Precision Microwave Moisture Measurement

User's Manual

6510020267 (supersedes 46022400)

Precision Microwave Moisture Measurement

December, 2006

Confidentiality Statement

Notice

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Introduction

This manual enables Honeywell field and factory personnel to install, calibrate, and maintain Honeywell Precision Microwave Moisture Sensors on Da Vinci Systems.

Audience

This manual is intended for use by engineers or process engineers and assumes that the reader has some knowledge of the operation of a paper machine and a basic understanding of mechanical, electrical and computer software concepts.

About this manual

This manual contains nine chapters.

Chapter 1, **Installation**, describes the Precision Microwave Moisture Sensor installation procedure.

Chapter 2, **Sensor Specifications,** describes the sensors and their specifications.

Chapter 3, **Software Description,** provides the calibration equations and calibration constants for the non-contacting, dual-sided Precision Microwave Moisture Sensor.

Chapter 4, **Hardware Alignment,** describes the hardware alignment procedures.

Chapter 5, **Static Calibration,** describes the static calibration procedure.

Chapter 6, **Da Vinci System Maintenance/Calibration Software,** describes the Precision Microwave Moisture Sensor maintenance/calibration software used on the Da Vinci System.

Chapter 7, **Dynamic Calibration,** describes the dynamic calibration procedure.

Chapter 8, **Da Vinci System Production Software**, explains how to perform a dynamic calibration of the Precision Microwave Moisture Sensor using the Real-Time Application Environment (RAE) software.

Chapter 9, **Troubleshooting,** describes common troubleshooting procedures.

Related reading

Use this manual in conjunction with the Scanpro Manuals (DS-20, DS-30, and SA-150). The Scanpro manuals provide a detailed description of the sensor electronics, show typical waveforms, and give the layout and schematic diagrams of the printed circuit boards.

Some descriptions of the Scanpro sensors and some figures in this manual have been copied (with modifications) from the Scanpro manuals.

The document *Microwave Moisture Sensor Forms* (p/n 42000857) consists of three pages of forms that may be helpful in calibrating and maintaining the sensors.

Installation drawing 092270xxI contains the installation schematic diagram for the sensor. See Chapter 4.

These documents contain related reading material.

Honeywell p/n	Document Title / Description
46018100	Precision Platform Installation and Setup Manual
46018200	Da Vinci System Installation and Setup Manual

Honeywell p/n	**Document Title / Description**
6510020192	Da Vinci Operator’s Manual

Conventions

These conventions are used in this manual:

NOTE: Text may appear in uppercase or lowercase except as specified in these conventions.

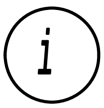
`Boldface`	Boldface characters in this special type indicate your input.
`Special Type`	Characters in this special type that are not boldfaced indicate system prompts, responses, messages, or characters that appear on displays, keypads, or as menu selections.
Italics	In a command line or error message, words and numbers shown in italics represent filenames, words, or numbers that can vary; for example, filename represents any filename. In text, words shown in italics are manual titles, key terms, notes, cautions, or warnings.
Boldface	Boldface characters in this special type indicate button names, button menus, fields on a display, parameters, or commands that must be entered exactly as they appear.
lowercase	In an error message, words in lowercase are filenames or words that can vary. In a command line, words in lowercase indicate variable input.
Type	Type means to type the text on a keypad or keyboard.
Press	Press means to press a key or a button.
`[ENTER]` or **`[RETURN]`**	**`[ENTER]`** is the key you press to enter characters or commands into the system, or to accept a default option. In a command line, square brackets are included; for example: **`SXDEF 1 [ENTER]`**
`[CTRL]`	**`[CTRL]`** is the key you press simultaneously with another key. This key is called different names on different systems; for example, **`[CONTROL]`**, or **`[CTL]`**.
`[KEY-1]-KEY-2`	Connected keys indicate that you must press the keys simultaneously; for example, **`[CTRL]-C`**.

Click — Click means to position the mouse pointer on an item, then quickly depress and release the mouse button. This action highlights or "selects," the item clicked.

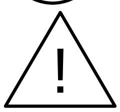
Double-click — Double-click means to position the mouse pointer on an item, then click the item twice in rapid succession. This action selects the item "double-clicked."

Drag X — Drag X means to move the mouse pointer to X, then press the mouse button and hold it down, while keeping the button down, move the mouse pointer.

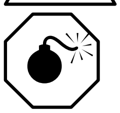
Press X — Press X means to move the mouse pointer to the X button, then press the mouse button and hold it down.



The information icon appears beside a note box containing information that is important.



The caution icon appears beside a note box containing information that cautions you about potential equipment or material damage.



The warning icon appears beside a note box containing information that warns you about potential bodily harm or catastrophic equipment damage.

Figures in this manual

Figures depicting product diagrams or schematics are included in this manual for illustration and explanation purposes only, and may not match the revision of the drawing that is currently available. Use Installation drawings that are

- shipped with the product,
- available from your local Honeywell representative/Technical Assistance Center,
- available at kview intranet site (Honeywell field personnel only).

Honeywell, Vancouver Operations part numbers

Honeywell, Vancouver Operations assigns a part number to every manual. Sample part numbers are as follows:

6510020004

6510020048 Rev 02

The first two digits of the part number are the same for all Honeywell, Vancouver Operations products. The next four digits identify part type. Type numbers 1002 designates technical publications. The next four digits identify the manual. These digits remain the same for all rewrites and revision packages of the manual for a particular product. Revision numbers are indicated after the Rev. If no revision numbers follow the part number, then it is the first edition of the manual, Rev 00.

1. Overview and Installation

This manual is intended to be used on Honeywell 092270-01 (Scanpro DS 20) Standard Range Microwave Moisture Sensors and on 092270-02 (Scanpro DS-30) High Range Microwave Moisture Sensors.

Table 1-1 shows the model numbers and maximum water range for each type.

Table 1-1. Model Numbers for DS-20 and DS-30 Dual-Sided, Non-Contacting Microwave Moisture

Marketing Model No.	Hardware Model No.	Scanpro Model No.	Maximum Water Weight
2270	092270-01	DS-20	600 gsm
2273	092270-02	DS-30	1500 gsm

1.1. Installation procedure

Before installing a Precision Microwave Moisture Sensor, read this manual, paying special attention to Chapter 2 and Chapter 4. To install the sensor:

1. Check the calibration constant table in the maintenance frame or production frame for a given code that matches that on the calibration data sheets provided with the system (see Subsection 3.1.2).

2. Check the alignment procedure for the sensor. Before aligning, familiarize yourself with the location of the three printed circuit

boards in the sensor head, and with the principles of operation and diagnostic signals (see Chapter 4).

3. Check that the sensor and central unit are connected. Open the central unit cover and observe the two LEDs in the lower left corner. The first LED (D1) is the data transmission indicator, which is on all the time; it flickers when the value changes.

   The second LED (D2) indicates a fault in the signal transmission if it is lit; it should not be lit.

4. Check the voltages in the central unit and record their values on the record sheet.

5. Check the jumper settings on both the Differentiator board and the Oscillator board to choose the proper range (standard or high).

6. Perform a stability test to make sure that the sensor is stable (see Subsection 6.3.3).

7. Enable the appropriate correctors (for example, Z-Correction, dry end, and profile correction).

8. Verify the static calibration Samples (see Section 5.6).

9. Enter Dynamic Correction calibration constants (see Section 7.1).

10. Perform dynamic calibration (see Chapter 7).

2. Sensor Specifications

Honeywell Precision Microwave Moisture Sensors are supplied by Scanpro of Bromma, Sweden. The DS-20 and DS-30 models are part of a new family of sensors with improved electronics. They are more stable, have greater range, and do not require a coaxial cable between the sensor head and the central unit at the computer bay. Table 2-1 shows the model numbers and maximum water weight ranges for dual-sided, non-contacting Precision Microwave Moisture Sensors.

Table 2-1 Model Numbers for Dual-Sided, Non-Contacting Precision Microwave Moisture Sensors

Marketing Model	Hardware Model	Scanpro Model	Maximum Water Weight
2270	092270-01	DS-20	600 gsm
2273	092270-02	DS-30	1500 gsm

Model 092270-01 replaces Model 092270-00 (Scanpro MD-20, range up to 400 gsm). The Scanpro model number refers to the sensor head unit. This is repackaged by Honeywell to mount into the PrecisionPak head or multi-sensor head (Model No. 092033-17) or the EnviroPak head. The Scanpro Central Unit SA-150 is used for all models. See Chapter 4 for a schematic of the dry end sensor in the PrecisionPak head.

The sensor consists of a resonant cavity with the sheet passing through the middle. The water in the sheet has a high dielectric constant at the measure resonant frequency (1.8 GHz) and thus affects the exact resonant frequency. The measure frequency resonance has an amplitude peak at the sheet position, so the frequency is strongly affected by the sheet dielectric constant. The reference frequency (3 GHz) resonance has low amplitude at the sheet position, so it is not strongly affected by the sheet dielectric constant. It is used to correct for other effects (gap variations, electronic drift, and so on).

The lower head contains only a passive half-cavity. The half-cavity in the upper head has two antennas and one (in the DS-20) or two (in the DS-30) detector diodes. The antennas are fed by the Oscillator board. Note that there is an attenuator on each of the cables where they attach to the cavity.

The Microwave Oscillator board (Honeywell 34000043, Scanpro 100-08071) contains the two oscillators (1.5 to 1.8 GHz and 2.5 to 3 GHz), amplifiers, and mixers. The oscillator starts at a frequency above both resonances, is ramped down until resonance is detected, locks at that frequency for 1 ms while a frequency measurement is made, and is ramped down to the second resonance where another measurement is made. The frequency descends further and then ramps back up, repeating both measurements.

The Differentiator board (Honeywell 34000044, Scanpro 100-08076) controls the sweep signal that controls the oscillator, receives the detected signal from the detector diode, and converts and sends it to the MS-Controller board. It also contains a circuit for adjusting the sensitivity of the measuring head.

The MS-Controller board (Honeywell 34000045, Scanpro 100-07984) generates the control signals for the sweep generator on the Differentiator board, subtracts the measure and reference frequencies, and sends the resulting moisture measurement to the central unit through a serial link.

The central unit (Honeywell 34000042, Scanpro SA-150, A8240002) provides -28 VDC power for the measuring head and converts the serial signal to other forms. Scanpro provides outputs in the form of 0 – 10 VDC, 0 – 20 or 4 – 20 mA current, 1 – 10 kHz frequency signal, and a parallel output for both moisture and temperature. Honeywell uses only the 0 – 10 VDC analog moisture output, which is read using MSS setup.

2.1. Standard Range Sensor

Model Number: Honeywell 092270-01, Scanpro DS-20.

Water Weight Range: 6 to 600 gsm. Suitable for many dry end and wet end applications.

Moisture Range: 2 to 70% moisture.

Basis Weight Range: Above 100 gsm.

Repeatability: Equivalent to 0.5 gsm water weight or 0.1% moisture, whichever is greater.

Static Accuracy: 2•Sigma = ± 0.25% for moisture in the range of 4% to 12%. Above 12%, 2•Sigma = ± 0.02 •Sheet Moisture. Table 2-2 gives the accuracies at low basis weight and moisture.

Table 2-2 Typical Sensor Errors at Low Basis Weight and Moisture

% Moisture	2•Sigma Accuracy for Dry Basis Weight		
	100 gsm	200 gsm	400 gsm
1%	-	-	0.7%
2%	-	0.8%	0.4%
3%	1%	0.5%	0.25%
4%	0.8%	0.4%	0.25%
6%	0.5%	0.25%	0.25%
12%	0.25%	0.25%	0.25%

Dynamic Accuracy: 2•Sigma = ± 0.5% for moisture in the range of 4% to 12%. Above 12% moisture, 2•Sigma = ± 0.02•Sheet Moisture.

Response Time: 12.6 ms or 80 readings per second.

Cross-Direction Resolution: Less than 8.7 cm., or 3.4 inches full width at half maximum.

Gap: May be 10.2 mm (0.4 inch) or 12.7 mm (0.5 inch).

Ambient Temperature: Maximum 110°C for cavity.

Power Requirements: 115/220 VAC, 50-60 Hz for the central unit, which supplies -28 VDC at 400 mA to sensor head electronics.

2.2. High Range (Wet End) Sensor

Model Number: Honeywell 092270-02, Scanpro DS-30.

Water Weight Range: 100 to 1500 gsm. Suitable for many wet end applications.

Moisture Range: 10 to 70% moisture.

Basis Weight Range: Above 100 gsm.

Repeatability: Equivalent to 2 gsm water weight or 0.3% moisture, whichever is greater.

Static Accuracy: 2•Sigma = ± 0.5% for moisture in the range of 10% to 25%. Above 25%, 2•Sigma = ± 0.02•Sheet Moisture.

Dynamic Accuracy: 2•Sigma = ± 0.5% for moisture in the range of 10% to 25%. Above 25% moisture, 2•Sigma = ± .02•Sheet Moisture.

Response Time: 12.6 ms or 80 readings per second.

Cross-Direction Resolution: 8.7 cm., or 3.4 inches full width at half maximum.

Gap: Must be 12.7 mm (0.5 inch).

Ambient Temperature: Maximum 110°C for cavity.

Power Requirements: 115/220 VAC, 50-60 Hz for the central unit, which supplies –28 VDC at 400 mA to sensor head electronics.

3. Software Description

The Precision Microwave Moisture Sensor uses Real-Time Application Environment (RAE) software on a Da Vinci System.

3.1. Calibration Equations and Constants

This chapter describes the calibration equations and constants for Precision Microwave Moisture Sensors when used in conjunction with Da Vinci's RAE system software.

There is a single analog voltage output from the sensor. There are no contact inputs or outputs for Precision Microwave Moisture Sensors. There is no Background function in the sensor software.

3.1.1. Calibration Equations

3.1.1.1. Reference/Standardize

During Reference/Standardize, the system reads the sensor voltage output with an empty gap, **Open Volt**. Two limit checks are performed: If ABS(Open Volt-T0 Open Volt)>JFL VoltT0, or if ABS(Open Volt – Last Volt)>JFL Volt, then an error message is printed. **Last Volt** is the voltage reading of the previous standardize. If the limit checks are passed, **Open Volt** is saved for subsequent subtraction from Sample and onsheet readings to correct for any drift of the electronics or buildup of dirt on the sensor windows.

3.1.1.2. Sample/Onsheet Static Moisture

During the Sample function, the voltage readings **Volt Now** are read and averaged over the sampling period. When scanning onsheet, the **Volt Now** are likewise read and averaged over the slice. The **Net Volts** are calculated:

Net Volt = Volt Now – Open Volt

When scanning onsheet, the Z-Correction and Profile Correction are performed if they are enabled:

Volt Z = Net Volt•[1 – NKZ•(ZNOW–ZSTD) + PCOR]

where:

NKZ = Z sensitivity coefficient

ZNOW = Slice Z reading

ZSTD = Z Sensor reading at last Standardize

PCOR = Additive profile array value for slice

NOTE: Z and PROC correctors can be performed only during scanning. The profile corrector should be enabled only after building the profile array and pointing the array to the particular code. (See Section 8.1 and Subsection 8.1.1)

In Sample mode, the software calculates **MWR = Net Volt/BW**. Onsheet, the software calculates **MWR = Volt Z/BW**. Here, **BW** is the basis weight in gsm. During Sample mode, this is the entered basis weight. Onsheet, it is the current slice value measured by the Basis Weight Sensor.

Two algorithms are available. The Dry End Algorithm is suitable for moisture ranges with minimum moisture below 10%. Its exact form is confidential, but it linearizes the value **MWR – MWR0** to give a value **MWF** that is linear with percent moisture. Here, **MWR0** is a calibration constant, the grade-grouped static offset. The Wet End Algorithm is suitable for higher moisture levels, and simply sets **MWF=MWR**.

Finally, the raw or static moisture is calculated:

$$\mathbf{MR = MWD + MWA \bullet MWF}$$

where:

MR = Raw (static) percent moisture

MWA = Grade-grouped static slope

MWD = Grade-grouped static intercept

If the **BW Corrector** is enabled, the raw or static moisture is calculated as follows:

$$\mathbf{MR} = \frac{\mathbf{MWD + MWA * MWF + MWB * BW}}{\mathbf{1 + MWB * BW}}$$

where:

MR = Raw (static) percent moisture

MWA = Grade-grouped static slope

MWD = Grade-grouped static intercept

MWB = Grade grouped basis weight slope

BW = Basis Weight

During Sample mode, BW is the entered Basis Weight target; onsheet, it is the current slice value measured by the Basis Weight Sensor.

3.1.1.3. Onsheet Dynamic Correction

Onsheet, the software makes a temperature correction if it is enabled:

$$\mathbf{DMTP = MR + TMPD \bullet (TNOW - TCAL) + TMPA \bullet (TNOW - TCAL) \bullet MR}$$

where:

DMTP = Percent moisture corrected for sheet temperature

TNOW = Current sheet temperature

TCAL = Temperature at calibration time

TMPA = Slope of temperature correction

TMPD = Intercept of temperature correction

If the temperature corrector is not enabled:

DMTP =MR

Finally, a dynamic correction is made:

MOIS = DYND + DYNA•DMTP

where:

MOIS = Final dynamically corrected percent moisture for slice

DYNA = Slope of dynamic correction

DYND = Intercept of dynamic correction

In MXOpen and earlier versions, the Volt Z and Net Volts were read in Counts. As a result, the MWR, MWF, MWA, and MWD (Slope and Intercept) were in the range of 20 to 30, 0.8 to 5, 2 to 6, and -0.008 to -0.9, respectively. On the Da Vinci platform, the Volt Z and Net Volts are read in volts. As a result, the MWR number (and, as a result, the MWF) is very small.

Further, the slope will be a very large number (compared to MXOpen). For example, in a Da Vinci system, MWR, MWR0, and MWF numbers might be 0.003, 0.0005, and 0.03, respectively.

Slope and intercept might be MWA=205 and MWD = -0.3969, respectively.

3.1.2. Calibration Constants

3.1.2.1. Static Calibration Constants

Table 3-1 gives the static calibration constants that are determined during static sensor calibration. These are the constants that are usually determined in the factory. Normally, MWA and MWD should be re-determined in the field. Enter the values in Table 3-1 in the **MWP11 Calibration Table** in the **main code** under the **Recipe Maintenance** frame for a permanent store. Loading the code can retrieve these constants. You can also set this in the **Maintenance** frame for temporary storage.

Table 3-1 Static Calibration To Be Determined

Name	Default	Time-Zero/Grade	Interpretation
TCAL	100°F	Time-Zero	Calibration Temperature
T0 Open Volt	0.5 ± 0.1V	Time-Zero	Cal Stdz Volt
MWR0	0	Grade	Offset (Dry End Algorithm)
MWA	0	Grade	Static Slope
MWD	0	Grade	Static Intercept
MWB	0	Grade	Static BW Slope

3.1.2.2. Dynamic Calibration Constants

Table 3-2 gives the dynamic calibration constants. These constants are to be determined in the field, so the default values are set when the system is shipped. When the dynamic calibration constants are determined in the field, enter them in the **MWP11 Calibration Table** in the **main code** under **Recipe Maintenance** frame for a permanent store. You can also set these in the **Maintenance** frame for temporary storage.

Table 3-2 Dynamic Calibration To Be Determined in the Field

Name	Default	Grade/Non-Grade	Interpretation
NKZ	0	Grade	Z-Correction Constant
TMPA	0	Grade	Temp. Correction Slope
TMPD	0	Grade	Temp. Correction Intercept
DYNA	1	Grade	Dynamic Correction Slope
DYND	0	Grade	Dynamic Intercept

3.1.2.3. Software Database

The Precision Microwave Moisture Sensor gauge has 4 Enable and Disable functions that can be set in the **MWP11 Configuration Table** in the main

code under **Recipe Maintenance**. You can also select each one of them under the recipe-based option in the **Sensor Maintenance** frame.
The functions are:

- Enable Z-Correction during Sample
- Enable Temperature Correction during Sample
- Enable BW corrector
- Enable Profile corrector

The calibration data can be retrieved by loading the **Recipe Code** in the maintenance frame. All values are floating-point and are shown in Table 3-3.

Table 3-3 Calibration Data

Constant	Description
T0 Open Volt	Time-Zero Standardize Volts
DYNA	Dynamic Correction Slope
DYND	Dynamic Correction Intercept
MWA	Static Calibration Slope
MWD	Static Calibration Intercept
MWR0	Offset for Dry End Algorithm
MWB	Basis Weight Correction Slope
NKZ	Z-Correction Constant
Temp CAL	Temperature at Calibration Time
TMPA	Temperature Correction Slope
TMPD	Temperature Correction Intercept

Set the Standardize Limit Check limits in the MWP11 Limit Table in the main code of the Recipe Setup frame:

Voltage:	250 kHz	500 kHz	2 MHz
JFLVolt T0:	0.03	0.06	0.24
JFL Volt:	0.03	0.06	0.24

To set up the limit in the **MWP11 Limit Table**:

1. Select the **Setup** button on the Horizontal dispatcher.
2. Select **Recipe Maintenance**.

3. Under **Main Code Table**, select **MWP11 Limit Table**.
4. In the **MWP11 Limit Table**, change the value of MWP11 JFL Volt T0 and MWP11 JFL Volt to.0.24V, then save them. (The default value of this tolerance is 0.24V at 2 MHz.)

4. Hardware Alignment

This chapter describes the hardware alignment of the system. For hardware alignment, you need:

- Digital voltmeter with two clip leads
- Oscilloscope with 3 X1 probes
- Alignment record sheet

An alignment record sheet is provided with each sensor to record the relevant alignment data. At the completion of each section, record the data specified on the record sheet.

