FLIGHT SAFETY FOUNDATION

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Reducing The Risk of Runway Excursions

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Director of Technical Programs

Participants

- EASA
- CANSO
- IFALPA
- FAA/CAST
- LVNL
- Boeing
- DGAC France
- Flight Safety Foundation
- IFATCA
- NLR
- ALTA
- Airbus
- Embraer
- ACI
- IATA
- ERA
- Eurocontrol
- AAPA
- US NTSB
- AEA
- Honeywell
- ALPA

Runway Safety Issues

- Runway Incursions
- Runway Confusion
- Runway Excursion

Runway Excursion:

When the wheels of an aircraft on the runway surface depart the end or the side of the runway surface.

Runway excursions can occur on takeoff or on landing.

They consist of two types of events:

Veer-Off: Excursion in which an aircraft departs the side of a runway

Overrun: A runway excursion in which an aircraft departs the end of a runway

The Players

- Aircraft Manufacturers
- Operators
  - Aircrews
  - Management
- Airports
- ATC
- Regulators

Runway

Safety

Data

Confusion

Incursion

Excursion

Runway Safety Accident Data

1995–2009

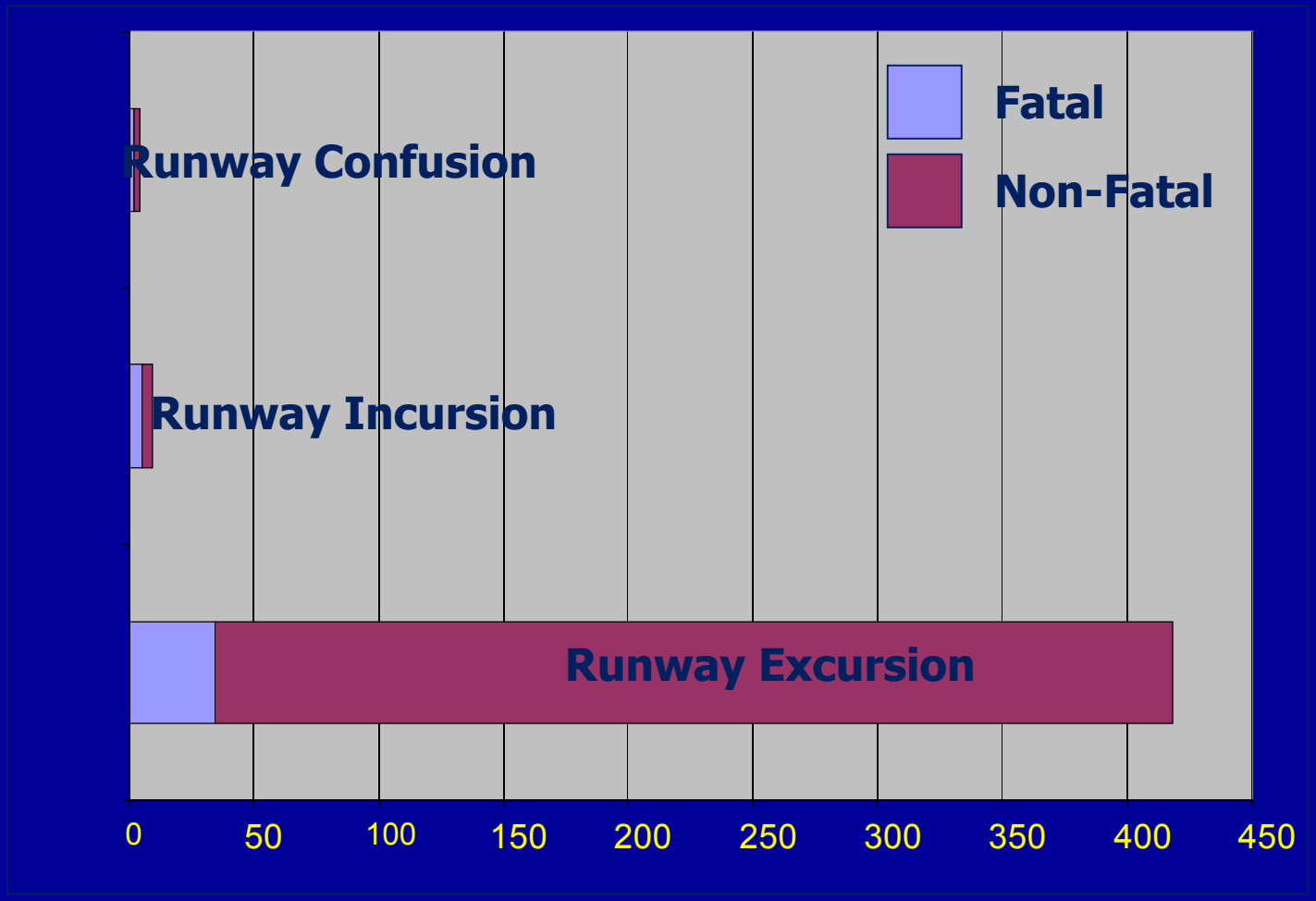
1,508 Total Accidents

	Number		Percent of Total
Incursions:	10 (.7/year)	1.0/year	.6%
Confusion:	5 (.3/year)		.3%
Excursions:	442 (29.8/year)		29%

