Federal Aviation Administration

Causal Factors for General Aviation Accidents/Incidents Between January 1984 and October 2004

TC05-0018

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Introduction

1.0 Executive Summary

The Small Airplane Directorate reviewed accident and incident data for a 20-year time period (January 1984 through October 2004) to determine the major causes of general aviation accidents. The Aviation Safety/Accident Prevention (ASAP) database provided accident and incident records for this report.

The intent of the study is to provide an initial review of accident and incident data to determine the top 10 leading major causal factors of general aviation accidents for various categories of aircraft.

The data consists of the following two major categories:

- Aircraft operating under Part 91 General Operating and Flight Rules; and
- Aircraft operating under Part 135 Operating rules for Commuter and On Demand Operations.

We reviewed a total of 62,037 records. Part 91 operations accounted for 57,117 records (92%) and Part 135 operations accounted for 4,920 records (8%).

Causal factors that were Air Transport Association of America (ATA) code related were considered as mechanical related and consisted of 26% of all accident/incident reports.

We separated the data by categories of aircraft type, such as single-engine, multiple-engine, and glider. Additional category groupings are by the following leading three manufacturers of general aviation products, which are Cessna, Piper, and Beechcraft. These three manufacturers account for most general aviation products in service over the 20-year period.

The report focuses on leading accident or incident causal factors to help target resources for determining possible mitigation of accidents or incidents. Within the FAA, the areas of design and operation will benefit from focusing on these leading accident or incident causal factors.

2.0 Analysis Method

2.1 Methodology

The ASAP system in Ft. Worth, Texas, provided data for the analysis in this report. The dataset consists of all part 23 accidents/incidents where the aircraft was operating under either Federal Aviation Regulation (FAR) part 91 operations or part 135 operations. The time period for the dataset is January 1984 to October 2004.

The data is in Microsoft ® Access format. We used ®Access query commands to perform all data searches and queries.

We divided the data into FAR part 91 operations and FAR part 135 operations. We further divided part 91 operations and part 135 operations data into single-engine, multiple-engine, and glider groups for each of the major three manufacturers: Cessna, Piper, and Beechcraft. We divided this data into fatal and non-fatal events.

We listed the top ten causal factors for each group. We intend for this report to graphically display the top ten causal factors for the various general aviation classes and operations.

We used ATA codes to determine if mechanical failure attributed to an accident or incident.

2.2 Data Sources

We gathered all the data for the analysis in this report from the Accidents/Incidents section of the ASAP database. The data in the ASAP database is downloaded from the Oklahoma City national database weekly.

2.3 Assumptions

This report does not verify the accuracy of the individual record coding of the causal factors.

Some causal factor codes may overlap. For this report, we used the causal factor code defined from each record as the database indicated. Again, we did not conduct a review of the accuracy or relevance of each record's causal code.

2.4 Definitions

The Accident/Incident causal factor coding system is somewhat cryptic in nature. The following causal factor definitions clarify some of the incident or accident codes addressed in this report:

Improper Operation of Brake/Flight Control on Ground: Loss of directional ground control due to improper operation of brake or flight controls. Typical examples are: losing directional control during landing, improper use of brake system, and losing directional control during take-off.

Selected Unsuitable Terrain: Landing on unimproved areas, landing on unknown terrain condition, and veering off runway onto unimproved areas.

Unsafe Acts by Third Party: Unauthorized ground vehicles colliding with aircraft, aircraft to aircraft collision during ground operation, maintenance induced problems, and unauthorized personnel present during ground operations.

Inadequate Preflight Inspection of Aircraft: Failure to remove aircraft tie downs, door not latched on take-off, improper setting of seat stops prior to take-off, fuel cap not properly installed, failure to remove control locks prior to take-off, and improper setting of control trim prior to take-off.

Failure to Avoid Objects or Obstructions: During ground or air operations such as striking towers, other aircraft on ground, power lines, ground support equipment, trees, and wild life, such as deer, on the ground.

Poor Preflight Plan/Aircraft Performance: Exceeded ability of aircraft to climb during towing flight, operation in excessive wind or gust components, operation off of improper runway surface for aircraft type, and exceeded density altitude limit of aircraft type.

Inadvertently Retracting Landing Gear: Pilot accidentally retracted gear, selected gear up instead of flaps up.

Landing Gear Actuator: Failure of the landing gear actuator system including failure of down lock system, and failure of actuator motor/transmission.

Landing Gear Strut/Axle/Truck: Failure of the strut assembly, trunnion area including bearings, torque link system, and landing gear attachment brackets/hardware.

Exceed Load Design: Loss of aircraft integrity caused by exceeding design loads due to over speed, over weight, acrobatic flight in non-rated aircraft, and down/up drafts.

Miscellaneous Pilot Unsafe Acts: Pilot distraction induced accident/incident such landing on wrong runway or taxiway, take off without Air Traffic Control (ATC) clearance, flying too low and striking trees, other aircraft, etc., and not securing gas or oil caps resulting in loss of fuel/oil.

3.0 Results

3.1 Overview

Our analysis provides a high-level look at what is causing general aviation aircraft involvement in both accidents and incidents. We accomplished this by analyzing a large amount of accident and incident data, dividing it into specific groups, and applying simple filter tools that determine a ranking of the data.

This report does not focus on commuter aircraft operations. The Small Airplane Directorate produced a "Small Airplane Commuter Service Issues Study" in June of 2002. That study is specifically dedicated to the commuter fleet of aircraft. That report is available from the Small Airplane Directorate Continued Operational Safety Branch.

3.2 Observations

We reviewed 62,037 accident/incident records during our analysis. Of this total, 57,117 records were on aircraft operating under part 91 rules. The remaining 4,920 records were of aircraft operating under part 135 rules.

Landing gear issues were a primary cause for accidents of both part 91 single and multiple engine accidents. Failure of the retraction/extension system along with failure to extend the gear accounted for 12% of all part 91 accidents.

Improper operation of brakes/flight control on ground also was a leading causal factor of part 91 accidents. 6,108 events (11%) of part 91 accidents were due to improper operation of brake/flight control during ground operations.

The leading causal factor for both Cessna and Piper aircraft was improper operation of brake/flight control during ground operations. The leading causal factor for Beechcraft was failure to extend the landing gear.

Part 135 operations proved to be similar in that landing gear retraction/extension system failure was the leading factor.

16,213 accidents/incidents (26%) are classified with an ATA code as the causal factor. An ATA code indicates a mechanical malfunction of the aircraft's systems. The remaining accidents/incidents were attributable to non-mechanical factors, including pilot error, human factor related problems, and improper procedures.

The top ATA system codes indicating mechanical issues are as follows:

ATA Code	Count	%	ATA Title
32	7824	48.3%	Landing Gear
85	1790	11.0%	Reciprocating Engine
24	1240	7.6%	Electrical Power
28	1058	6.5%	Fuel
73	511	3.2%	Engine Fuel and Controls

The leading ATA system code was landing gear. Through out this analysis, landing gear was a leading factor in general aviation accidents/incidents.

The ATA component codes are a four-digit code that focuses on the specific component or section of a system.

The top 10 ATA component codes indicating mechanical issues are as follows:

ATA Code	Count	%	ATA Title
3230	3788	23.4%	Landing Gear Retraction/Extension System
8500	905	5.6%	Engine (Reciprocating)
3233	526	3.2%	Landing Gear Actuator
3213	511	3.2%	Main Landing Gear Strut/Axle
3242	452	2.8%	Brake
2400	421	2.6%	Electrical Power system
8530	399	2.5%	Reciprocating Engine Cylinder section
2800	370	2.3%	Fuel
2434	337	2.1%	DC Generator-Alternator
8520	331	2.0%	Reciprocating Engine Power section

Landing gear retraction/extension system problems were, by a large percentage, the leading mechanical problem with general aviation aircraft.

The following is a review of the leading manufacturers involved in accidents or incidents with ATA code as a causal factor. Percentages below the top three manufacturers decrease rapidly; therefore, many of the manufacturers have been grouped under "Other".

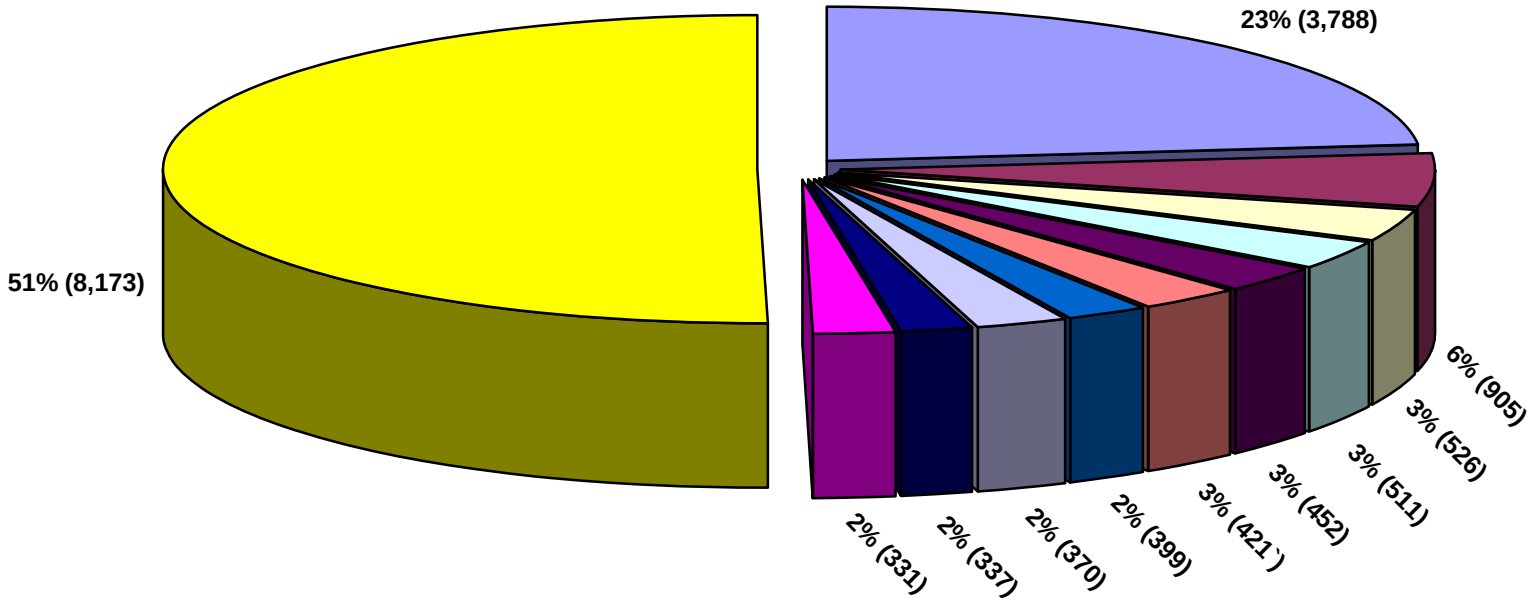
Manufacturer	Count	%
Cessna	5753	35.5%
Piper	4260	26.3%
Beech	2575	15.9%
Mooney	627	3.9%
Swearingen	490	3.0%
Bellanca/American Champion	467	2.9%
Gulfstream	414	2.6%
Other (35+ other manufacturers)	1627	10.0%

3.3 Continued Activity

The Small Airplane Directorate conducted the analysis for this report to support the Continued Operational Safety program. The program targets the general aviation fleet of 250,000+ aircraft to determine how to make them safer. With the growing age of the general aviation fleet, Continued Operational Safety concerns will become more varied within the different fleets of aircraft models.

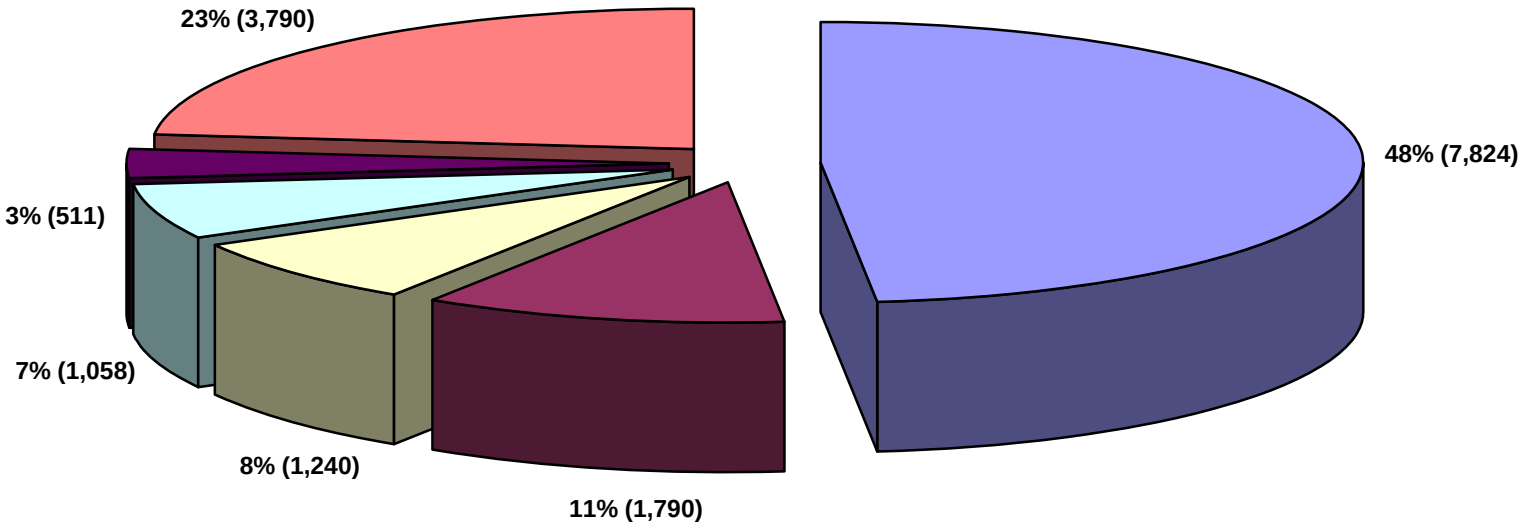
The Small Airplane Directorate will continue to explore problems with the general aviation fleet. Precursor criteria determination is an ongoing project. This report will help determine what investigative tools safety engineers should use to identify electrical and electronic problems within fleets of aircraft. Precursor identification can aid in preventing accidents before they happen.

Leading ATA Codes

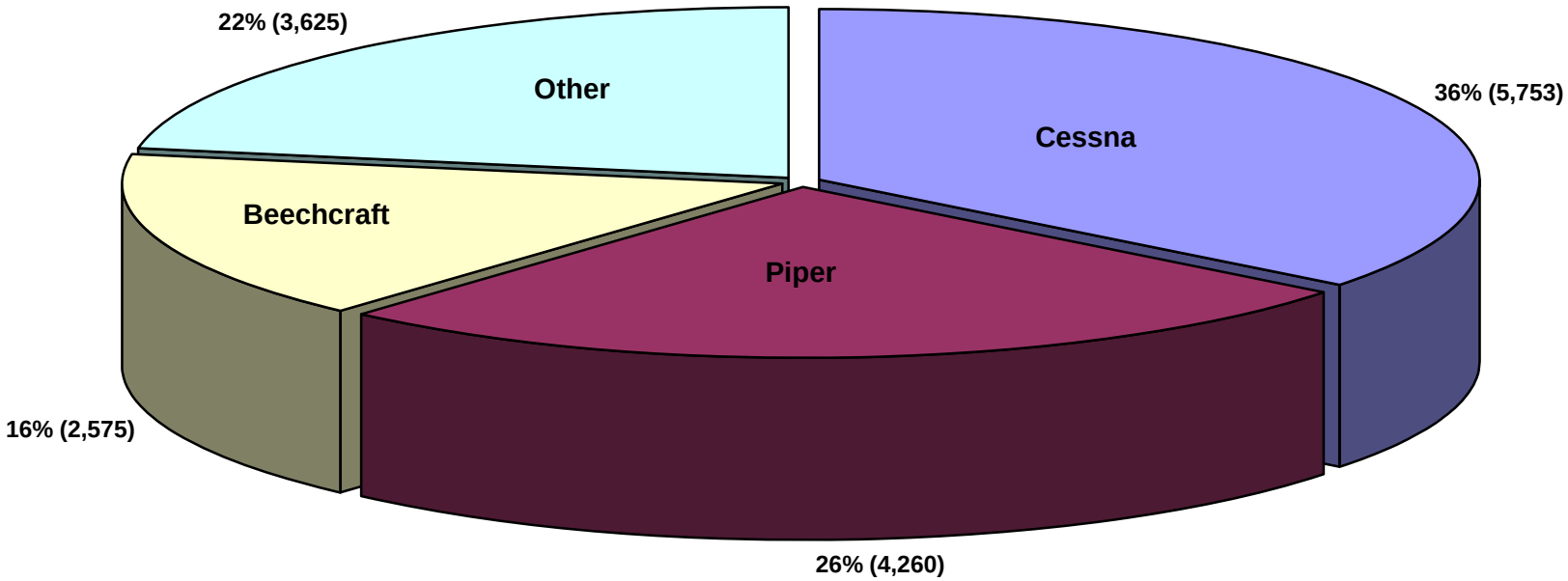


- 3230 - Landing Gear Retraction/Extension System
- 8500 - Engine (Reciprocating)
- 3233 - Landing Gear Actuator
- 3213 - Main Landing Gear Strut/Axle
- 3242 - Brake
- 2400 - Electrical Power system
- 8530 - Reciprocating Engine Cylinder section
- 2800 - Fuel
- 2434 - DC Generator-Alternator
- 8520 - Reciprocating Engine Power section
- All Others

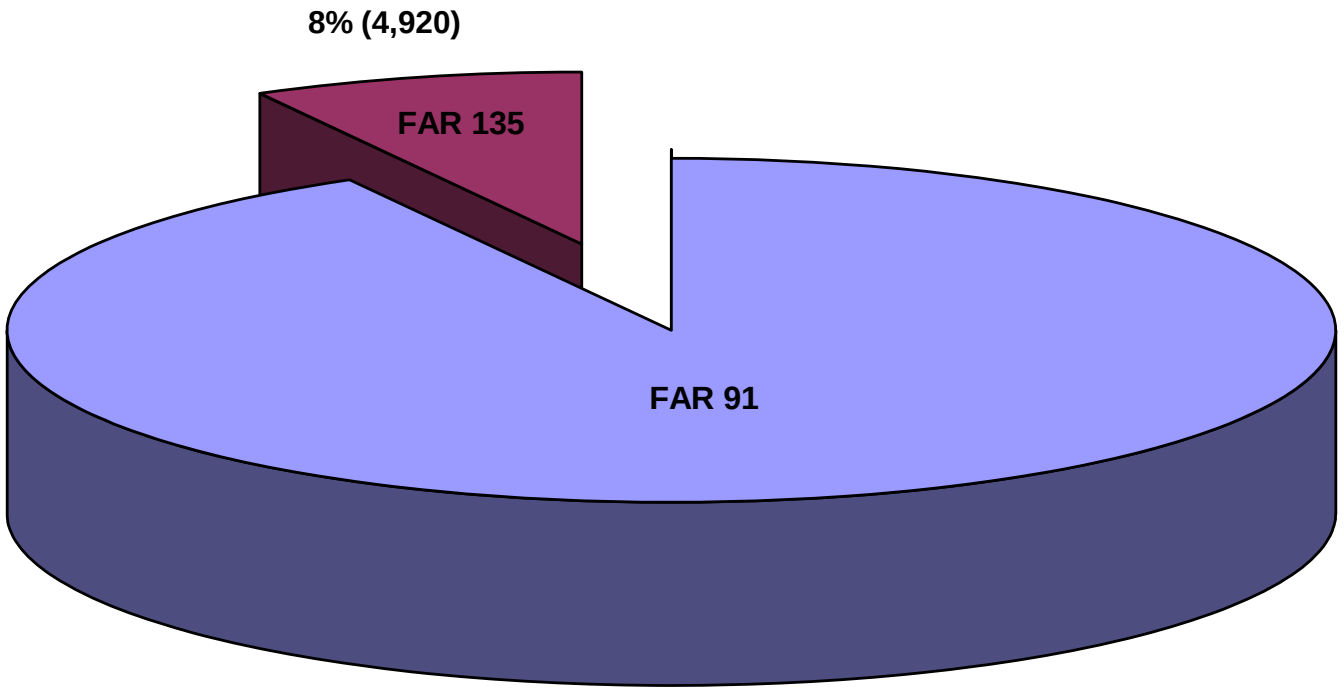
Leading ATA Systems



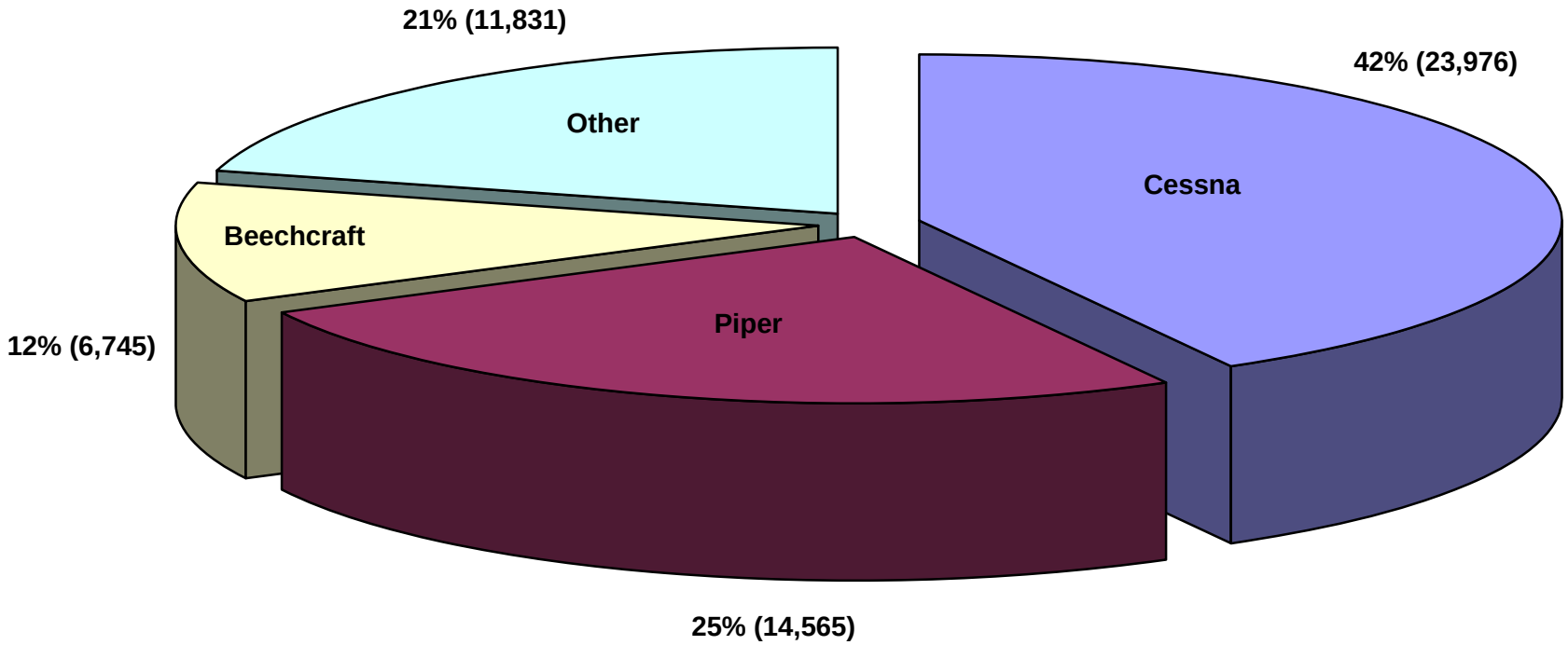
Leading Manufacturers
(ATA Codes By Manufacturer)



