FG5 GRAVITY METER

"To the best of
our knowledge, the
FG5 gravimeter represents
the current state-of-the-art
in the measurement of
absolute gravity."

–AMERICAN GEOPHYSICAL UNION,
EOS JOURNAL

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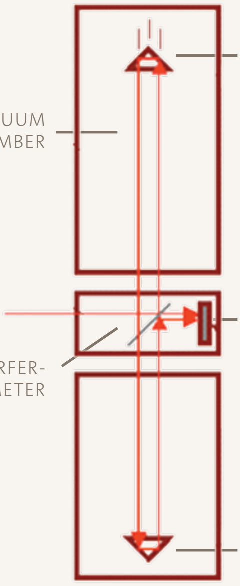
Since its introduction in 1992, the FG5 has become the industry standard in absolute gravity instrumentation. Based directly on international standards of time and distance, the FG5 provides unparalleled accuracy and precision. Whether applied in geophysical research, environmental monitoring, or laboratory metrology, the FG5 is still the highest quality, most versatile absolute gravimeter available today.

PRINCIPLE OF OPERATION

The FG5 operates by using a free-fall method. An object is dropped inside a vacuum chamber and its position is monitored very accurately using a laser interferometer. In 2004, the BIPM (Bureau International de Poids et Mesures) proclaimed the ballistic freefall method as an official primary method for measuring gravity.



The free-fall trajectory of the dropped object is referenced to a very stable active-spring system called a "Superspring". The Superspring provides seismic-isolation for the reference optic to improve the noise performance of the FG5.

The optical fringes generated in the interferometer provide a very accurate distance measurement system that can be traced to absolute wavelength standards. Very accurate and precise timing of the occurrence of these optical fringes is done using an atomic rubidium clock that is also referenced to absolute standards.

The measurement is directly tied to international standards, and this is what makes the FG5 an absolute gravimeter. By basing the measurement on these standards, the system is inherently calibrated and will neither drift nor tare over time.

INSTRUMENT FEATURES

- Automatic data acquisition and system controller (Microsoft Windows®-based laptop PC)
- Real-Time data processing automatic data storage
- Optional environmental Monitoring Package: includes automatic logging of barometric pressure, ambient temperature and other system information
- Real-time gravity corrections for tides, ocean loading, polar motion, and atmospheric attraction
- "Superspring" long period (30-60s) active isolation device
- Built in collimation optics for verticality alignment
- Drag-free chamber eliminates residual drag on freefall object
- Frequency stabilized HeNe laser (Iodine stabilized HeNe laser option available for highest accuracy applications)
- Built in Rubidium atomic clock
- Ion-vacuum pump with battery backup power supply
- Custom-built shipping containers

