

# M234 / M235 / M236 SELF-DESTRUCT FUZES

**THE  
48<sup>TH</sup> ANNUAL FUZE CONFERENCE**



**communications**

**KDI Precision Products, Inc.**



**APRIL 2004**



# OUTLINE

- Self-Destruct (SD) Fuze Objectives
- SD Fuze Requirements
- KDI SD Fuze Design and Operation
- Safety Test and Army Certification
- Type Classification Test Results
- High Rate Fuze Equipment Status
- High Rate Battery Equipment Status
- Product Improvements
- SD Fuze Schedule
- Summary

# SD Fuze Objective

- Reduce the Number of Hazardous DPICM Grenade Dud Submunitions on the Battlefield

## Advantages:

- ⇒ Enables Maneuverability
- ⇒ Reduces Clean-up Efforts
- ⇒ Addresses Humanitarian Issues

# U.S. Army SD Fuze Requirements

- Artillery (M234)
  - 97% Primary Mode (Ground Impact)
  - 99.8% Tactical Mode (Includes SD Function)
- ER-MLRS (M235)
  - Less Than 1% Hazardous Duds
  - Less Than 5% UXO (Fly-Off Requirement)



# KDI's SD Fuze Key Design Feature

- Two Autonomous Fuzing Systems
  - PD Primary
  - Electronic Time SD
- Mechanical Arming of Primary Fuze Not Required to Arm SD Fuze
- Only SD Fuze Type Classified for U. S. Army and U. S. Navy Utilization

➡ 105 MM

➡ ERGM

➡ 5" 54

➡ XM982

➡ ER-MLRS

➡ GMLRS

# Background Fuze Operation

- SD Fuze Replacement for M223 Designed to Reduce the Number of Submunition Duds
- Minor Differences Between Artillery and MLRS Fuze
- Primary Mode of Operation
- Self-Destruct (Secondary) Mode of Operation

# Self-Destruct Fuze Operation



1



2



# Safety Testing

- MIL-STD-331-B Testing 
  - Detonator Out-of-Line Testing 
  - New Shunt Design / Testing 
  - E3 Testing 
  - Power On Reset 
  - Grenade Stack Test 
  - Propagation Test 
- EOD Issues 
    - Ribbon Color
    - Battery Bleed Down
  - Energetics Compatibility 
  - Approved Fuze Fault Tree 
  - MIL-1316 Checklist 

# Army Certifications

- M234 Type Classified 24 Mar 98
- M235 Type Classification Paperwork in Process
- M236 Passed U.S. Army Safety Certification Firings
- Approved Fuze Fault Tree
- Approved MIL-1316 Checklist
  - Waiver For Stored Energy Granted
- M234/235 Granted AFSRB Final Safety Certification
- Fuze Line Qualification Planned For 4th Quarter 2003
- Fuze First Article Planned For 4th Quarter 2003

# M234 SD Fuze Artillery Test Result

<i><b>TEST</b></i>	<i><b>CONFIGURATION</b></i>			
	<i><b>Primary Only</b></i>		<i><b>Tactical</b></i>	
Grenade Functioning	(30/2585)	98.84%	(3/1439)	99.79%
Air Drop	(21/1081)	98.0%	(0/156)	100%
Initial Safety & Sequential Env.	(193/8125)	97.4%	2/1350)	99.9%
DT&E Total		97.6%		99.83%



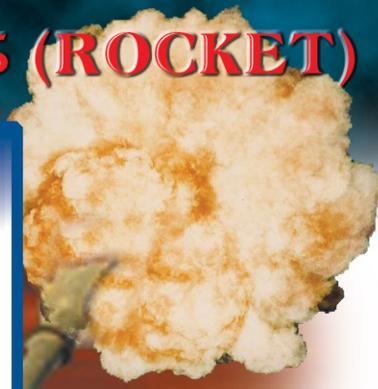
# M235 SD Fuze MLRS Test Results

## DVT TESTING

<i>Temperature / Range</i>	<i>Reliability</i>	
Hot @ 48Km	(5/461)	98.9%
Ambient @ 25Km	(2/1014)	99.8%
Cold @ 16Km	(9/1012)	99.1%
Weighted Mission Total:		99.52%

