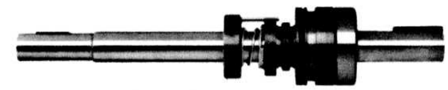
SMITH PUMPS



WORKING LIQUID FLOW CONDITIONS AFFECT PUMP SHAFT SEAL LIFE

The dynamic heat transfer characteristics of liquefied gas flow notably affect the durability of mechanical shaft seals in typical transfer pumps. Just as internal circulation of handled product cools, lubricates, and maintains the other internal working parts within acceptable temperature limitations, handled product must circulate through the mechanical seal chamber, absorb frictional heat, and immediately discharge through the pump liquid exit port, along with the rest of the output flow.

Required circulation through this area must contain at least a certain minimum volume of liquid, to absorb and carry off the frictional heat generated through normal mechanical seal operation. Naturally, any factor, which decreases available internal flow of liquid, or increases frictional heat generation, will aggravate the rate of wear. **It would seem that *lessening* the working pressure on the mechanical seals in all cases would result in decreased tension, which theoretically should reduce friction and prolong mechanical seal life.** Some different makes of liquefied gas pumps are actually designed with shaft seals exposed only to the inlet (supply tank) pressure. Although most mechanical seal applications would probably benefit under this design criterion, *there are some circumstances where mechanical seal wear is not aggravated, but actually decreased, by exposure to higher pressure from the discharge side.* For example, tension is minimized when liquefied gases are handled at very low pressures, but fluid being delivered to pump suction especially under a vacuum, may contain enough vapor to prevent required mechanical seal cooling. This type of potential cavitation can result in subsequent cumulative heat damage. Vapor bubbles tend to collapse when exposed to pump differential pressure, increasing the available circulation of liquid, which improves cooling effects. In this case, seals cooled by *discharging* flow would last longer. Some pumps are designed for exclusive mechanical seal exposure only to discharge pressure. However, under good average conditions, if pump mechanical seals are always open to *discharge*, instead of *inlet* pressure, they can wear faster.

A third type of pump design incorporates the mechanical seals in a manner, which is not as effective in preventing potential working tension wear problems. It is a sort of "compromise", where the shaft seals are exposed to a "medium" pressure, approximately the average of the inlet and discharge pressures.

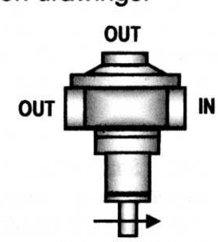
The most popular, Smith base-mounted pumps are reversible. They can be run in just one direction of rotation, so the shaft seals function only against inlet pressure, or only against outlet pressure. ***The following table can be used as a general guide for most installations. Where exposing shaft seals exclusively to inlet pressure is a definite advantage, the inlet line from the supply tank must be connected as shown below.*** For all models listed, the right hand port (as viewed from the shaft end of the pump) becomes the pump inlet port, and is listed as "OK". The drive shaft then rotates in the direction shown as proper for this connection. Some listed models have additional ports, which are also "OK" for pump inlet ports, as illustrated below. If the pumps are run in the opposite direction from that corresponding with the table, the porting reverses, and the seals are then exposed to discharge pressure. See porting and rotational diagrams in "AL-3", "CP-1", "CP-3", and dimension drawings.

TABLE FOR CONNECTING INLET LINES TO SMITH PUMPS
SO SHAFT SEALS ARE EXPOSED TO INLET (SUPPLY TANK) PRESSURE

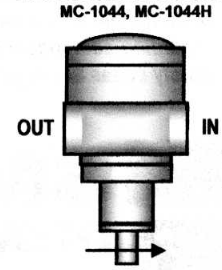
PUMP MODEL TYPES	INLET PORTS IN MAIN HOUSING RIGHT-HAND	TOP	LEFT-HAND	INLET PORT IN GEAR END COVER
MC-1044,MC-1044H*	OK	NONE	NO	NO
MC-2, MC-2F, MC-2H*	OK	NONE	NO	NONE
MC-3, MC-3H*	OK	NONE	NO	NONE
TC-1044H	OK	NONE	NO	NO
TC-2, TC-2F, TC-3	OK	OK	OK	NO
ATC-2R, ATC-2L	OK	NONE	OK	NO
ATC-2RH, ATC-2LH	OK	NONE	OK	NO

NOMENCLATURE: OK - use; NO - do NOT use; NONE - There is no port in this location.

* See diagrams to the right of this table, which illustrate porting and rotational direction for inlet pressure on mechanical seals.