Runway Safety Data
1995–2010
Runway Excursion Data

- 36% of turbojet accidents
- 24% of turboprop accidents

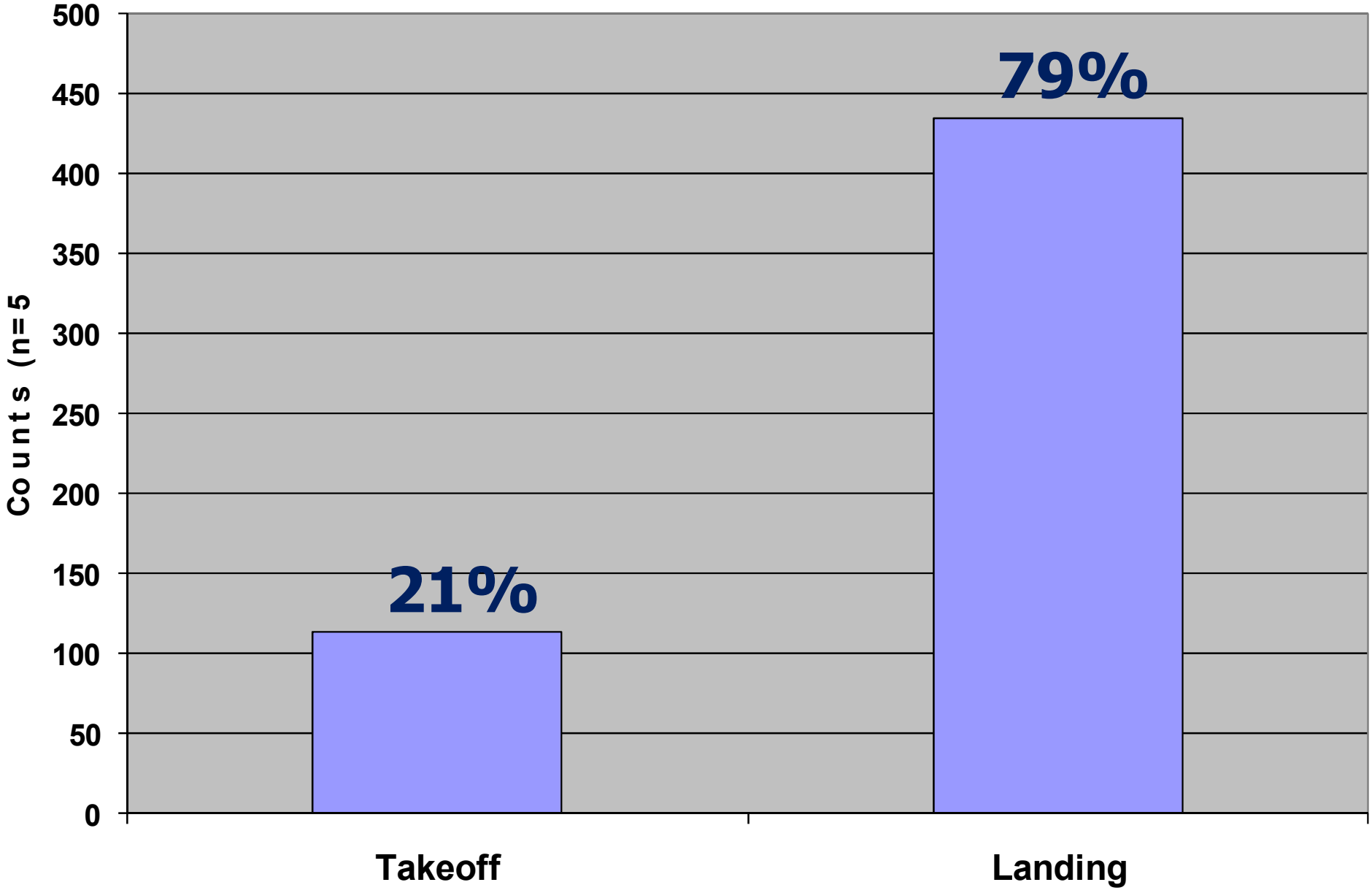
Fatal and Non-Fatal Runway Accidents by Type, 1995 Through 2009



