Mechanalysis model MIL8800 Machinery Protection Monitoring System – API670 Compliance Statement

Preface

This document is a summary of the API670 Edn4 specification against which the current modules of the MIL8800 machinery protection monitor are designed to. As the API specification states that certain aspects are not inclusive and so these have to be agreed between the user and the supplier. This document is not exhaustive but does attempt to cover the main clauses in some detail. The Mechanalysis (India) Ltd (MIL) responses are for minimum compliance but in many cases the company has products that exceed the specification (e.g. accelerometer or eddy current probe sensor temperature ranges). The company also has the Sensonics Ltd of UK systems available (Sentry-G3 that is also API670 compliant). Mechanalysis products undergo continuous improvement as needed by its Customers; these will be made available on an as needed basis.

Clause No.	Clause	Requirement in Brief	MIL Response
1	General		
1.1	Scope	Machinery Protection System – minimum requirement	**MIL confirms compliance** for rotary machines requirement.
1.2	Alternate Designs	With Purchaser and Vendor's mutual agreement	**Yes, MIL agrees.**
1.3	Conflicting Requirements	Information included in the customer's PO governs.	**Yes, MIL agrees.**
2	References		
3	Definitions		
4	General Design Specifications		
4.1	**Component Temp. Ranges**	Machinery Protection System components to perform over testing and operating temperature ranges over which accuracy will be as in Table 1	**MIL confirms compliance**
4.2	Humidity		
4.2.1	Transducer system	Transducer system accurate as in Table 1 for up to 100% condensing, non-submerged, with protection of connectors.	**MIL confirms compliance.**
4.2.2	Monitor system	Monitor system accurate as in Table 1 for up to 95% non-condensing	**MIL confirms compliance.**
4.3	**Shock**	Accelerometers shall be capable of surviving a mechanical shock up to 5000 g, peak	**MIL confirms compliance.**

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4.4	**Chemical resistance**		
4.4.1		Probes, extension cables and probe drivers suitable for H_2S and ammonia environment.	MIL confirms compliance.
● 4.4.2		Compatibility with other specified chemicals – joint responsibility of Purchaser & Vendor	Yes, MIL agrees.
4.5	**Accuracy**		
4.5.1	Transducer & Monitor	Accuracy for Sensor and Monitoring system as per Table 1	MIL confirms compliance.
4.5.2	If requirements of Table 1 are exceeded	For applications for transducer or monitor exceeding requirements of Table 1, vendor to provide document showing how accuracy is affected Notes – 1) For applications exceeding 2mm range, the probe with 4mm range, 100mV/mil is not covered in the scope of this standard. 2) Similarly smaller dia shafts, the curvature could, consult vendor.	MIL confirms compliance.
4.5.3		ECP accuracy to be verified for actual target are	MIL confirms compliance.
4.5.4		While verifying ECP accuracy in the Operating temp range the components not under test will be in the Testing temp range	MIL confirms compliance.
4.6	Interchangeability	All components are physically and electrically interchangeable.	MIL confirms compliance when of the same brand.
4.7	Scope of Supply and Responsibility	Ref. Appendix B	MIL confirms compliance.
5	**Conventional Hardware**		
5.1	**Transducers for Radial Shaft Vibration, Axial Position, Phase Reference and Speed Sensing.**		
5.1.1	**Proximity Probes**		
5.1.1.1		Chemically resistant for as in 4.4	MIL confirms compliance.
5.1.1.2		8mm tip dia., reverse mount, hex nut, 25mm length and 3/8-24-UNF-2A threads	MIL confirms compliance.
● 5.1.1.3		Other thread, 8 or 5 mm dia options, when specified	MIL confirms compliance.

