PROMAT

NDT

JAMES INSTRUMENTS

Non Destructive Test Equipment

T-T-100

Aggrameter®

Operator's Instruction Manual

Original Instructions: Revision June, 2021

PROMAT

Notice

CE

The Aggrameter® has been tested in accordance with the EU regulations governing Electro-Magnetic compliance and it meets required directives.

PROMAT

We: James® Instruments Inc.

Of: Chicago, IL

In accordance with the following Directive(s):

2014/35/EU Low Voltage Directive

hereby declares that:

Equipment: Aggrameter®
Model Number: T-T-100

is in conformity with the applicable requirements of the following documents.

Ref. No. Edition/date	Title
EN 61000-6-3 2015	Electromagnetic compatibility (EMC).Generic standards. Emission standard for residential, commercial and light-industrial environments.
EN 61000-6-2 2012	Electromagnetic Compatibility (EMC) Part 6-2: Generic Standards—Immunity for Industrial Environments.

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all applicable Essential Requirements of the Directives.

Signed:

Name: Michael Hoag
Position: President, James® Instruments Inc.
Location: Chicago, IL

On: 5/10/2020

NDT JAMES INSTRUMENTS Non Destructive Test Equipment

Table of Contents

Introduction

The James® Instruments Aggrameter® is an innovative, easy-to-use digital meter for testing moisture in granular materials. It allows users to measure the complex dielectric constant of a mixture made up of water, sand, gravel, crushed stone and other fine and coarse aggregates. The Maximum aggregate particle size that may be tested is approximately 3/8” (or 9.5mm) in diameter. (Note: If testing larger aggregate sizes, the test prongs may break, and will need to be replaced.)

The Aggrameter® measures the hidden moisture in aggregate. To do this, the user simply inserts the prongs of the probe into the aggregate material to be measured, and instantly the percentage of moisture is shown on the display. The unit can be used with or without the collapsible extension pole (~ 41” long). When using the extension pole, the user can take moisture tests while standing.

The unit comes calibrated for sand, gravel, and crushed stone. It can also be programmed by the user for up to 10 different materials (or mixtures). For greatest accuracy, the unit should be calibrated and programmed for the specific material(s) used.

The Aggrameter® has the capability to upload the stored test data to a PC for later analysis. To help synchronize and differentiate the uploaded data, a time clock has been added to the test data.

Applications

Determine the moisture content of sand, gravel, crushed stone and other fine and coarse aggregates.

Features

Built-in microprocessor can convert the dielectric constant directly into the percentage of moisture present.
100 MHz sensor probe and logging unit that can process the test data, and store it for later retrieval.
Robust stainless steel prongs that have been designed to be inserted into various granular materials.
Variety of modes to assist the user in determining the moisture content.
Programming capabilities for up to 10 different user materials.
A collapsible Extension Pole; in which the length (maximum 41 inches) can be adjusted according to the user's comfort.

Instrument Contents List

Each James® Instruments Aggrameter® comes with the following items included in the carrying case. (Extension Pole not shown)

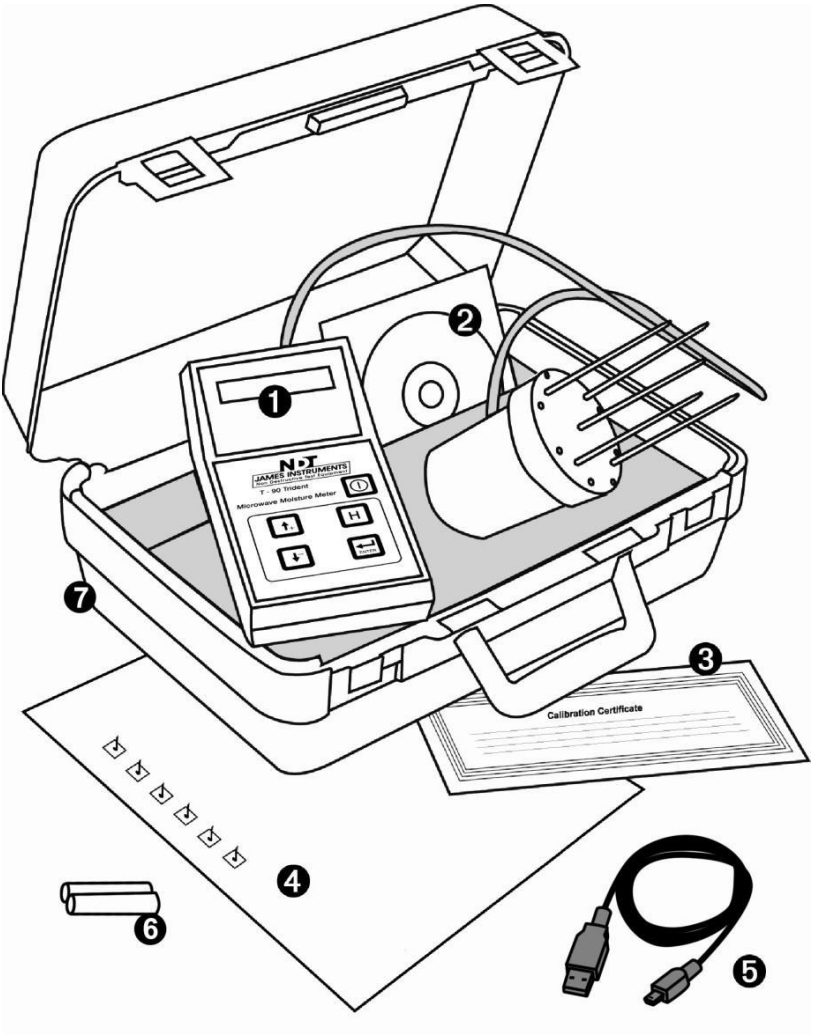

Figure 1: Aggrameter® Contents

Contents List

Item #	Definition
1	**Aggrameter® (with Sensor Probe)** – Used to measure and display information about the moisture content.
2	**Aggrameter® Software CD** – Used to upload data from the Aggrameter® to a PC. (aka. Aggralinx®**)**
3	**Calibration Certificate** – Certificate to confirm that the instrument has been calibrated to meet, or exceed published specifications.
4	**Check List** – Check list of items completed by a James® Instruments Inc. technician prior to packaging the unit.
5	**USB Cable** – Serial cord used to connect the Aggrameter® to a PC; in order to upload data.
6	**2 "AA" Batteries** – Supplies power to Aggrameter®.
7	**Case** – Carrying case for Aggrameter® and accessories.
8	(Not Pictured) **Extension Pole**

Aggrameter® Overview

The following is an overview of all of the external features of the Aggrameter®.

