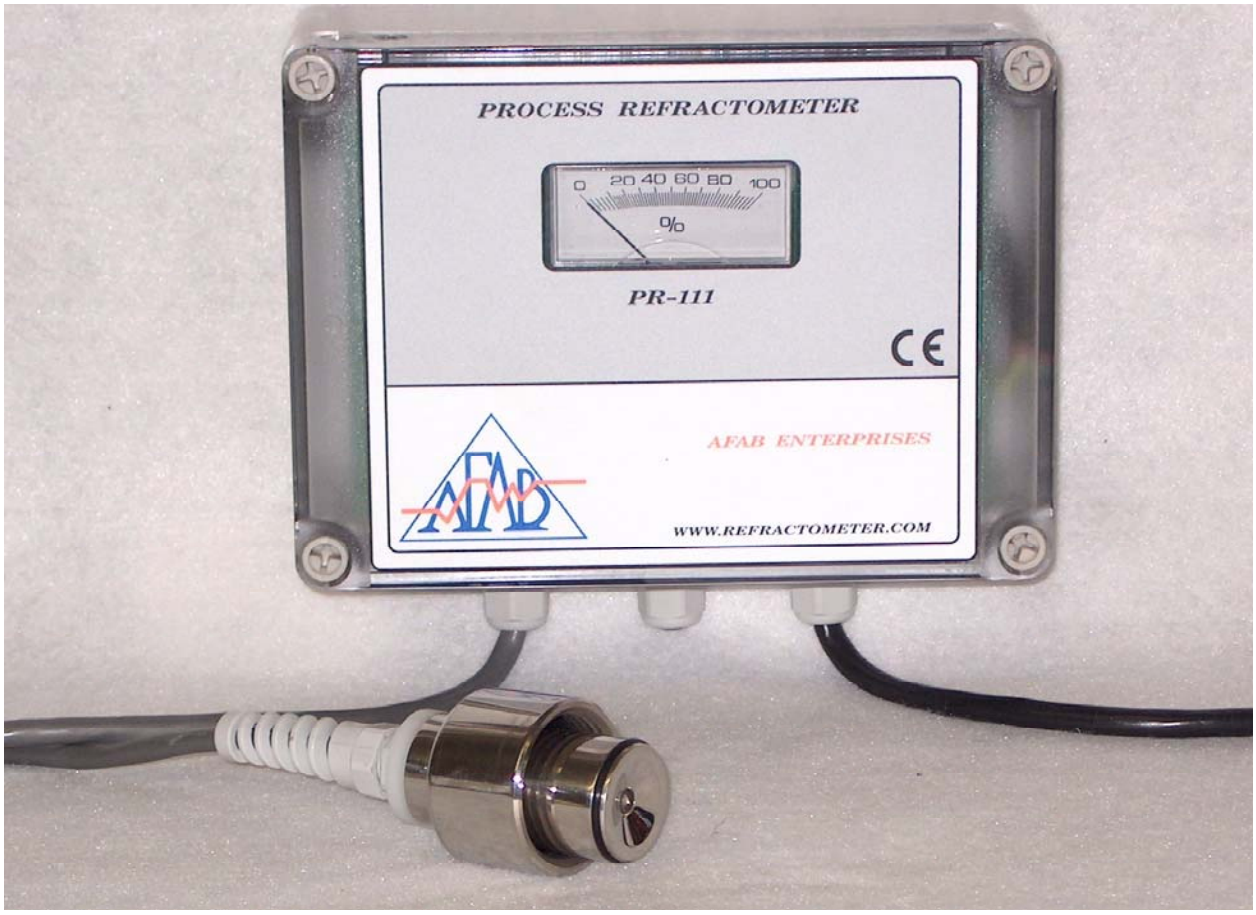
ENTERPRISES



PR-111

INLINE PROCESS REFRACTOMETER

INSTALLATION MANUAL

PR-111

INSTALLATION AND OPERATING INSTRUCTIONS

STEP #1: PACKAGE INSPECTION:

Upon receipt of your order, unpack and inspect the instrument for possible damage during shipment. Fill out the warranty registration card and return it to AFAB Enterprises. Do this first.