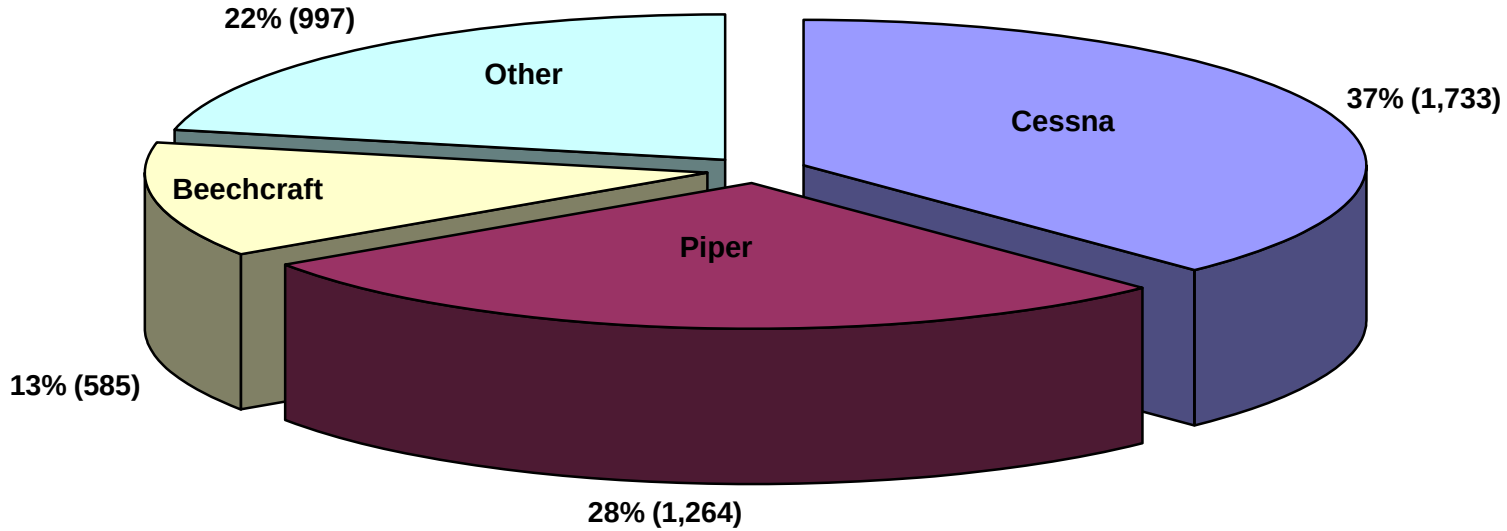
All Accidents FAR 91 and FAR 135
(62,037)



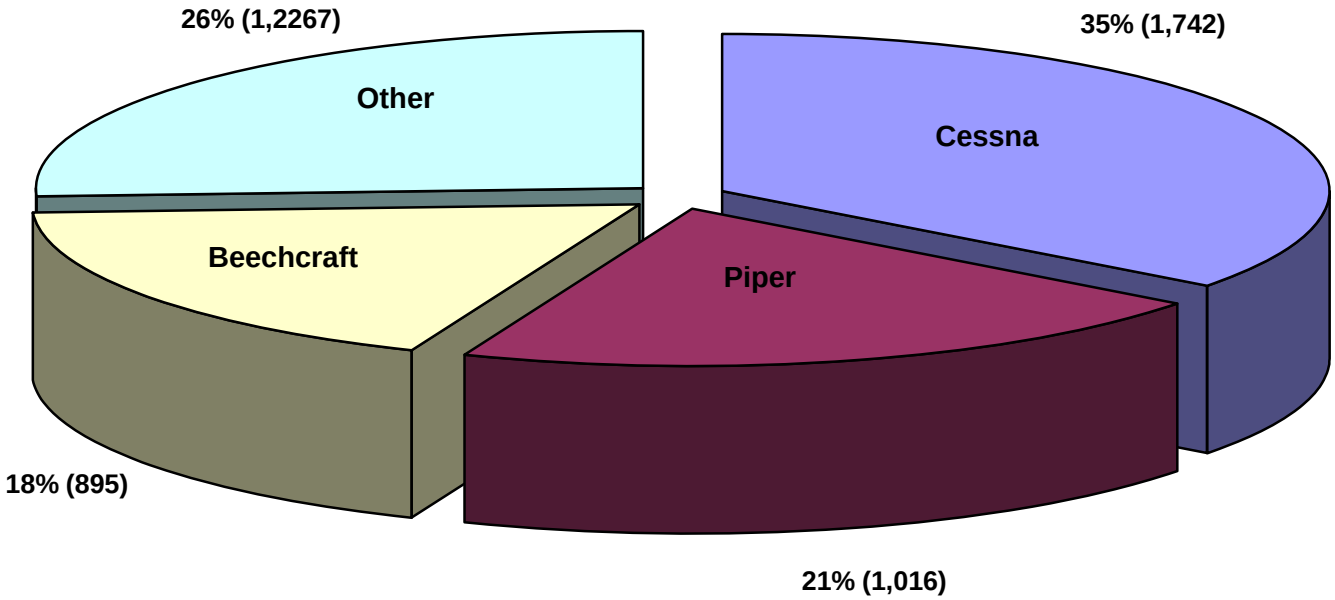
FAR 91 - All Accidents
(57,117)



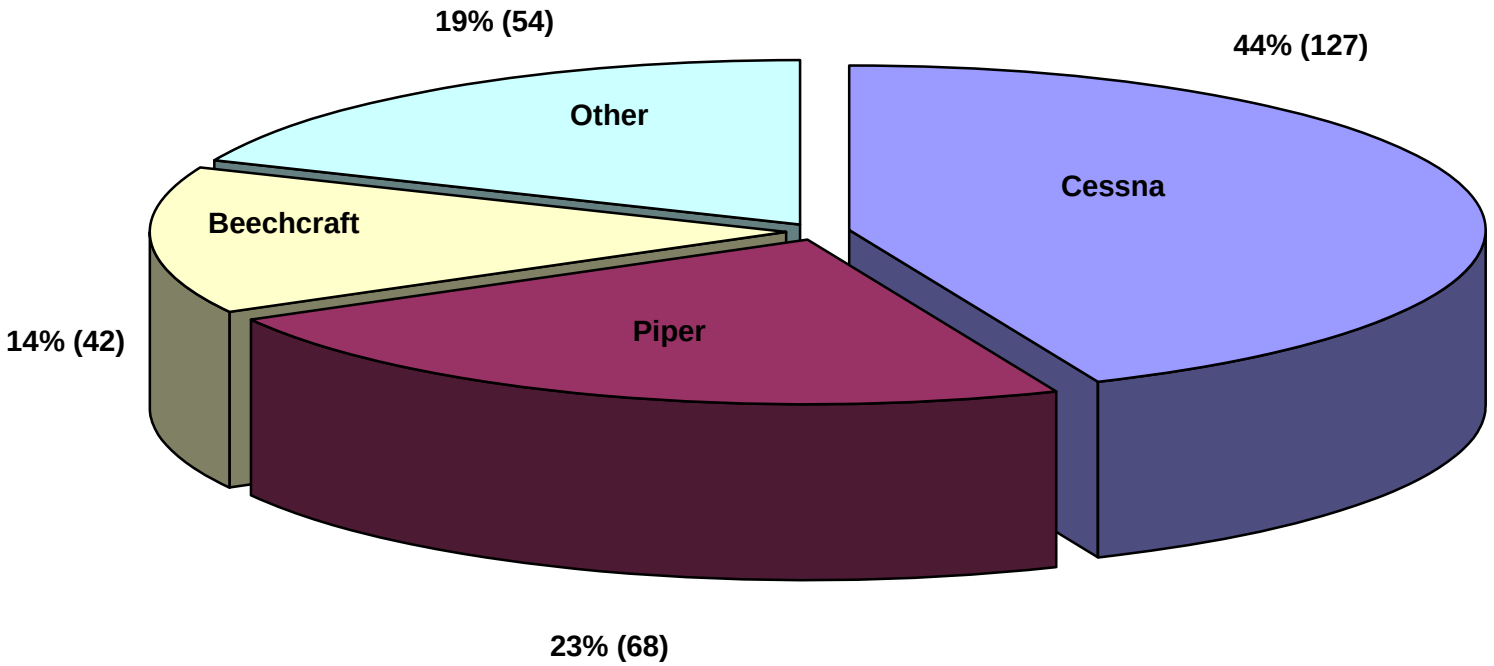
FAR 91 - Fatal Accidents
(4,579)



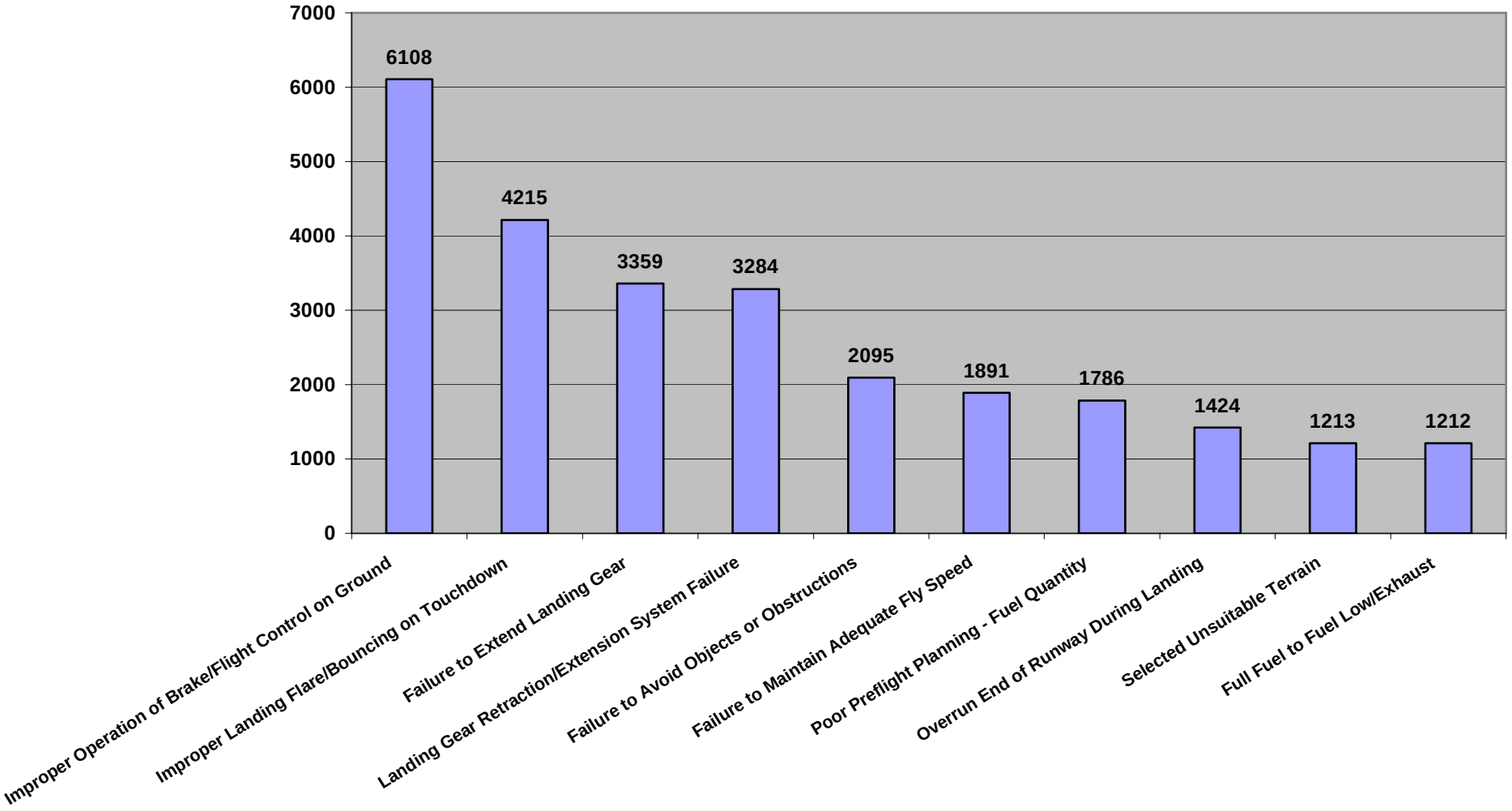
FAR 135 - All Accidents
(4,920)



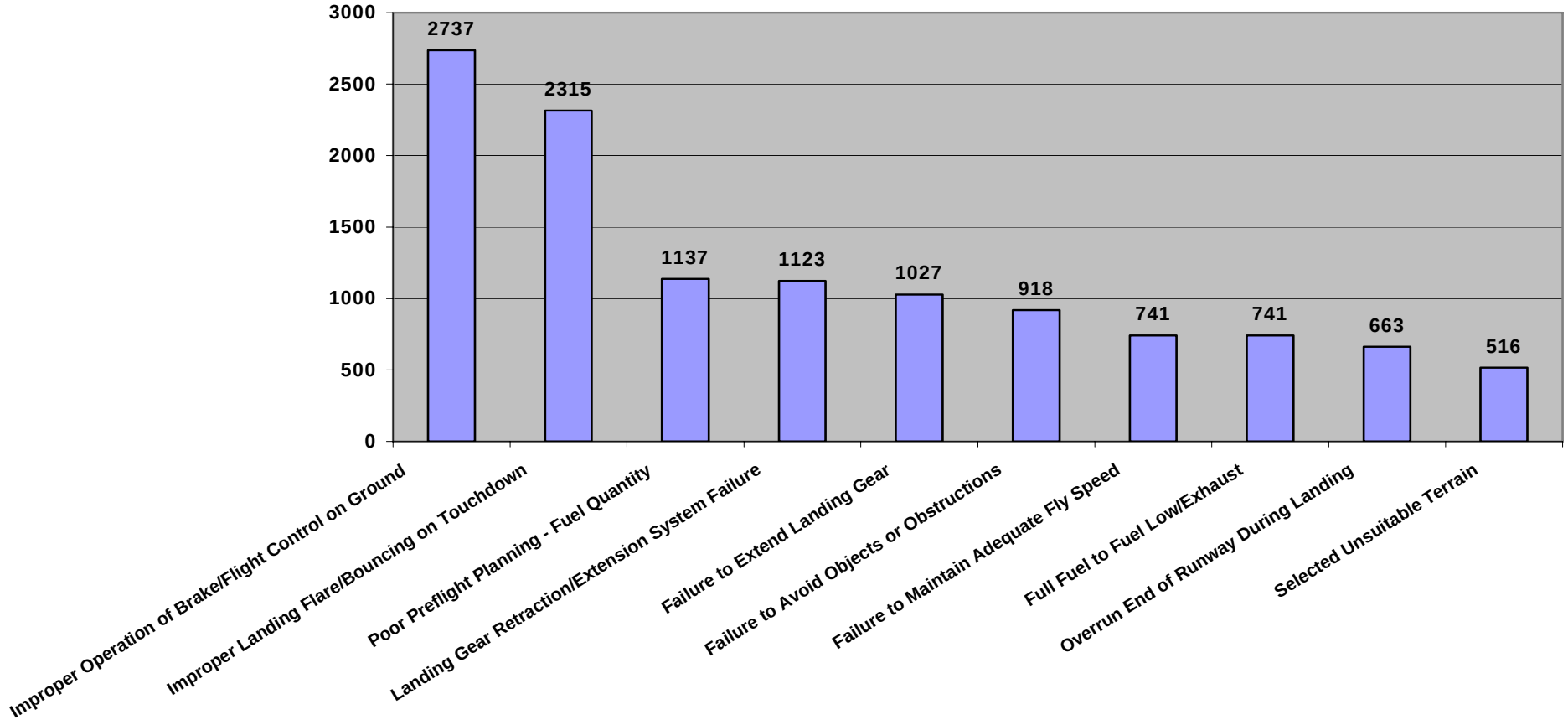
FAR 135 - Fatal Accidents
(291)



