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2. DESCRIPTION OF THE INSTRUMENTS

2.1 Overview

Figure 1 shows a schematic diagram of the instruments used for the vibration testing of the angle drive gearbox. An accelerometer bolted to the gearbox casing converts the vibration into an electrical signal which is amplified and then passed through an attenuator to one channel of a tape recorder. The signal from one phase of the engine tachogenerator is passed through an isolating transformer to the other channel of the tape recorder. In this manner, signals representing the vibration and speed of the gearbox may be recorded simultaneously.

When the tape is reproduced, the tachogenerator signal controls the sampling rate of the spectrum analyzer and the cut-off frequency of the anti-aliasing filter. The vibration signal is passed through this filter to the spectrum analyzer, where its component frequencies are displayed. Entering the appropriate scaling factor into the spectrum analyzer allows the direct digital read-out in engineering units of each vibration component.

Since the sampling rate of the spectrum analyzer is proportional to the frequency of the tachogenerator signal, the spectrum will be displayed as a function of engine orders instead of absolute frequency. Although the engine speed will change during the test, the position of each vibration component will remain fixed on the display.

With the spectrum analyzer in the peak mode, the memory contents at the end of a vibration test will show the highest vibration level reached by each component during the test. By comparing the magnitude of each component with a table of maximum permissible vibration levels, the condition of the gearbox may be assessed.

The use of the tape recorder is optional. On-line analysis may be performed with equal ease and greater accuracy; therefore it is recommended that on-line analysis be performed whenever possible.

Further details of each of the instruments are given in the following sections.

2.2 Accelerometer

The Kistler 815A2 Piezotron Accelerometer is a hermetically sealed quartz transducer containing an integral impedance converter which provides a low-impedance output enabling conventional shielded cable to be used without degradation of performance.

The accelerometer may be mounted on any flat surface normal to the required measurement axis using a threaded stud in a tapped hole. Adhesive mounting is not recommended, as tests by ARL have shown that the high frequency response is degraded by this method.

The accelerometer mounting procedures are described in Sections 4.4 and 5.1. Full performance data are contained in Reference 2.

2.3 Amplifier

The Kistler 504E Dual Mode Amplifier is suitable for use with either straight piezoelectric transducers or transducers containing an integral impedance converter.

A transducer sensitivity control on the amplifier enables the amplifier output to be set to integer values of engineering units per volt as selected by the amplifier range control, regardless of the sensitivity of the transducer.

Power for the impedance converter in the transducer is provided by the amplifier via the connecting cable. Plug-in low-pass filters may be selected in order to reduce the effect of the transducer resonance and attenuate unwanted noise.

Full specifications are provided in Reference 3.

2.4 Attenuator

The RECORD LEVEL controls on the tape recorder do not have detents and can only be set repeatably in the MIN and MAX sensitivity settings. Unfortunately the optimum sensitivity setting required to match the amplifier and tape recorder lies between these two extremes. To obtain repeatable attenuation of the vibration signal, a simple, frequency-compensated attenuator has been supplied by ARL. When the RECORD LEVEL control is set to the MAX position and the attenuator inserted in the connection between the amplifier and the tape recorder, the correct attenuation is produced. The attenuator is housed in a small aluminium tube and may be connected either way around without impairing the high-frequency performance of the tape recorder.

2.5 Isolating Transformer

During testing, the engine tachogenerator signal is used to drive the test-house tachometer. To avoid ground loop noise problems the tachometer signal ground is isolated from the tape recorder input ground by a transformer. The signal produced by the tachogenerator is in excess of 60 mV RMS and contains a very large component at the frequency of the tenth harmonic of the tachogenerator shaft speed. Before this signal can be recorded or used to control the tracking adapter, it must be isolated, attenuated and filtered.

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