hold eyelids apart and flush thoroughly with water for 15 minutes. <b>Skin</b> – Remove contaminated clothing. Wash skin thoroughly for 15 minutes with soap and water. <b>Inhalation</b> – Remove to fresh air. <b>Ingestion</b> – Do not induce vomiting. Dilute with water. Contact physician. <b>In all cases contact a physician immediately if symptoms persist.</b></p>
<b>Handling and Storage</b>	<p><b>COMPONENT A: Keep away from heat, sparks, sunlight, electrical equipment or flame. VAPORS MAY IGNITE AND EXPLODE. DO NOT SMOKE.</b> Open doors and windows during use. Use adequate local and mechanical ventilation. Wear protective equipment (chemically resistant gloves/goggles/clothing) to prevent direct contact with skin and eyes. Use properly fitted NIOSH vapor cartridge respirator if ventilation is poor. Wash thoroughly with soap and water after use. Remove contaminated clothing after use. Store product in tightly sealed containers in a cool, dry well ventilated area at temperatures between 55° F and 75°F away from ignition sources.</p> <p>Use explosion-proof electrical (ventilating, lighting and material handling) equipment.</p> <p>Use non-sparking tools. Take precautionary measures against electrostatic discharges.</p> <p>To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material.</p> <p><b>COMPONENT B:</b> Keep products in original container. Store in cool, dry well ventilated area. Keep away from material or conditions listed in conditions to avoid. Do not grind or subject peroxide to frictional heat or shock. Do not add peroxide to hot reaction mixtures. Do not transfer to rigid containers with tight or screw-on closures. Do not allow peroxide to dry out, as the material will become friction sensitive. Wear protective equipment and/or garments list for personal protective equipment. Avoid inhalation and skin and eye contact. Dispense and transfer in an area separate from storage area. The addition of accelerators from polymerization may result in vigorous decomposition. Store below 100°F. Do not return to original container.</p>

# Industrial Flooring

## Clean Up

**COMPONENT A:** In case of spill, eliminate all ignition and heat sources. Ventilate area. Open doors and windows. Wear chemical resistant gloves/goggles/clothing. In absence of proper ventilation use properly fitted NIOSH respirator. Confine spill, collect using noncombustible absorbent material and place in properly sealed container. Dispose of excess product in accordance with applicable local, state and federal regulations.

**COMPONENT B:** Evacuate area of all unnecessary personnel. Wear protective equipment and/or garments described in PPE if exposure conditions warrant. Keep out of reach of water sources and sewers. Carefully collect the material and transfer to polyethylene-lined containers. Do not allow peroxide to dry out, add water if necessary.

## Additional Info

Technical Data Sheets are updated periodically. To ensure the most current version is being used, visit Technical Resources on [www.sikafloorusa.com](http://www.sikafloorusa.com). Proper material application is the responsibility of the user. Site visits made by Sika personnel are for making technical recommendations only and not for supervising or providing quality control.

### KEEP CONTAINER TIGHTLY CLOSED • KEEP OUT OF REACH OF CHILDREN • NOT FOR INTERNAL CONSUMPTION • FOR INDUSTRIAL USE ONLY

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**Prior to each use of any Sika product, the user must always read and follow the warnings and instructions on the product's most current Technical Data Sheet, product label and Material Safety Data Sheet which are available online at [www.sikafloorusa.com](http://www.sikafloorusa.com) or by calling Sika's Technical Service Department at 800-933-7452. Nothing contained in any Sika materials relieves the user of the obligation to read and follow the warnings and instruction for each Sika product as set forth in the current Technical Data Sheet, product label and Material Safety Data Sheet prior to product use.**

Sika warrants this product for one year from date of installation to be free from manufacturing defects and to meet the technical properties on the current Technical Data Sheet if used as directed within shelf life. User determines suitability of product for intended use and assumes all risks. Buyer's sole remedy shall be limited to the purchase price or replacement of product exclusive of labor or cost of labor. **NO OTHER WARRANTIES EXPRESS OR IMPLIED SHALL APPLY INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. SIKA SHALL NOT BE LIABLE UNDER ANY LEGAL THEORY FOR SPECIAL OR CONSEQUENTIAL DAMAGES. SIKA SHALL NOT BE RESPONSIBLE FOR THE USE OF THIS PRODUCT IN A MANNER TO INFRINGE ON ANY PATENT OR ANY OTHER INTELLECTUAL PROPERTY RIGHTS HELD BY OTHERS.**

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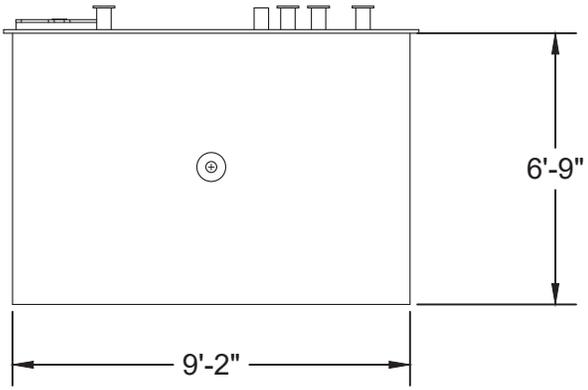
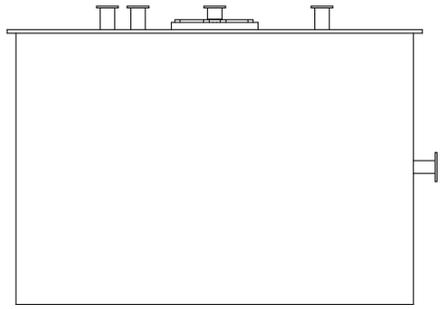
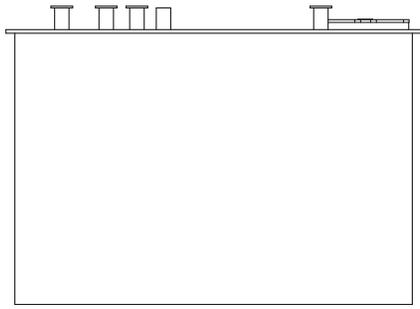
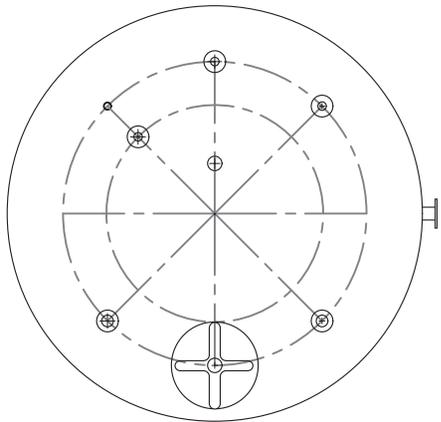
The Sika logo consists of the word "Sika" in a bold, italicized, sans-serif font, with a registered trademark symbol (®) to its right. The text is white and is set against a red triangular background that points downwards.

# APPENDIX I Aqua Metals Tanks

## Aqua Metals Non-Wirtz Tanks

Tank Location			Tank Information							
Tank Location	Inside/ Outside	Tank ID	Mfr	Tank Description	Tank Capacity	Qty	Material of Construction	Tank Integrity Calculations	Seismic Installation Calculations	Installation Inspection
Digestion	Inside	TK-701	Houston Polytank	Electrolyte Digestion Tank	1,700 Gallons	1	Polypropylene	Due 29-AUG-2016 from Houston Polytank 3 <sup>rd</sup> -party NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Digestion	Inside	TK-702, TK-703, TK-704, TK-705	Houston Polytank	Reaction Digestion Tank	7,300 Gallons	4	Polypropylene	Due 29-AUG-2016 from Houston Polytank 3 <sup>rd</sup> -party NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Digestion	Inside	TK-706	Poly Processing	Double Containment Tanks	12,150 Gallons	2	HP-XLPE	Due 12-SEP-2016 from PolyProcessing 3rd-party NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Digestion	Inside	TK-700	Poly Processing	Pregnant Electrolyte Tank	7,300 Gallons	1	HP-XLPE	Due 3-OCT-2016 from PolyProcessing 3rd-party NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Digestion	Inside	TK-707	Poly Processing	Depleted Electrolyte Tank	7,300 Gallons	1	HP-XLPE	Due 3-OCT-2016 from PolyProcessing 3rd-party NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Aquarefining	Inside	TK-8xx-E	Poly Processing	Electrolyzer Tank	150 Gallons	96	HP-XLPE	Due 12-SEP-2016 from PolyProcessing 3rd-party NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Aquarefining	Inside	TK-8xx-D	Poly Processing	Electrolyte Storage Tank	615 Gallons	1	HP-XLPE	Due 3-OCT-2016 from PolyProcessing 3rd-party NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Aquarefining	Inside	TK-8xx-P	Poly Processing	Module Depleted Outlet Tank	4,250 Gallons	16	HP-XLPE	Due 12-SEP-2016 from PolyProcessing 3rd-party NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Bulk Electrolyte Storage	Outside	TK-400, TK-401	Poly Processing	Module Pregnant Feed Tank	4,250 Gallons	16	HP-XLPE	Due 8-AUG-2016 from PolyProcessing 3rd-party NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Produced within 2 weeks of Installation

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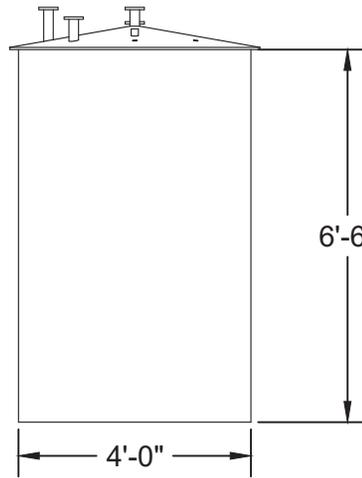
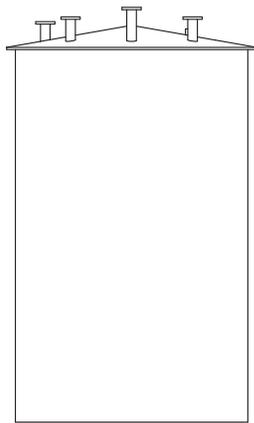
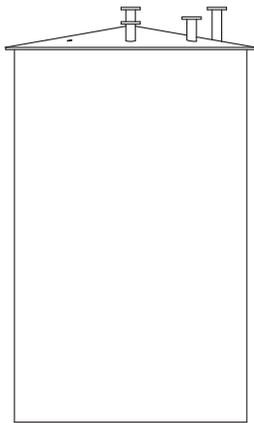
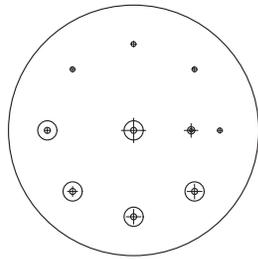


1,400 GAL UPRIGHT 6' - 9" x 9' - 2" Ø TANK D2 CONCEPT  
TK-701

<small>UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES</small>		<small>DESIGN</small>	<small>NAME</small>	<small>DATE</small>	<b>AquaMetais</b>
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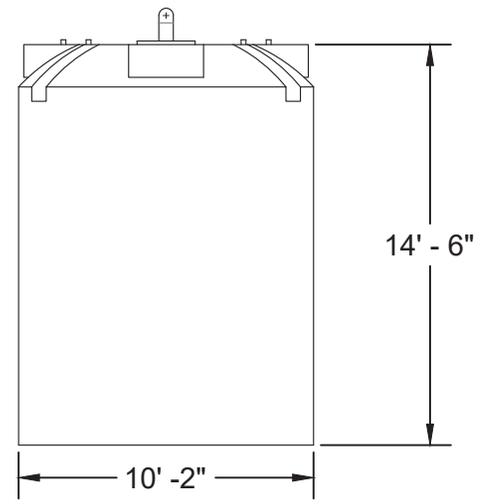
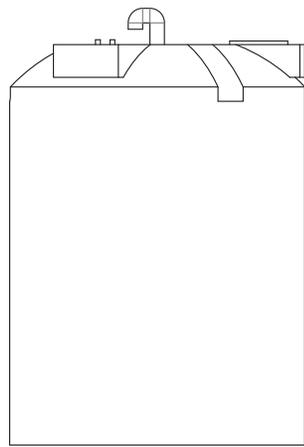
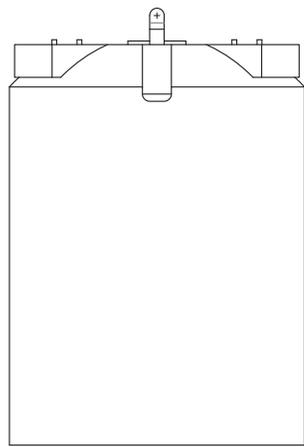
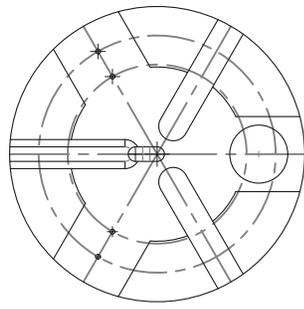


600 GAL. 6' - 6" TALL x 4' - 0"Ø C CONCEPT

TK-707

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8 | 7 | 6 | 5 | 4 | 3 | 2 | 1



7,300 GAL. UPRIGHT 14' - 6" x 10' - 2" Ø TANK  
TK-700, TK-706

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A

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

UNLESS OTHERWISE SPECIFIED:		DESIGNED BY	NAME	DATE	AquaMetals
TOLERANCES:		CHECKED BY			
FRACTIONS: 1/16"		DESIGNED BY			
DECIMALS: 0.0005"		ENGINEER			
DIMENSIONS: 1/8"		DR			
DIMENSIONS: 1/16"		DATE			
DIMENSIONS: 1/32"		SCALE			
DIMENSIONS: 1/64"		PROJECT			
DIMENSIONS: 1/128"		APP. NO.			
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DIMENSIONS: 1/512"		APPLICATION			
DIMENSIONS: 1/1024"		DO NOT SCALE DRAWING			

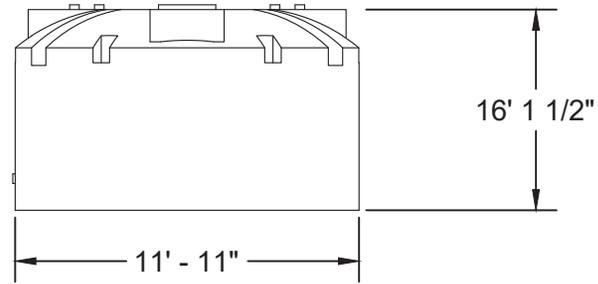
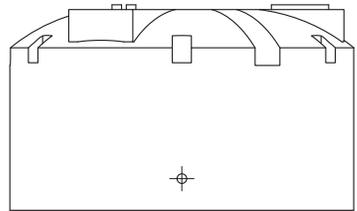
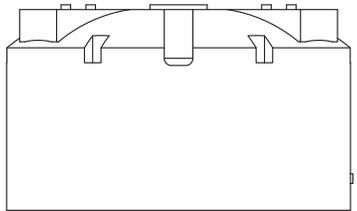
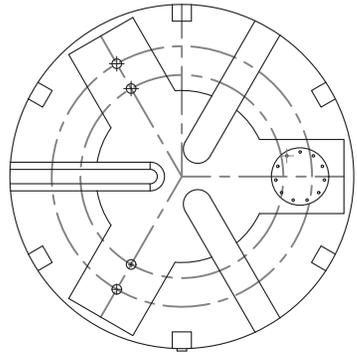
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WITHOUT PERMISSION OF AQUA METALS IS  
PROHIBITED.



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SCALE: 1:20	WEIGHT:	SHEET 1 OF 1



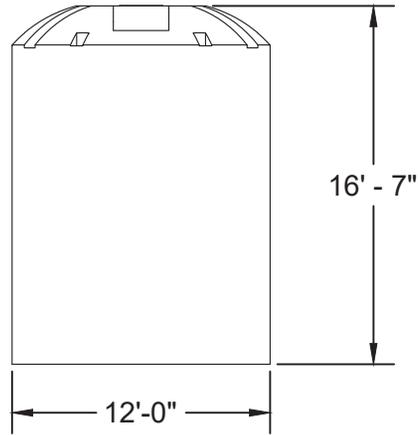
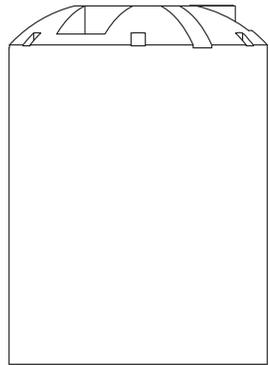
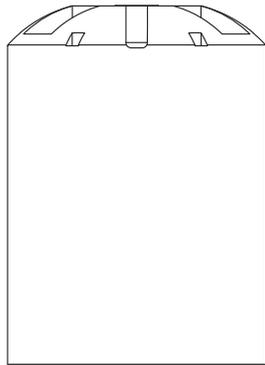
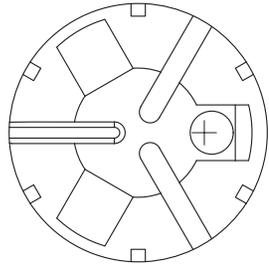
8 | 7 | 6 | 5 | 4 | 3 | 2 | 1



4,250 GAL. UPRIGHT TANK 16' - 1 1/2" x 11' - 11" Ø  
TK-8XX-D, TK-8XX-P

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<small>APPROVED FOR CONSTRUCTION: DATE: _____</small>	<small>APPROVED FOR PURCHASE: DATE: _____</small>	<small>APPROVED FOR FABRICATION: DATE: _____</small>	<small>APPROVED FOR INSTALLATION: DATE: _____</small>	<small>SIZE: DWG. NO. _____ ARCH: _____ SCALE: 1" = _____ WEIGHT: _____ SHEET 1 OF _____</small>

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1



12,150 GAL. UPRIGHT TANK 16' - 7" x 12' - 0" Ø

TK-400, TK-401

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1

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REVISIONS: NO.   DATE   DESCRIPTION		MATERIALS: PART NO.   QUANTITY   USED ON		THIRD ANGLE PROJECTION		
APPLICATION   DO NOT SCALE DRAWING		SIZE: DWG. NO.   REV ARCH: D		SCALE: 1:3   WEIGHT:   SHEET 1 OF		

## APPENDIX J Wirtz-Supplied Tanks

## Aqua Metals Tanks Supplied by Wirtz

Tank Location	General Arrangement	Item # Per GA	Tank Part Number	Tank Description	Tank Capacity	Material of Construction	Tank Integrity Assessment	Seismic Installation Calculations	Installation Inspection
Battery Breaking	800-23-1001 GA-D	7	888-88-0014	Acid Collection Tank	500 Gallons	HDPE (High Density Polyethylene)	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Battery Breaking	800-24-0001-D	3	821-00-0200	Elutriator	250 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Battery Breaking	800-24-0001-D	7	812-00-0100	Metallic Lead Classifier	1,025 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Battery Breaking	800-24-0001-D	9	820-00-0058	Recirculation Tank	2,925 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Battery Breaking	800-24-0001-D	14	815-00-0700	Plastic Classification Tank	4,300 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Battery Breaking	800-24-0001-D	17	815-00-0850	ABS Classification Tank	4,300 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Battery Breaking	800-28-0001C-GA	1	822-00-0168	Surge Tank	3,250 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Battery Breaking	800-28-0001C-GA	4	822-00-0173	Intermediate Slurry Tank	4,875 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Desulfurization	800-28-0001C-GA	7	822-00-0163	Slurry Tank	4,875 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Desulfurization	800-28-0001C-GA	12	822-00-0183	Desulfurization Reaction Tank #1	3,868 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Desulfurization	800-28-0001C-GA	17	822-00-0183	Desulfurization Reaction Tank #2	3,868 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Desulfurization	800-28-0001C-GA	20	822-00-0178	Lead Carbonate Slurry Holding Tank	4,875 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-24-0001-D	20	888-88-0013	Poly Classification Water Recycle Tank	500 Gallons	HDPE (High Density Polyethylene)	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-25-0001-E	1	888-88-0016	Incoming Effluent Tank	5,000 Gallons	HDPE (High Density Polyethylene)	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-25-0001-E	4	862-04-0048	Formulation Tank	2,000 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-25-0001-E	10	862-05-0058	Neutralizer Dosing Tank #1	2,708 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-25-0001-E	13	862-05-0058	Neutralizer Dosing Tank #2	2,708 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-25-0001-E	16	862-05-0068	Reaction Tank #1	2,708 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-25-0001-E	18	862-05-0089	Reaction Tank #2	2,708 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-25-0001-E	21	828-00-0020	Anionic Polymer Tank	150 Gallons	HDPE (High Density Polyethylene)	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-25-0001-E	25	862-07-0038	Flash Tank	1,728 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-25-0001-E	27	862-07-0078	Flocculation Tank	1,728 Gallons	304 Stainless Steel	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-25-0001-E	29	888-88-0011	Lamella Clarifier	2,050 Gallons	Carbon Steel - Epoxy Coated	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-25-0001-E	30	888-88-0017	Treated Water Storage Tank	5,000 Gallons	HDPE (High Density Polyethylene)	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-25-0001-E	34	888-88-0015	Sludge Tank	1,000 Gallons	HDPE (High Density Polyethylene)	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation
Water Treatment	800-25-0001-E	39	888-88-0013	Small Clarified Water Tank	500 Gallons	HDPE (High Density Polyethylene)	Due 28-AUG-2016 from McElhanev NV P.E.	Due 8-AUG-2016 from Tectonics NV P.E.	Findings Letter Produced within 2 weeks of Installation



# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 888-88-0014

**Description:** Acid Collection Tank

**Material of Construction:** HDPE (High Density Polyethylene)

**Capacity (Gallons):** 500

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 821-00-0200

**Description:** Elutriator

**Material of Construction:** 304 SST

**Capacity (Gallons):** 250

**Leak Testing Certification:**

- ✓ Hydro Testing Prior to Shipment
- ✓ Dye Penetrant All Welded Surfaces



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 812-00-0100

**Description:** Metallic Lead Classifier

**Material of Construction:** 304 SST

**Capacity (Gallons):** 1025

**Leak Testing Certification:**

- ✓ Hydro Testing Prior to Shipment
- ✓ Dye Penetrant All Welded Surfaces



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 820-00-0058

**Description:** Recirculation Tank

**Material of Construction:** 304 SST

**Capacity (Gallons):** 2925

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 815-00-0700

**Description:** Plastic Classification Tank

**Material of Construction:** 304 SST

**Capacity (Gallons):** 4300

**Leak Testing Certification:**

- ✓ Hydro Testing Prior to Shipment
- ✓ Dye Penetrant All Welded Surfaces



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 815-00-0850

**Description:** ABS Classification Tank

**Material of Construction:** 304 SST

**Capacity (Gallons):** 4300

**Leak Testing Certification:**

- ✓ Hydro Testing Prior to Shipment
- ✓ Dye Penetrant All Welded Surfaces



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 888-88-0013

**Description:** Poly Classification Water Recycle Tank

**Material of Construction:** HDPE (High Density Polyethylene)

**Capacity (Gallons):** 500

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 888-88-0016

**Description:** Incoming Effluent Tank

**Material of Construction:** HDPE (High Density Polyethylene)

**Capacity (Gallons):** 5000

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 862-04-0048

**Description:** Formulation Tank

**Material of Construction:** 304 SST

**Capacity (Gallons):** 2000

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 862-05-0058

**Description:** Neutralizer Dosing Tank #1

**Material of Construction:** 304 SST

**Capacity (Gallons):** 2708

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 862-05-0058

**Description:** Neutralizer Dosing Tank #2

**Material of Construction:** 304 SST

**Capacity (Gallons):** 2708

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 862-05-0068

**Description:** Reaction Tank #1

**Material of Construction:** 304 SST

**Capacity (Gallons):** 2708

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 862-05-0089

**Description:** Reaction Tank #2

**Material of Construction:** 304 SST

**Capacity (Gallons):** 2708

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 828-00-0020

**Description:** Anionic Polymer Tank

**Material of Construction:** HDPE (High Density Polyethylene)

**Capacity (Gallons):** 150

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 862-07-0038

**Description:** Flash Tank

**Material of Construction:** 304 SST

**Capacity (Gallons):** 1728

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 862-07-0078

**Description:** Flocculation Tank

**Material of Construction:** 304 SST

**Capacity (Gallons):** 1728

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 888-88-0011

**Description:** Lamella Clarifier

**Material of Construction:** Epoxy Coated Carbon Steel

**Capacity (Gallons):** 2050

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 888-88-0017

**Description:** Treated Water Storage Tank

**Material of Construction:** HDPE (High Density Polyethylene)

**Capacity (Gallons):** 5000

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 888-88-0015

**Description:** Sludge Tank

**Material of Construction:** HDPE (High Density Polyethylene)

**Capacity (Gallons):** 1000

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 888-88-0013

**Description:** Small Clarified Water Tank

**Material of Construction:** HDPE (High Density Polyethylene)

**Capacity (Gallons):** 500

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 862-00-0168

**Description:** Surge Tank

**Material of Construction:** 304 SST

**Capacity (Gallons):** 3250

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 822-00-0173

**Description:** Intermediate Slurry Tank

**Material of Construction:** 304 SST

**Capacity (Gallons):** 4875

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 822-00-0163

**Description:** Slurry Tank

**Material of Construction:** 304 SST

**Capacity (Gallons):** 4875

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 822-00-0183

**Description:** Desulfurization Reaction Tank #1

**Material of Construction:** 304 SST

**Capacity (Gallons):** 3868

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 822-00-0183

**Description:** Desulfurization Reaction Tank #2

**Material of Construction:** 304 SST

**Capacity (Gallons):** 3868

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



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# WIRTZ MANUFACTURING COMPANY INC.

## EQUIPMENT INSPECTION CHECKSHEET

**Customer Name:** Aqua Metals

**Tank Part Number:** 822-00-0178

**Description:** Lead Carbonate Slurry Holding Tank

**Material of Construction:** 304 SST

**Capacity (Gallons):** 4875

**Leak Testing Certification:**

✓ Hydro Testing Prior to Shipment



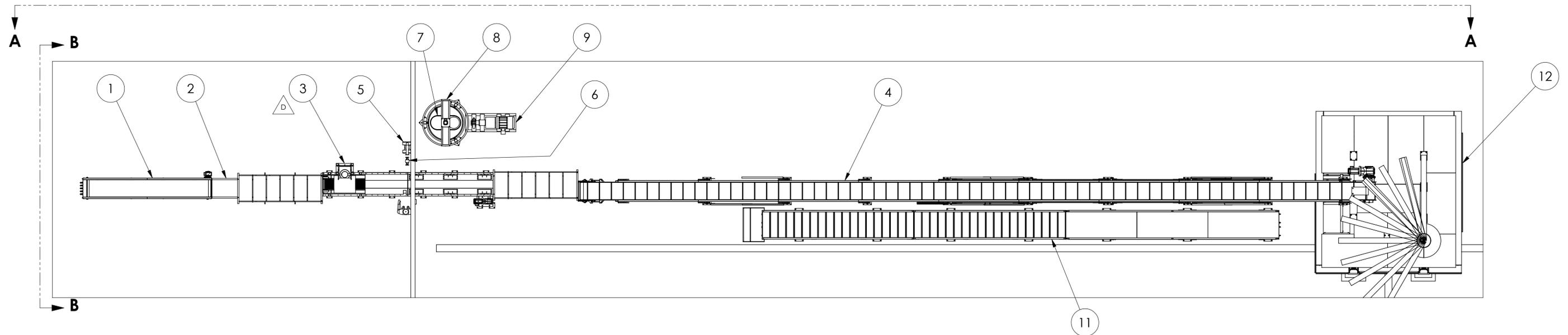
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[www.wirtzusa.com](http://www.wirtzusa.com) E-mail [sales@wirtzusa.com](mailto:sales@wirtzusa.com) & [gridmold@wirtzusa.com](mailto:gridmold@wirtzusa.com)

Revision 3, 22-Jul-2016

ITEM NO.	AQM NO.	BRS NO.	DESCRIPTION
1	CN-101	801-00-0240	BATTERY LOADING CONVEYOR
2	CN-102	888-90-0008	BATTERY WEIGHING CONVEYOR
3	TK-101	804-00-0005	BATTERY DRAINING UNIT
4	CN-104	802-00-0070	BATTERY CRUSHING INFED CONVEYOR
5	P-105	888-38-0020	1" DIAPHRAM PUMP
6	F-103	888-86-0008	1/32" MESH SCREEN
7	TK-105	888-88-0014	ACID RECOVERY TANK
8	AG-105	825-00-0245	ACID RECOVERY TANK AGGITATOR
9	P-106	888-38-0017	ACID RECOVERY TANK PUMP
10	F-106	888-86-0010	AUTOMATIC SELF-CLEANING FILTER
11	N/A	800-23-0010	INCLINE CONVEYOR STAIRWAY
12	N/A	800-23-0300	BATTERY CRUSHER SUPPORT STRUCTURE
13	N/A	24150	BATTERY CRUSHER SOUND PROOFING ASSEMBLY (NOT SHOWN)

SEE NOTE {

NOTE: ITEM #10 IS SHOWN ON DWG. 800-24-0001



D	6/2/2016	S.G.B.
REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 FORT HURON, MI 48061-5006  
 USA

**DESCRIPTION**  
 AQUA METAL ACID DRAINING SYSTEM  
 GENERAL ARRANGEMENT

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: +0.003"  
 2 PLACE DECIMALS: +0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

ENGINEERED BY: S.G.B. DATE: 6/1/2015  
 DETAILED BY: DATE:  
 APVD BY: DATE:  
 SHEET: 1 OF 3  
 ASSY NO.: 800-23-0001

DRAWING NO.: **800-23-1001 GA-D**

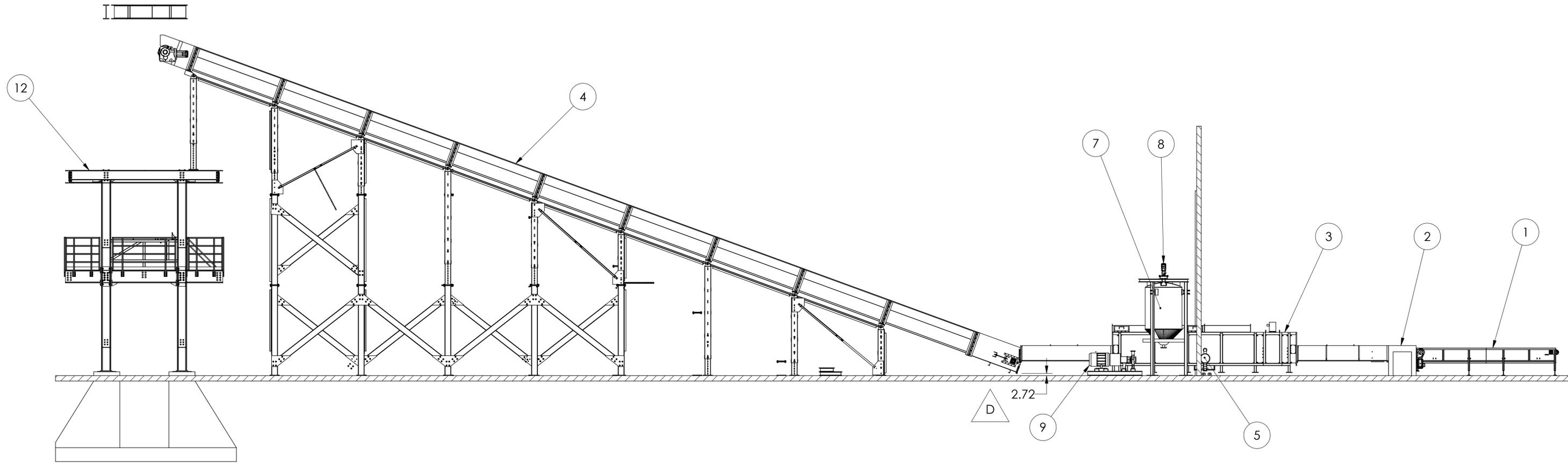
MAKE \_\_\_\_\_ PCS.

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

CAD FILE: \\WM-DC1\nas2\Battery Recycling Systems\Drawings\800 - Layouts\800-23 Aqua Metals ADS\800-23-1001

REF:  
 Revision 3, 22-Jul-2016  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.



**SECTION A-A**

NOTE: ITEM # 11 NOT SHOWN IN THIS VIEW FOR CLARITY

D	6/2/2016	S.G.B.
REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 FORT HURON, MI 48061-5006  
 USA

DESCRIPTION  
**AQUA METAL ACID DRAINING SYSTEM  
 GENERAL ARRANGEMENT**

ENGINEERED BY: S.G.B. DATE: 6/1/2015  
 TOLERANCES ARE:  
 0 PLACE DECIMALS: ±0.5mm  
 1 PLACE DECIMALS: ±0.25mm  
 2 PLACE DECIMALS: ±0.08mm  
 ANGLES: ±0.5°

MAKE \_\_\_\_\_ PCS.

APPROVED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

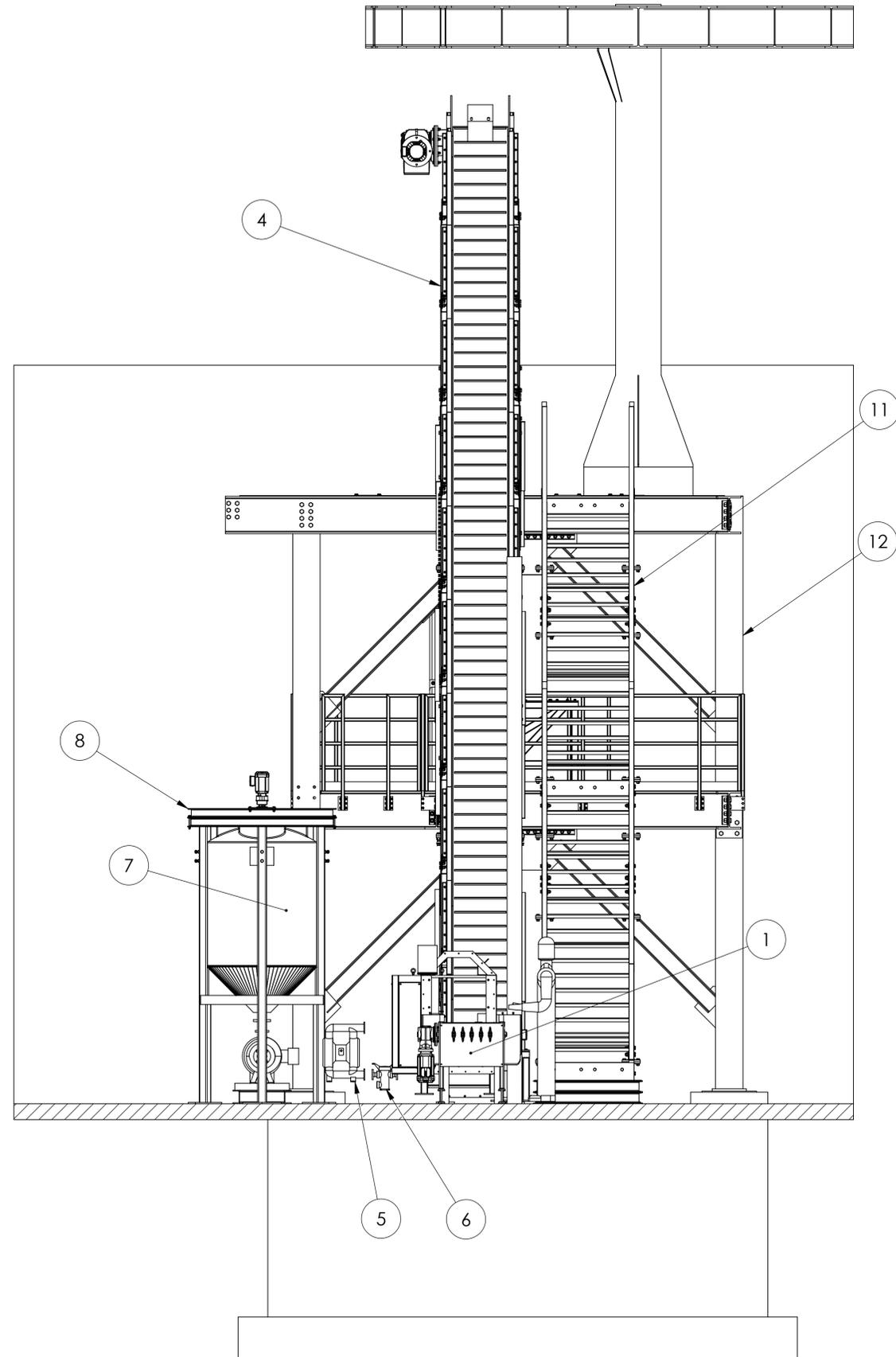
DRAWING NO.  
**800-23-1001 GA-D**

SHEET: 2 OF 3  
 ASSY NO.  
 800-23-0001

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

CAD FILE: \\WM-DC1\nas2\Battery Recycling Systems\Drawings\800 - Layouts\800-23 Aqua Metals ADS\800-23-1001

REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.



SECTION B-B

REF:  
 Revision 3, 22-Jul-2016  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

D	6/2/2016	S.G.B.
REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 FORT HURON, MI 48061-5006  
 USA

DESCRIPTION  
**AQUA METAL ACID DRAINING SYSTEM  
 GENERAL ARRANGEMENT**

ENGINEERED BY: S.G.B. DATE: 6/1/2015  
 TOLERANCES ARE:  
 0 PLACE DECIMALS: ±0.5mm  
 1 PLACE DECIMALS: ±0.25mm  
 2 PLACE DECIMALS: ±0.08mm  
 ANGLES: ±0.5°

MAKE \_\_\_\_\_ PCS.

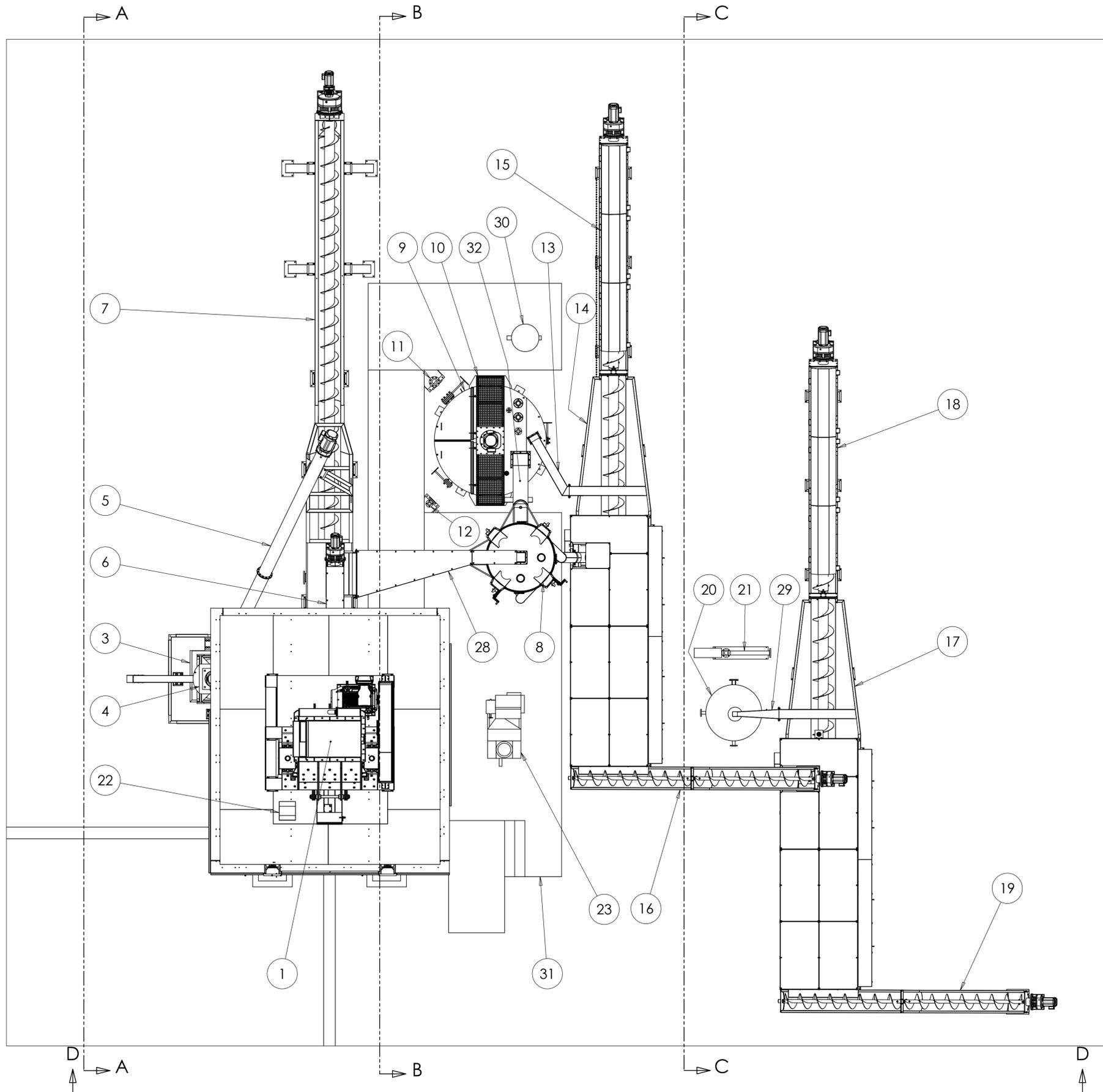
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.

DRAWING NO.  
**800-23-1001 GA-D**

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

SHEET: 3 OF 3  
 ASSY NO.  
 800-23-0001

CAD FILE: \\WM-DC1\nas2\Battery Recycling Systems\Drawings\800 - Layouts\800-23 Aqua Metals ADS\800-23-1001



ITEM NO.	AQM NO.	DWG. NO.	DESCRIPTION
1	CR-201	810-00-0920	HAMMER MILL
2	VS-201	888-86-0004	PRIMARY VIBRATING SCREEN
3	TK-203	821-00-0200	ELUTRIATOR
4	AG-203	821-00-0200	ELUTRIATOR AGITATOR
5	CN-204	821-00-0200	ELUTRIATOR INCLINE SCREW CONVEYOR
6	CN-205	816-00-0050	VIBRATING SCREEN INCLINE SCREW CONVEYOR
7	TK-301	812-00-0100	METALIC LEAD CLASSIFIER
8	VS-301	888-86-0005	SECONDARY VIBRATING SCREEN
9	TK-304	820-00-0058	RECIRCULATION TANK
10	AG-304	820-00-0057	RECIRCULATION TANK AGGITATOR
11	P-303	888-38-0014	4" X 6" UPFLOW PUMP
12	P-305	888-38-0015	2" X 3" RECIRCULATION PUMP
13	N/A	815-00-0897	PCT #1 OVERFLOW TROUGH
14	TK-306	815-00-0700	PLASTICS CLASSIFICATION TANK
15	SC-307	815-00-0700	SEPARATOR SCREW CONVEYOR
16	SC-308	815-00-0700	PLASTICS SCREW CONVEYOR
17	TK-309	815-00-0850	ABS & POLYPROPLYENE CLASSIFICATION TANK
18	SC-310	815-00-0850	ABS & POLYCARBONATE SCREW CONVEYOR
19	SC-311	815-00-0850	POLYPROPLYENE SCREW CONVEYOR
20	TK-312	888-88-0013	POLY CLASSIFICATION WATER RECYCLE TANK
21	P-312	888-38-0017	POLY CLASSIFICATION WATER RECYCLE PUMP
22	HP-206	888-31-0014	HAMMER MILL HYDRAULIC PUMP
23	SC-200	888-70-0001	SCRUBBER
24	TK-200	888-70-0001	SCRUBBER WATER RECIRCULATION TANK
25	N/A	910-00-1059	BREAKER DISCHARGE CHUTE
26	N/A	821-00-0513	PRIMARY VIBRATING SCREEN TO ELUTRIATOR CHUTE
27	N/A	811-00-0085	INCLINE SCREW CONVEYOR TO MLCT CHUTE
28	N/A	812-00-0350	MLCT TO SECONDARY VIBRATING SCREEN CHUTE
29	N/A	815-00-0896	PCT#2 TO WATER RECYCLE TANK CHUTE
30	F-106	888-86-0010	AUTOMATIC SELF CLEANING FILTER
31	N/A	N/A	SEPARATION SYSTEM WORK PLATFORM
32	N/A	812-00-0381	SECONDARY VIBRATING SCREEN TO RECIRC. TANK

**NOTE: ITEM #30 AUTOMATIC SELF-CLEANING FILTER IS FROM DWG. 800-23-1001B GA**

REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

D	4/29/2016	TDM
REV	DATE	AUTHOR

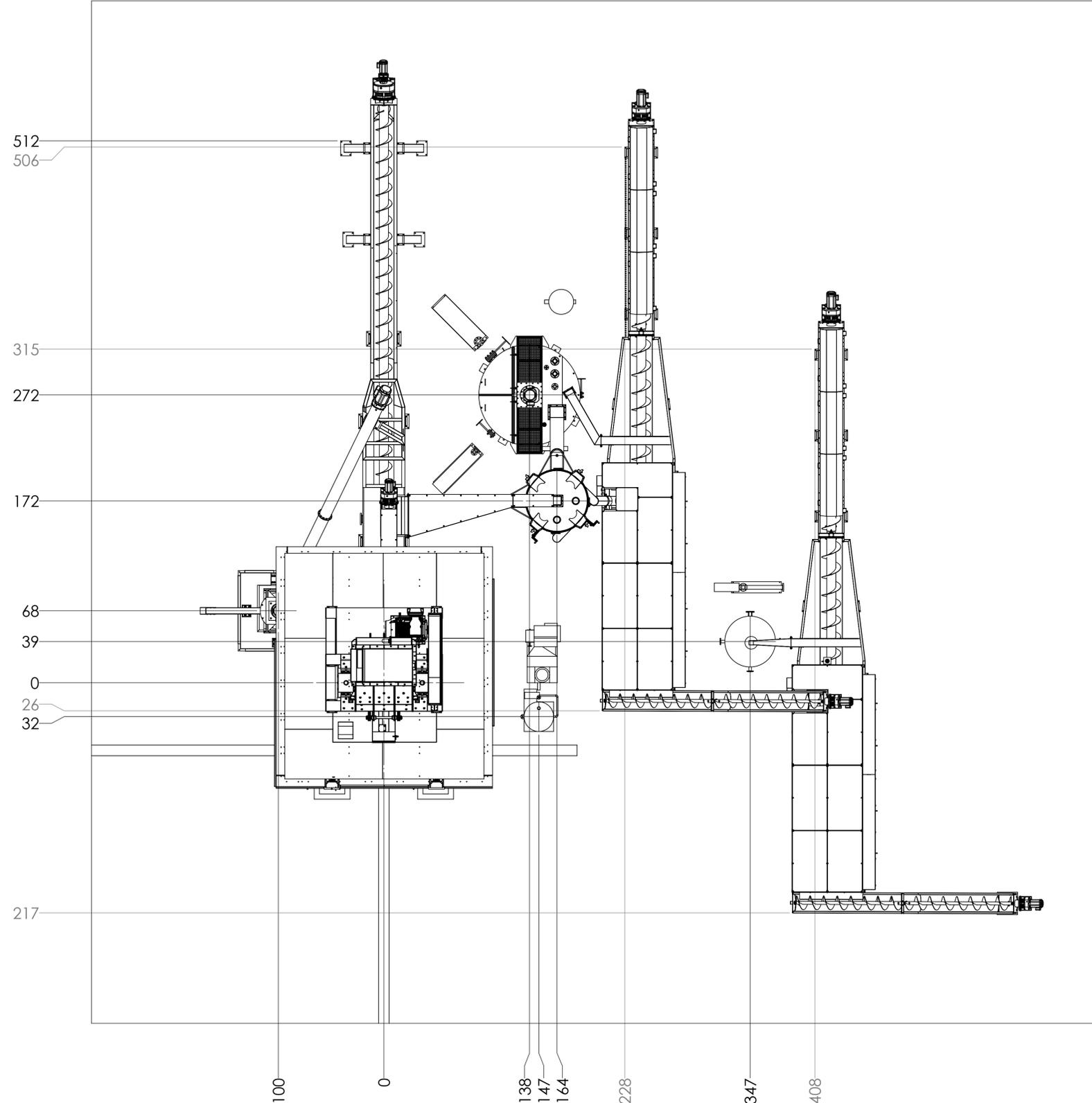
**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 FORT HURON, MI 48061-5006  
 USA

DESCRIPTION:  
**AQUA METAL BATTERY BREAKING & SEPARATION SYSTEM GENERAL ARRANGEMENT**

ENGINEERED BY: S.G.B. DATE: 1/8/2016  
 UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: +0.003"  
 2 PLACE DECIMALS: +0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

MAKE \_\_\_\_\_ PCS.  
 THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.  
 CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE.  
 CAD FILE: T:\Drawings\800 - Layouts\800-24 Aqua Metals BBS\800-24-0001

DRAWING NO.: **800-24-0001-D**  
 SHEET: 1 OF 5  
 ASSY NO.: 800-23-0001



REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

D	4/29/2016	TDM
REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 FORT HURON, MI 48061-5006  
 USA

DESCRIPTION  
**AQUA METAL BATTERY BREAKING & SEPARATION SYSTEM  
 GENERAL ARRANGEMENT**

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: ±0.003"  
 2 PLACE DECIMALS: ±0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

MAKE \_\_\_\_\_ PCS.

