Hale Products, Inc. Service Bulletins

Bulletin#: SB78 **Revision#:** A **Date:** 8/31/2004

Product Type Covered: Hale Pump X **Hurst Tool** **Lukas Tool**

Product Covered:

Midship Pump and Engine Recommendations

Problem Statement:

Caterpillar C7 330 HP engines stalling at idle.

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Body of the Bulletin

The latest series of engine emission controls appear to contribute to a loss of low speed torque and response on Caterpillar C7 and C9 engines. In some applications the engine can stall when additional load is engaged. This load can come from the fire pump, hydraulic driven AC generators, air compressors or other accessories. Extra caution should be used when engineering, specifying and using a Caterpillar engine with multiple accessories.

Hale addressed a different issue of reduced torque at elevated RPM on Caterpillar engines earlier this year by recommending numerically lower pump gearbox ratios (See Hale Service Bulletin Number SB76 dated 1-9-2004). While the ratio change solved many pumping problems it may also be necessary to increase the low idle speed of the engine to prevent engine stalling at pump engagement. Normally this speed is set at 700 RPM. By increasing the idle to 800 or 900 RPM there is additional torque available as well as an RPM pad before the stall point of the engine. Allison transmission allows 900 RPM engagement speeds for emergency vehicles.

NOTE: Some pumps such as Hale HFM and CSD series front mount pumps cannot be engaged at speeds greater than 700 to 750 RPM. In these cases an engine with higher low speed torque is required.

While this problem does not occur on all installations it occurs more often on apparatus equipped with high load accessories that engage at engine idle. These accessories include but are not limited to hydraulic AC generators, air compressors, hydraulic rescue tool pumps and compressed air foam systems. The stalling occurs after shifting the split shaft gearbox from road to pump, the range selector on the Allison transmission is shifted from N to D and 4th Range lock-up occurs. The Allison transmission locks up very quickly and when this occurs the driven accessory(s) require more torque and a faster response from the engine than is currently available at the low idle speeds.

As a result of the lower torque and slower response experienced with the Caterpillar C7 engine, special consideration must be given to engagement of fire pumps with these additional accessories. Hale, working with Allison, has requested a soft start solution in their next generation controls. However, we expect this change to take Allison a minimum of two years to implement after they start working on the solution. Allison will not begin the process of this change implementation until a sufficient number of requests have been made. OEMs should contact their Allison representative to request this update in the next version of their control system or it will not be made available.

Meanwhile there is a torque converter lock-up ON or OFF message on the transmission J1939 bus and a single wire available on the Allison ECU that can be set up to soften the engagement by delaying lock-up momentarily. The OEM can engineer an interlocked system to take advantage of these Allison control options to obtain a smooth reliable shift on the newer lower capacity C-7 engines. Of course the OEM needs to make sure the system is properly interlocked and the output shaft speed switch on the Allision transmission can be the control that allows lock-up once the shaft is spinning. Again if you need this option built into the Allison controls in the future, contact your Allison representative and request this feature in future software revisions or the system will have to continue to be engineered at the OEM.

When designing fire apparatus with higher load accessories, alternative 300+ HP range engines should be considered. The following information has been obtained from the engine manufacturers and is provided to assist with engine selection. As engine manufacturers work to meet the 2007 emissions standards, we may see additional changes in output torque capability in the future so this list is a short term reference only.

ENGINE MODEL	RATED HP	PEAK TORQUE	TORQUE @ 700 RPM (lb-ft)	TORQUE @ 1000 RPM (lb-ft)
Caterpillar C7-330	330 @ 1600	860 @ 1440	395	490
Mercedes MBE926-300	300 @ 2200	860 @ 1300	535	664
Mercedes MBE926-330	330 @ 2200	1000 @ 1300	531	701
Cummins ISC 330	330 @ 2000	950 @ 1300	500	700

Hale will continue to work with the engine manufacturers in an attempt to stay ahead of engine changes that may adversely affect pump engagement and operation and advise whenever possible. However, the OEM is the system integrator and should use extra care when selecting lower HP/displacement engines combined with additional options that require low speed power.

A NOTE ABOUT PUMP/ENGINE COMBINATION RECOMMENDATIONS

It is imperative that the apparatus manufacturer always check with the engine manufacturer for approval of a net horsepower curve. In addition the inertia and torque required to run accessories must now be considered.

A Hale Qmax 2000 GPM pump with a CAFSPro compressed air foam system takes approximately 100 lb-ft of torque to run at idle (700 RPM). There is a momentary peak torque roughly three times that to bring the system up to 700 RPM from a dead start with the standard Allison transmission arrangement. This peak torque only lasts a fraction of a second, and with engines of typical torque and response capability it is not an issue. However, some engines may have a problem with the newer emissions controls.

Hale makes recommendations for pump engine combinations on our published recommendation list based on information obtained from the engine manufacturers. Hale attempts to take into account engine performance differences as well as additional parasitic loads that could be present on the apparatus. The following are taken into consideration when Hale develops their pump engine recommendations.

The engine's actual performance can vary as much as ± 5% from published curves. The published performance curves are based on SAE J1995 standard conditions of 29.61 in. Hg (100 kPa) and 77^{O} F (25^{O} C). Most of the curves are based on engine performance without fan but with air compressor, fuel pump, lubricating oil pump and water pump.

Hale's rating charts and pump engine recommendation list are starting points to select the proper pump rating and gearbox ratio. On the rating chart the gearbox input speed and horsepower requirements shown are nominal ± 5%. When using the rating chart, it is important to obtain net horsepower output of the engine. The engine manufacturers published curve may not represent a true net horsepower when totaling all the power deductions that may be encountered during operation and testing. Deductions could include but are not limited to engine and vehicle accessories, elevation, temperature, barometric pressure, etc.

The Hale Pump/Engine Combination List is based on the latest horsepower-RPM curve as furnished by the engine manufacturer at the time of publication. To create a realistic net horsepower curve, Hale deducts additional horsepower to help cover most standard accessory items and other power consuming loads. A partial example would be; power steering pump, fan engaged, alternator charging, air compressor (loaded), air cleaner, air temperature and barometer. Any added load on the engine may require a pump ratio recalculation to insure sufficient horsepower for pump performance, and/or special engagement procedures to prevent problems with pump operation.

This bulletin will be updated as further information becomes available.