Because the PR-111 is an inline instrument, it is essential that the following steps be followed for calibration verification. DO NOT ATTEMPT TO VERIFY THE PERFORMANCE OF THIS INSTRUMENT USING A BENCH TOP SETUP OF THE PR-111 WITHOUT CONSULTING THE FACTORY.

DO NOT UNDER ANY CIRCUMSTANCES IMMERSE THE PROBE INTO THE LIQUID TO BE MEASURED.

Note: The following procedure(s) require time and patience. Please follow these directions carefully.

STEP #2: ADAPTER INSTALLATION:

Install the adapter into your process line in the intended location. The adapter provided with your PR-111 is specially designed and built to match your process line specifications. In order for the PR-111 to provide optimum performance, it is essential that the adapter is installed correctly. Orient the adapter so that the probe mount (spud) is on the side of the process line, allowing the probe to be mounted parallel to the floor. Adapters installed in vertical pipe runs (liquid flowing up the pipe) may be installed in any convenient position.

Adapters installed in horizontal pipe runs must be installed on the side of the pipe, so that the body of the probe will be parallel to the ground (see next page for illustration). It is essential that the probe is parallel to the ground. This eliminates the collection of air bubbles or sedimentation on the probe prism.

PROBE INSTALLATION

THE PHOTO BELOW ILLUSTRATES A GOOD INSTALLATION OF THE PR-111 INLINE PROCESS REFRACTOMETER'S PROBE. NOTE THAT THE PROBE IS INSTALLED PARALLEL TO THE FLOOR.

PR-111 Probe in horizontal pipe installation

STEP #3: CONSOLE LOCATION:

Locate the PR-111 enclosure in a convenient location where it may be viewed easily. This should be a clean, dry area, suited for operator convenience, and free from temperature and humidity extremes.

STEP #4: SENSING PROBE:

Install the measurement probe in the spud mounting piece provided on the process adapter and check carefully for proper alignment**.** Note that the probe uses an O-ring seal around the face of the probe to eliminate leakage. The retaining nut does not provide the seal, and so does not have to be overly tightened for a good O-ring seal. **To ensure proper sealing of the probe, hand-tighten the probe nut. Do not overtighten the retaining nut, and do not use a pipe wrench for this procedure.** Again, be sure that the probe is mounted parallel to the floor. (See page 13 for photo).

STEP #5: PROVIDE CURRENT OUTPUT (4 – 20mA):

If you are running the output from this instrument to a PC, data logger or PLC-type device, you will need to connect the 4-20mA output of the unit to your system.

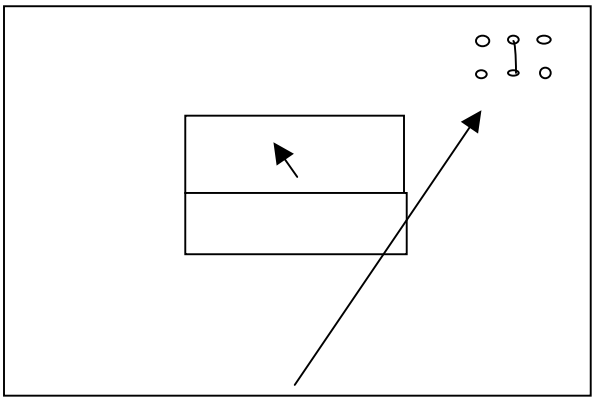
NOTE: The PR-111 provides a non-isolated 4-20mA output. You will need an isolated input for your recording/controlling device.

The 4-20 mA output connections are located on the circuit board inside the console at TB-2. This terminal board is located inside of the instrument console on the rear of the PC board. See FIGURE 6 for details.

