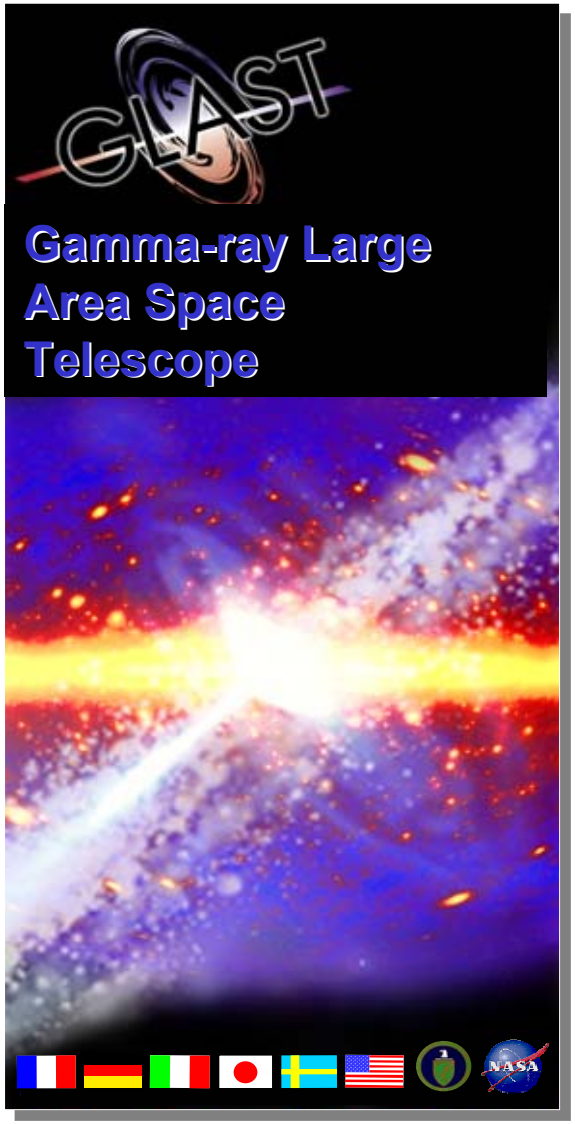

Status Report
GSFC W Tile Etching & Priming For GLAST Trays
5 October 2004

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GSFC Efforts

1. Examination of 100μ W Tile
   a. Cross-Section Photomicrographs
   b. Surface Examination
   c. Metallurgical Composition
2. Check on BR127 Batch & Verification of GSFC Application Process
3. Check of BR127 Compatibility with 2216
4. Development of an Effective Acid Etch for W
5. Proof of Etch & Primer Effectiveness
6. Recommendation for Process Control Test Specimen
7. Tile Processing Status

1a. Photo Examination of 100μ W

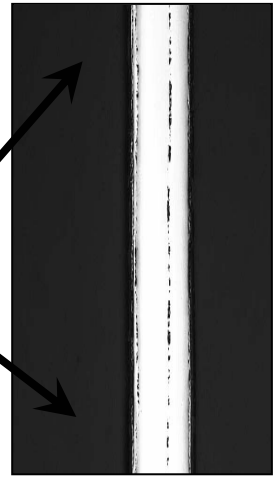


Figure 3. Cross section of tungsten foil showing "stringers" of included material.~ 200X

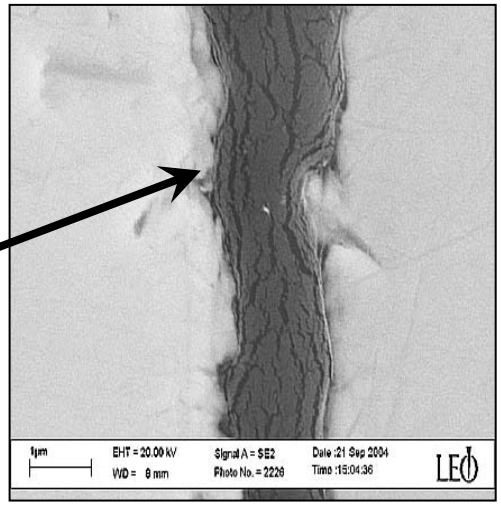


Figure 5. SEM photograph of included material. EDS revealed very high carbon, low tungsten content in included material as opposed to tungsten base material

Photomicrographs Show Carbon-like Foreign Material and Layered Nature of Tile

Conclusions:

a. Etch Must Remove Surface Material Beyond Nearest "Stringer" to Surface
b. Stringer Areas May Weaken Tile