FOR VALIDATION, CALL:  
AMSTA-AR-FSA-P  
MR. Leon Springer  
(973) 724-2208

# SELF-DESTRUCT FUZES M234 (ARTILLERY) / M235 (ROCKET)



SAFETY SPIRAL FLAG    SAFETY SPIRAL    RIVET

ARMING SCREW    SAFETY CLIP    HOUSING    WEIGHT

PRINTED WIRING BOARD  
IC, TIMER CHIP  
CAPACITOR  
CAPACITOR

SAFETY SPIRAL ASSEMBLY    BATTERY COVER    SAFETY SHUNT    SAFETY PIN  
SLIDE SUBASSEMBLY    RESERVE BATTERY

HOUSING ASSEMBLY

SLIDE ASSEMBLY

UNLOADED FUZE ASSEMBLY

LOADED FUZE ASSEMBLY

TAPERED BALL SLEEVE  
WIRING BOARD ASSEMBLY

PIVOT    ACTIVATION SPRING    SPRING AXLE  
SAFETY BALL    SAFETY PIN    LEVER

ARMING SPRING    SHOCK POST    COVER

EED COVER    EED COVER  
M55 STAB DETONATOR



# Self-Destruct Fuze Assembly Line

## PALOMAR PRODUCTS CHIP ON BOARD



Base Machine 1



Shunt Assembly Machine



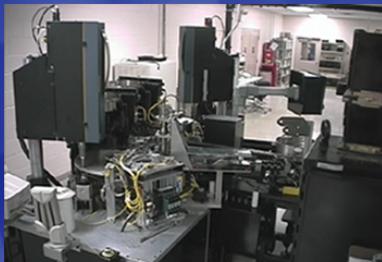
QSI Slide Sub-Assembly Molding Machine



Base Machine 3



Base Machine 2



# Palomar Products Chip on Board Printed Wiring Board (PWB) Assembly (Machine) Status

## PALOMAR PRODUCTS CHIP ON BOARD



PRINTED WIRING BOARD



IC, TIMER CHIP



CAPACITOR

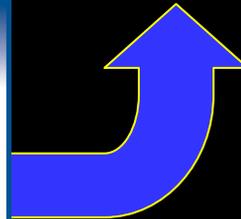


CAPACITOR

TAPERED BALL SLEEVE



WIRING BOARD ASSEMBLY



# Printed Wiring Board (PWB) Assembly (Machine) Status

- **Palomar Line**
  - Palomar Line Has Been Accepted a Rate
  - Palomar Line Is Production Ready

# Slide Subassembly Machine



SLIDE ASSEMBLY

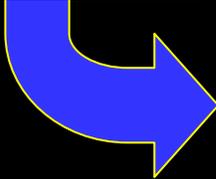
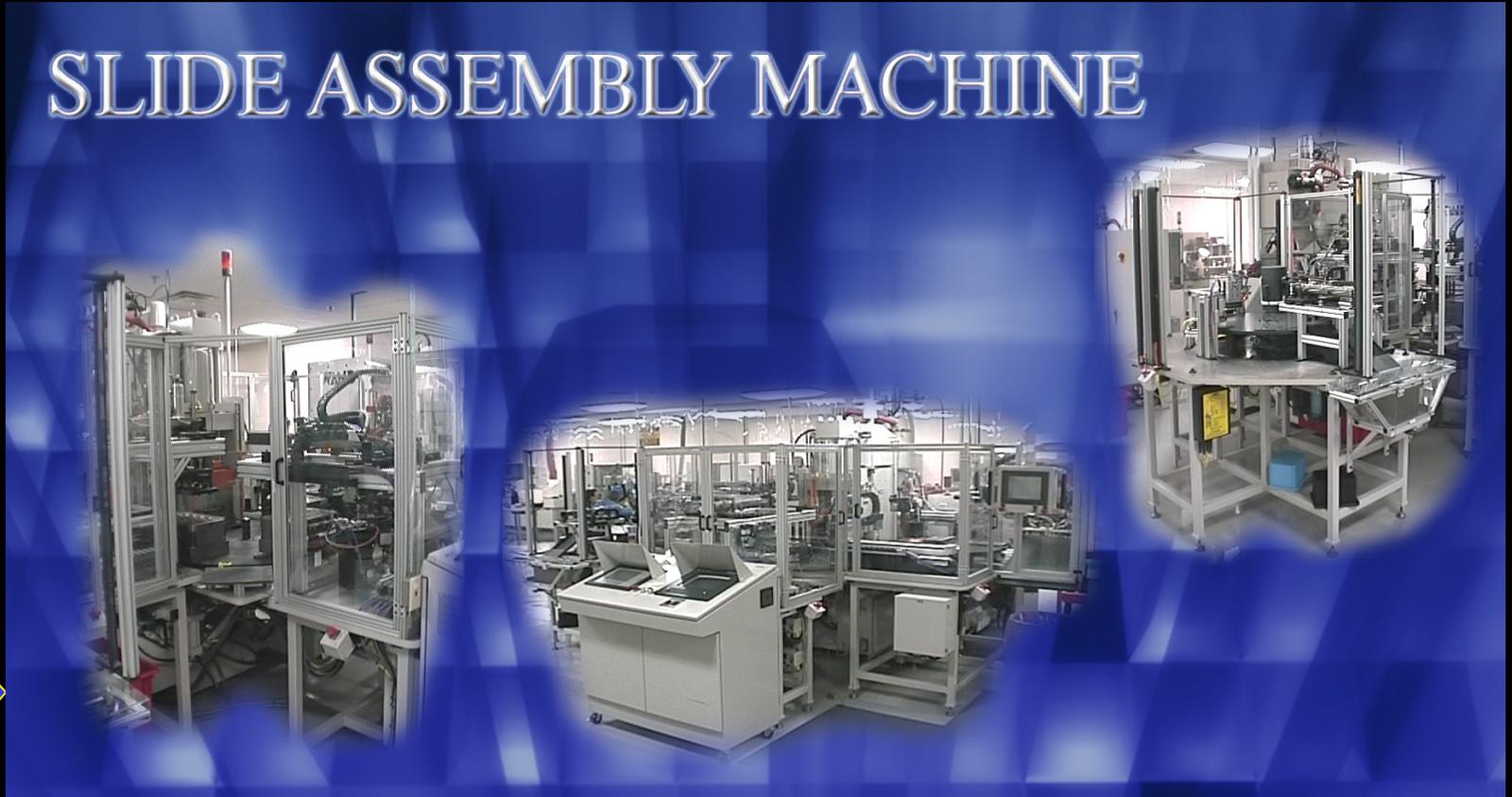