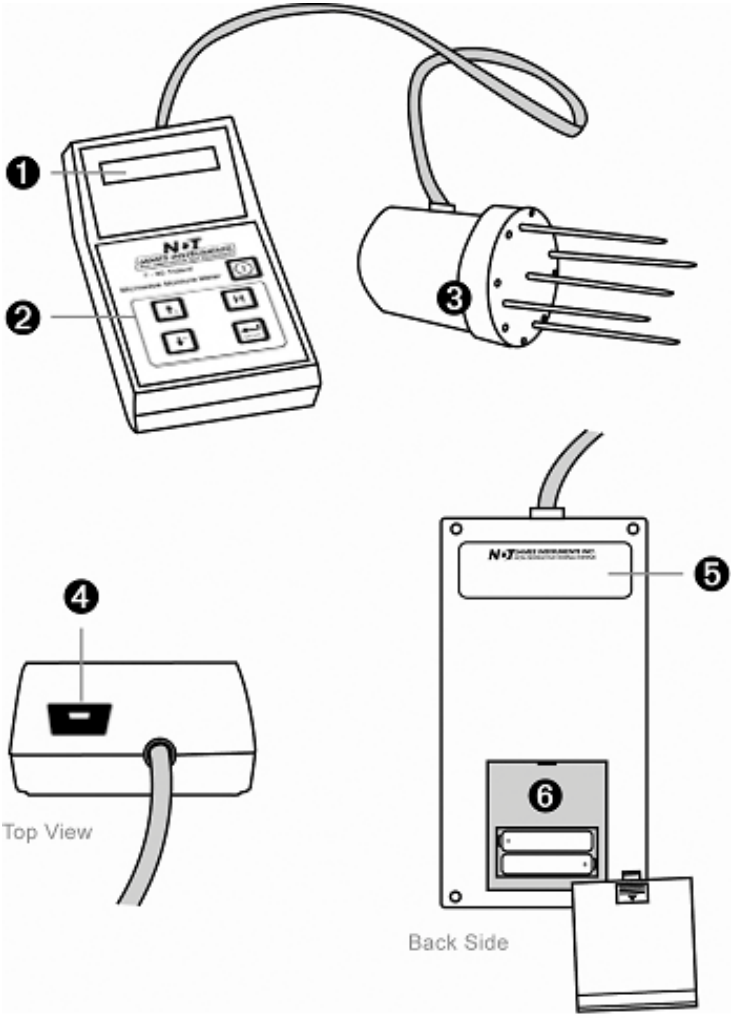

Figure 2: Aggrameter® Moisture Meter Overview

Instrument Functions

Item #	Definition
1	Display screen.
2	Control panel.
3	Sensor Probe.
4	USB port to upload data to a PC.
5	Manufacturer label shows model and serial numbers.
6	Battery compartment, takes 2 - “AA” batteries; slide open to replace.

Important Operational Notes

The following items are critical for achieving the best possible test results.

The Aggrameter® should only be used on sand and aggregates. It is not designed for testing soil. This corresponds to material that is created by mechanical weathering (by nature or machine) of a larger parent rock. Particles produced by mechanical weathering have approximately three-dimensional shapes. Soil particles produced by chemical weathering should not be used with the Aggrameter®; these result in clay type soils and correspond to particles with a roughly two-dimensional flake shape.

Water also has the tendency to be distributed unevenly throughout an aggregate sample. Typically it will have a higher amount of water at the bottom of the sample, than at the top. Therefore, for accurate readings, it is recommended to remove the top layer of material to be tested as this is generally the driest region. Also, the more suspected moisture there is in a material, the deeper the depth you want your testing to be done.

Three to five tests per sample create consistent readings for fine aggregates, such as sand. As the particle size increases, the consistency of the water distribution decreases. Thus, larger aggregates require more test readings per sample in order to get a consistent value. Typically eight to ten test readings per sample are enough for even the largest aggregate sizes.

Be sure to minimize any disturbance of the material under test. Consistent implementation of the procedure will lead to consistent results.

It has been found that the moisture content of sand and aggregates can vary by as much as 5% throughout a small volume.

Instrument Sensor Probe

The Aggrameter® sensor probe measures the complex dielectric constant of the test material. As the dielectric constant of water is four to eight times greater than most aggregates, changes in water content directly affect the sensor probe's output. This output reading is then converted, and the moisture content is displayed directly as a percentage of dry weight.

The sensor probe has five stainless steel prongs. Each prong is 3.5" in length, with a diameter of 0.125". These prongs are inserted into the test material to get a moisture content reading. When used in a test, the entire length of the steel prongs should be inserted into the test material. Proper placement is when, the base of the sensor probe (or white ring) touches the material; however, care should be taken not to compress the material when inserting the probe.

Additionally, although the prongs have a robust design, when inserting the sensor probe into the test material it is possible to bend or break the prongs. The maximum aggregate size to test is 3/8" in diameter. Therefore, care must be used when testing mixes with coarse (or large) aggregates.

The volume being tested should be at least 7.5" in diameter, two-and-a-half times larger than the diameter of the 3" wide probe. To obtain an accurate reading, the aggregate should not be in a metal container; as metal interferes with the dielectric reading of the aggregate. Therefore, aggregates containing appreciable amounts of metal elements should not be tested with the Aggrameter®.

Proper cleaning and maintenance of the sensor probe is required for accurate readings. (See Maintenance section on p.38)

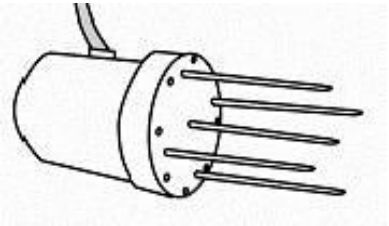

Figure 3: Sensor Probe

Fig. 4: Extension Pole setup

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NEW Collapsible Extension Pole

* The **Aggrameter®** can be used with or without the Extension Pole.

* Designed to reduce fatigue by allowing the user to stand during a test.

* Allows for easier reading of the display.

* Conveniently fits inside of the storage case.

* The Coiled Cable allows the sensor to be used up to 8ft away from the test unit.

* The latest version uses collets between the pole sections; which allows the user to adjust the pole length to ~ 40 inches long.

Extension Pole - Storage and Usage

Fig.5: Extension Pole Storage location

Fig. 6: Loosen Lower Pole section first, and pull out.

Note: Do not completely remove pole section(s); as it is difficult to re-insert.

Fig. 7: Attach the Extension Pole to Sensor Adaptor piece. Snap in place.

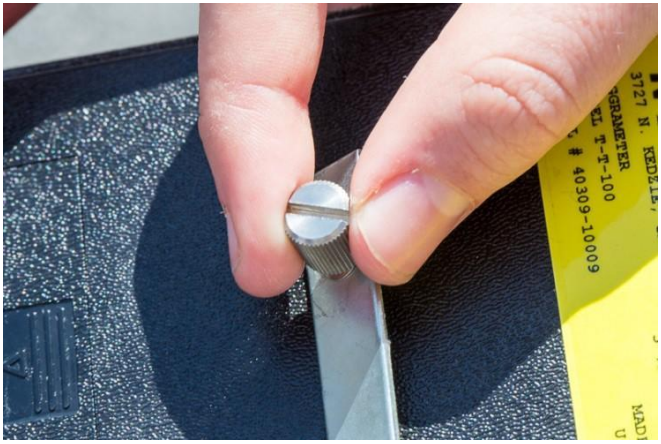

Fig. 8: Attach Bracket to bottom of Aggrameter® test unit.

Tighten the thumb screws onto the back of the Aggrameter® case for a snug fit. Do not over tighten.

Control Panel

The following buttons appear on the Aggrameter®.

