



SPECIFICATION – Lot 1

One (1) Handheld XRF Spectrometer with HE purge capability

1. Scope

1.1. 1.1. This Specification defines the technical requirements for one (1) portable, compact, and lightweight X-ray Fluorescence (XRF) analyzer (hereinafter referred to as “the System”) for training, research and service purposes. The System shall be suitable for on-site deployment at the location of the artifacts and shall be operable in museums, laboratories, and field environments. Handheld operation shall be the primary mode of use. The System shall also support stand-mounted operation for the analysis of small, delicate, or geometrically complex objects.

1.2. The System shall be capable of non-destructive elemental analysis of archaeological and cultural heritage artifacts, including, but not limited to, ceramics, glass, glazes, obsidian, historical metals, pigments, and residues. The System shall additionally support applications in environmental, geological, and materials analysis, including environmental soil screening, geological investigations, and positive material identification (PMI) of industrial alloys.

1.3 The System shall be supplied to X-TechLab at Seme City Institute of Technology and Innovation, Cotonou, BENIN, (hereinafter referred to as the “End User”) within the IAEA BEN0004 Technical Cooperation project.

2. Applicable Documents

The following documents shall be applicable for this Specification to the extent specified hereinafter:

ISO 9001:2015 Quality management system

<https://www.iso.org/standard/46486.html> or an equivalent quality assurance system

In the event of conflict between the documents listed above and the content of this Specification, the content of this Specification shall take precedence to the extent of the conflict.

3. Definitions, Acronyms, and Abbreviations

The following definitions, acronyms, and abbreviations shall apply throughout this Specification unless defined otherwise hereinafter:

CRMs Certified Reference Materials

FWHM Full width at half maximum

kcps Thousands of counts per second



SDD Silicon Drift Detector
XRF X-ray Fluorescence

4. Requirements

4.1. Functional and Performance Requirements

The System shall meet the following functional and performance requirements:

- 4.1.1. The System shall meet the following functional and performance requirements:
- 4.1.2. Be handheld and portable.
- 4.1.3. Have a mass of less than 2 kg, including the battery.
- 4.1.4. Enable elemental analysis from Na to U.
- 4.1.5. Support measurements in air and with He purge;
- 4.1.6. Operate within an ambient temperature range from -10°C to $+40^{\circ}\text{C}$ and shall provide at least IP54 protection against dust and splashes.
- 4.1.7. Capable of being powered from the local main supply.
- 4.1.8. Record a timestamp and GPS coordinates for each measurement.

4.2. Technical Requirements

The System shall meet the following technical requirements:

4.2.1. Excitation requirements

- 4.2.1.1. The sample excitation shall be performed using an X-ray tube.
- 4.2.1.2. The X-ray tube shall have an anode material of Mo or Rh or Ag.
- 4.2.1.3. The X-ray tube high voltage shall be continuously adjustable between 6 kV and 60 kV.
- 4.2.1.4. The X-ray tube output power shall be between 1 W and 5 W.
- 4.2.1.5. The X-ray tube shall be used in conjunction with a set of filters capable of automatic exchange.
- 4.2.1.6. The System shall permit multiple excitation conditions by allowing filter changes and adjustment of tube voltage and current.
- 4.2.1.7. The System shall have the possibility to collimate the X-ray beam automatically from the software.
- 4.2.1.8. The X-ray spot shall be of two (2) sizes. Approximately 8 mm for large spot and 3 mm for small spot.

4.2.2. Detection requirements

- 4.2.2.1. The fluorescence detection shall be performed using an SDD detector.
- 4.2.2.2. The SDD shall be equipped with a low-absorption window (preferably graphene) to enhance performance for light elements. A Beryllium window should be avoided.
- 4.2.2.3. The active detector area shall be equal or greater than 20 mm^2 .
- 4.2.2.4. The energy resolution shall be less than 140 eV (FWHM) at the Mn K α line at a counting rate of at least 200 kcps.

