TRACER 5

Legacy Refined - Handheld XRF for Cutting-Edge Researchers

XRF Spectrometer

Innovation with Integrity

As the first member of the TRACER 5 family, the TRACER 5i introduces a whole new instrument platform. While the TRACER 5i platform has the ability to completely control the excitation conditions, it also adds many new features which have been requested by our users. The user of the TRACER 5i can control the current and voltage directly from the integrated processor and interactive touch screen display. The user can select filters from the integrated filter wheel or insert user-designed filters. In addition, the measurements can be made in air, vacuum or helium atmosphere, which can be selected based on the needs of the user. The detector configuration, the SharpBeam™ geometry of the front end and a small distance between the sample and detector make for a very sensitive system with some of the lowest detection limits available today. The TRACER 5i has approximately three times the sensitivity of the previous generation TRACERs.

Features of TRACER 5 family:

- Integrated processor and data storage
- Interactive touch screen display
- Internal Camera
- Selectable measurement spot size
- User designed filters plus Filter wheel
- 50 kV; 4-Watt X-ray source
- High count rate; high resolution detection
- Wi-Fi and USB connectivity

The internal camera allows the user to view the sample to be analyzed and precisely align the target using the reticle projected onto the sample image. Up to five images may be stored with each spectrum for later identification of the sample area analyzed.

The user can select the size of the analysis spot by simply changing the source collimator with 3 mm and 8 mm spot supplied as standard as well as user constructed spot sizes.

The integrated Wi-Fi and USB allows communication with the users PC. This provides connection to a suite of software which allows complete control of the instrument and live display of the spectrum as the date is being collected.
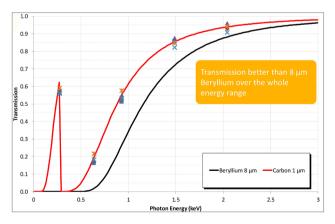
This software provides the ability to perform qualitative, semi-quantitative and quantitative analysis of spectra collected.
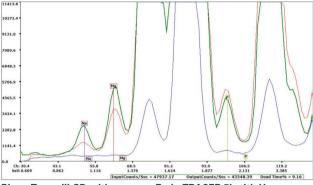
● TRACER 5g

The TRACER 5g incorporates a new detector with a 1 μm graphene window. The graphene window replaces the traditional 8 μm beryllium window. This ground-breaking window is one of the first commercial uses for graphene, an advanced material composed of atomic layers of carbon atoms arranged in hexagonal lattices. While the graphene is extremely thin its unique structure makes it extremely strong. The graphene window has higher transmission of X-rays throughout the energy spectrum and dramatically improves the transmission for light elements:
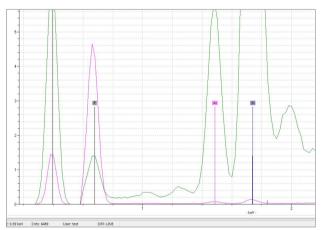
- 3X sensitivity for Sodium (Na)[1]

- 2X sensitivity for Magnesium (Mg)[1]

- 300 ppm Detection Limit for Na with He[2]

- 100 ppm Detection limit for Mg with He[2]

- Detection of Fluorine (F)

This improved light element performance opens opportunities for chemostratigraphy and quantitative characterization of geologic samples not previously realized using portable XRF. The improved detection

limits will greatly enhance the measurement of carbonates and evaporites, particularly for applications in mining and oil and gas. For example, the improved detection limits for Mg will enable handheld XRF to differentiate calcite, high magnesium calcite and dolomite in carbonates.

Blue – Tracer III-SD with vacuum; Red – TRACER 5i with He; Green – TRACER 5g with He

Normalized to Rh backscatter; red is Teflon (76% F), green is floriate (50% F)

In the field of soil and crop science, high Na, Mg, Ca levels in soil can have adverse effects on crops which are intolerant to high salinity, such as corn and soybeans. The TRACER 5g will enable agronomists to perform handheld XRF measurements of Na in soil from tolerable levels of 500 ppm to intolerable levels of over 12,000 ppm.

