

GENERAL SPECIFICATION

SURVEYS

GS EP GEO 216

Onshore geophysical site survey - Electro-Magnetic Geophysical Survey

02	05/2015	Organisation change – January 2015
01	10/2012	Text removed and replaced by text of GS EP GEO 215
00	01/2012	First issue
Rev.	Date	Purpose of the revision

Owning entity: DSO/TEC

Managing entity: DSO/TEC/GEO

Document update realised by
standards coordination by
Reorganisation 2015

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1. Scope

The content of this General Technical Specification indicates the minimum standards required by Company for Ground Electromagnetic (EM) geophysical survey using Frequency Domain instruments. 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 start of mobilization.

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, as well as interpreted maps as per objectives of the Particular Technical Specifications.

The final product shall be an Expert Report.

The scope of the Work is included in 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 D 6639 - 01 (2008)	Standard guide for using the Frequency Domain Electromagnetic Method for Subsurface Investigations
ISO 80000-1	Quantities and units – Part 1 General

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 213	Onshore geophysical site survey - Micro-Gravity 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 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. Ground Electromagnetic survey objectives and methodology

3.1 EM survey objectives

Ground Electromagnetic is a geophysical method for measurements of ground conductivity, from the near-surface to a depth of few tens of meters.

Field applications are numerous and concern either hydrogeological, civil engineering, environmental or archaeological surveys:

- Locating gravel deposits, and determining their extent
- Mapping saline intrusions
- Detection of old mine galleries or pits
- Mapping pollution plumes in groundwater
- Mapping bedrock topography
- Mapping terrain conductivity for electrical grounding (cathodic protection)
- Searching for fault and fracture zones
- Archaeological exploration
- Locating buried metallic conductors (pipes, UXO, drums...).

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It is important to keep in mind that the Ground Electromagnetic method is more efficient when searching for a conductive target in a resistive medium, than to resolve resistive targets in a conductive medium.

3.2 Methodology

Ground Electromagnetic is an active method based on the transmission of an electromagnetic field of fixed frequency in the ground. This primary field (inductive field) is generated by a transmitter coil energized with an alternating current. The time-varying magnetic field arising from this alternating current in the transmitter coil induces a very small current in the earth, which generates a secondary electromagnetic field superimposed to the primary field, which is recorded by the receiver coil.

Comparison of the magnitude of this secondary field (H_s) with the primary field (H_p) allows the computation of an apparent conductivity (C_a) expressed in the following formulae:

$$C_a = \frac{4}{2\pi f \cdot \mu \cdot s^2} \left(\frac{H_s}{H_p} \right) = K \cdot \frac{H_s}{H_p}$$

Where:

- f Fixed frequency
- μ Permeability of free space
- s Spacing between coils.

Measurement equipments are designed to keep factor K constant by adjusting frequency versus distance between antennas.

The interest of this inductive method over conventional resistivity methods is that measurements don't need any coil-to-ground contact, which allows high speed acquisition surveys.

4. Units and abbreviations

4.1 Units

Only the ISO **International System** of units ([ISO 80000-1](#)) 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)
EM	Electro-Magnetic
C_a	Apparent conductivity in mS/m (milliSiemens/metre)