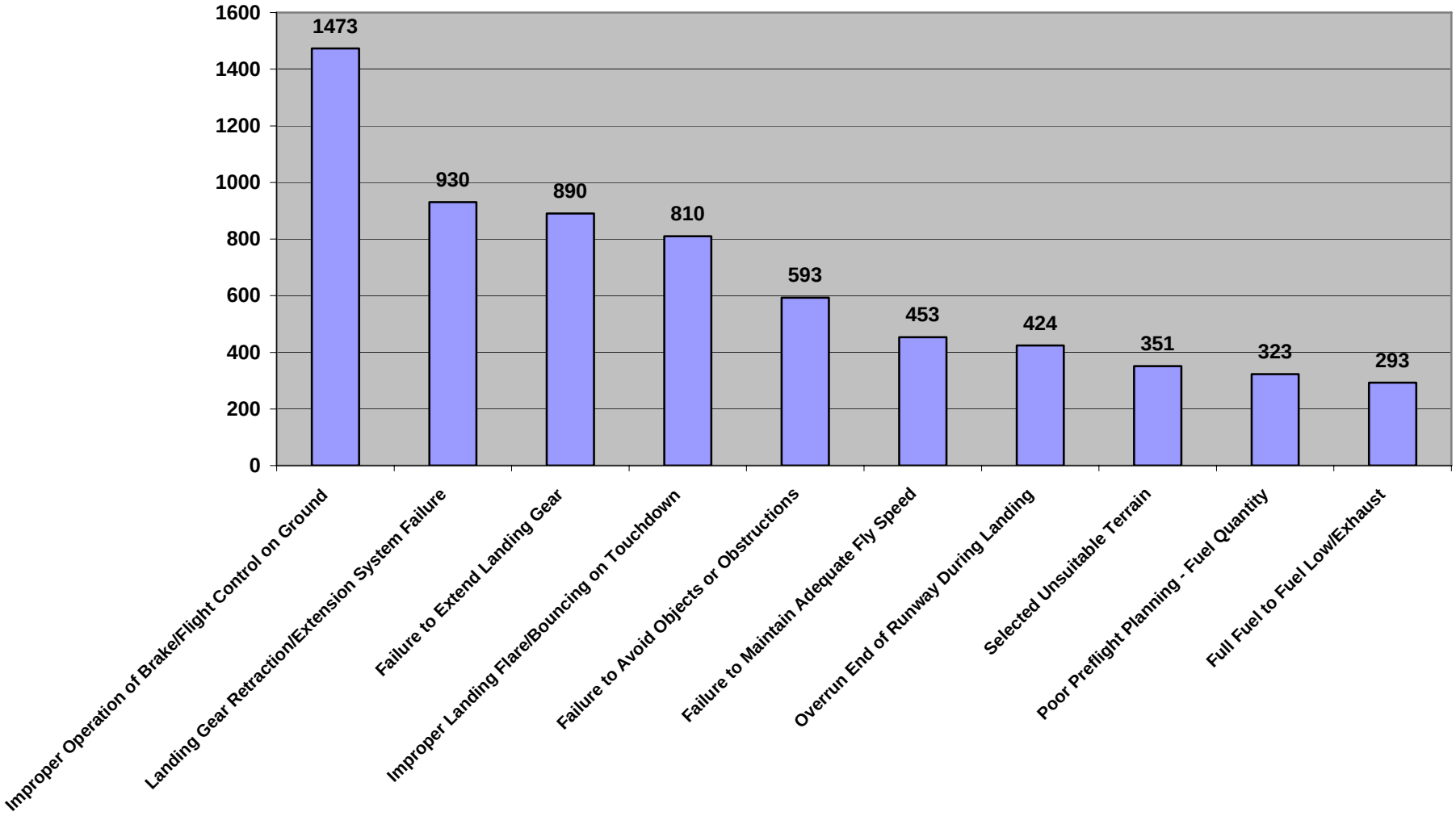
FAR Part 91 - All Engines



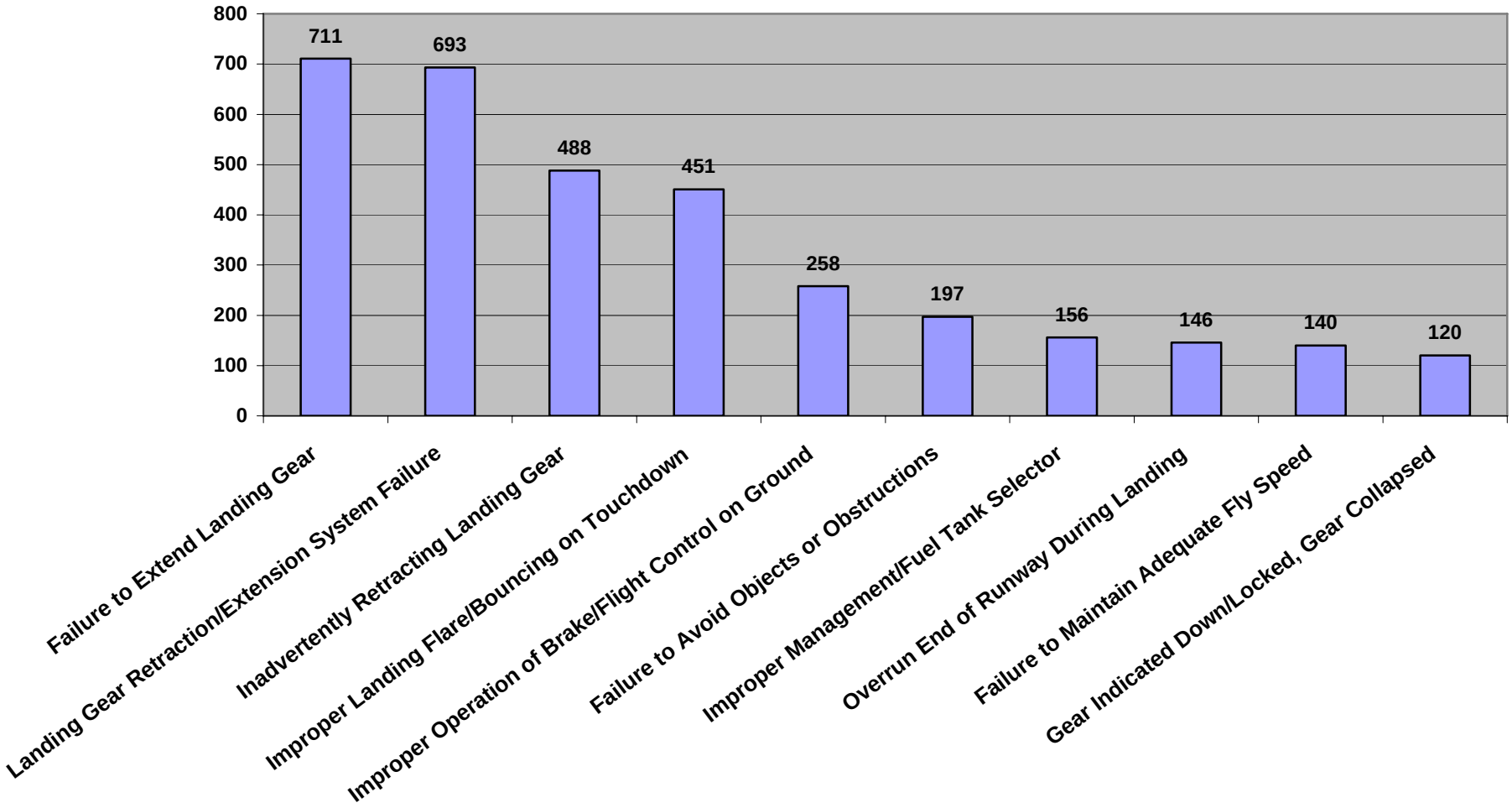
FAR Part 91 - All Engines - Cessna



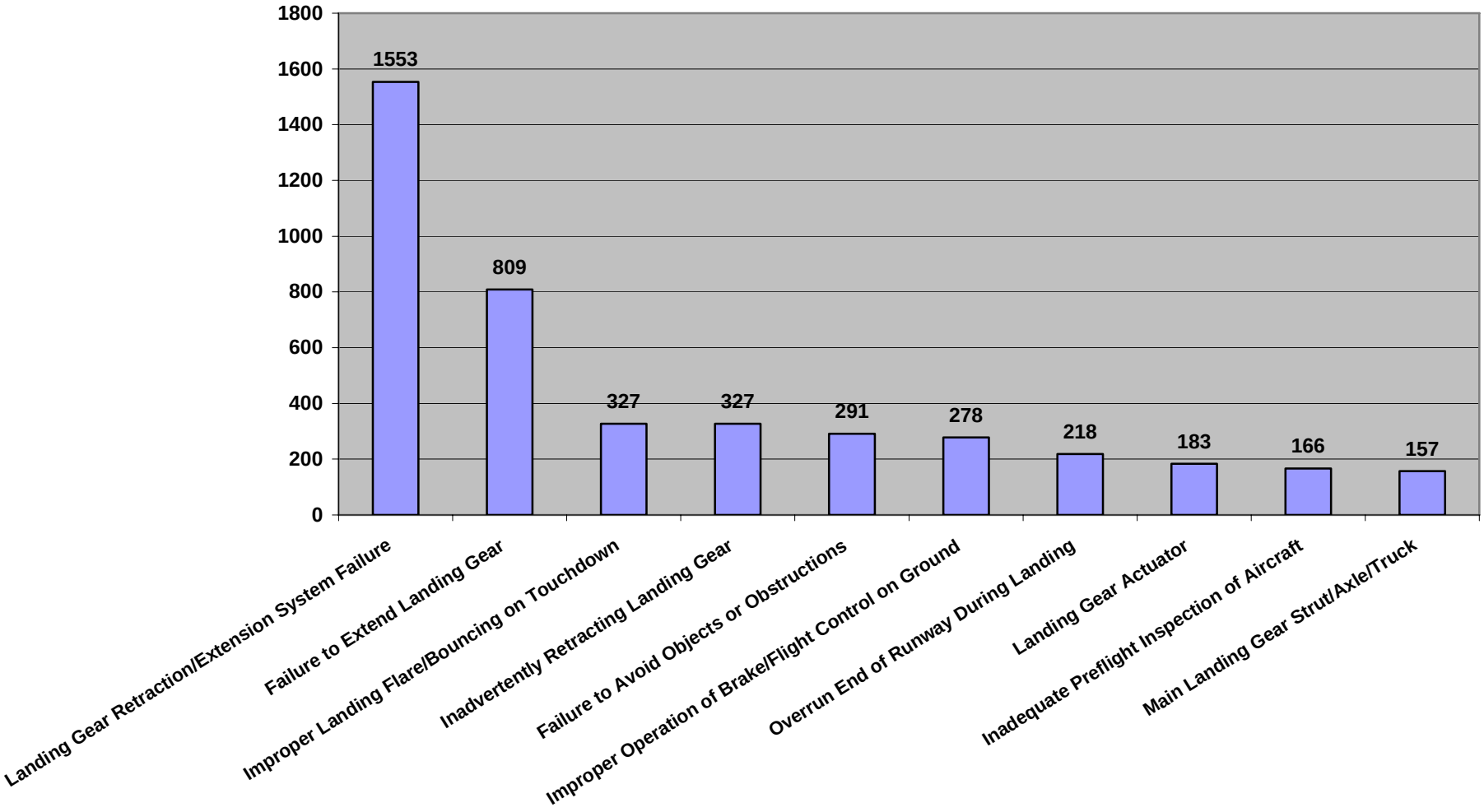
FAR Part 91 - All Engines - Piper



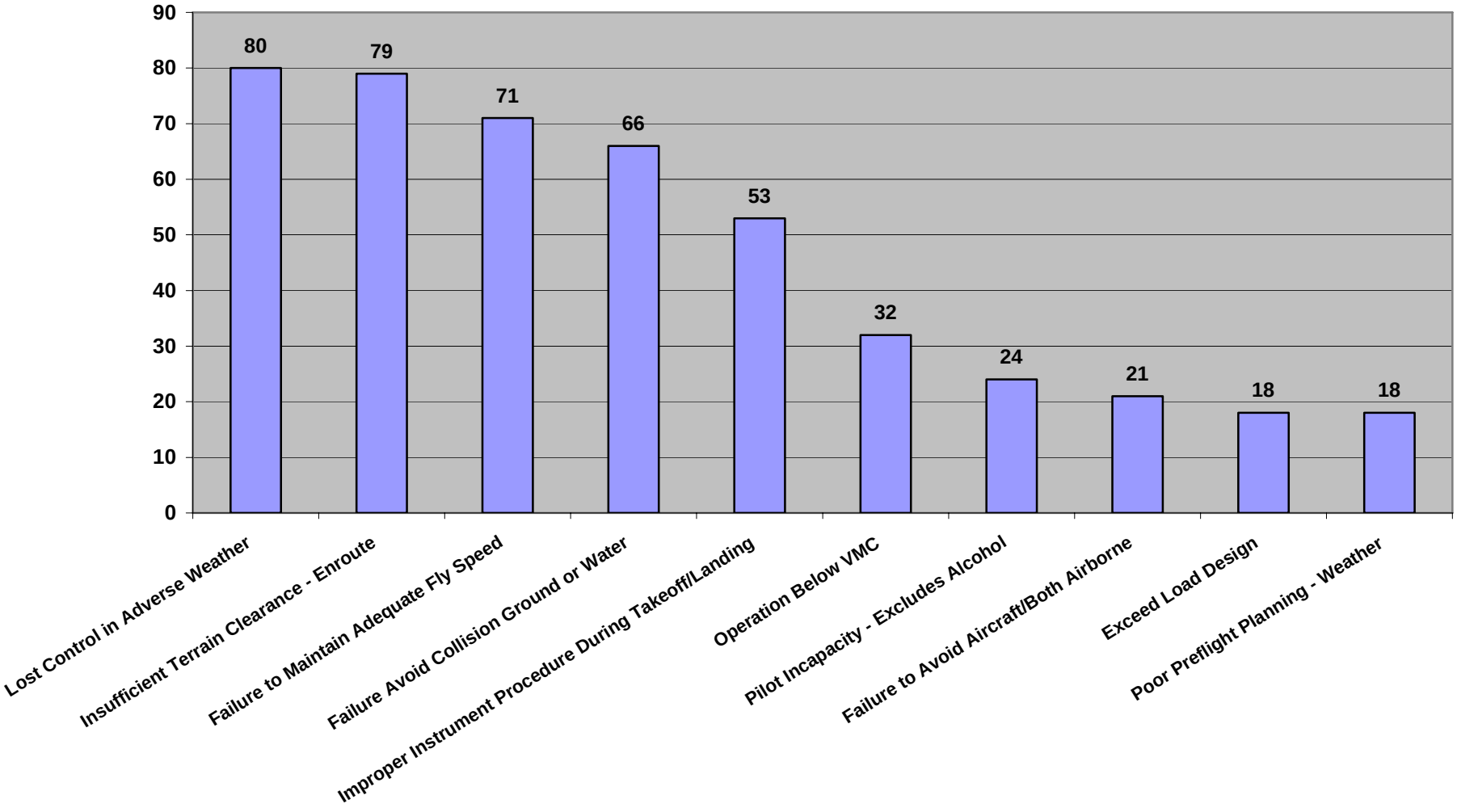
FAR Part 91 - All Engines - Beechcraft



FAR Part 91 - Multiple Engine



FAR Part 91 - Multiple Engine - Fatal



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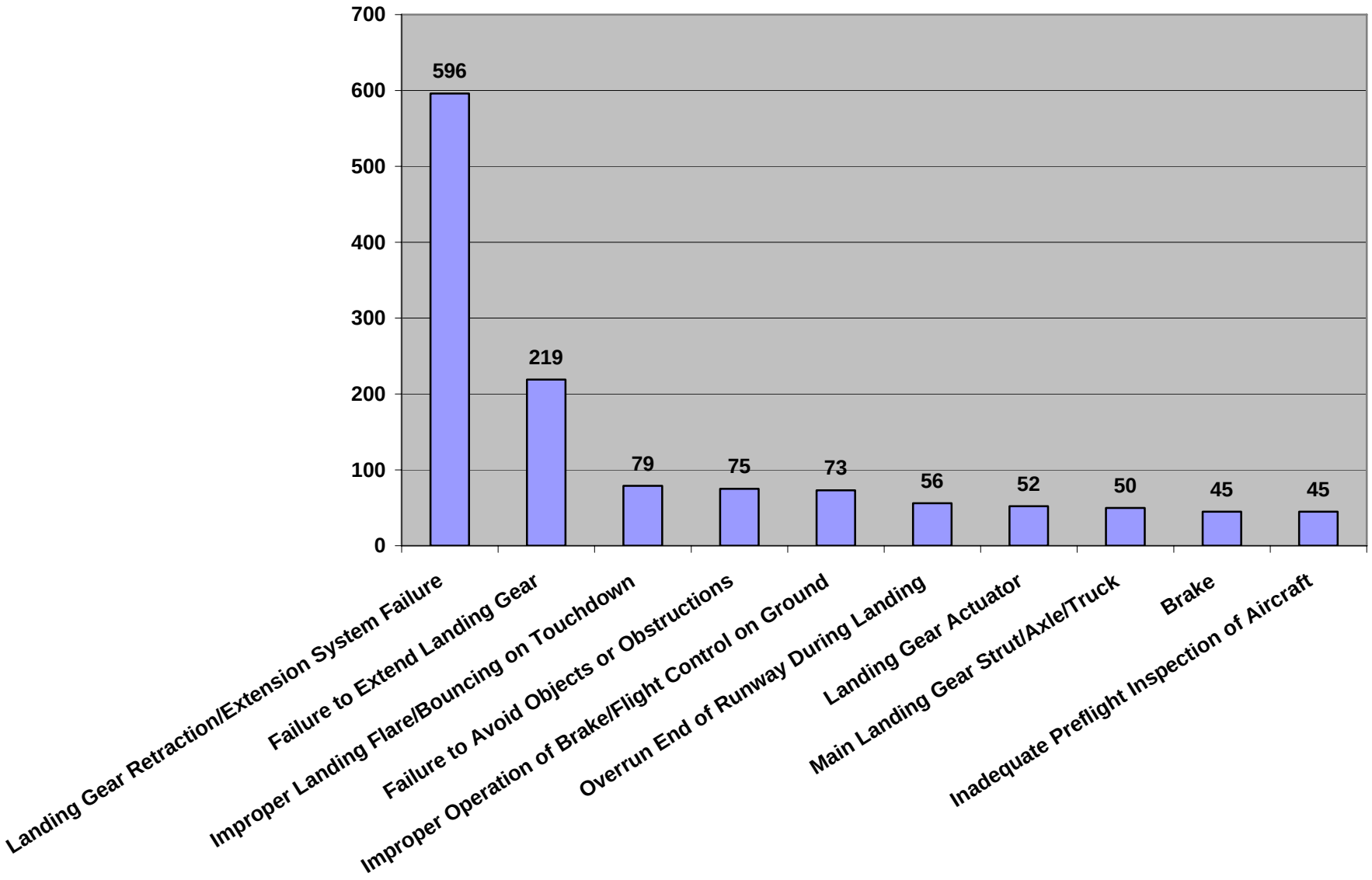
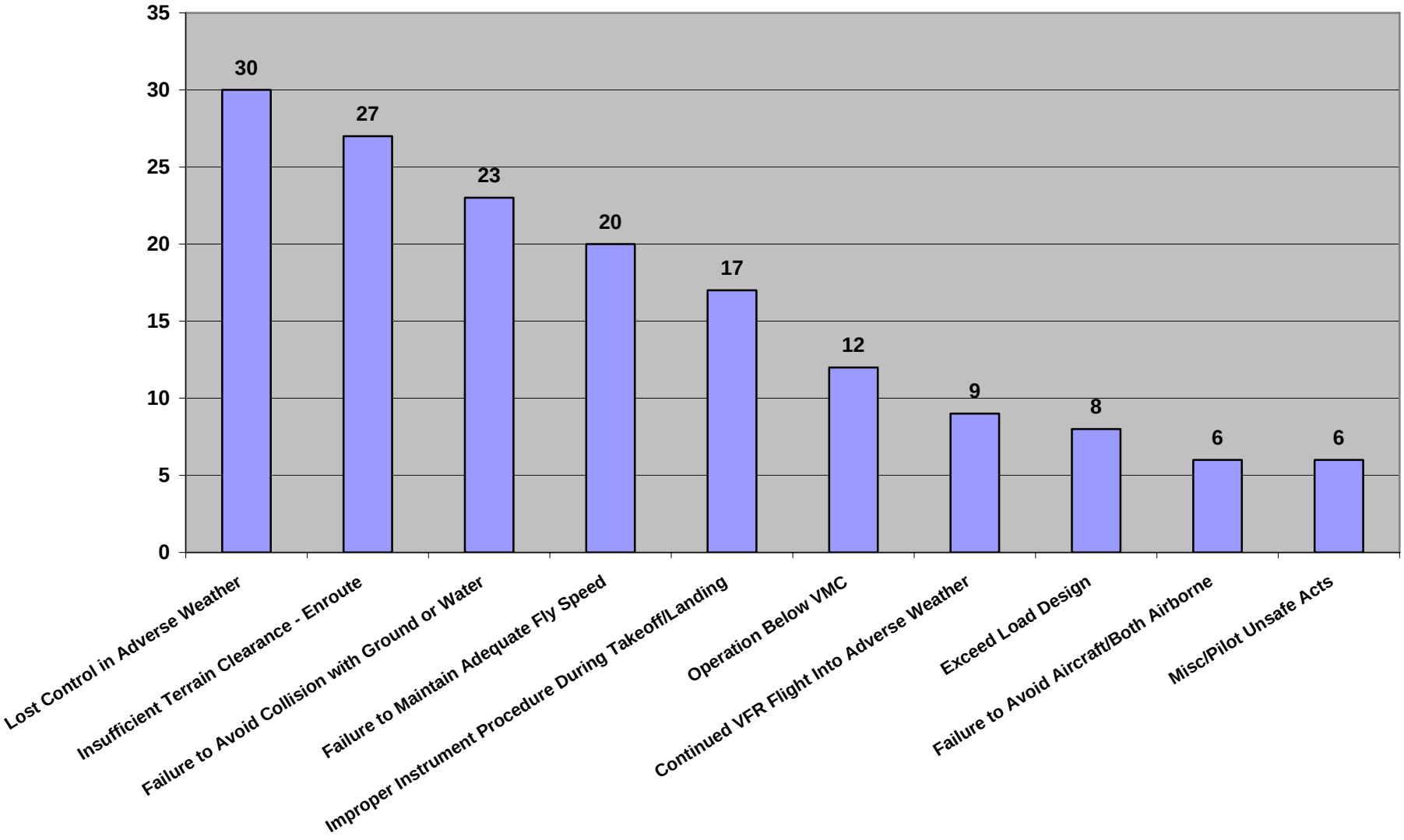


