

# CLEANING LABORATORY EVALUATION SUMMARY

SCL #: 1999  
 DateRun: 01/21/1999  
 Experimenters: Jason Marshall, Sandy Pomer  
 ClientType: Cleaner Manufacturer  
 ProjectNumber: Project #1  
 Substrates: Aluminum, Steel  
 PartType: Coupon  
 Contaminants: Cutting/Tapping Fluids, Lubricating/Lapping Oils, Oil  
 Cleaning Methods: Mechanical Agitation  
 Analytical Methods: Goniometry, Gravimetric  
 Purpose: To evaluate client's cleaning products for the removal of motor oil

Experimental Procedure: Three cleaning solutions supplied by the client for testing. Ten percent solutions were made into 500 mL beakers using DI water and then heated to 140 F on a hot plate. Two substrate types were selected for the experiment, Aluminum and Cold Rolled Steel.

Initial contact angle measurements were recorded on pre-weighed coupons. 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.

The coupons were then contaminated with motor oil using a hand held swab and then weighed a second time. Three coupons were cleaned in each solution for 5 minutes using a manually agitated bath. At the end of the cleaning, coupons were rinsed in tap water at 120 F for 30 seconds. Drying was performed using a Master Appliance Corp, Hot-air gun model HG-301A at 500 F for 2 minutes. Final gravimetric weights were recorded and cleaning efficiencies were calculated. The cold rolled steel coupons were unable to re-analyzed using contact angle.

SUBSTRATE MATERIAL: Aluminum 202-6061 T-4; Cold Rolled Steel 202-1020  
 CONTAMINANTS: Oil-Castrol 10W-40

Results: Two of the solutions were found to be moderately successful in removing the oil from the substrates. Formula 7001-CP and 7300 cleaned over 80% of the contaminant. Table 1 list the overall cleaning efficiencies for each of the cleaning solutions.

Table 1. Cleaning Efficiencies

Solution	9001-CP	7001-CP	7300
Coupon 1	64	78.91	92.68
Coupon 2	72.28	92.92	89.68
Coupon 3	72.16	79.75	97.09
Ave	69.48	83.86	93.15
Std Dev	4.74	7.86	3.73

After the coupons were weighed, the cold rolled steel coupons were determined to contain a thin film oil. Because of this film, the final contact angles were not able to be evaluated. Table 2 lists the initial and final angles for the aluminum coupons.

Table 2. Contact Angles for Aluminum

Initial Reading	Final Reading
75	55
71	30
79	40
Ave: 75	Ave 42

The results obtained were not what was to be expected. After cleaning the bubble of water actually sat lower on the coupon. This was determined to be related to either the remaining oil or cleaner residue.

Summary:

<b>Substrates:</b>	Aluminum, Steel
<b>Contaminants:</b>	Cutting/Tapping Fluids, Lubricating/Lapping Oils, Oil

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Company Name:	Product Name:	Conc.:	Efficiency:	Effective:	Observations:
Watson Technical Associates	Watson Formula 9001CP	10	69.48	<input type="checkbox"/>	
Watson Technical Associates	Watson Formula 7300	10	93.15	<input checked="" type="checkbox"/>	
Watson Technical Associates	Watson Formula 7001-CP	10	83.86	<input checked="" type="checkbox"/>	

Conclusion:

Two of the cleaners were determined gravimetrically to remove most of the motor from the coupons.  
Contact angle was found to be inconclusive in determining the effectiveness of the cleaning solutions.