Hypervelocity Impact of Composite Overwrapped Pressure Vessel (COPV) and Comparison to a Numerical Model

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Objectives

- Expose COPV to hypervelocity impact (HVI) testing in pressurized and unpressurized condition.
- Assess overall COPV damage incurred by HVI.
- Identify impact conditions likely to result in catastrophic rupture.
- Broaden the conclusions made from experiment by numerical analysis.

Model

- CAD model based on CT scan

Hypervelocity Impact Testing

Testing occurred at NASA White Sands test Facility (WSTF) Remote Hypervelocity Test Laboratory (RHTL) in Las Cruces, New Mexico.

Test Matrix

Material | COPV Liner | Projectile | EOS
---|---|---|---
Aluminum 6061-T6 | Mie-Gruneisen analytic | Spherical 1.52 | Gruneisen, user option
Composite overlap | Mie-Gruneisen, user option | Spherical 1.52 | Gruneisen analytic
Aluminum projectile | Sesame labulated | Spherical 1.52 | Gruneisen, user option

Experimental and Modeling Results

- HITF16163, Pressurized test, Pass
- HITF16169, Pressurized test, Venting failure
- HITF16162, Pressurized test, Rupture failure
- HITF 16212, Unpressurized test, Pass
- HITF 16394, Unpressurized test, Perforation
- HITF 16211, Unpressurized test, Perforation

Conclusions

- Experiments demonstrate COPV has capacity to withstand hypervelocity impact.
- Failure mode appears to be related to impact energy.
- A numerical model was designed to broaden the scope of this effort.
- Pressurizing of COPV in numerical impact simulations will be the next effort.

References

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