Technical Note 27: How to Make Slope and Bias Adjustments for CropScan 1000G, 1000B and 2000B
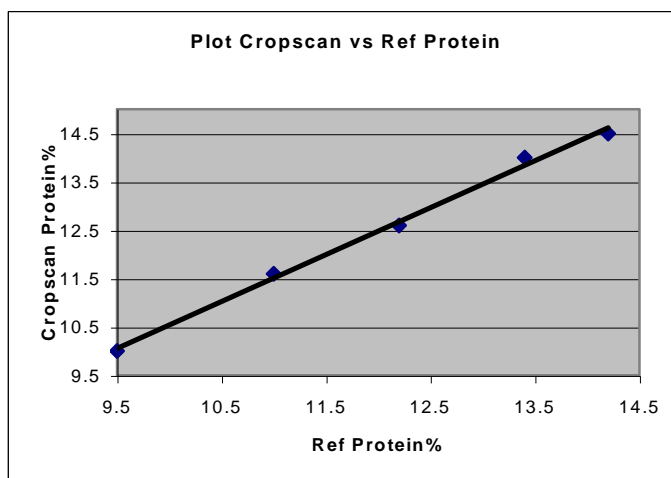
Bias and Slope Adjustment

Each calibration has one or several components, eg, protein, moisture and fat. Each of these component calibration models have a Bias and Slope adjustment facility. The Bias and Slope can be adjusted in order to correct the calibration to some reference method of analysis for each component, ie, Kjeldalh for protein, Oven Drying for moisture and Soxhlet Extraction for fat.

Bias adjustment is where all samples read high or low by a constant amount. The average difference between the NIR readings and reference readings = the Bias.

Sample	Cropscan	Ref	Diff
1	9.5	10	0.5
2	11	11.6	0.6
3	12.2	12.6	0.4
4	13.4	14	0.6
5	14.2	14.5	0.3
	Bias = Average		0.5

Plot Cropscan vs Ref Protein

As shown above the NIR anlayser is reading 0.5 lower than the reference method. As such, 0.5 is added to the existing bias to bring the NIR analyser into alignment with the reference method.

Slope and Bias adjustment is where some samples read high and some read low as compared with the reference readings. The Slope and Bias is calculated by plotting the NIR Analyser readings vs the reference readings in Excel. By adding a trend line in Excel to the plot, the Slope and Bias can be taken from the equation shown.

Sample	Cropscan	Ref	Diff
1	10.5	10	-0.5
2	11.8	11.6	-0.2
3	12.6	12.6	0
4	13.2	13.8	0.6
5	13.8	14.5	0.7
	Bias = Average		0.1

Plot Cropscan vs Ref Protein

$y = 1.3847x - 4.6424$
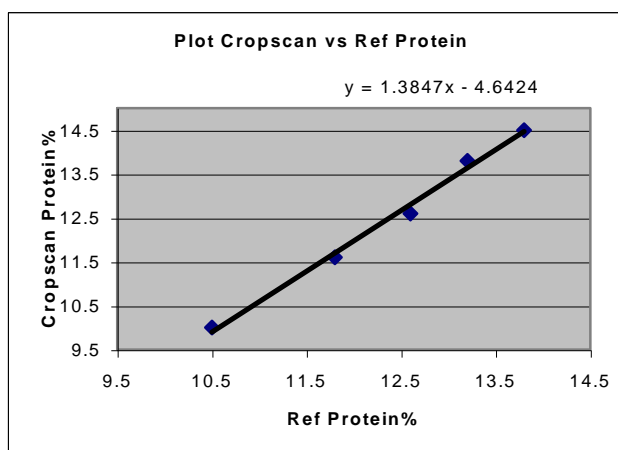
In the example above, the Slope = 1.3847(rounded off to 1.385) and the Bias or Intercept = -4.6.

```
1 - Wheat Soft              6 - Wheat Hard
2 - A S W                   7 -
3 - Barley                  8 -
4 - Canola                  9 -
5 - Oats              10 -
                      Press ENTER for more
Select Product
```
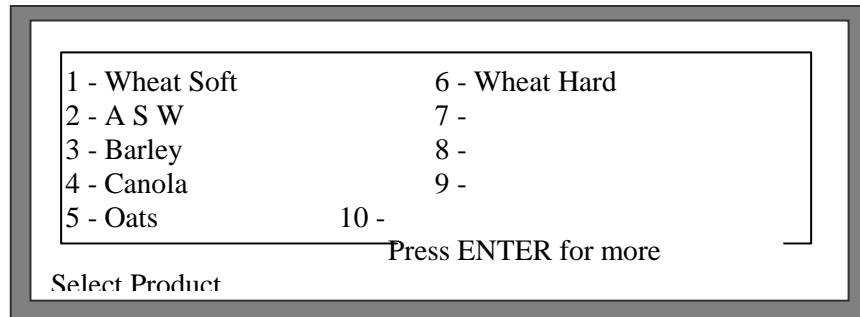
Figure 20, Select product screen.