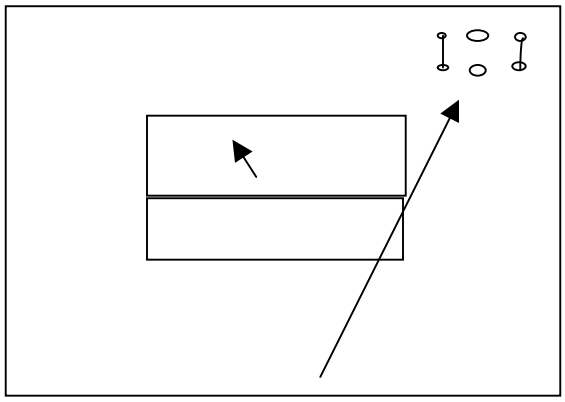
Maximum loop resistance for this circuit is 600 ohms.

STEP #6: ELECTRICAL POWER:

Plug the electrical power cord provided with your unit into your specified power supply. (You can check the power supplied on the PR-111 circuit board by checking the top right corner of the circuit board – see below. If you have a single wire connection in the center (J1) position, the unit is set up for 220VAC. If you have two connections, one on each of the outer (J2 & J3) positions, the unit is set up for 110VAC. The position numbers are marked on the back of the board.)



220 VAC



110VAC

CAUTION: If your power cord does not match the outlet you have available, do not attempt to plug the unit into that power supply without confirming the power supply requirements for the PR-111. Severe damage will result if the power supplied is not compatible.

If your unit is not shipped with a power cord, connect a clean source of appropriate voltage to TB-1 terminals located inside the instrument console on the rear of the circuit board.
See FIGURE 5 for details.

STEP #7: BEGIN PROCESS OPERATION:

Once the adapter is in place in your process line, the probe has been inserted, and you have a good O-ring seal, begin the process operation. Once the process liquid is flowing past the sensor, check the sensing probe to insure a proper seal between the probe and it's mounting spud on the process adapter. No process fluid should be seen in the area of the retaining nut. Allow the process fluid to attain normal process operating conditions of temperature and fluid concentration. Note that these operating conditions should be reflected in the specifications used for calibration of the PR-111. Apply power to the PR-111.

STEP #8: CALIBRATION VERIFICATION:

NOTE: All adjustments made to the PR-111 potentiometers should be made using a non-ferrous screwdriver to avoid magnetic influences on the analog meter readings.

Once the above steps have been followed:

a. Take a sample of the process fluid, and simultaneously record the meter reading on the PR-111 meter.

b. Do a lab analysis of the sample fluid.

c. Return to the PR-111. Look at the new meter reading:

1. If the meter reading has changed while lab analysis was being performed, add or subtract the difference between the old meter reading and the lab analysis to the new meter reading. Adjust the coarse and/or the fine zero potentiometers to bring the meter reading to this number

2. If the meter reading has not changed, adjust the coarse and/or fine zero potentiometers to match the new meter reading to the lab analysis.

FINE TUNING:

IT WILL PROBABLY BE NECESSARY TO ADJUST THE FINE ZERO TO OBTAIN THE DESIRED READING AS REFERENCED TO YOUR LAB STANDARD AFTER THE UNIT HAS BEEN INSTALLED. Allow the process temperature and concentration to stabilize and the measurement probe to come into equilibrium within normal operating conditions. To fine tune, use the FINE ZERO adjustment ONLY ! Set the fine zero adjustment located on the front of the circuit board so that the PR-111 reading agrees with your known process sample.

ANALOG METER:

The analog meter display and 4-20mA output correspond to the customer provided range of the instrument. Reference the calibration certificate to verify your instrument settings.

For example, if the instrument is calibrated for 10 – 20% solids, 0% on the analog meter and an output of 4mA correspond to a reading of 10% solids. Also, 100% on the analog meter and an output of 20mA correspond to a reading of 20% solids.

RECALIBRATION INSTRUCTIONS

NOTE: Do not attempt to recalibrate the PR-111 unless you are changing the operating parameters of calibration span, temperature, process fluid, etc. This instrument has been carefully calibrated prior to shipment and re-calibration in the field is not necessary. Please contact AFAB Enterprises before beginning a recalibration procedure.

TEST AND CALIBRATION:
Note: Please do not perform these procedures unless you are sure that the unit is incorrectly calibrated. In most cases, only the fine zero will require adjusting. Again, use a non-ferrous screwdriver when making these adjustments.

