SMITH PUMPS

PREVENTIVE MAINTENANCE INSPECTION PLAN FOR MEDIUM AND HIGH CAPACITY SMITH PUMPS

Smith pumps are designed to give very good service over years of field use. Although the day-to-day operation of Smith pumps does not require periodic maintenance, lubricating, or servicing, the pumps should be maintained on a preventive basis, in a well designed and operated liquid transfer system. Performance testing is a recommended useful tool to insure early identification and correction of pumping problems, to minimize the cost of replacement parts, and to insure acceptable and safe operation of the pump. In addition, regular pump inspections are necessary to determine preventive parts replacement intervals. Disassemble and reassemble pumps in a safe, approved manner, following all applicable procedures in "AL-1", "AL-17A", "AL-45" (N_2O), "AL-97", "AL-99" and "AL-201". Reseal the casings properly. Contact the factory if there are any questions.

1. **Keep Spare Parts on Hand.** When a pump is ordered, we suggest that one or more sets of recommended spare parts always be shipped with it. Both standard and optional parts are illustrated in the pump assembly views. Standard construction parts are indicated with an asterisk (*) in the corresponding parts lists. Generally speaking, a recommended spare parts "kit" includes a mechanical shaft-seal assembly, a grease seal, an o-ring (for main housing bushing), and complete sets of gears, idler gear shafts, and main shaft bushings; however, depending upon the model(s) and incorporated options, certain items, styles, or quantities may vary (see pg. 4, "AL-20", and "AL-21").

2. **The First Scheduled Parts Inspection.** Pump duration depends to a very great extent upon the piping system and use conditions, which vary from site to site. It is impossible to predict an accurate service life interval for any components, without having first accomplished scheduled inspections on the working pump(s). The observable areas of wear depend upon the construction options ("NS", "SA", "Z", "S"), the liquid(s) handled, and the duty cycle (see specific service literature). In a properly operated and well-designed transfer system, the *first* significant wear patterns almost always occur in one or more of the following, as illustrated on pg. 4: idler gear bushings (C), idler gear shafts (B, D), and gears (C, E). Eventually, noticeable wear develops on other parts, such as main shaft bushings (H, I, J), mechanical shaft-seal assembly (G), and casings (B, D, F).

   Pumps should be disassembled in a recommended, safe manner, and all components *initially* inspected not very long after they have been placed in service. For example, a typical first inspection would be recommended at 250,000 USG (950,000 liters) for medium capacity pumps (such as the ATC-2, MC-1044/MC-1044H, MC-2, MCAT-2, TC-1044H, and TC-2 Series); and at 500,000 USG (1,900,000 liters) for high capacity pumps (such as the ATC-3, 4, and 5; MC-3, 4, and 5; MCAT-3, and 4; and TC-3 Series). These first intervals are short enough so that the idler gear bushings, idler gear shafts, and gears should show only very slight wear in almost any kind of service.

   When the end of this first interval approaches, be sure to have a spare set of gears with bushings and a spare set of idler gear shafts on hand. When ordering parts, be sure to specify the model number and serial number of the pump for which the parts are intended. The serial number is stamped on the label plate and also on the main housing (see assembly views). Carefully depressurize the pump, and isolate it from the system in an approved, safe manner. Remove the gear end cover, and take out the gears (in larger pumps there may be several sets of gears). Place the gears on a well-lighted work table. Mark the gears in an appropriate manner, so that if they can continue to be used, they will be reinstalled *in the same housing and configuration, exactly as before*.

3. **Inspection of Idler Gear Bushings.** There is always one drive gear in each set of gears (C) and (E) on pg. 4. The main shaft transfers power to the drive gear. The drive gear bore contains a half-round keyway, which accepts the drive key(s) in the main shaft. There are always either two or four idler gears in each gear set. Pumps having model numbers beginning with "MC", "MCAT", or "ATC" have two idler gears per gear set; model numbers beginning with "TC" have four idler gears per set. The only exception is with the MC-2Q Series, which have a straight slotted keyway, and four idler gears per set. All drive gears in low capacity Smith pumps also have straight slotted keyways.

