	Standard Operating Procedure Inline Metal Detector		SOP Number B-629	Revision 6
			Effective Date 03/22/22	Page Page 1 of 15
Written by/ Date <i>[Signature]</i> 02-25-22		Reviewed by/ Date <i>[Signature]</i> 03/04/22		Approved by/ Date <i>[Signature]</i> 03/02/22
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1.0 Purpose

The purpose of this procedure is to define the process for the setup, operation, cleaning and calibration of the Inline Metal Detectors.

2.0 Scope

This procedure applies to the Inline Metal Detectors in operation at Ion Labs, Inc.

3.0 Responsibility

- 3.1 It is the responsibility of production (packaging) personnel and QC inspectors to follow this procedure.
- 3.2 It is the responsibility of the department supervisor to implement this procedure and to ensure that the procedure is being followed.

4.0 Definitions

- 4.1 QC – Quality Control

5.0 References

- 5.1 Machine Manual
- 5.2 Cleaning Log
- 5.3 B-111, SOP, Cleaning of Manufacturing/Production Areas and Equipment

6.0 Procedure

6.1 Setup, Operation, and Calibration

Note: Refer to Attachments 1 and 2 for setup instructions.

6.1.1 Calibration verification will be performed prior to each use using a calibration sample kit. Annual calibration will be performed with a QC-Controlled Calibration sample kit. The sample kit will consist of the following test pieces:

6.1.1.1 1.50mm Ferrous Red

6.1.1.2 2.00mm Ferrous Red

6.1.1.3 2.00 Aluminum Yellow

6.1.1.4 3.00mm Aluminum Yellow

6.1.1.5 2.00mm SS316 Blue (Stainless Steel)

6.1.1.6 3.00mm SS316 Blue (Stainless Steel)

6.1.2 Turn the power on.

6.1.3 The machine will go through a system startup that will take a minute.

6.1.4 With the display of the machine showing a bar graph with empty rectangles (no metal detected), the machine is ready to test. If adjustments are needed, contact Maintenance department.

6.1.5 Pass the calibration sample kit through the center of the machine, one at a time. The samples contain different metals and should activate the machine to alert that metal is present, bar graph will show filled rectangles when metal is present. The sample should be automatically discarded into the reject plate on the conveyor. If this process does not happen, please refer to Attachment 3.

Note: Document test sample results in batch record as required. Each test piece in the sample kit should be placed in the same type of container used in the manufacturing process (e.g. the product bottle) with product in the container. Ideally, place the same amount of product in the container as will be in the final product. If there is not enough space in the container to hold the test piece and the full amount of product, reduce the amount of product to accommodate the test piece.

6.1.6 When the calibration samples have successfully passed, the machine is ready for operation.

6.1.7 Production and QC will perform hourly metal checks after startup and record the checks in the batch record.

6.1.7.1 If metal is found during production run, checks will be increased as needed to ensure that the metal detector is fully functional for the entirety of the batch.

6.1.8 During operation, if metal is detected, the bottles will be discarded to the reject plate. These bottles are to be accounted for in the waste section of the batch production record and disposed. Immediately contact the QC department for investigation and impact analysis.

6.2 Cleaning Procedure

6.2.1 Remove all product and paperwork from the previous batch.

6.2.2 Refer to SOP B-111 Cleaning of Manufacturing/Production Areas and Equipment to follow the cleaning procedure applicable to this type of equipment.

6.2.3 Document cleaning in the cleaning logbook.

6.2.4 Contact a QC inspector to verify equipment cleanliness and to check the cleaning logbook.

7.0 Revision History

Revision	Date	Description of Changes	CCR #	By
1	07/25/13	New	13-625	B. Mosall
2	01/27/16	Biennial Review: updated SOP format.	15-0732	P. Zittere
3	06/22/16	Add calibration information	16-0623	D. Popp
4	04/04/17	Add requirements for checking the integrity of the metal detector calibration sample kit	16-1121	N. Zhang
5	10/29/20	Scheduled review: revised cleaning procedure to align with current process. Added test sample requirements.	CC-20-0750	K. Burris
6	02/24/22	Add requirement to include product in packaging bottles when testing metal detector sensitivity.	CC-22-0084	D. Herd

8.0 Attachments

- 8.1 Attachment 1 – Setting Up the Machine
- 8.2 Attachment 2 – Using the Menu System
- 8.3 Attachment 3 – Troubleshooting

Attachment 1 – Setting Up the Machine

Setting Up the Machine

The detector and reject system (if fitted) should now be completely installed. The aim of this section is to describe how to set up the detector for a particular product, including automatic setting of detection parameters and calibration of timers for accurate rejection.

