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Reduction in Parasitic Losses by Careful Choice of Alternator Drive System

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ABSTRACT
Concerns over greenhouse gas emissions are driving governments and the automotive industry to seek out ways of reducing vehicle CO_2 emissions. Engine friction reduction is one means of reducing CO_2 emissions, through fuel consumption improvements. The ancillary drive system typically contributes up to 8% of the total engine friction level, so improvements in this system can make a real difference to engine efficiency, fuel consumption and CO_2 emissions.

MAHLE has undertaken a series of rig tests, based on a 2.5 litre gasoline engine, but built to a minimum friction level of hardware. Using motored drive torques, the losses associated with different alterator drive concepts was investigated:

- Standard 150A alternator
- Reduced capacity 120A alternator
- Reduced capacity 120A alternator driven by a dual speed gearbox
- Reduced capacity 120A alternator driven by a twin-belt dual ratio pulley

The engine test configuration enabled the friction sensitivity to be considered in respect of oil temperature, belt tension, belt temperature and alternator loading, as well as the hardware changes considered.

The twin-belt concept demonstrated a friction improvement capability, whereas changing the effective alternator ratio by means of a dual speed gearbox demonstrated a detriment. The use of a twin-belt system could offer the opportunity to reduce the overall FEAD system losses as well as potentially enabling smaller alternators to be specified. Cost and packaging issues permitting, this could reduce the parasitic losses associated with an alternator drive system.

With a twin-belt arrangement, the test engine demonstrated an improvement in net parasitic losses of between 300W and 400W, at an engine speed of 5000 RPM and alternator loading of 60A. For the same test conditions, a dual speed gearbox would need to be operating at an efficiency above approximately 80% to avoid a net worsenining in parasitic losses, whilst the measured efficiency of the test unit was approximately 60%.

This paper considers the approach to the testing, the test results obtained and some further discussion.