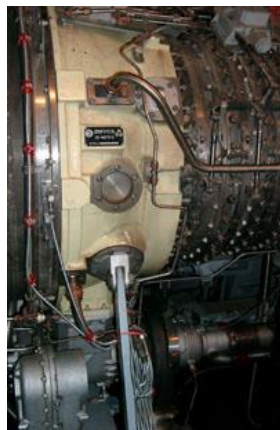




# MB Win475

## “Extreme Range” Temperature Sensitivity Calibration and Performance Verification of Vibration Transducers



Courtesy of rms-seattle.com

Measuring acceleration, pressure, temperature and strain in extreme, harsh-duty environments is increasingly common. Vibration monitoring transducers operate continuously at temperatures above 400 degC, for intermittent duty at over 700 degC, and over large 600 degC thermal cycling excursions. Such applications include gas turbine, jet engine and automotive engine development and monitoring. Prolonged exposures to the bitter cold of the Arctic tundra and high altitudes are harsh environmental conditions at the other end of the temperature scale. Silicon carbide MEMS and other accelerometer technologies (existing and under development) measure vibration in these extreme conditions. Development, use, and calibration of such transducers require tools to generate vibration at these harsh temperatures. Test, calibration, and measurement needs include validating the stability and reliability of the transducer & cabling, characterizing its thermal performance, and developing temperature sensitivity curves over this “extreme range” of end-use temperatures. This “Extreme Range” option to the MB Win475 Calibration Family provides this functionality.

### Specs & Features

#### Win475-“Extreme Range” Temperature Sensitivity Calibration & Performance Verification System

- ❖ Subjects accelerometer being calibrated (DUT) to controlled temperatures over range of +800 to -185 degC; no humidity
- ❖ Measures DUT temperature sensitivity with high repeatability while exciting at 160 Hz over this temperature range
- ❖ Capable of vibrating at frequencies from 10 – 1,000 Hz over this temperature range, limited by transmissibility & stiffness of ceramic stinger (see white item in picture) and DUT mass
- ❖ Win475 Test Scheduler software reads thermocouple & controls heating elements and LN<sup>2</sup> valves to achieve setpoint temps
- ❖ Win475 Test Scheduler automatically sequences Cryofurnace ramp times, setpoint temperatures, dwell times, etc.
- ❖ Win475 Test Scheduler automatically activates vibration and measures sensitivity once Cryofurnace achieves setpoint temps
- ❖ Win475 software includes automatic alarms & aborts; designed for unattended operation; safe unattended shutdown
- ❖ Temperature control:  $\pm 1$  degC at control thermocouple; temperature heat-up rate  $> 10$  degC/min; faster for cool-down
- ❖ Temperature dwell or soak times can be as long as 7 days
- ❖ Cryofurnace internal dimensions: 200mm dia. X 600mm long, internal shell constructed of heavy-gauge Inconel; external shell constructed of heavy-gauge stainless steel, safe to touch at temperature extremes
- ❖ Chromalox heating coils, Incoloy sheathing and MagOxide core
- ❖ Direct injection of liquid nitrogen (LN<sup>2</sup>) achieves cold temperatures with advantages over compressor-based refrigeration
  - Eliminates compressor maintenance
  - Reduces lab noise levels due to the elimination of the compressors
  - Eliminates compressor heat from being exhausted into lab
  - Lowers electrical costs, compared to mechanical refrigeration
- ❖ Cryofurnace has side exit for transducer cables, including hardline cables common for high temperature transducers
- ❖ DUT mounts to ceramic stinger entering thru rear of Cryofurnace; ceramic wool surrounds stinger to minimize heat losses
- ❖ Front-opening door provides access to mount/dismount DUTs to stinger and for dressing cables
- ❖ Door-mounted variable speed fan recirculates internal air to achieve temperature uniformity
- ❖ Cryofurnace power supply has microprocessor controller, allowing either manual programmable control via push-button or software-control via RS232 linked to Win475 PC
- ❖ Cryofurnace is rated for 7 KW, 240VAC, 50/60, 1 phase
- ❖ Vibration from CAL ENERGIZER RED, oriented horizontally, so LN<sup>2</sup> collects in bottom of Cryofurnace not leaking onto shaker
- ❖ Vibration  $\leq 3$  gRMS at 160Hz; amplitudes at 10 – 1000 Hz determined by stiffness & transmissibility of stinger & DUT mass
- ❖ Calibrating at 800 degC requires that the REF and shaker be thermally insulated and spatially isolated from hot temps; REF typically has an operating range of 90 degC; shaker moving element glue begins to soften around 90 degC
- ❖  $> 350$ mm long ceramic stinger between exciter/REF and DUT provides this thermal insulation and isolation
- ❖ CAL ENERGIZER RED has very stiff internal flexures & stiff external flexures (see picture) to support long cantilevered stinger with concentrated end mass from DUT & hardline cables (small shaker cannot react over-turning forces from hardline cables)
- ❖ Stinger made from machinable ceramics; modulus of elasticity & density comparable to aluminum; five (5) stingers included
- ❖ REF is 100mV/g sensitivity, comparison calibrated, mounted between CAL ENERGIZER RED moving element and stinger