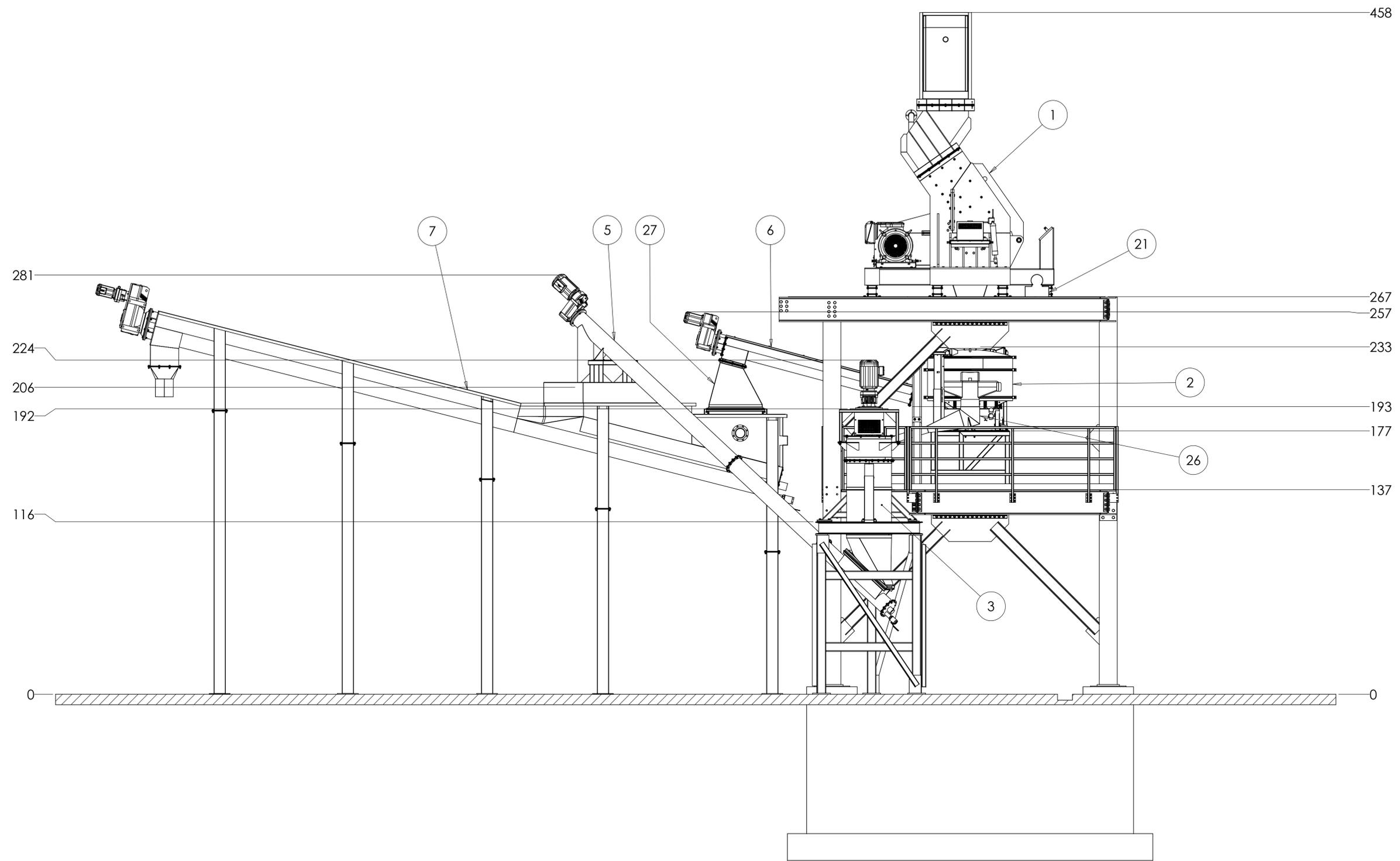
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.

DRAWING NO.  
**800-24-0001-D**

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

SHEET: 2 OF 5  
 ASSY NO. 800-23-0001

CAD FILE: T:\Drawings\800 - Layouts\800-24 Aqua Metals BBS\800-24-0001



SECTION A-A

D	4/29/2016	TDM
REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 FORT HURON, MI 48061-5006  
 USA

DESCRIPTION  
**AQUA METAL BATTERY BREAKING & SEPARATION SYSTEM**  
 GENERAL ARRANGEMENT

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: +0.003"  
 2 PLACE DECIMALS: +0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

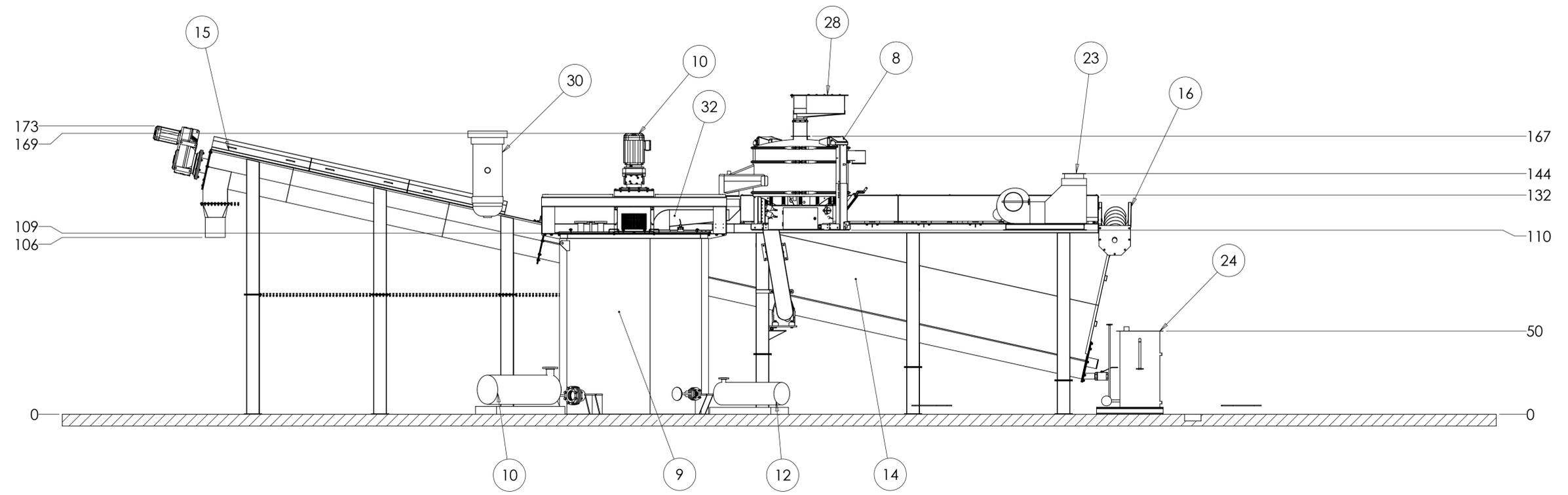
MAKE \_\_\_\_\_ PCS.

ENGINEERED BY: S.G.B. DATE: 1/8/2016  
 DRAWING NO. **800-24-0001-D**

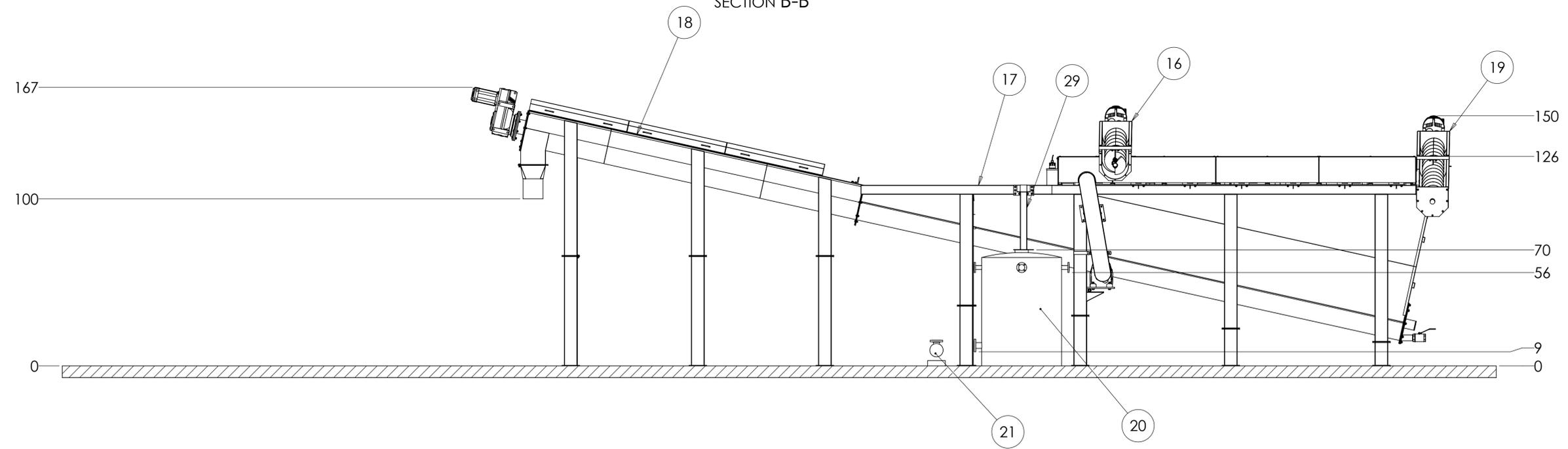
ASSEMBLY NO. 800-23-0001

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE  
 SHEET: 3 OF 5

REF:  
 Revision 3, 22-Jul-2016  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.



SECTION B-B



SECTION C-C

D	4/29/2016	TDM
REV	DATE	AUTHOR

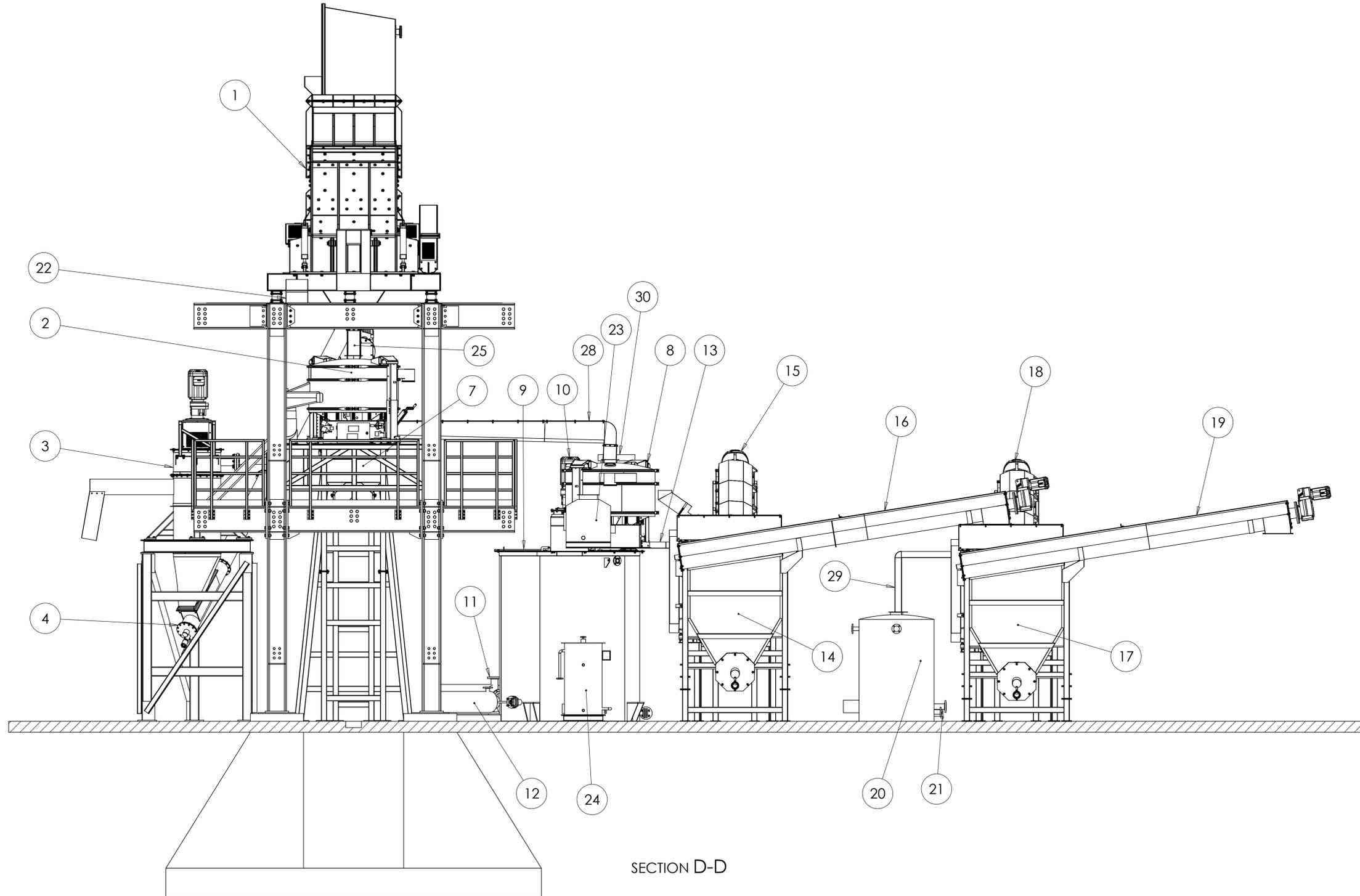
**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 FORT HURON, MI 48061-5006  
 USA

DESCRIPTION AQUA METAL BATTERY BREAKING & SEPARATION SYSTEM GENERAL ARRANGEMENT	
ENGINEERED BY S.G.B.	DATE 1/8/2016
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: 3 PLACE DECIMALS: +0.003" 2 PLACE DECIMALS: +0.01" FRACTIONS = STOCK SIZES ANGLES: ±0.5°	
DRAWING NO. <b>800-24-0001-D</b>	
SHEET: 4 OF 5	
ASSY NO. 800-23-0001	

MAKE \_\_\_\_\_ PCS.

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 CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE.  
 CAD FILE: T:\Drawings\800 - Layouts\800-24 - Aqua Metals BBS\800-24-0001

REF:  
 Revision 3, 22-Jul-2016  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.



SECTION D-D

REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

D	4/29/2016	TDM
REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 FORT HURON, MI 48061-5006  
 USA

DESCRIPTION  
**AQUA METAL BATTERY BREAKING & SEPARATION SYSTEM  
 GENERAL ARRANGEMENT**

ENGINEERED BY: S.G.B. DATE: 1/8/2016  
 DETAILED BY: DATE:  
 UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: +0.003"  
 2 PLACE DECIMALS: +0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

MAKE \_\_\_\_\_ PCS.

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.

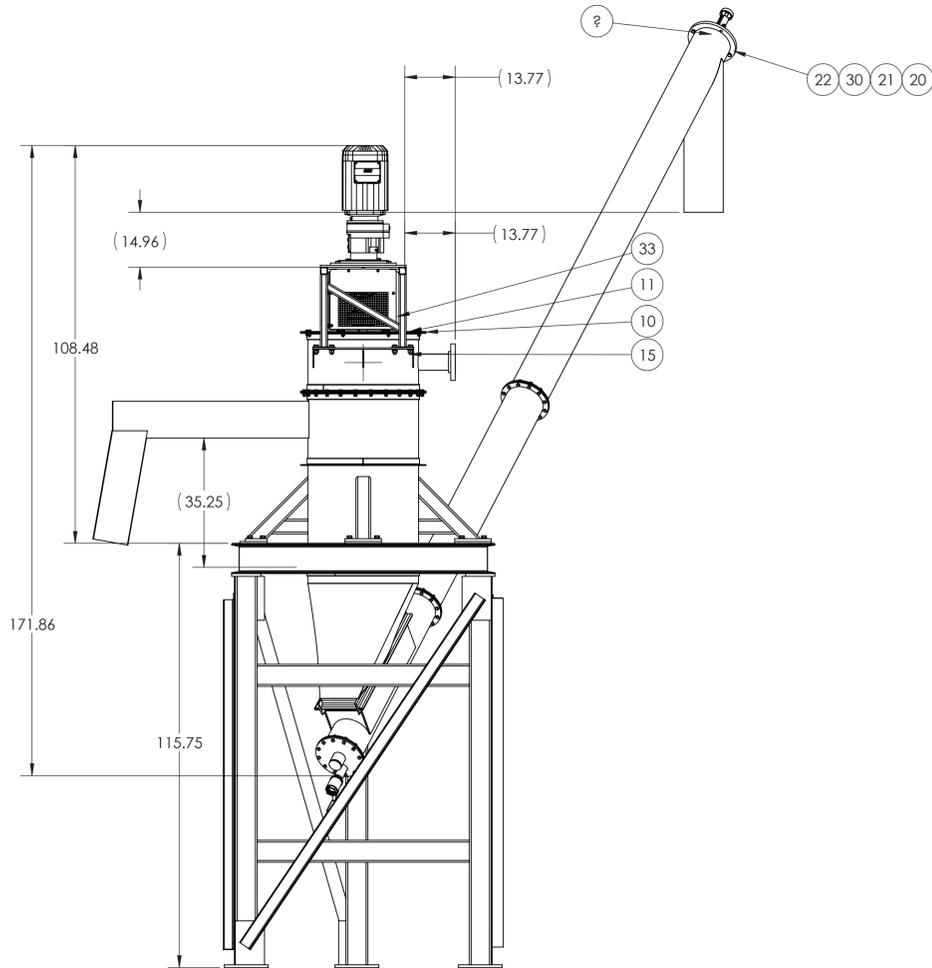
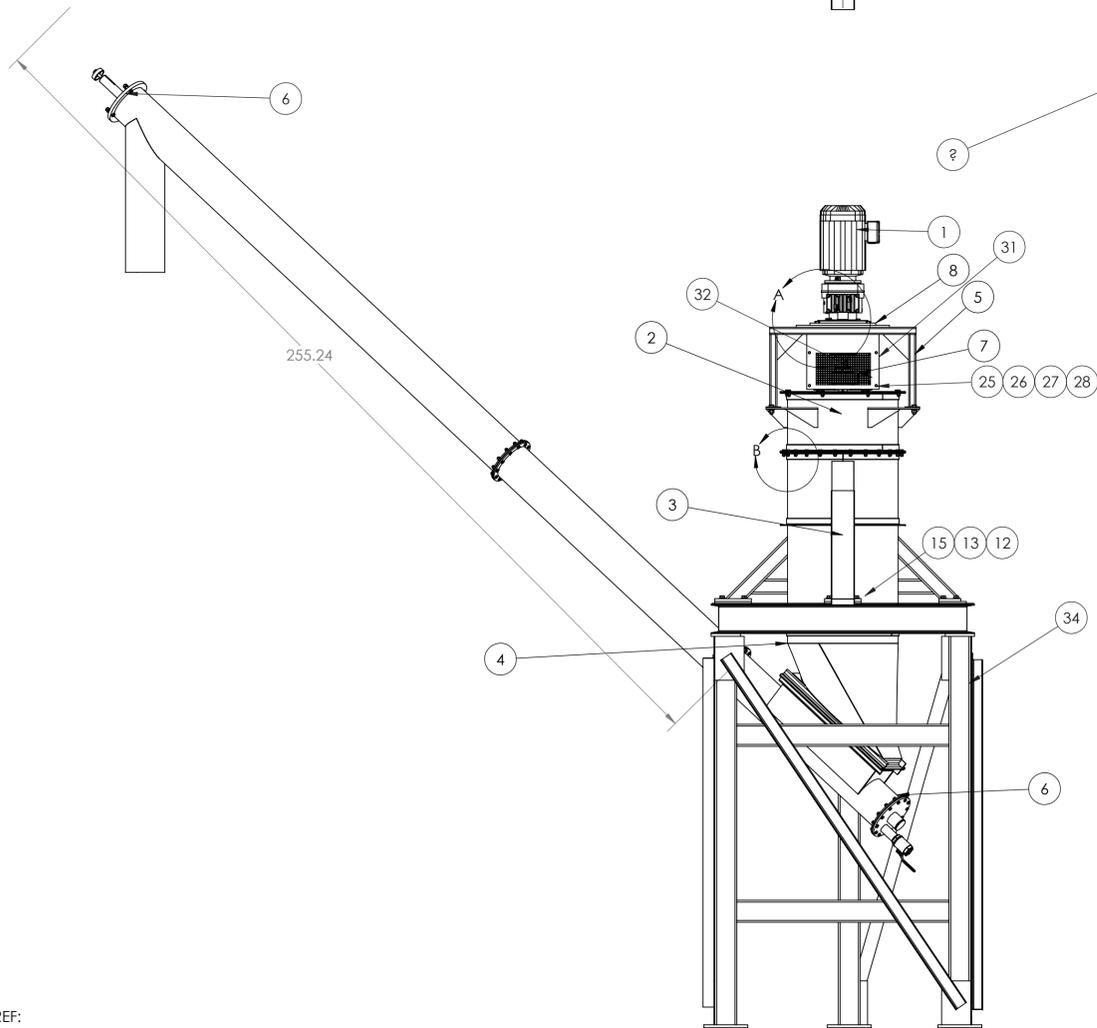
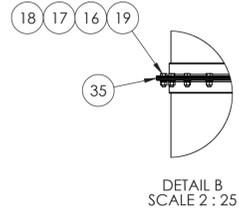
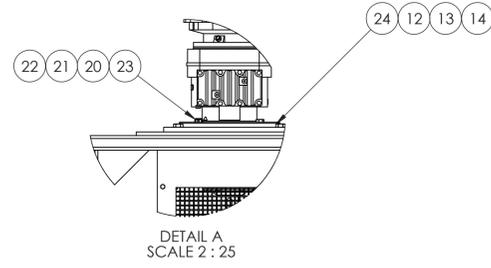
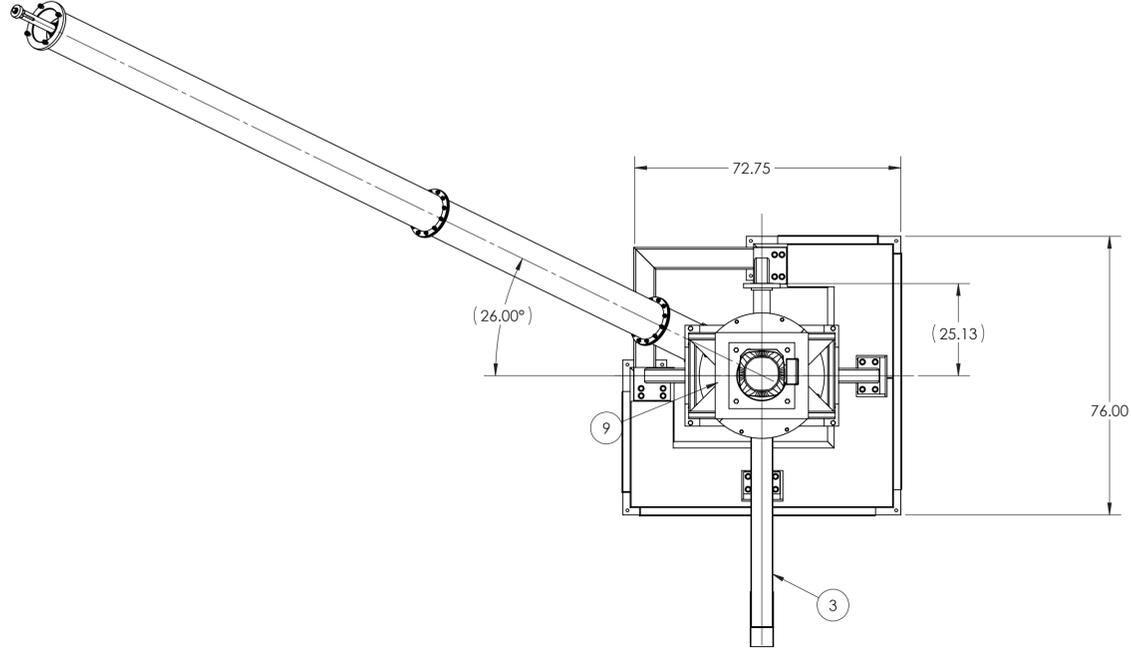
DRAWING NO. **800-24-0001-D**

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

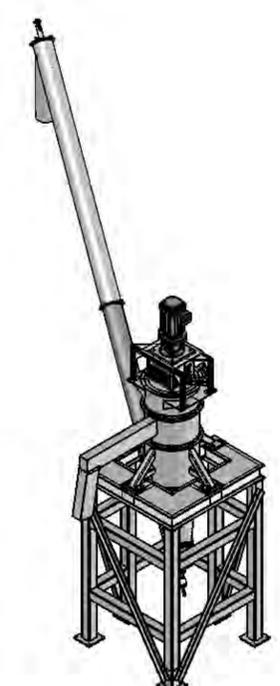
SHEET: 5 OF 5 ASSY NO. 800-23-0001

CAD FILE: T:\Drawings\800 - Layouts\800-24 - Aqua Metals BBS\800-24-0001

821-00-0200



ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-57-0024	MOTOR, GEAR: 20HP, 278 RPM, 480 VAC, 60HZ, 3PH
2	1	821-00-0201	ELU INLET WELDMENT
3	1	821-00-0202	ELU SILO WELDMENT
4	1	821-00-0203	ELU TANK WELDMENT
5	1	821-00-0204	MOTOR FRAME WELDMENT
6	1	821-00-0205	CONVEYOR TUBE ASSEMBLY
7	1	821-00-0207	MIXER SHAFT ASS'Y
8	1	821-00-0217	MOTOR MOUNTING PLATE
9	1	821-00-0245	ELU SHAFT STABILIZER
10	2	821-00-0445	NEOPRENE LID SEAL
11	2	821-00-0446	ELU SST LID
12	29	888-64-0114	WASHER, FLAT 3/4" 316 SST
13	29	888-64-0123	WASHER, LOCK, 3/4" 316 SST
14	12	888-64-0105	NUT, HEX, 3/4-10 UNC 316 SST
15	24	888-64-0033	HEX HD BOLT, 3/4-10 UNC x 2" LG. 316 SST
16	60	888-64-0111	FASTENER, FLAT WASHER, 1/2", 316 SST
17	60	888-64-0120	FASTENER, LOCK WASHER, 1/2" 316 SST
18	56	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST
19	56	888-64-0007	FASTENER, HH BOLT, 1/2-13 UNC x 1-1/2" LG. 316 SST
20	12	888-64-0113	WASHER, FLAT 5/8", 316 SST
21	8	888-64-0122	WASHER, LOCK, 5/8", 316 SST
22	8	888-64-0104	NUT, HEX, 5/8-11 UNC, 316 SST
23	4	888-64-0028	FASTENER, HH BOLT, 5/8-11 UNC x 3" LG. 316 SST
24	4	888-64-0035	FASTENER, HH BOLT, 3/4-10 UNC x 2-1/2" LG. 316 SST
25	8	888-64-0003	FASTENER, HH BOLT, 3/8-16 UNC x 1" LG. 316 SST
26	8	888-64-0110	WASHER, FLAT 316 SST 3/8
27	8	888-64-0119	WASHER, LOCK, 3/8" 316 SST
28	8	888-64-0101	NUT, HEX, 3/8-16 UNC 316 SST
29	4	888-64-0351	FASTENER, HH BOLT, 1/2-13 UNC x 3/4" LG. 316 SST
30	4	888-64-0027	FASTENER, HH BOLT, 5/8-11 UNC x 2-1/2" LG. 316 SST
31	1	821-00-0349	COUPLING GUARD PLATE
32	1	821-00-0350	ELU - COUPLING GUARD
33	1	821-00-0351	ELU - COUPLING GUARD COVER
34	1	821-00-0500	ELUTRIATOR STRUCTURE
35	2	821-00-0413	ELU - FLANGE SEAL
36	1	821-00-0512	OVERFLOW DISCHARGE CHUTE WELDMENT
37	1	822-00-0185	SHAFT END SPACER - ELU SCREW CONVEYOR
38	1	888-64-0034	FASTENER, HH BOLT, 3/4-10 UNC x 2-1/4" LG. 316 SST



MAKE \_\_\_\_\_ PCS.

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CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE.

CAD FILE: \\WIM-DC1\nas2\Battery Recycling Systems\Drawings\821 - ELU - Elutriator\821-00-0200-0200

ENGINEERED BY TS	DATE 9/1/2015	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS TOLERANCES ARE: 0 PLACE DECIMALS: ±0.5mm 1 PLACE DECIMALS: ±0.25mm 2 PLACE DECIMALS: ±0.08mm ANGLES: ±0.5°
DETAILED BY TS	DATE 12/7/2015	
APPROVED BY	DATE	

DESCRIPTION: ELUTRIATOR

DRAWING NO. **821-00-0200-C**

SHEET: 1 OF 2

ASSY NO.

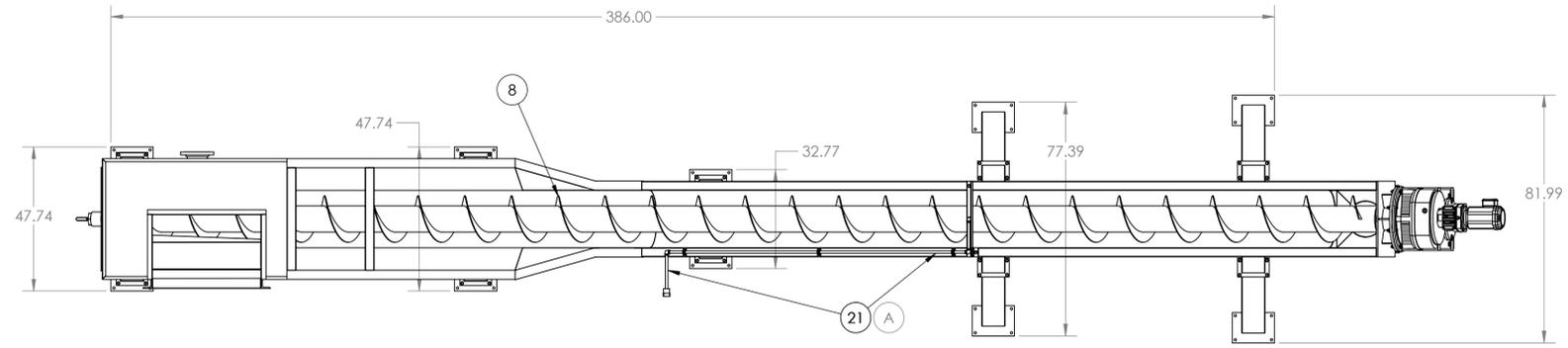
C	2/10/2016	S.G.B.
REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
1105 24TH STREET  
PORT HURON, MI 48061-5006  
USA

REF: 821-00-0203, 821-00-0204, 821-00-0205, 821-00-0207, 821-00-0217, 821-00-0245, 821-00-0445, 821-00-0446, 821-00-0512



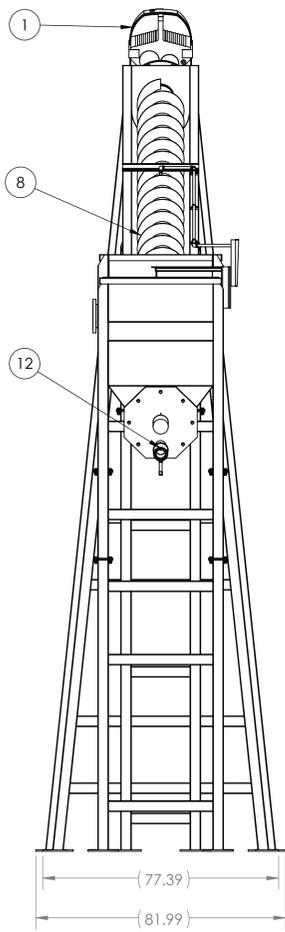
812-00-0100



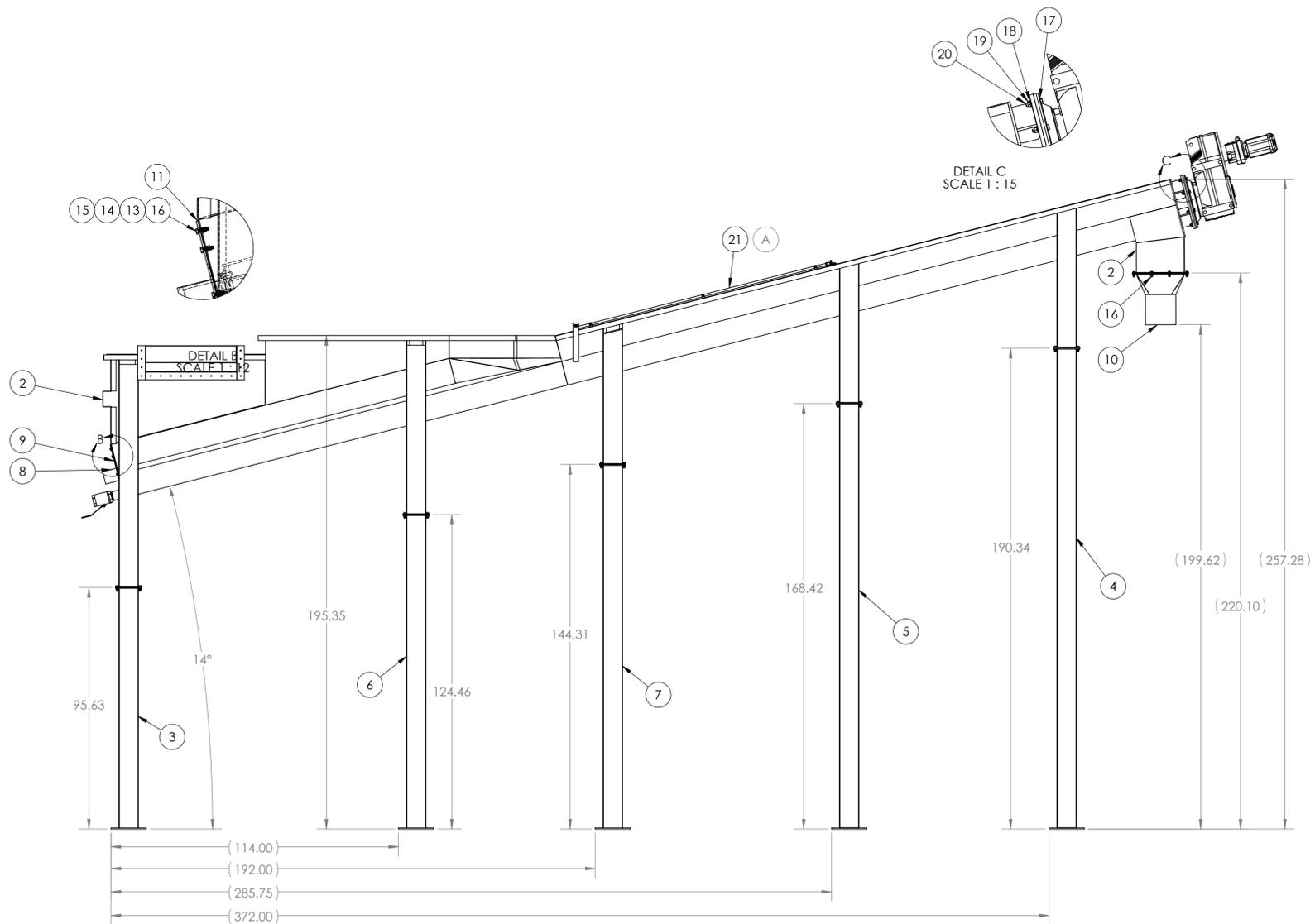
TOP VIEW

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-57-0018	5 HP GEARMOTOR
2	1	812-00-0102	MLCT FRAME WELDMENT
3	1	812-00-0109	MLCT LEG - 95"
4	1	812-00-0110	MLCT ANGLED LEG - 190"
5	1	812-00-0113	MLCT ANGLED LEG - 168"
6	1	812-00-0116	MLCT LEG - 124"
7	1	812-00-0117	MLCT NARROW LEG - 144"
8	1	812-00-0129	MLCT SCREW CONVEYOR
9	1	812-00-0136	MLCT BACK PLATE
10	1	812-00-0150	MLCT LEAD CHUTE
11	1	812-00-0151	MLCT END PLATE GASKET
12	1	888-62-0028	BALL VALVE, 3" NPT, T316 SST
13	120	888-64-0111	FASTENER, FLAT WASHER, 1/2", 316 SST
14	60	888-64-0120	FASTENER, LOCK WASHER, 1/2", 316 SST
15	60	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST
16	60	888-64-0008	FASTENER, SCR HEX CAP 1/2"-13UNC X 1-3/4"LG, 316 SST
17	16	888-64-0113	FASTENER, FLAT WASHER, 5/8", 316 SST
18	8	888-64-0122	FASTENER, LOCK WASHER, 5/8", 316 SST
19	8	888-64-0104	FASTENER, HEX NUT, 5/8-11 UNC, 316 SST
20	8	888-64-0028	FASTENER, HH BOLT, 5/8-11 UNC x 3" LG, 316 SST
21	1	812-00-0382	SPRAY BAR ASSEMBLY

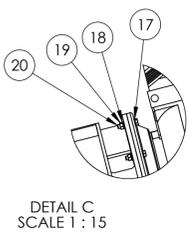
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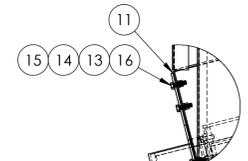
LEFT VIEW



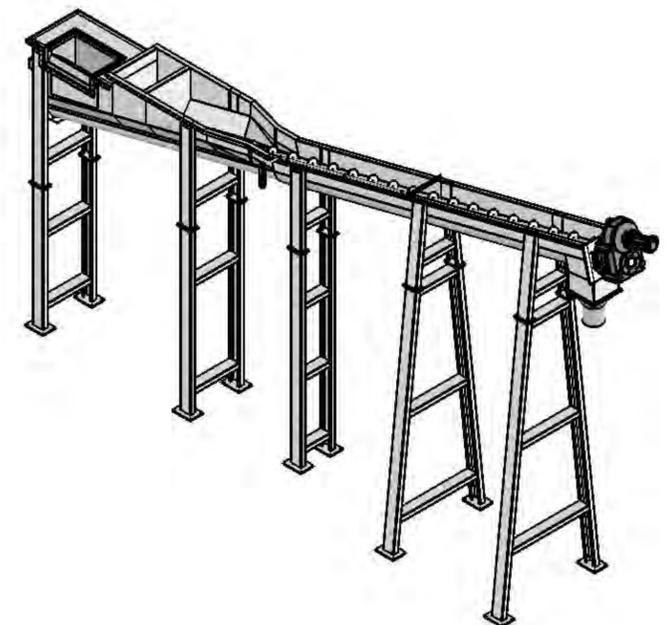
FRONT VIEW



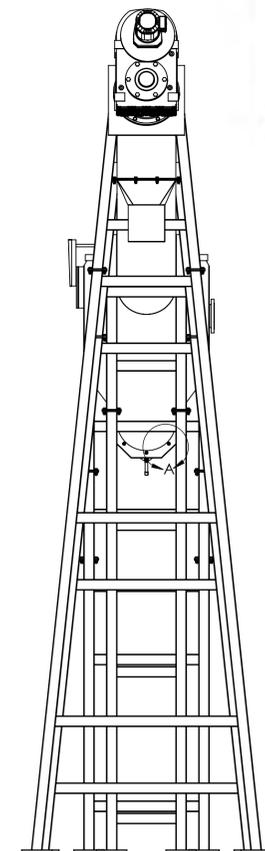
DETAIL C  
SCALE 1:15



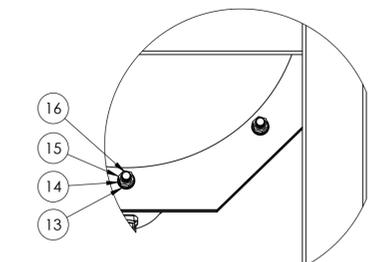
DETAIL B  
SCALE 1:2



ISOMETRIC VIEW



RIGHT VIEW



DETAIL A

A	3/30/2016	EG
REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 PORT HURON, MI 48061-5006  
 USA

DESCRIPTION		MLCT MAIN ASSEMBLY	
ENGINEERED BY	DATE	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
TS	10/5/2015	TOLERANCES ARE:	
DETAILED BY	DATE	3 PLACE DECIMALS: ±0.003"	
TS	10/5/2015	2 PLACE DECIMALS: ±0.01"	
APPROVED BY	DATE	FRACTIONS = STOCK SIZES	
TS	10/5/2015	ANGLES: ±0.5°	
DRAWING NO.		<b>812-00-0100-A</b>	
SHEET: 1 OF 1		ASSY NO.	

MAKE \_\_\_\_\_ PCS.

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

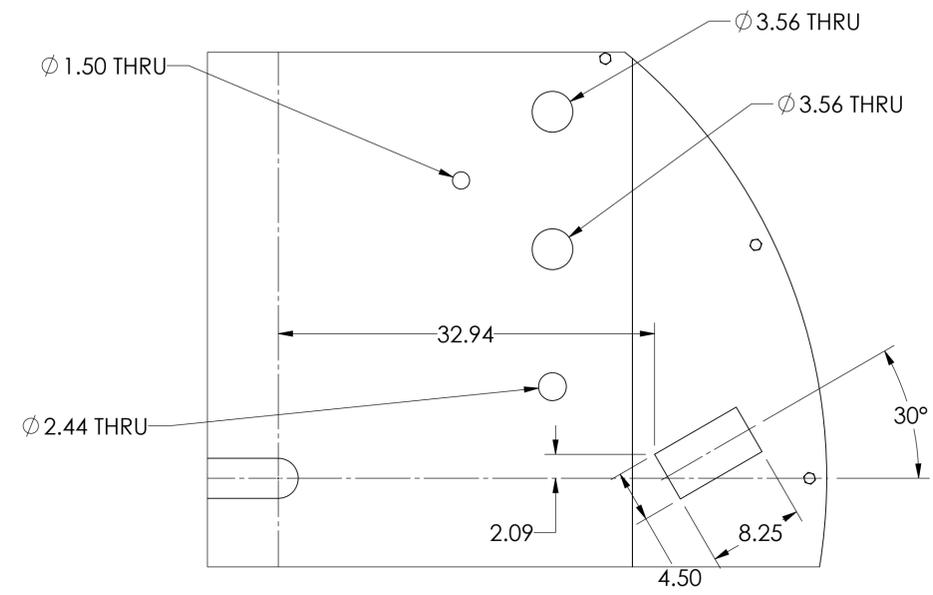
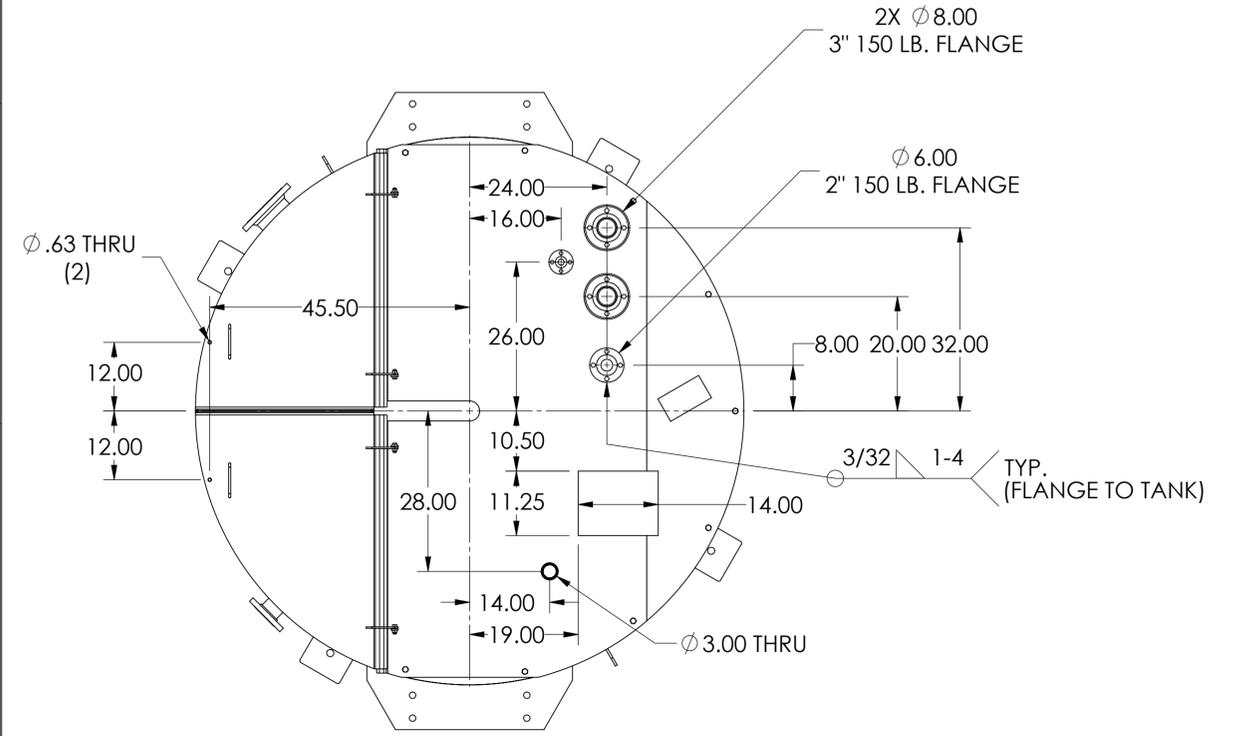
CAD FILE: \\NAS2\ncs2\Battery Recycling Systems\Drawings\812 - MLCT - Metallic Lead Classification Tank\812-00-0100

REF: 812-00-0103, 812-00-0104, 812-00-0105, 812-00-0106, 812-00-0107, 812-00-0108, 812-00-0109, 812-00-0110, 812-00-0111, 812-00-0112, 812-00-0113, 812-00-0114, 812-00-0115, 812-00-0116, 812-00-0117, 812-00-0118, 812-00-0119, 812-00-0120, 812-00-0121, 812-00-0122, 812-00-0123, 812-00-0124, 812-00-0125, 812-00-0126, 812-00-0127, 812-00-0128, 812-00-0129, 812-00-0130, 812-00-0131, 812-00-0132, 812-00-0133, 812-00-0134, 812-00-0135, 812-00-0136, 812-00-0137, 812-00-0138, 812-00-0139, 812-00-0140, 812-00-0141, 812-00-0142, 812-00-0143, 812-00-0144, 812-00-0145, 812-00-0146, 812-00-0147, 812-00-0148, 812-00-0149, 812-00-0150, 812-00-0151, 812-00-0152, 812-00-0153, 812-00-0154, 812-00-0155, 812-00-0156, 812-00-0157, 812-00-0158, 812-00-0159, 812-00-0160, 812-00-0161, 812-00-0162, 812-00-0163, 812-00-0164, 812-00-0165, 812-00-0166, 812-00-0167, 812-00-0168, 812-00-0169, 812-00-0170, 812-00-0171, 812-00-0172, 812-00-0173, 812-00-0174, 812-00-0175, 812-00-0176, 812-00-0177, 812-00-0178, 812-00-0179, 812-00-0180, 812-00-0181, 812-00-0182, 812-00-0183, 812-00-0184, 812-00-0185, 812-00-0186, 812-00-0187, 812-00-0188, 812-00-0189, 812-00-0190, 812-00-0191, 812-00-0192, 812-00-0193, 812-00-0194, 812-00-0195, 812-00-0196, 812-00-0197, 812-00-0198, 812-00-0199, 812-00-0200

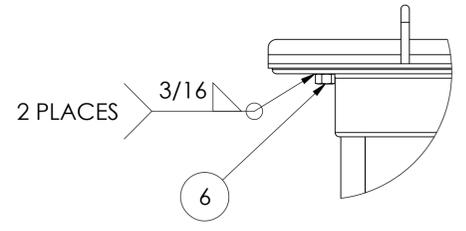
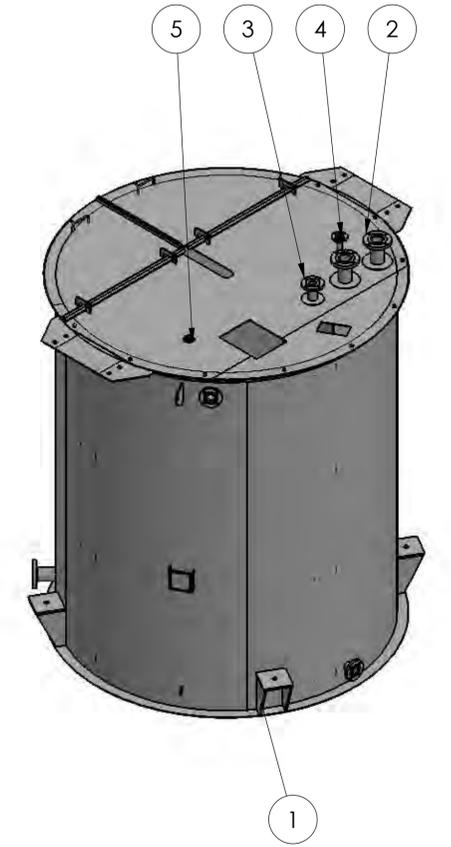


820-00-0058

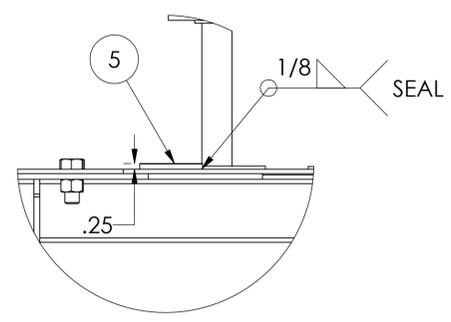
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-88-0002	RECIRCULATION TANK (2700)
2	2	862-05-0092	3" PIPE FLANGE WELMENT
3	1	820-00-0054	2" PIPE FLANGE WELMENT
4	1	810-00-1068	1" PIPE FLANGE WELMENT
5	1	888-61-0007	PIPE COUPLING, STAINLESS STEEL, 2" PIPE DIA., NPT FEMALE
6	2	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST



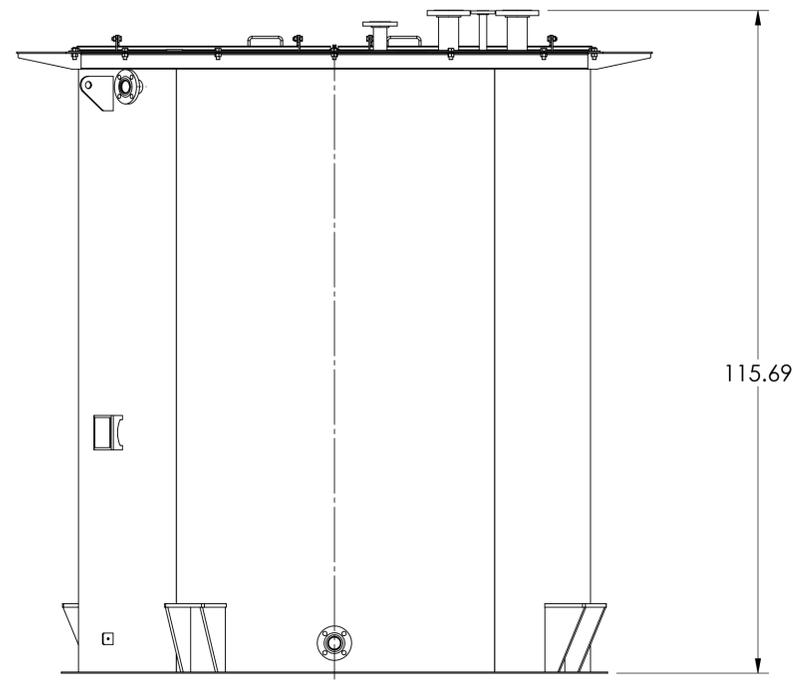
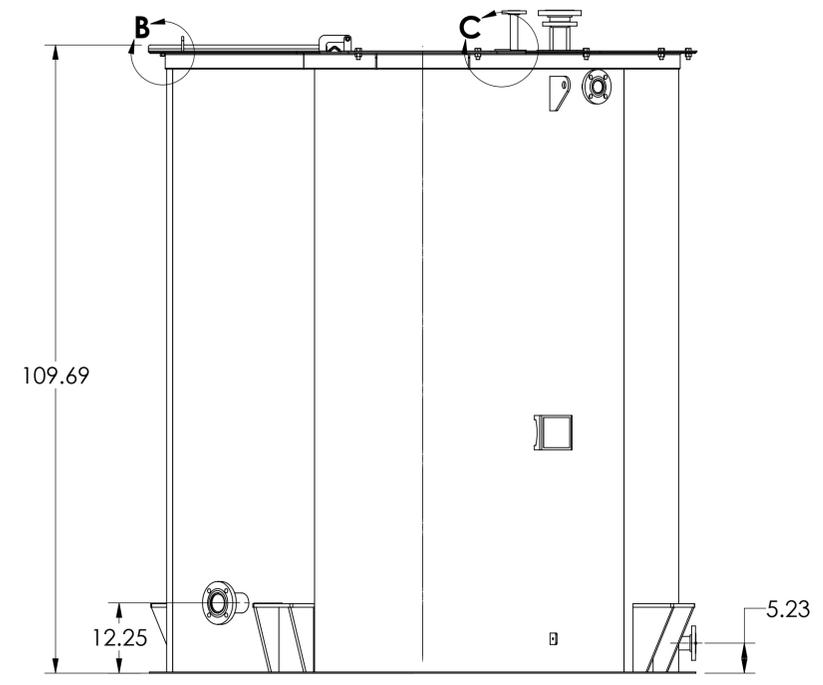
ADDED VIEW FOR CLARITY



DETAIL B



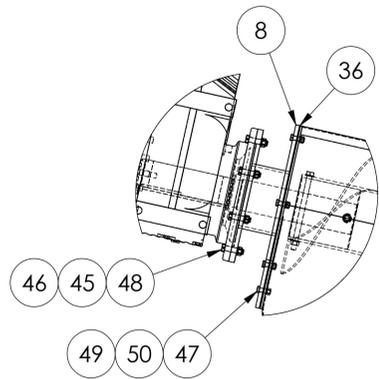
DETAIL C



REF:  
Revision 3, 22-Jul-2016  
NOTE: DEBURR & REMOVE ALL SHARP EDGES.