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Clause No.	Clause	Requirement in Brief	MIL Response
5.1.1.4		1mtr integral cable	MIL confirms compliance.
5.1.1.5		Clear heat shrinking tube for tagging	MIL confirms compliance.
5.1.2	ECP Extension Cable	Coaxial, 4 Mtr, with heat shrink tubing.	MIL confirms compliance.
5.1.3	Connectors	Mechanical, electrical, environmental	MIL confirms compliance.
5.1.4	Oscillator-Demodulator / Probe Driver		
5.1.4.1		Probe driver be suitable for sensor and ext. cable, 200mV/mil output, power supply -24V DC, interchangeable, noise <20mV pp at monitor input, isolated from ground.	MIL confirms compliance.
● 5.1.4.2		DIN rail mounting when specified	MIL confirms compliance.
5.1.5	Magnetic Speed Sensor	Sub clauses 1 to 4	MIL confirms compliance.
5.2	Accelerometer based Casing Transducers		
5.2.1	Casing Vibration Transducers		
5.2.1.1	Piezoelectric Accelerometers	1. Case isolated	MIL confirms compliance.
		2. SS 316 material, hermetically sealed, 25mm dia max., height 65mm max	MIL confirms compliance.
		3. Mounting surface 0.4micron roughness finished, ¼-28 UNF threading etc.	MIL confirms compliance.
		4. Mounting stud, other threads etc. when specified	MIL confirms compliance.
		5. Transverse sensitivity <5% of principal axis	MIL confirms compliance.
		6. Noise floor <0.004 g rms.	MIL confirms compliance.
5.2.1.2	Accelerometer cable	1. To be supplied by vendor meeting temp requirements	MIL confirms compliance.
		2. Accelerometer cable 5mtr. Length	MIL confirms compliance.
		3. Clear heat shrink tubing for tagging	MIL confirms compliance.

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Clause No.	Clause	Requirement in Brief	MIL Response
5.2.1.3	Connectors	1. Mechanical, electrical and environment requirement, SS 300 material, tensile load 225 Newtons or 50 Pounds	MIL confirms compliance.
5.3	Temperature Sensors		
5.3.1	Sensors		
● 5.3.1.1		PT100, 3-wire system is standard. When specified, grounded type thermocouple J type (IEC 584-1). For electrically insulated bearings isolated T/c will be provided.	MIL confirms compliance.
● 5.3.1.2		Leads individual and overall shielded. Steel braiding etc., when specified.	MIL confirms compliance.
5.3.1.3		Clear heat shrink tubing for tagging	MIL confirms compliance.
5.3.2	Wiring	a. Three wire for PT100. b. For thermocouples, extension wire of same material	MIL confirms compliance. MIL confirms compliance.
5.3.3	Connectors	Single compression type, like-metal-to-like-metal between sensor and the monitor.	MIL confirms compliance.
5.4	Monitor Systems		
5.4.1	General		
5.4.1.1	Responsibility	The entity responsible to certify compliance with all provisions of this standard.	MIL confirms compliance.
5.4.1.2	Contiguous	One contiguous enclosure (rack)	MIL confirms compliance.
5.4.1.3	Monitor – Minimum features and functions required		
5.4.1.3.a		Single circuit failure (power source and system power source excluded) shall not affect >2 Chls (>6 channels for temperature)	MIL confirms compliance.
● 5.4.1.3.b		Safety Instrumented Systems standard ISA S84.01 – 1996, when specified.	MIL8800 complies with CE Marking Safety standards IEC61010
● 5.4.1.3.c		When specified, additional two configurations will be provided using redundancy or otherwise 1. Alarm/Trip state not affected by single circuit failure (power source excepted) 2. A/T not affected by circuit failure (power source included (mandatory for Over speed detection system)	 MIL confirms compliance. MIL confirms compliance.

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Clause No.	Clause	Requirement in Brief	MIL Response
5.4.1.3.d		Min resolution of 2%/1Deg C/1rpm for display and associated outputs	MIL confirms compliance
5.4.1.3.e		Field programmable and password protected	MIL confirms compliance
5.4.1.3.f		**Method of energizing all indicators**	MIL confirms compliance
5.4.1.3.g		PCB with protective conformal coating	MIL confirms compliance
5.4.1.3.h		Time synchronization for RTC	MIL confirms compliance When used with On-Line Simultaneous Diagnostics System
5.4.1.4	**Signal Processing Functions**	a. Isolation - Failure of one sensor not to affect any other channel b. Means to indicate Internal circuit faults, transducer fault – indication, No fault condition – indicator, c. Individual buffered output on BNC on front panel and also on the rear panel	MIL confirms compliance. MIL confirms compliance. MIL confirms compliance.
		d. Calibration for 200mV/mil sensitivity	MIL confirms compliance.
		e. Digital communication, short circuit will not affect circuitry and output to follow measured variable and remain at FS as long as it is at or above FS, Modicon MODBUS protocol,	MIL confirms compliance.
		f. 4-20mA output for each channel	MIL confirms compliance.
5.4.1.5	Alarm and integrity comparison functions		
5.4.1.5.a		Alarm / Trip adjustable over entire monitored range	MIL confirms compliance.
5.4.1.5.b		Independent Alarm Relay output and non-voting OR logic required	MIL confirms compliance.