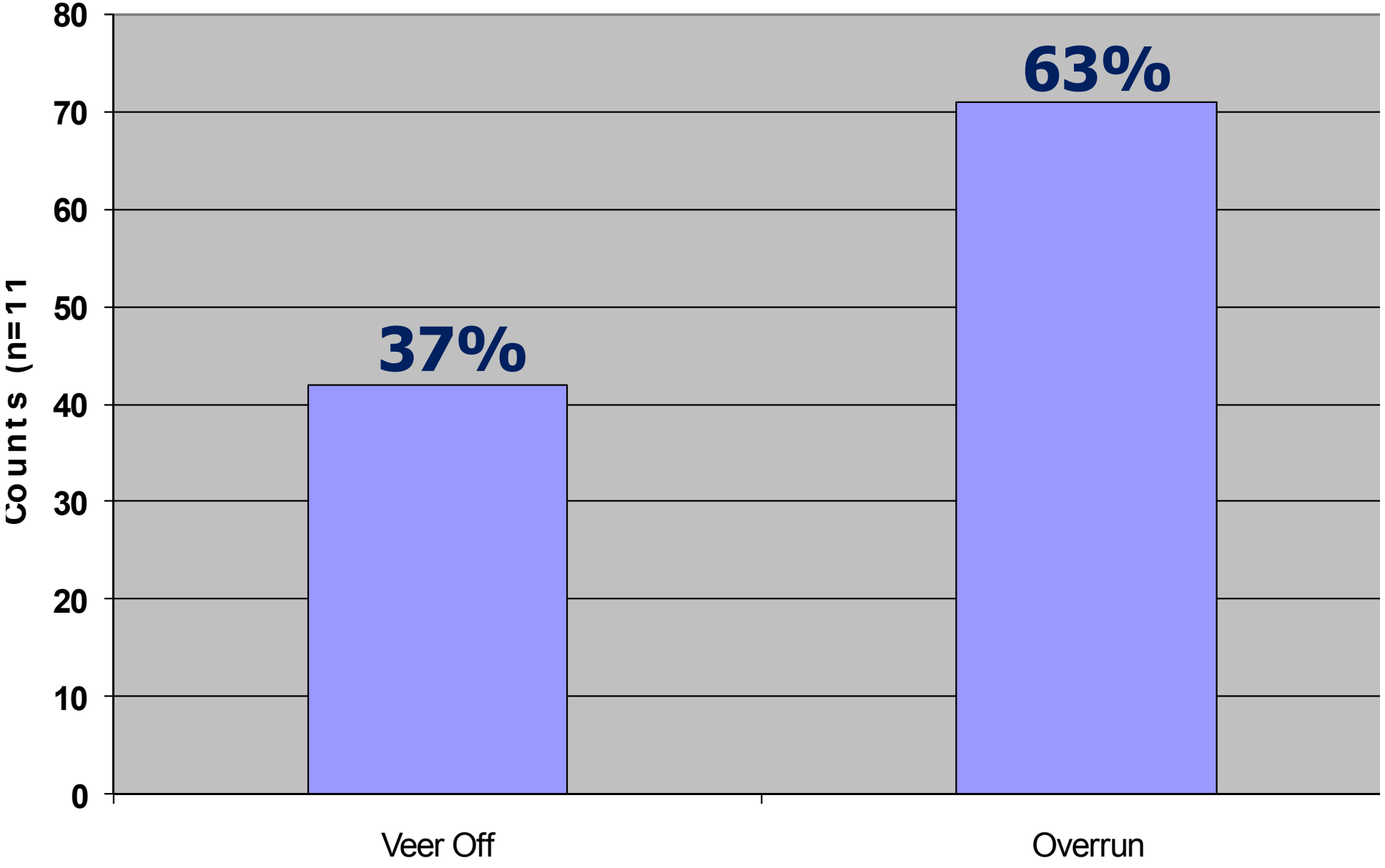

SWISSAIR


N370W
CAUTION

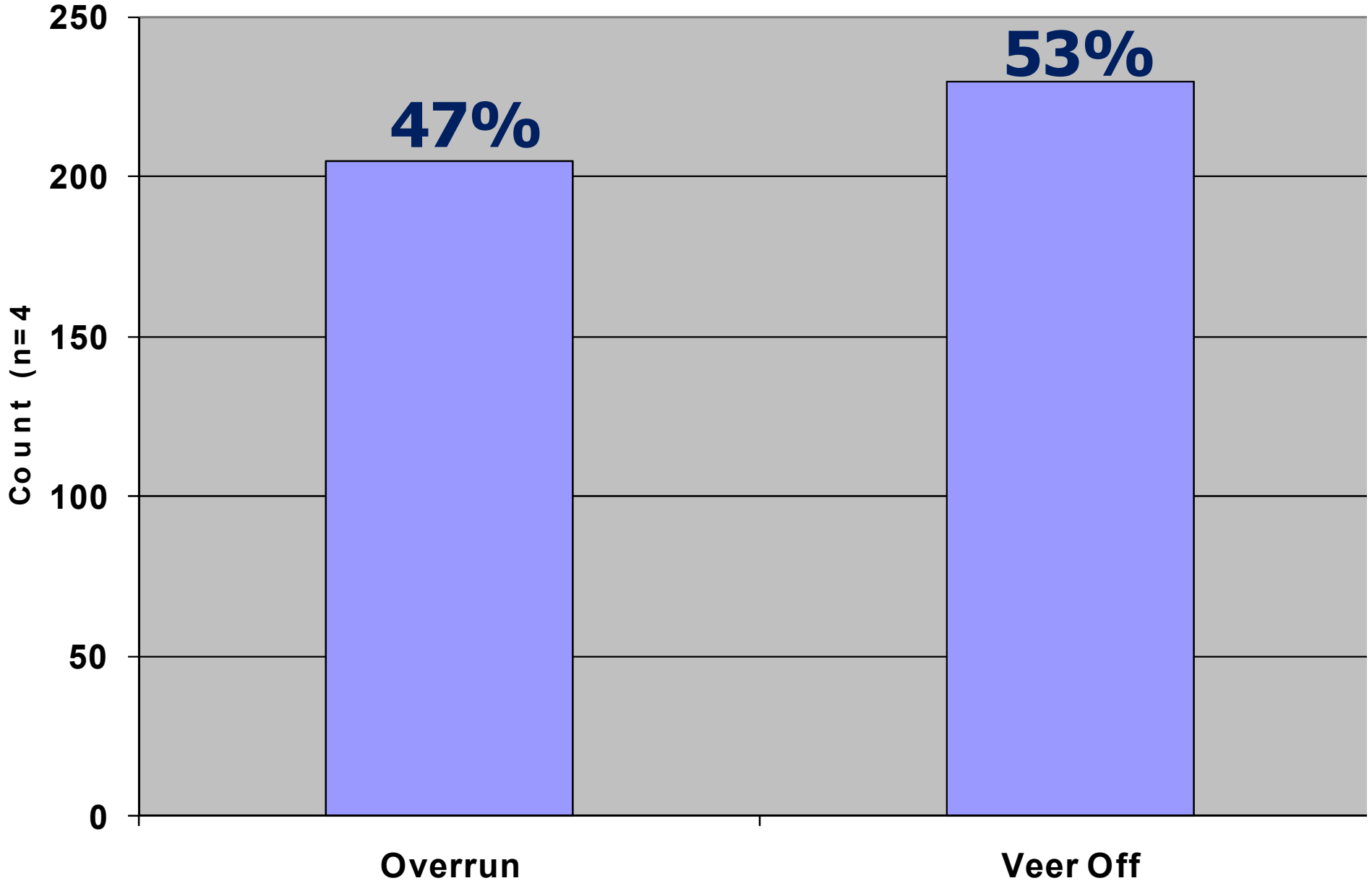
Runway Excursions - Type



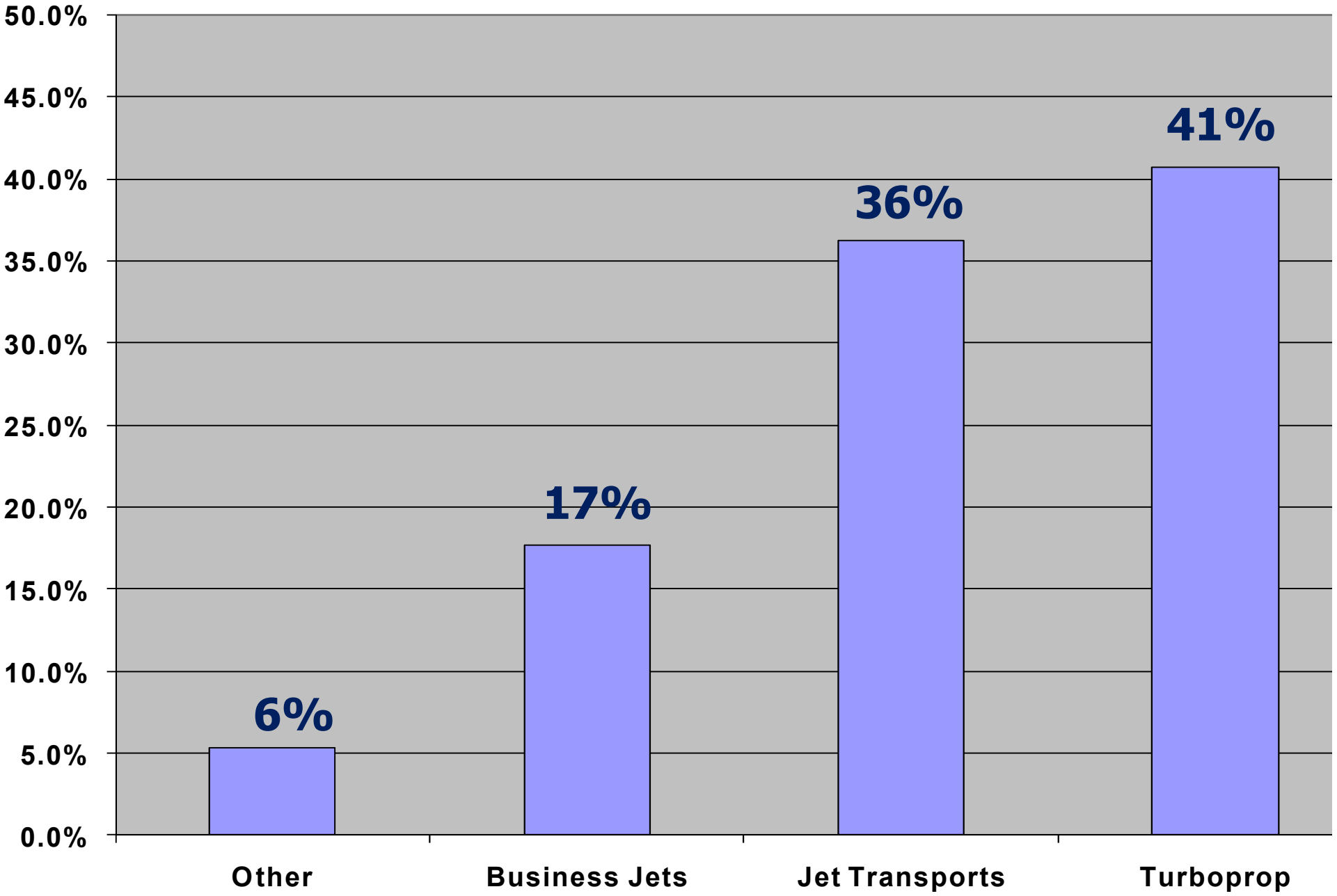
Takeoff Excursions



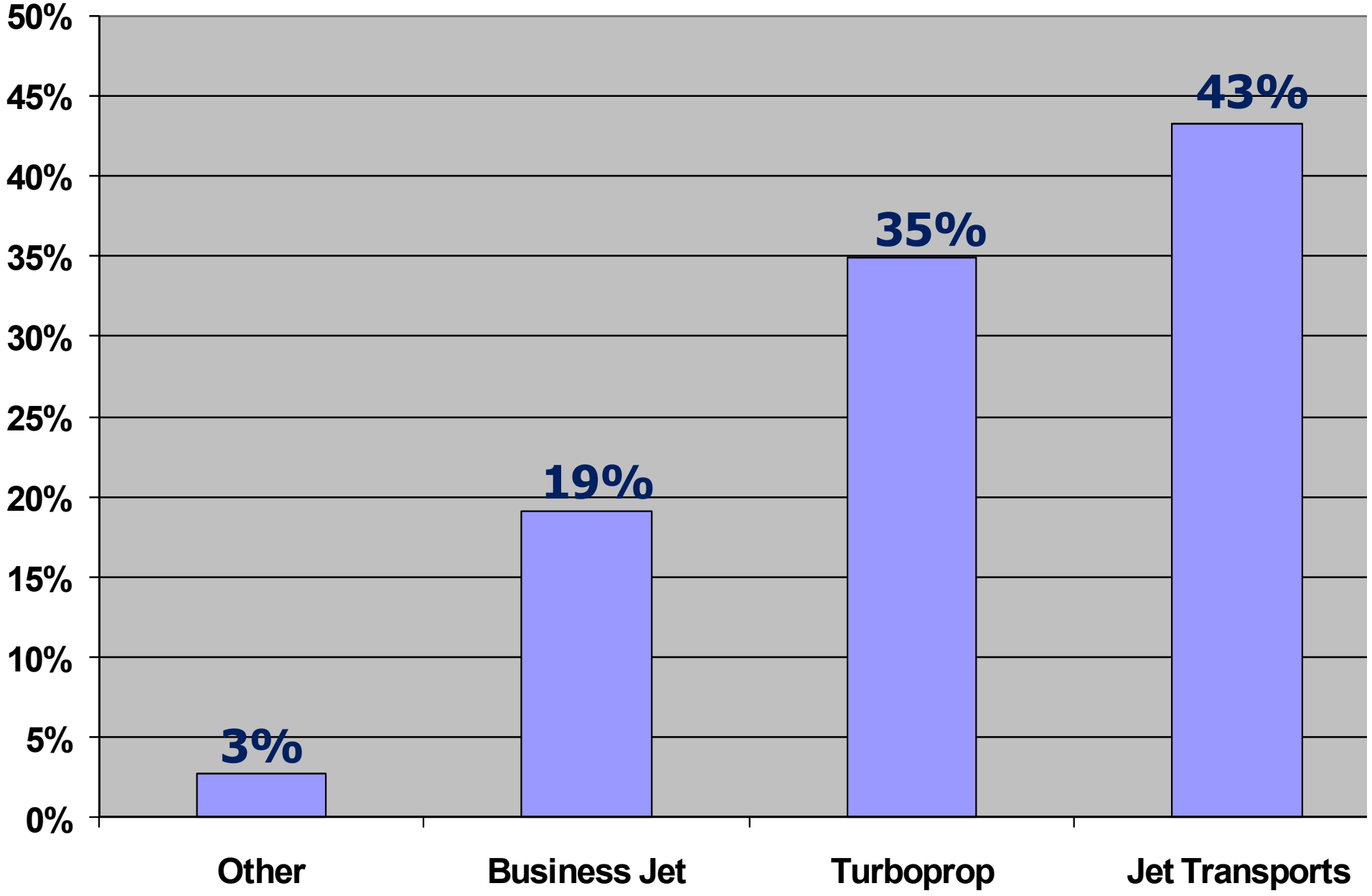
Landing Excursions - Type



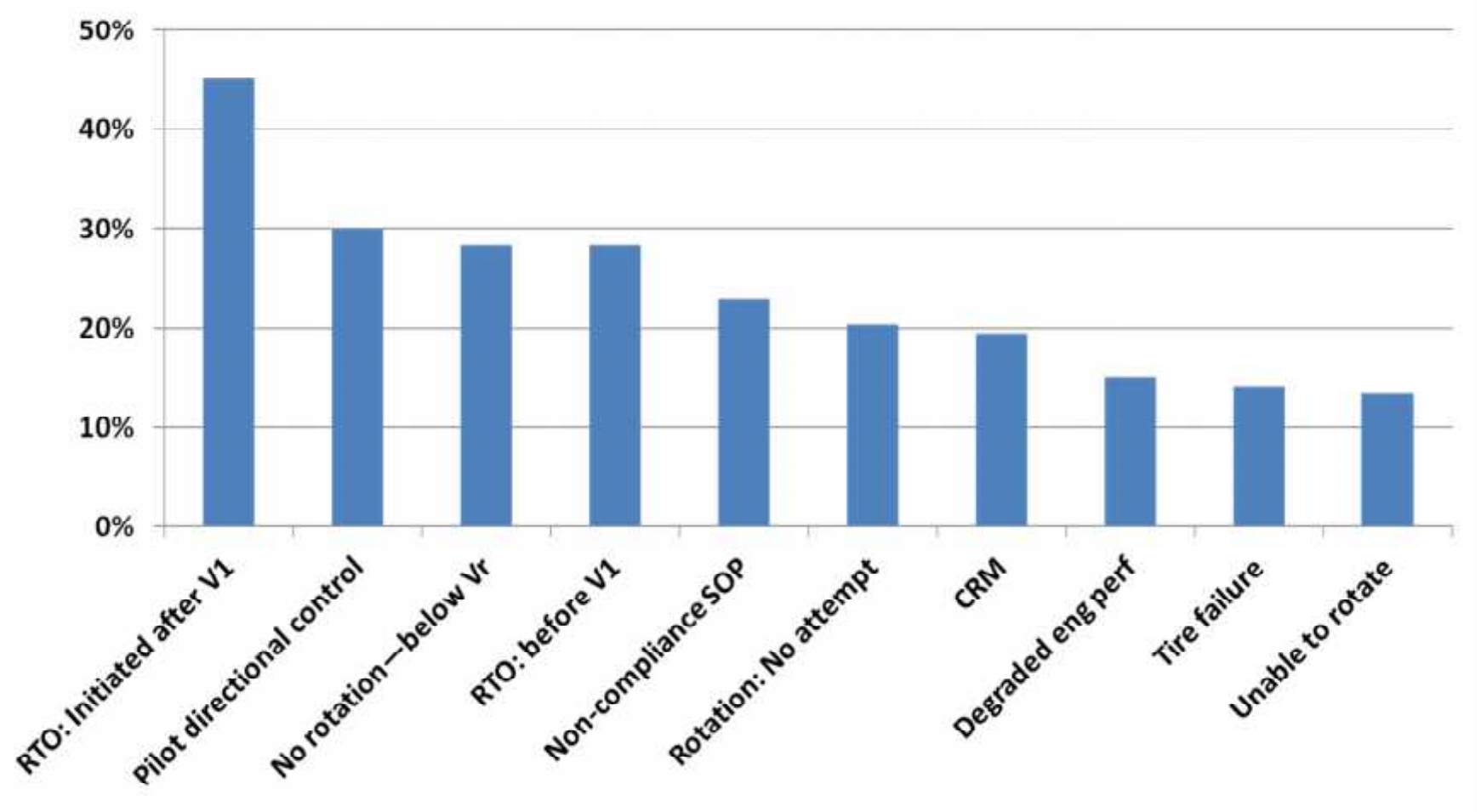
Takeoff Excursions - Fleet Composition



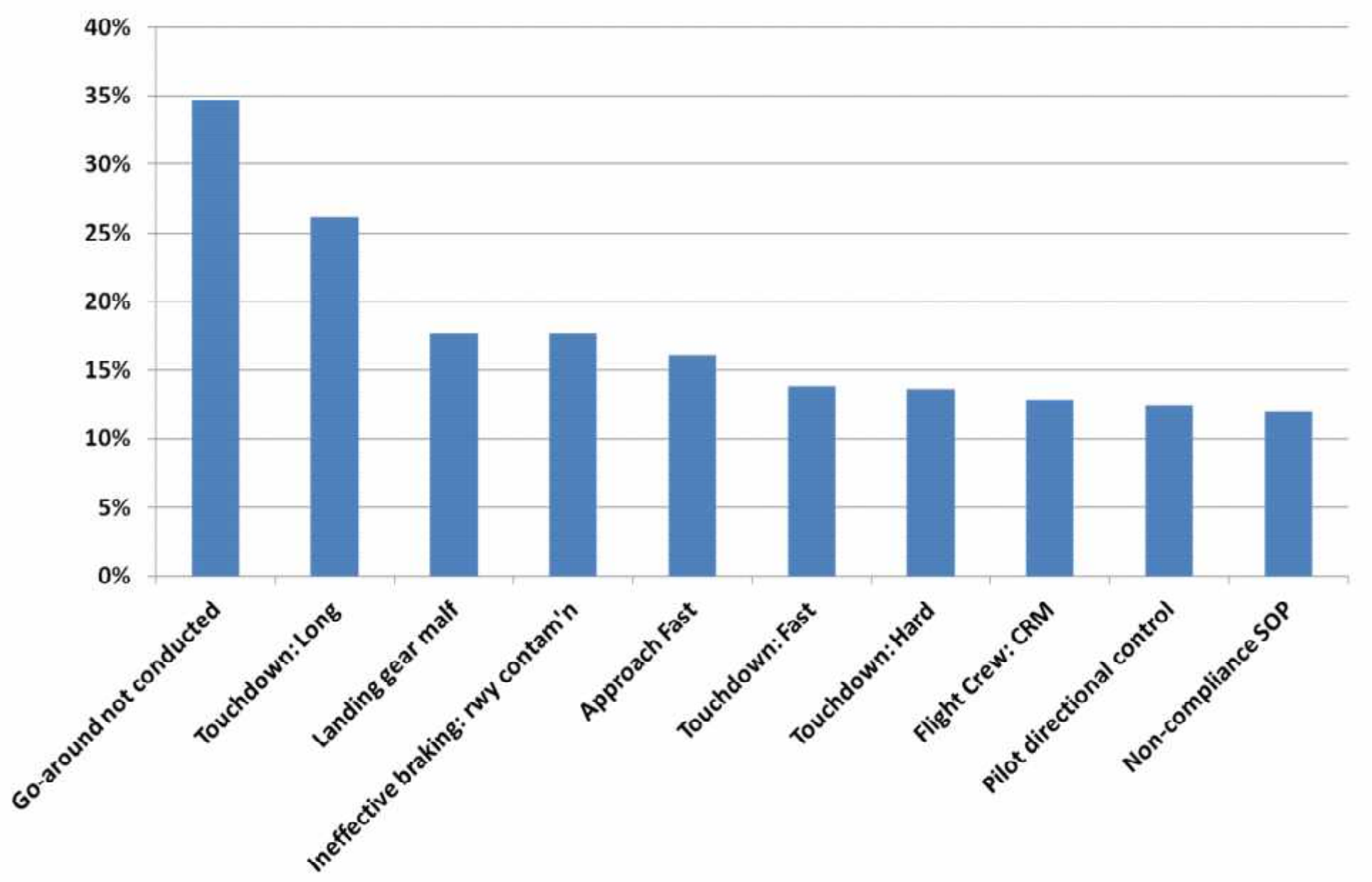