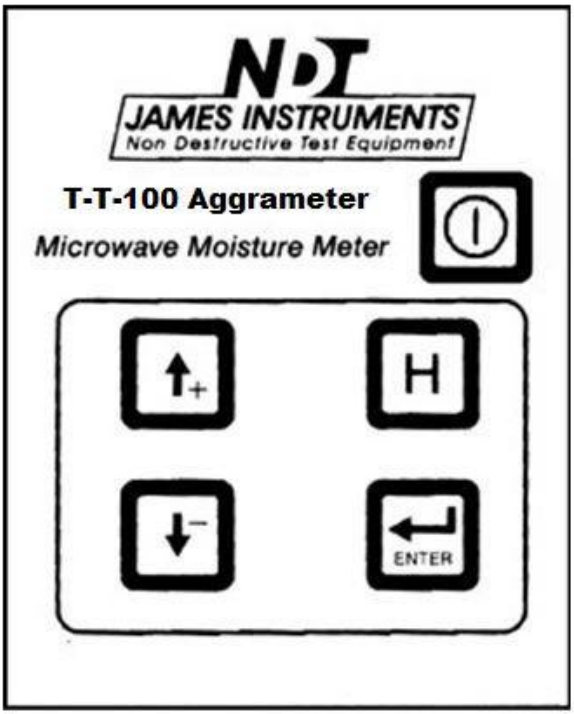

Figure 9: Aggrameter® Buttons

Control Panel Buttons

The following describes the function(s) of the buttons on the Aggrameter®.

Key	Definition
	The **Power** button. This button turns the instrument ‘on’ and ‘off’.
	The **Up** arrow. Used to scroll up through the menus and increase a displayed value.
	The **Down** arrow. Used to scroll down through the menus and decrease a displayed value.
	The **Enter** key. Used to select a menu item, and to save displayed values. Pressing Enter will briefly display an “S” next to the value displayed. This reading will then be stored in the unit along with the type of material tested; as well as the date and time. (**Note**: The stored data can only be reviewed when uploaded to a PC.)
	The **H** (or **Hold**) key. Used to hold the current test value. Pressing the H key holds the current test value, and displays to the user the running average of the entered readings. An “A” appears next to the displayed value.

Instrument Display

Direct

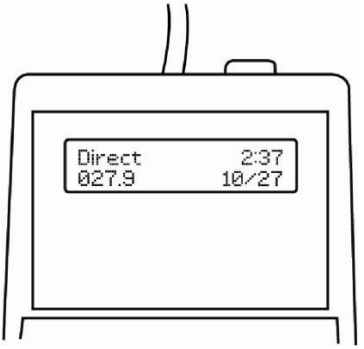

Figure 10: Direct Mode

This mode should be used when calibrating the unit to a specific user material. The displayed value is the raw mV reading coming from the sensor to the analog-to-digital converter in the unit.
By recording the mV values for a range of moisture tests, and the correlating values placed in a regression graph (see pg. 33-34), the unit will then be calibrated for the specific material tested by the Aggrameter®.

To measure moisture content:

1. Turn ‘on’ the unit using the button.
2. Wait for the introduction screen to disappear.
3. Gently insert the probe prongs into the aggregate so that each prong is fully submerged.
4. The display will then show your results.
5. To save test results, press **Enter**. The data will be saved for further review, or available to upload later.

User

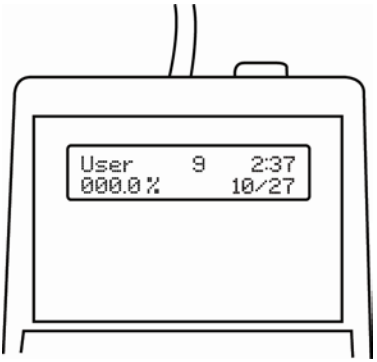

Figure 11: User Mode

The Aggrameter® can be programmed with up to 10 different user materials. These materials can then be stored within the unit as: User 0 – 9, and are displayed in sequential order. These user programs are adjusted according to the “Change User” material section, page 19. The displayed value from the user-program instantly shows the moisture value based on the user generated calibration settings.

Change Date

This mode is used to set the internal Real-Time Clock. Even with the power off, the clock operates via an internal Lithium battery, tracking the current time and date.

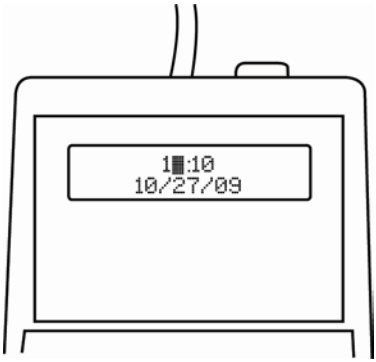

Figure 12: Change Date Mode

To adjust the date and time:

1. Using the keys, scroll to **Change Date?** And press **Enter**.
2. The cursor blinks over the hours displayed. Using the arrow keys, set the current hour and minutes, and press **Enter** to confirm each selection.
3. The cursor moves to the month, day, and year. Again, using the arrow keys, select the current month, day, and year and press **Enter** to confirm each selection.

To properly identify your records, every result that is saved on the Aggrameter® will include the time and date of the test.

Upload Data

This mode is used to upload data from the Aggrameter® to a PC. (Also review Software Operation on page 32.)

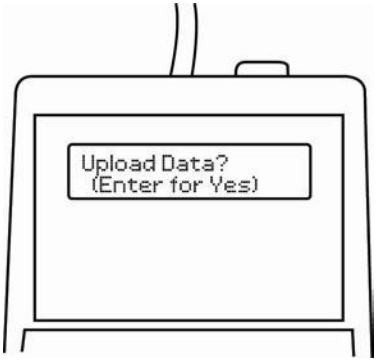

Figure 13: Upload Data Mode

To upload data to a PC:

1. Connect the Aggrameter® to a PC via a USB serial port and the supplied USB cable.
2. Open the Aggrameter® software by going to **Start / Programs / Aggralinx®** (or use the Desktop Icon)
3. Once connected to the PC, the Aggralinx® software locates the correct Com Port.
4. On the Aggrameter®, use the keys scroll to **Upload Data?** And press **Enter**.
5. The Aggrameter® will give you the option to erase the data from the unit once the upload is finished.
6. Press the Up Arrow to delete the data from the meter or the Down Arrow to continue to save the data. The Aggrameter® can store over 150 test readings.

7. Once all of the data has been transferred, it will appear on the software screen. (See Figure 9 below)

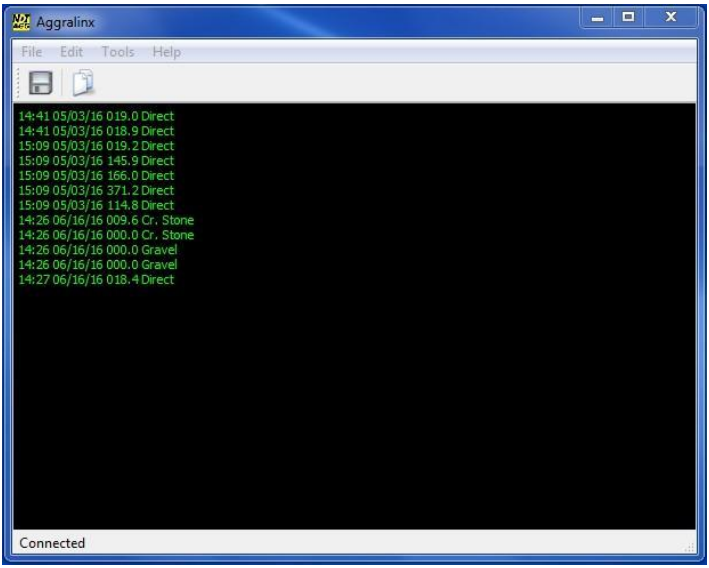

Figure 14: Upload Data (Sample only)

8. Click **File / Save As** and select a file name and location to save the data. (Note: Data is saved as a Text file.)

Change User Material

This mode is used to change the user program.

