

METALLURGICAL AND MECHANICAL EVALUATION OF MOLD METALS

1.0 INTRODUCTION

A set of five materials were evaluated through various tests in an effort to identify differences in metallurgical and mechanical characteristics. The evaluation incorporated the following tests:

- Chemical analysis (Employing Glow Discharge Optical Emission Spectrometry)
- Mechanical Testing (ASTM E8)
- Rockwell Hardness Measurements (ASTM E18)
- Brinell Hardness Measurements (ASTM E10)
- Abrasion Resistance (Employing linear abrasion methodology)
- Cyclic Compression Testing (Employing surface to surface contact at 5000psi through 10,000 cycles)
- Surface roughness and scanning electron microscopy of compression specimens before and after testing.

Sample material identification was as follows:

- Alumold
- Aluminum
- P-20
- Hokotol
- QC-10

2.0 Summary of Observations

Evaluation of the five alloys revealed that the "P-20" alloy was by far the hardest, strongest and most abrasion resistant material, as would be expected considering it to be a steel alloy, while the other materials were aluminum alloys. With respect to the aluminum alloys, it would appear the "Hokotol" and "Alumold" exhibited the best overall physical characteristics, while the "QC-10" was a close runner-up. The "Aluminum" material was significantly softer and less resistant to abrasion when compared with than any of the other alloys represented in this report.

The cyclic compression testing stress of 5000 psi over 10,000 cycles did not appear to significantly alter the surface texture of any of the alloy samples, suggesting that any of these materials could withstand loading of this nature. However, if loading or the number of cycles was increased significantly, it would be expected that the life expectancy of these alloys would best be represented by their mechanical properties.

The following is a presentation of our observations.

3.0 TEST METHODOLOGY AND RESULTS

3.1 Chemical Analysis / Glow Discharge Spectrometry

The GDS-850A Atomic Emission Spectrometer can simultaneously analyze forty-one different wavelengths with the support of special features including:

- A Grimm-type 4 mm glow discharge source.
- A 0.75 m direct-reading spectrometer with a 1800 & 3600 groove holographic gratings and Wavelength range of 119-800 nm with the dual spectrometer option installed.
- Window - driven software interfaced with a LEICO 486 base computer.

The GDS-850A provides accurate elemental compositions from depths of tens of nanometers to one hundred micrometers. It performs rapid, routine surface analyses on conductive materials. Results are presented in Table 1.

Table 1. Chemical Analysis (%wt)

	Aluminum	Alumold	Hokotol	QC-10	P-20
C					0.36
Cr	0.05	0.01	0.01	<0.01	1.89
Cu	2.79	2.13	1.71	1.78	
Fe	1.03	0.04	0.04	0.04	
Mg	1.06	2.16	2.18	1.6	
Mn	0.06	0.01	0.01	<0.01	1.45
Mo					0.22
Ni					1.02
P					0.010
S					0.008
Si	0.18	0.06	0.03	0.03	0.27
Ti	0.03	0.04	0.04	0.01	
Zn	0.05	6.20	6.18	8.47	