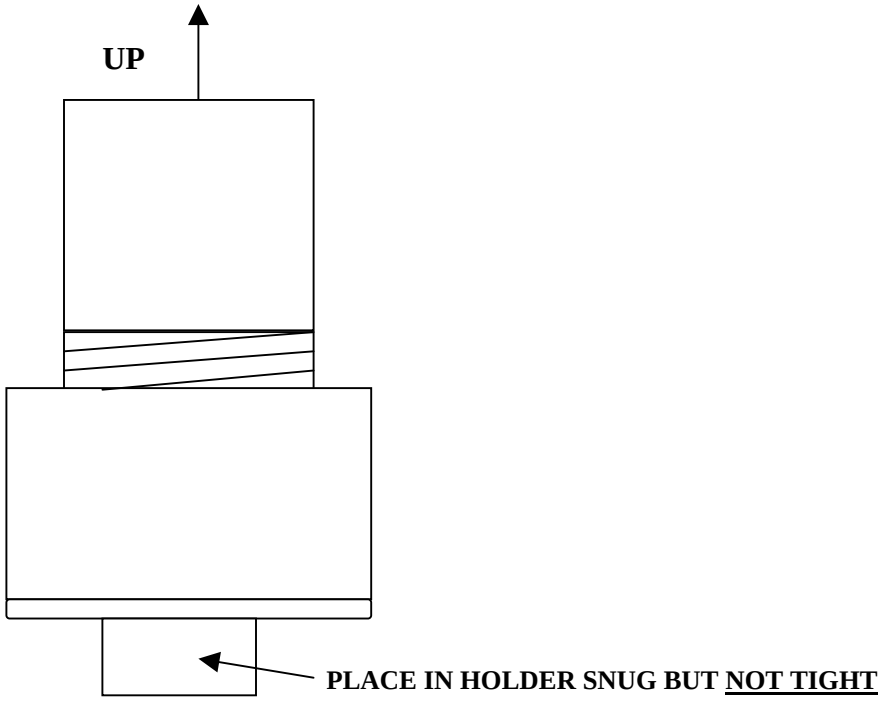
TO BEGIN: **APPLY ELECTRICAL POWER TO THE INSTRUMENT AND ALLOW 3 MINUTES FOR THE INSTRUMENT TO ACHIEVE STABLE OPERATION. BE SURE SWITCH <u>S1</u> ON THE CIRCUIT BOARD IS IN <u>OP MODE.</u>**

TO USE SAMPLE CHAMBER:

1. Insert the probe into the sample chamber and hand-tighten the probe nut.

2. Use some available stand to hold the probe so that the open end of the sample chamber is up.
   (See Figure 1, BELOW)

FIGURE 1:



When applying the sample:

1. Fill the sample chamber ¾ full.
   (See Figure 2, BELOW)

FIGURE 2:

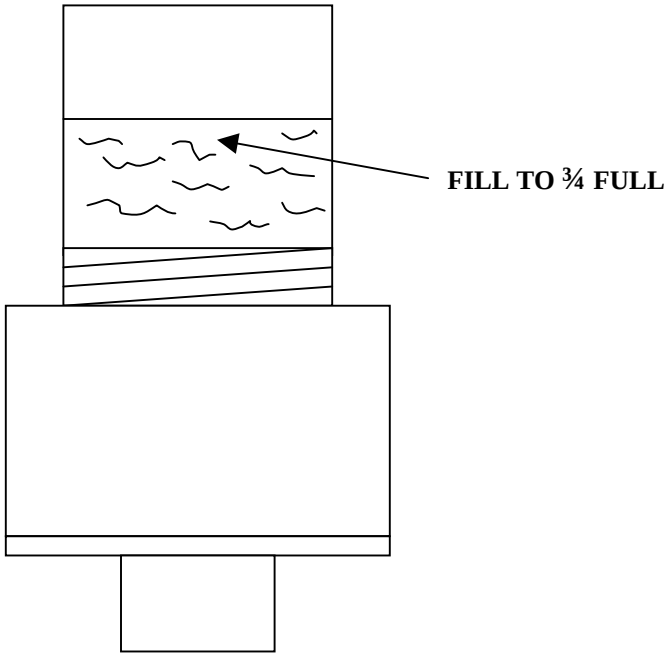
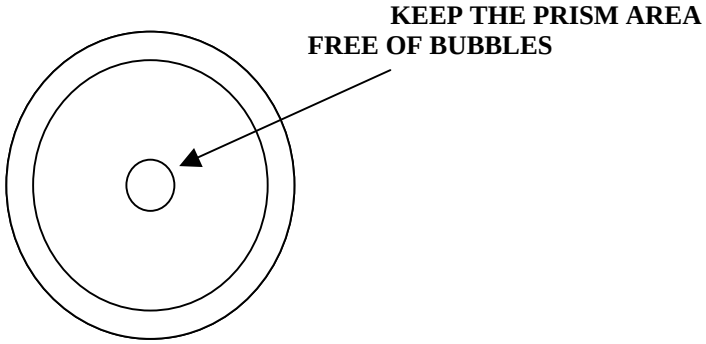


