

# BIGHORN pump series

## Installation & Maintenance Manual



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## 1. BEFORE STARTING

**PLEASE READ THIS GUIDE ENTIRELY BEFORE BEGINNING INSTALLATION  
ALSO, READ SUPPLEMENTAL INFORMATION RELATING  
TO OPTIONAL CONTROL EQUIPMENT**

### 1.1 CRANKCASE OIL PLUG

The pump module crankcase vent has been plugged to prevent accidental oil leakage during shipment. Remove the plug and replace with the supplied vent cap before operating pump unit. Failure to do so will cause oil leaks.

### 1.2 OIL LEVEL

Check that the oil level appears 1/2 way in the sight gauge or within range on the dipstick in the pump head.

### 1.3 INLET WATER SUPPLY PRESSURE.

When the pump module is running, it must be supplied with an inlet water supply of NEVER LESS THAN 20 P.S.I. (1.40 BAR) and NEVER MORE THAN 90 P.S.I. (6.20 BAR)

- Inlet water supply pressure should be steady and should not be allowed to fluctuate outside of these ranges. Failure to do so can result in damage to equipment and is not covered by warranty.
- IF WATER PRESSURE DROPS BELOW 20 PSI, THE PUMP WILL SHUT OFF AND THE FAULT LIGHT WILL COME ON. SEE SECTION 9 **SYSTEM OPERATION** FOR FUTURE INFORMATION.

### 1.4 OIL CHANGE INTERVAL

The crankcase oil must be changed after the first **50 hours** of operation and from then on, once every 500 hours or every 6 months, whichever comes first.

- ISO-68 HYDRAULIC MINERAL OIL is recommended for all applications
- Secondary choice SAE-20 CRANKCASE MINERAL OIL may be used for all applications

### 1.5 HIGH PRESSURE FITTINGS

The system operates at 1,000 P.S.I. (70 bar) and should always be shut down when working on fittings or manifold line. When adjusting the orientation of the nozzles, follow the procedures. Extreme caution should always be exercised when working with high pressure water. Always wear safety glasses when working around fog equipment.

### 1.6 INLET WATER SUPPLY PLUMBING MATERIAL

Only rated and approved brass fittings or stainless steel fittings should be used to make plumbing connections. The use of **galvanized or steel pipe fittings** can cause system failure, nozzle blockage and pump damage.

### 1.7 FLUSHING THE SYSTEM

Before pressurizing the system, flush all plumbing and atomization lines thoroughly to purge any residual debris. Please refer to the startup section 7 of this manual.

### 1.8 TEFLON TAPE

When using Teflon tape on NPT threads, leave 1 or 2 of the starting threads showing. This will prevent pieces of Teflon tape from entering the system, which could cause blockage or damage.

# WATER QUALITY

## **2. WATER QUALITY**

To obtain the best performance, special consideration should be given to the quality of water used in a MicroCool fog system.

MicroCool® IS NOT RESPONSIBLE FOR NOZZLE BLOCKAGE DUE TO POOR WATER QUALITY.

### **2.1 TOTALLY DISSOLVED SOLIDS COUNT**

Water with total dissolved solids (TDS) counts of greater than 500 parts per million (PPM); water with high calcium and magnesium carbonate levels, or water with pH levels below 6.5 and above 7.5 may not be satisfactory and could lead to excessive nozzle blockage and nozzle maintenance.

### **2.2 WATER ANALYSIS**

If there is any doubt about water quality, a water analysis is recommended. Of major interest is the water's Langelier Saturation Index (LSI) together with other items such as hardness and TDS. A slightly negative, or neutral, Langelier index is preferred, whereas a positive index may indicate a tendency to form calcium carbonate deposits in the lines and nozzles. If using city water, an analysis should be available from the city/town water department. If in any doubt, please contact your MicroCool representative for further information.

### **2.3 WATER TREATMENT**

Generally speaking most municipal water is suitable for atomization. Well water, river water and the like should be tested before atomizing. If an analysis indicates any unusually high levels of undesirable elements proper treatments are available. MicroCool® can supply a variety of water treatment systems. Please contact MicroCool® for further details.

### **2.4 ULTRAVIOLET WATER PURIFIERS (OPTIONAL)**

Optional ULTRAVIOLET high intensity light purifiers can also be installed on the inlet water supply to sterilize the system water. By bombarding the water with UV light, dangerous pathogens, spores and germs are destroyed. UV systems must be regularly serviced to maintain the correct high intensity output.

### **2.5 REVERSE OSMOSIS WATER TREATMENT (OPTIONAL)**

MicroCool offers optional comprehensive reverse osmosis packages for all applications. Units are available for large scale industrial as well as domestic installations.

Reverse Osmosis units incorporate a semi-permeable membrane that micro filters the water to 0.0001 microns removing bacteria, viruses, aqueous salts and metal ions. By eliminating these from the supply water, MicroCool ensures that clean, hygienic water is used in each system. Clean water will also reduce nozzle blockage, foul smelling water and white "chalky" deposits on material close to the fog spray.

MicroCool reverse osmosis systems are designed specifically for each application – please consult with MicroCool specialists for more details.

### **3. INSTALLATION OF THE PUMP MODULE**

#### **3.1 PRE-INSTALLATION PROCEDURE**

- Determine pump module location
- Identify water supply/connection for the system
- Determine routing of the high pressure manifold from the pump.
- Establish drainage location from the pump.
- Verify correct electrical power supply to the pump.
- Determine all of the above for optional Equipment - Sectioning Controllers, Temperature/Humidity Controllers, Reverse Osmosis, UV sterilizers, etc...

#### **3.2 POSITIONING THE PUMP MODULE**

The pump module requires a flat, level surface. Position selection will largely depend on the availability of power and water, but remember the points outlined on the previous pages as the terms of the pump warranty depend on it.

A concrete floor or a concrete slab is ideal. Using a level, ensure that the BIGHORN unit sits as level and plumb as possible.

#### **3.3 WATER SUPPLY AND CONNECTION**

The water supply should be capable of **1.5 times** the maximum flow of the pump as shown in the table below.

Pump Model & Flow	Minimum Flow Rate USGPM	MIN Flow Rate (LPM)	MIN Pressure psi / bars
BIGHORN 1000	1.50	6.00	20 / 1.40
BIGHORN 2000	3.00	12.00	20 / 1.40

Correct water pressure and supply rate are essential to pump operation. All pump modules require a minimum of 20 P.S.I. (1.40 BAR) and a maximum of 90 P.S.I. (6.20 BAR) while in operation. The pressure should always be constant and not fluctuate outside these ranges, especially on system start up. All pump modules are equipped with an inlet water fault delay timer that tolerates small drops in pressure, but will ultimately “fault off” if low pressure is present for more than a few seconds.

Ensure that either rubber hose, copper or PVC pipe is used to provide the correct water supply to the BIGHORN unit. Never use steel or galvanized steel fittings. Always use the largest diameter pipe possible.

The inlet hose connection is 3/8” Female NPT Thread  
The outlet hose connection is 1/4” Male thread NPT

Use care and do not over tighten.

#### **3.4 INLET WATER HOSE**

MicroCool can supply an inlet hose connection kit for your BIGHORN pump – call your MicroCool specialist and ask for item number IHK0001.

#### **3.5 PUMP DRAINAGE**

After the pump module shuts down, the water remaining in the manifold lines will drain out through the pump module and the end of the atomization lines. Ensure that the drain outlet is routed to a suitable drainage point to avoid flooding. A 6 foot (1.8 M) low pressure drain hose is provided from the drain solenoid. This hose can be extended as necessary.



## 4. PUMP MODULE POWER SUPPLY

After all water and plumbing connections have been completed, a licensed, qualified electrician should connect the power supply to the pump. It is important to follow the National Electrical Code (NEC), as well as any local codes to ensure a safe installation.

### 4.1 ELECTRICAL SPECIFICATION

Establish that the circuit to be used to power the pump module is of the same electrical specification as the pump module. The BIGHORN electrical specification can be found on the serial number data plate on the pump module (inside the pump control box).

### 4.2 ELECTRICAL CIRCUIT

The circuit to the pump module must be dedicated and properly sized to carry the electrical load placed upon it by the pump motor. Please refer to the serial number data plate on the pump module for more details.

### 4.3 ELECTRICAL POWER SUPPLY

The power supply to the pump module must be hard wired to a correctly rated fuse protected circuit complying with NEC guidelines. **NOTE:** This pump unit has a frequency inverter. If local electrical code requires a GFCI (Ground Fault Circuit Interrupter), this pump will require a special GFCI unit. Please contact MicroCool for details.

### 4.4 TERMINAL STRIP - POWER

After verifying all of the above, power should be on to the terminal strip located inside the NEMA 3R electrical enclosure mounted on the pump module. We recommended that the correct sized wiring be in conduit (preferably liquid tight); make the final connection to the high voltage terminal strip.

### 4.5 ELECTRICAL CONNECTIONS- LOW VOLTAGE

**NOTE:** All control wiring such as remote start must be SHIELDED cable of suitable size, for this application.



Enclosure

- a. Resets VFD Drive
- b. Open to Disable Manual ON/OFF

## 5. BIGHORN – VFD BASICS

- The VFD (Variable Frequency Drive) controls the speed of the electrical motor (and subsequently the pump head) by changing the Frequency (Hertz).
- The VFD is shipped with a minimum factory setting of 30 Hz. This will produce the minimum speed at which the pump is still capable of adequate oil distribution within the crankcase. This minimum setting will ensure reduced motor and pump wear.
- The VFD is factory set at a maximum of 60 Hz. This will produce the maximum designed water flow of the pump at 1000 psi / 70 Bar.
- For more details on the VFD drive, the readings and fault status refer to the WEG Drive supplement which is enclosed.

## 6. MICROCOOL BIGHORN - STARTING THE SYSTEM

### 6.1 SYSTEM FLUSH

The system must be flushed before pressurization. This removes any contaminants such as dirt, brass filings or Teflon tape that have found their way into the system. At the end of each atomization line, there is a plug or an automatic drain valve. **Do not** install plugs or automatic drain valves until the system has been completely flushed.

### 6.2 WATER & DRAIN VALVES

Turn on the water supply to the pump module. Ensure that the drain valves or plugs at the end of lines are not installed.

### 6.3 TURN ON POWER



Switch to Manual 'MAN' Position

1. Turn on the power supply to the BIGHORN module, and then turn the circuit breaker switch mounted inside the electrical enclosure to the on position. Ensure the VFD reads "RDY".
2. To start the pump, switch the "MAN/OFF/AUTO" switch to the MAN position.

### 6.4 PUMP IS RUNNING

The pump system is now in operation. The VFD will increase the speed of the motor / pump to maximum speed (60 Hz) to fill the manifold and nozzle lines.