The Microwave Moisture Sensor Forms, p/n 42000857, consist of three pages that are helpful in calibrating and maintaining the sensor.

Before aligning the sensor, familiarize yourself with the location of the three boards in the sensor head and with the principles of operation and diagnostic signals as shown in the Scanpro manuals. Normally, the sensor is aligned in the Scanpro factory and then readjusted in the Honeywell factory to have the proper offset. Make only those adjustments necessary to achieve the described operation. Make a copy of the Precision Microwave Moisture Sensor Setup and Alignment Record Sheet, and record the final appropriate values on it. Keep the record sheet with this manual. Refer to the sheet and update it when the sensor is serviced.

CAUTION:	The High Range Microwave Moisture Sensor (092270-02) may be affected by contact between the sheet guide and your body or other conducting material. Keep your body and any electrically conducting materials at least 5 cm (2 inches) away from the sheet guide during alignment, stability testing, standardization, and Sample measurement.

4.1. Central Unit

Check that the sensor and central unit are connected according to Figure 4-1, Figure 4-2, and Figure 4-3.

Figure 4-1 and Figure 4-2 show the installation wiring for the sensor in multi-sensor (Quadrapack) and PrecisionPak heads, respectively. Figure 4-3 shows the installation wiring for the sensor in a PrecisionPak head. Alternatively, the sensor can be connected directly using the test cable supplied by Scanpro. Plug in the power cord of the central unit, loosen the 4 screws on its cover, and then open the cover. Observe the two LEDs at the lower left on the cover. The first LED (D1) indicates that serial data transmission from the head is being received in the central unit. It is always on when the sensor is operating correctly; it will flicker when the value being transmitted changes. The second LED (D2) indicates a fault in the signal transmission; it should not be lit.

Figure 4-4 shows the layout of a dry end sensor in a multi-sensor head, while Figure 4-5 shows the layout in a PrecisionPak head. Figure 4-6 and Figure 4-7 cover the layout of a wet end sensor in a multi-sensor and PrecisionPak head, respectively.

NOTE:	Figures here are included for reference only. Please refer to drawing 092270XX, shipped with the product.

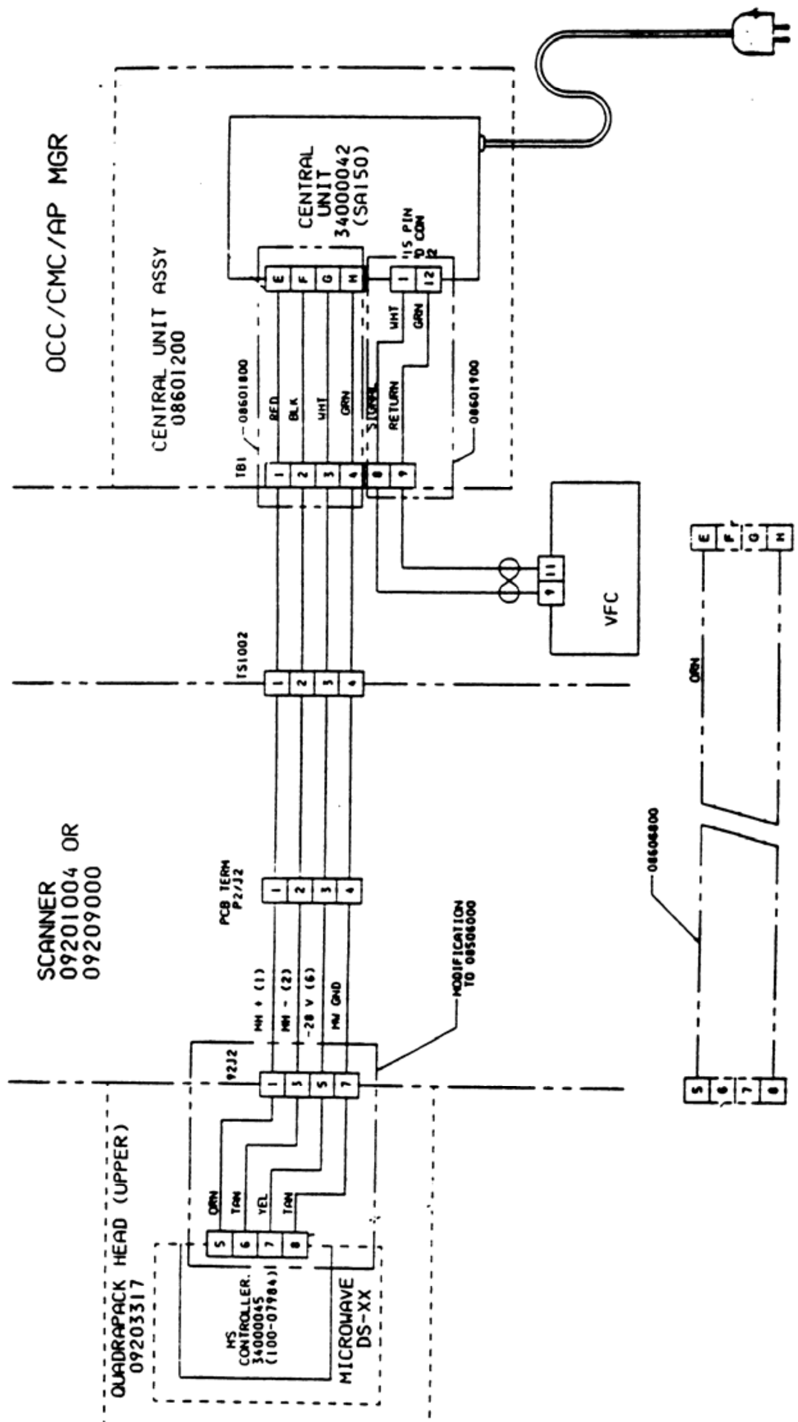


Figure 4-1 Installation Wiring for Sensors in a Multi-Sensor (Quadrapack) Head

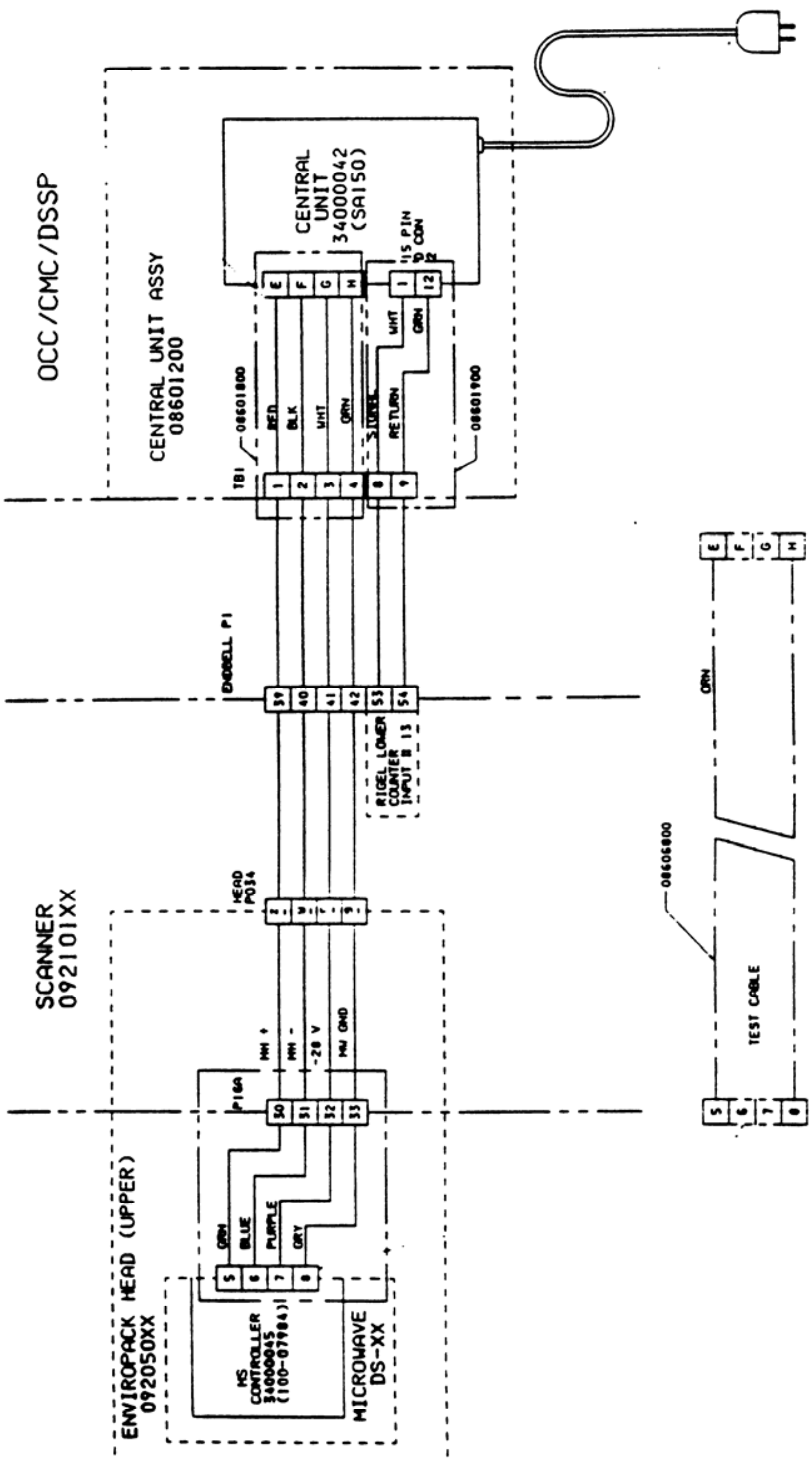


Figure 4-2 Installation Wiring for Sensor in a PrecisionPak Head

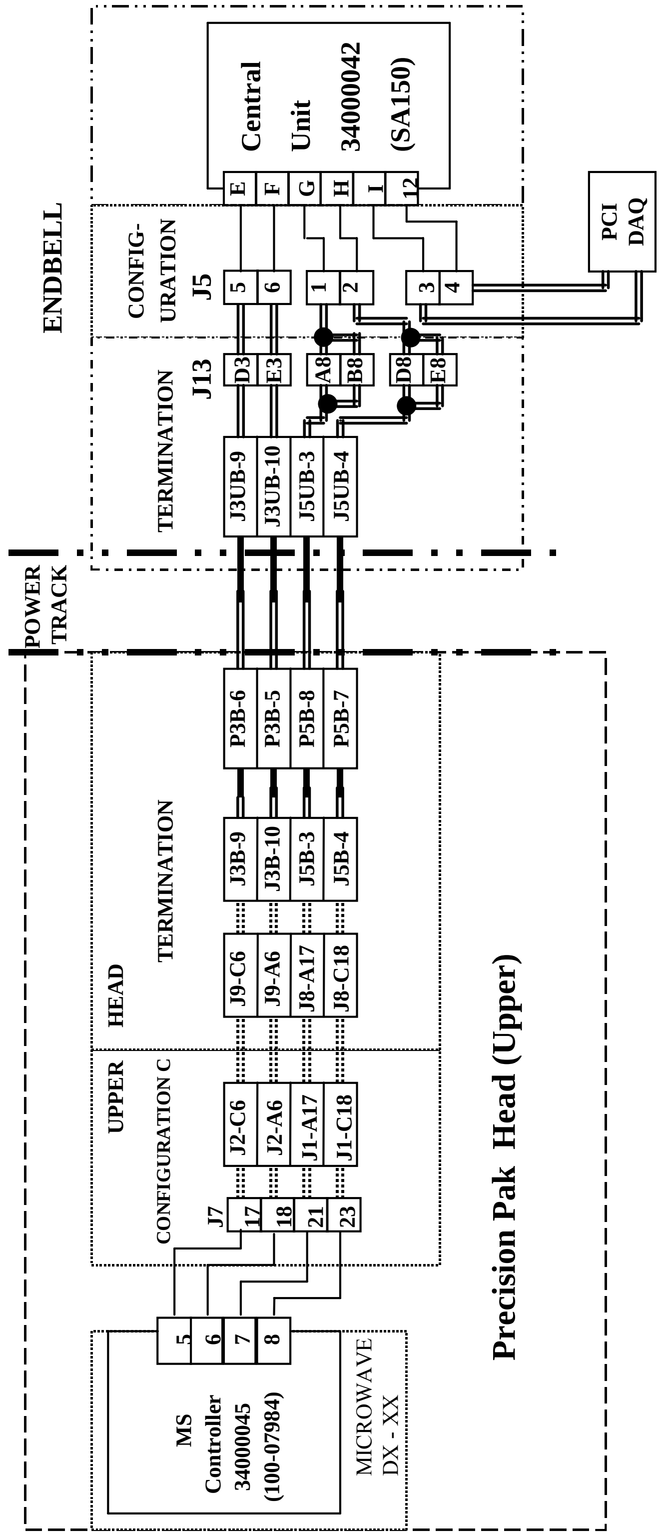


Figure 4-3 Installation Wiring for Dry End Sensor in a PrecisionPak Head

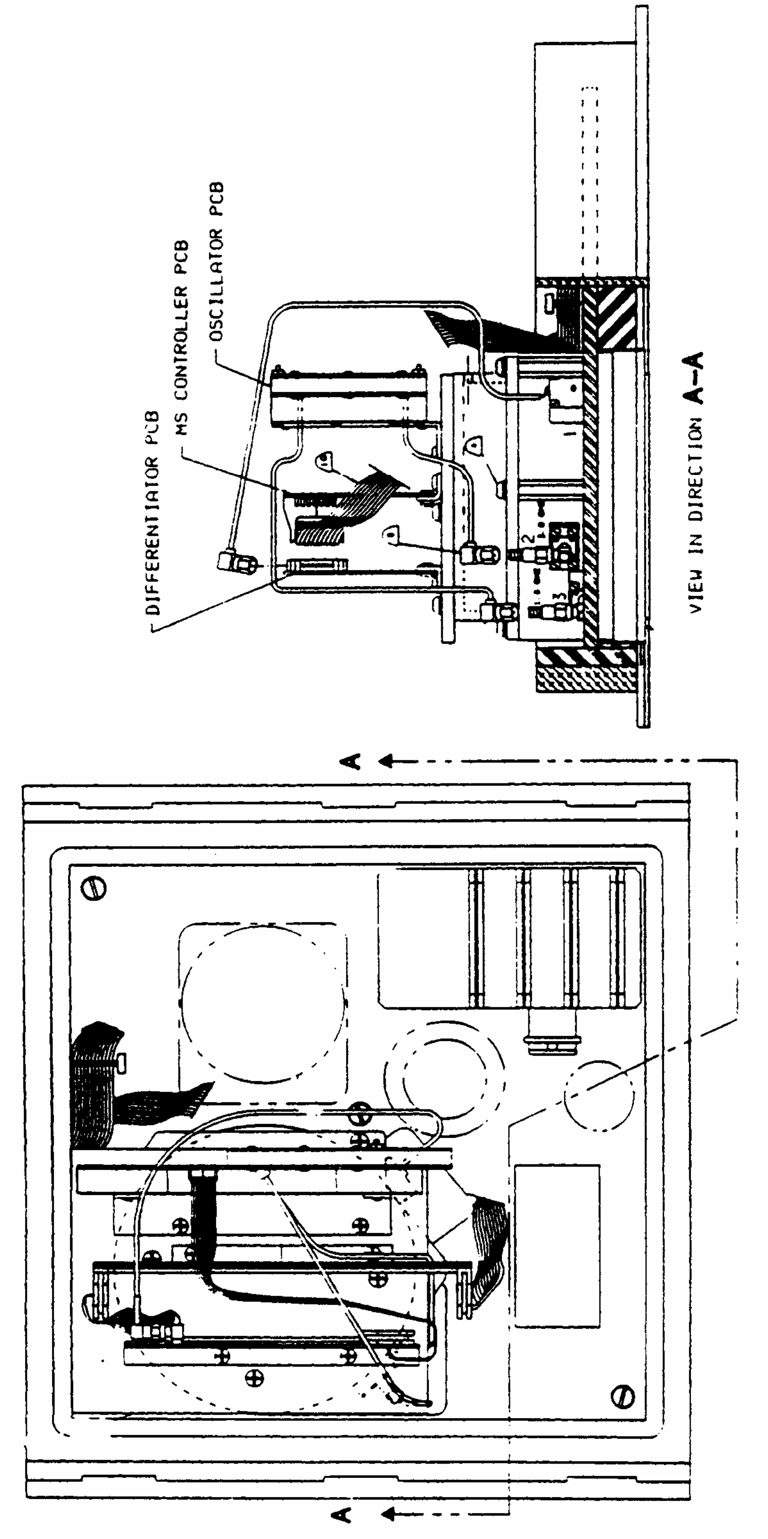


Figure 4-4 Layout of a Dry End Sensor in a Multi-Sensor (Quadrapack) Head in a PrecisionPak Head