FAR Part 91 - Multiple Engine - Fatal - Cessna



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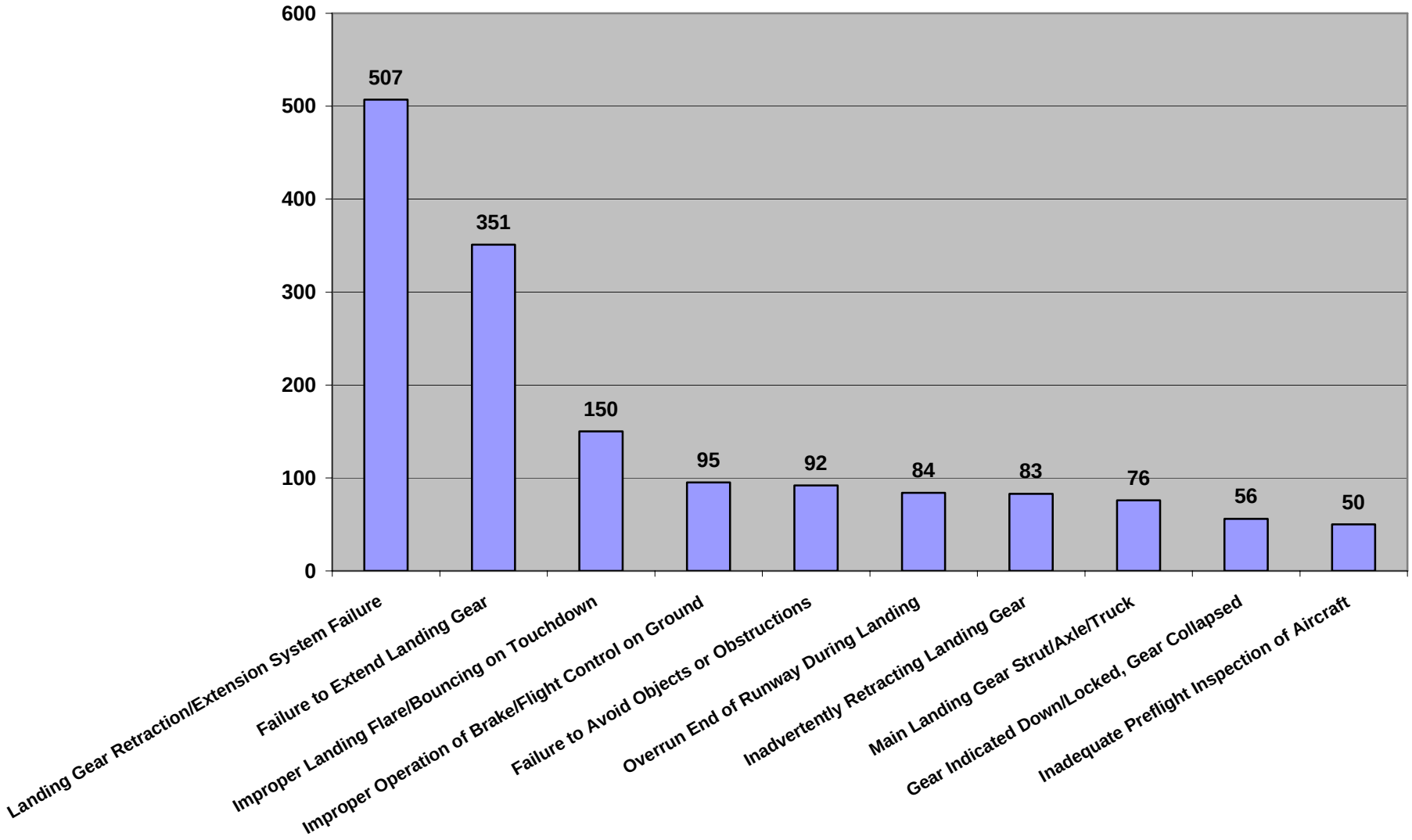
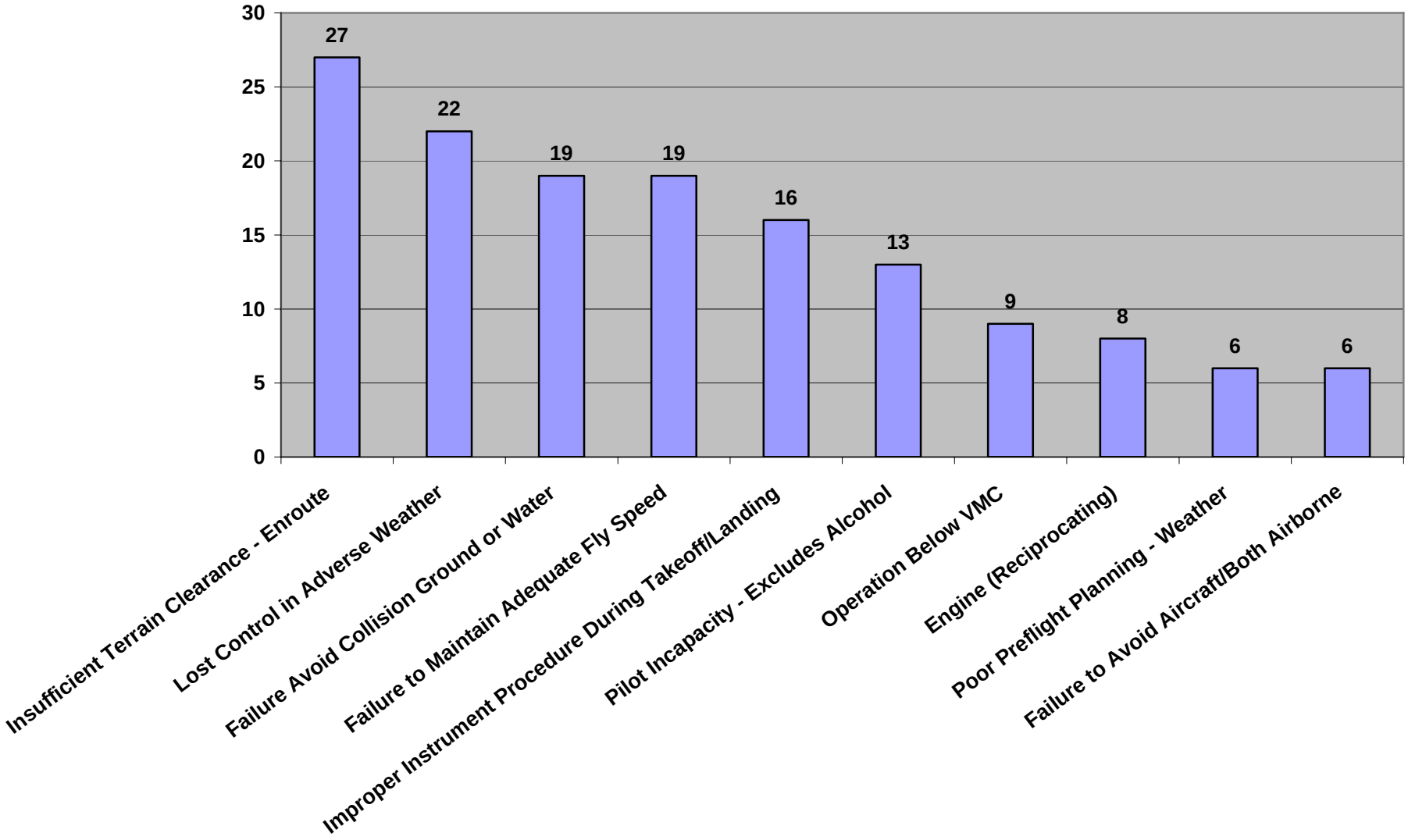
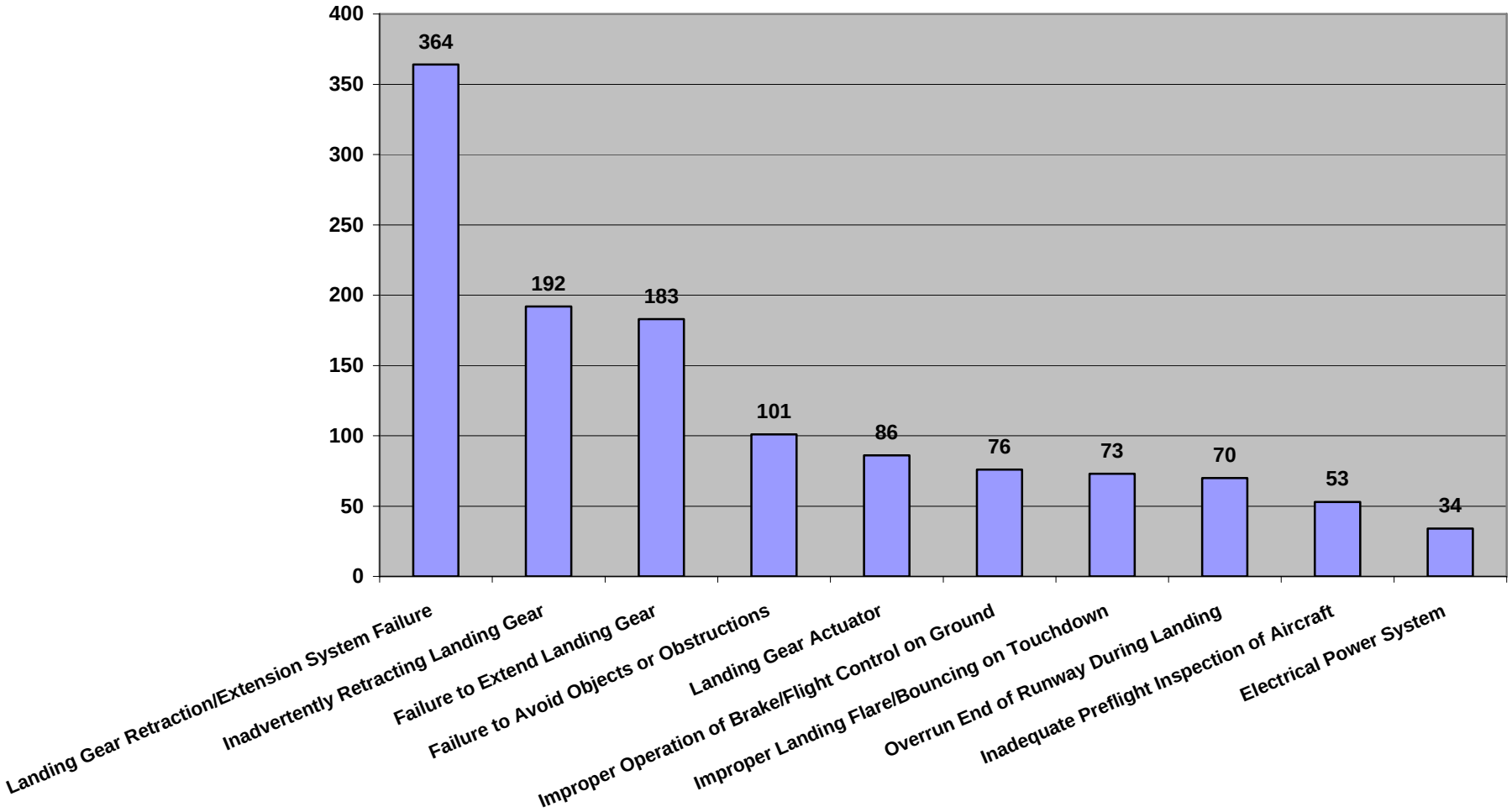


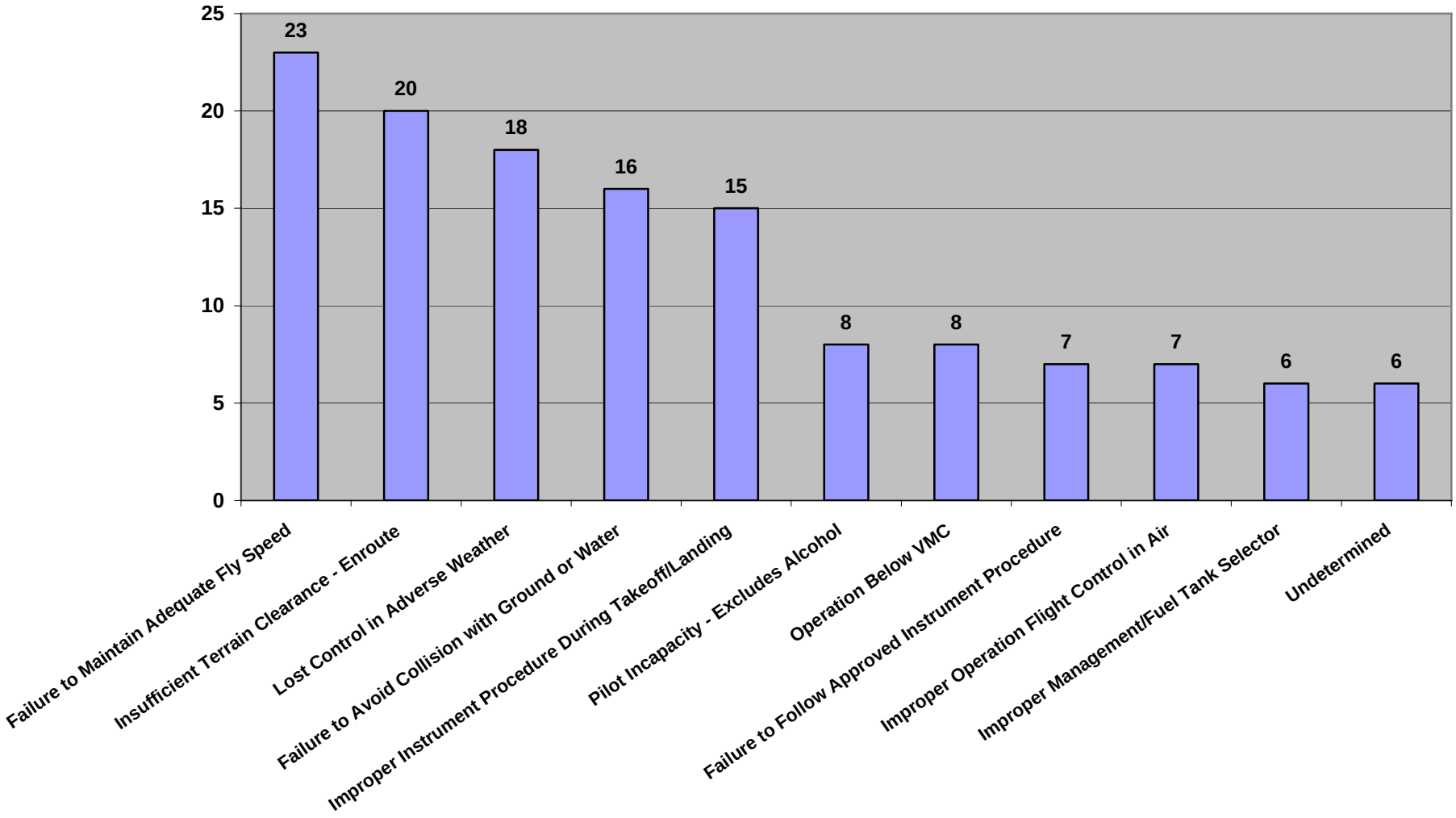
FAR Part 91 - Multiple Engine - Fatal - Piper



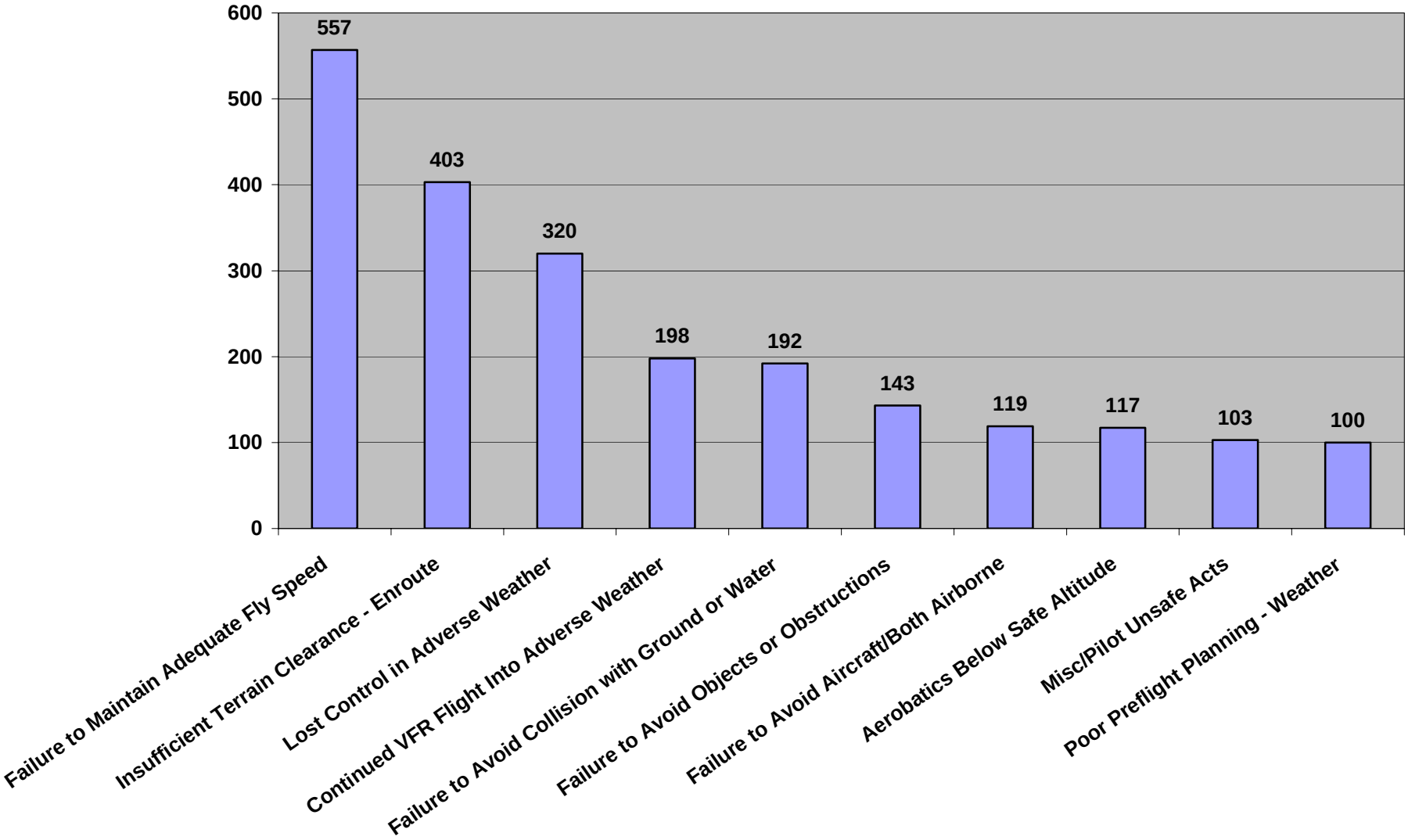
FAR Part 91 - Multiple Engine - Beechcraft



FAR Part 91 - Multiple Engine - Fatal - Beechcraft



FAR Part 91 - Single Engine - Fatal



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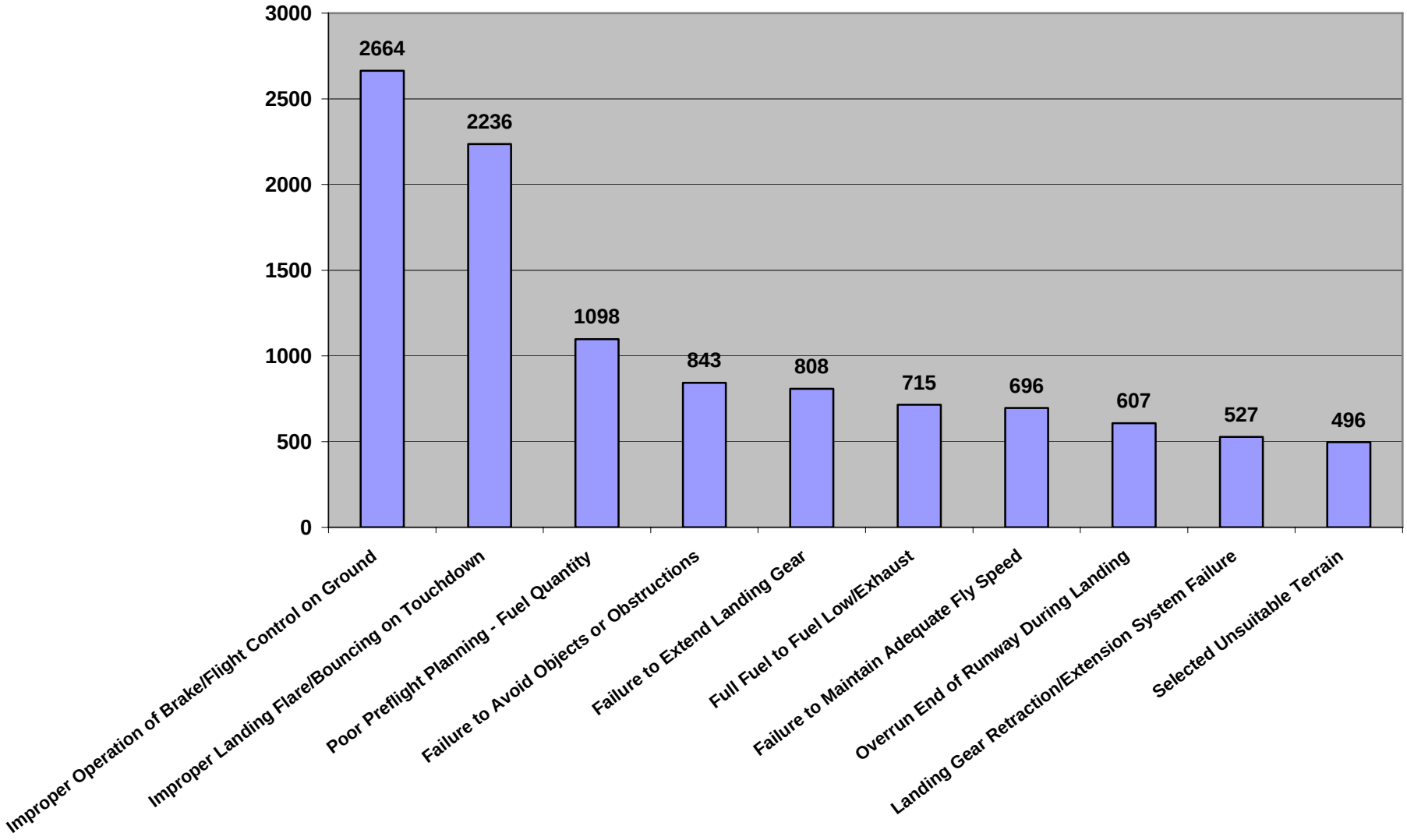

