Low Flow

High Flow

ADVANCING NANOBUBBLE TECHNOLOGY

MOLEAER Trinity™ NANOBUBBLE GENERATOR

OWNERS MANUAL

IMPORTANT SAFETY INSTRUCTIONS

READ AND FOLLOW ALL INSTRUCTIONS

SAVE THESE INSTRUCTIONS

CUSTOMER SERVICE / TECHNICAL SUPPORT

If you have questions about ordering Moleaer, Inc. replacement parts and products, please use the following contact information:

CUSTOMER SERVICE:

Monday to Friday: 8:00 a.m. to 5:00 p.m. PST

Phone: +1 (424) 558-3567

Email: mailto:info@moleaer.com

WEBSITE:

www.moleaer.com

Sections

WARRANTY INFORMATION

Section 1 Contents

Limited Warranty

Warranty

Moleaer warrants that the Goods will be free from defects in material and workmanship for a period of 12 months from delivery. Moleaer shall in no event be liable for defects or damage attributable to modifications performed or repair work done other than by Moleaer personnel or to abuse, accident, catastrophe, force majeure event, shipment, improper use, maintenance, storage or application or any other external cause.

EXCEPT FOR ANY WRITTEN PERFORMANCE WARRANTY THAT MOLEAER HAS EXPRESSLY INCORPORATED IN THIS CONTRACT, MOLEAER DISCLAIMS ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT.

Claims; Exclusive Remedy

Any warranty claim must be made to Moleaer in writing within 10 days of discovery of the alleged defect. After obtaining prior written authorization from Moleaer, Buyer shall return all allegedly defective Goods, freight pre-paid, for examination by Moleaer. If Moleaer finds that the Goods are defective and covered by the warranty, Moleaer's sole obligation shall be, at Moleaer's option, to repair or replace the Goods, or to refund the purchase price therefor, and to reimburse Buyer's reasonable shipping costs. The buyer shall be responsible for all charges for handling returned items not found defective. The remedy set forth in this Paragraph 4 is Buyer's sole and exclusive remedy for any breach of warranty or claim related to the Goods other than pursuant to any written performance warranty that Moleaer has expressly incorporated in this Contract.

Limited Warranty

MOLEAER SHALL NOT BE LIABLE FOR SPECIAL, INDIRECT, CONSEQUENTIAL, OR INCIDENTAL DAMAGES, INCLUDING DAMAGES FOR LOST OR PROSPECTIVE PROFITS OR OTHER ECONOMIC DAMAGES, ARISING OUT OF OR RELATED TO THIS CONTRACT OR THE GOODS. MOLEAER'S TOTAL LIABILITY, WHETHER IN CONTRACT OR TORT OR OTHERWISE, SHALL NOT EXCEED THE PORTION OF THE PRICE PAID BY THE BUYER ALLOCABLE TO THE GOODS GIVING RISE TO THE LIABILITY. THE LIMITATIONS IN THIS PARAGRAPH WILL APPLY NOTWITHSTANDING THE FAILURE OF THE ESSENTIAL PURPOSE OF ANY LIMITED REMEDY.

This limitation shall not apply to claims for personal injury directly caused by Moleaer's willful or reckless acts.

To register your product and learn more about the limited warranty, visit our website or scan the QR code with your mobile device: https://www.moleaer.com/warranty-management

Additional resources can be found on the customer portal on our website, https://www.moleaer.com/portal

European Declaration of Conformity

We, Moleaer, declare under our sole responsibility that the product Moleaer nanobubble generator Trinity as outlined in the product information below marked with the CE mark on the nameplate to which this declaration relates conforms with the Council Directives on the approximation of the laws of the EC member states listed below, following standards or other normative document(s).

The Nanobubble Generator Trinity consists of a minimum of one pump, a pump starter, frame, pressure sensor, solenoid valve, on/off switch, nanobubble generator, pressure gauges, 24V power supply, alarm lights, and a dissolved oxygen sensor.

General Information About the Product

Product Name	Product Variant	General Feature
Trinity S5	Standard	Nanobubble Generator, Rotometer, Gauges, Valves
Trinity L1	Standard	Nanobubble Generator, Rotometer, Gauges, Valves
Trinity L2	Standard	Nanobubble Generator, Rotometer, Gauges, Valves
Trinity L4	Standard	Nanobubble Generator, Rotometer, Gauges, Valves
Trinity L6	Standard	Nanobubble Generator, Rotometer, Gauges, Valves

Applicable Directives

Machinery Directive (2006/42/EC); Low Voltage Directive (2014/35/EU) and EMC Directive (2014/30/EU); Pressure Equipment Directive (2014/68/EU): CATEGORY: SEP; Standard Used: EN ISO 12100:2010; RoHS Directive: 2011/65/EU EN 61000-6-2:2005 & 2015/863/EU; Standard Used: EN 50581:2012

The Technical Construction File is Maintained at:

3232 West El Segundo Boulevard, Hawthorne, CA 90250, USA

The Authorized Representative Located within the Community is:

Jan Eric Haagensen; Ole Dyrengsveg 14, 2340 Løten, Norway

Per Annex II.B of the Machinery Directive (98/37/EC):

The machinery, product, assembly, or sub-assembly covered by this Declaration of Conformity must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the provisions of the applicable Directive(s).

This EU declaration of Conformity is only valid when published as part of the Moleaer, Inc. installation and operating instructions. (Publication numbers; 01/02/03/04/05/06 2019V1/2/3/4/5/6)

Date of Issue: August 2019

Place of issue: Los Angeles, California, USA

Bruce Scholten, CTO

SAFETY INSTRUCTIONS

Section 2 Contents

Important Notice

This guide provides installation and operation instructions for this product. Consult Moleaer with any questions regarding this equipment.

Attention Installer

This guide contains important information about the installation, operation, and safe use of this product. This information should be given to the owner and / or operator of this equipment after installation.

The Trinity nanobubble generator (NBG) must be installed in a sheltered, well-ventilated area to protect it from excess moisture.

Attention User

This manual contains important information that will help you in operating and maintaining this product. Please retain it for future reference. Additional information and resources related to Moleaer products are available at https://www.moleaer.com/portal or call (U.S.) +1 (424) 558-3567 for additional free copies of these instructions.

READ AND FOLLOW ALL INSTRUCTIONS. SAVE THESE INSTRUCTIONS.