1b. Surface Examination

- GSFC Chemist's Results:
  - Etched Surface is Clean (Minor Hydrocarbons Found)
  - Surface Remains Clean after 120C Temperature Exposure
  - Soak in Acetone does not Extract Contaminants from Tile

Conclusion: Etched Tile Should not Pose a Contamination Problem to Primer Cure

1c. Metallurgical Composition

- Check on Metallurgical Composition is in Progress

2. BR127 Batch and Process Verification

- BR127 Batch Checked Using Standard Lap Shear Specimen

Adherent Material	Adhesive Material	Lap Shear Strength (psi)	
		Test Value	Vendor Data
0.063" 6061 (Standard GSFC Etch and BR-127 Primer)	Loctite EA 9309.3NA	3971*	4200

*EA 9309.3 NA Failed Adhesively to Primer. Primer Remained on Adherents

Conclusions: BR127 Batch & Application Process are Proper

3. BR127 Compatibility with 2216

- W Lap-Shear Specimens Failed 2216 Cohesively w/o Primer Failure

Adherent Material	Adhesive Material	Lap Shear Strength (psi)	
		Test Value	Vendor Data
700-micron W (MIL-HNBK-961B Etch and BR-127 Primer)	Scotchweld 2216 Gray	3764* 3564*	3200

*2216 Cohesive Failure. BR127 Remained on W

Conclusion: BR127 is Compatible with 2216

4. Effective Etch for Tungsten

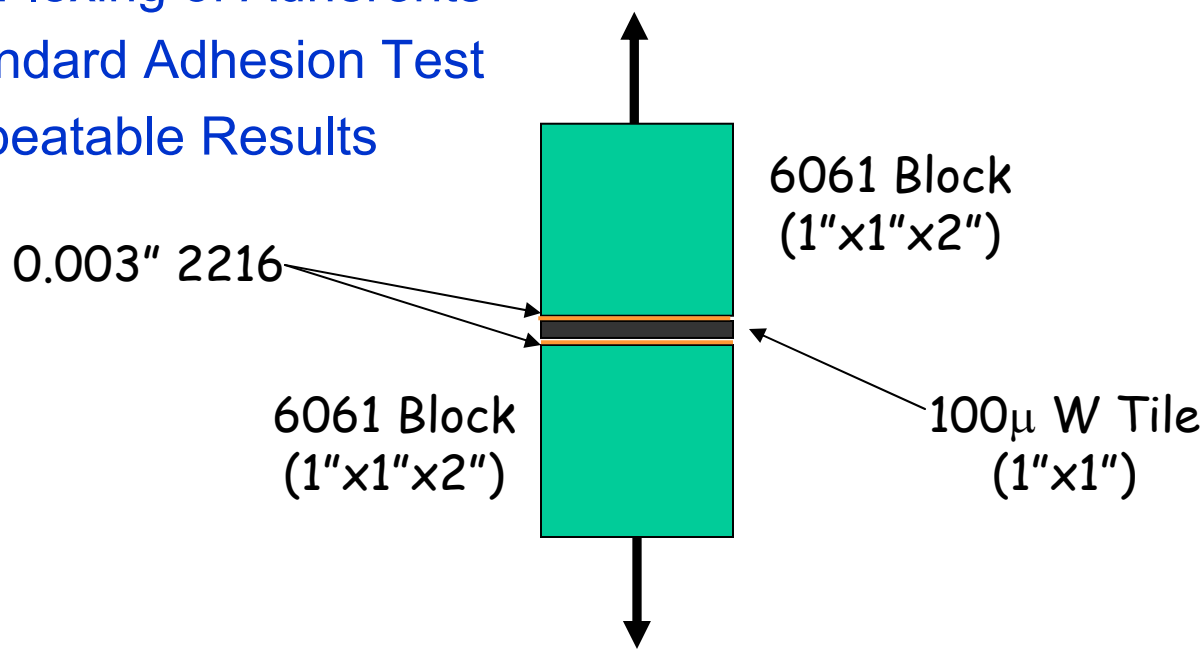
- Etches Investigated
  - a. MIL-HNBK-961B: HF, Nitric, Sulfuric, H_20
  - b. HF
  - c. Ammonium Biflouride

Etch Type	Results
a.	Minimal W removed; More Like Acid Cleaning than Etching
b.	Aggressive Etch; Roughened Etched Surface Suitable for Bonding; Material Removal is Controllable.
c.	Commercial Formulation; Roughened Etched Surface Suitable for Bonding; Material Removal is Controllable (5% to 10% by weight); Best potential for Production Use

