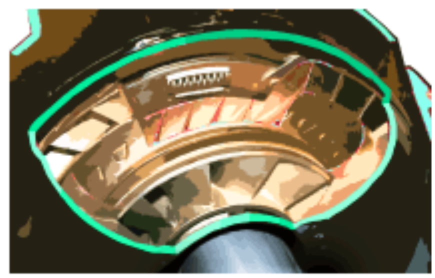
Automotive Automatic Transmissions

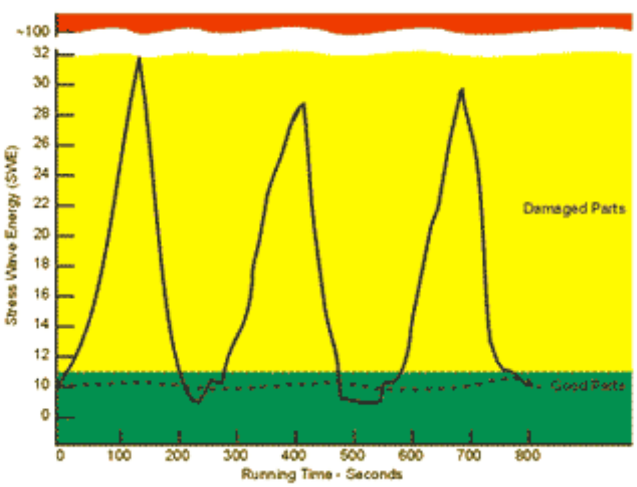
Identifying gear damage and isolated damage zones

Stress Wave Analysis (SWAN™) was successfully tested on automatic automotive transmissions. The technology identified gear damage and isolated the damage zone on this type of complex, dynamic system.

This demonstration was conducted in a test cell with the transmission driven by a V-8 engine and loaded by a dynamometer. The transmission was a typical three speed automatic with two planetary gear systems. The gearbox was first operated (at constant speed and load) to acquire Stress Wave Energy (SWE) measurements with no defective parts installed. This produced SWE readings that ranged from nine to eleven as shown in the figure.

The transmission was then disassembled and rebuilt with one damaged gear/bearing assembly in each planetary gear system (each planetary gear system has four planet gear/bearing assemblies). The damaged planet assemblies each had light to moderate spalled pins (planet bearing rolling elements) and pitting on the gear teeth. This damage level was described by the transmission manufacturer as the smallest level of damage that would justify a rebuild.





The SWE readings were then retaken under the same test conditions, with these discrepant parts installed. The SWE increased to three times the normal levels, but in a periodic manner. This periodic increase in the levels of friction and shock energy was found to be due to the frequency with which the damage zone of the one of four damaged planet gears in each planetary gear system became the principle load carrying member of the overall gear/bearing system.

This case also illustrates the ability of the SWAN technique to operate effectively on a complex dynamic system, with a very complex material path for conduction of structure-borne stress waves from deeply buried machine elements, to a sensor that is externally mounted on the machine's housing.

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