This is the safety alert symbol. When you see this symbol, on your system or in this manual, look for one of the following signal words and be alert to the potential for personal injury.

Warns about hazards that can cause death, serious personal injury, or major property damage if ignored.

Warns about hazards that may or can cause minor personal injury or property damage if ignored.

Warns about conditions that can cause a malfunction.

NOTE:

Indicates special instructions not related to hazards. Carefully read and follow all safety instructions in this manual and on equipment. Keep safety labels in good condition; replace if missing or damaged.

When installing and using this electrical equipment, basic safety precautions should always be followed, including the following.

General Warnings

This appliance is not intended for use by persons (including children) of reduced physical, sensory, or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning the use of the appliance by a person responsible for their safety.

DANGER **FAILURE TO FOLLOW ALL INSTRUCTIONS AND WARNINGS CAN RESULT IN SERIOUS BODILY INJURY OR DEATH. THIS EQUIPMENT SHOULD BE INSTALLED AND SERVICED ONLY BY A QUALIFIED SERVICE PROFESSIONAL. INSTALLERS, OPERATORS, AND OWNERS MUST READ THESE WARNINGS AND ALL INSTRUCTIONS IN THE OWNER'S MANUAL BEFORE USING THIS PUMP. THESE WARNINGS AND THE OWNER'S MANUAL MUST BE LEFT WITH THE PRODUCT OWNER.**

Risk of Electrical Shock or Electrocution

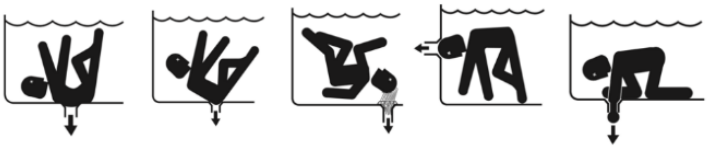
DANGER **ELECTRICAL EQUIPMENT THAT REQUIRES HIGH VOLTAGE CAN SHOCK, BURN, OR CAUSE DEATH.**

High Pressure Hazard

DANGER **STAND CLEAR OF PUMP AND FILTER DURING STARTUP. CIRCULATION SYSTEMS OPERATE UNDER PRESSURE. WHEN ANY PART OF THE CIRCULATING SYSTEM (I.E., LOCKING RING, PUMP, FILTER, VALVES, ETC.) IS SERVICED, AIR CAN ENTER THE SYSTEM AND BECOME PRESSURIZED. PRESSURIZED AIR CAN CAUSE THE PUMP HOUSING COVER, FILTER LID, AND VALVES TO VIOLENTLY SEPARATE, WHICH CAN RESULT IN SEVERE PERSONAL INJURY OR DEATH. FILTER TANK LID AND STRAINER COVER MUST BE PROPERLY SECURED TO PREVENT VIOLENT SEPARATION. STAND CLEAR OF ALL CIRCULATION SYSTEM EQUIPMENT WHEN TURNING ON OR STARTING UP PUMP. BEFORE SERVICING EQUIPMENT, MAKE NOTE OF THE FILTER PRESSURE. BE SURE THAT ALL CONTROLS ARE SET TO ENSURE THE SYSTEM CANNOT INADVERTENTLY START DURING SERVICE. TURN OFF ALL POWER TO THE PUMP.**

Suction Entrapment Hazard

DANGER **STAY OFF THE MAIN DRAIN AND AWAY FROM ALL SUCTION INLETS! FAILURE TO DO SO CAN RESULT IN SERIOUS BODILY INJURY OR DEATH.**



This generator produces high levels of suction and creates a strong vacuum at the main drain at the bottom of the body of water. This suction is so strong that it can trap adults or children under water if they come near a drain or a loose or broken drain cover or grate.

NOTE: All suction plumbing must be installed in accordance with the current local codes, standards, and guidelines.

PRODUCT INTRODUCTION

Section 3 Contents

Introduction

Moleaer Inc. develops industrial-scale nanobubble systems that deliver extraordinary improvements in sustainable food production, chemical-free water treatment, and the recovery of natural resources.

The Moleaer Trinity™ is a nanobubble gas-injection technology tailormade for the food production industry. Its principal function is to harness the power of oxygen to improve the quality of irrigation water, promote plant growth, suppress, or eliminate pathogens, and remove biofilm from surfaces. With simplicity and near-perfect efficiency, the Trinity Nanobubble Generator (NBG) supersaturates water with dissolved oxygen and trillions of nanobubbles. Bubbles of this size exhibit extraordinary properties including neutral buoyancy, high negative surface charge, enormous surface area, and strong oxidation potential. These characteristics enable Moleaer to deliver an easily implemented, sustainable, and cost-effective solution to customers seeking to improve food production and water treatment. The combination of Trinity's high oxygen-enriched efficiency and stable oxygen-enriched nanobubbles enable higher oxygen transfer into the root zone where oxygen enrichment plays an important role in facilitating nutrient absorption and pathogen suppression.

