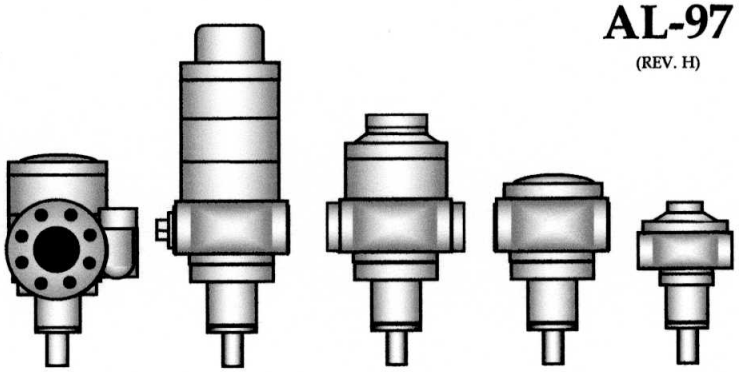
SMITH PUMPS



RECOMMENDED PERIODIC TEST OF PUMP FLOW RATE AND GEAR INSPECTION PROCEDURE (FOR MEDIUM TO HIGH CAPACITY SMITH PUMPS)

The liquid handling characteristics of each pump will differ, as will the corresponding characteristics of each transfer system in service. Therefore, in order to initially establish a proper comparative base line for determining any subsequent changes in pump output flow, it is very important to carefully check and confirm the pump performance when it is first installed, as it relates to its particular liquid transfer system. As with any inspection procedure of this magnitude, it must be performed according to all applicable Safety Codes and practices consistent with local, State, or Federal law and company procedures.

We highly suggest that the pump flow rate be periodically checked, preferably at different levels of differential pressure (i.e.: "high", "medium", and "low"), in order to more accurately determine whether a potential problem exists. These system flow rate tests could be accomplished quarterly, and would serve to indicate if any condition exists which is causing the pump to lose output. The first check could be done at the lowest possible differential pressure, which would allow a comparison of the pump's "nominal" output. The second reading might then be taken at about half the original setting of the bypass valve, or at the pressure, which could approximate average run conditions. The third part of the pressure test could be done, for example, at the point just before the differential pressure bypass return valve in the pump outlet line starts to open. **Once these figures are determined, write them down and remember them. (The following table could be used to record the test results):**

SYSTEM OUTPUT TEST RESULTS			
DATE	LOWEST PSID	MID RANGE PSID	HIGHEST PSID

These figures, when compared to the results of other volume-per-unit-of-time flow tests under the same differential pressure conditions accomplished during the course of future inspections, will easily reveal any significant decreases in measured system output, which could possibly relate to either (1) pump wear, or (2) other system conditions inhibitive to proper output flow characteristics.

The conditions under which this procedure is performed are not absolute. It should be noted that due to variable factors, even though this same series of periodic tests is accomplished in the same pumping system each time, it will probably never cause exactly the same conditions upon the pump. Inevitably, there could be some small variances, possibly as much as ± 5%, from one series of tests to another, simply due to slight changes in drive speeds, liquid temperatures, handled fluid characteristics, or typical product contamination.

However, if the output through the end of the line, has consistently dropped *more than* 5% from the original figures, there is probably something wrong with one or more components in the transfer system, which should be investigated, *in a timely fashion.* It is important to keep in mind that a noticeable drop in system output *may, or may not, relate to the pump performance. The other system components should be checked first, before simply assuming that any drop in system output is a result of loss in pump efficiency.*

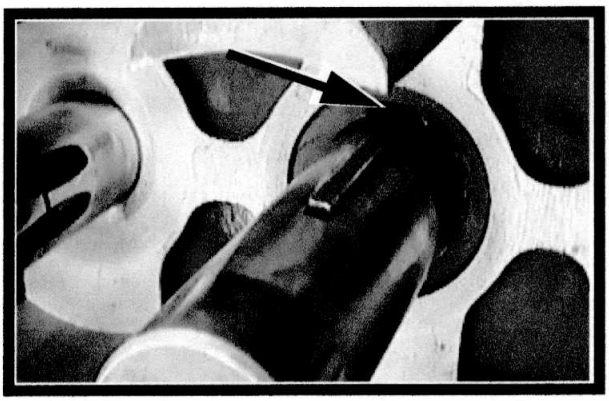
If there are any questions about accomplishing this part of the inspection procedure on the system components other than the pump, always contact the specific equipment manufacturer or his area representative. We cannot overstress the importance of following each specific manufacturer's instructions as necessary, for proper system checks and maintenance. Once it has positively been determined that a significant drop in system output is due to pump inefficiency, the pump can then be disassembled and inspected in the proper, recommended, manner.