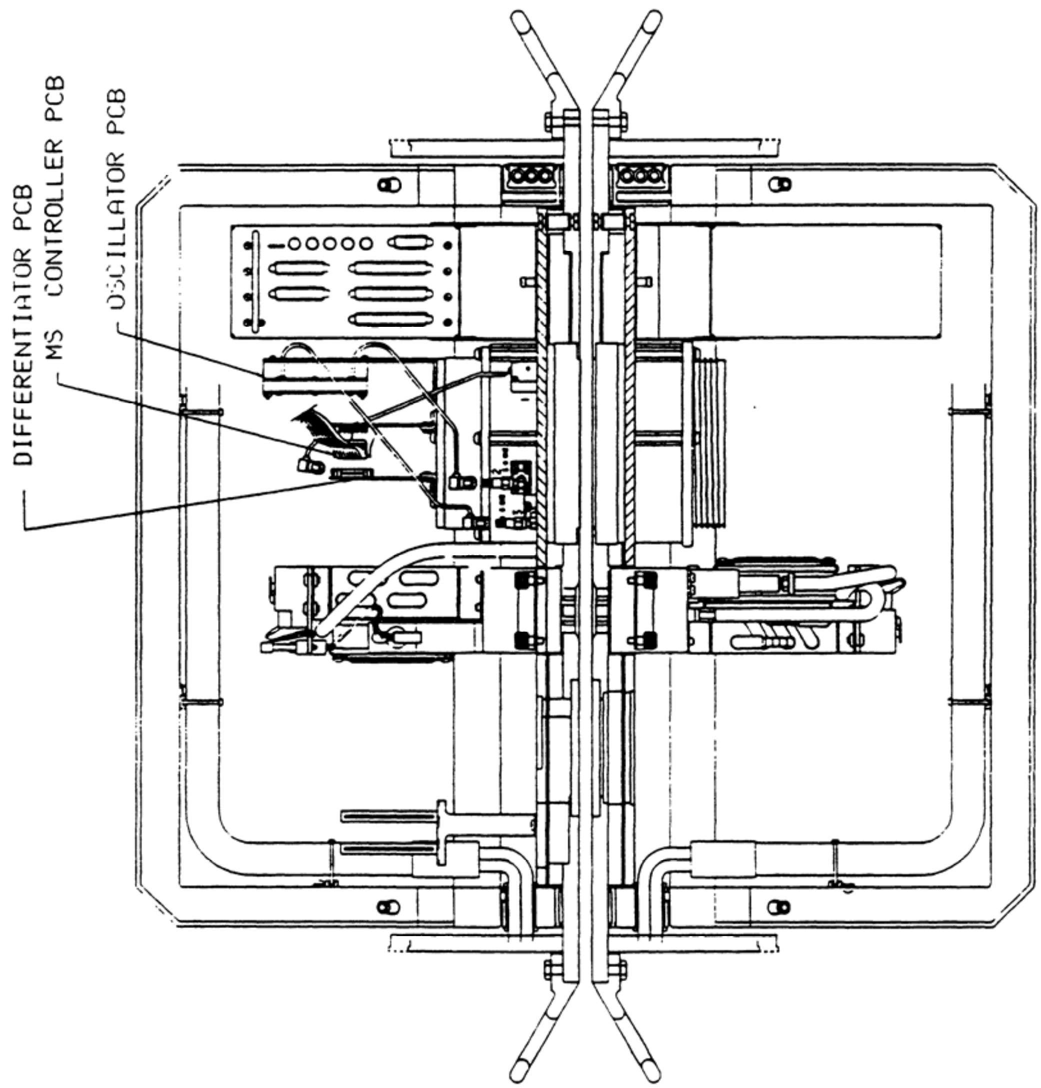


Figure 4-5 Layout of a Dry End Sensor in a PrecisionPak Head

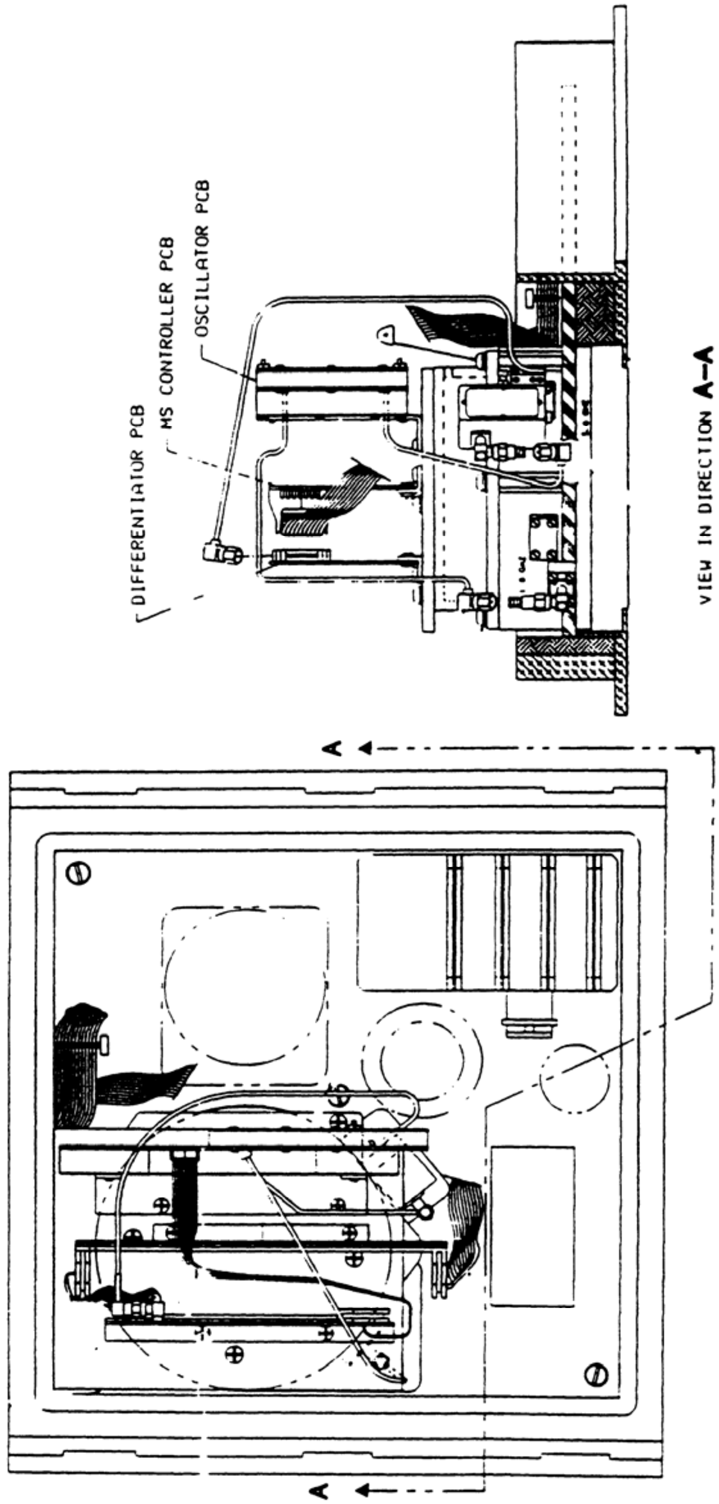


Figure 4-6 Layout of a Wet End Sensor in a Multi-Sensor (Quadrapack) Head

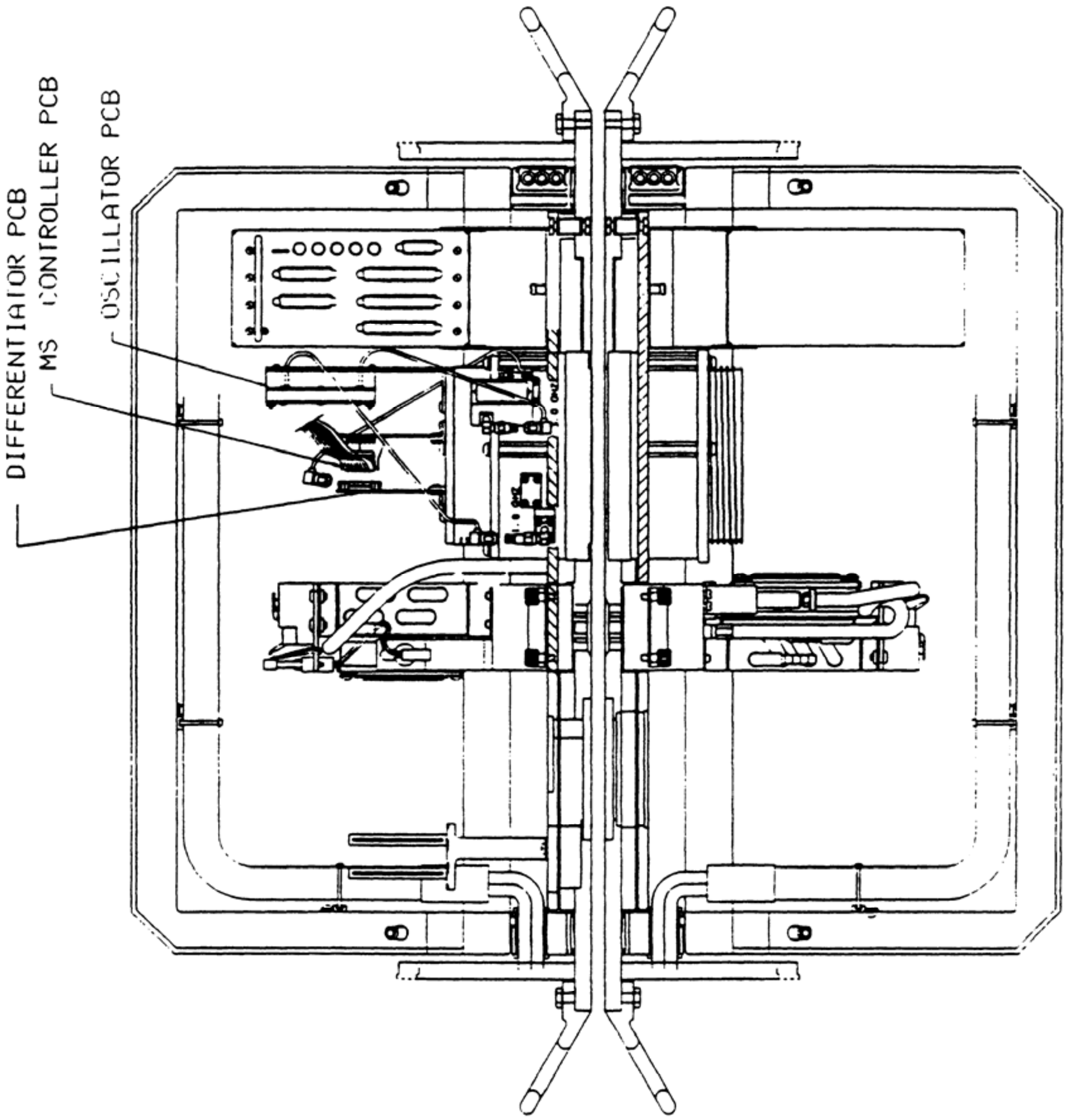


Figure 4-7 Layout of a Wet End Sensor in a PrecisionPak Head

Check the voltages listed in Table 4-1 and record their values on the record sheet.

Table 4-1 Voltages of Capacitors

Capacitor	Voltage
C8	5.0 ± 0.2 VDC
C9	–15 ± 1 VDC
C10	15 ± 1 VDC
C11	35 ± 3 VDC
C12	28 ± 1 VDC

NOTE: The DC voltage measured at the sensor head should be in the range of -27 to -28 VDC.

4.2. Sensor Head Alignment

Check the jumpers listed in Table 4-2. See Figure 4-8 and Figure 4-9 for help in locating the jumpers on the boards. For the locations of the boards, refer to the Installation Drawings supplied with your system. The same boards may be used on either the Standard Range Sensor or the High Range Sensor. Always check the jumpers when replacing these boards. Record their positions on the record sheet.

Table 4-2 gives the jumper settings for Standard and High Range.

Table 4-2 Jumper Settings for Standard and High Range

Jumper	Standard Range	High Range
S1/Differentiator Board	Present	Absent
S1/Oscillator Board	Pin 3 to Pin 6	Pin 1 to Pin 4

Honeywell 34000043, Scanpro 10008071

Jumper S1 between pins 3 and 6 for dry end sensor (DS-20 092270-01)

Jumper S1 between pins 1 and 4 for wet end sensor (DS-30 092270-02)

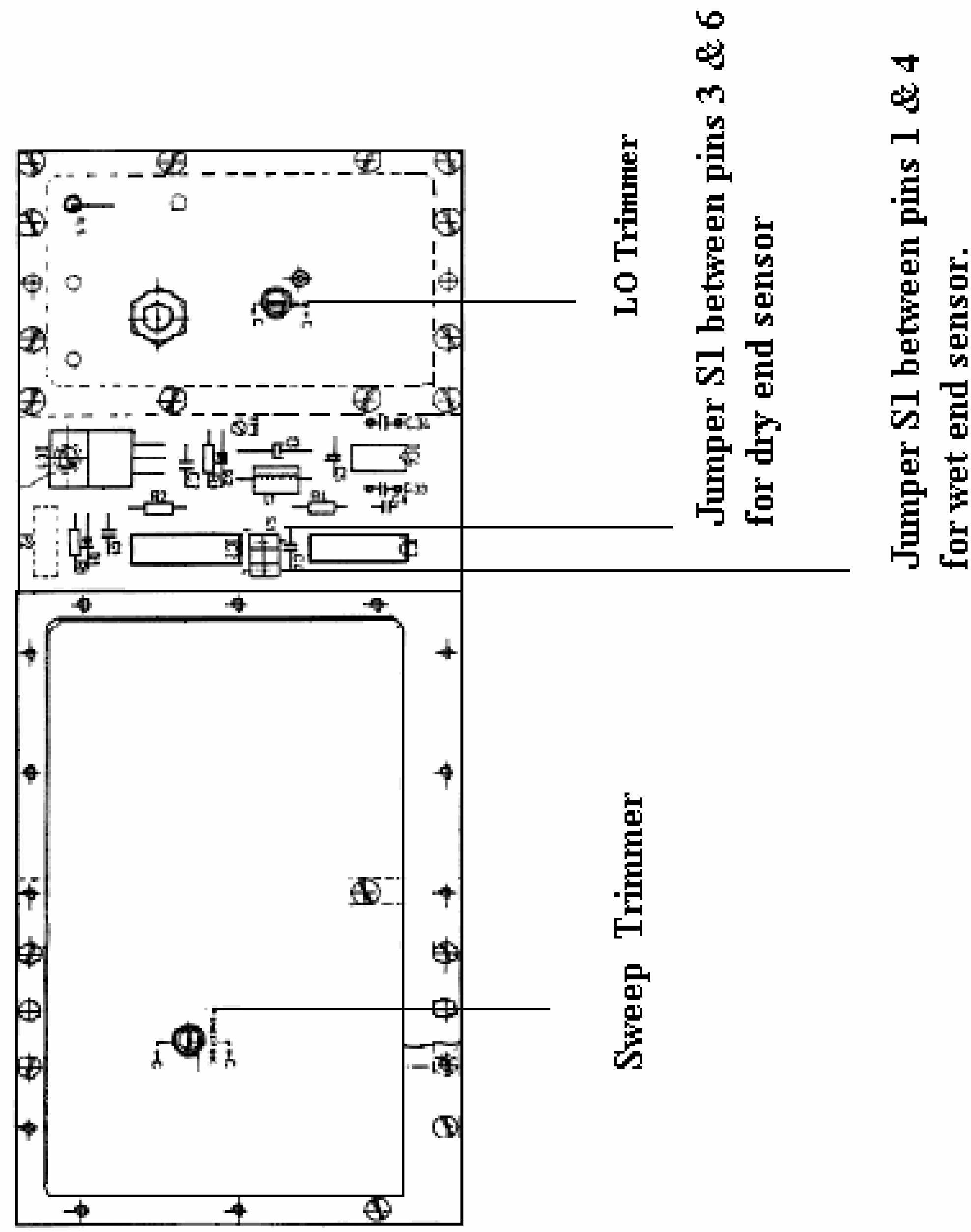


Figure 4-8 Layout of Oscillator Board Honeywell 34000044, Scanpro 10008076 (Figure courtesy of Scanpro)

Jumper S1 present for dry end sensor (DS-20 092270-01)

Jumper S1 absent for wet end sensor (DS-30 092270-02)

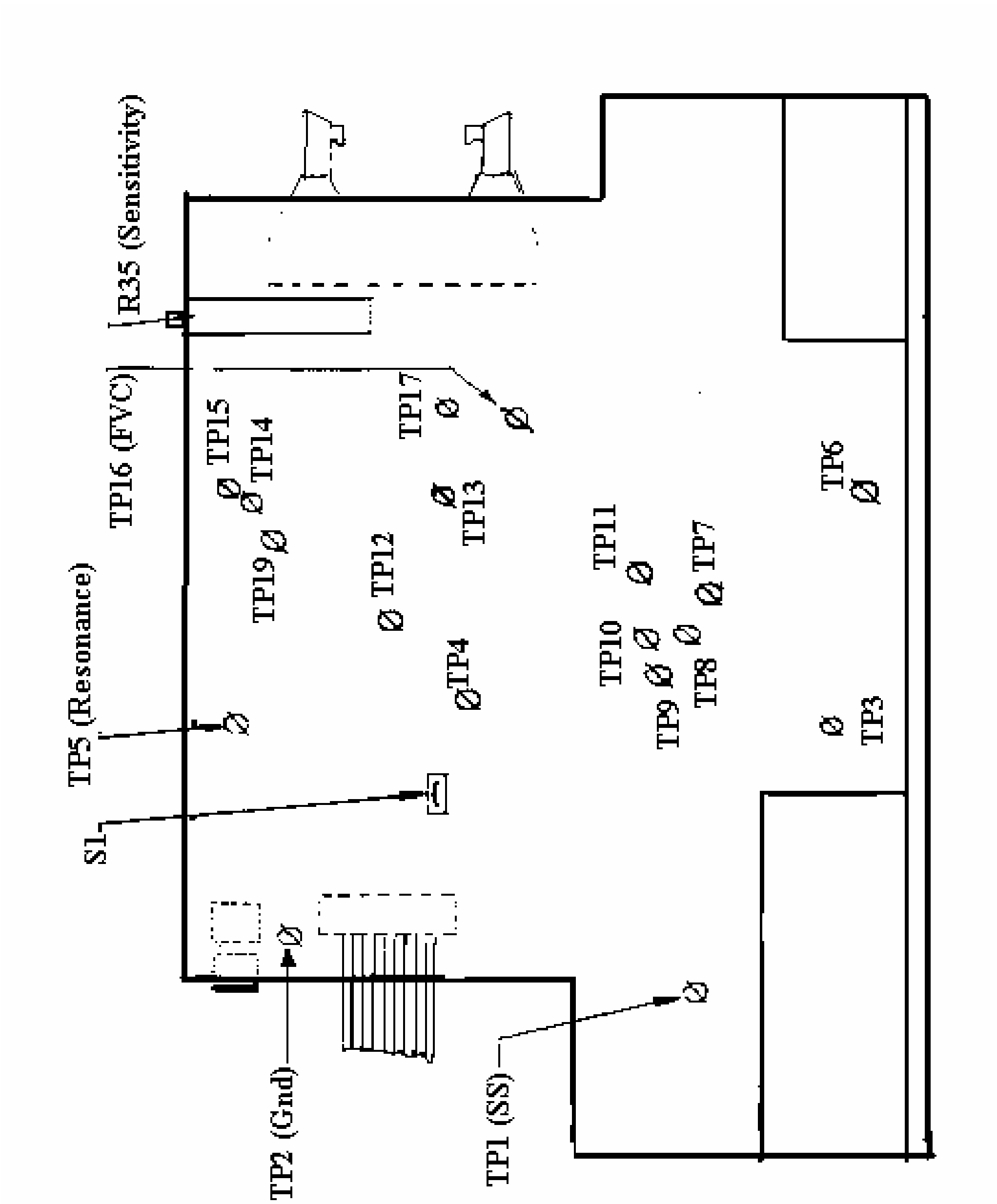


Figure 4-9 Layout of Differentiator Board

Using three probes (preferably X1 rather than X10), connect an oscilloscope with sweep set at 2 ms to the Differentiator board. Table 4-3 gives the test points for the Differentiator board.

Table 4-3 Test Points for Differentiator Board

Connection	Signal Name
Ground to TP2	Ground
Trigger to TP1	SS
Chan 1 (.5 VDC/div.) to TP16	Frequency-to-Voltage Converter
Chan 2 (.5 VAC/div.) to TP5	Resonance

Check that Channel 1 (TP16 – FVC) looks like Figure 4-10, and that Channel 2 (TP5 – Resonance) looks like Figure 4-11. The FVC should have ramps A and B and baseline C at approximately the same height. The total amplitude is typically 1 to 2 volts. If this is the case, proceed to the sensitivity calibration (See Section 4.3). If this is not the case, Scanpro advises replacement of the Oscillator board (34000043) and return of the original board if it is under warranty. This requires ready access to a spare. For cases where this is impossible:

1. Adjust the SWEEP trimmer capacitor on the Oscillator board until the oscilloscope trace for Channel 1 (TP16 – Frequency-to-Voltage Converter) looks like that shown in Figure 4-10.

2. Adjust the LO fixed oscillator trimmer capacitor on the Oscillator board until the trace for Channel 2 (TP5 – Resonance) looks like that shown in Figure 4-11.

3. Readjust the SWEEP trimmer capacitor so that ramps A and B on the Channel 1 trace (TP16) indicated in Figure 4-10 have approximately the same height. These are typically –0.3V.

4. Readjust the LO trimmer so that baseline C and ramp B (see Figure 4-10) have approximately the same height. The baseline is typically –0.4V, and ramp B is typically –0.3V.

5. Record the ramp voltages on the record sheet. Set at 2 ms/div. and 0.5 VDC/div.

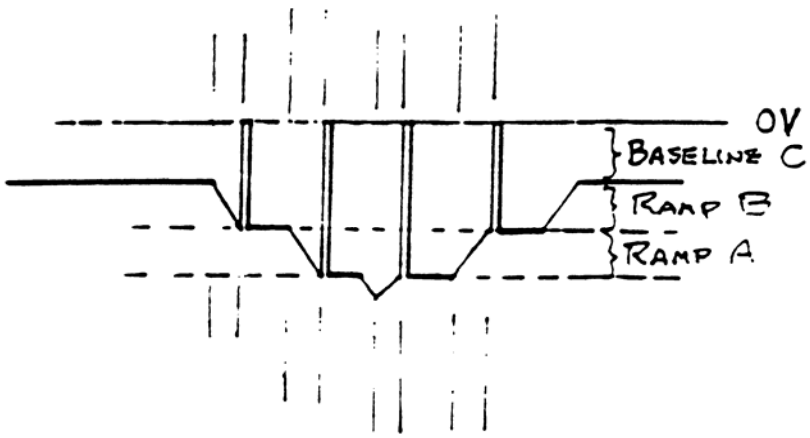


Figure 4-10 Typical Waveform on TP16 of the Differentiator Board (Frequency-to-Voltage Converter) (Figure courtesy of Scanpro)

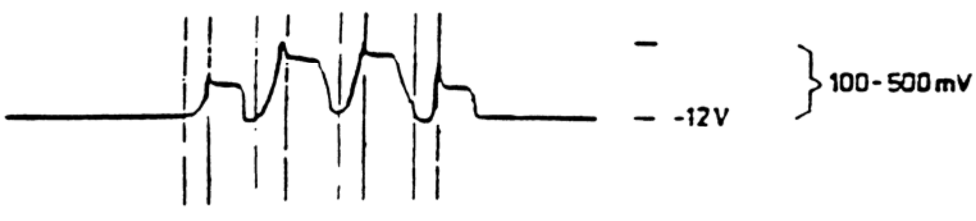


Figure 4-11 Typical Waveform on TP5 of the Differentiator Board (Resonance) (Figure courtesy of Scanpro)

4.3. Sensitivity Calibration

Perform the Sensitivity Calibration during initial factory alignment and calibration. Check at installation and recheck whenever components are replaced or when the sensor head is realigned (see Section 9.4).

Check that the jumper S2 gain setting on the door of the central unit is appropriate for the maximum water weight for your application. Table 4-4 gives the jumper position for DS-20 and DS-30 for various water weight ranges. Check that the setting is appropriate using a prepared, moisturized Sample with the maximum water weight to be measured.

The output should be no more than 9 VDC. Record the jumper S2 setting on the record sheet.

Table 4-4 DS-20 and DS-30 Jumper Positions for Water Weight Ranges

Gain	DS-20 Range (gsm)	DS-30 Range (gsm)	Jumper Position
1	150	375	right
2	300	750	middle
4	600	1500	left

Check that the sensor output to the VFC (Central Unit Assembly TB1, terminals 8 (+) and 9 (return), gives a voltage of 0.5 ± 0.1 VDC when the sensor gap is empty. If it does not, adjust the 2 or 3 Preset Selector rotary switches (ICH1 – 3) on the MS-Controller board in the upper sensor head to obtain this voltage. Record the offset voltage on the record sheet. Perform a Reference on the Honeywell system and then record the offset volts on the record sheet.

Standard Samples. Depending on access to the head gap, decide which Sample paddle(s) should be usable – short and/or long. Choose one paddle and plastic standard Sample from the Sample Accessory Kit (09762401 for Multi-Sensor Head; 09762402 for EnviroPak Head). Use the following procedure to determine the time-zero volts for the standard Sample:

1. Insert the guide pins (07538200, 07538300).
2. Perform a Reference with the appropriate thin Sample paddle – short 07538001 (2 each) or long 07538101 (2 each).
3. Sandwich the standard Sample between the paddle pieces, then insert it into the gap of the sensor.
4. Read the output voltage, and record the difference between this value and the offset voltage from Section 4.3.
5. Perform a Sample on the system, and record the Net Volts printed in the Sample report.

6. At setup or calibration time, record the voltage difference and Net Volts on a sticker affixed to the plastic Sample.

7. Record the voltage difference on the record sheet.

NOTE:	Whenever parts of the sensor are replaced, follow the instructions in Section 9.4 to ensure that the static calibration will be accurate.

5. Static Calibration

This chapter describes the procedures for performing static calibration. Normal installation requires only hardware checks and verification or recalibration. Chapter 6 describes in detail the Da Vinci software for static calibration.