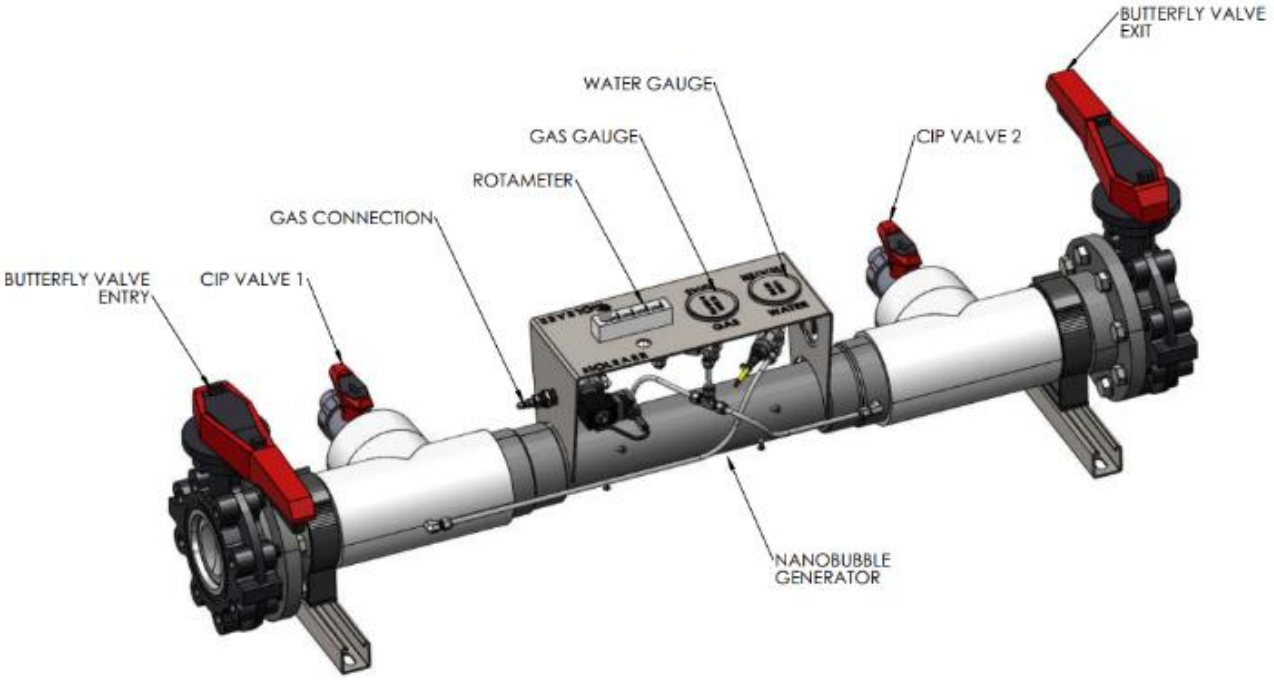
Additional Documents

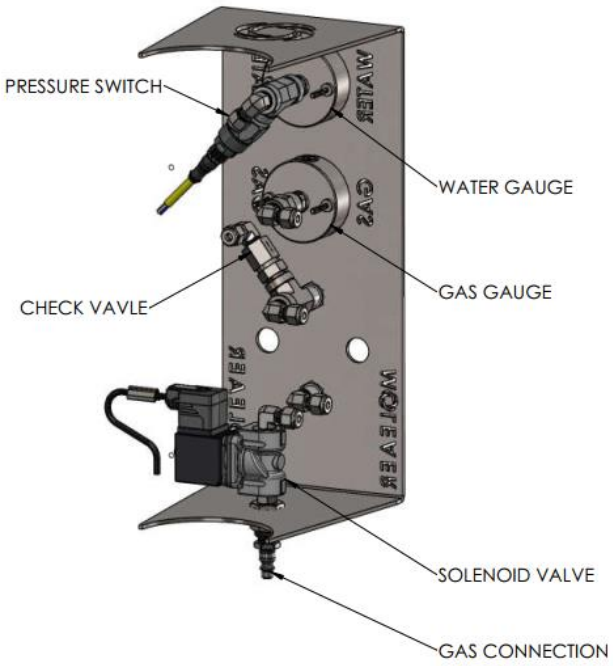
Available upon request.

1. P&ID drawings: Shows unit's process flow, general components specifications (piping and instrumentation), and electrical requirements.
2. Electrical schematics: Detailed electrical wiring and general specifications of the components
3. GAD: General arrangement of the unit, dimensions and information about the inlet, outlet, and customer points of connection port sizes.
4. 3D CAD models: 3D CAD models of the units are available on request. Contact Moleaer.
5. Installation Manual: Provides general instructions to install the product.
6. Installation Drawings: Provides visual installation schematic.