Landing Excursions - Fleet Composition



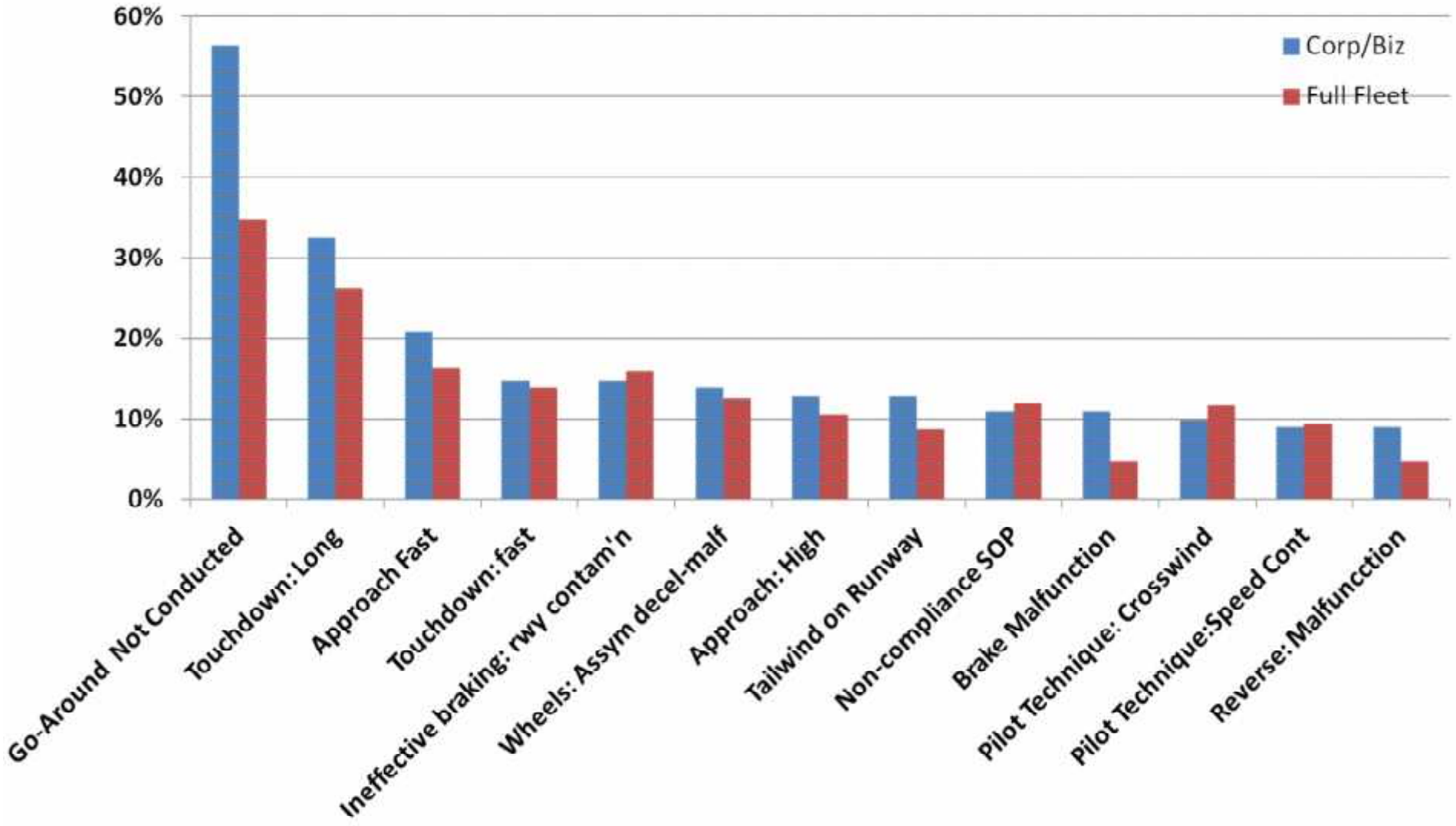
Takeoff Excursions – Top 10 Factors



Landing Excursions – Top 10 Factors



Corp/Biz Aircraft vs. Full Fleet - Landing Excursions



Runway Safety Observations

- Data shows we are being effective in preventing runway incursion ***accidents,*** but the number of incidents and severity still indicates a very high risk
