

GENERAL SPECIFICATION

SURVEYS

GS EP GEO 211

Onshore Geophysical Site Survey Seismic refraction geophysical survey
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1. Scope

The content of this General Technical Specification indicates the minimum standards required by Company for seismic refraction 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 (Exhibit A2).

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 the surveyed area is acceptable
- **Interpretation phase.**

Reports shall include measured and computed data and interpreted cross-sections 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
ISO 80000-1	Quantities and units – Part 1 General

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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 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. Seismic refraction survey objectives and methodology

3.1 Seismic refraction survey objectives

Seismic refraction shall be used to achieve an accurate and continuous definition of the soil layering down to a maximum penetration depth of 80 m. Seismic refraction results are used to:

- Characterize the seismic velocities (V_p) and thicknesses of superficial layers overlying a substratum. In particular, velocities give indication on soil compaction, rock weathering and rippability and water level.
- Determine the depth of the weathered/fractured and/or compact bedrock top levels. Since the depths are calculated at the impact points as well as at the receiving points, a continuous and detailed bedrock relief is obtained along the entire receiver line.
- Characterize lateral changes of soil and rock properties along the entire investigated profile, including fractured zones, contact zones, deep depressions, channeling, etc.

The seismic refraction has also other applications in connection with civil engineering projects:

- Determination of groundwater level in the superficial soil layers
- Selection of sand and gravel deposits
- Evaluation of the exploitation feasibilities for quarry sites.

Correlation between velocity classes and geology shall be done on the basis of existing boreholes results and/or geological information.

3.2 Methodology

The seismic refraction method utilizes the refraction of seismic waves on geological layers and rock/soil units in order to characterize the subsurface geological conditions and structures.

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.

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4.2 Abbreviations

GIS	Geographical Information System (chart database)
DGPS / GPS	Differential / Global Positioning System
RTK	Real Time Kinematics (DGPS system)
SEG-2	Society Exploration Geophysicists format 2
SEG-Y	Society Exploration Geophysicists format Y
Vp	P-wave velocity
WGS 84	World Geodetic System 1984

5. Seismic spread layout

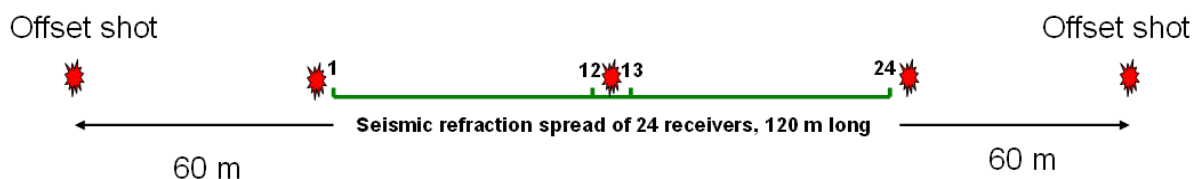
The standard spread shall comprise 24 receivers with 5 shots (one in the centre, 2 at each end of the spread, and 2 at an offset equal to half the spread length). In geologically complex areas, the spread shall be upgraded to 48 receivers with 7 shots. Details are provided in the following subsections.

Contractor shall endorse Company's requirements in terms of spread layout. If Contractor considers that the proposed spread layout may not achieve Company's objectives, Contractor shall propose an alternative layout, which shall be properly justified and ultimately approved by Company.

5.1 Determination of receivers and shots number

The standard spread shall comprise 24 receivers with 5 shots (one in the centre, 2 at each end of the spread, and 2 at an offset equal to half the spread length). A typical layout is presented in Figure 1.

Figure 1 - Standard seismic spread layout, 24 channels-5 shots



In geologically complex areas, the spread shall be upgraded to 48 receivers with 7 shots. A typical layout is presented in Figure 2.