Liquiflo Chemical Processing Pumps

Endura® AB-Series General Description

The patented Endura-AB is an **A**ir **B**arrier, magnetically coupled end-suction centrifugal pump series that is capable of pumping solids and dry-running indefinitely. It is manufactured by Liquiflo Equipment Company and is available in Long-Coupled (Power Frame) or Close-Coupled (C-Face mounting) styles.

DIMENSIONAL ENVELOPE

The **long-coupled** option is dimensionally in full compliance with the ANSI B73.1 specification and **will retrofit any existing ANSI pump installation**.

The **close-coupled** option requires **no piping modifications**. The magnetic coupling mounts directly on the motor shaft, requiring the motor to be moved forward. This C-Face mounting eliminates the need for manual coupling alignment.

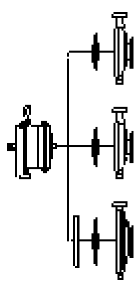
The back pull-out design enables the removal of the rotating assembly without removing the casing from the piping.

AVAILABLE STANDARD SIZES

Group I:	Max RPM
1.5x1x6	3550
3x1.5x6	3550
1.5x1x8	3550

Group II:	Max RPM
3x2x8	3550

Group I

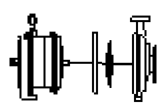


1½x1x6

3x1½x6

1½x1x8

Group II



3x2x8

IMPELLER

All Group I AB Pumps are a closed impeller design. The Group II AB Pump is an open impeller design.

FLANGES

The AB is fitted with a standard 150# serrated Raised Face flanged casing. 300# serrated Raised Face flanged casings are optional.

MATERIALS

The standard option for the pump basic material is 316 Stainless Steel. Consult the factory for the availability, price and delivery of non-standard materials.

O-RINGS

Teflon O-rings are standard for the casing and containment can. The gas seal O-ring package consists of five O-rings and is available in Viton or Kalrez. See page 4 or consult the factory for other materials.

TEMPERATURE RANGE

The standard AB pump can be applied at temperatures between –60 °F and +350 °F.

PRESSURE CAPABILITY

AB pumps are rated for 275 PSIG at temperatures between –60 °F and +100 °F. Above 100 °F, the rated pressure is linearly de-rated. At 350 °F, the rated pressure is 205 PSIG (316 SS).

CONTAINMENT SHELL

The AB containment shell is made from Transformation-Toughened Zirconia (TTZ) and is hydrostatically tested at 412 PSI. TTZ is a non-conductive ceramic material, and therefore does not experience eddy current losses, as a metal containment shell does. As a result, the overall pump efficiency of the AB design is substantially higher than that of the regular mag-drives that use metal containment shells.

BEARINGS

The AB design stands out from other mag-drives because it combines the seal-less mag-drive feature and a gas seal, which prevents pumped fluid from entering the containment shell area. The gas seal is positioned directly behind the impeller, with the rotary portion mounted on the rear impeller shroud. This allows the radial bearing to be positioned very close to the impeller, with an extremely small overhang length (L). Since there is no liquid at the back end, regular lubricated-for-life antifriction ball bearings are used. The "stiffness ratio" ($S=L^3/D^4$, where "D" equals the shaft diameter) is very small. The ratio for AB pumps equals 9.3, as opposed to other ANSI pump design ratios that are much higher, ranging from 20 to 120. These very robust AB shafts virtually eliminate shaft deflections, making the AB capable of withstanding significant hydraulic radial loads that are present at low flow operations.

MINIMUM FLOW RATE

A generally accepted industry practice for minimum flow rate is 15% of the flow rate at the Best Efficiency Point (BEP).

LOSS OF SUCTION, CAVITATION, DRY-RUNNING & RUN-OUT OPERATION

The loss of suction is not a problem for the AB design, as long as the gas pressure in the containment is maintained.

For regular mag-drives, cavitation is a serious problem. Cavitation vaporizes liquids, thus starving the mag-drive journal bearings from the essential lubrication the pumped product provides. The AB design does not use journal sleeve bearings; therefore, the loss of liquid during cavitation is not a problem, and pump failure is prevented. However, other cavitation-related effects, such as impeller and casing damage, can still occur. These are strictly a function of the wet-end material selection for cavitation resistance.

