Technical Performance Specification

Power Turbine Speed Probe For LM2500 Gas Turbine Engine

Background: LM2500 Engine Power Turbine Speed Probe provides power turbine over-speed protection by monitoring two speed signals from the power turbine and de-energizing the gas turbine fuel shutoff valves in the event of a power turbine over-speed or the loss of both speed signals. The principle of operation would be to generate the power required for the output signals.
This PT speed probe specified in this specification must fit into a GE LM2500 Gas Turbine Engine (Twin and Single Shank engine configuration) and perform on a US Navy ship as required and be fully interchangeable with the existing speed probe. The speed probe must operate with an output, which will allow a no gap adjustment installation.

1. **Description:** The PT speed probe must meet the following requirements:

   a. **Size** – Part must conform to the dimensional requirements of the attached drawing 7379222.
   b. **Shape** – A cone tip is required for this design.
   c. **Temperature range** – Must operate within the following temperature ranges as defined in drawing 7379222:
      Zone A -20 to 375 deg. F.
      Zone B -20 to 500 deg. F.
      Zone C -20 to 800 deg. F.
      Zone D -20 to 1000 deg. F.
   d. **Material** – All metals used in the construction of the assembly shall either be corrosion resistant or shall be adequately protected to resist corrosion. Extended periods of non-operation of the component or operation while exposed to salt air atmosphere must be considered in the selection of material. Component must be cadmium free.
   e. **Construction** – The assembly shall be constructed so that none of its elements are susceptible to damage or becoming loose or worn as a result of normal service use, storage, assembly, or disassembly, proven design features and processes shall be used. Backsides of all connectors and all wiring not enclosed in flexible conduit shall be encapsulated in suitable material. All connections shall be good mechanical joints before brazing or soldering.
   f. **Cleanliness** – When received by the purchaser, the assembly and all internal parts shall be clean and free from dirt, metal chips and other foreign matter, which could be a potential hazard to the satisfactory operation of the component or operation of the gas turbine of which, it is used.
   g. **Shelf Life** – The probe shall be capable of being retested to its acceptance limits without adjustment or replacement of parts after an unused period of time.

h. **Storage on Engine** – The probe shall operate within its acceptance limits after 60 months storage assembled on an engine.

i. **Waveform** – The voltage waveform shall contain less than 20 percent of total harmonic content as measured on an approved type waveform analyzer. The shape of the waveform shall fall somewhere within a triangle and a rectangle drawn between zero cross over points and the peak voltage values both positive and negative voltages. The waveform shall comply with these requirements at all power turbine speed up to the over-speed condition of 4000 RPM and at all air gap conditions.

j. **Load Impedance** – The load impedance shall be in the range of 3000 to 100,000 ohms.

k. **Wire Size** – The pickup shall not contain conductors either single or stranded, which have a diameter of less than .0025 inch as measured without insulation.

l. **Coil Ground Connection** – The pickup coil shall be ungrounded. A separate ground lead shall be provided through the conduit to a two-pin connector.

m. **Insulation Strength** – The assembly shall be capable of substaining a test of 500 volts RMS, 60 cycles, for 30 seconds without damage or breakdown.

n. **Insulation Resistance** – The insulation resistance of the assembly shall be a minimum of 20 megohms at 500 volts dc.

o. **Seal Design** – The pickup shall be hermetically sealed with the exception of the cable and connector. The cable and connector shall be design and constructed such that when properly mated (connected) it shall not permit entrance of moisture or foreign matter to the extent of failing to meet the prescribed insulation resistance between all circuits and all circuits connected together and ground. This requirement applies over the full range of rapidly and slowly varying environment conditions specified.

p. **Fungus Proof** – The assembly shall be fungus proof.

q. **Lubrication** - The assembly shall be designed so that no lubrication is required on contact surfaces, threaded joints or elsewhere either in the assembly or when mating with connectors.

r. **Wrenching Torque** – The probe shall be capable of withstanding a torque value of 440 lb. – in. minimum between anti-torque wrench flat and a nut which mates the threaded body.

s. **Ignition Proof** – Under normal operation, all electrical components of the assembly, including the electrical connector when mated, shall be ignition proof so as not to ignite any explosive mixture surrounding it.

t. **Exciter Gear Rotation** – All characteristics and requirements shall be met with either direction of exciter gear rotation (83 Tooth).

u. **Installation** – Probe to require no setting tools or shims. A high output is required from a 'no gap adjustment' installation.

v. **Operating Life** – 20,000 Hours min.

w. **Signal Voltage Vs. Signal Frequency** – The following is the signal voltage Vs. Signal Frequency for Magnetic Pickup.

