

# Chapman Ranch Lint Cleaner Brush Evaluation

## Summary of Fiber Quality Data

"Dirty" Module – 28 September 2005 Ginning Date

The following information records the results of a preliminary evaluation of a wire brush modification to the grid bars of saw-type lint cleaner. All that is addressed here is data from a single module that had a very high trash content. For this particular module, there were no strong indications that the brushes had a significant impact (positive or negative) on the fiber quality properties of the lint.

### Materials and Methods

Seed cotton and lint samples were collected during ginning of a single module at Chapman Ranch gin on September 28, 2005 (first module of the day). The first set of samples was collected from the side of the gin plant where the lint cleaners had not been modified (designated as "No-Brush"). On this side the first stage of lint cleaning was through a Super 86 lint cleaner with a second stage through Super 66. After approximately 50% of the module had been processed, the side of the gin plant with lint cleaners containing the brush modified lint cleaners was activated (nearly identical set up, except first stage of cleaning was through a Moss 66" lint cleaner).

### Sample Locations

The following five locations were sampled for seed cotton or lint during the ginning process on both the modified and standard sides of the gin plant:

- Module;
- Feeder = Feeder apron of the gin stand;
- 0 LC = entrance to 1<sup>st</sup> lint cleaner;
- 1 LC = after the first stage of lint cleaning;
- 2 LC = after the second stage of lint cleaning

Five samples were taken from the module before ginning, and during the ginning process, five samples were collected from each location. Five lint cleaner waste samples were also collected from the waste stream of each lint cleaner.

### Sample Analysis

The seed cotton collected from the module and feeder apron were ginned at Cotton Incorporated on a 10-saw bench-top gin stand. Large trash (sticks and burs) were removed during the ginning process. Trash, seed, and lint were all weight after the ginning was complete.

All lint samples were submitted to Cotton Incorporated's Textile Service Lab for analysis with the following instruments:

- MDTA 3 – Gives a very accurate analysis of trash content (> 0.5 mm); dust, and lint fragments;
- HVI – Same system used at the USDA classing office (no leaf grade);

- AFIS – More detailed fiber length information than HVI, plus estimates of neps (fiber entanglements) and fiber maturity.

The parameters from these instruments were view graphically both as treatment (brush or no-brush) means and individual data points – see Appendix A of this report. Review of these data clearly showed there were differences in fiber quality within the module; therefore, all statistical analysis is based on data adjusted for the lint condition prior to lint cleaning. For example, in order to determine if the brush modification increased the amount of trash removed from the lint, the amount of trash in the lint prior to the first stage of lint cleaning when the brush side of the plant was running was subtracted from the amount of trash after lint cleaning with the brush modification. That process was repeated for the non-brush modification and then the differences between the brush and no-brush trash levels were compared.

No quantitative analysis was performed on the lint cleaner waste samples, but a simple visual comparison was made between the waste from the brush-modified and unmodified cleaners spread on a black background.

## Results and Discussion

Figure 1 is a representation of the HVI Uniformity Index (UI) averaged at each sample location, and will be used as an example to illustrate the way the data was processed. In this figure, the yellow bar represents the average UI based on the five samples pulled from the side of the module and processed on the 10-saw gin. Next is the UI for the lint reaching the gin's feeder apron ("Feeder" – also lab ginned), with the blue bars representing cotton that is eventually processed through the brush modified lint cleaner, while the red bars represent the cotton destined for the unmodified lint cleaner. Note in the transition from the "feeder" to the "0 Lint Cleaning" there appears to be an increase in UI. This abrupt change can be attributed to the impact of the 10-saw gin – it is not as "gentle" as a commercial scale gin stand. The last two locations are where any differences due to the brushes would be present. For the example shown in Figure 1, the UI is lower for the brush modified lint cleaner for samples taken at both stages of lint cleaning. The fact that the UI was higher for the cotton fed into the brush-modified cleaner compared to that entering the standard cleaner provides further evidence that there were true differences in UI due to the lint cleaning treatment. Many of the other fiber quality parameters are presented in a format similar to figure 1 in Appendix A.

The discussion of Figure 1 is reflected in Table 1 where fiber quality parameters with statistically significant differences are shown (all of the data from this study is in the Excel file: **ChapmanRanch09282005ALLdata.xls**). Statistically, the data in the table can be interpreted as the UI was decreased by 1.3 and 1.6 when the brushes were used compared to when they were not. However, this trend in the UI from the HVI data is inconsistent with the trends seen in the fiber length distribution data from AFIS. In Table 1, the AFIS data for the first stage of lint cleaning indicates that with the brushes: average fiber length increased [ L(w) and L(n)]; and short fiber decreased [SFC(w) & SFC(n)]. Typically decreases in HVI uniformity are associated with opposite trends in the AFIS parameters noted. The AFIS machine provides more robust information related to fiber length distribution than the HVI; therefore, there is a hint of a slight increase of fiber length distribution when using the brushes. But it should also be noted that the AFIS length parameters were only statistically different for the first stage of lint cleaning, where the comparison involves two lint cleaners that are not identical.

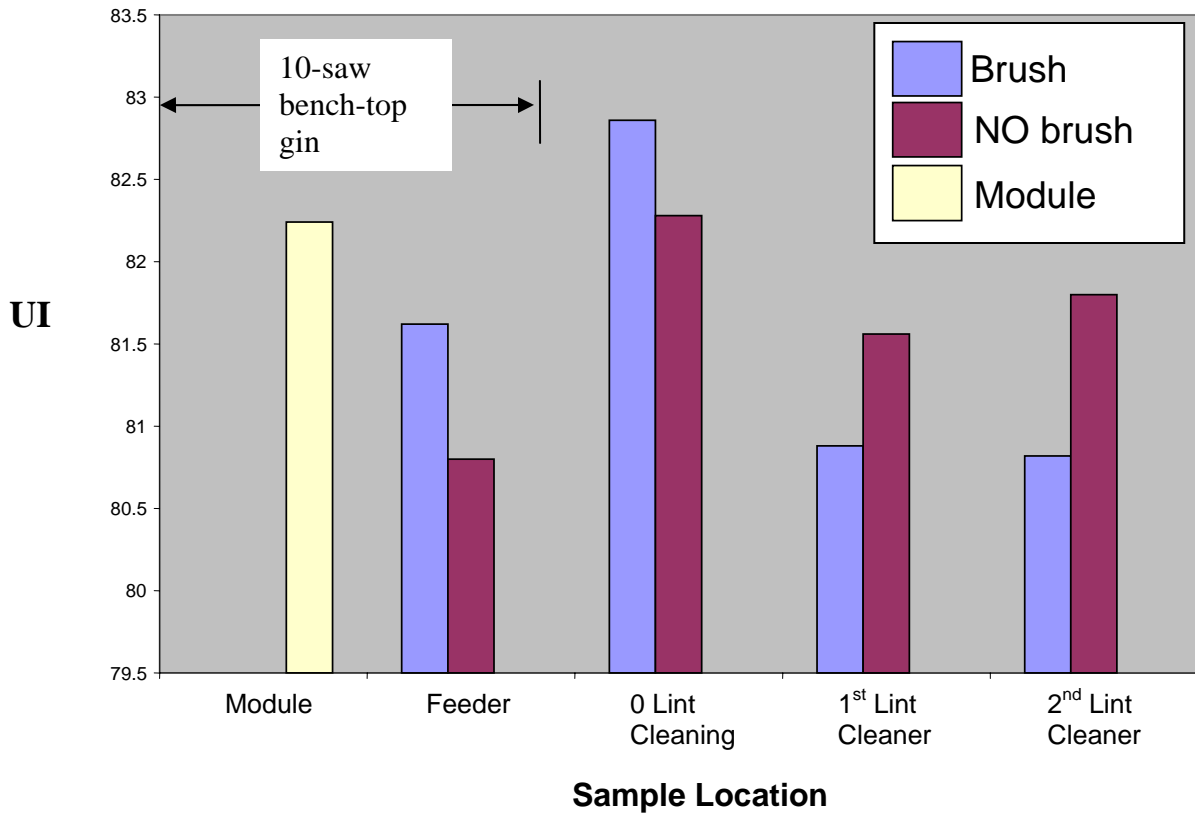


Figure 1 – HVI uniformity index averaged by location for the side of the gin plant with brush-modified (Brush) and standard (NO brush) lint cleaners. Each bar represents the average of five samples.

Table 1: Statistically significant differences (Brush minus No-Brush) in fiber quality parameters after accounting for differences prior to lint cleaning

Location	HVI		AFIS				MDTA 3
	UI	SFC%	L(w) [in]	SFC (w) [%]	L(n) [in]	SFC (n) [%]	Fiber Fragments (%)
1 <sup>st</sup> Lint Cleaner	-1.3	Ns	0.028	-1.4	0.040	-3.1	Ns
2 <sup>nd</sup> Lint Cleaner	-1.6	1.8	ns	ns	Ns	ns	-0.08

*ns = Not significant*

The lint cleaner waste streams did not show any clear differences in the type of trash exiting the lint cleaner of the brush versus standard lint cleaner. A collection of the photos of the lint cleaner waste is compiled in the file "**TrashPics28Sept05Chapman2.pdf**". The sampling methods used did not allow for evaluation of the quantity of waste generated per lint cleaner.

There were no significant effects of the brushes on color or trash content of the lint. Figure 2 provides an illustration of the trash content of the lint throughout the ginning process (data from MDTA 3). The \* on module and feeder indicate the lint was processed on the lab gin and the contribution of sticks and burs have been added at those locations. The seed cotton cleaning was effective in removing a large amount of trash (31% in module to 11% at feeder apron). Despite the large reduction in trash level prior to the gin stand, the trash level of 10% is one of the highest recorded (#2 out of a data set of 20 from 11 gins during the 2005 ginning season) – without a doubt this was dirty cotton. The remaining trash entangled in fiber was significantly reduced by the first stage of lint cleaning (1 LC), but the second stage did not have a significant on the amount of trash present. In most similar situations, reduction to ~2.5% trash content would be expected after a second stage of lint cleaning. This could be an indication that the remaining trash was highly entangled with the fiber and that this level of entanglement may not have been conducive to evaluate the impact of the brushes on lint cleaning.

