Engineered Material Arresting Systems
**Concept:** The Runway Safety Area (RSA) offers an additional level of safety to the airport in the event that an airplane undershoots, or overruns the end of the runway. RSA’s are designed to reduce the risk of damage to airplanes and passengers as well as provide greater accessibility for firefighting and rescue equipment during such incidents.
On February 28, 1984, a Scandinavian Airline System DC-10-30 aircraft overran after landing on runway 4R at John F. Kennedy (JFK) International Airport and plunged into Thurston Basin.

National Transportation Safety Board (NTSB) accident report DCA84AA018 indicated that the DC-10 departed the end of the runway at about 75 knots and entered Thurston Basin 600 feet later still moving at about 38 knots.
In consideration of the potential for catastrophic overrun accidents, the NTSB issued the following Safety Recommendation A-84-37 to the FAA:

“Initiate research and development activities to establish the feasibility of soft ground aircraft arresting systems and promulgate a design standard, if the systems are found to be practical.”
FAA Airport Technology Research

• Development of a mathematical model to represent the tire/material interface

• Prediction of stopping distance within the arrestor bed

• Verification of the mathematical model by field testing

• Demonstration full scale arrest of a Boeing 727 airplane from a speed of 55 knots.
Engineered Systems Arresting Company (ESCO)  
[Now…Division of Zodiac Aerospace Corporation]  
&  
The Port Authority of New York & New Jersey
Research and Development

- Materials research and testing
- Several small and medium scale material tests
- Software created to determine aircraft response to soft ground materials
- Mathematical model and predicted stopping distance
- Full-scale aircraft arrest of FAA test aircraft
- Aircraft Rescue & Firefighting (ARFF) vehicle mobility tests
- Material fire tests
- Affects on navigation aides
- Moisture protection considerations
- Cold weather testing
- Prototype arrestor bed at JFK
- Jet blast resistance coatings
Math Model Validation
EMAS
October 2, 2013
Research Results

- Satisfied NTSB Recommendations
  - Feasibility of using a soft ground material to arrest aircraft
  - Promulgating a standard

FAA AC 150/5220-22A
FAA Order 5200.9
**Concept:** An EMAS is designed to stop an overrunning aircraft by exerting predictable deceleration forces on its landing gear as the EMAS material crushes. It must be designed to minimize the potential for structural damage to aircraft, since such damage could result in injuries to passengers and/or affect the predictability of deceleration forces.

Engineered Materials means high energy absorbing materials of selected strength, which will reliably and predictably crush under the weight of an aircraft.
ESCO’s EMAS product is currently installed at 72 runway ends at 47 United States airports.
## 100% Aircraft Arrestment Success

<table>
<thead>
<tr>
<th>Date</th>
<th>Crew and Passengers</th>
<th>Incident</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 1999</td>
<td>30</td>
<td>A Saab 340 commuter aircraft overran the runway at JFK</td>
</tr>
<tr>
<td>May 2003</td>
<td>3</td>
<td>A Gemini Cargo MD-11 overran the runway at JFK</td>
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<tr>
<td>January 2005</td>
<td>3</td>
<td>A Boeing 747 overran the runway at JFK</td>
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<tr>
<td>July 2006</td>
<td>5</td>
<td>A Mystere Falcon 900 overran the runway at Greenville Downtown Airport in South Carolina</td>
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<tr>
<td>July 2008</td>
<td>145</td>
<td>An Airbus A320 overran the runway at ORD</td>
</tr>
<tr>
<td>January 2010</td>
<td>34</td>
<td>A Bombardier CRJ-200 regional jet overran the runway at Yeager Airport in Charleston, WVA</td>
</tr>
<tr>
<td>October 2010</td>
<td>10</td>
<td>A G-4 Gulfstream overran the runway at Teterboro Airport in Teterboro, NJ</td>
</tr>
<tr>
<td>November 2011</td>
<td>5</td>
<td>A Cessna Citation II overran the runway at Key West International Airport in Key West, FL</td>
</tr>
</tbody>
</table>
JFK – 1999
Saab 340 Arrested at the end of Runway 4R after overrun.
JFK – May 30, 2003
Cargo MD-11 Arrested at the end of Runway 4R after overrun.
JFK – January 22, 2005
Cargo B-747 Arrested at the end of Runway 4R after overrunning during landing in snow storm
Charles Yeager Airport, WV
Completed installation
As applied
CRW – January 19, 2010
PSA Airlines CRJ-200 arrested at the end of runway at Yeager Airport, Charleston, WV
A Cessna Citation II overran the runway at Key West International Airport in Key West, FL.

There were 5 passengers/crew on board. No injuries.
R&D Current Status

• FAA maintains open CRDA’s with two EMAS manufacturers
  – ESCO/Zodiac Aerospace
  – Norsk Glasgjenvinning (NGG)

• ESCO
  – continues to pursue product enhancement through improved protective materials
  – several new FAA/ESCO R&D projects

• NGG
  – NGG is seeking operational deployments in Norway and pursuing North American options
Seam Seal Damage - Wildlife

ESCO/Zodiac continually conducts research to identify materials and methods to improve their product.
Wildlife Monitoring
Testing Seam Seal

- Flame Testing
- Accelerated weathering
- Outdoor weathering
- Mechanical properties
  - Tensile
  - Tear
  - Puncture
  - Extreme Temperature
- Chemical Resistance
- Static Testing
- Adhesion
Norsk Glasgjenvinning (NGG) - Glasopor

EMAS
October 2, 2013
Typical Layout

Figure 2. Glasopor EMAS Typical Layout and Dimensions

Figure 4. Typical Glasopor Fragments (2)
Super storm sandy
emas damage
EMAS Field Inspections of Storm Affected EMAS
Scrim Inspection - Borescope
Inspection – Moisture Content
Inspection – Field Strength Test
Storm Affected EMAS

• Results from inspections were shared with each airport

• Recommendations were made for either continued inspection, replacement of damaged blocks, or entire EMAS bed replacement

• Potential FEMA aide for repairs or replacement
Future EMAS R&D Work

• Improve testing capabilities of
  – Field Strength Tool (FST)
  – Moisture Content

• Determine field performance and longevity of EMAS systems at airports
  – Help airports plan for replacement

• Testing of new snow removal device from EMAS
FAA Information on EMAS

- U.S. Department of Transportation Federal Aviation Administration– ORDER 5200.9
- Advisory Circular 150/5220-22A - Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns
  - Download R&D Technical Reports

Questions?

<table>
<thead>
<tr>
<th>FAA Contacts</th>
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<tbody>
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