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Clause No.	Clause	Requirement in Brief	MIL Response
5.4.1.5.c		Trip output for each channel or voting output to corresponding Trip Relay. OR / AND logic as in – 5.4.2.4 (radial shaft vibration) and 5.4.6.4 (temp). 5.4.3.4 (axial)requirement trip relay will activate when both the sensors or the circuits fail (TX Fail) or if either channel has failed (TX Fail) and other channel has trip occurrence or when trip occurs for both the channels AND logic. 5.4.4.6 (piston rod drop for reciprocating machines), MIL caters for rotary machines.	MIL confirms compliance. Independent Trip Relay output for all variables is provided. OR or AND within the monitor channels or Voting with other channels can be achieved by configuring the relay contacts as required.
5.4.1.5.d		Trip Time Delay – protected, 1-3 sec, field settable, 1 sec standard (except overspeed)	MIL confirms compliance.
5.4.1.5.e		Alarm / Trip Relay actuation delay < 100msec. For overspeed detection it is <40msec	MIL confirms compliance.
5.4.1.5.f		Alarm indication for each channel or axial shift channel pair	MIL confirms compliance.
● 5.4.1.5.g		Trip LED indication for each channel independent of voting logic When specified, Trip LED indication will conform to voting logic.	MIL confirms compliance.
● 5.4.1.5.h		When specified, password protected Trip Over-ride shall be provided with LED indication on front panel. Trip Over-ride to activate Common Alarm for remote annunciation, (to remove failing or intermittent channel from service)	MIL confirms compliance. To be incorporated as required.
5.4.1.5.i		Front Panel Switch for resetting and Rear Panel connections for Remote Reset for latching Alarm / Trip.	MIL confirms compliance Front Panel Switch is provided for resetting. Remote Reset will be added as per customer requirement.
5.4.1.5.j		Means to identify First Out Alarm / Trip	Since each module is independent no unit is dependent on another.
5.4.1.6	Display / Indication Function		

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Clause No.	Clause	Requirement in Brief	MIL Response
5.4.1.6.a		Dedicated to indicate measured variables, A/T set points, DC Gap/Bias voltages, update at min rate of once per sec. - higher-of-two for shaft vib - highest for temp - all axial positions - highest casing vib for each M/c case - speed indication and over-speed	**MIL confirms compliance** Both the channels are displayed independently for all types of variables, for temperature four channels are displayed. Speed is indicated, Phase Ref output provided on front panel BNC
5.4.1.6.b		Non-integral display meeting all integral display requirements to meet – power status, comm. link status, system circuit fault, system alarm, system trip, system trip by-pass	**Not applicable.** MIL8800 has integral and dedicated digital and analog displays.
5.4.1.7	**Power Supplies**		
● 5.4.1.7.a		Input mains power 90-132V or 180-264V AC rms, switch selectable, with line frequency 50/60 Hz, accuracy requirement as specified in Table 1 When specified, the following Power Supply options may be used: 19to32V DC, 14-70V DC, 90-140V DC	**MIL confirms compliance** MIL8800 accepts 90-270V AC, 50/60 Hz mains power input.
5.4.1.7.b		The system power supplies to cater to all the components of MPS as per Cl. 3.38	**MIL confirms compliance**
5.4.1.7.c		The output voltage will be -24V DC supplies to all Probe Drivers, accuracy requirement as specified in Table 1	**MIL confirms compliance**
5.4.1.7.d		All power supplies to sustain to infinite short circuit and should return to normal when the short circuit is removed	**MIL confirms compliance**
5.4.1.7.e		Fault condition in one transducer circuit will not affect another	**MIL confirms compliance**
5.4.1.7.f		Immunity to transient twice the normal peak voltage for 5μsec, no damage done, should not affect normal operation	**MIL confirms compliance** MIL8800 complies to EMI/EMC Standard IEC71326 of CE Marking
5.4.1.7.g		VMS to sustain loss of power for min 50msec.	**MIL confirms compliance**