## 6.5 LOW WATER PRESSURE

If the inlet water pressure gauge drops below 20 P.S.I. (1.4 BAR) (or out of the green zone) when the pump starts, the pump will go into fault mode and will not start.

There must be between 20 PSI (1.4 BAR) and 90 PSI (6.2 BAR) of pressure available to the pump at all times  
**NOTE:** should the water pressure drop below the factory preset of 20 psi, the system goes to E06 “FAULT”. The system will automatically try to restart after a 30 second delay. If the water pressure has been restored, the system will continue running normally.

The BIGHORN pump incorporates a delay timer on the water pressure switch that allows the system to run for a few seconds before going to alarm.

If the water pressure has not been restored, the system will attempt to start a further two times at 30 second intervals. If the water pressure has still not been restored, the system will remain in fault and will need to be manually reset.

To reset the unit; turn the MAN/OFF/AUTO switch to the “OFF” position and press the “Red/Green Button” on the VFD panel one time and release. The system is now reset.

The setting on the water pressure-sensing switch is factory preset at 20 PSI / 1.4 Bar and does not require any further adjustment.

## 6.6 SYSTEM RUN

Let the module run for five minutes making sure that there is a good flow of water running out the end of each atomization line. Lines may have to be flushed in groups with a large system. The system is now ready for pressurization.

# 7. PRESSURIZING THE SYSTEM

Safety glasses must be worn when adjusting pressure. Always keep guards and covers in place.

## 7.1 INSTALL DRAIN VALVES

Install the automatic drain valves, or plugs, into the open ends of the atomization lines. Use Teflon tape on NPT threads and tighten each fitting firmly. Do not apply tape to compression fittings.

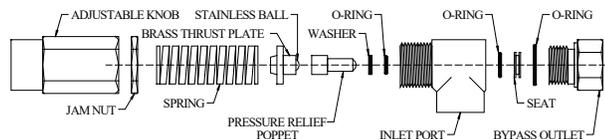
## 7.2 MAN/OFF/AUTO SWITCH

Select the MAN (ON) position on the main switch. Select AUTO if using external controllers or switches. The VFD will now adjust the speed of the motor / pump so that the system pressure is steady at 1,000 psi / 70 bar. Depending on the number of nozzles running in the system at any particular time,

## 7.3 PRESSURE REGULATOR

**DO NOT ADJUST THE PRESSURE REGULATOR.** The regulator is installed as a safety valve only and is factory set at 1200 psi / 84 Bar. Should the regulator be taken apart for any reason, the correct reassembly sequence is shown below.

**NEVER DISSASSEMBLE THE REGULATOR UNDER PRESSURE!**



If for any reason the regulator is adjusted, or changed, follow this procedure to reset the correct adjustment.

- 7.3.1 Turn off the electrical supply at the disconnect switch to electrically isolate the pump.
- 7.3.2 Locate the pressure transducer and unplug the electrical lead.
- 7.3.3 Restore the power and start the unit by selecting MAN (ON) position on the main switch.
- 7.3.4 Adjust the regulator by turning clockwise or counter-clockwise until the pressure gauge indicates 1,100 psi (75.8 Bar). When the pressure is steady at 1,100 make sure that the “Jam Nut” is tightened to lock the adjustment in position.
- 7.3.5 Select OFF on the main switch to turn the pump off, disconnect the electrical supply.
- 7.3.6 Plug electrical lead back into transducer, restore electrical power.

## 8. DRAIN VALVE SEQUENCE

### 8.1 SYSTEM ON/OFF

TURN THE MAN/OFF/AUTO switch to the OFF position. The BIGHORN pump now enters its preprogrammed drain sequence.

### 8.2 RAMP DOWN

The pump will electronically ramp down (slow to a stop) to avoid any water hammer. After a 3 second delay, the inlet solenoid valve will close and the drain solenoid will open. The system pressure is relieved. Excess water will drain out of the BIGHORN pump and the MicroCool nozzle system.

### 8.3 LOW SYSTEM SHOCK

This BIGHORN system, unique to the MicroCool pump range, is electronically activated to reduce system “shock” and alleviates potential water hammer in the system that can damage the pump and the nozzle system. This procedure is preprogrammed into the Variable Frequency Drive.

## 9. SYSTEM OPERATION

### 9.1 EXTERNAL CONTROLS

With external thermostats, humidity controllers or master control units correctly connected to the remote start terminals in the Electrical Enclosure (see diagram above), MAN/OFF/AUTO switch must be set in the AUTO\* position and the MicroCool BIGHORN pump will operate in full automatic mode.

\*If operating the BIGHORN pump in AUTO, the terminal/block switch inside the Electrical Enclosure should be opened, disabling the MANUAL switch.



External Controls: Disable Manual Switch

9.2 **TROUBLE SHOOTING CHART**

QUICK DIAGNOSTICS & TROUBLESHOOTING		
PROBLEM	POINTS TO CHECK	CORRECTIVE ACTION
Pump runs but does not build pressure	<ul style="list-style-type: none"> <li>leaks in lines</li> <li>pump speed</li> <li>ensure drain valve is closing</li> </ul>	<ul style="list-style-type: none"> <li>repair leaks</li> <li>repair or replace drain</li> </ul>
Pump switch is on but does not run, no error on VFD	<ul style="list-style-type: none"> <li>power on</li> <li>remote switch in on position</li> </ul>	<ul style="list-style-type: none"> <li>switch on power</li> <li>ensure remote switch &amp; pump switch are on</li> </ul>
Pump switch is on but does not run, error E06 on VFD	<ul style="list-style-type: none"> <li>water pressure</li> <li>thermal switch</li> <li>filter cartridge</li> </ul>	<ul style="list-style-type: none"> <li>restore water pressure to pump</li> <li>re-set thermal switch</li> <li>change filter cartridge</li> </ul>

If the pump still does not run, contact MicroCool® for further troubleshooting.

**10. SYSTEM MAINTENANCE**

**10.1 CRANKCASE OIL**

Initially the Crankcase Oil must be changed after the first 50 hours operation.  
After that it should be changed after every 500 hours of operation.

Crankcase Oil Capacity	
AR range	11 fl oz.
GIANT	11 fl oz.

Examples of 500 hours operation:

- 15 weeks of 5 hour operation per day
- 9 weeks of 8 hour operation per day
- 6 weeks of 12 hour operation per day
- 3 weeks of 24 hour operation per day



**10.2 TYPE OF CRANKCASE OIL**

ISO-68 HYDRAULIC MINERAL OIL IS RECCOMENDED FOR ALL APPLICATIONS  
*In the event that ISO-68 is not available, SAE-20 CRANKCASE MINERAL OIL may be substituted*

**10.3 ELECTRICAL MOTOR MAINTENANCE**

All motors have sealed rotor bearings and do not require lubrication.

**10.4 INLET WATER FILTER**

The inlet water filter, 5-micron cartridge, must be regularly inspected. The durability of the filter cartridge depends entirely upon the cleanliness of the inlet water. When the “outlet gauge” shows a significant drop in pressure during operation or in particular if the needle is in the red zone, it is time to change the filters. The filter cartridges should be changed at least once every year.



## 10.5 **ATOMIZATION HOSE AND MANIFOLD**

The hoses and lines should be periodically inspected for damage such as cuts and abrasions. Also check that the hoses have not come into contact with sharp edges or are vibrating against an abrasive surface.

## 10.6 **SYSTEM FLUSH – SHUT DOWN - WINTERIZING**

If the system is to be SHUT DOWN for a period of time, all automatic drain valves or end plugs should be removed and the complete system flushed. Then all water remaining in the lines should be air purged. The supply water to the pump module should be turned off. Empty filter housings of any remaining water and replace filter cartridges with new dry cartridges. Turn off electrical power to pump module. This will help to prevent water freezing and damaging the pump or its components.

# 11. **GUIDELINES FOR LOCATION AND INSTALLATION OF ATOMIZATION LINE**

## 11.1 **AIRFLOW**

Fog evaporation and subsequent humidification or cooling is enhanced by air movement and flow. Continuous cooling requires continuous ventilation (a fresh supply of warm or hot dry air). The proper installation and positioning of the atomization lines across any prevailing airflow can seriously affect performance. Contact a MicroCool Specialist for design recommendations.

## 11.2 **SUPPORTS & ALIGNMENT**

Align atomization lines with any existing rigid supports such as trusses, rafters, gutters, support poles or walls. If such supports are not available or are not convenient, then suitable support structures should be designed and fabricated to create maximum fog effectiveness.

## 11.3 **NOZZLE ANGLE**

The best nozzle angle may vary with application. Consult a MicroCool specialist for best advice.

## 11.4 **NOZZLE DIRECTION**

Avoid pointing atomization nozzles directly at or towards any close object or surface where the fog can collide before evaporation. Adjust ROC nozzles or Flex line nozzles to avoid this situation. For welded stainless lines use of a nozzle extender to change the spray direction or use a nozzle plug to block off the fog.

## 11.5 **CEILINGS & SHADE SCREENS**

If the atomization lines are to be installed below a ceiling or a shading structure, a distance of 18" to 24" (450mm to 600mm) should be preserved. This allows the nozzles to be orientated at the correct angle without directly spraying on any surface.

## 11.6 **HOT SURFACES**

Flexible atomization lines or manifold hoses should never be allowed to come in direct contact with any hot surface. They should be kept back a minimum distance of 39" (1mt) from steam pipes, heaters, hot surfaces, etc. If flexible manifold lines must be routed across roof structures, it is recommended that they be protected and insulated from both the hot roof surface and intense direct sunlight. Mounting flexible lines in PVC chase tubing is recommended. Flexible lines/manifolds will shrink in normal applications. Allow at least 1" (2.5 cm) slack for every 10ft (3mt) lengths during installation.

## 11.7 **DRAINAGE**

When using a municipal water supply, atomization lines and manifold hoses should be installed so they will drain. It is important that all lines be installed with a gradient of at least 1:100. Pitch all lines back to the pump and use auto drain vales at the end of each line.

## 11.8 **VENTING**

In some instances, it is advisable to install an automatic drain valve pointed straight up, if there is a high point in the system that cannot otherwise drain. This allows air to enter the system when draining, speeding up the drainage time. Conversely, this will allow air to leave the system when filling/pressurizing and eliminates trapped air pockets.

## 11.9 TWISTS & KINKS

Avoid twisting and kinking the flexible lines/manifolds while un-spooling and installing. Thermoplastic hose has a "memory" and after a period of time will tend to twist back into the original position. When installing flexible nozzle lines, use of the special tool to re-align nozzles is recommended. Failure to do so may result in twisted lines that may initially look fine but under pressure will move considerably.