- Data shows runway excursions are the most common type of runway safety accident (96%) and the most common type of fatal runway safety accident (80%)
- Severity of runway excursions dependent on:
  - Energy of aircraft when departing the runway
  - Airport layout, geography, and rescue capability

Basics

- Stabilized approach with landing in touchdown zone
- Energy = Mass X V^2
- Effect of reverse thrust is significantly greater on a contaminated runway
- Calculations and rules are important, but so is adhering to the conditions used to calculate them:
    * e.g., abort past V1
    * Land long, land fast

Conclusions

- Unstable approaches increase the risk of landing runway excursions
- Failure to recognize the need for and to execute a go-around is a major cause of landing runway excursions
- Establishing and adhering to standard operating procedures (SOPs) will enhance flight crew decision making and reduce the risk of runway excursions

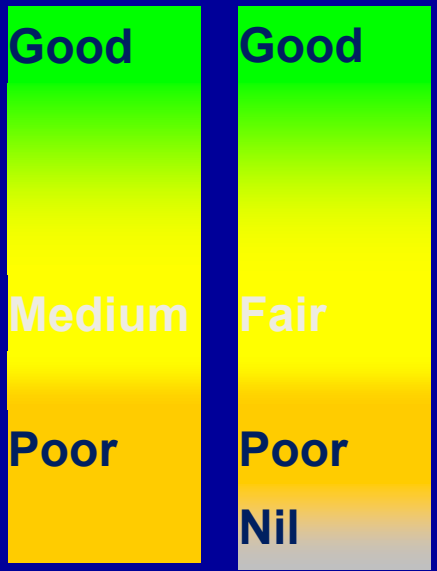
Conclusions

- Contaminated runways increase the risk of runway excursions
- Universal standards related to runway conditions, and comprehensive performance data related to aircraft stopping characteristics, would assist in reducing the risk of runway excursions

