

- determined for the continuous monitoring of vibration of TV3-117 aeroengines
- optimized as an immediate functional substitute of the existing IV500E vibrometer series 2
- developed based on the MLM 1.2 monitor modernization
- certified according to RTCA/DO 160F standard



1. Purpose

MLM 1.2 TVE vibration monitoring unit is determined for the continuous monitoring of vibration of two helicopter TV3-117 aeroengines during both land trial runs and flight. For its design and mechanical construction MLM 1.2 TVE ranks to type series of MLM 1.2 aeroengine monitors.

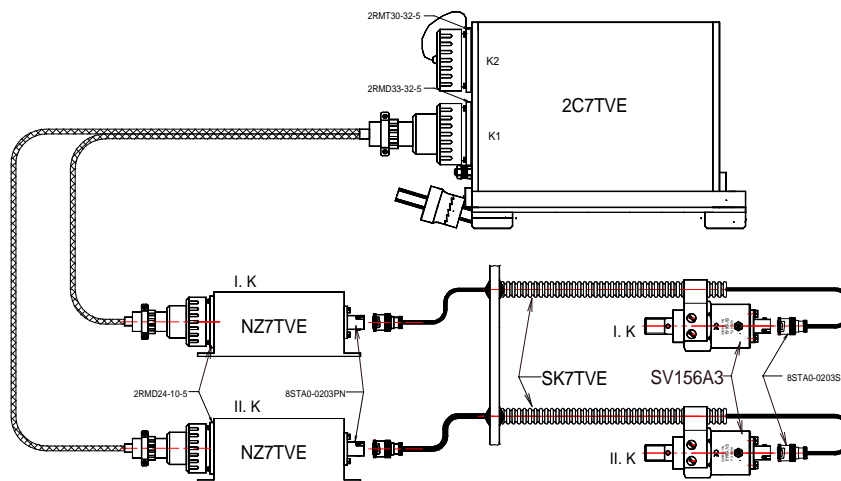
MLM 1.2 TVE monitor is optimized as the immediate functional substitute of the existing IV500E vibrometer series 2. All components are easily commutable both by their dimensions and regarding the connection place. While assembly the original cable connection between USS 6 and BE-9 is used. Also the cable connection from BE-9 into the board network is fully commutable.

In MLM 1.2 TVE monitor, there are comparators and minimal deviation of sensor sensitivity exactly set from factory, so there is no need of the calibration and operation parameters settings. The monitor arrangement allows using of control and diagnostic systems used for IV-500E vibrometer control and installation in current time.

The up-to-date design of MLM 1.2. TVE monitor fully corresponds with requirements of current RTCA/DO 160 F standard, extends safety functions (e.g. controlling of disconnection from cable to sensor as innovation), thanks to extraordinary parameters stability doesn't require the scheduled calibration and setting operations, increases the operation reliability and eliminates the false failure signals caused by sensor cable characteristics or change of electronics parameters.

2. Description

Pic. 1: MLM 1.2 TVE set



MLM 1.2 TVE components

- SV156A3 Sensor with bracket
- SK7TVE Signal cable
- NZ7TVE Amplifier module
- Cables in helicopter
- 2C7TVE Box of electronics

The vibration monitor consists of 2 pieces of SV156A3 piezoelectric accelerometers. These sensors are connected by the special low-noise SK7 TVE cables led through the bushing to NZ7 TVE charge amplifiers placed in the helicopter's cockpit. From NZ7 TVE amplifiers signals are led by the standard wiring (originally determined for IV500E set) to 2C7 TVE two-channel diagnostic unit, placed also in the cockpit. 2C7 TVE unit (the same dimensions as the original BE-9 block series 2) evaluates vibration by two single-channel separated C7 TVE measuring units, placed in 2C7 TVE.