TAPERED BALL SLEEVE



WIRING BOARD ASSEMBLY

## SLIDE ASSEMBLY MACHINE

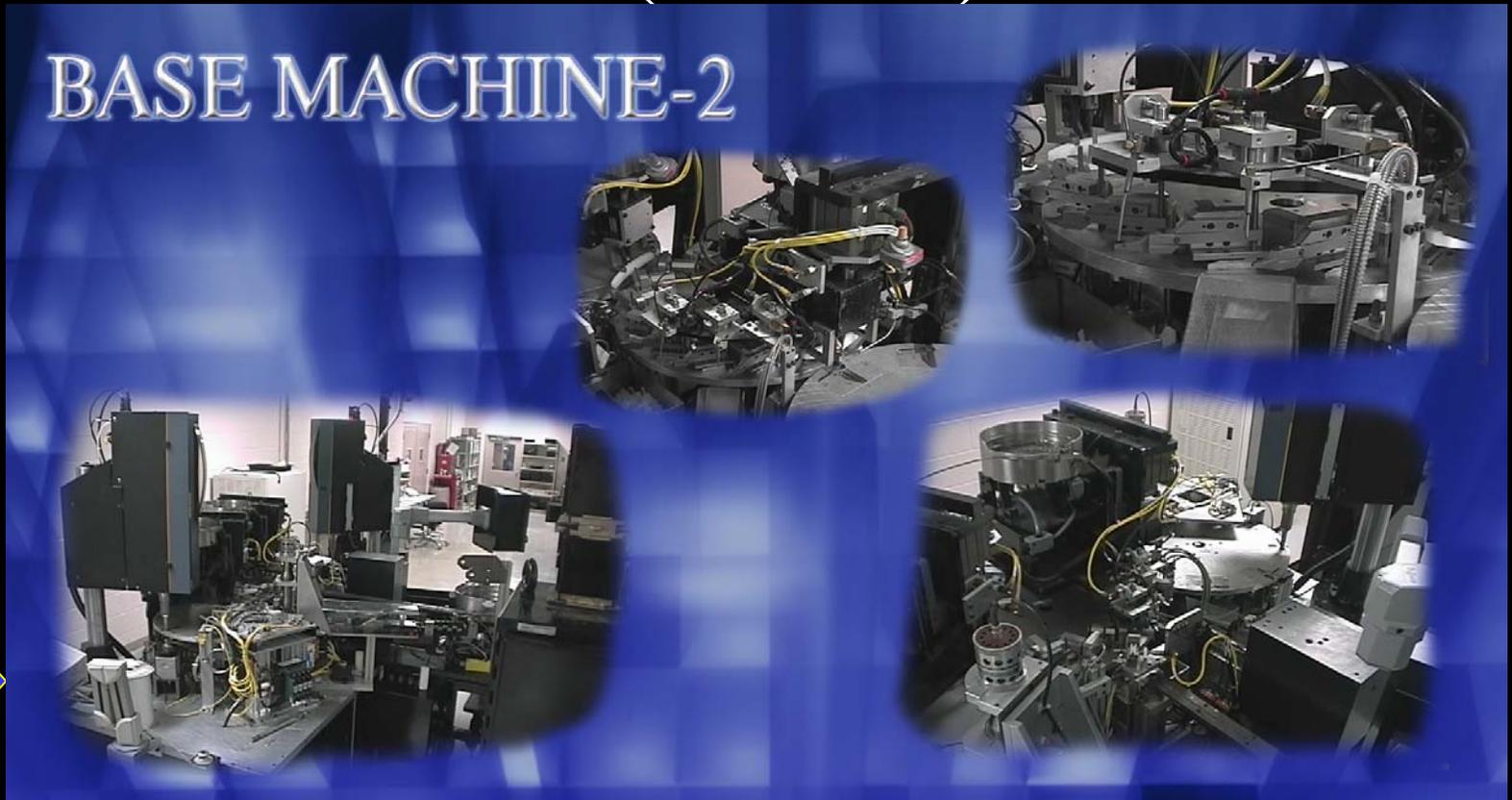
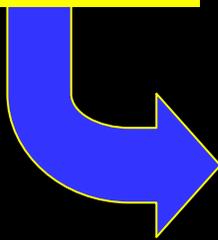


# Slide Subassembly Machine Status

- QSI Machine
  - QSI Line Has Been Accepted at 100% rate
  - QSI Line Is Production Ready

# Spiral Safety Flag Assembly Machine (BM-2)

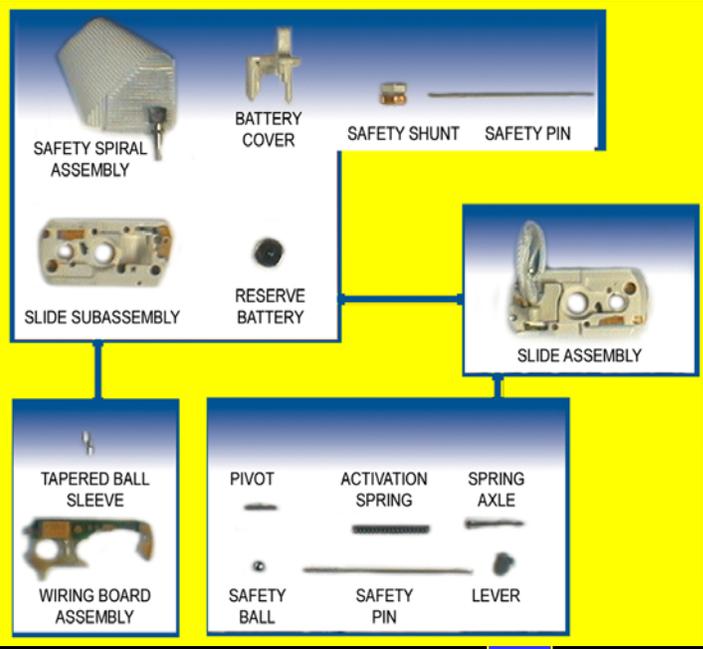
BASE MACHINE-2



# Spiral Safety Flag Assembly Machine (BM-2) Status

- **Base Machine #2 (BM-2) Tilted Spiral Flag Assembly**
  - BM-2 Has Been Accepted at 100% Rate
  - BM-2 Is Production Ready

