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Section 12
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LAB 1
Notch Sensitivity in Low Ductility Materials

OBJECTIVE

To determine the notch sensitivity in materials with low ductility

PROCEDURE

1. Measure all dimensions of the specimen, width, thickness, and notch depth, then calculate the ligament width. Record your data.
2. Now place the specimen in the MTS Criterion Testing Machine and make sure that the specimen is properly aligned with the edge of the specimen parallel to the back of the jaw. Min contact of the grips should be ¾.
3. Start the test and load the specimen to failure, observe where the crack starts and record the ultimate load.
4. Finally remove the specimen and return the machine to default. Repeat for other specimens. Don't let the fractured surfaces touch when removing from the machine.
5. Submit the data in your lab report.

DATA AND RESULTS

Table 1- Notched Specimen Data

Material	Specimen	Width w (m)	Thickness t (m)	Net Notch Depth a (m)	Ligament Width (m)	Failure Load P (N)
1095	3	0.01528	0.00115	0.00961	0.00567	2632.75
1095	1	0.01528	0.00116	0.00307	0.01221	4906.86
1095	2	0.01526	0.00116	0.00688	0.00838	5145.35
Al 6061	3	0.01526	0.00315	0.00905	0.00621	5085.56
Al 6061	2	0.01526	0.00316	0.00638	0.00888	7969
Al 6061	1	0.01526	0.00315	0.00358	0.01168	11361.983
CRS	1	0.01521	0.00321	0.00400	0.01121	14615
CRS	3	0.01518	0.00328	0.00200	0.01318	17345
CRS	2	0.01523	0.00320	0.00600	0.00923	17477
Al 7075	1	0.01520	0.00318	0.00890	0.00630	10856.465
Al 7075	2	0.01520	0.00318	0.00532	0.00988	14259.53
Al 7075	3	0.01520	0.00318	0.00349	0.01171	20403.691

ANALYSIS OF DATA

- **AI7075 SPECIMEN 3**
- Determination of specimen full area:
  - A_{tot} = thickness (t) * width (w) =0.00318*0.01520=4.8336*10^{-5} m^2
- Derivation and determination of ligament area:

- A_{lig} = thickness (t) * ligament width (w_{lig})=0.00318*0.01171=3.72378*10^{-5} m^2

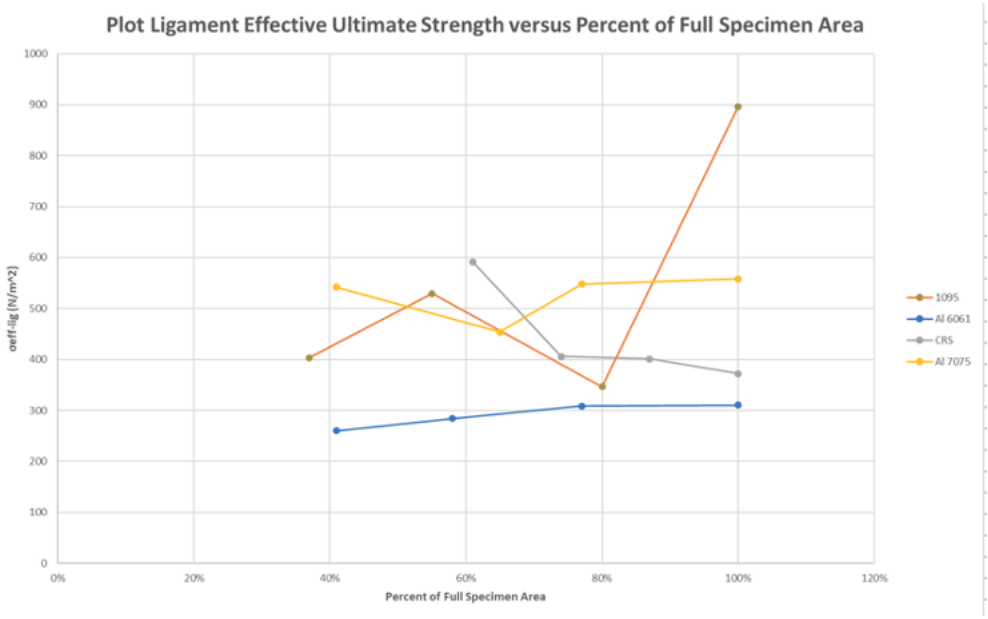
- Calculation of percent of full specimen area:
  - A % = (A_{lig} / A_{tot})*100 =(3.72378*10^{-5} / 4.8336*10^{-5})*100 =77%

- Calculation of ligament effective ultimate strength:
  σeff – lig = Failure Load P/ A lig = 547929550.1 N/m^2

Table 2- Notched Specimen Analysis Results

Material	Specimen	Total Area A (m^2)	Ligament Area (m^2)	A%	σeff-lig (N/m^2)
1095	3	0.000017572	6.52E-06	37%	403.7650487
1095	2	1.77E-05	9.72E-06	55%	529.313431
1095	1	1.77E-05	1.42E-05	80%	346.4415826
1095		1.77E-05	1.77E-05	100%	8.96E+02
Al 6061	3	0.000048069	1.96E-05	41%	259.978018
Al 6061	2	4.82E-05	2.81E-05	58%	283.9904778
Al 6061	1	0.000048069	0.000036792	77%	308.8166721
Al 6061		0.000048069	0.000048069	100%	310.275
CRS	2	0.000048736	0.000029536	61%	591.7185807
CRS	1	4.88E-05	3.60E-05	74%	406.1516058
CRS	3	4.98E-05	4.32E-05	87%	401.222288
CRS		4.98E-05	4.98E-05	100%	3.72E+02
Al 7075	1	0.000048336	0.000020034	41%	541.9020166
Al 7075	2	0.000048336	3.14E-05	65%	453.8592035
Al 7075	3	0.000048336	3.72E-05	77%	547.9295501
Al 7075		0.000048336	0.000048336	100%	558.495

Figure 1



DISCUSSION OF RESULTS

1. If an alloy is flaw or notch insensitive, the ligament effective ultimate strengths would not depend on the effective cross-sectional areas. Is either allow sensitive to the presence of geometrical discontinuities? Support your responses with references to the four sets of data collected.

    a. If we look at the plot for all the materials, we can see that the slope for 1095 was the steepest. A small increase in area percentage leads to a large increase in stress. It's the most notch sensitive out of the bunch.
2. A very soft and ductile Aluminum alloy 1100 is the type commonly used in electrical conductors. Based on your experiments, what would your expectations be as to its notch sensitivity?
    a. From the experiment we can see that aluminum 1100 sample has the lowest notch sensitivity as the graph is not too steep.
3. Comment on the fracture surfaces. Were they expected for this kind of test?
    a. The fractures were expected for this test because the specimens had a notch in the middle and that's where the fracture occurred during the stress. Even if there was no notch the fracture still would've occurred somewhere in the specimen.

CONCLUSION

This lab was successful in demonstrating the notch sensitivity of the specimens. The test was able to produce the Ultimate Strength from the machine and we used that to plot the curves which explained how a material reacts with load.