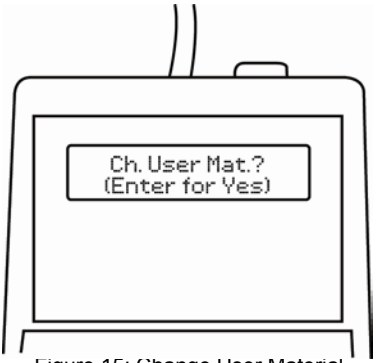

Figure 15: Change User Material

To change the user program:

1. Using the keys, scroll to **Ch. User Mat.?** And press **Enter**.
2. At the User Prog? Screen, select the user program you wish to change, ranging from 0-9, using the keys and press **Enter**.

Figure 16: User Program

3. At the OFFSET screen, select the desired + or - offset using the keys.

Pressing the up or down arrow keys will increase this value. Pressing and holding the plus or minus keys will rapidly increase this value.

Figure 17: Offset

4. Press **Enter** to confirm your OFFSET selection.
5. At the GAIN screen, select the desired gain using the  keys.

   Pressing the up or down arrow keys will increase this value. Pressing and holding the plus or minus keys will rapidly increase this value.

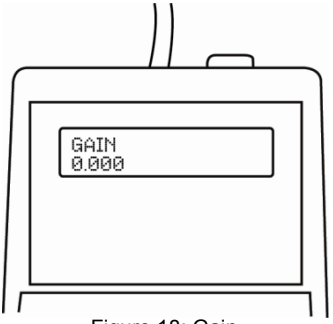

Figure 18: Gain

6. Press **Enter** to save these values into memory and set up the user program for subsequent use.

Sand

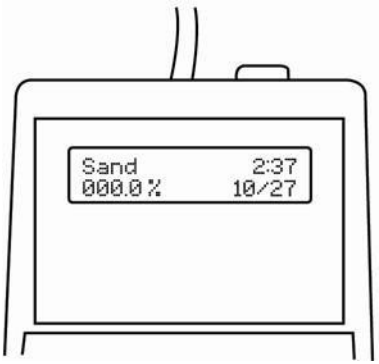

Figure 19: Sand Mode

The Aggrameter's® reading of moisture in sand is superior to other techniques. Moisture contents of beyond 20% by weight can be rapidly and accurately determined by the Aggrameter®.

The reading obtained in this mode is generally within 2% to 3% of the actual moisture level. More accurate readings can be obtained by pre-calibrating the unit to the specific sand being tested.
(See Instrument Calibration on pages 35-36)

Gravel

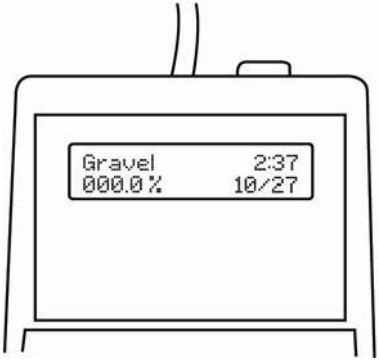

Figure 20: Gravel Mode

This is the general category for the smaller aggregates with rounded edges that are commonly used in construction. The Aggrameter® will generally read moisture levels to the 12% range by weight (while wet).

Crushed Stone

Figure 21: Crushed Stone Mode

Crushed stone refers to rock building material that has sharper corners and packs less densely than gravel. The maximum aggregate particle size to be tested is determined by the size of the test prongs on the probe, or approximately 3/8” in diameter. The maximum percentage of moisture detected depends heavily on the size of the stones.
Small finely crushed stones have a moisture percentage detection of up to 10%. Bigger crushed stones have a maximum percentage range of up to 8%.

Software Installation

The PC software that has been developed for the Aggrameter® is for data uploading, and to assist in creating custom user modes. To install the software on a PC, follow these instructions.

To install the software:

1. Insert the Aggrameter® PC Software CD into the CD-ROM drive. (aka. Aggralinx®)
2. The display will show the following… Click on “Open folder to view files”.

Figure 22: Installation File Location

3. Click on “setup” to start the installation process for the Aggrameter® (Aggralinx®) Software.

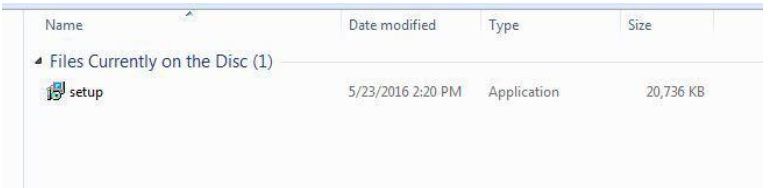

Figure 23: Setup File on CD

4. The Aggralinx® Setup Wizard appears. Click **Next.**

Figure 24: Aggralinx® Setup Wizard

5. Accept the terms in the License Agreement, and click **Next**.

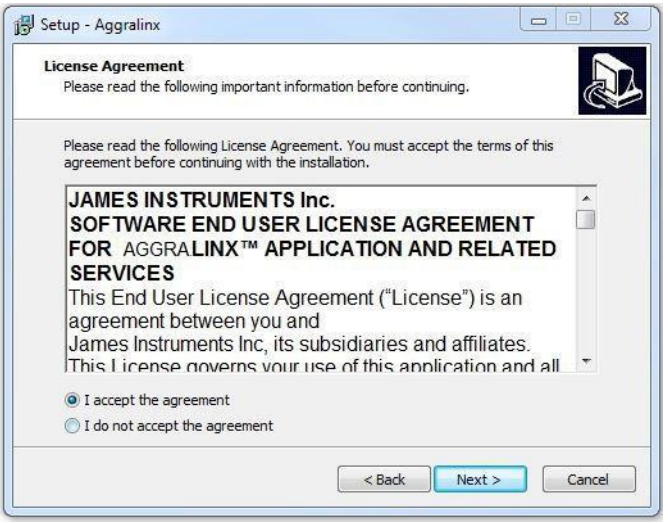

Figure 25: License Agreement Screen

6. Enter the file destination Location. Press **Next** to continue. (Default setting is… C:\Program Files (x86)\Aggralinx)

