



Metro 23 Engine Over Torque Recording in the FDR

AWB 31-006 **Issue :** 1
Date : 8 October 2013

1. Effectivity

M-7 Aerospace, SA227-DC Metro 23 aircraft.

2. Purpose

To make operators and maintainers of SA227 aircraft aware of an issue with recording of engine over torque parameters. The design of the Metro 23 engine torque recording system does not directly record values of engine torque over the range from 100 to 120% into the Flight Data Recorder (FDR).

3. Background

The ATSB has provided CASA with details, where engine over torque conditions are not being captured on the FDR.

The M7 Aerospace SA227-DC Aircraft Flight Manual allows for an engine over torque condition under certain power settings. See Figure 1.

Power Setting	Foot – Pounds	Operating Time	Percent Torque
Maximum Continuous	3301	Continuous	100
Takeoff (Dry)	3630	5 minutes	110
Takeoff (Wet)	3630	5 minutes	110

Figure 1 - M-7 Aerospace SA227-DC Airplane Flight Manual TPE331-12 torque operating limitation

Honeywell TPE331-12 engine maintenance manual specified a series of engine torque values and limiting operating time. See Figure 2.

Shaft Horsepower	Lebow torque meter load cell		Torque signal conditioner
Shaft Horsepower	Foot – Pounds	Operating Time	Percent Torque
1000	3301	Continuous	100
1050 to 1100	3466 to 3631	5 minutes	105 to 110
1100 to 1120	3632 to 3699	15 seconds	110 to 112
1120 to 1143	3700 to 3772	5 seconds	112.1 to 114.3
1143 to 1168	3773 to 3857	At any time	114.3 to 116.8
1169	3858	At any time	116.9

Figure 2 - Honeywell TPE331-12 torque operating limitation



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The documentation for the aircraft maintenance and engine maintenance manuals specifies the torque signal conditioner output would range from +5 volts dc to 0 volts dc, which corresponds to a torque indication of 0% (0 ft/lbs) to 100% (3301 ft/lbs).

The aircraft engine torque indicating instrument calibration procedure indicates that the instrument will indicate from 0% torque to 120% torque which correlates with a nominal input voltage from +5 volts dc to -1 volts dc.

Tests were carried out on the operation of the flight recorder, with input signals specified by the aircraft torque indicator instrument calibration procedure. The tests confirm a 'foldback' operation when subjected to negative input voltage which corresponds to an over torque condition.

The result is such that a cockpit indication of greater than 100% torque would be recorded with the same characteristic as a reduction in torque. A manual interpretation of the recorded values of engine torque is needed to assess whether an engine over-torque event has occurred.

The characteristic of the reduction in torque from the value recorded at 100%, seen in Figure 3, was unusual when compared with a normal take off power application as shown in Figure 4