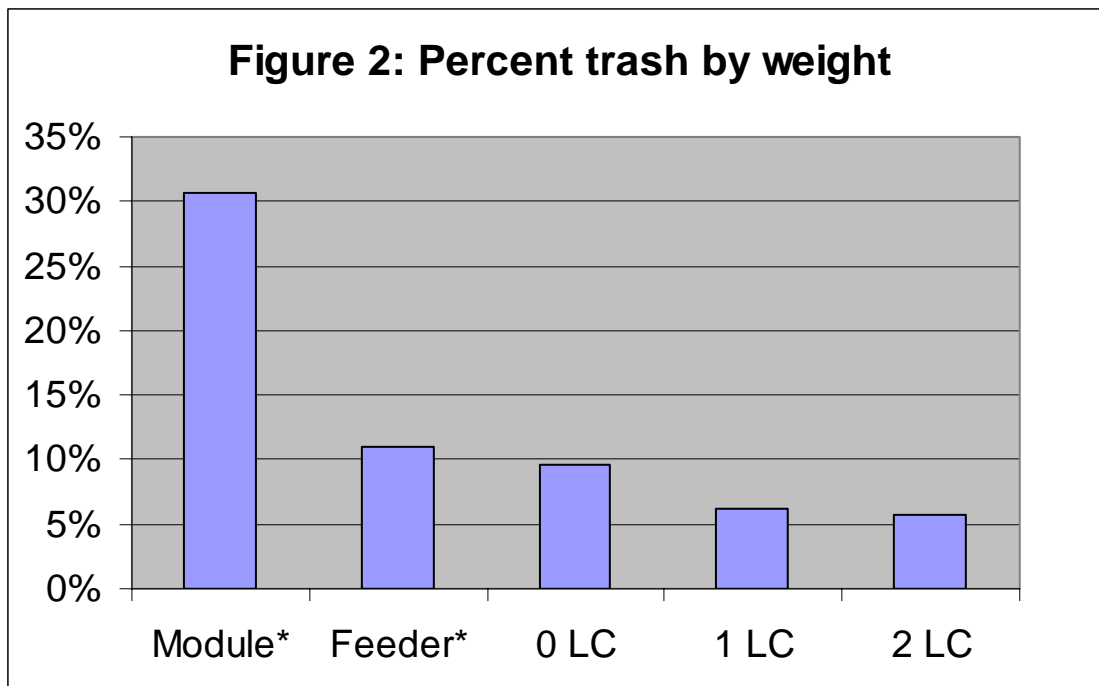
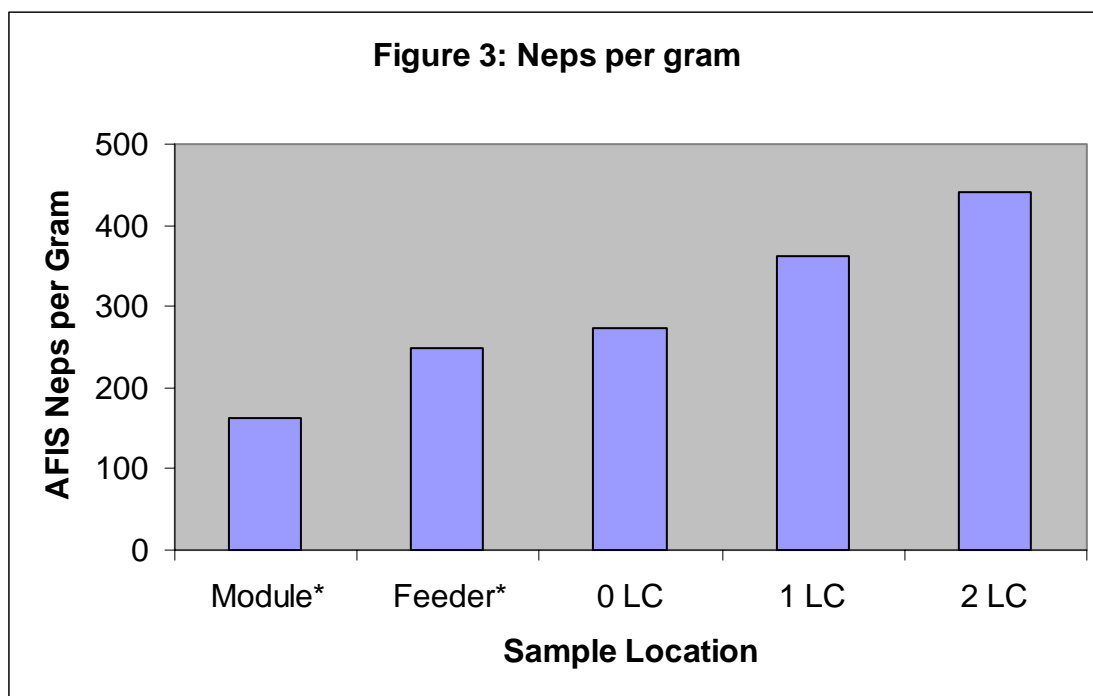


Figure 3 charts the amount of AFIS neps per gram at each stage of the ginning process (10 samples per location). For the data used to generate Figure 3, the nep counts at the module and feeder were reduced by 70 neps per gram as previous work established the lab gin used to process the samples added at least this many neps to the lint. The nep levels shown in Figure 3 are at the center of the range reported for stripper harvested cotton in Texas (data from a five year study<sup>1</sup>).

<sup>1</sup> R. V. Baker and A. D. Brashears. 1999. Effects of multiple lint cleaning on the value and quality of stripper harvested cotton. Proceedings of the Beltwide Cotton Conference, Volume 2:1391-1393.

## Conclusions

After correcting for differences in the cotton condition before reaching the lint cleaner, of the 32 fiber quality parameters evaluated, seven had statistically significant differences that may have been attributed to the brush-modified lint cleaners. The brushes appeared to have a negative impact on uniformity index (UI); however, there were large differences in the uniformity index prior to entering the first lint cleaner that may not have been completely accounted for. This result for UI was also inconsistent with trends in the fiber length data from AFIS. Statistically the brushes slightly improved AFIS fiber length parameters at the first stage of lint cleaning; however, these differences were not statistically significant when the second stage of lint cleaning was evaluated. There were slight differences in the model of lint cleaners used at the first stage of cleaning, so it is possible these differences may be attributed to the lint cleaner models as opposed to the brush modification. Implications from this analysis are limited as the information is based on evaluation of a single module that was not typical of modules in the region. From this data set it is difficult to conclude there are any clear fiber quality benefits from the brushes. Conversely, there is no convincing evidence of any negative fiber quality impacts from use of the brushes.



## APPENDIX A:

### Graphs of MDTA3; HVI and AFIS data.

Gray highlight = MDTA 3 data

Yellow = HVI

Green = AFIS

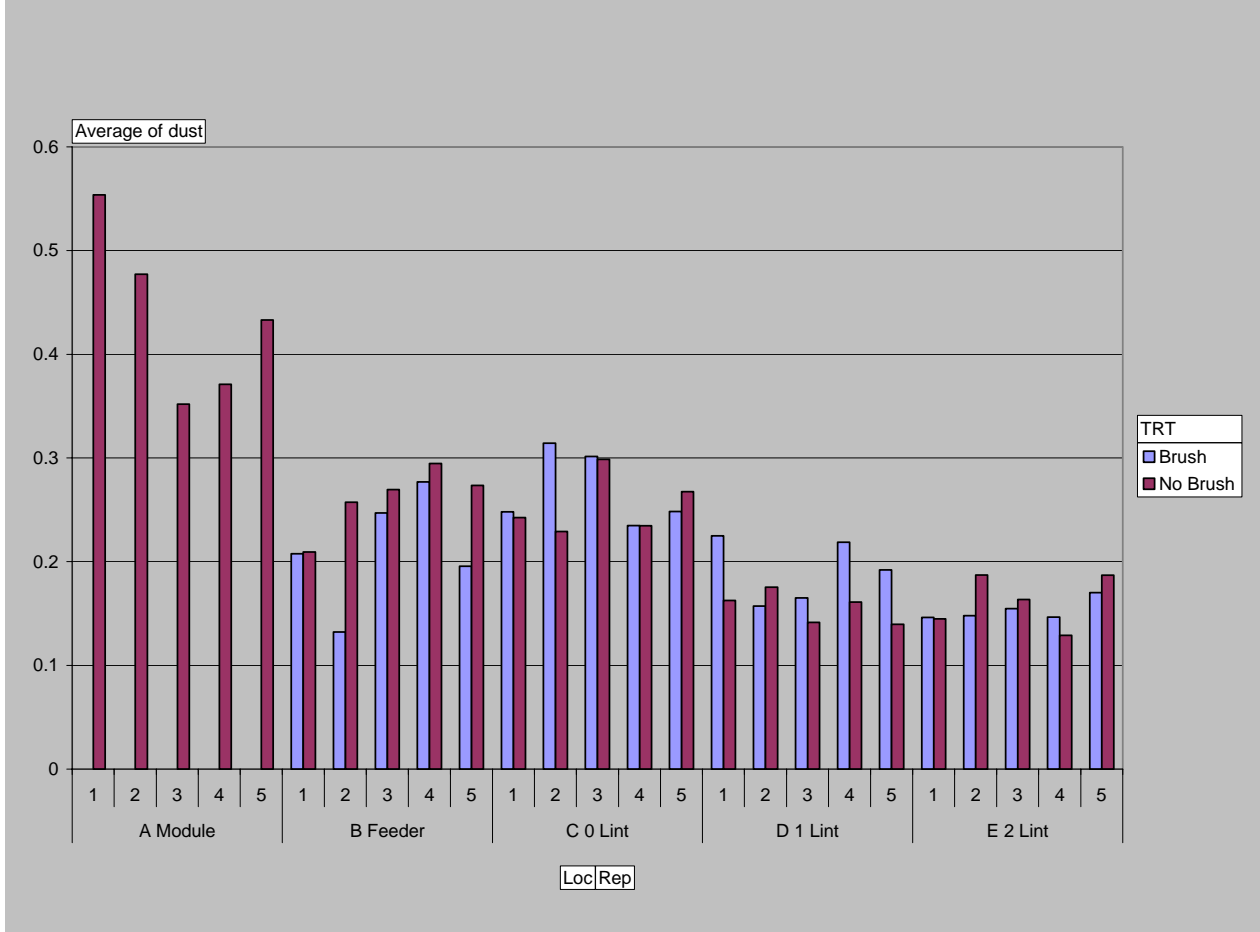
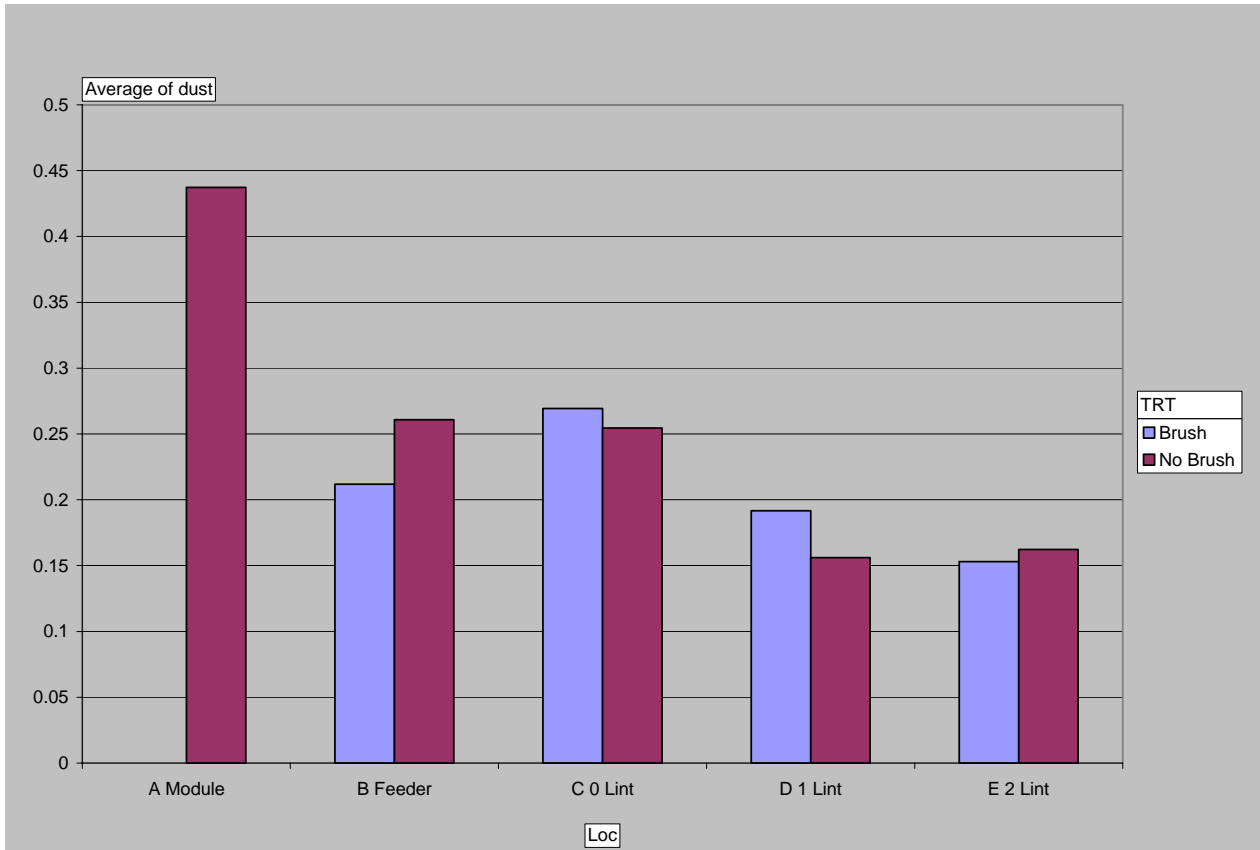
The first graph is similar to figure 1 – mean values of the five samples taken per treatment (brush or no-brush). The graph below represents the individual values for each of the five readings. The second graph can be used to identify outliers that may interfere with the statistical analysis.