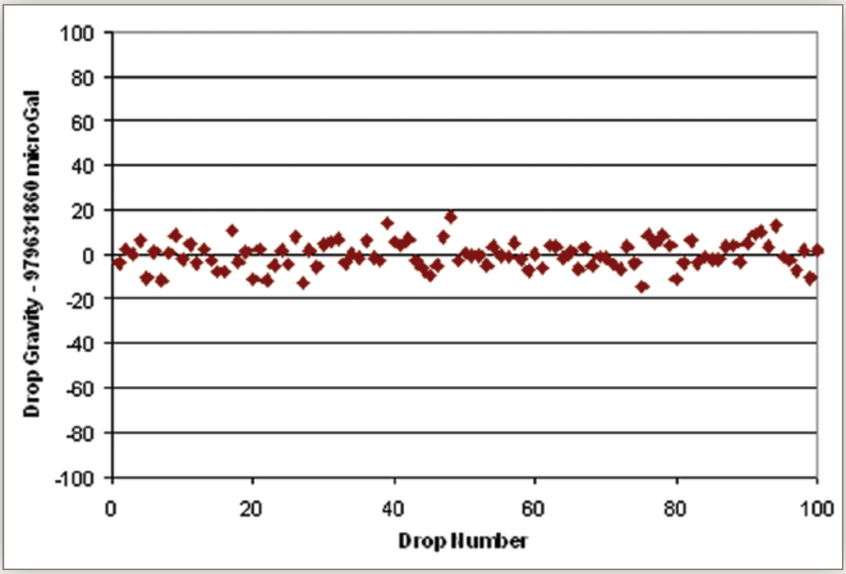
GENERAL SPECIFICATIONS

TOTAL SHIPPING WEIGHT	150 kg in 6 containers
TOTAL VOLUME	1.5 m^3
FLOOR SPACE REQUIREMENT	3 m^2
INPUT VOLTAGE	110-240 VAC, 50-60 Hz
NOMINAL POWER REQUIREMENT	~500 W

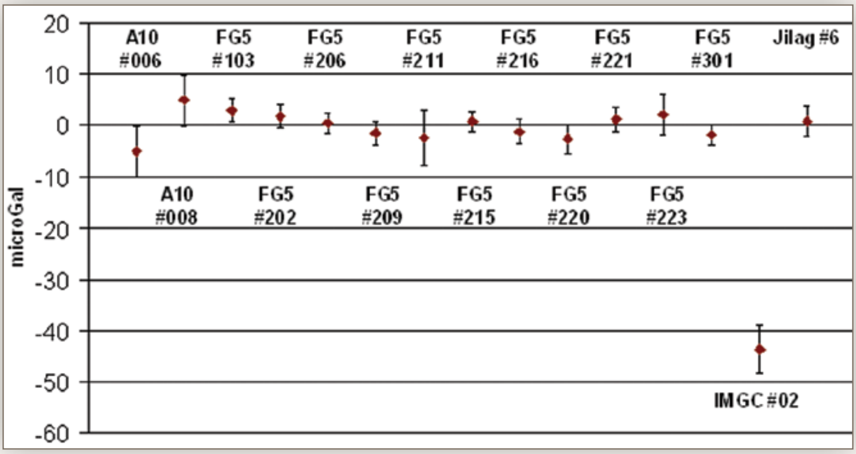
PERFORMANCE SPECIFICATIONS

ACCURACY	2 μGal (observed agreement between FG5 instruments)
PRECISION	15 μGal/sqrt(Hz) at a quiet site [eg. ~1 μGal in 3.75 minutes, or 0.1 μGal in 6.25 hours]
OPERATING DYNAMIC RANGE	World-Wide
OPERATING TEMPERATURE RANGE	20°C to 30°C