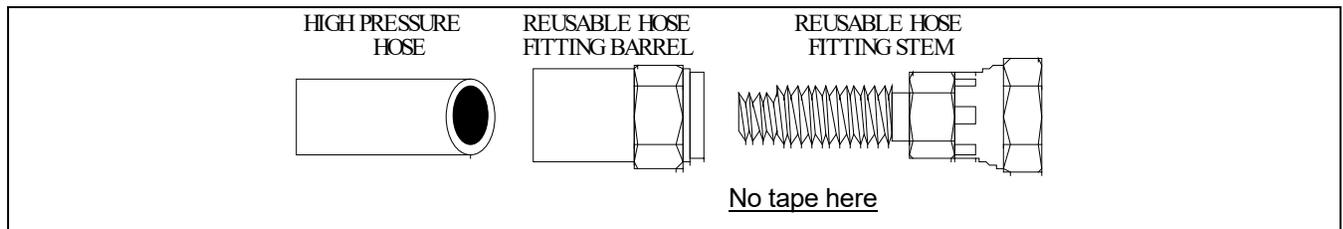
## 11.10 SUPPORT & ROUTING

Whatever support method is used, both atomization and manifold hoses must be routed carefully and **held securely**. It is important they are not allowed to excessively vibrate, sag unduly, bend around a radius of less than 6" (15cm) or be permitted to come into contact with sharp edges. Always leave extra line when bending around corners and making bends to compensate for shrinkage.

## 12. INSTALLATION OF FLEXIBLE ATOMIZATION & MANIFOLD LINE FITTINGS

### 12.1 USE OF REUSABLE HOSE FITTINGS

Reusable hose fittings have standard 1/4", 3/8" and 1/2" National Pipe Thread (NPT) for connection to each other or to other standard brass fittings. Teflon tape must always be used on the male threads of any fitting to create a liquid tight seal. However, the stem component of a reusable hose fitting, i.e. that bit that screws down inside the hose, should never be wrapped with Teflon tape. The following diagrams illustrate typical uses for reusable hose fittings:



12.1.1 Female swivel fittings have a rotating head that allows connections to be made without having to rotate the hose as the fitting is screwed into position. Reusable hose fittings can be used in conjunction with any standard brass fitting to permit connection with the pump modules or solenoid valves. No Teflon tape is required with this fitting.



12.1.2 Male fittings have a rigid NPT thread that can be fixed to a female NPT fitting. This allows manifold hoses or atomization lines to be connected or branched. Teflon tape must be wrapped around the male threads of any fitting to create a liquid tight seal, except when a female swivel reusable hose fitting is connected to the male fitting.



12.1.3 Female 1/4" Rigid fittings are always used at the end of flexible atomization lines to hold an automatic drain valve or a plug.



12.1.4 Do not over-tighten fittings. Fittings may crack and leak.

### 13. INSTALLATION OF REUSABLE HOSE FITTINGS

Reusable hose fittings are used to make high pressure hose connections. They are used to join manifold hoses to high-pressure pump modules, atomization lines and for numerous other applications. There are various styles of reusable hose fittings, but the method used to fit them to hose is the same.



Figure 1: Tools Required



Figure 2: Screw Ferrule onto Hose Counter/Anti Clockwise



Figure 3: Tighten Ferrule on Hose



Figure 4: Stop Tightening when the Line is within 1/16" - 1.6 mm of Thread



Figure 5: Dip Applicator in Silicone

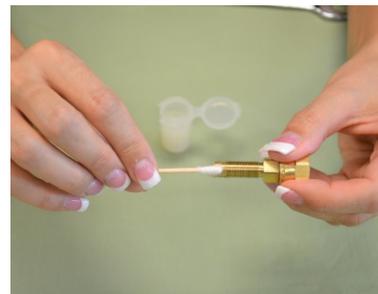


Figure 6: Apply Silicone to Stem



Figure 7: Apply Silicone to Inside of Ferrule



Figure 8: Screw Stem into Ferrule

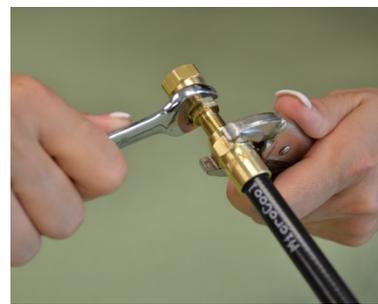


Figure 9: Using a Wrench, Screw in the Ferrule



Figure 10: Stop with 1/8" - 3mm Gap



Figure 11: Fitting Installed



Figure 12: Female Swivel Fittings Do **NOT** Require Tape on the Male Fitting



Figure 13: National Pipe Thread Male (NPTM) Requires PTFE Tape on the Thread



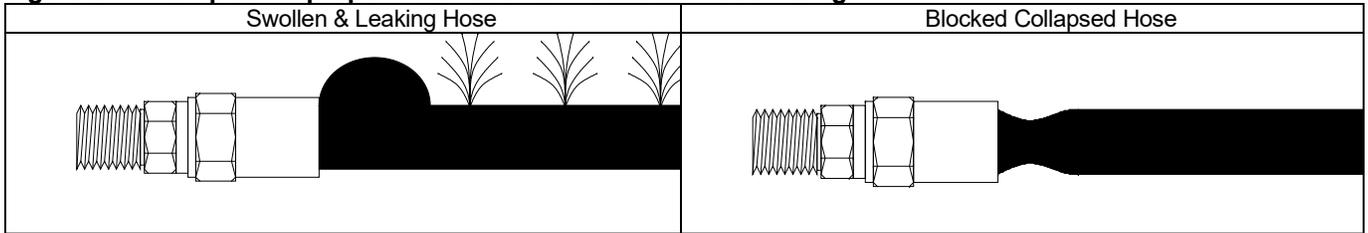
Figure 14: National Pipe Thread Female (NPTF) Requires PTFE Tape on the Male Thread

**13.1 WARNING:**

Improper end fitting installation or lack of lubrication during end fitting installation will cause the inner lining of the hose to be torn, leading to leakage, hose swelling or a blockage. Line shrinkage will also cause leakage. The hose will swell and/or leak water within 6” of the fitting if installed incorrectly.

Always keep the hose straight and make sure the hose, barrel and stem are lubricated and in alignment during the assembly process. See figure 3 below showing described problems. These conditions are not warrantable.

**Figure 3. – Examples: Improper Installation of Re-usable Hose Fitting**

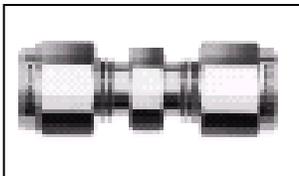


Example 1: Swollen & Leaking Hose

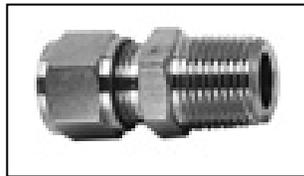
Example 2: Blocked & Collapsed Hose

**14. INSTALLATION OF STAINLESS STEEL LINE FITTINGS**

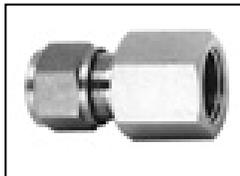
Stainless steel compression fittings are used to make high-pressure line connections. They are used to join manifold lines to high-pressure pump modules, atomization lines and for numerous other applications. Although there are various styles of compression tube fittings, the method used to install them is the same.



UNION TEE CONNECTION



MALE CONNECTOR



FEMALE CONNECTOR



90° ELBOW

- Union- .....Fitting used to connect two pieces of stainless steel tubing.
- Male Connector- .....Fitting used to connect stainless steel tubing to female reusable hose fittings.
- Female Connector- .....Fitting used to connect stainless steel tubing to auto drain valves.
- 90 Elbow-.....Fitting used to connect stainless steel tubing around 90° corners.
- Tee Connection- .....Fitting used to connect stainless steel tubing at an intersection.

#### 14.1 INSTALLATION INSTRUCTIONS—TUBE FITTINGS

For proper fitting performance, the tubing surface finish should be clean, free from nicks or scratches. Do not use out-of-round tubing, which does not easily go through fitting components.

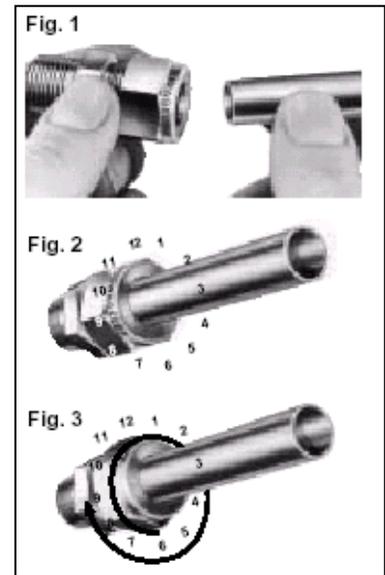
**NOTE:** These instructions apply to traditional fittings and fittings with the advanced back ferrule geometry.

Insert tubing into the compression tube fitting (Fig. 1).

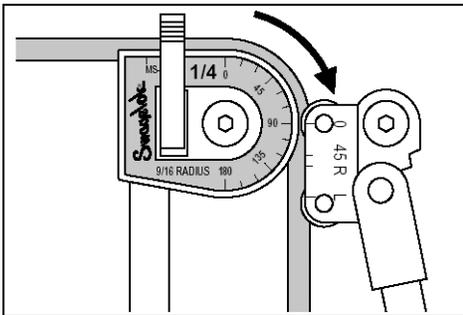
Make sure that the tubing rests firmly on the shoulder of the tube fitting body and that the nut is finger-tight.

Scribe the nut at the 6 o'clock position (Fig. 2).

While holding fitting body steady, tighten the nut 1 1/4 turns to the 9 o'clock position. (Fig. 3)



Figures 1-3.



#### 14.2 INSTALLATION INSTRUCTIONS-TUBE BENDING

The stainless steel tubing may be bent to fit around objects with a tubing bender. MicroCool tool part# TKT0012 may be used or you may obtain one locally.

## 15. INSTALLATION OF ATOMIZATION LINE

### 15.1 METHODS OF SUSPENDING ATOMIZATION LINES

The two basic methods used to mount and suspend atomization lines are

1. Stainless Steel Aircraft Cable.
2. Hose Mounting Clamps.

The type of structure and the location where the atomization lines will be installed determines the appropriate method. Often a combination of methods is used.

### 15.2 USE OF AIRCRAFT CABLE

Aircraft Cable is 7 x 7 stranded 1/16" (0.31mm) stainless steel cable, rated at about 500 lbs. tensile strength. With this method, the atomization line is attached using cable ties at approximately 12"(304mm) on-center. It is extremely important that the cable be installed along the top of the atomization line with the cable tie snaps being placed on the hose, not the cable. See figure 6.

The Aircraft Cable is strung between posts, columns or a fabricated structure that locates the atomization line in the desired position. The cable is then drawn tight by a ratchet mechanism. This method allows atomization line to span distances of up to 10 to 15 feet (3 to 5 MT) where there is lack of continuous support.