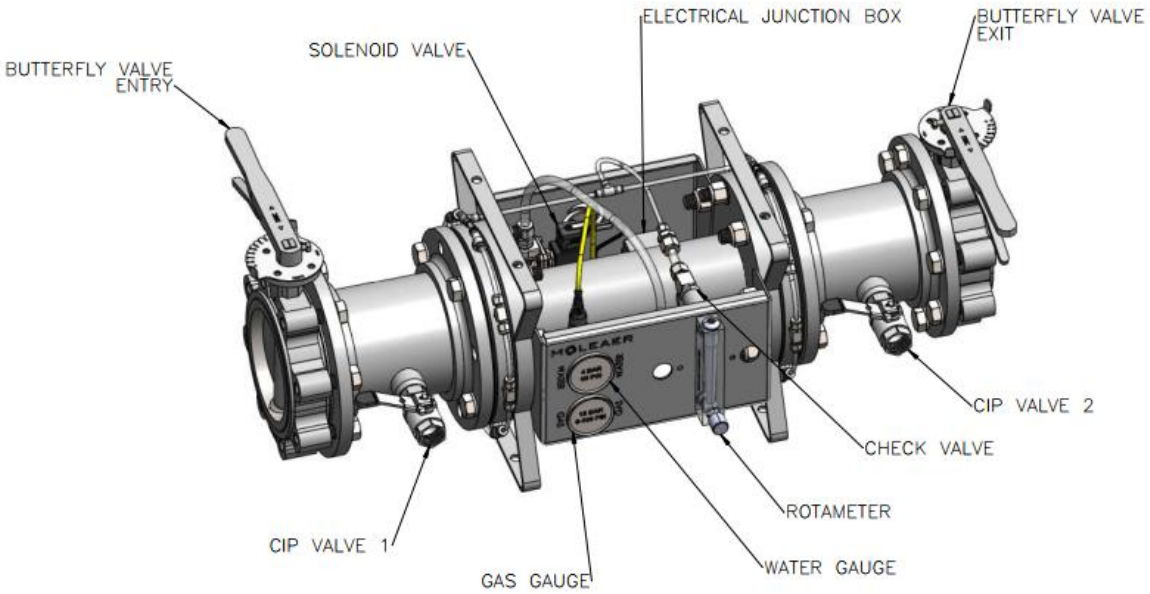
Equipment General Arrangement

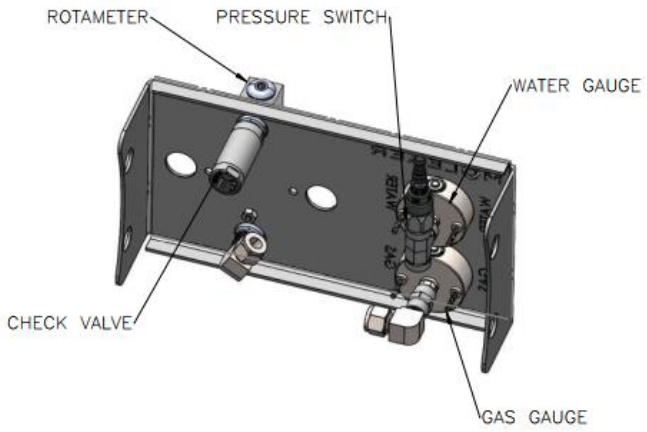
Low Flow

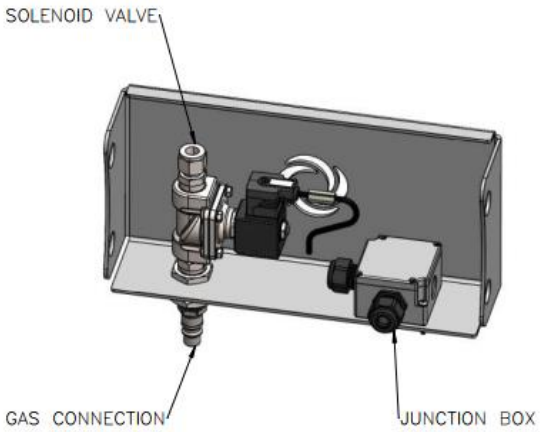




High Flow


ELECTRICAL JUNCTION BOX
BUTTERFLY VALVE EXIT
SOLENOID VALVE
BUTTERFLY VALVE ENTRY
MOLEAER
CIP VALVE 2
CHECK VALVE
ROTAMETER
CIP VALVE 1
WATER GAUGE
GAS GAUGE


ROTAMETER
PRESSURE SWITCH
WATER GAUGE
CHECK VALVE
GAS GAUGE


SOLENOID VALVE
GAS CONNECTION
JUNCTION BOX

INSTALLATION INSTRUCTIONS

Section 4 Contents

General Installation Information

Read these instructions thoroughly prior to assembly and installation.

Only a qualified plumbing professional should install the Moleaer Trinity NBG.

Location Requirements

Be sure the Trinity NBG location meets the following requirements:

1. Provide short, direct suction piping returns (reduces friction loss). For suction lifts over 10 ft (3 m) and liquid temperatures over 120° F (49° C), consult pump performance curve for net positive suction head required (NPSH R).
2. The Trinity NBG should be installed downstream and on the pressure side of the pump.
3. Install the Trinity NBG in a sheltered, well-ventilated area to protect from excess moisture (i.e., rain, splashing, etc.) and flooding.
4. Install and secure the Trinity NBG with the appropriate pipe supports in either a vertical or horizontal orientation.

NOTE: The systems gas rotameter must always be oriented vertically. Adjust orientation with the based on if the Trinity is installed vertically or horizontally.

5. The Trinity generator location should allow access for servicing.

Piping Connections

Intake

1. Be sure all plumbing connections are clean and tight to avoid possible air leaks and entrainment of air on the suction side of the pump.
2. Use larger pipe sizes to reduce head loss. The suction pipe diameter should be the same or larger than the pump inlet.
3. Plumbing on the suction side of the pump should be short as possible.
4. Install piping as close to the water level as possible.
5. Run straight, horizontal piping for the suction side of the pump. Ideally, the length of the piping should be equal to about 3 to 5 times of the pipe diameters.
6. Install intake screen on the intake pipe when solids may be present. Ensure mesh size does not restrict flow at the generator's designed flow rate.

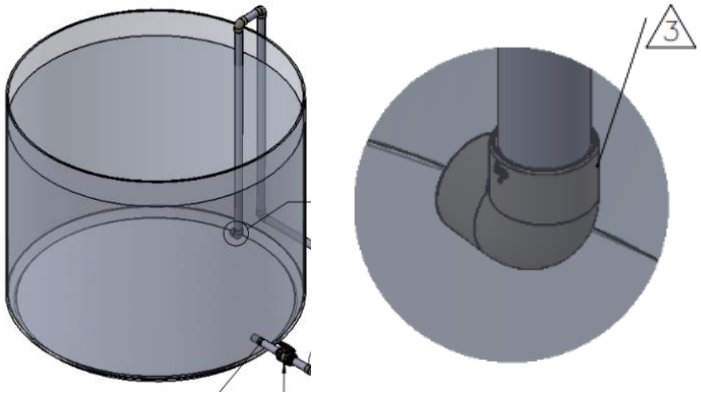
NOTE: If the Trinity generator is installed above the liquid source, the following MUST be provided:

- ***Slope the piping upward from the liquid source.***
- ***Use a foot valve or check valve ONLY, if necessary, for priming or to hold the prime during intermittent duty.***
- ***The suction strainer or suction bell MUST be at least 3 times the suction pipe diameter area.***
- ***Ensure that the size and minimum submergence over the suction inlet is sufficient to prevent air from entering through a suction vortex.***

Discharge

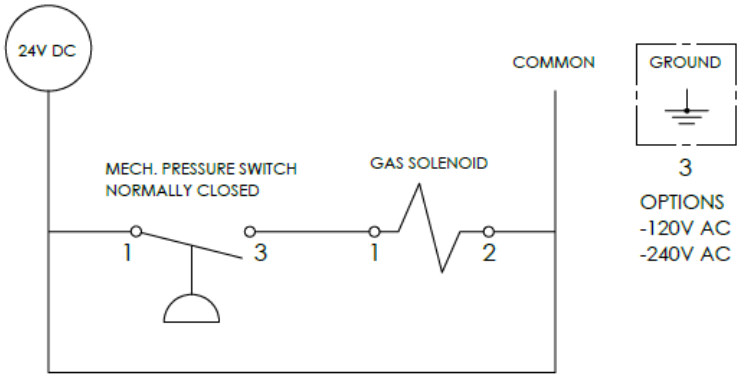
1. Install the discharge pipe as deep as possible to maximize the discharge head.
2. Install a 90 degree elbow on the end of the discharge pipe to direct the oxygen nanobubble water in the desired direction.
3. The recommended discharge orifice size per system flow rate is as follows:

Recommended Discharge Orifice Size	
Trinity System	**Orifice Size**
S5	2” / DN 50
L1	3” / DN 80
L2	5” / DN 125
L4	6”/ DN 150
L6	8” / DN 200



Valves

CAUTION **Leaving the oxygen valve open when the pump is operational may cause loss of prime.**



1. Use a check valve in the discharge line when using this pump for any application where there is significant height to the plumbing after the pump.
2. Be sure to install check valves when plumbing in parallel with another pump. This helps prevent reverse rotation of the impeller and motor.
3. Optional: Install a diaphragm valve on the discharge line, closest to the point of discharge to enable hydraulic pressure and flow modulation.