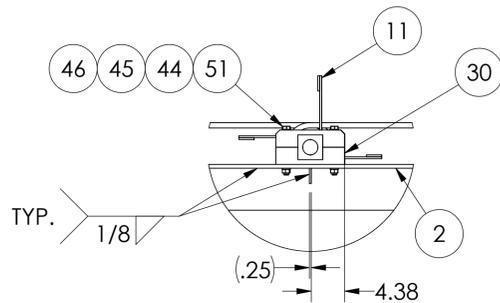
0	REV	DATE	AUTHOR
<p><b>BATTERY RECYCLING SYSTEMS, INC.</b> 1105 24TH STREET PORT HURON, MI 48061-5006 USA</p>			
DESCRIPTION		RECIRCULATION TANK MODIFIED W/ TOP FLANGES	
ENGINEERED BY	DATE	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
S.G.B.	3/14/2016	TOLERANCES ARE:	
DETAILED BY	DATE	3 PLACE DECIMALS: $\pm 0.003$ "	
S.G.B.	3/15/2016	2 PLACE DECIMALS: $\pm 0.01$ "	
APPROVED BY	DATE	FRACTIONS = STOCK SIZES	
		ANGLES: $\pm 0.5^\circ$	
DRAWING NO.		<b>820-00-0058-0</b>	
SHEET: 1 OF 1		ASSY NO.	
<small>CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE. CAD FILE: \\WM-DC1\nas2\Battery Recycling Systems\Drawings\820 - RCT - Recirculation Tank\820-00-0058</small>			

815-00-0700

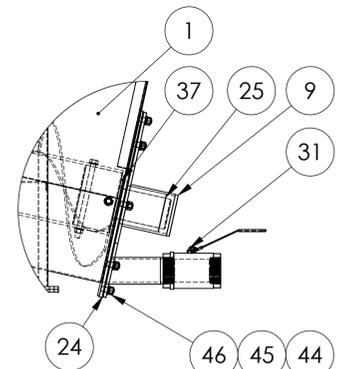
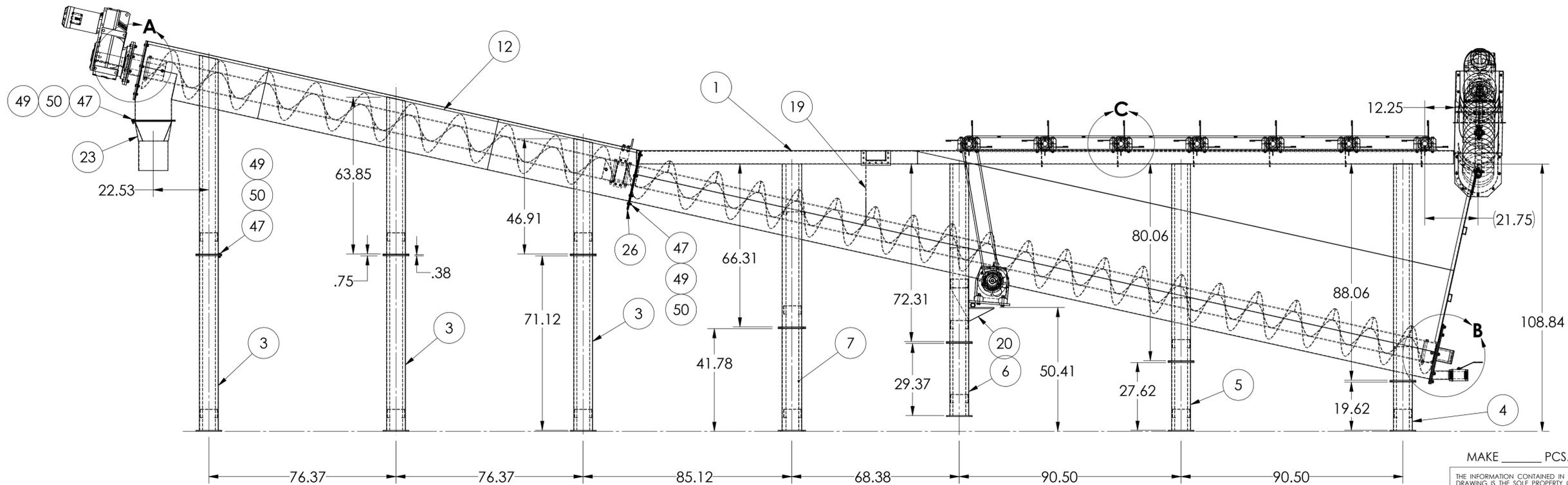


DETAIL A

ITEM NO.	QTY.	PART NO.	DESCRIPTION	ITEM NO.	QTY.	PART NO.	DESCRIPTION
33	5	888-50-0027	SPROCKET, DOUBLE SINGLE, #60, 24 TOOTH, 2" BORE	1	1	815-00-0750	TANK ASSEMBLY
34	8	S0304S1E	SQ-SST 1/2" x 3" LG. ASTM-A276	2	2	815-00-0125	BEARING SUPPORT BAR
35	6	888-50-0022	CHAIN LINK, HALF, #60, SST	3	3	815-00-0730	LEG WELDMENT - BOTTOM FRONT
36	1	815-00-0829	GASKET, DRIVE END	4	1	815-00-0734	LEG WELDMENT - BOTTOM BACK
37	1	815-00-0206	SPACER - AUGER SHAFT	5	1	815-00-0735	LEG WELDMENT - BOTTOM RIGHT MIDDLE
38	1	815-00-0805	SADDLE BRACKET	6	1	815-00-0736	LEG WELDMENT - BOTTOM LEFT MIDDLE
39	2	815-00-0804	SADDLE RING	7	1	815-00-0737	LEG WELDMENT - TANK, BOTTOM FRONT
40	4	888-64-0039	FASTENER, HH BOLT, 3/4-10 UNC x 4" LG. 316 SST	8	1	815-00-0197	MOTOR MOUNT, AUGER DRIVE
41	4	888-64-0105	FASTENER, HEX NUT, 3/4-10 UNC 316 SST	9	1	815-00-0136	BEARING HOUSING - LOWER
42	8	888-64-0114	FASTENER, FLAT WASHER, 3/4" 316 SST	10	14	815-00-0214	GUSSET, BEARING SUPPORT BAR
43	4	888-64-0123	FASTENER, LOCK WASHER, 3/4" 316 SST	11	5	815-00-0224	PADDLE
44	36	888-64-0113	FASTENER, FLAT WASHER, 5/8", 316 SST	12	1	815-00-0751	UPPER TROUGH WELDMENT W/ LEGS
45	44	888-64-0122	FASTENER, LOCK WASHER, 5/8", 316 SST	13	1	815-00-0220	PADDLE, W/ FINGERS
46	44	888-64-0104	FASTENER, HEX NUT, 5/8-11 UNC, 316 SST	14	1	815-00-0227	PADDLE, DRIVE
47	138	888-64-0007	FASTENER, HH BOLT, 1/2-13 UNC x 1-1/2" LG. 316 SST	15	1	815-00-0801	WELDING FLANGE - BACK SIDE
48	8	888-64-0027	FASTENER, HH BOLT, 5/8-11 UNC x 2-1/2" LG. 316 SST	16	1	815-00-0802	WELDING FLANGE - RIGHT SIDE
49	138	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST	17	1	815-00-0803	WELDING FLANGE - LEFT SIDE
50	138	888-64-0120	FASTENER, LOCK WASHER, 1/2" 316 SST	18	1	815-00-0760	AUGER ASSEMBLY
(A) 51	28	888-64-0383	FASTENER, HH BOLT, 5/8-11 UNC x 6" LG. 316 SST	19	1	815-00-0809	DIVIDER PANEL
				20	1	815-00-0143	MOTOR PIVOT BRACKET
				21	1	815-00-0810	V-NOTCHED TROUGH
				22	1	815-00-0811	DISCHARGE SCREW CONV.
				23	1	815-00-0823	CHUTE
				24	1	815-00-0215	GASKET, LOWER BEARING HOUSING
				25	1	815-00-0205	BUSHING - AUGER SHAFT
				26	1	815-00-0513	GASKET, CENTER SECTION
				27	1	815-00-0210	MOTOR MOUNT - PADDLE DRIVE
				28	1	888-50-0025	SPROCKET, SINGLE, #60, 24 TOOTH, 2-3/8" BORE
				29	3	888-50-0026	SPROCKET, SINGLE, #60, 24 TOOTH, 2" BORE
				(A) 30	14	815-00-0875	BEARING ASSEMBLY
				31	1	888-62-0028	BALL VALVE, 3" NPT, T316 SST
				32	1	888-50-0021	CHAIN, #140, SINGLE, SST, 55 FEET



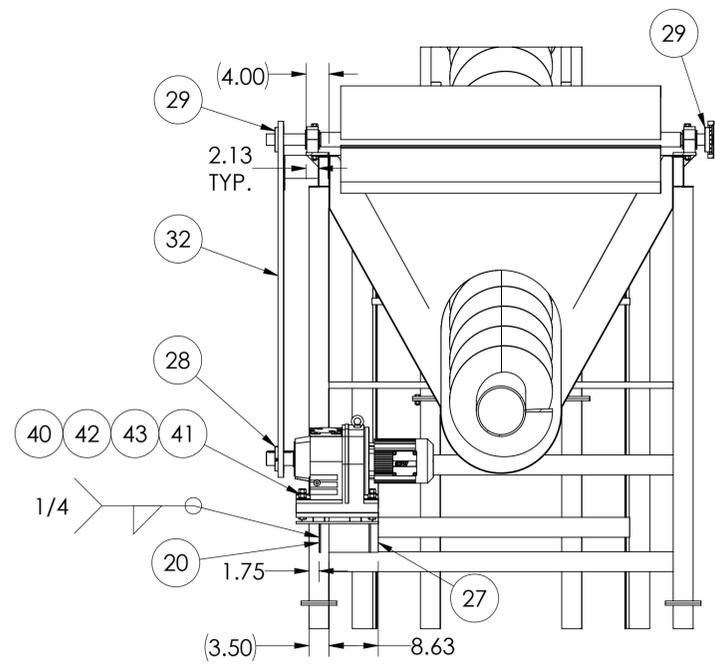
DETAIL C



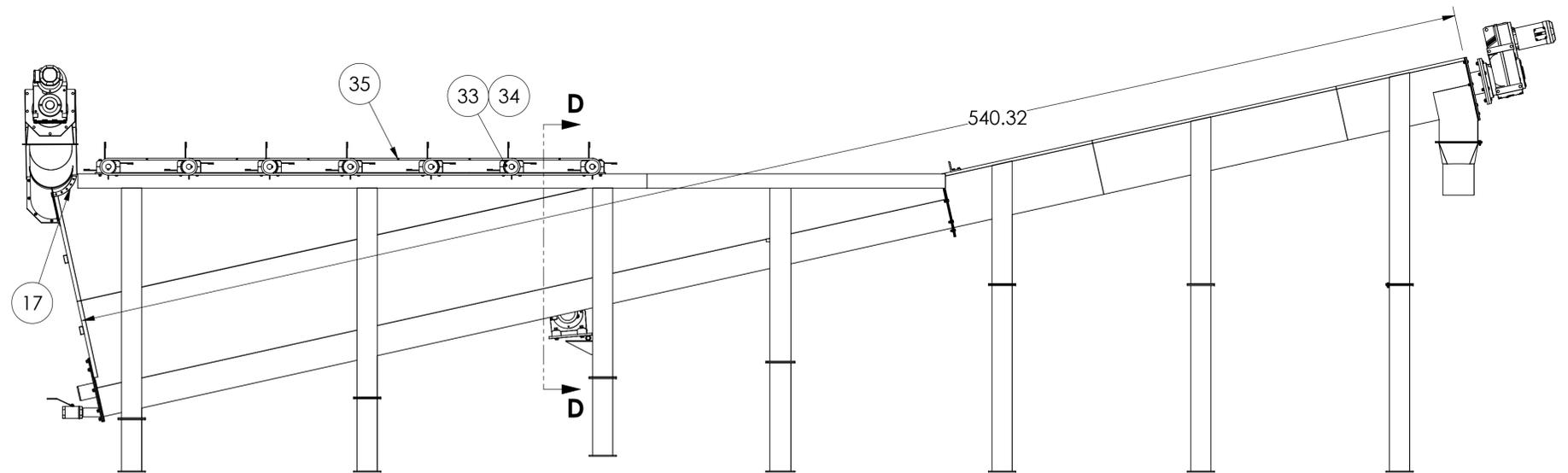
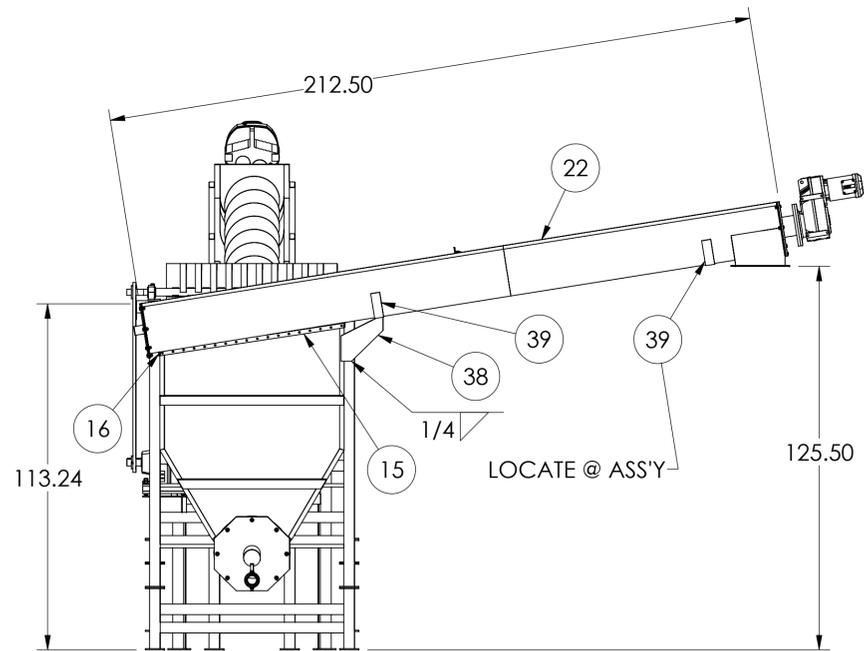
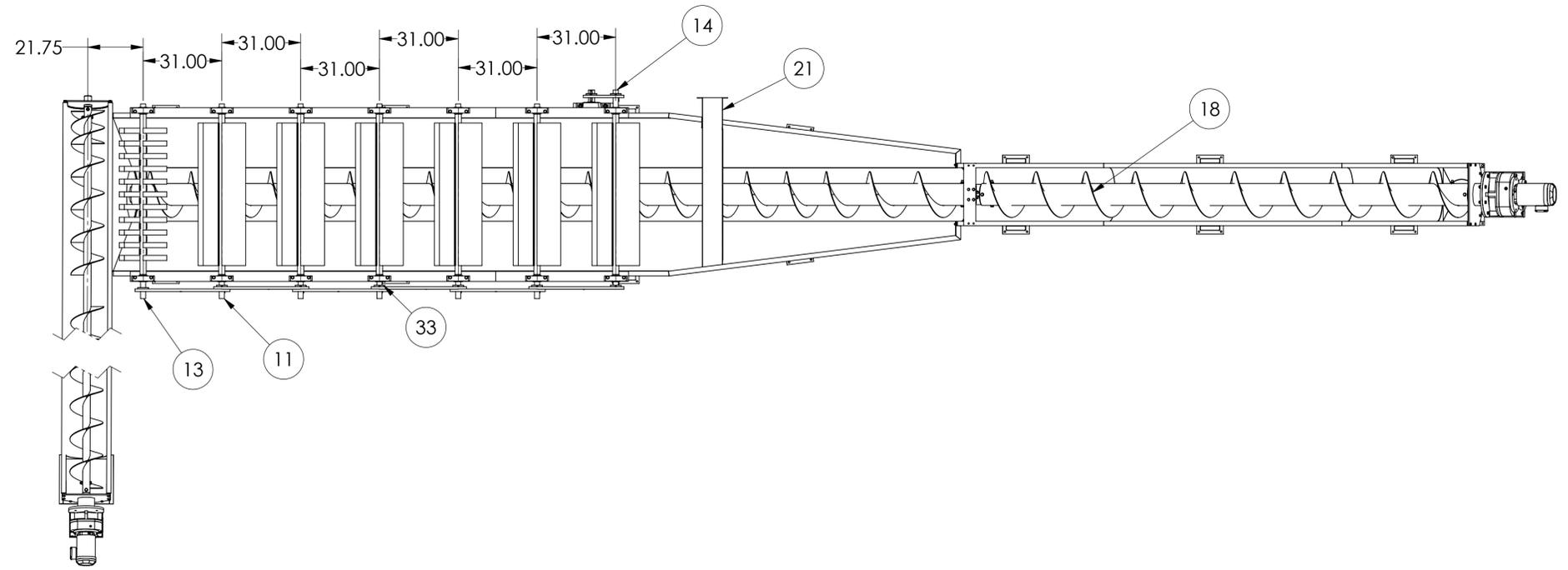
DETAIL B

REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

ENGINEERED BY BLS	DATE 12/30/2015	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: 3 PLACE DECIMALS: ±0.003" 2 PLACE DECIMALS: ±0.01" FRACTIONS = STOCK SIZES ANGLES: ±0.5°
DESCRIPTION PLASTICS CLASSIFICATION TANK - XL	DATE 1/28/2016	REVISION A
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.	DATE 1/28/2016	AUTHOR TS
CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE	DRAWING NO. <b>815-00-0700-A</b>	
CAD FILE: \\NAS2\vol2\Battery Recycling Systems\Drawings\815 - PCT - Plastics Classification Tank\815-00-0700	SHEET: 1 OF 2	



SECTION D-D



REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

MAKE \_\_\_\_\_ PCS.

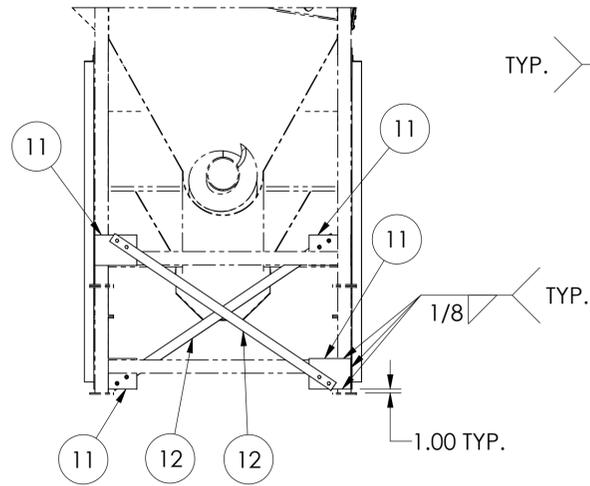
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE  
 CAD FILE: \\NAS2\ros2\Battery Recycling Systems\Drawings\815 - PCT - Plastics Classification Tank\815-00-0700

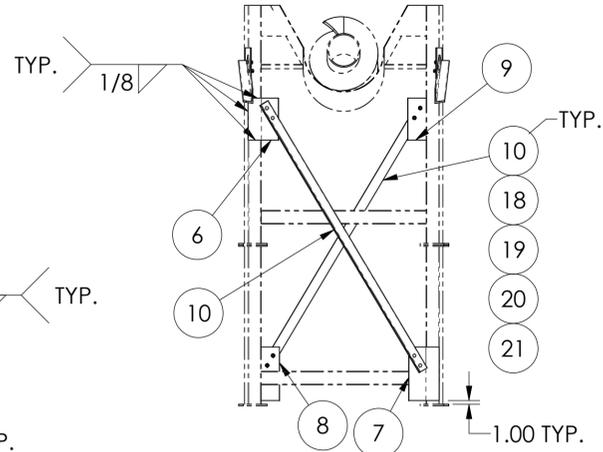
A	1/28/2016	TS
REV	DATE	AUTHOR

<p>1105 24TH STREET          PORT HURON, MI 48061-5006          USA</p>	
<b>DESCRIPTION</b> PLASTICS CLASSIFICATION TANK - XL	
ENGINEERED BY <b>BLS</b> 12/30/2015 DATE	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS TOLERANCES ARE: 0 PLACE DECIMALS: ±0.5mm 1 PLACE DECIMALS: ±0.25mm 2 PLACE DECIMALS: ±0.08mm ANGLES: ±0.5°
DRAWING NO. <b>815-00-0700-A</b>	SHEET: 2 OF 2 ASSY NO.

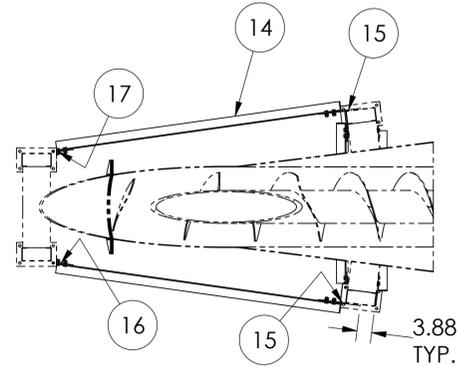
815-00-0930



SECTION C-C

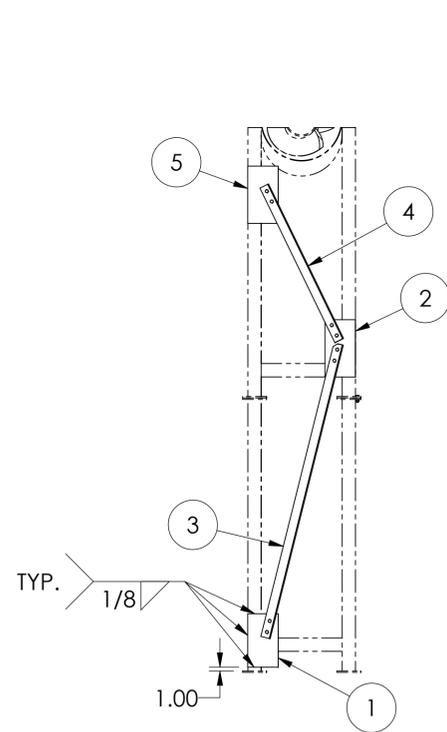


SECTION D-D

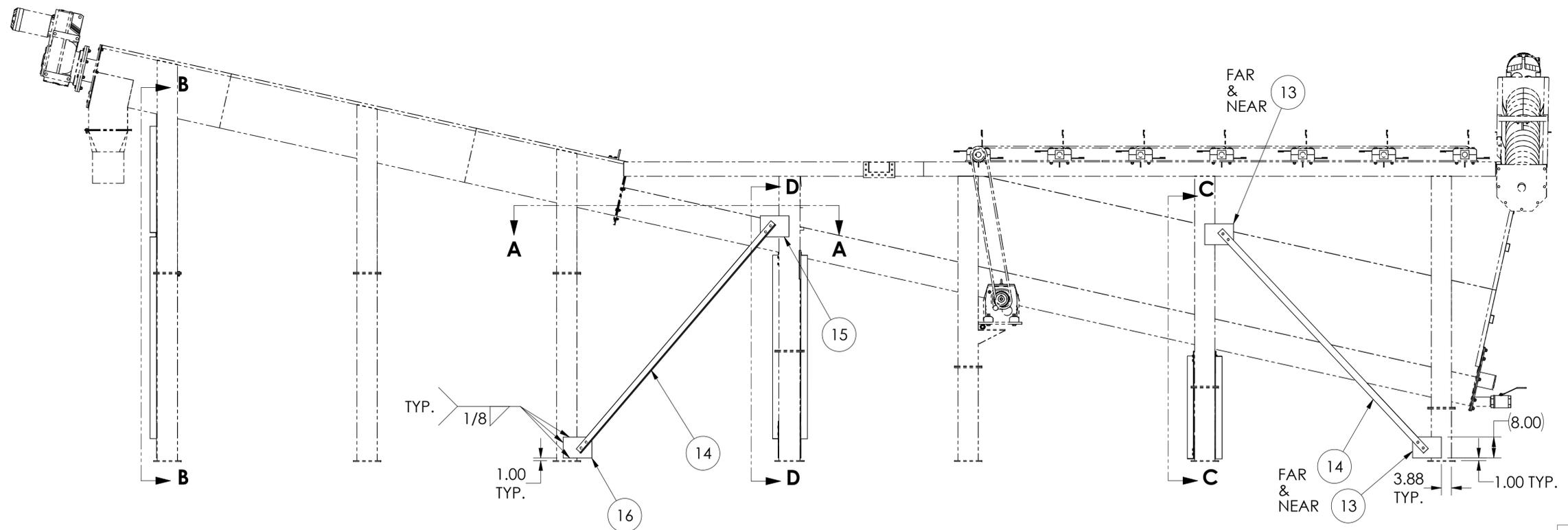


SECTION A-A

ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	815-00-0921	GUSSET PLATE - A1
2	1	815-00-0922	GUSSET PLATE - A2
3	1	815-00-0923	CROSS BRACE - A1
4	1	815-00-0924	CROSS BRACE - A2
5	1	815-00-0925	GUSSET PLATE - A3
6	1	815-00-0926	GUSSET PLATE - A4
7	1	815-00-0927	GUSSET PLATE - A5
8	1	815-00-0928	GUSSET PLATE - A6
9	1	815-00-0929	GUSSET PLATE - A7
10	2	815-00-0931	CROSS BRACE - A3
11	4	815-00-0932	GUSSET PLATE - A8
12	2	815-00-0933	CROSS BRACE - A4
13	4	815-00-0934	GUSSET PLATE - A9
14	4	815-00-0935	CROSS BRACE - A5
15	2	815-00-0936	GUSSET PLATE - B1
16	1	815-00-0937	GUSSET PLATE - B2
17	1	815-00-0938	GUSSET PLATE - B3
18	40	888-64-0006	FASTENER, HH BOLT, 1/2-13 UNC x 1-1/4" LG. 316 SST
19	40	888-64-0111	FASTENER, FLAT WASHER, 1/2", 316 SST
20	40	888-64-0120	FASTENER, LOCK WASHER, 1/2" 316 SST
21	40	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST



SECTION B-B



REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

0	REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 PORT HURON, MI 48061-5006  
 USA

DESCRIPTION: **BRACE ASSEMBLY PCT**

ENGINEERED BY: BLS DATE: 4/20/2016  
 DETAILED BY: DATE:   
 DRAWING NO.: **815-00-0930-0**

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE: 3 PLACE DECIMALS: ±0.003"  
 2 PLACE DECIMALS: ±0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

MAKE \_\_\_\_\_ PCS.

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

CAD FILE: \\wim-dc1\nas2\Battery Recycling Systems\Drawings\815-PCT - Plastics Classification Tank\815-00-0930

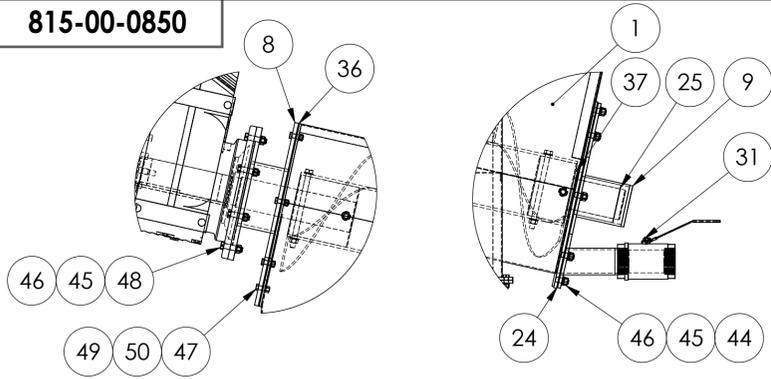
MAKE \_\_\_\_\_ PCS.

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

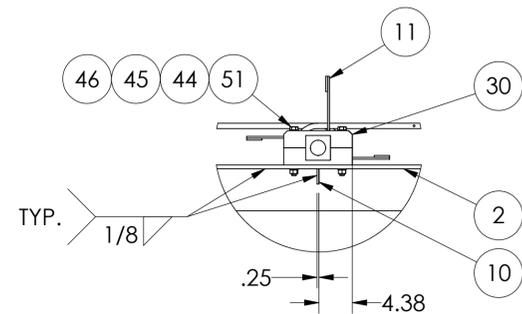
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815-00-0850



DETAIL A

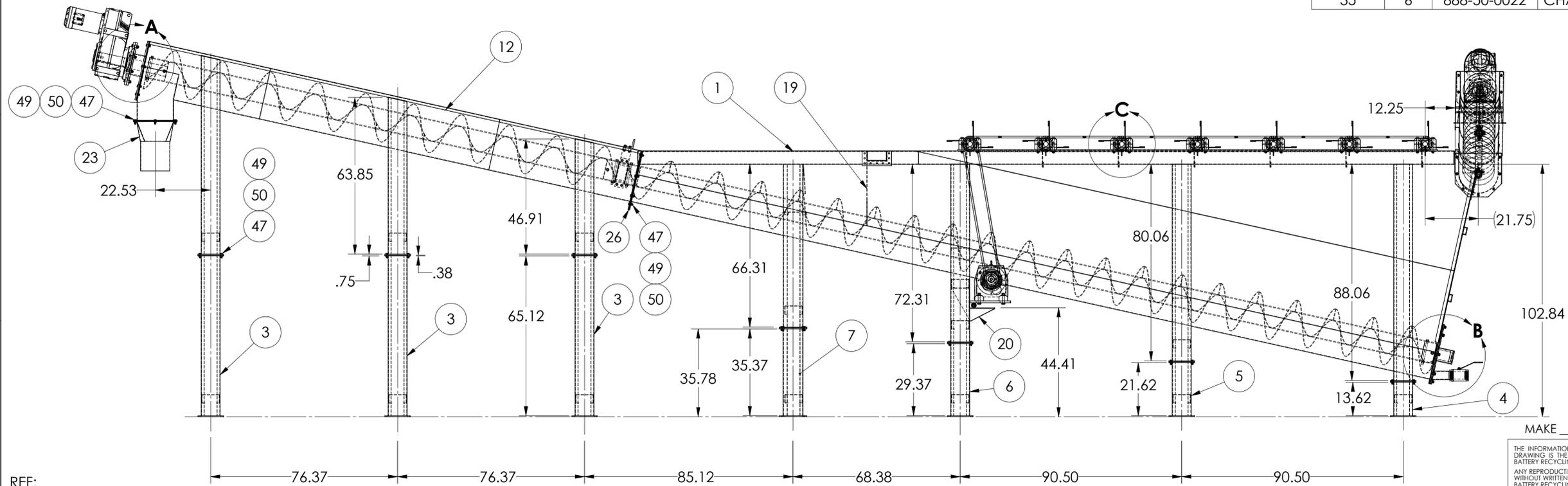
DETAIL B



DETAIL C

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
36	1	815-00-0829	GASKET, DRIVE END
37	1	815-00-0206	SPACER - AUGER SHAFT
38	1	815-00-0805	SADDLE BRACKET
39	2	815-00-0804	SADDLE RING
40	4	888-64-0039	FASTENER, HH BOLT, 3/4-10 UNC x 4" LG. 316 SST
41	4	888-64-0105	NUT, HEX, 3/4-10 UNC 316 SST
42	8	888-64-0114	WASHER, FLAT 3/4" 316 SST
43	4	888-64-0123	WASHER, LOCK, 3/4" 316 SST
44	36	888-64-0113	WASHER, FLAT 5/8", 316 SST
45	44	888-64-0122	WASHER, LOCK, 5/8", 316 SST
46	44	888-64-0104	NUT, HEX, 5/8-11 UNC, 316 SST
47	93	888-64-0007	FASTENER, HH BOLT, 1/2-13 UNC x 1-1/2" LG. 316 SST
48	8	888-64-0027	FASTENER, HH BOLT, 5/8-11 UNC x 2-1/2" LG. 316 SST
49	93	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST
50	93	888-64-0120	FASTENER, LOCK WASHER, 1/2" 316 SST
51	28	888-64-0383	FASTENER, HH BOLT, 5/8-11 UNC x 6" LG. 316 SST

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	815-00-0750	TANK ASSEMBLY
2	2	815-00-0125	BEARING SUPPORT BAR
3	3	815-00-0851	LEG WELDMENT - BOTTOM FRONT
4	1	815-00-0852	LEG WELDMENT - BOTTOM BACK
5	1	815-00-0855	LEG WELDMENT - BOTTOM RIGHT MIDDLE
6	1	815-00-0861	LEG WELDMENT - BOTTOM LEFT MIDDLE
7	1	815-00-0859	LEG WELDMENT - TANK, BOTTOM FRONT
8	1	815-00-0197	MOTOR MOUNT, AUGER DRIVE
9	1	815-00-0136	BEARING HOUSING - LOWER
10	14	815-00-0214	GUSSET, BEARING SUPPORT BAR
11	5	815-00-0224	PADDLE
12	1	815-00-0751	UPPER TROUGH WELDMENT W/ LEGS
13	1	815-00-0220	PADDLE, W/ FINGERS
14	1	815-00-0227	PADDLE, DRIVE
15	1	815-00-0801	WELDING FLANGE - BACK SIDE
16	1	815-00-0802	WELDING FLANGE - RIGHT SIDE
17	1	815-00-0803	WELDING FLANGE - LEFT SIDE
18	1	815-00-0760	AUGER ASSEMBLY
19	1	815-00-0809	DIVIDER PANEL
20	1	815-00-0143	MOTOR PIVOT BRACKET
21	1	815-00-0810	V-NOTCHED TROUGH
22	1	815-00-0811	DISCHARGE SCREW CONV.
23	1	815-00-0823	CHUTE
24	1	815-00-0215	GASKET, LOWER BEARING HOUSING
25	1	815-00-0205	BUSHING - AUGER SHAFT
26	1	815-00-0513	GASKET, CENTER SECTION
27	1	815-00-0210	MOTOR MOUNT - PADDLE DRIVE
28	1	888-50-0025	SPROCKET, SINGLE, #60, 24 TOOTH, 2-3/8" BORE
29	3	888-50-0026	SPROCKET, SINGLE, #60, 24 TOOTH, 2" BORE
30	14	815-00-0875	BEARING ASSEMBLY
31	1	888-62-0028	BALL VALVE, 3" NPT, T316 SST
32	1	888-50-0021	CHAIN, #140, SINGLE, SST, 55 FEET
33	5	888-50-0027	SPROCKET, DOUBLE SINGLE, #60, 24 TOOTH, 2" BORE
34	8	S0304S1E	SQ-SST 1/2" x 3" LG. ASTM-A276
35	6	888-50-0022	CHAIN LINK, HALF, #60, SST



REF: Revision 3, 22-Jul-2016  
NOTE: DEBURR & REMOVE ALL SHARP EDGES.

MAKE \_\_\_\_\_ PCS.

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING SYSTEMS, INC. IS PROHIBITED.

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE.