Every C7 TVE channel measures and evaluates engine vibration defined like an effective value of vibration speed in the band from 190 up to 340 Hz. Outputs from every channel are:

1. SE Standard exceeding switch (for connection of the yellow light on the control panel)
2. HV Hazardous vibration switch (for connection of the red light on the control panel)
3. DC voltage signal proportional to vibration for diagnostic set control
4. AC voltage signal of real-time vibration connectable to the analyzer or oscilloscope
5. DC voltage signal of acoustic emission for extended diagnostics possibilities
6. AC voltage signal of acoustic emission for extended diagnostics possibilities

In case the vibration exceed fixed values 45 mm/s for Standard exceeding and 60 mm/s for Hazardous vibration, the switches are activated.

The unit input is a signal of stabile internal test generator activation of every channel, controlled by the separate button from the panel and it is determined for testing of both units. By button pressing the stabile internal generator is connected to input of NZ7 TVE amplifier through sensor capacity. It simulates 85 mm/s input signal from sensor. This signal tests also the correct sensor connection and this will cause the test of complete measuring path including SE and HV switches function.

For the extension of engine symptoms monitoring in the inaudible area there is added the ultrasonic channel with DC and AC output for another eventual use, e.g. during land trial runs.

The monitor has the circuit of sensor or wiring failure signaling. Unlike the IV500 E, the MLM 1.2 TVE set allows to ensure also the sensor false connection.

Tab. 1 Parameters for every channel

<i>Electrical parameters</i>		
Power supply	DC 28 V, typ. 120 mA, max 240 mA	
Vibration sensor	2 SV156A3 accelerometers	
Vibration – AC output		
AC output transmission coefficient	3,50 V / 100 mm/s	
Measuring range	0 - + 8 V	
Output voltage range	min - 12 V, max +12 V	
Vibration – DC output		
DC output transmission coefficient	7,00 V / 100 mm/s	
Measuring range	0 up to + 8 V	
Output voltage range	min -0,6 V, max 12 V	
Switches of vibration exceeding alarm signal - SE (standard exceeding) a HV (hazardous vibration)		
Function	electronic switch of power supply voltage Un=+28V, switches Un when SE and HV are exceeded	
SE vibration nominal value	45 mm/s (factory settings)	
HV vibration nominal value	60 mm/s (factory settings)	
Control of signal path function		
Function	connects internal oscillator to the signal path input	
Input	0V - off, +28 V - on	
Oscillator start corresponds to vibration value	85 mm/s	
Another parameters:		
Operation conditions - temperature		
2C7 TVE	- 55 up to +85 °C	
NZ7 TVE	- 55 up to +85 °C	
SK7 TVE	- 55 up to +175 °C	
SV156A3	- 55 up to +175 °C	
Another operation conditions	tested according to 16 RTCA/DO 160F standard: tab. 2	

Tab. 2: Conditions according to RTCA/DO 160F standard

<i>Tested parameters of MLM 1.2 TVE set according to RTCA/DO 160F standard</i>		
Parameter	Section / standard	Category
Temperature and altitude	4	B2
Low temperature limit on the ground	4.5.1	-55°C
High temperature limit on the ground	4.5.3	+85°C
Low operation temperature	4.5.2	-55°C
High operation temperature	4.5.4	+75°C
Altitude test	4.6.1	15200 m
Decompression test	4.6.2	15200 m
Overpressure test	4.6.3	x
Temperature variation	5	B
Humidity	6	C
Operational shock and crash safety	7	A
Vibration	8	UG
Explosion proofness	9	X
Waterproofness	10	Y
Fluid susceptibility	11	X
Sand and dust	12	D
Fungus resistance	13	F
Salt fog	14	S
Magnetic effects	15	Z
Power input	16	ZXX
Voltage spike	17	A
AF conducted susceptibility	18	Z
Inducted signal susceptibility	19	ZC
Radiated and conducted susceptibility	20	TT
Radiated and conducted emission	21	B
Lightning testing	22	A1C11
Lightning direct effects	23	X
Icing, article 24.2	24	X
ESD	25	A
Fire resistance	25	X

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