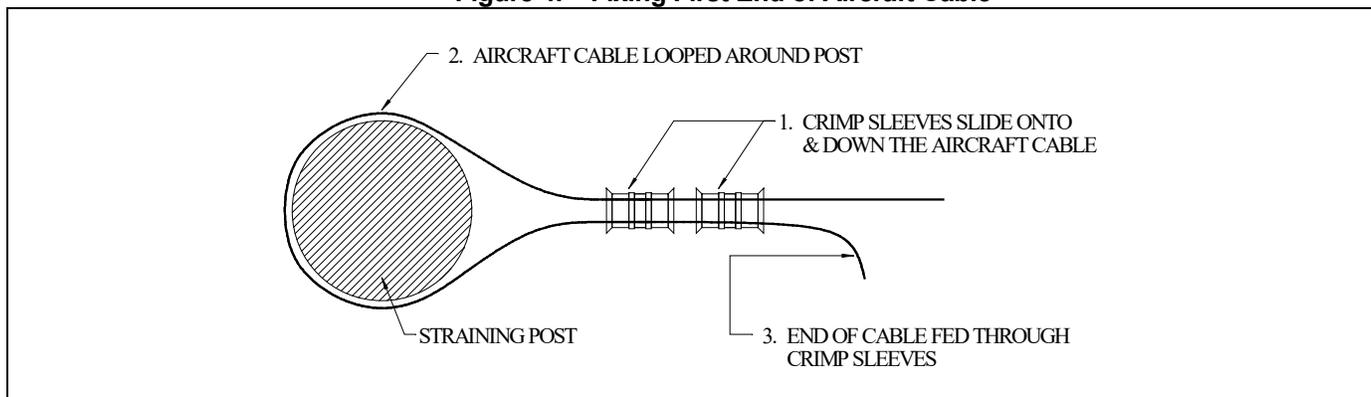
Typical situations where this method would be useful are fixing atomization line to structures of greenhouses, storage houses, waste load-out facilities, perimeter fencing around sludge ponds or strung between poles to span across sewage lagoons. The possibilities are numerous.

### 15.3 AIRCRAFT CABLE INSTALLATION TECHNIQUE

*Special tools required: Aircraft Cable cutter & 1/16" Sleeve crimping tool.  
(Aircraft cable tool kit MicroCool PART# TKT0003)*

1. Select the two points from which you require your manifold line or atomization line to span. Points may be existing structures such as roof beams, columns, etc. or fabricated poles that will allow cable to be wrapped around.
2. If the points are on a wall or any other flat surface, eyelets will have to be fabricated to fix the ends of the cable. Remember, to create a drainage gradient for the atomization lines, the points must not be level.
3. Pull one length of Aircraft Cable between the two points. Pull an extra 2 feet (0.61 M) and cut using the cable cutter.
4. The Aircraft Cable ends are generally fixed by forming a loop and this is held using crimp sleeves. Please refer to the following drawing.

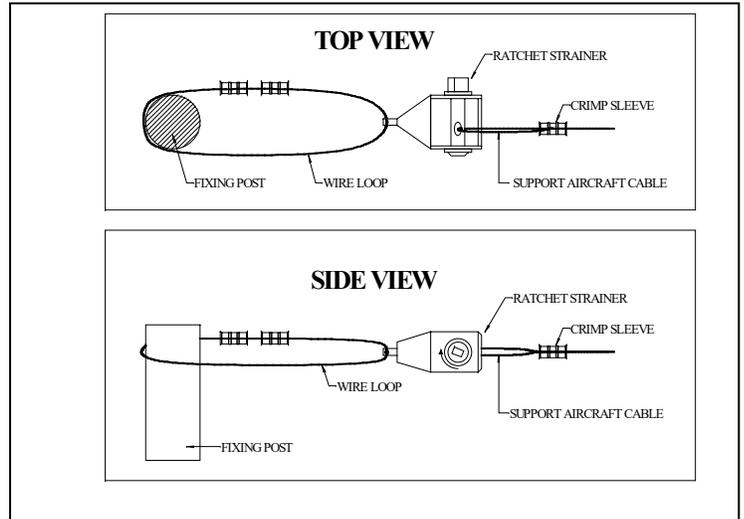
**Figure 4. – Fixing First End of Aircraft Cable**



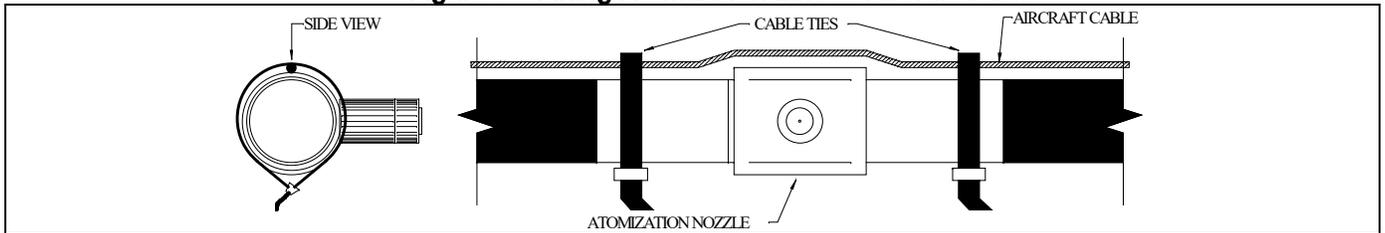
5. Take one end of the Aircraft Cable and pull it around the point in the above fashion. Use the crimping tool and firmly crimp each sleeve three times along its length.

**Figure 5. – Fixing Ratchet Strainer to Aircraft Cable**

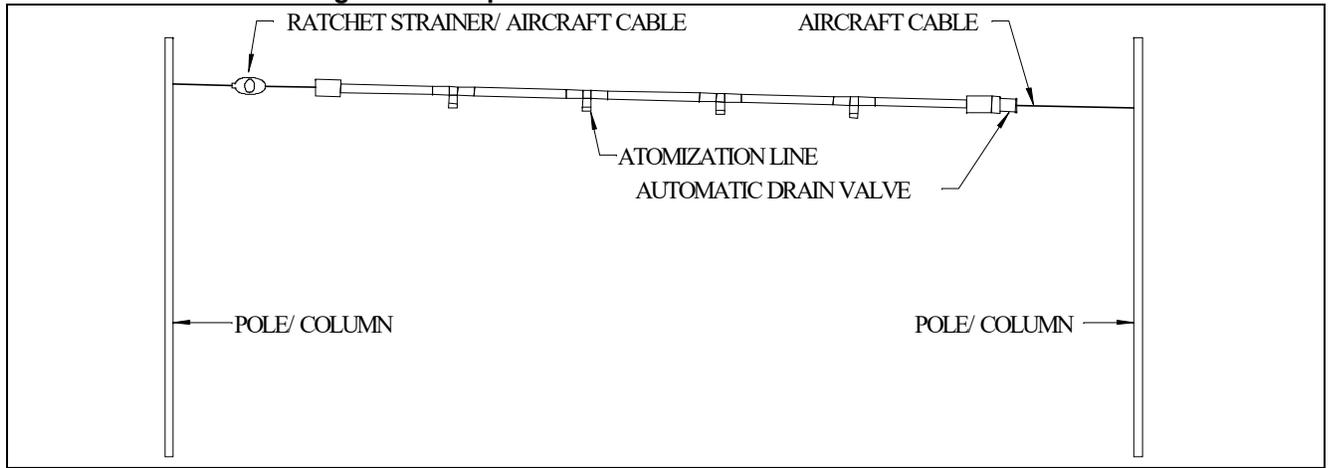
6. The other end of the Aircraft Cable is now ready to be fixed, however, the cable will have to be tightened or tensioned to prevent the atomization line from sagging and to create the necessary drainage gradient. To do this a ratchet tightener must be installed in the line.
7. To install the ratchet tightener, use the short length of Aircraft Cable supplied with the ratchet and form a loop by running the short length of cable through the eyelet, around the post and secure with two crimp sleeves. Next, run the end of the support Aircraft Cable through the revolving pin taking up as much slack as possible. Then, secure using one crimp sleeve.
8. Using a wrench, twist the revolving pin to take up the remaining slack in the support Aircraft Cable. Keep twisting until the Aircraft Cable is tight and does not sag. Make sure that the Aircraft Cable is straight and is not being deflected by other object.
9. Unroll the atomization line on the ground below the Aircraft Cable. Do not allow the atomization line to become excessively dirty and make sure the protective caps on the end of the nozzles and lines remain in place. While on the ground, it may be convenient to align the nozzles into the desired position; however, this is reasonably straightforward to do when the line is suspended.
10. Take one end of the atomization line and using zip ties (part# ACT0009); attach the complete line to the cable loosely. Connect atomization line to manifold line. Proceed from this point working your way to the end of the atomization line tightening the zip ties and orientating the nozzles to your preferred spray direction. Attach zip ties to atomization line at a distance of no more than 12" (300mm). Please refer to figure 7 on page 12. Zip tie lock clip should be mounted away from Aircraft Cable. This will attach atomization line to cable securely.
11. When finished the atomization line should be suspended as illustrated in figure 8.



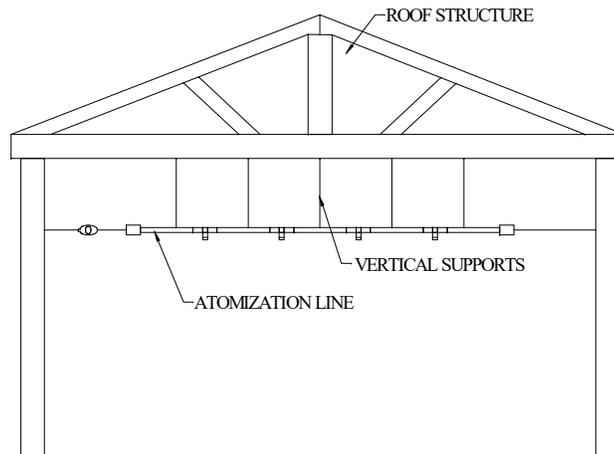
**Figure 6 – Fixing Atomization Line to Aircraft Cable**



**Figure 7 – Suspended Aircraft Cable and Atomization Line**



**Figure 8 – Supporting Atomization Line at Mid-Span**



12. The weight of the atomization lines may cause the Aircraft Cable to sag. To overcome sagging it is necessary to support the atomization line along its length. In the diagram below, short lengths of Aircraft Cable have been attached to a roof structure and then dropped and fixed to the Aircraft Cable supporting the atomization line at an interval of 10 to 15 feet. (3 to 4.5 MT). Please refer to figure 6. Always consider line drainage when suspending overhead atomization lines.

