CLEANING LABORATORY EVALUATION SUMMARY

SCL #:	2000
DateRun:	02/28/2000
Experimenters:	Jason Marshall
ClientType:	Light Manufacturer
ProjectNumber:	Project #2
Substrates:	Glass/Quartz
PartType:	Part
Contaminants:	
Cleaning Methods:	
Analytical Methods:	Goniometry
Purpose:	To evaluate cleanliness for two types of light bulbs.

Experimental Procedure:

Laser or optical contact angle goniometry is the measurement of a secondary effect to extrapolate surface cleanliness. A small drop of deionized water is placed on the substrate of interest. A light is shown to reflect the droplet's interface with the surface. Usually, the higher the contact angle (that is, the height of the bubble), the greater the contamination. Conversely, water dropped on a clean surface generates a much smaller, flatter contact angle. An example of this effect is noticeable after waxing and then washing a car; the remaining wax acts as a contaminant and the residual water on the surface of the car 'bubbles up.' The technique is limited in that only the cleanliness under the tiny drop is measured so that several readings must be taken. Flat surfaces are more conducive to accuracy with this method.

Before measurement, the angle measurement card must be calibrated with the laser. The laser should hit the measurement card directly in the center. When calibrating do not turn the laser from side to side because it will affect results. Then place the sample onto the sample stand. Adjust the stand so that the laser skims the surface of the sample. This will happen when the laser creates a line across the surface of the sample. When the laser skims the sample surface a vertical line should be on the measurement card. Adjust the card so that the line starts at the center of the card and goes directly along the 0 line. If the line is bent this means that the sample is not level and it must be adjusted.
Once calibrated, place a 2 microliter drop on the surface of the sample with the syringe. Move the sample with the control knobs so that the laser skims over the surface of the sample and through the location where the water droplet meets the sample surface. Two lines should appear on the measurement card. The angle between these two lines is the angle of contact between the water droplet and the sample.

One reading was taken per light bulb. Ten samples from each tray were analyzed. The average values and standard deviation values were calculated using Microsoft Excel. Table lists the six sets used.

Table 1. Light Bulb Groups
Set 1 Control 2/18
Set 2 Wash SI S8W 2/18
Set 3 Wash SI 2/18 S8W
Set 4 Control 2/17
Set 5 Wash
Set 6 Wash 2/17

SUBSTRATE MATERIAL: Glass-automobile lights
CONTAMINANTS: Unknown
CONTAMINATING PROCESS USED: Samples were received contaminated
CLEANING METHOD: Analysis only

Results:

The readings from the two sets washed on 2/18 were lower than the control group from the same day, 11.8 and 14.4 compared to 21.6. The set of bulbs from 2/17 did not differ significantly from the control group, 19.7 and 22.3 versus 19.6. Table 2 shows the ten readings from each group of lights as well as the average values and standard deviations.

Table 2. Contact Angle Goniometry Readings

	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6
Bulb 1	29	10	22	24	18	22
Bulb 2	18	10	15	23	17	22
Bulb 3	20	10	10	21	12	10
Bulb 4	25	14	11	16	30	34
Bulb 5	20	10	13	23	16	20
Bulb 6	27	15	12	20	21	20
Bulb 7	20	10	21	17	16	22
Bulb 8	20	18	11	18	21	21
Bulb 9	19	12	18	20	20	31

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Bulb 10	18	9	11	14	26	21
Average	21.6	11.8	14.4	19.6	19.7	22.3
Std Dev	3.72	2.79	4.2	3.14	4.96	6.15

Observation: Larger number => bubble sitting higher on bulb

Summary:

Conclusion: The bulbs cleaned on 2/18 appear to be cleaner than the control group that was not washed. The 2/17 bulbs were as did not reveal any differences in cleanliness when compared to its control group from the same day.