030.0112.01.0

S1 TITAN/TRACER 5ⁱ

User Manual

Innovation with Integrity

Handheld XRF

FCC ID: 2AKJ9HMP001

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

In order to comply with FCC/ISED/MIC RF Exposure requirements, this device must be installed to provide at least 20 cm separation from the human body at all times.

Table of Contents

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1. Instrument Description and Care

Introduction

User documentation for the S1 TITAN and TRACER 5^{i} analyzers is in the form of a suite of Manuals, each with its own specific purpose. This document, the *S1 TITAN and TRACER 5^{i} User Manual*, describes –

- Instruments.
- Safety precautions.
- Safety features.
- Basic use.

Complete kit

An instrument comes with the following –

- Software and calibrations.
- Check samples appropriate to the specific calibrations.
- A charger, power cord, and two batteries.
- A USB/CD loaded with Bruker Toolbox, all manuals, demonstration software for S1 DATA TOOLS, and utilities.
- Radiation safety video.
- Four extra windows.
- Screwdriver or Hex driver and two spare nose plate screws.
- USB flash drive.
- Filters and collimators for TRACER 5^{i}.
- Filter making tools for TRACER 5^{i}.
- Pelican case.

X-ray use

The S1 TITAN and TRACER 5^{i} are fully field portable analyzers based on energy dispersive X-ray fluorescence (EDXRF) technology and use an X-ray tube as their excitation source. When energized, the instruments generate low-energy X-rays.

Calibration options

The instrument is factory calibrated, based on customer-ordered configuration. Calibrations are available for various applications, such as:

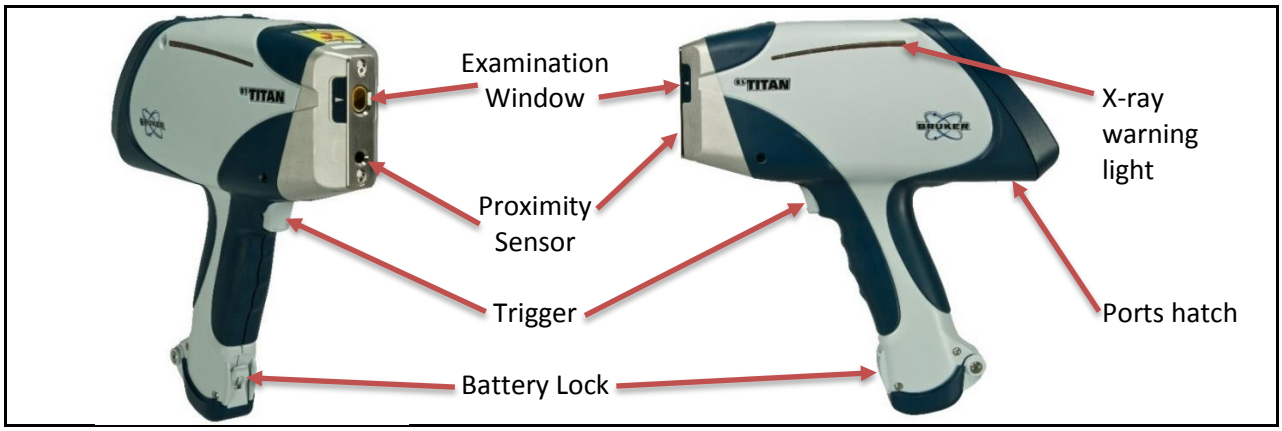
- Alloy analysis.
- Mining analysis.
- Restriction of Hazardous Substances (RoHS) chemical content.
- Lead and other heavy metals in toys and consumer products.
- Soil contamination analysis.

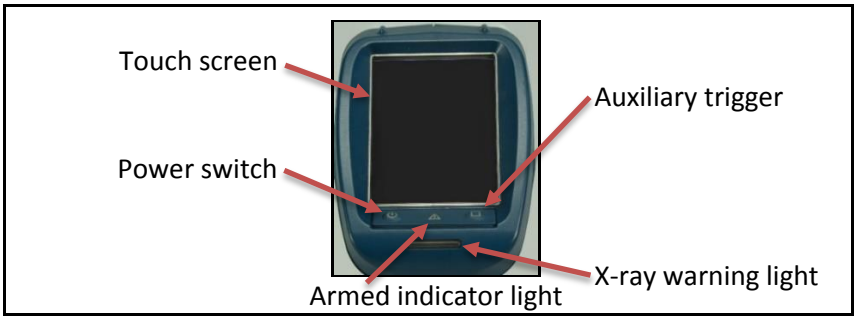
Registration and licensing

For information on how to register and/or license your analyzer, See *Registration and Licensing FAQ,* Bruker document 030.0050.

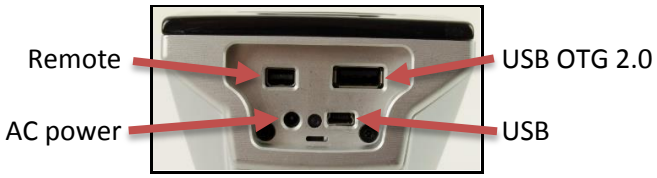
1.1. Instrument Components

S1 TITAN





TRACER 5[i]



Descriptions

The following table, in alphabetical order, describes each component:

Component	Description
Armed indicator	Indicates that the instrument is ready to take a measurement.
Auxiliary trigger	Allows dual hand operation as required in certain countries.
Battery	Provides power to the instrument.
Battery door lock	Keeps the battery secure.
Collimator hatch (TRACER 5^{i} only)	Accesses the collimator/filter assembly.
Examination window	Source location of X-rays.
Hose fitting (TRACER 5^{i} only)	Provides an attachment location for a vacuum or Helium flush hose.
Ports	Provide connections for USB, remote, USB flash drive, and power.
Power switch	Powers the instrument on and off.
Proximity sensor	Prevents the instrument from activating without a sample in place.
Rail (TRACER 5^{i} only)	Allows accessories to be easily attached.
Touch screen	Controls the instrument through a pressure sensitive user interface. *Using a stylus is helpful.*
Trigger	Initiates a measurement.
X-ray warning light	Warns when X-ray is activated.

TRACER 5^{i} windows

Both the S1 TITAN and the TRACER 5^{i} come with a clear examination window but the TRACER 5^{i} has additional window configurations for different applications.

Application	Configuration	Reason
Normal use	Clear window	The window protects the detector.
Vacuum	Gridded window	The grid reinforces the window against air pressure during the vacuum. However, during normal use, the grid interferes with measurements of light elements.
He flush	No window	Allows the Helium flow to escape.

Clear window for normal use

Gridded window for vacuum

No window for He flush

1.2. TRACER 5^{i} Collimators and Filters

Description

The TRACER 5^{i} has additional, interchangeable features –

- Filters.
- Collimators, stamped with either an 8 or 3.

They are applied as an assembly: a filter is inserted into the filter holder, which is attached to the collimator with a screw.


Black filter holder


Assembly


Collimators

Filter types

The instrument comes with five filter options and five filter holders (below) marked in different colors to indicate the filter type.

Filter	Name on Screen	Holder Color
Ti 25µm	Blue	Blue
Cu 200µm:Ti 25µm:Al 300µm	Black	Black
Al 76µm	Orange	Orange
C 60µm:F 190µm	Teflon	White
No filter	None	Beige

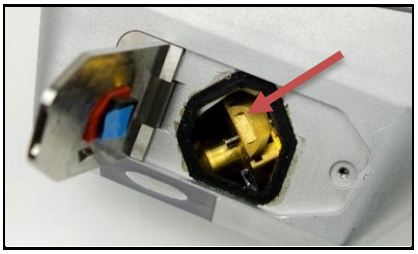
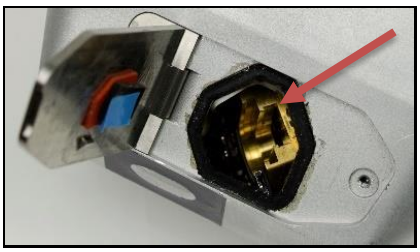
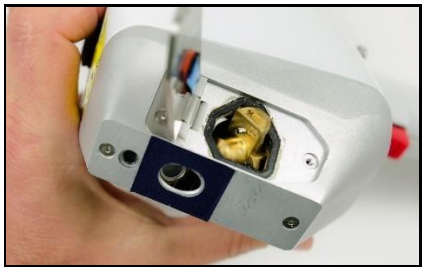
Collimators

The collimator determines the size of the spot on the sample to be tested. For most applications, 8mm is best. The 3mm collimator reduces the focal point size and, therefore, the analyzed area. For safety reasons, a collimator must be installed at all times.

If a collimator is…	Then
Installed	The size is displayed in the status bar and recorded in the data file.
Not installed	The instrument is prevented from entering the armed state and will not produce X-rays.

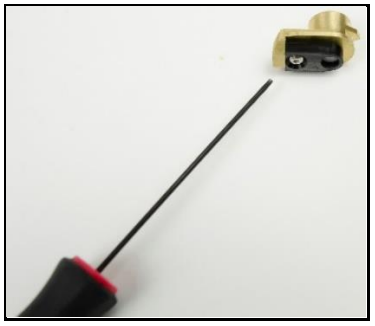
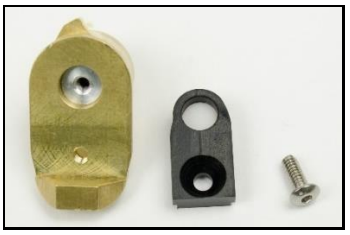
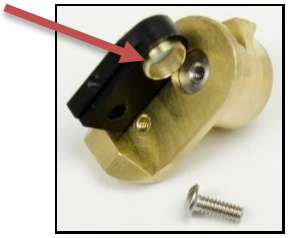
Installing a collimator

To install an alternate collimator –

Step	Action
1	Ensure that the instrument is powered off.
2	Using the provided 0.050 inch hex screwdriver, open the collimator hatch located on the side of the instrument nose. Do not allow debris to get inside the hatch area. 
3	Using a thumbnail on the lip of the currently installed collimator, slide it out. It may be tight. 
4	Line up the new collimator with the groove inside the hatch and slide it in until it clicks. Again, do not allow debris inside.  
5	Securely close the hatch and screw it shut.

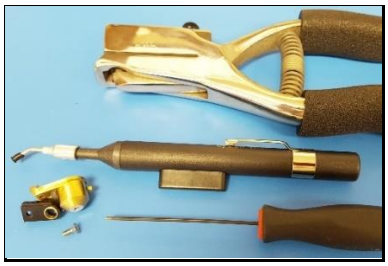
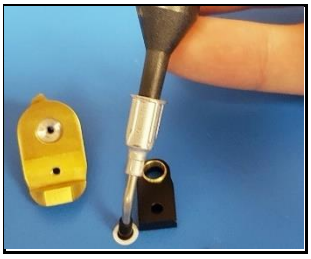
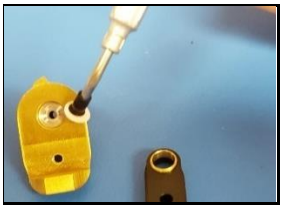
Changing filters

To change manual filters attached to a collimator –

Step	Action
1	Note the configuration of the current filter holder on the collimator. 
2	Using the provided 0.050 inch hex screwdriver, unscrew the filter holder from the collimator. 
3	Align the new filter holder with the collimator. Note the metal band fits into the collimator. 
4	Attach the screw.

Making a filter

To make a custom filter –

Step	Action
1	Collect necessary tools: • Hole punch • Vacuum stick • 0.050 inch hex screwdriver • Collimator assembly 
2	Use the hole punch to cut the filter material. 
3	Retrieve the filter piece from the hole punch. 
4	Use the vacuum stick to pick up the filter piece without touching it. ***To operate the vacuum stick –*** 1. Press and hold the button. 2. Touch the tip to the filter piece. 3. Release the button. 
5	Place the filter piece in the collimator. Release the filter piece by pressing the vacuum stick button. For a multilayer filter, the filter piece with the highest atomic number must be placed in the collimator last so it is closest to the X-ray source.  
6	Screw the filter holder onto the collimator. 

1.3. General Care and Maintenance

Low maintenance

The instrument, when used properly, should require very little maintenance beyond –

- Battery recharging. See **Power Sources**, page 14.
- Window replacement. See below.
- Quality checking. See **Quality Check**, page 55.

Touch screen

The touch screen uses sensitive electronics and should be cleaned regularly using a soft, lint-free or microfiber cloth. ***Do not –***

- Use cleaners as they may damage the screen.
- Use compressed air.
- Leave the analyzer where the touch screen is exposed to direct sunlight.

Cleaning exterior

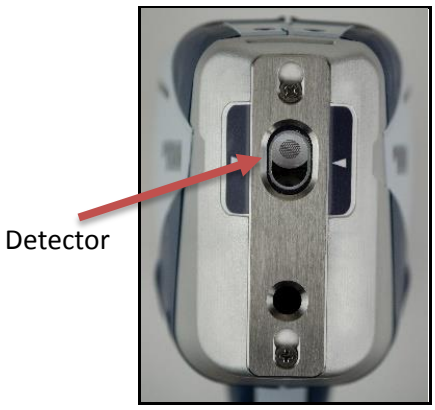
If the exterior of the analyzer becomes dirty, wipe it gently with a damp, lint-free cloth. *Avoid harsh solvents and compressed air.*

1.4. Changing Windows

Description

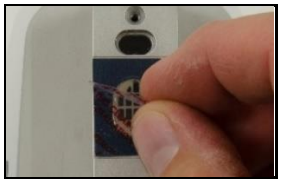
The window in front of the detector is delicate, only 4 µm thick Prolene™, and periodically requires replacement.

