

# MSi Testing & Engineering, Inc.

Your Source for Metallurgical Testing and Failure Analysis

1390 N. 25th Avenue  
Melrose Park, IL 60160  
708-343-3444  
F A X 3033



TESTING CERT #0510-01

## SAMPLE IDENTIFICATION

| Description       | Part Number | Material            | Condition |
|-------------------|-------------|---------------------|-----------|
| Fractured Housing |             | Cast 356.0 Aluminum | T6        |

## PERFORMED TESTING

Metallographic Examination  
Tensile Testing  
Hardness Testing  
Chemical Testing

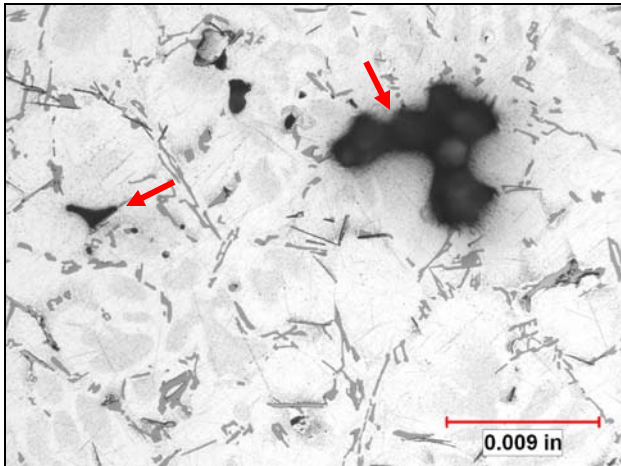
## COMMENTS

1. The microstructure of the casting was typical of 356.0 aluminum in the T6 condition, which consisted of unmodified eutectic silicon particles in a matrix of aluminum. However, internal **gas porosity** was observed distributed throughout the casting cross section. The porosity was most likely related to hydrogen gas from the degassing process. The size and distribution of the most severe porosity was not considered gross, but in our opinion, approached what would be considered the maximum limits of commercial quality, and contributed to the failure.
2. The **tensile and yield strength** results of the housing were 33,200 psi and 31,600 psi, respectively, which were typical values for 356.0-T6 for separately cast test bars. The % elongation result of 1% was less than typical and suggests a brittle material condition.
3. The chemical test results of the submitted housing classify as Aluminum Association (AA) 356.0 cast aluminum. Sodium, calcium, or strontium were not used as modifying agents to enhance ductility.

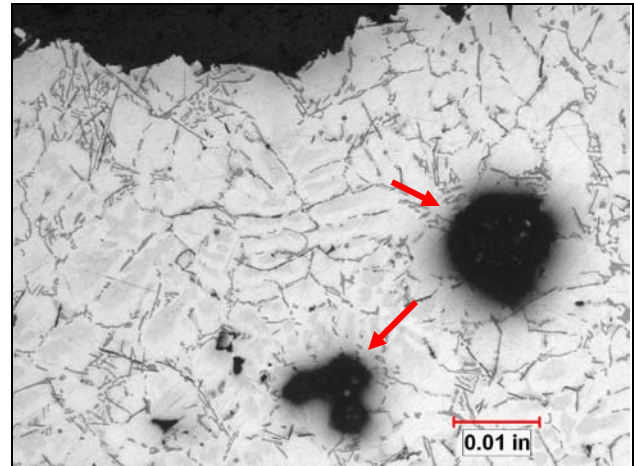
## SUMMARY of TEST RESULTS

### Metallographic Examinations

1. A section was removed through the fracture to examine the general microstructure and level of any internal porosity. The microstructure of the casting consisted of semi-rounded and elongated silicon particles in an aluminum matrix, which was typical of 356.0 aluminum in the T6 condition. (See Photo 1)
2. The porosity observed was rounded or semi-rounded, which was typical of hydrogen gas. (See Photo 2)
3. The amount of porosity observed would potentially contribute to reduced % elongation and lower ductility.



**Photo 1:** Mag: 100X; Etchant: Keller's Reagent  
View of the general microstructure and porosity.



**Photo 2:** Mag: 50X; Etchant: Keller's Reagent  
View of the most severe porosity along the fracture.

### Tensile Testing

1. The **tensile and yield strength** results of the housing were 33,200 psi and 31,600 psi, respectively, which were typical values for 356.0-T6 for separately cast test bar specimens. The % elongation result of 1% was less than the typical amount of 2.0 – 4.0%.
2. See the test results as shown in Table 1.

### Hardness Testing

1. The **Brinell hardness test** result of 95 HBW was above the typical value of 70 – 75 HBW for 356.0 – T6 condition.
2. See Table 2.

Report No. [REDACTED]

**Chemical Testing**

1. The chemical test results of the submitted housing classify as Aluminum Association (AA) 356.0 cast aluminum.
2. See the test results as shown in Table 3.

**Table 1 - Tensile Testing \***

|                                     | <b>Results</b> | <b>Typical **</b> |
|-------------------------------------|----------------|-------------------|
| Tensile Strength, psi               | 33,200         | 33,000            |
| Yield Strength, psi<br>(.2% offset) | 31,600         | 24,000            |
| % Elongation in 1" (4D)             | 1              | 3.5               |

\* Testing performed in accordance with **ASTM B557**.

\*\* Typical values for separately cast test bar specimens of 356.0-T6 (Sand Molding).

**Table 2 - Hardness Testing \***

|                                       | <b>Results</b> | <b>Typical</b> |
|---------------------------------------|----------------|----------------|
| Core Hardness, HBW <sub>(500kg)</sub> | 95             | 70 – 75        |

\* Testing performed in accordance with ASTM E10.

**Table 3 - Chemical Testing \***

|                       |           |
|-----------------------|-----------|
| Silicon               | 6.9 %     |
| Iron                  | .34       |
| Copper                | .17       |
| Manganese             | .08       |
| Magnesium             | .27       |
| Chromium              | .02       |
| Zinc                  | .06       |
| Titanium              | .13       |
| Other Elements, Each  | <.05      |
| Other Elements, Total | <.15      |
| Aluminum              | Remainder |

\* Testing performed in accordance with ASTM E1251.