Conclusions: Ammonium Biflouride is Most Suitable for Production and Appears to Give a Bondable Surface

5. Proof of Etch & Primer

- Original Test Specimen was T-peel Type
  - Flexing of Adherents is Inherent in Specimen
  - Flexing Loosens Primer Unrealistically Compared to Expected Tray Deformation
- Switched to Flatwise Tension Specimen (Modified ASTM C297)
  - No Flexing of Adherents
  - Standard Adhesion Test
  - Repeatable Results



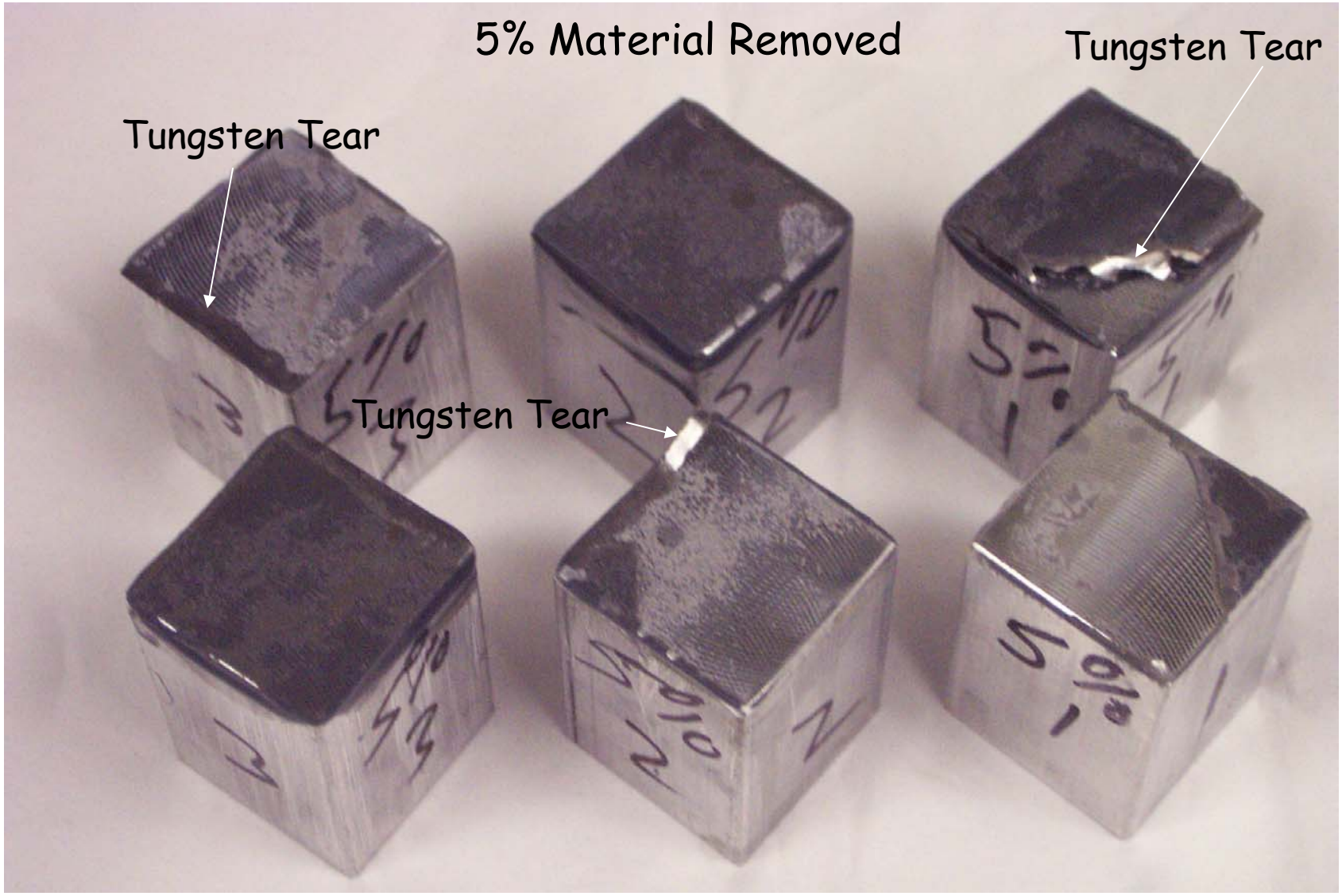
5. Flatwise Tension Results

100-micron W Tiles:
Ammonium Biflouride Etch and BR-127 Primer; 5% Weight Removed by Etch
Production Size Bath