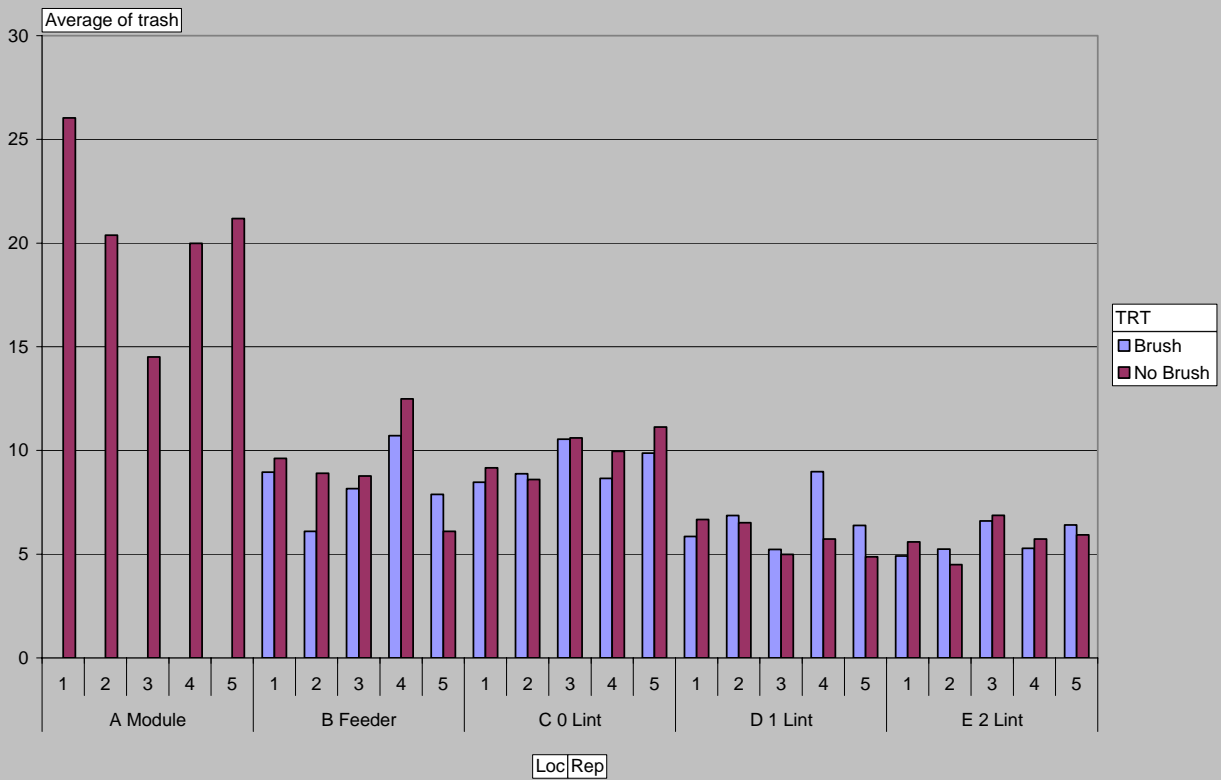
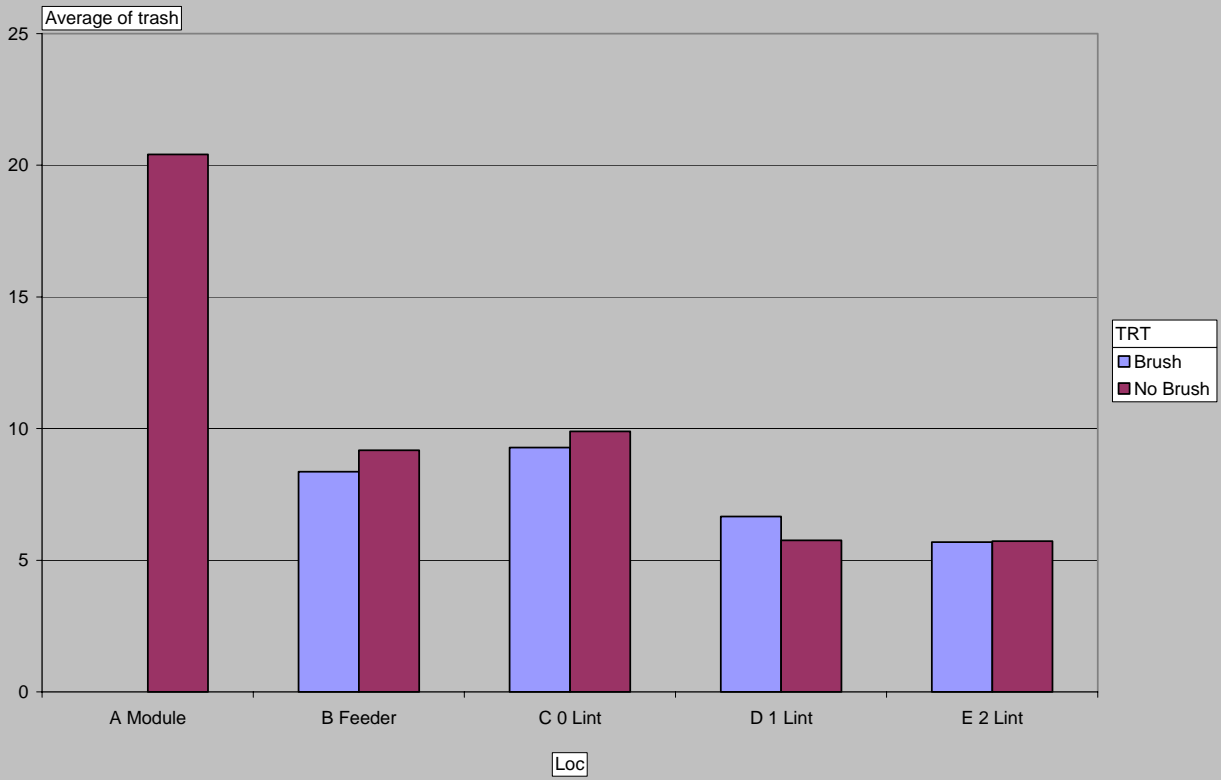
The parameters from each instrument are briefly described before their respective graphs. A more detailed description of the AFIS data will be provided as a hard copy.

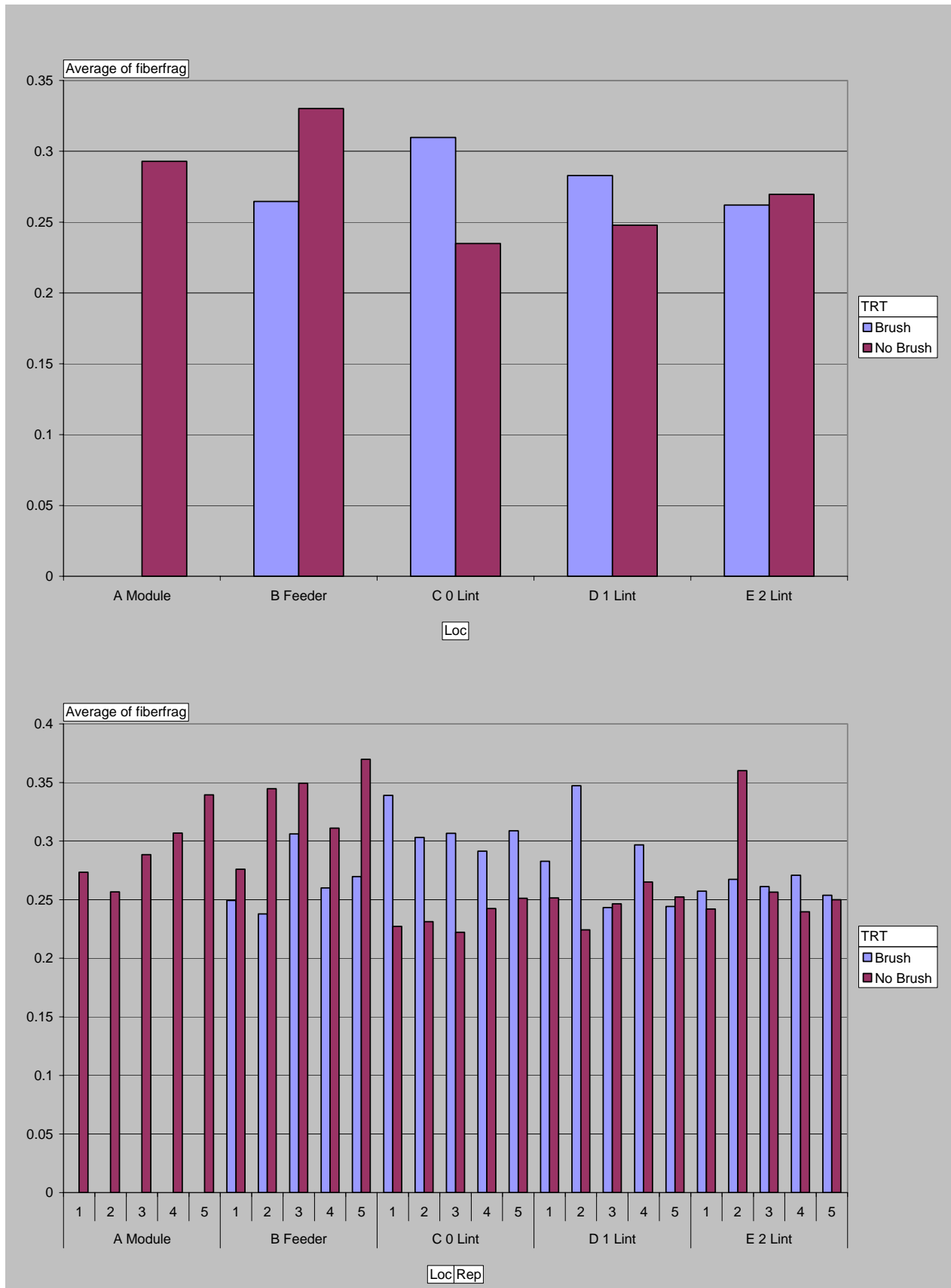


# MDTA 3 Data

The following three pages are charts of data from Zellweger Uster MDTA-3. This instrument uses a 10 gram fiber sample and separates the lint and reports the non-lint percent trash (greater than 500 micrometers), percent dust (less than 500 micrometers) and percent fiber fragments. This is a physical separation and all percentages are on a mass basis (more robust than **trash** data from the AFIS machine).







# HVI Data

## Definitions

**MIC** - Micronaire (fineness) values of 3.4 or below indicate fine and perhaps immature fibers, and values of 5.0 or higher indicate coarse fibers. Values of 3.5 to 4.9 are desirable and indicate mature, well-developed fibers.

**UHM** - upper half mean - Fiber Length: Fiber length is reported in hundredths of an inch and is the average of the longest 50 percent of the fibers in the sample. Long fibers are desirable because they produce greater yarn strength, aid in spinning finer yarns, and can be processed at higher speeds.

**UI** - Fiber uniformity index (UI) provides a relative measure of the length uniformity of cotton fibers. Uniformity is calculated as the ratio of the average length of all fibers to the average length of the longest 50 percent of the fibers in the sample. High uniformity values are associated with a high-quality product and with low manufacturing waste.

