**ZLS Land Gravity Meter**

**Introduction**

It took ZLS over 6 years to develop a new metal, zero-length spring land gravity meter. The Burris Gravity Meter™ is not a repackaging of old technology. It is a new meter designed especially to take advantage of the latest advances in digital technology. The result is a meter with superior digital performance and ease of use. It is the most precise, rugged and lightest gravity meter on the market. UltraGrav™ control electronics by Herb Valliant automate the Burris Gravity Meter™ allowing it to be used with microGal precision.

**Easy for Beginners - Sophisticated for Experts**

Whatever your level of experience, UltraGrav™ makes using the Burris Gravity Meter™ fast and easy to operate. When configured for automatic reading, students and beginners can sit back and let UltraGrav™ do all the work. Feeling the need for more control, professionals and experienced operators can customize UltraGrav™ for more complex scenarios. In addition to single-mode operation, continuous-mode operation permits earth-tide and secular recordings. If speed is of the essence, menu selected precision allows you to choose the desired level of precision for the job: the lower the level of precision, the faster the reading. UltraGrav™ also provides for the meter to be operated remotely via Bluetooth connection. With UltraGrav™, it is no longer necessary to have a highly skilled operator to obtain accurate results.

**Computer Controlled and Data Logging**

A microprocessor-based, automatic reading and data logging system, UltraGrav™ controls the meter for blunder-free observations. UltraGrav™ does all the work for you. It takes the reading, applies the calibration factor, corrects for earth tides and off level position*, then stores the data and displays the results, all in an instant! UltraGrav™ comes installed on an Android Tablet for flexibility in the field. The observer can remotely monitor and operate the meter via the standard Bluetooth connection. Field proven, UltraGrav™ has been used successfully to upgrade existing Model G and D meters for over 24 years. UltraGrav™ is a comprehensive and mature system that eliminates costly transcription mistakes.

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**Land Applications**

- Petroleum
- Mineral
- Civil Engineering
- Geophysical Mapping
- Geotechnical
- Archaeological
- Groundwater Studies
- Environmental Studies
- Tectonic Research
- Vulcanology
- Geothermal

**Models**

- Calibrated Screw
- Non-Calibrated Screw
- Earth Tide

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**Burris Gravity Meter™**

- Highest Quality
- Most Precise
- Most Rugged
- Lightest
The Heart of the Burris Gravity Meter™

Each Burris Gravity Meter™ is built around a handmade, metal, zero-length spring. ZLS springs have extremely low hysteresis and drift rates. When new, ZLS springs drift approximately 1.0 mGal per month and when mature, drift less than 0.500 mGals per month. Data have shown that the spring's drift rate improves with age. The prototype has a drift rate of approximately 0.030 mGals per month. UltraGrav2™ provides unsurpassed precision over large ranges and eliminates a class of errors known as circular error. Calibration values are stable over time as they are determined by a metal micrometer screw. The Burris Gravity Meter™ has consistently yielded standard deviations of 0.003 mGal or better during routine field tests.

The Gravity Meter Sensor Design

The Burris Gravity Meter™ is based on a new zero-length spring suspension. The new suspension was designed to take full advantage of the latest development in digital technology. Fast response, stable, high accuracy, and a large feedback range are the benefits of the new design. A metal alloy was used for the zero-length spring because of its low drift characteristics. Experiments have proven that ZLS metal springs are extremely stable. A metal micrometer screw was chosen to give the meter a 7,000-milligal range. For stability, strength, and ruggedness, all sensor components are made of metal. Limit stops and a beam arrestment protect the meter during transportation.

The new suspension system and an electrostatic feedback force are used to oppose gravitational forces on the proof mass. The UltraGrav2™ control system incorporates an inherently linear pulse-width modulated (PWM) electrostatic feedback system to automatically null the beam (Valliant, 1986). The low power feedback system automatically produces an electrostatic feedback voltage from the output voltage of the capacitive position indicator. This feedback voltage is then applied to the capacitor plates restoring the beam to the null position and keeping it there. The feedback voltage necessary to null the beam is proportional to the relative gravity value. The beam signal can be monitored on the galvanometer or on the screen of the Android device.

The sensor, electronic levels, and critical electronics are all shielded from ambient temperature changes by a highly stable thermostated oven. A very efficient insulating material is used to further reduce the effects of temperature changes. Use of the thermostated oven and insulation allows the meter to be operated in ambient temperature ranging from -15 to + 50 C.

Reliability

ZLS Corporation has over a century of combined experience in the design and manufacture of metal, zero-length spring gravity meters. The UltraGrav2™ control system by Herb Valliant has been used and proven in the field by leading universities and agencies around the world since 1994. The Burris Gravity Meter™ was developed by the world’s most experienced designer of metal spring gravity meters, Larry Burris. Each Burris Gravity Meter™ is unconditionally warranted against any defects in parts or craftsmanship for a period of two years and carries a two year warranty against sticking of the mass on the stops.
Android Tablet, GPS and Recorded Data

UltraGrav2™ is installed on a 7” Android tablet for flexibility in the field. The app can be installed on any Android device 6” or larger with Bluetooth capability. This makes UltraGrav2™ convenient to use and easy to maintain in the field. Data files can be viewed within the Android device for quality checks. Saved observations can be downloaded via USB cable, memory stick or simply e-mailed. Data files once saved are protected from loss of power.

UltraGrav2™ has been streamlined to be easier to use yet is more powerful. GPS coordinates from the Android device can be used if more accurate coordinates are not available. The program offers optional filtering to facilitate single observations during noisy environmental conditions. Many of the functions have been combined to give you more information. There are three different formats for recording data, one for single point measurements and two for continuous measurements. Although the recorded information varies for each format, following is an example of recorded formation.