Never touch or use compressed air on the detector. The detector window is 8µm Be, fragile, and expensive.



Changing windows

To change a window –

Step	Action
1	If necessary, unscrew and remove the nose plate using the supplied screwdriver. TRACER 5^{i} 
2	Peel off the old window. *Avoid any contact with the sensitive detector.* S1 TITAN 
3	Remove old adhesive with isopropyl alcohol. TRACER 5^{i} 
4	Peel the white backing from the new window. TRACER 5^{i} 
5	For the S1 TITAN, center alignment arrows over the middle of the aperture. S1 TITAN 
6	Carefully apply the new window to the nose. TRACER 5^{i} 
7	Peel off the clear front protective cover. Otherwise, light element measurements will be inaccurate. TRACER 5^{i} 
8	Replace the nose plate. Firmly secure the screws but do not over-tighten.

1.5. Power Sources

What is provided

The analyzer is supplied with –

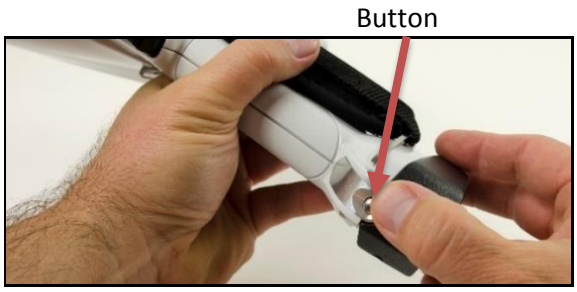
- Two Lithium ion (Li-ion) batteries, part number 160.0009.
- Battery charger with a cord, part number 160.0010. (Do not use a different charger with these batteries.) For more information, consult the manufacturer's battery charger manual.

S1 TITAN battery removal

To remove a battery from the S1 TITAN, while pressing the base, lift up the locking clip and pull down the door. Pull out the battery.

TRACER 5^{i} battery removal

To remove a battery from the TRACER 5^{i}, press the battery door button, open the door, and pull out the battery.



Battery installation

To install a battery into an instrument, slide in the battery and close the door until the locking clip clicks. Note that the battery can be inserted completely in only one configuration.

Remaining charge

To check the charge remaining on a battery –

On the “Bruker” side of the battery, push the white button on the left. Green lights indicate the approximate remaining charge in percent.

Charging

To charge a battery –

Step	Action
1	To prolong battery life, ensure that the ambient temperature during charging is between +5 °C and +45 °C (40 °F to 115 °F).
2	Plug power adapter into back of charger.
3	Plug power cord into power adapter.
4	Plug power cord into a wall outlet.
5	Insert battery into charger with the Bruker name on the left side.

During charging, the green light blinks. A solid green light indicates the battery is fully charged. For more information, consult the manufacturer’s battery charger manual.

Duration

A charge lasts, depending how the instrument is used, about four to eight hours.

Warnings

Do not –

- Disassemble, crush, or puncture a battery.
- Place a battery in fire or water.
- Charge a battery except with the supplied charger.
- Short battery terminals by allowing them to touch metal.
- Dispose of batteries in the trash.

Disposal

To dispose of a battery –

- Contact your local waste management company regarding disposal and recycling programs.
- If there is no local disposal program, return used Bruker batteries to Bruker. A nominal shipping charge applies.
- If a battery fails to operate normally within the warranty period, return it to Bruker for evaluation and repair.

Using AC adapter

Optionally, the instrument may be powered by an AC adapter purchased from Bruker. (This is different from the *battery* AC adapter.) ***To power the analyzer with an AC adapter –***

Step	Action
1	With the supplied cord, connect the AC adapter to a 90-240V AC wall outlet.
2	Connect the AC adapter to the analyzer's power port.

Maintaining power

The analyzer may be connected to the AC adapter prior to removing the battery so power to the unit is maintained.

Bruker brand only

Using another brand of adapter could damage the analyzer and voids the warranty.

1.6. Contacting Bruker

Email: support.hmp@bruker.com
Phone: +1 (509) 783-9850
Web: www.bruker.com/hhxrf
Address: 415 N. Quay Street
Kennewick, WA 99336 USA

2. Radiation Safety

Description — This section describes the radiation profiles of the S1 TITAN and TRACER 5^{i}, X-ray warnings, and safety recommendations.

Proper use — When the instrument is used properly, X-ray radiation from instrument poses no harm to the user or others. Use the instrument for only its intended use.

Each instrument — A radiation profile is measured on each instrument before it leaves the factory.

Safe use — Safe use of any XRF device is based on the principles of:

Principle	Description
Time	Managing the amount of time during which X-rays are produced.
Distance	• Keeping all parts of the user's body as far away from the X-ray producing nose as possible. • Pointing the analyzer away from others. • Keeping others away from the instrument during use.
Shielding	• Ensuring that the instrument is mechanically intact and sound. • When measuring small samples that might allow X-ray radiation to escape, use a benchtop or desktop stand and close the lid.

ALARA — Collectively, these practices are known as "As Low as Reasonably Achievable" (ALARA). Safe practice is further discussed during user training. For more details, see the *Radiation Safety Manual,* Bruker document 030.0011.

Occupational limits — The following table lists the annual exposure limit.

TRACER 5^{i}	Eye	Skin
Rem	15	50
Sieverts	0.15	0.5

2.1. Radiation Profile – S1 TITAN

Testing standards — The radiation profile reflects the radiological conditions during worst-case (high voltage, high power) instrument operation.

To establish radiation profiles –

- IEC 62495 (2011), *Nuclear instrumentation – Portable X-ray fluorescence analysis equipment utilizing a miniature X-ray tube* was used as a guide.
- The analyzer was set at the maximum voltage and current established for analysis, with a standard material sample over the examination window.
- Per the guide, measurement of stray radiation (leakage and scatter) was conducted at 10, 30, and 100 centimeter distances from the surface.
- Additionally, the geometric size of the X-ray beam and the open beam radiation dose equivalent rates were recorded at 0, 5, 10, 30, and 100 centimeters.

General testing conditions

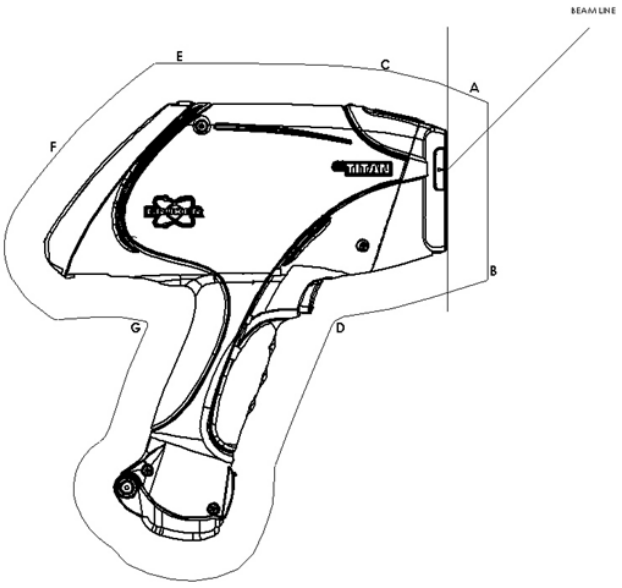
Radiation measurements were conducted –

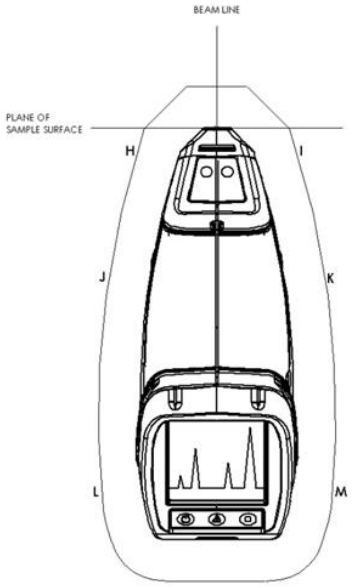
- Using a Thermo micro-rem low energy plastic scintillation radiation survey instrument.
- With the survey meter calibrated by the survey meter manufacturer.
- Referenced to the center of the detector volume.

Readings

Readings were taken at 50kV, 39 µA, with a Duplex 2205 sample over the examination window and rounded up to the nearest 5 µRem/hr value.

Displayed isodistance contours show the maximum value likely to be encountered in x10^{-6}Rem/hr (µrem/hr) or equivalently in x10^{-8} Sieverts/hr.



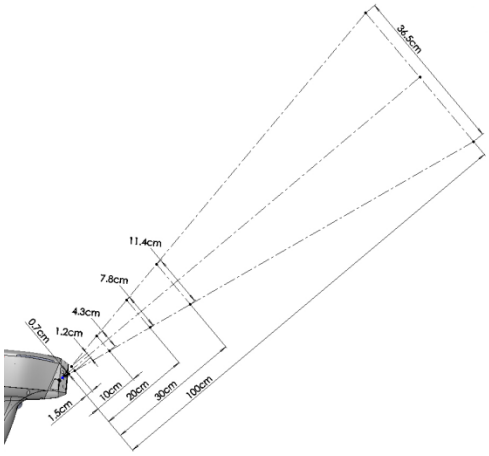


	Duplex µrad(µSieverts)/hr		
Location	10cm	30cm	100cm
A	≤45(0.45)	≤20(0.20)	≤5(0.05)
B	≤10(0.10)	Background	Background
C	≤5(0.05)	≤5(0.05)	Background
D	Background	Background	Background
E	Background	Background	Background
F	Background	Background	Background
G	Background	Background	Background
H	≤40(0.40)	≤5(0.05)	Background
I	≤40(0.40)	≤5(0.05)	Background
J	≤10(0.10)	Background	Background
K	≤10(0.10)	Background	Background
L	≤5(0.05)	Background	Background
M	≤5(0.05)	Background	Background

X-ray beam diameter

The following table provides specific beam diameters at selected distances from the beam port when no sample is in place.

Beam Port Distance in cm	**Beam Diameter** in cm
1.50	1.20
5	2.5
10	4.23
30	11.34
100	36.5



Testing conditions, open beam

Radiation measurements were conducted –

- Using a Thermo RadEye B20-ER meter corrected by results from NanoDots.
- With the survey meter calibrated by the survey meter manufacturer.

The dose at the Beam Port for the open beam measurement was extrapolated from the 5cm and 10cm results on a logarithmic scale as described in IEC 62495.

Distance vs. dose

	Worst-Case			
	50KeV, 39µA			
	Blank, No Filter			
Distance (cm)	**Dose** (Rem/hr)	**Dose** (Sieverts/hr)	**With Duplex** (µRem/hr)	**With Duplex** (µSieverts/hr)
Beam Port	223.7	2.237	1300	13.00
5 cm	119.0	1.190	289.0	2.890
10 cm	63.24	0.6324	144.5	1.445
30 cm	19.9	0.199	44.2	0.442
100 cm	1.96	0.0196	Background	Background
Eye / Skin Time to Limit	4.02 / 13.4 Minutes	4.02 / 13.4 Minutes		

2.2. Radiation Profile – TRACER 5^{i}

Testing standards

The radiation profile reflects the radiological conditions during normal and non-normal instrument operational conditions.

To establish radiation profiles –

- IEC 62495 (2011), *Nuclear instrumentation – Portable X-ray fluorescence analysis equipment utilizing a miniature X-ray tube* was used as a guide.
- The analyzer was set at three conditions established for normal analysis and two worst-case conditions with and without a sample over the examination window. For ease in viewing, three of the settings are shown below.
- Per the guide, measurement of stray radiation (leakage and scatter) was conducted at 10, 30, and 100 centimeter distances from the surface, as well as at 5cm.
- The geometric size of the X-ray beam and the open beam radiation dose equivalent rates were recorded at 5, 10, 30, and 100cm and extrapolated back to the surface.

General testing conditions

Radiation measurements were conducted –

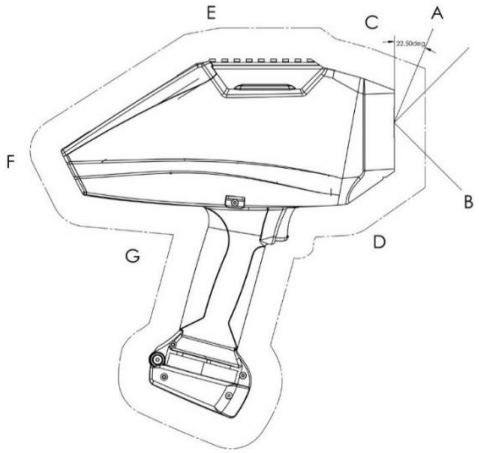
- Using a Thermo RadEye B20-ER meter.
- With the survey meter calibrated by the survey meter manufacturer.

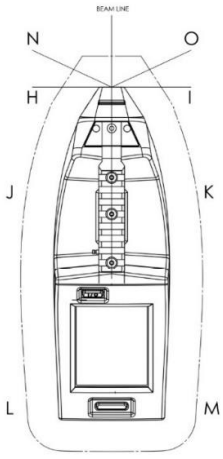
Readings

The instrument stray radiation profile was collected –

- Operating without a filter.
- With the larger 8cm collimator.
- At its effective maximum power (40keV and 99uA in the appendix) and maximum voltage (50keV and 39uA).
- At distances of 5, 10, 30, and 100cm.
- With and without a sample covering the opening at the nose of the instrument.
- Using a duplex (3mm thick) check sample.
- Operating at commonly used setting and corresponding filters for 50 (in the appendix), 40, and 15 keV.

Locations for the stray radiation profiles and results are shown in the figures and tables below, and the appendix. Correction factors to agree with results from 80 pkV, 2.9mm Al HVL NanoDots (TLD dosimeters) from Landauer were applied.