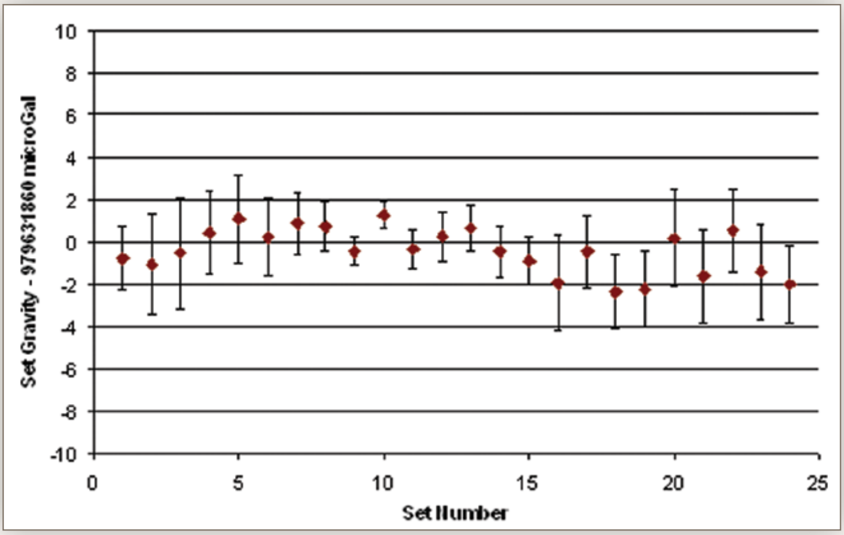
EXAMPLE DATA DESCRIPTION



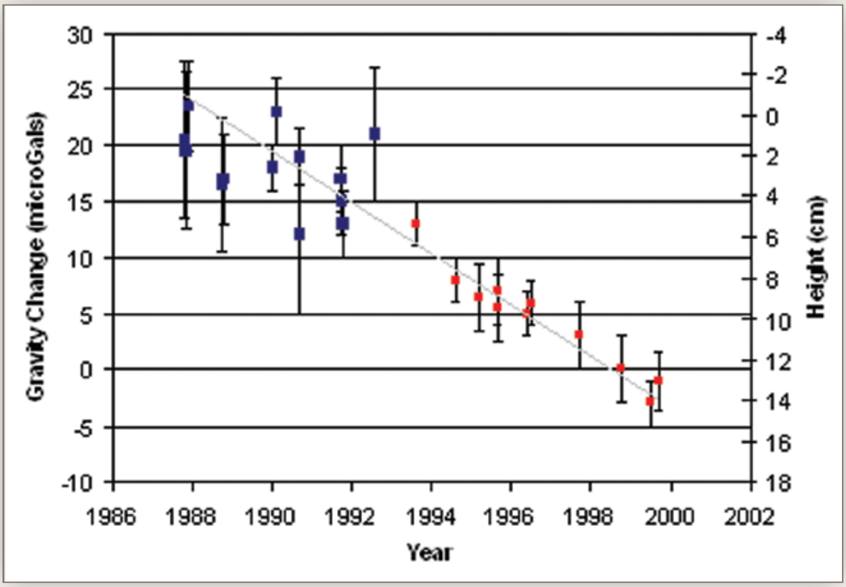
Shown above are individual measurements in a laboratory setting. The standard deviation between drops is better than 6 μGal. Note that the measured absolute gravity value, in this case 979 631 858 μGal, is computed and reported in real time.



Shown above are the results of an inter-comparison of various absolute gravimeters in Walferdange, Luxembourg, 2003. [Ref: "Results of the International Comparison of Absolute Gravimeters in Walferdange (Luxembourg) of November 2003, O. Franics, et. al, International Association of Geodesy Symposia, Vol 129, 2004]. Fifteen absolute gravimeters run by independent operators were compared over five days. The standard deviation of the FG5 instruments was 2.3 μGal.



Shown above are the results of a 24-hour site occupation (24 sets of 100 drops each). The set scatter is on the order of 1 μGal, indicating sub-μGal measurement precision.



Shown above are the results of absolute gravimeter measurements at Churchill, Canada [Ref: A. Lambert et al., "New constraints on Laurentide postglacial Rebound from Absolute Gravity measurements," Geophysical Research letters, Vol 28, No. 10, pp. 2109-2112, May 15, 2001]. The blue squares are from JILA-g meter measurements, and the red squares are FG5 measurements. The slow reduction in gravity over 12 years is due to postglacial rebound (uplift in the crust as the earth recovers from the weight of the ice in the last ice age). This type of long-term study is only possible with the inherent stability of an absolute gravimeter.

FG5 APPLICATIONS

GEOPHYSICAL RESEARCH

- Vertical crustal motion detection
- Complementary verification of displacements measured with GPS and VLBI
- Volcanic magma flow monitoring
- Postglacial rebound studies
- Uplift of subduction studies
- Earthquake research
- Long period tidal monitoring and earth inelasticity modeling

ENVIRONMENTAL MONITORING

- Water table monitoring in deep and/or multiple aquifers
- Nuclear waste management and cleanup
- Global sea level studies for global warming

EXPLORATION AND RESOURCE MANAGEMENT

- Oil exploration
- Mineral exploration

PRECISION MEASUREMENTS AND CALIBRATIONS

- Pressure transducer and load cell calibration
- Redefinition of the kilogram in the SI system of units
- Big G determinations and equivalence principle
- Calibration of superconducting of other high precision relative gravity meters

INERTIAL NAVIGATION

- Gravity reference station determinations
- Relative gravity network control points
- Establishing geodetic tie points for gravity networks
- Defining the geoid

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