The carbon-graphite idler gear bushings must be accurately honed after installation, to attain the proper inside diameter and surface finish. The proper i.d. of these bushings in all idler gears after installation and honing is 0.752-0.753 inches (19.10-19.13 mm.). Measure the inside diameter of the used bushings, while the used gears are on the work table. If the sizes as measured do not exceed 0.754 inches (19.15 mm.), there has been very little wear and the bushings are still within functional tolerance. If the sizes as measured exceed 0.754 inches (19.15 mm.), after such a short first interval of use, it will be important to examine the piping system and its operation to find the cause of such wear, which is excessive.

When the idler gear bushings have worn to a diameter above 0.754 inches (19.15 mm.) the complete gear set must be replaced. Idler gears with bushings worn less than these amounts need not be replaced. However, all idler gears in a functioning set must be in identical condition. Never use new and used idler gears together in the same housing.

4. **Inspection of the Gears.** These are items (C) and (E) on pg. 4. For the MC-1044/MC-1044H, and TC-1044H Series, the new gear length is 1.746-1.747 inches (44.35-44.37 mm.). For the TC-2 and 3 Series, the new drive gear length is 1.745-1.746 inches (44.32-44.35 mm.), and the new idler gear width is 1.746-1.747 inches (44.35-44.37 mm.). For the Model MC-2Q, the new drive gear length is 3.996-3.997 inches (101.50-101.52 mm.), and the new idler gear length is 1.997-1.998 inches (50.72-50.75 mm.). For the MCAT-2, 3, and 4 Series, the length of all new, finished gear assemblies is 2.245-2.246 inches (57.02-57.05 mm.). For MC and ATC-2, 3, 4, and 5 Series, the new gear length is 1.996-1.997 inches (50.70-50.72 mm.). If the measured used gear length is not more than two thousandths of an inch (0.002" or 0.05 mm.) less than the minimum dimension described above, the gear can be reused. Otherwise, it should be replaced. *If reinstalling used gears, be sure to return them to the same housing and gear bores from which they were originally removed.*

   Measurement of outer gear diameters is not usually required in a preventive maintenance inspection. The most revealing wear patterns have to do with the gear bores, related housing areas, and *especially* the shape, contour, and meshing wear patterns of all gear teeth. Since pumps are normally run only in one direction of rotation, any notable tooth wear can be detected by visually comparing the working and non-working sides of the gear teeth. If there appears to be no detectable difference in the contour of each side of the gear teeth, there is probably no appreciable wear, and the gear can most likely be reused. However, once the gears and shafting are reassembled into the casing, check the backlash between meshing teeth as well as bore clearances to be absolutely sure (see technical bulletin "AL-97" for additional information).

   Visually detectable differences in tooth contour are indicative of excessive clearance between meshing teeth. Gear backlash beyond acceptable limitations will adversely affect pump performance, even when worn gears are reassembled backwards so the teeth form working contact on the non-worn side. A visibly worn gear should always be replaced. Since the drive gear transmits required torque to two or four simultaneously driven gears, it is usually the first gear with visually detectable tooth contour wear. Gears should be replaced if any one of the following has occurred: (a) the gear bushings have worn excessively; (b) the length of the gears is too small; or (c) the shape, or contour of the gear teeth has changed.

5. **Recommended Procedure if Excessive Gear Wear Is Detected.** Examine the piping system to make sure it is properly designed. Investigate to make sure the pump is being maintained and operated properly. Consider use of the heavy-duty ("NS") gear option in all pumps.

6. **Inspection of Idler Gear Shafts.** In most cases there will be no measurable wear on these parts installed in items (B) and (D) on pg. 4. They are difficult to measure, as they are pressed into place. They can be measured if they are pressed out of the pump casing(s). The proper diameter is 0.750 inches (19.05 mm.). If the measured diameter of a worn area is less than 0.749 inches (19.02 mm.) the shaft must be replaced. Usually, a visual inspection for wear is satisfactory. Place a light close to the shafts within the pump so that the shaft surfaces can be easily visualized. Look for scoring marks. If these are noted, replace the idler gear shafts. If there appears to be a darker color on one side of a

shaft, or if one side of the shaft appears to be shinier than, or not as shiny as, the rest of the observed surface, run your finger lightly over the visually different area. If it feels rough, or if wear can be noted in any other way, replace the shaft. If it does not feel rough, and if wear cannot be noted in any other way, the shaft does not have to be replaced. In cases of observed highly aggravated idler gear shaft wear, the heavy-duty idler shaft option "SA" is highly recommended.

