SMITH PUMPS

SMITH PUMPS USED IN LIQUEFIED SO_2 TRANSFER SERVICE

GENERAL. Sulfur Dioxide (SO_2) has a relatively low vapor pressure, is a toxic, colorless, non-flammable gas of pungent odor, and is easily condensed to a colorless liquid, boiling at -10° C.. It can be readily produced by burning sulfur or sulfides, and is released into the atmosphere from such sources as volcanic activity, carboniferous fuel combustion, smelting, and other industrial processes. It has been traditionally used in the manufacture of Sulfuric Acid, Sulfites, other sulfur compounds, sulfite pulp, and in petroleum refining as a reducing and bleaching agent; also as a preservative, disinfectant, fumigant, and refrigerant. SMITH pumps are for pumping pure, clean SO_2 liquid, in non-destructive surroundings. SMITH pumps exposed to less than atmospheric pressure, during or after operation, must be supplied with specific vacuum modifications to perform satisfactorily. Additionally, as SO_2 readily combines with water to form acid, *adequate precautions must always be taken to insure handled fluid is not moisture-contaminated, as otherwise, corrosion fatigue may cause pump seizure*.

Optional incorporated factory modifications are in accordance with specific use conditions, and are identified by an additional letter "S" in the model number, such as "MC-2**S**". *Altered units may perform unsatisfactorily if not used as originally intended*. All SMITH SO_2 pumps have the following features: (1) mechanical shaft seals, and outboard ball bearings, are isolated from the external environment; (2) other parts, such as the bearing retainer plate (normally made of aluminum), are manufactured from more resistant materials; (3) optional stainless steel fasteners are available; (4) special austenitic alloy casings may be available for some models, at additional cost. *However, never use SMITH pumps for contaminated SO_2, or in extremely hostile environments. SMITH pumps are not recommended for such hazardous applications, and especially not for chronic internal exposure to acid, or external exposure to highly corrosive substances or atmospheres*. Our Engineering Department asks that whenever an order or quotation request is placed for a new installation, to please send a rough sketch or drawing indicating equipment sizes and relative elevations, and to include detailed descriptions of environmental conditions and complete liquid specifications, with percentages, types, and viscosity of oils, chemicals, moisture, or other impurities present in the pumped fluid. Temperature ranges and duty cycles are also important for us to know. Application feasibility, RPM range, and determination of required use-specific options depend upon this kind of information.

Most SO_2 liquefied gas transfer accomplished by SMITH pumps falls within a temperature range of -15° F. to +150° F., and typical corresponding application data stamped on pump tags for these services reads "Max. allowable pressure: 400 psi / 28 bar; Max. differential pressure: 75 psi / 5 bar". We have supplied units for higher and lower temperature ranges, greater differential pressures, as well as continual vacuum conditions to 4 PSIA. 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.

SMITH pumps should always be run within factory specified operation intervals, which invariably coincide with the required PSID, the pump drive speed, and the liquid's specific temperature/pressure characteristics. For example, in continuous duty for more than 6 consecutive hours, and/or cold temperature services where vacuum is present, a 750 – 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 factors, a somewhat higher or the next standard direct drive speed should be used, but only in non-continuous and highly intermittent service. In this manner, greater pressure differentials at higher RPM can be realized without sacrificing unit longevity (1800 RPM is the *maximum* drive speed for most models, but is not necessarily the *recommended* RPM). Depending upon the duty cycle and the liquid viscosity, differential pressures of 150 PSID or more may be acceptable, but depend entirely upon the use conditions. Contact the factory for additional information.

A unique feature of the SMITH SO_2 pump is its pretested integral shaft, ball bearing, and mechanical seal assembly ("shaft-seal assembly"). This use-specific three-piece assembly has many advantages over familiar two-piece mechanical sealing designs. 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 state-of-the-art, manufactured completely in-house, specifically for the intended service. The three-piece design is very adaptable, and cuts the surface speed of the mating seals to half that of a two-piece seal assembly. The net result is proportionally less frictional heat generation, and prolonged mechanical shaft seal life. SMITH optionally modifiable SO_2 mechanical shaft-seal assemblies are easily custom-constructed for service under specific use-determined conditions, such as intermittent or continuous vacuum, thermal shock, or unusual temperature range. SMITH pumps have 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 shaft exit.

PUMP INLET PIPING DESIGN. With SMITH pumps in liquefied SO_2 gas 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. Outlet lines must also be given careful consideration to keep differential pressures within specified limitations.

Low capacity pumps for SO_2 service 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 piping recommendations in our literature must be carefully followed, with the pump as close as possible to, or directly under 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 SO_2 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 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 from the same 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.

NOISE. At *rated RPM* (maximum design speed for most SMITH rotary gear pumps handling liquefied SO_2), 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.

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