The run-out operation usually presents two problems for pumps: motor overload and insufficient NPSH at the run-out condition. The overload of the motor is an issue for AB pumps, but the NPSH issue is not as critical as it is for other pump types. Run-out may cause pumps to cavitate, but because of its dry-running capability, the AB pump will simply continue to run and will resume pumping once the run-out problem is rectified.

SOLIDS HANDLING CAPABILITY

Standard mag-drives cannot tolerate solids because they clog up the sleeve bearings. The bearings of AB mag-drives are isolated from the process fluid and, therefore, can pump solids. The AB pump can handle up to 40% solids by weight, and in certain cases, even higher.

MAXIMUM VISCOSITY

The maximum viscosity of the AB pump is similar to any comparable ANSI pump and is generally applied under 200 centipoise (cP). For fluid viscosities over 2 cP, a Viscosity Correction per Standard ANSI/HI 9.6.7 is required to size the pump and motor. Consult Liquiflo or the local distributor for assistance with sizing of viscous fluid applications.

VENT & DRAIN

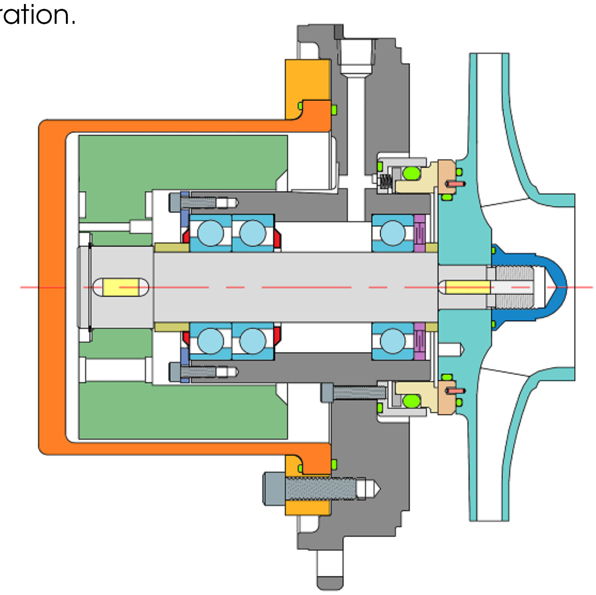
The AB pump is self-venting due to its top discharge, ANSI design, and is supplied with a standard ½" NPT drain plug on the front of the casing.

FEATURES & ADVANTAGES

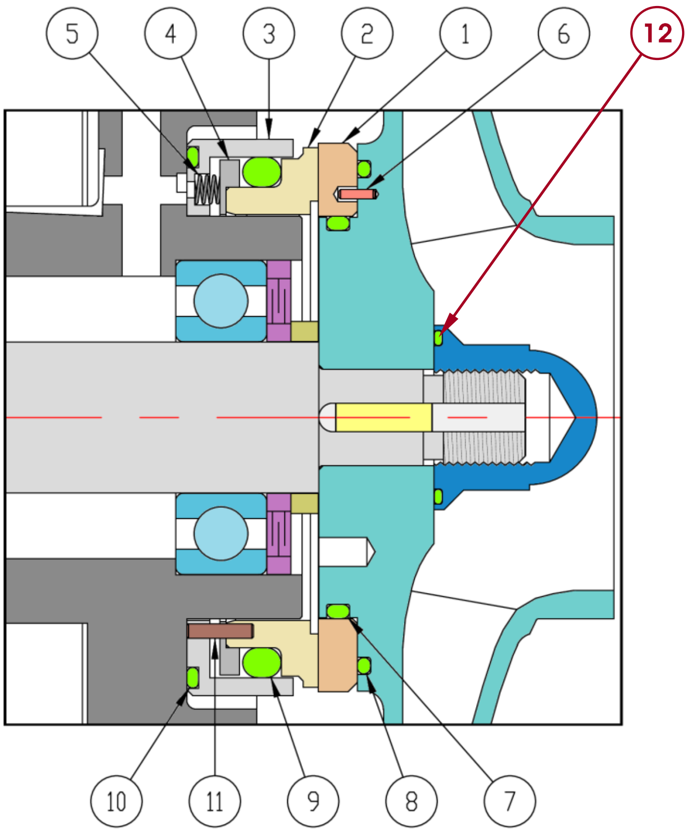
- Indefinite dry-running capability
- Can pump fluids containing up to 40% solids
- Impeller is keyed to the shaft and attached with a nut to prevent backing off into casing if rotation is incorrect
- Shaft is oversized to minimize deflections (lowest L^3/D^4 ratio – 9.3)
- Greased-for-life antifriction ball bearings
- Inherent secondary containment (gas seal is primary containment)
- TTZ ceramic containment can eliminates eddy current power losses
- Close-coupled or Power Frame mounting options
- ANSI-dimensional for easy change out
- Back pullout and modular design simplifies maintenance