Worst-case 1 highest energy

Tests were performed with the following settings:

Setting Type	Value
Voltage (keV)	50
Current (µA)	39
Filter	Blank #2

At **5** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	2781439(27814.39)	83.1(0.831)
B	3272.7(32.727)	Background
C	726.1(7.261)	18.1(0.181)
D	1123.4(11.234)	21.7(0.217)
E	75.9(0.759)	Background
F	256.5(2.565)	Background
G	Background	Background
H	2351.6(23.516)	112.0(1.120)
I	1419.6(14.196)	292.6(2.926)
J	191.5(1.915)	47.0(0.470)
K	151.7(1.517)	Background
L	Background	Background
M	Background	Background

At **10** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	46204.9(462.049)	Background
B	1556.9(15.569)	Background
C	689.9(6.899)	Background
D	942.8(9.428)	Background
E	86.7(0.867)	Background
F	54.2(0.542)	21.7(0.217)
G	Background	Background
H	726.1(7.261)	39.7(0.397)
I	906.7(9.067)	90.3(0.903)
J	317.9(3.179)	79.5(0.795)
K	292.6(2.926)	68.6(0.686)
L	79.5(0.795)	65.0(0.650)
M	57.8(0.578)	75.9(0.759)

At **30** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	5869.6(58.696)	Background
B	386.2(3.862)	Background
C	386.2(3.862)	Background
D	386.2(3.862)	Background
E	132.7(1.327)	Background
F	209.3(2.093)	Background
G	Background	Background
H	356.7(3.567)	Background
I	312.5(3.125)	Background
J	312.5(3.125)	Background
K	165.1(1.651)	Background
L	106.1(1.061)	Background
M	59.0(0.590)	Background

At **100** cm

Location	Open Beam (µrad/hr)	Duplex (µrad/hr)
A	2980.1(29.801)	Background
B	128.4(1.284)	Background
C	163.5(1.635)	Background
D	134.3(1.343)	Background
E	99.2(0.992)	Background
F	119.7(1.197)	Background
G	61.3(0.613)	Background
H	61.3(0.613)	Background
I	113.8(1.138)	Background
J	81.7(0.817)	Background
K	61.3(0.613)	Background
L	61.3(0.613)	Background
M	90.5(0.905)	Background
N	61.3(0.613)	Background
O	131.3(1.313)	Background

Standard setting 1 alloy phase 1

Tests were performed with the following settings:

Setting Type	Value
Voltage (keV)	40
Current (µA)	5.2
Filter	Ti25/Al300mm #1

At **5** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	180582(1805.82)	Background
B	238.4(2.384)	Background
C	68.6(0.686)	Background
D	75.9(0.759)	Background
E	Background	Background
F	Background	Background
G	Background	Background
H	148.1(1.481)	7.2(0.072)
I	54.2(0.542)	7.2(0.072)
J	Background	Background
K	Background	Background
L	Background	Background
M	Background	Background

At **10** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	2387.7(23.877)	Background
B	39.7(0.397)	Background
C	Background	Background
D	Background	Background
E	Background	Background
F	Background	Background
G	Background	Background
H	18.1(0.181)	Background
I	57.8(0.578)	Background
J	Background	Background
K	Background	Background
L	Background	Background
M	Background	Background

At **30** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	268.3(2.683)	Background
B	Background	Background
C	Background	Background
D	Background	Background
E	Background	Background
F	Background	Background
G	Background	Background
H	Background	Background
I	23.6(0.236)	Background
J	Background	Background
K	Background	Background
L	Background	Background
M	Background	Background

At **100** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	163.5(1.635)	Background
B	Background	Background
C	Background	Background
D	Background	Background
E	Background	Background
F	Background	Background
G	Background	Background
H	Background	Background
I	Background	Background
J	Background	Background
K	Background	Background
L	Background	Background
M	Background	Background
N	Background	Background
O	Background	Background

Standard setting 2 alloy phase 2

Tests were performed with the following settings:

Setting Type	Value
Voltage (keV)	15
Current (µA)	11.35
Filter	Blank #2

At **5** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	4374.5(43.745)	Background
B	68.6(0.686)	Background
C	Background	Background
D	Background	Background
E	Background	Background
F	Background	Background
G	Background	Background
H	7.2(0.072)	Background
I	7.2(0.072)	Background
J	3.6(0.036)	Background
K	Background	Background
L	Background	Background
M	Background	Background

At **10** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	148.1(1.481)	Background
B	28.9(0.289)	Background
C	Background	Background
D	Background	Background
E	Background	Background
F	Background	Background
G	Background	Background
H	Background	Background
I	Background	Background
J	Background	Background
K	Background	Background
L	Background	Background
M	Background	Background

At **30** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	53.1(0.531)	Background
B	Background	Background
C	Background	Background
D	Background	Background
E	Background	Background
F	Background	Background
G	Background	Background
H	Background	Background
I	Background	Background
J	Background	Background
K	Background	Background
L	Background	Background
M	Background	Background

At **100** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	20.4(0.204)	Background
B	Background	Background
C	Background	Background
D	Background	Background
E	Background	Background
F	Background	Background
G	Background	Background
H	Background	Background
I	Background	Background
J	Background	Background
K	Background	Background
L	Background	Background
M	Background	Background
N	Background	Background
O	Background	Background

Testing conditions, open beam

Measurements of the main beam without a sample (open Beam) were collected at 5, 10, 30, and 100cm. The result at the sample position was extrapolated from measured results using a semi-log plot as described in IEC 62495. The main beam leaves the front of the instrument going forward and up at a 45-degree angle. Locations where the intensity of the main beam falls to 10% and 1% of the intensity at its center were recorded using the "Standard Setting 1 Alloy Phase 1" only. See the following figure.

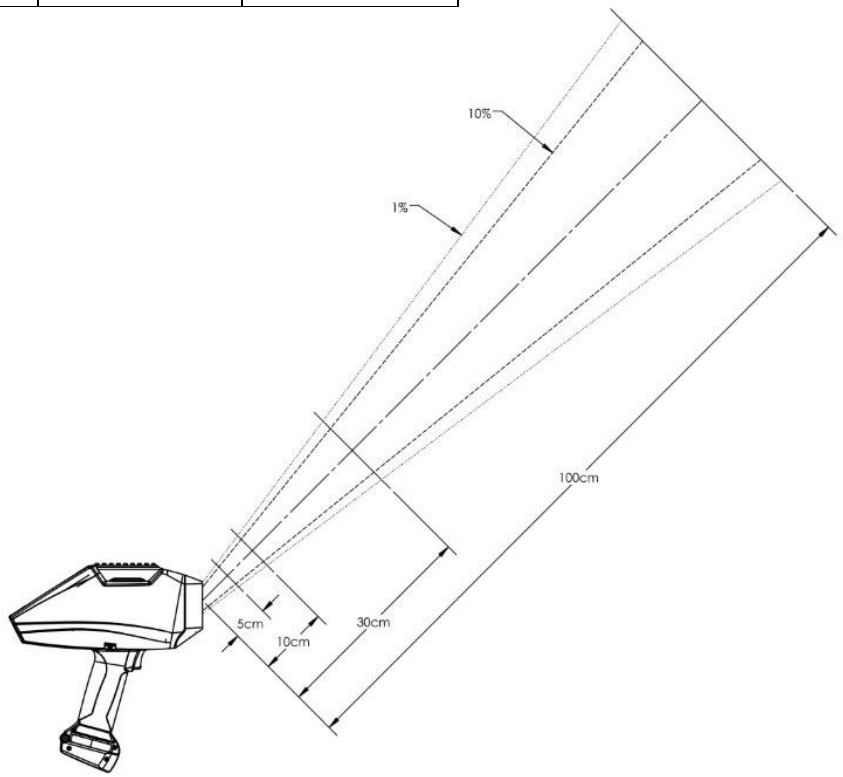
RadEye gives instantaneous results but is not accurate over large energy ranges. A second survey of the main beam was done with 80 pkV, 2.9mm Al HVL NanoDots (TLD dosimeters) from Landauer with a request to apply the correction factor for NIST H30 that most closely matches the X-rays in the beam for the setting used.

The NanoDots were exposed at the locations defined with the RadEye at 10, 30 and 100cm distances from the nose, for a measured time using the Standard Setting 1 Alloy Phase 1. NanoDots do not give instantaneous results but are more accurate. The RadEye was used to find the location of the center of the main beam. Its readings at that time were recorded so a comparison of the results from the NanoDots and RadEye could be made.

X-ray beam diameter

The following table provides specific beam diameters at selected distances from the beam port when no sample is in place.

Distance in cm	**1%** in cm	**10%** in cm
5	4.5	3.4
10	5.45	4.0
30	10.5	7.9
100	32.0	23.7



Correction factors

During testing, the following correction factors were used:

Distance	Nist H30 Correction Factor
5 cm	3.612
10 cm	3.612
30 cm	2.948
100 cm	2.919

Distance vs. dose in mRad

	Worst-Case 1 Highest Energy		Standard Setting 1 Alloy Phase 1		Standard Setting 2 Alloy Phase 2	
	50KeV, 39μA		40KeV, 5.2μA		15KeV, 11.35μA	
	Blank, No Filter		Ti25/Al300μm filter		Blank, No Filter	
In mRad	mRad		mRad		mRad	
Distance (cm)	Open Beam	With Sample	Open Beam	With Sample	Open Beam	With Sample
100	1839	Background	120	Background	34	Background
30	3320	0.027	1126	Background	398	Background
10	143697	0.220	9031	Background	2854	Background
5	163420	0.372	10656	Background	3161	Background
Surface	218936	0.632	14006		4310	
Eye / Skin Time to Limit	4.2 / 13.7 Minutes	2.7 / 9 Years	66 / 214 Minutes		214 / 696 Minutes	

Distance vs. dose in mSieverts

	Worst-case 1 Highest Energy		Standard Setting 1 Alloy Phase 1		Standard Setting 2 Alloy Phase 2	
	50KeV, 39μA		40KeV, 5.2μA		15KeV, 11.35μA	
	Blank, No Filter		Ti25/Al300μm filter		Blank, No Filter	
In mSieverts	mSieverts		mSieverts		mSieverts	
Distance (cm)	Open Beam	With Sample	Open Beam	With Sample	Open Beam	With Sample
100	18.39	Background	1.197	Background	0.339	Background
30	33.20	0.000265	11.262	Background	3.98	Background
10	1437.0	0.002204	90.308	Background	28.537	Background
5	1634.2	0.003721	106.563	Background	31.608	Background
Surface	2189.4	0.006324	140.06		43.100	
Eye / Skin Time to Limit	4.2 / 13.7 Minutes	2.7 / 9 Years	66 / 214 Minutes		214 / 696 Minutes	

2.3. Precautions

- Prior to using the instrument, read the *Radiation Safety Manual,* Bruker document 030.0011.
- Improper handling or use could result in radiation exposure.
- Do not allow anyone other than trained personnel to operate the analyzer.
- Only sell or transfer the analyzer to persons registered to receive it.
- Notify your regulatory agency upon the transfer or disposal of the analyzer.
- Comply with all instructions and labels provided with the device.
- Before pressing the trigger, be aware of the direction the X-rays travel.
- While measuring, do not place any part of your body, especially the eyes or hands, near the X-ray source.


- Do not hold a sample by hand to the window for analysis. Hold the window to the sample.

- Occasionally, a sample may not be reflective enough to trigger the proximity sensor. Place a piece of white paper or other reflective material between the sample and sensor. If necessary and allowed by law, a supervisor can deactivate the proximity sensor.
- To test small, thin, or low-density materials, such as plastic, wood, soil, paper, or ceramics, use the optional background plate, or benchtop or desktop stands.


- If required by a regulatory agency, wear an appropriate dosimeter.
- When in use, the device should be in the operator's possession at all times.
- Always store the instrument in a secure location.
- Keep the instrument cool and dry, including during transport.
- Know the instrument’s location at all times. Track all instruments, operators assigned to use them, locations they were used, storage, removal, and transportation.

If the analyzer is damaged, even if it remains operational, immediately –

1. Remove the battery pack and disconnect all power sources.
2. Notify Bruker at +1 (509) 783-9850, or support.hmp@bruker.com.

If the analyzer is lost or stolen, immediately notify –

1. The appropriate regulatory agency in the state or country in which the device was located.
2. Local law enforcement authorities.
3. Bruker at +1 (509) 783-9850, or support.hmp@bruker.com.

Never remove labels from the analyzer. This voids regulatory approval of the instrument.

Safety officer

If you have questions, check with your radiation safety officer or a Bruker radiation safety officer at +1 (509) 783-9850, or support.hmp@bruker.com.

2.4. Safety Features

Introduction

The instrument includes a fail-safe electronic control system consisting of primary and secondary interlocks. The control system is designed to –

- Aid in the safe use of the instrument.
- Prevent accidental exposure to radiation.
- Prevent the instrument from generating radiation in case of damage.

As with any safety control system, it cannot prevent injury from intentional misuse. Never attempt to disable or otherwise circumvent a safety control.

Power switch interlock

A push-button main power switch interlock controls power to all components. The switch must be activated before any other actions can be initiated. When power is activated, X-ray warning lights flash and, after a few seconds, the touch screen displays.

Password

Once the instrument initializes, a password is requested. The analyzer will neither operate nor generate X-rays without a valid password.

X-ray warning

Once the password is successfully entered, an X-ray radiation warning is displayed. To continue, press and release the trigger.

Proximity sensor

The proximity sensor detects when an object is within range of the examination window. X-rays can be generated only if the sensor detects an object.

Disabling the interlock

For some less favorable testing conditions, the proximity sensor interlock may need to be bypassed. See *Supervisor Manual*, Bruker document 030.0113. Some locales may not allow this.