5.1. Sample Selection

5.1.1. Standard Sample Selection

Five moisturized Samples of each grade are required for calibration. In addition, a bone-dry Sample is required for each grade for calibration with the Dry End Algorithm. The bone-dry Sample must be bone-dry at the time it is measured on the sensor. Therefore, it may be a good idea to delay preparation of this Sample until shortly before measurement to avoid having to re-dry it. Select the sheets required to die out the Samples, and label them to indicate grade number and (for dry end applications) the top side and Machine Direction (MD) orientation. Select five target moisture values spanning the range needed.

5.1.2. Representative Grade Selection

If there are so many grades that it is impractical to moisturize Samples for all of them, select a set of grades that is representative in basis weight and composition. For dry end sensors, it may be helpful to use the method of "Bone-Dry Grade Grouping":

1. For each grade, die out one 7-inch-diameter Sample using the 54000271 die in the Sample Accessory Kit.
2. Label the Sample to indicate the grade, top side, and MD.
3. Pre-weigh and mark an aclar bag for each Sample.
4. Bone-dry each Sample for four hours at 105 ± 0.5°C, and place it in its aclar bag.
5. Weigh the bagged Sample and subtract the bag weight, recording the bone-dry Sample weight.
6. Perform a Reference on the sensor with an empty bag in the Sample fixture in the gap.
7. Measure each Sample on the sensor, using the Sample fixture.
8. Plot the sensor Volts vs. bone-dry weight, and select the grades to be moisturized using the following criteria:
    a. Include grades that cover the full basis weight range.
    b. If the plot shows a definite systematic difference between different product types, include a range of weights for each type.
    c. Choose grades that represent a large percentage of the customer's production, if this is known.

5.2. Sample Preparation

5.2.1. Materials Required

To prepare Samples, the following materials are required:

- Lab with controlled humidity and temperature (23°C and 50% relative humidity), free from drafts and vibration
- Analytical balance, accurate to 0.1 mg
- Faraday cage balance pan, to accommodate a 7-inch Sample

- Forced-air drying oven, controlled to 105 ± 0.5°C, with drying racks
- Aclar bags (7-inch Honeywell p/n 32000269) and bag sealer (p/n 42000030)
- Sample die (7-inch) and hammer
- Aluminum foil for Sample protection
- Humidity cabinets, or beaker of boiling water (covered by screen) and tweezers

5.2.2. Procedure

Using the 7-inch-diameter die, die out five Samples for each grade selected. For grades on dry end sensors that have not been previously calibrated (they have no value of MWR0):

1. Include a sixth bone-dry Sample.
2. Before removing the round Sample from the sheet, mark the Sample I.D., and mark the MD orientation on both sides of the Sample.
3. Bone dry all Samples for four hours in the 105°C oven.
4. Pre-weigh one aclar bag for each Sample.
5. Label each bag with the grade and target moisture level.

   To conserve the expensive large aclar bags, use one for both the bone-dry and moisturized Sample, or use foil bags for the bone-dry weighing of Samples that are not to be measured bone-dry on the sensor.
6. Record the bag weights on the moisture Sample worksheet.
7. Remove each bone-dry Sample and quickly insert it in its bag.
8. Seal the bag very near the top to allow for re-use.
9. Weigh the bone-dry Samples and subtract the bag weights to get the dry Sample weight.

10. Enter the dry Sample weight on the worksheet.

11. Calculate a target weight for the wet Samples using the formula:

    T = 100 • Dg/(100-M)

    where:

    T = Target Sample weight in grams

    M = Target percent moisture

    Dg = Bone-dry Sample weight in grams

12. Enter the target weight on the worksheet.

13. For each Sample to be moisturized, carefully cut off the seal on the bone-dry Sample, remove the Sample, and reweigh the empty bag.

14. Bring each Sample up to the target moisture level using ambient air, steam, humidity chambers, or a water bath.

    For very wet Samples, it may be necessary to wet the Samples with isopropyl or ethyl alcohol followed by a water bath.

15. Seal each Sample quickly in its aclar bag, removing excess air.

16. Weigh the bagged Samples, record the weights, and calculate the percent moisture and basis weight for each Sample.

    $$\%M = \frac{\text{WetSample} + \text{Bag} - \text{WetBag} - \text{Bone-DrySample}}{\text{WetSample} + \text{Bag} - \text{WetBag}}$$

    Basis Weight in gsm = (WetSample+Bag – WetBag) • 40.276

    To convert to other units, use:

    Basis Weight in lbs/1000ft^2= Basis Weight in gsm • 0.2048

    Wrap each set of Samples in aluminum foil for protection.

5.3. Hardware Checks

CAUTION: The High Range Microwave Moisture Sensor (092270-02) may be affected by contact between the sheet guide and your body or other conducting material. Keep your body and any electrically conducting materials at least 5 cm (2 inches) away from the sheet guide during alignment, stability testing, standardization, and Sample measurement.

1. Perform three References with an empty gap, then record the average value.
2. Perform three Samples on the Scanpro Standard Sample, and record the average.
3. Set up a run of 30 References with an empty gap.
4. When the 30 References are completed, calculate the drift relative to the Standard Sample reading:

   $$\text{Drift} = \frac{\text{Voltsmax} - \text{Voltsmin}}{\text{Volts(Standard Sample)}}$$

   If Drift < 0.01, the sensor is stable enough for calibration.
5. If the sensor is not stable enough for calibration, make sure that the windows are clean and the head cooling is working, then repeat the References until the sensor is stable.

5.4. Sample Measurement

CAUTION: The High Range Microwave Moisture Sensor (092270-02) may be affected by contact between the sheet guide and your body or other conducting material. Keep your body and any electrically conducting materials at least 5 cm (2 inches) away from the sheet guide during alignment, stability testing, standardization, and Sample measurement.

1. Bring the sensor to its equilibrium offsheet temperature with air-gap air and air-gap heating off.

2. Record the time-zero temperature (approximately room temperature) as the time-zero constant, TCAL. This temperature can be found on the Maintenance frame as TEMP NOW in currently enabled units (°F or °C) after a Sample measurement has been performed.

3. For dry end sensors, enable the Dry End Algorithm on the MICROWAVE MOISTURE STATUS. You can do this either by setting the Dry End Algorithm to 1 under the **Configuration Phase** in the **Sensor Maintenance** frame or through the **Recipe Setup** for permanent storage. If you set the algorithm to zero(default), you are enabling the wet end sensor. Figure 5-1 shows the setting up of the Dry End Algorithm under the configuration phase in the maintenance frame.

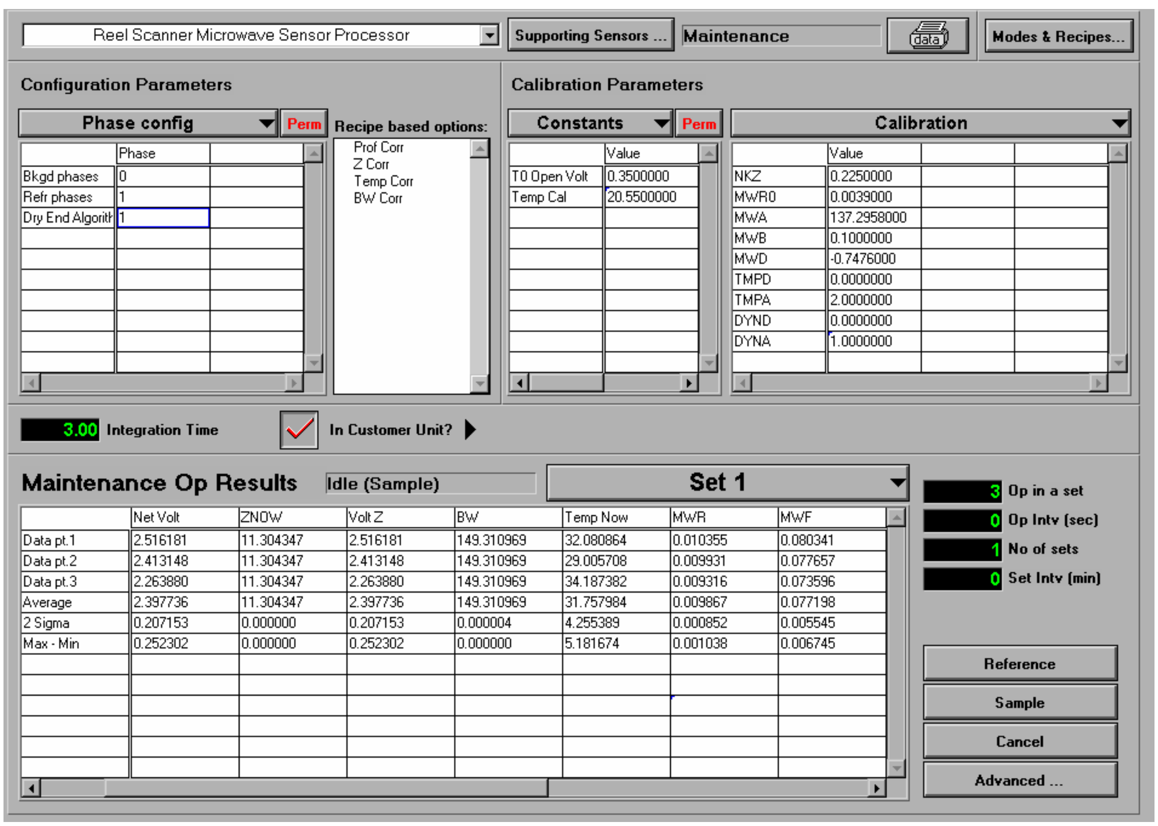


Figure 5-1 Enabling the Dry End Algorithm Under Phase Configuration in the Maintenance Frame

To enable the dry end through Recipe setup, follow these steps:

1. Select the **Set Up** button on the Horizontal dispatcher.
2. Under **Set Up**, select the **Recipe Maintenance** button.
3. In the **Main Code Table**, choose the **MWP11 Configuration Table**.
4. In the **MWP11 Configuration Table**, set the Dry End Algorithm to be **True** for dry end and **False** for wet end, then save it.

Figure 5-2 displays the setting up of the Dry End Algorithm in the **MWP11 Configuration Table** under **Main Code Table**.

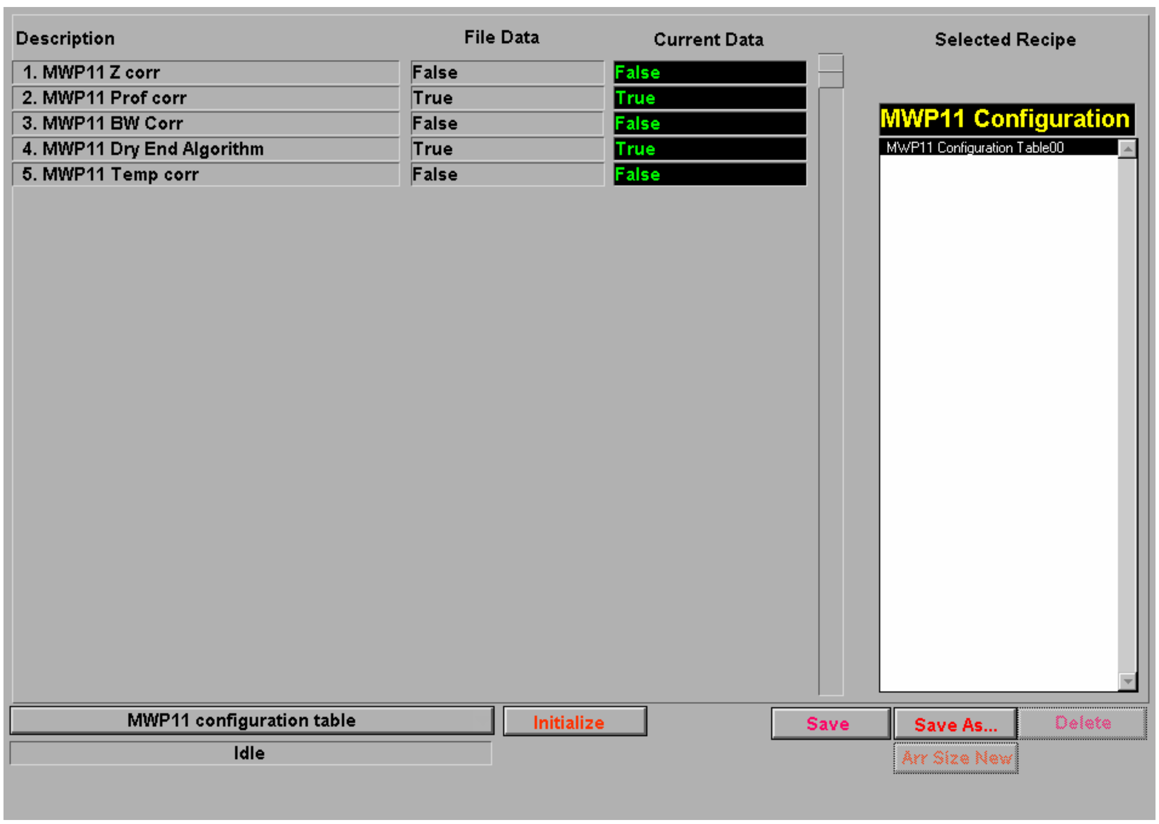


Figure 5-2 Display of the Setting Up of the Dry or Wet End Algorithm in the MWP11 Configuration Table Under Recipe Setup

If you enable it either under the Recipe setup or by setting 1 under configuration parameters in the maintenance frame, the processor is set for Dry End Algorithm. If you do not enable the dry end button, it is automatically set for the Wet End Algorithm.

Dual-sided Precision Microwave Moisture Sensors must have constants BAGA and BAGB set to zero (only single-sided sensors use these values).

1. On the **Scanner Setup** frame, select **Engineering Units** (basis weight units will then be gsm) or **Customer Units** (make sure the units conversion factor UCF is set to the correct value for the customer's ream size).

2. Perform three References on an empty gap, and record the value of these as T0 open volt on the Calibration Record Sheet. This value will be entered into the software to be used in limit checks.

3. Perform three Sample readings on the Standard Sample and calculate the average.

   Subtract from this the average Reference Volts to get the average Net Volts for the Standard Sample, XS.

4. Perform another Reference reading on an empty aclar bag in the Sample Fixture.

For previously uncelebrated grades on dry end sensors, do the following:

1. Take the bone-dry Sample from the first grade, enter its basis weight (in the appropriate units as selected above) on the **Sensor Verify** frame, and perform a Sample on the bagged Sample in the Sample Fixture.

2. Record the value of MWR printed out.

3. Continue with the other bone-dry Samples, entering the basis weight, performing a Sample, and recording MWR. Group together any grades whose bone-dry MWR values agree within 3%. Use the average value of MWR for a group as the MWR0 for that group of grades. Record all these values.

For each grade:

1. Perform a Reference on an empty bag.

2. Enter the MWR0 value (dry end sensors only).

3. For each wet Sample, enter the basis weight on the **Sensor Verify** frame and perform a Sample with the bagged Sample in the Sample Fixture.

4. Record the values of MWF on the Calibration Record Sheet.

5.5. Data Reduction

Perform a linear regression to obtain the slope and intercept for each grade or group of grades that group together within the moisture accuracy specification.

Enter and store the grade data in the **MWP11 Calibration Table** under the main code in the **Recipe Maintenance** frame (MWA = slope, MWD = intercept, and MWR0 = bone-dry offset for Dry End Algorithm).

5.6. Verification

If necessary, reweigh the Samples and recalculate the moisture and basis weight.

Bring the sensor head to thermal equilibrium at the offsheet ambient temperature. Check the stability (see Subsection 6.3.3).

Enter the grade code. Perform a Reference on an empty aclar bag in the Sample Fixture.

Enter the Sample basis weight and lab percent moisture on the SENSOR VERIFY frame and perform a Sample on each Sample in the Sample Fixture.

The printed error for each Sample should be within the accuracy specification for at least 80% of the Samples.

6. Da Vinci System Maintenance / Calibration Software

To run the Maintenance/Calibration software on a Da Vinci system:

1. Start the Real-Time Application Environment (RAE) System.
2. From the **Scanner/Sensor** Menu on the horizontal dispatcher, select the **Sensor Maintenance** display.
3. Select the Microwave Moisture Sensor processor for the appropriate scanner.
4. Since the MW sensor uses the inputs like basis weight from the Nuclear Sensor and Performance Sensor, load these two supporting sensor processors also.

NOTE: Before going to Maintenance mode, load the desired grades and check the calibration constants. Follow the instructions that follow to set up the calibration constants and to enable various correctors.

6.1. Calibration Table Setup

You can set up the **MWP11 Calibration Table** and **Configuration Table** for each of the Recipe codes. The appropriate table that has been set up can be selected in the **Main Code Table** for each of the grade codes (recipes). For temporary usage, these calibration constants can also be entered through the **Calibration Constants Table** under **Calibration Parameters** in the **Sensor Maintenance Display**. Similarly for permanent storage, enable or disable the appropriate correctors in the grade code through the **MWP11 Configuration Table** in the **Recipe Maintenance Display** on the **Setup** menu. The appropriate correctors can be enabled or disabled by setting **True** or **False** in the **MWP11 Configuration Table**. Alternatively, this can also be enabled or disabled through **Recipe-Based Options** under the **Configuration Parameters** in the **Sensor Maintenance Display** for temporary usage.

To enable the corrector, double-click on the appropriate corrector. A check mark shows in front of it to indicate that it is enabled (To disable a corrector, double-click on it again and the check mark disappears). To set up the calibration constant table for the given code:

1. Go to the **Setup** button on the horizontal dispatcher and choose the **Recipe Maintenance** display.

2. In the **Main Code**, for example, set up the **MWP11 Calibration Table** and **MWP11 Configuration Table** to 00 for Code (Recipe) 00 as shown in Figure 6-1 and save this for particular code.

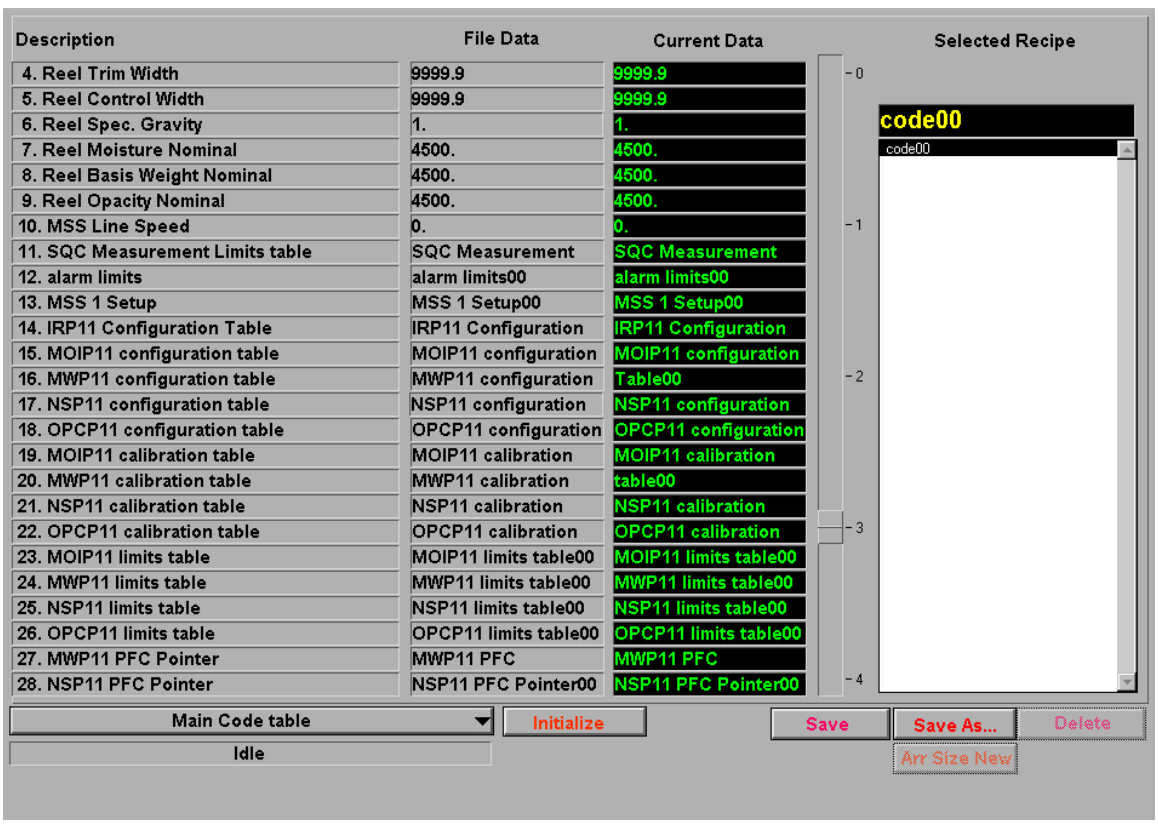


Figure 6-1 Main Code Table

To set up the calibration constants:

1. Press **Main Code Table**.

The display of the select value for the group appears. See Figure 6-2.

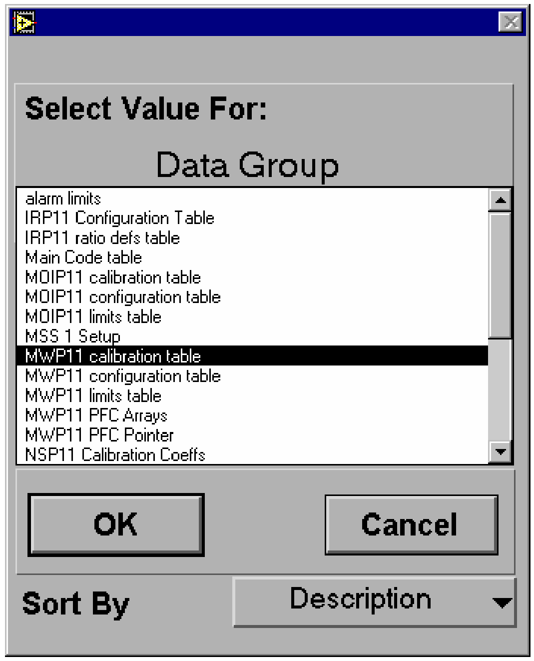


Figure 6-2 Selecting the Tables

2. Choose the **MWP11 Calibration Table** and press the **OK** button.

   This opens the **MWP11 Calibration Table**.