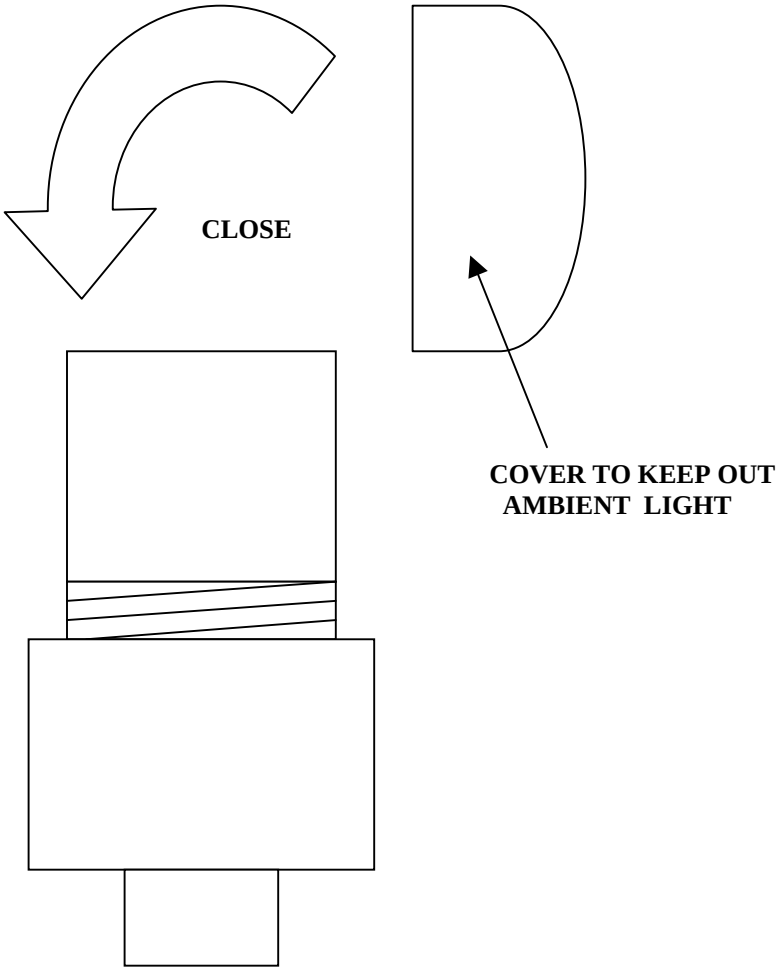
FIGURE 3:



2. Make sure there are no bubbles on the prism. Stirring gently with a cotton swab will help to assure this.

Cover the sample chamber to prevent the effects of ambient light.
(See Figure 4, BELOW)

FIGURE 4:



3. Note the indication on the analog meter.

4. Uncover the sample chamber and repeat steps 2-5 several times to make sure that the reading is stable and repeatable.

NOTE: Any air, dirt, coating, or particles on the prism will produce an error in the reading. Ambient light is also a source of error, so it is essential to cover the sample chamber when taking a measurement. Samples that contain suspended particles, must be stirred so that the particles do not settle on the prism.