15.4 **SPECIAL CONSIDERATIONS:**

**Do not attempt to install lines without intermediate support.**

**\*\*\*NOTE:** When wrapping flexible atomization line or manifold around a corner or coming to the end of a long run, leave approx. 4" to 6" extra per 10 foot of manifold line to account for possible line shrinkage. Failure to do so will result in line or fitting leakage or damage. See page 13, figure 9a for more information.

## 16. HOSE CLAMP INSTALLATION TECHNIQUE

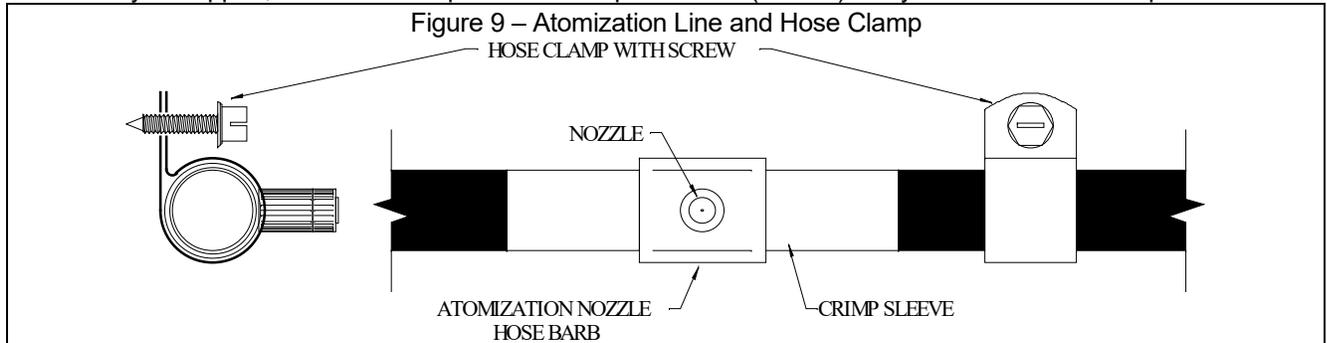
In this fast and simple technique, a hose clamp is used to fix the manifold/atomization line to walls or any surface where there is continuous support. The hose clamp is used at a frequency of approximately 16" (450mm) on-center for flexible line and approximately 36" (925mm) on-center for stainless steel line. This method can be used to run the hose/line either horizontally or vertically. See Figure 9 for further information.

It may be useful to mark out the path that you want the manifold hose or atomization line to follow on the support surface. Do this using chalk line or a pencil. Consider line drainage when installing manifold/atomization lines.

Open the hose clamps and wrap each around the hose/line to be supported at not less than 16" (450mm) center to center.

Lift one end of the hose/line into position and attach the clamp to the support surface using a screw. When attaching to masonry, it will be necessary to drill a hole and use a wall anchor and screw to hold the hose clamp in position. If attaching to metalwork, self-drilling and tapping screws can be used and when fixing to timber normal wood screws can be used.

Work from one side of the manifold/atomization line to the other, pulling the line straight and keeping it straight as you go. A drainage gradient will have to be preserved. Do not permit the hose/line to sag between support points. If this is likely to happen, use more clamps. Place clamps about 2" (50 mm) away from hose barb crimp sleeve.



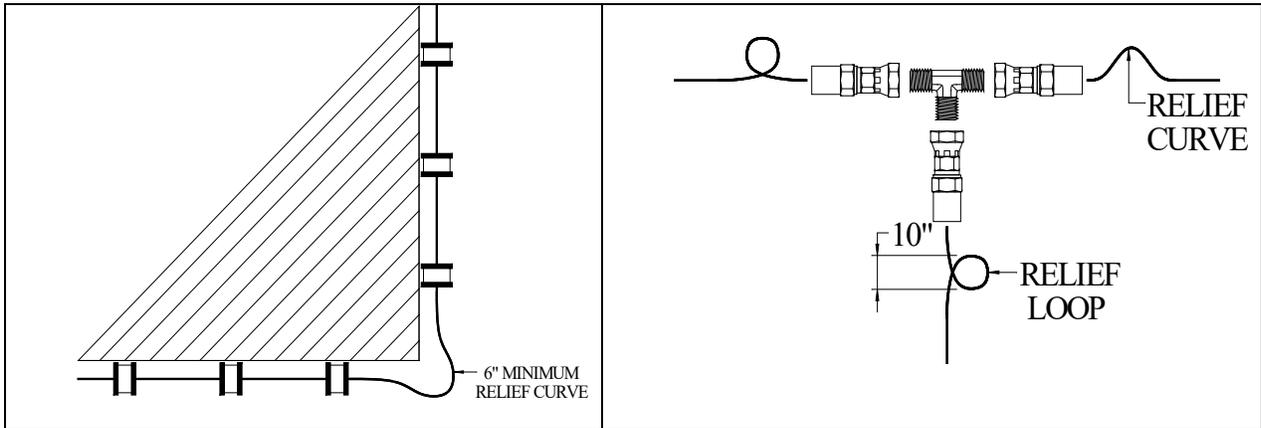
### 16.1 SPECIAL CONSIDERATIONS:

Hose clamps are available in 1/4", 3/8" and 1/2" diameter for flexible and stainless steel lines and should be sized according to the outside diameter of hose being attached.

Screw size should be #10 diameter x 1" (25mm) long in either a dome or hex head style. Do not use countersink head screws.

## 16.2 FLEXIBLE MANIFOLD OR FLEXIBLE NOZZLE LINE RELIEF ROUTING

Figure 9a:



Leave extra flex line around corners

Loops or Curve at the ends of long flex line runs before corners

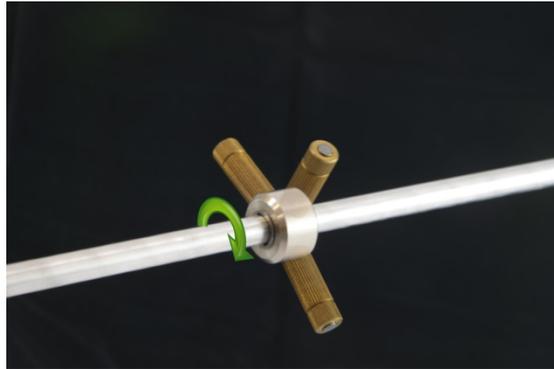
**\*\*\*NOTE:** When wrapping flexible atomization line around a corner or coming to the end of a long manifold run, leave approx. 4" to 6" extra per 10 foot of manifold line to account for possible line shrinkage. Failure to do so will result in line or fitting leakage or damage not covered under warranty.

## 17. ORIENTATION OF ATOMIZATION NOZZLES

The atomization nozzles mounted in flexible and ROC atomization lines are 360° adjustable. After the atomization lines have been installed it may be necessary to orientate the nozzles to create the desired fog pattern.

### **ROC Lines**

Rotate the ROC (Rapid Orientation Collar) until the nozzle is pointing in the desired direction. The use of any mechanical tool is generally not required if this procedure is undertaken at early start-up. However, if the system has been operating for some time it may be necessary to use pliers or vice grips to rotate the collar. Avoid leverage on the nozzle which can result in nozzle thread breakage.



## Flexible Lines

Flexible nozzle lines will require a nozzle orientation tool, MicroCool Part # TKT0001 as shown in Figure 10.

The nozzle orientation tool is clamped onto the crimp ferrules on each side of the nozzle and held firmly with one hand. A piece of 3/8" tube is then slid over the end of the nozzle. This is then used with moderate force to rotate the nozzle into the desired position. See diagram A. Make sure that the tool is tightly clamped and that the hose does not move on either side of the tool as the nozzle is turning.

If the nozzle will not turn using the 3/8" tube and moderate force, do not increase the amount of force. Instead a small pair of vise grips can be used to grasp the nozzle barb body (not the nozzle) and rotate it into the desired position. See diagram B.

**It is not recommended that a wrench or vise pliers be used to grab the nozzle and twist into position, as the nozzle stem is likely to be broken.**

### 17.1 NOZZLE ANGLE

Nozzle angle can vary depending on application. Contact a MicroCool Specialist for recommendations on best angles for different applications.

**NOTE:** Nozzles may need to be tightened during the installation. The nozzles may have come loose during transportation and installation.

Most applications require nozzles to be finger tight only. Mechanical tools to tighten nozzles should only be used with specific instruction from MicroCool. The same applies to the use of any locking sealants.

## 18. ATOMIZATION LINE/MANIFOLD HOSE DRAINAGE

Atomization lines are usually installed at proper gradients so that they self-drain. Generally, manifold hoses (that feed the atomization lines) should drain back to the pump where a drainage solenoid will open at system shutdown. When the system shuts down the automatic drain valve at the end of each line will open and drain out the remaining water. Therefore to handle drainage water, the end of each line if possible should be routed into a gutter or directed out with blue low-pressure blue hose.

In order to achieve the best possible drainage performance, an additional automatic line drain valve should be installed at the highest point in the system. This valve will allow air to enter the system and maximize the effects of siphoning and therefore decrease drainage time. Conversely, when the system is being filled with water, the valve will allow air to leave the system thus decreasing the fill time.

Figure 12 – Automatic Line Drain Valves



The arrow on the valve indicates the direction of water flow out of the atomization line.

## 19. **ATOMIZATION NOZZLES**

Occasionally because of either water quality or dissolved solid build up, an atomization nozzle may become blocked. With the system running, rub the top of the nozzle with the knurled sides of the nozzle-cleaning tool to remove any heavy build up or work the nozzle cleaning tool (MicroCool Part# TKT0002) 0.007" (0.177mm) wire up inside the nozzle orifice. See Figure 23. Spin the wire around and the blockage will become dislodged. Wear eye protection.

