Runway Excursion Mitigation and EMAS
Runway Excursions: Overruns – A Big Problem

- 40 per year (typically overruns for jet aircraft) for the past 16 years
- 34% of all turbojet aircraft accidents
- 24% of all turboprop aircraft accidents
- Over 50% of commercial aviation fatalities
- Excursions account for 83% of all fatal runway safety accidents

Source: Flight Safety Foundation

Kingston, Jamaica - Dec 2009

Brussels, Belgium – May 2008
Runway End Safety Areas (RESA)

- Provides a safety margin for aircraft that overshoot the runway surface
- Dimensions dictated by International Civil Aviation Organization (ICAO) and State Civil Aviation Authorities

- ICAO Required 60m + 90 m
- ICAO Recommended 60m + 240 m
- FAA Required 1000 feet (305 meter)
- FAA Recommended 1000 feet
- FAA Recommended 1000 feet undershoot protection w/ 70 Knot EMAS for overrun

EMAS in lieu of RESA allowed with Annex 14 Update
EMASMAX® - An Alternative to RESA
What is EMASMAX®?

- Bed of cellular cement blocks
- Placed at the end of a runway to decelerate an overrunning aircraft
- Tire/material interface provides resistive loads to decelerate the aircraft
- Reliably and predictably crushes under the weight of an aircraft
- The system is FAA-certified
- FAA-Approved computer model is used to determine final arrestor bed configuration
EMAS Design Criteria

- 70 Knots or better performance for all critical aircraft
  - Critical aircraft have more than 500 operations per year on runway

- Performance calculation
  - Aircraft braking and no reverse thrust from runway exit to entry of EMAS
  - No aircraft braking or reverse thrust once aircraft enters EMAS
Typical EMASMAX® Installation

Lead-In Ramp & Debris Deflector

Side & Rear Steps

Boston Logan Departure End of 15R
FAA Certification Test

Boeing 727 at 55 Knots
FAA Testing

- Jet Blast Resistance
- Crash and Rescue Vehicle
- Hot/Cold Temperatures
- Fire Resistance
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75 Systems Installed
Key West (EYW) International Airport Arrestment

3 Nov 2011: Cessna Citation 550 private jet with 5 passengers & crew

No injuries
Runway reopened within 2 hours

Photos Courtesy of Key West Int’l Airport

ZODIAC AEROSAFETY / ARRESTING SYSTEMS / ESCO
Teterboro Arrestment – October 2010

Teterboro, NJ Airport
Runway 06 Departure End

With EMAS - Arrestment
October 2010

Prior to EMAS - Overrun
February 2005

Above Photos Courtesy of Port Authority of NY & NJ
Charleston (CRW) Airport Arrestment

19 Jan 2010: US Air Express, Flight 2495, CRJ-200 regional jet with 34 pax & crew

No injuries

Runway reopened just under 6 hours

Aircraft returned to service
EMAS Installation
Yeager Airport Departure End of Runway 23
Charleston, WV
Toronto International Airport Accident

- TSB Final Accident Report
  12 Dec 2007

“The Board believes that all such runways could benefit from a RESA built in accordance with the ICAO Annex 14 recommended practice or the FAA’s runway safety area (RSA) standard

The Board believes that there exists a requirement for an alternate means of compliance, such as the use of an engineered material arresting system to provide a level of safety that is equivalent to a 300 m RESA”.
Chicago Midway Airport Accident

- NTSB Final Accident Report AAR-07-06
  - Findings Conclusion #23

“The absence of an Engineered Material Arresting System (EMAS) installation in the limited overrun area (RESA) for Runway 31C contributed to the severity of the accident; Even a nonstandard EMAS installation would have safely stopped the airplane before it left airport property.”
Final Thoughts

EMAS minimizes risk, saves aircraft and saves lives!

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Target Level of Safety

- Overrun Studies – Statistical Analysis
  - FAA
    - 90% of overruns came to rest within 1000’ (305m) beyond runway end
    - 90% of overruns exited the runway at a speed of 70 knots or less
  - ICAO State Letter AN 4/1.1.52-11/41, Attachment D, 30 May 2011, ICAO ADREP database
    - Standard 90m captures 61% of overruns
    - Recommended 240m captures 83% of overruns
ICAO RESA vs. ADREP Accident Database

Recommended RESA - 240m

Width of both Standard and Recommended RESA is equal to graded portion of strip

Not to Scale
EMASMAX® and RESA Comparison – FAA Guidance

- **EMASMAX® requires far less space to stop an aircraft**
  - ~650’ (200m) required to stop B747/A380 exiting at 70 knots
  - 70 Knot Stopping capability in less distance for smaller aircraft
  - FAA Grants full RESA (RSA) compliance for a 70 knot system that is 600’ (~180m) from runway threshold and the end of the EMAS

![Diagram showing distance comparison between EMAS and FAA requirements]

70 Kt. EMAS

FAA Required (1,000’)
ICAO Recommended (240m + 60m)
**EMASMAX® and RESA Comparison – FAA Guidance**

- EMASMAX® requires far less space to stop an aircraft
  - Insufficient RESA available for 70 knot system?
  - Maximum deceleration in available RESA
  - Minimum exit speed of 40 knots

40 - 50 Kt. EMAS
45 - 60m
Potential EMAS Capabilities

- Gain Recommended RESA stopping capability/capture rate/target level of safety in less space

70 Kt. EMAS for 737, A320 and Smaller Aircraft (≤150m)

ICAO Recommended (90m + 60m)

150m of RESA allows enough space for aircraft exiting ~50 knots
EMASMAX® and RESA Comparison – UNABLE to achieve ICAO Standard RESA Length

- Potential EMAS Capabilities
  - Gain Standard RESA stopping capability/capture rate/target level of safety in less space

40 - 50 Kt. EMAS
45 - 60m