For more detailed explanation of the software, please consult the 'Using the Menu System' section of this manual. If problems are encountered during setup, read the troubleshooting section of the manual.

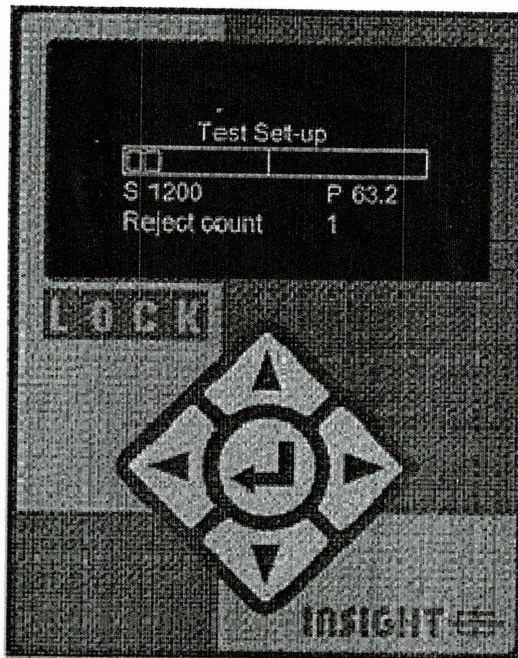


Figure 1: VFD Detector display and keypad

The display has eight lines of 32 characters and after power on or reset, the third line shows the current product name and the fourth line shows a "bar-graph".

The bar-graph can show up to 20 rectangles (bars) and can be used to see how good a product setup is. The bars show the size of signal being detected, the more bars the larger the signal.

Solid bars indicate that metal has been detected. Hollow bars indicate product effect or metal contamination that is not large enough to trigger the metal detector. If many hollow bars are displayed each time a product passes then the detector may be at risk from false triggering. When no signal is detected two bars will be displayed on the bar graph to indicate that the detector is actively looking for metal.

Attachment 1 – Setting Up the Machine (Cont'd)











Initial Test

Every detector is shipped with test samples - small pieces of conveniently packaged metal with which to test the detector. Before the detector is shipped, it is set up to see these samples without false triggering (false triggering is when the detector indicates that it has seen metal when none is present, and is due to electrical noise, vibration, large product effect, etc.). This setup is stored on the detector under the product name "Test setup".

With the detector switched on, check the bar-graph to make sure that the machine is not false triggering. If the detector starts to false trigger, consult the trouble-shooting guide.



Pass the test samples through the aperture. The detector is least sensitive in the center of the aperture, so the best test is to pass the sample through the center of the aperture. When passing test samples, make sure that hands, rings, watches etc. are kept away from the aperture. If the detector does not see the test samples consult the trouble-shooting guide (Sec 12).

Key Pad

The Keypad has five keys, labeled , , , , . In this manual, the , , ,  buttons are referred to as the **CURSOR** keys and the  button as **SELECT**.

Using the Keyboard

Escape Sequence


If at any time it is required to go to the normal running display, the  and  buttons on the keypad should be pressed simultaneously.

Passwords and Names

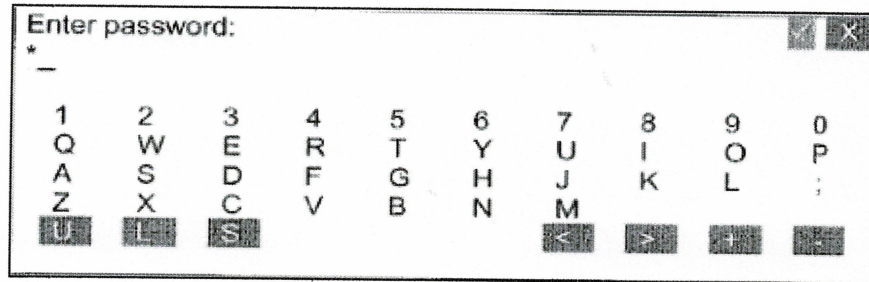
What follows is a basic introduction to security access and product name creation using the keypad string entry system. A more detailed description can be found in the relevant sections.