Electrical

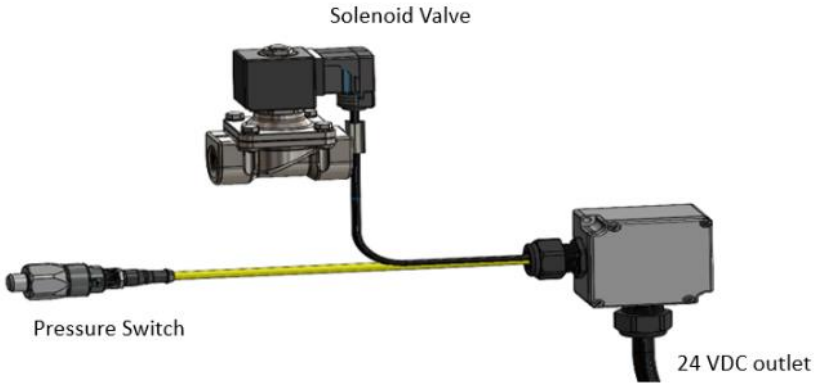
WARNING **Install all equipment in accordance with the National Electrical Code and all applicable local codes and ordinances.**

The Trinity NBG must be installed by a licensed or certified electrician or a qualified service professional in accordance with the National Electrical Code and all applicable local codes and ordinances. Improper installation will create an electrical hazard that could result in death or serious injury to users, installers, or others due to electrical shock, and may also cause damage to property.

DANGER **ALWAYS DISCONNECT POWER TO THE TRINITY GENERATOR AT THE CIRCUIT BREAKER BEFORE SERVICING THE PUMP. FAILURE TO DO SO COULD RESULT IN DEATH OR SERIOUS INJURY TO SERVICE PEOPLE, USERS, OR OTHERS DUE TO ELECTRIC SHOCK.**

A means for disconnection must be incorporated in the fixed wiring in accordance with the wiring rules.

- Solenoid needs to be operated by onsite controls in parallel with the pump circuit.
- If the pump is on and there is sufficient water pressure, the solenoid opens, allowing the gas to pass through.



Stray Current Corrosion and Prevention

WARNING **POTENTIONAL SHOCK HAZARD ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER.**

Ensure all electrical connections and equipment are properly grounded.

Regularly inspect and maintain electrical systems.

Install ground-fault circuit interrupters (GFCIs) where applicable.

Follow stray voltage prevention best practices for installation.

Overview

The Moleaer Trinity product incorporates various internal components made from stainless steel 316, known for its superior corrosion resistance and strength. Despite the robust nature of stainless steel 316, it is imperative to understand the potential risks posed by stray currents in the operational environment of the Trinity product.

Stray Current Corrosion

Stray current corrosion occurs when electrical currents unintentionally flow through metallic materials in an electrolytic environment. This can lead to accelerated corrosion through an electrochemical process known as electrolysis. In such a scenario, parts of the metal act as an anode, where metal ions are lost to the electrolyte, while other parts act as a cathode, potentially leading to material deposition. The presence of stray current can significantly expedite the corrosion process, undermining the integrity and longevity of the stainless-steel components.

Risks to Moleaer Trinity System

Given the Trinity product's reliance on stainless steel 316 components for its operation, undetected stray currents pose a significant risk. The accelerated corrosion can compromise the product's performance, safety, and durability.

Prevention and Mitigation

To safeguard the Trinity product from the adverse effects of stray current corrosion, it is crucial to implement the following strategies:

Inspection and Monitoring

Regularly inspect the operational environment for sources of stray current and monitor the condition of stainless-steel components for signs of corrosion. Early detection is key to preventing significant damage.

1. **Proper Grounding:** Ensure that all electrical and electronic equipment in the vicinity of the Trinity product is properly grounded. This helps in minimizing the risk of stray currents entering the system. Additional prevention measures such as utilizing grounding wires on each Trinity system can also be implemented.
2. **Use of sacrificial anodes:** Where feasible, incorporate sacrificial anodes between the pump and the Trinity product.
3. **Professional Consultation:** In environments known for high risks of electrical interference, consult with a corrosion specialist or an electrical engineer to evaluate the setup and recommend specific preventive measures tailored to your operational context

Gas Components

Specification

The Moleaer Trinity NBG is designed for use with compressed oxygen.

⚠WARNING **DO NOT MIX GASES WITH THIS SYSTEM.**

ALL GAS FITTINGS AND HOSES MUST BE MAINTAINED FREE FROM OIL AND LUBRICANTS.

⚠ DANGER **DO NOT PERMIT SMOKING OR OPEN FLAMES IN ANY AREAS WHERE LIQUID OXYGEN IS STORED OR HANDLED. THE TRINITY GENERATOR MUST BE SEPARATED FROM FLAMMABLES AND COMBUSTIBLES BY AT LEAST 20 FEET OR A HALF-HOUR FIREWALL.**

Connection

Connect the air or oxygen supply hose or fitting to the unit. Refer to the P&ID and the GAD drawings for the points of connections and the port sizes.

Flow and Pressure

1. Adjust the gas regulator on the feed gas tank or oxygen concentration (PSA) to supply the Trinity generator with a minimum gas pressure of 10 PSI (0.6 Bar) above the water pressure.

⚠WARNING **DO NOT EXCEED 140 PSI (9.65 BAR) IN GAS PRESSURE. EXCESSIVE GAS PRESSURE MAY COMPROMISE SEALS INSIDE THE GENERATOR AND RESULT IN A SUDDEN DROP IN PRESSURE. IF THIS OCCURS, CLOSE THE GAS FLOW METER COMPLETELY, REDUCE THE GAS PRESSURE FEEDING THE GENERATOR, AND THEN SLOWLY REOPEN THE VALVE AGAIN TO THE DESIRED GAS FLOW SET POINT.**

2. Apply soap water to gas fittings and connectors to ensure there are no gas leaks. If leaks are detected, then tighten fittings and/or connectors.

3. Gas flow rates can be adjusted depending on the application and desired effect. The Trinity generators are designed to deliver a spectrum of nano and/or microbubbles to meet the requirements of the process or application. Low gas flow rates produce more nanobubbles and have a higher gas transfer efficiency, whereas higher gas flow rates produce both nano and microbubbles that have a lower gas transfer efficiency but a higher mass transfer rate.

