| INTER PLANT STANDARD – STEEL INDUSTRY | | |
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| IPSS | **SPECIFICATION FOR VIBRATION MEASURING SYSTEM FOR HIGH SPEED MACHINES** *(Second Revision)* | **IPSS:2-07-027A-11** |
| | Corresponding IS does not exist | Formerly: IPSS:2-07-042-97 (*First Revision*) |

## 0.0 FOREWORD

0.1 This standard is proposed for On-line vibration and temperature measuring system for high speed critical machines such as STEAM TURBINES, GENERATORS, and TURBO BLOWERS etc.

## 1.0 SCOPE

1.1 The standard contains On-line Vibration and Temperature Measuring System (VTMS). VTMS shall be programmable type and shall display the parameters like shaft vibration, housing vibration, axial shift, differential expansion, casing expansion, keyphasor, eccentricity, bearing and lube oil temperature. The system shall also generate alarm and protection contacts for the protection of the machines.

1.2 It consists of the following

TRANSDUCER SYSTEM:

i) Proximity sensors for Vibration, axial shift, differential expansion, eccentricity, and keyphasor
ii) Velocity / Acceleration sensors for Housing Vibration
iii) Linear Variable Differential Transformer (LVDT) for Casing Expansion
iv) Temperature sensors for bearing and lube oil temperature
v) Signal Converter (Oscillator/Demodulator)
vi) Junction box

MONITORING AND PROTECTION ELECTRONICS:

vi) Microprocessor based monitoring and protection rack
vii) HMI (Human Machine Interface)

## 2.0 TRANSDUCER SYSTEM

### 2.1 *Proximity sensors*

This comprises of the sensor with integral cable along with an extension cable connected so as to reach the junction box installed nearby. These are used for measuring vibration, differential expansion, eccentricity, phase marker and axial shift of high speed machines. The proximity probes and extension cables shall be having extruded Teflon insulated and armored with Stainless Steel. The total length of the probe including the casing and the integral cable shall be 1 m. The cable connection between probe integral and extension cables as well as extension cable and oscillator/demodulator shall be of gold plated to ensure connection integrity so that tripping of machine due to loose connections is avoided. These connections shall be suitably sleeved from environmental conditions.

2.1.1 Mechanical specifications:

i) Type of sensor : Non contact
ii) Environment : Oil fumes
iii) Protection : Hermetically sealed
iv) Operating temperature: Up to 170º C
v) Diameter of the probe : 5 /8 /11 mm
vi) Extension cable length : 4 /8 m

2.1.2 Electrical specifications:

i) Excitation Voltage : -26 to -17.5 V DC, ± 5 A max.
ii) Response Voltage : 100 mV/mill minimum
iii) Frequency range : 0-10 K Hz± 5%
iv) Admissible load : ≥ 2 KΩ for Voltage output
≥ 750 Ω for current output
v) Sensitivity : 4 mV/µ meter or better
vi) Lead wire length limit : 300 m between oscillator/demodulator and monitor

### *2.2 Housing vibration (velocity/accelerometer)*

This comprises of the sensor along with cable connected so as to reach the junction box installed nearby which shall be hooked to the system through main cable.

2.2.1 Mechanical specifications:

i) Type of sensor : seismic/piezo contact

iii) Protection : Hermetically sealed

iv) Operating temperature: -50 to120 º C

v) Case material : SS 316

vi) Cable connector : 2 or 3 pin

2.2.2 Electrical specifications:

i) Excitation Voltage : 18 to 30 V DC, ± 5 A max.

ii) Frequency range : 2.5 to 6 K Hz

iii) Output impedance : <100 Ω

iv) Sensitivity : 3.94 mV/milli meter or better

v) Lead wire length limit : 300 m between probe and monitor

2.3 *Case expansion:*

Linear Variable Differential Transformer (LVDT) is used for casing expansion. A converter shall be mounted to deliver 1 to 5 V DC or 4 to 20 mA up to max load of 600 Ω.

2.3.1 Mechanical specifications:

i) Type of sensor : LVDT

iii) Protection : Hermetically sealed

iv) Operating temperature: Up to 50º C

v) Cable connector : terminals

vi) Stroke : 50 – 400 mm

2.3.2 Electrical specifications:

i) Excitation Voltage : 24 V DC ± 10%.

ii) Frequency range : 2.5 to 6 K Hz

iii) Output impedance : <600 Ω

iv) Lead wire length limit : 300 m between probe and monitor

2.4 *Temperature sensors*:

Temperature sensors are RTD Resistance Temperature Detector (with 3 or 4 wired connections) or Thermocouple based. These sensors which shall be inserted into the thrust/journal bearings generally up to 20 mm in length. The leads are overall shielded with a length of 3 m up to the nearest junction box ultimately reaching the temperature module of the mounting rack. This shall be duplex type.