ILLUSTRATIVE DIAGRAM FOR MC-1044, MC-1044H



ILLUSTRATIVE DIAGRAM FOR MC-2, MC-2F, MC-2H, MC-3, MC-3H

D-Series, E-Series, GC-1 Series, MC-1 Series, SQ-Series, special-purpose, and obsolete model types are not listed in the preceding table. In the case of the MC-1, which has a built-in, back-to-suction adjustable, differential pressure relief valve**, the inlet must be taken through a port that forces the shaft seal to take discharge pressure. If the back-to-suction, internal, differential pressure relief valve** does not have to be adjustable, use the GC-1 instead, as this model has the same capacity and dimensions, and must be connected so the shaft seal assembly takes inlet pressure.

The base-mounted model type MC-2Q does not have an internal, differential pressure relief valve. It is, however, not reversible, and designed for quiet operation. Where a low noise level is desired, that can be more important than prolonging as much as possible the life of the mechanical seals.

Base-mounted ATC-3R or 3L, ATC-3RH or 3LH, and TC-3F model types have 2-inch flanged side ports, and a 2-1/2 inch flanged gear end cover port. Since these pumps must be supplied with a 2-1/2 inch or 3-inch inlet line to avoid cavitational problems, the gear end cover port is usually recommended as the liquid inlet, the pumps run in only one direction, and their mechanical seals take discharge pressure.

Model types ATC-4LF or 4RF, ATC-4LFH or 4RFH, ATC-5LF or 5RF, ATC-5LFH or 5RFH, MC-4 or 4H, and MC-5 or 5H, are base-mounted, high-capacity units. These pumps do not have internal, differential pressure relief valves, but they are more sensitive to inlet flow restriction than the lesser-capacity models. They require the use of a "Low NPSH", 4-inch gear end cover inlet port, to prevent pump cavitation ("starvation", or "lack of flooded suction"). They are thereby configured exclusively for discharge pressure upon their mechanical seals, as they must only be run in one appropriate direction.

Flange-mounted types, medium capacity MCAT-2L or 2R, and high capacity MCAT-3L or 3R, are not reversible, and have non-adjustable, internal, back-to-suction, differential pressure relief valves**. Much like the MC-1, the mechanical seals in the MCAT-2L and 3L are exposed exclusively to outlet pressure; in a fashion similar to the GC-1, the MCAT-2R and 3R seals only see inlet pressure.

E-Series and D-Series low-capacity, motor-mounted LPG pumps were designed with low initial cost as the governing factor. All models are not reversible and have internal, non-adjustable, differential pressure relief valves. To be operational, the D-Series relief valve must be connected to an external line. In the E-Series, the internal relief valve can be set to discharge either back to pump suction**, or to an external line. The shaft seal takes "medium" pressure as discussed earlier.

The low-capacity Smith SQ-Series, motor or base mounted pumps, were originally designed for continuous recirculation of low-pressure liquid Carbon Dioxide. They are mostly utilized with the seal assembly exposed exclusively to inlet flow, corresponding to the built-in, non-adjustable, differential pressure relief valve, which must be installed with an external line and is operational only in one direction of rotation. Special-purpose SQ-Series do not have internal relief valves, and are reversible.

** It should be noted that frequent back-to-suction fluid bypassing can cause severely accelerated mechanical seal damage due to excessive vapor formation from accumulation of absorbed heat. ***Mechanical seal failure is probable, under continuous adverse conditions caused by inadequate bypass protection** (see "AL-15", "AL-18B" and "AL-41").* For additional information, contact the factory. Also, see other Smith literature such as: "AL-3"; "AL-17A"; "AL-36"; "AL-93"; "AL-105"; "ED-1", "GM-1", "IS-7", "IS-11", "IS-12", "IS-13", "PI-1, 2A, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16"; "CP-1"; and "CP-3".[1]

---

[1] ***Note: Smith Precision Products Company, Inc. is not responsible for the design, construction, or use of piping systems. The installations as literally described in our literature may not be acceptable in all areas, and could have to be modified. This bulletin, and other such literature from Smith Precision Products Company, Inc. relating to LPG, NH_3, CO_2, or similar low-pressure liquefied gases, or other non-related fluids, is for concept presentation, only. All presented data, whether empirical or theoretical, are from a pump manufacturer's standpoint. Proper system design, construction, and use require a site-specific engineering study including component manufacturer's current application data, with due regard for all of the applicable local, State, and Federal safety codes and regulations, such as, but not limited to, those promulgated by the NFPA, DOT, and ANSI.***

SMITH PUMPS

SMITH PRECISION PRODUCTS COMPANY
P.O. Box 276, Newbury Park, CA 91319 USA
1299 Lawrence Drive, Newbury Park, CA 91320 USA
Tel.: 805/498-6616 FAX: 805/499-2867
e-mail: SMPUMP1299@aol.com **web: www.smithpumps.com**