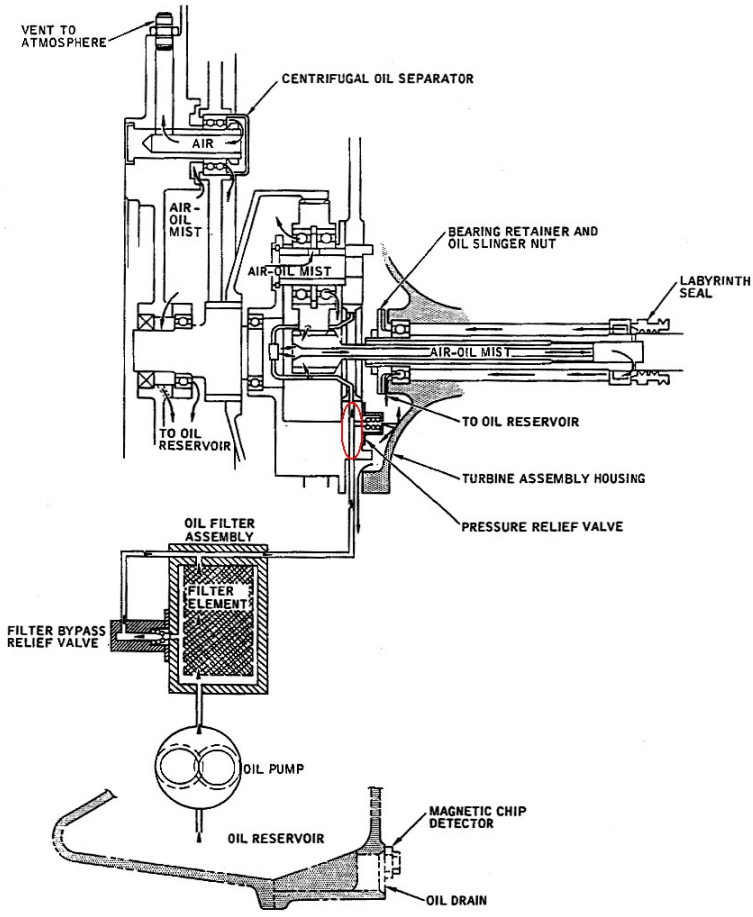
Add-On “Last Chance Filter“ for the Solar T-62T-32 Lubrication System

The Solar T-62T-32 160hp turboshaft engine is often selected by aviators for their homebuilt airplanes and helicopters. The engine itself is reliable, forgiving design with a few but livable shortcomings if they are taken care of.

One of these potentially dangerous flaws is the absence of a last-chance-filter in the engine's lubrication system.

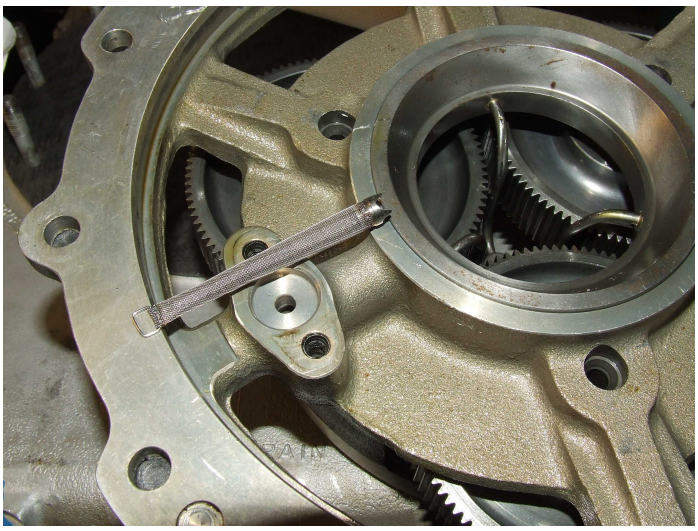
During our occupation with a stock T-32 engine to be put into an Ultrasport 496 turbine conversion, this actually led to a catastrophic failure of the roller bearing and damage to the “power head“ of that particular engine beyond repair (yet without high-energy debris being released form the engine).



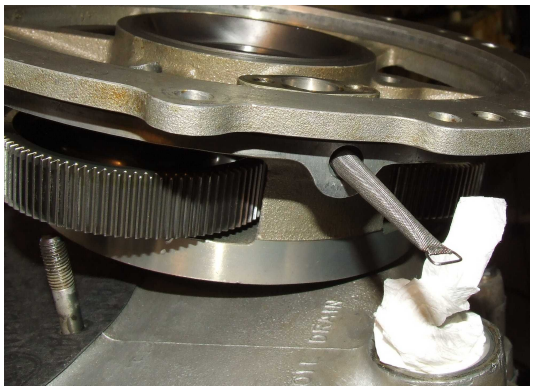
The wet-sump lubrication system of the T-62T-32 engine is rather simple, even minimalistic and is completely adequate for the original purpose of the engine if proper care is taken.