MEASUREMENT ZERO AND SPAN:

1. Fill the calibration chamber 3/4 full, with a sample of the low range value of product or equivalent sugar or syrup solution. Cover the chamber to exclude ambient light. If adjustment is required, adjust the COARSE ZERO trim pot on the circuit board to achieve the desired meter reading. Use FINE ZERO for the final setting.

2. Empty the chamber and clean and dry it thoroughly. Fill the chamber (3/4 full) with a sample of the high range product or equivalent sugar or syrup solution. Cover the chamber to exclude ambient light. If an adjustment is required, adjust the SPAN trim pot on the circuit board to achieve the desired meter reading.

Note 1: The zero and span adjustments should be repeated until there is no longer any adjustment required when moving between the values. If the "low" sample reads above 0% of scale, there will be an effect on this "low" reading when the span is adjusted. The amount will be equal to the % of scale for the "low" reading times the % of scale change in the span reading.
Note 2: Final zero setting should be accomplished in the process line under normal process conditions, as described in the section INITIAL CALIBRATION CHECK.

TEMPERATURE COMPENSATION:

1. Allow the instrument to stabilize at the low value of the temperature compensation range. This range should not exceed +/- 20 degrees F. around a nominal value. Note the measurement value as indicated by the PR-111, and make an accurate determination of the actual process concentration using an actual process sample.

Note: It is important to obtain this PR-111 measurement value using a device of the highest resolution possible. Use the digital meter supplied with the SM-2 Smart Meter, or attach a quality digital milliammeter to the 4-20 mA output of the PR-111.

2. Attach a quality voltmeter to read DC VOLTS between TP6 and GROUND on the PR-111 circuit board, then zero the voltmeter using the THERM ZERO potentiometer.

3. Increase the temperature of the process line and stabilize it at the desired high range temperature. Note the PR-111 measurement value as in step one of this procedure, and make an accurate determination of the actual process concentration using a new process sample at this new temperature, if this is a dynamic setup.

4. Find the difference between the PR-111 indicated high and low temperature values (Hval – Lval). Adjust the THERM GAIN trim pot on the circuit board to increase or decrease the indicated value of the PR-111 meter by this difference amount.

Note: Adjustment of the PR-111 fine zero may be necessary after this temp. comp. adjustment is made. See **Initial Calibration Check** for details.

NOTE: <u>This calibration should not be rushed. the temperature shift must be slow and the instrument must be allowed to come to equilibrium with the established temperature prior to making any adjustments.</u>

ADJUSTING THE 4-20 mA. OUTPUT:

1. Connect a 100 ohm resistor in series with a milliammeter and connect them to the 4-20 mA terminal block (TB2). Terminal 1 is positive, Terminal 2 is shield, Terminal 3 is negative. Your meter and resistor should be connected between terminals 1 and 3.

2a. With a known process sample in the calibration chamber, Note and record the present reading as displayed on the PR-111 analog meter and /or SM-2 digital meter. Adjust the coarse zero pot. to obtain a zero reading on the PR-111 analog meter and/or SM-2 digital meter. Now adjust the 4-20 ZERO trim potentiometer to obtain 4.0 mA. reading on the milliammeter.

2b. With the same sample in the chamber, adjust the coarse zero potentiometer to obtain a 100% reading on the PR-111 analog meter and/or SM-2 digital meter. Now adjust the 4-20 SPAN trim potentiometer for a reading of 20 mA on the meter.

3. After completing these two adjustments readjust the coarse zero potentiometer to return the PR-111 analog meter and/or SM-2 digital meter to the original reading as recorded in step 2a of this procedure.

NOTE: The ZERO and SPAN adjustments should be repeated until there is no longer any adjustment required when moving between the two values.

TB-1 on
Rear of PR-111 ckt. bd.

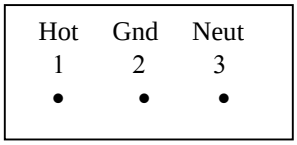


FIG. 5

TB-2 on
Rear of PR-111 ckt. bd.