# Slide Assembly Machine (BM-1)



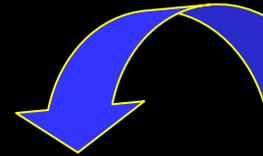
## BASE MACHINE-1



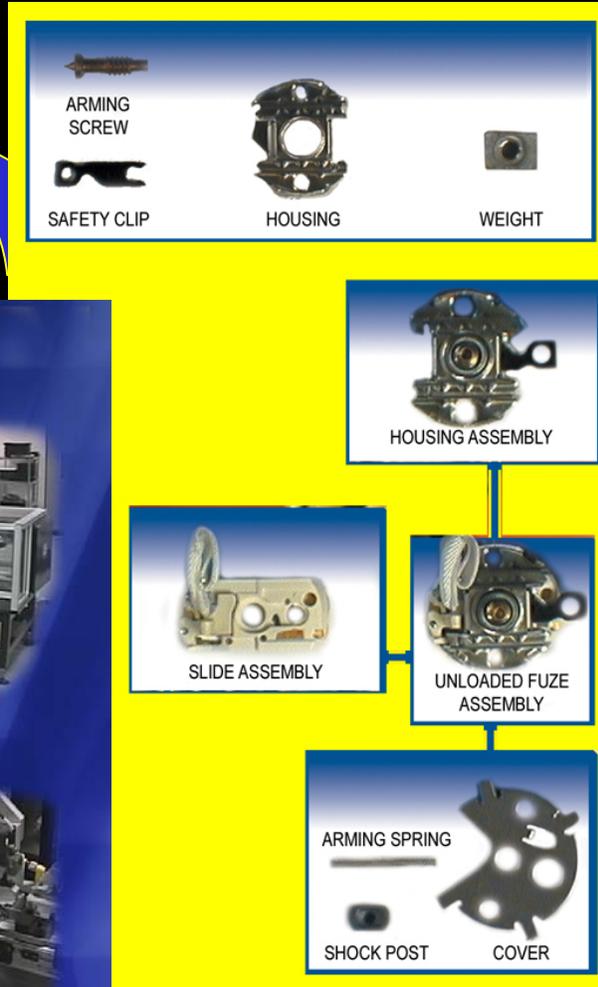
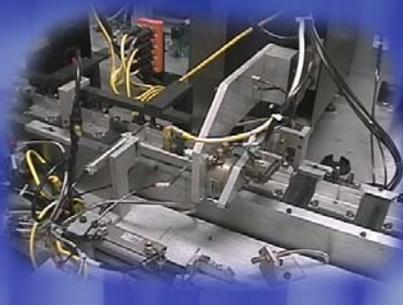
# Slide Assembly Machine (BM-1) Status

- **Base Machine #1 (BM-1) - Slide Assembly**
  - BM-1 Has Been Proven Out at Rate
  - BM-1 Meets Product Quality Requirements
  - Final Acceptance Is Scheduled for First Quarter 2004
  - Final 100% Acceptance Is Prior to 200,000 Production Units