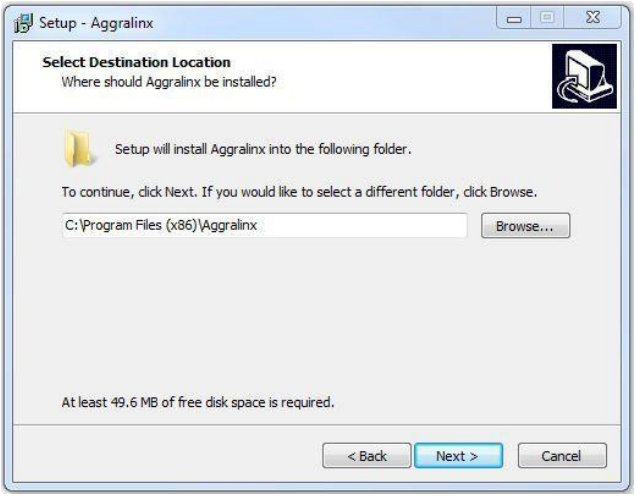

Figure 26: Destination Location Screen

7. Select Start Menu Folder. Select **Next** to continue.

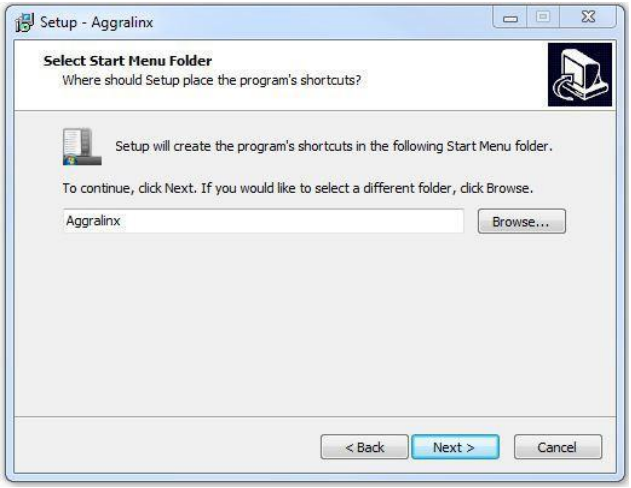

Figure 27: Select Start Menu Folder Screen

8. Create Aggralinx® Desktop Icon. Select **Next** to continue.

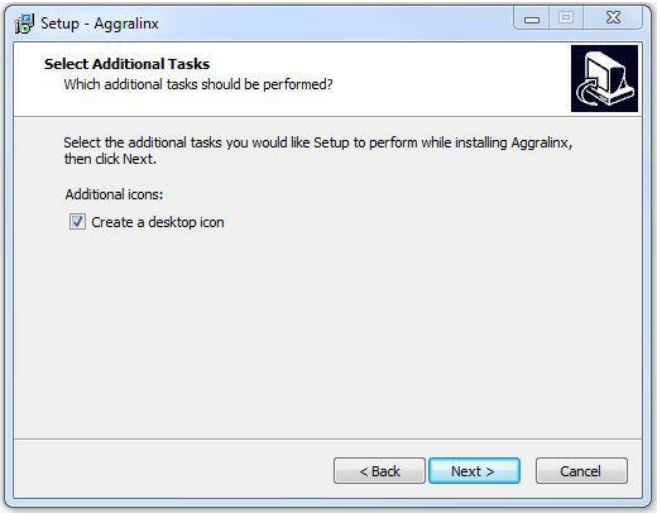

Figure 28: Create Desktop Icon Screen

9. Ready to Install Aggralinx® software. Press **Install**.

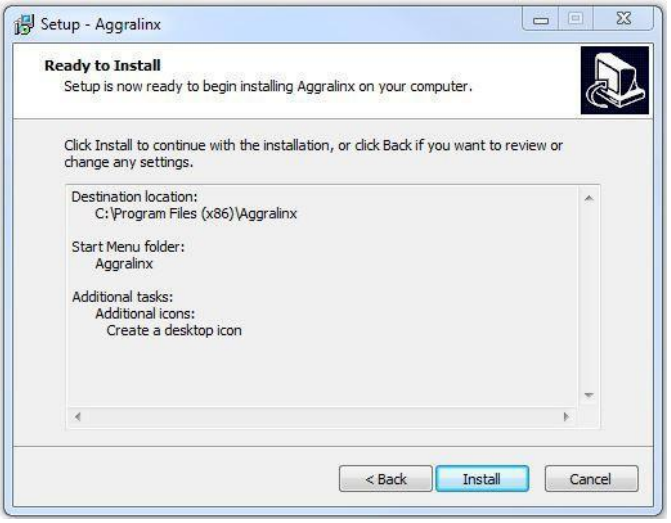

Figure 29: Ready to Install Screen

10. Completing the Aggralinx® Setup Wizard. Press **Finish**.

Figure 30: Completing Aggralinx® Setup Wizard Screen

11. FTDI CDM Driver Screen. Press Extract to proceed.

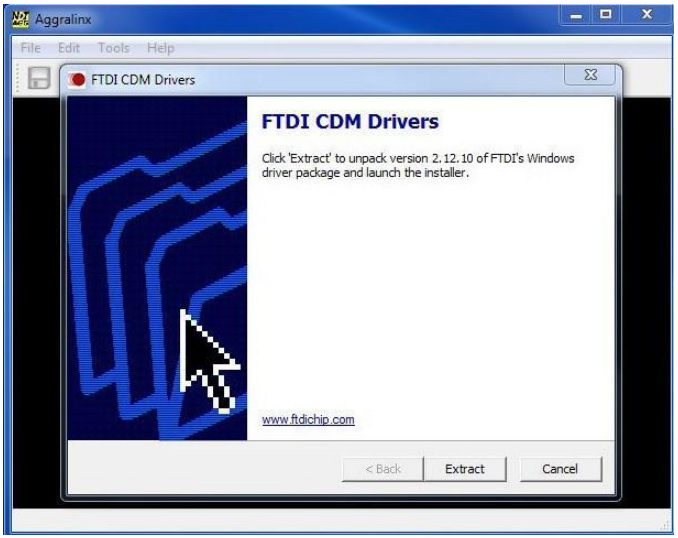

Fig. 31: FTDI CDM Driver Screen

12. Welcome to Device Driver Install. Press **Next** to continue.

Fig. 32: Device Driver Installation Wizard Screen

13. Device Driver License Agreement. Accept and press **Next**.

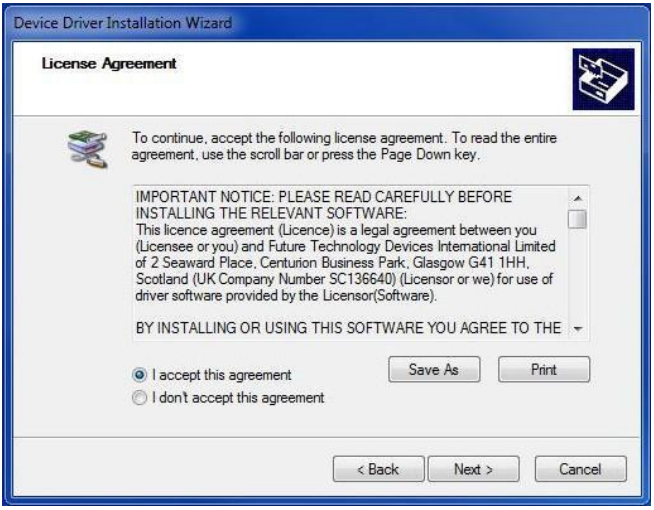

Figure 33: Device Driver License Agreement Screen

14. Completing Device Driver Installation Wizard. Press **Finish**.

Figure 34: Completing Device Driver Installation Screen

15. The Aggralinx® Icon appears on the Desktop. Select to enter the Aggralinx® software.

Figure 35: Aggralinx® Shortcut Icon

16. Check Serial Port screen will appear if the Aggrameter® unit is not properly plugged into one of the USB serial ports.