***Remember a blocked or badly performing nozzle reduces the capacity of the system to cool or humidify. It is similar to shutting off air conditioning units one at a time!***

If it is not possible to clean nozzles, contact MicroCool about replacement nozzles. A correct spray pattern should be a full round pattern that will measure 2" (50mm) across at 2" (50mm) from nozzle as shown in Figure 23 A. Figure 23 B shows how a fog nozzle and anti-drip valve are assembled. Figure 23 C shows different methods of nozzle leaking

**Figure 23 – Nozzles**

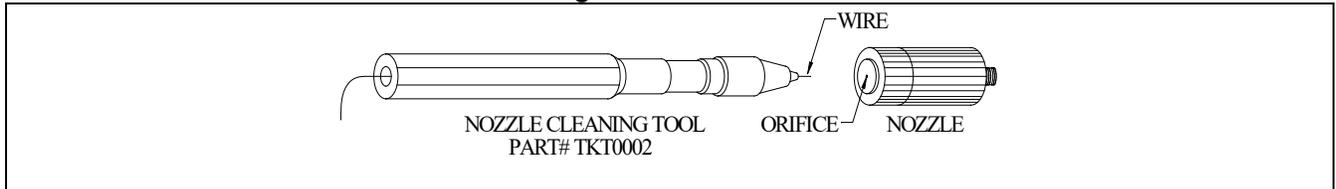


Figure 23 A – Proper Spray Pattern

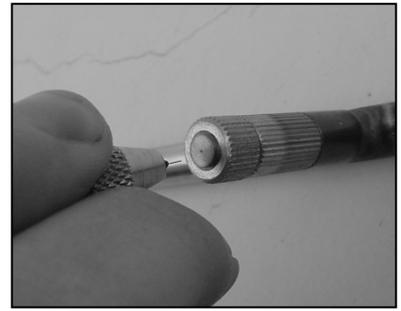
Figure 23 B – Nozzle Anti-Drip Assemble



Stiff Wire Brush Cleaning  
MicroCool Part# VTB0001



Stiff Wire Wheel in Portable Device  
MicroCool Part# VTB0002



MicroCool Nozzle Cleaning Tool  
MicroCool Part# TKT0002

# CERTIFICATE OF COMPLIANCE

**Certificate Number** 20190307-E352513  
**Report Reference** E352513-20120418  
**Issue Date** 2019- MARCH-07

**Issued to:** MICROCOOL  
72216 Northshore St. Unit 103-104  
THOUSAND PALMS CA 92276

**This is to certify that representative samples o** INDUSTRIAL CONTROL PANELS  
USL, CNL - Industrial control panels.

Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.

**Standard(s) for Safety:** UL 508A - Industrial Control Panels and C22.2 No. 14-10 - Industrial Control Equipment.

**Additional Information:** See the UL Online Certifications Directory at [www.ul.com/database](http://www.ul.com/database) for additional information

Only those products bearing the UL Certification Mark should be considered as being covered by UL's Certification and Follow-Up Service.

Look for the UL Certification Mark on the product.



Bruce Mahrenholz, Assistant Chief Engineer, Global Inspection and Field Services

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## 21. **WARRANTY**

Products manufactured by MicroCool® bear the following limited warranty:

MicroCool warrants that the goods to be delivered will be of the kind and quality described in the sales order or contract, and will be free of defects in workmanship or material. Should any failure to conform to this warranty appear within the time limit stated below, after the initial date of delivery, the MicroCool shall, upon notification thereof, and written substantiation that the goods have been stored, installed, maintained and operated in accordance with the seller's recommendations and standard industry practice, correct such defect by suitable repair or replacement at its own expense. This warranty is limited to repairing or replacing products that the manufacturer's investigation shows were defective at the time of shipment by the manufacturer. An RMA number must be obtained from MicroCool® before returning a product for warranty consideration or repair.

**Warranty period:**                    **One (1) year on all MicroCool manufactured goods**  
   **Two (2) years on coupled Weg motor and VF Drive**  
   **The lesser of One (1) year or 4,000 hours use on pump head**

Notification Period:                    Notify MicroCool within 15 days of determining defect.

Product Return Period:                Return defect product within 30 days to MicroCool

All products subject to this warranty shall be returned for examination, repair or replacement, freight pre-paid to:

MicroCool  
72216 Northshore St.#103-104  
Thousand Palms, California 92276, USA

Phone#                    760-322-1111  
FAX#                      760-343-1820

E-mail address- [fog@microcool.com](mailto:fog@microcool.com)

Web site- [www.microcool.com](http://www.microcool.com)

This warranty is exclusive and is in lieu of any warranty or merchantability, fitness for a particular purpose or other warranty of quality, whether express or implied, except of title and against patent infringement. Correction of non-conformities, in the manner and for the period of time provided above, shall constitute fulfillment of all liabilities of the seller to the purchaser with respect to, or arising out of the goods, whether based on contract negligence, strict tort or otherwise.

**LIMITATION OF LIABILITY** - Repair or replacement of defective products as provided above is the sole and exclusive remedy provided hereunder and the seller shall not under any circumstances be liable for special or consequential damages such as, but not limited to, damage or loss of other property or equipment, loss of profits, or revenue, cost of capital, cost of purchased or replacement goods, or claims or customers of purchaser for service interruptions. The remedies of the purchaser set forth are exclusive and the liability of seller with respect to any contract, or anything done in connection therewith such as the performance or breach thereof, or from the manufacture, sale, delivery, resale, installation or use of any goods covered by or furnished under this contract whether arising out of contract, negligence, strict tort, or under any warranty, or otherwise, shall not, except as expressly provided herein, exceed the price of the goods upon which such liabilities based. This is the only warranty on any MicroCool® product; no other writing or description in the literature shall be construed as a warranty. Products manufactured by other than MicroCool® bear the following limited warranty:

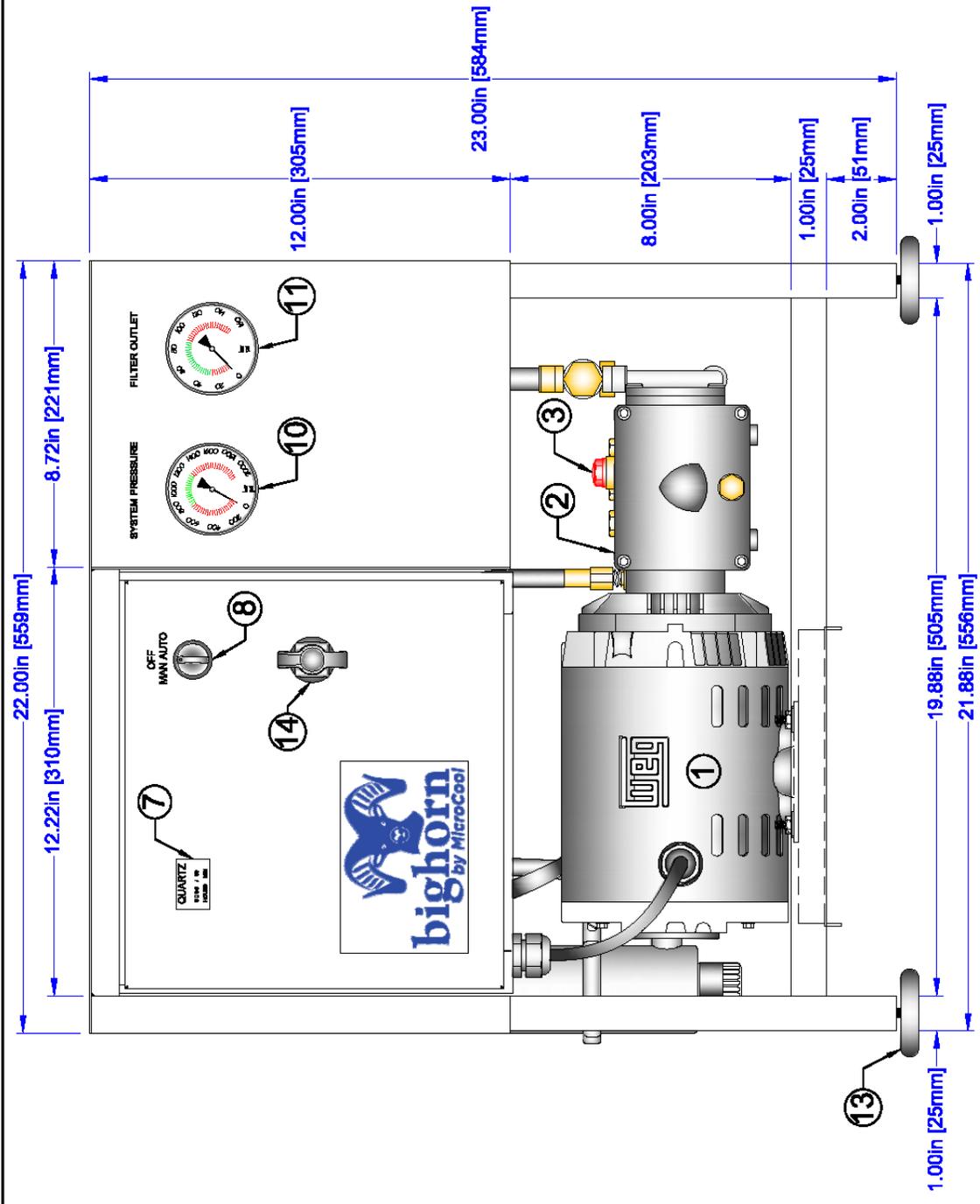
Seller warrants that the goods manufactured by others will conform to the description herein stated. No other warranty express or implied is made, and the warranty of the manufacturer is hereby assigned and transferred to the buyer. Furthermore, except for the manufacturer's warranty, if any, the products sold hereunder are sold as is. MicroCool® is not liable for any incidental or consequential damages in connection with these products.

In addition to all of the above, MicroCool® accepts no liability if the system is used to dispense corrosive, toxic or other non-approved agents. MicroCool® will not be responsible for poor water quality damage or nozzle blockage due to poor water quality.

