

BRÜEL & KJÆR® Engine Vibration Kits

SAFRAN Helicopter Engine Vibration Test Kit Type 3656-A

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

Type 3656-A is developed by Hottinger Brüel & Kjær (HBK) in close collaboration with SAFRAN HE, a leading helicopter engine manufacturer.

The test kit comprises:

- A vibration meter (with measurement templates for all SAFRAN HE engines)
- A high-temperature accelerometer
- 10 m cable

All components are packed in a handy shoulder bag.



Uses, Benefits and Features

Uses

- Standard: Vibration check during a run-up from engine START to FLIGHT
- High N1/NGG rate: Vibration check during a run-up from FLIGHT to the maximum speed of the gas generator reachable on ground (or in flight for Arriel® 1 single-engine helicopters after Deep Maintenance Intervention)

Benefits

- Immediate decisions according to engine maintenance manual instructions
- Recording and documentation of test data according to SAFRAN HE requirements for easy interaction with SAFRAN HE Services

Features

- Verifies overall vibration levels in a specific frequency range during engine run-up/high N1-NGG rate against allowable limits
- SAFRAN HE templates for all engine families are included
- Message if level limitations are exceeded
- Metadata annotation according to SAFRAN HE 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)

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

SAFRAN HE ENGINE FAMILY	FRONT SENSOR	REAR SENSOR	HIGHN1/NGG RATE
Aneto® 1	✓		✓
Ardiden® 1	✓	✓	
Ardiden® 3	✓	✓	
Arrano® 1	✓	✓	✓
Arriel® 1	✓	✓	✓
Arriel® 2	✓		✓
Arrius® 1		✓	✓
Arrius® 2		✓	✓
Artouste® II		✓	
Artouste® III		✓	
AST 600	✓	✓	✓
Astazou® III	✓		
Astazou IV		✓	
Astazou XIV	✓		
Makila® 1	✓		✓
Makila® 2	✓	✓	✓
MTR 390	✓	✓	
RTM 322	✓		✓
TM 333		✓	
Turmo® III-IV		✓	✓

Description

The vibration measurements are performed during an aircraft ground run, where the engine is run up under specific controlled conditions. Charge Accelerometer Type 8324 is installed on the engine in a predefined position and connected to Hand-held Vibration Analyzer Type 2250-H-100. The vibration analyzer features measurement templates and vibration limits from all SAFRAN HE 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 vibration analyzer will give visual feedback of the status: LEVEL 1, LEVEL 2 or LEVEL 3. The vibration signals and test results are recorded during the test to provide optional post-processing by SAFRAN HE. Detailed test annotation is easily appended by the operator using SAFRAN HE predefined metadata.

The System

Fig. 1 The vibration analyzer (Engine Vibration Consultant). The simplified display shows only the required information, such as vibration level, limits and results



Engine Vibration Test Kit Type 3656-A includes all the hardware and software needed to perform vibration test procedures in accordance with SAFRAN HE engine maintenance manuals:

- **The heart of the system:** Hand-held Vibration Analyzer Type 2250-H-100 that is equipped with SAFRAN HE engine templates (see Table 1)
- **A sensor and conditioning unit:** High-temperature Industrial Charge Accelerometer Type 8324 and Cable-integrated Charge to CCLD* Type 2647-D-004 (see Fig. 2). Type 2647-D-004 is a 10-meter, low-noise, high-temperature cable with an integrated charge-to-CCLD converter specifically customised for demanding engine measurements
- **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 Windows®-based computer via a USB interface. Measurement Partner Suite further allows the data to be directly packed and sent by email to the SAFRAN HE Support Centre

Aircraft Engine Testing

SAFRAN HE requires that engine vibrations are regularly measured and compared to manufacturer's field limits. These tests lead to the operational decisions on whether to allow the engine 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 function of the engine shaft speeds. Dedicated maintenance staff will typically use the full Vibration Check System for Aircraft Engines Type 3641 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.

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



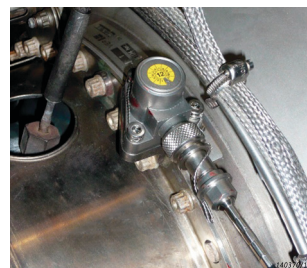
However, many operators will prefer to use a handier tool that offers minimal complexity, but that still provides the information requested in the engine maintenance manual. Engine Vibration Test Kit Type 3656-A provides this simple and quick engine test capability.

Test Procedure

Vibration test setup:

- The accelerometer is installed at the specified location with three screws (Fig. 3)
- The cable/conditioning unit is connected between the accelerometer and the vibration analyzer

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



* Constant current line drive, also known as DeltaTron® (ICP and IEPE compatible)

