

Date 24/10/13

Addendum no:- 4181-19-01021, Rev00.

for Specification no TG60720.

**Against cl no 01.(B).1:- Sensor requirements will be as follows:-**


Fiber Optic Accelerometer:- 8 nos (Instead of 12) (with sealed feed through conditioner & with 6 mtrs Fiber optic integral cable).

**Against cl no 2.1:- Vibration monitoring modules requirements will be as follows:-**

Twelve (Instead of Sixteen) channels vibration monitoring modules (2/4 channels per module) along with associated power supply units will be required

**Rest will be as per specification no TG60720, rev00.**

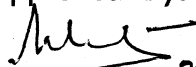
Generated By:-

 24/10/13.

Satish Kumar

Sr.Manager/CIE

Approved By:-

 24/10/13

Shri KB Batra

AGM /CIE & TCX

सामग्री सूची संख्या  
INVENTORY NO.

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**GEN END WINDING VIBRATION MONITORING EQUIPMENT WITH FIBER OPTICS SENSOR FOR TURBO-GENERATORS**

**BHEL'S EXPERIENCE**

**1.0 GENERAL:**

This specification covers the requirement of Fibre Optic Vibration Monitoring System (FOVMS) for Generator end winding overhang zone. The system will comprise of FO Vibration Sensors, integrated Cable, Signal conditioners, field JB's, safety barriers and a Cabinet comprising monitoring module, PSU, fuses etc.

The Fiber Optics (FO) sensors shall be mounted at different locations on generator overhang winding on both ends and will be connected by special optical integral cable and terminated on lead-in-plates. There will be two lead in plates (BHEL scope), one at turbine end and one at Exciter end. **The work of mounting FO sensors on Generator overhang and making connection up to lead-in-plate is in scope of BHEL Haridwar and shall be carried out at BHEL works.**

Signal conditioner shall mounted on Lead in plates. Electrical signals will be taken to generator mounted JB by low noise screened cable. The signal from JB will be taken to EW Cabinet having vibration monitoring modules by low noise cables to ensure minimum corruption in signal.

The control cabinet shall be of Rittal/ Pyrotech (or other reputed make, subject to BHEL's approval). The degree of protection shall be IP-32 or as specified in enquiry / order. This cabinet will be placed in air conditioned room in the power station Control Room. The equipment will generally be used to monitor 2X (94Hz-106Hz) vibrations in displacement mode. However, there will also be the facility to monitor 1X Hz (47Hz-53Hz) and overall (Sigma) values which shall be software selectable or switch selectable to operator. The corresponding 4-20mA outputs for 2X /1X / sigma values will be made available for external use in the client's DCS.

There shall be in-built provision for supply of 24VDC to signal conditioner from vibration monitoring modules.

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TSX	LALIT KUMAR			निर्माणकर्ता	WORKED BY	SATISH KUMAR	
QAX	SK CHAUHAN			जांचकर्ता	CHECKED BY	RAJNISH GUPTA	
सहमत विभाग	नाम	दिनांक एवं हस्ताक्षर		पर्यवेक्षणकर्ता	SUPERVISED BY	VINOD KUMAR	
AGREED DEPTT	NAME	DATE & SIGNATURE		स्वीकृति	APPROVED: AGM (CIE)		GR.No 3.40
REV.NO. 00				निर्माण	PREPARED: CIE	जारी	DATE: 22-03-13
Dr 22-03-13				ISSUED	ISSUED: TSX		

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**✓ Scope of Supply:-**  
**(A) - To be supplied directly to Site (as mentioned in PO)**

1. End Winding Vibration Monitoring (EWVM) Cabinet - 1 No.  
The cabinet will house Vibration monitoring modules, PSUs, fuses etc.
2. Any other items/ accessories/ spares which is essential for proper operation of the system.

Commissioning at site (To be quoted against separate code)

**(B) - To be supplied to BHEL Haridwar (for mounting on Generator)**

1. Fiber Optic Accelerometer - 12 nos  
(with sealed feed through conditioner & with 6 mtrs Fiber optic integral cable)
2. Fiber Optic Accelerometer - 4 nos  
(with sealed feed through conditioner & with 10 mtrs Fiber optic integral cable)
3. Field Junction Boxes - 2 nos.
4. Cable length from lead-in-plate to JB - 2 mtrs

Also refer figure-02 for **typical** fig for Fiber Optic Accelerometer and fig-03 for field JB.