CAD FILE: \\WM-DC1\nas2\Battery Recycling Systems\Drawings\815 - PCT - Plastics Classification Tank\815-00-0850

ENGINEERED BY	DATE	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
BLS	1/7/2016	TOLERANCES ARE:
DATE		3 PLACE DECIMALS: +0.003"
		2 PLACE DECIMALS: +0.01"
		FRACTIONS = STOCK SIZES
		ANGLES: ±0.5°

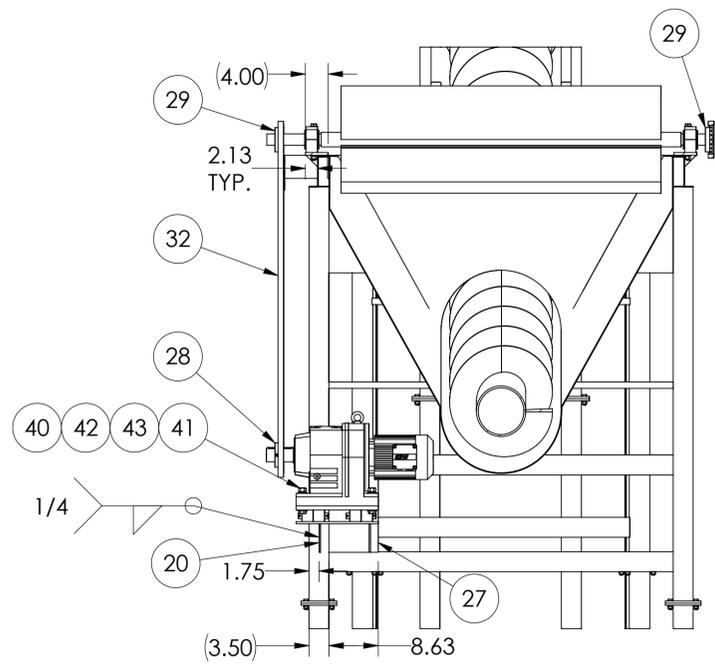
DESCRIPTION: PLASTICS CLASSIFICATION TANK - XL SHORT LEGS

DRAWING NO. **815-00-0850-C**

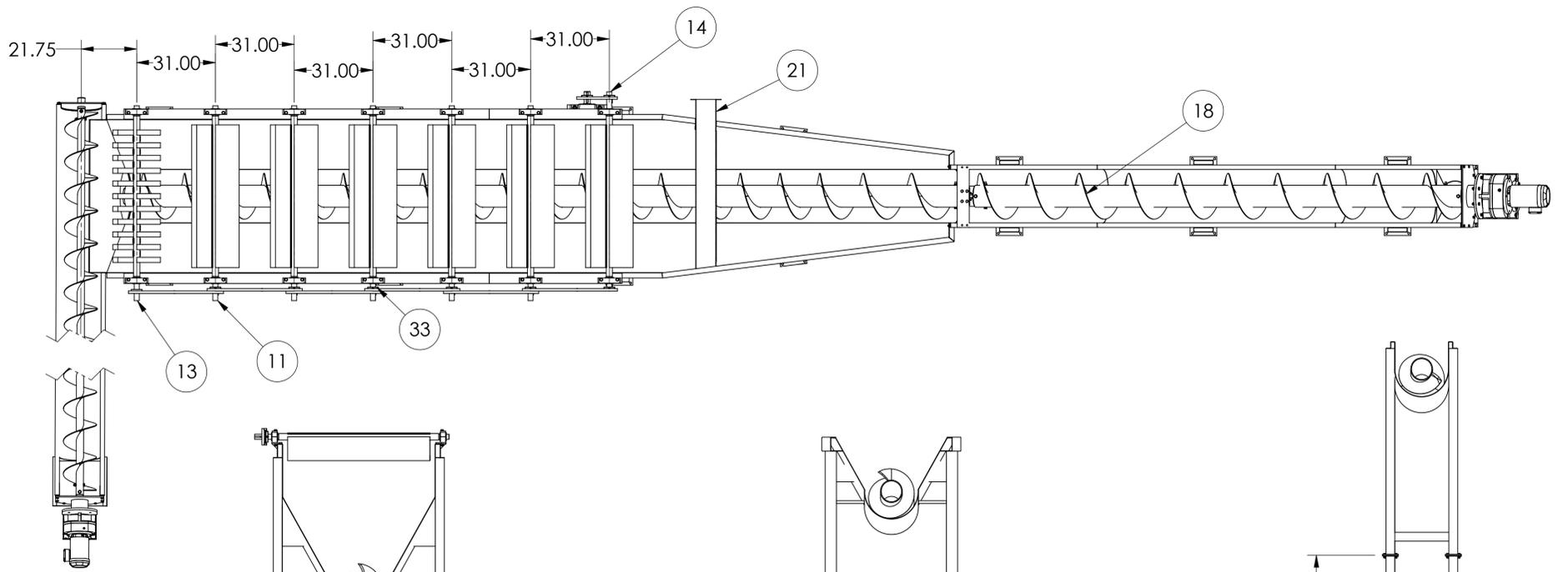
SHEET: 1 OF 2

**BATTERY RECYCLING SYSTEMS, INC.**  
1105 24TH STREET  
PORT HURON, MI 48061-5006  
USA

C	6/14/2016	TS
REV	DATE	AUTHOR



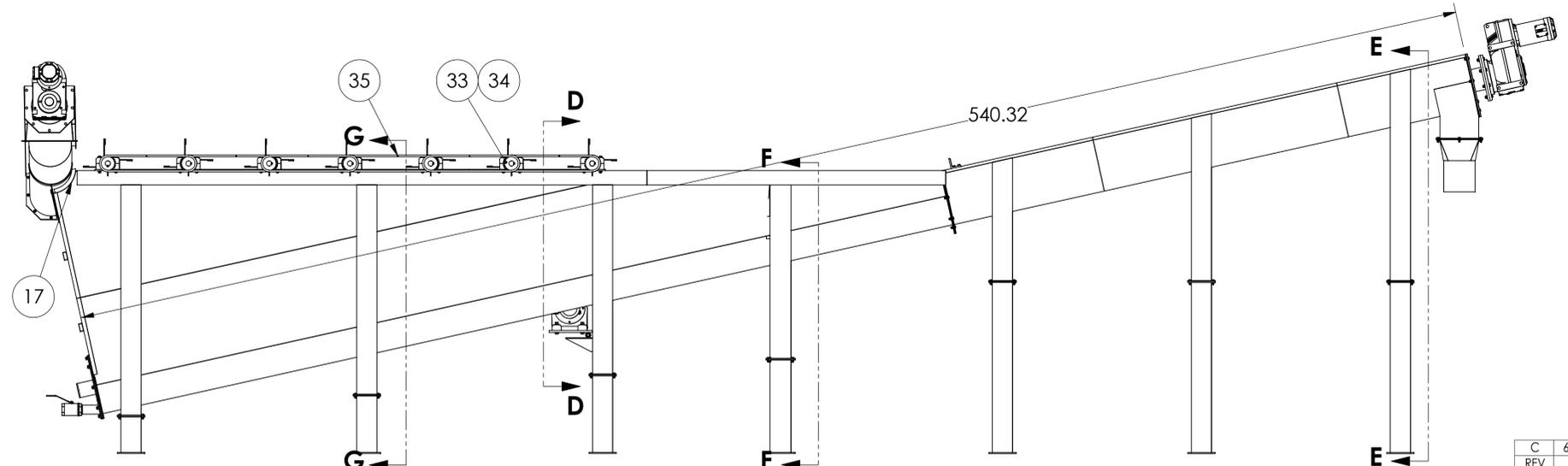
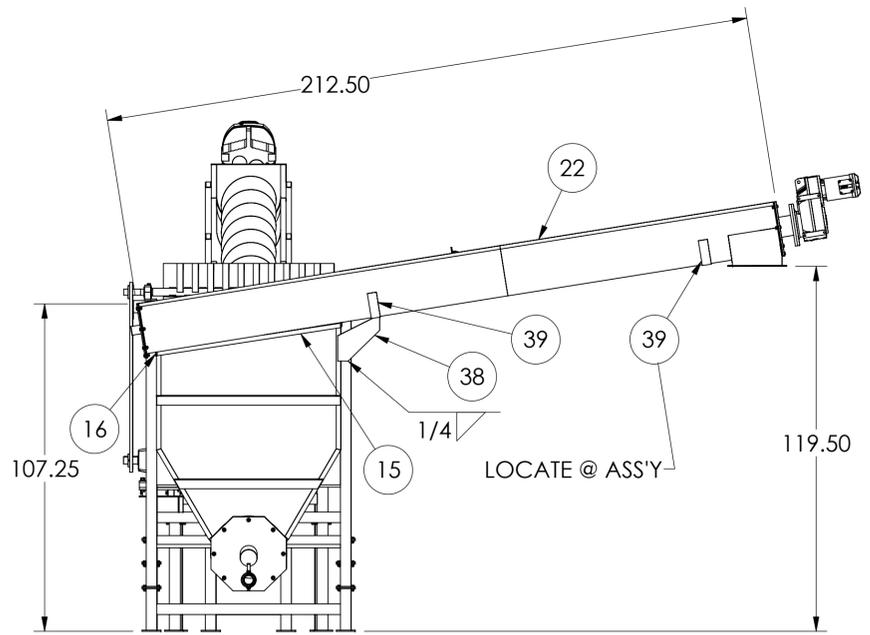
SECTION D-D



SECTION G-G

SECTION F-F

SECTION E-E



REF:  
 Revision 3, 22-Jul-2016  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

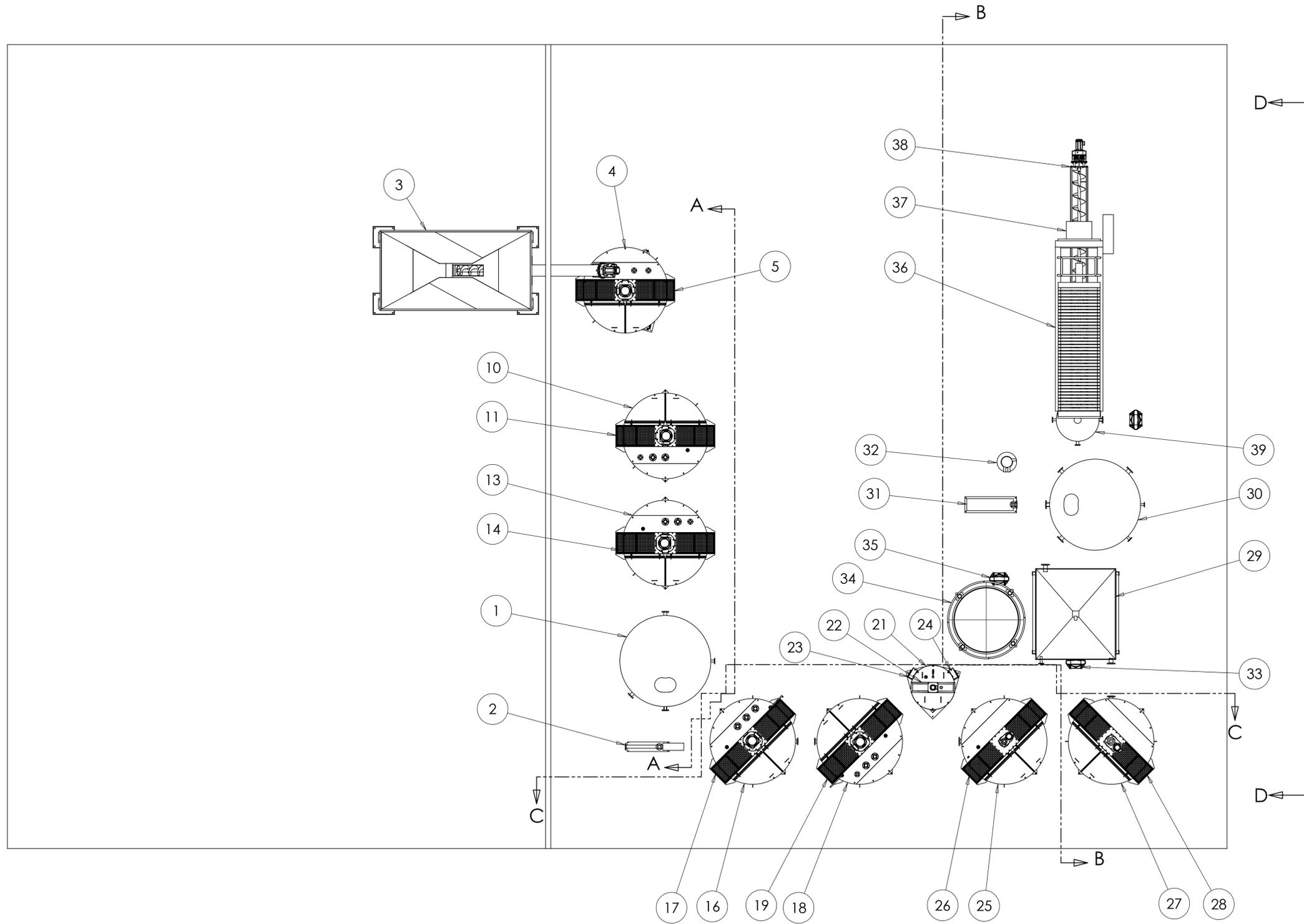
ENGINEERED BY	DATE	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS
BLS	1/7/2016	TOLERANCES ARE:
DETAILED BY	DATE	0 PLACE DECIMALS: +0.5mm
		1 PLACE DECIMALS: +0.25mm
		2 PLACE DECIMALS: +0.08mm
		ANGLES: ±0.5°
APPROVED BY	DATE	DRAWING NO.
		<b>815-00-0850-C</b>
SHEET: 2 OF 2		ASSY NO.
CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE		
CAD FILE: \\WM-DC1\nas2\Battery Recycling Systems\Drawings\815 - PCT - Plastics Classification Tank\815-00-0850		

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 PORT HURON, MI 48061-5006  
 USA

DESCRIPTION  
**PLASTICS CLASSIFICATION TANK - XL SHORT LEGS**

C	6/14/2016	TS
REV	DATE	AUTHOR

MAKE \_\_\_\_\_ PCS.



ITEM NO.	AQM NO.	BRS NO.	ITEM DESCRIPTION
1	TK-001	888-88-0016	INCOMING EFFLUENT TANK
2	P-001	888-38-0017	EFFLUENT TANK PUMP
3	TK-002	862-03-0101	CALCIUM HYDROXIDE POWDER HOPPER
4	TK-003	862-04-0048	FORMULATION TANK
5	AG-003	862-04-0049	FORMULATION TANK AGITATOR
6	LC-001	888-17-0026	LOAD CELL #1
7	LC-002	888-17-0026	LOAD CELL #2
8	LC-003	888-17-0026	LOAD CELL #3
9	P-004	888-38-0017	FORMULATION PUMP
10	TK-005	862-05-0058	NEUTRALIZER DOSING TANK #1
11	AG-005	862-05-0059	NEUTRALIZER DOSING TANK AGITATOR #1
12	P-006	888-38-0017	NEUTRALIZER DOSING TANK PUMP #1
13	TK-007	862-05-0058	NEUTRALIZER DOSING TANK #2
14	AG-007	862-05-0059	NEUTRALIZER DOSING TANK AGITATOR #2
15	P-008	888-38-0017	NEUTRALIZER DOSING TANK PUMP #2
16	TK-010	862-05-0068	REACTION TANK #1
17	AG-010	862-05-0069	REACTION TANK AGITATOR #1
18	TK-009	862-05-0089	REACTION TANK #2
19	AG-009	862-05-0069	REACTION TANK AGITATOR #2
20	P-012	888-38-0017	NEUTRALIZED EFFLUENT PUMP
21	TK-011	828-00-0020	ANIONIC POLYMER TANK
22	AG-011	828-00-0059	ANIONIC POLYMER AGITATOR
23	P-0XX	888-38-0009	POLYMER FORMULATION METERING PUMP
24	P-018	888-38-0008	POLYMER DOSING METERING PUMP
25	TK-013	862-07-0038	FLASH TANK
26	AG-013	862-07-0039	FLASH TANK AGITATOR
27	TK-014	862-07-0078	FLOCCULATION TANK
28	AG-014	862-07-0079	FLOCCULATION TANK AGITATOR
29	TK-020	888-88-0011	LAMELLA CLARIFIER
30	TK-015	888-88-0017	TREATED WATER STORAGE TANK
31	P-015	888-38-0013	TREATED WATER PUMP
32	F-015	888-39-0005	MULTI-MEDIA FILTER
33	P-020	888-38-0016	SLUDGE PUMP
34	TK-025	888-88-0015	SLUDGE TANK
35	P-025	N/A	SLURRY PUMP (FILTER PRESS PACKAGE)
36	FP-015	888-90-0002	FILTER PRESS
37	P-016	N/A	GEAR PUMP (FILTER PRESS PACKAGE)
38	CN-015	816-00-0100	SLUDGE SCREW CONVEYOR
39	TK-025	888-88-0013	SMALL CLARIFIED WATER TANK
40	P-025	888-38-0016	SMALL CLARIFIED WATER PUMP

E	3/30/2016	S.G.B.
REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 FORT HURON, MI 48061-5006  
 USA

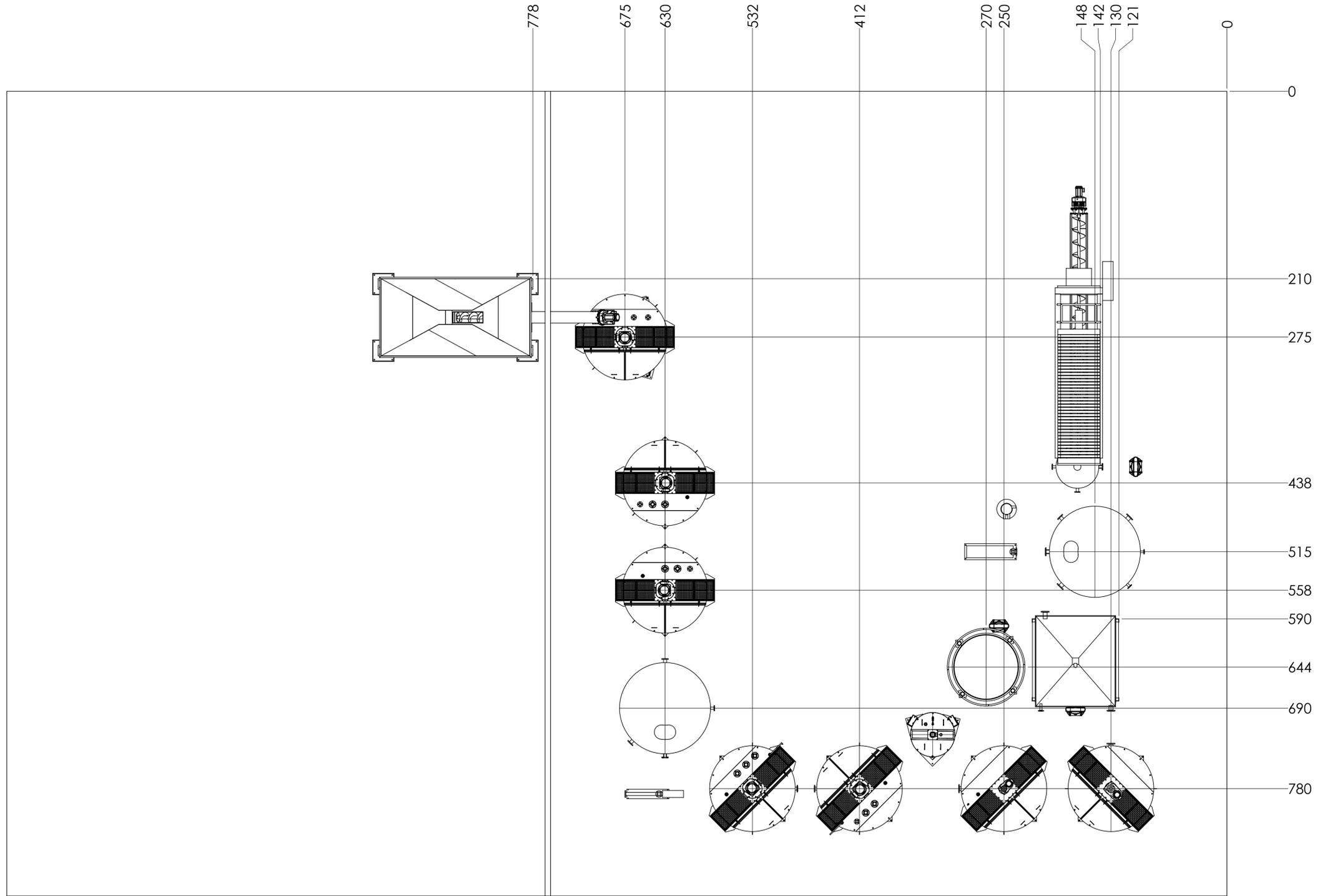
DESCRIPTION:  
**AQUA METAL 3 LPS WATER TREATMENT SYSTEM GENERAL ARRANGEMENT**

ENGINEERED BY: S.G.B. DATE: 6/1/2015  
 UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: +0.003"  
 2 PLACE DECIMALS: +0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

MAKE \_\_\_\_\_ PCS.  
 DRAWING NO. **800-25-0001-E**  
 SHEET: 1 OF 3  
 ASSY NO. 800-23-0001

REF:  
 Revision 3, 22-Jul-2016  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.  
 CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE.  
 CAD FILE: T:\Drawings\800 - Layouts\800-25 Aqua Metals ETP, 800-25-0001



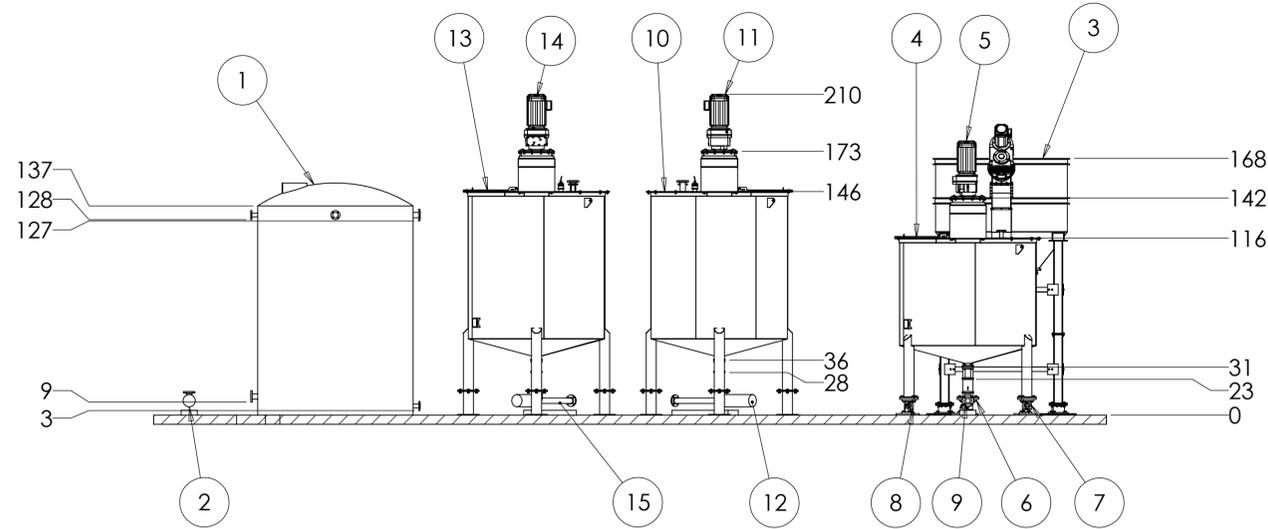
REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

MAKE \_\_\_\_\_ PCS.

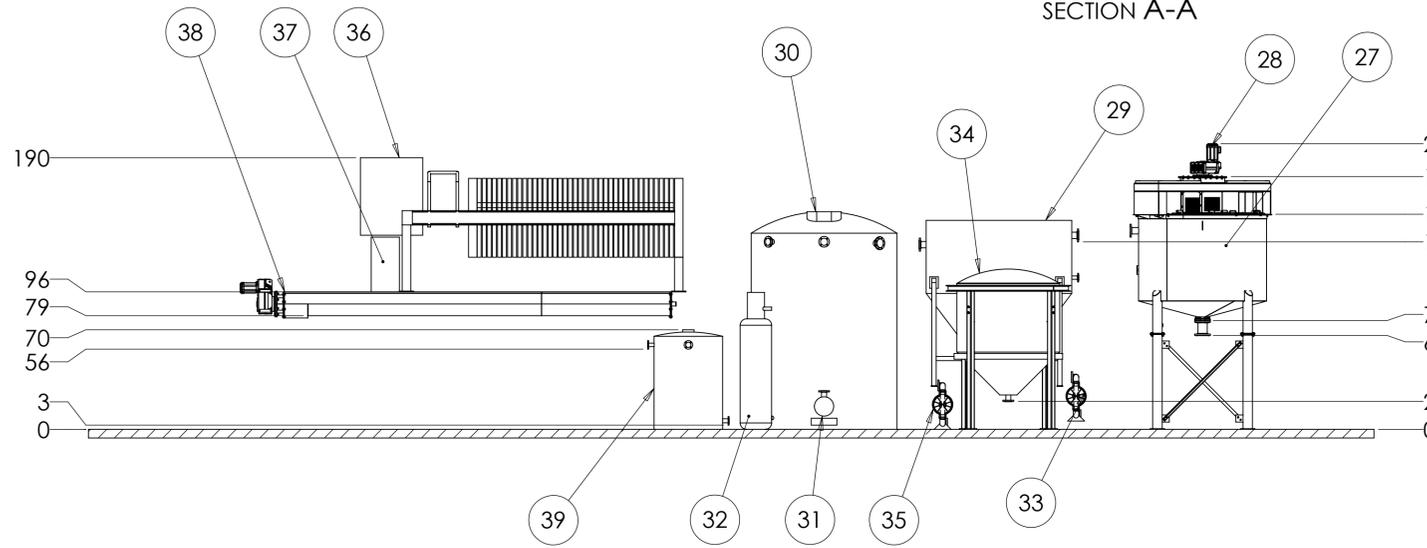
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.  
 CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE  
 CAD FILE: T:\Drawings\800 - Layouts\800-25 Aqua Metals ETP\800-25-0001

E	3/30/2016	S.G.B.
REV	DATE	AUTHOR

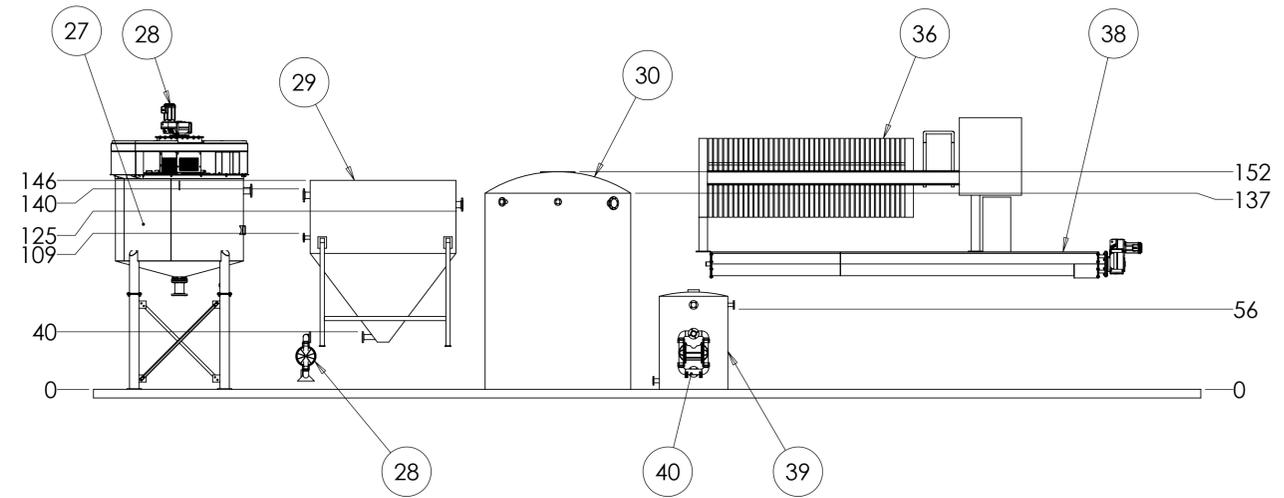
<b>BATTERY RECYCLING SYSTEMS, INC.</b> 1105 24TH STREET FORT HURON, MI 48061-5006 USA	
DESCRIPTION <b>AQUA METAL 3 LPS WATER TREATMENT SYSTEM GENERAL ARRANGEMENT</b>	
ENGINEERED BY <b>S.G.B.</b>	DATE <b>6/1/2015</b>
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:	
3 PLACE DECIMALS: ±0.003" 2 PLACE DECIMALS: ±0.01" FRACTIONS = STOCK SIZES ANGLES: ±0.5°	
DRAWING NO. <b>800-25-0001-E</b>	SHEET: 2 OF 3
ASSY NO. <b>800-23-0001</b>	



SECTION A-A

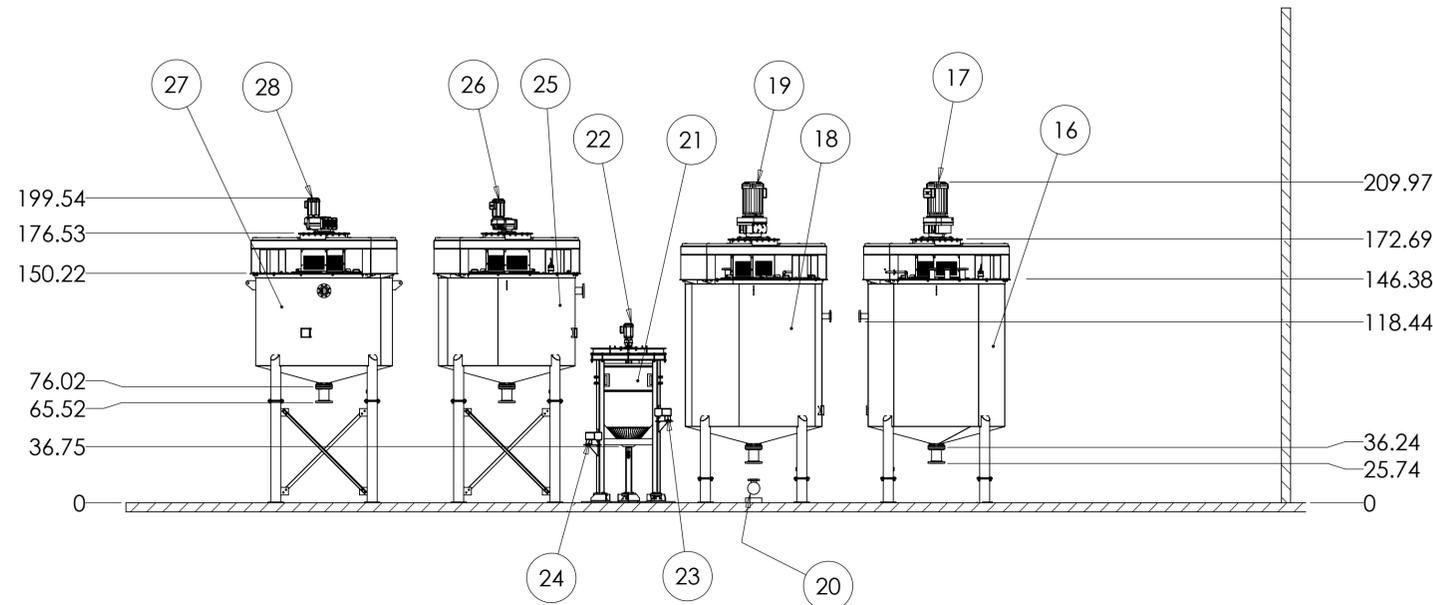


SECTION B-B



SECTION D-D

MEZZANINE HIDDEN  
IN THIS VIEW



SECTION C-C

REF:  
Revision 3, 22-Jul-2016  
NOTE: DEBURR & REMOVE ALL SHARP EDGES.

E	3/30/2016	S.G.B.
REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
1105 24TH STREET  
PORT HURON, MI 48061-5006  
USA

DESCRIPTION AQUA METAL 3 LPS WATER TREATMENT SYSTEM GENERAL ARRANGEMENT	
ENGINEERED BY S.G.B.	DATE 6/1/2015
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: 3 PLACE DECIMALS: +0.003" 2 PLACE DECIMALS: +0.01" FRACTIONS = STOCK SIZES ANGLES: ±0.5°	
APPROVED BY	DATE
DRAWING NO. <b>800-25-0001-E</b>	
SHEET: 3 OF 3	ASSY NO. 800-23-0001

MAKE \_\_\_\_\_ PCS.

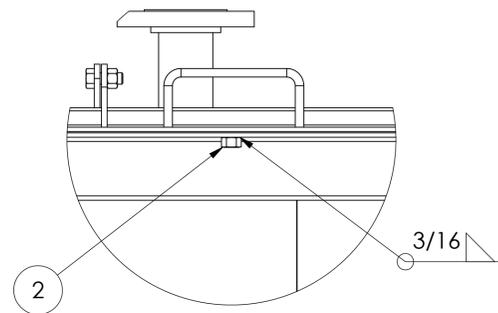
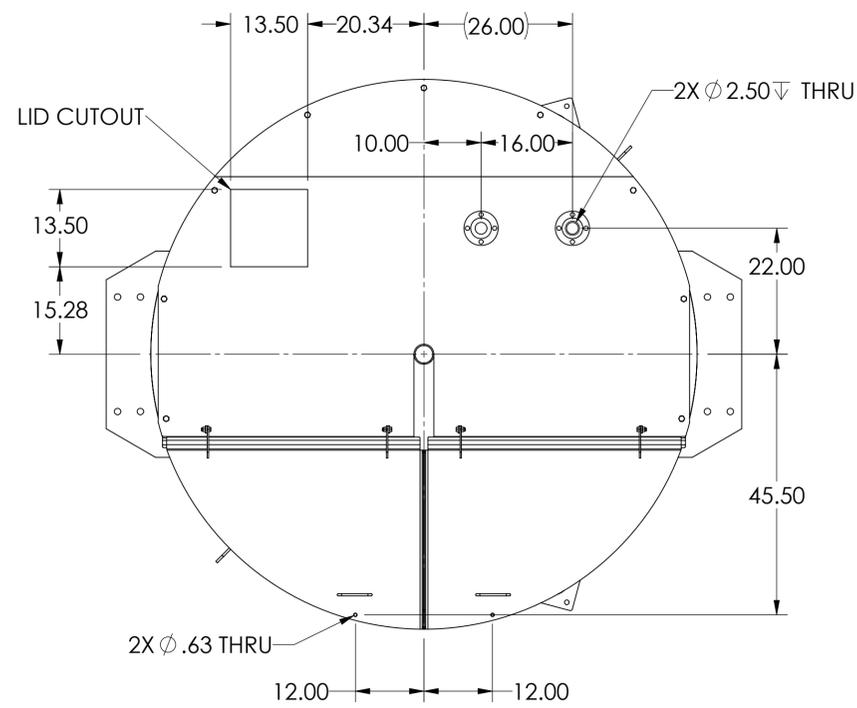
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

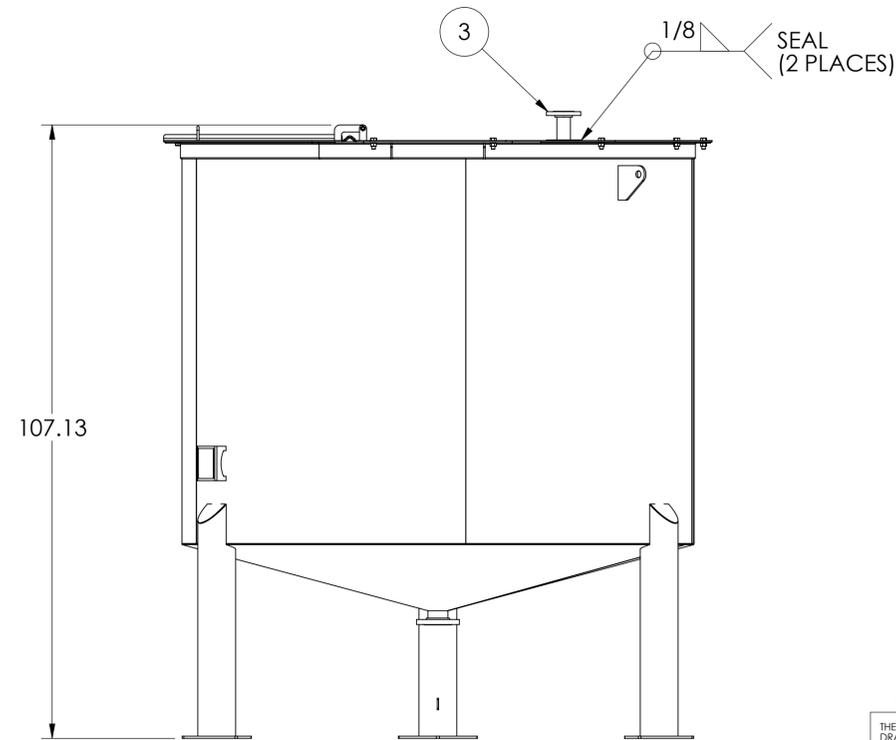
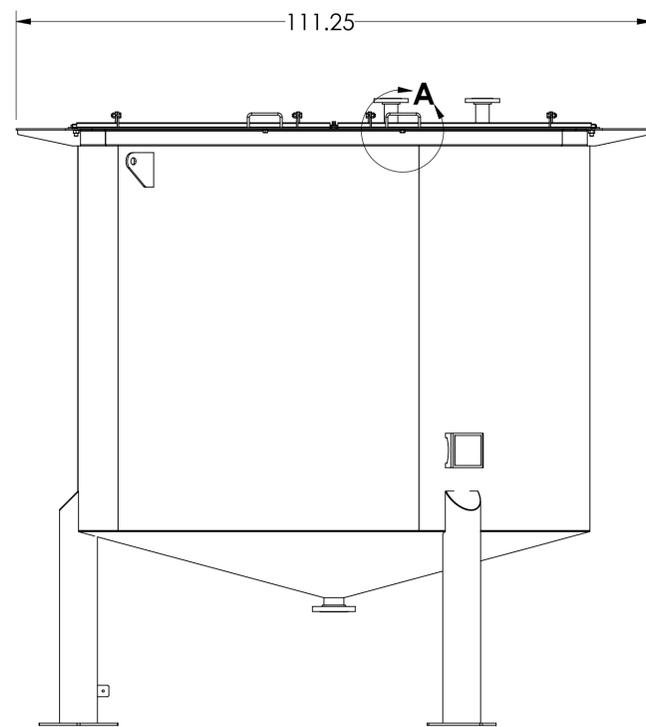
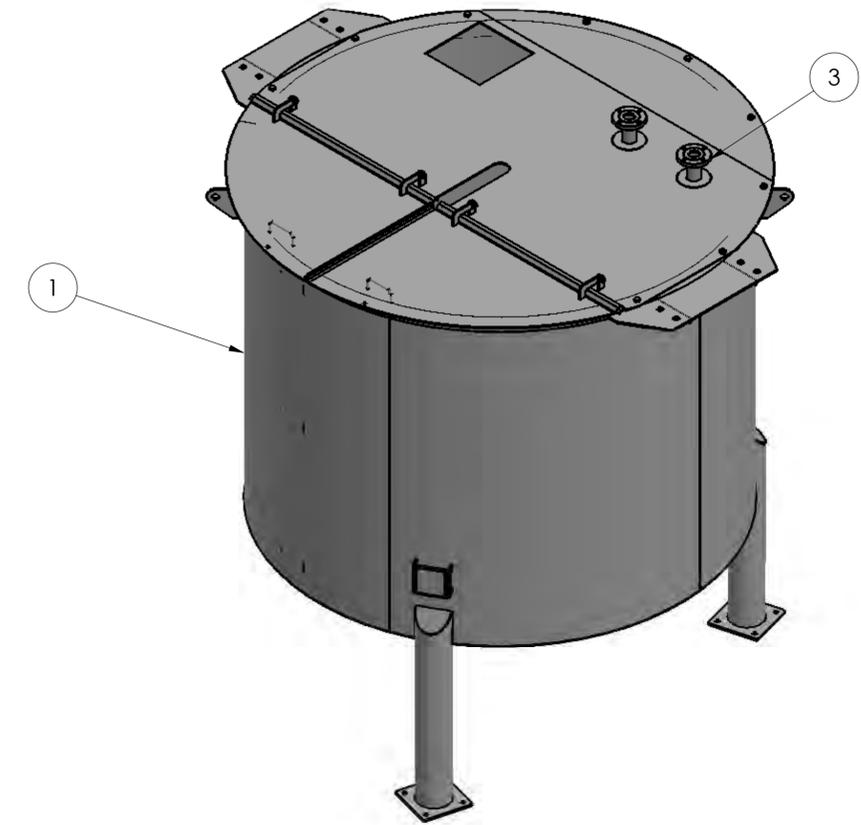
CAD FILE: T:\Drawings\800 - Layouts\800-25 Aqua Metals ETP, 800-25-0001

862-04-0048

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-88-0005	FORMULATION TANK (CFT) (1900)
2	2	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST
3	2	820-00-0054	2" PIPE FLANGE WELMENT



DETAIL A



REF:  
Revision 3, 22-Jul-2016  
NOTE: DEBURR & REMOVE ALL SHARP EDGES.

MAKE \_\_\_\_\_ PCS.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
TOLERANCES ARE:  
3 PLACE DECIMALS: +0.003"  
2 PLACE DECIMALS: +0.01"  
FRACTIONS = STOCK SIZES  
ANGLES: ±0.5°

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

CAD FILE: \\WIM-DC1\nas2\Battery Recycling Systems\Drawings\862-ETP\862-04 CFT\_862-04-0048

0	REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
1105 24TH STREET  
PORT HURON, MI 48061-5006  
USA

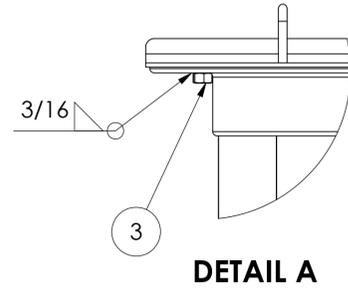
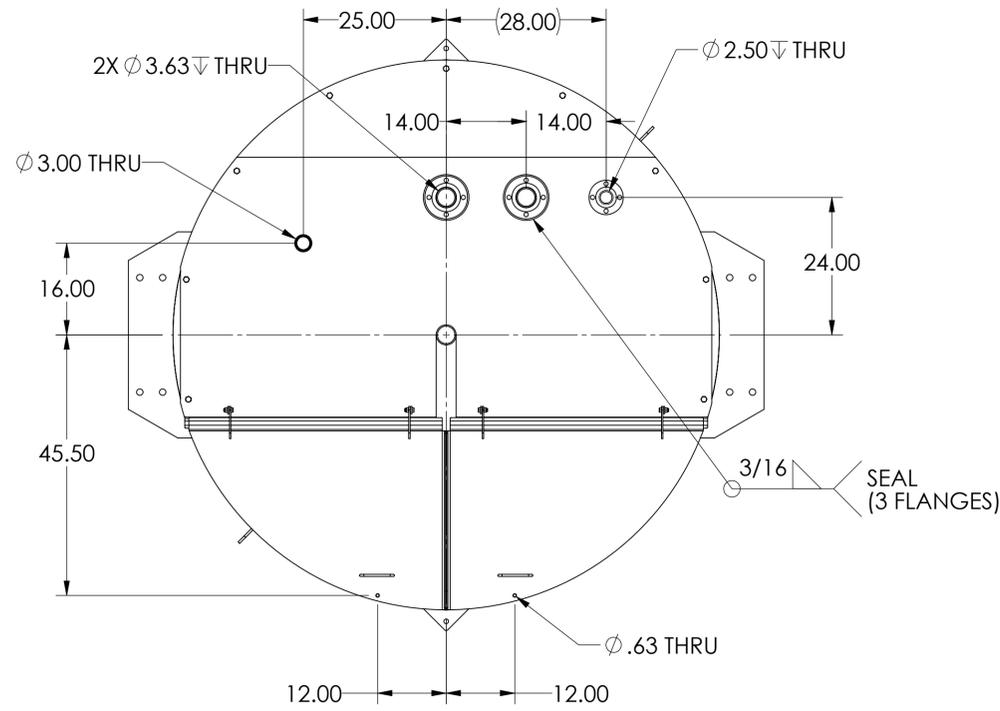
DESCRIPTION: CFT TANK

ENGINEERED BY: TS DATE: 3/15/2016  
DETAILED BY: TS DATE: 3/16/2016  
APPROVED BY: DATE: 3/16/2016

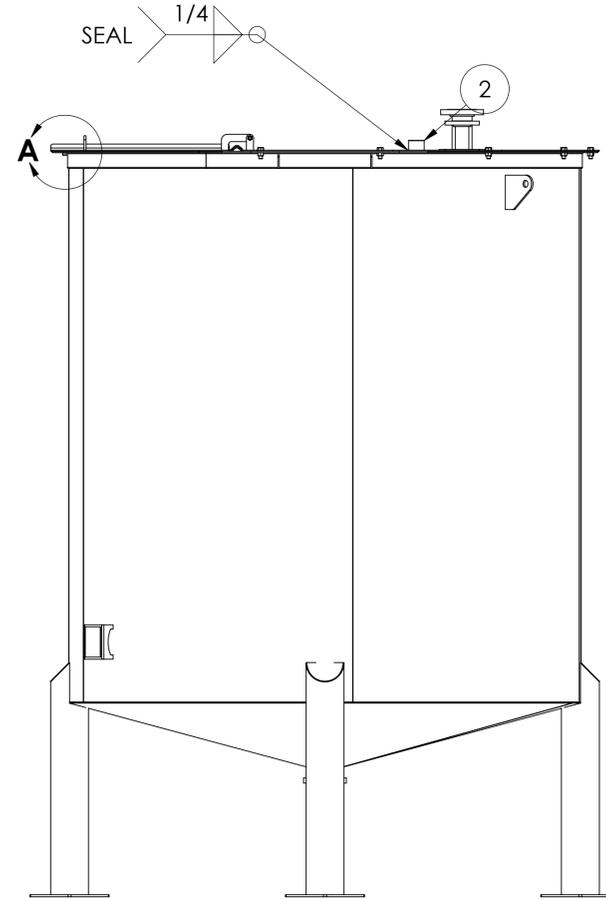
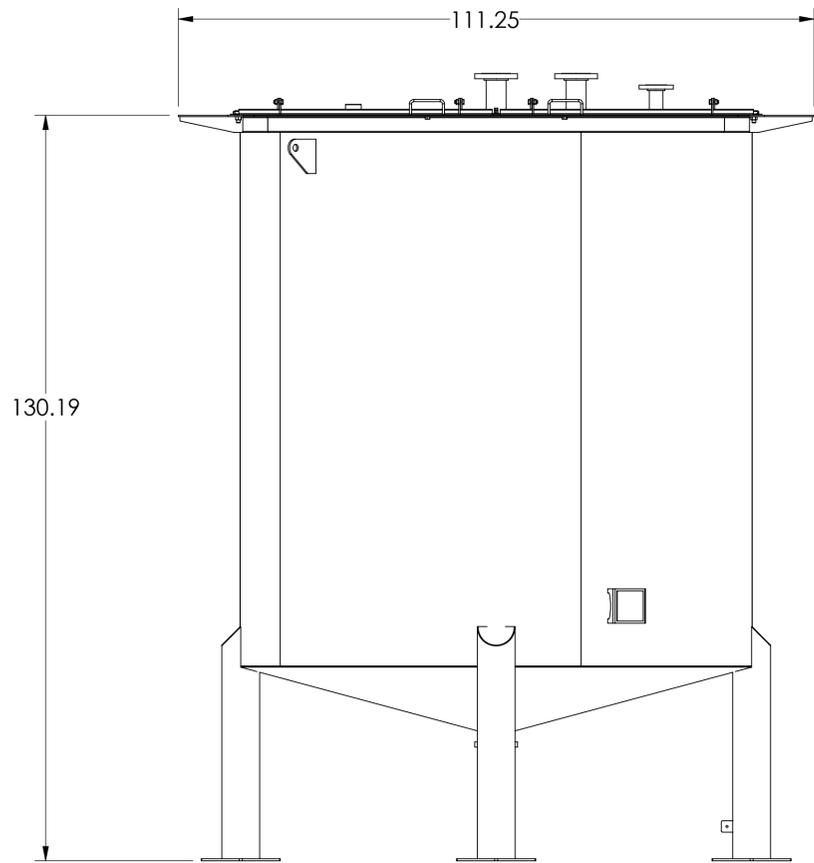
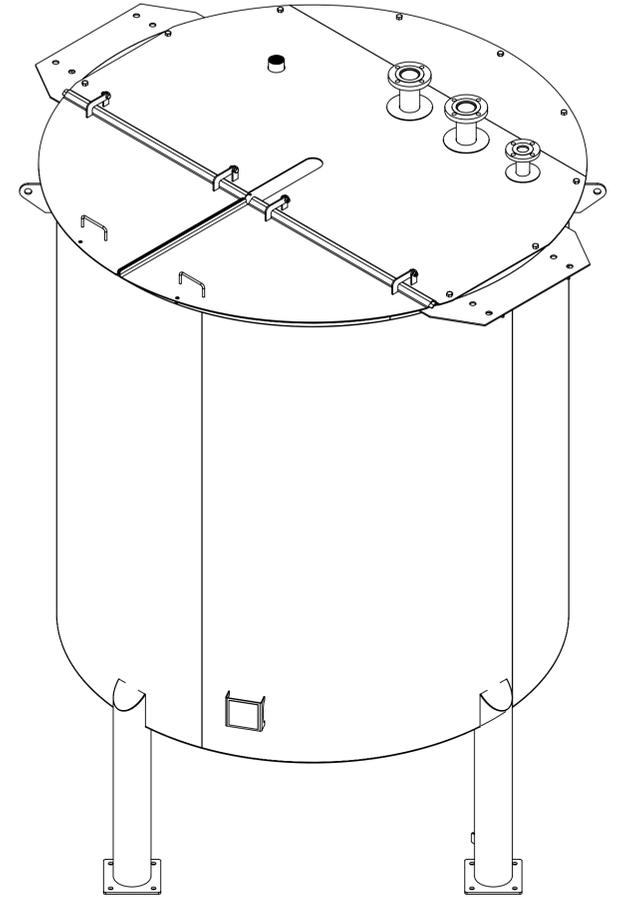
DRAWING NO. **862-04-0048-0**

SHEET: 1 OF 1

862-05-0058



ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-88-0006	NEUTRALIZER DOSING TANK (NDR) (2600)
(A) 2	1	888-61-0007	PIPE COUPLING, STAINLESS STEEL, 2" PIPE DIA., NPT FEMALE
3	2	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST
4	2	862-05-0092	3" PIPE FLANGE WELMENT
5	1	820-00-0054	2" PIPE FLANGE WELMENT



REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

MAKE \_\_\_\_\_ PCS.