Specimen	Failure Load (lb)	Failure Mode
1	Problem with Test Machine	W Tear over 1/8 of Specimen[1]
2	2345	W Tear on Specimen Edge[1]
3	2451	W Tear; 2216 Cohesive Failure to Block[1]
Average	2398	

[1]BR-127 Remained Attached to 2216

5. Flatwise Tension Specimens: 1,2,3



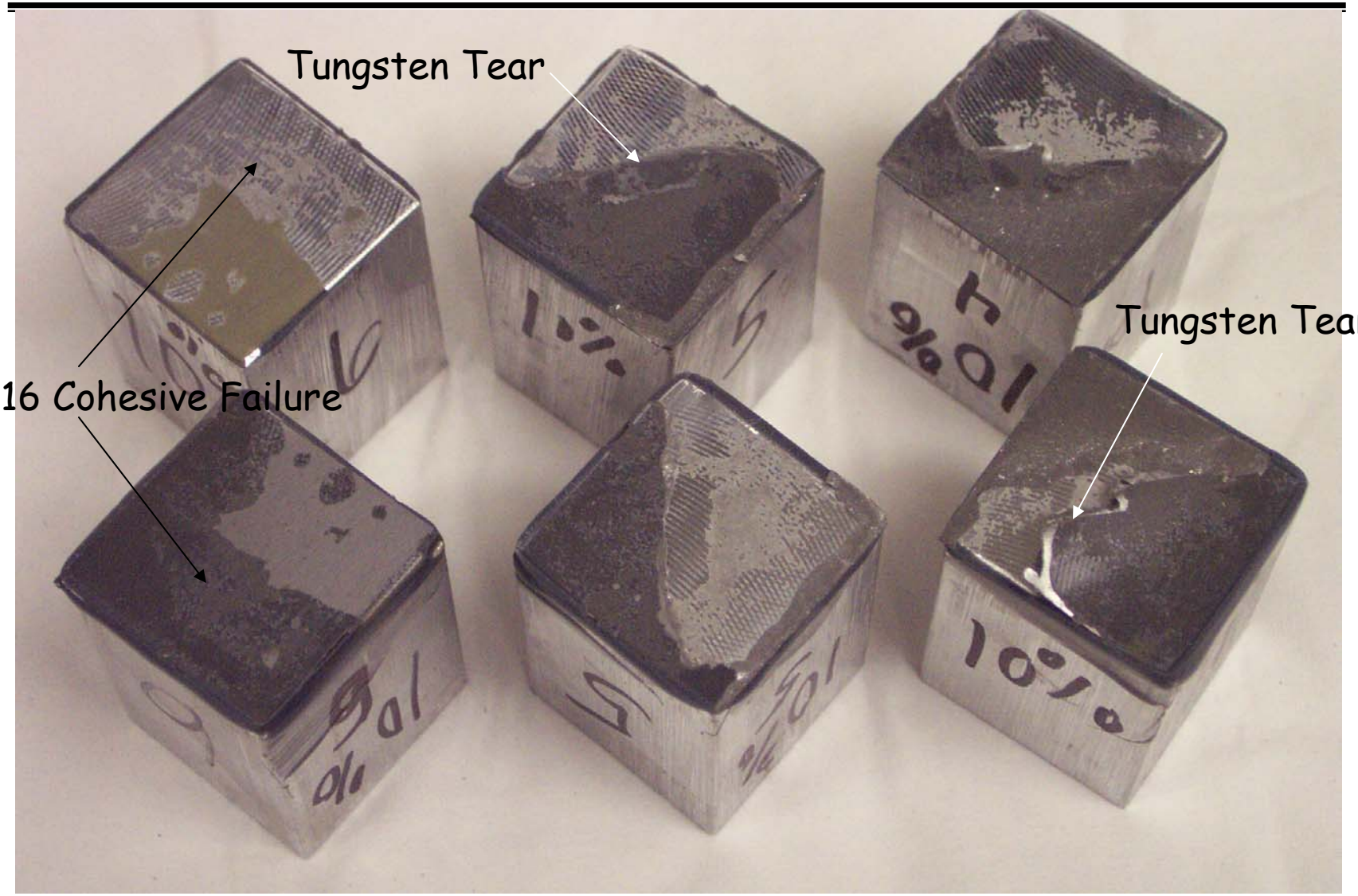
5. Flatwise Tension Results Continued

100-micron w tiles:
Ammonium Biflouride Etch and BR-127 Prime; 10% Weight Removed by Etch
Production Size bath

