

Turbomeca Engine Vibration Test Kit Type 3656-A

The Turbomeca Engine Vibration Test Kit Type 3656-A is designed for field inspection of all Turbomeca helicopter engine families. Vibration test measurements are performed according to the respective maintenance manual.

Type 3656-A has been developed by Brüel & Kjær Sound and Vibration in close collaboration with Turbomeca, a leading helicopter engine manufacturer.

The test kit comprises a vibration meter (with measurement templates for all Turbomeca engines), a high-temperature accelerometer, and a 7 m cable, all packed in a handy shoulder bag.



Uses, Benefits and Features

Uses

- Vibration test for field inspection maintenance of aircraft engines on the ground
- High GG speed vibration checks for Arriel 1[®] engines
 - On ground for twin-engine helicopters
 - In flight for single-engine helicopters

Benefits

- Immediate and unambiguous pass/fail decisions according to engine maintenance manual instructions
- Recording and documentation of test data according to Turbomeca requirements for easy interaction with Turbomeca Services

Features

- Verifies overall vibration levels in a specific frequency range during engine run-up against allowable limits
- Message if level limitations are exceeded
- Turbomeca templates for all engine families are included
- Meta-data annotation according to Turbomeca requirements
- One handed operation and simplified operator user-interface
- Only one transducer and one cable needed
- No computer required during measurements
- No tachometer connection required
- Manual storage of results with full annotation including the raw signal for post-processing
- Enhanced diagnostics can be carried out after the test by post-processing the raw time signal
- Easy reporting, data transmission and data export to consumer software
- Long-life rechargeable battery operation (>8 hours)

The vibration measurements are performed during an aircraft ground run, where the engine is run up under specific controlled conditions. Accelerometer Type 8324 is installed on the engine in a pre-defined position and connected to Hand-held Vibration Analyzer Type 2250-H-100. The Vibration Analyzer features measurement templates and vibration limits from all Turbomeca engine families, and will process the vibration measurements according to the maintenance manual instructions of the specific engine type.

The vibration measured is automatically compared to the individual limits of the specific engine, and the 2250-H-100 will give visual feedback of the status – passed or limit exceeded. The vibration signals and test results are recorded during the test to provide optional post-processing by Turbomeca. Detailed test annotation is easily appended by the operator using Turbomeca predefined Meta Data.

System Description

Fig. 1
Type 2250-H-100
Hand-held Vibration Analyzer (Engine Vibration Consultant) – the simplified display showing only the required information, such as vibration level, limits and pass/fail results



Engine Vibration Test Kit Type 3656-A includes all the hardware and software needed to perform on-the-ground vibration test procedures in accordance with Turbomeca engine maintenance manuals. The heart of the system, Hand-held Vibration Analyzer Type 2250-H-100 (Fig. 1) is equipped with Turbomeca engine templates for Ardiden®, Arriel®, Arrius®, Artouste®, Astazou®, Makila®, RTM 322, TM 333 and Turmo® engine families (Table 1).

Type 3656-A is delivered with the sensor and conditioning unit (Fig. 2) consisting of a high-temperature industrial Charge Accelerometer Type 8324 and a cable/conditioning unit Type 2647-D-004. Type 2647-D-004 is a seven meter, low-noise, high-temperature cable with an integrated charge to DeltaTron converter, specifically customized for demanding engine measurements.

The PC-software Measurement Partner Suite BZ-5503, delivered with Type 2250-H-100, allows archiving and transfer of both measurements and time signals to any Microsoft® Windows®-based computer via a USB interface. The Measurement Partner further allows these data to be directly packed and sent by e-mail to Turbomeca Support Center.