When the instrument is logged out or powered off, the interlock is ***not*** automatically re-enabled.

Trigger interlock

X-rays are generated when the trigger is pressed. When using the manual trigger setting (see **SETTINGS Button**, page 35), the trigger must be continuously squeezed during measurements. When the trigger is released, X-ray generation stops.

Auxiliary trigger

In some countries, both hands are required to be on the instrument when X-rays are generated. The auxiliary trigger, built into each instrument, is part of that two stage implementation.

Minimum backscatter

During each measurement, the X-ray count-rate is continuously monitored. If the count-rate drops below the allowable threshold, as it would in the absence of a sample, X-ray generation discontinues, minimizing potential exposure.

X-ray warning lights

When X-rays are generated, red lamps along the instrument's side and beneath the screen illuminate. The lamp incorporates redundant LED elements for increased reliability. If more than two red LED elements fail, X-rays cannot be generated.

Buzzer

In Canada, when the trigger is pressed, an audible alarm indicates X-rays are being generated.

Automatic log off

If the analyzer remains idle for more than the time specified in Supervisor Mode (default 5 minutes), it logs off the user. Upon login, the previous session is restored.

Labels

Warning labels identify the analyzer as radiation producing. The manufacturer's plate underneath contains regulatory information. Do not tamper with or remove any labels.

TRACER 5^{i} hatch

To generate X-rays, the collimator must be installed and the hatch must be securely closed.

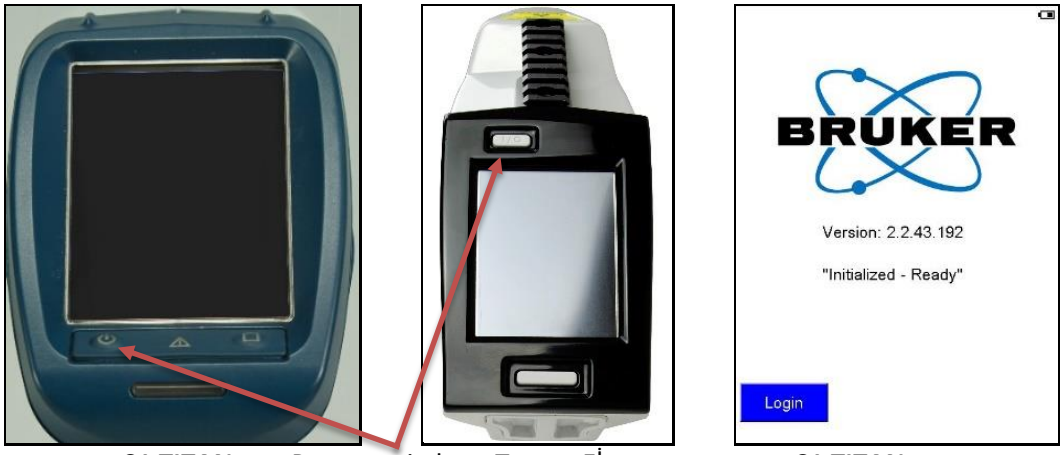
3. Starting Up

Powering on

To use the analyzer, it must be powered on and logged into.

To power on the analyzer –

Firmly press the power switch for one second.	The instrument takes several moments to initialize. It is ready when **Login** is displayed.

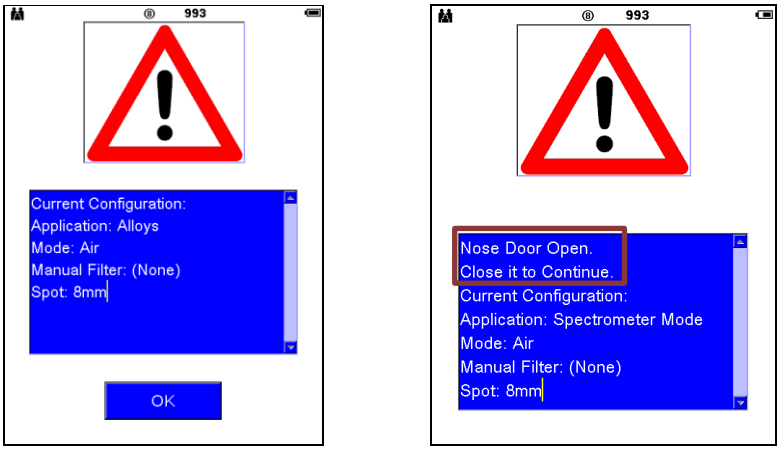


S1 TITAN Power switch **TRACER 5^{i}** **S1 TITAN screen**

TRACER 5^{i} screen

When a TRACER 5^{i} boots up, the following screen is displayed. It describes the current instrument configuration, including the last application used and hardware settings.

To continue, tap **OK**.



TRACER 5^{i} open hatch

If **OK** is not displayed, the hatch (little door in the nose) is open and the instrument is in an unsafe state. Close the hatch and the window closes.

Powering off

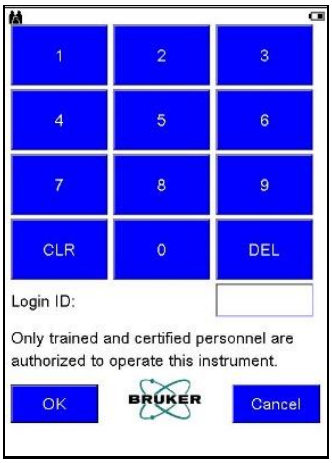
To turn off the analyzer –

Firmly press the power switch for one second.	The instrument powers down.

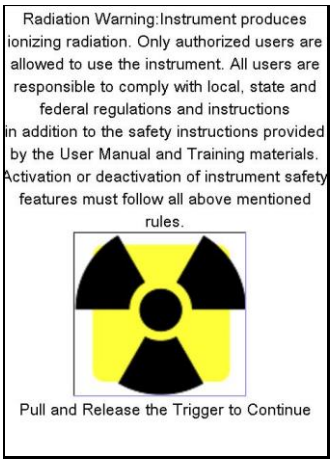
Log in

To log in –

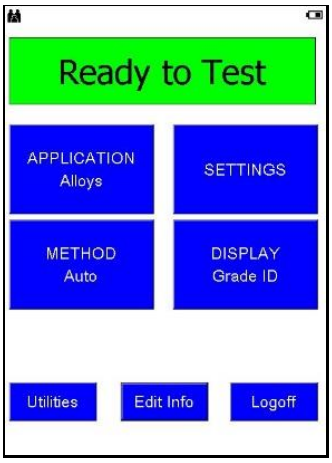
Step	Action	Result
1	After powering on the analyzer, tap **Login**.	The login screen is displayed.
2	Tap the password. The default is 12345. To delete one character at a time, from right to left, tap **DEL**. To clear the field entirely, tap **CLR**.	The field reflects the changes.
3	Tap **OK**.	The radiation warning screen is displayed.
4	Press and release the trigger.	The **Ready to Test** screen is displayed.



Log in screen



U.S. Radiation Warning



Ready to Test screen

Wrong password

If an invalid password is entered, the message **Password is invalid OK** is displayed. Tap **OK** to remove the message and try again.

Screen description

The **Ready to Test** screen –

- Displays information in the status bar.
- Provides access to menu trees from which all analyzer functions can be performed.

Status bar icons

The status bar, across the top of the screen, always displays the user icon (or for supervisor), and power status, but may show additional icons –

Icon	Description
Print	Print. See the *Accessories Manual*, Bruker document 030.0116.
GPS or GPS	GPS or No GPS. See the *Accessories Manual*, Bruker document 030.0116.
	A USB flash drive is installed.
1001	(TRACER 5^{i} only) Pressure in millibars. This is an example value only.

TRACER 5i collimator icons

ⓔ	③	⑧	ⓤ
Empty	3mm	8mm	Unknown

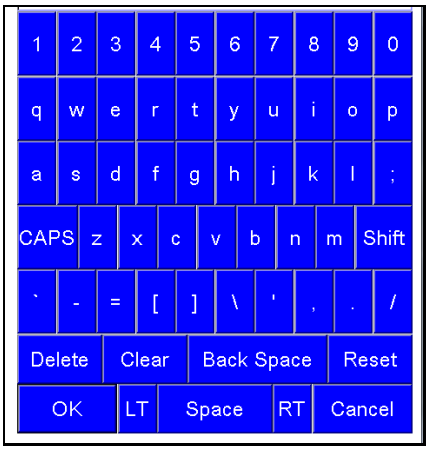
Power status

Power status is displayed in the status bar with one of the following icons –

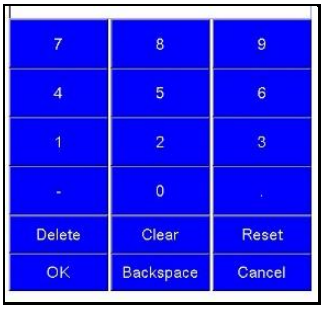
Icon	Status
	External power
	Battery at 100%
	Battery at 75%
	Battery at 50%
	Battery at 25%
	Empty battery
	Error connecting to battery

Keyboards

From several screens an alphanumeric or numeric keyboard may be accessed for data entry.



Alphanumeric keyboard



Numeric keyboard

Keys

Key	Function
CAPS	Toggles between all capital letters and all lower case letters.
Shift	Changes the case of only the next letter tapped.
Delete	Removes the character to the right of the cursor.
Clear	Removes all characters from the field.
Backspace	Removes the character to the left of the cursor.
Reset	Restores the field without changes.
OK	Saves changes and closes the keyboard.
LT and RT	Move the cursor left or right in the selected field.
Cancel	Closes without saving changes.

Typical use

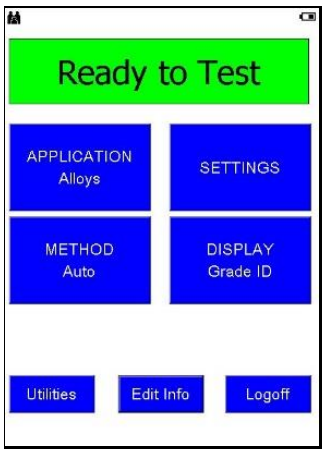
Typical use of the analyzer is –

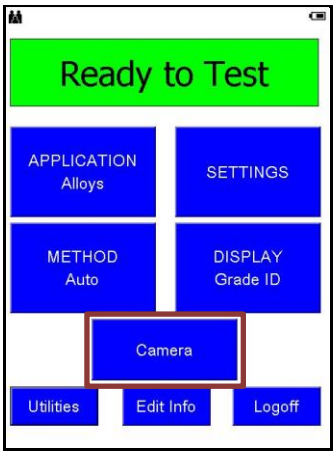
1. Name a sample (optional).
2. Scan the sample.
3. Review the results of the scan.
4. Repeat steps 2-4 as necessary.
5. Back up data.
6. Run report.

Main functions

The **Ready to Test** screen includes seven touch buttons, eight if a camera is installed –

Button name	Purpose
APPLICATION	Specifies the purpose for which the instrument is used.
METHOD	Specifies a calibration applicable to the selected application.
SETTINGS	Specifies trigger behavior and measurement duration.
DISPLAY	Specifies how measurement results are displayed.
CAMERA	If a camera is installed, accesses camera features.
Utilities	Accesses options to display results and back up data.
Edit Info	Allows measurement data to be named and described.
Logoff	Logs off the current user and displays the login screen.





Created files

When a measurement is taken, the following files are created and saved on the instrument:

Data Type	Description
Element concentrations	• Saves measurement data to Results.csv in the Bruker\Data folder, readable in Excel. What data is saved depends on the selected application. • Saved data can be viewed on the Results screen or with a Windows Compatible PC running Bruker Instrument Tools. See the *Bruker Toolbox User Guide*, document number 030.0119.
Spectra	• Saves data as a .pdz file and can include spectra, element concentrations, and more. • If copied to a PC, the file can be opened by Bruker Instrument Tools (see the *Bruker Toolbox User Guide*, document number 030.0119) to display spectra or generate a results report with grade IDs, limits results, or percent concentrations, depending on the selection from the **DISPLAY** screen.

4. APPLICATION Button

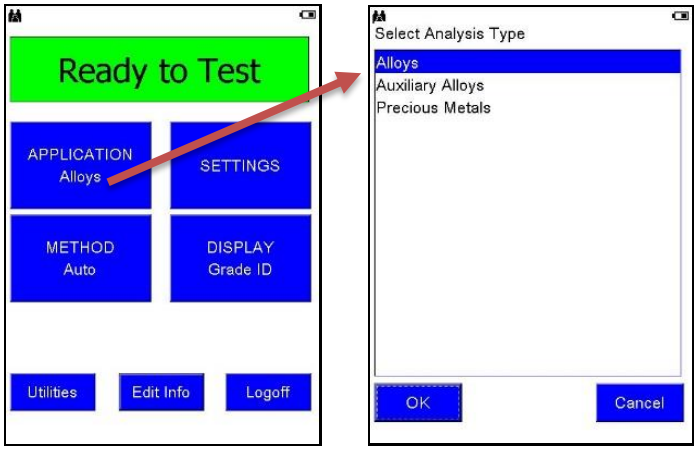
Description

The **APPLICATION** Button accesses application options. The intended use of the instrument determines which option to select.

Possible options

Available applications based on the purchased configuration can include –

- Standard alloys.
- Restricted materials.
- Mining.
- Precious metals.
- Other custom applications.



Selecting application

To select an application –

Step	Action	Result
1	From the **Ready to Test** screen, tap **APPLICATION**.	The **Select Analysis Type** screen is displayed.
2	Tap an application name.	The application name is highlighted.
3	Tap **OK**.	The **Ready to Test** screen is displayed with the name of the selected application on the **APPLICATION** button.