During the development of the TRACER 5g, the front-end configuration was redesigned to produce the cleanest spectra in the history of Bruker! The TRACER 5g sets a new standard for the qualitative analysis of objects from the spectra with fewer artifacts and less background than any previous TRACER. (See spectra on page 7)

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1. Compared to TRACER 5i
2. These values are typical and will vary from instrument to instrument

Applications

Art Conservation & Authentication
- Evaluate pigments & objects for authentication
  - ✓Dating
  - ✓Understand previous conservation

- Analyze objects
  - ✓Determine authenticity
  - ✓Fabrication details
  - ✓Identification of poisonous materials
  - ✓Find non-original material

Exploratory Geology
- Analyze Geochemistry
  - ✓Ores
  - ✓Cores
  - ✓Drill cuttings
  - ✓Soil
  - ✓Sediment

- Measure/Map
  - ✓Majors
  - ✓Minors
  - ✓Target elements

Archeological Studies
- Sourcing
  - ✓Obsidian
  - ✓Lithic
  - ✓Ceramics

- Analyze Objects
  - ✓Determine authenticity
  - ✓Proper conservation
  - ✓Understand objects
  - ✓Toxic material analysis

Food Safety
- Quality analysis at critical control (QACC) points
  - ✓Raw materials
  - ✓Finished products
- Hazardous analysis at critical control points (HACC)
  - ✓Adulterant
- Foreign Body Identification (FBI)
- Analyze food fortificants
  - ✓Fe and Ca in milk

Applications

Plant & Soil Health
- Quality Analysis
  - ✓Fertilizers
  - ✓Nutrients
  - ✓Irrigation sources

- Heavy Metal Analysis
  - ✓Sustainable fields
  - ✓Elemental uptake
  - ✓Effective remediation

Material Science and Research
- Portable XRF analysis
  - ✓Material Science
  - ✓Research

- Elemental analysis across disciplines
  - ✓Chemistry
  - ✓Physics
  - ✓Agronomy
  - ✓Geology
  - ✓Biology

Education
- Safety interlocked XRF elemental analysis
  - ✓In labs
  - ✓In field

- Provides illustrative analysis
  - ✓Qualitative analysis
  - ✓Semi-quantitative analysis
  - ✓Quantitative analysis

- Extensive support software with live spectral display
  - ✓Artax
  - ✓BIT
  - ✓EasyCal

Other Applications
- Alloys
- Precious metals
- Social responsibility
- Environmental assessment

Detector options
- 8 µm Beryllium
- 1 µm Graphene

SharpBeam™ front end geometry
- Maximizes count rate
- Increases light element sensitivity
- Well defined measurement spot
- Minimizes detection of X-ray scatter

Measurement atmosphere
- Air
- Vacuum
- Helium

Large area SDD
- CUBE™ preamplifier
- High count rate capability
- Resolution <140 eV at 250,000 cps
- Increased sensitivity

Excitation filters
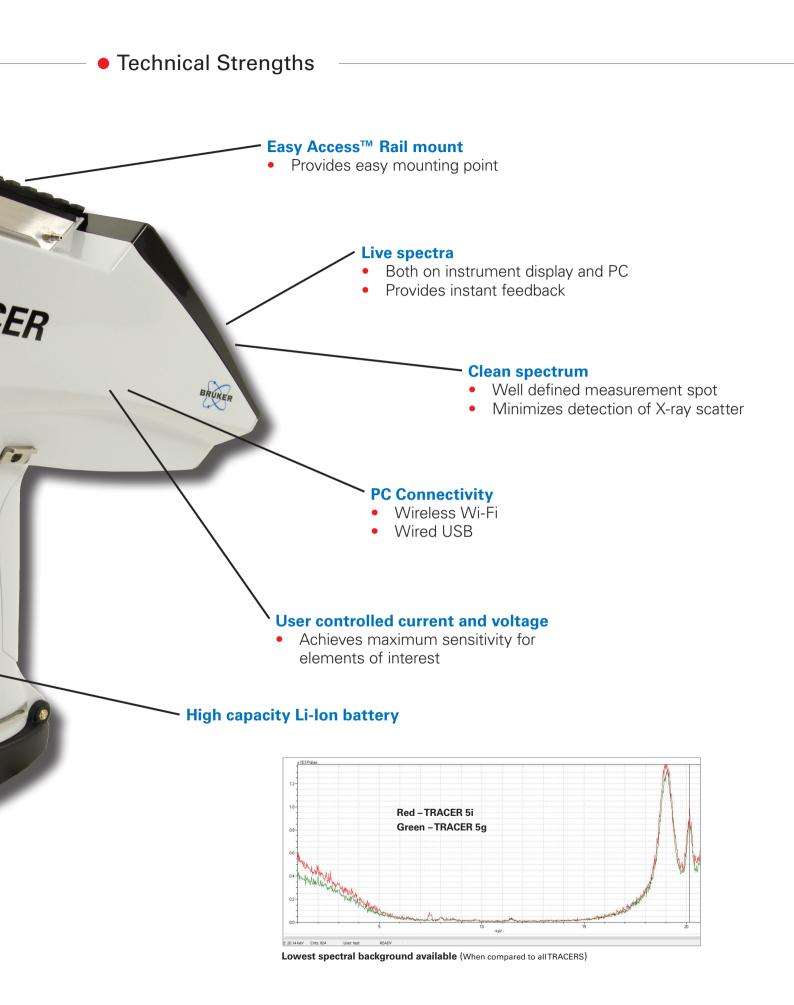- Five position filter wheel
- User designed manual filter