RECOMMENDED SPARES

AB Module – Complete spare rotating assembly. The module is a complete pump, less the casing, outer magnet and mounting bracket. It is recommended when a quick turn-around is essential for plant operation.



Barrier Seal Assembly Package – When servicing the pump, it is recommended to buy the *Barrier Seal Assembly Package*, which contains all parts to replace the pump's seal, as well as the Impeller Nut O-ring. The 3-digit part number suffix denotes the material of the O-rings (as shown in the lower table).



Barrier Seal Assembly – Parts List		
Item	**Req.**	**Description**
1	1	Mating Ring (Rotating Face)
2	1	Primary Ring (Stationary Face)
3	1	Retainer, Barrier Seal
4	1	Disc, Barrier Seal
5	4	Spring, Barrier Seal
6	2	Pin, Rotating Face
7	1	O-Ring, Positioning (2-143)
8	1	O-Ring, Sealing (2-151)
9	1	O-Ring, Dynamic (2-337)
10	1	O-Ring, Retainer (2-152)
11	2	Pin, Stationary Face*
12	1	O-ring, Impeller Nut

* Pins for Stationary Seal Face are integrated with the Seal Retainer (Item 3).

Note: Item 12 (O-ring, Impeller Nut) is not part of the Barrier Seal but is included with the Barrier Seal Assembly Package.

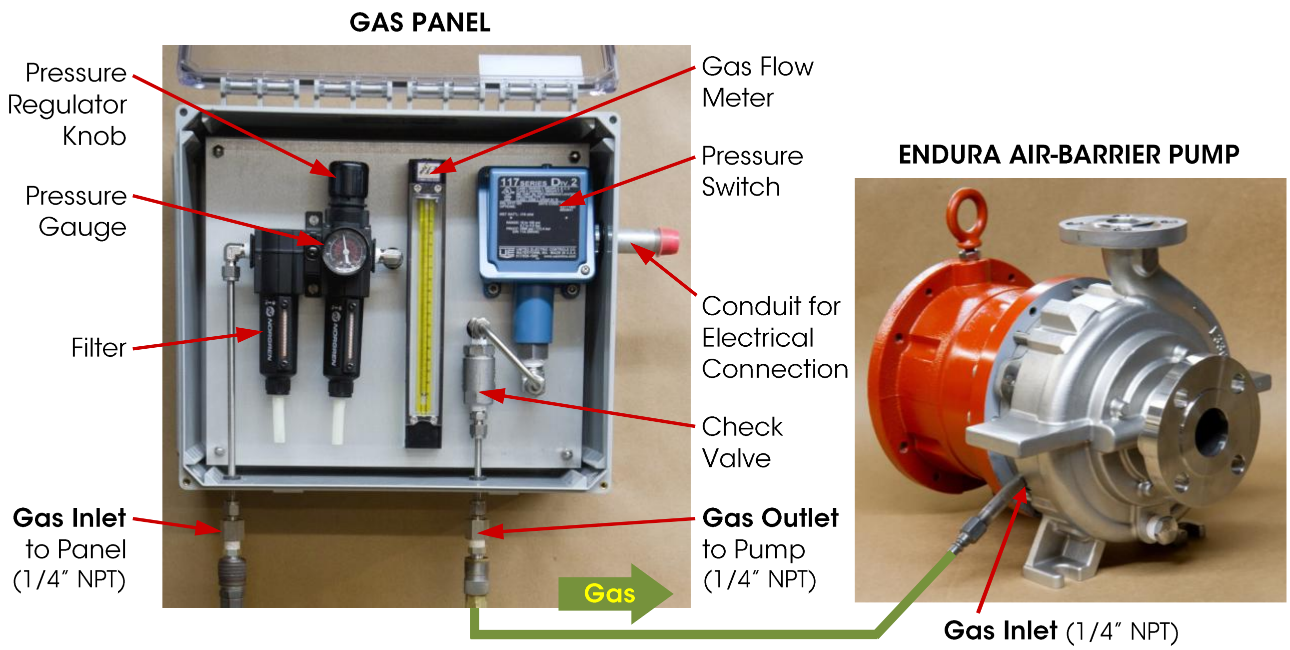
Barrier Seal Assembly Package – Parts Numbers & Materials			
Part Number	**Seal Faces**	**Hardware**	**O-Rings**
2981-151	Silicon Carbide	316 SS	Viton
2981-152	Silicon Carbide	316 SS	EPDM
2981-153	Silicon Carbide	316 SS	Kalrez 4079
2981-154	Silicon Carbide	316 SS	Kalrez 1050LF