Frequency – HZ	Min Output – volts P-P 3K	Min Output – volts P-P 10K	Max Output – Volts P-P 100K

	ohms load .090 in. gap	ohms Load .090 in. gap	ohms Load .35 in. gap
138	0.14	0.22	3.63
692	0.77	1.34	19.4
1383	1.46	2.62	37.0
2767	2.64	5.05	84.3
4150	3.49	7.17	140.0
4942	3.85	8.07	166.0
5533	4.18	8.80	187.0
6225	4.42	6.75	196.0

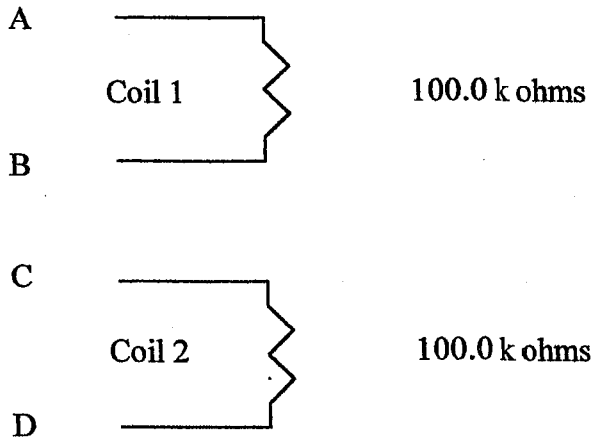
Note: 3500 RPM = 4980 HZ

x. **Electrical Characteristics** – The nominal speed pickup resistance from pin to pin at 72 deg. F. shall be as below. The nominal speed pickup coil inductance shall be as tabulated below at 72 deg. F.
Resistance – 950 ohms
Inductance – 168 millihenries

y. **Voltage Output** – The probe's pole tip shall be set against the test wheel. The voltage outputs shall be measured and recorded at the air gaps and wheel speed listed below, with the load specified in figure 1. These limits shall also apply with adjacent coils shorted.
Limits
Output between pins A and B both connectors
Speed: 100 RPM, air gap 0.065inches min.
Limits: 0.25 Vpp min.

Speed: 3600 RPM, air gap 0.035 inches min.
Limit: 130.0 Vpp max.

Figure 1 Load for both coils



z. **Safety** - The Power Turbine Speed Probe should be designed such that it produces maximum stored energy while operating under minimum air gap, and maximum speed condition

aa. **Operating Condition** – The table below describes the Electrical Characteristics of the FSEE where the output signal from the Speed Probe will input.

Internal Power Supplies	Normal Operating Range	Parameter Range
+/- 15vdc (regulated)	+/- 15 vdc +/- 0.4% , 0.5 Amp max	
	0 to 6917 Hz	0 to 5000 rpm

bb. **Vibration** – The probe shall be capable of withstanding the Vibration test of MIL-STD-167 Type 1.

cc. **Shock** – The probe shall be capable of withstanding the shock Test of MIL-S-901 for grade A equipment.

dd. **Inspection** – Quality Assurance inspection shall be performed By the vendor on the power turbine speed probe prior to delivery. This inspection shall consist of an examination of the probe with the dimensional, material, operational and performance requirements set forth in this specification.