User-selected spot size
- 3 mm for small spot analysis
- 8 mm for maximum counts

Internal camera
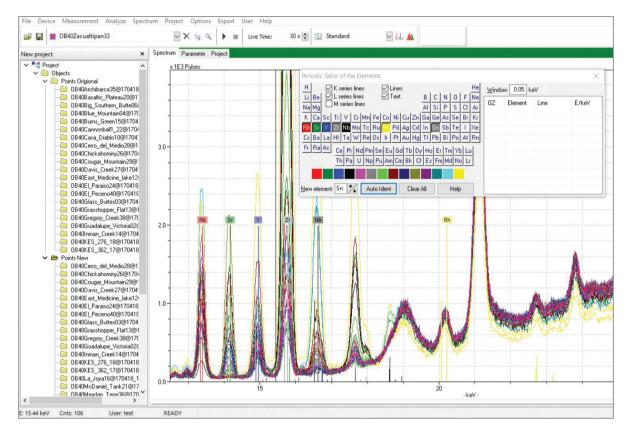- Shows exactly where measurement occurs
- Up to 5 images of sample at the measurement point

TrueTouch™ trigger switch

Easy Access™ Rail mount
- Provides easy mounting point

Live spectra
- Both on instrument display and PC
- Provides instant feedback

Clean spectrum
- Well defined measurement spot
- Minimizes detection of X-ray scatter

PC Connectivity
- Wireless Wi-Fi
- Wired USB

User controlled current and voltage
- Achieves maximum sensitivity for elements of interest

High capacity Li-Ion battery

Red – TRACER 5i
Green – TRACER 5g

Lowest spectral background available (When compared to all TRACERS)

Artax™

Artax software provides the ability to visualize, identify and analyze the relative elemental content of almost any substance on earth. This easy to use spectral analysis software empowers anyone with an inquisitive mind to determine how the elements interact within their sample set.

Artax Features:

- Connection via Wi-Fi or USB
- Controls all excitation parameters
- Acquires & Displays spectra live
- Database Management
- Bayesian Deconvolution
- Excel formatted data export
- Spectrum Matching

The Artax software provides a project management data base. You can organize all your spectra in a structure which meets your needs. This project database can contain hundreds of thousands of spectra which can be organized in a structure which is logical for your project.

The secret ingredient in Artax is the investigator. Artax allows the user to apply their knowledge of the objects under investigation to guide analysis. The investigator applies his or her subject matter expertise while the software applies the advanced mathematics involved in Bayesian analysis of the spectra. Outputs from Artax are in Excel format, so they can be imported into any of the analysis programs you already use. For example, the spatial variation of potassium in a crop's leaves can be plotted in ESRI ArcMap, the concentrations of sodium corroding a priceless artifact can be mapped in R, and relative changes in Molybdenum in a rock core can be plotted as a log curve in Petrel.