Spare Parts – All individual parts can be purchased separately (refer to pump Bill of Materials).

BARRIER SEAL OPERATION

The Barrier gas seal is at the heart of this patented pump design. It uses pressurized gas (typically nitrogen) to provide "lift-off" between the seal faces, allowing them to operate without mechanical contact; thus, the seal's life is theoretically indefinite, because the faces do not contact each other and therefore do not wear out. When the pump is idle, however, the seal faces do shut, providing further protection (in addition to the gas pressure), by preventing process liquid from leaking into the containment shell. The gas support system is shown and explained below:

BARRIER SEAL GAS SUPPORT SYSTEM



The supplied gas must be clean, dry, pressure-regulated, and **available at all times – regardless of whether the pump is running or idle**. The required gas pressure is dependent on the operating conditions. Generally, the pressure should be adjusted such that the flow meter reading is between 60 and 70 units, and never outside the range of 30 to 120 units.

The Principle of the Gas Supply System:

Clean, dry nitrogen (or a similar gas) is supplied by the plant system or from a gas tank or bottle. Typically, a high-pressure regulator is used to reduce the pressure prior to entering the panel, to **100 PSIG**.

Inside the panel is a **filter**, followed by the **low-pressure regulator** (refer to the panel photo above). The low-pressure regulator is rated to 250 PSIG, but the overall panel pressure rating is limited to 200 PSIG by the rating of the gas flow meter. Rotate the top knob <u>clockwise to increase</u> the pressure or <u>counterclockwise to decrease</u> the pressure as necessary. Once the pressure is set, the knob can be locked (by pushing it down) to prevent accidental readjustment.

The **gas flow meter** follows the pressure regulator. It measures the gas flow in units which also depend on gas pressure. However, in practice, gas flow is more conveniently expressed in standard cubic feet per minute (SCFM). The approximate conversion formula is:

$$\text{Gas Flow (SCFM)} \approx \frac{\text{Scale Reading x} \sqrt{\frac{\text{Gas Pressure (PSIA)}}{14.7}}}{28310}$$

For example, if the meter reads 50 units and the gas pressure is 70 PSIG (i.e. 84.7 PSIA), then the gas flow in standard units is:

$$\text{Gas Flow} \approx \frac{50 \text{ x} \sqrt{\frac{84.7}{14.7}}}{28310} = 0.004 \text{ SCFM (typical case)}$$

The maximum flow rate is at the maximum allowable gas pressure (100 PSIG or 114.7 PSIA) and the maximum reading of the scale of the gas meter (150 units):

$$\text{Gas Flow} \approx \frac{150 \text{ x} \sqrt{\frac{114.7}{14.7}}}{28310} = 0.015 \text{ SCFM (extreme case)}$$

Note: If the gas meter ball "tops out", the reading is meaningless, and a problem must be present.