**STR** – Fiber Strength: Yarn strength and ease of processing are positively correlated with strong-fibered cottons. Strength values are reported in grams of force required to break a bundle of cotton fibers with the holding jaws separated by 1/8 inch. The size of the bundle of fibers is described in tex units. Fiber strength is described from very low to very high within UHM classifications.

**ELO** - Fiber Elongation: Elongation is the degree of extension of the fibers before a break occurs when measuring strength. Fiber bundle elongation is correlated with yarn elongation but has an insignificant effect on yarn strength. Its value and importance in yarn manufacture has not been fully established.

4.9 and below Very low

5.0-5.8 Low

5.9-6.7 Average

6.8-7.6 High

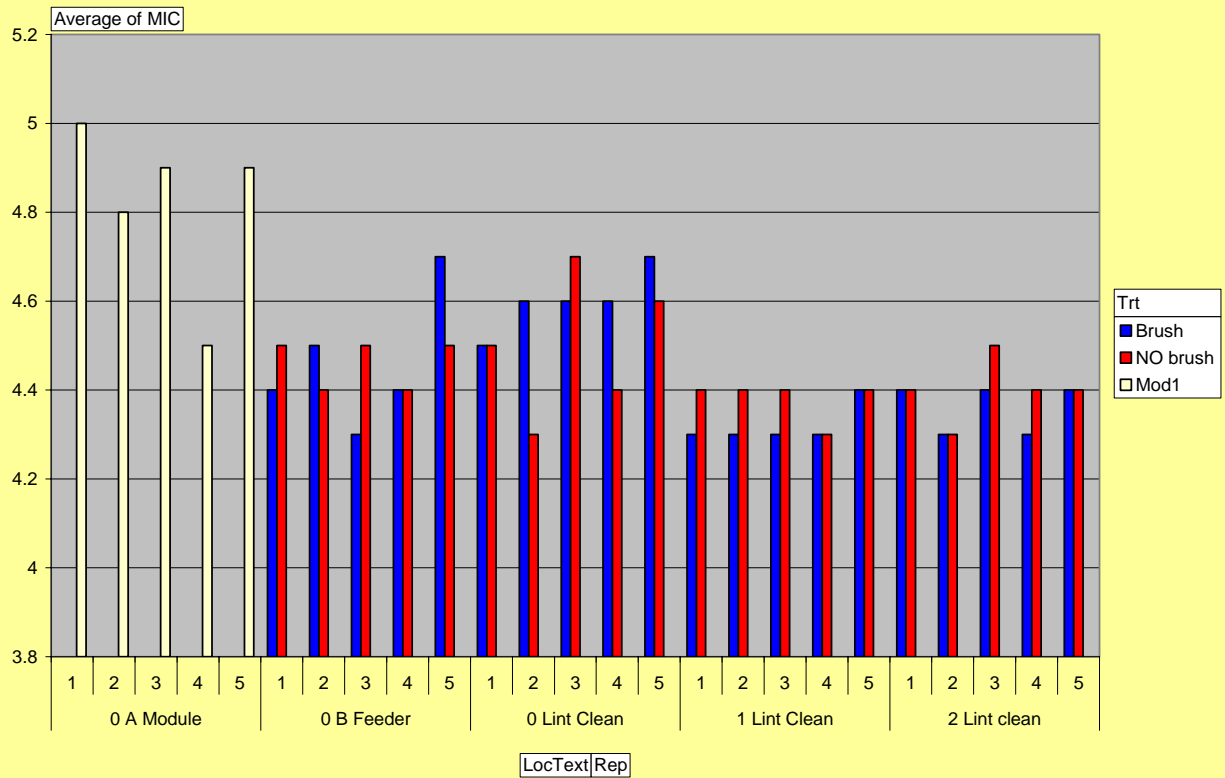
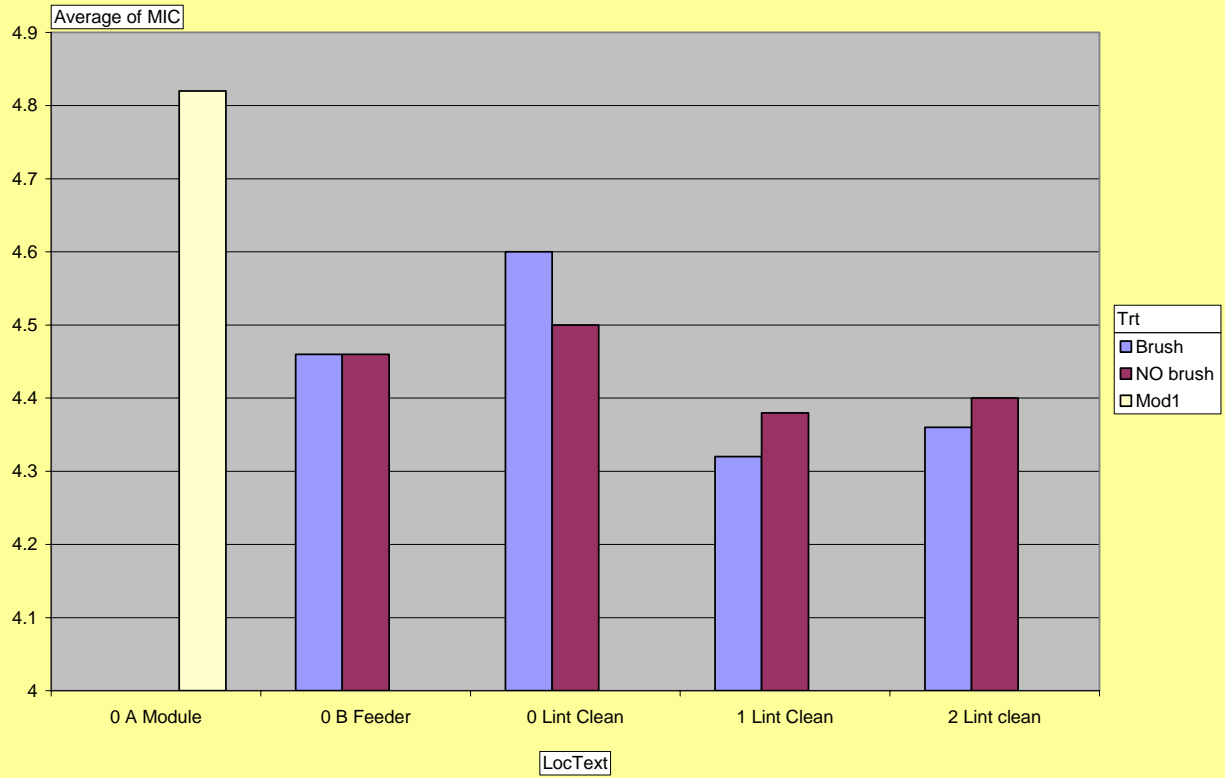
7.7 and above Very high

**Rd** – Reflectance

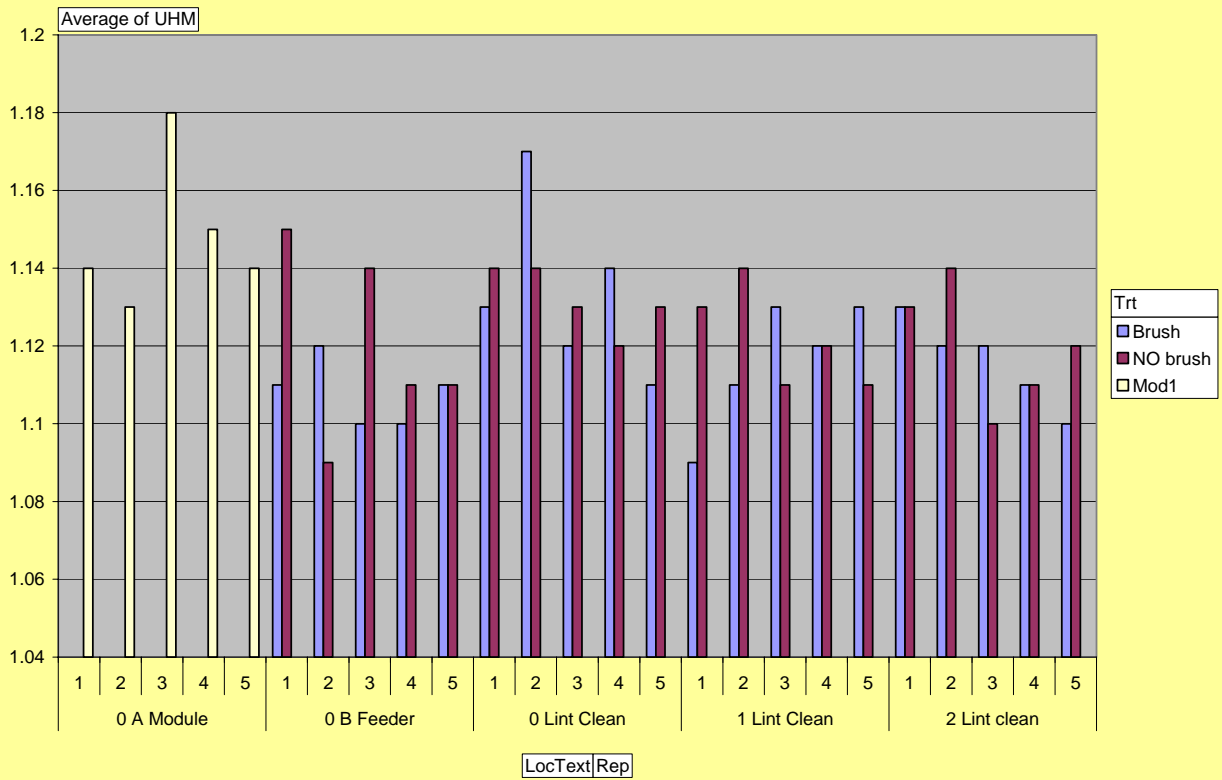
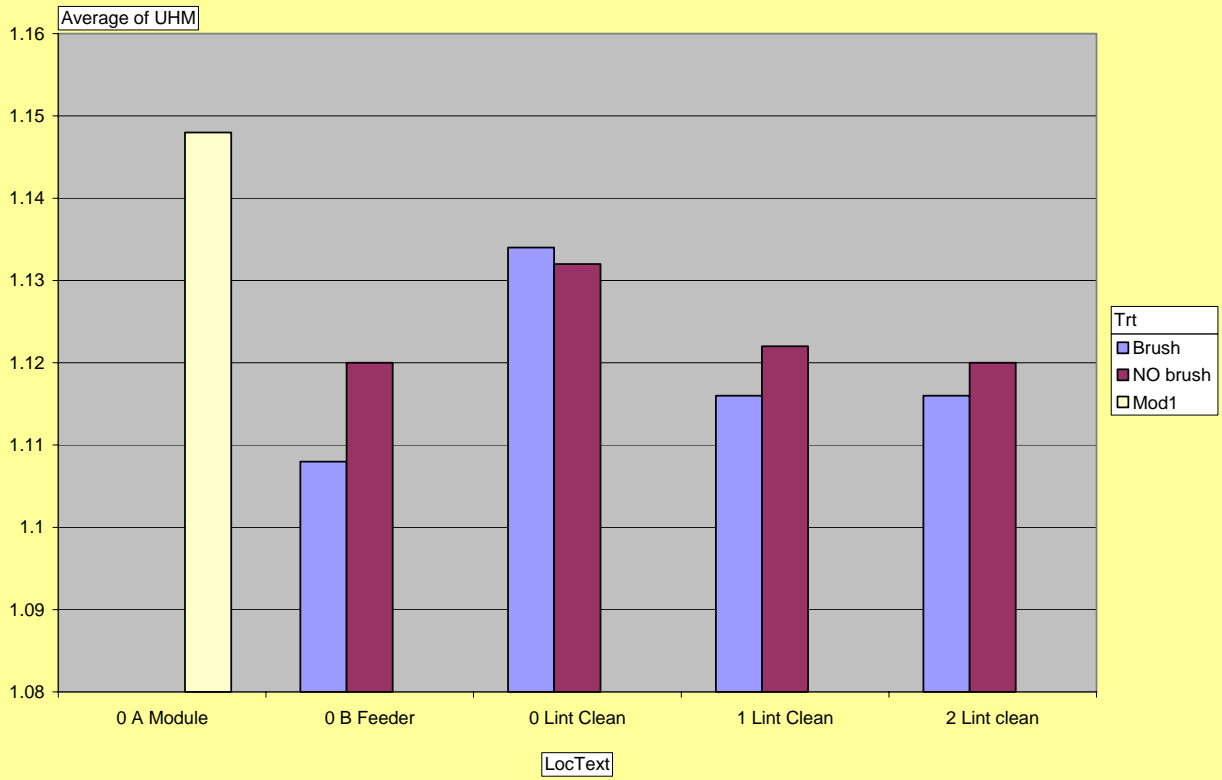
**+b** - yellowness: measurements are related to grade through a color chart which was developed by a USDA researcher. The degree of gray is expressed as percent reflectance (Rd) and usually ranges from 50 to 85% with higher values desirable. Yellowness is expressed as Hunter's +b that ranges from 5, least yellow, to 18.