CHECKING THE GEAR CLEARANCES DURING PUMP DISASSEMBLY.

Please refer to the last page of this bulletin, or "AL-1". See the appropriate bulletins, manuals, assembly views, and parts lists for your particular Smith pump model, to determine if the pump can be disassembled in the field.[1] If this is so, disassemble the pump gear end cover ("F") in a safe, approved manner, and check the tooth profile of the first accessible "drive gear" (center gear "C"), as viewed from the gear end. Since these pumps are usually used in one direction of rotation, the normal working wear will be concentrated on one side of the gear teeth. Any of the gear teeth can be used as a typical reference. If a discernible difference can be seen by visual comparison of the curve profile on both sides of

[1] There are certain cases where due to chemical incompatibilities and safety concerns, highly controlled procedures are required for conducting field repairs. Be sure to read, and completely understand, all pertinent information with regard to the particular service. Contact factory for additional information.

this gear tooth, then there is excessive gear wear, and the gear set in this housing will have to be replaced. Note that the "shaft end cover" is normally never removed for these operations.

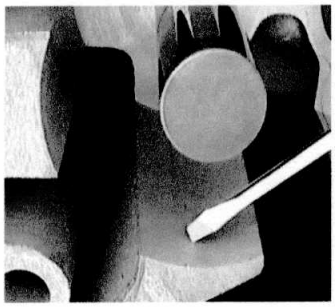


NOTE: The slot in the "TC-11S" bushing mounted in the "secondary housing" is there to accommodate the corresponding drive gear key(s) during disassembly and reassembly. Be sure that the slot is properly aligned with the key when the secondary gear casing is removed and reassembled.

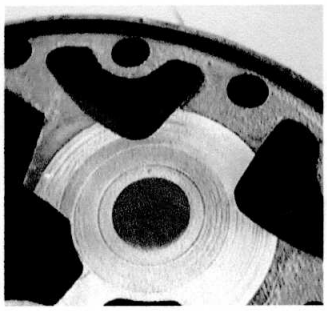
If the pump has one "secondary gear housing" ("D"), or more (as would be the case with the model types "ATC", "TC", "MC", or "MCAT" / "-3", "-4", or "-5"), perform the same procedure with the next housing "drive gear" (center gear "E"), and so on. Once again, upon checking the tooth profile, if a discernible difference can be visualized in the curvature of one side, as compared to the other side, the gear set in this housing will have to be replaced. After examining the drive gear profile, continue the visual inspection by checking for signs of missing gear tooth material, and wear on the diameters and ends of all gears. It is very important that the gear ends be flat, and have no surface irregularities. *If any discrepancies are noticed, the gear set must be replaced before rebuilding the pump.* With a complete gear set in good apparent condition (as confirmed by the visual inspection previously discussed), the casings may now be reassembled temporarily, and the casing gear clearances measured, in the following manner:

Slide the main housing drive gear (center gear "C") onto the drive shaft, into position in the main housing drive gear bore. It may have to slide over one or more secondary housing drive keys. Install the idler gears (top and bottom gears "C") onto the idler gear shafts (located in housing "B"). Check the fit of the idler gear bushings on the shafts for excessive looseness. This clearance must be a "tight sliding fit", between 0.002 - 0.004 inches (0.05 - 0.10 mm). Once this clearance has been verified as correct, check the gear length clearance. Placing a suitable tool with a straight edge across the main housing face, use a feeler gauge to measure the distance between the straight edge and the face of each gear. If there is no measurable wear by the gear faces into the back of the "gear end cover" ("F"), or "secondary gear housing" ("D"), the previously mentioned measurement determines the *total* gear end play. If there is wear by the gears into the "gear end cover" ("F"), or into the back of the "secondary gear housing" ("D"), that wear will have to be added to the first measurement.

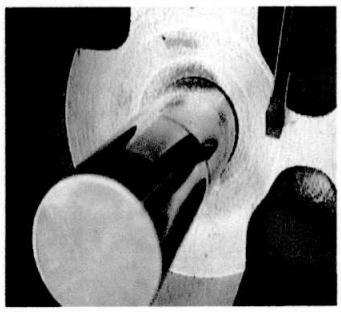
QUICK VISUAL WEAR CHECK



Checking for wear on the pocket diameters.



Normal gear end cover face with no functional wear.



Checking for wear on the pocket ends.

Frequently, a quick visual inspection can save time. For example, if there are visible signs of excessive material removal from the areas shown, the pump *cannot be repaired.* However, if there is no visible wear, the casings can be used again, and the pump can be repaired.