Passwords and Names are entered using the keyboard display: from switch on pressing the **SELECT** key on the keypad causes the **INSIGHT** menus to be displayed.

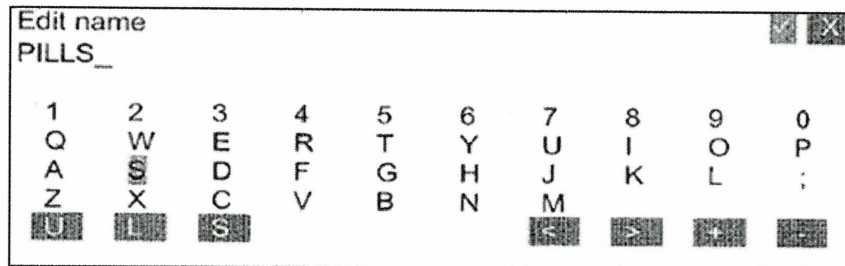
Selecting any of the top three items from the menu list will cause the following screen to be displayed.

As will be described later the system requires a password, one of the default passwords for the system is '2', so use the **CURSOR** keys to select 2 and press **SELECT** on the keypad. The password is entered by using the **CURSOR** keys to highlight the  symbol and then press **SELECT** on the keypad.

Attachment 1 – Setting Up the Machine (Cont'd)



On screens where Names are required the display will look like that shown below. For example if a product with the name 'PILLS' is entered, the following display will be seen:



The second line of the display is the name that is being input. The underline is the **EDIT STRING CURSOR**. The keypad **CURSOR** and **SELECT** are used to add characters to the string at the position of the **EDIT STRING CURSOR**. The string entered cannot have leading spaces.

The bottom line of the display contains control functions, which are:

- U Select upper case
- L Select lower case
- S Select special characters
- < Move **EDIT STRING CURSOR** left
- > Move **EDIT STRING CURSOR** right
- + Insert space at **EDIT STRING CURSOR**
- Delete character at **EDIT STRING CURSOR**

The maximum number of characters in a Name is 20.

When the edit is complete the Name is entered by moving the **CURSOR** to the ✓ and pressing **SELECT**. If the ✓ is selected the 'Save changes' screen is displayed. Selecting the 'X' will discard the entered string.

Attachment 1 – Setting Up the Machine (Cont'd)

Confirming Changes

All **INSIGHT** settings are stored in FLASH memory. The FLASH memory is loaded into RAM memory on power on. Any changes to the working configuration will, upon exit from the screen were the changes were made, causes the 'Save changes' screen to be displayed:

Product name	
<i>Save changes</i>	
Are you sure?	
No	Yes

If **No** is selected the changes are discard and the FLASH memory copied to the RAM memory. If **Yes** is selected the RAM memory is copied to the FLASH memory permanently saving the new settings.

Main Menu (Quick Start)

Pressing **SELECT** on the keyboard when the normal running display is on view gives the following display:

INSIGHTMenus	X
Product setup	
Adjust product presets	
System setup	
DDS display	
User information	

Attachment 1 – Setting Up the Machine (Cont'd)

Product setup

The aim of this subsection is to get the metal detector to learn the characteristics of a particular product. In order to do this, some product samples will be required. The description of how to use the software is kept deliberately brief in this subsection, for more detail see the 'Using the Menu System' section of the manual.

Use the **CURSOR** keys to select 'Select product', and press **SELECT** on the keypad, you will then be asked to enter a password. The factory default setting for this is '2', so you will use the **CURSOR** keys to select '2' and press **SELECT** on the keypad. The password is entered by using the **CURSOR** keys. Then navigate to the $\sqrt{\quad}$ and press **SELECT** on the keypad.

Do sample test
Select product
New product
Setup product
Delete product
Copy product

Use the **CURSOR** keys to select **New Product**, and press **SELECT** on the keypad. The display will then show a flashing cursor in the position of the new product to be entered. To enter a new product use the **SELECT** and **CURSOR** keys to enter the Product name. Once the product name has been entered the display should show:

Setup product
Automatic
Manual

Note: It is not recommended to do a manual setup; this is primarily used for testing by service technicians.

Use the **CURSOR** keys to select **Automatic**, and press **SELECT** on the keypad. The display should show:

Setup product
Pass product: 1

Attachment 1 – Setting Up the Machine (Cont'd)

The product to be set up needs to be passed through the machine until the setup is complete.