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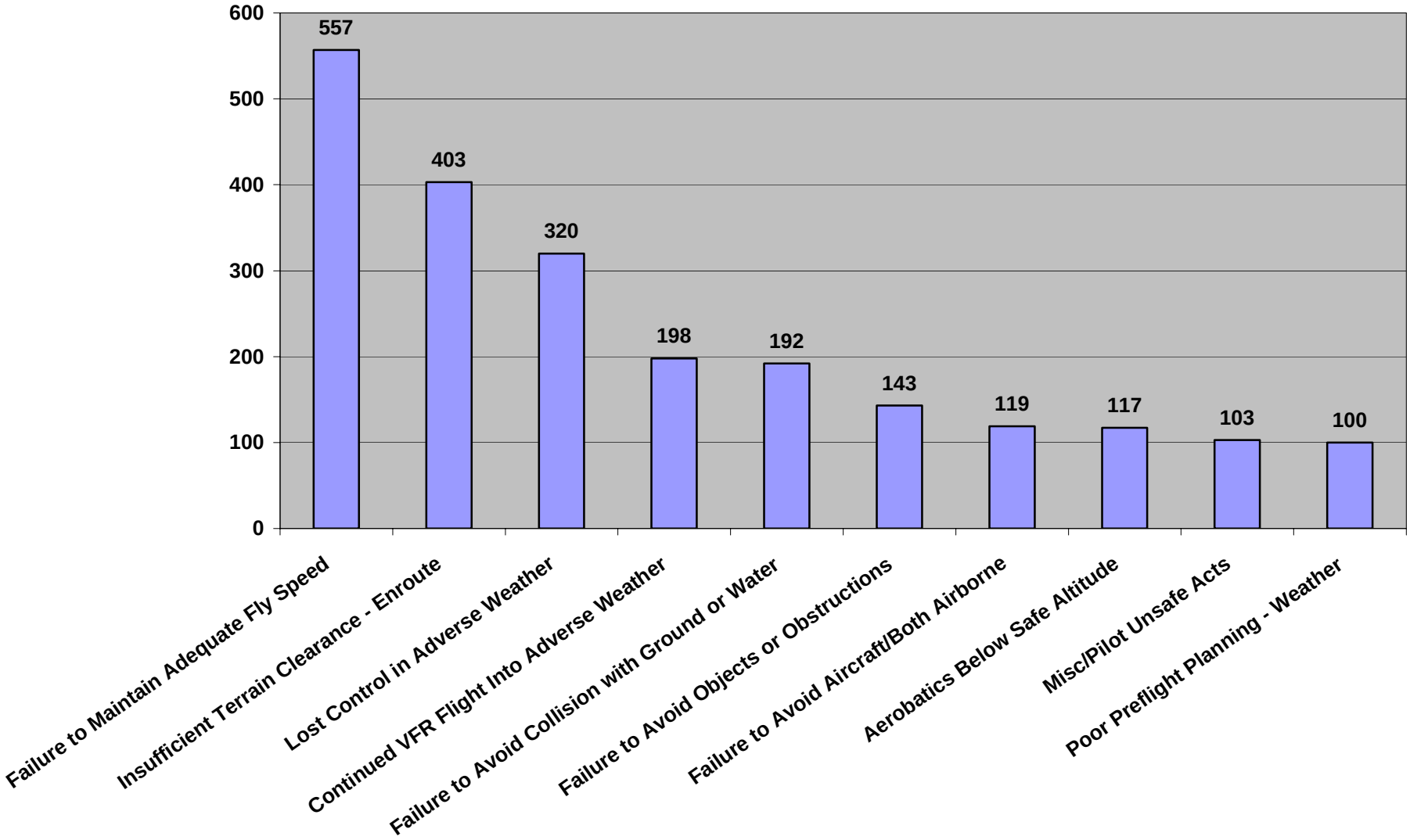
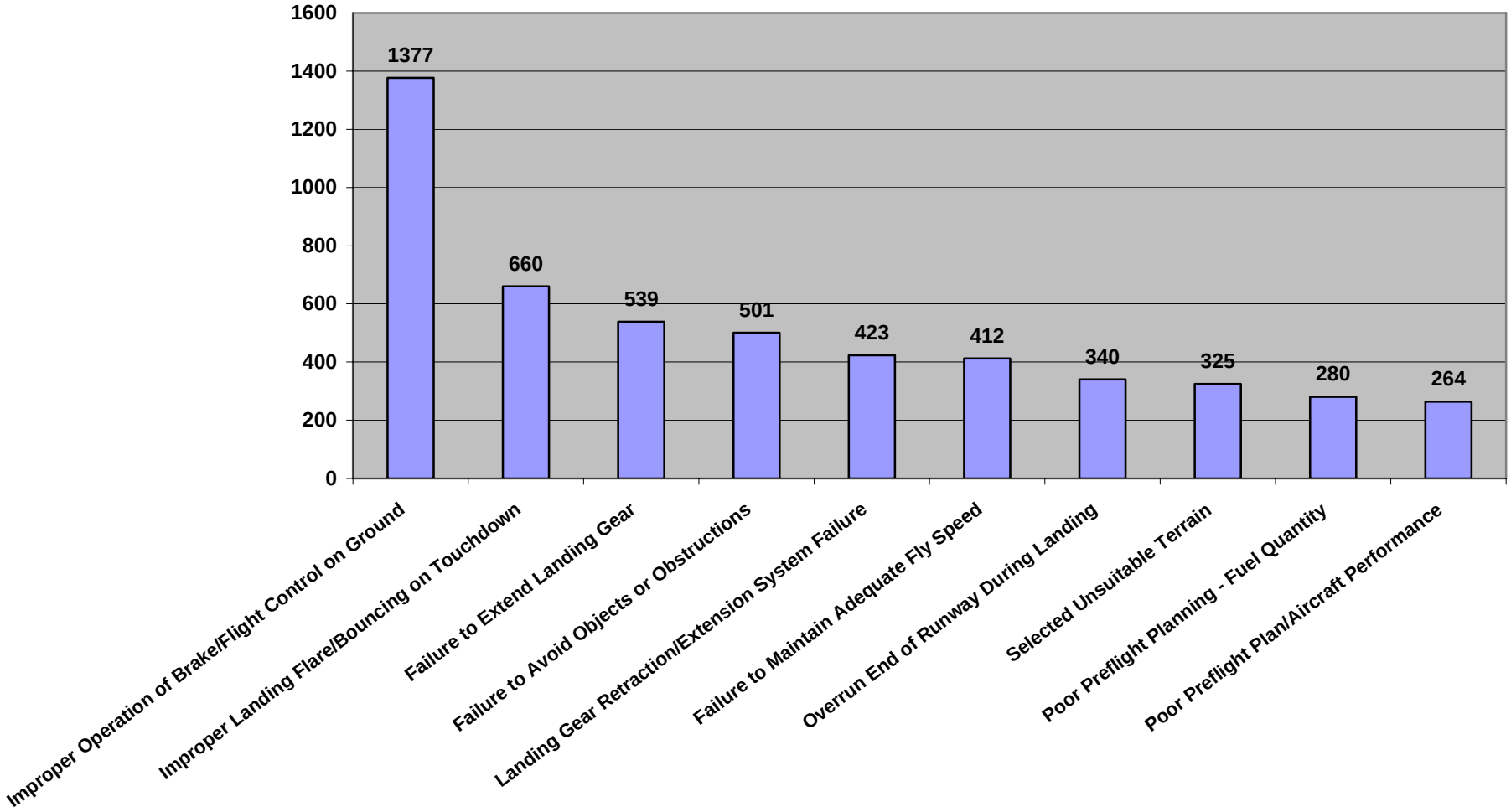
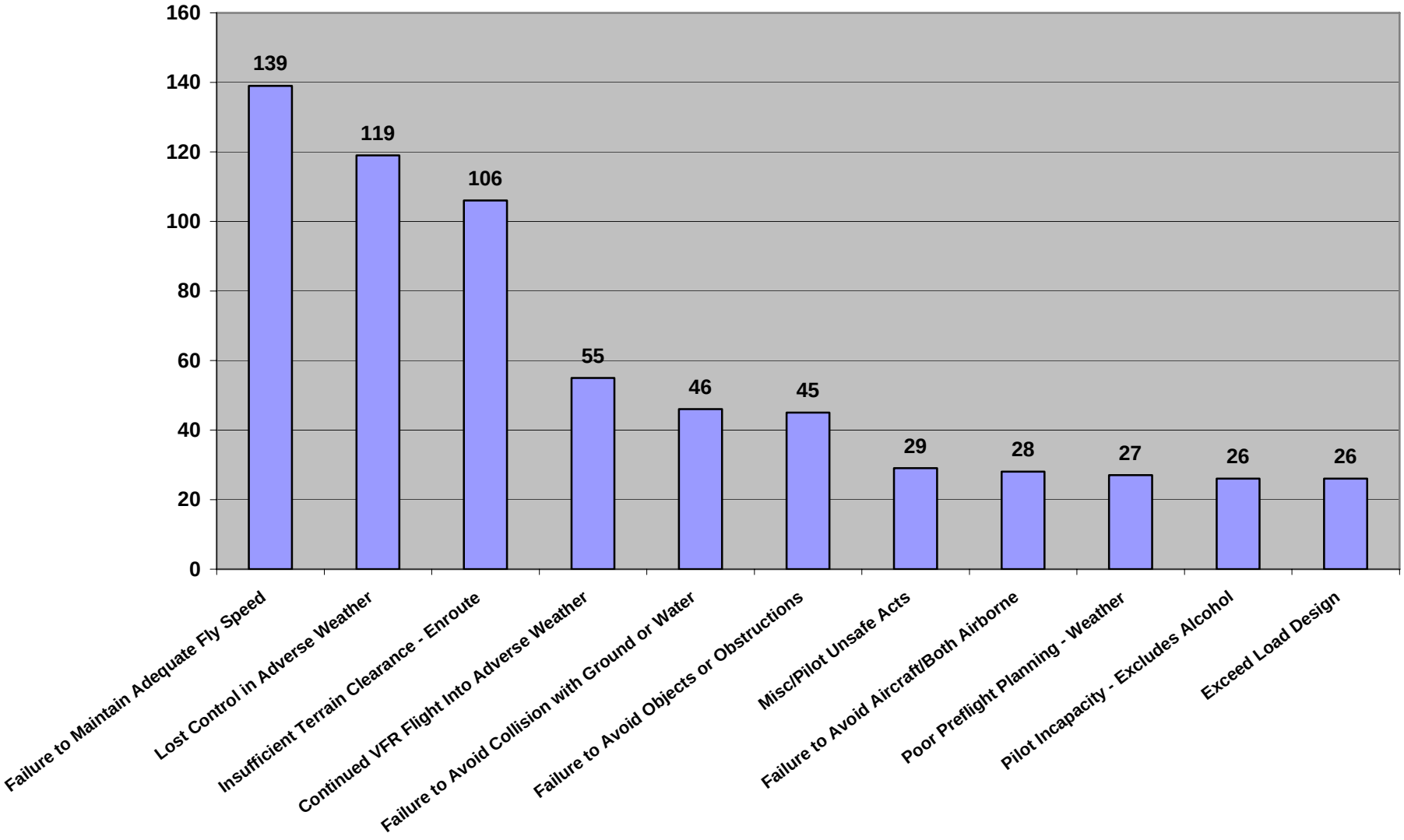


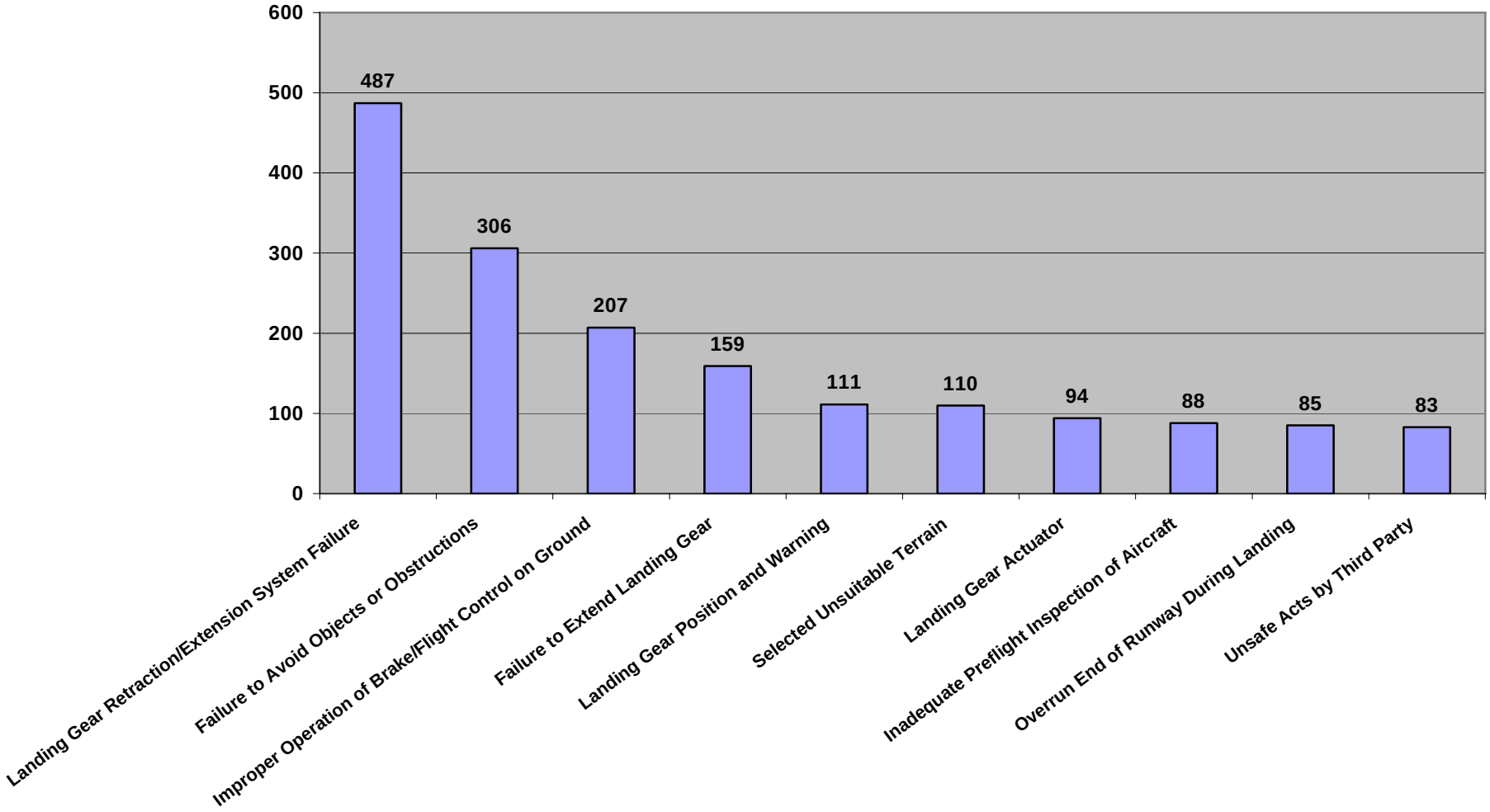
FAR Part 91 - Single Engine - Piper



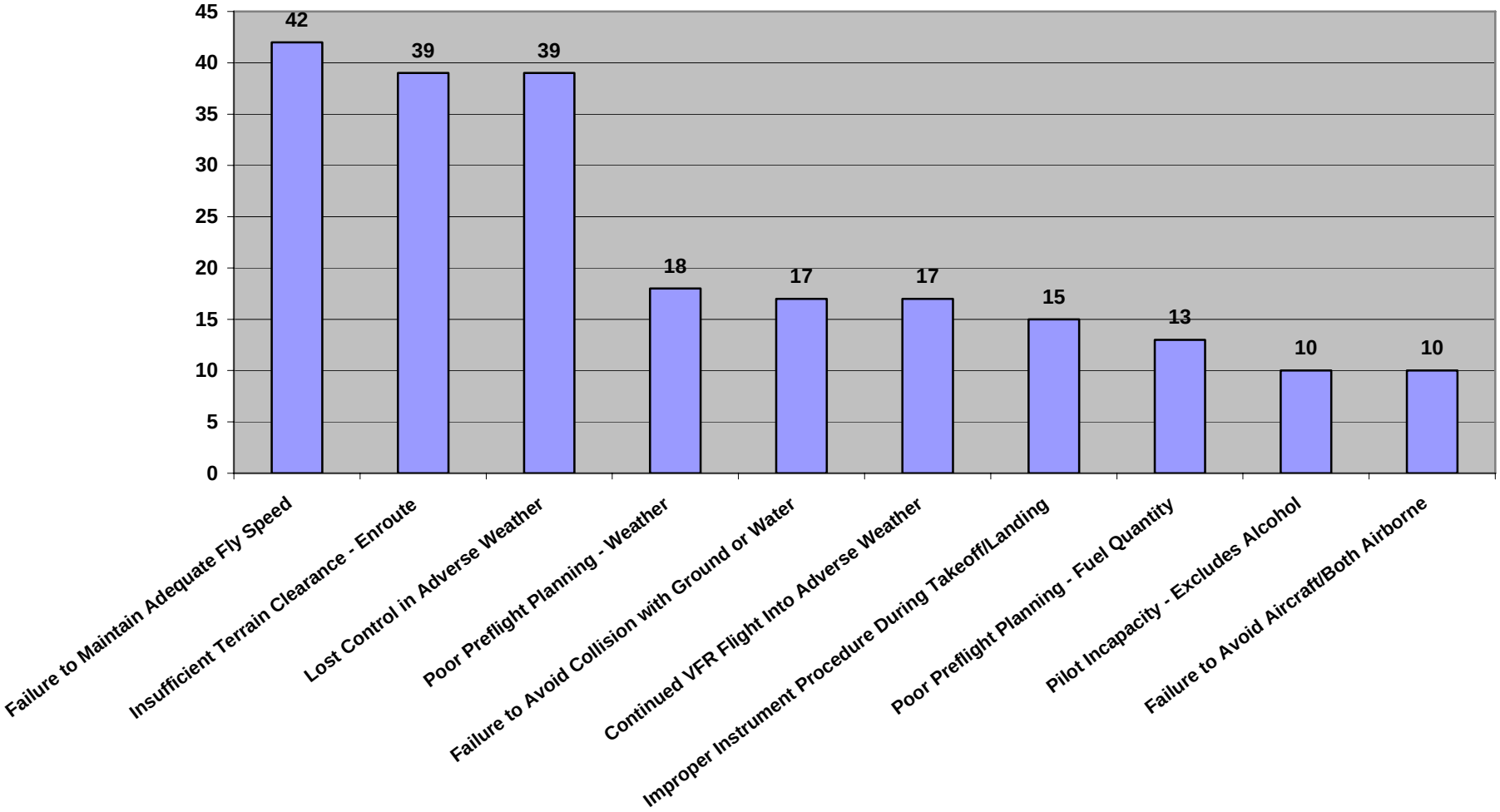
FAR Part 91 - Single Engine - Fatal - Piper