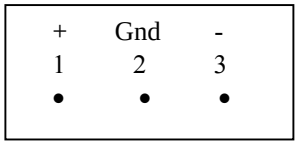


FIG. 6

CAUTION:

THIS INSTRUMENT IS PACKAGED IN A NEMA 4 POLYCARBONATE ENCLOSURE. CARE SHOULD ALWAYS BE EXERCISED TO ENSURE THAT THE COVER IS PROPERLY SECURED TO PREVENT MOISTURE DAMAGE OR ELECTRICAL SHOCK.

WHEN THE COVER IS REMOVED FOR CALIBRATION OR SERVICE, BE ADVISED THAT POTENTIALLY LETHAL VOLTAGES ARE EXPOSED ON SOME CIRCUIT BOARD TERMINATIONS. PLEASE EXERCISE EXTREME CAUTION.

WHEN REMOVING THE SENSING HEAD FROM A FILLED OR PRESSURIZED LINE, NO PRESSURE SHOULD BE FELT ON THE HEAD AS THE MOUNTING NUT IS LOOSENED. INDICATIONS OF PRESSURE SHOULD BE INVESTIGATED BEFORE PROCEEDING.

DISPERSION "BACKSCATTER" CIRCUIT

THEORY OF OPERATION:

The standard optical probe utilizes a reference and a measurement silicon detector. Also inside the probe is a third detector, which has been positioned to respond to scattered or "dispersed" light from suspended substances or the light dispersion qualities of the product sample. The current generated by this third cell is, therefore, proportional to the light scattering qualities of the product sample. The current is converted to a voltage and is integrated into the measurement signal of the refractometer to effectively "null" the error-causing effect of this "scattered" light. The dispersion circuit is adjusted by a trim potentiometer (P1) on the dispersion circuit board.

If your instrument has been custom calibrated at the factory using a sample of your product, adjustment of the dispersion circuit should not be required. In the event you change the chemistry of your solution and this change effects these optical qualities of the product it may be necessary to adjust the dispersion bias potentiometer to compensate for the formulation change. Clockwise rotation of the potentiometer will increase the effect of the dispersion circuit.
NOTE: DO NOT ADJUST THE DISPERSION CIRCUIT WITHOUT PRIOR CONSULTATION WITH THE FACTORY.

ADJUSTMENT:

If your instrument was not custom calibrated at the factory the dispersion bias potentiometer is pre-set 10 turns counter clockwise, thus there is very little dispersion compensation provided. The following steps are necessary to calibrate the dispersion circuit:
Note: It is very important to understand that the overall objective of this adjustment is to negate the effects of the light scattering qualities of one or more different solutions of the same Brix or concentration value.

DIFFERENCE BETWEEN TWO SAMPLES

1. Make an accurate determination of the concentration of the two product solutions under question to insure that they are of the same dissolved solids concentration. Ideally they should both be equal to mid range concentration. They will be referred to as best case (clearest) and worst case (occluded) samples.
2. Expose the sensor to the best case sample using the sample chamber as before, and make note of the display reading on the PR-111 Refractometer. Empty and clean the

sample chamber thoroughly.

2. Expose the sensor to the worst-case sample using the sample chamber and adjust the dispersion bias potentiometer (P1) to obtain a display reading equal to four or five times the difference noted between the samples. CCW if worst-case reads higher than best-case, CW if worst-case reads lower than best-case. The solution should be agitated to insure that that any particles under suspension are maintained in the same manner as if they would be under actual process conditions. It will be necessary to readjust the coarse and fine zero adjustments to restore the instrument reading to its original value after each adjustment of P1. This procedure should be repeated until there is no difference in reading between worst-case and best-case samples.

Note 1: It is important that the concentrations and temperatures of these two samples remain the same as this adjustment is made.

Note 2: In the case that more than two solutions are to be compared, it will be necessary to select the best and worst case solutions for adjustment purposes. The intermediary solution should be used as a check after the adjustment has been completed.

Note 3 Because there is an interaction between the DISPERSION POTENTIOMETER (P1) and the instrument ZERO and SPAN POTENTIOMETERS, it will be necessary to recalibrate the PR-111 after the dispersion adjustment is made.