Every time the 'Pass product' count is incremented the product should be passed through the aperture until the setup is finished, otherwise the detector will be unable to learn the product's signal correctly.

Note: While passing the product make sure that no metal goes near the aperture, particularly watches, rings, etc.

Keep passing product until the display shows something similar to the following:

INSIGHT Single Frequency

Product name	
Sensitivity	00100
Phase	30.0
Height	32000
Height checking	No
Gain	High

INSIGHT Multi Frequency

Product name	
Sensitivity	00100
Phase	30.0
Height	32000
Height checking	No
Gain	High
Frequency	High

Pressing **SELECT** will display the 'Save changes' screen, selecting 'Yes' will save the new products signal data to FLASH Memory and then return to the normal running display showing the product name and bar graph.

The detector is now setup to ignore the signal from the product, but still see metal. Pass the product through the aperture and make sure that the detector does not trigger. If it doesn't, move on to the next subsection: 'Reject timers'. If the detector does trigger on the product read the notes below.

Note on Automatic Setup

The detector will usually be able to set itself up automatically, however the following points should be borne in mind. Products can have different effects depending on their temperature, moisture content and packaging. Orientation of product can also cause an affect known as the 'product effect, e.g. if a setup is done with products passed lengthways, a product passed width ways may be rejected.

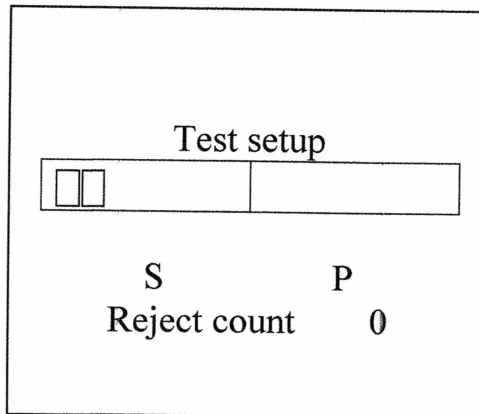
If the product varies a lot, or the environment is electrically noisy, then the sensitivity of the detector may need to be reduced. In order to do this, read about the 'product detection envelope', in section 8.2.1.3 'Product settings'. To alter these settings see section 8.5.2.5.2 'Detection Settings'.

Attachment 2 – Using the Menu System

This section of the manual describes how to access the machine and product settings using the menu system. It is intended mainly for reference and is not meant to describe how to set up a machine or product, or why certain options are required.

Power up/ Normal Running Display

When the unit is switched on the display is similar to the following. This is called the normal running display.



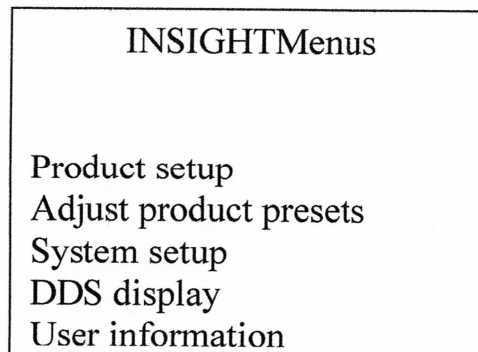
The string, "Test setup", is the name of the currently selected product. The name of the product could be anything that has been input into the system using the 'New product' menu item in the 'Product setup' menu.

The bar-graph can be used to see how good a product setup is, the bars show the size of signal being detected, the more bars the larger the signal. Solid bars indicate that metal has been detected.

The next line shows the size and phase of the last reject, and if enabled, the Product count.

Insight Menus

From the normal running display, when **SELECT** is pressed, the following screen will be displayed:



These menu items are used to set up or obtain diagnostic information from the system.

Attachment 2 – Using the Menu System (Cont'd)

The **CURSOR** and **SELECT** keys can be used to select a menu item in the list or the X which will cause the system to exit the current menu and return to the normal running display.

User Information

The **CURSOR** and **SELECT** keys can be used to select the 'User information' menu item. Selecting this will provide information about the systems setting. A password is not required and none of the information can be modified with the exception of the 'Product count' menu item.

If 'Product count off' is selected it will change to 'Product count on'. The value set here determines whether the product count is seen on the normal running display.