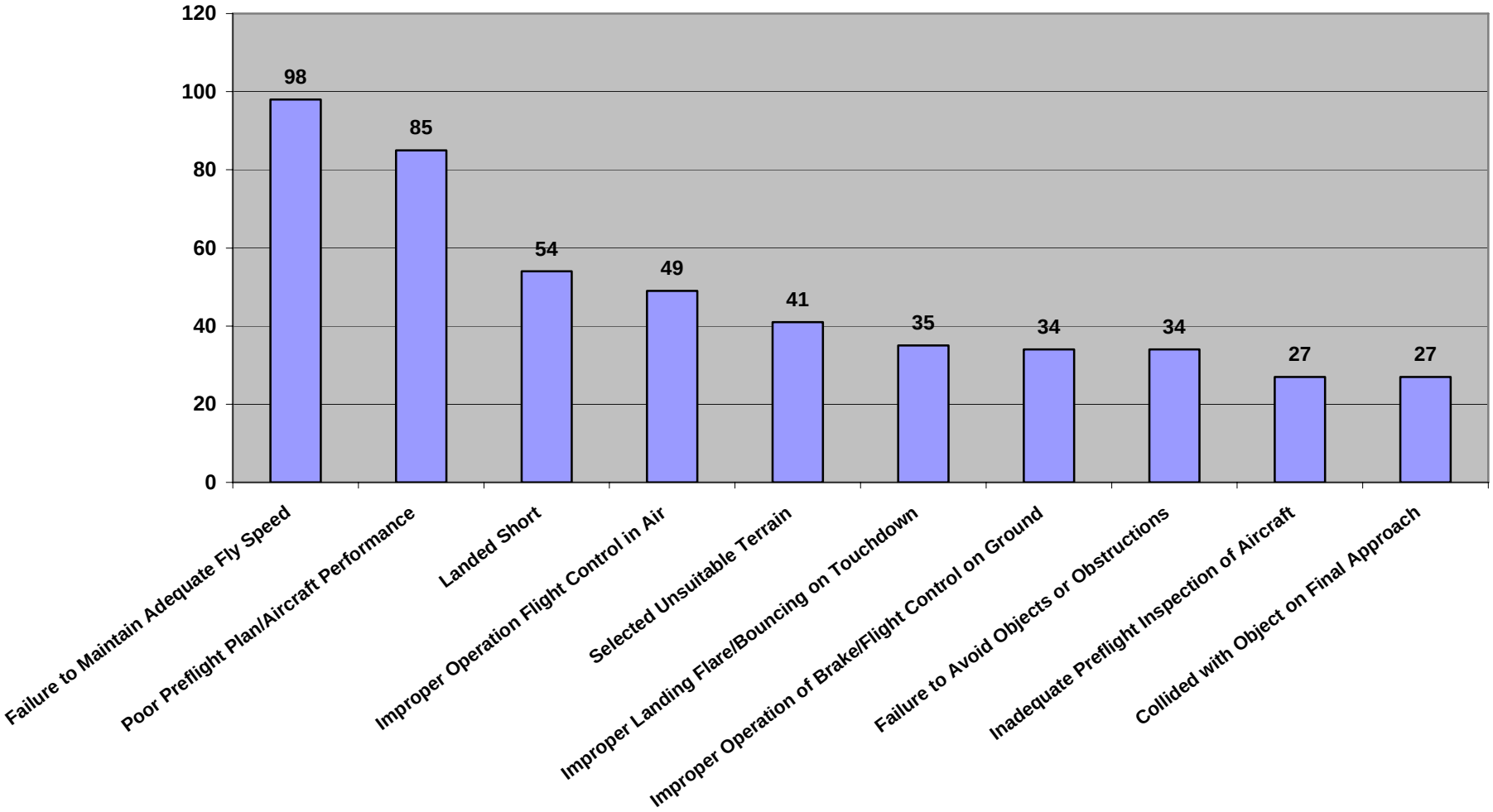
FAR Part 135 - All Engines



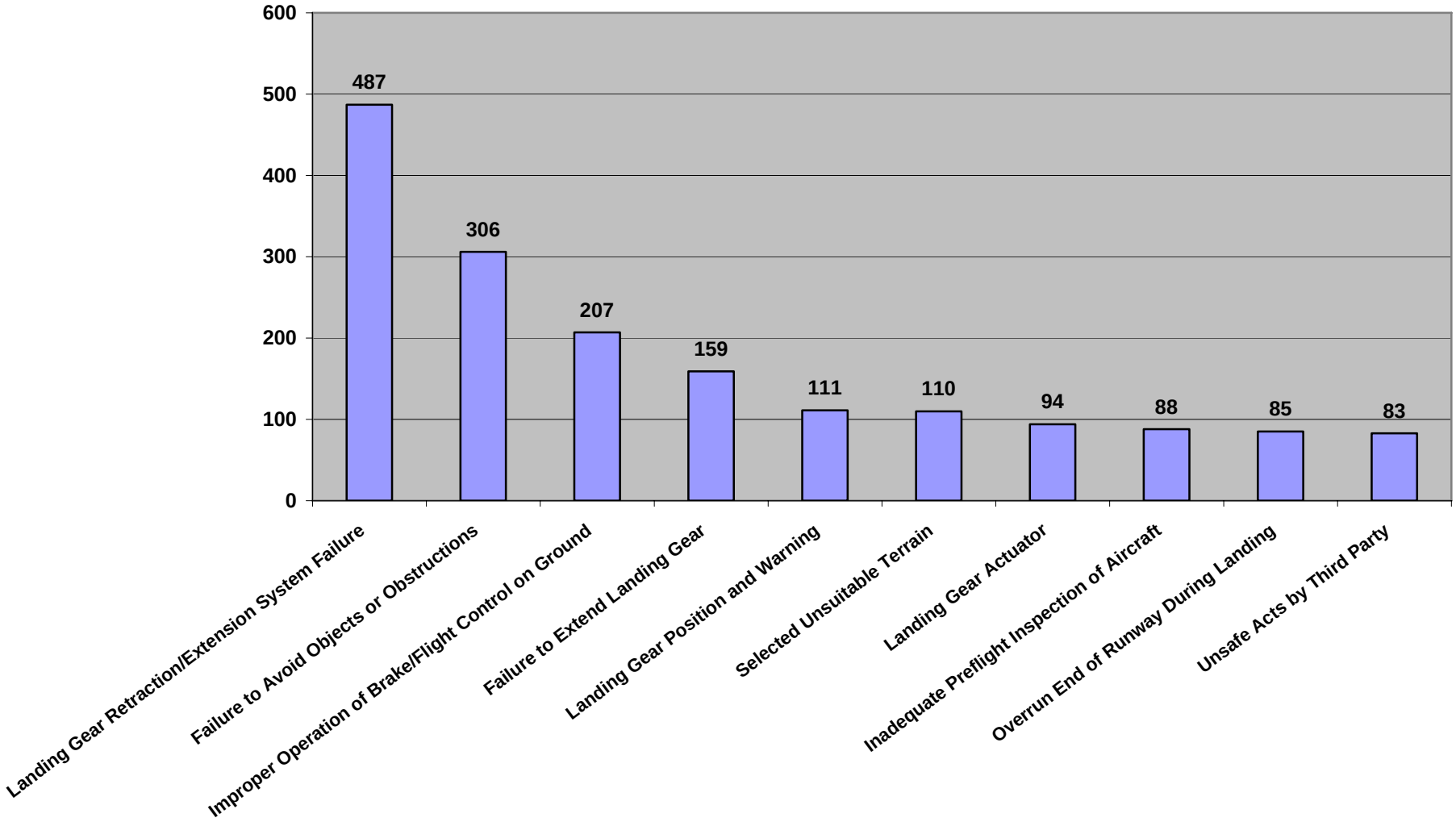
FAR Part 91 - Single Engine - Fatal Beechcraft



FAR Part 91 - Gliders



FAR Part 135 - All Engines



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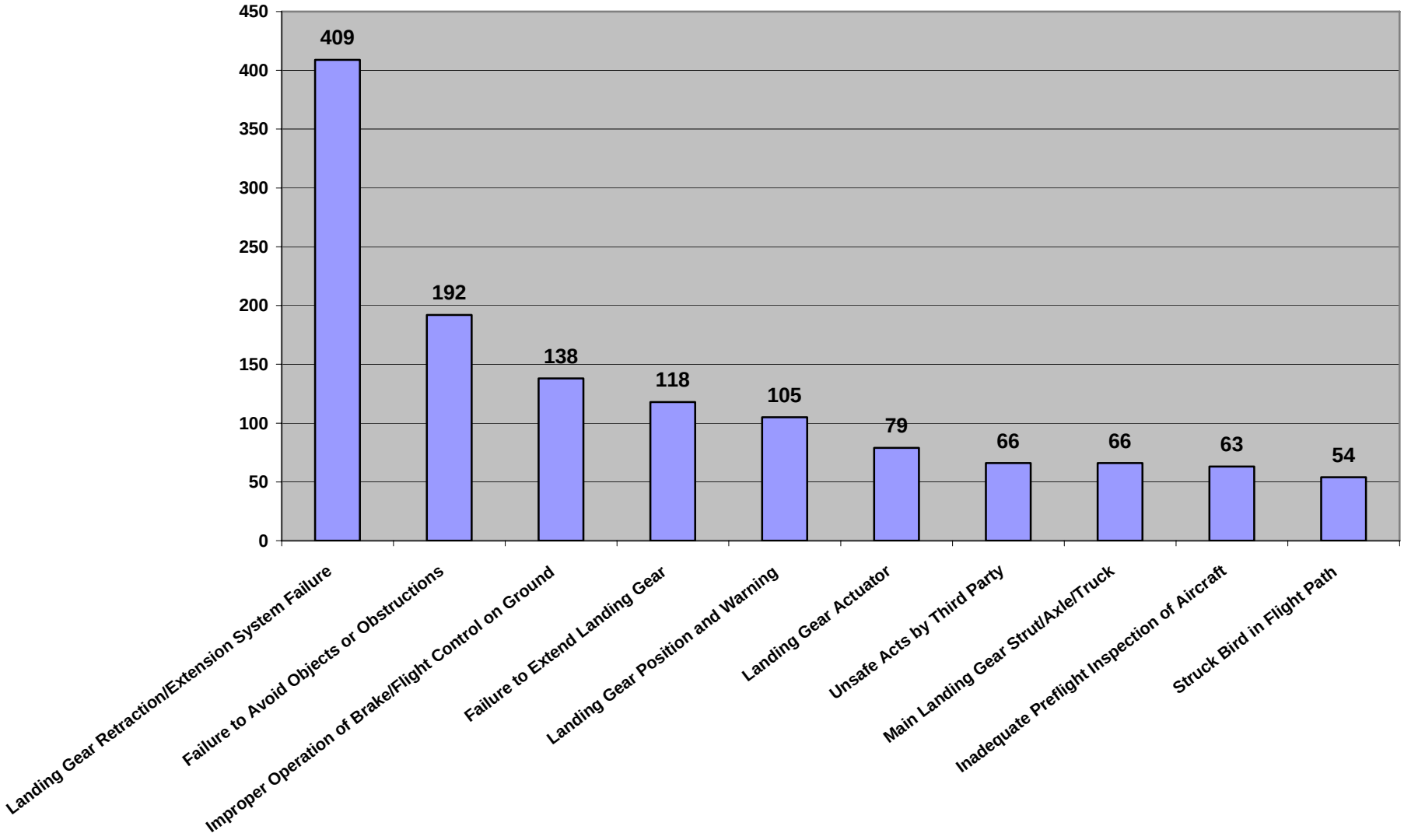
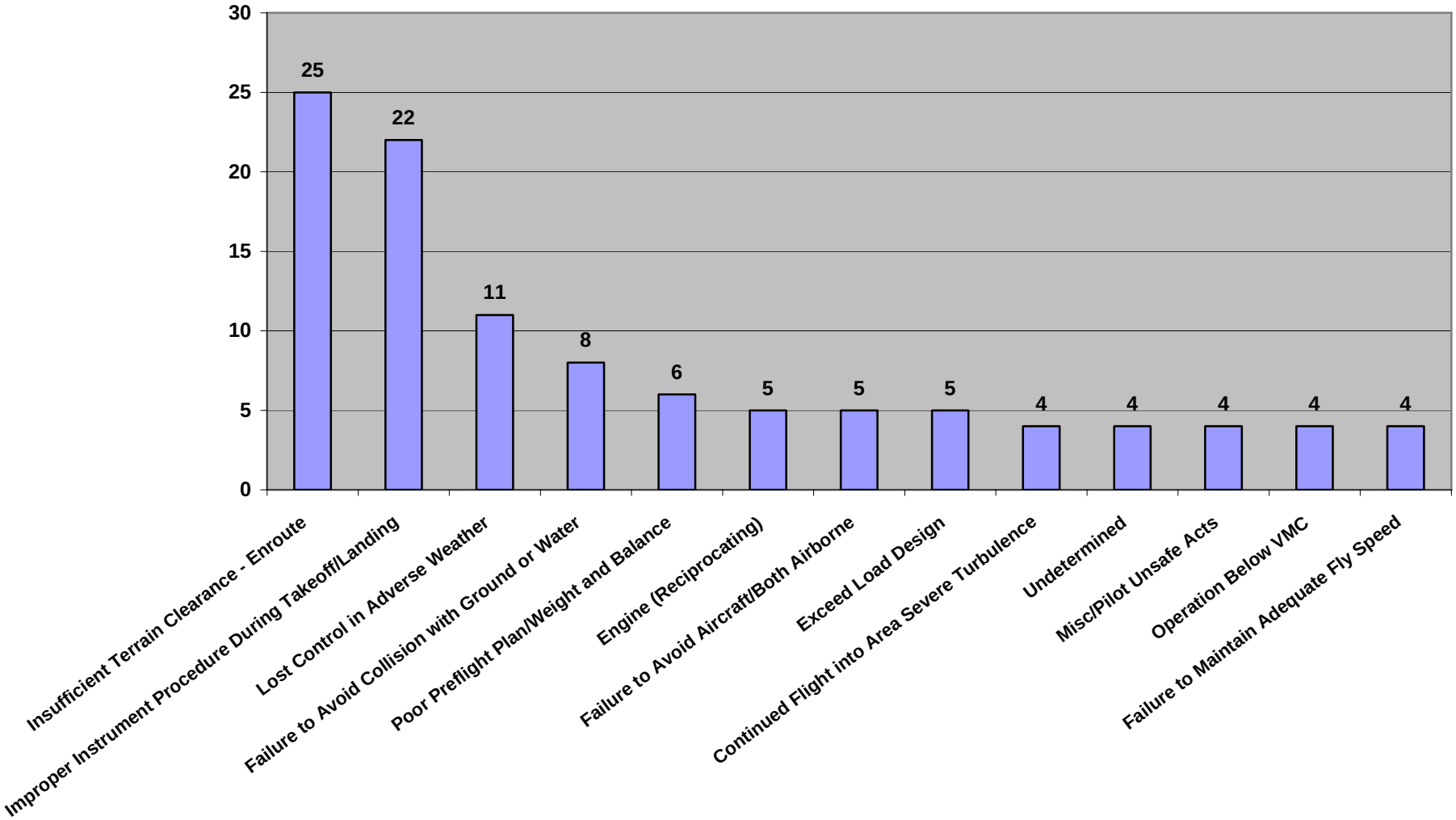
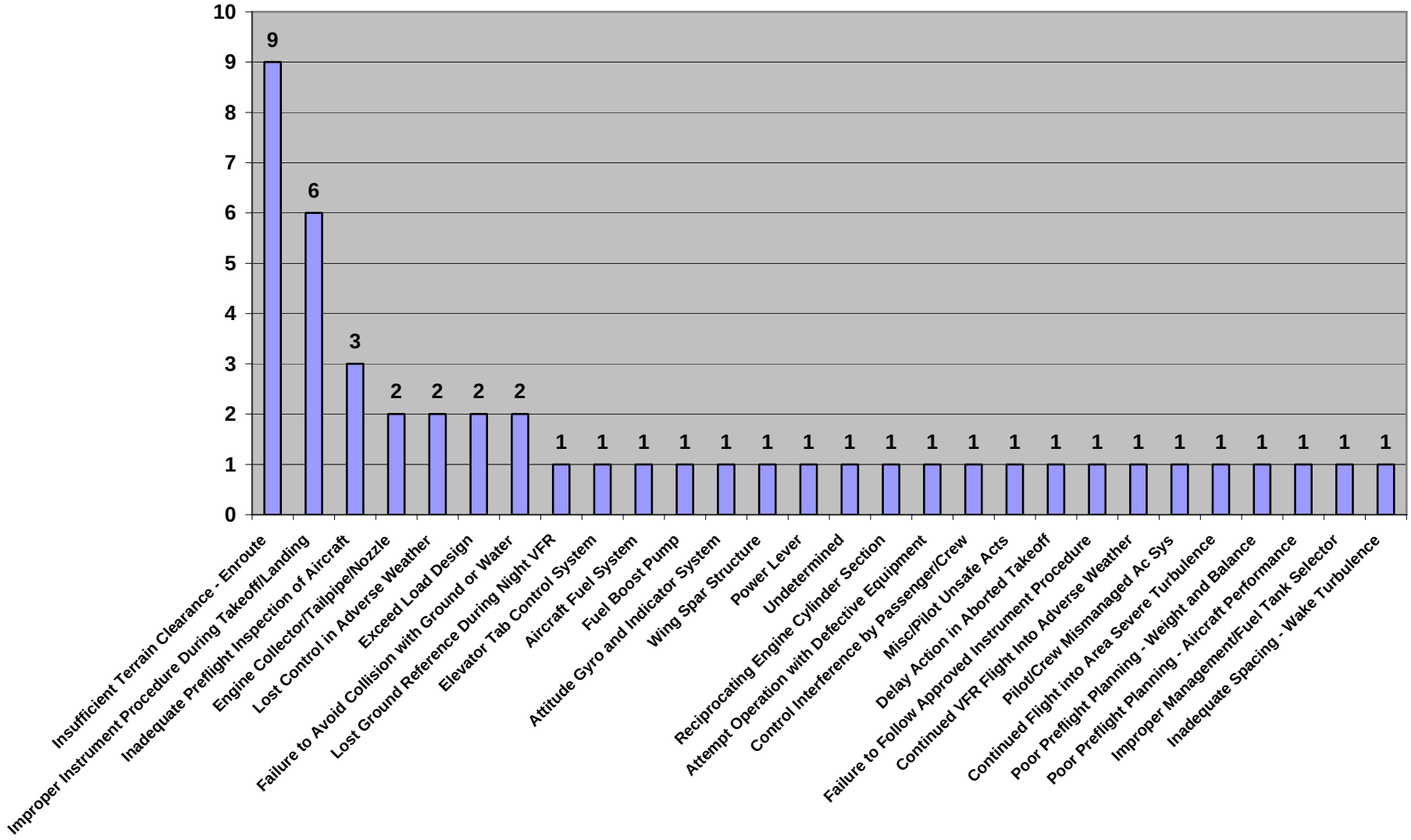