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

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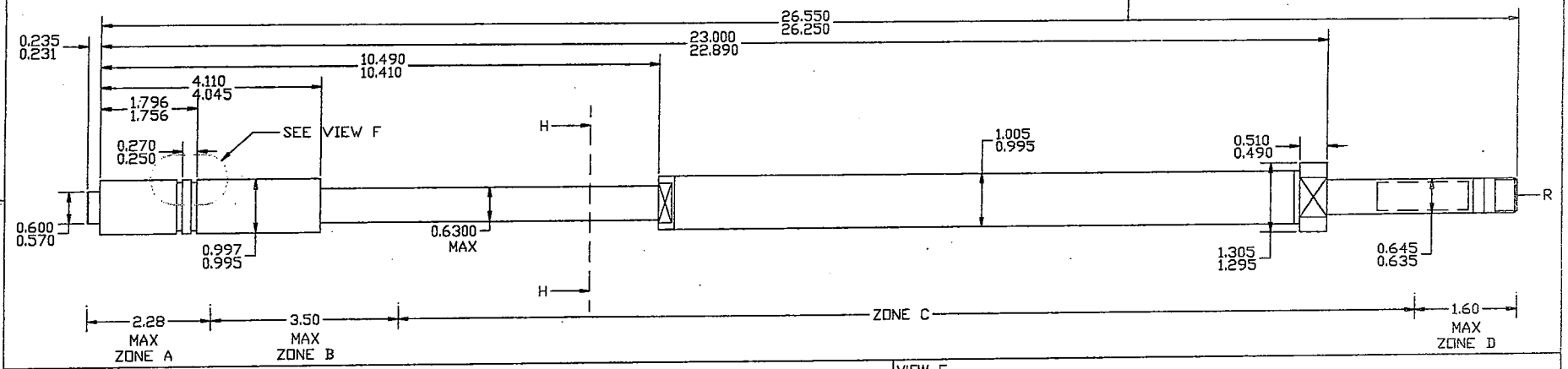
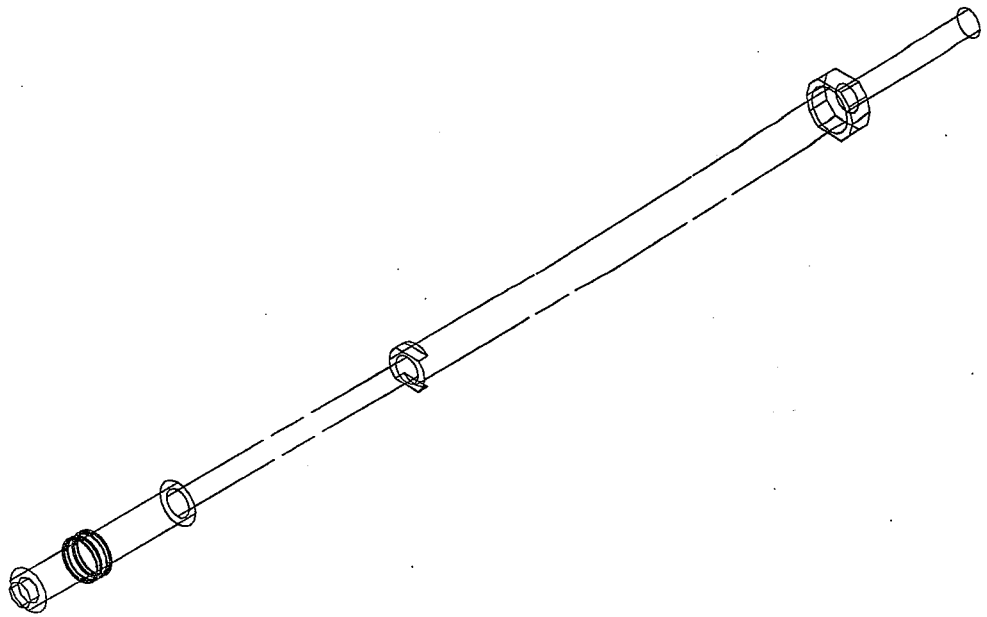


ISO



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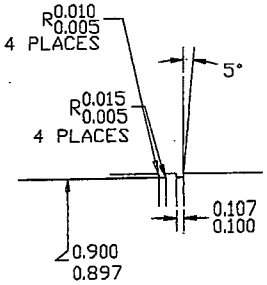

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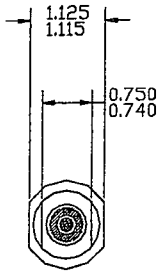

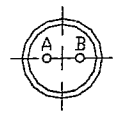

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UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES	SIGNATURES	DATE	NSWC NAVAL SURFACE WARFARE CENTER CARDEROCK DIVISION CODE 9333, PHILADELPHIA PA, USA
DIMENSIONS ± 0.010 ANGLES ± 5 DEG	DRAWN BY S. DESHMUKH		
MATERIAL	CHECKED BY S. DESHMUKH		LM2500 POWER TURBINE SPEED PROBE
	APPROVED BY		SIZE A · FSCM NO. · DWG NO. 7379222 · REV
			SCALE NTS · SHEET 1 OF 1