

GENERAL SPECIFICATION

SURVEYS

GS EP GEO 213

Onshore geophysical site survey - Micro-Gravity Geophysical Survey

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1. Scope

The content of this General Technical Specification indicates the minimum standards required by Company for microgravity geophysical survey.

However, should Company consider that any aspect of the work requires more detailed investigation, Company reserves the right to apply further Particular Technical Specifications.

All Equipment and Materials necessary to complete the survey in accordance with this Contract shall be supplied by Contractor. Such Equipment and Materials shall include all spare parts and spare Equipment units as may be necessary to provide normal and continuous operations, and shall be in good operating condition prior to the award of Contract.

Such Equipment shall be properly maintained in such a way as to assure accuracy within the tolerances set by the manufacturer for such Equipment. Contractor undertakes to provide a statement of the surveying accuracy of this Equipment.

The Work defined in these Specifications shall be performed in accordance with the Agreement.

- The Work shall include the following phases: **Data acquisition phase**
- **Data processing phase:** This phase is to be carried out in conjunction with data acquisition in order to be sure that survey objectives are reached
- **Interpretation phase.**

Reports shall include measured and computed data, and interpreted maps, as per objectives of the Particular Technical Specifications.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
ASTM D6430	Standard guide for using the Gravity Method for Subsurface Investigation
ISO 1000	Specification of SI units and recommendations for the use of their multiples and of certain other units

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP GEO 210	Onshore Geophysical Site Survey - Cross hole geophysical survey
GS EP GEO 211	Onshore Geophysical Site Survey - Seismic refraction geophysical survey
GS EP GEO 212	Onshore Geophysical Site Survey - Multichannel surface waves geophysical survey
GS EP GEO 214	Onshore geophysical site survey - Electric Geophysical Survey
GS EP GEO 215	Onshore geophysical site survey - Radar Geophysical Survey
GS EP GEO 216	Onshore geophysical site survey - Electro-Magnetic Geophysical Survey
GS EP GEO 401	GIS requirements for engineering site surveys and studies
GS EP GPA 202	Seismic HSE for Land Activities
GS EP POS 003	Onshore land surveying and positioning works
GS EP POS 004	The use of Differential Global Navigation Satellite System

3. Microgravity survey objectives and methodology

3.1 Microgravity survey objectives

Microgravity is a method used for geological and geotechnical investigations, to detect density anomalies related to ground disturbances.

Main field of application in civil engineering is to identify and characterize subsurface voids (old quarries, galleries related to abandoned mines, karstic cavities, sinkholes...) more or less filled in or flooded.

Other application fields are listed below:

- Mining: search for dense lodes and massive ore bodies, search for not very dense fractured or weathered zones
- Hydrogeology: karstic and weathered zones, river deposits
- Environment: object or target to be detected

3.2 Methodology

The microgravity method is based on the measurement of the relative value of the vertical component of gravity at the ground surface, in order to establish the subsurface distribution of densities.

Target is to locate area of lateral evolution of the subsurface soil density, in order to appropriately define a complementary boreholes campaign to characterize and identify origin of

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those density anomalies, which can be either related to mass deficit (voids, fractured zone or low density deposits...), or mass excess (hard bedrock elevation, high-density buried object..).

4. Units and abbreviations

4.1 Units

Only the ISO International System of units (ISO 1000) shall be used in all relevant measurements, processing and reporting.

4.2 Abbreviations

GIS	Geographical Information System (chart database)
DGPS / GPS	Differential / Global Positioning System
RTK	Real Time Kinematics (DGPS system)
WGS 84	World Geodetic System 1984
Gal	Unit of gravitational acceleration ($1 \text{ Gal} = 10^{-2} \text{ m/s}^2$), with the Earth's average gravity of approximately 980 Gals
μGal	One part per billion of a Gal ($1 \mu\text{Gal} = 1/1000000 \text{ Gal}$)

5. Microgravity layout

Contractor shall request from Company all available prior information, to finalize the technical program, such as geological context, results of previous geophysical investigations, access to the site and state of the ground surface.

Contractor shall endorse Company's requirements in terms of the layout for measurements. If Contractor considers that the proposed measurement grid may not achieve Company's objectives, Contractor shall propose an alternative layout, which shall be properly justified, and submitted to Company approval.

5.1 Determination of measurement grid

Determination of measurement grid will be established on the basis of Company's objectives and characteristics of the site. Targets shall be defined in terms of size, depth, orientation and expected density contrasts. Gravity data may be obtained along a single line profile, widely spaced profile lines, or over a uniform grid.

Contractor will have to calculate, by forward modelling, the expected amplitude and width of the gravity anomaly related to the different targets listed by the Company. This will determine the required measurement station spacing.