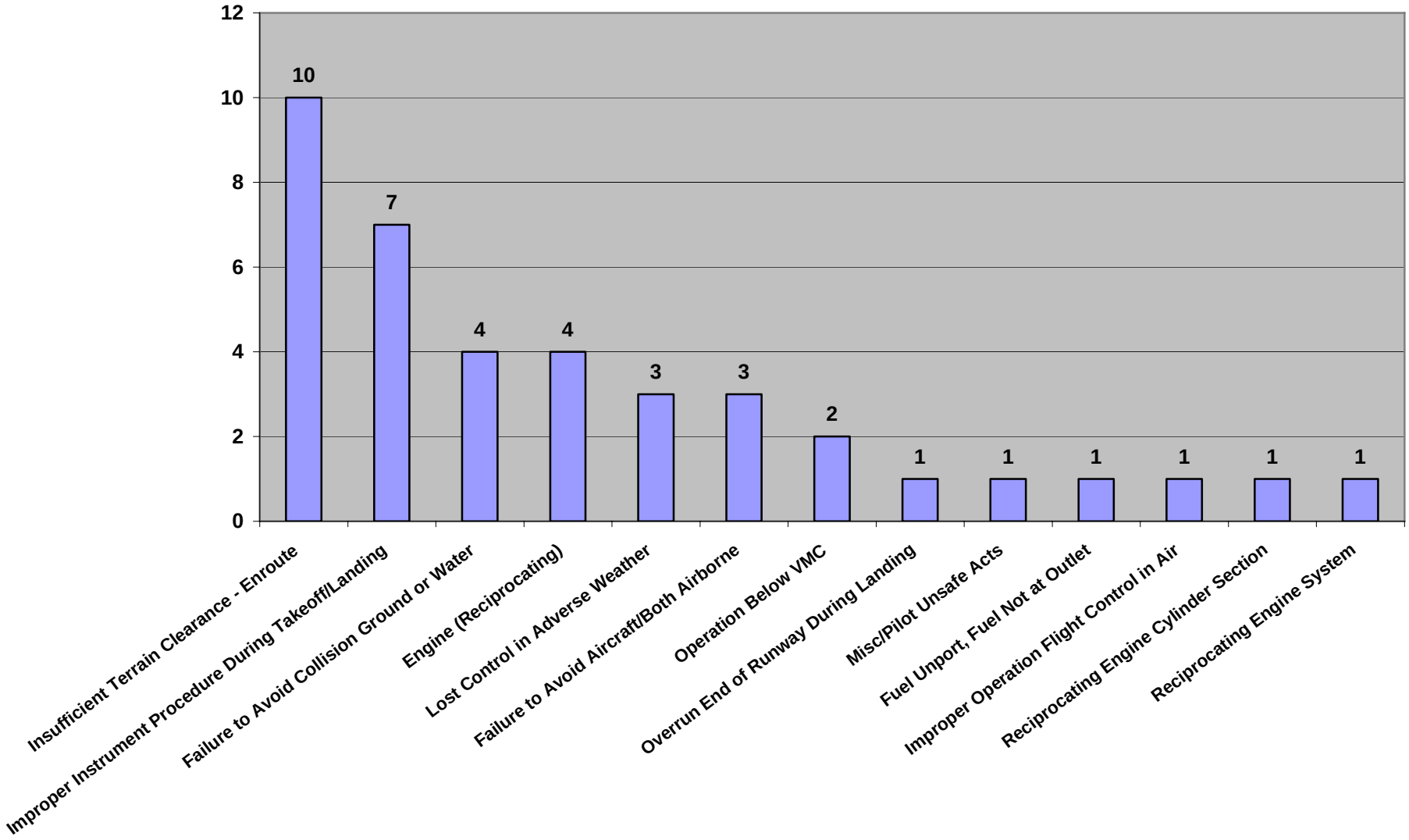
FAR Part 135 - Multiple Engine - Fatal



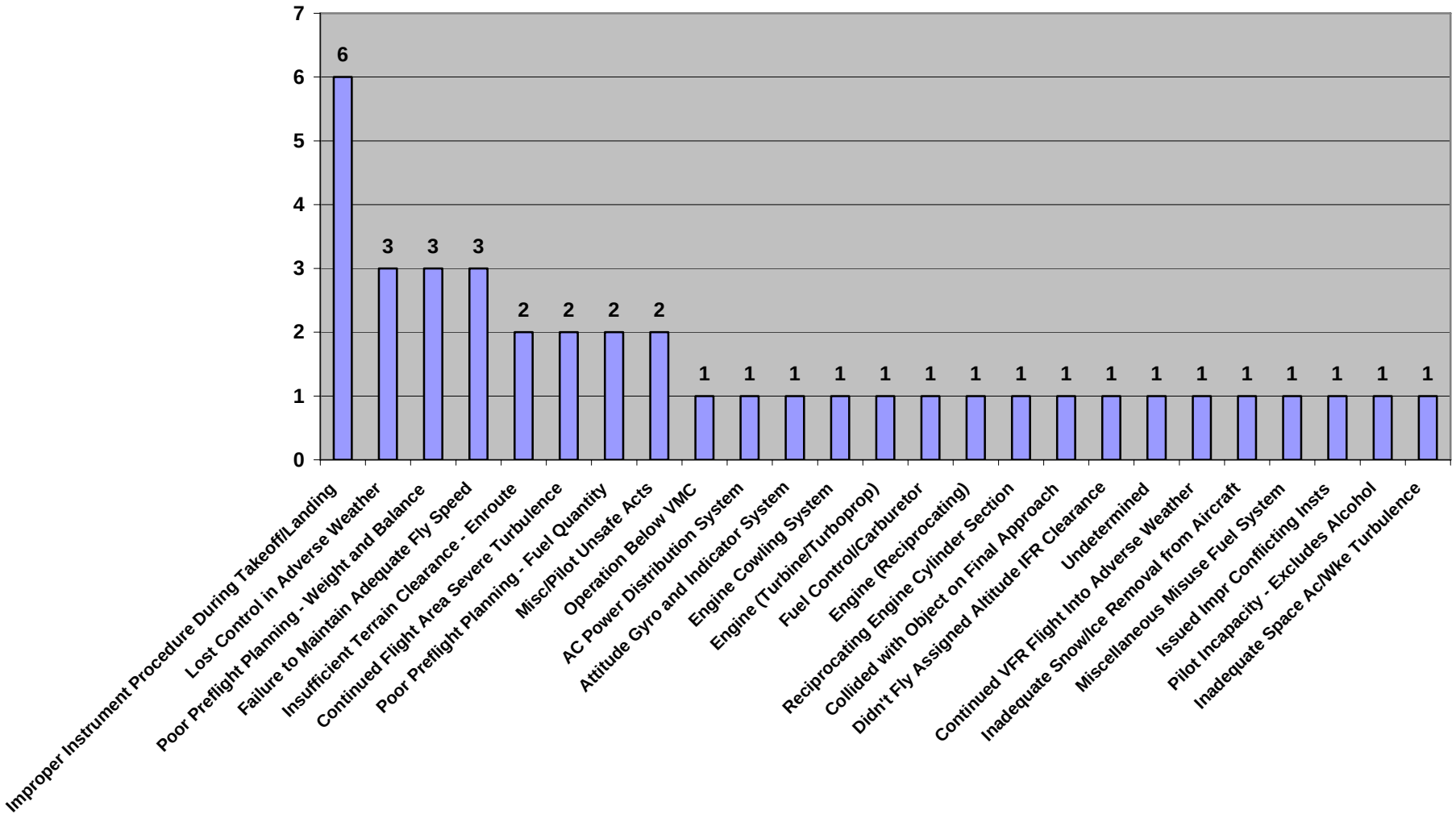
FAR Part 135 - Multiple Engine - Fatal - Cessna



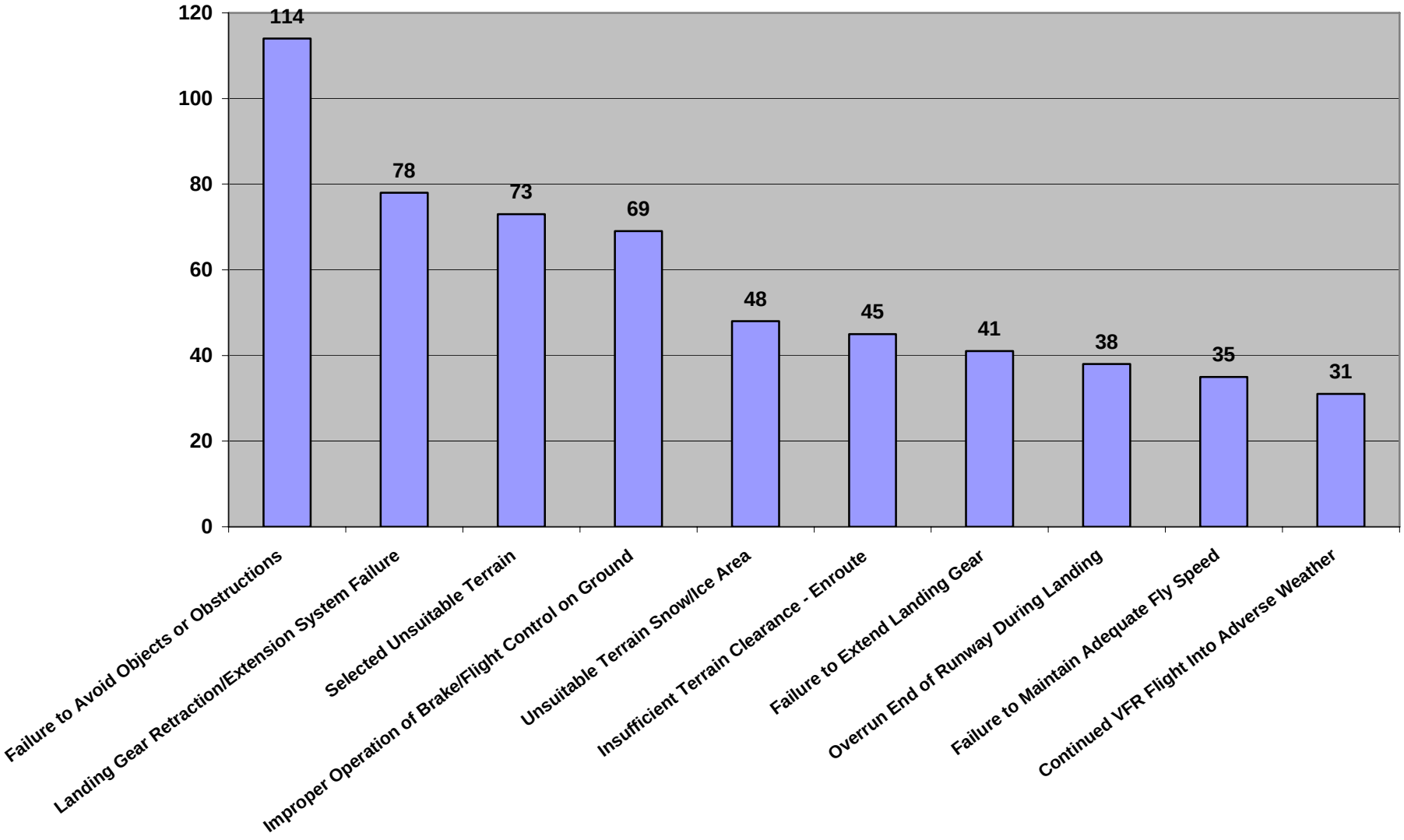
FAR Part 135 - Multiple Engine - Fatal - Piper



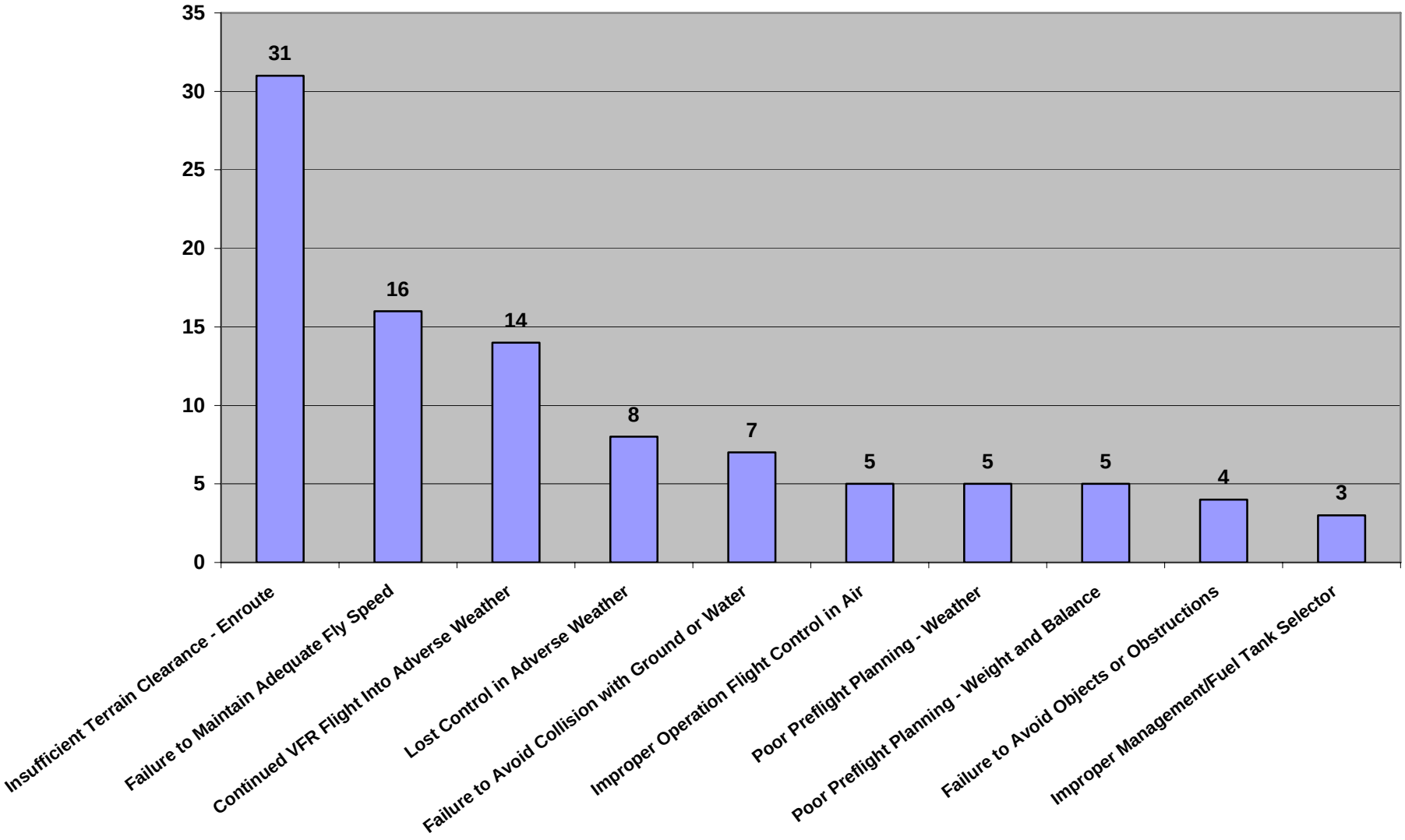
FAR Part 135 - Multiple Engine - Fatal - Beechcraft



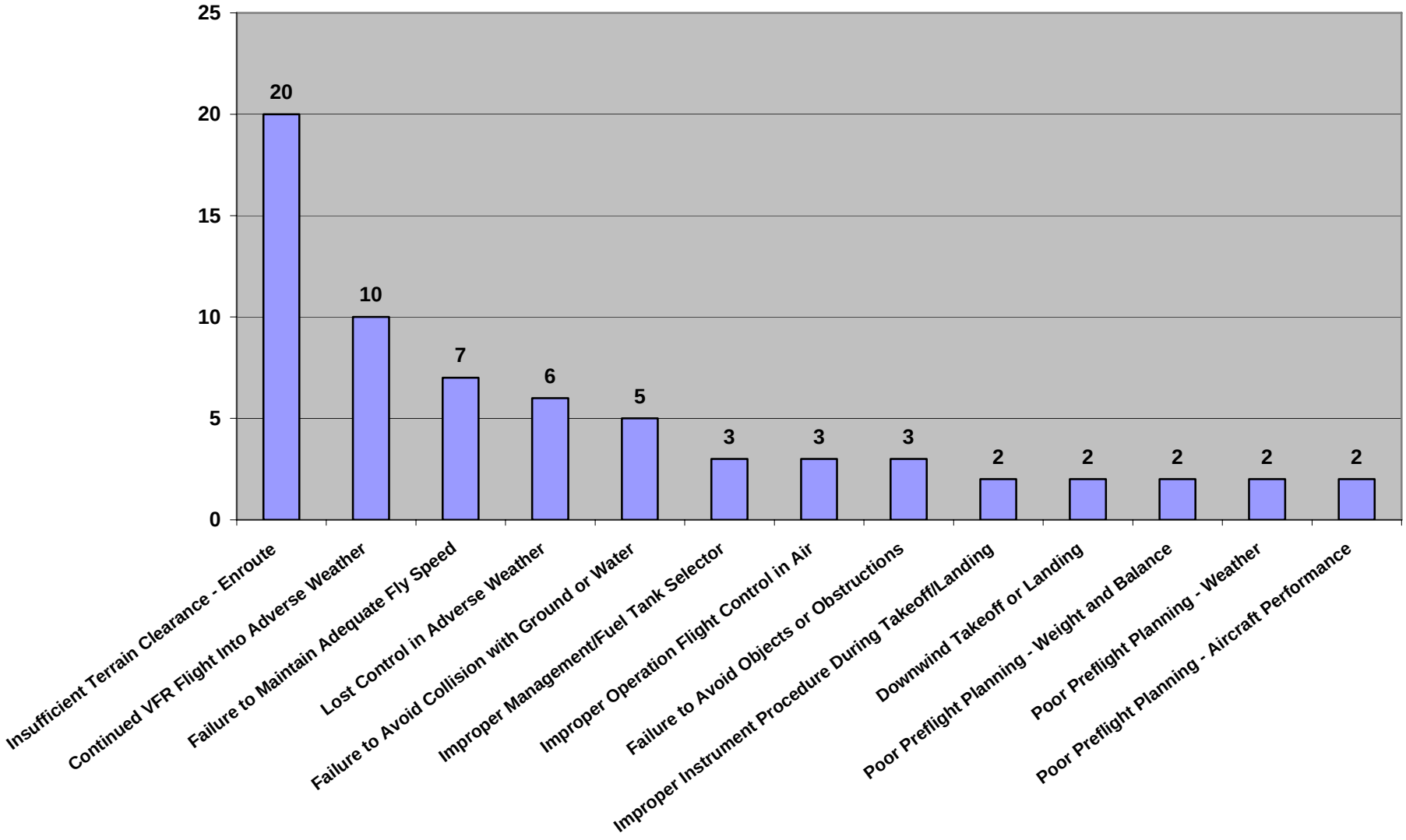
FAR Part 135 - Single Engine



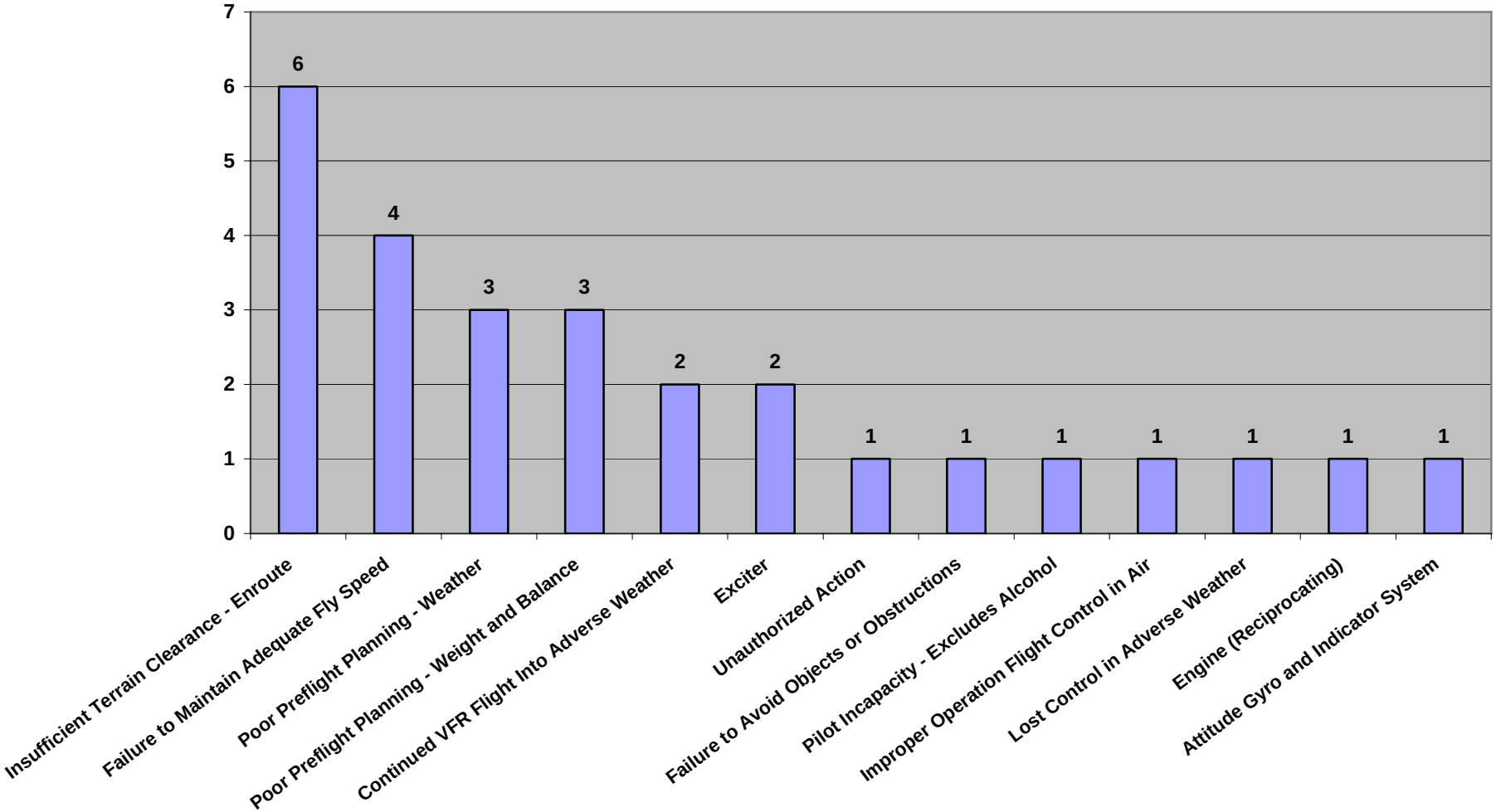
FAR Part 135 - Single Engine - Fatal



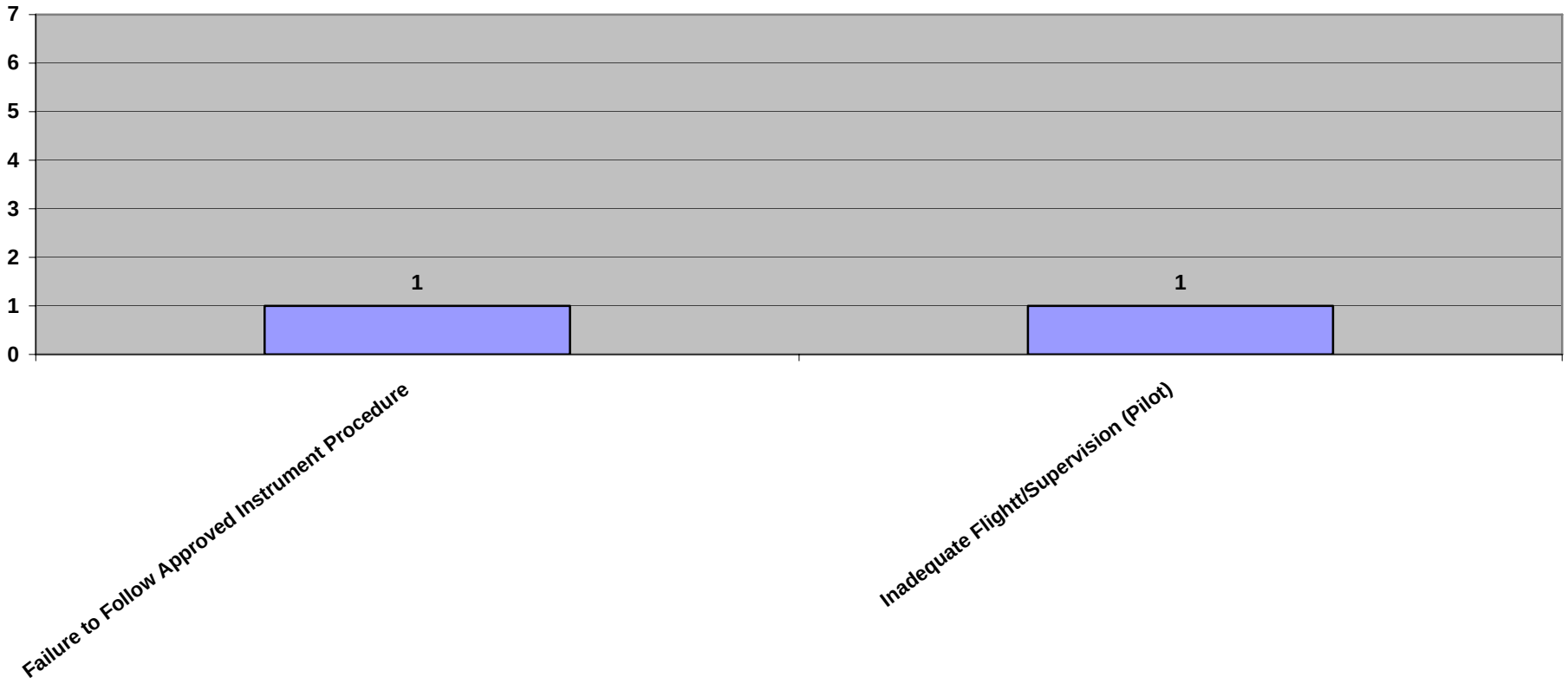
FAR Part 135 - Single Engine - Fatal - Cessna



