SMITH PUMPS FOR FLUOROCARBON-BASED LIQUEFIED GAS REFRIGERANTS

(Such as, but not limited to FREON®, SUVA®, GENETRON®, FORANE®, KLEA®, ARCTON®, PURON®, and similar fluids)[1]

GENERAL. These liquefied gases are generally very stable, a quality directly related to their molecular structure. SMITH pumps were originally designed for transferring such low-viscosity, non-lubricating fluids, and have been used successfully for several decades with the CFC's and HCFC-22. They now handle equally as well the alternative HCFC, PFC, and HFC types, with or without entrained or dissolved synthetic or petroleum-based lubricant residues (such as AB, MO, or POE). Some of these current "retrofit" refrigerants with improved environmental properties are incompatible with traditional sealing element compounds; therefore, updated SMITH refrigerant pumps are commonly assembled with no synthetic elastomers in areas contacted by handled fluids.

Another unique feature of the SMITH pump is its pretested integral shaft, ball bearing, and three-piece mechanical seal assembly ("shaft-seal assembly"). This assembly has many advantages over familiar two-piece mechanical seals. For example, SMITH pumps can be purposely installed so the mechanical seals are exclusively exposed to either entering, or exiting fluid, in accordance with drive shaft rotation. SMITH mechanical shaft-seal assemblies are compatible with the standard replacement HCFC, PFC, and HFC refrigerants now in service, which supersede the older CFC types. They are state-of-the-art, manufactured completely in-house, specifically for the intended service. They utilize a very adaptable three-piece design, which cuts the surface speed of the mating seals to half that of a two-piece seal. The net result is proportionally less frictional heat generation, and prolonged mechanical shaft seal life. SMITH mechanical shaft-seal assemblies can be custom-constructed to simultaneously withstand such conditions as intermittent or continuous vacuum, thermal shock, highly variable viscosity, and unusually broad temperature ranges. All SMITH pumps have only *one* mechanical seal assembly, which can be easily replaced from the drive end of the pump without disturbing the gearing and without removing the pump from the piping system. Mechanical seal leakage activates an auxiliary rotary seal, preventing subsequent ball bearing damage, and relieves to atmosphere exclusively through an adaptable leak detection port out of the casing near the drive shaft exit.

Our Engineering Department asks that whenever an order or quotation request is placed for a new installation, a rough sketch or drawing indicating equipment sizes and relative elevations be sent along with it, as well as complete liquid specifications, including percentages, types, and viscosity of oils or other chemicals, contaminants, and impurities. Temperature ranges are also important for us to know. Determination of application suitability, and required use-specific modifications, depend upon this kind of information. For example, at colder temperatures, if oil is present in the pumped fluid, it may be necessary to increase the gear clearances.

SMITH pumps are well over-designed for the usual clean liquefied gas refrigerant transfer operations, in *non-hostile environments*. Always contact the factory regarding special applications. The average temperature ranges of the liquefied gas refrigerants handled by SMITH pumps are within -40° F. to +150° F., and corresponding application data stamped on pump tags for these services typically reads "Max. allowable pressure: 400 PSI / 28 bar; Max. differential pressure: 125 psi / 9 bar". We have supplied units for higher and lower temperature ranges, greater differential pressures, as well as continual vacuum conditions to 4 PSIA. Standard SMITH pumps for liquefied gases can readily be modified to withstand temperature ranges between -150° F. to +400° F., and pressures to 600 PSIG, with an ample margin of safety.

Optional incorporated SMITH liquefied gas refrigerant pump modifications are in accordance with specific service conditions. SMITH pumps originally altered for particular circumstances are identified by an additional letter "S" in the model number stamped on the tag, such as "MC-2F**S** NSSA". *These units may give unsatisfactory performance if not used as originally intended*. Handled liquefied gas refrigerants should not contain abrasive contaminants, especially when they are continuously recirculated. For continuous duty and/or cold temperature services where vacuum is present, in order to acquire longest pump life, a 750 –

[1] These current market product names were chosen at random, just to illustrate some familiar brands of refrigerants produced by typical manufacturers: "Freon®" and "Suva®", DuPont; "Genetron®", Honeywell; "Forane®", Arkema; "Klea®" and "Arcton®", INEOS; and "Puron®", Carrier. There are many others too numerous to mention here.