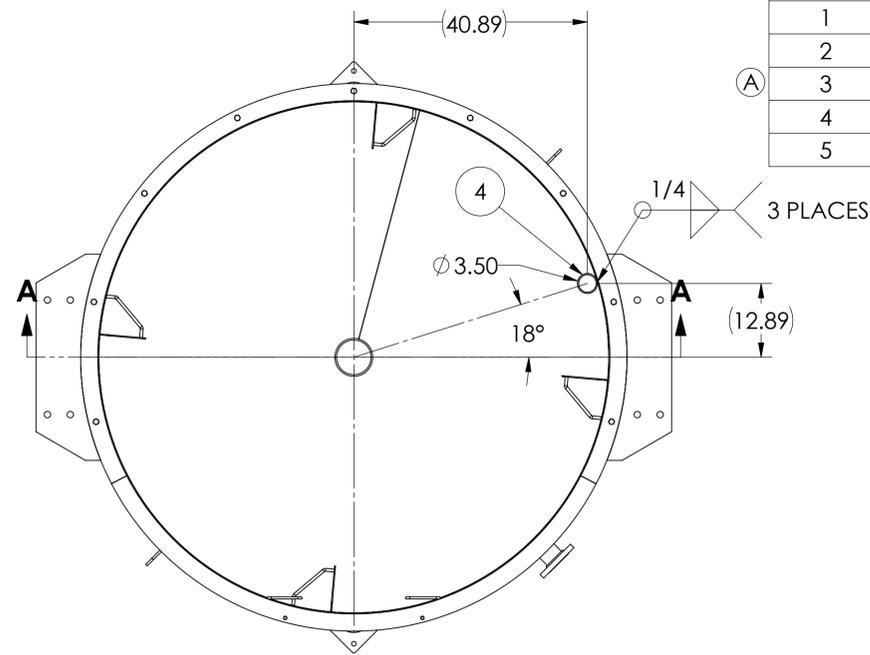
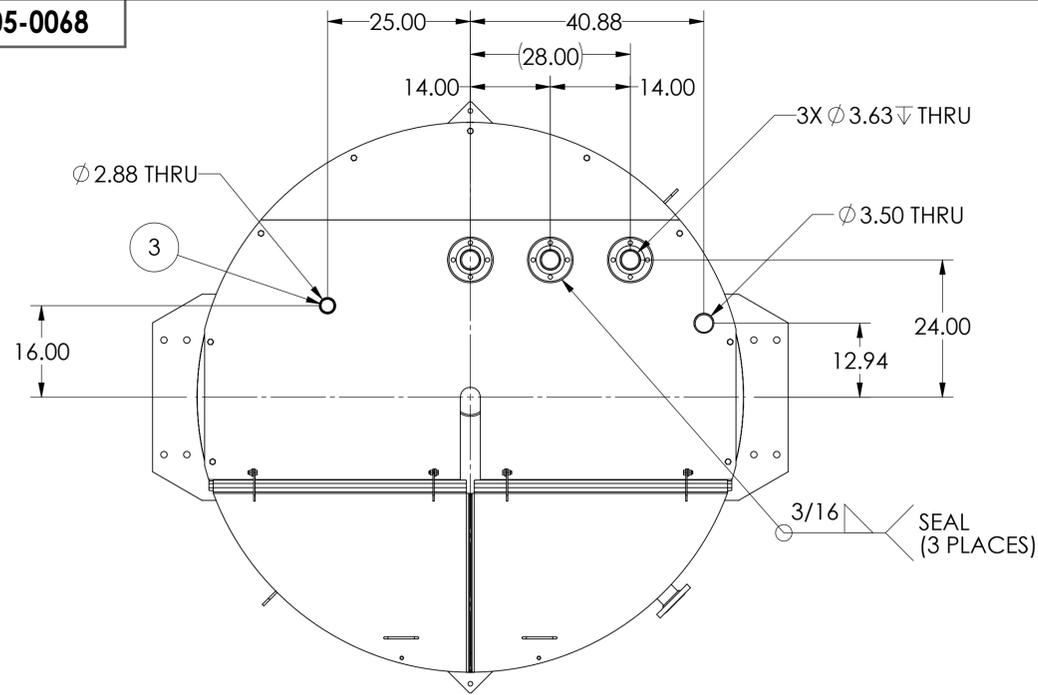
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: +0.003"  
 2 PLACE DECIMALS: +0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

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 CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

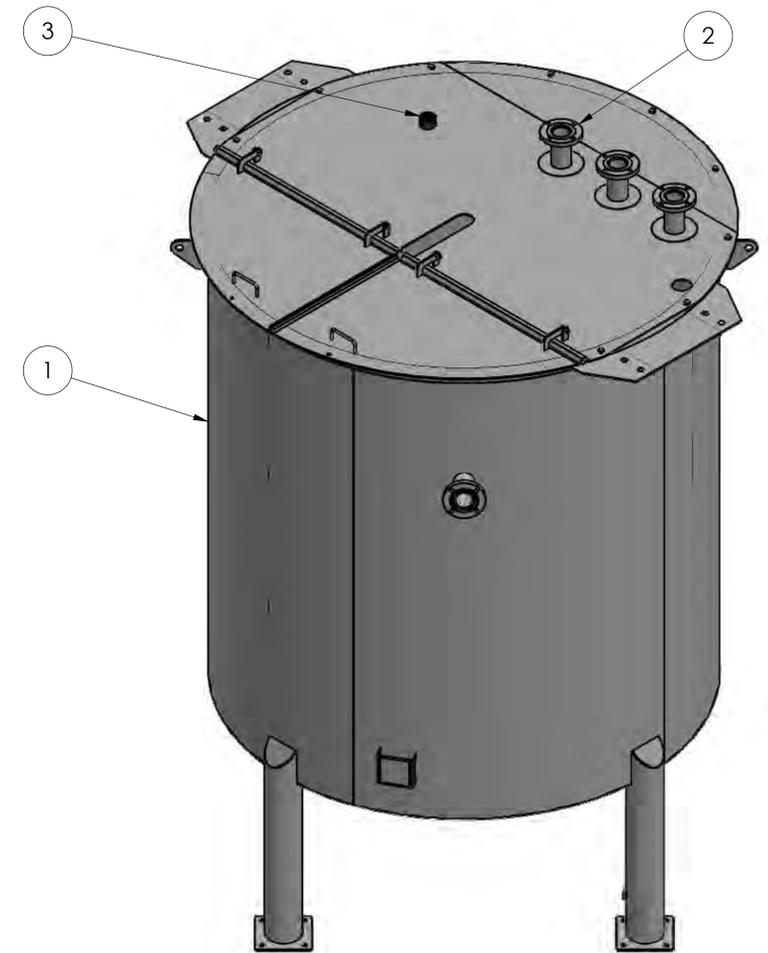
CAD FILE: \\WM-DC1\nas2\Battery Recycling Systems\Drawings\862-ETP\862-05-NR\862-05-0058

	<b>BATTERY RECYCLING SYSTEMS, INC.</b> 1105 24TH STREET PORT HURON, MI 48061-5006 USA
DESCRIPTION <b>DAY TANK</b>	ENGINEERED BY: TS DATE: 3/15/2016 DETAILED BY: TS DATE: 3/15/2016 DRAWING NO.: <b>862-05-0058-A</b> SHEET: 1 OF 1
A REV DATE AUTHOR	TS 4/1/2016

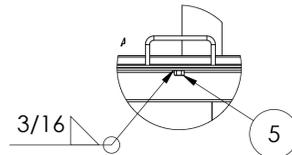
862-05-0068



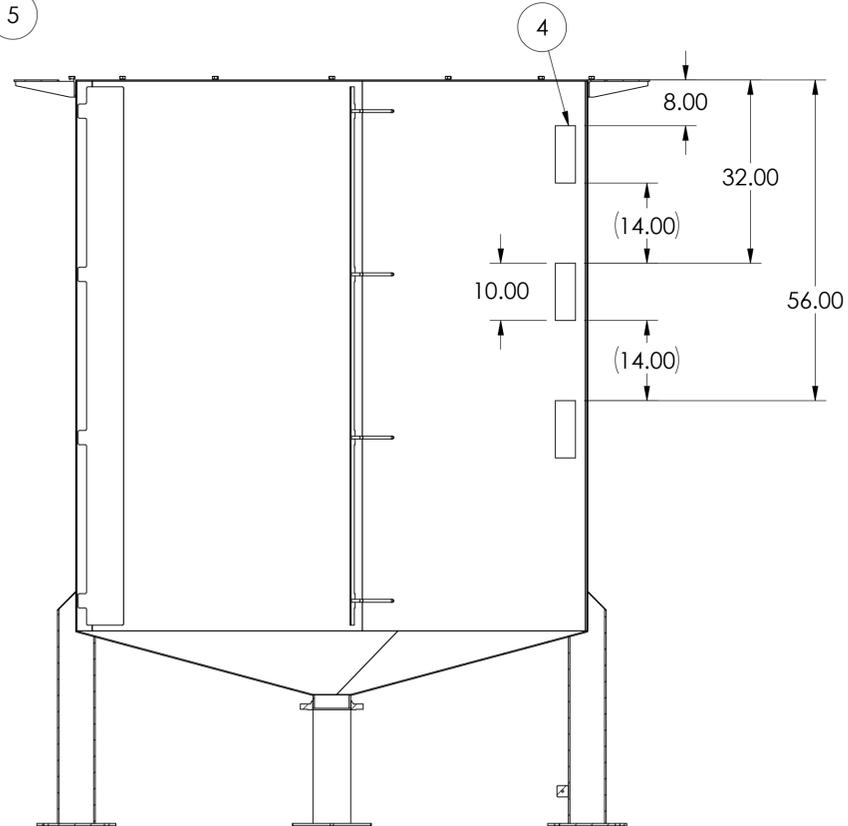
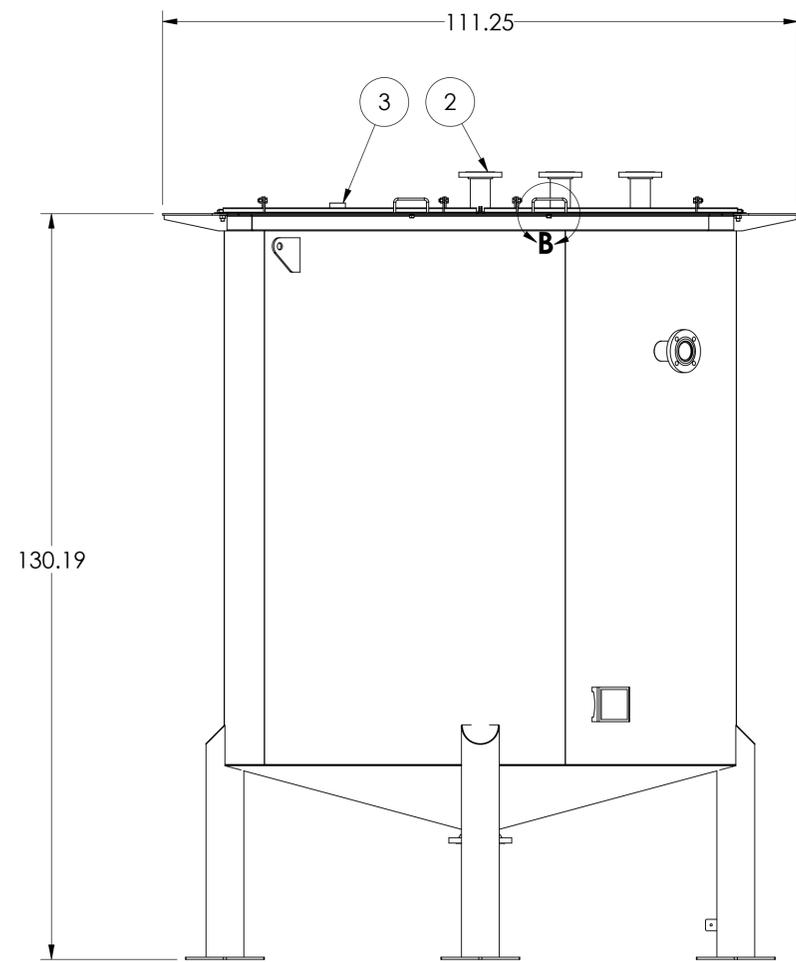
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-88-0009	NEUTRALIZER REACTOR TANK (NR) (2600)
2	3	862-05-0092	3" PIPE FLANGE WELMENT
3	1	888-61-0007	PIPE COUPLING, STAINLESS STEEL, 2" PIPE DIA., NPT FEMALE
4	3	S1304P8F3W	P-SST SCH. 40 X 3 DIA. X 10" LG T304 ASTM-A312
5	2	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST



LID NOT SHOWN



DETAIL B



SECTION A-A

REV	DATE	AUTHOR
A	4/1/2016	TS

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 PORT HURON, MI 48061-5006  
 USA

DESCRIPTION	
REACTOR TANK	
ENGINEERED BY TS	DATE 3/15/2016
DESIGNED BY TS	DATE 3/15/2016
APPROVED BY	DATE
DRAWING NO. <b>862-05-0068-A</b>	
SHEET: 1 OF 1	

MAKE \_\_\_\_\_ PCS.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: +0.003"  
 2 PLACE DECIMALS: +0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

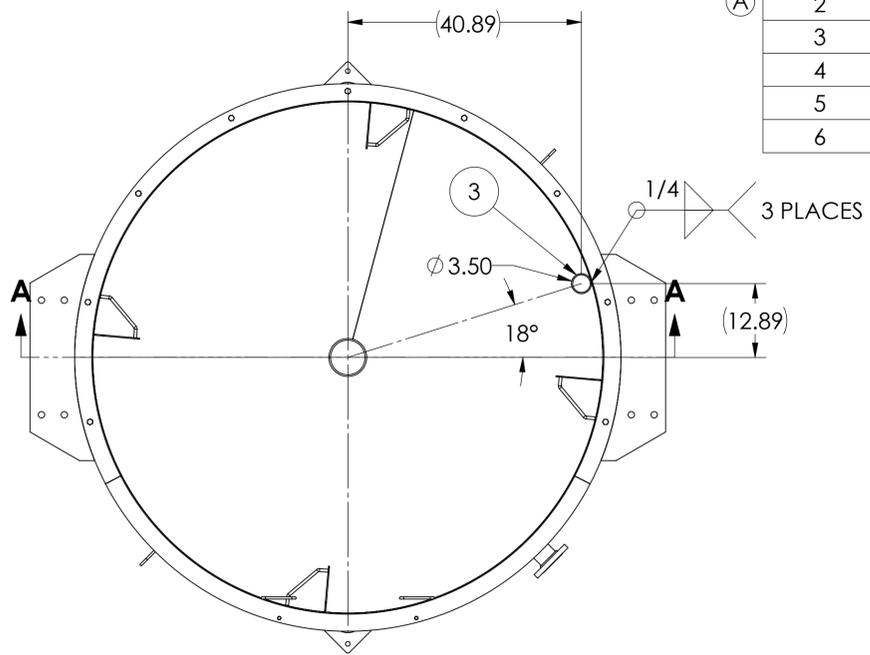
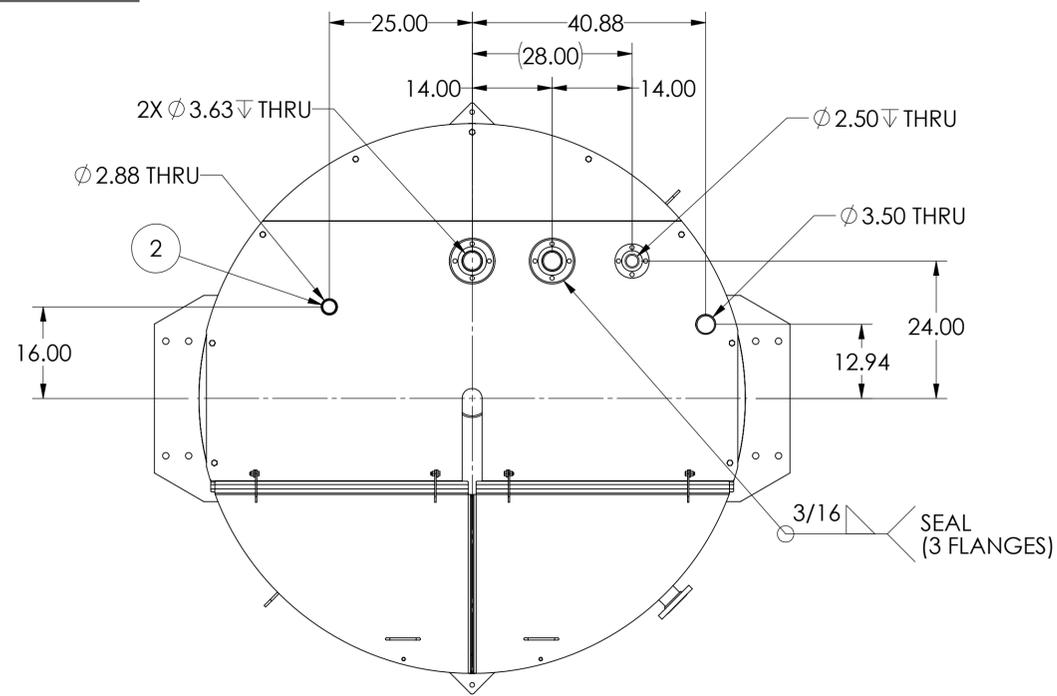
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

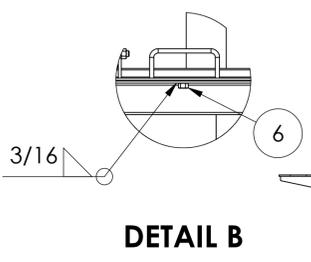
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REF:  
 Revision 3, 22-Jul-2016  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

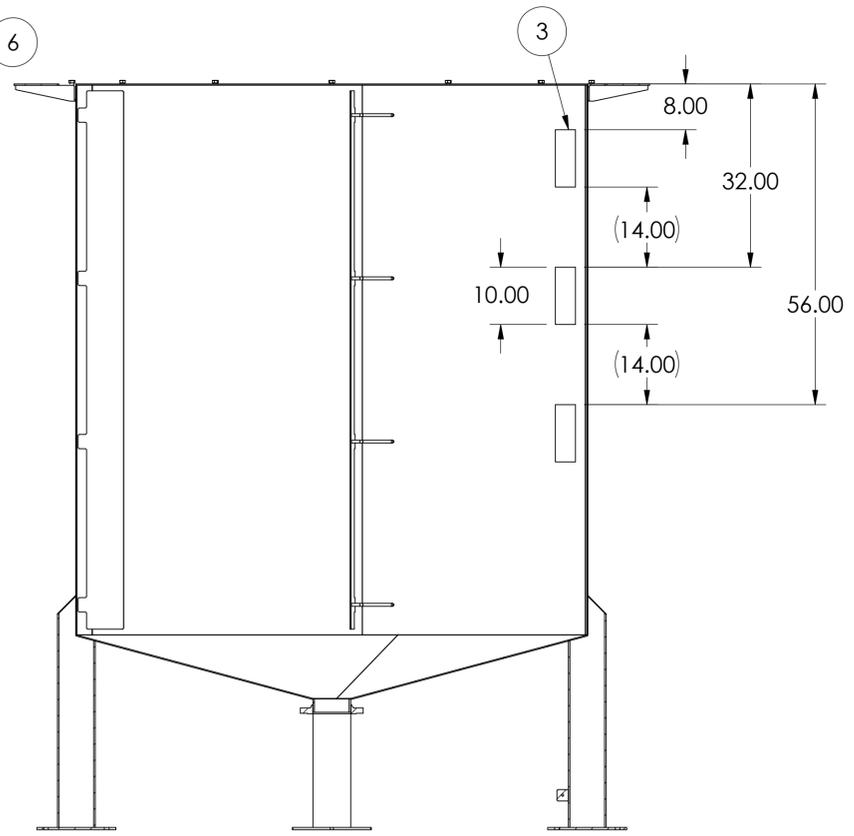
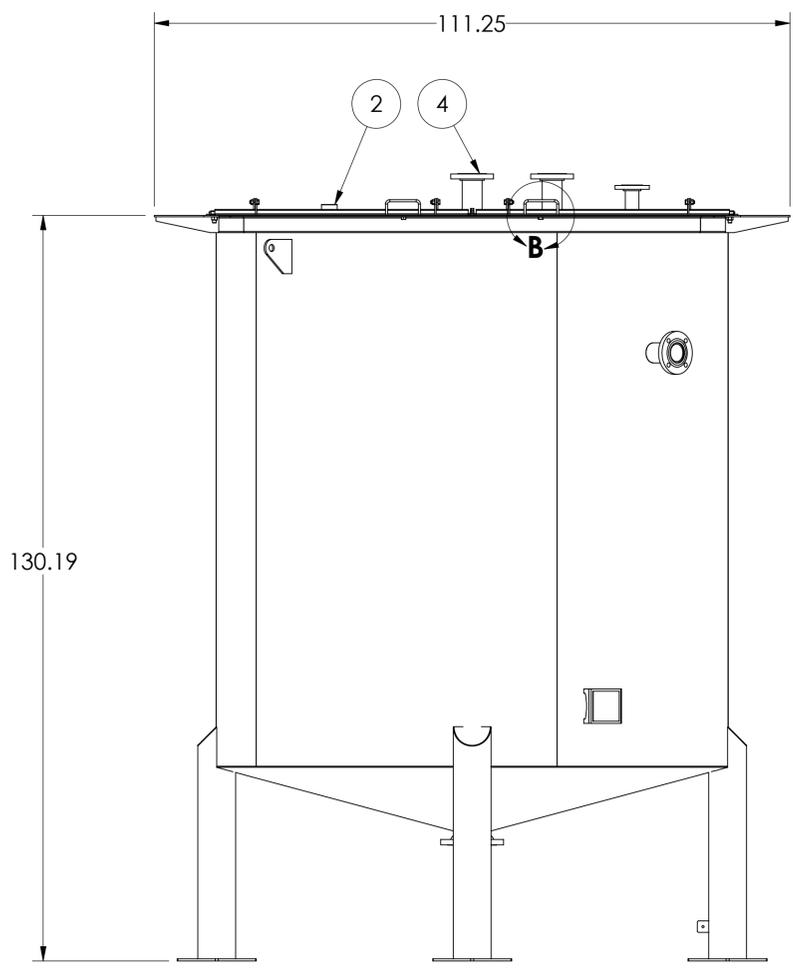
862-05-0089



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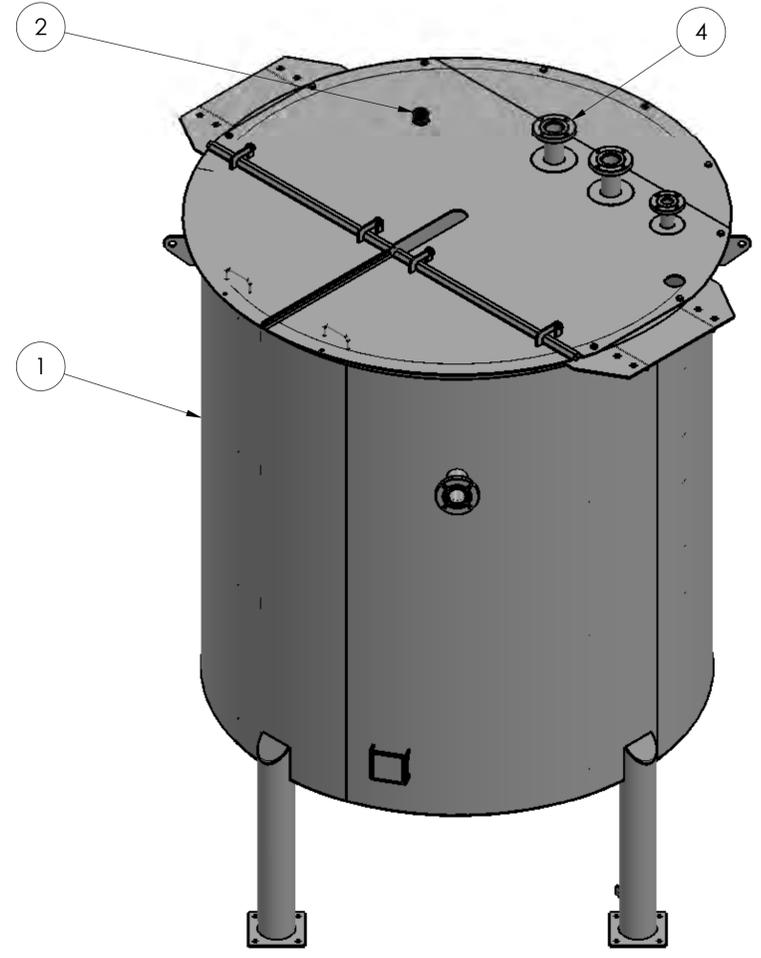


DETAIL B



SECTION A-A

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-88-0009	NEUTRALIZER REACTOR TANK (NR) (2600)
2	1	888-61-0007	PIPE COUPLING, STAINLESS STEEL, 2" PIPE DIA., NPT FEMALE
3	3	S1304P8F3W	P-SST SCH. 40 X 3 DIA. X 10" LG T304 ASTM-A312
4	2	862-05-0092	3" PIPE FLANGE WELMENT
5	1	820-00-0054	2" PIPE FLANGE WELMENT
6	2	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST



REF:  
 Revision 3, 22-Jul-2016  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

MAKE \_\_\_\_\_ PCS.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: +0.003"  
 2 PLACE DECIMALS: +0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

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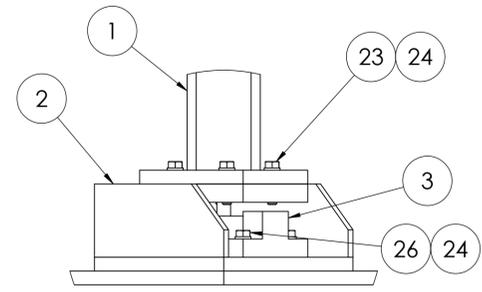
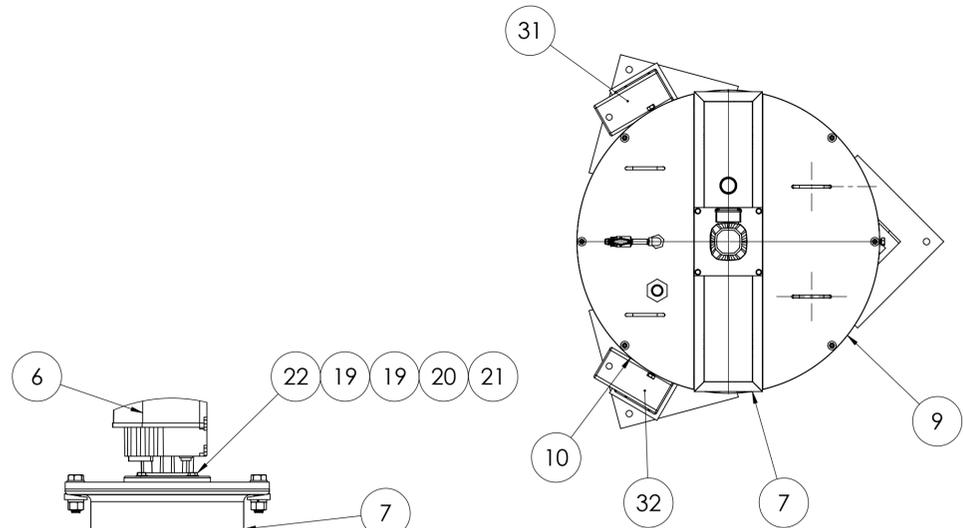
ENGINEERED BY TS	DATE 3/15/2016	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: 3 PLACE DECIMALS: +0.003" 2 PLACE DECIMALS: +0.01" FRACTIONS = STOCK SIZES ANGLES: ±0.5°
DETAILED BY TS	DATE 3/15/2016	
APPROVED BY	DATE	DRAWING NO. <b>862-05-0089-A</b>
SHEET: 1 OF 1	ASSY NO.	

DESCRIPTION  
 REACTOR 2 TANK

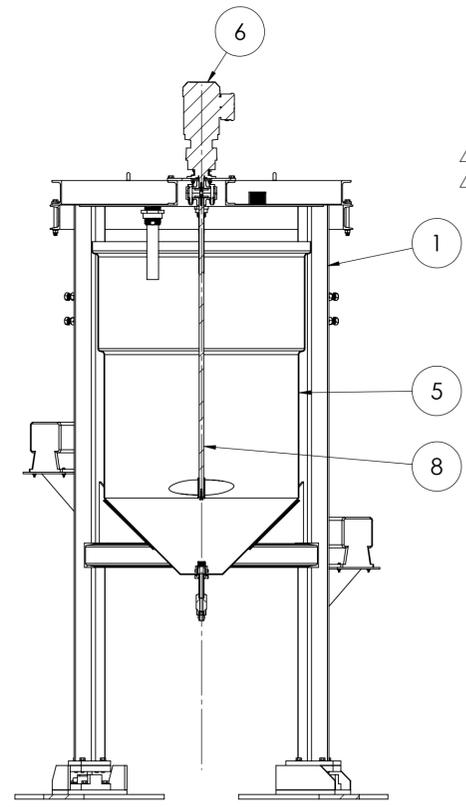
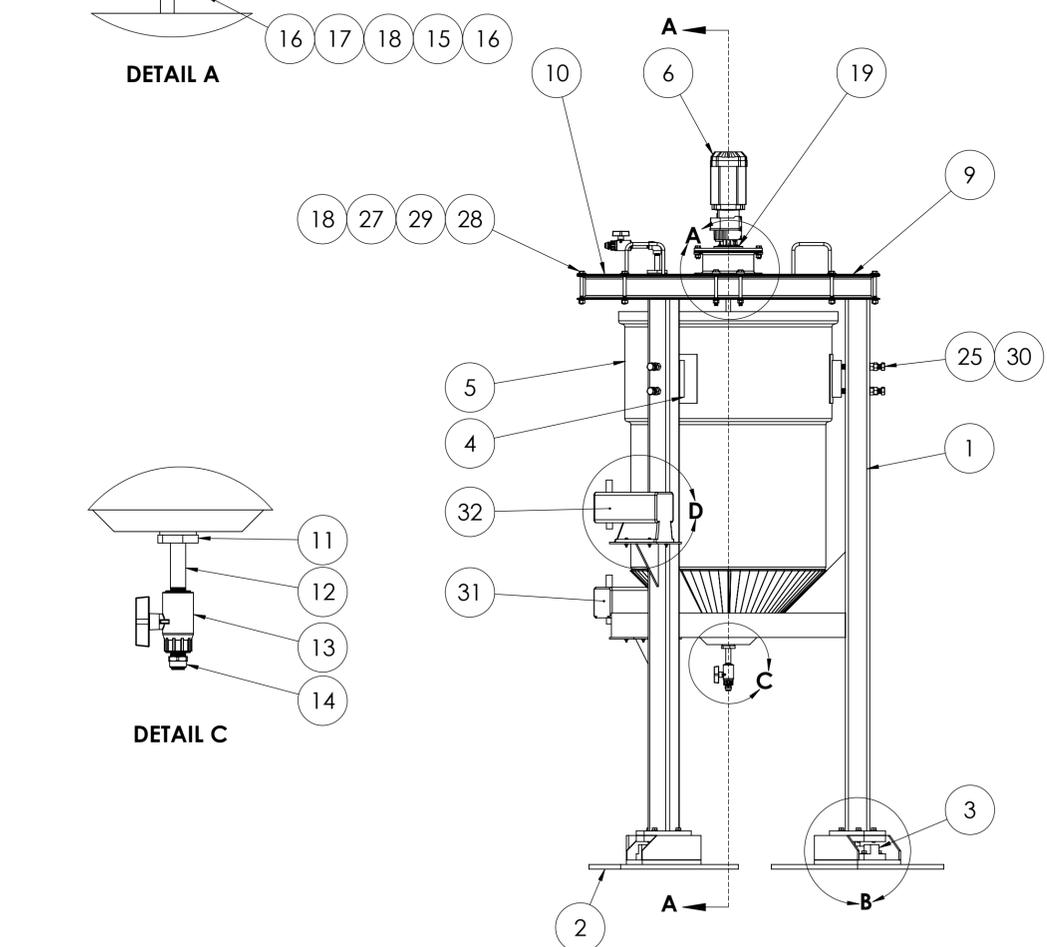
BATTERY RECYCLING SYSTEMS, INC.  
 1105 24TH STREET  
 PORT HURON, MI 48061-5006  
 USA

REV A 4/1/2016 TS  
 DATE AUTHOR

828-00-0020



DETAIL B



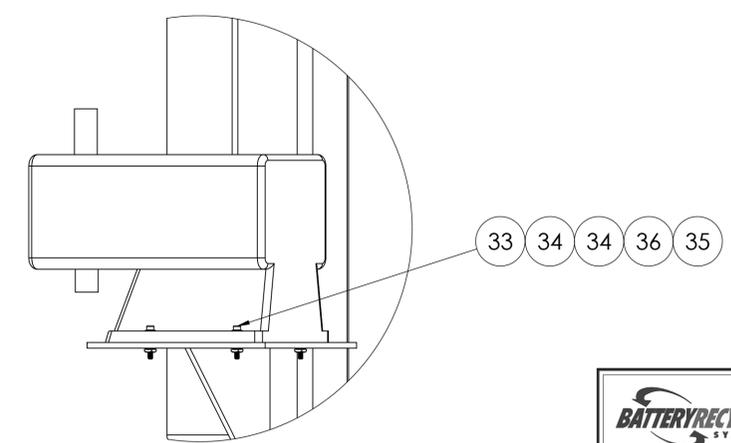
SECTION A-A

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	828-00-0021	POLYMER TANK MAIN FRAME WELDMENT
2	3	828-00-0040	LOAD CELL MTG. BRACKET WELDMENT
3	3	000-17-0442	LOAD CELL, 5K SST
4	3	828-00-0037	TANK CLAMP WELDMENT
5	1	888-88-0010	TANK, POLYPROPYLENE 150 GALLON
6	1	888-57-0034	MOTOR, GEAR, 1HP, 460 V, 60 HZ, 3 PH, 283 RPM
7	1	828-00-0094	MIXER SUPPORT ASSEMBLY
8	1	828-00-0059	AGITATOR ASSEMBLY - POLYMER TANK
9	1	828-00-0042	TOP COVER A WELDMENT
10	1	828-00-0095	TOP COVER B ASSEMBLY
11	1	888-23-0001	THROUGH-WALL FITTING, PVC, 1/2" PIPE DIA. x NPT FEMALE x NPT FEMALE
12	1	888-23-0006	NIPPLE-PVC - SCH 80 - 1/2" NPT x 4" LG.
13	1	888-23-0003	VALVE, BALL, PVC, 1/2" NPT
14	1	888-23-0002	PUSH-TO-CONNECT TUBE FITTING, PLASTIC, 1/2" PIPE x 1/2" TUBE, NPT MALE
15	4	888-64-0373	FASTENER, LEVELING WASHER, 1/2" 316 SST
16	4	888-64-0374	FASTENER, HH BOLT, 1/2-13 UNC x 5-1/2" LG 316SST
17	4	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST
18	10	888-64-0120	FASTENER, LOCK WASHER, 1/2" 316 SST
19	8	888-64-0285	FASTENER, FLAT WASHER, 1/4", 316 SST
20	4	888-64-0198	FASTENER, LOCK WASHER, 1/4", 316 SST
21	4	888-64-0160	FASTENER, HEX NUT, 1/4-20 UNC, 316 SST
22	4	888-64-0375	FASTENER, HH BOLT, 1/4-20 UNC X 1-1/4" LG 316 SST
23	12	-	SCR. HEX. HD. 1/2-13 UNC x 2" LG.
24	24	-	WASHER, LOCK 1/2", GR.5, ZINC PLATED
25	6	-	SCREW, HHC, 3/4"-10 UNC X 8" LG., GR.5, ZINC PLATED
26	12	-	SCR. HEX. HD. 1/2-13 UNC x 2" LG.
27	6	-	NUT, HEX, 1/2"-13 UNC
28	6	-	SCREW, HHC, 1/2-13 X 5" LG
29	6	-	WASHER, FLAT, 1/2"
30	6	888-64-0321	FASTENER, HEX NUT, 3/4-10 UNC GR. 8, STEEL Zn/PL
31	1	888-38-0008	METERING PUMP, 120 GPD, 100 PSI
32	1	888-38-0009	METERING PUMP, 600 GPD, 30 PSI
33	8	888-64-0387	SCR, SHCS #10-24 X 1-1/4" LG. SST 316
34	16	888-64-0388	WASHER, FLAT, #10, SST 316
35	8	888-64-0389	NUT, SQUARE, #10-24, SST 316
36	8	888-64-0390	WASHER, SPLIT LOCK, #10, SST 316
37	100	888-39-0004	TUBING- 3/8" ID x 1/2" OD CLEAR PVC
38	100	888-39-0001	TUBING- 1/2" ID x 3/4" OD CLEAR PVC

NOTES:

- ITEM 6, 7 AND 8 SHOULD BE ASSEMBLED BEFORE ATTACHING TO ITEM 1

**B** -ITEMS 37 AND 38 ARE NOT SHOWN IN DRAWING



DETAIL D

REF:  
Revision 3, 22-Jul-2016  
NOTE: DEBURR & REMOVE ALL SHARP EDGES.

MAKE \_\_\_\_\_ PCS.

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

CAD FILE: T:\Drawings\828 - PT - Polymer Tank\828-00-0020

B	3/24/2016	TDM
REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
1105 24TH STREET  
PORT HURON, MI 48061-5006  
USA

DESCRIPTION: POLYMER TANK ASSEMBLY

ENGINEERED BY: TDM DATE: 1/5/2016  
DETAILED BY: TDM DATE: 1/13/2016  
APPROVED BY: DATE:

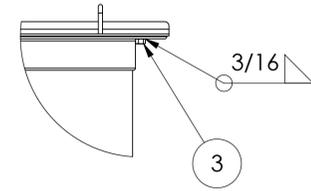
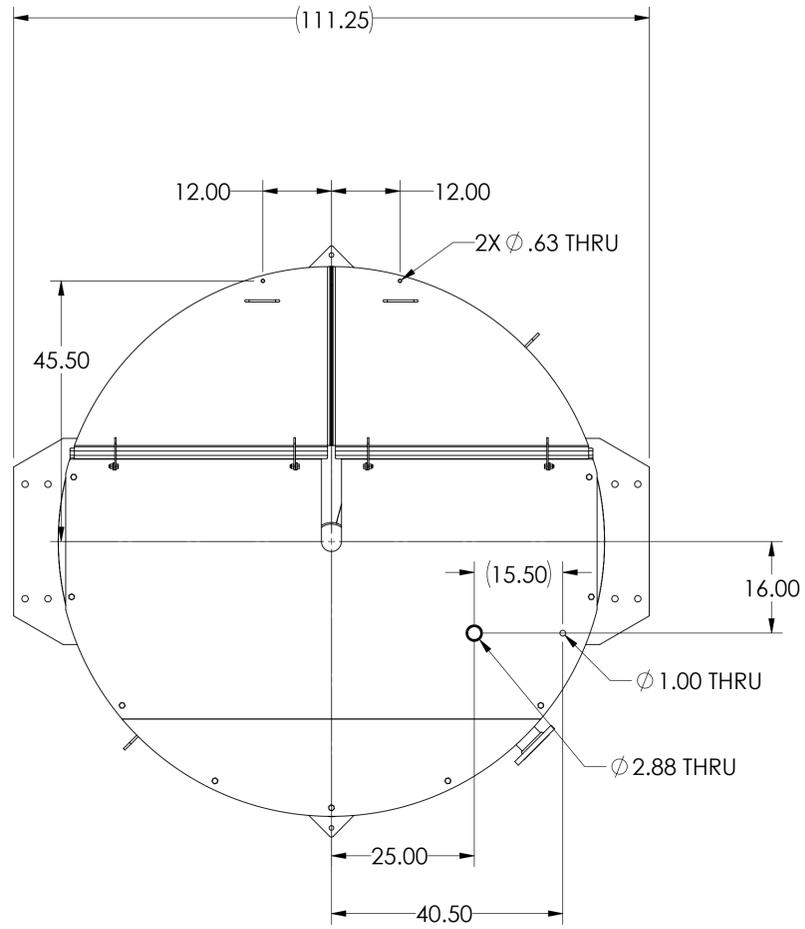
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
TOLERANCES ARE:  
3 PLACE DECIMALS: ±0.003"  
2 PLACE DECIMALS: ±0.01"  
FRACTIONS = STOCK SIZES  
ANGLES: ±0.5°

DRAWING NO. **828-00-0020-B**

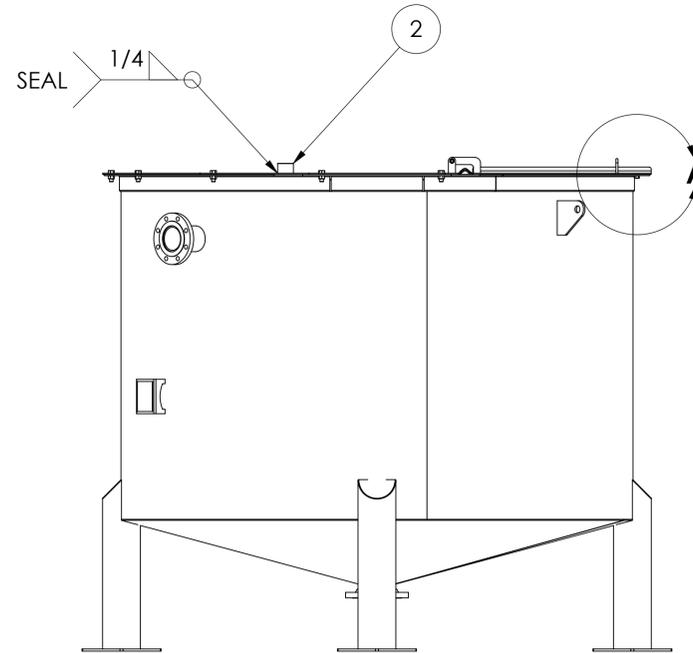
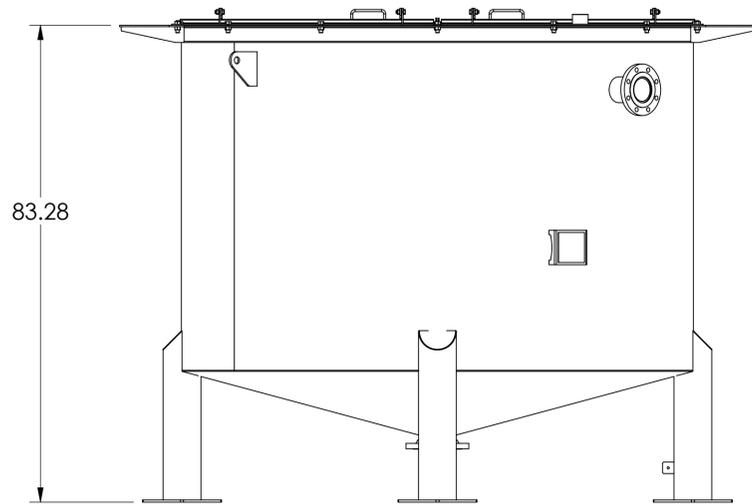
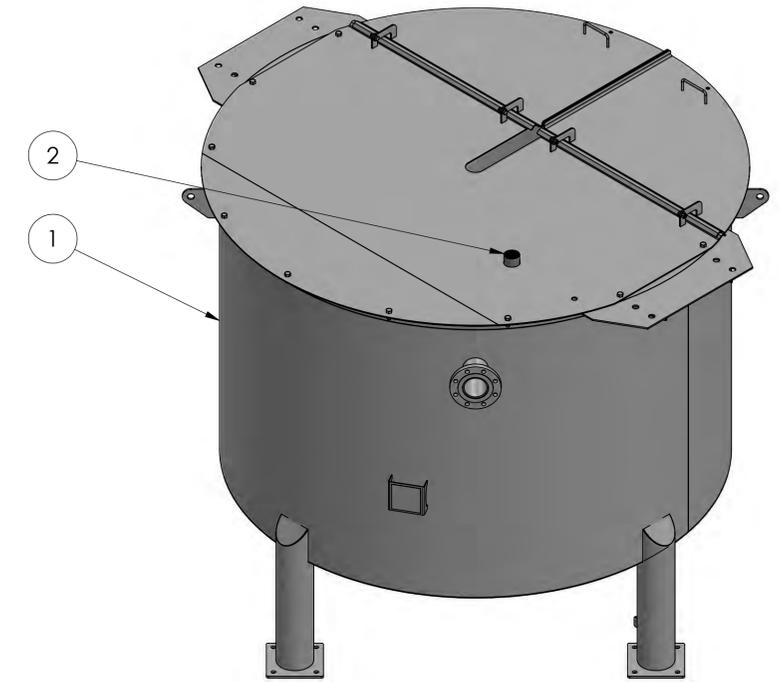
SHEET: 1 OF 1

862-07-0038

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-88-0007	FLASH TANK (FT)
(A) 2	1	888-61-0007	PIPE COUPLING, STAINLESS STEEL, 2" PIPE DIA., NPT FEMALE
3	2	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST



DETAIL A



REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

MAKE \_\_\_\_\_ PCS.

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CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

CAD FILE: \\WM-DC1\nas2\Battery Recycling Systems\Drawings\862-ETP\862-07-FT\862-07-862-07-0038

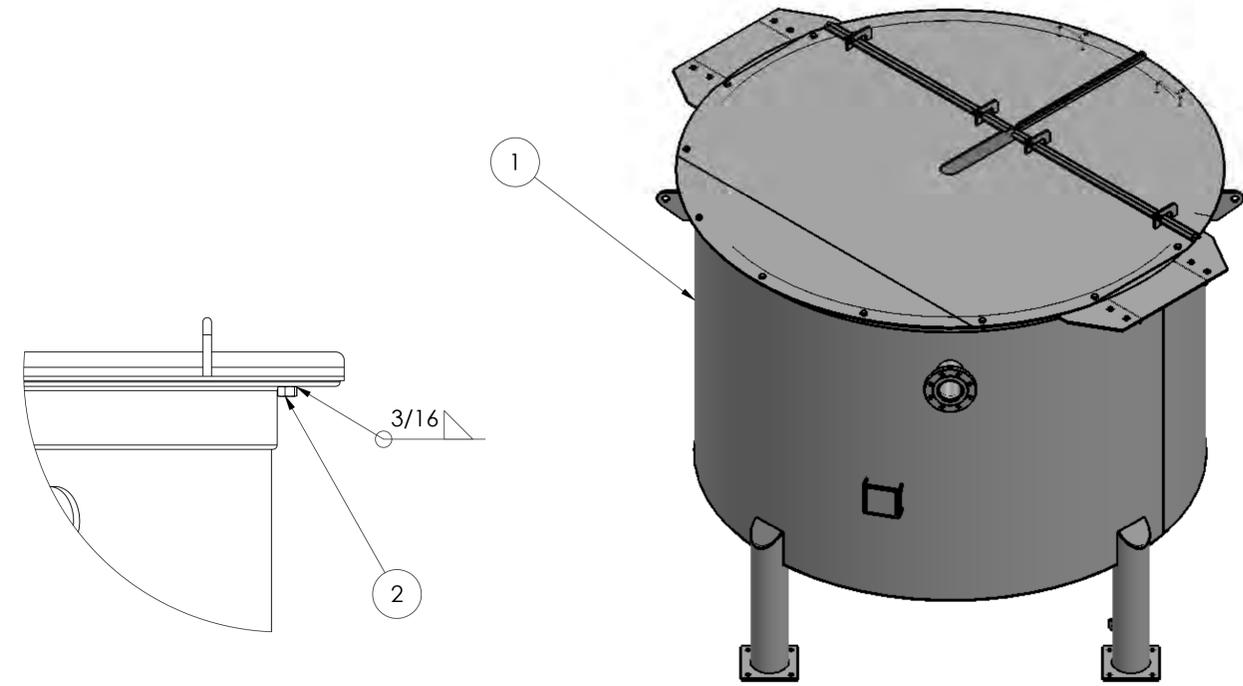
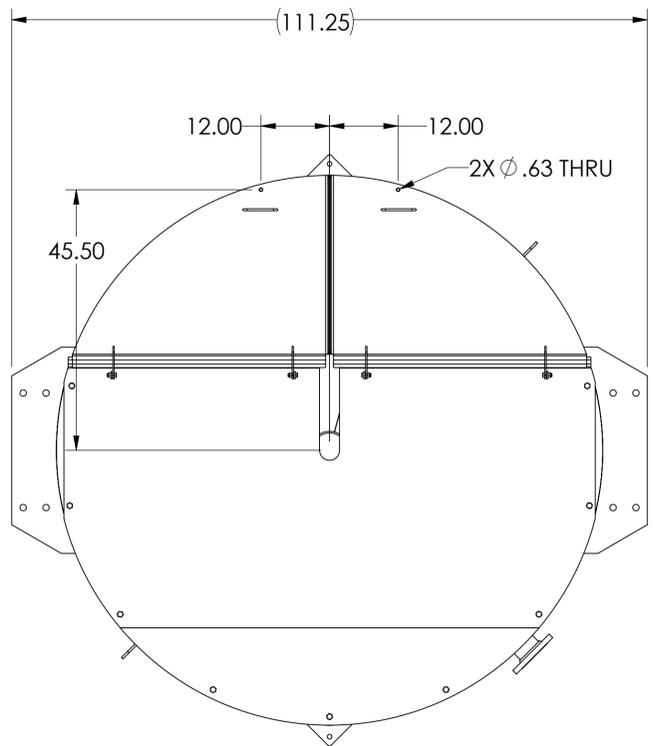
ENGINEERED BY TS	DATE 3/15/2016	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: 3 PLACE DECIMALS: ±0.003" 2 PLACE DECIMALS: ±0.01" FRACTIONS = STOCK SIZES ANGLES: ±0.5°
DETAILED BY TS	DATE 3/15/2016	
APPROVED BY	DATE	DRAWING NO. <b>862-07-0038-A</b>
SHEET: 1 OF 1		ASSY NO.

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 PORT HURON, MI 48061-5006  
 USA

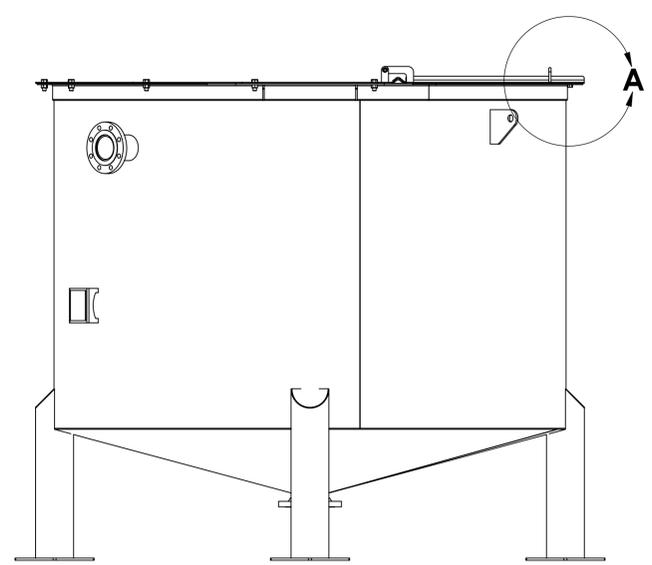
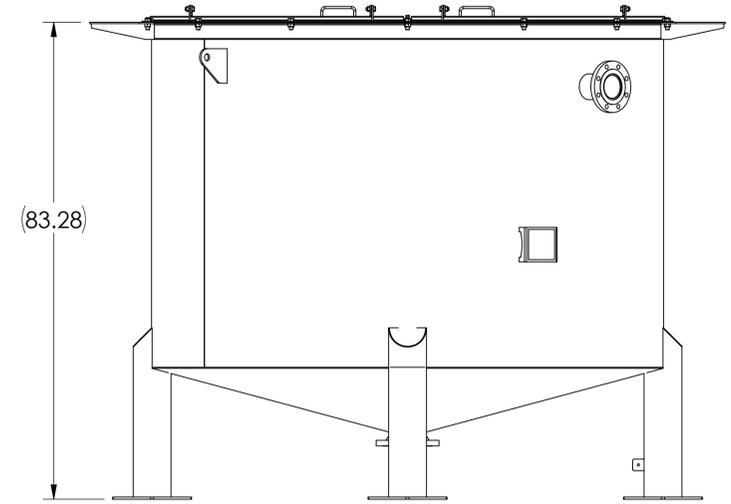
A	4/1/2016	TS
REV	DATE	AUTHOR

862-07-0078

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-88-0008	FLOCCULATION TANK
2	2	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST



DETAIL A



REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

MAKE \_\_\_\_\_ PCS.