**2.0 Technical Requirement:** The system shall comprise of the followings:

2.1 Sixteen channels vibration monitoring modules (2/4 channels per module) along with associated power supply units and accessories mounted in a free standing cabinet of size 600(W)x800(D)x 2200(H) along with inbuilt Software based band pass filters for individual channels to filter out required 1X and 2x frequencies components

Preferably, the vendor shall supply the microprocessor based, fully programmable modules to provide stator end winding vibrations at 100Hz in terms of displacement (0-400 microns Pk-to-Pk). For selected frequency, the 4-20mA hard wired outputs from the vibration monitoring modules will be made available for client's DDCMIS use. The system shall be suitable for redundant 230V AC ± 10%, 50Hz UPS power supply (unless specified otherwise in the enquiry / order). Paint shade of the cabinet & JB shall be informed after placement of order as per end customer requirement. The paint thickness will be 100 Microns minimum.

2.2 Junction Boxes along with termination accessories. Details as per figure-3.

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सामग्री सूची संख्या  
INVENTORY NO.  
 P-6436

REV.NO. 00

निर्माणकर्ता WORKED BY	SATISH KUMAR.
जांचकर्ता CHECKED BY	RAJNISH GUPTA

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2.3 The fiber optics sensor will be mounted inside the Generator by BHEL at its Haridwar unit.

The fiber optics sensor should meet following requirements:

a) Operation parameters:-

2.3.1 Frequency range: 30Hz - 350Hz.

2.3.2 Amplitude Range :  $\geq 0-1000 \mu\text{m}$  (Peak-Peak ) /  $360\text{ms}^{-2}$  (RMS) @ 100 Hz

2.3.3 Sensitivity : 100 mV/g Acceleration Or 10 mV/  $\mu\text{m}$  Displacement +/- 10%.

2.3.4 Insulation Voltage ( between sensor head and ground ) : 2KV

2.3.4.1 Normal operation :  $\geq 27$  KV at 50 Hz

2.3.4.2 During application of 1 minute proof voltage :  $\geq 56$  KV at 50 Hz

2.3.5 Operating Pressure/ Environment :  $\geq 5$  bar (Hydrogen)

2.3.6 Current : 35 mA each sensor.

2.3.7 Power supply : 24VDC.

2.3.8 Maximum Shock Acceleration :  $\geq 5000 \text{ms}^{-2}$  ( pk ) for about 1ms

2.3.9 Resonance Frequency :  $\geq 500$  Hz

2.3.10 Transverse Sensitivity : Typically < 5% with respect to sensitive axis

2.3.11 Residual Noise : Typically < 10 mV overall noise in the frequency range

2.3.12 Ignition protection :- ATEX EX // 3G mb // C T4

b) Environment :-

i) Temperature : 0 to 90° C

ii) Relative humidity :  $\geq 90\%$  RH

iii) Magnetic Field :  $\geq 1$  tesla at 50 Hz

iv) Electrical field :  $\geq 1$  KV / mm at 50 Hz

c) Physical parameter

i) Sensor body: PPO Noryl and Ceramic or any other appropriate high insulation material


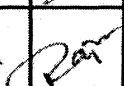
ii) Weight : < 40 gram ( light and compact design will be preferred )

iii) Optical Integral Cable Length : 6 / 10 meters as per cl no 1.B.1 /1.B.2

iv) Fibre-Optic Cable Sheath : Integral PTFE tubing of dia.  $\geq 5$  mm or suitable material appropriate with sufficient strength and minimum bending radius of about 80 mm

3.0 Low Noise screened cables, along with termination accessories for connections between signal conditioner and Generator mounted JB.

4.0 Mandatory spares comprising 10% of the installed modules / amplifiers rounded off to next higher number. These should be quoted separately.