OPERATION MANUAL

Section 5 Contents

Nanobubble Generator Operation

CAUTION **The pump must be fully primed before operation. Refer to installation manual for more details.**

WARNING **OPERATION AT OR NEAR ZERO WATER FLOW CAN CAUSE EXTREME HEAT, PERSONAL INJURY, OR PROPERTY DAMAGE.**

1. Open intake and discharge valves to flood piping and prime the pump.

NOTE: If the pump and the Trinity generator is located above the water line of the tank or water body, it is important to install a check valve just above the intake screen.

WARNING **DO NOT EXCEED 100 PSI (7 BAR) WATER PRESSURE.**

2. Turn on the pump starter switch and run pump at normal operating conditions and check the piping for visible leaks. If necessary, adjust the pipe supports.

NOTE: Confirm the pump flow rate. Pump flow rates should be within the recommended flow range for the distinct Trinity series. Pump flow rates lower than the system specifications will affect system performance and are not recommended.

3. Open the needle valve on the Gas Flow Meter and set oxygen flow at the desired injection rate.
4. Adjust discharge line valves to desired water flow rate and hydraulic pressure.

Startup

Use the following sequence to start the Trinity NBG.

Step 1. Close the clean in place (CIP) valves.

Step 2. Open the butterfly valves.

Step 3. Close the rotameter completely by turning the rotameter knob counterclockwise.

Step 4. Turn the rotameter knob clockwise and make three complete turns.

Step 5. Make sure there is at least 45 PSIG (3.10 Barg) of gas pressure available from the gas source. Do not open the gas source.

Step 6. Power up the unit. Most units are powered by a 24 VDC signal with an amp draw of less than 2. The sticker on the equipment must show the power requirement for the unit.

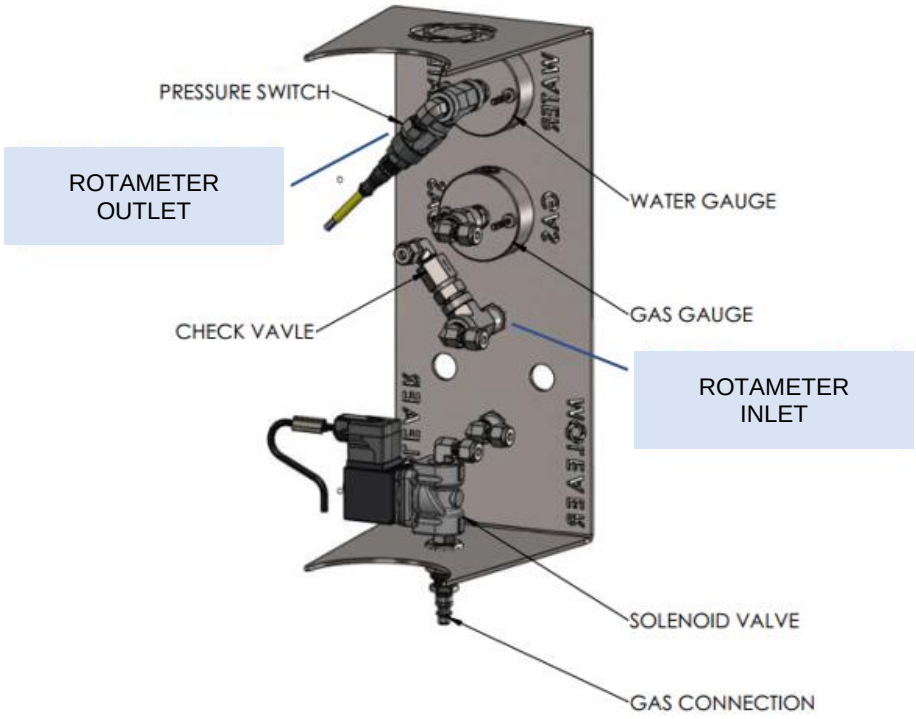
The unit is equipped with a pressure switch. The switch allows the solenoid valve to let the gas in if the water pressure is more than 6 PSIG (0.4 Barg). If the water pressure is less than 6 PSIG (0.4 Barg), the user must find a method to increase the water pressure by either increasing the pump speed or the pump head.

Backflow to Rotameter

While the solenoid valve is closed (during the shutdown period or at the low-water-pressure condition), it is normal for the water to backflow into the gas tubing and reach the outlet of the rotameter.

CAUTION **If the rotameter is filled with water, the check valve must be inspected. while the unit is turned off and inlet and outlet butterfly valves are isolated.**

See the following figure for the rotameter and check valve schematic. Always disconnect power from the equipment before troubleshooting.



Step 7. Open the gas source slowly and allow the equipment to build gas pressure. As soon as the gas pressure exceeds about 10 PSI (0.6 Bar) over the water pressure, the rotameter should start showing the gas flow.

Step 8. Depending on the available gas pressure, and the desired dissolved oxygen (consult the datasheet and your Moleaer's sales rep if needed), the gas flow and pressure can be adjusted by the rotameter's knob. Note that the pressure and flow are codependent, in other words, higher gas flow on the rotameter requires higher gas pressure.

Step 9. Allow the unit to run for at least five minutes and look for any audible or visual leak in the equipment. Address the leakage as necessary. Use hand soap water if needed on the gas fittings.

Step 10. The equipment should be running continuously at this point. The solenoid valve allows the gas in if there is sufficient water and gas pressure. Low water pressure closes the solenoid valve and low gas pressure drops the rotameter indicator.

NOTE: Since every installation is different, the 10 PSI (0.6 Bar) pressure difference between the water and gas pressure may differ from one installation to another. The best indication of the gas flow is the displacement of the rotameter indicator from the bottom of the rotameter scale.

Winterizing

Trinity is designed for indoor applications where temperature is controlled. However, if it is installed outdoors or in areas where temperature can go below freezing, some precautions must be taken to avoid potential equipment and system failures. polyvinyl chloride (PVC) pipes are in danger of freeze-cracking when the ambient temperature approaches 19.4°F (-7°C). Ice begins to form and gradually blocks the pipe. This blockage causes a rise in water pressure. Eventually, the pipe ruptures and damages the equipment. Some advanced planning will assist you in keeping your pipes intact during winter months. As a rule, pipes should be buried at least 12 in. (30 cm) below normal frost depth. Both intake and discharge (including goosenecks) should also be below frost depth. The impact strength of PVC pipe decreases during cold weather. At 32° F (0° C), however, the pipe still maintains 70% to 90% of its 73° F (23° C) strength.