2.4.1 Mechanical specifications:

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| i) | Type of sensor | : PT 100 or J-type Thermocouple |
| ii) | Environment | : Oil film |
| iii) | Protection | : Hermetically sealed |
| iv) | Cable connector | : terminals |

2.4.2 Electrical specifications:

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| i) | Lead wire length limit | : 300 m between probe and monitor |

**2.5 JUNCTION BOXES:**

Junction boxes for enclosing the connectors of probe integral cable and extension cable in weather proof environment are to be provided. The junction boxes for housing the Oscillator/Demodulators shall be made of 2mm thick sheet steel with hinged door and having protection class of IP 55. Cable entry shall be from bottom of the JB through cable glands. The JBs shall be supplied along with all mounting and fixing accessories.

3.0 **MICROPROCESSOR BASED MONITORING AND PROTECTION RACK:**

The electronics rack shall house the power supply modules, rack interface module, monitoring modules, relay modules, communication gateway module, system display module etc. as required to meet the following Hardware features.

3.1 *General Specifications:*

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| Mounting | : 19” rack. |
| No. of Racks | : Adequate number depending on no. of channels |
| Operating temperature | : ≤65$^{o}$ C |

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| Relative humidity | : 40-95 % non condensing |
| Body | : Highly corrosion resistant |
| Power supply | : redundant with 230 V AC 50 Hz and/or 24 V DC |

3.2 *Hardware Features* :

3.2.1 Modules shall be **hot swappable**, without affecting monitoring system performance.

3.2.2 Modules shall have **diagnostic indications** on the front plate like: channel healthiness (OK lamp), alarm, trip and bypass conditions.

3.2.3 Modules shall have 4–20 mA DC buffered transducer output signals corresponding to the measured value of each channel.

3.2.4 One port should be available on the front panel for interfacing to a programming station.

3.2.5 Channel defeat facility shall be provided in all the modules

3.2.6 Vibration Modules shall have Trip multiplication facility

3.3 Modules

i) Power supply module:

Out of range protection: Low/High voltage AC/DC
Indication on front panel: LED for supply OK

ii) Communication/ phase marker module

LED Indications for

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| Communication | : OK |
| Configuration | : OK |
| System | : OK |
| Controls | : Rack reset button, address switch, configuration key lock |
| Protocol | : RS 232, RS 485, RS 432, Ethernet TCP/IP |

iii) Proximitor / seismic module :

Inputs : accepts from 1 to 4 proximity, velocity or acceleration signals

Scale factor : freely configurable

Outputs : LEDs for OK, BYPASS

iv) Temperature module:

Inputs : Accepts combination of thermocouple or RTD from 1 to 6 channels

Indications : LEDs for OK, BYPASS

v) Relay module:

Type : SPDT/DPDT maximum 5A contact

Environment : Epoxy sealed

Operation : selected through switch for normally energize / de-energize

vi) Gateway module : For third party communication

Communication protocol : modbus over TCP/IP

Data : collects data such as current values and current alarm statuses via high speed internal network buses

Outputs : LEDs for communication OK status

3.4 *Software Features*

3.4.1 Each channel shall have alarm (alert) and shutdown (danger) set points that are individually adjustable over the entire monitored range.

3.4.2 Each channel shall have danger bypass / defeat facility

3.4.3 The output signal from each channel shall be independent and fault in one channel shall not reflect on other output channels.

3.4.4 System to have extensive software diagnostics to identify system faults like module failure, channel fault, etc.

3.4.5 Configuration and data acquisition software based on Windows platform shall be supplied along with the system

3.4.6 Facilities for Trends in Various groups and their storage facilities shall be available

3.5 *Human Machine Interface(HMI)*

3.5.1 The number shall be as per operational requirement

3.5.2 Security feature for log-in at different levels for Operator, Engineer, etc

3.5.3 To be configured on latest windows Operating system

3.5.4 Regular back ups and trends shall be transferrable on to CDs/DVDs for back-up

3.5.5 The system shall have PC based color LCD display of minimum 19" size.

3.5.6 The display unit shall indicate the system events, alarm event list, data of all channels in graphical / bar graph and text format. Programming software as required for programming / parameterization shall be included.

## 4.0 **SPECIAL TOOLS:**

4.1 Simulation equipment along with required connectors, accessories etc. for Calibration and testing of TRANSDUCERS and ELECTRONICS shall be included.

4.2 One no. of portable programming unit along with licensed operating software, monitoring and diagnostic software (for the system supplied). The programming device shall be based on a compact portable PC of reputed make. The operating system software, configuration & diagnostic software shall be provided on CDs/DVDs. The user should be able to reload all the above software from CDs/DVDS. Application software shall be taken as back up periodically by the user. Suitable cables with connectors shall be provided along with the programming unit.

## 5.0 **DESIGN STANDARDS:**

i) VTMS including the microprocessor based electronics; all field devices and accessories shall confirm to latest edition of API 670 standards in respect of design, construction, accuracy, response etc. and shall meet the site requirement for reliable measurement unless specified otherwise in this specification for any parameter.

Ii) The vibration & temperature monitoring systems shall be UL/CSA/CE listed.