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			जांचकर्ता CHECKED BY	RAJNISH GUPTA	 22/03/13

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**5.0 Any other accessory / item which may be considered essential by the vendor for proper commissioning / measurement / monitoring of the vibration signals.**

**6.0 ACCURACY:**

The supplier shall indicate accuracies and linearity of individual important items like fiber optics sensor, convertor, monitoring modules, 4 - 20 mA output & overall system as such.

**7.0 ROUTINE TESTING:** The equipment shall be subjected to following tests at supplier's works.

- 7.1 Dimensional details/ visual checking as per the approved GA drawing to ascertain that model no. offered is as per purchase order and mounting/ cutout dimensions are as per catalogues furnished with the offer.
- 7.2 IR value of terminal blocks to be measured with 500V megger. The value shall be in M. ohms.
- 7.3 Checking of scope / technical particulars covered under clauses 1.0 & 2.0.
- 7.4 HV test at 2kV (rms) for one sec. between live and earth parts as per relevant IS (excluding electronics components/ modules). The equipment will pass the test without failure.
- 7.5 Burn in test of electronics component should be for 48 hrs at elevated temp ( $\geq 55$  °C). The test report of in-house tests carried out for this can be considered.
- 7.6 Functional checking of the equipment as per approved schematics before dispatch. Vendor to mention "List of all tests" which should be carried out on the components/ module/ overall system at his works to ensure system performance at site.

**8.0 TYPE TESTING :**

The type test certificates of similar equipment for the following climatic tests (which shall not be older than 5 years) as per IEC60068/ IS9000 (relevant parts) will be furnished along with the offer. If these are not available, the party will carry out these type tests from reputed test house and furnish the test certificates to BHEL for acceptance



- 5.1 Dry heat test
- 5.2 Temperature cycle test
- 5.3 Damp heat test
- 5.4 Surge withstand test as per ANSI 37.90a or other relevant standards.

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**9.0 ACCEPTANCE NORMS :-**

- 9.1 Carrying out of routine tests as per clause 7.0
- 9.2 Compliance to clause 8.0

✓ Calibration data/ curves (between acceleration to mV output upto 15g of acceleration) / data sheet for amplifiers, display modules and 4-20 mA output value shall also be submitted for approval.

Before dispatch test results as per above and in compliance of above shall be send to BHEL for approval. Dispatch of the equipment shall be subject to approval of these test results.

**10.0 TEST AND GUARANTEE CERTIFICATES:**

Three copies of test certificates for routine & type tests and guarantee certificates in English shall be furnished

**11.0 RECOMMENDED SPARES:**

The list of recommended spares required for 5 years operation with prices of individual items will be furnished for BHEL's reference. BHEL reserves the right to order these components at prevailing rates within 6 months of the placement of the main order.

**12.0 PACKING:**

The items shall be packed in 2 Packages (1) For Site supply (2) For BHEL Haridwar Supply.

The equipment shall be packed in such a way that no damage occurs to any of its components during transit & storage.

**13.0 MARKINGS:**

Each package shall be marked with the following:

1. BHEL order number
2. Designation of component/assembly
3. Suppliers name & reference
4. Net weight / gross weight
5. Project Name

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**14.0 INSTALLATION & COMMISSIONING:**

The supplier shall arrange for satisfactory commissioning of supplied equipment at site. The offer for the same will be included in main offer separately. The erection of cabinet and laying of the cables will be done by BHEL at site.

However, all terminations, installation of modules, balance activities and commissioning of the system shall be done by the vendor. **The vendor shall also provide training to customer site engineers during visit for better understanding and operation of the system at site.**

**15.0 DOCUMENTS FOR APPROVAL:-**

The vendor will furnish GA /Schematic drawings of the offered system including data sheets for the offered amplifiers/ vibration modules/ power supply modules etc. for BHEL's approval before dispatch the items.

**16.0 O&M MANUALS:-**

The O&M manuals comprising of BOM with make, installation & commissioning instructions, operation & maintenance procedure, service procedure, technical/ circuit details and data sheets of the used instruments will be furnished in hard copy and soft copy. Numbers of O&M manual and CD will be as per inquiry or Purchase Order.

**17.0 INSPECTION:-**

BHEL reserves the right to depute their / customer's representative during final testing at supplier works. The supplier will arrange this inspection without any additional cost.