3. In the calibration table, enter the calibration constants for a given code and save them as **MWP11 Calibration Table** for the given code. For example, Figure 6-3 shows the setup of **MWP11 Calibration Table 00** for a given **Code 00**.

4. Select **MWP11 Configuration Table** in **Select value for the data group**.

5. Set the location to **True** for correctors that need to be enabled, and set the others to **False** for correctors that are to be disabled.

6. Save the above table as **MWP11 Configuration Table 00**. For example, Figure 6-4 shows the **MWP11 Configuration Table** in which the Dry End Algorithm and BW corrector have been enabled.

7. For each **Main Code Table** in a grade code, select the appropriate table in the **MWP11 Calibration Table** and **MWP11 Configuration Table**. These grade codes can then be loaded in the Maintenance or Production mode through the **Modes and Recipe** button on the Sensor Maintenance display, which is explained in detail in Section 6.2.

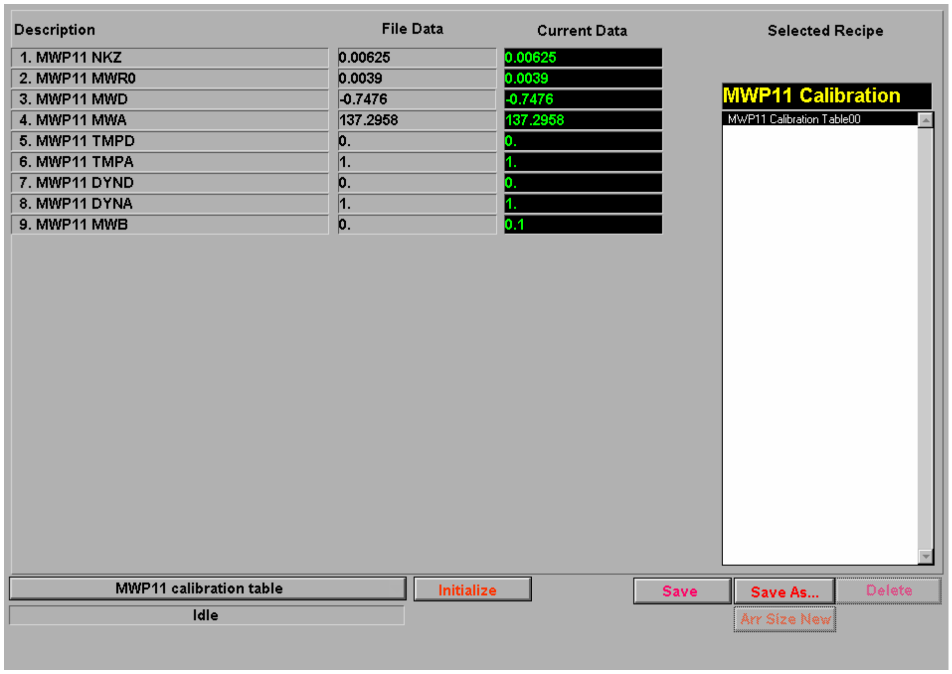


Figure 6-3 MWP11 Calibration Table for a Given Code

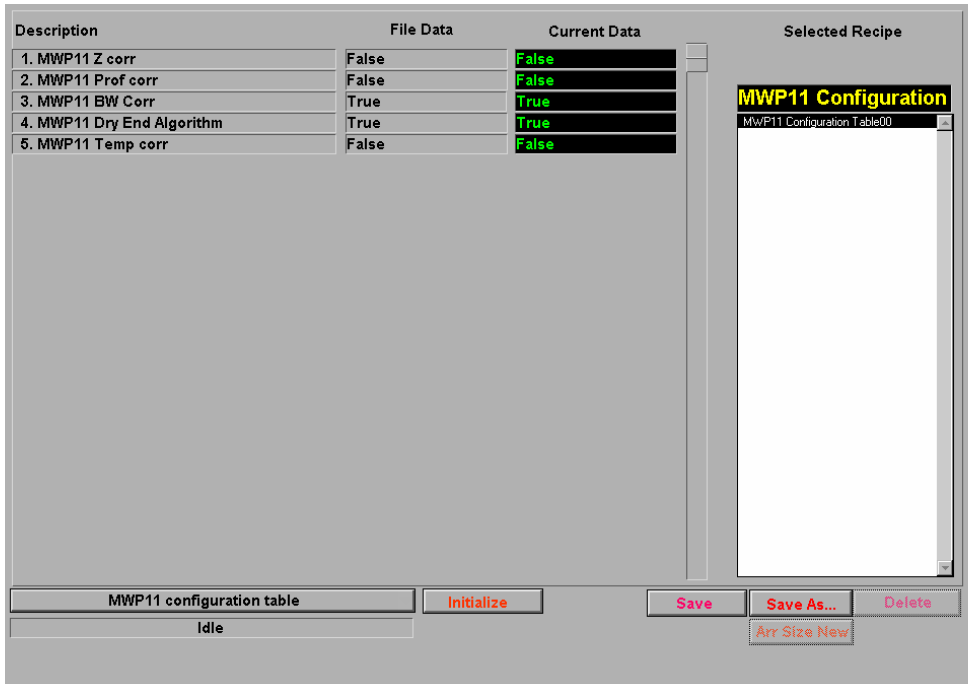
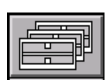
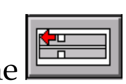


Figure 6-4 MWP11 Configuration Table Showing Dry End Algorithm and BW Corrector Enabled

6.2. Maintenance Mode Setup

1. Check that the gap is in alignment.
2. Check that the pin alignment holes are aligned.
3. Press the  button on the vertical dispatcher to bring up the **Scanner Control** display.
4. Select the appropriate scanner(s) and press the  button on the **Scanner Control** display to take the select head(s) offsheet.
5. Change to Maintenance mode and load a grade code, as follows:
   a. Press the **Modes and Recipes** button on the Sensor Maintenance display to bring up the **Maintenance Select** screen (see Figure 6-5)

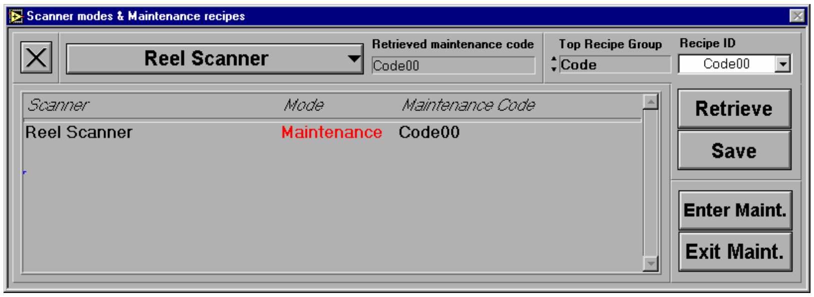


Figure 6-5 Maintenance Select Screen

b. Select the appropriate scanner.

c. Under **Top Recipe Group**, select the code.

d. Under **Recipe ID**, select a grade code that is set up for the appropriate reel.

e. Press the **Enter Maint**. button.

f. Press the **Retrieve** button and save the information.

g. Press  to close the Maintenance Select screen.

NOTE:	The Exit Maint. button is used to switch from Maintenance mode to Production mode.

The results of sensor operations such as Reference and Sample are stored in the *Sensor Reports.MDB* file in the directory *C:\HMX\Database*. The default maximum number of records per operation per sensor set to store records in this file is 100. When the maximum number of records is reached, the newest record replaces the oldest record in the file, so be sure to save the sensor report before it reaches 100.

6.2.1. Sample Preparation

For Sample selection and preparation, see Chapter 5.

6.3. Hardware Checks

CAUTION:	The High Range Microwave Moisture Sensor (092270-02) may be affected by contact between the sheet guide and your body or other conducting material. Keep your body and any electrically conducting materials at least 5 cm (2 inches) away from the sheet guide during alignment, stability testing, standardization, and Sample measurement.

6.3.1. Reference from Supporting Sensors

The Precision Microwave Moisture Sensor takes the input from the performance processor and the nuclear processor for the sheet temperature and the basis weight measurement. So, before going into the Microwave Processor, choose the Performance Processor as shown in Figure 6-6.

1. Choose the proper units by pressing the  button, which is accessible from the vertical dispatcher, and go to the **System Setup and Debug** screen.
2. Set up the basis weight units to the appropriate customer units in the **Units Setup** button.
3. Check the **In Customer Units?** checkbox on the **Sensor Maintenance** display to inform the system that the basis weight values entered at verification are in customer units.

   The default is always set in engineering units.
4. Perform a **Background** and **Reference**. Figure 6-6 shows the Background measurement of the Performance Sensor.
5. Now choose the nuclear sensor processor and perform the Background and Reference. Figure 6-7 shows the Reference measurement of the processor.
6. Put the Sample under BW sensor and perform the Sample.

The Microwave Processor is now ready to make measurements. Make sure that you have chosen the proper algorithm under the configuration parameters as shown in Figure 6-8 (for example, that you have enabled the Dry End Algorithm (by setting 1) or the Wet End Algorithm (by setting 0)).

NOTE:	After performing the Background, Reference, and Sample on the Performance Sensor and the Nuclear Sensor, choose the Microwave Moisture Sensor processor.

7. Set the integration time to three seconds.

8. Set the Operation in a set to be about 3, and # of sets to be 1.

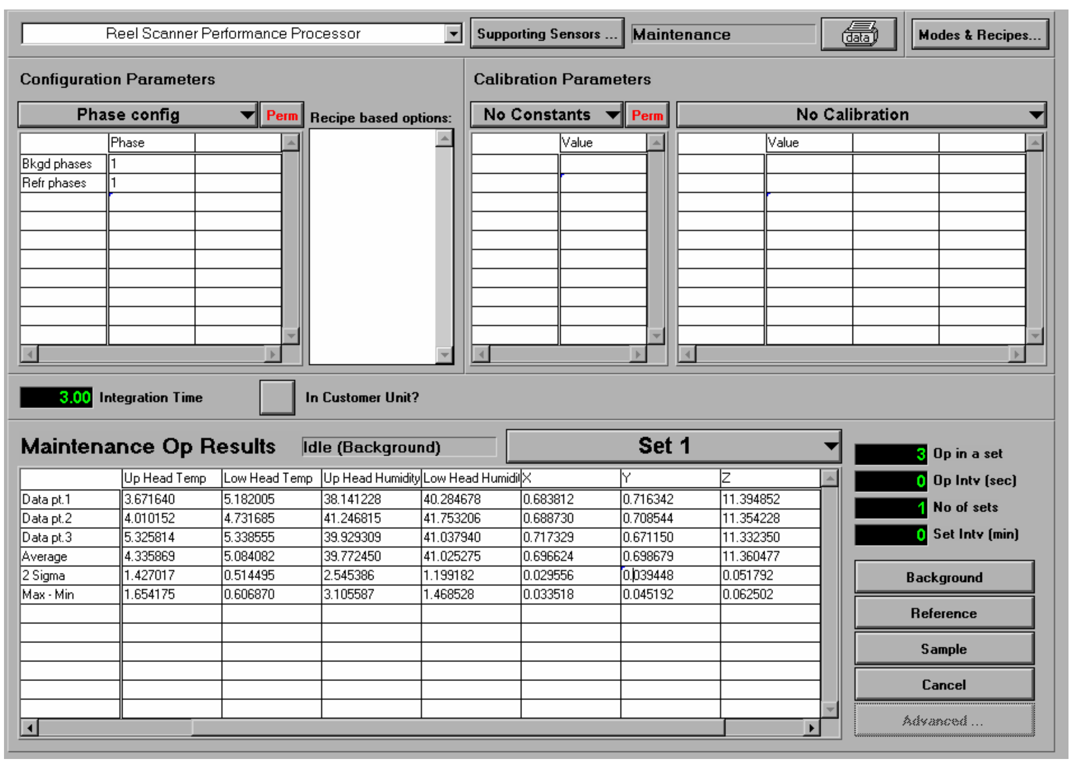


Figure 6-6 Background Measurement of the Performance Sensor

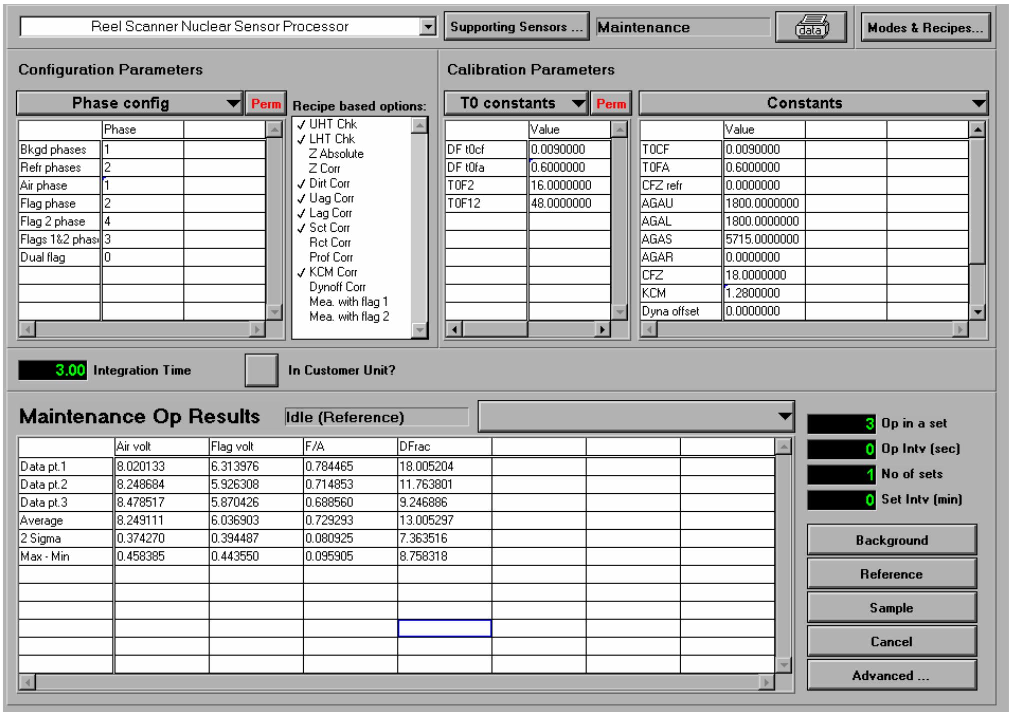


Figure 6-7 Reference Measurement of the Nuclear Processor

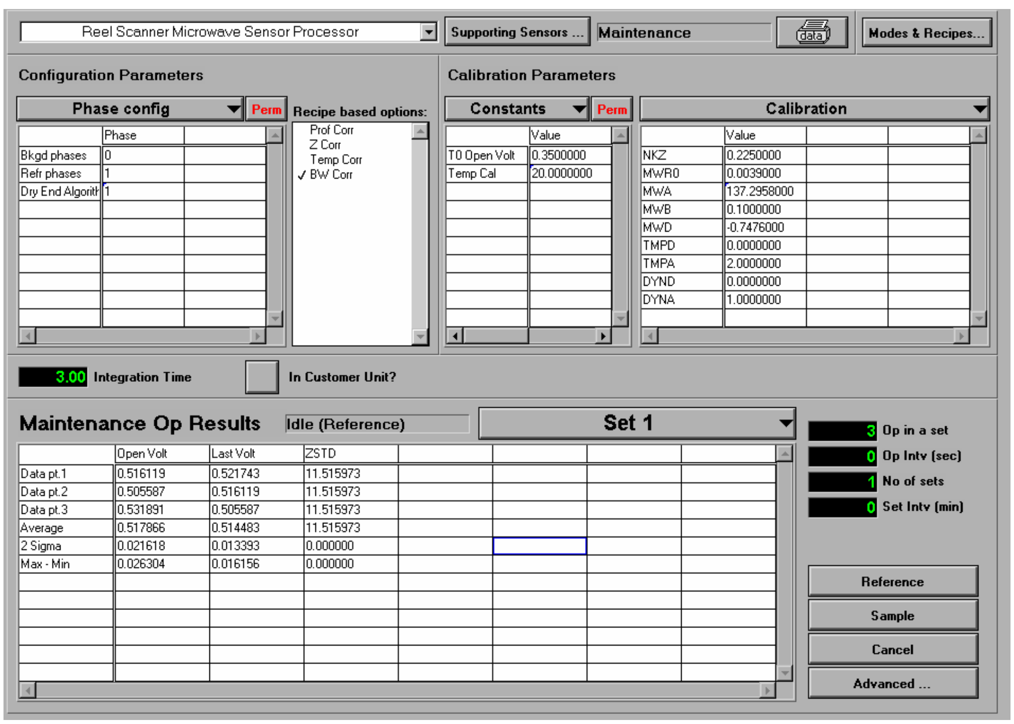


Figure 6-8 Reference Measurement of the Precision Microwave Moisture Sensor

6.3.2. Reference

1. Perform the Reference with an empty gap and record the average value.

   Figure 6-8 shows the Reference measurement of the Microwave Processor.

2. Place the Sample fixture under the Precision Microwave Moisture Sensor and align the fixture such that the fixture ring aligns with that of the head.

3. Once it is aligned, tape the bottom of the fixture so that it does not move.

4. Perform the Reference.

5. Place the standard Scanpro Sample in the Sample fixture, and then place it in the gap.

6. Set **op in a set** to 3 and perform the Sample.

7. Record the average value in terms of volts.

   Figure 6-9 shows the Sample measurement of the sensor.

8. Record the average value of the standard Scanpro Sample reading.

6.3.3. Stability Test

1. Remove the Sample along with the Sample fixture and perform 30 References with an empty gap.

2. When they are completed, note down the Max- Min of the set of 30 References and calculate the drift relative to the standard Sample reading:

   $$\text{Drift} = \frac{\text{Volts}_{\text{Max}} - \text{Volts}_{\text{Min}}}{\text{Average Volts (Standard Sample)}}$$

   Figure 6-8 shows the Reference measurement of the Precision Microwave Moisture Sensor.

3. If the drift < 0.01, the sensor is stable enough for calibration. If it is not, make sure that the windows are clean and that the head cooling is working, then repeat the References until the sensor is stable.

Figure 6-9 displays the Sample measurement of the sensor.

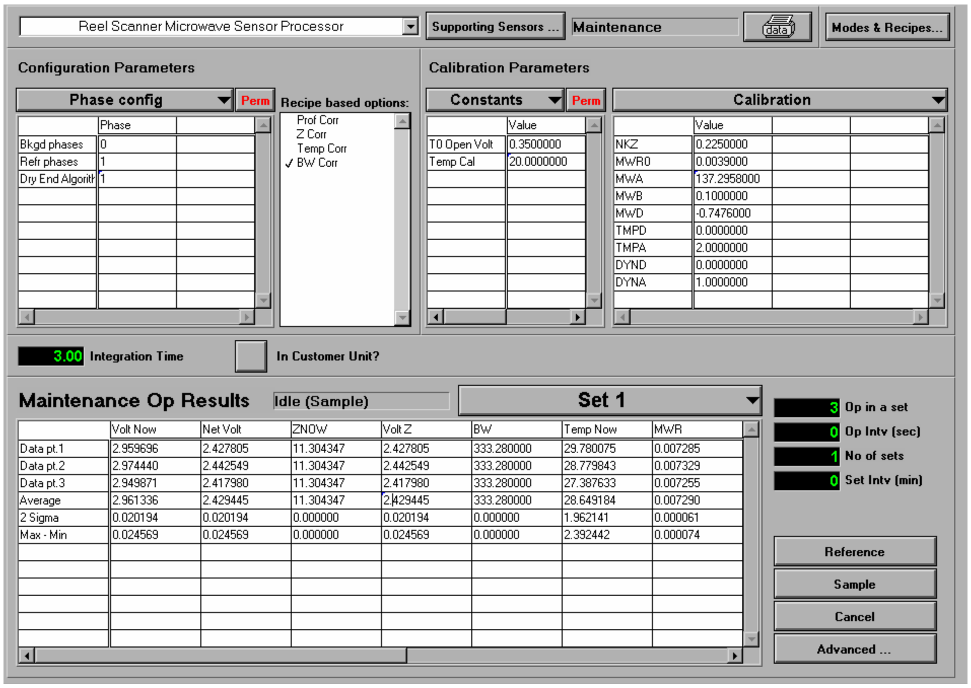


Figure 6-9 Sample Measurement of the Sensor

6.4. Sample Measurement

CAUTION:	The High Range Microwave Moisture Sensor (092270-02) may be affected by contact between the sheet guide and your body or other conducting material. Keep your body and any electrically conducting materials at least 2 inches (5 cm) away from the sheet guide during alignment, stability testing, standardization, and Sample measurement.

1. Since the Microwave takes the input from the Performance Sensor and the Basis Weight Sensor, perform a Background, Reference, and Sample on the Performance Sensor.

2. Perform a Background and Reference on the Basis Weight Sensor,
3. Place the Sample under the BW Sensor in the sheet guide and perform the Sample. The Microwave Moisture Sensor is now ready to make the measurement.
4. Bring the sensor to its equilibrium offsheet temperature with air-gap air and air gap heating off.
5. Record the time-zero temperature (approximately room temperature) as the time-zero temp calibration. This temperature can be found on the Sensor Maintenance frame as a temperature now in currently labeled units (°F or °C) when the Sample measurement is performed.