Table 1
Engine templates included with Type 3656-A, covering the whole range of Turbomeca engines

Engine	Ref	Front	Rear
ARDIDEN 1H1		✓	✓
ARRIEL1		✓	✓
ARRIEL 2	✓		
ARRIUS 1	✓		
ARRIUS 2	✓		
ARTOUSTE II	✓		
ARTOUSTE III	✓		
ASTAZOU III and XIV GG	✓		
ASTAZOU III and XIV OS	✓		
ASTAZOU IV	✓		
MAKILA 1	✓		
MAKILA 2		✓	✓
RTM 322	✓		
TM 333	✓		
TURMO IIIC4 and IVC	✓		

Aircraft Engine Testing

Turbomeca requires that engine vibrations are regularly measured and compared to manufacturer's field limits. These tests lead to the operational decisions whether to allow the aircraft to fly or not, and whether maintenance action is to be taken on the engine. Such tests are usually performed during an engine run-up, and ideally vibration of the first order of each shaft (gas generator and power turbine) is individually measured as a

Fig. 2
Charge Accelerometer
Type 8324 and
conditioning unit
Type 2647-D-004



function of the engine shaft speeds. Dedicated maintenance staff will typically use a full Vibration Check System for Aircraft Engines (Types 3641 or 3649) for this type of test, where vibration at all engine locations, as well speed information from two shaft tachometers, are measured simultaneously in order to assess independently the condition of the different engine components on the spot.

However, many operators will prefer to use a handier tool that offers minimal complexity, but still provides the information requested in the engine maintenance manual. Engine Vibration Test Kit Type 3656-A provides this simple and quick engine test capability.

Test Procedure

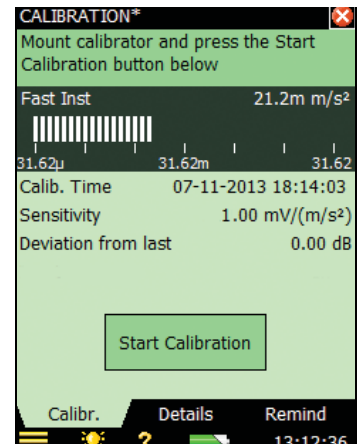
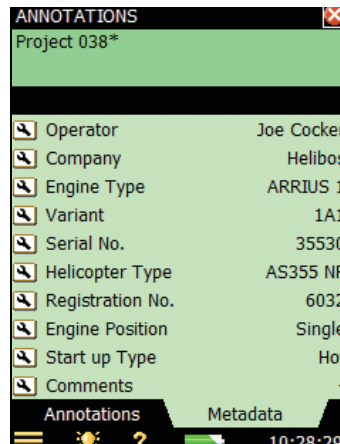
Fig. 3
Charge Accelerometer
Type 8324 shown
fitted to engine
bracket



A vibration test requires that the accelerometer first be installed at the specified location, see Fig.3. The Vibration Analyzer Type 2250-H-100 is then started, the template corresponding to the engine under test is selected, (see Fig. 4, Left), and the Meta data fields are documented (see Fig. 4, Centre).

Before starting the vibration test, the engine must be brought to the required test condition (e.g., oil temperature). When achieved, the measurement on the 2250-H-100 is started. The engine is then run up until flight idle is reached (or other specified speed), at which time the measurement is stopped, the engine is stopped and the measurements are stored.

Fig. 4
Left: Turbomeca
engine templates are
selected with the
stylus on the touch
screen colour display
Centre: Meta-data
fields for
documentation of the
test runs.
Right: Calibrate your
system with the
(optional) easy-to-use
calibration procedure




Test Results

The simple display contains all the necessary information: the maximum overall value reached during the run-up; whether it is within limits or not; and a warning concerning the signal recording quality (no overload).

The bar graph is updated in real-time during the measurement and indicates the current overall value. At the end of the test, the display (see Fig. 1) shows the limit (in red), the maximum value reached (in white), and the bars at the left side of the scale show the value at the time when the measurement was stopped, corresponding usually to flight idle speed unless otherwise specified in the test.

Measurement Partner Software BZ-5503 allows the download of all data stored in Type 2250-H-100 to a PC. This includes the measurements, the signal recording and the meta-data. Following the recommendations in the engine maintenance manuals, the raw measured data can be sent to Turbomeca for further analysis. By clicking on the mail icon, Microsoft Outlook is opened and the packed data attached to an e-mail.