Runway Condition Reporting

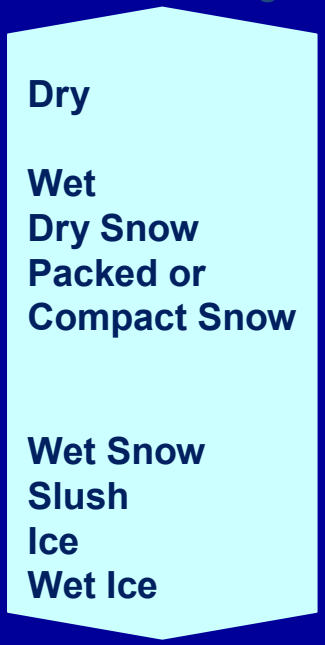
Summary of Methods

① Airplane Braking Action Report PIREPs

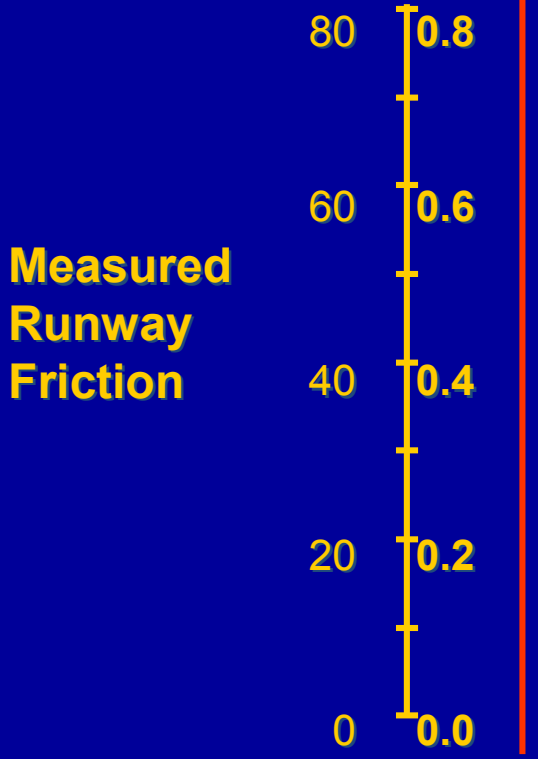


* Per airline/FAA discussion as result of August 2006 workshop in Washington, D.C.

Runway Description



③ Runway Friction Report



Braking Action Chart

Table 1

BRAKING ACTION

Braking Action		Estimated Correlations		
Term	Definition	Runway Surface Condition	ICAO	
			Code	Mu
Good	Braking deceleration is normal for the wheel braking effort applied. Directional control is normal.	• Water depth of 1/8" or less • Dry snow less than 3/4" in depth • Compacted snow with OAT at or below -15°C	5	40 & above
Good to Medium	-		4	39 - 36
Medium (Fair)	Braking deceleration is noticeably reduced for the wheel braking effort applied. Directional control may be slightly reduced.	• Dry snow 3/4" or greater in depth • Sanded snow • Sanded ice • Compacted snow with OAT above -15°C	3	35 –30
Medium to Poor	-		2	29 - 26
Poor	Braking deceleration is significantly reduced for the wheel braking effort applied. Potential for hydroplaning exists. Directional control may be significantly reduced.	• Wet snow • Slush • Water depth more than 1/8" • Ice (not melting)	1	25 - 21
Nil	Braking deceleration is minimal to non-existent for the wheel braking effort applied. Directional control may be uncertain. **Note:** *Taxi, takeoff, and landing operations in nil conditions are prohibited.*	• Ice (melting) • Wet Ice	-	20 & below

Note: The ICAO term **Unreliable** and SNOTAM code of "9" indicates contamination is outside the approved operational range for the friction measuring equipment in use and therefore mu values are not provided. This typically occurs in poor or worse conditions (greater than 1/8" of wet snow, slush or standing water) whereby a potential for hydroplaning should be expected. *Use PIREPs and the depth and type of runway contaminants to assess actual braking conditions.*

Boeing Note: This page is advisory information as developed by a team of US airline technical pilots and other interested parties. The creation of the table was initiated by a FAA workshop on runway condition reporting held in August of 2006.

Runway Condition Measurement and Reporting

- CRFI
- Mu
- ICAO
- FAA
- Tapley Meter
- CFME
- Safe Land

"A single overarching source of guidance is needed for production and promulgation of runway condition information"--- ICAO

Conclusions

- Combinations of risk factors (such as abnormal winds and contaminated runways or thrust reverser issues and contaminated runways) have an undesirable synergistic effect on the risk of an excursion

Landing Excursion Risk Factor Interactions

- **Overrun** accidents
  - Go-around not conducted events
    - 85% Touchdown long/fast
    - 79% Unstabilized approach
    - 40% Runway contamination
  - Touchdown long/fast events
    - 85% Go-around not conducted
    - 72% Unstabilized approach
    - 50% Runway contamination
  - Unstabilized approach events
    - 97% Go-around not conducted
    - 89% Touchdown long/fast
    - 49% Runway contamination

Contamination + Other Factors

Takeoff Excursions – contaminated runway

- 75% of accidents initiated prior to V1
- 50% of accidents had adverse winds (cross, tail)

Landing Excursions – contaminated runway

- 55% of accidents had adverse winds (cross, tail)

FSF Goal:

Make aviation safer by reducing the risk of an accident