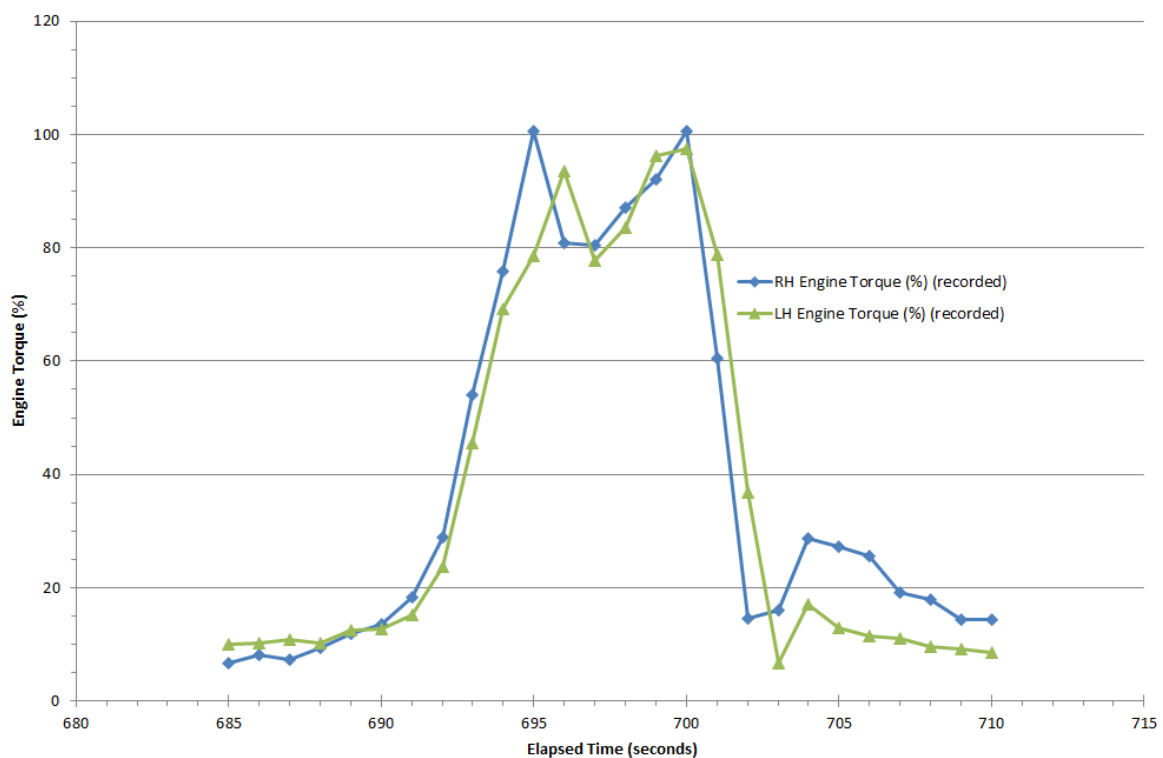


Figure 3 - Plot of Flight Data Recorder information from Rejected takeoff



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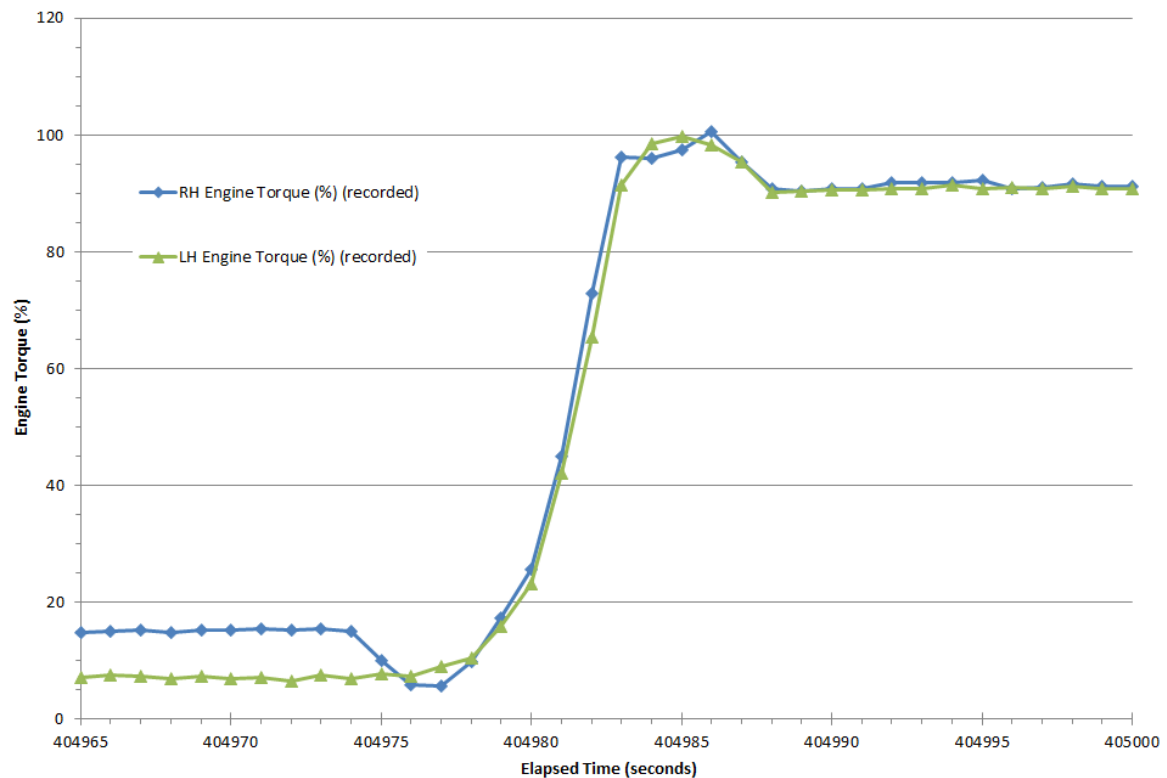


Figure 4 - Plot of Flight Data Recorder information from Normal takeoff

The recorded torque for the left engine shows a smooth increase, peaking at about 100% torque and subsequently decreasing to about 90% torque. The right engine torque shows a smooth increase until a value of about 96% torque when the trace appears to 'dip' while still rising to a maximum value of about 101%, a similar characteristic as observed during the rejected take off. The right engine torque subsequently follows the trend of the left engine torque and decreases to about 90% torque.