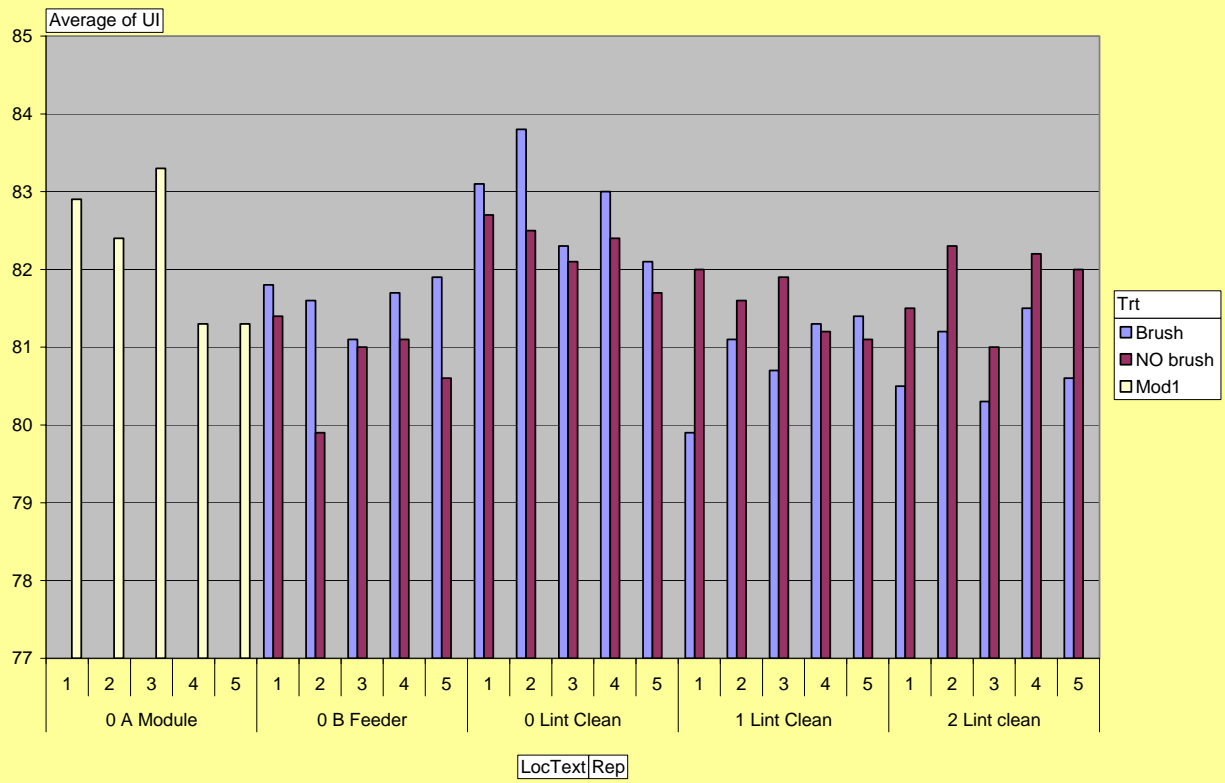
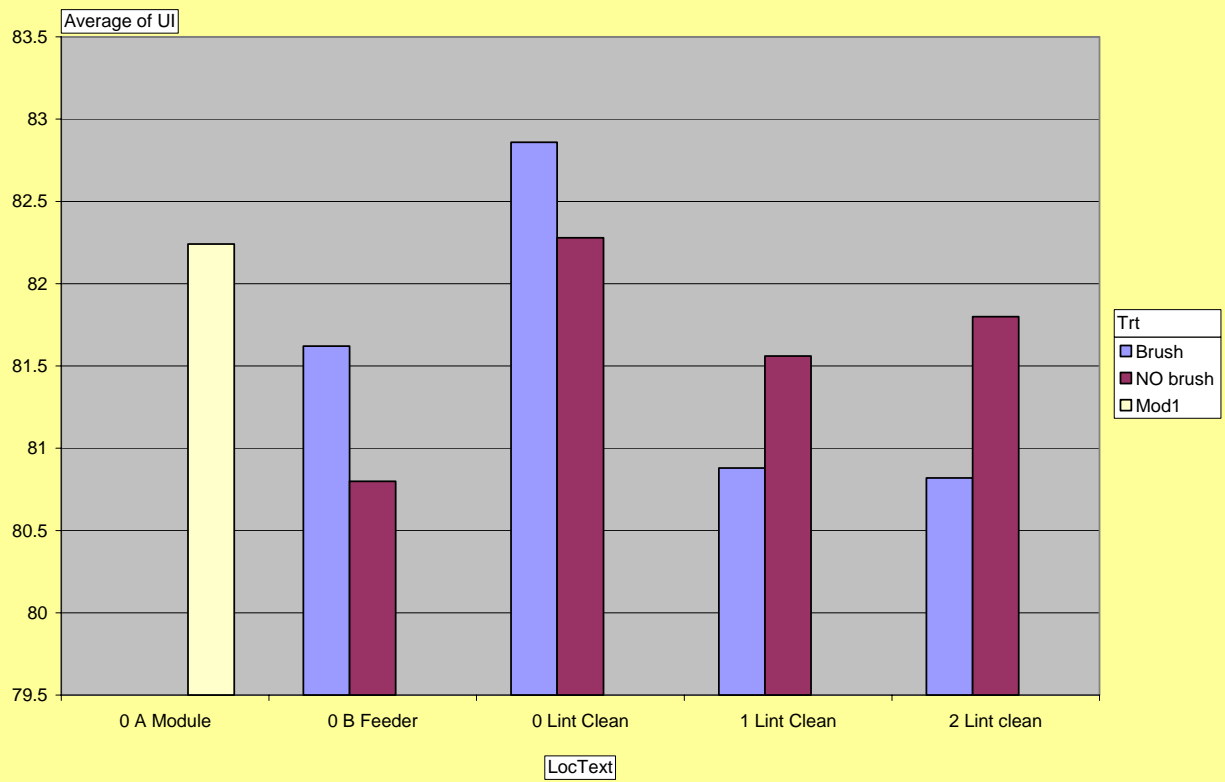
**AREA** - The HVI systems measure trash or non-lint content by use of video camera to determine the amount of surface area of the sample that is covered with dark spots. As the camera scans the surface of the sample, the video output drops when a dark spot (presumed to be trash) is encountered. The video signal is processed by a microcomputer to determine the number of dark spots encountered (COUNT) and the percent of the surface area covered by the dark spots (AREA). The area and count data are used in an equation to predict the amount of visible non-lint content as measured on the Shirley Analyser. The HVI trash data output is a two-digit number which gives the predicted non-lint content for that bale.

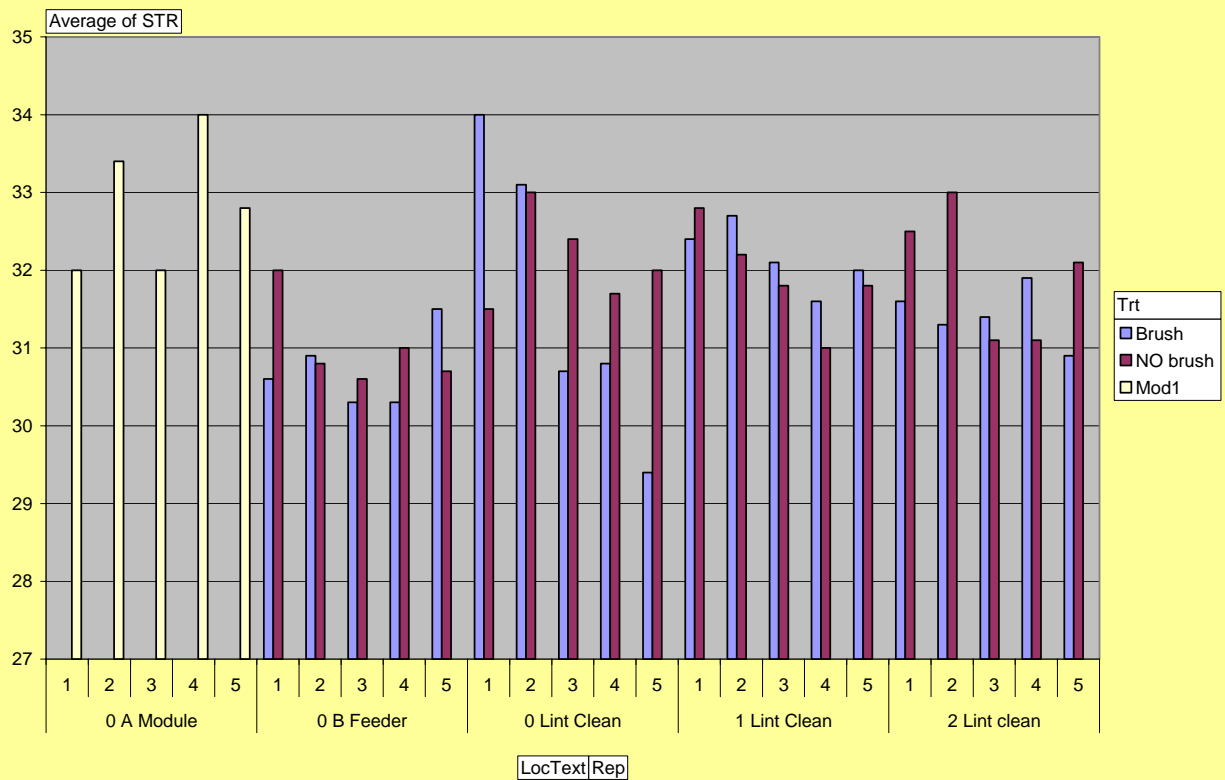
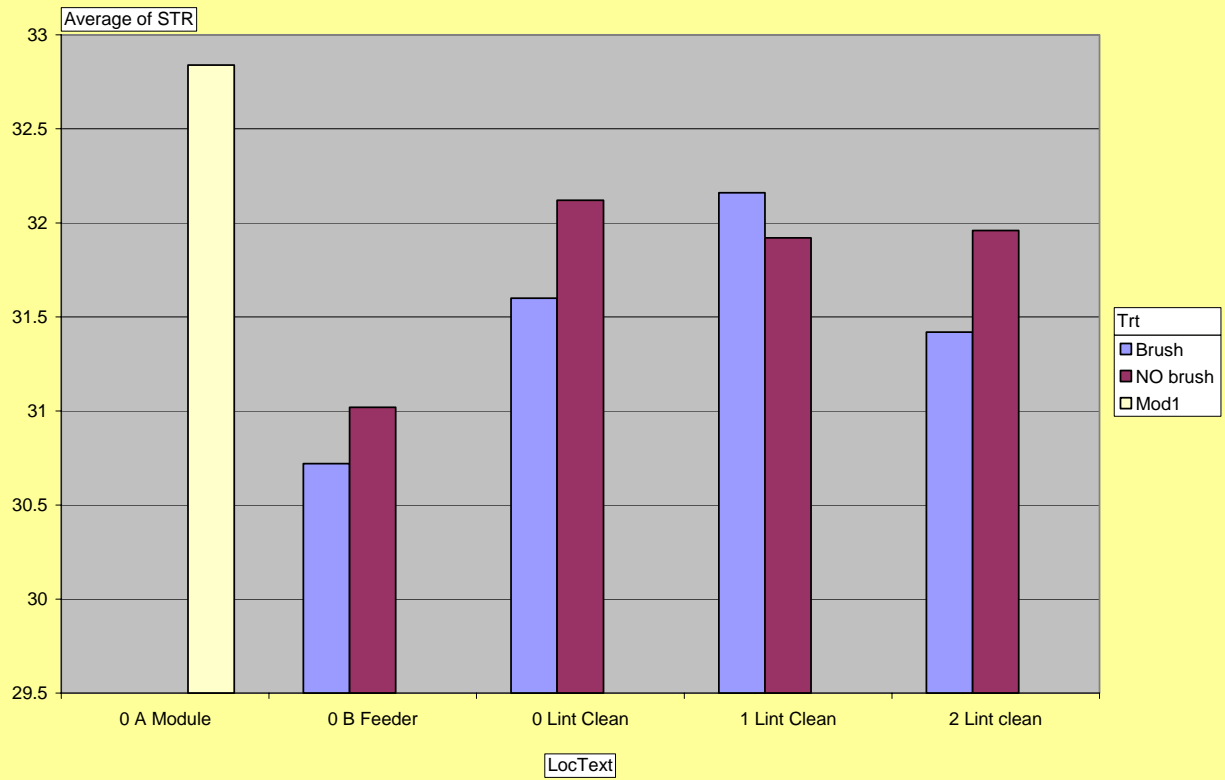
MIC