4.2.3. Hardware, software, data storage and transfer

- 4.2.3.1. The System shall have an internal VGSA CMOS camera;



- 4.2.3.2. The System shall be provided with a built-in computer for instrument operation, spectra acquisition, spectrum evaluation and quantitative analysis;
- 4.2.3.3. The contractor shall provide a laptop with an operating system of Windows 10 Pro or newer version with the same capabilities of the built-in computer. A French keyboard is strongly preferred. A US one is acceptable if a FR option is not possible;
- 4.2.3.4. The furniture shall include a perpetual license of the software required to manipulate the data obtained from the instrument. The software shall have full control of the instrument, control of all excitation parameters and live spectra displayed on analysis;
- 4.2.3.5. The software shall provide options to export multiple spectra in batch mode to plain ASCII format;
- 4.2.3.6. The System shall provide for the quantitative analysis of the following classes of materials: (1) Alloys (also for small spot analysis), (2) Precious alloys, (3) Mining samples, (4) Geological samples, (soils, sediments, minerals);
- 4.2.3.7. The software shall allow creation/customization of calibrations (e.g. user factors, custom methods/libraries) via an advanced (password-protected) interface and/or vendor supported method development, including exportable method settings;
- 4.2.3.8. The data transfer to PC shall be done via USB, Bluetooth or Wi-Fi.

4.2.4. Accessories

The Contractor shall provide:

- 4.2.4.1. A set of at least ten (10) CRMs covering the intended analytical matrices. As a minimum, the set shall include CRMs for metals/alloys and soils/geological materials and CRMs for heritage-relevant glass and ceramic;
- 4.2.4.2. At least five (5) quality control check standards (control samples) intended for routine performance verification and drift monitoring. These shall be supplied with documented certified or expected values and an accompanying recommended quality control procedure;
- 4.2.4.3. At least five (5) spare windows for avoiding the contamination of the analyser during in situ measurements;
- 4.2.4.4. A shield for radioprotection during in-situ measurements;
- 4.2.4.5. Two (2) rechargeable battery packs and an AC battery charger;
- 4.2.4.6. A portable benchtop stand;
- 4.2.4.7. A carrying case and PC connection cable;
- 4.2.4.8. A helium purge system and mobile vacuum pump to enable enhanced detection of light elements.

5. Marking

The System shall have all safety markings in English language.

6. Packing



The System, for the shipment by air to the End-User, shall be packed in accordance with international standards that are applicable for the shipment by air of this kind of equipment.

7. Quality Requirements

7.1. The System shall be manufactured, shipped and installed in accordance with the Contractor's ISO quality assurance system or an equivalent quality assurance system.

7.2. The Contractor shall document the compliance with this quality assurance system.

8. Testing and Acceptance

The System, prior to shipment, shall be tested for conformance of the System with manufacturer's performance specifications and the minimum requirements specified herein.

The System, after installation, shall be tested by the Contractor together with the End-User to demonstrate that the performance meets the manufacturer's performance specifications and the minimum requirements specified herein as determined by the IAEA and the End-User.

The results of the testing of the System shall be documented by the Contractor in an acceptance protocol that shall be signed by the End-User.

9. Installation and Training

The Contractor shall install the System at End-User facility.

During the commissioning the System shall be tested by the Contractor together with the End-User to demonstrate that the manufacturers' performance specifications and the requirements specified herein, as determined by the IAEA and the End-User. The results of the testing of the System shall be documented by the contractor in an Acceptance Protocol that shall be signed by the End-User.

The Contractor shall provide a two (2) day training in French or English for up to three (3) staff of the End-User in the operation, troubleshooting and maintenance of the System at the End-Users's location within the installation of the System.

10. Deliverable Data Items

The Contractor shall provide the following deliverables:

10.1. Two (2) complete sets of Operation and Servicing Manuals and technical drawings per System in the French or English language in hard copies and electronic version;



- 10.2. A report providing information on pre-shipment testing or factory acceptance certificate (FAC) (ref. paragraph 8. above);

11. Support

- 11.1. The contractor shall identify any routine or preventive support and maintenance plan that is appropriate to this End-User, with full contact details, in-country or regional support is preferred.
- 11.2. The Contractor shall provide an itemized list of consumables and special operation and maintenance tools which may be required for the operation of the System, and components where replacement is expected within a typical ten-year life span.
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