FAR Part 135 - Single Engine - Fatal - Piper



FAR Part 135 - Single Engine - Fatal - Beechcraft



Appendix

FAR Part 91 - All Engines

Improper Operation of Brake/Flight Control on Ground	6108
Improper Landing Flare/Bouncing on Touchdown	4215
Failure to Extend Landing Gear	3359
Landing Gear Retraction/Extension System Failure	3284
Failure to Avoid Objects or Obstructions	2095
Failure to Maintain Adequate Fly Speed	1891
Poor Preflight Planning - Fuel Quantity	1786
Overrun End of Runway During Landing	1424
Selected Unsuitable Terrain	1213
Full Fuel to Fuel Low/Exhaust	1212

FAR Part 91 - All Engines - Cessna

Improper Operation of Brake/Flight Control on Ground	2737
Improper Landing Flare/Bouncing on Touchdown	2315
Poor Preflight Planning - Fuel Quantity	1137
Landing Gear Retraction/Extension System Failure	1123
Failure to Extend Landing Gear	1027
Failure to Avoid Objects or Obstructions	918
Failure to Maintain Adequate Fly Speed	741
Full Fuel to Fuel Low/Exhaust	741
Overrun End of Runway During Landing	663
Selected Unsuitable Terrain	516

FAR Part 91 - All Engines - Piper

Improper Operation of Brake/Flight Control on Ground	1473
Landing Gear Retraction/Extension System Failure	930
Failure to Extend Landing Gear	890
Improper Landing Flare/Bouncing on Touchdown	810
Failure to Avoid Objects or Obstructions	593
Failure to Maintain Adequate Fly Speed	453
Overrun End of Runway During Landing	424
Selected Unsuitable Terrain	351
Poor Preflight Planning - Fuel Quantity	323
Full Fuel to Fuel Low/Exhaust	293

FAR Part 91- All Engines - Beechcraft

Failure to Extend Landing Gear	711
Landing Gear Retraction/Extension System Failure	693
Inadvertently Retracting Landing Gear	488
Improper Landing Flare/Bouncing on Touchdown	451
Improper Operation of Brake/Flight Control on Ground	258
Failure to Avoid Objects or Obstructions	197
Improper Management/Fuel Tank Selector	156
Overrun End of Runway During Landing	146
Failure to Maintain Adequate Fly Speed	140
Gear Indicated Down/Locked, Gear Collapsed	120

FAR Part 91 - Multiple Engine

Landing Gear Retraction/Extension System Failure	1553
Failure to Extend Landing Gear	809
Improper Landing Flare/Bouncing on Touchdown	327
Inadvertently Retracting Landing Gear	327
Failure to Avoid Objects or Obstructions	291
Improper Operation of Brake/Flight Control on Ground	278
Overrun End of Runway During Landing	218
Landing Gear Actuator	183
Inadequate Preflight Inspection of Aircraft	166
Main Landing Gear Strut/Axle/Truck	157

FAR Part 91 - Multiple Engine - Fatal

Lost Control in Adverse Weather	80
Insufficient Terrain Clearance - Enroute	79
Failure to Maintain Adequate Fly Speed	71
Failure Avoid Collision Ground or Water	66
Improper Instrument Procedure During Takeoff/Landing	53
Operation Below VMC	32
Pilot Incapacity - Excludes Alcohol	24
Failure to Avoid Aircraft/Both Airborne	21
Exceed Load Design	18
Poor Preflight Planning - Weather	18

FAR Part 91 - Multiple Engine - Cessna

Landing Gear Retraction/Extension System Failure	596
Failure to Extend Landing Gear	219
Improper Landing Flare/Bouncing on Touchdown	79
Failure to Avoid Objects or Obstructions	75
Improper Operation of Brake/Flight Control on Ground	73
Overrun End of Runway During Landing	56
Landing Gear Actuator	52
Main Landing Gear Strut/Axle/Truck	50
Brake	45
Inadequate Preflight Inspection of Aircraft	45

FAR Part 91 - Multiple Engine - Fatal - Cessna

Lost Control in Adverse Weather	30
Insufficient Terrain Clearance - Enroute	27
Failure to Avoid Collision with Ground or Water	23
Failure to Maintain Adequate Fly Speed	20
Improper Instrument Procedure During Takeoff/Landing	17
Operation Below VMC	12
Continued VFR Flight Into Adverse Weather	9
Exceed Load Design	8
Failure to Avoid Aircraft/Both Airborne	6
Misc/Pilot Unsafe Acts	6

FAR Part 91- Multiple Engine - Piper

Landing Gear Retraction/Extension System Failure	507
Failure to Extend Landing Gear	351
Improper Landing Flare/Bouncing on Touchdown	150
Improper Operation of Brake/Flight Control on Ground	95
Failure to Avoid Objects or Obstructions	92
Overrun End of Runway During Landing	84
Inadvertently Retracting Landing Gear	83
Main Landing Gear Strut/Axle/Truck	76
Gear Indicated Down/Locked, Gear Collapsed	56

FAR Part 91 - Multiple Engine - Fatal - Piper

Insufficient Terrain Clearance - Enroute	27
Lost Control in Adverse Weather	22
Failure Avoid Collision Ground or Water	19
Failure to Maintain Adequate Fly Speed	19
Improper Instrument Procedure During Takeoff/Landing	16
Pilot Incapacity - Excludes Alcohol	13
Operation Below VMC	9
Engine (Reciprocating)	8
Poor Preflight Planning - Weather	6
Failure to Avoid Aircraft/Both Airborne	6

FAR Part 91 - Multiple Engine - Beechcraft

Landing Gear Retraction/Extension System Failure	364
Inadvertently Retracting Landing Gear	192
Failure to Extend Landing Gear	183
Failure to Avoid Objects or Obstructions	101
Landing Gear Actuator	86
Improper Operation of Brake/Flight Control on Ground	76
Improper Landing Flare/Bouncing on Touchdown	73
Overrun End of Runway During Landing	70
Inadequate Preflight Inspection of Aircraft	53
Electrical Power System	34

FAR Part 91 - Multiple Engine - Fatal - Beechcraft

Failure to Maintain Adequate Fly Speed	23
Insufficient Terrain Clearance - Enroute	20
Lost Control in Adverse Weather	18
Failure to Avoid Collision with Ground or Water	16
Improper Instrument Procedure During Takeoff/Landing	15
Pilot Incapacity - Excludes Alcohol	8
Operation Below VMC	8
Failure to Follow Approved Instrument Procedure	7
Improper Operation Flight Control in Air	7
Improper Management/Fuel Tank Selector	6
Undetermined	6

FAR Part 91 - Single Engine

Improper Operation of Brake/Flight Control on Ground	5796
Improper Landing Flare/Bouncing on Touchdown	3853
Failure to Extend Landing Gear	2550
Failure to Avoid Objects or Obstructions	1770
Landing Gear Retraction/Extension System Failure	1729
Failure to Maintain Adequate Fly Speed	1666
Poor Preflight Planning - Fuel Quantity	1659
Overrun End of Runway During Landing	1189
Full Fuel to Fuel Low/Exhaust	1116
Selected Unsuitable Terrain	1094

FAR Part 91 - Single Engine - Fatal

Failure to Maintain Adequate Fly Speed	557
Insufficient Terrain Clearance - Enroute	403
Lost Control in Adverse Weather	320
Continued VFR Flight Into Adverse Weather	198
Failure to Avoid Collision with Ground or Water	192
Failure to Avoid Objects or Obstructions	143
Failure to Avoid Aircraft/Both Airborne	119
Aerobatics Below Safe Altitude	117
Misc/Pilot Unsafe Acts	103
Poor Preflight Planning - Weather	100

FAR Part 91 - Single Engine - Cessna

Improper Operation of Brake/Flight Control on Ground	2664
Improper Landing Flare/Bouncing on Touchdown	2236
Poor Preflight Planning - Fuel Quantity	1098
Failure to Avoid Objects or Obstructions	843
Failure to Extend Landing Gear	808
Full Fuel to Fuel Low/Exhaust	715
Failure to Maintain Adequate Fly Speed	696
Overrun End of Runway During Landing	607
Landing Gear Retraction/Extension System Failure	527
Selected Unsuitable Terrain	496

FAR Part 91 - Single Engine - Fatal - Cessna

Failure to Maintain Adequate Fly Speed	213
Insufficient Terrain Clearance - Enroute	198
Lost Control in Adverse Weather	112
Continued VFR Flight Into Adverse Weather	93
Failure to Avoid Collision with Ground or Water	83
Failure to Avoid Aircraft/Both Airborne	68
Failure to Avoid Objects or Obstructions	65
Misc/Pilot Unsafe Acts	51
Poor Preflight Planning - Weather	42
Pilot Incapacity - Excludes Alcohol	30
Lost Ground Reference During Night VFR	30

FAR Part 91 - Single Engine - Piper

Improper Operation of Brake/Flight Control on Ground	1377
Improper Landing Flare/Bouncing on Touchdown	660
Failure to Extend Landing Gear	539
Failure to Avoid Objects or Obstructions	501
Landing Gear Retraction/Extension System Failure	423
Failure to Maintain Adequate Fly Speed	412
Overrun End of Runway During Landing	340
Selected Unsuitable Terrain	325
Poor Preflight Planning - Fuel Quantity	280
Poor Preflight Plan/Aircraft Performance	264

FAR Part 91 - Single Engine - Fatal - Piper

Failure to Maintain Adequate Fly Speed	139
Lost Control in Adverse Weather	119
Insufficient Terrain Clearance - Enroute	106
Continued VFR Flight Into Adverse Weather	55
Failure to Avoid Collision with Ground or Water	46
Failure to Avoid Objects or Obstructions	45
Misc/Pilot Unsafe Acts	29
Failure to Avoid Aircraft/Both Airborne	28
Poor Preflight Planning - Weather	27
Pilot Incapacity - Excludes Alcohol	26
Exceed Load Design	26

FAR Part 91 - Single Engine - Beechcraft

Failure to Extend Landing Gear	528
Improper Landing Flare/Bouncing on Touchdown	378
Landing Gear Retraction/Extension System Failure	329
Inadvertently Retracting Landing Gear	296
Improper Operation of Brake/Flight Control on Ground	182
Improper Management/Fuel Tank Selector	137
Failure to Maintain Adequate Fly Speed	110
Failure to Avoid Objects or Obstructions	96
Gear Indicated Down/Locked, Gear Collapsed	91
Electrical Power System	79

FAR Part 91 - Single Engine - Fatal - Beechcraft

Failure to Maintain Adequate Fly Speed	42
Insufficient Terrain Clearance - Enroute	39
Lost Control in Adverse Weather	39
Poor Preflight Planning - Weather	18
Failure to Avoid Collision with Ground or Water	17
Continued VFR Flight Into Adverse Weather	17
Improper Instrument Procedure During Takeoff/Landing	15
Poor Preflight Planning - Fuel Quantity	13
Pilot Incapacity - Excludes Alcohol	10
Failure to Avoid Aircraft/Both Airborne	10

FAR Part 91 - Gliders

Failure to Maintain Adequate Fly Speed	98
Poor Preflight Plan/Aircraft Performance	85
Landed Short	54
Improper Operation Flight Control in Air	49
Selected Unsuitable Terrain	41
Improper Landing Flare/Bouncing on Touchdown	35
Improper Operation of Brake/Flight Control on Ground	34
Failure to Avoid Objects or Obstructions	34
Inadequate Preflight Inspection of Aircraft	27
Collided with Object on Final Approach	27

FAR Part 135 - All Engines

Landing Gear Retraction/Extension System Failure	487
Failure to Avoid Objects or Obstructions	306
Improper Operation of Brake/Flight Control on Ground	207
Failure to Extend Landing Gear	159
Landing Gear Position and Warning	111
Selected Unsuitable Terrain	110
Landing Gear Actuator	94
Inadequate Preflight Inspection of Aircraft	88
Overrun End of Runway During Landing	85
Unsafe Acts by Third Party	83

FAR Part 135 - Multiple Engine

Landing Gear Retraction/Extension System Failure	409
Failure to Avoid Objects or Obstructions	192
Improper Operation of Brake/Flight Control on Ground	138
Failure to Extend Landing Gear	118
Landing Gear Position and Warning	105
Landing Gear Actuator	79
Unsafe Acts by Third Party	66
Main Landing Gear Strut/Axle/Truck	66
Inadequate Preflight Inspection of Aircraft	63
Struck Bird in Flight Path	54

FAR Part 135 - Multiple Engine - Fatal

Insufficient Terrain Clearance - Enroute	25
Improper Instrument Procedure During Takeoff/Landing	22
Lost Control in Adverse Weather	11
Failure to Avoid Collision with Ground or Water	8
Poor Preflight Plan/Weight and Balance	6
Engine (Reciprocating)	5
Failure to Avoid Aircraft/Both Airborne	5
Exceed Load Design	5
Continued Flight into Area Severe Turbulence	4
Undetermined	4
Misc/Pilot Unsafe Acts	4
Operation Below VMC	4
Failure to Maintain Adequate Fly Speed	4

FAR Part 135 - Multiple Engine - Fatal - Cessna

Insufficient Terrain Clearance - Enroute	9
Improper Instrument Procedure During Takeoff/Landing	6
Inadequate Preflight Inspection of Aircraft	3
Engine Collector/Tailpipe/Nozzle	2
Lost Control in Adverse Weather	2
Exceed Load Design	2
Failure to Avoid Collision with Ground or Water	2
Lost Ground Reference During Night VFR	1
Elevator Tab Control System	1
Aircraft Fuel System	1
Fuel Boost Pump	1
Attitude Gyro and Indicator System	1
Wing Spar Structure	1
Power Lever	1
Undetermined	1
Reciprocating Engine Cylinder Section	1
Attempt Operation with Defective Equipment	1
Control Interference by Passenger/Crew	1
Misc/Pilot Unsafe Acts	1
Delay Action in Aborted Takeoff	1
Failure to Follow Approved Instrument Procedure	1
Continued VFR Flight Into Adverse Weather	1
Pilot/Crew Mismanaged Ac Sys	1
Continued Flight into Area Severe Turbulence	1
Poor Preflight Planning - Weight and Balance	1
Poor Preflight Planning - Aircraft Performance	1
Improper Management/Fuel Tank Selector	1
Inadequate Spacing - Wake Turbulence	1

FAR Part 135 - Multiple Engine - Fatal - Piper

Insufficient Terrain Clearance - Enroute	10
Improper Instrument Procedure During Takeoff/Landing	7
Failure to Avoid Collision Ground or Water	4
Engine (Reciprocating)	4
Lost Control in Adverse Weather	3
Failure to Avoid Aircraft/Both Airborne	3
Operation Below VMC	2
Overrun End of Runway During Landing	1
Misc/Pilot Unsafe Acts	1
Fuel Unport, Fuel Not at Outlet	1
Improper Operation Flight Control in Air	1
Reciprocating Engine Cylinder Section	1
Reciprocating Engine System	1

FAR Part 135 - Multiple Engine - Fatal - Beech

Improper Instrument Procedure During Takeoff/Landing	6
Lost Control in Adverse Weather	3
Poor Preflight Planning - Weight and Balance	3
Failure to Maintain Adequate Fly Speed	3
Insufficient Terrain Clearance - Enroute	2
Continued Flight Area Severe Turbulence	2
Poor Preflight Planning - Fuel Quantity	2
Misc/Pilot Unsafe Acts	2
Operation Below VMC	1
AC Power Distribution System	1
Attitude Gyro and Indicator System	1
Engine Cowling System	1
Engine (Turbine/Turboprop)	1
Fuel Control/Carburetor	1
Engine (Reciprocating)	1
Reciprocating Engine Cylinder Section	1
Collided with Object on Final Approach	1
Didn't Fly Assigned Altitude IFR Clearance	1
Undetermined	1
Continued VFR Flight Into Adverse Weather	1
Inadequate Snow/Ice Removal from Aircraft	1
Miscellaneous Misuse Fuel System	1
Issued Improper Conflicting Instructions	1
Pilot Incapacity - Excludes Alcohol	1
Inadequate Space Aircraft/Wake Turbulence	1

FAR Part 135 - Single Engine

Failure to Avoid Objects or Obstructions	114
Landing Gear Retraction/Extension System Failure	78
Selected Unsuitable Terrain	73
Improper Operation of Brake/Flight Control on Ground	69
Unsuitable Terrain Snow/Ice Area	48
Insufficient Terrain Clearance - Enroute	45
Failure to Extend Landing Gear	41
Overrun End of Runway During Landing	38
Failure to Maintain Adequate Fly Speed	35
Continued VFR Flight Into Adverse Weather	31

FAR Part 135 - Single Engine - Fatal

Insufficient Terrain Clearance - Enroute	31
Failure to Maintain Adequate Fly Speed	16
Continued VFR Flight Into Adverse Weather	14
Lost Control in Adverse Weather	8
Failure to Avoid Collision with Ground or Water	7
Improper Operation Flight Control in Air	5
Poor Preflight Planning - Weather	5
Poor Preflight Planning - Weight and Balance	5
Failure to Avoid Objects or Obstructions	4
Improper Management/Fuel Tank Selector	3

FAR Part 135 - Single Engine - Fatal - Cessna

Insufficient Terrain Clearance - Enroute	20
Continued VFR Flight Into Adverse Weather	10
Failure to Maintain Adequate Fly Speed	7
Lost Control in Adverse Weather	6
Failure to Avoid Collision with Ground or Water	5
Improper Management/Fuel Tank Selector	3
Improper Operation Flight Control in Air	3
Failure to Avoid Objects or Obstructions	3
Improper Instrument Procedure During Takeoff/Landing	2
Downwind Takeoff or Landing	2
Poor Preflight Planning - Weight and Balance	2
Poor Preflight Planning - Weather	2
Poor Preflight Planning - Aircraft Performance	2

FAR Part 135 - Single Engine - Fatal - Piper

Insufficient Terrain Clearance - Enroute	6
Failure to Maintain Adequate Fly Speed	4
Poor Preflight Planning - Weather	3
Poor Preflight Planning - Weight and Balance	3
Continued VFR Flight Into Adverse Weather	2
Exciter	2
Unauthorized Action	1
Failure to Avoid Objects or Obstructions	1
Pilot Incapacity - Excludes Alcohol	1
Improper Operation Flight Control in Air	1
Lost Control in Adverse Weather	1
Engine (Reciprocating)	1
Attitude Gyro and Indicator System	1

FAR Part 135 - Single Engine - Fatal - Beech

Failure to Follow Approved Instrument Procedure	1
Inadequate Flight/Supervision (Pilot)	1