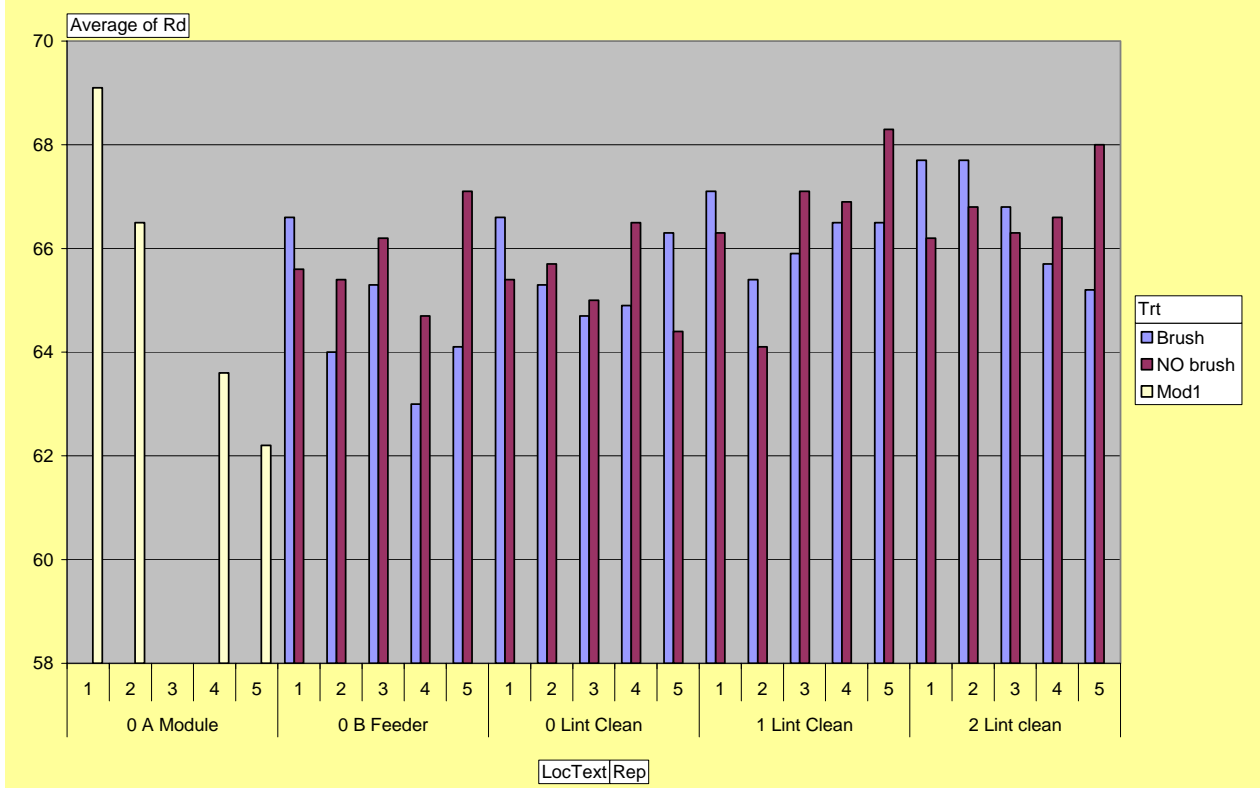
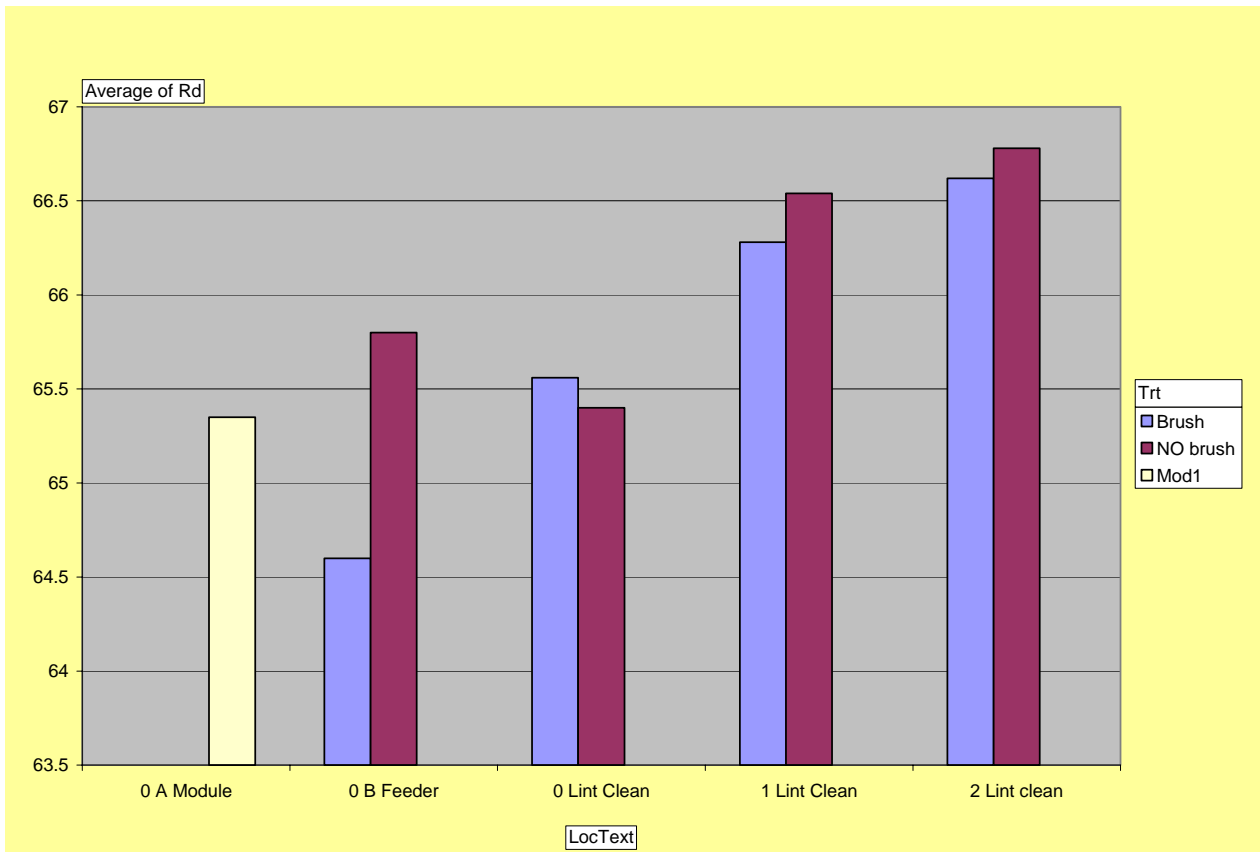