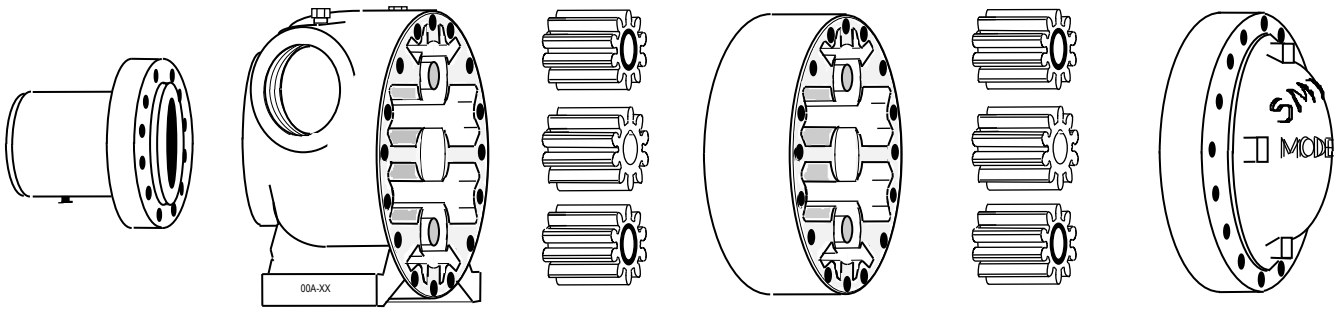
7. **The Mechanical Shaft-Seal Assembly.** Even when accomplishing the very first preventive maintenance inspection, the mechanical shaft-seal assembly, (G), must never be neglected. Mechanical seal assemblies should be checked for leakage, frequently. With the exception of Nitrous Oxide pumps, checking for seal leaks in pumps handling the usual liquids follows a visual procedure, looking for bubbles at the "leak detection port". In most cases, open the spring-loaded cover, wet the area with approved bubble solution, and in a safe approved manner place your finger over the port with light pressure, to observe visual signs of leakage. If there is a small check valve in place of the fitting with the spring loaded cover, wet the pressure exit area with approved bubble solution, and in a safe approved manner place your finger over the port with light pressure, to observe visual signs of leakage. All Smith pumps have a "leak detection port" for this purpose. A use-specific leak detection instrument may also be employed**.** Note that the visual method is not recommended for highly reactive fluids such as Nitrous Oxide; an N_2O leak detection instrument should be used to detect leaks from a Smith Nitrous Oxide pump mechanical shaft-seal assembly (see "AL-15", "AL-45", "AL-97" and "AL-201").

   Under normal operating conditions, the mechanical shaft-seal assembly should be replaced after 12,000 hours of use. However, it may have to be replaced sooner, especially if leaks, or worn bushing contact surfaces are detected. Instructions for replacing mechanical shaft-seal assemblies are sent with every pump and every replacement assembly. It is important to know that the ball bearing that supports the pump drive shaft is one of the components included in the Smith mechanical shaft-seal assembly. Therefore, a required visual inspection of this assembly, after a pump performance test as described in bulletin "AL-201", includes the condition of the ball bearing. The grease seal should be removed and the ball bearing checked for grease. If little or no grease is present, the entire shaft seal assembly should be replaced. We recommend a 30% "DC-33" grease pack.