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CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

CAD FILE: \\WM-DC1\nas2\Battery Recycling Systems\Drawings\862-ETP\862-07-F1\862-07-862-07-0078

0		
REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 FORT HURON, MI 48061-5006  
 USA

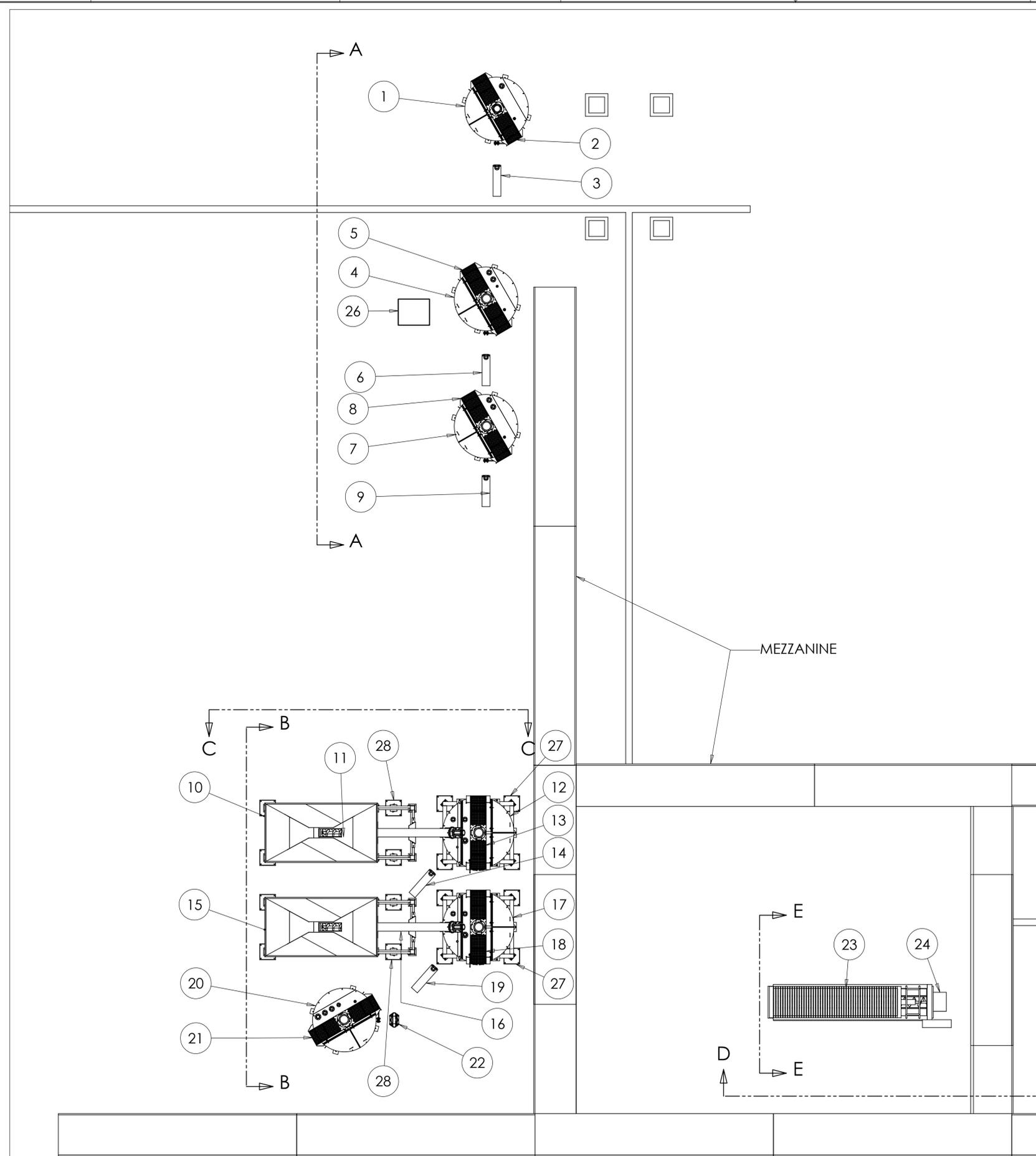
DESCRIPTION: FLOC TANK

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: ±0.003"  
 2 PLACE DECIMALS: ±0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

ENGINEERED BY: TS DATE: 3/15/2016  
 DETAILED BY: TS DATE: 3/15/2016  
 APVD BY: DATE: 3/15/2016

DRAWING NO. **862-07-0078-0**

SHEET: 1 OF 1



ITEM NO.	AQM NO.	BRS NO.	DESCRIPTION
1	TK-601	822-00-0168	SURGE TANK
2	AG-601	822-00-0167	SURGE TANK AGGITATOR
3	P-602	888-38-0018	SURGE TANK TRANSFER PUMP
4	TK-603	822-00-0173	INTERMEDIATE SLURRY TANK
5	AG-603	822-00-0172	INTERMEDIATE SLURRY TANK AGGITATOR
6	P-604	888-38-0018	INTERMEDIATE SLURRY TANK PUMP
7	TK-613	822-00-0163	SLURRY HOLDING TANK
8	AG-613	822-00-0172	SLURRY HOLDING TANK AGGITATOR
9	P-614	888-38-0018	SLURRY HOLDING TANK PUMP
10	TK-605	862-03-0105	NEUTRALIZER TANK
11	CN-605	862-03-0105	SCREW CONVEYOR #1
12	TK-606	822-00-0183	DESULFURIZATION REACTION TANK #1
13	AG-606	822-00-0151	DESULFURIZATION REACTION TANK #1 AGGITATOR
14	P-609	888-38-0018	REACTION TANK TRANSFER PUMP #1
15	TK-607	862-03-0105	NEUTRALIZER TANK
16	CN-607	862-03-0105	SCREW CONVEYOR #2
17	TK-608	822-00-0183	DESULFURIZATION REACTION TANK #2
18	AG-608	822-00-0151	DESULFURIZATION REACTION TANK #2 AGGITATOR
19	P-610	888-38-0018	REACTION TANK TRANSFER PUMP #2
20	TK-611	822-00-0178	LEAD CARBONATE SLURRY HOLDING TANK
21	AG-611	822-00-0172	LEAD CARBONATE SLURRY HOLDING TANK AGGITATOR
22	P-616	888-90-0004	DIAPHRAGM PUMP
23	FP-615	888-90-0004	100 CU. FT. FILTER PRESS
24	P-615	888-90-0004	GEAR PUMP
25	CN-015	N/A	LEAD CARBONATE SCREW CONVEYOR
26	N/A	N/A	LIQUID TOTE
27	LC	822-00-0160	LOAD CELL MOUNTING ASSEMBLY (REACTORS)
28	LC	862-03-0130	LOAD CELL MOUNTING ASSEMBLY (POWDER HOPPER)

REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

MAKE \_\_\_\_\_ PCS.

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 CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE.  
 CAD FILE: T:\Drawings\800 - Layouts\800-28 Aqua Metals Desulf\800-28-0001

C	3/18/2016	S.G.B.
REV	DATE	AUTHOR

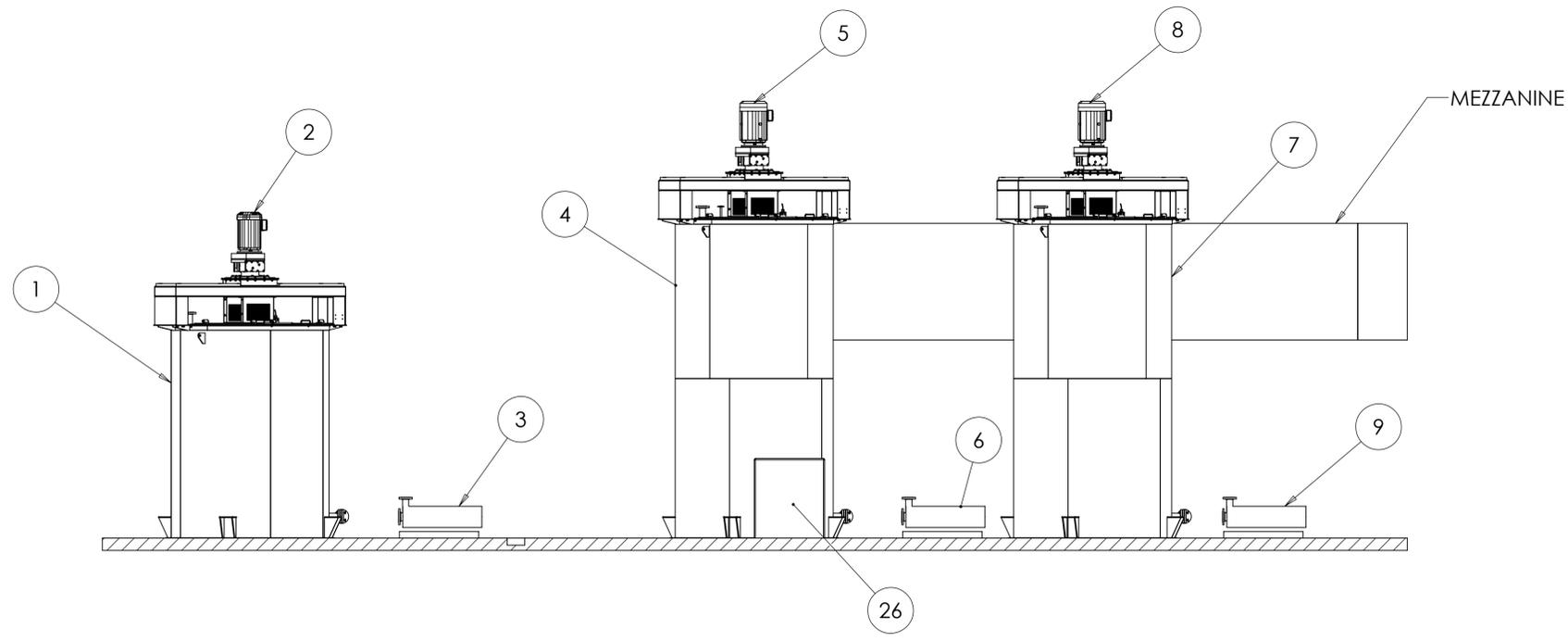
**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 PORT HURON, MI 48061-5006  
 USA

DESCRIPTION: **AQUA METAL DESULFURIZATION GENERAL ARRANGEMENT**

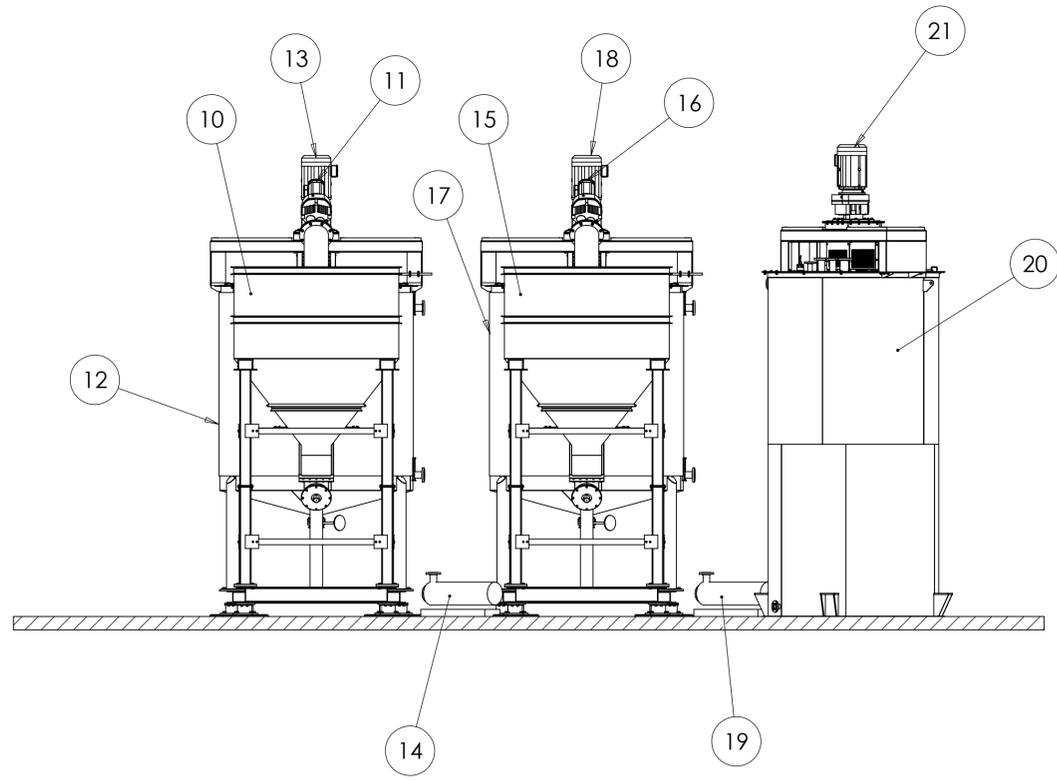
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: +0.003"  
 2 PLACE DECIMALS: +0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

ENGINEERED BY: S.G.B. DATE: 1/8/2016  
 DETAILED BY: DATE:  
 APVD BY: DATE:  
 SHEET: 1 OF 3

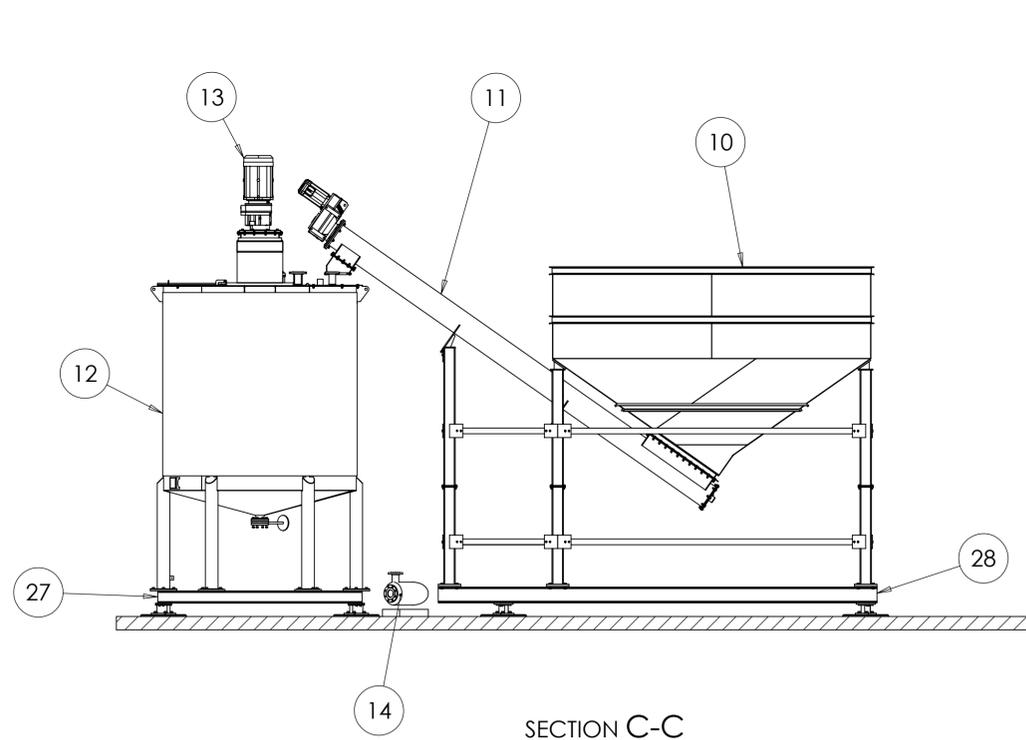
DRAWING NO.: **800-28-0001 GA-C**  
 ASSY NO.: 800-23-0001 GA



SECTION A-A  
SCALE 1 : 48



SECTION B-B  
SCALE 1 : 48



SECTION C-C  
SCALE 1 : 48

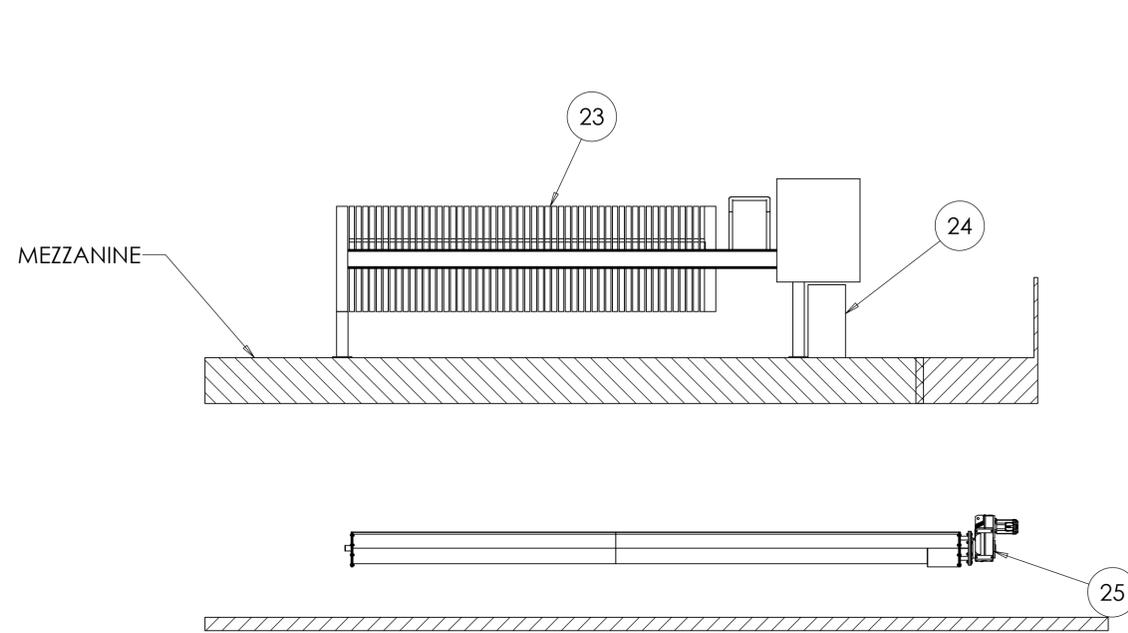
REF:  
Revision 3, 22-Jul-2016  
NOTE: DEBURR & REMOVE ALL SHARP EDGES.

MAKE \_\_\_\_\_ PCS.

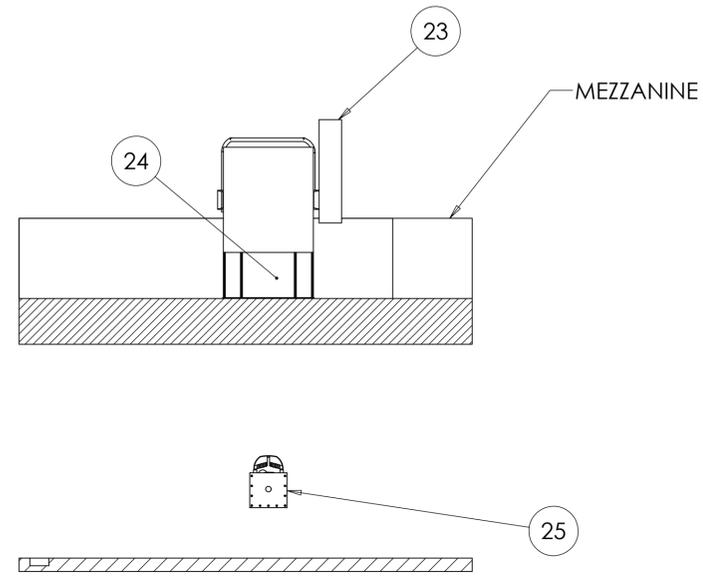
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF BATTERY RECYCLING SYSTEMS, INC. ANY REPRODUCTION IN PART OR WHOLE WITHOUT WRITTEN PERMISSION OF BATTERY RECYCLING, INC. IS PROHIBITED.  
CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE.  
CAD FILE: I:\Drawings\800 - Layouts\800-28 Aqua Metals Desulf\800-28-0001

C	3/18/2016	S.G.B.
REV	DATE	AUTHOR

 <b>BATTERY RECYCLING SYSTEMS, INC.</b> 1105 24TH STREET FORT HURON, MI 48061-5006 USA	
DESCRIPTION	AQUA METAL DESULFURIZATION GENERAL ARRANGEMENT
ENGINEERED BY S.G.B.	DATE 1/8/2016
DETAILED BY	DATE
APPROVED BY	DATE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: 3 PLACE DECIMALS: ±0.003" 2 PLACE DECIMALS: ±0.01" FRACTIONS = STOCK SIZES ANGLES: ±0.5°	
DRAWING NO. <b>800-28-0001 GA-C</b>	
SHEET: 2 OF 3 ASSY NO. 800-23-0001 GA	



SECTION D-D  
SCALE 1 : 48



SECTION E-E  
SCALE 1 : 48

MAKE \_\_\_\_\_ PCS.

REF:  
Revision 3, 22-Jul-2016  
NOTE: DEBURR & REMOVE ALL SHARP EDGES.

C	3/18/2016	S.G.B.
REV	DATE	AUTHOR

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 FORT HURON, MI 48061-5006  
 USA

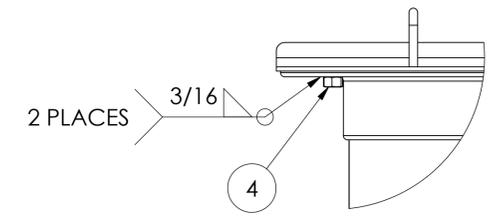
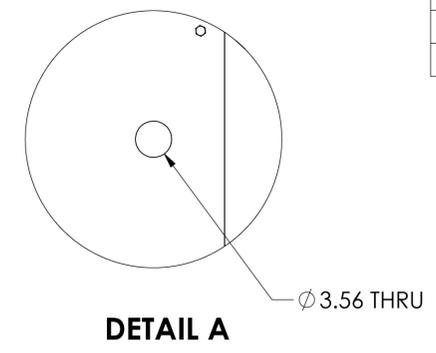
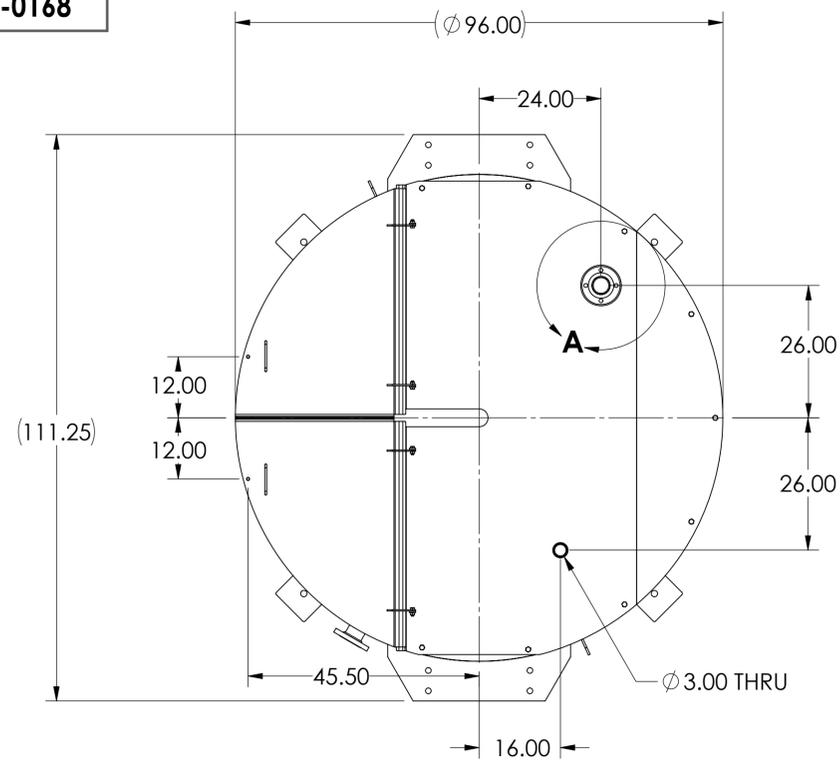
DESCRIPTION		AQUA METAL DESULFURIZATION GENERAL ARRANGEMENT	
ENGINEERED BY	DATE	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
S.G.B.	1/8/2016	TOLERANCES ARE:	
DETAILED BY	DATE	3 PLACE DECIMALS: ±0.003"	
APPROVED BY	DATE	2 PLACE DECIMALS: ±0.01"	
		FRACTIONS = STOCK SIZES	
		ANGLES: ±0.5°	
DRAWING NO.		800-28-0001 GA-C	
SHEET: 3 OF 3		ASSY NO. 800-23-0001 GA	

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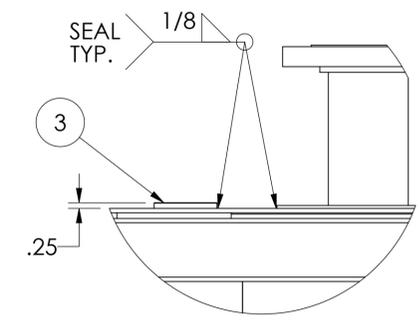
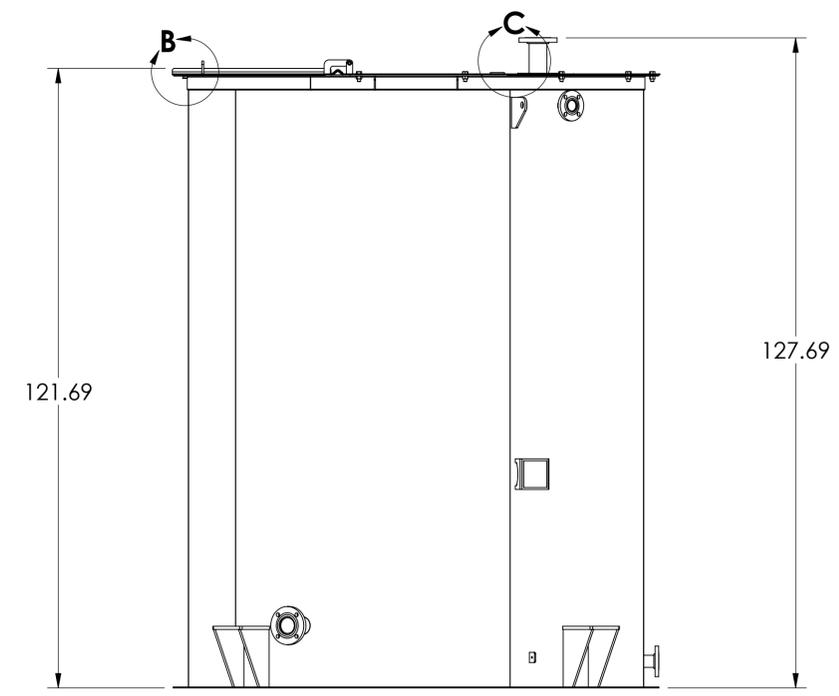
CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

CAD FILE: T:\Drawings\800 - Layouts\800-28 Aqua Metals Desulf\800-28-0001

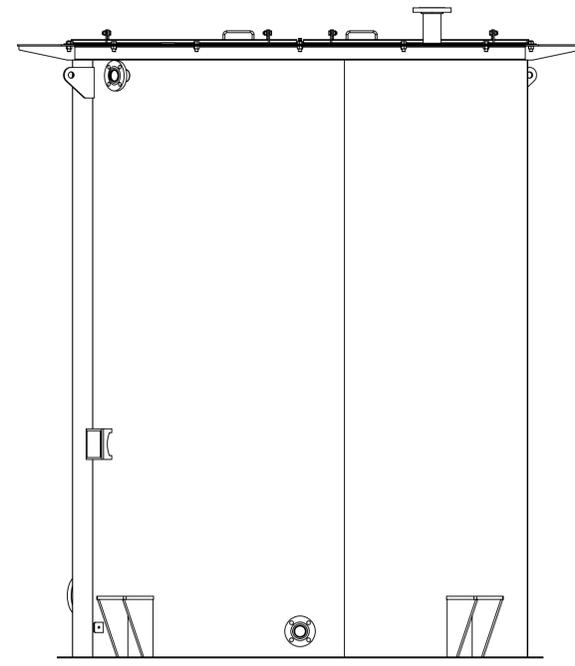
822-00-0168



DETAIL B



DETAIL C



ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-88-0003	SURGE TANK (3000)
2	1	862-05-0092	3" PIPE FLANGE WELMENT
3	1	888-61-0007	PIPE COUPLING, STAINLESS STEEL, 2" PIPE DIA., NPT FEMALE
4	2	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST



REV	DATE	AUTHOR
0		

**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 PORT HURON, MI 48061-5006  
 USA

DESCRIPTION: SURGE TANK WELMENT

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: ±0.003"  
 2 PLACE DECIMALS: ±0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

ENGINEERED BY: TS DATE: 4/20/2016  
 DETAILED BY: TS DATE: 4/22/2016  
 DRAWING NO.: **822-00-0168-0**

MAKE \_\_\_\_\_ PCS.

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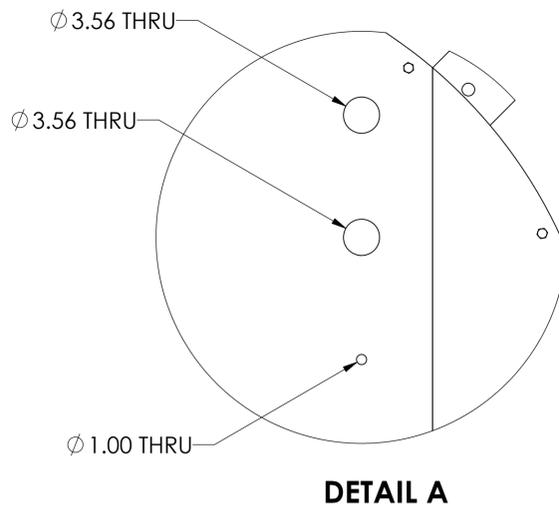
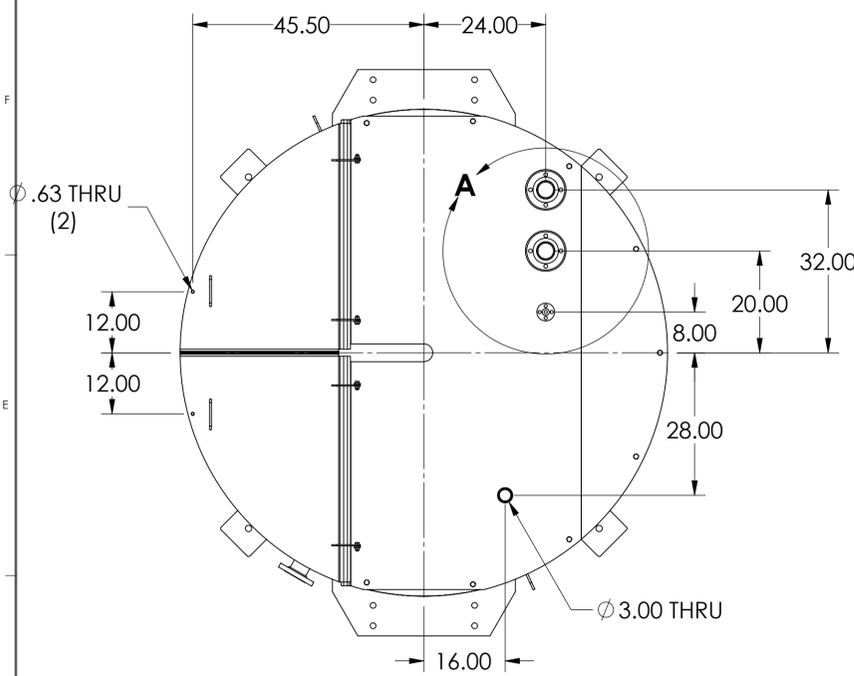
CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

CAD FILE: \\WM-DC1\nas2\Battery Recycling Systems\Drawings\822 - SGT - Surge Tank\822-00-0168

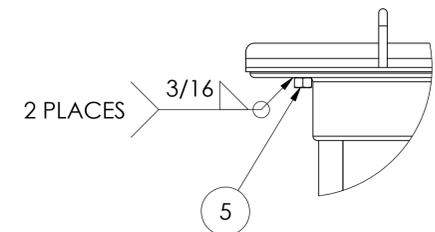
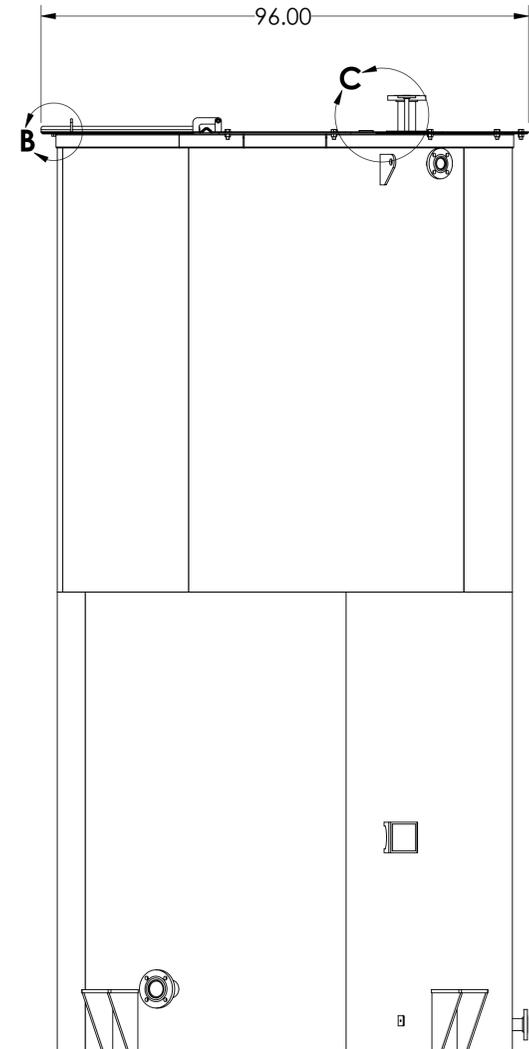
REF:  
 Revision 3, 22-Jul-2016  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

822-00-0173

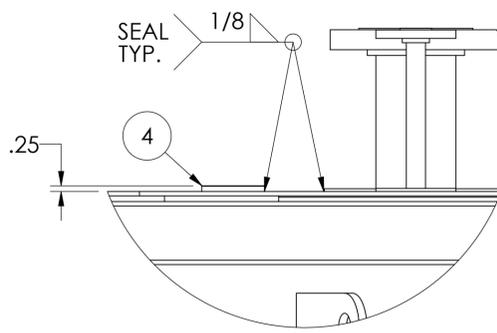
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-88-0004	SLURRY TANK (4700)
2	2	862-05-0092	3" PIPE FLANGE WELMENT
3	1	810-00-1067	1/2" PIPE FLANGE WELDMENT
4	1	888-61-0007	PIPE COUPLING, STAINLESS STEEL, 2" PIPE DIA., NPT FEMALE
5	2	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST



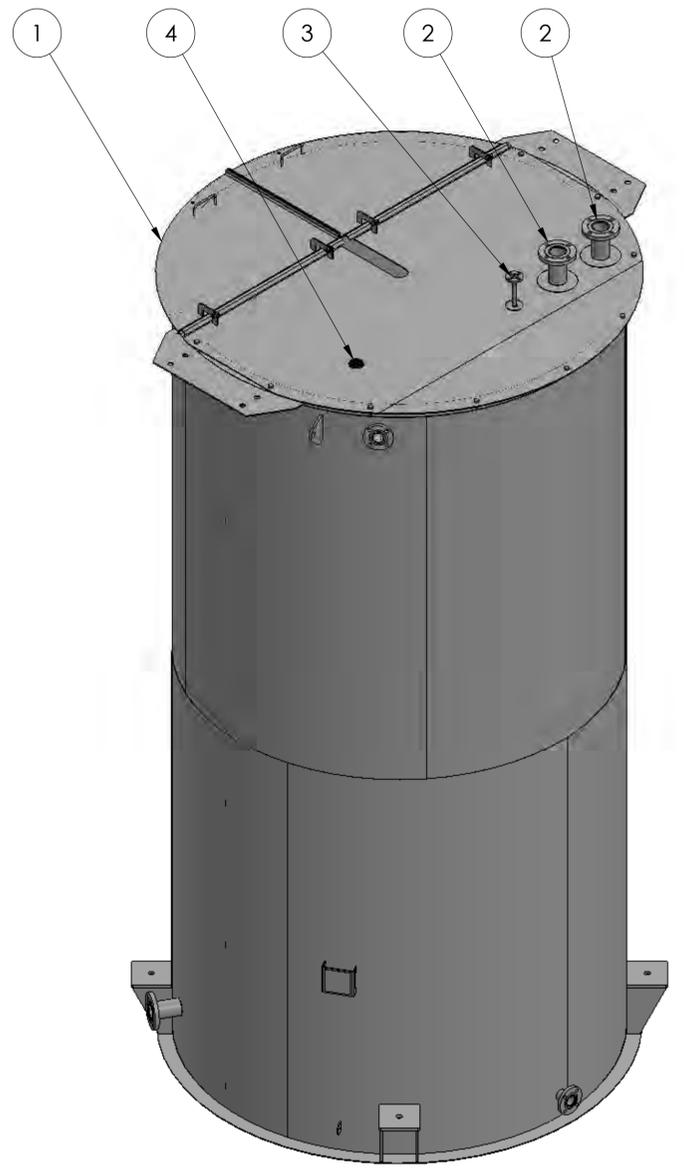
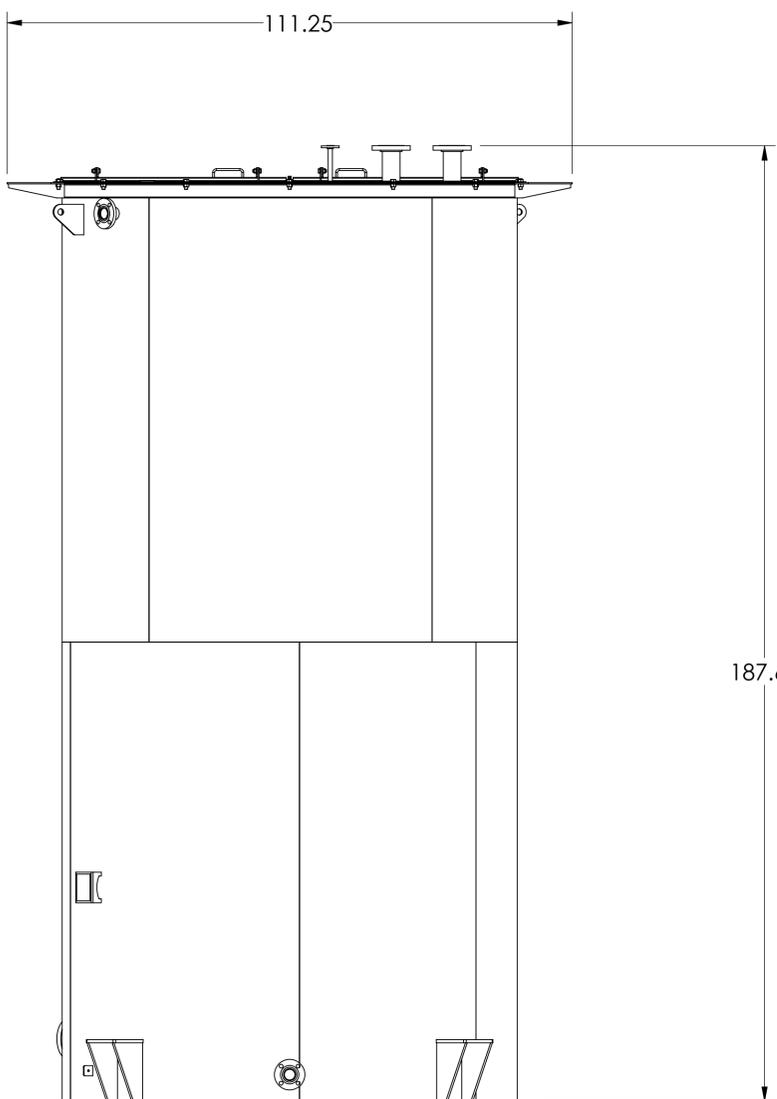
DETAIL A



DETAIL B



DETAIL C



REF: Revision 3, 22-Jul-2016  
NOTE: DEBURR & REMOVE ALL SHARP EDGES.

MAKE \_\_\_\_\_ PCS.

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CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE

CAD FILE: \\WM-DC1\nas2\Battery Recycling Systems\Drawings\822 - SGT - Slurry Tank\822-00-0173

0	REV	DATE	AUTHOR
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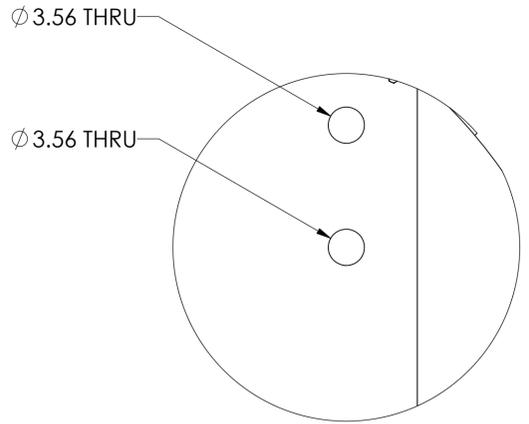
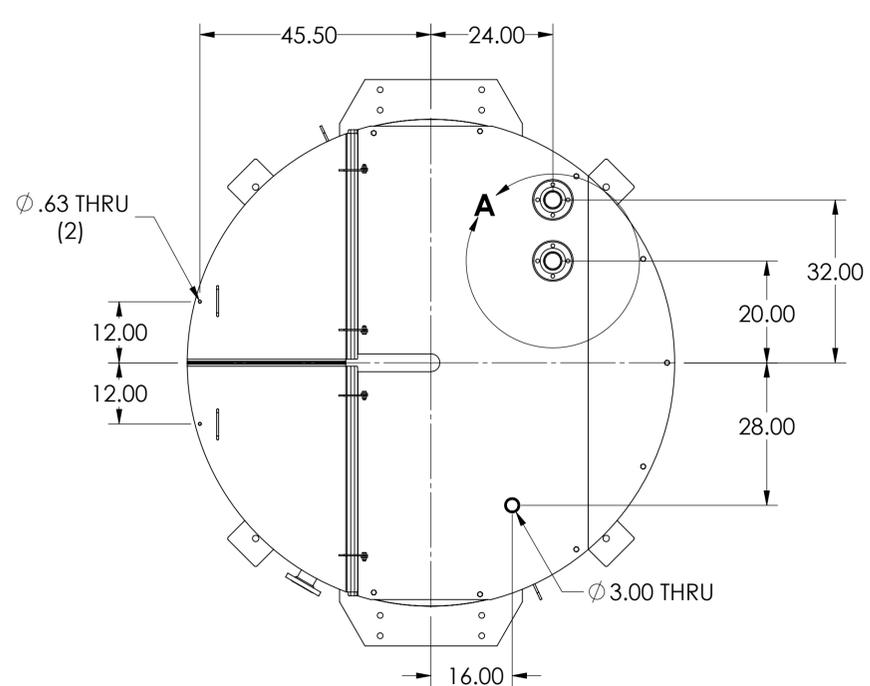
**BATTERY RECYCLING SYSTEMS, INC.**  
1105 24TH STREET  
PORT HURON, MI 48061-5006  
USA

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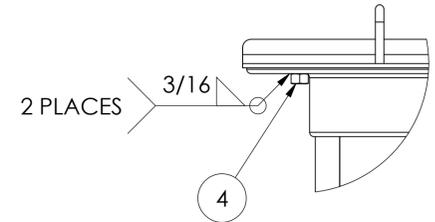
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2 PLACE DECIMALS: ±0.01"  
FRACTIONS = STOCK SIZES  
ANGLES: ±0.5°

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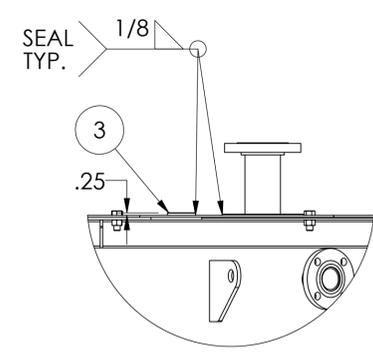
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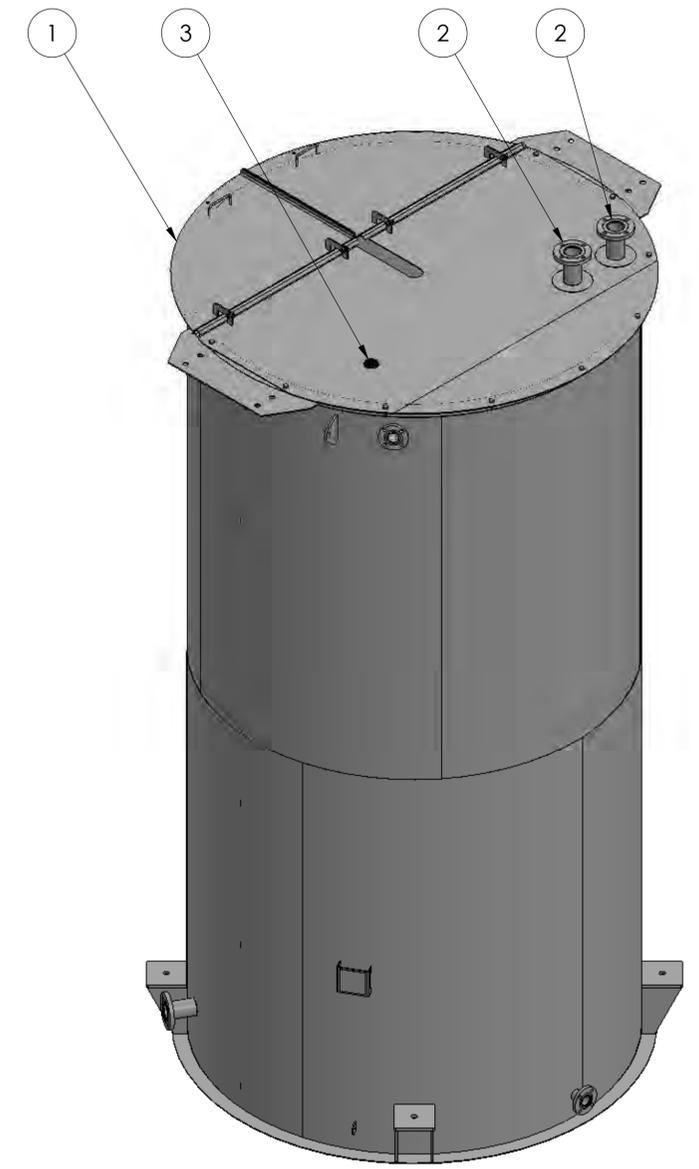
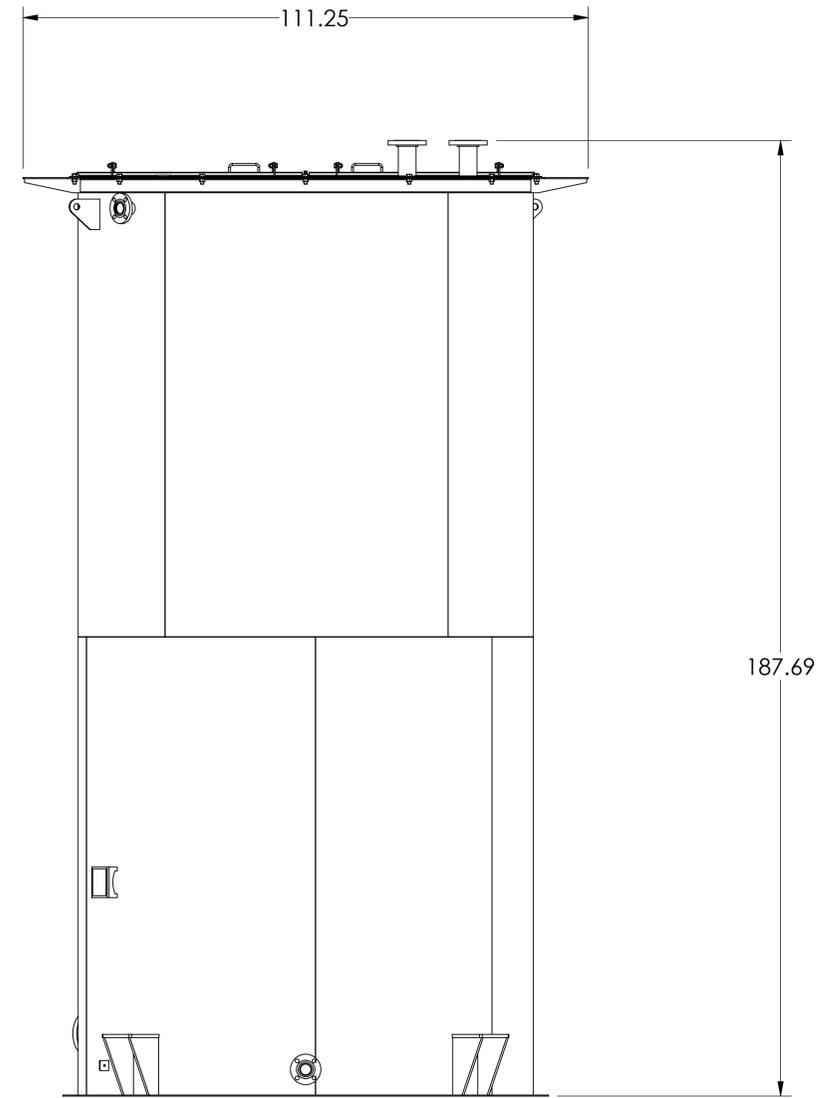
DETAIL A



