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Date 3/3/09

## Ransohoff Test Report # XXXX-XX



**Customer  
Address  
Address**

**Attn: Contact Name**

**Ransohoff Equipment: Lean-Jet RB-2**

We trust this test report meets with your requirements, however,  
if you require any additional information, please call.  
Matthew Baumat, Technical Center Process Engineer (513) 870-1762



*A NM Group Global, LLC Company*

**Purpose:**

- Develop a cleaning process using the Lean-Jet RB-2 to effectively clean aluminum components.

**Parts and Equipment:**

- Aluminum components processed by Ransohoff for Customer in our Lean-Jet RB-2.



Parts Tested



Lean-Jet RB-2

<b>Lean- Jet RB-2</b>	
Machine Type	Lean-Jet™ Rotary Basket Washer (RB-2)
Machine Serial Number	Proprietary
Wash and Rinse Nozzles	Proprietary
Nozzle Flow Rate	Proprietary
Wash and Rinse Spray Pressure	Proprietary
Line Rinse Nozzles	Proprietary
Line Rinse Flow Rate	Proprietary
Eductors	Proprietary
Eductor Flow Rate (Turbulation)	Proprietary
Blower Rating (Regenerative)	Proprietary
Ultrasonic Specification	Proprietary
Wash and Rinse Filters	Proprietary

**Process Parameters:**

	<b>Process #1</b>
Wash Chemistry	5% Evercycle ACI
Wash Temperature	140°F
Rinse Chemistry	DI Water
Rinse Temperature	140°F
Blow-Off Temperature	200°F
Turbulated Wash	120 sec
Ultrasonic Wash	240 sec
Open Air Wash	60 sec
Tubulated Rinse	90 sec
Ultrasonic Rinse	60 sec
Open Air Rinse	60 sec
Blow - Off	180 sec

- The parts were setup in the Lean-Jet RB-2 as shown below:

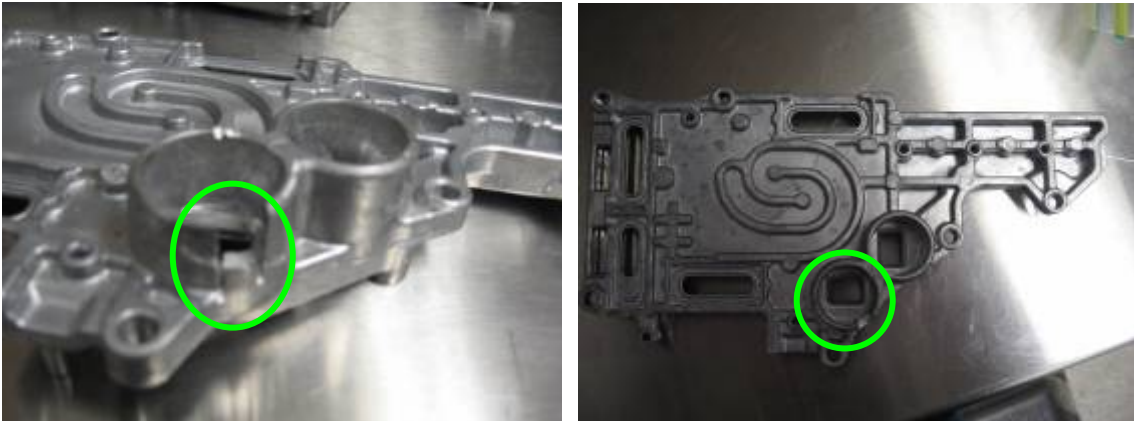


**Results:**

- After the cleaning processes, two (2) parts were cleanliness tested per Gravimetric / Millipore Cleanliness Procedure (WI 7.2.1-1). The solvent used was mineral spirits and the Millipore pad size was 5 microns. See below for the results.

<b>Process</b>	<b>Contaminant Weight (mg)</b>	<b>5-15 µm</b>	<b>15-100 µm</b>	<b>100-600 µm</b>	<b>&gt;600 µm</b>	<b>Max Particle Size (µm)</b>
<b>Spec – Maximum Number of Particles Allowed (per 1000 cm<sup>2</sup>)</b>	N/A	130,000	16,000	1,000	4	N/A
<b>Process #1 Part #1</b>	0.26	397	947	45	0	486
<b>Process #1 Part #2</b>	0.27	751	1733	65	0	576

- After the cleaning processes, two (2) parts were sent to an independent laboratory to conduct an XPS analysis. Due to the nature of this test, a small segment of the part was required to be cut away to be tested. See below for complete results.



### ***XPS Analysis***

#### Background

Cleaned and uncleaned aluminum castings were analyzed for surface composition using XPS (x-ray photoelectron spectroscopy). Attention was paid to the presence of chlorine on casting surfaces, as removal of this element is of particular interest to the customer.

#### Experimental

Small samples cut from castings using a solvent-cleaned hacksaw blade were analyzed using XPS, which determines the elemental composition and oxidation state of the uppermost few nanometers of the sample surface state.