# Unloaded Fuze Assembly Machine (BM-3)



BASE MACHINE-3

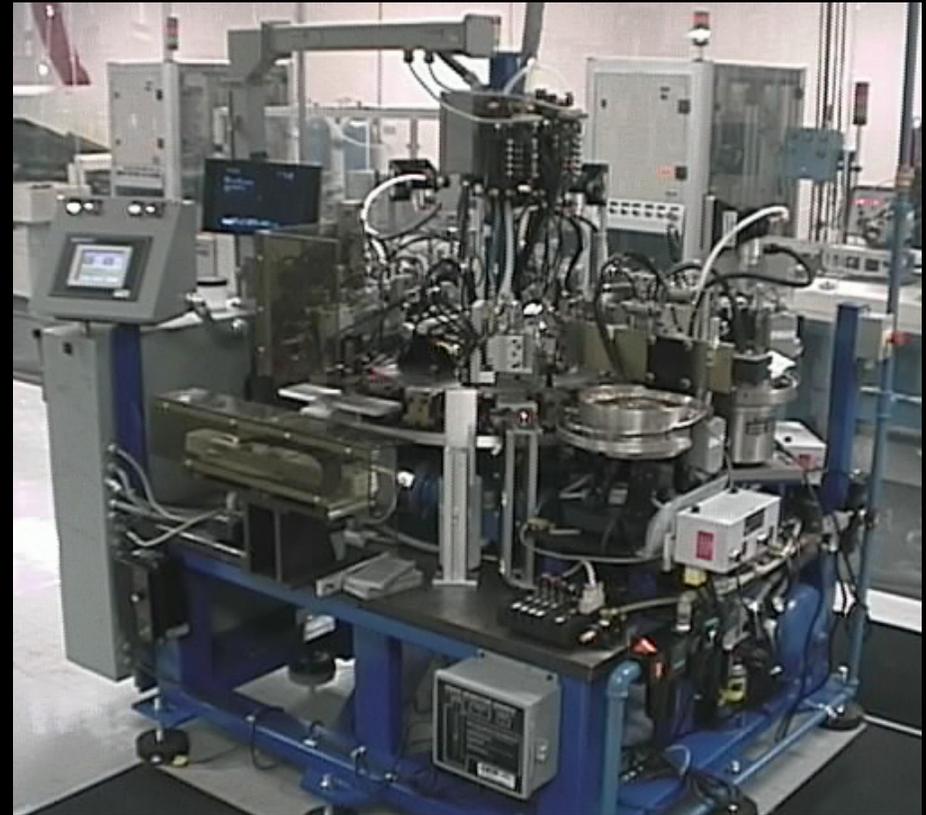


## Unloaded SD Fuze Assembly Equipment Status (BM-3)

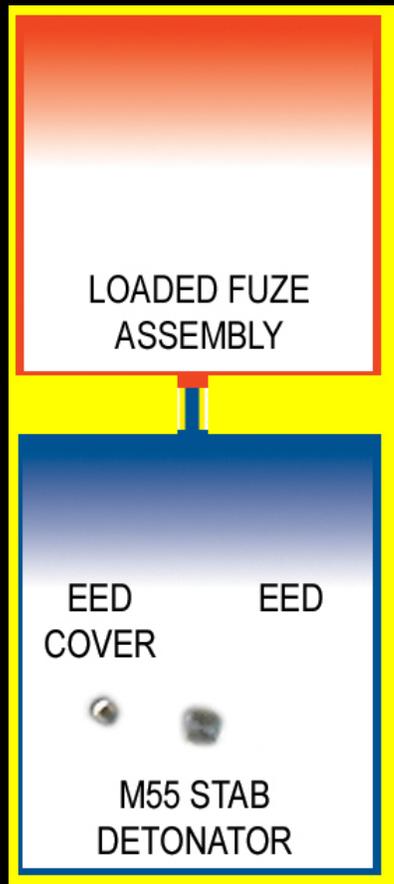
- **Base Machine #3 (BM-3) - Fuze Assembly**
  - BM-3 Has Been Accepted at 96% Rate
  - BM-3 Final Acceptance Will Be First Quarter 2004
  - BM-3 Is Production Ready

# Shunt Assembly Machine Status

- Proven Out at Datum  
At 100% Rate
- Shunt Machine is  
Production Ready



# SDF Loading Equipment

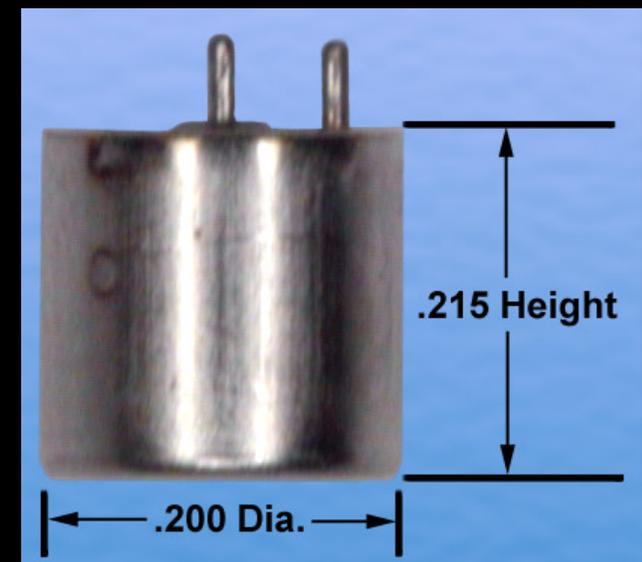


# SDF Loading Equipment Status

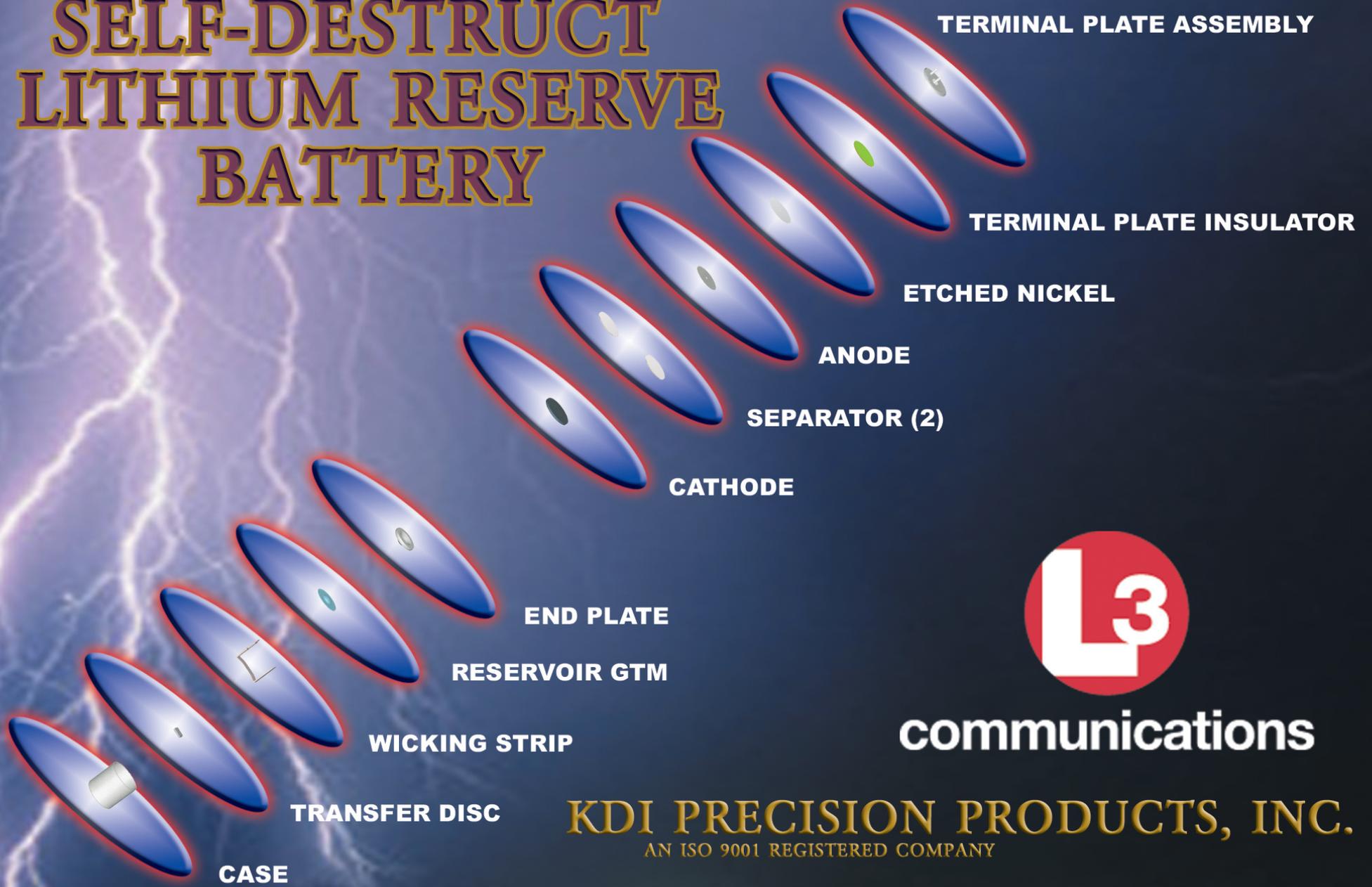
- SDF Loading Equipment Has Been Proven Out at 75% Rate
- Final Acceptance Is Scheduled for First Quarter 2004
- Equipment Production Ready