This *total* gear end play should never exceed 0.008 inches (0.20 mm). (Contact the factory for the applicable procedures regarding the "MC-2Q Series", which constitute an exception).

Now, use two feeler gauge blades simultaneously between the left and right sides of each gear and the corresponding walls of the gear pockets. Begin with the drive gear (center gear "C") in the "main housing" ("B"). The sum of the two widths should not exceed 0.010 inches (0.25 mm). Check the clearance around the two driven gears (top and bottom gears "C"), in the same fashion. Insert the widest possible blade on one side first, and make sure that the sum of the two widths in this case is never more than 0.020 inches (0.50 mm). If these measurements are less than the maximum, the clearance is within specified tolerances. If these measurements are beyond the maximum, it is usually because the excessive wear on the used gear set was not noticed during the visual inspection. When this is determined to be the case, discard the used gear set, install a new gear set, and take all the measurements again.

Once the gears have passed these two inspections, measure the "backlash". Insert a feeler gauge between the meshing gear teeth, first in the top gear combination, and then, in the bottom one, where the "drive gear" (center gear "C") meshes with the two "idler gears" (top and bottom gears "C"). This measurement will indicate the total amount of tooth wear and working diametral clearance. With the exception of the "MC-2Q Series", the actual maximum backlash with the gears installed in the pump is 0.024 inches (0.61 mm). Therefore, when measured with a feeler gauge, *if a 0.020 (0.50 mm) gauge can be fitted between the meshing teeth, there is essentially too much clearance in the pump for an acceptable repair which will last a reasonable amount of time.* [2]

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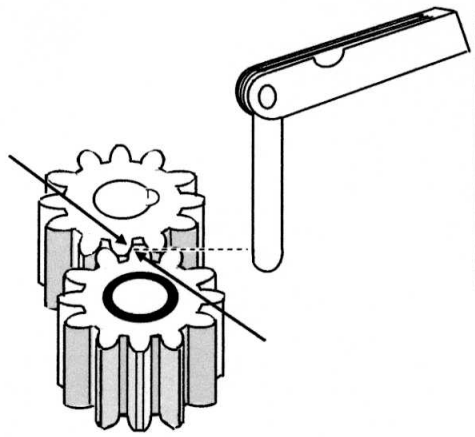
[2] **The used gears may be turned around so the wear occurs on the opposite sides of the gear teeth, but only when they have been properly measured, and certified to be within the acceptable tolerances. (The exception to**



PUMP TYPE	BACKLASH, NEW	MAXIMUM
MC-1044 SERIES	.006 - .012	.024
MC-1044H SERIES	.006 - .012	.024
MC-2,3,4, AND 5 SERIES	.006 - .012	.024
ATC-SERIES	.006 - .012	.024
TC-SERIES	.006 - .012	.024
MCAT-SERIES	.006 - .012	.024

Usually, this condition occurs because there is excessive wear on the gear teeth. However, it is possible that at least part of this condition exists due to wear on used shafting within the pump. If the gear set is used, replace it with a new one, and take the backlash measurements, again. If then within tolerance, continue assembling the pump. Repeat these operations with the gears in the other gear casings.

Once the gear inspections are complete, the next step requires you to disassemble the gear casings, again. Remove all the secondary gear casings from the "main housing" ("B"). It is easier to do the following operation, by removing the gears from the "main housing", and reinstalling them afterward. Support the housing firmly on a workbench, with good illumination. The main casing can be supported on its mounting feet. With a broad-bladed knife, or some other such instrument, *carefully remove all of the original casing sealant from all the exposed sealing faces ("gear end cover", "main housing", and "secondary gear housing(s)").* Make sure that these surfaces are clean, and flat before proceeding. Apply casing sealant very sparingly, with a sponge applicator, or by hand, to the front housing face(s) only, where the gears are installed. Do not apply the sealant to the "gear end cover" or to the back of the "secondary gear housing(s)". [3]

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this rule is the "MC-2Q Series" pumps which use gears that can only be aligned in one direction). Otherwise, the pump will not handle product efficiently, and will be troublesome during use. Contact the factory for specific information.

[3] We recommend the use of "Gasoila Soft-Set" or "PLS #2", Teflon®-based thread sealant, for use as a casing face sealant in Smith LPG, NH_3, and CO_2 pumps. Other services may require different sealants and special cleaning techniques. Contact the factory for specific information with relation to the particular service in question. Be sure to always follow *all* safety recommendations.