A **pressure switch** may also be supplied with the panel. Its purpose is to alert the operator in the event of the loss of nitrogen gas. (Note: If the "explosion-proof" switch is required, it must be mounted separately, outside the panel.) Depending on what a customer is using for an alarm, the switch may be wired either normally open (NO) or normally closed (NC). The pressure level can be adjusted by turning the knob inside the pressure switch. The switch has an adjustable pressure range of 10-100 PSI and is rated at 250 PSIG, 15 A, 480 VAC.

The last panel component is a **check valve**. This device allows the barrier gas to flow only in the forward direction (to the pump) and protects the panel components by preventing process liquid from accidentally flowing into the panel.

START-UP PROCEDURE of the Air-Barrier Pumps (refer to IOM Manual for complete instructions)

1) Check the Gas Panel for Leaks:

Connect the panel to the nitrogen supply line, but do not connect it to the pump: have the panel outgoing tubing closed off. Turn the nitrogen supply on and set the gas pressure inside the panel (as read on the pressure regulator) to 80 PSIG. Initially, the ball inside the gas meter may top out. If this occurs, gently tap the top of the panel and the ball will settle down. There should be no leaks, and the gas flow meter should read zero – the ball should settle at the bottom of the scale. If this is not the case, fix any panel leaks before proceeding.

2) Connect the Panel to the Pump and Test the Barrier Seal:

Turn off the nitrogen and connect the panel to the pump; then turn the nitrogen back on and adjust the pressure regulator to 70 +/- 5 PSIG. Gas will rush into the pump and fill up the containment can quickly. The ball in the gas meter should slowly settle down at the bottom, after the initial in-rush of gas. At this point, the gas seal faces inside the pump are closed-shut and there should be no gas flow. On occasion, the flow meter may indicate a small flow if the seal faces are not perfectly seated. A reading of 20 units or less of flow is acceptable. If the flow is higher, a couple of turns of the motor rotor via the back fan can help to settle the seal, thus reducing the gas flow or bringing it down to zero. If the gas flow cannot be reduced to 20 units or less, the gas seal of the pump must be investigated before proceeding.

3) Check Motor Lockout and Safety Devices:

Ensure that the motor switch is in the OFF position and locked out. A pressure switch should be installed to stop the motor in case the barrier gas does not have sufficient pressure. A power sensor should be installed to stop the motor if a loss-of-load or overload is detected. If the pump is long-coupled, ensure that the coupling guard is installed before operating the pump.

4) Open the Isolation Valves and Check Direction of Rotation:

After the pump is connected to the system piping, flood the pump with process fluid. Make sure that the suction valve is wide open and that the discharge valve is only slightly open. This will require the least power from the motor and help prevent magnet decoupling. Do not allow fluid into pump without gas. Make sure that there are no leaks. Remove the motor lockout and jog the motor to check the direction of rotation. The rotation must be counterclockwise as seen from the pump end.

5) Starting the Pump:

Energize the pump and observe the gas meter: the ball should start slowly rising within 10-15 seconds and should settle between 30 and 120 units of scale. If this does not occur, there could be a problem that would need troubleshooting: consult the IOM manual, your local distributor, or the factory.

Note: In some cases, across-the-line rapid starting may cause decoupling of the magnetic coupling. In these cases, slow starting may help (i.e. using variable speed drive). However, do not prolong the start-up time excessively; proper operation of the gas seal depends on its ability to "lift off," which takes place above a certain minimum value of "lift off speed." Barrier seals lift off at approximately 700 RPM. Prolonged operation at lower speeds must be avoided to prevent damage to the seal faces from overheating.

6) Operating Conditions:

Open the discharge valve until the desired flow rate is reached. Observe the discharge and suction gauges and continue to monitor the gas flow meter and the gas pressure gauge. The gas flow may drift slightly but this is not a problem. If the flow drifts outside the recommended operating range, the pressure regulator should be adjusted to restore the desired 30 – 120 units of flow on the meter. Adjust the pressure regulator slowly and in small turns. Once it is set, fix the pressure regulator knob (push it down) and close the panel. Observe the pump for 10-15 minutes to make sure that it is operating smoothly, with no excessive noise or vibrations.

7) Periodic Monitoring:

It is a good idea to monitor the gas flow and product flow several times per shift and to keep a log of the data. Contact the distributor or the factory if an unusual drifting trend is observed.