

Interoffice

National Radio Astronomy Observatory

New Mexico

October 24, 1990

To: Distribution  
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Subject: Maser Shipping Shock Tests

Attached is a summary of the measured mechanical shock results after shipping either the real or dummy maser. The goal is to gain confidence in the NRAO shipping container and logistic procedures for air freight transport of the VLBA Hydrogen Maser.

## Maser Shipping Shock Tests

Note: All data in G's (x,y,z) peak was recorded on an Impact - O - Graph model M4. The instrument was mounted on the maser/dummy chassis.

Phase I: Usual maser shipment by NRAO passenger van. Real maser returned from Kitt Peak to AOC.

Results: 1G(z) max during loading/unloading.  
<1G(z) during transit.

Phase II: Dummy maser shipment in NRAO crate by flat bed NRAO truck. Local route for two hours.

Results: 1.5G(z) max during loading/unloading.  
<1G(z) during transit.

Phase III: Dummy maser shipment in NRAO crate by EMERY AIR Albuquerque - El Paso - Dayton - Boston and return same route.

Results: 2G(z) truck loading at AOC.  
<1G(z) truck transit to/from Albuquerque.  
9G(z), 4G(y), 5G(x) airfreight loading in Albuquerque.  
2.5G(z) typical airfreight loading/unloading  
<1.0G(z) in flight transit.

The 9G(z) shock was the worst case and it did major damage to the crate structure (photo's available). It's my opinion that a real maser would have been severely damaged under the same condition.

Phase IV: Redesign/rebuild maser crate and repeat dummy air freight shipment. NRAO maser personnel will accompany flight and witness loading and unloading.