Spectro-meter mode

Applications have a preset voltage, current, and filter that cannot be changed. **Spectrometer Mode** allows those settings to be adjusted within limits. Spectra are recorded, but data are not analyzed.

Settings

For each application, settings can be defined. Settings include –

- Method
- Display options
- Phase durations (measurement times)
- Manual or automatic trigger

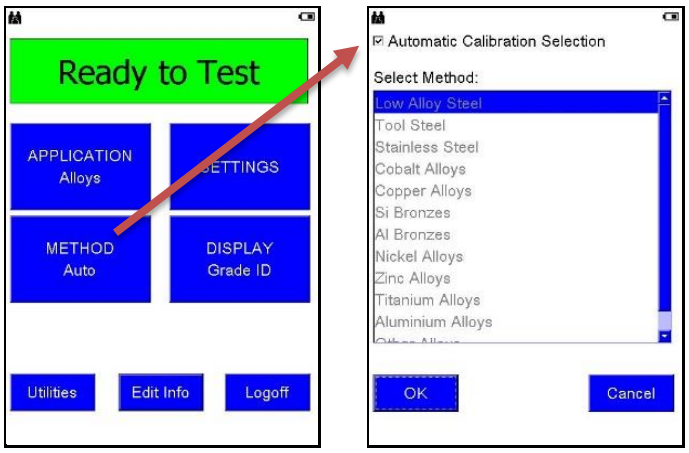
Whenever the application is changed, settings are changed to those defined for that application.

5. METHOD Button

Description

The instrument analyzes a sample using a specifically selected calibration, or method. The selection can be automatic or user-specified. Automatic is recommended.

The selected application determines available options in **METHOD**. For more information, see *Applications Module*, Bruker document 030.0115.



Selecting a method

***To select a method other than* Automatic Calibration Selection –**

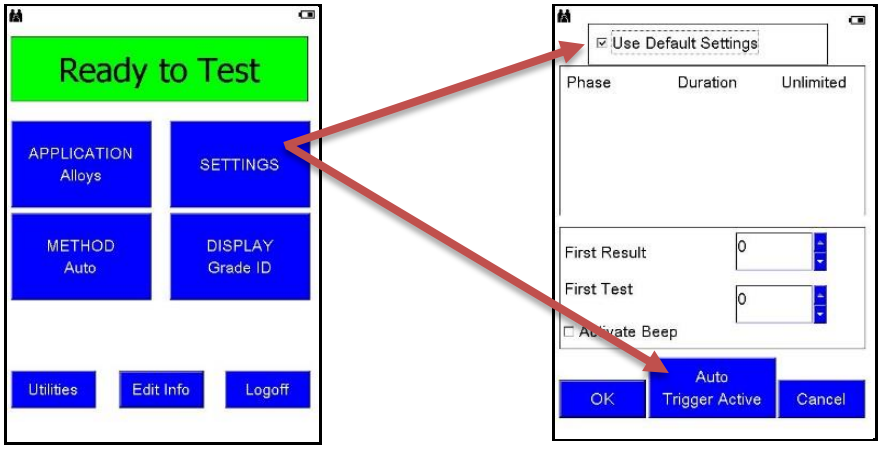
Step	Action	Result
1	From the **Ready to Test** screen, tap **METHOD**.	The **Select Method** screen is displayed.
2	Ensure that **Automatic Calibration Selection** box is not checked. If it is checked, tap it.	The box is empty.
3	Tap a method name.	The method name is highlighted.
4	Tap **OK**.	The **Ready to Test** screen is displayed with the name of the selected method on the **METHOD** button.

6. SETTINGS Button

Description

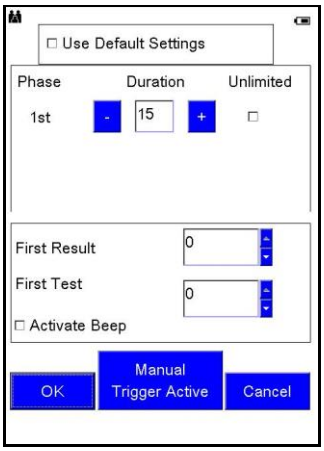
The options in **SETTINGS** define trigger behavior and multiple measurement times, or phases. The selected application determines available phases. For example, PMI can have one phase; Alloys has two phases, and Geo Exploration can have three phases.

The following screens are for applications other than **Spectrometer Mode**. For **Spectrometer Mode**, see page 37.

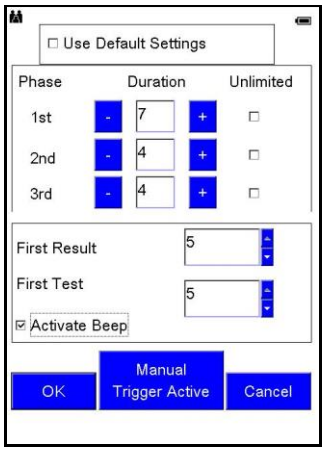


Default settings

Default settings are set at the factory, or by the supervisor, and determine the length of the measurement. If **Use Default Settings** is checked, phase options are not displayed.



Use Default Settings *un*checked, single phase



Use Default Settings *un*checked, multi-phase

Phases

Phase	Description
1st	A quick, high level assay used to refine settings for the subsequent phase.
2nd	A more specific and accurate assay based on first phase information.
3rd	An additional assay available for some applications.

Accuracy

The longer the measurement, the more accurate the results. Every second to several seconds of a measurement, depending on the application, displayed results are updated.

Phase length

To manually set the length of each phase –

Step	Action	Result
1	From the **Ready to Test** screen, tap **SETTINGS**.	The **SETTINGS** screen is displayed.
2	Ensure that **Use Default Settings** box is not checked. If it checked, tap it.	Phase options are displayed.
3	Ensure the box below **Unlimited** is unchecked.	The box is empty and fields previously grayed out are available.
4	Set each phase duration in seconds by tapping either the minus sign (**-**) or the plus sign (**+**) to decrease or increase, respectively, the measurement duration. OR Tap the field.	The field reflects the number change. OR A numeric keyboard is displayed.
5	On the keyboard, tap a number and **OK**.	The keyboard is removed and the field reflects the number change.
6	For subsequent phases, repeat steps 3-5. ***To disable subsequent phases***, set duration to 0.	
7	Tap **OK**.	The Settings are saved and the **Ready to Test** screen is displayed.

One phase

If a method does not use multiple phases, only one phase is displayed.

Unlimited

Unlimited indicates the measurement continues while the trigger is pressed and ends when the trigger is released. It is not a timed measurement but is limited to 300 seconds.

If **Unlimited** is checked for a phase, the instrument will NOT use that phase or additional phases.

First result

The interval in seconds between the start of an assay and when the **First Result** displays can be set manually. This assures that results from shorter, less accurate test times are not displayed.

First test

The time can be set manually before the **First Test** displays and records. Longer test times are more accurate. **First Test** settings must always be as long as, or longer, than **First Result** times.

Results of the first test are compared to the Grade Library and, if a match is found, the grade ID is displayed.

Activate beep

This checkbox determines if an audible alarm sounds when a grade match is found.

Trigger options

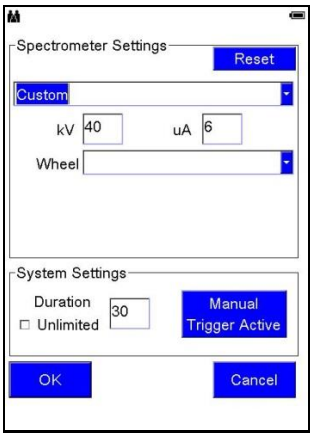
Manual Trigger Active – The instrument operates while the trigger is pressed or until safety criteria are exceeded.

Auto Trigger Active – The measurement begins when the trigger is pressed and released. Analysis time is controlled by defined phase durations. The measurement can be stopped at any time by pressing and releasing the trigger again. This option is not available in all markets.

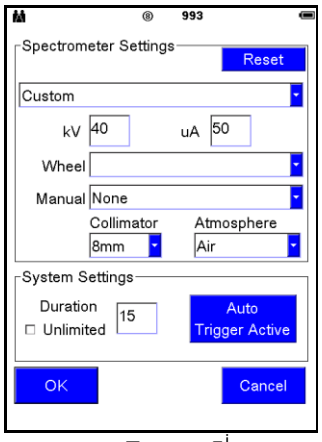
7. SETTINGS Button – Spectrometer Mode

Description

If **Spectrometer Mode** was selected under **APPLICATION**, then under **SETTINGS** one of the following screens is displayed, depending on instrument type.



S1 TITAN

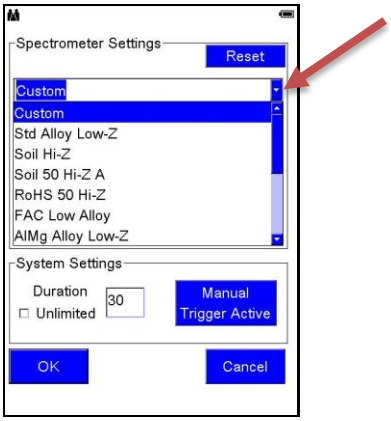


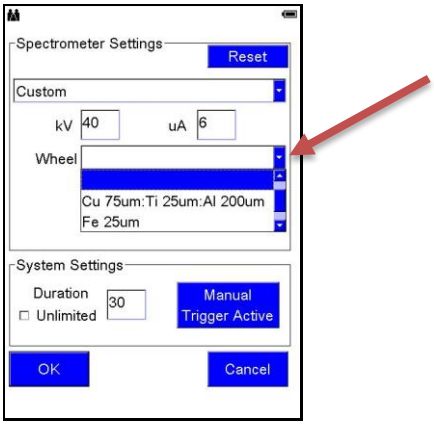
TRACER 5^{i}

Standard settings

To select a standard spectrometer setting –

Step	Action	Result
1	From the **Ready to Test** screen with application **Spectrometer Mode** selected, tap **SETTINGS**.	The **Spectrometer Settings** screen is displayed.
2	***To select a defined setting***, tap the down pointing triangle below **Reset**.	A dropdown list is displayed.
3	Tap a selection.	The setting name is displayed in the field and the **kV** and **µA** fields reflect appropriate settings.
4	Tap the down pointing triangle to the right of **Wheel**, scroll down if necessary, and tap a filter name. Note that S1 TITAN models 200 and 500 do not have **Wheel** displayed.	The filter name is displayed.
5	Define **System Settings** as necessary.	
6	Tap **OK**.	Settings are saved and the **Ready to Test** screen is displayed.





Custom settings

To customize spectrometer settings –

Step	Action	Result
1	From the **Spectrometer Settings** screen, tap the field next to **kV** (kilovolts) or **µA** (microamp).	The numeric keyboard is displayed.
2	Tap a value and tap **OK**.	The keyboard is removed and the field reflects the change.
3	Repeat steps 1 and 2 for the other field.	

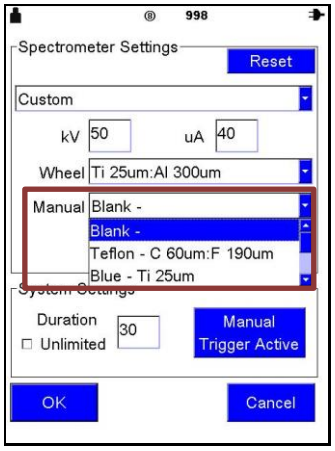
Reset

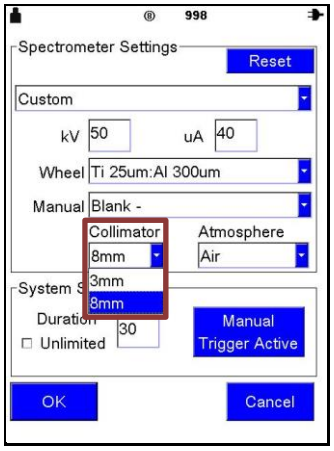
To restore values, tap **Reset**. Original values are displayed.

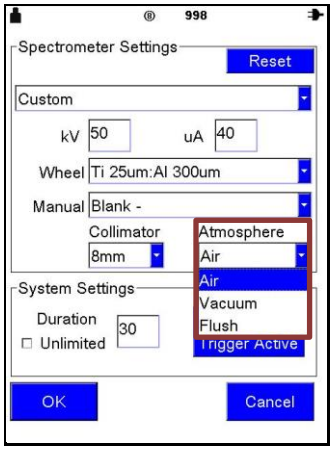
Additional TRACER 5^{i} settings

The TRACER 5^{i} has the described setting options plus the following. These settings are required to tell the instrument which hardware options are installed so the data is recorded in measurement files.

Option	Lists options for…
Manual	Filters that can be manually installed.
Collimator	Collimators that can be manually installed. (If a collimator is installed but another is selected here, the installed collimator number in the status bar is displayed in red instead of black.)
Atmosphere	Atmospheric measurement environments: **Air** – normal use. **Vacuum** – setting for use with a vacuum pump to eliminate air between the sample and detector. **Flush** – setting for use with a Helium flush to replace air between the sample and detector.





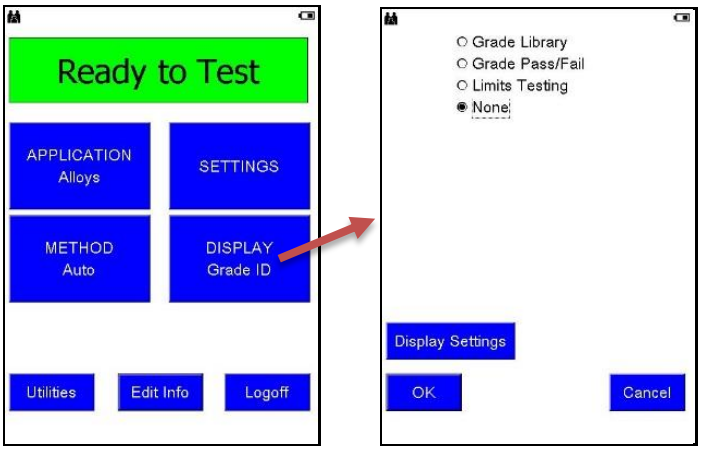


8. DISPLAY Button

Description

How measurement results are displayed is determined by options selected under the **DISPLAY** button.