Cover the entire sealing surface, and then remove the sealant by hand or with a sponge applicator, approximately 1/16 - 1/8 inch (1.5 - 3 mm) back from the inside edges to prevent excessive sealant from depositing inside the pump when the cover is tightened-up. Do not use a rag for this purpose. Do not use contaminated sealant. *Use only the recommended sealant.*[4] Be careful not to allow any debris, brush hairs, cloth fibers, or dirt, between the joined surfaces. The sealant only has to be applied to the front main housing sealing face, and to the corresponding sealing face(s) of the secondary housing(s). *Do not apply it to the gear end cover sealing face, or to the backside of the secondary gear housing(s).*[5]

Install the gears into the "main housing" ("B"). Fit the step of the "gear end cover" ("F"), or the "secondary gear housing" ("D") into the corresponding groove of the "main housing" ("B"). If the pump has one secondary housing or more, install two shorter cap screws first, and tighten them snugly to properly seat the "secondary gear housing" ("D") against the "main housing" ("B") face.

Remove the shorter cap screws, and repeat the gear installation procedure with sealant application. Do not install the gear end cover cap screws, until all the casings ("B" and "D") which contain the gears ("C" and "E") are successively seated against each other. Then, carefully place the "gear end cover" ("F") onto the end casing, being careful to align corresponding internal flow ports properly, install all of the cap screws through the "gear end cover" ("F") holes which line-up with the corresponding "secondary gear housing" ("D") holes, into the "main housing" ("B"), and tighten them slightly more than "hand-tight" in a circular fashion, first. Then, tighten the cap screws to the recommended torque[6]. Allow the sealant to dry for a few hours, preferably over night. Before exposing the pump to pressure, be sure to check the torque again on all the "gear end cover" ("F") cap screws. Finally, if the unit is a *flanged* Smith pump, when installing it, be sure to torque the corresponding flange cap screws properly. *Make sure none of the cap screws are missing, or defective in any way.*[6]

Once the torque has been checked, *follow recommended procedure to pressure-test the unit before placing it into service.* Contact the factory, if there are any questions. As mentioned previously, all procedures must be done in an approved, safe manner. Always follow all applicable safety codes, regulations, and company procedures.

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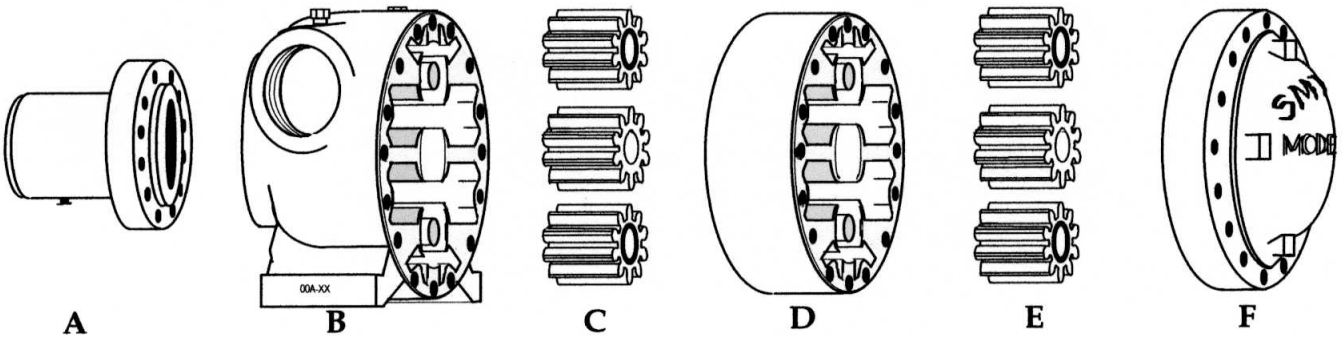
[4] *Never assemble the casings without applying the correct sealant in the recommended manner. Following this procedure improperly will lead to pump failures, and casing leaks to atmosphere.* There are certain non-recommended sealing compounds which may be incompatible with the liquid(s) handled or the pump construction materials. They are not recommended by their respective manufacturers, or by us, for use in this type of handling equipment. In general terms, the sealants which should be avoided are either of the wrong viscosity, incompatible with handled liquid(s), harden too quickly, or contain potentially problematic components such as acids, solid particles, debris accumulations, rubber, dirt, fibers, resins, and greases.

[5] See specific instructions regarding the "MC-2Q Series" pumps, which are an exception.

[6] Torque 3/8-16T body cap screws 20-25 ft-lbs (27-34 N · m) and 3/8-16T flange cap screws, 30 ft-lbs (41 N · m). Torque the 7/16-14T body cap screws 25-30 ft-lbs (34-41 N · m), and 7/16-14T flange cap screws, 35 ft-lbs (47 N · m). Contact the factory if there are any questions.



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 medium to high capacity 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.

SMITH PUMPS

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