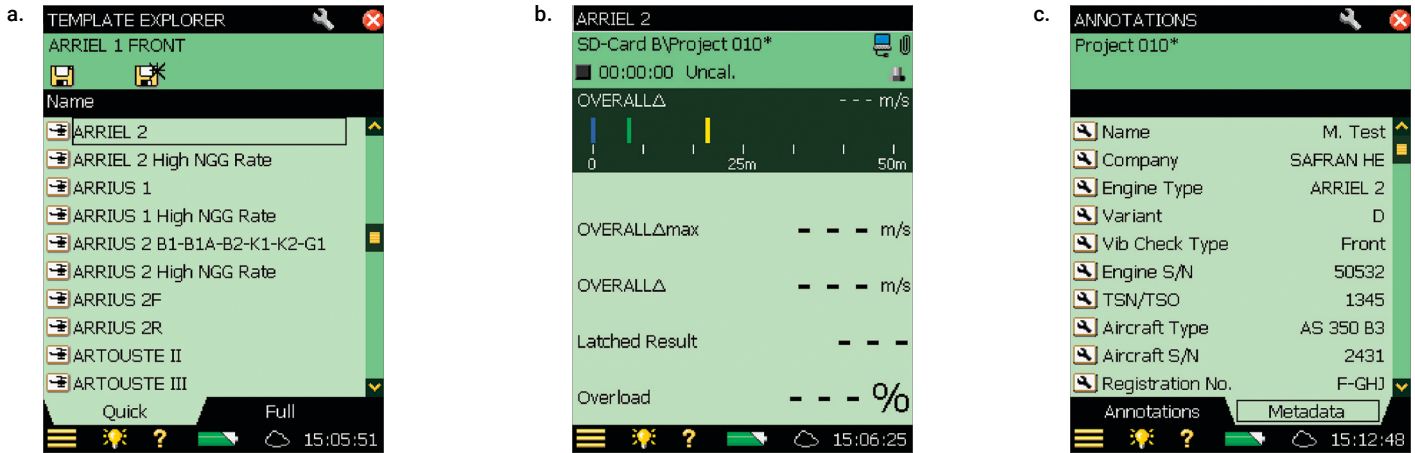
When all the equipment is installed and secured:

- Start the vibration analyzer
- Select the template corresponding to the engine under test (Fig. 4a). The acquisition page will appear (Fig. 4b)
- Enter the metadata fields (Fig. 4c)
- Bring the engine to the required test condition (for example, oil temperature)

When the test condition is achieved, you will stop the engine and run through the vibration test procedure:

- Start the measurement on the vibration analyzer (five seconds before the engine start)
- Start the engine and run up until FLIGHT (or other specified speed) is achieved
- Stop the measurement and store the results
- Stop the engine following the flight manual recommendations

Fig. 4 a.: SAFRAN HE engine templates are selected with the stylus on the touch screen colour display; b.: Metadata fields for documentation of the test runs; c.: Calibrate your system with the (optional) easy-to-use calibration procedure



Test Results

The simple display contains all the necessary information:

- The bar graph is updated in real time during the measurement and indicates the current overall value
- The maximum overall value reached during engine run-up (OVERALLΔmax)
- The instantaneous/last value during engine run-up (OVERALLΔ)
- The result of the engine vibration check (Latched Result), which will be either Level 1, Level 2 or Level 3
- An overload indication (Overload)

Please note the value giving the % of saturation seen on the vibration analyzer input during the vibration check (signal recording quality); To consider the measure as valid, this value must be equal to 0%. If the value is not equal to 0%, you must

check the acquisition chain (cable damage, bad connection, etc.) and redo the acquisition.





At the end of the test, the display (see Fig. 5) indicates the threshold reached, Level 1, Level 2 or Level 3, during the run-up and/or the high N1/NGG rate. Depending on this result, it will be necessary to refer to the task of the engine maintenance manual to know the recommendations of SAFRAN HE.

Measurement Partner Suite BZ-5503 allows the download of all data stored in the vibration analyzer to a PC. This includes the measurements, signal recording and metadata. Following the recommendations in the engine maintenance manuals, the raw measurement data can be sent to SAFRAN HE for further analysis. By clicking the email icon, an email client is opened and the packed data attached to an email.

Fig. 5 Vibration check results on the acquisition page. a.: Green LEVEL 1: Keep the engine in service; b.: Yellow LEVEL 2: Unload and send the vibration raw data to SAFRAN HE for analysis. Refer to the engine maintenance manual for recommendations; c.: Red LEVEL 3: Unload and send the vibration raw data to SAFRAN HE for analysis. Refer to the engine maintenance manual for recommendations



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 – SAFRAN Helicopter Engine Vibration Test Kit 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 BP 2183

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 BP 2143 (Types 8324-G and 8324-G-001). The Type 8324+Type 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 (@ 160 Hz): 1 ± 10% mV/ms⁻² (10 mV/g)

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

Frequency Response: ± 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 g (2.33 oz)

Cable Length: 10 m (33 ft):

- Converter: 1 m (3.3 ft)

- Cable: 6 m (19.8 ft)

Connector (cable end): LEMO

Mounting: ARINC footprint (3 × M4)

Ordering Information

NOTE: The SAFRAN HE item number (*italics*) is given where relevant

SAFRAN Helicopter Engine Vibration Test Kit Type 3656-A (TM #4865G001)

Includes Type 2250-H-100, Type 8324 and Type 2647-D-004:

Type 2250-H-100 Engine Vibration Test Consultant (TM #5351G001) includes the following:

- KE-0440: Travel bag for Hand-held Analyzer (TM #5351G101)
- Type 2250-W: Hand-held Analyzer (TM #5351G201)
- BZ-7235: SAFRAN HE 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 and USB A to Mini interface cable, 1.8 m (TM #5351G601)
- UA-1654: 5 Extra Styli (TM #5351G701)

Type 8324 High-temperature Industrial Charge Accelerometer (TM #9610017700)

includes the following:

- Type 8324: Accelerometer
- YS-8407 4 × Accelerometer Mounting Screws CHC M4 × 10 (TM #1616040107)

Type 2647-D-004 Cable-integrated Charge to CCLD Converter (TM #5352G101)

10 m cable with charge-to-CCLD converter, 1 mV/ms⁻² sensitivity

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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