**18.0 QUALITY PLAN AND INSPECTION:**

The complete QA plan giving details of items of test to be carried out during the various stage of manufacturing will be furnished for approval along with offer in BHEL format. BHEL reserves it's right to depute their / customer representative during testing at supplier works. The supplier will arrange this inspection without any additional charges.

**19.0 GUARANTEE:-**



The equipment shall be guaranteed for a minimum period of 18 months from the date of supply or 12 months from the date of commissioning, whichever is earlier. The equipment shall be guaranteed for a minimum period of 18 months from the date of supply or 12 months from the date of commissioning, whichever is earlier.

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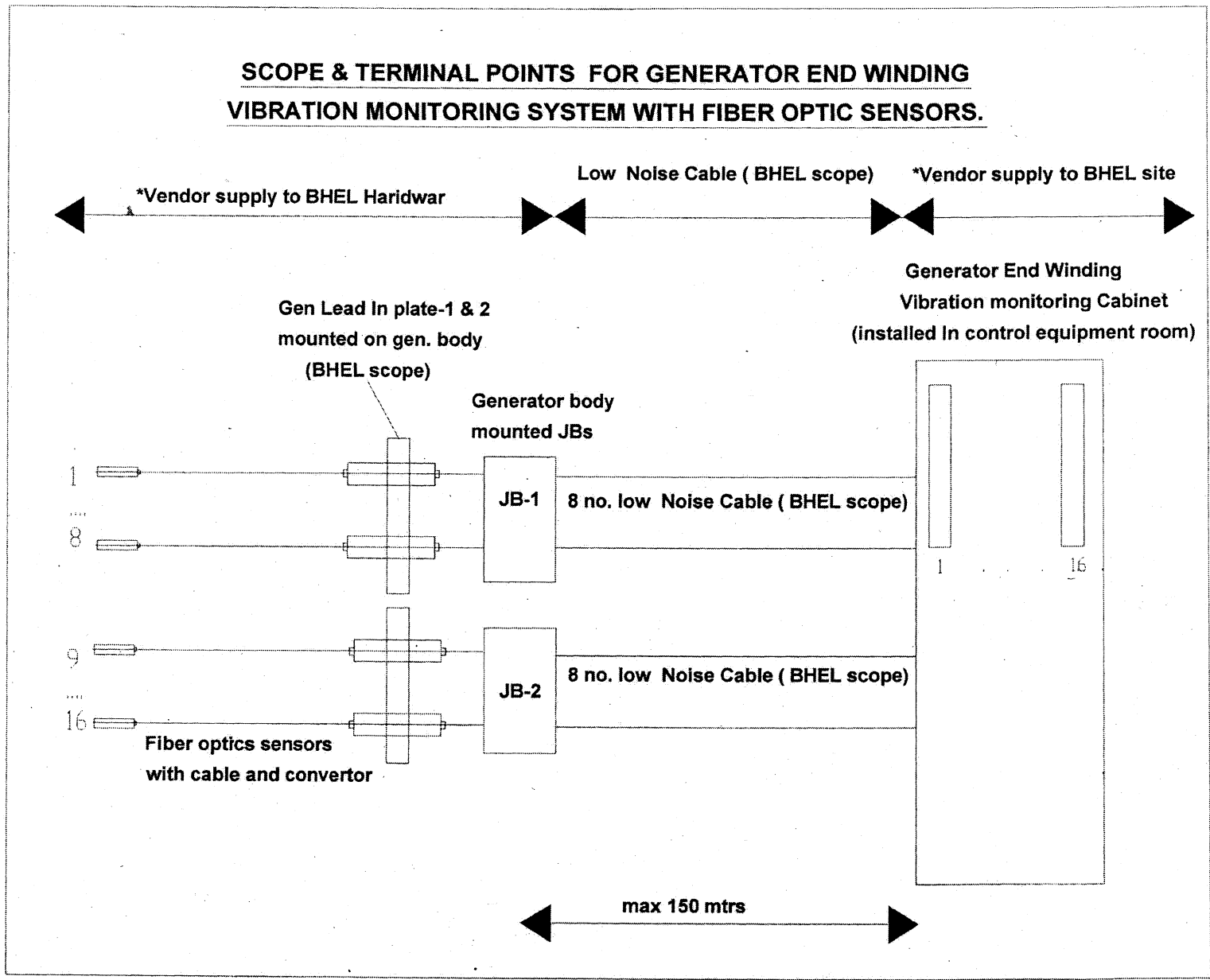