Note 3: In the unlikely event that there is insufficient range of the COARSE and FINE ZERO adjustments, you may extend their ranges by completing one of the following procedures. To increase their CCW direction solder a 100 K ohm resistor from the wiper of the coarse zero potentiometer to PIN 4 (plus 12 V) of any convenient operational amplifier. To increase their CW direction solder a 100 K ohm resister from the wiper of the coarse zero potentiometer to PIN 11(minus 12 V.) of any convenient operational amplifier.

SMART METER INSTRUCTIONS NOTE:

If the SM-2 “Smart Meter” has been supplied with the PR-111, the instruction manual will be included. **The SM-2 has been calibrated along with the PR-111 and should not require calibration. If it is determined that re-calibration is necessary, please refer to this manual for instructions, or contact AFAB Enterprises for assistance.**

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www.refractometer.com

One-Year Limited Warranty

For one year after the date of shipment to End-user, the Supplier will, at its sole discretion, replace, repair or furnish credit for any product purchased by End-user that, in the Supplier's judgment, has a defect in material or workmanship, provided the product is returned, transportation charges prepaid, to the Supplier with the Supplier's prior permission and return authorization number, and provided further that the product has not been misused (including electrostatic discharge), improperly operated, or subjected to unauthorized repairs or modifications. This warranty is in lieu of all other warranties, expressed, implied or statutory, including the warranty of merchantability and the warranty of fitness or of suitability for a particular purpose and of all other obligations or liabilities on the Supplier's part, and the Supplier neither assumes nor authorizes any other person to assume for the Supplier any other liabilities in connection with the sale of the said product. If the Supplier's examination does not disclose a defect in material or workmanship on a product claimed to be defective, the End-user agrees to pay the Supplier's established charges for unpacking, testing, and repackaging the product for reshipment to the End-user. This provision states the End-user's exclusive and sole remedy for breach of warranty. This provision does not extend the original warranty period of any product that has been repaired or replaced by the Supplier.

This warranty is the only warranty made by the Supplier with respect to the goods delivered under this Agreement, and may be modified or amended only by a written instrument signed by a corporate officer of the Supplier and accepted by the End-user. The products that at the End-user's request are delivered without complete encapsulation are specifically excluded from the warranty set out in this Agreement. All such products are sold "as is."

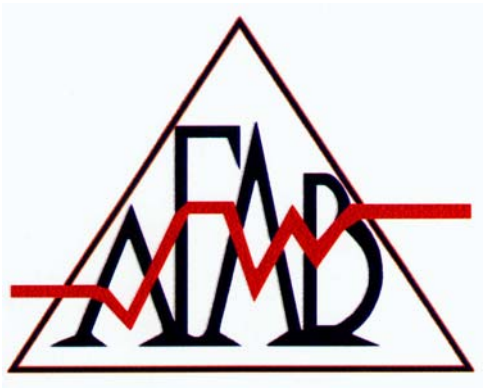
Disclaimer, No Other Warranty. Except for the express warranty set forth above, the Supplier grants no other warranties, express of implied, by statute or otherwise, regarding the products, their fitness for any purpose, their quality, their merchantability, or otherwise.

Limitation of Liability. The Supplier's liability under the warranty shall be limited to replacement, repair or credit for the customer's purchase price. In no event shall the Supplier be liable for the cost of procurement of substitute goods by the customer or for any special, consequential or incidental damages for breach of warranty.

30 Day Trial Evaluation

The parameters of the 30-day trial evaluation are fairly simple and common sense. If you have established credit with us you can order the unit with a Purchase Order and be billed on a Net 30-day invoice. At the end of the 30 days you can either pay the invoice or send the unit back. If you do not have established credit with us then you can purchase the unit, and if you return it, receive a refund.

The unit must be in like-new condition for return. If the unit has been abused, repair or replacement costs will be charged. The trial evaluation applies to the PR-111 and the Steam Purge Control units only. Adapters and Smart Meters are made to order and are not returnable or refundable.



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