NOTE: Winterizing is a good time to lubricate the pump lid o-rings.

Preparation For Above Water-Freezing Temperature

Insulate exposed pipes. Wrap pipes with thermal insulation or heat tape. Four types of thermal insulation are available for water pipes and each one is assigned an R value. The R value indicates the heat retention for each material. spiral wrap is the lowest cost and has the lowest R value and the most difficult installation process. R 4 foam tubing is highly recommended. Measure the insulation and trim to the pipe length. Seal the insulation using duct tape.

Preparation For Below Water-Freezing Temperature

If there is a chance that the system is going to lose power, then drain the system:

1. Open the pump lid and remove the drain valve or plug at the bottom of the pump housing.
2. Drain the whole system.
3. Re-install the valve or plug and loosely install the pump lid.
4. Remove the stainless steel (SS) plug from the lower discharge side of the nanobubble generator block.

⚠WARNING **When using compressed air to blow out the system, wear appropriate eye protection and stand away from the unit.**

5. Remove any sensors prior to system blowout.
6. Blowout the system. Do not use pressure above 51 PSI (3.5 Bar). Do not blowout the system from the pump.
7. Close the isolation valves after blowout.
8. Add 1 quart (1 liter) of food grade propylene glycol to any water remaining in the unit.
9. Leave the unit off until the temperature remains above 32° F (0° C) for 24 hours.

⚠WARNING **Always disconnect power to the Trinity at the circuit breaker before servicing the pump. Failure to do so could result in death or serious injury to service people, users, or others due to electric shock. Read all servicing instructions before draining the pump.**

Cleaning and Sanitizing

Cleaning the fluid circuit is an important part of the NBG operation. The NBG can become contaminated after it has been used for some time. Pollutants such as colloids, biofilms, mineral scales, and biological matter build up over time. Contaminants can be absorbed by the diffuser surface and the pipes in the system, resulting in decreased performance and possibly serious damage. Periodic cleaning is essential to optimal system performance. The frequency of cleaning depends upon the water quality and local environmental factors. Moleaer recommends that all NBGs be cleaned at least monthly.

Cleaning of an NBG system is usually indicated by the following operating conditions:

- The system is unable to reach 80% of the specified nominal gas flow with the gas flow valve wide open (see data sheet for each NBG to identify nominal gas flow for each system).
- The normal increase in dissolved oxygen in one pass has decreased by 25%.
- The pressure of the gas injection required to maintain gas flow exceeds the supply gas pressure.

⚠CAUTION **If cleaning is delayed too long, a complete recovery of the unit may not be possible.**

Safety Precautions

When using any chemical indicated here or in subsequent sections, follow accepted safety practices. Consult the chemical manufacturer for detailed information about safety, handling, and disposal.

Each cleaning situation is different; therefore, specific cleaning recommendations are dependent on the type of foulant. Consult the general cleaning instructions for information that is common to all types of cleaning, such as suggested equipment, pH and temperature limits, and recommended flow rates. Apply the specific recommendations as needed.

Cleaning solution temperature must not exceed 212° F (100° C).

Cleaning solution pH range is 2 to 4.

Preparation

When preparing cleaning solutions, ensure that all chemicals are dissolved and well mixed before circulating the solutions through the system. See the Recommended Clean Solutions Chart in this section.

It is recommended that the system be flushed with good-quality water (68° F (20° C) minimum temperature) after cleaning. City or well water of drinking water quality is recommended. Care should be taken to operate initially at a reduced flow and pressure to flush the bulk of the cleaning solution from the system before resuming normal operating pressures and flows. Despite this precaution, cleaning chemicals will be present on the treated water side following cleaning. Therefore, the treated water should be diverted to a drain for at least 30 minutes or until the water is clear when starting up after cleaning.

During the recirculation of cleaning solutions, the maximum temperature must not be exceeded. The maximum allowed temperature is dependent on pH and material type. (See datasheet or consult Moleaer Sales or Tech Service for guidance.)

Ensure the system power is disconnected during cleaning procedures to avoid accidental startup of the pump or gas production system.

⚠CAUTION **Closing the main valves and starting the main pump system may result in either piping failures or pump seal failures.**

NOTE: The maximum temperature limit during cleaning is 113° F (45°C) for all PVC systems.

NOTE: The minimum and maximum pH limits for all PVC systems are 1 and 13, respectively.

Cleaning

The cleaning procedure of an NBG system consists of the following process steps.

Step 1. **Production of the Cleaning Fluid:** The fluids used for the cleaning process need to be of a certain pH, and all chemicals must be dissolved and mixed before the cleaning fluid is added into the NBG.

Step 2. **Removal of Feed Water from Piping that Will be Treated with the Cleaning Fluid:** This includes closing the main isolation valves for process flow.

Step 3. **Low-Flow Recirculation Through the System via the Clean in Place (CIP) Valves:** The cleaning fluid is now in the system, and the feed water has been forced out of the system.

Step 4. **Soaking in the Cleaning Fluid:** The pump is shut off, and the cleaning fluid will soak into the NBG.

Step 5. **Drainage of the Cleaned Piping:** The applied cleaning fluid is pumped out of the system. By sampling the cleaning fluid and analyzing the samples, one can determine the amount of contamination.

Step 6. **Rinsing Out the System:** For the rinsing process, either clean or good quality water is used.

Step 7. **Starting Up the Cleaned System:** The installation is started up according to the usual process parameters. When cleaning fluid is still present in the piping, the system needs to be rinsed until the water quality is satisfactory.

Recommended Cleaning Solutions						
Foulant	**Cleaning Solution**					
	0.1% (W) NaOH and 1.0% (W) Na_4EDTA, pH 12, 35° C Max.	**0.1% (W) NaOH and 0.025% (W) Na-DSS, pH 12, 35°C Max.**	**0.2% (W) HCl, 25°C and pH 1 to 2**	**1.0% (W) $Na_2S_2O_4$, 25°C and pH 5**	**0.5% (W) H_3PO_4, 25°C and pH 1 to 2**	**1.0% (W) NH_2SO_3H, 25°C and pH 3 to 4**
Inorganic Scales (i.e., $CaCO_3$)			Preferred	Alternative	Alternative	
Sulfate Scales ($CaSO_4$, $BaSO_4$)	OK					
Metal Oxides (i.e., iron)				Preferred	Alternative	Alternative
Inorganic Colloids (silt)		Preferred				
Silica	Alternative	Preferred				
Biofilms	Alternative	Preferred				
Organic	Alternative	Preferred				

Stray Current Corrosion and Prevention

Overview

The Moleaer Trinity product incorporates various internal components made from stainless steel 316, known for its superior corrosion resistance and strength. Despite the robust nature of stainless steel 316, it is imperative to understand the potential risks posed by stray currents in the operational environment of the Trinity product.

