

Micro Electro-Mechanical System Safe and Arm Device (MEMS S&A)

Provides end-to-end process for achieving high-volume, low cost, precision manufacture of explosively loaded metal MEMS S&A devices.

OBJECTIVE / SOLUTION

A high aspect ratio (HAR >20:1) micro-fabrication approach and micro-scale firetrain (MSF) loading process will be developed for producing MEMS based Safe and Arm Devices. This enabling technology will be used in precision airbursting munitions for the 25mm XM25 and XM307 systems, as well as 155mm artillery systems. These nontraditional approaches to manufacture will assist the Objective Family of Weapons in meeting affordability goals during production and will enable increased functionality for future artillery fuzing. A LIGA (German acronym for lithography, electroforming and molding) approach has been demonstrated for fabricating precision components. Further cost reductions will be realized by using a hybrid approach to fabricate polymeric and metal alloy components. Adopting MEMS technology for fuzing applications will require a move away from traditional explosive loading techniques (e.g., pelletized cup loading) and a move toward scalable loading techniques.

ACHIEVEMENTS

- Various micro fabrication technologies have been investigated. Ultra-violet LIGA has been demonstrated as an alternative to X-Ray LIGA with similar feature fidelity and smooth HAR sidewall results.
- Die level micro-assembly has been demonstrated using an Onyx platform provided by Air-Vac Engineering Corp. (Phase I).
- Secondary explosive formulation RSI007 has been approved by the Services for use. Alternative explosive formulations have been developed to demonstrate the benefits of "direct write" firetrain loading processes.

BENEFITS

- Lowers S&A unit costs by 50%.
- Smaller S&A device volume will permit either a larger payload or increased fuze functionality (i.e. modes of operation).
- HAR MEMS-based S&A will be used in other fuzing systems.

STATUS

- Domestic sources for HAR MEMS devices in small (military) quantities are currently limited to academia, Department of Energy (DoE) laboratories, and small design/fabrication houses.
- Fabrication of S&A components using X-ray LIGA, UV LIGA, Powder Injection Molding, and Die Cast was accomplished under technical direction of the ARDEC Fuze Division.
- MEMS S&A designs are Government owned.
- Current LIGA fabrication and process development is being performed by Axsun Technologies, Livermore, CA.
- Phase II—MEMS S&A level automated micro assembly demonstration will begin in FY07.

WEAPON SYSTEMS / SECONDARY ITEMS IMPACTED

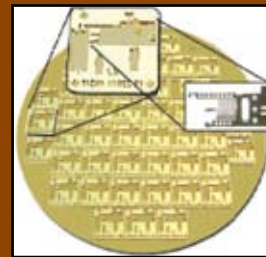
- Precision Guided Kit—155 mm Artillery fuzing
- XM307 Advanced Crew Served Weapon (ACSW)—Secondary for Future Combat Systems
- XM25 Integrated Airburst Weapon System for Future Modular Force

POTENTIAL COST AVOIDANCE

- \$40,500,000 for one program (XM25) with a 12.2 million unit production run.



XM25 Integrated Airburst Weapon System



L5 Wafer



Random Parts



Auto-assembly Unit



Kitted Parts