Specimen	Failure Load (lb)	Failure Mode
4	2460	W Tear over 50% of Specimen[1]
5	2476	W Tear over 50% of Specimen[1]
6	2456	30% Adhesive to Tile; 70% cohesive to Block[1,2]
Average	2464	

[1]BR-127 Remained Attached to 2216
[2]2216 Likely Failed to Block First and Caused 2216 to Fail to Tile

5. Flatwise Tension Specimens: 4,5,6



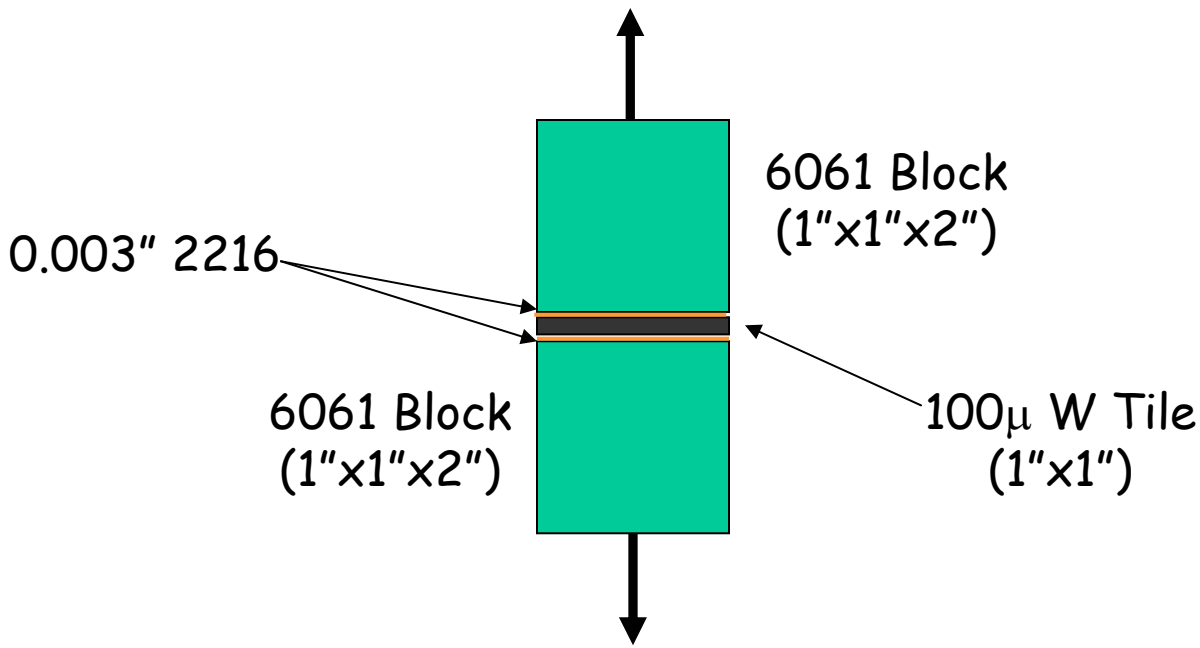
Flatwise Tension Conclusions

Conclusions:

a. Samples with 5% & 10% Material Removed Performed Equally Well
b. Select 5% Material Removal to Minimize Science Impact
c. BR127 Adhesion to Etched W is Very Good
d. BR127 Adhesion Can Exceed W Delamination Strength
e. Ammonium Biflouride Etch and BR127 Should Work for Tile Bonding

6. Process Control Test

- Recommend Flatwise Tension Test for Process Control Test
- Tests Tile and Its Bonding Surface Directly
- Data Indicate 2000 lb as a Reasonable Pass-Fail Value



7. GSFC Tile Processing

- Ammonium Biflouride Etch Process was Scaled Up for 10-Tile Batch
  - 5% Material To Be Removed by Etch
  - Bath Will be Checked Daily to Ensure Proper Material Removal
- GSFC Can Etch & Prime Upwards of 75 Tiles per Day
- Status As of 5 October 2004:
  - 270 100μ Tiles Have Been Etched & Primed
  - Process Control Test Results were Good
- GSFC Can Process over 300 Tiles per Week

Conclusion:

GSFC is Willing & Able to Process (Etch & Prime) GLAST Tiles for Tower Production