# Lithium Reserve Battery Line

- Battery Design Was Completed by ATK and Qualified
- High Rate Equipment Was Not Acceptable
- New Equipment Has Been Purchased From RD Systems
- Contract Awarded To RD Systems in May 2001
- Battery Line Was Installed At KDI in August 2003 (In Debug)
- KDI Has Retained THALES USFA, Netherlands to Consult on All Battery Issues



# SELF-DESTRUCT LITHIUM RESERVE BATTERY

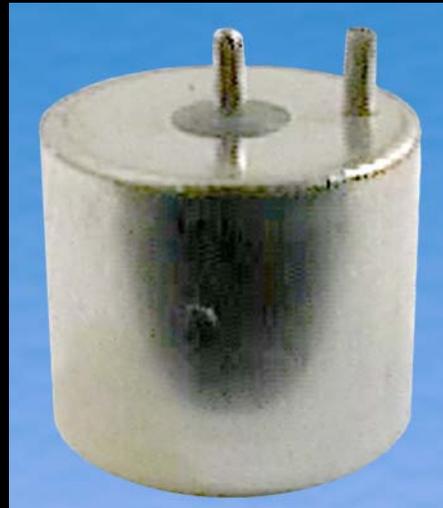


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# SDF Battery Animation



# Lithium Reserve Battery

- Contract Structure
- Unique Battery HRE Contract
  - Preliminary Design Review (PDR)
    - Ampule Fill & Seal (Process)
    - Lithium Lamination Process
  - Brainstorming Review
  - Critical Design Review
    - Each Machine/Process
  - Release Component Fabrication
  - Proveout at RD Systems
  - Modified First Article
  - Final Acceptance KDI