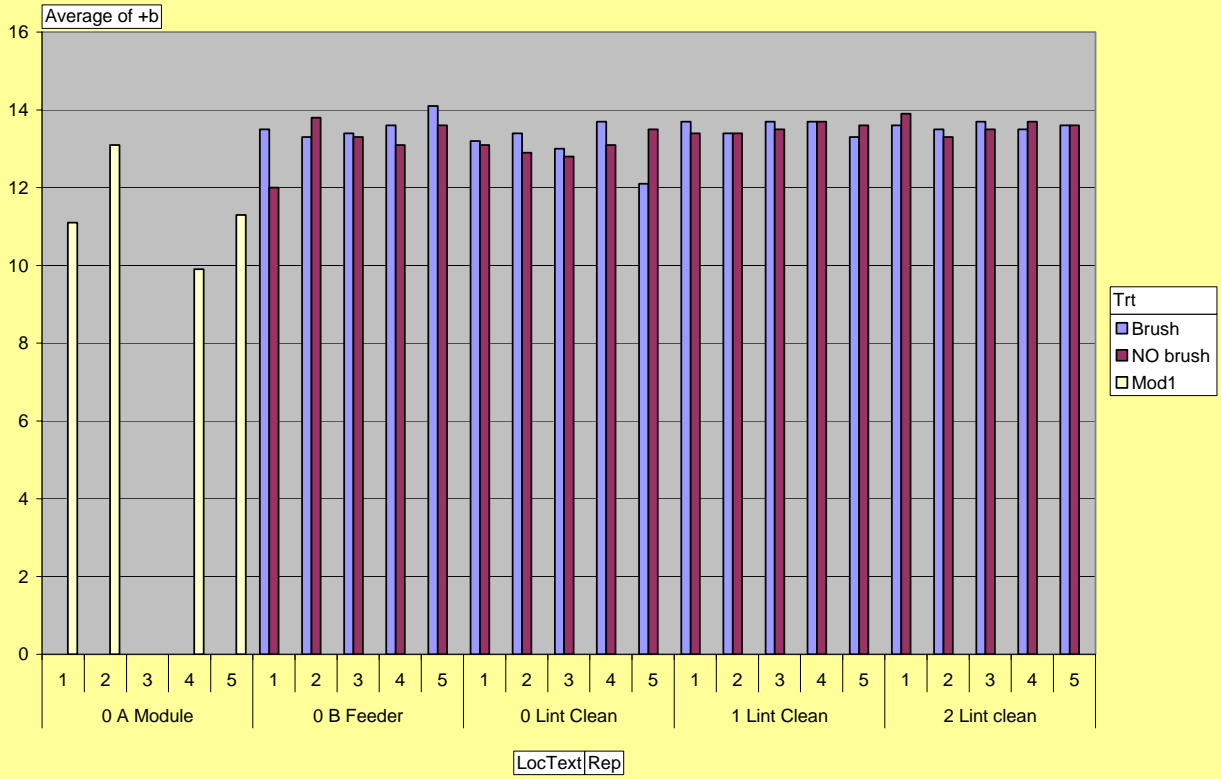
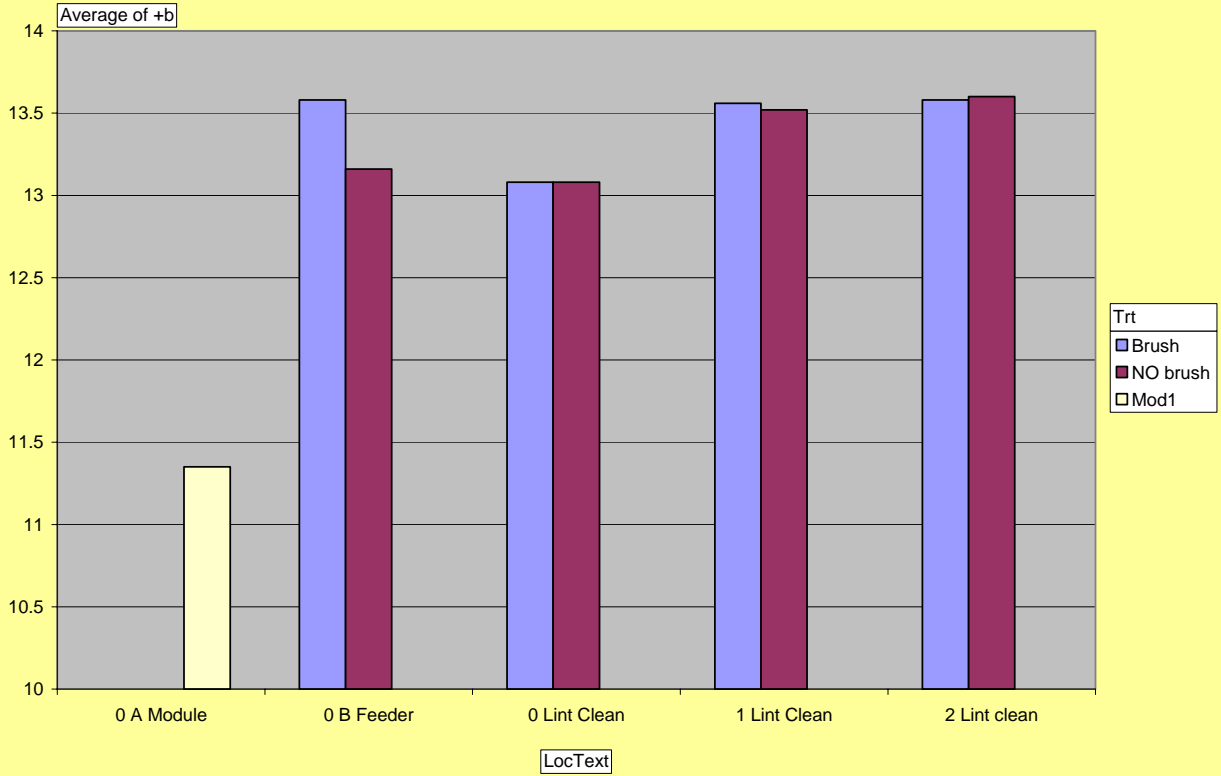
# Upper Half Mean Length (HVI)

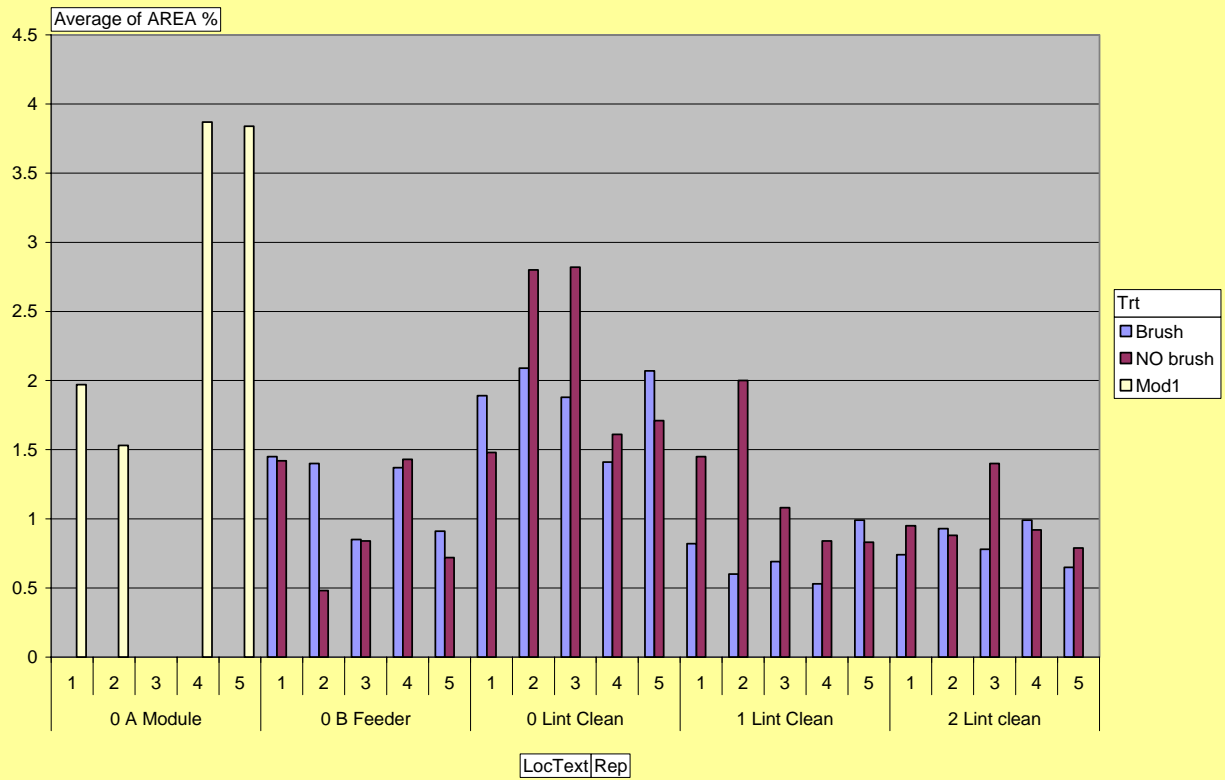
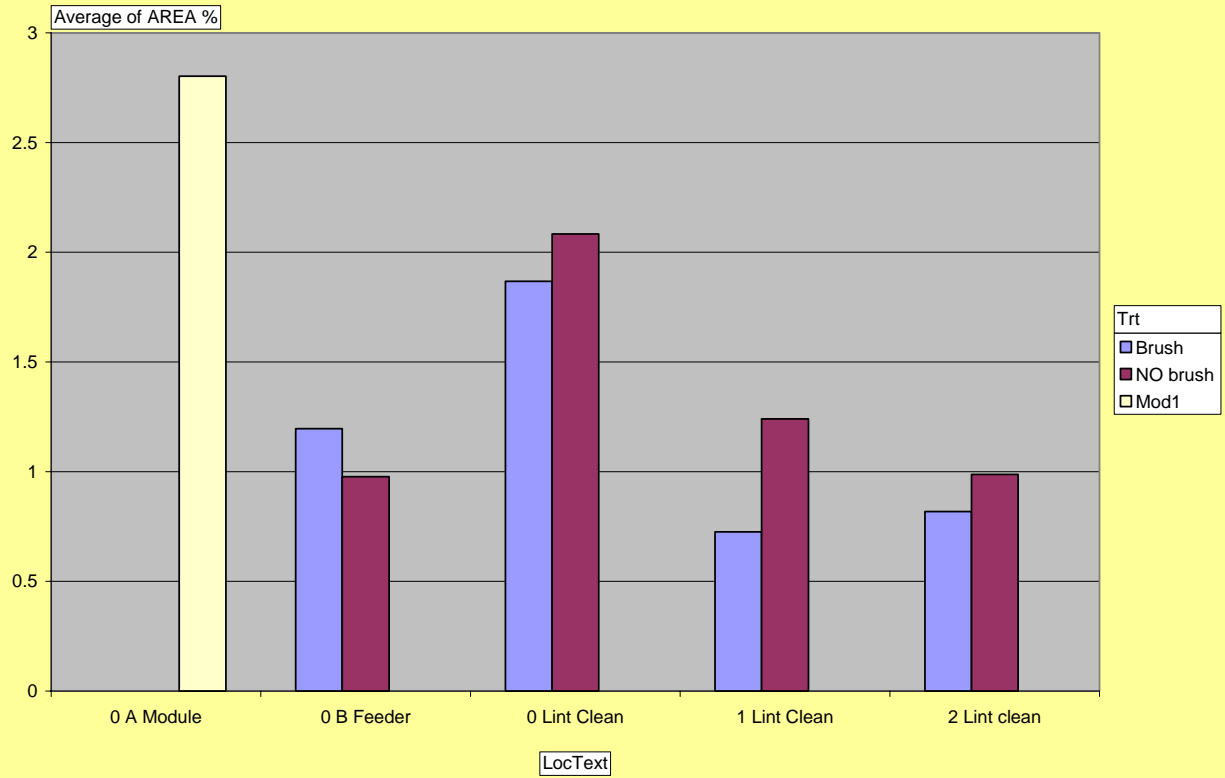