Oil is pumped from the sump by a gear pump though a gallery in the gearbox casing to the oil filter cavity that's also part of the cast gearbox casing. Oil flows through the filter element from outside to inside and is ducted by the machined filter cover to the filter downstream channels which are again part of the gearbox casing(s). Here, a fitting for the oil pressure switch is located as well as another pressure tap (which can be used for an oil pressure gauge). After that, the oil is ducted through a hollow spoke of the planetary gear spider to the central lubrication area. On the rear face of the spider, the oil pressure relief valve is located. Excessive oil is ejected to the inner wall of the turbine assembly housing where it is cooled by dissipating it's heat to the metal structure. Oil is injected through four orifices to directly lubricate and cool the high-speed machinery. The orifices are radial bores in the three oil transfer pipes around the sun gear and one central nozzle that directs an oil jet into the hollow sun gear/pinion shaft. All four nozzles have a diameter in the range of 0.6~0.7mm.

Since there is no last chance filter present to protect these nozzles, particles that are larger than the nozzle diameter in at least one direction, may (partially) block the nozzles. Especially critical is the central nozzle since this provides lubrication and cooling to the two high-speed bearings of the engine's turbine rotor shaft (revolving at round about 61,000 rpm). Under marginal lubrication conditions, the cylindrical roller bearing located inside compressor impeller hub, is the first component to fail. This results in either a sheared or fractured rotor shaft, a fractured shaft tunnel and as a consequence severe damage to all turbine rotor and stator components. A damage like this is not economically repairable and requires a replacement turbine power head to get the engine back to servicable condition.



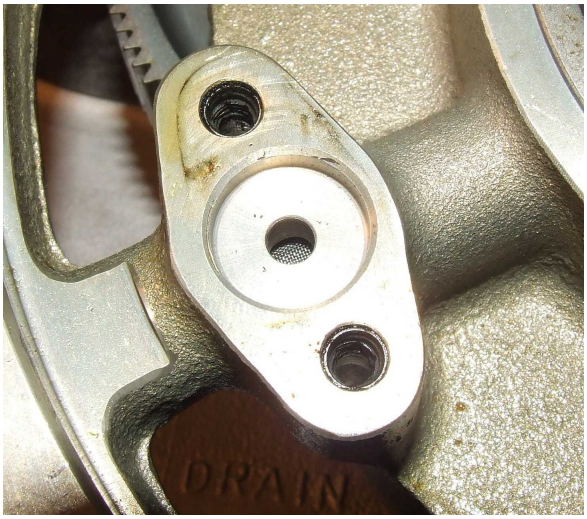
The primary way for dirt to enter the lubrication system is via the oil filter cover. This machined component contains the oil filter bypass valve and closes the circuit from the central oil filter (clean oil) area to the galleries downstream of the oil filter. This cover is inserted into a recess of the gearbox casing and held in place by a circlip. This recessed area is problematic since dirt tends to accumulate there and may even stay after thorough cleaning in the slot of the circlip. Moreover, fragments of the O-ring that seals the cover to the cavity may stay in that area or enter the galleries downstream the oil filter upon reassembly. Since even very careful and accurate handling of these components will not completely eliminate this threat, we decided to look for options to integrate a last chance filter into the engine to prevent particles larger than approx. 0.2mm from reaching the oil injection nozzles.



Quickly it was understood that such a filter can be located inside the radial oil passage in the spoke of the planetary gear spider. Since this passage is a machined bore, it is accurate enough to accept a very slim filter element that discharges directly into the annular oil distribution cavity around the pinion. The filter element is specifically produced for that application from stainless steel wire mesh of very fine gauge, rolled into a tapered tube shape and spot welded to a machined base that tightly fits the bore. The seam of the filter is also welded and a pulling eye made of stainless steel wire is attached to the other end. The clearance around the filter is sufficient to permit part of the oil to discharge though the pressure relief valve.

In order to place the last chance filter in the engine, the power head needs to be removed from the engine gearbox and the spider has to be lifted from its seat (by using pry bolts in the threaded holes of the spider body and trying to keep the spider as parallel to the seat as possible during the procedure). When the spider assembly is removed from the engine, it's a good idea to check that the oil passages are clear by injecting WD40 or brake cleaner into the radial orifice. Other than shown in the photos, the oil pressure relief valve should not be removed.

After all oil nozzles are found to be clear (or have been properly cleaned), the LCF element is inserted as shown into the bore as far as it will go. The pulling eye has to stay below the circular surface of the spider body.



After that, the spider is re-inserted into the gearbox casing (care has to be taken not to squeeze the O-ring upon the spider is pushed in the final few millimeters). Now the power head will be put back and all the fuel tubing and electrical connections will be re-established.

With this filter in place, the risk of an engine failure due to dirt bypassing the oil filter or otherwise finding its way into the galleries downstream the oil filter is virtually eliminated.

Filters are available upon request (the photos show a prototype that's performing flawlessly in an Ultrasport 496 conversion.

Thomas Baumgart (webmaster@te-baumgart.de)