Stray Current Corrosion

Stray current corrosion occurs when electrical currents unintentionally flow through metallic materials in an electrolytic environment. This can lead to accelerated corrosion through an electrochemical process known as electrolysis. In such a scenario, parts of the metal act as an anode, where metal ions are lost to the electrolyte, while other parts act as a cathode, potentially leading to material deposition. The presence of stray current can significantly expedite the corrosion process, undermining the integrity and longevity of the stainless-steel components.

Risks to Moleaer Trinity System

Given the Trinity product's reliance on stainless steel 316 components for its operation, undetected stray currents pose a significant risk. The accelerated corrosion can compromise the product's performance, safety, and durability.

Prevention and Mitigation

To safeguard the Trinity product from the adverse effects of stray current corrosion, it is crucial to implement the following strategies:

Inspection and Monitoring: Regularly inspect the operational environment for sources of stray current and monitor the condition of stainless-steel components for signs of corrosion. Early detection is key to preventing significant damage.

1. **Proper Grounding**: Ensure that all electrical and electronic equipment in the vicinity of the Trinity product is properly grounded. This helps in minimizing the risk of stray currents entering the system. Additional prevention measures such as utilizing grounding wires on each Trinity system can also be implemented.

2. **Use of sacrificial anodes:** Where feasible, incorporate sacrificial anodes between the pump and the Trinity product.

3. **Professional Consultation:** In environments known for high risks of electrical interference, consult with a corrosion specialist or an electrical engineer to evaluate the setup and recommend specific preventive measures tailored to your operational context.

System Troubleshooting		
Problem	**Possible Cause**	**Corrective Action**
External Pump will not prime	• Air circulating in system. • Gas valve opens when pump not running. • No water in pump strainer pot.	• Check suction piping and valve on any suction gate valves. • Secure the lid on pump strainer pot and be sure lid gasket is in place. Check water level to make sure suction port is not drawing air. • Be sure suction lines, pump strainer, and pump volute are full of water. Be sure valve on suction line is working and open (some systems do not have valves).
Pump motor not running (for external pumps power via Trinity control panel)	• Open circuit breaker or blown fuse. • Pump Impeller binding. • Pump improperly wired. • Defective pump motor.	• Reset breaker or replace fuse. • Clear impeller. • Check pump wired correctly.
Reduced capacity and/or head	• Air pockets or leaks in suction line. • Pump will not prime - too much air.	• Check suction piping and valve on any valve suction gate valves. • Clean pump strainer pot. • Check to see if impeller is clogged.
Insufficient dissolved oxygen saturation	• Vacuum leaks in suction line. • Gas flow too low. • Gas leaks. • Hydraulic pressure is too high relative to gas pressure. • Internal fouling or scaling. • Discharge orifice too large / discharge hydraulic pressure too low.	• Check plumbing connections and suction piping. Check to be sure suction port is not drawing air into the system. • Increase gas flow. • Increase gas pressure / Reduce hydraulic pressure. • Check for gas leaks. • Perform CIP. • Increase system run time. • Reduce discharge orifice size / increase hydraulic pressure.

System Troubleshooting		
Problem	**Possible Cause**	**Corrective Action**
Excessive power consumption	• Impeller binding. • NPSH too low – excessive suction lift or losses. • Discharge head too low – excessive flow rate.	• Clear the impeller. • Check the pump curve for NPSH requirements. • Check the flow.
Pump flow too low	• Voltage too low.	• Check and correct the voltage.
Pump back pressure too high	• Discharge nozzle or piping obstructed. • Discharge valve engaged too much.	• Check for blockage in piping. • Ensure all valves are fully open.
Low gas pressure on system gauge	• Feed gas pressure too low. • Internal fouling.	• Follow specified “clean-in-place” procedures to internal cleaning. • Increase flow rate. • Check for stray current and signs for any advanced corrosion.
Gas flow too low	• Feed gas pressure too low • Internal fouling	• Follow specified “clean-in-place” procedures to internal cleaning. • Increase feed gas pressure • Check for restrictions in the gas line
Gas flow meter not working	• Moisture in the rotameter. • Blockage of the check valve.	• Disassemble the rotameter by take the top screw off and dry the components. • Disassemble and clean or, replace the check valve.
Too many large bubbles	• Gas flow too high. • Discharge orifice too large / discharge hydraulic pressure too low.	• Reduce gas flow. • Reduce discharge orifice size / increase hydraulic pressure.

System Troubleshooting		
Problem	**Possible Cause**	**Corrective Action**
Insufficient gas transfer	• Feed gas pressure too low. • Delta gas pressure out of range. • Excessive moisture and / or contaminant in the gas line. • Internal system fouling. • Discharge orifice too large / discharge hydraulic pressure too low.	• Increase feed gas pressure at the gas regulator. • Clean rotameter, gas lines, and fittings. • Follow specified “clean-in-place” procedures for internal cleaning. • Reduce discharge orifice size / increase hydraulic pressure.

MONTHLY INSPECTION

Section 6 Contents

Monthly Inspection Checklist

Monthly Inspection Checklist			
Checked	**Model**	**Component**	**Description**
☐	All	Gas Leakage	Use soap water to check the gas leakage on the joints and fittings. Check for signs of cracking on the tubes.
☐	All	Water Pressure	Check water pressure gauge. Note reading and compare with the previous readings.
☐	All	Gas Pressure	Check gas pressure gauge. Note the reading and compare with previous readings.
☐	All	Rotameter	Check rotameter value and compare with previous readings. The combination of low flow and low pressure is an indication of fouling. Follow CIP instructions.
☐	All	Visual Inspection	Check gas tubing and look for spots with condensation, and heat marks. Detached tubes to drain any condensed water.
☐	All	CIP	Use the CIP tool to clean the NBG. Refer to CIP bulletin for details. The CIP tool can be purchased from Moleaer.

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