For information on **Grade Library** and **Grade Pass/Fail** options, see the *Alloy Module*, Bruker document 030.0114.



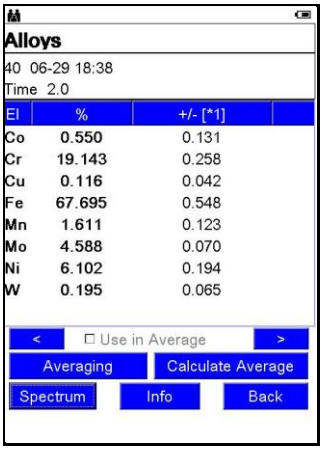
Limits Testing

Limits Testing displays measurement results against minimum and maximum values. For more information, see *Restricted Materials Screening Application Guide*, Bruker document 030.0117 and *Soil Application Guide*, Bruker document 030.0118.

None

Selecting **None** provides a sample analysis without a comparison to a grade library. The **Results** screen displays –

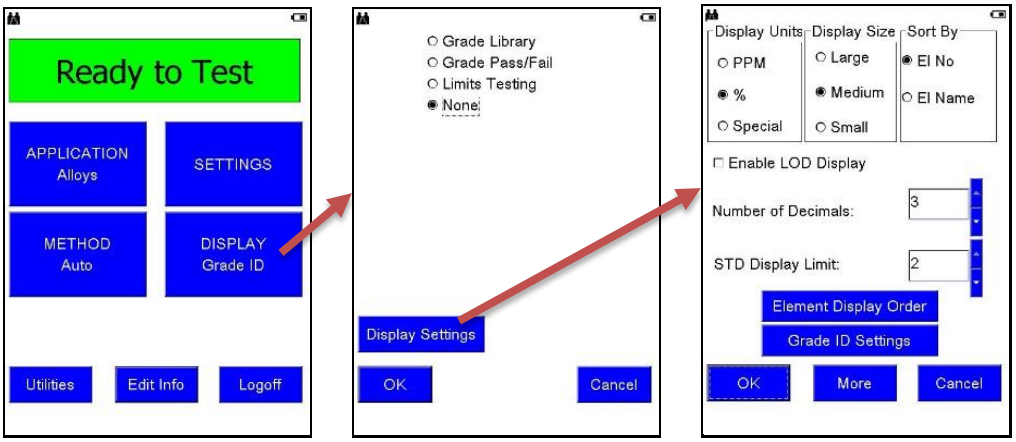
- Index number.
- Date and time of the assay.
- Assay duration in seconds.
- Detected elements.
- Element percentages or PPM and their statistical +/- error range. (The longer the measurement, the smaller the +/- error range.)



8.1. Display Settings

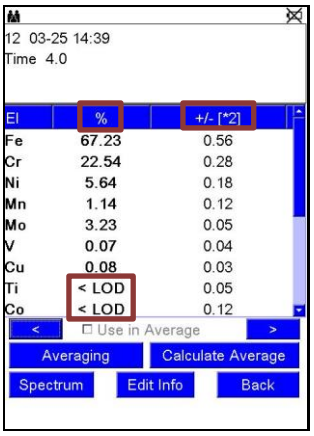
Description

How measurement results are displayed is specified on the **Display Settings** screen.



Description of options

Option	Description
Display Units	Measurement results can be displayed in – • **PPM** – Parts per million. • **%** – Percent. • **Special** – An application-defined setting; or as defined in EasyCal. See *EasyCal – a Comic Strip*, Bruker document 030.0101.
Display Size	The font size on the Results screen.
Sort By	Results are sorted by element atomic number (**El No**) or alphabetically by element name (**El Name**).
Enable LOD Display	Results include analyzed elements with an assay less than the limits of detection (LOD). The LOD is defined as n*STD, where n is a number from 1 - 5 and STD is standard deviation.
Number of Decimals	The number of digits displayed to the right of the decimal point of a percent value.
STD Display Limit	The number of standard deviations on the Results screen. The error displayed with an assay is n*STD. If the assay is less than n*STD and **Enable LOD Display** is checked, the assay is displayed as <LOD.



8.2. Element Display Order

Description

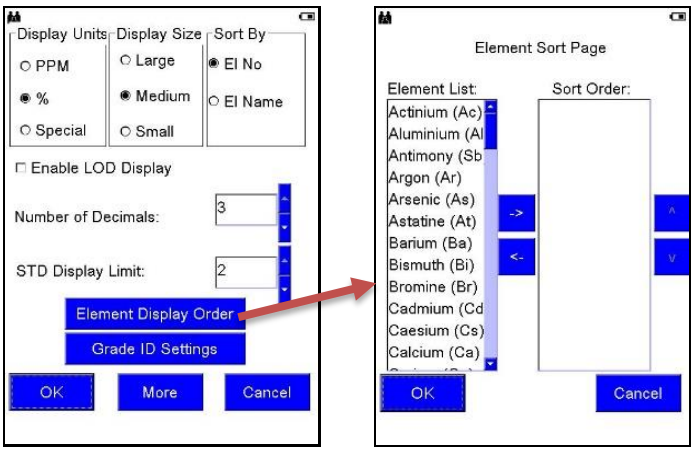
Element order can be customized, rather than sorting by element atomic number or alphabetically by element name.

Note that results will list only those elements selected.

Sorting one at a time

To customize the element order on the Results screen* one *element at a time –

Step	Action	Result
1	Under **DISPLAY** and then **Display Settings**, tap **Element Display Order**.	The **Element Sort Page** is displayed.
2	Under the **Element List**, tap the name of the first element to be displayed in a result list.	The selected element name is highlighted.
3	Tap the right pointing arrow.	The selected element name is moved to the **Sort Order** list.
4	Populate the **Sort Order** list with element names in the desired order by repeating steps 2 and 3.	The **Sort Order** list is populated with element names in the order names are moved over.
5	To move an element name back to the **Element List** on the left, tap the name under **Sort Order** and then the left pointing arrow.	The selected element name is moved back to the **Element List**.
6	To save the modified sort order, tap **OK**.	When assays are taken, results are listed in this order.



Sorting multiple at a time

To customize the element order on the Results screen **multiple** ***elements at a time –***

Step	Action	Result
1	Under **DISPLAY** and then **Display Settings**, tap **Element Display Order**.	The **Element Sort Page** is displayed.
2	Under the **Element List**, tap multiple element names to be displayed in a result list.	Selected element names are highlighted.
3	Tap the right pointing arrow.	The selected element names are moved to the **Sort Order** list in alphabetical order.
4	To change the order of elements in the **Sort Order** column, tap an element name.	The element name is highlighted.
5	To move the element name up or down in the list, tap the up pointing or down pointing carat on the right.	The selected element name moves up or down accordingly.
6	To save the modified sort order, tap **OK**.	When assays are taken, results are listed in this order.

8.3. Grade ID Settings and More

Grade ID Settings

Options on the **Grade ID Settings** screen affect how measurement results are displayed. See the *Alloy Module*, Bruker document 030.0114.

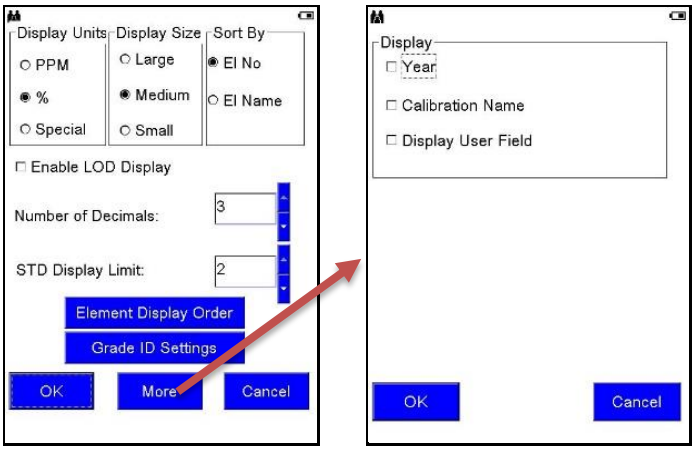
More

To display additional options to customize for the Results screen – from the **Display Settings** screen, tap **More**.

Year – In addition to the date, displays the year of the measurement.

Calibration Name – Displays the name of the method.

Display User Field – Displays the value of the first user field. See **Edit Info Button**, page 46.

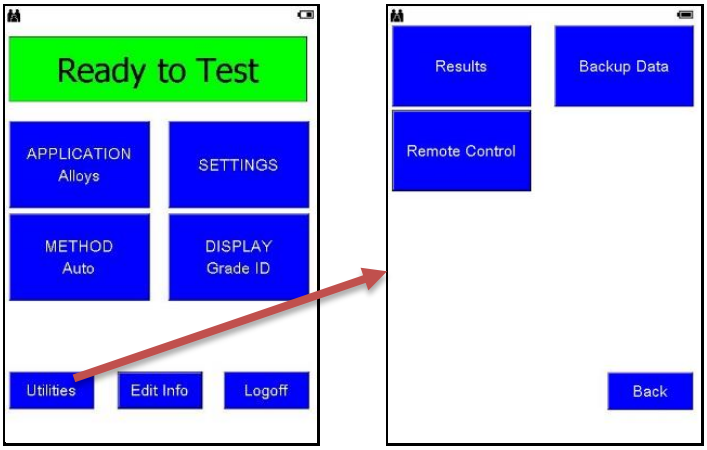


9. Utilities Button

Description

The **Utilities** button accesses options to –

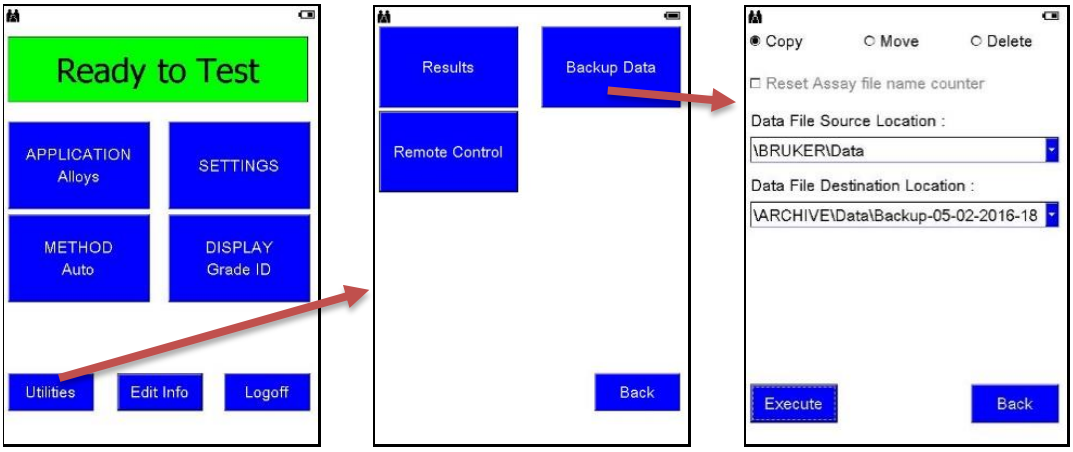
- Display **Results** of measurements. See **Results**, page 48.
- **Back up Data** by copying or moving, with the option to delete.
- Allow **Remote Control** of the instrument.



9.1. Back up Data

Description

This option under **Utilities** provides the ability to –
Copy – copies data to an external location, leaving data in the instrument memory.
Move – copies data to an external location and deletes data stored in the instrument.
Delete – removes data from the instrument memory without copying.



Reset counter

When the **Reset the Assay file name counter** box is checked, if data are moved or deleted, the index counter resets to 1. This function is not available when **Copy** is selected.

Location fields

Data File Source Location and **Data File Destination Location** fields cannot be edited. For any additional available options, tap the drop down arrow.

Destination location

Data from the instrument is copied to a –

USB flash drive,	if a USB flash drive is installed.
New folder in the instrument memory,	if ***no*** USB flash drive is installed.

Flash drive recom-mendations

Subject	Description
Large drives	Large flash drives take longer to be recognized.
Powering on	If a flash drive is installed, instrument initialization time increases.
Files on new drives	New flash drives may contain manufacturer files and programs unnecessary for Bruker use. Use them at your own risk.
Viruses	Flash drives can spread viruses. Drives included with the analyzer are new and guaranteed virus-free. PCs used with the instrument should have up-to-date antivirus software.

Optimize performance

To optimize analyzer performance and reduce initialization time, data should be periodically removed from the instrument and the installed USB flash drive.

PC

Data in other locations on the instrument can be moved to a PC where results can be viewed via Bruker Instrument Tools. See the *Bruker Toolbox User Guide*, Bruker document 030.0119.

Copy/move

To copy or move data from the instrument to an external location –

Step	Action	Result
1	Tap the **Utilities** button and **Backup Data**.	The **Backup Data** screen is displayed.
2	Tap an option to **Copy** or **Move**.	
3	If moving, check the **Reset Assay file name counter** box, if desired.	The box is checked.
4	Tap the **Data File Source Location** drop down arrow to view possible source files and select one.	
5	Tap the **Data File Destination Location** drop down arrow to view possible destinations and select one.	
6	Tap **Execute**.	After files are copied or moved, the **Utilities** screen is displayed.