The Bias and Slope constants can be modified by selecting 1) Adjust Bias and Slope, from the CALIBRATION Setup Mode screen. The following screen will be displayed:
Select the product that you wish to change. When the product has been selected the following screen will be displayed:
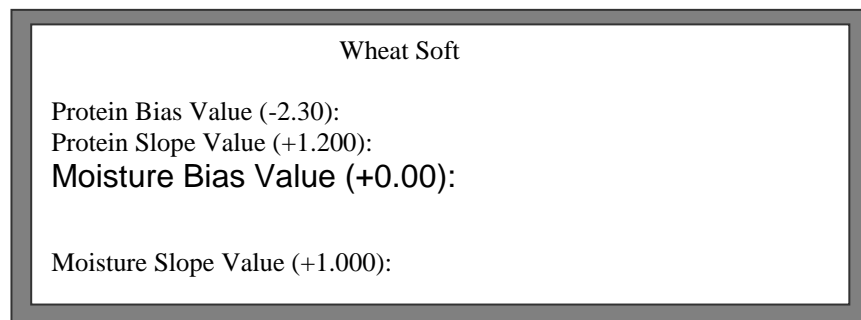(Assuming product 1, "Wheat Soft", was chosen above)

```
                Wheat Soft

Protein Bias Value (-2.30):
Protein Slope Value (+1.200):
Moisture Bias Value (+0.00):


Moisture Slope Value (+1.000):
```

Figure 21, Bias and slope adjustment screen. Press SAVE to store the new values.

The Protein Bias value will be presented first. Enter the new value and press SAVE to store it to memory, or just press SAVE to leave the previous value, displayed in brackets, unchanged. Once the Protein Bias value has been entered the Protein Slope value will be displayed, enter the new slope value the same way. Now enter values for the Moisture Bias and Slope values and press SAVE. The screen will return you to the CALIBRATION Setup Mode screen

Autocalibration

The Bias and Slope can be adjusted manually as discussed above, however the Autocalibration procedure assists the operator to make a Bias or a Bias and Slope adjustment automatically.

The Autocalibration routine will automatically match the instrument with any receival silo or reference laboratory. This routine asks the operator to scan between 1 and 9 samples. After each scan the screen displays the NIR results and asks the operator to enter the reference values. The software adjusts the Bias, where only 1-4 samples are used for Autocalibration or Bias and Slope, where 5-9 samples are used for Autocalibration.

Press 3) Autocalibration. Enter the number of samples (from 1 to 4 for Bias only or 5 to 9 for Bias and Slope) you will use for the Autocalibration and press SAVE.

```
Enter # of Cal Samples: ■
```

Figure 23, Autocalibration Mode screen.

The next screen is the Select product screen, select the product you want to use. After selecting

```
1 - Wheat Soft              6 - Wheat Hard
2 - A S W                   7 -
3 - Barley          8 -
4 - Canola          9 -
5 - Oats                    10 -
                      Press ENTER for more
Select Product
```

Figure 24, Select product screen.

the product the normal routine of analysis will proceed.

At the end of the analysis the following screen will appear with the sample results. Enter your reference values and press SAVE after each entry (see Figure 25). The final screen will display the old and new Slopes & Bias. Press SAVE to store the new Calibration or Cancel. After saving, press Cancel to return to main menus.

```
Protein value: 12.10      Ref Protein: ■
Moisture value: 11.20   Ref Moisture: ■



Enter Ref. value & Press SAVE to store
```

Figure 25, Autocalibration results screen.

```
Protein Bias Old: 0.5      Protein Bias New: 1.0
Moisture Bias Old: 0.1  Moisture Bias New: 0.3 ■



Press SAVE to store or CANCEL
```

Figure 26, Autocalibration results screen.

Outlier Detection

This feature checks each scan and the results to see if they are consistent with the rest of the results. If the software detects an "Outlier" it will reject the results and not include the specific results in the averaged results.

There are two outlier detection methods;

1) Z Scores: uses a statistical calculation to detect results greater than 1.5 times the standard deviation from the mean of all the scans.
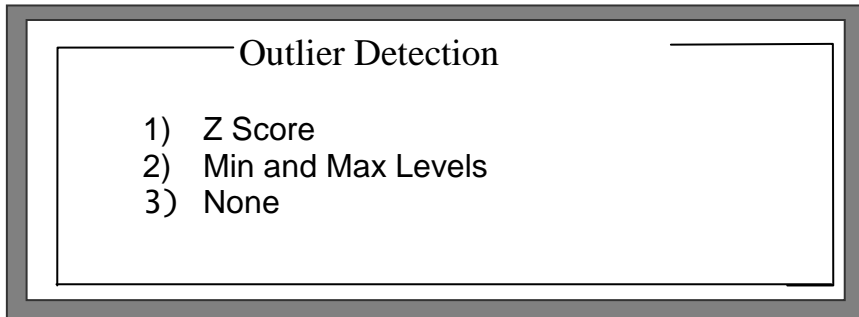
```
                    Outlier Detection

        1)   Z Score
        2)   Min and Max Levels
        3)   None
```

Figure 26. Outlier Detection Options

2) Min Max: simply rejects the lowest and highest results.

Select either method or select 3) None for no outlier detection.