Figure -01



**उत्पाद मानक (शैव - हरिद्वार)**

**PRODUCT STANDARD (HEEP - HARDWAR)**

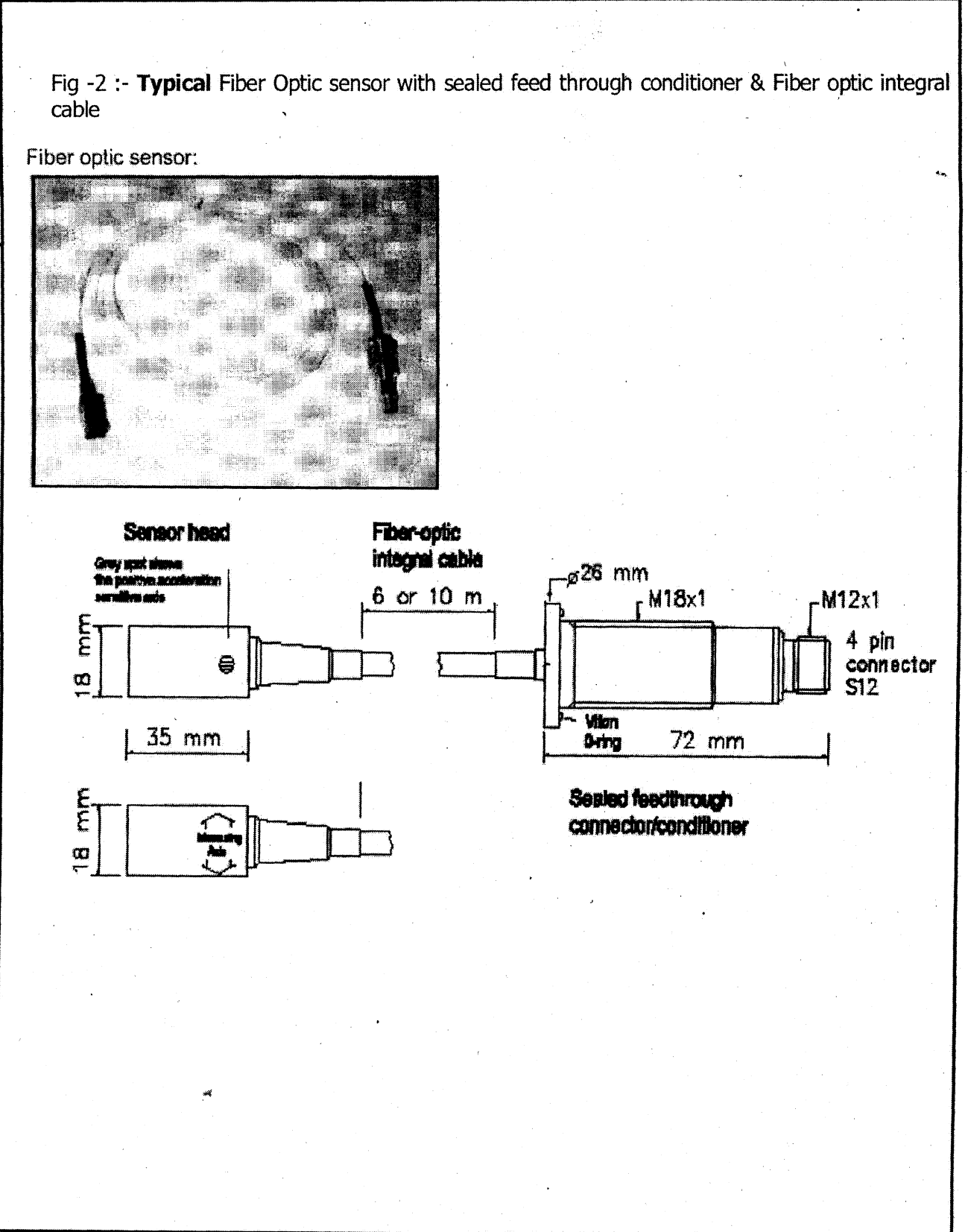
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