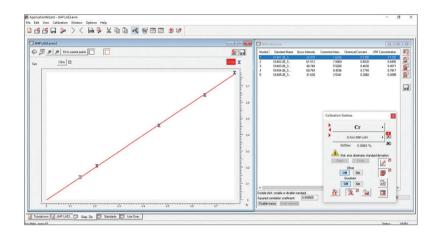**TRACER 5 checking for poisons on object under NAGPRA program**

EasyCal™

The EasyCal™ software package gives you the unique capability to create and modify custom calibrations for your TRACER 5. Custom calibrations give you the ability to match the calibration on your instrument to your unique sample set to cover the elements and concentration ranges which are important to your investigation. The simple steps for the creation of a calibration:

- Define elements and compounds
- Define standards concentration
- Measure standards
- Create calibration for each element
- Define any spectral overlaps
- Load calibration on instrument
- Measure unknowns

As the field work progresses, it is possible that some samples lead to the discovery of unexpected elements or other anomalous results. Some samples may simply be collected as QA/QC samples.

When these samples are analyzed in the laboratory, they will provide important additional information. The results of these analyses, along with the spectra collected in the field, can be added to the calibration. You can then adjust the calibration to better fit this expanded set of standards. If new elements of interest are discovered, EasyCal allows them to be added to the calibration. Each time the calibration is revised it will generate results which are closer to the true values. You can recalculate old results with the revised calibration allowing all your data to be fully comparable through time, even if you encounter the unexpected!

Bruker Instrument Toolbox

Bruker Toolbox is composed of two separate programs, RemoteCtl and BIT (Bruker Instrument Tools), which are simultaneously installed on your PC.

RemoteCtl connects to your instrument using either a Wi-Fi or USB connection. Once the unit is connected you can operate the instrument completely from the keyboard or touch screen on your PC.

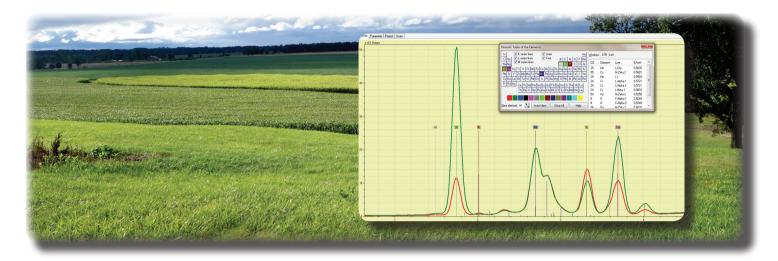**Operating TRACER 5i using Bruker Toolbox RemoteCtl**

Bruker Instrument Tools is a utility program which provides support for the instrument. Like Remote, BIT connects to your instrument either by Wi-Fi or USB connection. Once connected, BIT allows easy transfer of files between the instrument and your PC, as well as controlling the instrument and displaying live spectra during data acquisition.

In addition to acquiring and displaying spectra, BIT has several utility functions including:

- Instrument Software Update
- Report Generation
- Grade Table maintenance
- Maintenance of various instrument control tables

● Characterize Materials and Objects

It's About the Science of Light

Human Vision: We characterize an object by "capturing" what we see at a molecular level when light shines on it - shape, size, texture, color – and processing that data with stored knowledge.

TRACER Vision: The TRACER characterizes an object by "capturing" what it sees at an elemental level when light shines on it – photon energies and intensities – and processing that data with stored knowledge.

Human and TRACER Views of Corn Crops

Molecular observations of leaves from two corn seed brands indicate differences in color - dark green and light green. Elemental observations indicate the dark green leaves have more aluminum, silicon and calcium and the light green leaves have more phosphorus and potassium.

The combination of observations and TRACER measurements, along with knowledge of fertilizers, nutrients and contaminants takes the world of precision agriculture to new levels.

Point & Shoot versus Shoot & Analyze

Most handheld XRF instruments are designed to operate in the **point & shoot** configuration. Those instruments are supplied with a factory installed calibration which are designed for a particular application such as alloy analysis or geological sample analysis. Each of these calibrations is based on a set of assumptions, such as the sample homogeneity and thickness and will give very good results when those assumptions are meet. However, when samples of unknown composition are measured and the assumptions are not met, these calibrations will give poor results and can lead to wildly incorrect conclusions about the sample under test.