# Lithium Reserve Battery Automation Line



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SELF DESTRUCT BATTERY MANUFACTURING PROCESS FLOW



### Legend

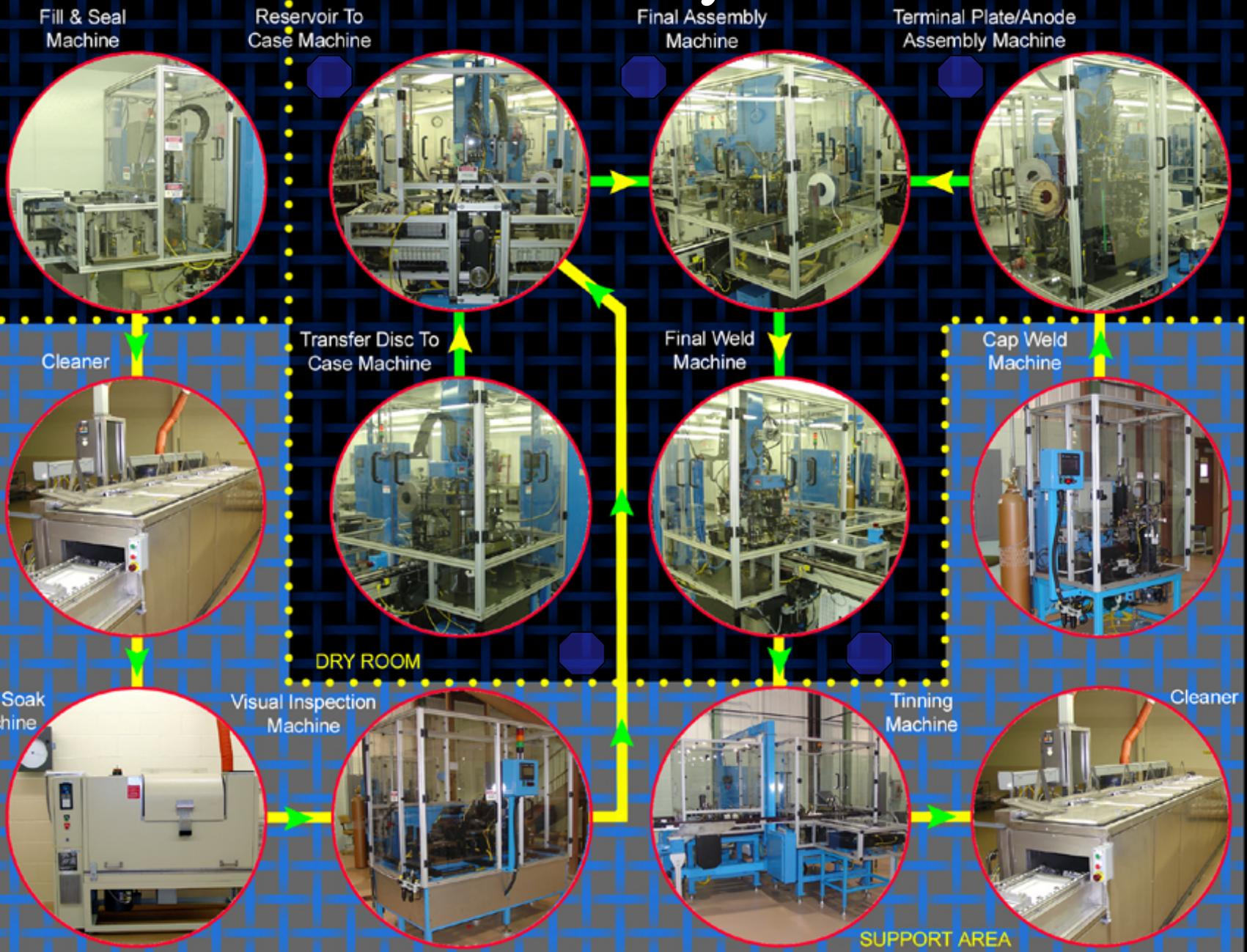
Direction of Flow



Dryroom

Manual Feed

Conveyor Feed



# SDF (PIP)

- Two (2) Integrated Product Improvements
  - Packaged EED
  - Packaged IC

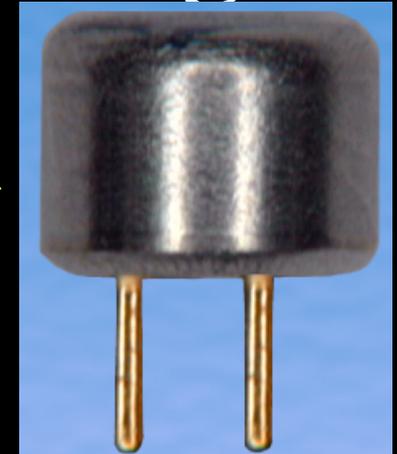
# SDF (PIP) Current EED Design

- The Current EED Has Three (3) Explosive Elements That Are Loaded Into the Fuze and Consolidated
- After Consolidation, a Cover and Encapsulate Are Placed on Top of the Explosive Elements

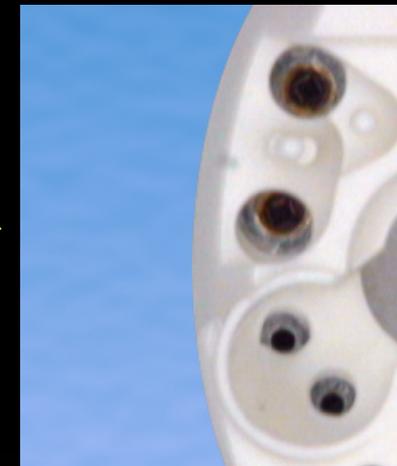


# SDF (PIP) Packaged EED Design

- The Packaged EED Is a Two (2) Pin Hermetic Sealed Detonator



- The Packaged EED's are Inserted Into
- Receptacles That Are Surface Mounted on the PWB

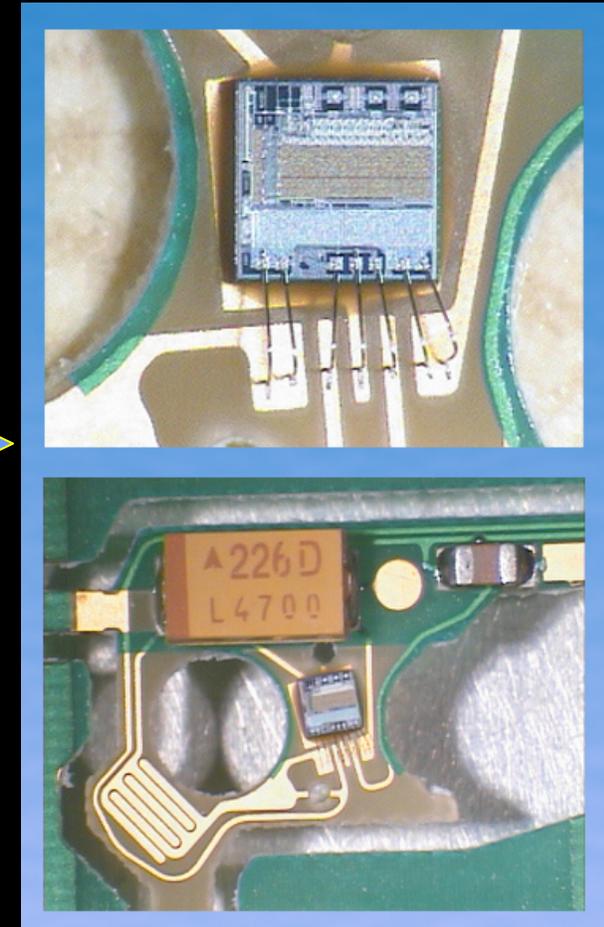


# SDF (PIP) Packaged EED Advantages

- Reduces the Printed Wiring Board Complexity
- Assembly Process Is Less Complicated
- Lot Acceptance Can Be Performed at the Component Level
- Explosive Output Is 1.5 Times Greater
- Requires Less Energy to Fire