The display shows the following when the 'User information' menu item is selected:

Tacho measurement OPPS	X
Do noise test	
Voltage measurement	
Product settings	
Reject timers	
System input messages	
Machine ID	
Product count off/on	

Note: The 'Tacho measurement' menu item can be hidden / displayed (see section 8.6.3.3.1)

Do Noise Test

The following is displayed when 'Do noise test' menu item is selected:

Doing Noise Test	X
Sensitivity	00015
Phase	036.2
Height	00012

The Noise test is repeated every 5 seconds and the measured values displayed. To return to the 'User information' menu press **SELECT**.

Attachment 2 – Using the Menu System (Cont'd)

Voltage Measurement

The following is displayed when Voltage Measurement is selected:

	Volts
Balance Voltage	0.038
Drive Voltage	40.0
X Channel	0.1
Y Channel	0.0

Product Settings

The detection parameters are displayed if Product Settings is selected:

INSIGHT Single Frequency

Test setup	
Sensitivity	00100
Phase	0.0
Height	32000
Height Checking	No
Gain	High

INSIGHT Multi Frequency

Test setup	
Sensitivity	00100
Phase	0.0
Height	32000
Height Checking	No
Gain	High
Frequency	High

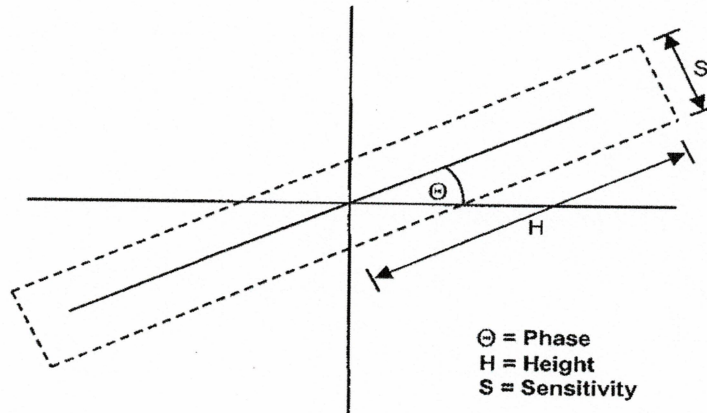
In the diagram below S = sensitivity where width is used as the sensitivity setting, h = height and 8 = phase used for detection.

Note: Sensitivity and height refer to characteristics of the electrical signal produced from the product, and have nothing to do with its physical dimensions.

If height-checking is disabled, i.e. then height is not being used for detection and the product detection envelope will open-ended.

The other figure displayed is the gain (G) and there are two gain settings with code version V6.xx, i.e. High and Low.

Attachment 2 – Using the Menu System (Cont'd)



Product Detection Envelope

The following is displayed when the menu item **Reject timers** is selected:

Syschek time	1.00S
Photocell time	00.50S
Detection window	00.50S
Delay time	01.50S
Reject time	00.50S

Configure System Inputs

Selecting the **Configure system inputs** menu item will display the following:

02/01/2010 14:47	
Input	Enabled
Tacho input	0
Photocell input	0
Reject check input	0
Product check input	0
Auxiliary input 1	0
Auxiliary input 2	0

Attachment 3 - Troubleshooting

The aim of this section is to list common problems and possible solutions. The fault finding section of the Installation Manual should also be consulted.

False Triggering/Poor Sensitivity

This is the most common problem with metal detectors. There are many possible reasons for it, so the first thing to do is to narrow down the source of the problem. To do this, select the "TEST SETUP" preset and pass the test sample provided through the metal detector. Now read the relevant paragraph below.

Fails to Detect Test Sample

The detector is now less sensitive than when it left Lock Inspection. A technician should check that the power supply cables are wired correctly. If everything appears to be okay, call Lock.

Detect Samples but False Triggers

There are many possible reasons for this. Below is a list of possible causes.

Components guiding/transferring products through the metal detector should be clean and contain no metal. Sometimes metal becomes embedded in the guiding/transferring components, causing the head to trigger at regular intervals. Under no circumstances should metal fasteners be used in guiding/transferring components.

Moving metal in the metal-free zone – There must be no metal in the metal free zone. Consult the Installation Manual.

Earth loops – All metal items must be securely bonded to each other or insulated. Intermittent metal-to-metal contacts can often cause problems.

Electrical interference – All high current cables should be routed well away from the detector and its cabling.