Compliance with Standards

	<p>The CE marking is the manufacturer's declaration that the product meets the requirements of the applicable EU directives. RCM mark indicates compliance with applicable ACMA technical standards – that is, for telecommunications, radio communications, EMC and EME.</p> <p>China RoHS mark indicates compliance with administrative measures on the control of pollution caused by electronic information products according to the Ministry of Information Industries of the People's Republic of China.</p> <p>WEEE mark indicates compliance with the EU WEEE Directive.</p>
Safety	EN/IEC 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use. UL 61010B–1: Standard for Safety – Electrical measuring and test equipment.
EMC Emission	EN/IEC 61000–6–3: Generic emission standard for residential, commercial and light industrial environments. CISPR 22: Radio disturbance characteristics of information technology equipment. Class B Limits. FCC Rules, Part 15: Complies with the limits for a Class B digital device.
EMC Immunity	EN/IEC 61000–6–1: Generic standards – Immunity for residential, commercial and light industrial environments. EN/IEC 61326: Electrical equipment for measurement, control and laboratory use – EMC requirements.

Specifications – Type 3656-A

HAND-HELD VIBRATION ANALYZER TYPE 2250-H-100

The general specifications for Type 2250-H-100 can be found in Product Data BP2183

Weight: 650 g (23 oz.) including rechargeable battery

Dimensions: 250 × 93 × 50 mm (9.84 × 3.7 × 1.9")

ACCELEROMETER TYPE 8324 AND CABLE/CONDITIONER TYPE 2647-D-004

The general specifications for the accelerometer and cable can be found in Product Data BP2143 describing Type 8324-G and 8324-G-001. The Type 8324/2647-D-004 combination shares all characteristics with Type 8324-G-001, except for the cable-end connector, which for Type 2647-D-004, is LEMO

Voltage Sensitivity (@ 160Hz): $1 \pm 10\%$ mV/ms⁻² (10 mV/g)

Measuring Range: ± 5000 ms⁻² (± 500 g)

Frequency Response: $\pm 10\%$ 100 Hz to 9 kHz

Mounted Resonance Frequency: 30 kHz

Residual Noise: 4 mms⁻² (0.4 mg)

Transverse Sensitivity: <3 %

Temperature Range: -196 to +250°C (-321 to +482°F)

Weight (excluding cable): 66 gram (2.33 oz)

Cable Length: 7 m (23 ft): 1 m (3.3 ft) Converter, 6 m (19.8 ft) Cable

Connector (Cable end): LEMO

Mounting: ARINC footprint (3 × M4)

Ordering Information

Note: The Turbomeca type numbers (*italics*) are given where relevant

Turbomeca Engine Vibration Test Kit Type 3656-A

(*TM # 4865G001*), including Type 2250-H-100, Type 8324 and 2647-D-004:

Hand-held Vibration Analyzer Type 2250-H-100 (*TM # 5351G001*)

- KE-0440: Travel bag for Hand-held Analyzer (*TM # 5351G101*)
- 2250-H-001: Type 2250 Vibration Meter (*TM # 5351G201*)
- BZ-7235: Turbomeca Basic Engine Software
- QB-0061: Battery Pack (*TM # 5351P202*)
- UL-1009: SD Memory Card for Hand-held Analyzers (*TM # 5351G401*)
- ZG-0426: Mains Power Supply (*TM # 5351G501*)
- AO-1494 and AO-1476: USB Standard A to USB Micro B/ Mini interface cable, 1.8 m (*TM # 5351G601*)
- UA-1654: 5 Extra Styli (*TM # 5351G701*)

Accelerometer Type 8324

- Type 8324: High Temperature Industrial Charge Accelerometer (*TM # 9610017700*) including:
 - YS-8407 4 × Accelerometer Mounting Screws CHC M4 x 10 (*TM # 1616040107*)

Cable Type 2647-D-004

- Type 2647-D-004: 7 m cable with Charge to Deltatron converter, 1 mV/ms⁻² sensitivity (*TM # 5352G101*)

Optional Items

Software and Accessories Available Separately

BZ-7230 FFT Analysis Software
Type 4294-002 Accelerometer Calibrator (200 g) hand-held, battery powered

Service Available Separately

3656-CVI Initial chain calibration, accredited
3656-CVF Chain calibration, accredited

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