1000 RPM drive speed range is highly recommended, provided differential pressures are not in excess of 40 PSID. Due to necessary “slippage” flow across the gear faces, higher differential pressures within standard viscosity ranges under 110 Cks. may require faster drive speeds to prevent vapor locking. If it is theoretically determined that at a certain speed the pump will lose 50% of its nominal output due to pressure and viscosity characteristics, a somewhat higher or the next standard direct drive speed should be used. In non-continuous and highly intermittent service, greater pressure differentials at higher RPM can be realized without sacrificing unit longevity. Maximum design speed is the *rated* speed for most models, but it is not necessarily *recommended* speed. RPM must be properly matched with operation intervals, PSID, and liquid qualities. Differential pressures of 150 PSID or more may be acceptable, but depend entirely upon working conditions mostly relating to fluid composition, viscosity, and density. Contact the factory for additional information.

<u>PUMP INLET PIPING DESIGN</u>. With SMITH pumps in liquefied gas refrigerant service, “flooded suction” is absolutely essential to insure proper internal flow cooling effects. The *dynamic* inlet pressure of the fluid being handled has to remain at or above its natural vapor pressure. Therefore, the pump liquid supply system must have the lowest possible resistance to flow, taking into account any additional friction from entrained or dissolved oily residues (oversize piping may be required). Outlet lines though not as critical must be correspondingly designed.

Low capacity pumps for liquefied gas refrigerants have ¾” FNPT inlet and outlet connections. Some medium capacity (1-1/2”, 2”, and 2-1/2” FNPT) as well as high capacity (2”, 2-1/2”, and 4” FNPT) models have inlets sized larger than outlets. The pump inlet line must always be at least the same size as the pump inlet port. The pump must be as close as possible to a properly sized, bottom outlet supply tank, which should never be pumped completely dry. The lower the liquid vapor pressure, the higher the flow, or the further the pump is from the liquid source, the more critical it is for gravitational force through liquid elevation (the primary source of “NPSHA”) to overcome pump inlet line flow resistance. However, the NPSHA can be highly variable, requiring careful attention, especially when there is a minimal vapor pressure. Standard precautions for preventing “pump starvation” are applicable to refrigerant transfer, but when pump supply tank pressure is below atmospheric pressure, additional positive head energy may be necessary at pump suction.

Handling conditions, which can cause dynamic variances in liquid quality, available head pressure (NPSHA), and the required head pressure at pump suction (NPSHR), include but are not limited to (1) inlet line length; (2) pump duty cycle; (3) differential pressure requirements; (4) size and/or shape of the supply tank; (5) type, quality, or lack of piping insulation; (6) line sizes including the tank outlet as well as all other related components; (7) location and style of supply tank outlet(s); (8) contamination; (9) other simultaneous uses of the pump supply tank; (10) pump efficiency; (11) environment; etc. With variables such as these, any attempt to specify a minimum head requirement, without first completing the necessary study of the piping system, transferred liquid qualities, projected use intervals, and environmental conditions, could be misleading.

<u>NOISE</u>. At *rated RPM* (maximum design speed with SMITH rotary gear pumps for liquefied gas refrigerants) the inherent displacement principle can lend itself to noise more so than other designs. However, sound pressure values are greatly reduced by operating SMITH pumps at less than maximum design speed. Levels of under 58 dB(A) can be realized through lower drive speeds, proper piping, and adequate isolation.

See SMITH literature such as, but not limited to “CP-1”, “CP-3”, “AL-3”, “AL-17A”, “AL-36”, “AL-40”, “AL-41”, “AL-201”, and “AL-204”, for additional information on topics previously discussed, and related aspects. Smith Precision Products Company, Inc. is not responsible for the design, construction, or use of piping systems. This bulletin and all other SMITH literature relating to low-pressure liquefied gases, whether containing empirical or theoretical data, are from a pump manufacturer’s standpoint, and are for concept presentation, only. Certain installations may not be acceptable in all areas, and could have to be modified. Illustrations should not be taken literally. Completeness of such information cannot be guaranteed. Proper system design, construction, and use require a site-specific engineering study with due regard for all of the current component manufacturers’ application data, and all applicable safety codes and regulations, such as but not limited to those promulgated by the NFPA, DOT, and ANSI; including all other applicable federal, state, provincial, or local standards, codes, regulations, and laws.

SMITH PUMPS

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