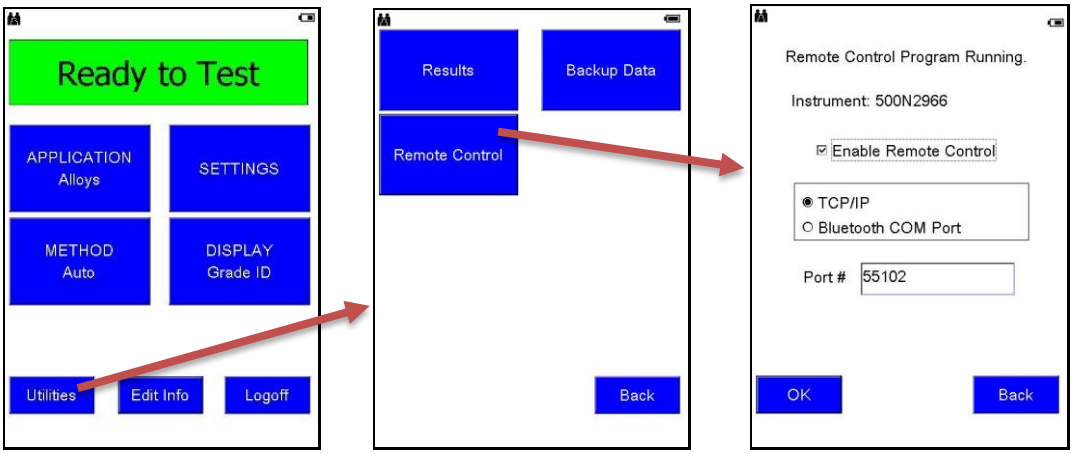
Delete

To delete all assays from the selected **Data File Source Location** ***on the instrument*** **–** tap **Delete** and **Execute**. The measurements are deleted and the **Utilities** screen is displayed.

9.2. Remote Control

Description

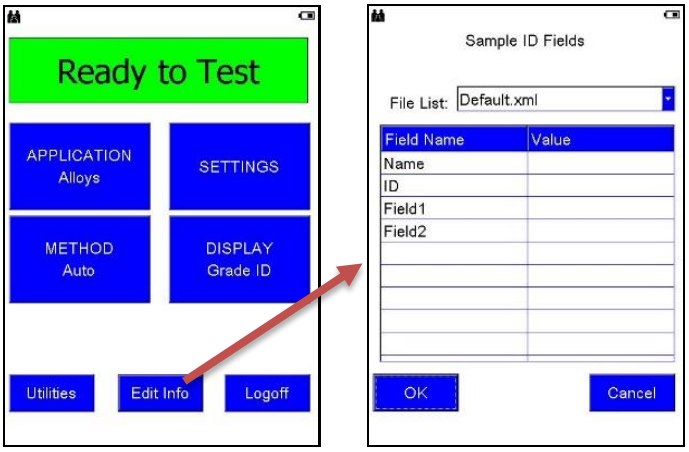
When the **Enable Remote Control** box is checked, the analyzer can be operated remotely from a PC. For instructions, See the *Bruker Toolbox User Guide*, Bruker document 030.0119.



10. Edit Info Button

Description

Before a measurement is taken, an assay can be named and described. This information is saved to the Results.csv file and the <index>-<Application>.pdz (e.g., 00456-Alloys.pdz) spectrum file.



Sample ID

Whatever is entered in the first field under **Value** is what is displayed in the **SampleId** field in Results (and the **Name** field in **Report Generator** in Bruker Instrument Tools). If **Operator** is the first value, then the second value is used for **SampleId**.

File List

More than one source file may be available with different or additional **Field Names**.

To access additional source files, tap the downward pointing arrow to the right of the **File List** field. A dropdown list is displayed. Tap a selection.

Labeling an assay

To label subsequent assays –

Step	Action	Result
1	From the **Ready to Test** screen, tap the **Edit Info** button.	The **Sample ID Fields** screen is displayed.
2	Double tap a field under **Value**.*	A keyboard is displayed.
3	Enter appropriate information.	The field reflects the change.
4	Tap **OK**.	The keyboard is removed and information is saved in the field.
5	Repeat steps 2 - 4 as necessary.	
6	To save changes to the **Sample ID Fields** screen, tap **OK**.	The **Ready to Test** screen is displayed and subsequent assays are labeled accordingly until these settings are changed.

*List option

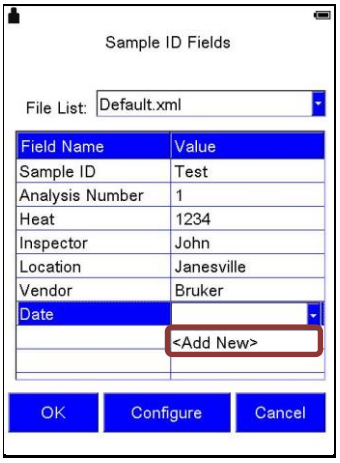
If the **List** checkbox, available in Supervisor Mode, is checked for the applicable **Field Name**, when a field under **Value** is tapped once, a dropdown list is displayed, rather than a keyboard. Select from the list or **<Add New>**, as described below.

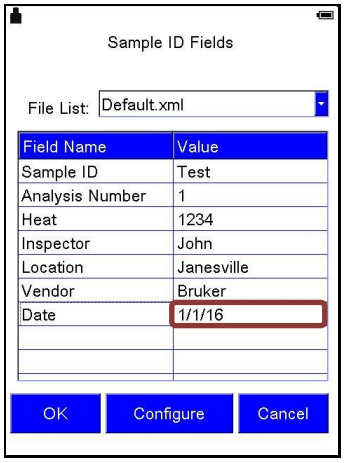
Adding values with <Add New>

Note that once a value is added, it cannot be removed from the list.

***To add values to a dropdown list if the* List *checkbox available in Supervisor Mode is checked for the applicable* Field Name –**

Step	Action	Result
1	From the **Sample ID Fields** screen, tap a **Value** field.	A dropdown list with **<Add New>** is displayed.
2	Tap **<Add New>**.	The keyboard is displayed.
3	Enter a value and tap **OK**.	The new value is displayed in the **Value** field.
4	Tap **OK**.	The change is saved and the **Ready to Test** screen is displayed.





11. Results

Description

Results of a measurement are displayed two ways –

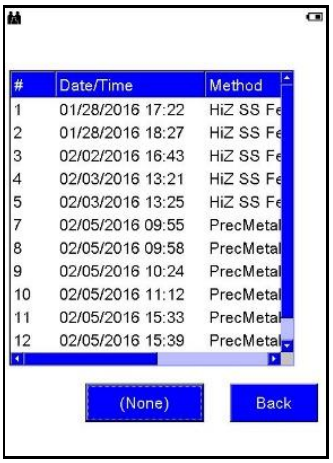
- During and immediately after a scan.
- Through the **Utilities** -> **Results** buttons.

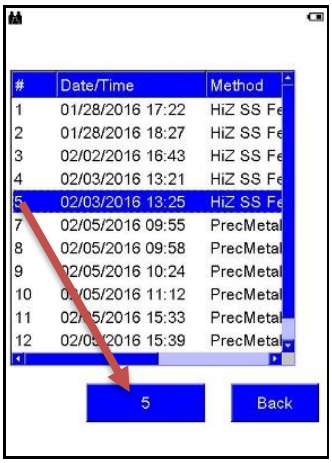
The actual screen configuration varies depending on the selected method and settings defined under **DISPLAY**. See **DISPLAY Button**, page 39.

Past results

To review the results of a past analysis –

Step	Action	Result
1	From the **Ready to Test** screen, tap the **Utilities** button.	The **Utilities** screen is displayed.
2	Tap **Results**.	A table showing every assay stored in memory, in reverse order of Index number (most recent measurement at the top), is displayed.
3	Touch scroll up and down, left and right, to see all assay names. Tap a measurement to review.	The sample is highlighted.
4	At the bottom of the screen, tap the sample's index number.	Results of the sample's assay are displayed.





Display toolbar

To remove the lower toolbar, double tap the center of the screen. To display it again, double tap again.

Toolbar displayed

Toolbar removed

1. ID match — If the sample matches grade IDs in the library, up to three matching IDs are displayed. If not, the application name is displayed.

2. Assay information — The following information is provided for quick reference –

- Index number of the sample.
- The date and time the assay was measured.
- Length of the measurement in seconds.
- If averaging, the index numbers of the selected assays.

3. Columns

Column Heading	Description
El	Element symbol.
Min and Max	Minimum and maximum percent allowed according to the grade library. Note that some applications do not use a grade library and **Min** and **Max** are not displayed.
%, PPM, or Special	Amount of the element in either percent, parts per million, or units defined in EasyCal. See *EasyCal – a Comic Strip*, Bruker document 030.0101.
+/- [*n]	Standard deviation.

Sorting — ***To sort data in a column in descending or ascending order –*** tap a column heading.

4. < and > — ***To view different assays ordered by index number –*** use the back and forward options, **<** and **>**.

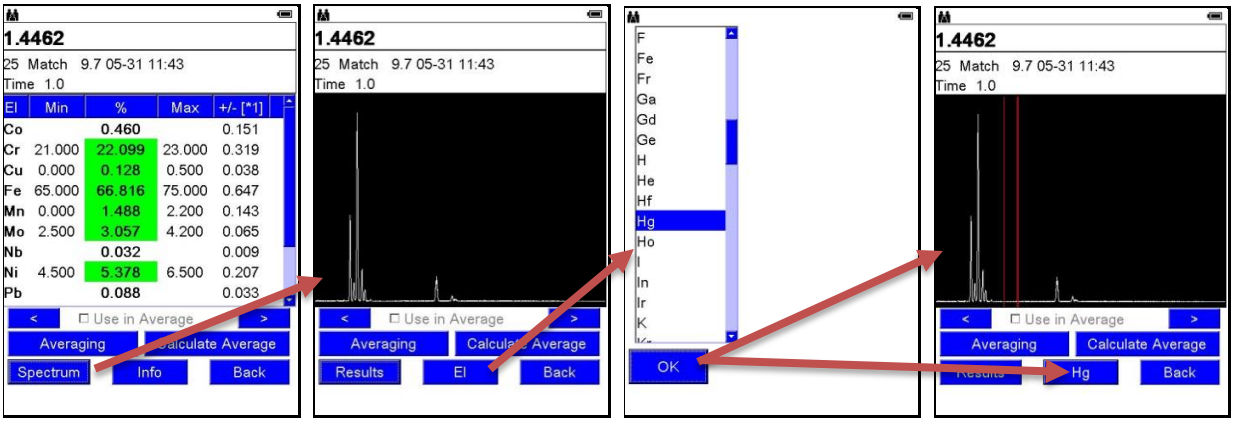
5. Info — ***To display the assay's name, ID, and other information, if applicable –*** tap **Info**. This information cannot be edited.

11.1. Spectrum

Elemental spectrum

To view the spectrum and specific elements for the selected assay –

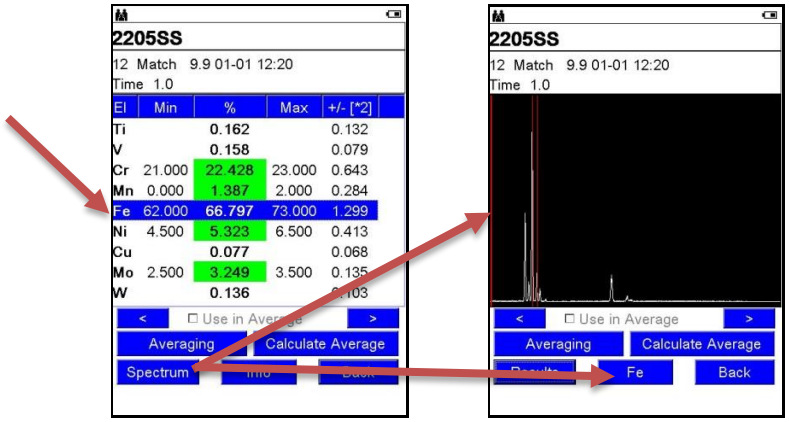
Step	Action	Result
1	From the **Results** screen of a specified assay, tap **Spectrum**.	The **Spectrum** screen is displayed.
2	Tap **El**.	A list of element symbols is displayed.
3	Scroll down to see all elements. Tap one.	The element is highlighted.
4	Tap **OK**.	The spectrum is displayed with one or more red vertical bars identifying peaks for the selected element. **El** is now replaced with the symbol of the selected element.
5	***To identify a spectrum peak***, tap it.	One or more red vertical bars is displayed and the element symbol is displayed on the **El** button.



Alternative

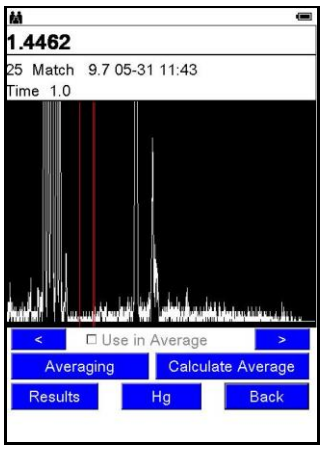
To view the spectrum and specific elements for the selected assay an alternative way –

Step	Action	Result
1	From the **Results** screen of a specified assay, tap an element.	The element row is highlighted.
2	Tap **Spectrum**.	The spectrum is displayed with that element's peaks noted by red vertical bars. The selected element's symbol is displayed on the **El** button.



