Production and Assessment of Fatigue Damage in 2024-T3 Aluminum Samples

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Background

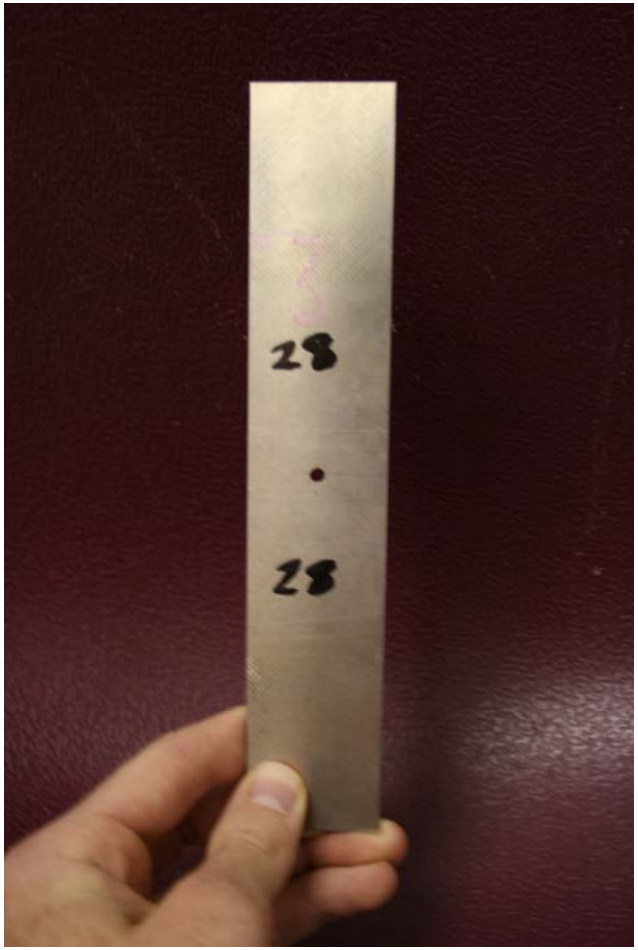
- In order for plane skin to be thoroughly examined for cracks, the inside of the hull must be removed.
- Boeing has contracted Sandia to test non destructive devices that will save them time/money.

None destructive scanning devices

- Manufacturer: Direct Measurements Inc.
  - Device: 2D bar code reader measuring true stain.
- Manufacturer: Positron Systems Inc.
  - Device: photon annihilation method that counts dislocations in the metal matrix.

Intro and goals

- Sandia has supplied us with 8x1.5x.04 inch 2024-T3 aluminum specimens with a 5/8 inch hole drilled in the middle. Each specimen represents a section of airplane skin with a rivet hole drilled in it.
- The purpose of our research is to produce fatigue in our specimens by subjecting them to a series of tension cycles imitating the pressurizing and depressurizing of an airplane hull.



Lab setup

- The first task was to run our Instron tensile machine in a series of load block cycles in accordance with the R=.1 specifications.
- R=.1 requires the cycle tension in the specimen to alternated between 20ksi and .2ksi.
- A Lab View VI was created to produce a DC voltage from the DAQ card to the Instrom machine to control tension cycling of the machine.

Procedure

- We began our testing by cycling our specimen until cracking appeared.
- Once cracks appear, the specimen is labeled and the number of cycles documented.
- The cracked specimens were then sent in to be tested for striation marker bands.

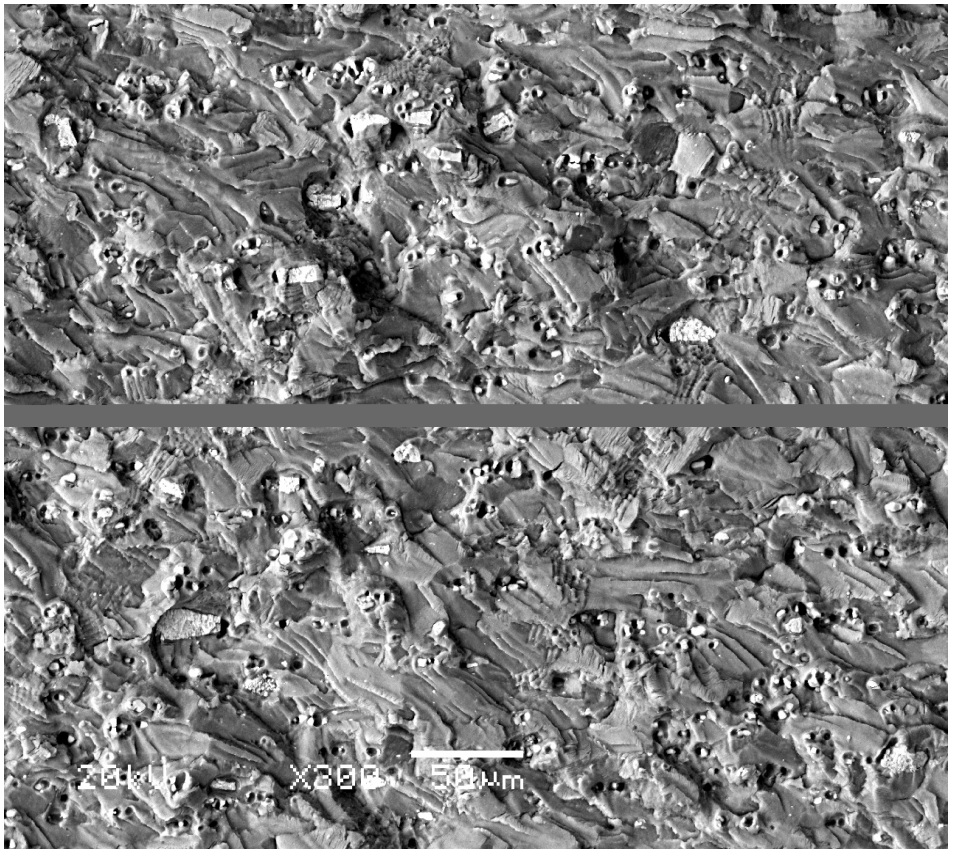
Results

- After many trial runs, we began to get reasonable, recurring results. We sent specimens 34-40 in to be analyzed.
- As seen from the table of data, the average cracking point for a specimen was between 145,000 to 180,000 cycles.

Specimen #	Rate (Hz)	Cycles when crack detected	Cycles until break at hole
# 33	5	NA	141,200
#34	5	145,562	NA
#35	5	161,655	NA
#36	5	129,486	NA
#37	5	184,246	NA
# 38	5	163,528	NA
# 39	5	129,250	NA
# 40	5	170,622	NA

Results

- Striation marker bands found in our final specimens.
  - We want to be able to count fatigue crack striations from the point of fast fracture back to the point of crack initiation. This is because the two companies involved have both claimed the ability to predict crack initiations as well as measure the fatigue condition of the metal part.



Actual tests

- 15 specimens with bar codes were sent to us from Direct Measurement Inc.
- Each specimen was put through 10 cycles and then sent back to DMI.

Problems

- Results came back from DMI saying the every specimen had undergone some compression.
- Found that while inserting the specimen into the clamps, it was undergoing slight compression.
- Solution: turn the load command on first and then clamp the specimen.

Conclusions

- Have succeeded in producing striation marker bands in our specimens.
- Need to control our loading sequence to avoid subjecting our specimen to any compression.

Are there any questions?