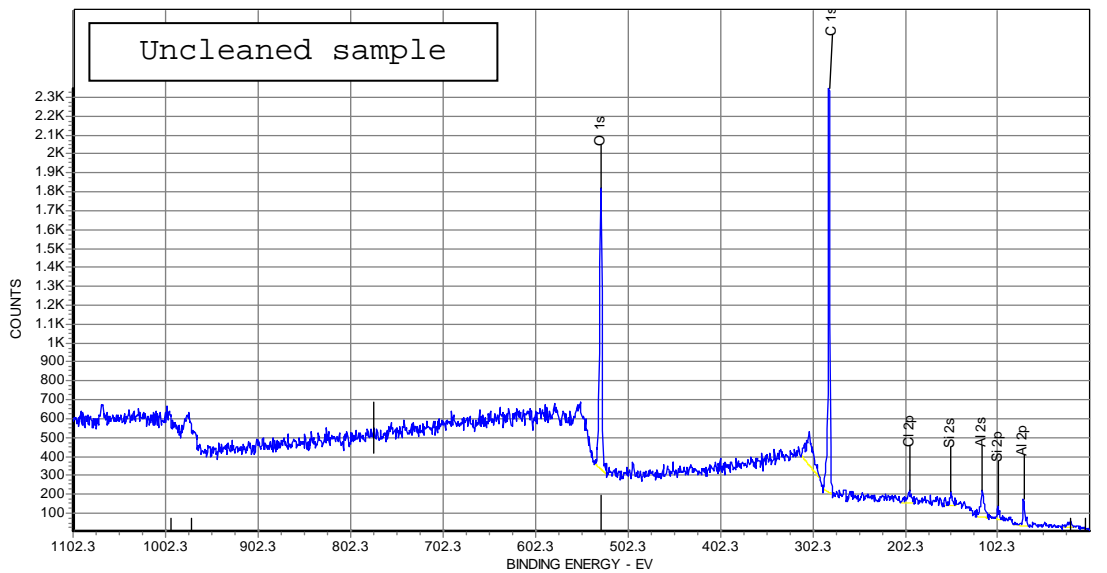
#### Results and Discussion

Atomic compositions obtained from the most recent samples are shown in the accompanying Table where they are compared with data obtained from uncleaned and cleaned castings on 10/15/2008. Individual XPS spectra are shown in Figures 1 through 4.

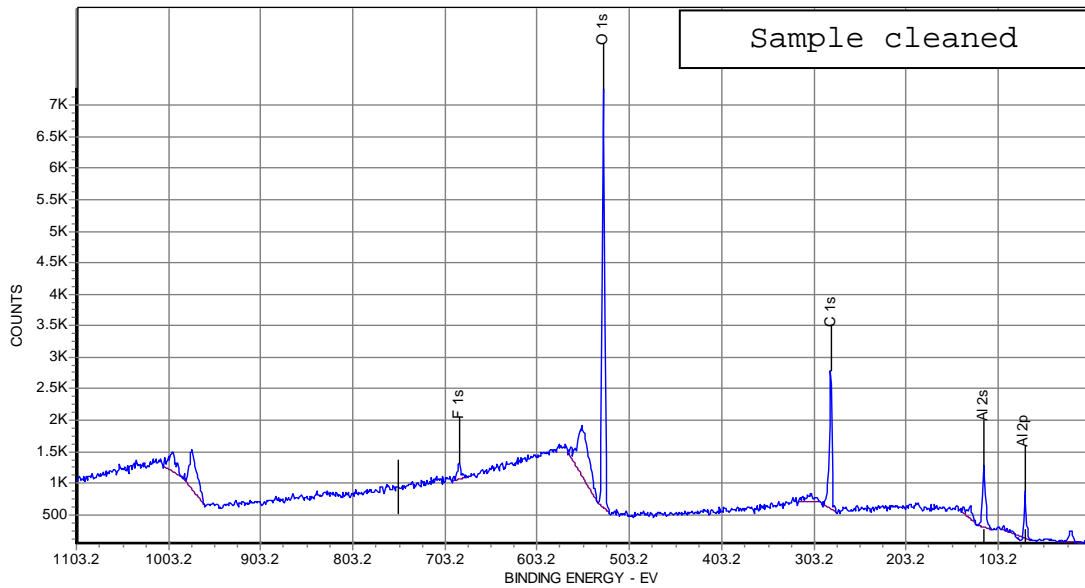
**Table 1.** Results from XPS analysis

Element	Atom %			
	Uncleaned	Cleaned 10/15/08	Cleaned 3/3/09; Sample 1	Cleaned 3/3/09; Sample 2
Carbon	63.3	31.8	38.0	34.9
Oxygen	23.0	41.6	42.8	43.2
Chlorine	1.9	1.3	--	--
Silicon	2.8	7.8	--	--
Aluminum	9	7.5	17.3	20.3
Calcium	--	3.5	--	--
Sulfur	--	4.3	--	--
Phosphorous	--	2.2	--	--
Fluorine	--	--	2.0	1.6