Vertical enhancement

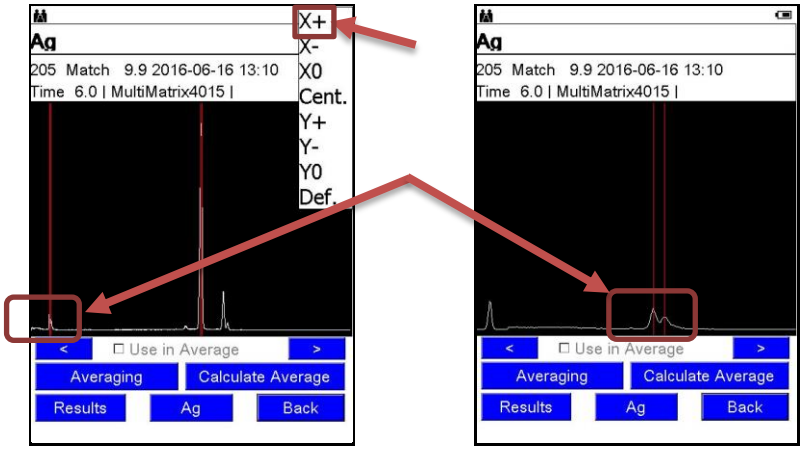
To exaggerate peaks, tap the spectrum and drag upward.



Axis toolbar

The axis toolbar manipulates the spectrum display to better view details. ***To display it***, tap the screen and hold.

Option	Description
X+	Stretches the x-axis (keV) scale to zoom in on the spectrum. To view the entire spectrum, tap and drag horizontally.
X-	Compresses the x-axis (keV) scale to zoom out from the spectrum.
X0	Re-centers and returns the spectrum to the original x-axis scale.
Cent.	Re-centers the spectrum on both the x- and y-axes.
Y+	Stretches the y-axis (count rate) scale.
Y-	Compresses the y-axis (count rate) scale.
Y0	Returns the spectrum to the original scale along the y-axis.
Def.	Restores the spectrum to its default setting; the spectrum is re-centered and the original scale along both axes is restored.



11.2. Averaging

Averaging

Values from selected measurements can be averaged. Assays can be selected individually or by default.

Note: Only assays taken with the same method can be averaged.

Average results

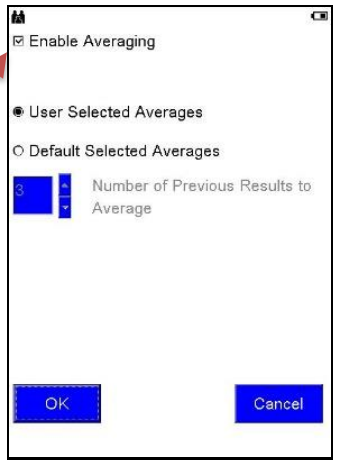
Average results are –

- Calculated for elements and +/- values. If an element is missing from one of the averaged results, the value is 0. For example, results of three assays are averaged. Al is detected at 60%, 60%, and 0%. The average is 40%.
- Analyzed for Grade Matching and Pass/Fail.
- Saved in the results list and in Results.csv.

Enable averaging

When **Enable Averaging** is checked for an assay –

- Averaging is available to all assays stored in the Results.csv file.
- The **Use in Average** and **Calculate Average** options are displayed on the Results screen.
- The ability to average remains in effect until **Enable Averaging** is unchecked**.**



Screen options when **Enable Averaging** is ***un***checked

Screen options when **Enable Averaging** is checked

To enable

To enable assays to be included in an average calculation –

Step	Action	Result
1	If a Results screen does not display **Use in Average**, tap **Averaging**.	The **Averaging** screen is displayed.
2	Tap the **Enable Averaging** checkbox.	A checkmark is displayed.
3	Tap **OK**.	The Results screen is displayed and any assay stored on the instrument can be used in an average calculation.

User selected

***To average multiple* user selected *assays* –**

Step	Action	Result
1	From the Results screen, tap **Averaging**.	The **Averaging** screen is displayed.
2	Tap **User Selected Averages**.	The radio button is filled.
3	Tap **OK**.	The Results screen is displayed and any assay stored on the instrument can be used in a user selected average calculation.
4	Tap the **Use in Average** checkbox for each assay included in the average calculation. ***To display additional assays*** to be used in the average calculation, use **<** and **>** to flip through previous and subsequent assays.	A checkmark is displayed.
5	When all desired assays have checked **Use in Average** boxes, tap **Calculate Average**.	Index numbers of assays used in the calculation are listed in the status bar (e.g. **AVG 8 9 11 15**). Their calculated average is displayed and stored in Results.csv.

Default selected

***To average* Default Selected *assays* –**

Step	Action	Result
1	Display the assay with the highest index number of the assays to be part of an average calculation. For example, to average assays 7 - 9, display index number 9.	
2	Tap **Averaging**.	The **Averaging** screen is displayed.
3	Tap **Default Selected Averages**.	The radio button is filled.
4	Set the number of previous assays to be included in the average calculation by tapping either the up or down pointing triangle to increase or decrease, respectively, the value. OR Tap the field.	The field reflects the change. OR A numeric keyboard is displayed.
5	Tap a number and **OK** to close the keyboard and **OK** to accept the settings.	The selected assay is displayed again.
6	Tap **Calculate Average**.	The average values of the number of assays specified is displayed. Assays part of the average are identified in the status bar and in Results.csv by index number. For example, if the **Number of Previous Results to Average** is **3** and the starting index number is 9, **AVG 7 8 9** is displayed.

Averaged results cannot be averaged

Results of an average calculation cannot be included in a subsequent average calculation. This means for –

- **User Selected Averages** – The **Use in Average** option is not available for results of an average calculation.
- **Default Selected Averages** – A current average does not include values from any averages falling within the specified range of assays to be averaged.

Example

For example, if –

- The **Number of Previous Results to Average** is **3.**
- The starting index number is 9.
- Index number 7 is a previously average set of results.

The specified range backward skips index number 7 and instead includes index number 6. **AVG 6 8 9** is displayed in the status bar.

12. Quality Check

Description — This test verifies assays measured and recorded on the instrument are accurate.

Process — ***To verify that your instrument is calibrated correctly –***

Step	Action
1	Set **APPLICATION** to **Alloys** and **Method** to **Automatic Calibration Selection**.
2	From the **Ready to Test** screen, measure the supplied Duplex 2205 Check Sample 10 times.
3	Average the 10 assays. See **Averaging**, page 52.
4	Compare the average measured value for each element against the Acceptance Limit maximum and minimum on the Check Sample Report supplied with your instrument.
5	If all averaged measurements fall within MAX and MIN limits, continue to use the instrument. If averages fall outside MAX and MIN limits, with respect to standard deviation, check – • Measurement times • Sample surface • Instrument window If the instrument does not perform as expected, contact Bruker at support.hmp@bruker.com, +1 (509) 783-9850.

Individual reports — The following figure is an example only. When performing a quality check, use the Check Sample Report included with your instrument. It contains values specific to it as determined during testing at the factory.

Measurement	Time	Si	P	Ti	V	Cr	Mn	Fe	Ni	Cu	Nb	Mo
1	25 by 25	0.469	0.027	0.000	0.135	22.602	1.015	66.653	5.568	0.216	0.022	3.294
2	25 by 25	0.461	0.019	0.000	0.140	22.591	1.025	66.728	5.517	0.213	0.022	3.283
3	25 by 25	0.532	0.021	0.000	0.106	22.532	1.011	66.718	5.533	0.210	0.021	3.315
4	25 by 25	0.395	0.020	0.013	0.127	22.543	0.981	66.836	5.549	0.200	0.022	3.314
5	25 by 25	0.679	0.020	0.000	0.123	22.538	0.999	66.664	5.486	0.214	0.021	3.257
6	25 by 25	0.277	0.023	0.000	0.113	22.550	0.974	67.054	5.478	0.213	0.022	3.296
7	25 by 25	0.439	0.021	0.000	0.117	22.565	0.974	66.795	5.573	0.208	0.021	3.287
8	25 by 25	0.388	0.022	0.000	0.131	22.573	1.028	66.805	5.515	0.209	0.019	3.310
9	25 by 25	0.373	0.019	0.003	0.117	22.639	0.996	66.774	5.557	0.205	0.020	3.296
10	25 by 25	0.514	0.022	0.000	0.117	22.597	1.010	66.688	5.531	0.213	0.020	3.288

Average Measured Value	**0.453**	**0.021**	**0.002**	**0.122**	**22.573**	**1.001**	**66.771**	**5.531**	**0.210**	**0.021**	**3.294**
Standard Deviation	0.109	0.002	0.004	0.010	0.034	0.020	0.117	0.032	0.005	0.001	0.017
→ Acceptance Limit MIN	**0.000**	**0.000**	**0.000**	**0.070**	**22.402**	**0.902**	**66.187**	**5.370**	**0.162**	**0.011**	**3.208**
→ Acceptance Limit MAX	**0.997**	**0.045**	**0.042**	**0.175**	**22.744**	**1.101**	**67.356**	**5.692**	**0.259**	**0.031**	**3.380**

Check Sample Report, example only

Appendix A Additional TRACER 5^{i} Radiation Profile Test Results

Description To read testing standards and conditions, see **Radiation Profile – TRACER 5^{i}** on page 20.

Worst-case 2 highest power

Tests were performed with the following settings:

Setting Type	Value
Voltage (keV)	40
Current (µA)	99
Filter	Blank #2

At **5** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	458762102(4587621)	28.9(0.289)
B	6722.5(67.225)	Background
C	1520.8(15.208)	21.7(0.217)
D	2044.6(20.446)	Background
E	198.7(1.987)	Background
F	581.6(5.816)	Background
G	39.7(0.397)	Background
H	4302.2(4.3022)	57.8(0.578)
I	2279.4(22.794)	104.8(1.048)
J	310.7(3.107)	Background
K	274.5(2.745)	Background
L	Background	Background
M	Background	Background

At **10** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	81244.2(812.442)	Background
B	2893.5(28.935)	Background
C	1412.4(14.124)	Background
D	2134.9(21.349)	Background
E	177.0(1.770)	Background
F	516.6(5.166)	Background
G	Background	Background
H	1556.9(15.569)	14.4(0.144)
I	1773.6(17.736)	39.7(0.397)
J	610.5(6.105)	39.7(0.397)
K	466.0(4.660)	18.1(0.181)
L	220.4(2.204)	28.9(0.289)
M	93.9(0.939)	14.4(0.144)

At **30** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	10881.3(108.813)	Background
B	769.4(7.694)	Background
C	798.9(7.989)	Background
D	798.9(7.989)	Background
E	265.3(2.653)	Background
F	356.7(3.567)	Background
G	Background	Background
H	542.4(5.424)	Background
I	622.0(6.220)	Background
J	415.7(4.157)	Background
K	474.6(4.746)	Background
L	173.9(1.739)	Background
M	259.4(2.594)	Background

At **100** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	5811.3(58.113)	Background
B	207.2(2.072)	Background
C	251.0(2.510)	Background
D	154.7(1.547)	Background
E	198.5(1.985)	Background
F	131.3(1.313)	Background
G	131.3(1.313)	Background
H	201.4(2.014)	Background
I	207.2(2.072)	Background
J	134.3(1.343)	Background
K	157.6(1.576)	Background
L	148.9(1.489)	Background
M	125.5(1.255)	Background
N	213.1(2.131)	Background
O	236.4(2.364)	Background

Standard setting 3 high voltage

Tests were performed with the following settings:

Setting Type	Value
Voltage (keV)	50
Current (µA)	9.7
Filter	Cu75,Ti25,Al200mm #3

At **5** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	288951.5(2889.51)	Background
B	184.2(1.842)	Background
C	25.3(0.253)	Background
D	65.0(0.650)	Background
E	18.1(0.181)	Background
F	Background	Background
G	Background	Background
H	148.1(1.481)	43.3(0.433)
I	148.1(1.481)	104.8(1.048)
J	Background	Background
K	Background	Background
L	Background	Background
M	Background	Background

At **10** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	3001.8(30.018)	Background
B	68.6(0.686)	Background
C	25.3(0.253)	Background
D	54.2(0.542)	Background
E	Background	Background
F	Background	18.1(0.181)
G	Background	Background
H	25.3(0.253)	18.1(0.181)
I	61.4(0.614)	79.5(0.795)
J	Background	18.1(0.181)
K	Background	18.1(0.181)
L	Background	18.1(0.181)
M	Background	18.1(0.181)

At **30** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	445.2(4.452)	Background
B	Background	Background
C	Background	Background
D	26.5(0.265)	Background
E	Background	Background
F	Background	Background
G	Background	Background
H	Background	Background
I	14.7(0.147)	Background
J	Background	Background
K	Background	Background
L	Background	Background
M	Background	Background

At **100** cm

Location	Open Beam µrad(µSieverts)/hr	Duplex µrad(µSieverts)/hr
A	216.0(2.160)	Background
B	Background	Background
C	Background	Background
D	Background	Background
E	Background	Background
F	Background	Background
G	Background	Background
H	Background	Background
I	Background	Background
J	Background	Background
K	Background	Background
L	Background	Background
M	Background	Background
N	Background	Background
O	Background	Background

Distance vs. dose

	Worst-Case 2 Highest Power		Standard Setting 3 High Voltage	
	40KeV, 99□A		50KeV, 9.7□A	
	Blank, No Filter		Cu75Ti25Al200□m filter	
	mRad/mSieverts		mRad/mSieverts	
Distance (cm)	Open Beam	With Sample	Open Beam	With Sample
100	4057 / 40.571	Background	81 / 0.809	Background
30	28891 / 288.91	Background	766 / 7.665	Background
10	357618 / 3576.18	Background	6141 / 61.409	0.033 / 0.000325
5	395525 / 3955.25	0.054 / 0.000542	7947 / 79.471	0.033 / 0.000325
Surface	541677 / 5416.77		10031 / 100.31	
Eye / Skin Time to Limit	1.7 / 5.54 Minutes		92 / 299 Minutes	