OAK RIDGE NATIONAL LABORATORY

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

1 Bethel Valley Road, Bldg. 4515 MS-6069
Oak Ridge, TN 37831-6069
Tel. (865) 574-1749
Fax (865) 574-6098
E-mail: laracurzioe@ornl.gov
http://www.ms.ornl.gov/htmlhome/mcauc/edgar.htm

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To: Gus A. Aramayo
Computational Materials Sciences Group
Building: 6025, Room: 011W
Mail Stop: 6359

From: Chris O. Stevens

cc: E. Lara-Curzio

Subject: Mechanical Evaluation of Aluminum Specimens

Enclosed you will find the preliminary results from the tensile evaluation of specimens obtained from an Audi A8 automobile.

Figure 1. Audi A8 automobile

As you recall, specimens were cut from selected components (see for example Figure 2 and 3) by regular milling operation. Tensile specimens conformed to the geometry shown in Figure 4. The tests were performed at a constant displacement rate of 1.9 mm/min using an electromechanical universal testing machine (Instron Mod. 4507) equipped with mechanical wedge grips, and a strain-gauge extensometer. Figure 5 shows the experimental set-up. The results from these tests (0.2% yield strength, ultimate strength, specimen elongation and maximum percent strain) have been summarized in Table 1. Please note that the total elongation of the specimens was determined at the end of the tests by measuring the distance in-between the root of the radii of curvature in the specimen (X-X' in Figure 4), whereas the maximum percent strain was calculated by the test machine software based on the total cross-head displacement and built-in compliance corrections.

Enclosed you will also find the tested specimens, records of the chart recorder, a summary of post-test dimensional measurements, records of the stress-strain curves, and a record of the extensometer output. (Please note that the range of the extensometer is 10%, and that to prevent damaging it, it was removed from the specimen prior to the end of the test).

You should be aware that the failure of at least one specimen (obtained from the front middle vent (EV1)) initiated from the "Audi" logo embossed on the back of the specimen.

I thank you for the opportunity of working with you in this very interesting project, and look forward to continue working with you in the future. Please do not hesitate to call me if you have any questions.

Figure 2. Location of specimens FS1 and FS2 from fender support.

Figure 3. Left fender showing location of specimens LF1, LF2 and LF3.

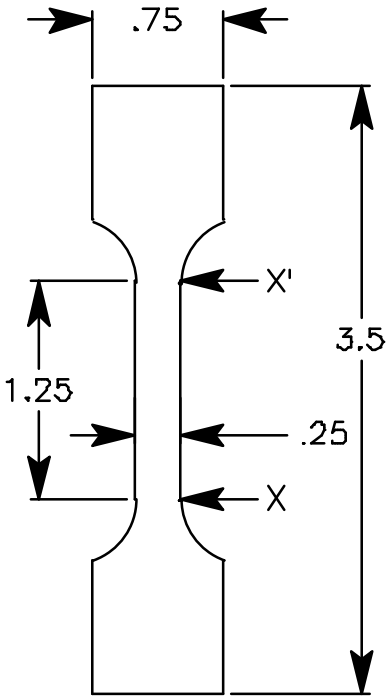

Figure 4. Schematic of tensile specimen. Dimensions in inches.

Figure 5. Experimental set-up. Visible in the picture are the mechanical-wedge grips, the load train, the aluminum specimen and the strain-gauge extensometer.

Table 1

Specimen	*Description*	*Stress @0.2% Yield MPa)*	*Stress @ Peak (MPa)*	*Measurements From Specimen* *Reduction in Area (1%)*	*Total Elongation) (Radius to Radius) (%)*	*Maximum Percent Strain From Instron (%)*
HP1	Hinge Pillar Front	226.48	244.86	42.54	10.84	10.98
HP2	Hinge Pillar Front	230.97	251.43	53.70	11.39	12.03
BP1	Center Pillar	215.45	245.52	30.38	8.66	10.19
AP1	Structural Support Inside Pillar	218.93	239.10	40.04	9.41	10.73
RSS1	Right Side top of center pillar	231.25	249.62	55. 99	12.32	12.23
BS2	Bumper Support 2	227.97	248.43	43.01	9.20	10.19
RFS1	Right Front Support	271.35	309.35	45.79	13.43	13.46
RFS2	Right Front Support, Rectangular Tube	220.64	238.76	58.35	10.63	10.49
FCP1	Front Cowl Panel	228.85	245.75	50.27	10.60	10.93
RST1	Right Shock Tower	291.25	313.97	43.25	9.80	11.64
FMEVH1	Front Middle Vent, Longitudinal	293.42	319.97	35.54	9.85	11.21
EVI	Front Middle Vent	261.07	283.04[1]	17.38	4.33	3.87
RFC1	Right Front Channel	189.01	220.72	61.32	13.47	13.90
LSH1	Left Front Shock Housing-Axial	229.42	247.60	57.49	11.05	10.64
LSH2	Left Front Shock Housing-Longitudinal	128.02	192.58[2]	21.61	10.12	10.82
FS1	Fender Support-Axial	213.63	231.85	60.17	10.51	10.85

[1] Failure appear to have started form Audi Logo embossed on back of specimen
[2] Bad Casting. Holes in fracture surface.

FS2	Fender Support	268.75	302.06	34.68	7.01	8.20
FS3	Fender Support-Rear, 45°	220.27	238.89	54.13	10.00	10.33
FSF3	Fender Support, Top	278.16	317.94	36.17	11.40	13.11
LF1	Left Front Fender	219.33	247.19	24.39	10.62	11.33
LF2	Left Front Fender-Middle	222.94	253.30[3]	41.86	11.13	10.77
LF3	Left Front Fender-Vertical	211.97	246.28	45.44	11.85	10.97
RR1	Roof, Top front of Windshield	194.05	226.20	36.03	11.98	13.49
R1	Roof Panel, Longitudinal	214.76	248.37	48.13	10.81	11.98
R2	Roof Panel, Axial	206.67	241.09	53.60	11.92	12.90
H1	Hood-Longitudinal, Front	211.64	241.49	56.90	10.45	11.30
H2	Hood-Axial	214.42[4]	246.20	45.33	11.26	11.70
H3	Hood-Longitudinal, Middle	219.19	250.79	38.80	11.29	12.30
RP1	Rocker Panel	252.57	285.16	51.32	10.03	11.33

[3] Failed at lower punch mark
[4] Extensometer slipped. 0.2% yield off a small amount