DETAIL B



DETAIL C



ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-88-0004	SLURRY TANK (4700)
2	2	862-05-0092	3" PIPE FLANGE WELMENT
3	1	888-61-0007	PIPE COUPLING, STAINLESS STEEL, 2" PIPE DIA., NPT FEMALE
4	2	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST

REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

MAKE \_\_\_\_\_ PCS.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: ±0.003"  
 2 PLACE DECIMALS: ±0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

DESCRIPTION: **SLURRY HOLDING TANK WELDMENT**

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 DETAILED BY: TS DATE: 4/22/2016  
 APVD BY: DATE: DRAWING NO. **822-00-0163-0**

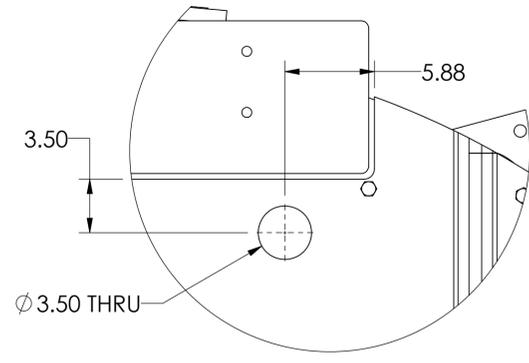
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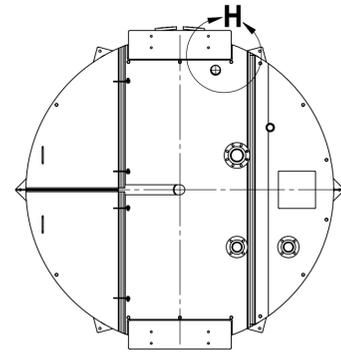
**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 PORT HURON, MI 48061-5006  
 USA

REV	DATE	AUTHOR
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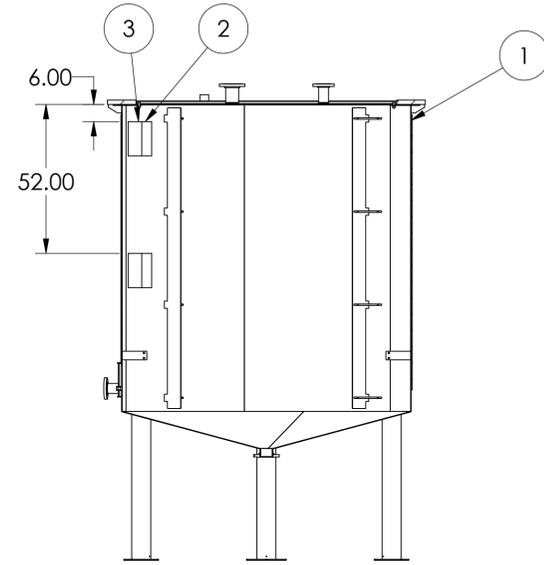
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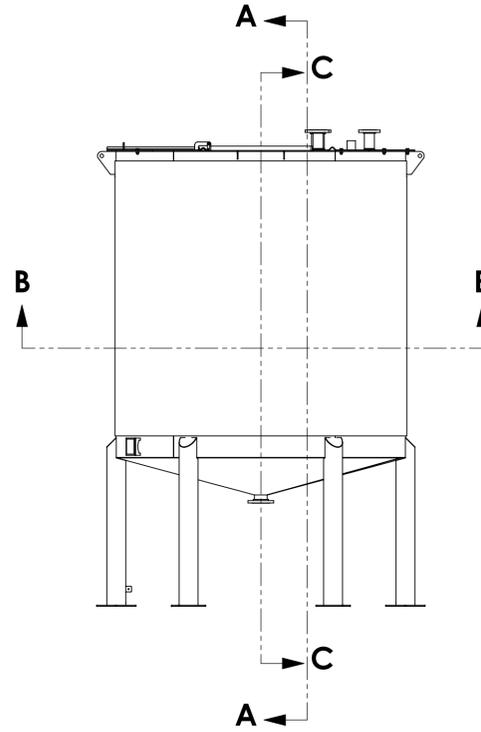
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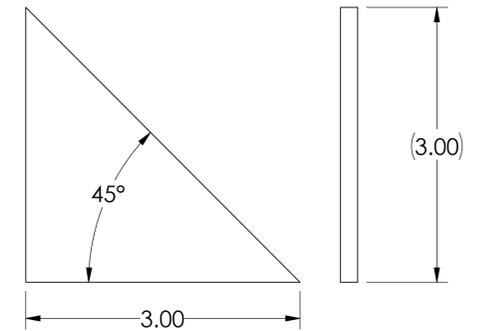
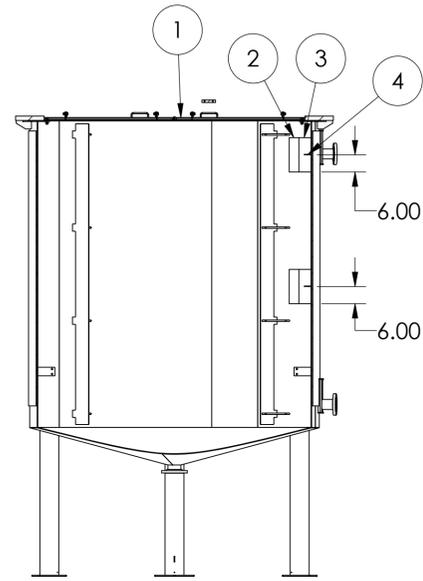
SECTION B-B



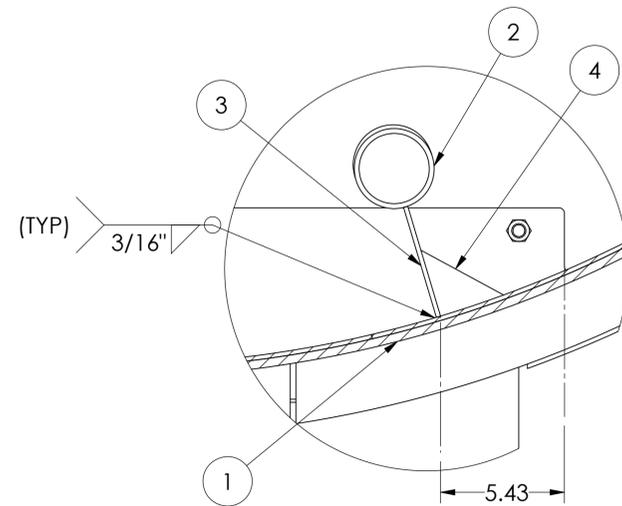
SECTION C-C



SECTION A-A



DETAIL 4



DETAIL D

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-88-0012	DESULFURIZATION REACTOR
2	2	S1304P8F3W	PIPE-SST SCH 40 x 3" PIPE x 12" LG T304 ASTM-A312
3	2	S0304F0I5D	F-SST 3/16 x 5 x 12" LG T304 ASTM-A276
4	2	S0304F0I3W	F-SST 3/16 x 3 x 3" LG T304 ASTM-A276

REF:  
**Revision 3, 22-Jul-2016**  
 NOTE: DEBURR & REMOVE ALL SHARP EDGES.

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ENGINEERED BY: TDM DATE: 5/4/2016  
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**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 PORT HURON, MI 48061-5006  
 USA

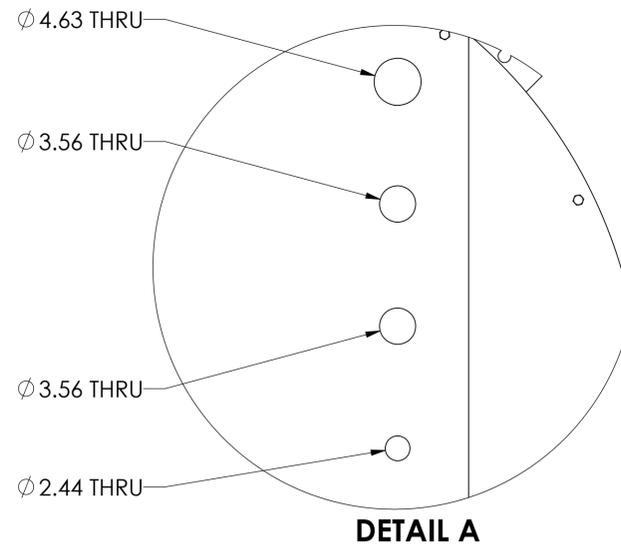
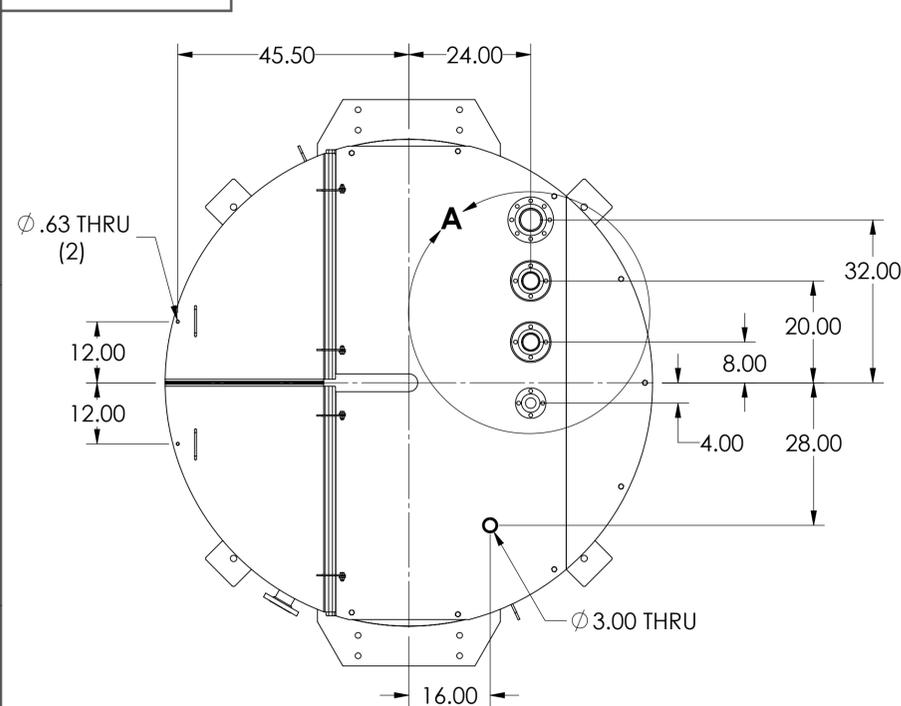
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 2 PLACE DECIMALS: ±0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

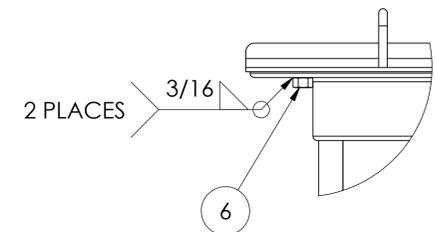
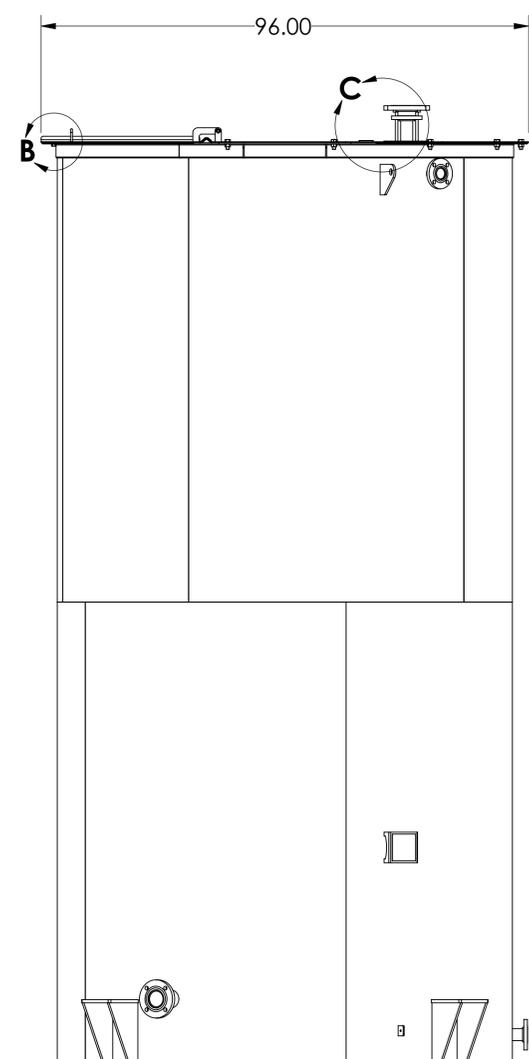
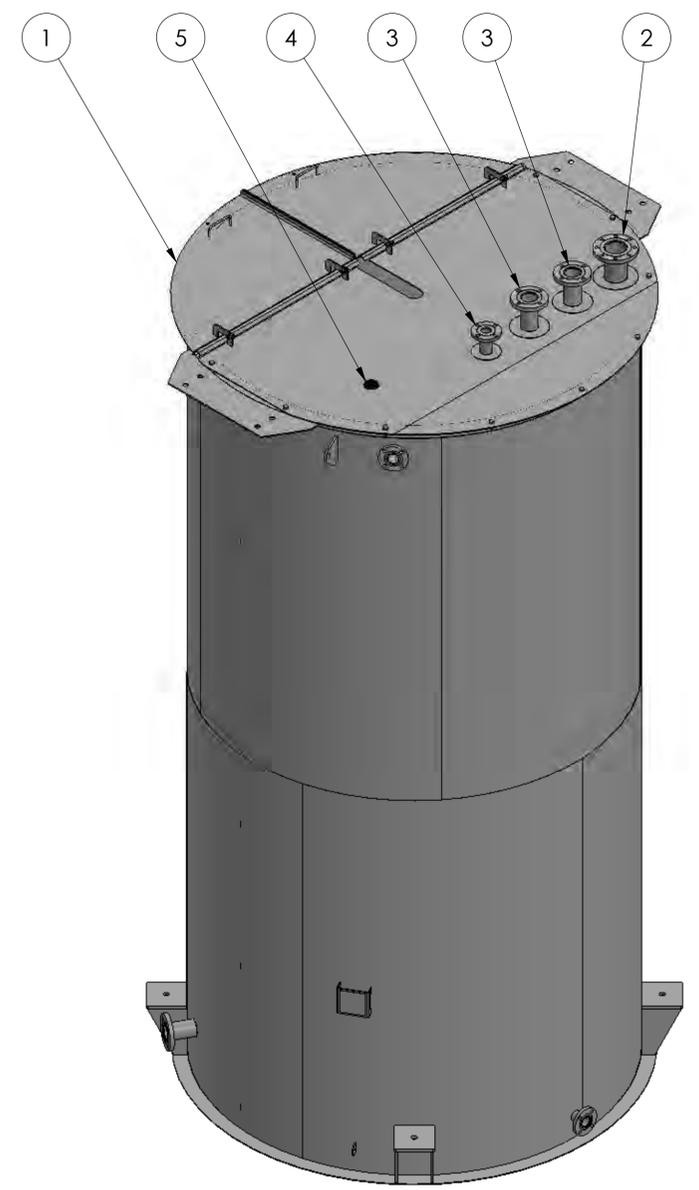
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DESCRIPTION: SHEET: 1 OF 1

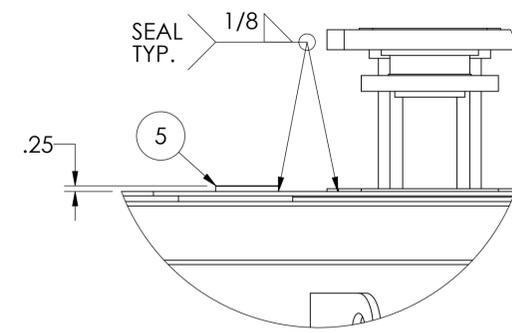
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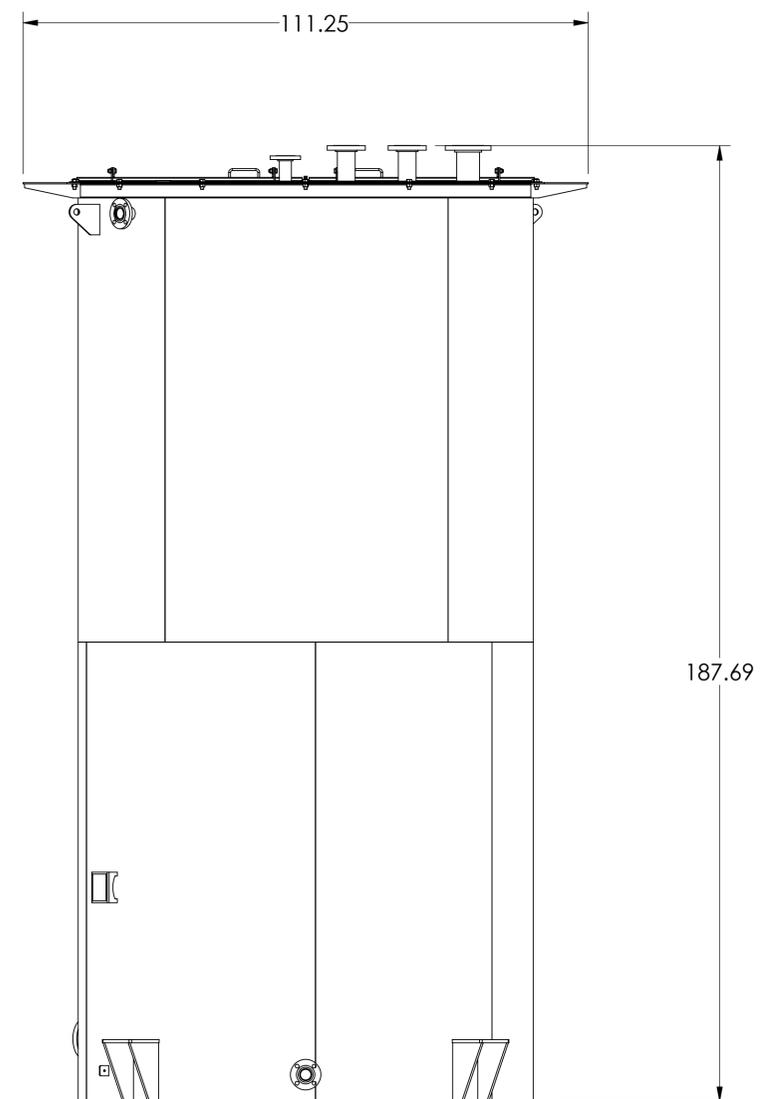
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	888-88-0004	SLURRY TANK (4700)
2	1	862-05-0207	4" PIPE FLANGE WELDMENT
3	2	862-05-0092	3" PIPE FLANGE WELMENT
4	1	820-00-0054	2" PIPE FLANGE WELMENT
5	1	888-61-0007	PIPE COUPLING, STAINLESS STEEL, 2" PIPE DIA., NPT FEMALE
6	2	888-64-0102	FASTENER, HEX NUT, 1/2-13 UNC, 316 SST



DETAIL B



DETAIL C



REF:  
**Revision 3, 22-Jul-2016**  
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REV	DATE	AUTHOR
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**BATTERY RECYCLING SYSTEMS, INC.**  
 1105 24TH STREET  
 PORT HURON, MI 48061-5006  
 USA

DESCRIPTION  
**LEAD CARBONATE SLURRY HOLDING TANK WELDMENT**

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 3 PLACE DECIMALS: ±0.003"  
 2 PLACE DECIMALS: ±0.01"  
 FRACTIONS = STOCK SIZES  
 ANGLES: ±0.5°

ENGINEERED BY: TS DATE: 4/21/2016  
 DETAILED BY: TS DATE: 4/22/2016  
 APVD BY: DATE:

DRAWING NO. **822-00-0178-0**

SHEET: 1 OF 1

# APPENDIX K Integrated Contingency Plan

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# AquaMetals Reno

## ***INTEGRATED CONTINGENCY PLAN***

Revision 3.0

*July 2016*

## Section I: INTRODUCTION

### 1. PURPOSE AND SCOPE

#### 1.1. Purpose

The following Integrated Contingency Plan (ICP) and Emergency Procedures have been prepared for the Aqua Metals Reno facility. The purpose of this plan is:

- 1) To act as a guide for all employees during actual emergency situations.
- 2) To minimize hazards to human health and the environment from fires, explosions, spills, or any unplanned sudden or non-sudden release of hazardous waste or constituents to air, soil, or surface water.
- 3) To familiarize local emergency response personnel—police, fire, and rescue departments, hospital and governmental personnel, emergency medical service—with the types of material handled and internal emergency response procedures.

The provisions in this plan will be carried out immediately whenever there is a fire, explosion, or potential or actual release of hazardous materials which could threaten human health or the environment. This plan is also intended to describe the actions facility personnel must take to minimize hazards to human health or the environment in the event of fires, explosions, or any unplanned sudden or non-sudden release of hazardous wastes. Aqua Metals Reno employees will not engage in emergency response operations other than incipient fires or incidental releases of hazardous materials. In the event of an emergency that requires offsite notification and response, as described in this plan, all Aqua Metals Reno employees will evacuate the plant buildings and report to the designated relocation point. An outside emergency responder will be contacted for emergency response as detailed in this plan.

Aqua Metals Reno will maintain this ICP at 2500 Peru Drive, McCarran, Nevada 89434, with copies available both inside and in the exterior Knox Box, to utilize in the event of an emergency. This document is a reference source to familiarize police, fire departments, and emergency response teams with the layout of the facility, properties of hazardous waste and materials handled at the facility and associated hazards, places where facility personnel would normally be working, entrances to and roads inside the facility, and possible evacuation routes at the Aqua Metals Reno facility. This written plan is available, upon request, to employees, their designated representatives, and Federal, State and Local officials.

#### 1.2. Scope

This ICP has been prepared in compliance with the requirements of 40 CFR Part 264 Subparts C and D, Nevada Administrative Code (NAC) 444.84555, 40 CFR Part 112, 29 CFR 1910.38, and 29 CFR 1910.120. The scope of this ICP covers the hazardous wastes that are generated during our Lead Acid Battery (LAB) recycling processes, the standard laboratory testing generated hazardous wastes, universal wastes, satellite accumulation areas, and waste storage areas.

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### 3. CURRENT REVISION DATE

The Aqua Metals Reno ICP was originally prepared in June 2016. The plan will be reviewed and audited as detailed in 3.1 and 3.2. Listed below are the most current review/revision to the ICP.

REVIEW & REVISION DATE	PLAN UPDATED (YES/NO)	DESCRIPTION OF REVISION(S)
07/18/16	YES	Updated Appendix A Legend, revised Table 1

#### 3.1. PLAN REVIEW

Aqua Metals Reno will review the ICP at least once a year and under the following conditions. All reviews and revisions will be documented in the table in Section 3.

1. The facility permit is revised.
2. The plan fails in an emergency or training exercise.
3. The facility changes or is altered: in its design, construction, operation, maintenance, or other circumstances—in a way that materially increases the potential for fires, explosions, or releases of hazardous waste or hazardous waste constituents, or changes the response necessary in an emergency.
4. The list of emergency coordinators changes.
5. The list of emergency equipment changes.

#### 3.2. AUDITS

Per SPCC requirements, Aqua Metals Reno will audit the ICP at least once every three years, to verify that the procedures and practices developed are adequate and being followed. The following changes to operations and equipment onsite will also require an update to the ICP:

- Commission or decommission of tanks;
- Replacement, reconstruction, or movement of tanks;
- Reconstruction, replacement, or installation of piping systems;
- Construction or demolition that might alter secondary containment.

## 4. GENERAL FACILITY IDENTIFICATION

The following section provides key facility and personnel information.

### 4.1. Facility Information

Facility Name: Aqua Metals Reno  
Owner/Operator: Aqua Metals Inc.  
1010 Atlantic Avenue  
Alameda, California 94501  
Facility Address: 2500 Peru Drive  
McCarran, Nevada 89434  
Mailing Address: 2500 Peru Drive  
McCarran, Nevada 89434  
Latitude: 39° 31' 37" N  
Longitude: 119° 29' 33" W  
NAICS Code: 562211, Hazardous waste material treatment facilities  
EPA ID#: NVR 000 092 049

### 4.2. Facility Description, Operations, and Waste Storage

Aqua Metals Reno consists of one 138,000 square foot building that sits on 12 acres of land. The facility is a small quantity generator of hazardous waste, large quantity handler of universal waste, destination facility for universal waste, and recycler of hazardous waste that is received from off-site. All process generated wastes are stored within the building in designated satellite accumulation points and one 180-day waste storage area. Appendix A shows the Facility Site Plan, locations of hazardous materials and hazardous wastes storage, emergency response equipment, eye wash/showers, and designated relocation points. The facility will operate continuously, 24 hours a day, 7 days a week, and will recycle up to 150 metric tons of used LABs per day to produce approximately 80 metric tons of reclaimed lead per day. There will be approximately 25 employees in the facility per shift, with 20 employees in the LAB processing areas and 5 employees who will spend the majority of their work day in the office spaces. The initial LAB recycling process will generate lead contaminated personal protective equipment (PPE), lead wastes, corrosive waste, and waste water treatment sludge.

### 4.3. Key Contacts

Table 1 contains the list of onsite emergency response administrators and coordinators for the facility.

Table 1: Onsite Emergency Contact Information for Aqua Metals Reno

Title	Name	Contact Information
Program Administrator	Stephanie Rucks	Mobile: 720-244-3149 Office: 775-525-1934

Title	Name	Contact Information
Lead Emergency Coordinator	Stephanie Rucks	Mobile: 720-244-3149 Office: 775-525-1934 8580 Gypsy Hill Trail Reno, Nevada 89523
Alternative Emergency Coordinator	Michael Krickel	Mobile: 765-702-1080 Office: 775-525-1932
Alternative Emergency Coordinator	Phil Lind	Mobile: 407-873-3435 Office: 775-525-1930
Alternative Emergency Coordinator	Chuck Staton	Mobile: 775-997-5604 Office: 775-525-1931
Alternative Emergency Coordinator	Alvin Johnson	Mobile: 985-640-6566
Chief Operating Officer	Selwyn Mould	Mobile: 925-639-1171 Office: 510-543-0143

**Program Administrator.** The Program Administrator has given authority to the emergency coordinators to expend funds and recruit trained employees in the event an incident requires implementation of the ICP.

**Emergency Coordinator.** The Emergency Coordinator serves as chief of the emergency team, which is on each operating shift. Whenever there is an actual or imminent emergency situation, an emergency coordinator notifies facility personnel with the alarm and/or intercom system, notifies local and state emergency response teams about emergencies, and serves as liaison with emergency response agencies. At least one emergency coordinator can always be reached by telephone. Emergency coordinators are responsible for hazardous waste management at the site. They are thoroughly familiar with all aspects of the ICP, all operations and activities at the facility, the location and characteristics of hazardous waste, the location of all records within the facility, and the facility layout.

In the event of a release, fire, or explosion, the emergency coordinator must:

- Immediately identify the character, amount, and exact source of any material released (e.g., by observation, review of facility records, manifests, or by chemical analysis).
- Assess the possible hazards to human health and the environment that may result.
- Document the incident (Appendix B).

## 5. CONTINGENCY PLAN COORDINATION AGREEMENTS

- 5.1. Appendix C contains the contact information for each of the federal, state, and local authorities, emergency services, emergency responders, and medical personnel that Aqua Metals Reno may contact in the in the event of fire, spill, or explosion at the facility.
- 5.2. The Storey County Fire Department Station 5 – Tahoe Reno Industrial Center - is the responding authority in the event of a fire at the Aqua Metals Reno facility. The fire department makes periodic inspections of the Aqua Metals Reno facility and is apprised of facility arrangements. The fire department has full authority as soon as they arrive at the site. Aqua Metals Reno utilizes Tahoe Pacific Hospital - North hospital whenever medical emergencies occur.

- 5.3. The Storey County Sheriff's Office is the responding authority should their services be needed.

## Section II: CORE PLAN AND IMPLEMENTATION

The ICP is implemented if an incident involving hazardous waste or hazardous materials is likely to threaten human health or the environment. The emergency coordinator or their alternate has full authority to determine the level of threat and to initiate the response to such a threat. All Aqua Metals Reno employees have the responsibility of carrying out the emergency procedures outlines in this ICP in order to protect themselves and their co-workers.

The ICP will be implemented during release, spill, fire, or explosion incidents at all hazardous waste generation and accumulation points, and at all hazardous materials use and storage areas throughout the facility. It will also be implemented whenever an incident might involve hazardous waste or materials anywhere in the facility or on company property.

The following incidents call for the implementation of the ICP once the emergency coordinator determines that the incident could threaten human safety and health or the environment outside the facility.

### 1. ICP INCIDENTS

#### 1.1. Spill. A spill incident occurs when:

- 1.1.1. A spill from containers or tanks which can be contained on-site but the potential exists for groundwater pollution.
- 1.1.2. A spill of any on-site generated or stored hazardous waste from containers or tanks which cannot be contained on-site, and which results in off-site soil contamination and/or ground or surface water pollution.

#### 1.2. Fire. A fire incident occurs when:

- 1.2.1. There is a thermal release of toxic fumes from hazardous waste.
- 1.2.2. A spreading fire could ignite materials at other locations at the site or cause heat-induced explosions.
- 1.2.3. A fire could spread to off-site areas.
- 1.2.4. The use of water or water and chemical fire-suppressant could result in contaminated run-off.

#### 1.3. Explosion. An explosion incident occurs when:

- 1.3.1. Safety hazards are created due to flying fragments or shock waves from a blast.
- 1.3.2. An explosion could ignite other hazardous waste at the facility.
- 1.3.3. An explosion involving hazardous waste could result in the release of toxic material.

## **2. EMERGENCY ALARM SYSTEM**

- 2.1.** In the event of an emergency, the facility emergency alarm & notification system is activated. All employees are instructed to activate the internal alarm system if the incident is an obvious immediate threat to fellow employees or the environment.
- 2.2.** The facility is equipped with emergency alarm pull stations, telephones, an intercom system, and posted evacuation routes.
- 2.3.** The notification systems run throughout the facility with both audible and visible alarms.
- 2.4.** Employees, visitors, and guests are responsible for listening to and carrying out instructions that are given to them over the alarm and intercom system.
- 2.5.** The emergency coordinator will ensure all alarms are investigated and instructions for evacuation, sheltering in place, etc. are given in a timely manner.

## **3. DISCOVERY**

The Emergency Coordinator or their alternates will determine the proper response in accordance with the control procedures. If an employee discovers a spill, fire, or other emergency, they must contact:

- 1) The emergency coordinator or alternate, and
- 2) The front office immediately.

If not present at the incident scene, the emergency coordinator or their alternates will be contacted directly and the following steps are completed:

- 3.1.** The emergency coordinator will immediately respond to the call and assess the situation.
  - 3.1.1.** If the incident can be controlled without evacuating the plant, emergency team members will be contacted to respond to the incident, and notification will be given via the intercom to not evacuate.
  - 3.1.2.** If the emergency coordinator determines that the incident requires evacuation of the plant, the coordinator immediately activates the internal alarm and notification is given via the intercom to evacuate.
- 3.2.** All employees hearing the alarm must proceed to the relocation areas located on the evacuation plan map to await further instructions (except for employees involved in critical operations).
- 3.3.** Members of the emergency team will proceed to designated relocation areas to await further instructions from the emergency coordinator.
- 3.4.** The emergency coordinator will concurrently assess the situation by identifying the character, exact source, amount, and extent of any released material. The coordinator makes an assessment of possible threats to human health and the environment.
- 3.5.** If the incident could threaten human health or the environment outside the Aqua Metals Reno property, the emergency coordinator will contact Clean Harbors, and [name of medical treatment facility or service] if injuries have occurred from the incident.
- 3.6.** The emergency coordinator will call the National Response Center and the state regulatory agency listed in Appendix C and report the incident. The report will include the:
  - 3.6.1.** Name and telephone number of the reporter

- 3.6.2. Name and address of the facility
- 3.6.3. Time and type of incident
- 3.6.4. Identification and quantity of materials involved
- 3.6.5. The possible hazards to human health and the environment outside the facility
- 3.7. Designated evacuation monitors will conduct a roll call for all employees who reported to the relocation areas. See the Evacuation Plan section, 7, of the ICP for more information.
- 3.8. The Emergency Coordinator fills out the Emergency Incident Report form in Appendix B.

#### **4. EMERGENCY RESPONSE PHASE**

The emergency coordinator provides specific direction for emergency action based upon information available regarding the incident and response capabilities and initiates emergency procedures, including protection of the public and notification of appropriate authorities.

In the event of an emergency, site personnel are evacuated and do not participate in emergency response activities, except as indicated below.

- 4.1. Limited On-Site Emergency Response Activities  
The emergency coordinator will take all necessary measures to contain the hazard within the facility property, and to prevent its spread to other nearby properties, with the assistance of the emergency team and emergency personnel assigned by the various parties contacted.
- 4.2. See Appendix D for the emergency procedures for spill containment.
- 4.3. See Appendix E for the emergency procedures for fires and explosions.
- 4.4. Off-Site Emergency Response  
The site also relies on off-site emergency response organizations to respond to site emergencies that will not be addressed by site personnel. See Appendix C for a list of response organizations.
- 4.5. These organizations have been provided a copy of the ICP; have been thoroughly briefed on site operations, hazards, and potential emergencies; have participated in a site walk-through if necessary; and are appropriately trained, staffed, and equipped to provide emergency response to this site. These organizations are contacted at least semi-annually or when changes in operations or new potential hazards are introduced on site to verify the accuracy of phone numbers and contact names and to ensure that current points of contact are aware of site operations and hazards.

#### **5. POST-EMERGENCY RESTORATION AND CLEANUP**

After the incident has been contained and controlled, the emergency coordinator, along with the emergency team, will provide for collection, treatment, and disposal of the waste and contaminated soil, water, or other materials by the emergency team or outside contractor, as appropriate. The following steps are completed by the emergency coordinators before the facility resumes operation:

- 5.1. Ensure that all emergency equipment is decontaminated, cleaned, and restored to

full operational status.

- 5.2. Investigate the cause of the emergency and take steps to prevent a recurrence of such or similar incidents.
- 5.3. Ensure that cleanup and restoration have progressed at least to the point of not jeopardizing the health and safety of the employees, and that EPA staff and local authorities have been notified before permitting resumption of the operations affected by the emergency.

## **6. EMERGENCY RESPONSE EQUIPMENT**

- 6.1. Only trained employees are permitted to deploy and use emergency response equipment. Appendix A shows the Facility Site Plan with the locations of emergency response equipment.
- 6.2. Appendix F describes ICP training and frequency, and exercises/drills.
- 6.3. Appendix G describes the types and uses of on-site emergency equipment.

## **7. EVACUATION PLAN**

- 7.1. Facility personnel evacuate the facility when the alarm system is activated and instructed to evacuate via the intercom system, or if the emergency coordinator determines that the safety and health of facility personnel is in danger.
- 7.2. If evacuation is necessary, the facility alarm system will be activated.
- 7.3. Facility personnel are instructed via the intercom system to proceed to the nearest exit and proceed to the designated relocation area as shown in Appendix A. If the nearest exit is blocked, personnel must use the next nearest available exit. A diagram of available exit routes is located in each work area.
- 7.4. Each employee immediately reports to the evacuation monitor upon reaching the relocation area.

## **8. CRITICAL OPERATIONS**

- 8.1. Aqua Metals Reno will identify any critical operations or processes which must be shut down or inactivated before an evacuation is completed, and will designate the operations and the personnel who will implement the shutdown or inactivation. During some emergency situations, it will be necessary for some specially assigned personnel to remain at the work areas to perform critical operations. See Table 2 for a list of work assignments for critical areas.

Table 2: Critical Area Assignments

<b>Work Area</b>	<b>Employee Name/Job Title</b>	<b>Description of Work Assignment</b>
Battery Breaker	Production Supervisor	E-stop activated
Control Room	Control Room Operator	Process E-stop activated
Kettles	Production Supervisor	Turn off natural gas to the kettles E-stop activated

**8.2.** In case the emergency situation will not permit, critical personnel will also evacuate to the relocation points.

**9. REPORTS AND RECORDKEEPING**

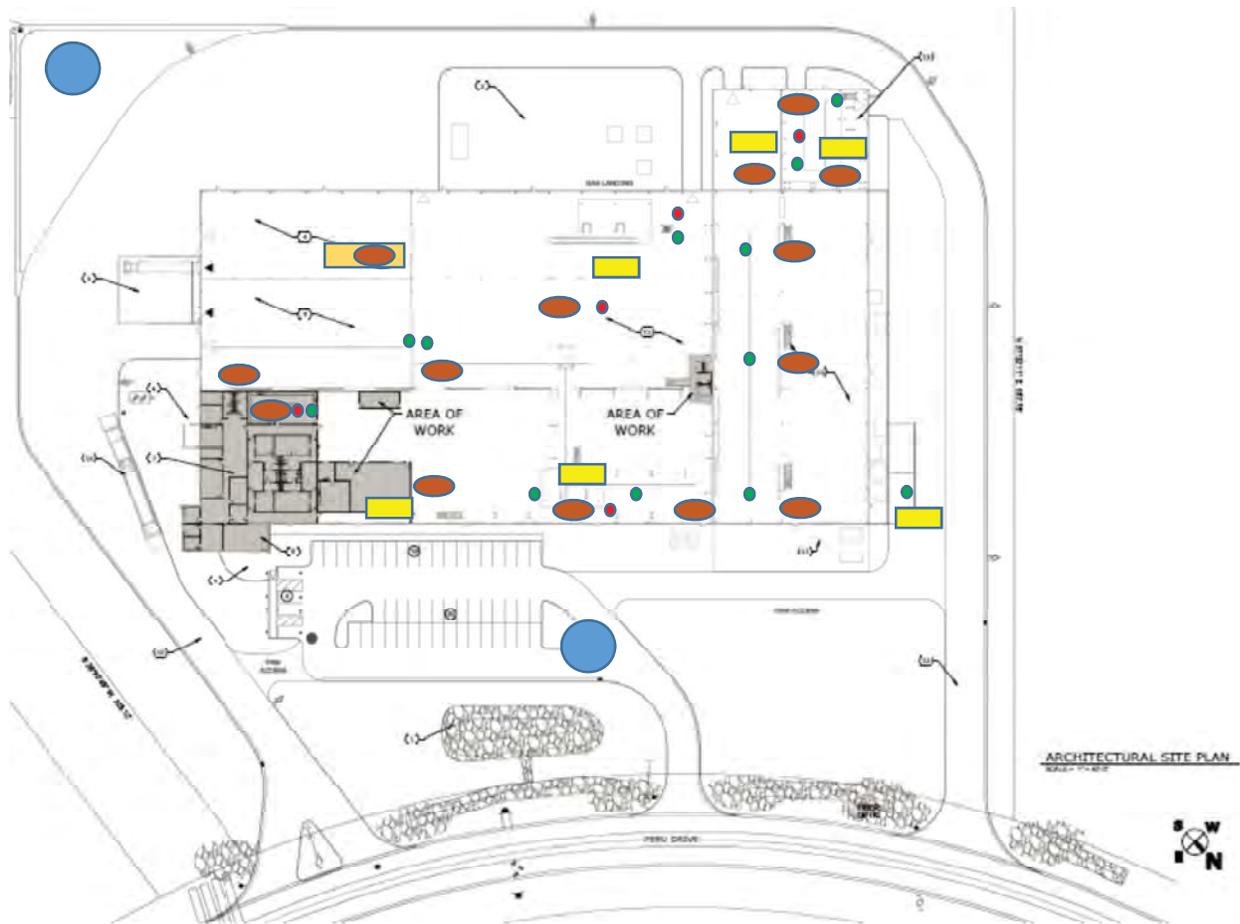
**9.1.** Within one (1) day of any incident requiring implementation of the ICP, the emergency coordinator will file a report with the EPA regional administrator and Nevada Division of Environmental Protection Bureau of Corrective Actions. The report will include the following information:

- 9.1.1. Name, address, and telephone number of the facility owner or operator
- 9.1.2. Name, address, and telephone number of the facility
- 9.1.3. Date, time, and type of incident
- 9.1.4. Extent of injuries, if any
- 9.1.5. Name and quantity of material involved
- 9.1.6. An assessment of actual or potential hazards to human health and the environment
- 9.1.7. Estimated quantity and disposition of recovered material that resulted from the incident

**9.2.** The program administrator will note in the operating record the time, date, and details of any incident that requires implementation of the Contingency Plan.

**Section III: APPENDICES**

## Appendix A: Facility Site Plan



### Facility Site Plan Legend

-  180-day waste storage area
-  Emergency eyewash/shower
-  Satellite accumulation point
-  Hazardous materials storage
-  Emergency response equipment
-  Designated relocation point

**Appendix B: Emergency Incident Report Form**

Emergency Report Incident No.  
Incident date and time:  
Where did the incident occur?

How did the incident occur?

Who reported the incident?  
Under whose control and what regulatory authorities are responsible or affiliated with the incident?

Describe the incident briefly:

Were there any chemicals/oils or raw materials involved, discharged or released?

Size of the area impacted:                    square feet (length x width)

Were there any reportable injuries, spills, or public/external notifications?

What course of action was taken?

Initially

Follow-up

What actions are being taken to prevent re-occurrences of an incident of this type? (Attach additional sheets if necessary)

**I hereby affirm the aforementioned is true to the best of my knowledge.**

_____	_____	_____
<b>Signature</b>	<b>Title</b>	<b>Date</b>
_____	_____	
<b>PRINT NAME</b>	<b>TELEPHONE NUMBER</b>	

## Appendix C: Emergency Services Contact Information

<b>OUTSIDE ASSISTANCE</b>	<b>Contact Person</b>	<b>Address /Location</b>	<b>Telephone</b>
Clean Harbors, Emergency Response	Corey Harbart	191 Coney Island Drive Sparks, NV 89431	775-331-9400
Northern Nevada Medical Center E/R	Emergency Room	2375 E. Prater Way Sparks, NV 89434	775-356-4040
Renown Regional Medical Center	Emergency Room	1155 Mill St Reno, NV 89502	775-982-4100
Storey County Sheriff's Office		205 S. C St. PO Box 205 Virginia City, NV 89440	911 or 775-847-0959
Storey County Fire Protection District	Station 5 - Tahoe-Reno Industrial Complex	1705 Peru Drive McCarran, NV 89434	911 or 775-847-0954
Nevada Division of Environmental Protection	Spill Reporting Hotline	24-hour hotline	888-331-6337
Nevada Division of Environmental Protection	Emergency Management	24-hour hotline	775 688-2830
Local Emergency Response Agency	Storey County Sheriff's Office	205 S. C St. PO Box 205 Virginia City, NV 89440	775-847-0959
Electric & Gas Company	NV Energy		775-834-4100
Sewer District	Farr West Engineering	5442 Longley Lane, Suite A Reno, Nevada 89511	775-851 – 4788
Poison Control Center			800-222-1222
EPA Region 9 Office	Emergency Response National Response Center		800-424-8802
OSHA Area Office	Reno State Plan Office	4600 Kietzke Lane Suite F-153 Reno, NV 89502	775-688-3700

## Appendix D: Emergency Response Procedures: Tank and Container Spills

The following actions will be taken in response to a spill of hazardous material:

1. The facility emergency alarm is sounded either from pull boxes, or by telephone or internal communication to the main office. Work in all areas will be shut down until the area is safely restored.
2. The emergency coordinator will be contacted.
3. The emergency coordinator must immediately identify the character, exact source, and extent of any released materials. This information must be obtained without entering the contaminated area. The Emergency Coordinator will obtain the following information:
  - a. Person(s) injured and seriousness of injury.
  - b. Location of the spill or leak, material involved, and source.
  - c. Type of material that has spilled or is leaking.
  - d. The approximate amount of material spilled, an estimate of the liquid discharge rate and the direction of the liquid flow.
4. Emergency response employees will only respond to chemical incidents where proper chemical identification and concentrations can be determined, and if they have proper training.
5. The emergency coordinator must evaluate the facility's emergency response equipment to determine if Aqua Metals Reno personnel can handle the corrective action and clean up. A list of the emergency response equipment is found in Appendix G.
6. For small spills: If Aqua Metals Reno personnel can safely and effectively perform corrective action and clean up, the following steps are to be taken under the authorization of the emergency coordinator:
  - a. Put personal protective equipment on.
  - b. Immediately set up a barrier to alert unauthorized personnel to keep out, if evacuation has not occurred.
  - c. Eliminate all possible sources of ignition and leakage.
7. Immediately begin containment by placing absorbent material on the spill within the secondary containment.
8. Set up decontamination zone to ensure proper decontamination procedures.
9. Use shovels and/or heavy equipment available at the facility to place contaminated absorbent into open top D.O.T. approved drums.
10. Any drummed cleanup materials are to be managed as hazardous waste until proper analysis has shown otherwise.
11. Drums of cleanup material are to be properly labeled.
12. Assigned personnel are to continue to cleanup and remove all residue until all contamination hazards are eliminated.
13. For large spills: If Aqua Metals Reno personnel cannot safely and effectively perform corrective action in the event of a spill, the emergency coordinator must:
  - a. Assess possible hazards to human health and the environment that may result from the spill.
  - b. Contact the local fire department and other emergency response organizations as listed in Appendix C.
14. During an emergency, the emergency coordinator must take all reasonable measures necessary to ensure that fires and explosions and releases do not occur, recur, or spread to other hazardous material waste at the facility. These measures must include,

where applicable, stopping processes and operations, collecting and containing released waste, and removing and isolating containers.

15. For small or large spills, the emergency coordinator must make the necessary reports as outlined in this plan.
16. After cleanup has occurred, the emergency coordinator must ensure that, in the affected area of the facility:
  - a. No waste may be incompatible with the released material stored.
  - b. All emergency equipment listed in the emergency response contingency plan is cleaned and fit for its intended use before resuming operations.
  - c. All disposable equipment used during the incident is replaced with new equipment in the appropriate area.

## Appendix E: Emergency Response Procedures: Fire and Explosion

1. The following are the procedures for responding to tank and drum storage fires.
  - 1.1. Determine what is on fire by location, drum label, inventory, log, or other means.
  - 1.2. Determine if persons are endangered by the fire or if the fire could spread to other wastes.
  - 1.3. Evacuate all endangered persons. In case of release of toxic gases or where there is potential for explosion, determine if off-site evacuation is advisable.
  - 1.4. Define the limits of the fire. Estimate the potential dangers due to location with respect to other wastes in the immediate vicinity. Call the local fire department (Appendix C) for fires that cannot be managed, such a small fire that can be extinguished with a fire extinguisher.
  - 1.5. After fire, clean up affected areas. Run-off from water used in firefighting should be treated as a hazardous waste and disposed of properly.

### Control Procedures: Fire/Explosion

The following actions will be taken if the container accumulation area is affected by fire or explosion:

- 1) The facility emergency alarm is sounded either from pull boxes, telephones, mobile telephones or internal communication to the main office. Work in all areas will be shut down until the area is safely restored.
- 2) The emergency coordinator will be contacted.