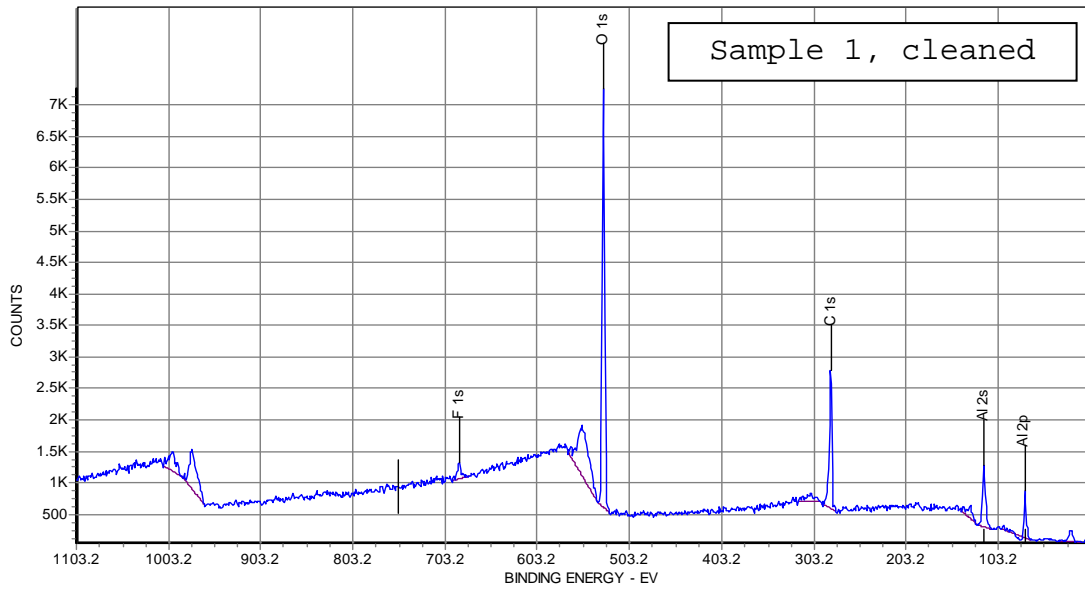
The carbon content of the uncleaned surface is twice the carbon content of the cleaned surfaces, indicating a significant amount of oily contamination was removed by both cleaning processes. Sample 1 and 2 are very similar in atomic composition. However, compared to the sample cleaned on 10/15/2008, they show fewer elements and no detectable chlorine. Approximately 2% fluorine was detected on these surfaces.



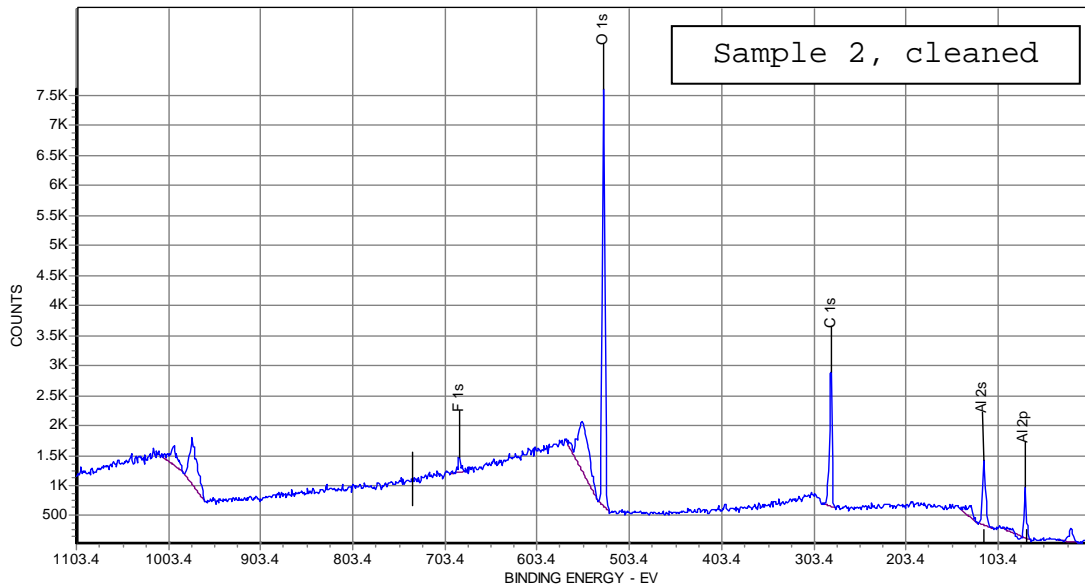
**Figure 1.** XPS spectrum of uncleaned aluminum casting



**Figure 2.** XPS spectrum of aluminum casting cleaned 10/15/2008.



**Figure 3.** XPS spectrum of aluminum casting cleaned 3/2/2009, sample 1.



**Figure 4.** XPS spectrum of aluminum casting cleaned 3/2/2009, sample 2.

### **Conclusions:**

- Upon review of the above results, it appears that the above process will meet the supplied cleanliness specification. The above process did not discolor or change the surface appearance of the aluminum. Along with exceptional particulate removal, the above cleaning process completely removed all of the chlorides from the surface of the part.

Please feel free to contact us with any further questions or concerns.

Sincerely,

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Cc: Dan Moore  
Regional Sales Manager

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