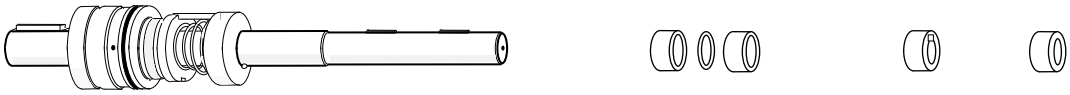
8. **Main Shaft Bushings.** Although under normal conditions balanced internal loading results in negligible wear in these carbon-graphite "journal bearings", they should still be checked during every preventive maintenance inspection. There are three types of main shaft bushings, one or more of which are utilized in different combinations depending on the model as illustrated on pg. 4: TS-11 (H), TC-11S (I), and TC-11 (J). The bushings will crack if tapped into position. They must be *pressed* into place, and will then acquire the proper internal diameter, as long as the housing bore has not been excessively enlarged. Bushings with visually detectable discrepancies such as one-sided wear patterns, surface discolorations, or circumferential cracking, must always be replaced. Measure the internal diameter of all shaft bushings, as well as the corresponding diameter of the drive shaft's supported surface. The ideal clearance is between 0.002 – 0.003" inches (0.05-0.08 mm.). If the measured clearance is no greater than 0.004 inches (0.10 mm.) in any of these areas, the parts can continue to be used. Otherwise, replace the main shaft bushings and the shaft-seal assembly as necessary, to reduce the shaft clearance to within acceptable tolerance. See "AL-97" for additional information.

9. **Inspection of Internal Bypass Valve Components (MCAT-Series Only).** These parts, and the main housing bypass valve seat, should be visually checked during every scheduled inspection. If they do not form a positive seal at the required spring tension, the pump will not function efficiently (see "PI-16", and "AL-58").

10. **Later Inspections.** If the first inspection shows little or no wear, the interval for subsequent preventive maintenance inspections can be increased. In such an event, the first interval can be doubled for the second inspection. If the second inspection also shows little wear, the interval may then be tripled. Check for subsequent casing wear (items "B", "D", and "F" on pg. 4). See catalogs "CP-1", "CP-3", technical bulletins "AL-1", "AL-2", "AL-3", "AL-15", "AL-17A", "AL-36", "AL-45", "AL-93", "AL-93B", "AL-97", "AL-200", "AL-201", and appropriate safety codes, such as NFPA 58; also applicable literature in Spanish *(informes técnicos en español "AL-1A", "AL-3A", "AL-17A", "AL-97A", "AL-200A" y "AL-201A").*



A B C D E F



G H I J

This drawing is made to show the general positions of parts in Smith pumps. It is not drawn to scale, as sizes and configurations do vary from one model type to another. The MC-3 model type was used in the above drawing because it is typical of the majority of units actually in service. Contact the factory if there are any questions. See specific assembly views and parts lists for exact information.

MODEL TYPES	DISTINGUISHING CHARACTERISTICS
MCAT-2 Series MC-1044/MC-1044H Series MC-2 Series, ATC-2 Series	**Assembled as shown in figures "A", "B", "C", "F", "G", and "H". All of these model types have one gear set, consisting of one drive gear, and two idler gears.**
TC-1044H Series TC-2 Series	**Assembled as shown in figures "A", "B", "C", "F", "G", and "H". All have one gear set, consisting of one drive gear and four idler gears.**
MCAT-3 Series MC-3 Series, ATC-3 Series MC-2Q Series	**Assembled as shown in figures "A", "B", "C", "D", "E", "F", "G", "H", "I", and "J". All of these model types have two gear sets, consisting of two drive gears, and four idler gears. The "MC-2Q" model types are an exception, having only one double-length drive gear, and four standard-length idler gears, and the external appearance of the "MC-3" Series.**
TC-3 Series	**Assembled as shown in figures "A", "B", "C", "D", "E", "F", "G", "H", "I", and "J". All of these model types have two gear sets, consisting of two drive gears, and eight idler gears.**
MCAT-4 Series, MC-4 Series ATC-4 Series	**Assembled as shown in figures "A", "B", "C", "D", "E", "F", "G", "H", "I", and "J". All of these model types have three gear sets, consisting in three drive gears and six idler gears. Each unit has two "D" casings.**
MC-5 Series ATC-5 Series	**Assembled as shown in figures "A", "B", "C", "D", "E", "F", "G", "H", "I", and "J". All of these model types have four gear sets, consisting of four drive gears, and eight idler gears. Each unit has three "D" casings.**

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