   Figure 6-9 shows T0 zero temp calib value in the Sample performance of the Sensor Maintenance frame.
6. In the Microwave Moisture Sensor, default is the wet end sensor. If it is a dry end sensor, enable the dry end by setting 1 for the Dry End Algorithm under **configuration parameter** in sensor maintenance or by loading the **recipe code** as explained in Section 6.1.
7. Choose the proper Engineering units or Customer units as explained in Subsection 6.3.1.
8. Perform three References on an empty gap and record the value of these as Time zero open volt on the calibration record sheet. This value is entered into the software to be used in limit checks. Figure shows the Reference display of the empty gap. Figure 6-10 gives you a Reference report of the empty gap.
9. Request a printout of the Reference report by going into the Sensor Report display and selecting the Microwave Reference report. The desired parameter can be selected under the field name by double-clicking on it, and it can be printed out using the printer button on vertical dispatcher.

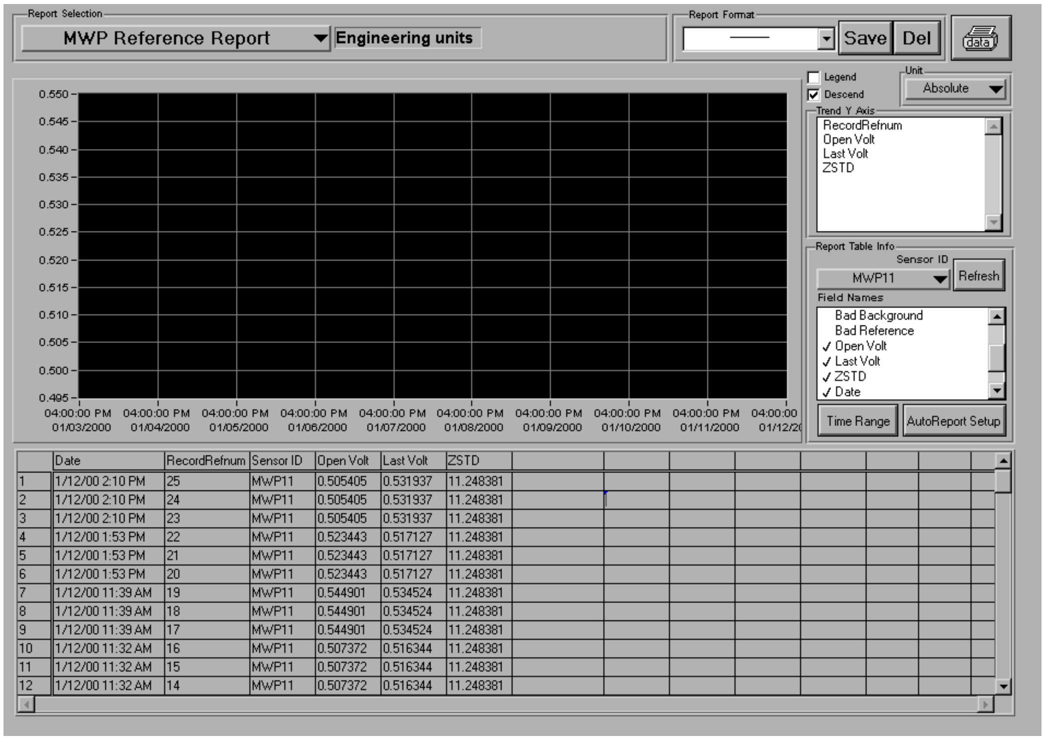


Figure 6-10 Moisture Reference Report

10. Place the Sample paddle in the gap and align it so the paddle ring matches that of the sensor.

11. Tape the bottom of the Sample holder so that it does not move. Perform a Reference with it.

12. Place the standard Scanpro Sample so that it is sandwiched between the paddles.

13. Perform three Sample readings on the standard Sample.

14. Note down the average Net Volt for the standard Sample, XS. Figure 6-9 displays the Sample measurement of the standard Sample.

15. Note down the Net Volt of the standard Scanpro Sample; in this case, it is 2.4294V. Figure 6-11 displays the Moisture Sample report. This value is used in the calculation of the drift.

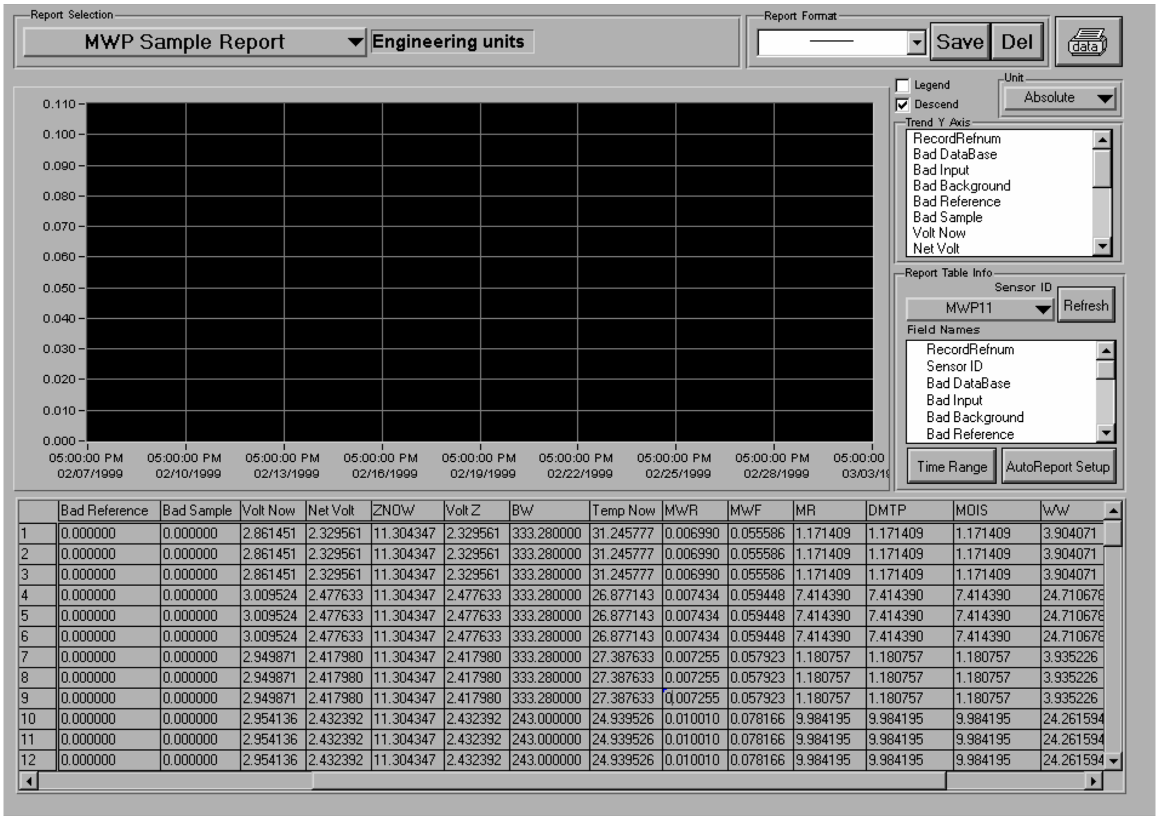


Figure 6-11 Sample Report of the Standard Scanpro Sample

16. Place an empty aclar bag in the Sample fixture and perform another Reference.

17. For previously uncalibrated grades on dry end sensors, take the bone-dry Sample from the first grade, enter its basis weight (in the appropriate units as selected above) on the Advanced frame, and perform a Sample on the bagged Sample in the Sample Fixture.

    Take care to ensure that the Sample is oriented properly for calibration and verification (that is, the fiber orientation should always be in the Machine Direction (MD).

    If the fiber orientation is at right angles to the normal MD, it can introduce an additional moisture error (decrease) of about 1.5%. In the case of online measurement, the sheet orientation is always parallel to the MD direction so it will not be a problem. Only during the calibration and verification does care have to be taken to orient the Sample properly.

18. Place the bone-dry Sample in the Sample fixture.

19. Perform the Sample on the advanced frame.

20. Record the value of the **MWR** printed out.

21. Continue with the other bone-dry Sample, entering the basis weight, performing the Sample, and recording the MWR.

22. Group together any grades whose bone-dry **MWR** value agrees within the 3%.

23. Use the average value of **MWR** for a group as the **MWR0** for that group's grades.

24. Record that value.

25. For each grade, perform a Reference on the empty bag. Enter the **MWR0** value in the calibration table (for dry end sensor only).

26. For each wet Sample, enter the basis weight on the advanced verification frame and perform the Sample with the bagged Sample in the Sample fixture.

27. Record the values of the **MWF** on the calibration record sheet.

6.5. Data Reduction

Perform a linear regression by plotting % moisture vs. MWF to obtain slope and intercept for each grade or group of grades within the moisture accuracy specification.

Enter and store the calibration data, such as MWA, MWD, MWB (if the BW corrector is enabled), and MWF in the **MWP11 Calibration Table**, under **Main Code Table** in the **Maintenance** frame.

6.6. Verification

6.6.1. "Advanced…" Button

Advanced maintenance procedures are performed in the advanced screen, which is brought up by pressing the **Advanced…** button in Maintenance mode from the Sensor Maintenance display. The advanced screen for the moisture sensor is shown in Figure 6-12.

Although maintenance operations are handled on a "per scanner" basis, *only one advanced screen can be brought up at a time*. The common interface maintains only one copy of working memory for the verification.

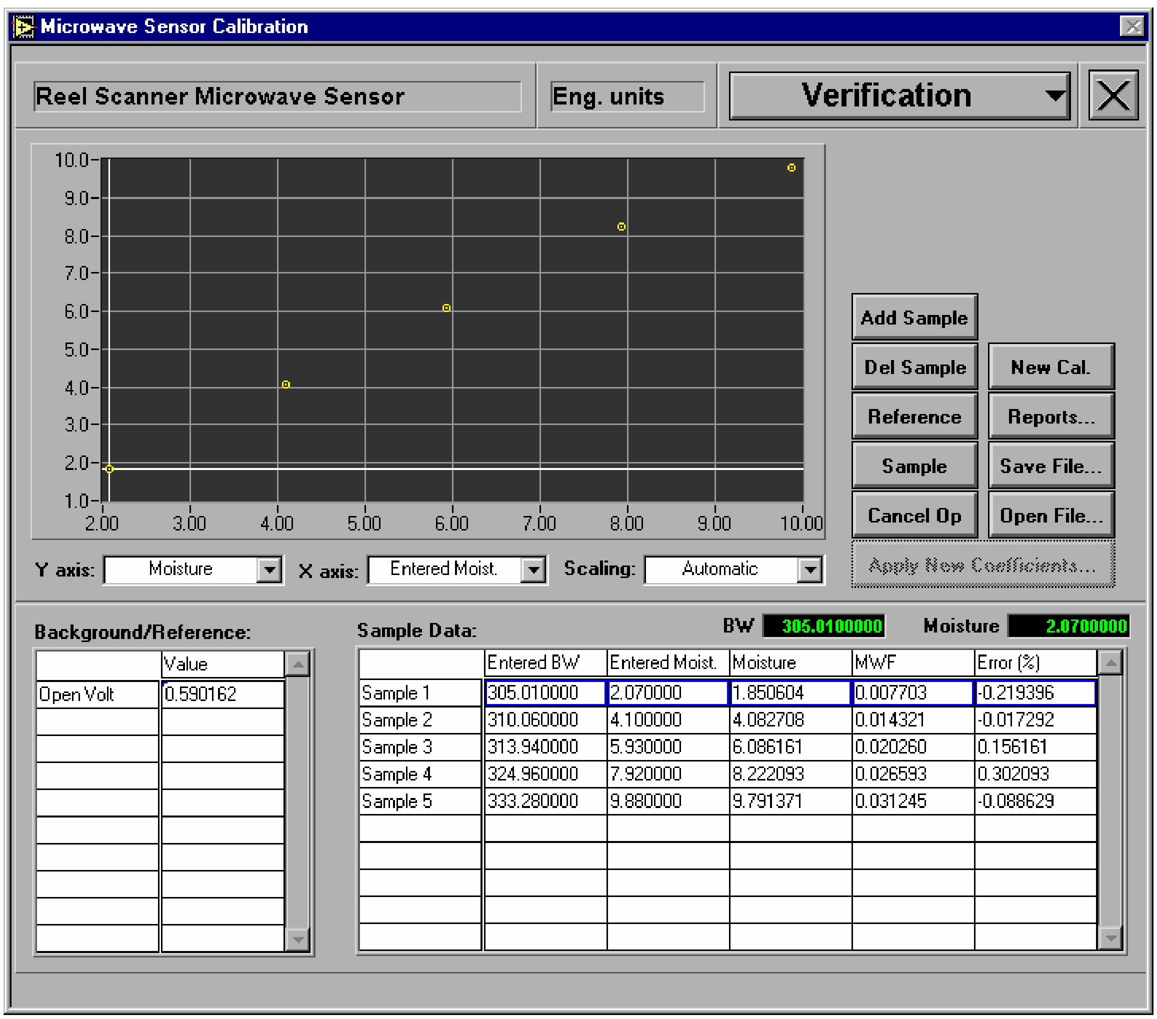


Figure 6-12 Advanced Screen

On top, the screen shows which moisture sensor in the system is under maintenance and which units, either engineering units or customer units, are being used. These two settings are inherited from the Sensor Maintenance display and can only be changed from there.

Table 6-1 provides button descriptions for the Microwave Moisture Advanced Mode.

Table 6-1 Microwave Moisture Advanced Mode Button Descriptions

Microwave Moisture Advanced Mode/Button	Description
Verification	For moisture sensors, the advanced screen contains only the Verification mode. It is used to verify a previously obtained calibration.
Add Sample	If the Sample Data table is empty, press this button once to add a Sample. This also enables the Sample operation. Thereafter, a new Sample is added to the Sample Data immediately after the row in which the cursor is highlighted. By default, the newly added Sample has Entered BW and Entered Moisture values of 0. To modify, place the cursor on the Sample entry row of interest and change the lab values using the BW and Moisture numeric controls.
Del Sample	To delete a Sample from the Sample Data table, place the cursor on the row that you want to delete, then press this button to remove the row.
Copy Wts	It is possible to save the effort to re-enter all of the lab values if they turn out to be identical by copying them from a file that was created and saved earlier. To do so, press this button, which prompts you to select a source file. Select the desired source file from which to copy, then acknowledge the choice by pressing OK.
New Cal.	To start a brand new verification, simply press this button to have a blank working Sample Data table.
Save File	At any time during the verification procedure, you can save the data to a file by pressing this button. The default path for the Microwave Moisture Sensor is: %MXRoot%HMX\Database\Calibration Data\ Microwave Moisture and it requires that you enter a filename.
Open File	At any time during the verification procedure, you can open the data from a file by pressing this button. The default path for the Microwave Moisture Sensor is: %MXRoot%HMX\Database\Calibration Data\Moisture and it requires that you enter a filename.
Reports	At the time of the release of this document (08/2000), this button does not print out a report of the moisture verification data.

6.6.2. Entry of Calibration Constants

1. Enter the appropriate determined calibration constants in the grade codes (recipes) through the **Recipe Maintenance** display on the Setup menu for permanent storage. The calibration constants can also be entered through the **Calibration Constants** table under **Calibration Parameters** in the **Sensor Maintenance** display for temporary usage.

2. Enable/disable the appropriate correctors in the grade codes (recipes) through the **Recipe Maintenance** display on the **Setup** menu for permanent storage. Correctors can also be enabled or disabled through the Recipe-based options under **Configuration Parameters** in the **Sensor Maintenance** display for temporary usage. To enable a corrector, double-click on the appropriate corrector and a check mark will be shown in front of the corrector to indicate that the corrector is enabled. (To disable a corrector, double-click on it again and the check mark will disappear.)

3. Press the  button, accessible from the vertical dispatcher, to go to the **System Setup and Debug** display. Set up the basis weight units to the appropriate customer units through the **Units Setup** button. Check the "In Customer Units?" checkbox on the **Sensor Maintenance** display to inform the system that the basis weight values entered at verification are in customer units.

6.6.3. Verification of the Calculation

To verify calibration:

1. Load a grade code containing the calibration constants and correctors of the Samples to be verified.

2. Recheck to make sure that the appropriate calibration constants and correctors are properly restored on the **Sensor Maintenance** display to be used by the Gauge Support Processor (GSP).

3. Request a printout of the calibration data by pressing the 

button on the **Sensor Maintenance** display.

4. In Maintenance mode, press the **Advanced…** button from the Sensor Maintenance display.

5. Start from a blank working space (**Sample Data** table). It is blank the first time you call up the advanced screen; otherwise, press the **New Cal.** button to reset the working space to blank.

6. Set up the **Sample Data** table by pressing the **Add Sample** button once for every Sample in a grade. For each Sample, enter the calculated basis weight in customer units in the BW field and lab %-moisture in the **Moisture** field. Save the entered data to a file as a safety measure.

7. Perform a Reference on an empty aclar bag in the Sample fixture.

8. Place the cursor on the first row in the **Sample Data** table. Perform a Sample using the paddle fixture.

9. When the operation is complete, the result is displayed in the **Sample Data** table. The cursor (the highlighted row) automatically moves down to the next entry/Sample.

10. Verify that the Error(%) is ≤ the 2•σ accuracy specification. (See Section 6.1). The verification results can be graphed with virtually any combination of variables.

11. Select a view that is the most informative in determining the goodness of the verification (for example, Error (%) on the vertical Y-axis vs. Entered Moisture on the horizontal X-axis). For example, Figure 6-12 shows the plot of Measured Moisture vs. Lab Moisture.

12. Repeat the Sample measurement until all of the Samples in a grade are measured.

13. Save the data again to include the verified data as a safety measure.

14. Do a frame copy of the verified data by pressing the button from the vertical dispatcher.

15. Repeat these steps each grade of Samples prepared.

Make note of any Samples that measure with an error of greater than the 2•σ accuracy specification. If more than 20 percent of the Samples that were not omitted during data reduction fail this criterion, the verification and/or calibration should be repeated until success is achieved. If more than one Sample needs to be omitted per grade, the omitted Samples for that grade should be replaced with freshly made Samples.

7. Dynamic Calibration

Dynamic correction is included to correct for flashoff (evaporation from hot sheet) of moisture between the scanner and the reel (reel scanners only), any difference between static calibration readings on bagged Samples and onsheet readings, and/or any residual sheet temperature dependence in the sensor. Performed it only after static calibration has been performed and verified. It is advisable to perform dynamic verification once a week.

Dynamic correction and sheet temperature correction are normally required for all Microwave Moisture Sensors.

7.1. Dynamic Correction

7.1.1. Few Data Points -- Intercept Only

If you have only a few data points (<10), it is probably best to use only an intercept correction. If there is no dynamic correction:

DYND = - Average[Sensor - Lab]

If there is dynamic correction, calculate for each point the value of MT (the sensor value without dynamic correction):

MT = (Sensor – DYND)/DYNA

then use:

DYND = – Average[MT – Lab]

7.1.2. 20 or More Data Points

When you have at least 20 data points, make a graph of lab percent moisture (vertical axis) against Sensor percent moisture. If there is already dynamic correction, use:

MT = (Sensor - DYND)/DYNA

Determine whether the graph looks like a ball or a line.

7.1.3. Ball – Intercept Only

If the range of moisture levels is narrow, the points may form a ball. In this case, the best you can do is to use a simple intercept correction. Use DYND = – Average [Sensor – Lab] if there is no existing dynamic correction, or DYND = – Average[MT – Lab] if there is already dynamic correction. Be sure to use DYNA = 0.

7.1.4. Line – Slope and Intercept

If the range of values is great enough that a line can be discerned, perform a linear regression on Lab (y) vs. Sensor (x). If there is already dynamic correction, use MT(x). Use DYNA = slope and DYND = intercept.

7.2. Sheet Temperature Correction

Sheet Temperature Correction is normally required for all Microwave Moisture Sensors where the online sheet temperature is different from the calibration temperature. The dielectric constant of water decreases with temperature, and that of cellulose increases with temperature. Figure 7-1 gives the error in an uncorrected sensor.

If the error is fairly constant, or if the moisture range normally encountered is very small (± 2%), you may normally use only a temperature correction intercept. From Figure 8-1, find the moisture error value for your nominal moisture level and a temperature change of ΔT=10°C. Next, multiply it by –0.1. Use this value for TMPD and use TMPA = 0. For example, in the range from 2% to 8% moisture, the typical error for ΔT=10°C is +0.5% moisture. Thus, for this typical dry end range, use TMPD = –0.05.

If you have a larger moisture range, use a slope and intercept. Pick 2 points from Figure 8-1, corresponding to the endpoints of your range, then perform a linear regression on the 2 points. Let TMPA = –0.1*slope and TMPD = –0.1•intercept.

Note that the Sheet Temperature Sensor measures the surface temperature of the sheet, not the bulk temperature that causes the temperature dependence. It is then possible for the Sheet Temperature to underestimate or overestimate (less common) the sheet temperature and thus the correction. If you observe sheet temperature dependence in dynamic verification results, adjust the TMPD or TMPA accordingly.