While the TRACER 5 supports factory installed calibrations and can be used in the **point & shoot** mode for routine analysis, it is capable of much more. The TRACER 5 and associated software is designed for use in cases where the sample does not meet any specific set of assumptions. When performing advanced investigations with the TRACER 5, the approach is to **shoot & analyze** the spectrum which is generated by your samples. This allows human understanding to be applied to the data generated. Using the TRACER 5 with ARTAX software, it is possible to do extensive qualitative and semi-quantitative analysis which will generate meaningful results which can then lead to well informed conclusions.

● TRACER Legacy

The TRACER 5 continues the legacy of the TRACER family in measuring non-uniform materials. This has made Bruker the leader in the Museum, Art and Archeology markets. The Art and Archeology users have long seen the TRACER as unique in its ability to provide elemental information regarding objects which require authentication and conservation. The TRACER family has been used in many geological research projects and in the field for mapping and core scanning. The TRACER family provides high quality information for advanced materials research in both industry and academia. In addition, the TRACER family has also been very popular in the teaching and education applications and there are many units in teaching laboratories. The Artax software which comes with the instrument provides the ability to do qualitative and semi-quantitative analysis, while EasyCal allows the user to create quantitative calibrations for their unique sample set.

2001
Tracer 1

2005
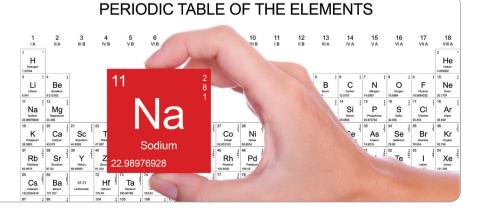TRACER III-V

2008
TRACER III-SD

2011
TRACER IV

2016
TRACER 5

TRACERS are advanced laboratory EDXRF analyzer systems with comprehensive elemental analysis features in a handheld configuration.

TRACERS can be configured to analyze elements as light as sodium to as heavy as uranium, providing scientists with a powerful research tool.

PERIODIC TABLE OF THE ELEMENTS

● Specifications

FEATURES	TRACER 5i	TRACER 5g
Detector	Proprietary 20mm² silicon drift detector with < 140 eV @ 250,000 cps Mn Kα; resolution for optimum light element analysis.	
Detector window	8 μm Beryllium	1 μm Graphene
Dimensions	27.3 cm x 9.4 cm x 29.5 cm (10.75 in x 3.7 in x 11.6 in) L x W x H	
Weight	1.9 kg (4.1 lbs) with battery or 1.6 kg (3.6 lbs) without battery.	
Power	Li-Ion battery and charger; AC adapter.	
Excitation source	Rhodium (Rh) thin window X-ray tube; X-ray generator 6-50 kV with 4.5-195 uA, maximum 4 Watt output. Operator adjustable current and voltage for optimum excitation.	
Collimation	User changeable collimator; 3 mm and 8 mm collimators supplied.	
Filters	Operator controlled, motorized 5 position primary beam filter wheel. Manual insertion filter/secondary target slot for factory or user made filters.	
Geometry	Features patented SharpBeam™ beam path for best performance at low power.	
Beam path	Capable of selectable beam path of vacuum, helium or air to detect elements as light as Fluorine (F) to as heavy as uranium (U).	
Internal camera	Internal VGA CMOS camera with ability to store up to 5 photos per assay.	
Interactive touchscreen	High performance and contrast daylight visible TFT LCD 9.4 cm (3.7") color touchscreen display.	
Convenience	TrueTouch trigger switch, relaxed ambidextrous hand grip strap and EasyAccess rail mount for accessories.	
Control software	Full control OS on analyzer and on PC software.	
Analysis software	Control of all excitation parameters and live spectra displayed on analyzer. Live spectra and qualitative, semi-quantitative and quantitative analysis on Windows® 7 or 10 PC.	
Data storage & data transfer	Direct storage on Thumb Drive. Data transfer to PC via USB or Wi-Fi. Bluetooth connectivity for accessories.	
System safety	Password protection; Sample proximity sensor; Low count rate (backscatter) shutoff	
Languages	Chinese, Chinese simplified, Dutch, English, French, French Canadian, German, Indonesian, Italian, Japanese, Korean, Polish, PortugueseBR, Russian, SpanishMEX, SpanishSPN, Thai, Turkish	
Operating environment	-10°C to +50°C (+14°F to 122°F); IP54 dust and splash resistant; Altitude: ≤ 2,500 m (8,200 ft)	
Certification	CE, FCC part 15	

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