- Observed Gravity and Dial Reading
- Feedback, Earth Tide, Level, and Temperature Corrections
- Beam Error and Standard Deviation
- Meter Height, Elevation, Latitude, Longitude
- Temperature, Cross and Long Level Frequency
- Observer ID, Station ID and Meter Serial Number
- Date and Time
- Elapsed time, Filter Time Constant, Data Output Rate
- Notes

ZLS Leveling System

The Burris Gravity Meter™ leveling system is fast and easy to use. It consists of three leveling legs which can be accessed from the top of the meter. The meter can be placed directly on the ground or on a base plate. Under normal field conditions, the Burris Gravity Meter™ can be precisely leveled for microGal readings within 30 seconds. However, precise leveling is no longer needed as UltraGrav2™ can be configured by the operator to perform automatic off level corrections. Unlike bottom leveling systems where the meter is placed blindly into slots, the Burris Gravity Meter™ is easily placed on the ground or a base plate. With the ZLS manual leveling system there are no motors to reduce battery life or break down during a survey.

Small, Portable and Weather Resistant

The Burris Gravity Meter™ contains the sensor, electronics, computer and battery "All-In-One" easy to handle unit. There is no need for a separate carrying case. No lost time taking the meter in and out of a case. The Burris Gravity Meter™ is sealed to keep out the weather so you do not have to worry about those sudden rain or dust storms. Under normal survey and climate conditions, the battery will last 12 – 14 hours. Small in size, the Burris Gravity Meter™ weighs 13 pounds with a standard lithium ion battery. This makes the Burris Gravity Meter™ the lightest land gravity meter on the market.
Two Burris Gravity Meter™ Models

There are two models of the Burris Gravity Meter, 1) Non-Calibrated Screw Burris Gravity Meter and 2) Calibrated Screw Burris Gravity Meter. Both meters are identical in construction and have the same reading resolution of 0.001 mGal when reading the force balance.

The Non-Calibrated Screw Meter does not have a calibrated micrometer screw. The meter is intended for users with short range surveys on flat areas and/or stationary site measurements requirements. The Non-Calibrated Screw Meter’s measuring screw itself does not measure gravity. The screw is used to adjust the meter to within the 50 mGal range of the force balance where it can take a gravity reading.

Non-Calibrated Burris Gravity Meter™
1. 50 mGal Automatic Nulling Range with Microgal Reading Precision
2. Worldwide Ranging Screw
3. Land Gravity Meter with Beam Galvo
4. Electronic Levels with Reading Galvos
5. UltraGrav2™ Electronics, Controller and Software

The Calibrated Screw Meter has a calibrated micrometer screw. This meter is intended for users who routinely have surveys covering large geographic areas, mountainous regions or continental surveys.

The Calibrated Screw Burris Gravity Meter is calibrated every 50 mGals over the entire 7,000-mGal meter range. Readings taken with UltraGrav2™ are free of circular error when the dial is set to a calibrated point. Calibration values are stable over time as they are determined by a hardened micrometer screw.

Calibrated Burris Gravity Meter™
1. 50 mGal Automatic Nulling Range with Microgal Reading Precision
2. 7000 mGal Worldwide Range
3. Land Gravity Meter with Beam Galvo
4. Electronic Levels with Reading Galvos
5. UltraGrav2™ Electronics, Controller and Software

Designed for Land Applications
- Two Models Available
- Same High Precision
- Calibrated Screw Model for Large Geographic or Mountainous Surveys
- Non-Calibrated Screw Model for Flat Areas or Stationary Measurements
- Earth Tide Configurations Available

Deliverables
- Burris Gravity Meter™
- Android Tablet with UltraGrav2™ Control System
- Burris Meter Power Supply
- ZLS Leveling Plate
- 2 Lithium Ion Batteries
- Lithium Ion Battery Charger
- Flash Memory Stick with Backup Programs and User’s Guide
**Sensor**
Type: Metal Zero-Length Spring
Hardened metal micrometer screw

Range: 7,000 mGal

Temperature range: -15 to +50°C

**Electronic Levels**
Range: +/- 5 arc-minutes (10 arc-minutes total)
Resolution: One arc-second

**Reading Resolution**
Recorded: Standard Version: Single reading mode: 0.001 mGal
Continuous reading mode (filtered): 0.0001 mGal

**Precision of Calibrated Points (Calibrated Screw Meters Only):**
Standard: +/- 0.015 mGal

Data Repeatability (Under normal conditions of background noise)
Within 50 mGal: 0.005 - 0.007 mGal (Feedback)
Over 50 mGal: +/- 0.015 mGal (Screw)

**Drift**
When New: Approximately 1.0 mgal per month
When Mature: Less than 0.3 mgal

**UltraGrav2™ Control System**
Type: Pulse width modulated electrostatic nulling system
Feedback range: Approximately 50 mGal
Input voltage: 10.5 to 14.0 volts DC
Auxiliary outputs: Analog: levels, Beam and Feedback
FM: Levels and Beam; PWM: Feedback

**Host Computer**
Type: Android Tablet
GPS: Android Tablet (Accuracy will depend on the accuracy of the Android device being used)
Power: Internal batteries

**Battery**
Standard Lithium Ion Battery Life (at 25 C)
Standby: 16 - 18 hr.
Operating: 12 - 14 hr.

Lithium Ion Battery Charger/Eliminator
Input voltage: 85 - 270 Volts, 47 - 63 Hz
Output voltage: 12.0 Volts
Dimension: 6.87 x 4.87 x 2.87 in. (17.5 x 12.4 x 7.3 cm)
Weight: 2 lb. (0.907 kg)

*Optional feature, level calibration by operator required. Specifications are subject to change without notice. Results may vary depending on conditions.*