Error in percent moisture as a function of percent moisture and temperature difference between calibration temperature and sheet temperature

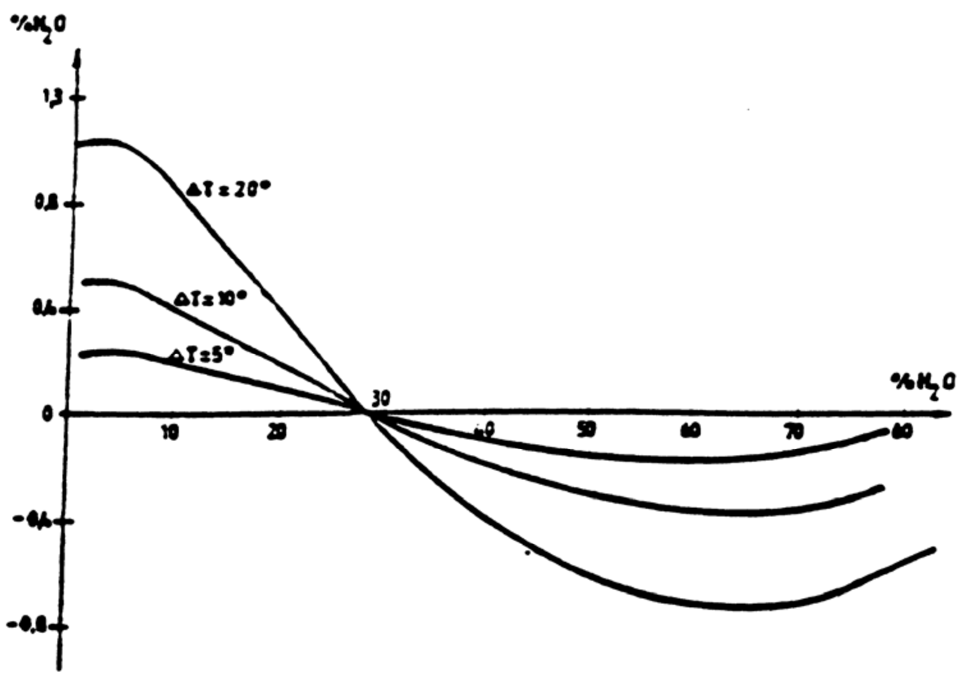


Figure 7-1 Sheet Temperature Dependence of Microwave Moisture Sensors (Figure courtesy of Scanpro)

7.3. Z-Correction

Microwave Moisture Sensors normally require Z-correction when there is significant scanner bowing. The appropriate value for NKZ must be entered in the **MWP11 Calibration Table** in the **Recipe Setup**, and the Z-Correction must be enabled on the Microwave Status frame.

7.3.1. Standard Range (Dry End) Z-Correction

For Standard Range sensors, the NKZ value depends on basis weight.

The following are typical values:

Basis Wt gsm		100	150	200	>300
	250 kHz VFC	0.125	0.075	0.064	0.05
NKZ	500 kHz VFC	0.0625	0.0375	0.032	0.025
	2 MHz VFC	0.0156	0.0094	0.008	0.00625

7.3.2. High Range (Wet End) Z-Correction

For High Range sensors, the NKZ value depends on water weight.

The following are typical values:

Water Wt gsm		400	500	600	>700
	250 kHz VFC	0.022	0.014	0.009	0.008
NKZ	500 kHz VFC	0.011	0.007	0.0045	0.008
	2 MHz VFC	0.0028	0.0018	0.0011	0.001

To obtain the water weight in gsm, multiply the basis weight in gsm by the percent moisture and divide by 100:

$$WWgsm = \frac{BWgsm \bullet \%MOI}{100}$$

8. Da Vinci System Production Software

To change from Maintenance mode to Production mode, do the following:

1. Go to the **Sensor Maintenance** frame and press the **Modes and Recipes** button.

   The **Scanner modes & Maintenance recipes** frame appears.

2. In the **Scanner modes & Maintenance recipes** frame, press the **Exit Maint.** Button and close the frame.

This takes you to Production mode from Maintenance mode, as shown in Figure 8-1.

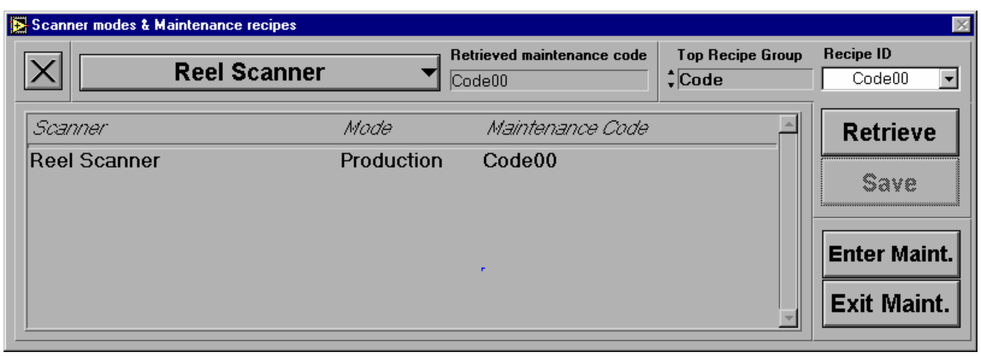


Figure 8-1 Scanner Modes and Maintenance Recipes

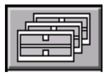
Before scanning, make sure that the gap between the sensor heads is clear and that all of the pins have been removed. Also, make sure that the proper recipe codes have been retrieved and that proper correctors have been enabled in the recipe-based option frame.

To set up the scan width in the Cross Direction (CD):

1. Go to the **MSS Setup Diagnostic** on the Horizontal dispatcher and choose the MSS scanner calibration test.

2. In the scanner calibration test frame, set the scanner width, sheet width, and slice width according to the instructions given in the *Da Vinci Operator's Manual* (p/n 6510020192).

   The system is now ready to scan.

3. Press the  button on the vertical dispatcher to bring up the Scanner control frame, as shown in Figure 8-2.

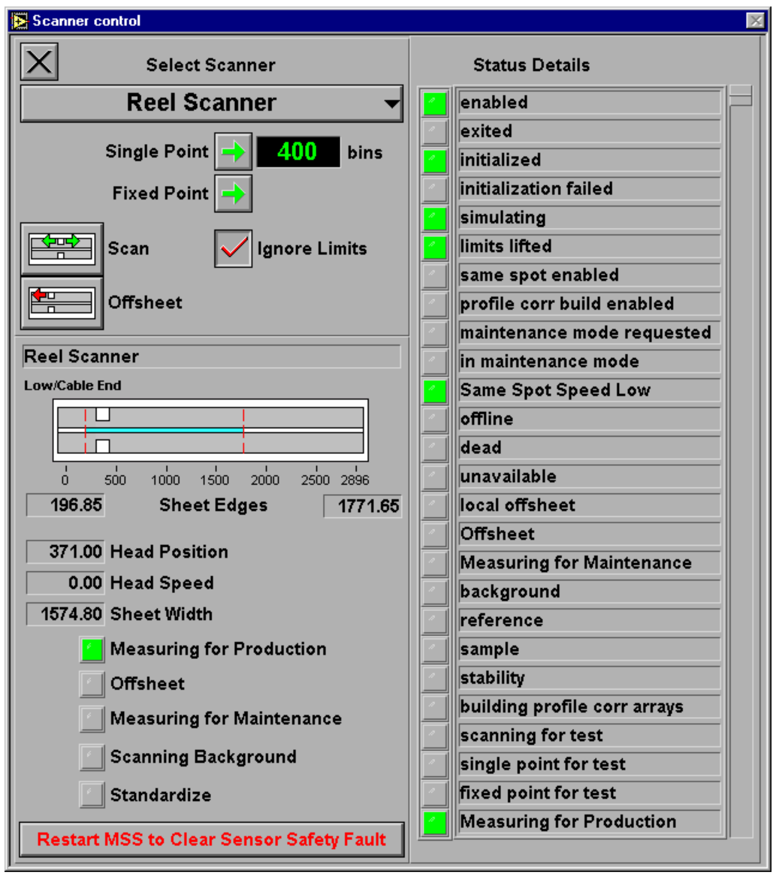
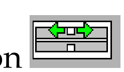


Figure 8-2 Scanner Control Frame

4. In the Scanner control frame, press the scan button  to scan the head.

   Before the sensor starts scanning, it takes the Background and Reference reading from all of the sensors (performance, basis weight, moisture, etc.) and stores it. While it is scanning, you can choose either the position snapshot or the single point by selecting the appropriate button in the **Sensor maintenance** frame (see Figure 8-3).

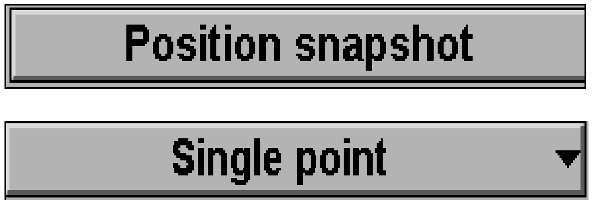


Figure 8-3 Selections for Various Types of Scan

1. For the single-point snapshot, set the single point to the desired position (in terms of bins), then press **Single Point**. For the position snapshot, you can set the position on the **Sensor Maintenance** of the **Production** display and the measurement readings can be monitored on the main display. Figure 8-4 shows the position snapshot of the production mode.

2. **Customer unit** can be chosen by enabling the customer unit. Default will be set in gms/square meter(gsm), C, and unit length of meters.

3. Change the units by pressing **System Setup** and the Debug button  on the vertical dispatcher.

4. Units can be set by pressing the **Report Units** setup bar.

To set the filter factor on the **Scanner Setup** display:

1. Press the **scanner/sensor** button on the horizontal dispatcher.

2. Press the **Measurement Setup** button.

3. In the **Measurement Setup** display, under the **Select Measurement** option, choose **Moisture** for measurement.

4. Under the measurement arrays, set the trend filter factor (Figure 8-5).

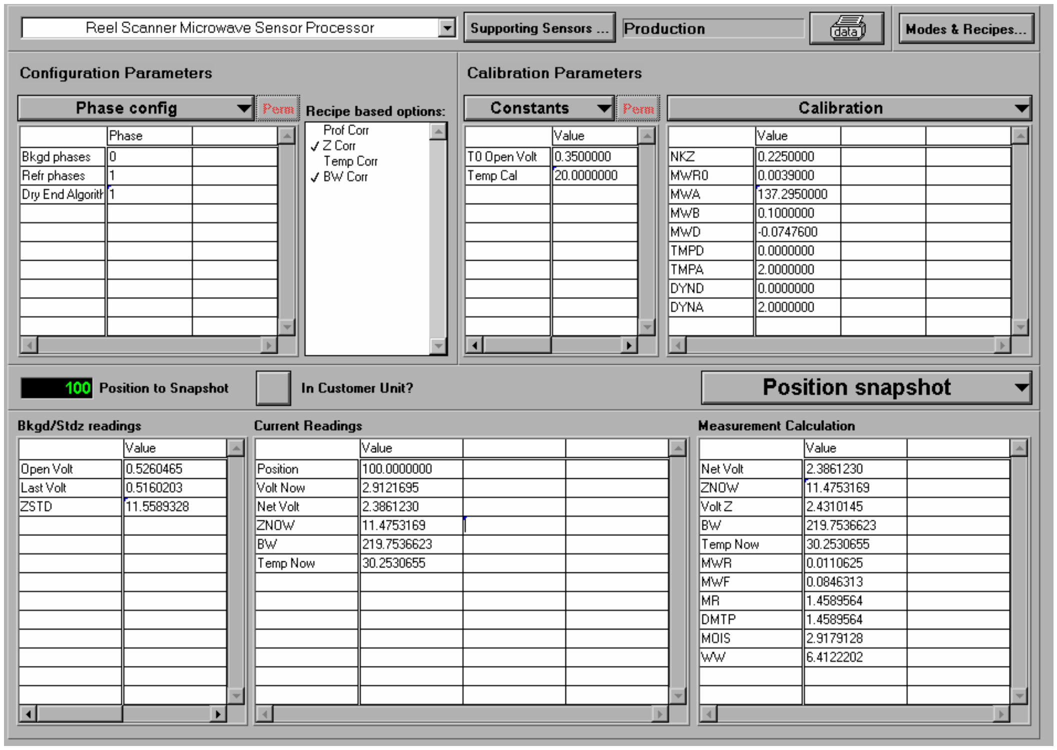


Figure 8-4 Sensor Maintenance Display for Production Mode

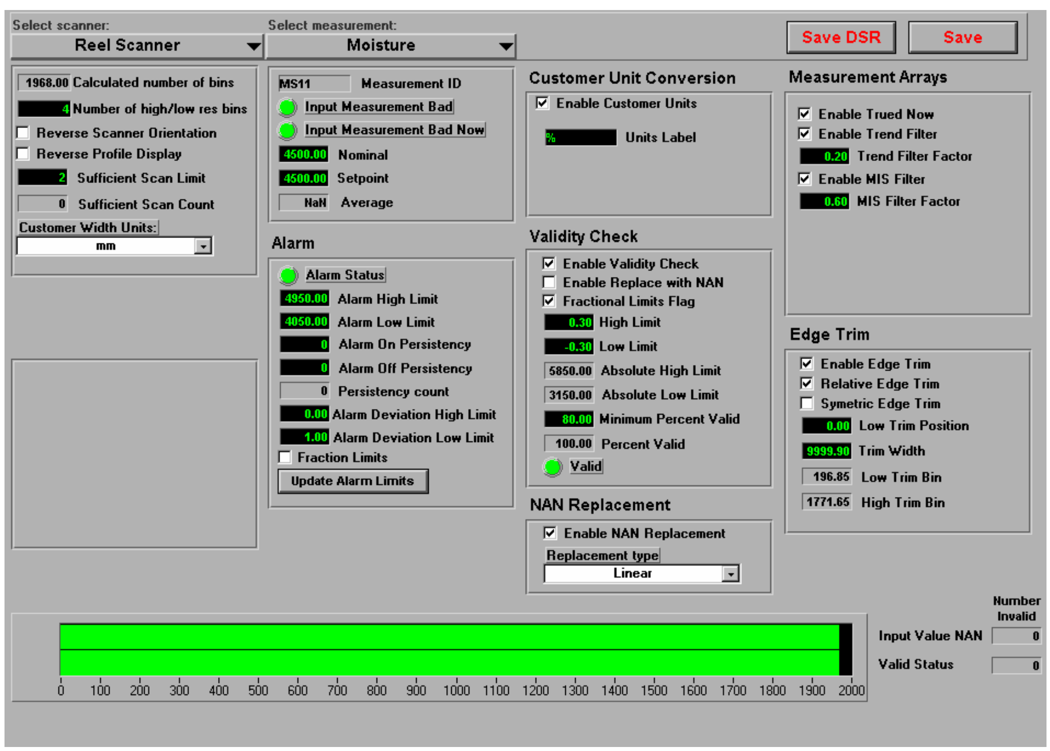


Figure 8-5 Measurement Setup Display

To set up the **profile report**:

1. Choose **Favorites** in the horizontal dispatcher.
2. Choose the **profile** button.
3. Choose the profile report of the desired measurement; for example, basis weight, MW moisture, or sheet temperature.

   You can monitor Now value or trend value by making an appropriate selection. A sample of the profile report is shown in Figure 8-6, which shows the profile of the basis weight, MW moisture, and sheet temperature. Use profile displays to locate one or more sections of the slices where the MW moisture, basis weight, and temperature are relatively flat.
4. After finding the flat region, allow the scanner to complete 15 scans before turn-up.
5. Monitor the average moisture on the sensor maintenance display until turn-up.
6. As soon as possible after turn-up, locate the slice at which the sensor was single-pointed and center the template over it.
7. Mark the sections corresponding to the chosen slices.
8. Use the knife to cut at least six wraps into the reel at each slice using the template marks.
9. Quickly peel off the layers, then insert them into the previously weighed bags and seal them.
10. Mark the bags with the slice number.
11. Take all of the Samples to the lab for weighing and drying.
12. For each of the Samples, calculate the wet Sample and dry Sample weights, and also the percent moisture.

    By plotting the lab data vs. the sensor data, you can determine the dynamic correction.
13. Use the dynamic record sheet to keep track of dynamic test results and corrector values.

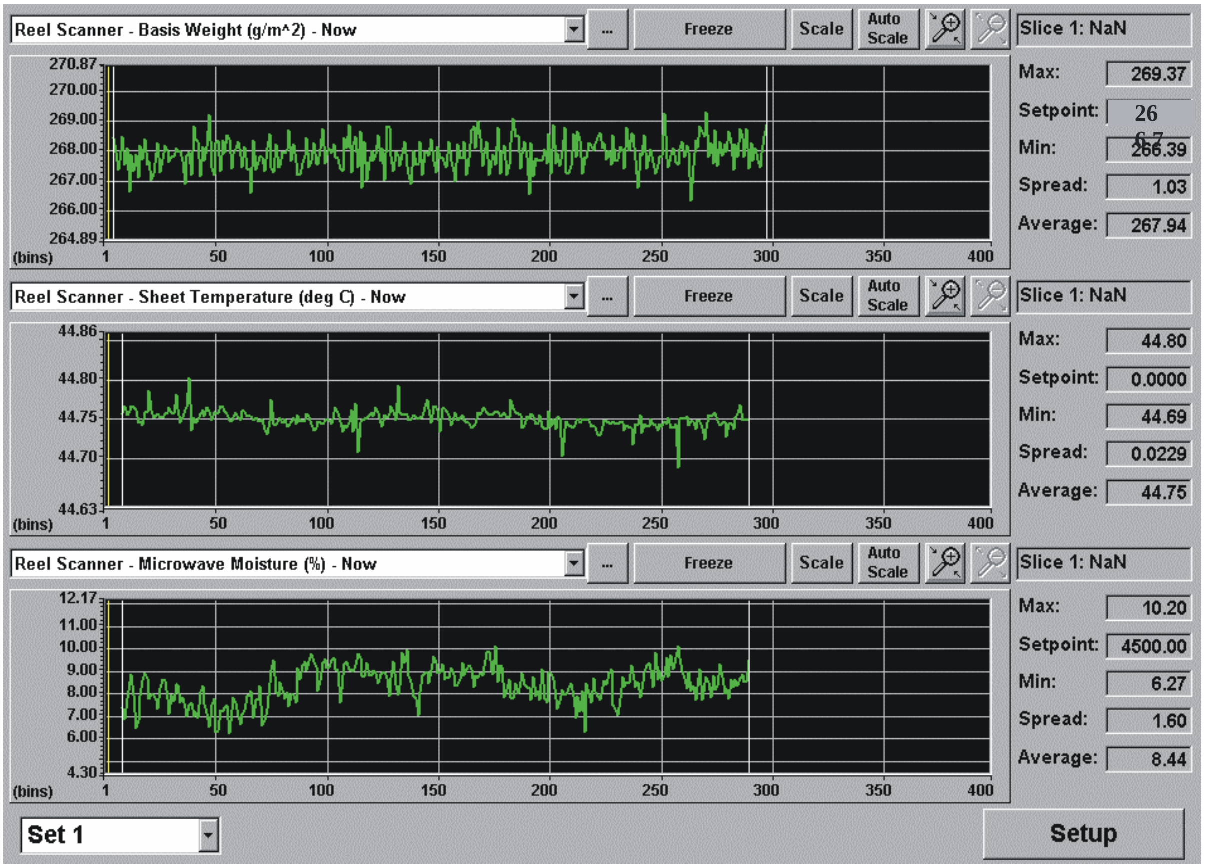


Figure 8-6 Profile Report of Basis Weight, Sheet Temperature, and Microwave Moisture

8.1. Profile Correction

The profile correction is normally used to correct for the misalignment of the heads in the X and Y direction during part of the scan. To use the profile correction, a profile array has to be built up and saved in the recipe code. During the profile buildup, in the case of moisture, it calculates the average voltage and displays the deviation from the average voltage value. This array, both in forward and reverse direction, is stored and saved for the given recipe. The details of the profile buildup are explained in the following section.

8.1.1. Profile Correction Buildup

To build the profile array:

1. On the horizontal dispatcher, choose the **profile correction** display.
2. In the **profile correction** display, press the **Recipe Mode** button.
3. Press the **Modes & Recipes** button in the right-hand corner,

   The **Scanner Modes and Maintenance Recipe** display appears.
4. Press the **Enter Maint.** button as shown in Figure 8-7.

   This sets you into Maintenance mode.

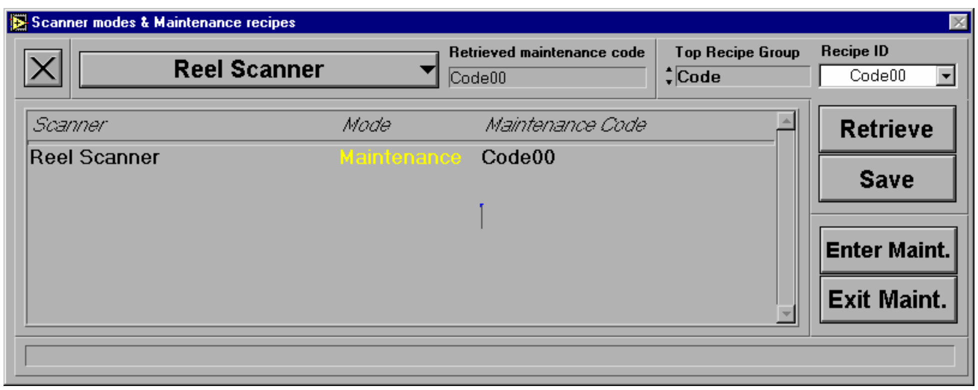


Figure 8-7 Scanner Modes and Maintenance Recipes Display

5. The instruction to build the profile array is given in the leftmost side of the profile buildup display. Figure 8-8 shows the profile buildup display for the MW sensor.