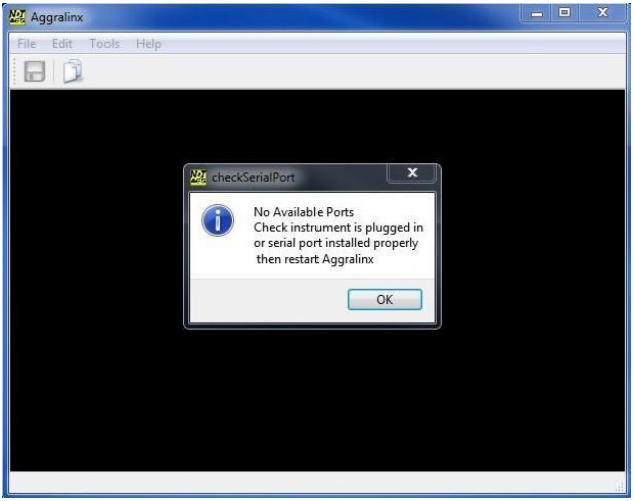

Figure 36: Aggralinx® No Available Ports screen. Check connections.

17. Check the Aggralinx® Help Screen for assistance.

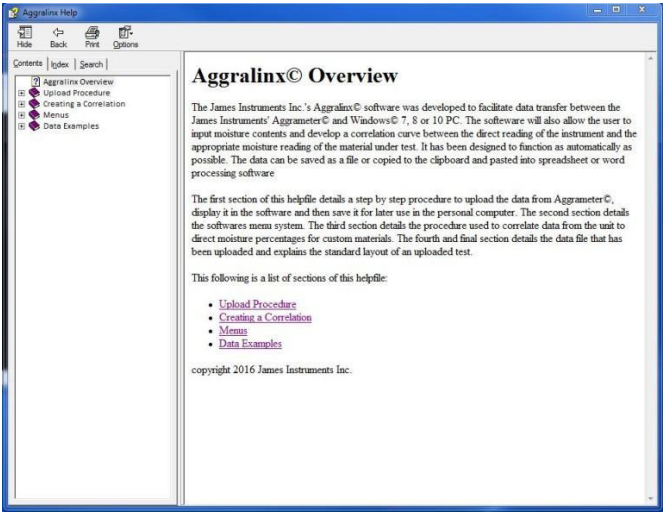

Fig. 37: Aggralinx® Help Screen.

Software Operation

The unit comes with PC software known as Aggralinx®, and is Windows 7, 8 and 10 compatible. The software simplifies the uploading of data to a PC; as well as to analyze the data for later programming of the unit. Once transmission of data from the Aggrameter® has occurred, this information will appear in the edit window in the software. The data can then be analyzed by the built-in software of the program, or with a common spreadsheet.

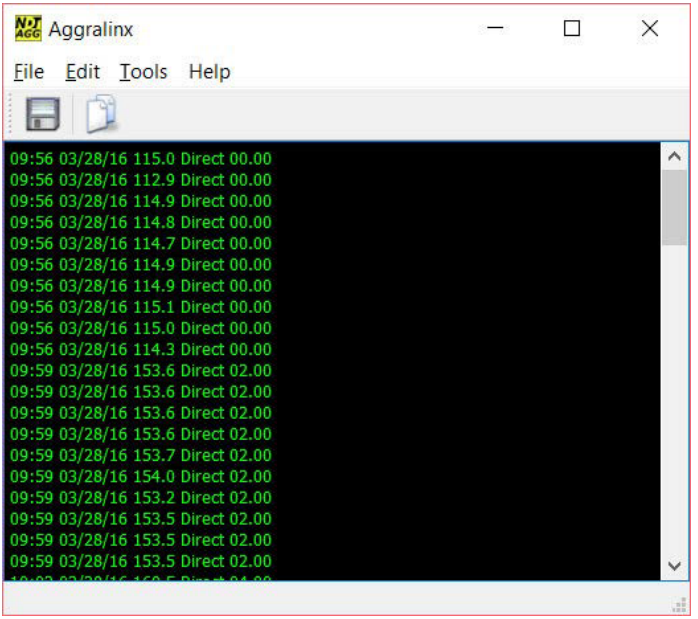

Figure 38: Software Spreadsheet

The software will take the user step by step through each record, and allow the user to enter the moisture percentage associated with the readings. Once all readings have an associated moisture percentage, the data can be graphically displayed, and the optimal correlation relationship determined.
Coefficients (Gain and Offset) representing this relationship are displayed for subsequent loading into the Aggrameter® unit.
Be sure to record these coefficients somewhere for later use.
(**Note**: Without the corresponding moisture percentages added, the correlation curve of the data cannot be plotted, and the display will read – “Data Not Entered”.)

To create a regression graph:

1. Upload data from the Aggrameter® unit to a PC using the Aggralinx® software.
2. In the Aggralinx® software, click **Tools / Moisture** to enter the moisture values. Use **B** (Back) or **F** (Forward), to edit the information entered.

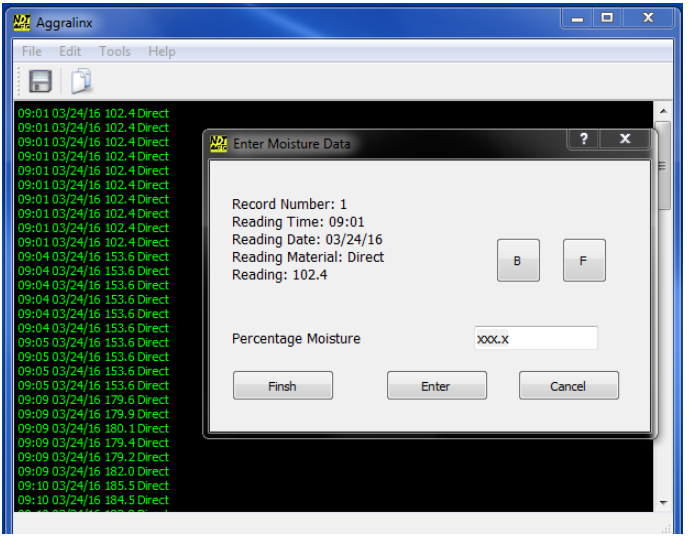

Figure 39: Software Analyze Menu Item

3. The software will take you through each record. Clicking **Enter** will update the data in the file, and advance to the next record number. Clicking **Cancel** cancels the edit operation. Be sure to “Save” the edited data records, to continue moisture percentages at a later time.
4. Once the last data point has been entered, click **Finish** in order to generate the correlation curve. (See Fig. 30)

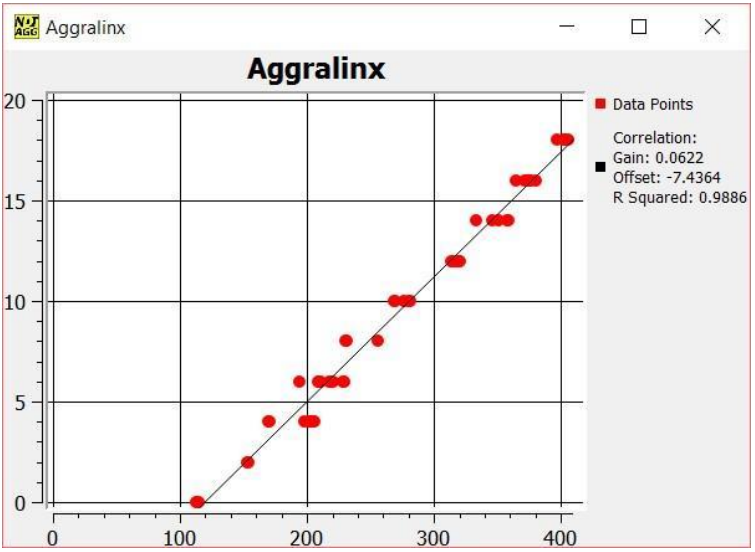

Figure 30: Software Regression Graph

The data is now graphically displayed.