In the event of a fire:

  - a) If the employee has had the appropriate training, the employee may use nearby firefighting equipment to provide early containment of the fire to significantly reduce the total damage. HOWEVER, FIRE FIGHTING ACTIVITIES THAT MAY CAUSE INJURY TO THE PERSONS INVOLVED SHOULD NOT BE PERFORMED.
  - b) If Aqua Metals Reno personnel cannot safely and effectively perform corrective action in the event of a fire and/or explosion, the emergency coordinator must:
    - i) Assess possible hazards to human health and the environment that may result from the fire and/or explosion. This includes:
      - A. Person(s) injured and seriousness of injury.
      - B. Location of any spill or leak, material involved, and source.
      - C. Type of material that has spilled, is leaking and/or is involved in the fire/explosion.
      - D. The approximate amount of material spilled, an estimate of the liquid discharge rate and the direction of the liquid flow.
    - ii) Contact the local fire department and other emergency response organizations as listed in Appendix C.
- 3) Operating equipment will be shut down as necessary and practical.
- 4) If the emergency coordinator determines that an area or site evacuation is required, the appropriate person must be notified to sound the proper alarm and all employees evacuate to the designated relocation points (Appendix A).
- 5) All injured persons will be removed, if possible, and medical treatment will be administered by trained personnel.
- 6) During an emergency, the emergency coordinator must take all reasonable measures necessary to ensure that fires, explosions and releases do not occur, recur, or spread to other hazardous material/waste at the facility. These measures must include, where

applicable, stopping processes and operations, collecting and containing released waste, and removing and isolating applicable containers.

- 7) The emergency coordinator must evaluate the facility's emergency equipment to determine if Aqua Metals Reno personnel can handle the corrective action and clean-up. A list of the emergency equipment is found in Appendix G.
- 8) If Aqua Metals Reno personnel can safely and effectively perform corrective action and clean-up, the following steps are to be taken under the authorization of the emergency coordinator:
  - a) Put personal protective equipment on.
  - b) Eliminate all possible sources of ignition.
  - c) Clean up the released/affected media from the fire or explosion per the spill control procedures listed in Appendix D.
- 9) For fires and explosions, the emergency coordinator must make the necessary reports as outlined in this plan.

## Appendix F: Training and Exercise/Drills

### 1. Training

Proper training is essential to the success of any emergency response action. All employees of Aqua Metals Reno will be trained in emergency response and hazard communication procedures. Aqua Metals Reno will provide training for all new employees and provide refresher training for all employees annually. Additionally, training will be provided whenever:

- There are changes to materials or equipment within the facility;
- The ICP is updated; and
- Exercises/ Drills indicate that employees do not understand their responsibilities.

Basic training for all employees will be conducted by the Emergency Coordinator and will include, at a minimum, the following items:

1. Risk/spill prevention.
2. A review of the ICP and description of its components.
3. Individual roles and responsibilities.
4. Information about hazards and protective actions.
5. Notification, warning and communication procedures.
6. Emergency response procedures.
7. Evacuation and accountability procedures.
8. Location and use of common emergency equipment.

In addition to the basic training described above, plant personnel will each receive fire extinguisher training annually and the Emergency Coordinators will receive additional training in emergency response. Records of all training, including who was trained, when, and by whom, will be documented and maintained on file.

#### 1.1. Employee Emergency Responsibilities

Employee's responsibilities and training requirements for actions covered in the ICP are detailed below.

##### 1.1.1. Emergency Coordinator and Alternates

##### 1.1.2. Training Requirements:

- 24 or 40-hour Incident Command Training: One Time/Initial
- 8-hour refresher training: Annually
- Hazard Communication training: Annually
- Fire Extinguisher training: Annually
- Thorough knowledge of the facility and the ICP

##### 1.1.3. Emergency Responsibilities:

- Determining the need to activate the ICP
- Determining when evacuation is required
- Contacting outside response personnel, and the authority to contract with commercial response firms during an emergency
- Shutting down the natural gas flow into the facility
- Accounting for all personnel at the rally point
- Notifying the proper authorities
- Training plant and office personnel
- Updating outside response personnel during an emergency
- Authorizing re-entry in to the facility at the conclusion of an emergency action
- Ensuring that emergency equipment is properly maintained
- Documenting each incident and reviewing the ICP to ensure its adequacy and that

- is up-to-date
- 1.1.4. **Plant Personnel**
- 1.1.5. Training Requirements
  - ICP Training: Annually
  - Hazard Communication Training: Annually
  - Fire extinguisher training: Annually
- 1.1.6. Emergency Responsibilities:
  - Notify the Emergency Coordinator and the front office when discovering an emergency incident
  - Evacuate the building and meet at the rally point whenever the evacuation signal or fire alarm is activated
  - Shut down all vehicles and equipment before evacuating
  - Account for all contractors/visitors that are at Aqua Metals Reno
- 1.1.7. **Office Personnel**
- 1.1.8. Training Requirements
  - ICP Training: Annually
  - Hazard Communication Training: Annually
  - Fire extinguisher training: Annually
- 1.1.9. Emergency Responsibilities:
  - Notify the Emergency Coordinator when an emergency incident is discovered
  - Contact outside personnel at the direction of the Emergency Coordinator or in the event the Emergency Coordinator is incapacitated as a result of the emergency
  - Evacuate the building and meet at the rally point whenever the evacuation signal or fire alarm is activated
  - Account for all contractors/visitors that are at Aqua Metals Reno

## 2. Exercises and Drills

Conducting exercises is one of the best means for assessing emergency plans and procedures, for determining the readiness of emergency responders, for resolving questions of coordination and clarifying roles and responsibilities, and for promoting awareness of potential hazards.

Once employees have been initially trained, Aqua Metals Reno will conduct exercises to determine if the ICP is workable and to determine if people are properly trained. In addition, it will give employees an opportunity to become familiar with their responsibilities so that they will act more instinctively during an emergency.

Each exercise will revolve around a potential emergency that is likely to arise at Aqua Metals Reno. At least one exercise per year will be conducted and may include coordination with outside agencies that will respond to an actual emergency. These agencies include the Storey County Fire and Sheriff Departments, EMTs, and private spill response contractors. The exercise will be carried through each phase of an emergency (e.g., discovery, notification, and evacuation) following the steps listed in the Core Plan. The exercise will be observed by Aqua Metals employees and possibly outside resources to evaluate the response. Following the exercise, the observer(s), the Emergency Coordinators, and the responding agencies will thoroughly analyze each component of the response and make recommendations for modifying the ICP or re-training personnel.

## **Appendix G: Emergency Response Equipment**

### **Personal Protective Equipment**

**Disposable coveralls  
Gloves  
Goggles  
Face shields  
Hard Hats  
Duct tape  
Air purifying respirators  
Disposable air purifying & particulate respirator cartridges  
Shoe Covers  
Fire blanket  
Assorted first aid supplies  
Safety showers and eye washes**

### **Fire Response Equipment**

**Sprinkler system  
Fire extinguishers**

### **Spill Response Equipment**

**Sorbent booms, pads & pillows  
Squeegees, brooms, buckets, mops  
Spark-proof shovels  
Sorbent sand  
Empty 55-gallon open head drums  
Drum repair kit  
1.5" diameter, 35 gpm stainless steel air pump**

### **Communication Equipment**

**Telephones  
Mobile Telephones  
Alarm Pull Boxes Connected to Alarm System  
2-way radios  
Intercom System**

## **Appendix H: Emergency Response Contingency Plan Distribution List**

The ICP will be kept on-site electronically and with a hard copy in the Knox Box. Notification letters will be sent via registered mail to the following organizations:

- Storey County Fire Protection District
- Storey County Sheriff's Department
- Clean Harbors, 3<sup>rd</sup> party Emergency Response
- Northern Nevada Medical Center E/R

Copies of the ICP will also be filed with:

- Storey County Fire Protection District
- Clean Harbors, 3<sup>rd</sup> party Emergency Response

2500 PERU DRIVE  
MCCARRAN, NV 89434



July 18, 2016

Storey County Fire Protection District  
Frederick Klinger  
P.O. Box 603  
Virginia City, NV 89440

**Subject:** Aqua Metals Notification Letter

Dear Fritz:

Aqua Metals is a business operating in the Tahoe Reno Industrial Center and must undergo routine inspections by the Nevada Division of Environmental Protection (NDEP) due to our generation of hazardous waste. In addition to routine inspections, businesses that generate hazardous waste are required to submit notice to emergency response organizations. Hence, the reason for the submittal of this letter.

According to the U.S. Environmental Protection Agency and NDEP, companies who generate hazardous waste in quantities greater than 220 pounds per calendar month must comply with 40 CFR subpart C Preparedness and Prevention. Specifically, companies must attempt to make arrangements with local authorities as explained below:

Sec. 265.37 Arrangements with local authorities.

(a) The owner or operator must attempt to make the following arrangements, as appropriate for the type of waste handled at his facility and the potential need for the services of these organizations:

- (1) Arrangements to familiarize police, fire departments, and emergency response teams with the layout of the facility, properties of hazardous waste handled at the facility and associated hazards, places where facility personnel would normally be working, entrances to roads inside the facility, and possible evacuation routes;
- (2) Where more than one police and fire department might respond to an emergency, agreements designating primary emergency authority to a specific police and a specific fire department, and agreements with any others to provide support to the primary emergency authority;
- (3) Agreements with State emergency response teams, emergency response contractors, and equipment suppliers; and
- (4) Arrangements to familiarize local hospitals with the properties of hazardous waste handled at the facility and the types of injuries or illnesses which could result from fires, explosions, or releases at the facility.

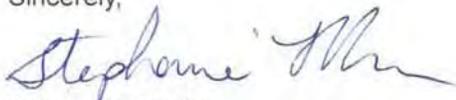
(b) Where State or local authorities decline to enter into such arrangements, the owner or operator must document the refusal in the operating record.

Aqua Metals would like to notify your department that we are a small quantity generator of hazardous wastes. These wastes include the following: lead contaminated personal protective equipment (PPE), lead wastes, corrosive waste, and waste water treatment sludge. If an emergency occurred involving these materials, it may include a spill or fire.

This letter is intended to make an attempt to notify authorities of the type of hazardous waste generated at our facility, as required. It is also an invitation for you to visit the facility and become more familiar with the floor layout and our evacuation routes. At present, employees occupy this entire facility from 7AM – 5PM. Once we are fully operational later this year, we will operate 24-hours per day, 7 days per week.

It is assumed that Storey County Fire Protection District would provide medical treatment as a result of an emergency at our facility. If this is not true, please notify us in writing. If you have any questions regarding this letter, please feel free to contact me at 720-244-3149.

Sincerely,

A handwritten signature in blue ink that reads "Stephanie Rucks". The signature is fluid and cursive, with the first name being the most prominent.

Stephanie Rucks

Environmental Health and Safety Manager

## Stephanie Rucks

---

**From:** DFS ADMIN <dfsadmin@nvblue.com>  
**Sent:** Monday, July 18, 2016 3:43 PM  
**To:** Frederick Klingler  
**Cc:** Stephanie Rucks  
**Subject:** FW: Aqua Metals Integrated Contingency Plan  
**Attachments:** Aqua Metals Integrated Contingency Plan\_V\_2.pdf

Fritz –

This has been uploaded under 2500 Peru Drive – Aqua Metals – Aqua Metals Integrated Contingency.

Thanks!

Amber Sambrano-Tye  
DFS Administrator/CSR  
Nevada Blue, LTD  
775-827-4441

---

**From:** Stephanie Rucks [mailto:stephanie.rucks@aquametals.com]  
**Sent:** Monday, July 18, 2016 1:58 PM  
**To:** DFS ADMIN  
**Cc:** Fritz Klingler (fklingler@storeycounty.org)  
**Subject:** Aqua Metals Integrated Contingency Plan

Hello Amber,

Attached, please find the ICP for Aqua Metals, 2500 Peru Drive, McCarran, Nevada. Thank you.

Warm regards,  
Stephanie

**Stephanie Rucks**  
Environmental Health and Safety Manager  
Aqua Metals Inc.  
2500 Peru Drive  
McCarran NV 89434  
Cell 720 244 3149  
<http://www.aquametals.com>



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2500 PERU DRIVE  
MCCARRAN, NV 89434



July 18, 2016

Storey County Sheriff Department  
P.O. Box 205  
Virginia City, NV 89440

**Subject:** Aqua Metals Notification Letter

Dear Storey County Sheriff Department:

Aqua Metals is a business operating in the Tahoe Reno Industrial Center and must undergo routine inspections by the Nevada Division of Environmental Protection (NDEP) due to our generation of hazardous waste. In addition to routine inspections, businesses that generate hazardous waste are required to submit notice to emergency response organizations. Hence, the reason for the submittal of this letter.

According to the U.S. Environmental Protection Agency and NDEP, companies who generate hazardous waste in quantities greater than 220 pounds per calendar month must comply with 40 CFR subpart C Preparedness and Prevention. Specifically, companies must attempt to make arrangements with local authorities as explained below:

Sec. 265.37 Arrangements with local authorities.

(a) The owner or operator must attempt to make the following arrangements, as appropriate for the type of waste handled at his facility and the potential need for the services of these organizations:

- (1) Arrangements to familiarize police, fire departments, and emergency response teams with the layout of the facility, properties of hazardous waste handled at the facility and associated hazards, places where facility personnel would normally be working, entrances to roads inside the facility, and possible evacuation routes;
- (2) Where more than one police and fire department might respond to an emergency, agreements designating primary emergency authority to a specific police and a specific fire department, and agreements with any others to provide support to the primary emergency authority;
- (3) Agreements with State emergency response teams, emergency response contractors, and equipment suppliers; and
- (4) Arrangements to familiarize local hospitals with the properties of hazardous waste handled at the facility and the types of injuries or illnesses which could result from fires, explosions, or releases at the facility.

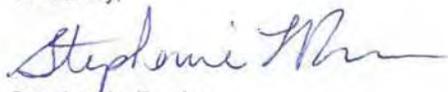
(b) Where State or local authorities decline to enter into such arrangements, the owner or operator must document the refusal in the operating record.

Aqua Metals would like to notify your department that we are a small quantity generator of hazardous wastes. These wastes include the following: lead contaminated personal protective equipment (PPE), lead wastes, corrosive waste, and waste water treatment sludge. If an emergency occurred involving these materials, it may include a spill or fire.

This letter is intended to make an attempt to notify authorities of the type of hazardous waste generated at our facility, as required. It is also an invitation for you to visit the facility and become more familiar with the floor layout and our evacuation routes. At present, employees occupy this entire facility from 7AM – 5PM. Once we are fully operational later this year, we will operate 24-hours per day, 7 days per week.

It is assumed that the Storey County Sheriff's Department may provide emergency response as a result of an emergency at our facility. If this is not true, please notify us in writing. If you have any questions regarding this letter, please feel free to contact me at 720-244-3149.

Sincerely,

A handwritten signature in blue ink that reads "Stephanie Rucks". The signature is fluid and cursive, with the first name being the most prominent.

Stephanie Rucks

Environmental Health and Safety Manager

2500 PERU DRIVE  
MCCARRAN, NV 89434



July 18, 2016

Northern Nevada Medical Center  
Emergency Room  
2375 E. Prater Way  
Sparks, NV 89434

**Subject:** Aqua Metals Notification Letter

Dear Northern Nevada Medical Center:

Aqua Metals is a business operating in the Tahoe Reno Industrial Center and must undergo routine inspections by the Nevada Division of Environmental Protection (NDEP) due to our generation of hazardous waste. In addition to routine inspections, businesses that generate hazardous waste are required to submit notice to emergency response organizations. Hence, the reason for the submittal of this letter.

According to the U.S. Environmental Protection Agency and NDEP, companies who generate hazardous waste in quantities greater than 220 pounds per calendar month must comply with 40 CFR subpart C Preparedness and Prevention. Specifically, companies must attempt to make arrangements with local authorities as explained below:

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(a) The owner or operator must attempt to make the following arrangements, as appropriate for the type of waste handled at his facility and the potential need for the services of these organizations:

- (1) Arrangements to familiarize police, fire departments, and emergency response teams with the layout of the facility, properties of hazardous waste handled at the facility and associated hazards, places where facility personnel would normally be working, entrances to roads inside the facility, and possible evacuation routes;
- (2) Where more than one police and fire department might respond to an emergency, agreements designating primary emergency authority to a specific police and a specific fire department, and agreements with any others to provide support to the primary emergency authority;
- (3) Agreements with State emergency response teams, emergency response contractors, and equipment suppliers; and
- (4) Arrangements to familiarize local hospitals with the properties of hazardous waste handled at the facility and the types of injuries or illnesses which could result from fires, explosions, or releases at the facility.

(b) Where State or local authorities decline to enter into such arrangements, the owner or operator must document the refusal in the operating record.

Aqua Metals would like to notify your department that we are a small quantity generator of hazardous wastes. These wastes include the following: lead contaminated personal protective equipment (PPE), lead wastes, corrosive waste, and waste water treatment sludge. If an emergency occurred involving these materials, it may include a spill or fire.

This letter is intended to make an attempt to notify authorities of the type of hazardous waste generated at our facility, as required. It is also an invitation for you to visit the facility and become more familiar with the floor layout and our evacuation routes. At present, employees occupy this entire facility from 7AM – 5PM. Once we are fully operational later this year, we will operate 24-hours per day, 7 days per week.

It is assumed that Northern Nevada Medical Center would provide medical treatment as a result of an emergency at our facility. If this is not true, please notify us in writing. If you have any questions regarding this letter, please feel free to contact me at 720-244-3149.

Sincerely,

A handwritten signature in blue ink that reads "Stephanie Rucks". The signature is fluid and cursive, with a long horizontal stroke at the end.

Stephanie Rucks

Environmental Health and Safety Manager

7015 0640 0002 3954 3869

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<input checked="" type="checkbox"/> Return Receipt (hardcopy)	\$0.00
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<input type="checkbox"/> Adult Signature Restricted Delivery	\$0.00

0436  
02



Postage	\$0.47
Total Postage and Fees	\$6.47

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Street and Apt. No., or PO Box No. P.O. Box 603  
City, State, ZIP+4® Virginia City, NV 89440

PS Form 3800, April 2015 PSN 7530-02-000-9047 See Reverse for Instructions

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Extra Services & Fees (check box, add fee as appropriate)	\$2.70
<input checked="" type="checkbox"/> Return Receipt (hardcopy)	\$0.00
<input type="checkbox"/> Return Receipt (electronic)	\$0.00
<input type="checkbox"/> Certified Mail Restricted Delivery	\$0.00
<input type="checkbox"/> Adult Signature Required	\$0.00
<input type="checkbox"/> Adult Signature Restricted Delivery	\$0.00

0436  
02



Postage	\$0.47
Total Postage and Fees	\$6.47

Sent To Storey County Sheriff Dept  
Street and Apt. No., or PO Box No. PO Box 205  
City, State, ZIP+4® Virginia City, NV 89440

PS Form 3800, April 2015 PSN 7530-02-000-9047 See Reverse for Instructions

7015 0640 0002 3954 3852

U.S. Postal Service™  
CERTIFIED MAIL® RECEIPT  
Domestic Mail Only

For delivery information, visit our website at [www.usps.com](http://www.usps.com)™.

SPARKS, NV 89434

Certified Mail Fee	\$3.30
Extra Services & Fees (check box, add fee as appropriate)	\$2.70
<input checked="" type="checkbox"/> Return Receipt (hardcopy)	\$0.00
<input type="checkbox"/> Return Receipt (electronic)	\$0.00
<input type="checkbox"/> Certified Mail Restricted Delivery	\$0.00
<input type="checkbox"/> Adult Signature Required	\$0.00
<input type="checkbox"/> Adult Signature Restricted Delivery	\$0.00

0436  
02



Postage	\$0.47
Total Postage and Fees	\$6.47

Sent To Northern Nevada Medical Center E  
Street and Apt. No., or PO Box No. 2375 E. Prater Way  
City, State, ZIP+4® Sparks NV 89434

PS Form 3800, April 2015 PSN 7530-02-000-9047 See Reverse for Instructions

## APPENDIX L Closure Plan and Cost Estimate



# AQUAMETALS (TRIC FACILITY) CLEAN CLOSURE PLAN

Rev. B

7/12/16

**Physical Address:** 2500 PERU DRIVE  
MCCARRAN, NEVADA 89434  
**General Facility Location:** TAHOE-RENO INDUSTRIAL CENTER  
2500 PERU DRIVE  
MCCARRAN, NEVADA 89434

## 1.0 Closure and Post-Closure Written Plan

The following closure plan has been developed in accordance with 40 CFR Part 264 Subpart G and is applicable only to the 138,000 square foot building located in McCarran, Nevada, Storey County,

- ~ latitude 39° 31' 37" N
- ~ longitude 119° 29' 33" W

The building sits on 12 acres of land, is a completely enclosed structure, does not store LABs prior to treatment, and does not treat or manage any hazardous wastes outside of the following areas:

- receiving
- battery breaking
- separation
- desulfurization
- digestion
- lead recovery
- waste water treatment
- refining and alloying
- finished goods

Exterior structures consist of two bulk chemical tanks on the north side of the building, and an NDEP air permitted process fugitive baghouse ventilation structure on the west side.

This Closure Plan addresses the removal and disposal of all hazardous materials and wastes, decontamination and removal and disposal of waste generated during the decontamination process, removal of all decontaminated LAB process equipment, decontamination of all LAB process equipment, sell or recycling of all LAB process equipment, and sampling and testing the interior and exterior of the building after decontamination has concluded.

The Closure Plan includes a closure cost estimate and financial assurance plan.

## 1.1 Closure Performance Standards

The clean closure plan detailed in section **1.2 Closure Plan Requirements** meets the performance standards outlined in 40 CFR Part 264.111, and identified below.

### 1.1.1 Minimize Maintenance

At the end of closure, the building and site will be free of hazardous materials and wastes and ready for immediate sale and occupancy. It is not anticipated that any ongoing maintenance will be required after the clean closure is executed.

### 1.1.2 Prevent Post Closure Release

No hazardous wastes are expected to remain after clean closure, as the hazardous materials, hazardous wastes, LAB processing equipment, and baghouse will be removed from the site. With no potential source, there is no risk to human health or the environment from the previous activities at the site.

## 1.2 Closure Plan Requirements

### 1.2.1 Maximum Hazardous Waste Inventory

Aqua Metals Reno will process a maximum quantity of 200 tons of LABs per day on a just in time basis. Thereby, there will never be onsite storage of LABs and in process LABs greater than the maximum quantity.

### 1.2.2 Methods for Removing, Transporting, Treating, and Disposing

At the initiation of the closure plan, the LAB recycling process will complete processing of all in process LABs, then begin the decontamination process as detailed in section **1.3 Final Closure**. The dismantling and decontamination of the LAB process equipment will be aided by forklifts, cranes, and other articulating lifts. Dismantled and cleaned equipment will not be removed from the closed facility until decontamination has been completed on all spaces except water treatment. Large LAB equipment, such as the separation tanks, desulfurization vessels, digestion tank, and refining/alloying kettles will be left on their support foundations and structural supports until they are sold.

The process fugitive bag house will be dismantled and placed in a covered hazardous waste container, and sent to a hazardous waste facility.



# AQUAMETALS (TRIC FACILITY) CLEAN CLOSURE PLAN

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## 1.2.3 Types of Off-site Waste Management Units to be Used

During closure, four different types of management units may be used to dispose of waste from the closure of Aqua Metals Reno. These include:

- municipal waste disposal landfills
- industrial waste landfills
- wastewater treatment facilities
- hazardous waste treatment, storage, and disposal facilities.

Typical municipal wastes generated from office activities will be disposed in a municipal landfill. These wastes will be collected for disposal by a commercial waste collection company contracted by Aqua Metals Reno.

Industrial waste will be characterized; waste that is not a hazardous waste will be disposed of in an industrial landfill designed for that purpose.

Wastewater will be treated to meet the Tahoe Reno Industrial General Improvement District (TRIGID) sewage discharge requirements and discharged. For any wastewater that falls outside the requirements, it will be transported to an appropriate facility for additional treatment and discharge.

Hazardous wastes will be characterized and a profile sheet will be completed prior to being transported to an appropriately licensed facility for management and disposal.

### 1.2.4 Description of Building

Aqua Metals Reno facility consists of one 138,000 square foot building, divided into the LAB processing area, office space, a testing laboratory, and employee wash facilities. The LAB processing area will be designed to eliminate contamination of non-LAB processing areas through both engineering and administrative controls, such as negative pressure, sealed HVAC units, a wet acid negative pressure scrubber on the battery breaking equipment, and standard operating procedures.

The LAB processing areas are designed to eliminate release of hazardous materials to the air, water, and soil. This is accomplished through sealed sumps and floor trenches that direct liquids to the water treatment area, bunds, and sealed floors. Additionally, fugitive emissions are filtered thru a fugitive emission bag house.

Exterior LAB processing support structures consist of the baghouse and 2 MSA holding tanks. Both items have been designed and installed per federal and state regulatory requirements.

### 1.2.5 Health and Safety During Closure Activities

Management practices at Aqua Metals Reno will be implemented to ensure procedures for the protection of worker health and safety are followed by those involved in closure activities. For the purpose of this Closure Plan, the levels of worker protection are defined as follows:

- Level C
  - Air purifying respirator and cartridges
  - Steel-toed boots
  - Boot covers
  - Protective coveralls
  - Chemically resistant gloves
  - Eye protection
  - Hard hat

### 1.3 Final Closure

In accordance with 40 CFR Parts 264.111 and 264.112, the steps for final closure have been identified. The general steps to be undertaken during final closure of Aqua Metals Reno include:

- Update the Closure Plan, as necessary.
- Notify NDEP of intent to close.
- Stop receiving and processing of LABs.
- Complete all in process lead recycling activities.
- Complete processing of all waste water within the closed system, properly dispose of hazardous waste sludge, and discharge properly cleaned, as required in the TRIGID waste water permit, waste water.
- Properly dispose of hazardous and universal wastes.
- Decontaminate LAB process equipment and interior surfaces.
- Dismantle emptied LAB process equipment.
- Process generated waste water through waste water treatment area, properly dispose of hazardous waste sludge, and discharge properly cleaned, as required in the TRIGID waste water permit, waste water.
- Encapsulate, dismantle, and properly dispose of baghouse.
- Execute sampling plan, and repeat decontamination and waste water treatment, and sampling as necessary.
- Decontaminate waste water system.
- Execute sampling plan.
- Properly dispose of hazardous waste.
- Discharge waste water per permit or transport offsite for proper disposal.
- Remarket or properly dispose of excess process chemicals.
- Sell LAB process equipment for reuse or recycling.
- Clean laboratory, locker rooms, and maintenance shop.
- Execute sampling plan.
- Sample exterior soils.

### 1.3.1 Notification of Closure

In accordance with 40 CFR 264.112, at least 45 days before initiation of closure activities, Aqua Metals Reno will notify the required regulatory agencies and will begin closure activities on a date specified in the notice. The notice will include a revised Closure Plan and a detailed schedule identifying the time frame for clean closing.

### 1.3.2 Start of Closure

In accordance with 40 CFR 264.112, closure of the facility will begin on the closure date specified in the notification letter to the NDEP. The first steps in closure of the facility will be to stop accepting LABs for recycling. Non-essential equipment and empty office and storage areas may be partially closed while all in process LAB recycling is completed.

## 1.4 Decontamination

All LAB process equipment will be emptied prior to decontamination commencing. As LAB process area decontamination is completed, interior surface decontamination will also occur, with the emptying, decontamination and dismantling of the waste water treatment area and interior surfaces occurring last.

The decontamination for all LAB process and interior surface areas will follow these general steps:

- Removal of liquids.
- Flush interior surfaces and pathways with a steam pressure sprayer.
- Clean interior and outer surfaces on and around the LAB process area with detergent.
- Dismantle LAB process equipment.
- Wipe test interior and exterior surfaces.
- Clean and re-test interior and exterior surfaces, as necessary.
- Properly dispose of generated wastes.

The process for decontamination of the baghouse will follow these general steps:

- Clear the baghouse of all hazardous materials.
- Allow to cool.
- Dismantle the system. Isolate each component.
- Remove and properly dispose of baghouse residues and bags.

#### 1.4.1 Disposal of Decontamination Equipment and Clothing

Decontamination equipment will be properly cleaned or may be considered hazardous waste and transported for appropriate disposal.

Contaminating clothing, gloves, coveralls, etc., generated during closure will be considered to be hazardous waste and will be transported to an appropriate disposal landfill.

#### 1.4.2 Soil Sampling of Exterior

Pre-operational exterior soil sampling was conducted in June 2016 by a third party Environmental Engineering and Science firm. Post closure exterior soil sampling will be conducted after interior decontamination has been completed. Soil sampling will consist of:

- The collection of eight to ten five-point composite surface soil samples for laboratory analytical testing.
- The final sample locations will be chosen in the field, with emphasis on spatial distribution and potential contaminant transport biasing.
- The locations of each of the five sample points per composite sample will be surveyed using a Trimble GPS, or similar device.
- The samples will be delivered under chain-of-custody protocol to a Nevada-certified analytical laboratory.
- The samples will be analyzed for metals concentration analysis using IPC scanning methodology.
- Analytical results will be evaluated and compared to risk screening levels.
- The investigation and test results will be documented.
- Sampling results will be submitted to NDEP.



# AQUAMETALS (TRIC FACILITY) CLEAN CLOSURE PLAN

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## 1.4.3 Sampling and Analysis

LABs are the sole hazardous waste accepted and processed at Aqua Metals Reno. Process chemicals and the resultant byproducts are detailed in section 3 - **Explanation of Recycling** of the Written Determination. A detailed closure sampling plan will be submitted to NDEP for review prior to the start of closure activities. The closure sampling plan will reflect the conditions and processes at Aqua Metals Reno at the time of closure.

**Table 1 - Sampling Program for Closure Cost Estimation**

<b>Sample Type</b>	<b>Area</b>
Wipe Samples (lead contamination)	
	Receiving
	Battery Breaking and Separation
	Desulfurization
	Digestion
	Aqua Refining
	Kettles, Refining and Alloying
	Finished Goods
	Water Treatment
	Water Treatment Chemical Storage





# AQUAMETALS (TRIC FACILITY) CLEAN CLOSURE PLAN

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## 1.6 Clean Closure Financial Review

\$397,900	Decontamination of all equipment, tanks, lines, floor drains, sumps, and interior building. <i>(See Table 3 for a cost breakdown and Attachment 1 Clean Harbor Quote #2435416)</i>
\$50,000	Non-hazardous material disposal. (packing materials, trash, plant consumables, furniture, non-permanent fixtures) <i>(See Table 4 for a cost estimation breakdown)</i>
\$100,000	Hazardous material disposal (Process Bag house(s), filter media, HEPA filters, non-cleanable hazardous structures) <i>(See Table 4 for a cost estimation breakdown)</i>
\$5,000	Soil testing (NDEP submittal)
\$30,000	Environmental oversight of the specialized cleaning and decontamination activities. <i>(See Table 5 for a cost breakdown and Attachment 2 McGinley &amp; Associates Quote)</i>
\$87,435	(15%) Contingency
<b>\$670,335</b>	<b>Estimated clean closure cost</b>

**Table 3: Clean Harbors Decontamination Cost Estimate Breakdown**

Specialized Cleaning Tasks	Number of Units	Unit Cost	Cost
Clean Chemical Storage Tanks and Associated Lines	14 Tanks	\$3,900.00	\$54,600.00
Clean Waste Water Treatment Tanks	5 Tanks	\$2,900.00	\$14,500.00
Clean Floor Drains/Sumps			
Clean Floor Sumps	8 Sumps	\$2,400.00	\$19,200.00
Clean Battery Breaking Unit	1 Unit	\$26,000.00	\$26,000.00
Clean Filter Press	5 Presses	\$3,500.00	\$17,500.00
Clean Aqua Refining Equipment	96 Units	\$1,000.00	\$96,000.00
Clean Kettles	2 Kettles	\$8,000.00	\$16,000.00
Clean Casting Unit	1 Unit	\$4,500.00	\$4,500.00



# AQUAMETALS (TRIC FACILITY) CLEAN CLOSURE PLAN

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Specialized Cleaning Tasks	Number of Units	Unit Cost	Cost
Clean Baghouse and HEPA Filtration Unit	2 Units	\$5,000.00	\$10,000.00
Clean Interior of Building	1 Building	\$91,600.00	\$91,600.00
Waste Disposal and Transportation (wash water)	40,000 Gallons	\$1.00 per gallon	\$40,000.00
<b>Grand Total</b>			<b>\$397,900.00</b>

**Table 4: Non-Hazardous and Hazardous Material Estimate Details**

<b>Non-Hazardous Waste</b>	
Clean Harbors pricing per 20 cubic yard roll-off, costs are as follows:	
Transport to Clive, Utah Clean Harbors disposal facility	\$2,400.00
\$50 per cubic yard of non-hazardous materials	\$1,000.00
<b>Total:</b>	<b>\$3,400.00</b>
We anticipate 8 - 12 roll-off container shipments at a cost of \$27,200 – \$40,800	
<b>Hazardous Waste</b>	
Clean Harbors pricing per 20 cubic yard roll-off, costs are as follows:	
Transport to Clive, Utah Clean Harbors disposal facility	\$2,400.00
\$350-375 per ton of lead waste, ~28 tons per roll off	\$10,500.00
<b>Total:</b>	<b>\$12,900.00</b>
We anticipate 5 - 7 roll-off container shipments at a cost of \$64,500 – \$90,300	



# AQUAMETALS (TRIC FACILITY) CLEAN CLOSURE PLAN

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**Table 5: Costs for Environmental Oversight of Specialized Cleaning and Decontamination**

Description of Work	Unit Rate	Quantity	Total
<b>Project Coordination</b>			
Project Manager (Licensed Lead Risk Assessor)	\$130.00	10	\$1,300.00
Senior Staff Scientist	\$110.00	10	\$1,100.00
Mileage	\$0.540	300	\$162.00
<b>Subtotal:</b>			<b>\$2,562.00</b>
<b>Limited Oversight and Final Clearance Testing</b>			
Project Manager (Licensed Lead Risk Assessor)	\$130.00	40	\$5,200.00
Senior Staff Scientist	\$110.00	40	\$4,400.00
Mileage	\$0.540	300	\$162.00
<b>Subtotal:</b>			<b>\$9,762.00</b>
<b>Wipe Sample Analysis</b>			
21 Metals Profile (Wipe Sample)	\$184.00	40	\$7,360.00
Inorganic Acid Profile (Wipe Sample)	\$201.25	35	\$7,043.75
<b>Subtotal:</b>			<b>\$14,403.75</b>
<b>Preparation of Report</b>			
Principal	\$170.00	2	\$340.00
Project Manager (Licensed Lead Risk Assessor)	\$130.00	16	\$2,080.00
CAD/GIS	\$85.00	9	\$765.00
Administration	\$60.00	2	\$120.00
<b>Subtotal:</b>			<b>\$3,305.00</b>
<b>Estimated Total Cost:</b>			<b>\$30,032.75</b>



# AQUAMETALS (TRIC FACILITY) CLEAN CLOSURE PLAN

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## Attachment 1 Clean Harbor Quote #2435416



Clean Harbors Environmental Services, Inc.  
191 Coney Island Drive  
Sparks, NV 89431  
www.cleanharbors.com

June 15, 2016

Attn: Ms. Stephanie Rucks  
Aqua Metals  
2500 Peru Dr  
McCarran, NV 89434

Quote #2435416

Dear Ms. Rucks:

Thank you for considering Clean Harbors Environmental Services, Inc. for your environmental service needs. We provide a broad range of environmental services including hazardous and non-hazardous waste transportation and disposal, laboratory chemical packing, emergency response, field services and industrial maintenance. We are pleased to provide this proposal based on the scope of work outlined below.

We offer our clients a broad spectrum of environmental services and the ability to dispose of hazardous material at or through a Clean Harbors' owned and operated facility. In addition to managing your waste streams, a Clean Harbors' professional can assist you with:

- Waste Transportation & Disposal
- Laboratory Chemical Packing
- Field Services
- 24-Hour Environmental Emergency Response
- Industrial Services
- InSite Services

I look forward to servicing your environmental needs. When you are ready to place an order, please contact our Customer Service group at 800.444.4244. If you have any questions or need further assistance, you may reach me at the number below.

Sincerely,

Corey R Harbart  
Technical Services Account Manager  
Phone: 775.331.9400



### QUOTE CONDITIONS

The proposal is based on the following assumptions and site conditions. Any work which falls outside of the assumptions will constitute work beyond the intended scope and be completed upon mutually satisfactory terms.

\*\*\*The future estimated cleanup cost includes everything needed to decontaminate all equipment, tanks, lines, floor drains, sumps and interior building surfaces. This estimate is based on three project that Clean Harbors Nevada has successfully performed in the past 3 years.

\*\*\*This estimate includes all employee blood testing for lead before and after the cleanup.

\*\*\*The estimate is based on 40,000 gallons of wash water for disposal. (water from tanks, lines, sumps, drains, and interior surfaces)

Future Estimated Cleanup Cost: \$397,900 (See Table 1)

Table 1: Cost Estimate Breakdown			
Specialized Cleaning Tasks	# of Units	Unit Cost	Cost
Clean Chemical Storage Tanks and Associated Lines	14 Tanks	\$3,900.00	\$54,600.00
Clean Waste Water Treatment Tanks	5 Tanks	\$2,900.00	\$14,500.00
Clean Floor Drains/Sumps	8 Trench Drains	\$1,000.00	\$8,000.00
Clean Floor Sumps	8 Sumps	\$2,400.00	\$19,200.00
Clean Battery Breaking Unit	1 Unit	\$26,000.00	\$26,000.00
Clean Filter Press	5 Presses	\$3,500.00	\$17,500.00
Clean Aqua Refining Equipment	96 Units	\$1,000.00	\$96,000.00
Clean Kettles	2 Kettles	\$8,000.00	\$16,000.00
Clean Casting Unit	1 Unit	\$4,500.00	\$4,500.00
Clean Baghouse and HEPA Filtration Unit	2 Units	\$5,000.00	\$10,000.00
Clean Interior of Building	1 Building	\$91,600.00	\$91,600.00
Waste Disposal and Transportation (wash water)	40,000 Gallons	\$1.00 per gallon	\$40,000.00
Grand Total			\$397,900



**AQUA METALS PLANT DECON (FUTURE ESTIMATE IF NEEDED)**

Description	UOM	Price
Equipment Operator	hour	\$64.00
Equipment Operator, Overtime	hour	\$96.00
Field Technician	hour	\$50.00
Field Technician Overtime	hour	\$75.00
Foreman	hour	\$65.00
Foreman Overtime	hour	\$97.50
Site Safety Officer	hour	\$124.00
Site Safety Officer, Overtime	hour	\$186.00
15 Gal HEPA Vacuum	day	\$177.00
3000psi Hot Water Pressure Washer	day	\$387.00
4 Gas/5 Gas Meter	day	\$183.00
Air Compressor 175-185 CFM	day	\$280.00
Bobcat Loader/Mini Excavator	hour	\$80.00
Confined Space Entry Gear (Retrieval & Rescue Equip)	day	\$375.00
High Pressure Blaster - 10,000 PSI 300 HP (50 GPM)	hour	\$73.00
Hose - Chemical, 2 in X 20 ft	day	\$38.00
Level C w/CPF1,2 or Polytyvec/Changeout	each	\$62.00
Manlift	day	\$258.00
Modified Level D (Tyvec, Gloves and Boots)	each	\$31.00
Pickup/Van/Car/Crew Cab	day	\$167.00
Self Contained Breathing Apparatus (SCBA)	day	\$270.00
Stake Body/Utility Truck	day	\$204.00
Tractor w/Vacuum Trailer	hour	\$87.00
Wet/Dry High Powered Vacuum Truck/Guzzler	hour	\$123.00
20,000 Gal Frac Tank	day	\$167.00
Lead Blood Test (per person)	each	\$120.00
Poly Sheet, 6mil 20ft x 100ft	each	\$118.00
Shrink Wrap	roll	\$49.00
Site Specific Health and Safety Plan	each	\$209.00
Speedi Dry	bag	\$12.36



## GENERAL CONDITIONS

- Except where superseded by an existing services agreement the following terms and conditions apply to this quoted business.
- The customer hereby acknowledges that the estimated cost is based upon a preliminary appraisal by a Clean Harbors Field Representative, and that the amount invoiced by Clean Harbors will be based upon labor and materials actually expended in performing the scope of work. Any changes in the scope will be billed on a time and materials basis.
- Clean Harbors guarantees to hold these prices firm for 60 days.
- Terms: Net 30 Days
- For work to begin we ask that you acknowledge the quotation with a signature and provide the appropriate purchase order number. Where modifications to the scope of services become necessary, Clean Harbors will notify the customer promptly and obtain customer authorization for such modifications and a revised contract price will be established in order to finish the project.
- This proposal is contingent on the customer providing full and complete access to the site. Customer represents and warrants to Clean Harbors that the customer has the legal right, title and interest necessary to provide access to the site. In addition, customer warrants that it has supplied Clean Harbors complete and accurate information regarding the site, subsurface conditions, utility locations, site ownership, hazardous materials or wastes and other substances or hazards likely to be present and any other reports, documentation or information concerning the scope of work.
- Interest will be charged at 1.5% per month or the maximum allowed by law for all past due amounts.
- Disposal will be managed within the Clean Harbors Network of Approved Facilities.
- Local, state and federal fees/taxes applying to the generating location/receiving facilities are not included in disposal pricing and will be added to each invoice as applicable.
- Materials subject to additional charges if they do not conform to the listed specifications.
- Electronically submitted profiles will be approved at no charge. Paper profiles will be charged at \$75.00 each.
- Clean Harbors supports many invoice delivery options (E-mail, Electronic Invoicing, EDI, Etc.). Pricing is based on Clean Harbors' standard invoice delivery method of E-mail. If another delivery method is required there could be an additional service fee per invoice. Any alternate delivery methods must be reviewed and approved by Clean Harbors prior to acceptance and implementation.
- A variable Recovery Fee (that fluctuates with the DOE national average diesel price), currently at 9.0%, will be applied to the total invoice. For more information regarding our recovery fee calculation please go to: [www.cleanharbors.com/recoveryfee](http://www.cleanharbors.com/recoveryfee).
- Pickups that require same day or next day service may be subject to additional charges.
- Pickups cancelled within 72 hours of scheduling will be subject to cancellation charges.
- Transportation charges to the final disposal facility will be charged in addition to local transportation to our truck to truck hub/local facility and will vary with logistics and routing.



**GENERAL CONDITIONS**

- Time over eight (8) hours in the normal workday and all day Saturday is considered overtime and will be billed at 1.5 times the applicable straight time rate for all billable personnel unless otherwise quoted. Sunday and Holidays are considered premium time and will be billed at 2.0 times the applicable straight time rate for all billable personnel unless otherwise quoted.
- This proposal is submitted contingent upon the right to negotiate mutually acceptable contract terms and conditions, which are reflective of the work contemplated, and an equitable distribution of the risks involved therein. In the event that such agreement cannot be reached, Clean Harbors reserves the right to decline to enter into such an agreement without prejudice or penalty.
- In the event that legal or other action is required to collect unpaid invoice balances, Customer agrees to pay all costs of collection, including reasonable attorneys' fees, and agrees to the jurisdiction of the Commonwealth of Massachusetts.

**ACKNOWLEDGEMENT**

Your signature below indicates your acceptance of the pricing and terms detailed in the quote above.

Thank you for the opportunity to be of service.

---

Signature

PO#

Date

---

Print Name

Quote # 2435416



# AQUAMETALS (TRIC FACILITY) CLEAN CLOSURE PLAN

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7/12/16

## Attachment 2 McGinley & Associates Quote

June 17, 2016

Aqua Metals, Inc.  
1010 Atlantic Avenue  
Alameda, CA 94501

**ATTN:** Mr. Selwyn Mould, Chief Operating Officer

**VIA EMAIL:** [Selwyn.Mould@aquametals.com](mailto:Selwyn.Mould@aquametals.com)

**RE: COST ESTIMATE TO PROVIDE ENVIRONMENTAL CONSULTING SERVICES, AQUA METALS, INC, 2500 PERU DRIVE, MCCARRAN, NEVADA**

Mr. Mould:

Per your request, McGinley & Associates, Inc. (MGA) is pleased to submit this proposal to provide environmental consulting services at the above-referenced site. Specifically, MGA proposes to provide environmental oversight for the specialized cleaning of the Aqua Metals battery recycling facility located in McCarran, Nevada at the time the facility is closed. Our proposed scope of services and cost estimate are provided in the following sections.

## **1. SCOPE OF SERVICES**

The proposed scope of environmental services to be provided includes:

- Nevada Certified Environmental Manager (CEM) oversight during specialized cleaning of equipment, interior building surfaces, tanks, sumps, and floor drains
  - cleaning services to be provided by specialized cleaning contractor whose fees are not included in this proposal
- Surface wipe sample collection of areas to be cleaned prior to cleaning and following completion of cleaning
- submittal of collected samples to a State of Nevada certified laboratory
  - all analytical fees are included in this proposal
- preparation of a comprehensive report discussing cleaning activities, wipe sample collection, and analytical results

### **1.1 CEM Oversight**

During specialized cleaning, limited CEM oversight will be provided as needed. Oversight will include discussions with surface remediation staff and recommendations will be provided if warranted.

### **1.2 Surface Wipe Sampling**

Prior to and following cleaning activities, wipe samples will be collected as needed under the direction of a Nevada CEM. The purpose of the wipe samples collected prior to cleaning is to

gather baseline data as well as to assist in the implementation of the cleaning activities. Confirmation wipe sampling will be performed following cleaning activities to ensure the facility has been cleaned to the required standards. Wipe sampling will be conducted for all contaminants of concern (COC). All samples will be submitted under proper chain of custody protocol to a State of Nevada certified analytical laboratory.

### 1.3 Preparation of Final Report

After all samples have been submitted and analyzed, a comprehensive report will be prepared. At a minimum, the following will be discussed in the report:

- Summary of work performed;
- Summary of observations made during the project;
- Sampling protocol and analytical methods used;
- Sample analytical results; and
- Conclusions and recommendations, if warranted.

## 2. COST ESTIMATE

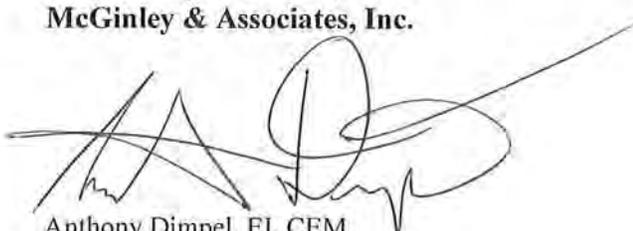
Our estimated fees for the services discussed herein are \$30,032.75 (see Table 1). All work will be performed on a time and materials basis and billed according to the MGA's fee schedule at the time the work is performed.

Any alteration or deviation from the above specifications involving extra cost of labor will only be executed upon written orders for same, and will become an extra charge over the sum mentioned in this contract.

## 3. CLOSING

We appreciate the opportunity to submit this proposal and look forward to working with you on this project. Should you have any questions please feel free to contact me at (775) 829-2245.

Respectfully Submitted,  
**McGinley & Associates, Inc.**



Anthony Dimpel, EI, CEM  
Project Manager

## Table 1: Estimated Cost for Environmental Consulting Services

Aqua Metals, 2500 Peru Drive, McCarran, NV

Description of Work	Unit Rate	Quantity	Total
<b>Project Coordination</b>			
Project Manager (Licensed Lead Risk Assessor)	\$130.00	10	\$1,300.00
Senior Staff Scientist	\$110.00	10	\$1,100.00
Mileage	\$0.540	300	\$162.00
<b>Subtotal:</b>			<b>\$2,562.00</b>
<b>Limited Oversight and Final Clearance Testing</b>			
Project Manager (Licensed Lead Risk Assessor)	\$130.00	40	\$5,200.00
Senior Staff Scientist	\$110.00	40	\$4,400.00
Mileage	\$0.540	300	\$162.00
<b>Subtotal:</b>			<b>\$9,762.00</b>
<b>Wipe Sample Analysis</b>			
21 Metals Profile (Wipe Sample)	\$184.00	40	\$7,360.00
Inorganic Acid Profile (Wipe Sample)	\$201.25	35	\$7,043.75
<b>Subtotal:</b>			<b>\$14,403.75</b>
<b>Preparation of Report</b>			
Principal	\$170.00	2	\$340.00
Project Manager (Licensed Lead Risk Assessor)	\$130.00	16	\$2,080.00
CAD/GIS	\$85.00	9	\$765.00
Administration	\$60.00	2	\$120.00
<b>Subtotal:</b>			<b>\$3,305.00</b>
<b>Estimated Total Cost:</b>			<b>\$30,032.75</b>

# APPENDIX M Financial Assurance