**MicroCool®**



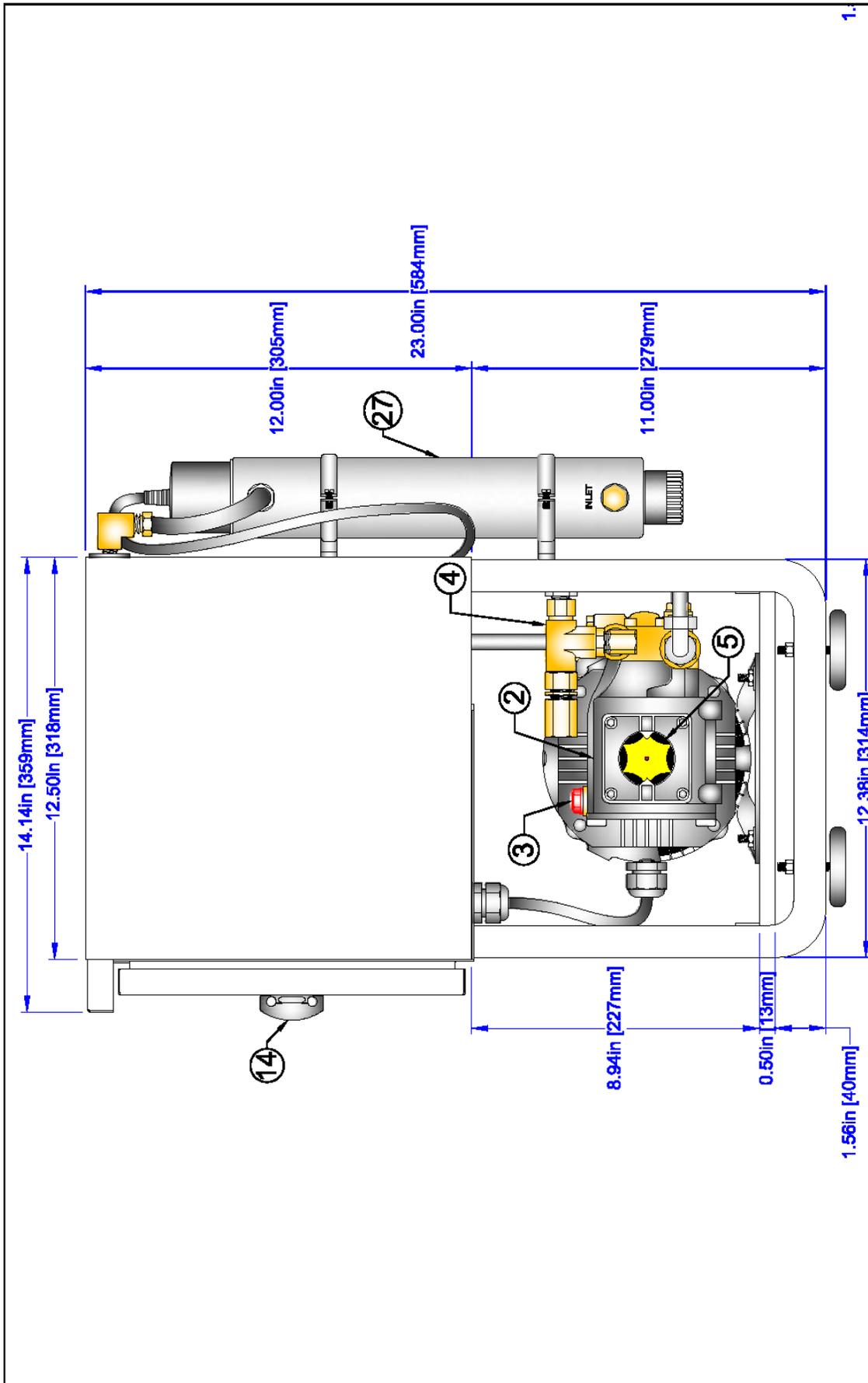
22. BIGHORN ILLUSTRATIONS



		<b>1</b> OF 8 SHEETS																									
FRONT VIEW		DWG. NAME FILE NO.																									
<b>UNAUTHORIZED CHANGES &amp; USES:</b> The drafter preparing these plans will not be responsible for or liable for, unauthorized changes to the drawings or specifications, and all changes must be approved by the owner or his/her agent.																											
DRAWN: D.A. DESIGNED: J.A. CHECKED: A.D.	SCALE: NA JOB NUMBER: NA DATE: 5/28/2015	<b>REVISIONS</b>																									
MicroCool Thousand Palms CA USA +1-760-322-1111 info@microcool.com www.microcool.com	<table border="1"> <thead> <tr> <th>DATE</th> <th>BY</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>	DATE	BY	DESCRIPTION										<table border="1"> <thead> <tr> <th>DATE</th> <th>BY</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>		DATE	BY	DESCRIPTION									
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DIMENSIONS UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: ANGLES ± 1° BEND ± 1° FINISHES: MILL FINISH UNLESS OTHERWISE SPECIFIED MATERIALS: STEEL FINISH: EAGLE WHITE POWDER COAT																											



22.2 BIGHORN BACK EXTERNAL VIEW



3  
OF 8 SHEETS

DWG NAME  
FILE NO.

**bighorn**

RIGHT SIDE VIEW

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This drawing is for informational purposes only. It is not intended for use in the field. All changes to this drawing must be approved by the designer of this product.

DRAWN: DA SCALE: NA  
DESIGNED: JA JOB NUMBER: NA  
CHECKED: AD DATE: 9/28/2016

DATE	BY	DESCRIPTION

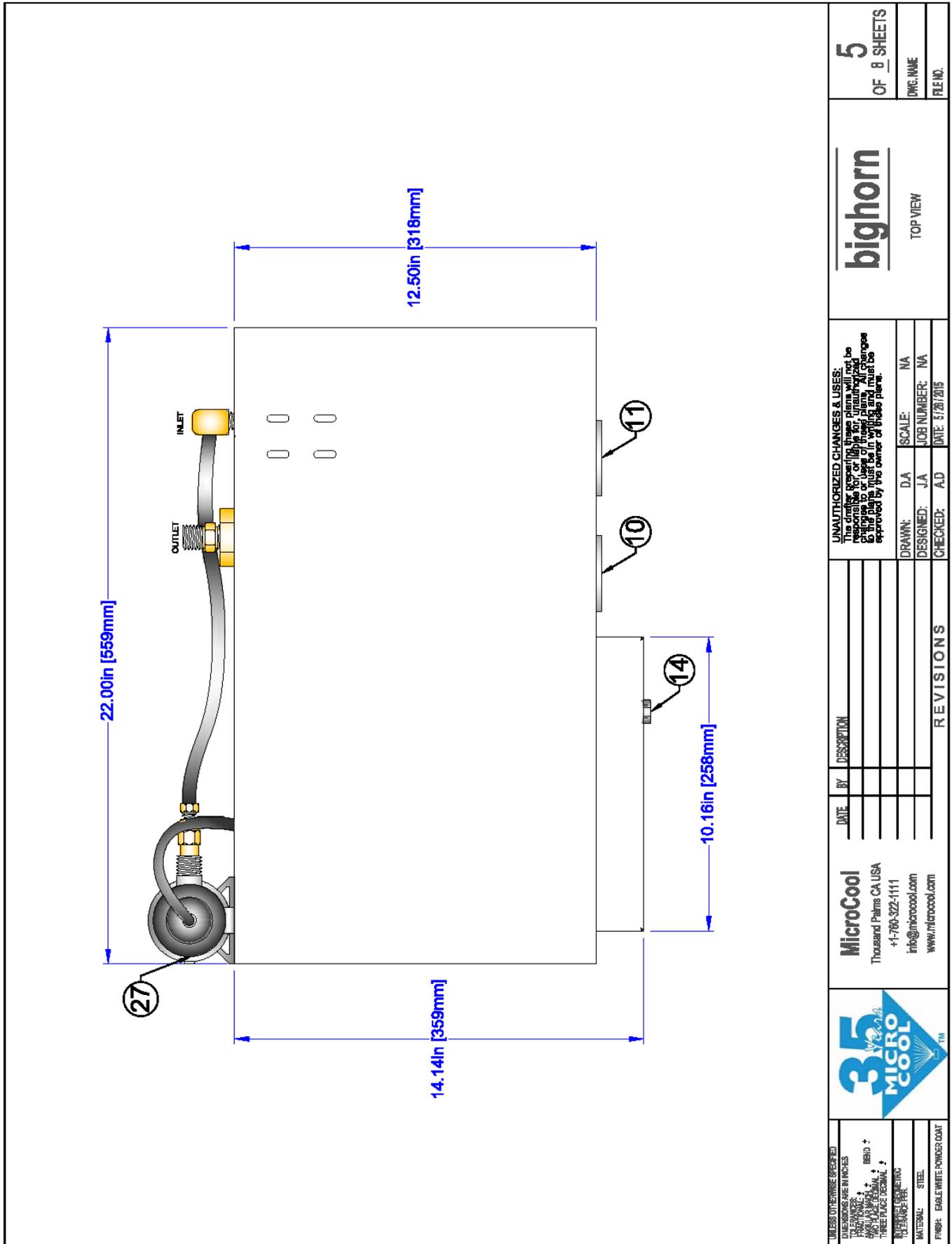
**MicroCool**  
Thousand Palms CA USA  
+1-780-322-1111  
info@microcool.com  
www.microcool.com



UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES:  
FRACTIONS: ± .005 INCHES  
DECIMALS: ± .001 INCHES  
THREE PLACE DECIMAL: ± .0005 INCHES  
MATERIAL: STEEL  
FINISH: ENAMEL WHITE POWDER COAT



22.4 BIGHORN LEFT EXTERNAL VIEW



5  
OF 8 SHEETS  
DWG. NAME  
FILE NO.

**bighorn**  
TOP VIEW

UNAUTHORIZED CHANGES & USES:  
This drawing is the property of Bighorn and shall be used only for the project and location specified herein. Any unauthorized changes to or use of these plans, or any other drawings, shall be the responsibility of the user and shall not be approved by the owner of these plans.