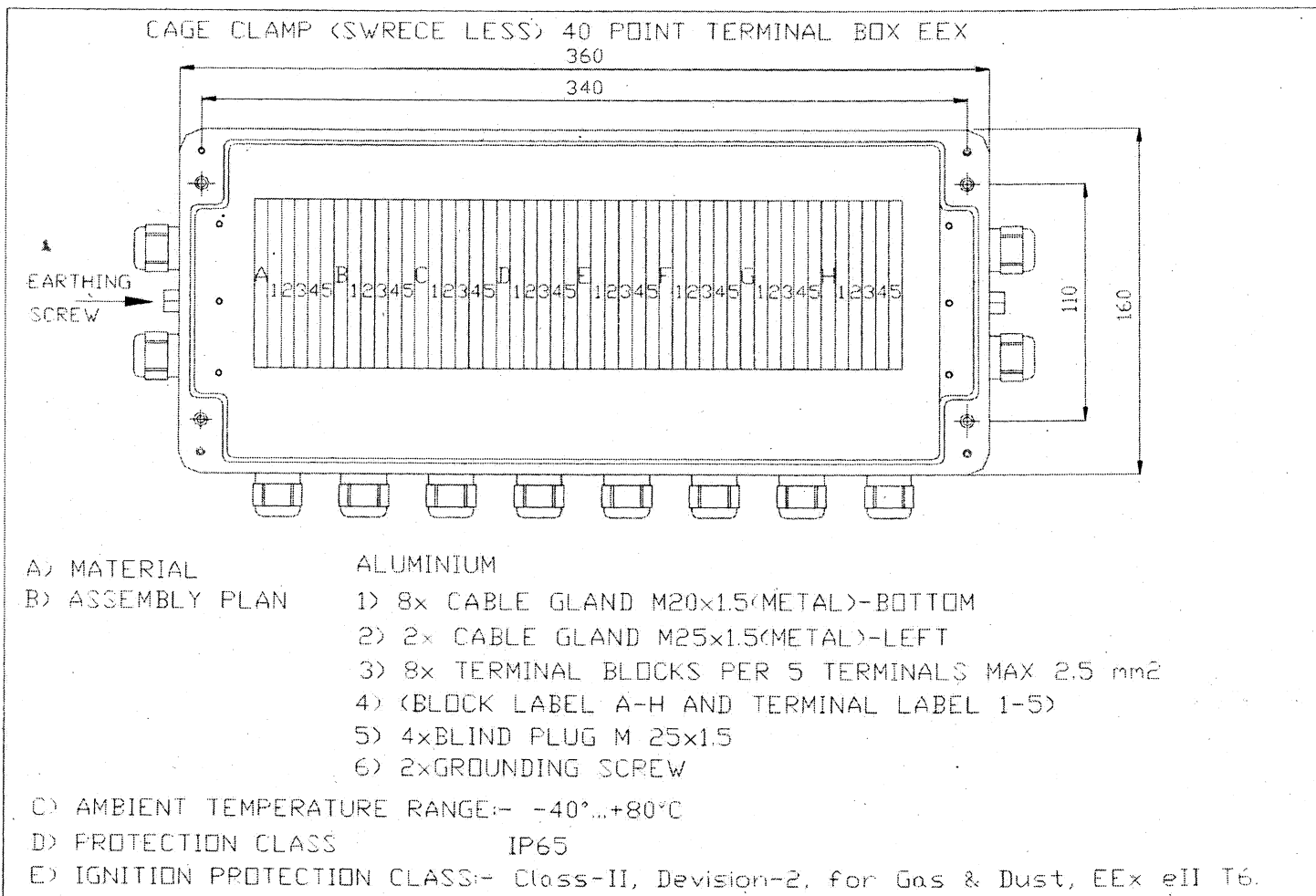


Fig -3 : Field Junction box.



उत्पाद मानक (क्षीय - हरिद्वार)

PRODUCT STANDARD (HEEP - HARDWAR)

TG60720

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