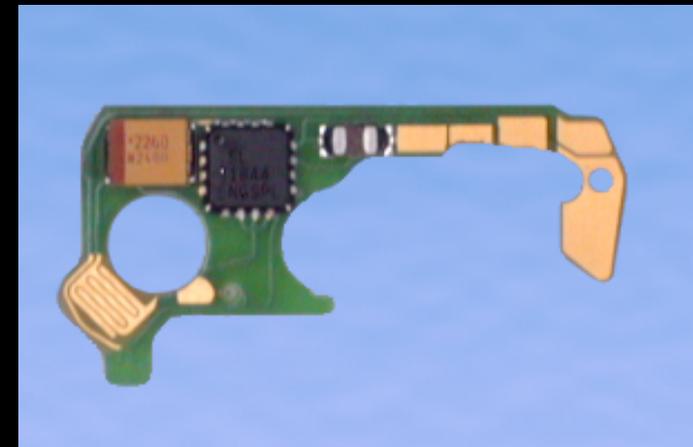
# SDF (PIP) Current IC Assembly Design

- The Current PWB Employs  Chip-on-Board (COB) Technology



# SDF (PIP) Packaged IC Assembly Design

- The Packaged IC Design Contains the Same Die Which Is Placed in an Micro Lead frame Package



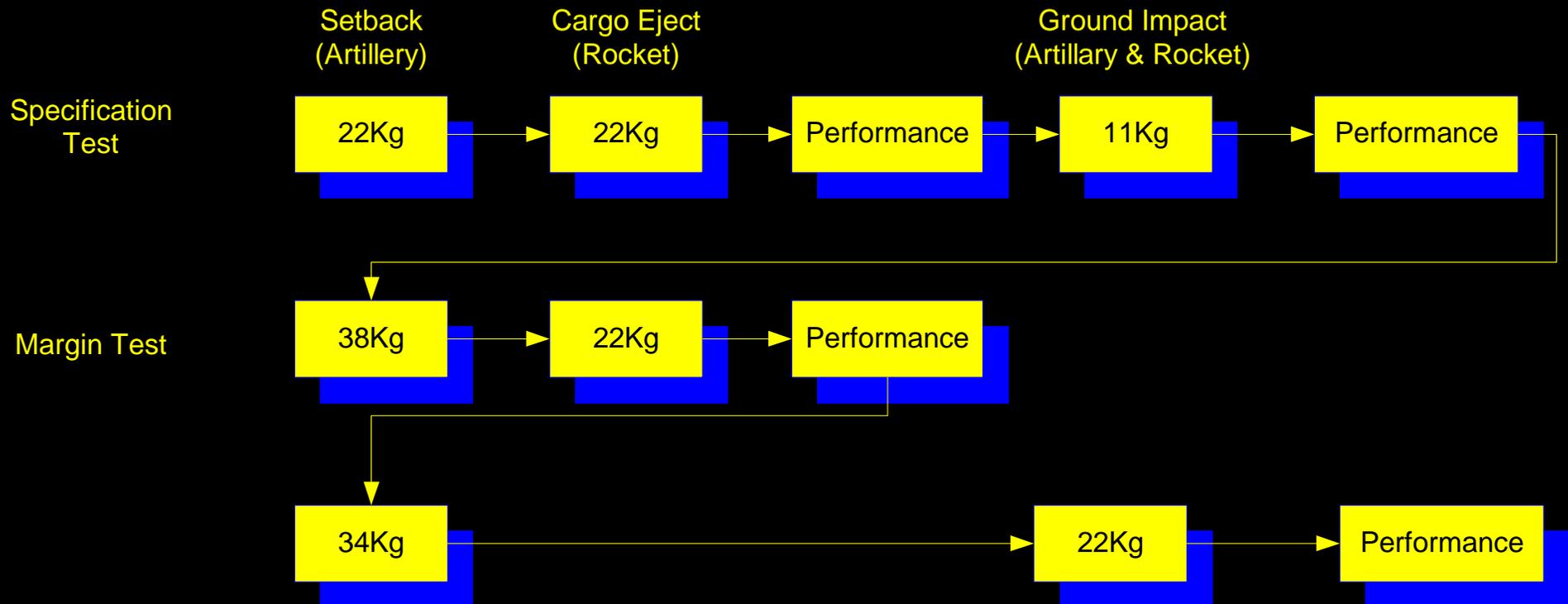
# SDF (PIP) Packaged IC Advantages

- Assembly Is Greatly Simplified
- Increase in Throughput
- Increase in Yield
- Test at the Component Level
- Design Is More Robust

# SDF (PIP) Test History

- Packaged EED  Qualified to MIL-I-23659 by USN
- Packaged IC  Structural Test to Confirm Robustness
- Flight Test  Worst Case Environments

# SDF (PIP) Packaged IC Structural Performance



- Both Specification and Margin Test Were Performed on the Same Hardware Set
- Test Performed Following 160 Thermal Shock Cycles (Specification Requires Eight)

# SDF Warm Line & GMLRS Fly Off Tests (PIP) Flight Test

- M915 Artillery  FVT: Performance 99.88% Flight: March 03
- M915 Artillery (Hot)  FVT: Performance 99.98% Flight: October 03
- M915 Artillery (Cold)  FVT: Performance 99.99% Flight: October 03
- GMLRS @ 16 Km  FVT: Performance 100% Flight: March 03
- GMLRS @ 20 Km  FVT: Performance 100% Flight: August 03
- GMLRS @ 65 Km (Hot)  FVT: Performance 100% Flight: December 03
- GMLRS @ 65 Km (Cold)  FVT: Performance 100% Flight: December 03
- GMLRS @ 19.5 Km (Cold)  FVT: Performance 97% Flight: January 04

**GMLRS Mission Reliability 97% UXO's & 99.6% Hazardous Duds**

# SDF Integrated Schedule

	2003					2004												2005			
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	
<b>Battery HRE Program</b>																					
Acceptance @ KDI	▼																				
First Article																					
Operational Sequence								▼													
T&H Testing								▼													
Battery Production																					
<b>M234 Fuze First Article</b>																					
Contract Release 06/2003																					
First Article Assembly									▼												
Complete Testing (KDI)									▼												
Complete Ballistic Testing										▼											
M234 Fuze Production																					