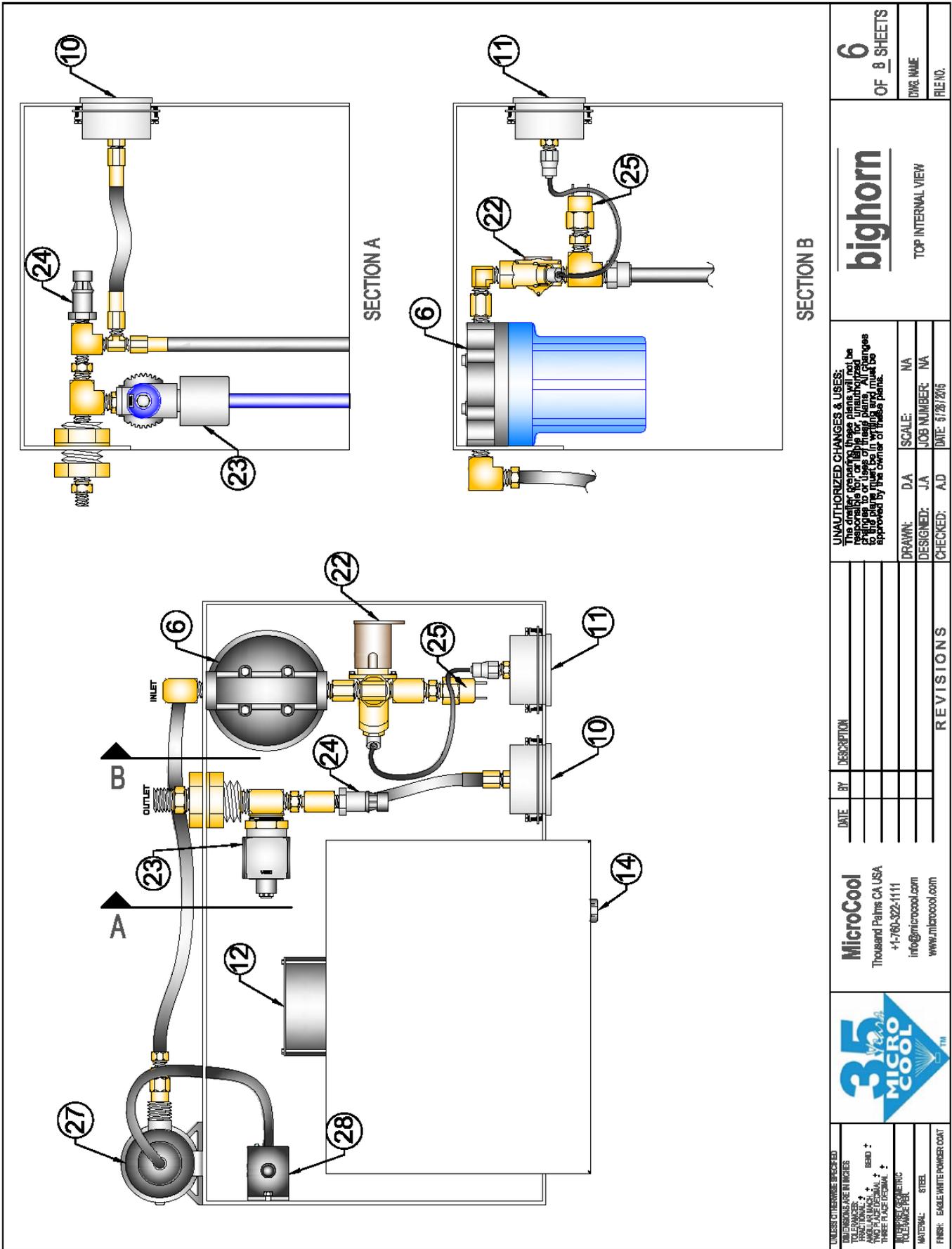
DRAWN: DA SCALE: NA  
DESIGNED: JA JOB NUMBER: NA  
CHECKED: AD DATE: 5/28/2015

DATE	BY	DESCRIPTION

**MicroCool**  
Thousand Palms CA USA  
+1-760-322-1111  
info@microcool.com  
www.microcool.com



UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN INCHES  
TOLERANCES: ± .005 INCHES  
FINISHES: MILL, BEND +  
WELD, POLISH, GALV., ZINC  
THREE PLACE DECIMAL, ±  
UNLESS OTHERWISE SPECIFIED  
MATERIAL: STEEL  
FINISH: ENAMEL POWDER COAT



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OF 8 SHEETS

DWG. NAME  
FILE NO.

**bighorn**  
TOP INTERNAL VIEW

UNAUTHORIZED CHANGES & USES:  
This drawing is for informational purposes only. It is not to be used for manufacturing or for any other purpose without the written approval of the designer. All changes to this drawing must be approved by the designer.

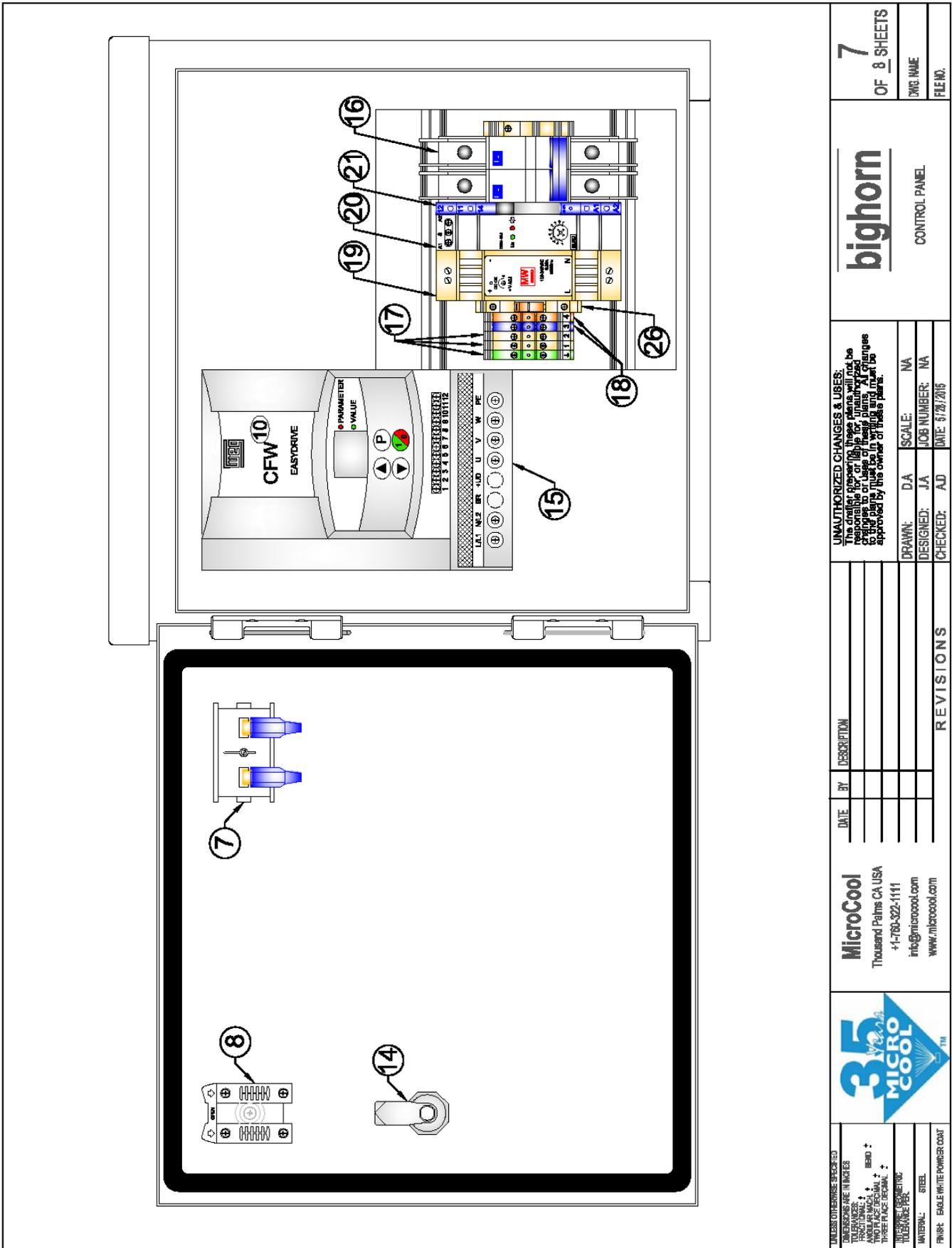
DRAWN: DA SCALE: NA  
DESIGNED: JA JOB NUMBER: NA  
CHECKED: AD DATE: 6/28/2016

DATE	BY	DESCRIPTION

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UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN INCHES  
TOLERANCES:  
FRACTIONAL: ± .005  
DECIMAL: ± .001  
THREE PLACE DECIMAL: ± .0005  
TOLERANCE PRACTICE: AS PER ASME Y14.5-2009  
MATERIAL: STEEL  
FINISH: ENAMEL POWDER COAT



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OF 8 SHEETS  
DWG. NAME  
FILE NO.

**bighorn**  
CONTROL PANEL

**UNAUTHORIZED CHANGES & USES:**  
This drawing is for informational purposes only. It is not to be used for manufacturing or for any other purpose. All changes to the design must be approved by the owner of these plans.

DRAWN: D.A SCALE: NA  
DESIGNED: J.A JOB NUMBER: NA  
CHECKED: A.D DATE: 5/28/2015

DATE	BY	DESCRIPTION

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UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES:  
FRACTIONAL: ± .005  
DECIMAL: ± .001  
THREE PLACE DECIMAL: ± .0005  
FINISH: UNLESS OTHERWISE SPECIFIED  
MATERIAL: STEEL  
FINISH: ENAMEL POWDER COAT

# NOTES

- ① 3 PHASE ELECTRIC MOTOR (MTR0057/MTR0103/MTR0203)
  - ② PUMP HEAD (PAR0005/PAR0010/PAR0020)
  - ③ OIL FILL CAP (AR3201890)
  - ④ PRESSURE SAFETY RELIEF VALVE (REGULATOR) (PUS0008)
  - ⑤ OIL SIGHT GLASS
  - ⑥ 5" MICRON SEDIMENT FILTER (PFH0506/PFC0005)
  - ⑦ HOUR METER (EMH0003)
  - ⑧ 3-WAY SWITCH (CSW00018)
  - ⑨ CONTACT BLOCKS (CSW0003)
  - ⑩ SYSTEM PRESSURE GAUGE (PGA0002)
  - ⑪ INLET WATER GAUGE (AFTER FILTER) (PGA0001)
  - ⑫ VENTILATION FAN (FAN3115/FAN3230)
  - ⑬ LEVELING MOUNT (PLM0002)
  - ⑭ DOOR RELEASE
  - ⑮ VFD ( VARIABLE FREQUENCY DRIVE) (VFD0051/VFD0052/VFD0101/VFD0102/VFD0202)
  - ⑯ CIRCUIT BREAKER (ECB0106/ECB0206/ECB0110/ECB0210/ECB0216)
  - ⑰ POWER INPUT
  - ⑱ REMOTE START
  - ⑲ 24 VDC POWER SUPPLY(PDC1524)
  - ⑳ DELAY ON TIMING RELAY(ETM0006)
  - ㉑ TERMINAL BLOCK RELAY(ERL0007/ERL0003)
  - ㉒ INLET SOLENOID (ESV0006/ESV1006)
  - ㉓ DRAIN SOLENOID (ESV0106/ESV0206)
  - ㉔ PRESSURE TRANSDUCER (PTR0002)
  - ㉕ LOW PRESSURE, PRESSURE SWITCH (PPS0011)
  - ㉖ MANUAL DISCONNECT TERMINAL
- UPGRADE OPTIONS
- ㉗ UV LIGHT 1-5 GPM (UVF0001)
  - ㉘ BALLAST

<p><b>35</b> MICRO COOL™</p>	<p><b>MicroCool</b> Thousand Palms CA USA +1-760-322-1111 info@microcool.com www.microcool.com</p>	<p>UNAUTHORIZED CHANGES &amp; USES: This drawing represents the design plans and shall be the responsibility of the user. UnAUTHORIZED changes to or use of these plans. All changes approved by the owner of this plan.</p>	<p style="font-size: 2em; font-weight: bold;">bighorn</p> <p style="text-align: right;">NOTES</p>	<p style="font-size: 2em; font-weight: bold;">8</p> <p>OF 8 SHEETS</p>																								
<p>REVISIONS</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>DATE</th> <th>BY</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>	DATE	BY	DESCRIPTION																<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>DRAWN: DA</td> <td>SCALE: NA</td> </tr> <tr> <td>DESIGNED: JA</td> <td>JOB NUMBER: NA</td> </tr> <tr> <td>CHECKED: AD</td> <td>DATE: 5/28/2016</td> </tr> </table>	DRAWN: DA	SCALE: NA	DESIGNED: JA	JOB NUMBER: NA	CHECKED: AD	DATE: 5/28/2016	<p>DWG. NAME</p> <p>FILE NO.</p>		
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<p>MATERIAL:</p> <p>FINISH:</p>																												