The Gain and Offset parameters are located along the right side of the Regression Graph. The two values can now be used to create a Custom User model in the Change User Material mode.

(**Note**: Be sure to record these Values, so they can be added again in the event of a memory loss.)

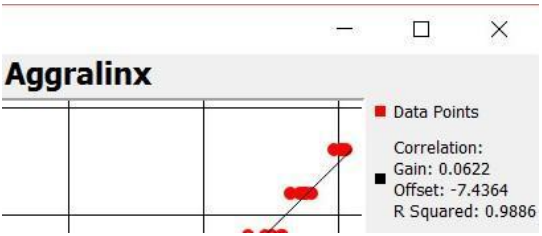

Figure 31: Software Regression Graph Gain and Offset

Instrument Calibration

For the best results with the Aggrameter®, the user should create “user” programs for the different materials the equipment will test. (**Note**: Aggregates can only absorb a certain amount of water. Thus, when evidence of standing water appears on the surface of the aggregate sample, the sample has reached saturation and can no longer absorb additional water.)

To calibrate the unit:

1. Collect 2 to 3 kilograms of the material you wish to calibrate the unit with.
2. Weigh the material and record the value.
3. Bake the material in an oven at 110° to 130° Fahrenheit (or 43° to 55° Centigrade), until it is dry and no longer loses any weight.

   When the material has thoroughly dried and lost all of its moisture, the calibration can start.
4. Set the material in a non-metallic container at least 7.5” in diameter, two-and-a-half times larger than the diameter of the 3” probe.
5. Weigh the dried material and record the value.
6. Turn on the Aggrameter®; using the  keys, scroll to **Direct**.

   To prevent any confusion, it is recommended to erase all prior data saved in the Aggrameter® unit.
7. Take a moisture reading of the dry material.
8. Take 10 readings for each moisture percentage starting at 0%. Store each reading by pressing **Enter**.
9. Add water to the material in 2% increments and mix it thoroughly in order to get consistent readings.

   (Note: Use the dried material weight to determine the proper volume of water to add. For example, 2% of a 2000 gram sample would be 40 grams.)

10. Continue adding water and taking data readings. This procedure should be repeated until the sample reaches full saturation; at this point, the reading from the meter will become constant.

    Full saturation occurs when a direct reading is 409.5%. For sand, this point will be between 20% and 30%. For aggregate, this point will be between 7% and 15%.

11. Upload the data to a PC. Refer to the Upload Data section of the Instrument Display chapter on how to do so.

12. Analyze the data. Refer to the Software Operation section starting on page 32, on how to do so.

13. Once the Microwave Moisture Regression Analysis dialog appears, the **Offset** and the **Gain** will be displayed. Record the two values for the tested mix.

14. On the Aggrameter® you can now enter a user program for the material using the calibrated Gain and Offset values. (Refer to the Change User Material section of the Instrument Display chapter on how to change a user program.)

    Once the **Offset** and **Gain** values are entered into the Aggrameter®, the calibration is complete.

    The unit can be calibrated to saturated surface dry as per standard procedures for mixing concrete. In step 3 rather than bake the aggregate down to oven dry conditions, follow the procedures for saturated surface dry.

Least Squares Analysis of a Straight Line Fit

For this method, we assume that there exists a linear relationship between the output of the probe and the amount of moisture in the material to be tested.

This relationship takes the form:
% Moisture = Gain * Direct Reading + Offset or
$y = mx + b$

What needs to be determined are the parameters - Gain (or m) and Offset (or b) from a given set of points determined by testing.
We can then define:
$S_{xx} = \Sigma x_i^2 - (\Sigma x_i)^{2/n}$
$S_{yy} = \Sigma y_i^2 - (\Sigma y_i)^{2/n}$
$S_{xy} = \Sigma x_i y_i^{\ 2} - (\Sigma x_i \Sigma y_i)/n$
Where x_i and y_i are individual pairs of values for x and y defining each of the pairs of points to be plotted, the quantity n is the number of points.
The Gain of the line (m) is now simply: $m = Sxy/Sxx$
The Offset (b) can be calculated as: $b = y_i/n - mx_i/n$
This is performed automatically by the accompanying software and is also available in most spreadsheet programs.

Coefficient of Determination
The Coefficient of Determination, also known as: R Squared (or R^2), is a number calculated during the analysis of the recorded data. It is located below the Gain and Offset values on the Regression Graph. (See page 34)
This value indicates the proportion of variance in the dependent variable that is predictable from the independent variable. And whose main propose (described by Wikipedia) is either the prediction of future outcomes or the testing of hypotheses, on the basis of other related information. It provides a measure of how well observed outcomes are replicated by the model...
(Review Wikipedia for more information on R^2...)

Maintenance

1. When the batteries are low on power, replace with two fresh "AA" size batteries. To gain access to the battery compartment, slide open the rear cover. (Verify the battery orientation before turning the unit back ON.).

2. The sensor prongs should be cleaned with a clean dry towel before and after usage. This is to prevent any build-up of material(s) which may affect future test readings.

(**Note**: Care must be used during the cleaning process to avoid any damage to the sensor prongs.)

3. In the event a prong does break, replace the damaged sensor prong (Part # T-065-10880-004) using the procedure below...
   a. Remove the 8 screws surrounding the white ring on the sensor probe base.
   b. Carefully separate the white ring from the sensor probe housing.
   c. Remove the internal nut from the damaged sensor prong, and unscrew the bad prong from the white ring (or base). (Note: The prong may be tight.)
   d. Reinstall the new sensor prong in the reverse order.
   e. When re-assembled, the unit is now ready for use.

Safety

Do not submerge unit in water; as this may cause
an electrical shock to the user.
The probe prongs are pointed, and can puncture the skin.

Specifications

Aggrameter® T-T-100

Moisture Range	0 - 20% by Dry Weight
Frequency	50 MHz
Power	2 AA Batteries
Display	2 x 16 Character LCD
Data Link	USB serial port
Weight	4 lbs. (1.8 kg)
Extension Pole	41 inches (~ 1041 mm) Maximum Length

Warranty Information

1. Contract

Unless otherwise stated all sales transactions are expressly subject to these terms and conditions. Modification or additions will be recognized only if accepted in writing by an authorized Officer of James® Instruments Inc. (hereinafter referred to as “James®” or the “Company”), or an officially designated representative. PROVISIONS OF BUYER'S PURCHASE ORDER OR OTHER DOCUMENTS THAT ADD TO OR DIFFER FROM THESE TERMS AND CONDITIONS ARE EXPRESSLY REJECTED. NO WAIVER OF THESE TERMS AND CONDITIONS OR ACCEPTANCE OF OTHERS SHALL BE CONSTRUED AS FAILURE OF THE COMPANY TO RAISE OBJECTIONS.