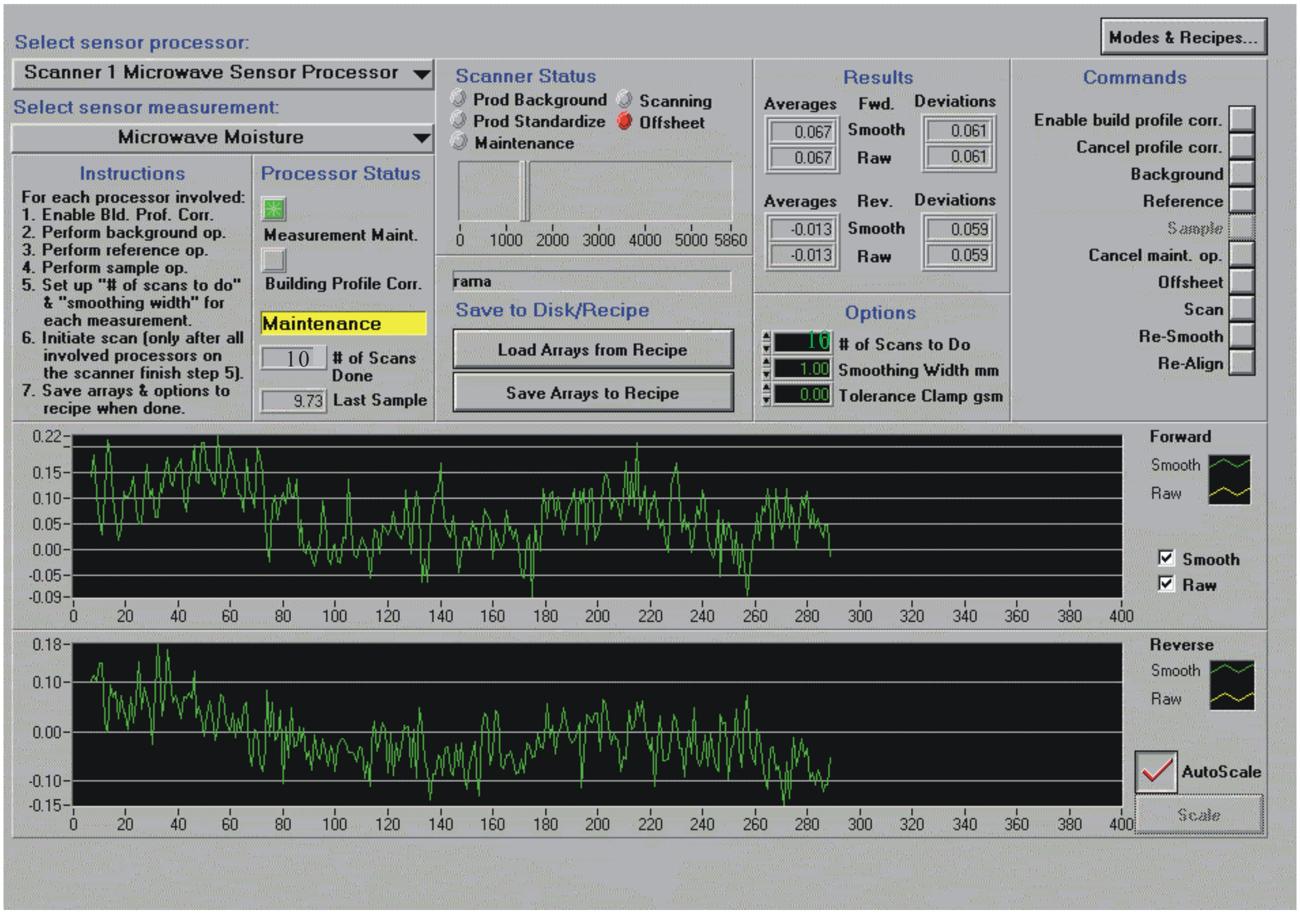


Figure 8-8 Profile Correction Buildup Display

6. Under **Select sensor processor**, choose **Reel Scanner Nuclear Sensor**. (See Figure 8-8)

7. Under **Sensor Measurement**, choose **Basis Weight**.

8. Select **Enable build profile correction**.

   The green button lights up, indicating that **build profile correction** has been enabled.

9. Perform a Background, Reference, and Sample by pressing the proper buttons as given in the instructions.

10. Go to the next sensor and, under **Select sensor processor**, choose the **Reel Scanner Microwave Moisture Sensor** processor.

11. Under **Sensor Measurement**, choose **Microwave Moisture**.

12. Perform a Reference and Sample by pressing the buttons as given in the instructions.

13. After performing the above steps for each of the sensor processors, enter the # of scan and smooth width for each processor.

    Now the scanner is ready to build the profile.

14. Press the **Scan** button.

    It builds the profile and plots the voltage profile both in forward and reverse direction. Finally, it plots the average profile of the # of scans. (See Figure 8-8.)

15. Save this array by pressing the **Save Array to the Recipe** button.

    The **Select ID and Groups to Apply** display appears.

16. Name the pointer.

Figure 9-9 shows the display of the **Select ID and Groups to Apply**. In that display, for example, name the profile array that has been built as MWP11 PFC Pointer 00. Choose whether to use a different ID for a different weight or to apply one to all.

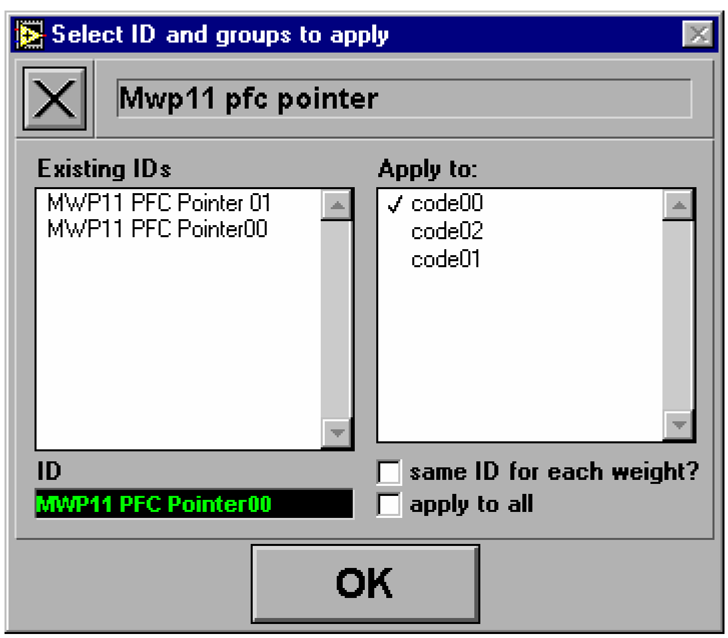


Figure 8-9 Select ID and groups to apply Display

17. To apply this pointer for a particular code, go to the particular code and double-click on it.

    A corrector appears in front of the code indicating that you have applied the given pointer for that particular code.

18. Press **OK**.

    For example, Figure 8-9 shows that the pointer array **MWP11 PFC Pointer 00** has been applied to code 00.

19. To set the pointer array to a particular code, go to **Recipe Maintenance** to change it. Point to the particular array to the given code by setting it up in **Recipe Maintenance**. To do this, go to the pointer array display and choose the particular pointer array, then save it. (Figure 8-10 shows the pointer array display.)

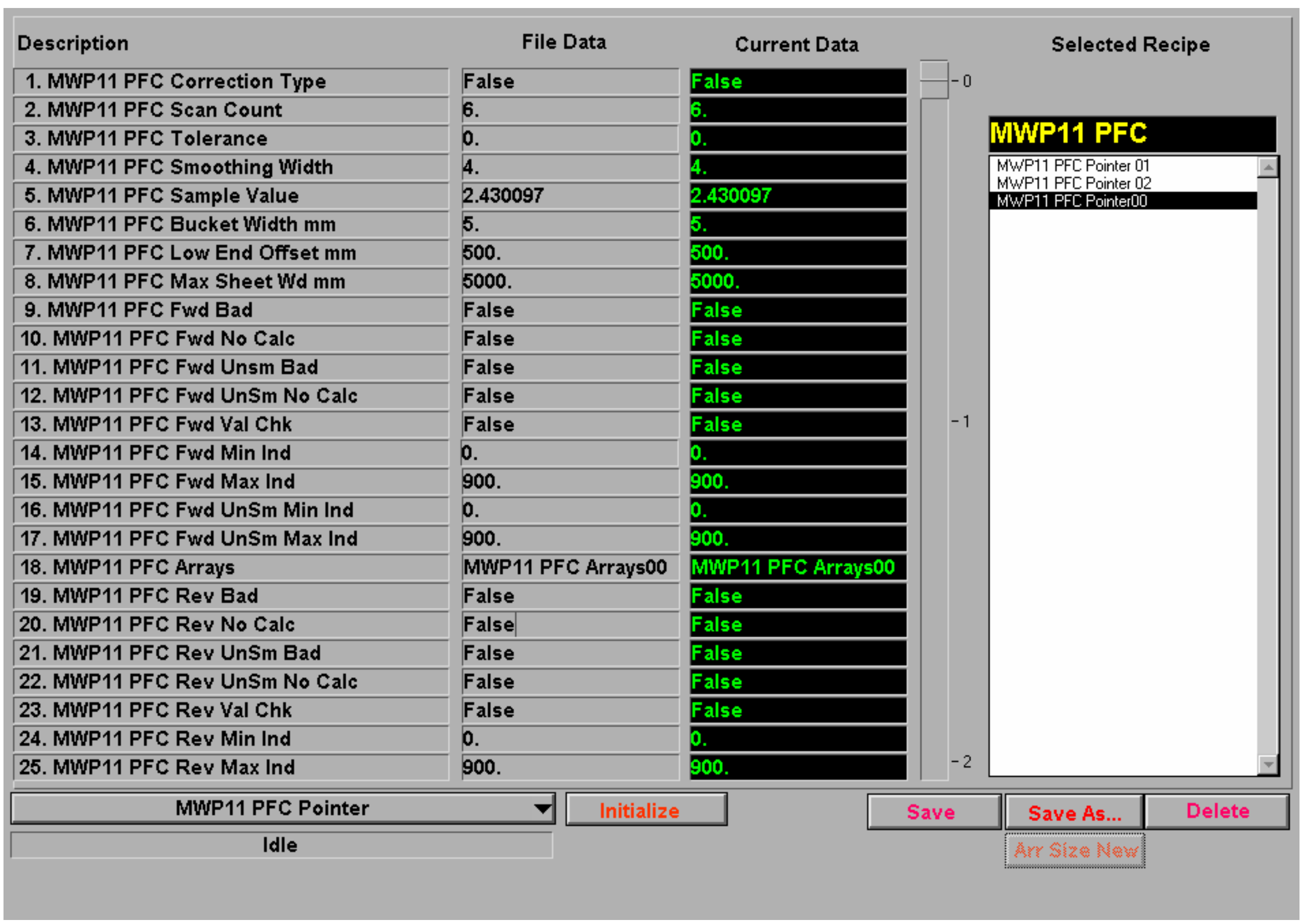
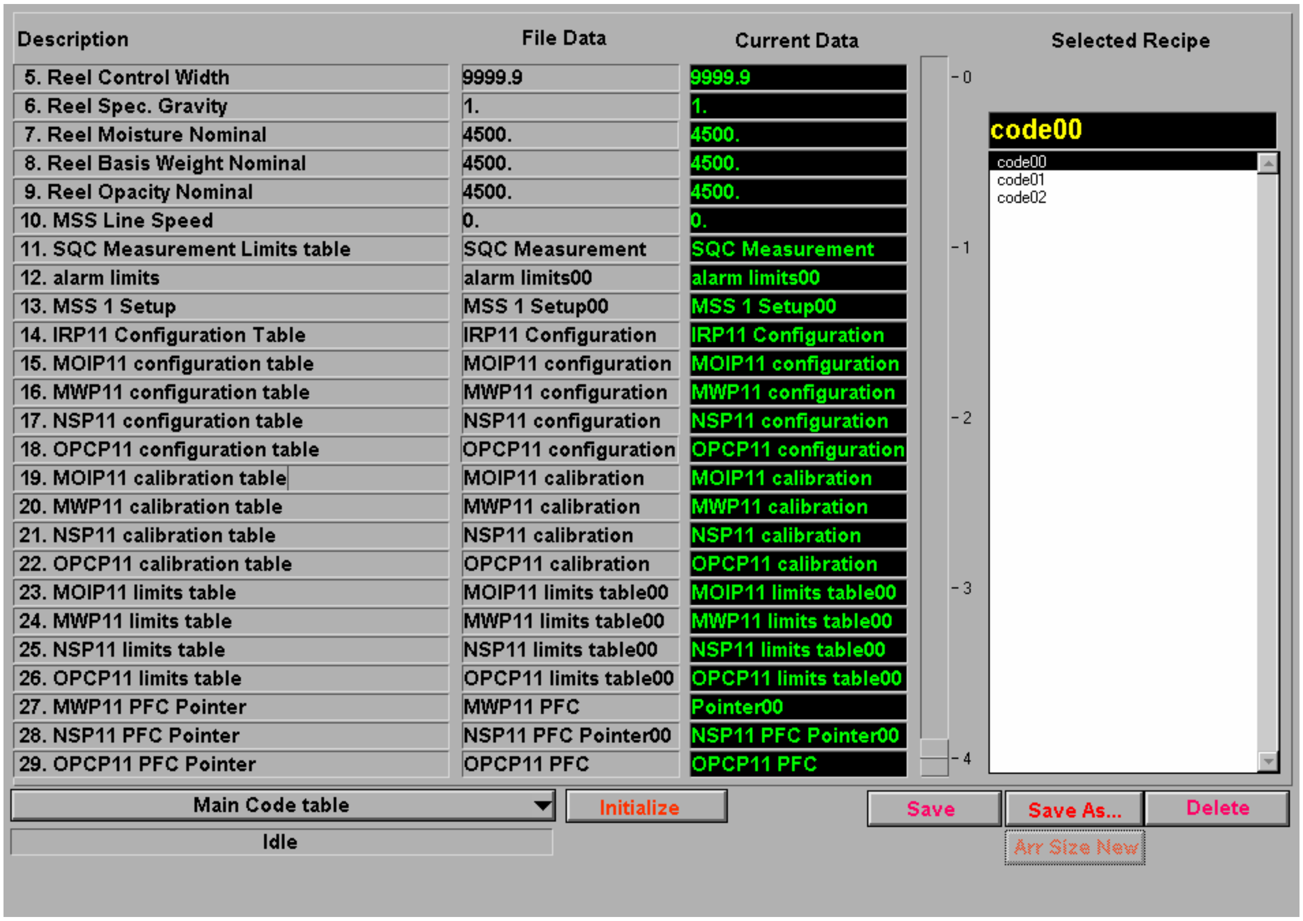


Figure 8-10 Display the MWP11 PFC Pointer Array Display

20. In the MWP11 PFC Pointer, choose the particular array and save it.

For example, Figure 8-10 shows the selection of the pointer as MWP11 PFC Array 00. Save this, then go to the main code and choose the MWP11 PFC pointer array to the recipe code 00. Save this. When you recall the code, this pointer array is displayed in the main code display. For example, Figure 8-11 shows that the MWP11 PFC Pointer has been pointed to the given code 00.



Description	File Data	Current Data
5. Reel Control Width	9999.9	9999.9
6. Reel Spec. Gravity	1.	1.
7. Reel Moisture Nominal	4500.	4500.
8. Reel Basis Weight Nominal	4500.	4500.
9. Reel Opacity Nominal	4500.	4500.
10. MSS Line Speed	0.	0.
11. SQC Measurement Limits table	SQC Measurement	SQC Measurement
12. alarm limits	alarm limits00	alarm limits00
13. MSS 1 Setup	MSS 1 Setup00	MSS 1 Setup00
14. IRP11 Configuration Table	IRP11 Configuration	IRP11 Configuration
15. MOIP11 configuration table	MOIP11 configuration	MOIP11 configuration
16. MWP11 configuration table	MWP11 configuration	MWP11 configuration
17. NSP11 configuration table	NSP11 configuration	NSP11 configuration
18. OPCP11 configuration table	OPCP11 configuration	OPCP11 configuration
19. MOIP11 calibration table	MOIP11 calibration	MOIP11 calibration
20. MWP11 calibration table	MWP11 calibration	MWP11 calibration
21. NSP11 calibration table	NSP11 calibration	NSP11 calibration
22. OPCP11 calibration table	OPCP11 calibration	OPCP11 calibration
23. MOIP11 limits table	MOIP11 limits table00	MOIP11 limits table00
24. MWP11 limits table	MWP11 limits table00	MWP11 limits table00
25. NSP11 limits table	NSP11 limits table00	NSP11 limits table00
26. OPCP11 limits table	OPCP11 limits table00	OPCP11 limits table00
27. MWP11 PFC Pointer	MWP11 PFC	Pointer00
28. NSP11 PFC Pointer	NSP11 PFC Pointer00	NSP11 PFC Pointer00
29. OPCP11 PFC Pointer	OPCP11 PFC	OPCP11 PFC

Figure 8-11 Main Code Table with the MWP11 PFC Pointer 00 Pointing to the Code 00

Once you point the pointer array to the given code, you can load the code. Now the system is ready to perform the profile correction when you enable it. To check how the profile correction is applied to the given scanning profile:

1. Choose the favorites on the horizontal dispatcher.
2. Go to the profile and select the profile of the particular sensor (for example, basis weight, sheet temperature, and microwave moisture as shown in Figure 8-6).

3. While scanning, watch the moisture profile and freeze it by pressing the **Freeze** button.

4. Enable the profile correction and watch the corrected profile. For example, Figure 8-12 displays the profile-corrected moisture versus the uncorrected moisture.

NOTE:	Since the corrected term is additive, the profile-corrected moisture also reads higher.

However, the difference in the valley-to-peak relationship has been reduced, so it displays the average moisture reading.

Figure 8-12 Profile-Corrected Moisture vs. Uncorrected Moisture

9. Troubleshooting

9.1. Central Unit

Check the central unit supply voltages (see Section 4.1). If they are incorrect, unplug the connection to the sensor head. If the voltages do not return, replace the 34000047 Power Supply board in the central unit.

Check that LED1 in the lower left corner of the cover of the central unit is lit, and that LED2 is not. If LED1 is not lit, the serial signal from the sensor head is interrupted. In that case, check that the signal is being generated on the MS Controller board in the sensor head (TP13, with TP12 as ground).

9.2. Sensor Head

Check the waveforms as shown in Figure 4-10 and Figure 4-11, and replace any of the three boards as indicated. When replacing the Oscillator board, be sure to note which cable is attached to which antenna. Each cable must have an attenuator. If they are reversed, the signals appear normal with no paper in the gap; however, when paper is introduced, the signals collapse.

9.3. Cavity Assembly

If no resonance is seen on TP5 on the Differentiator board, and you have tried replacing the Oscillator and Differentiator boards without success, the detector diode may have failed.

Check the diode using a digital DVM in diode check mode or on the 20 kOhm scale. The resistance should be a few hundred ohms in one direction and open circuit in the other.

9.4. Sensitivity Recalibration

When adjustments are made to the electronics, and/or boards are replaced, you must check the sensitivity. Recalibrate when it is not accurate enough.

9.4.1. Sensitivity Check

To check the sensitivity of the calibration:

1. Perform a Reference with an empty gap.
2. Insert the Honeywell Standard Sample and perform a Sample.
3. Compare the Net Volt with those recorded at calibration. They should agree within 1%. If they do not, then use either of the two methods in Subsections 9.4.2 or 9.4.3 to correct the sensitivity of the calibration.

9.4.2. Sensitivity Adjustment

Using this method, you adjust the sensitivity at the sensor head to produce the same output on the Standard Sample that was found at calibration time. The disadvantage of this method is that you must make the adjustment at the sensor head, but measure the output voltage.

This requires one of the following scenarios:

- Two people with a phone line

- One person who is willing to walk a lot
- Transporting the central unit to the scanner and using the Test Cable (08606800)

To adjust the sensitivity at the sensor head:

1. Measure the output voltage with a DVM with at least 3 significant figures.
2. Add to this value the Standard Sample voltage recorded at calibration time.
3. Insert the plastic Sample and measure the voltage.
4. Adjust R35 on the Differentiator board to obtain the calculated value to within 1% of the voltage at calibration time.

9.4.3. Calibration Adjustment

Using this method, you adjust the static calibration constants for all grades by a common factor to compensate for the change in sensitivity.

1. Perform a Reference with empty gap.
2. Insert the Standard Sample and perform a Sample.
3. Divide the Net Volt by those for the Standard Sample at calibration time to obtain the ratio RVOLTS = Net Volt/XS.
4. Adjust the static calibration constants as shown in Table 9-1.

Table 9-1 Static Calibration Constant Adjustments

Dry End Algorithm	Wet End Algorithm
MWA(new) = MWA(old)/√ RVOLTS MWD(new) = MWD(old) MWR0(new) = MWR0(old)•RVOLTS	MWA(new) = MWA(old)/RVOLTS MWD(new) = MWD(old)

9.5. Part Numbers

Table 9-2 contains a list of pertinent Honeywell and Scanpro part numbers.

Table 9-2 Part Numbers

Description	Honeywell Part No.	Scanpro Part No.
Window, Carbon	34000028*	100-08470
Central Unit SA-150	34000042*	A8240002
Oscillator Board	34000043*	100-08071
Differentiator Board	34000044*	100-08076
MS-Controller Board	34000045*	100-07984
Processor Board	34000046	100-08327
Power Supply Board	34000047	100-06908
Detector Assembly	6581800129*	30010726
Fuse, 1A 5x20mm	51000275*	
DS-20, unmodified	34000040**	A8240001
DS-30, unmodified	34000041**	A8240005
* To prevent lengthy downtimes, it is advisable to stock these items on-site. (These are the items available in the spares kit.) ** These items should not be ordered for field use; they are given for reference only.		