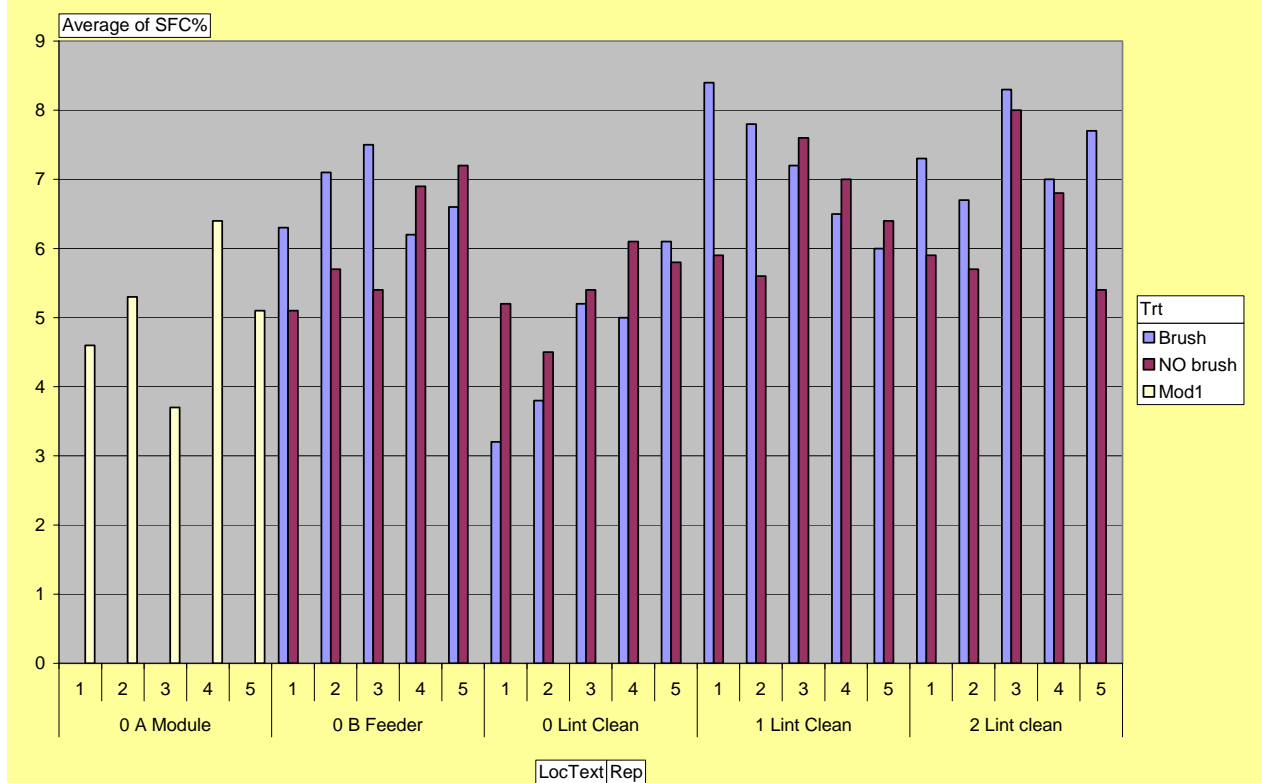
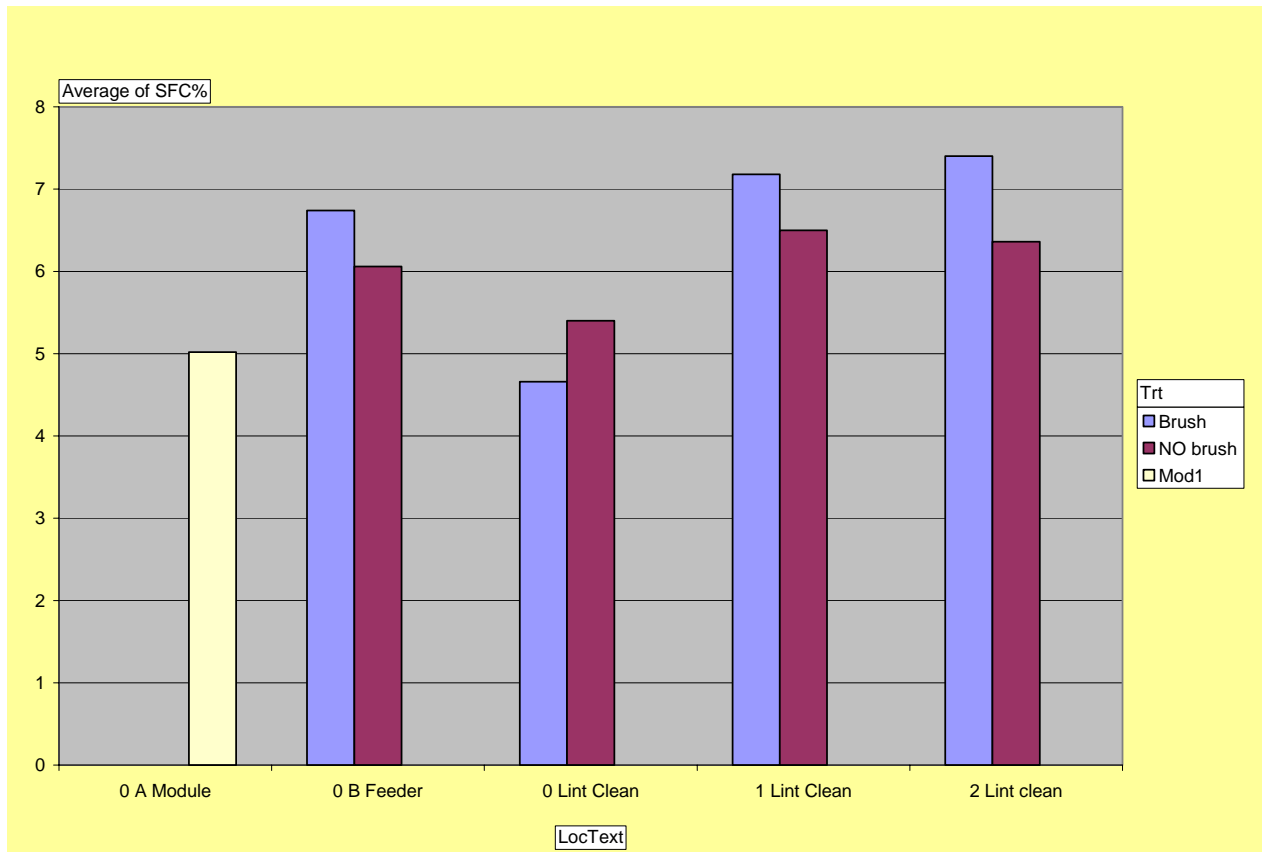


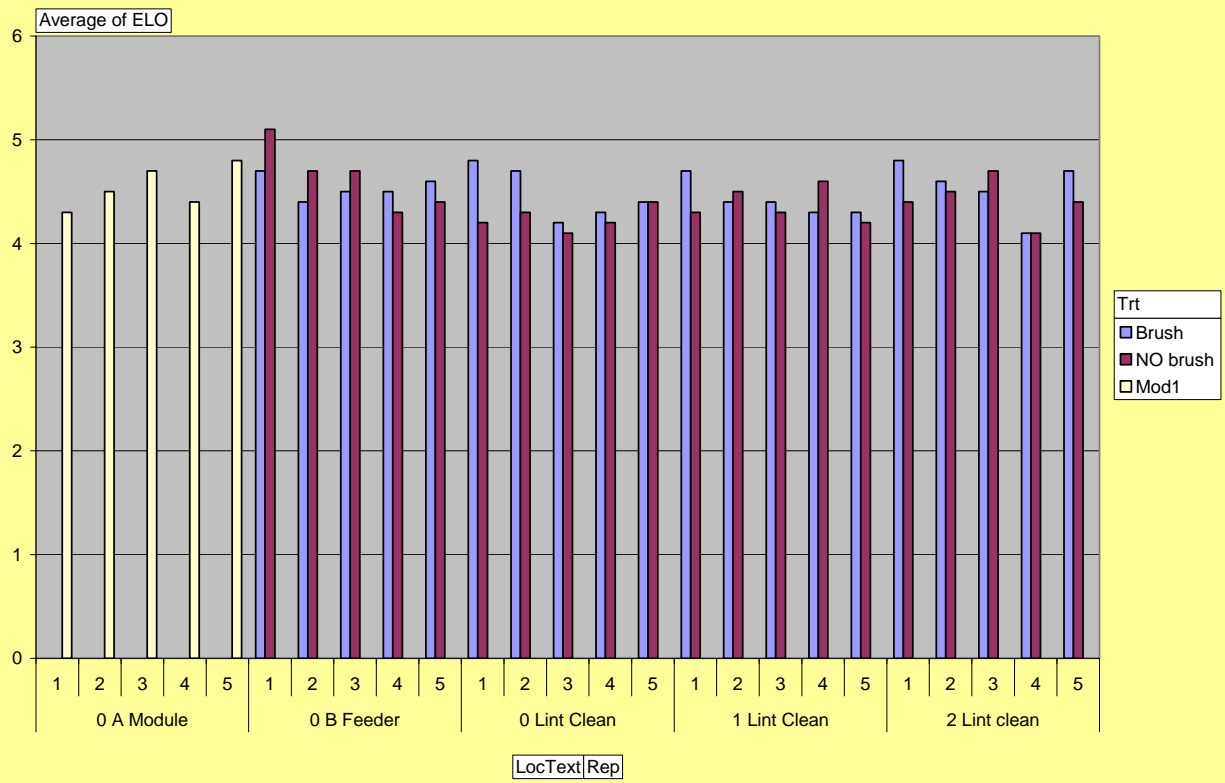
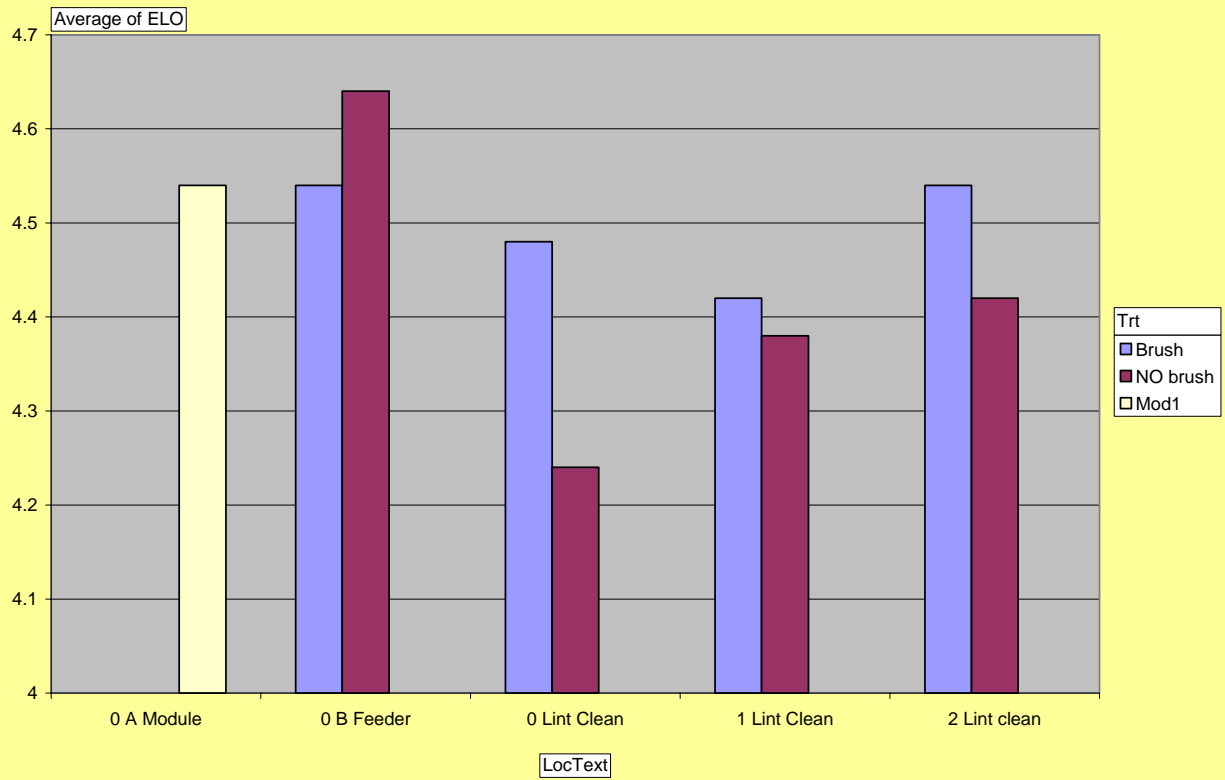












# AFIS Data

See the file "*AFIS\_USTER\_DataInterpretation.pdf*" for a detailed description of each parameter.

<b>Abbreviation Used:</b>	<b>Definition</b>
<b>Nep size (um)</b>	Avg Nep Size (mm)
<b>Neps per Gm</b>	Nep Count/g
<b>L(w) [in]</b>	Length by Weight
<b>L(w) CV [%]</b>	Length by Weight CV
<b>UQL (w) [in]</b>	UQL by Weight
<b>SFC (w) [%]</b>	SFC by Weight (%)
<b>L(n) [in]</b>	Length by Number
<b>L(n) CV [%]</b>	Length by Number CV
<b>SFC (n) [%]</b>	SFC by Number (%)
<b>L5% (n) [in]</b>	Length of longest 5%
<b>L2.5% (n) [in]</b>	Length of longest 2.5% ( <i>N/A by AFIS Pro</i> )
<b>Total Cnt/g</b>	Total Particle Count/g
<b>Trash Size [um]</b>	Avg Trash Size (mm)
<b>Dust Cnt/g</b>	Dust Count/g
<b>Trash Cnt/g</b>	Trash Count/g
<b>VFM [%]</b>	Visible Foreign Matter (%)
<b>SCN Size (um)</b>	Avg Seed Coat Nep Size (mm)
<b>SCN (Cnt/g)</b>	Seed Coat Nep Count/g
<b>Fine [mTex]</b>	Fineness (mTex)
<b>IFC [%]</b>	Immature Fiber Content (%)
<b>Mat Ratio</b>	Maturity Ratio

# AFIS Data