2. Warranties

The Company only warrants the equipment manufactured or supplied by the Company as set forth herein. James® makes no other warranties, either expressed or implied (including without limitation, warranties as to merchantability or fitness for a particular purpose). In no event shall James® be liable for any type of special, consequential, incidental, or penal damages, whether such damages arise out of or are a result of breach of contract, warranty, negligence, strict liability or otherwise. Warranty shall not apply where the equipment manufactured or supplied has been subject to accident, alteration, misuse, abuse, improper storage, packing, force majeure, improper operation, installation, or servicing. In addition, the following shall constitute the sole and exclusive remedies of Buyer for any breach by James® of its warranty hereunder.

a. New Products

James® warrants the equipment manufactured or supplied by James® as set forth herein. This limited warranty can only be exercised by the original purchaser of the equipment from James® or authorized James® Agent and is not transferable to any subsequent owner or party. This limited warranty gives you specific legal rights, and you may also have other rights which vary from case to case.

i. For James® Equipment

James® warrants that James's equipment will be free from defects in materials and workmanship for a period of twenty-four (24) months on the electronic portion and six (6) months on the mechanical portion from the date of shipment of equipment from James® to Buyer. Should any defects be found and reported by the Buyer during the applicable limited warranty period, the defect will be corrected upon return of the item to James®. James® will, during the applicable new equipment warranty period, provide the necessary replacement parts and labor to correct the defect.

Excluded from the new equipment warranty are all consumable and wear and tear items such as impact bodies, penetrators, connection cables, etc. These items are subject to usual wear and tear during usage. Refer to the Consumable, Wear and Tear Items section of this warranty document.

Option For Extended Limited Warranty Coverage

The original purchaser of any new equipment of James® which have been identified or labeled by James® from time to time in James's® sole discretion as being eligible for extended warranty coverage shall have the option to purchase certain extensions of the applicable limited warranty provided hereunder to the electronic portion of any such items for either a twelve (12), twenty-four (24) or thirty-six (36) month period (up to a possible maximum limited warranty coverage period for the electronic portions of such new James® equipment of sixty (60) months) by purchasing any such twelve (12), twenty-four (24) or thirty-six (36) month limited warranty extension period either all the time of the purchase of any such item(s) or within ninety (90) days from the date of delivery of the subject item(s) of the original purchaser of such item(s). The price for each such extended limited warranty coverage period shall be as determined by the Company from time to time and all such purchases of any extended warranty coverage periods shall only be effective upon a completed purchase order and payment directly between James® and the original purchaser of any such item(s). The extended warranty coverage periods are only valid with respect to the original purchaser of such item(s) from the Company and such extended warranty coverage is not transferable to subsequent owners of the subject item(s) or any other parties. Upon the purchase of any extended limited warranty coverage period, the Company will issue a certificate to Buyer evidencing the details of the applicable extended warranty coverage period purchased by the Buyer.

ii. For Other Manufacturer's Products Supplied by James®

Products of other manufacturers supplied as such by James® are warranted by James® only to the extent of any warranty provided by the original manufacturer, if any.

iii. For Parts and Sub-Assemblies

Parts or sub-assemblies purchased by the Buyer to perform its own repair work etc. are warranted as provided

hereunder by James® for six (6) months from date of shipment of material from James® to Buyer.

iv. For Consumables, Wear and Tear Items
James® supplies consumable items and items subject to wear and tear during normal usage of James® supplied products. These items are not covered under warranty. Buyer is to check for proper fit, form and function of such items upon receipt of such items. In case of a defect condition, Buyer can return the item to James® for evaluation within thirty (30) days of the date of shipment to the Buyer. James® reserves the exclusive right to issue full, partial, or no credit to the Buyer based on the condition of the returned item and circumstances related to the return. Examples of items in this category: connection cables, test blocks, impact bodies, penetrators, probes, extraction liquids, calibration liquids, pins, recording paper, test plugs, etc.

b. Calibration and Repair

i. For Calibration Services
James® does not warrant the calibration of any equipment. James® does however warrant the equipment manufactured by it, in proper working condition, to be capable of being adjusted to meet James® printed specifications, if any, for accuracy and performance as to the particular model type during the period of warranty applicable as stated above.

ii. For Repair Services
James® warrants repair work performed under the direct control and supervision of James® personnel for a period of three (3) months from the date repairs are completed either at James® or at the customer site. Should the defect for which the repair work was performed reoccur within this period, James® will supply the necessary parts and labor (repair at James® facility) or parts (repair at Buyer facility) required to repair the original equipment defect for which the repair parts and labor were required. Additional repair charges that may be incurred in conjunction with any repair service warranty event will be invoiced at the James® customer service rates and policies in effect at the time of the event.

Excluded are all consumable and wear and tear items such as impact bodies, probes, connection cables, etc. These

items are subject to usual wear and tear during usage. Refer to the Consumable Wear and Tear Item section of this warranty document.

c. Warranty Claims

i. For Warranty Claim Processing
James® has established James® organizations in the Americas, and Europe. Please visit the James® web site www.ndtJames®.com for latest address and contact information for the James® organization nearest you.

3. Regulatory Laws and/or Standards
The performance of the parties hereto is subject to the applicable laws of the United States. The Company takes reasonable steps to keep its products in conformity with various nationally recognized standards and such regulations, which may affect its products. However, the Company recognizes that its products are utilized in many regulated applications and that from time to time standards and regulations are in conflict with each other. The Company makes no promise or representation that its product will conform to any federal, provincial, state or local laws, ordinances, regulations, codes or standards except as particularly specified and agreed upon for compliance in writing as a part of the contract between Buyer and the Company. The Company prices can not include the cost of any related inspections or permits or inspection fees.

4. Notices
Notice by either the Company or Buyer will be made only by facsimile or similar electronic transmission, effective on the first business day after confirmed receipt, or by letter addressed to the) other party at its address as provided in this Agreement, effective three (3) business days after deposit with the U.S. Postal Services, postage prepaid, or one (1) business day after deposit with a recognized overnight express service.

5. Interpretation
Should any term or provision contained In the contract contravene or be invalid under applicable law, the contract shall not fail by reason thereof but shall be construed in the same manner as if such term or provision had not appeared therein.

6. Assignability
Neither this contract nor any claim arising directly or indirectly out of or in connection herewith shall be assignable by Buyer or by operation of law, without the prior written consent of Company. This document shall be binding upon and inure to the benefit of each party hereto and their respective permitted successors and assigns.

7. Governing Law

This Agreement shall be governed by and construed in accordance with the internal laws of the State of Illinois, without regard to its conflict of laws provisions. Buyer and the Company expressly agree to submit to the personal jurisdiction of the federal and/or stale courts silting in Chicago, Illinois, U.S.A. and agree that such courts may be utilized if necessary to obtain injunctive or any other relief. The Hague Convention and the United Nations Convention on Contracts for the International Sale of Goods shall not apply to the construction or interpretation of these Standard Terms and Conditions or affect any of its provisions.

END.