Comparisons and calculations were made to determine the difference between the recorded engine over-torque indications and the derived indications. See Figure 5.



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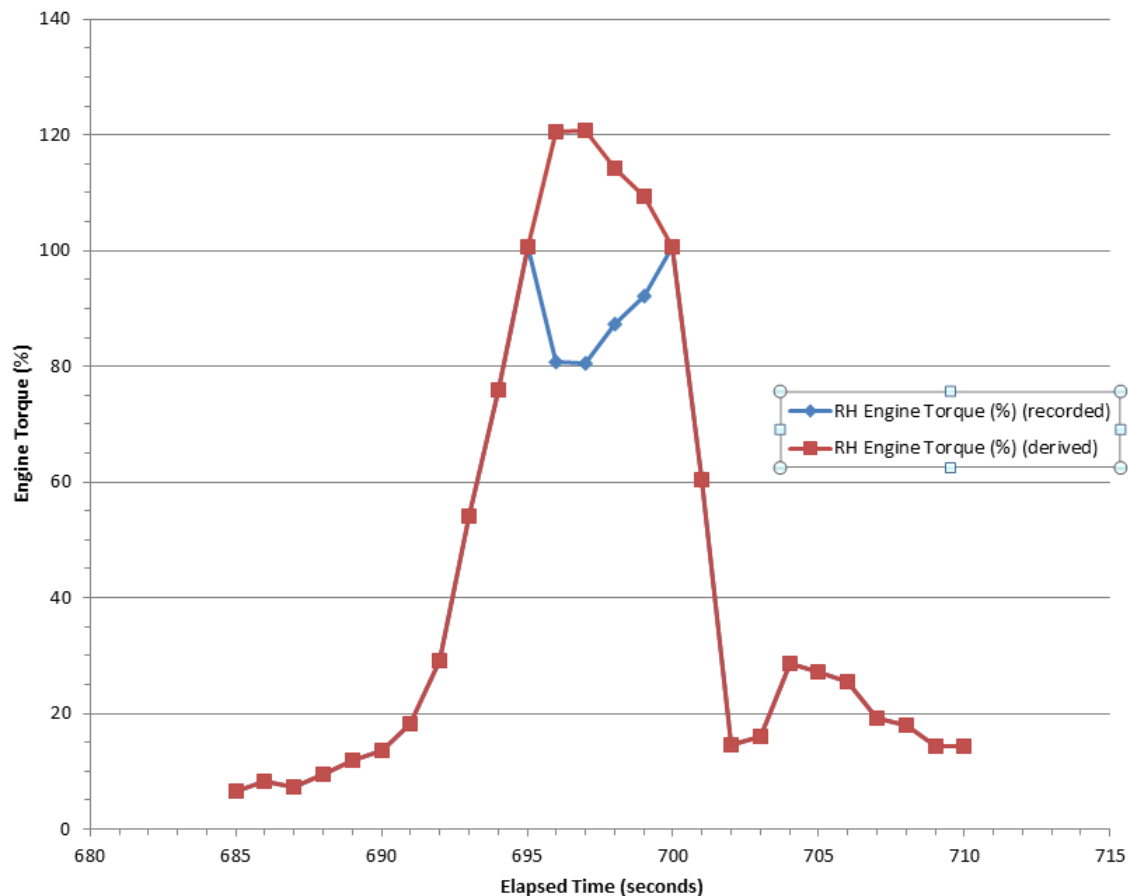


Figure 5 - Derived to recorded engine over-torque indications

The values in the red trace were manually derived by determining the difference from 100% torque. These values were calculated on the basis that the flight data recorder input voltage had reduced below 0 volts dc and the torque value would have been increasing above 100%.

Information to calibrate the torque indicating and recording system to monitor and record values of engine torque greater than 100%, could not be determined from the engine manufacturers' maintenance manual or the airframe maintenance manual.

4. Recommendations

Operators need to be aware when analysing engine over torque values from the FDR that engine torque values greater than 100% could appear as an under torque condition.

5. Reporting

Reporting to CASA can be made by the CASA SDR system.



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6. Enquiries

Enquiries with regard to the content of this Airworthiness Bulletin should be made via the direct link e-mail address:

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