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Clause No.	Clause	Requirement in Brief	MIL Response
5.4.1.7.h		Input power supply transformer to have separate windings and lamination grounded or shielded to eliminate HV coupling to transformer secondary. In case of insulation fault, input voltage will be shorted to ground.	**MIL confirms compliance** with the safety requirement MIL8800 uses SMPS that complies with Safety Standard IEC61010 of CE Marking
● 5.4.1.7.i		When specified, the redundant power supply meeting all power supply requirements of 5.4.1.7 will be fitted and capable of accepting same or different inputs as in 5.4.1.7.a). Each power supply is independently capable to power MPS.	**MIL confirms compliance**
5.4.1.8	**System-Output Relays**		
5.4.1.8.1		Min. one pair of relays Alarm / Trip for each of the variable (channel) One circuit fault relay	**MIL confirms compliance** Circuit Fault resets the microcontroller. TX Fail Relay is provided and as such meets the requirement.
5.4.1.8.2		Overspeed detection system will have one pair of Trip and Circuit fault, they will not be shared or voted with any other channel, Trip relay will be actuated when voting logic as per 5.4.8.4 when set point is violated.	**MIL confirms compliance**
● 5.4.1.8.3		Relays should be epoxy sealed, FS/NFS field selectable, 2C/O, all available for wiring. FS to Alarm and NFS to Trip is standard except for over-speed. Hermetically sealed when specified	**MIL confirms compliance**
5.4.1.8.4		FS (normally energized) for all Overspeed channels	**MIL confirms compliance**
5.4.1.8.5		Alarm / Trip Relays - Latching and Non-latching field changeable, Latching is standard. Circuit Fault Relay - Latching and Non-latching field changeable, Latching is standard.	**MIL confirms compliance** Circuit Fault resets the microcontroller. TX Fail Relay is provided and as such meets the requirement.

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Clause No.	Clause	Requirement in Brief	MIL Response
5.4.1.8.6		Circuit Fault relay – Fail Safe. Failure in sensor system, monitor, primary power or redundant power supply shall de-energize the circuit fault relay.	Circuit Fault resets the microcontroller. TX Fail Relay is provided and as such meets the requirement.
● 5.4.1.8.7		Relay contacts rating - 2Amp@120V DC or 28V DC or 1Amp @ 240V DC for min. of 10,000 operations Contact rating of 5Amps@120V AC resistive, when specified.	MIL confirms compliance MIL confirms compliance
5.4.1.8.8		For NFS Trip relay, a power interruption shall not transfer Trip relay C/O contacts regardless of the mode or duration of the interruption.	MIL confirms compliance
5.4.1.9	Trip By-pass for monitor maintenance	Trip bypass, tamperproof, internal or external, Common relay (in the rack or power supply), may be used for emote annunciation Tamperproof means of Trip Over-ride of entire MPS (except over-speed) for each monitoring system along with status indication and two sets of isolated external annunciator contacts. Maintenance of any nature will not shut-down the machine. (For maintenance only)	'External Trip Over-ride' will be added as per customer requirement. Each monitor is independent with provision for Trip Over-ride.

● 5.4.1.10	Digital Communication	When specified digital comm. To include -
		  a. Alarm status
		  b. Trip By-pass status
		  c. Alarm Log – time, date and value
		  d. Process value +/-2% resolution
		  e. Process value as % of Alarm / Trip to 1% resolution
		  f. Trip By-pass status of channel
		  g. Sensor OK limits
		  h. H/w and S/w diagnostics
		  i. Comm Link status
		  j, Alarm set points
		  k. Gap/Bias voltage
		  l. Current system time, time stamp and date of event of all transmitted data.
		  m. System Entry Log to include date, time, individual access code and record of changes
		  n. Set-point multiplier invoked (5.4.2.5 and 5.4.5.4)
			MIL confirms compliance
			When used with On-Line Simultaneous Diagnostics System.

5.4.1.11	Monitor Location	Indoor or outdoor	MIL confirms compliance