

**COMMANDER NAVAL AIR FORCES GROUND  
COLLISION ANALYSIS**

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## AIRFOR GROUND COLLISIONS

A ground collision for the purpose of this study is defined as an incident where an aircraft impacts an object or a person while located at a shore installation or ship flight deck. Only class C or more severe events are included. Bird strikes during take off and other takeoff/landing collisions have been excluded. Five years (FY2004-FY2009) were analyzed. The study also intended to examine CNATRA ground collisions; however there were only two events over the five year period.

Figure 1 displays the number and rate of AIRFOR ground collisions. The rate is per 100,000 sorties. Sorties were used instead of flight hours because sorties provided a better indication of aircraft ground movement than flight hours. During the act of extracting sortie counts, it was discovered that the feed of sorties from NAVAIR for the years 2007, 2008 and 2009 was missing sortie counts for several aircraft. For this reason flight hours and historical averages of hours per flight were used to calculate estimated sortie counts for affected aircraft.

Collisions by Year**			
FY	Total	Sorties	Rate
2005	20	253,073	7.90
2006	20	239,651	8.35
2007	16	239,242	6.69
2008	10	215,556	4.64
2009	17	213,459	7.96
Grand Total	83	1,160,981	7.15

\*\*FY07-FY09 are estimated sorties

**Fig 1: Ground Collision Rate**

The number of collisions decreased in 2008, and then returned to levels consistent with the 2005-2007 average in 2009. The average number of collisions from 2005-2007 was 18.67. Using a Poisson Distribution at the 95% confidence level, 10 or fewer collisions in 2008 represented a statistically significant reduction. The decrease was driven by fewer F/A-18 collisions. This will be demonstrated in later sections of the report.

Figure 2 shows the number and rate of ground collisions by aircraft model. It does not include aircraft to aircraft collisions. Since aircraft to aircraft collisions involve two or more aircraft, this will skew the data. Aircraft to aircraft collisions were examined separately.

Collisions by T/M/S			
T/M/S	Total	Sorties	Rate
EP-3E*	1	5,527	18.09
MH-53E	1	8,846	11.30
T-34C	1	9,513	10.51
P-3C*	6	65,753	9.13
E-6A/B	1	12,250	8.16
F-14	1	15,179	6.59
H-60F/H/R/S*	8	126,125	6.34
F/A-18	36	642,934	5.60
S-3B*	1	23,843	4.19
EA-6B	3	73,201	4.10
SH-60B	1	105,149	0.95
Grand Total	60		

\*contains estimated sorties for FY07-FY09

\*\*excluding aircraft to aircraft collisions

**Figure 2: Collisions By Aircraft Model  
(Excluding Aircraft To Aircraft Collisions)**

The F/A-18 was involved in 60% of the events. However its rate (5.60) is similar to the combined rate of the rest of the aircraft that sustained collisions (5.39). Using Fisher's Exact test comparing the F/A-18 with all other aircraft in figure 2 results in a p-value of 1.00 meaning there is no statistically significant difference. Similarly if the H-60F/H/R/S and P-3C are tested, p-values of .685 and .177 respectively result. There is no single aircraft model that has a significantly higher collision rate.

Figure 3 contains aircraft to aircraft collisions by aircraft model. No attempt was made to assign responsibility for counting purposes. All aircraft involved in the collision were counted.

Collisions by T/M/S			
T/M/S	Total	Sorties	Rate
UC-12M	1	5,658	17.67
F-14	1	15,179	6.59
E-2C*	2	34,666	5.77
F/A-18	37	642,934	5.75
S-3B*	1	23,843	4.19
EA-6B	3	73,201	4.10
UNK	3		
Grand Total	48		

\*contains estimated sorties for FY07-FY09

\*\*aircraft to aircraft collisions only

**Figure 3: Aircraft to Aircraft Collisions By Model**

77% of the involved aircraft were F/A-18. A comparison of the F/A-18 rate (5.75) with the other involved aircraft (7.21) yields a p-value of .468 meaning no significant difference.

Figure 4 shows a year by year look at collisions (excluding aircraft to aircraft) by model. The 2008 reduction in F/A-18 collisions can be seen in figure 4.

COLLISIONS BY T/M/S						
T/M/S	2005	2006	2007	2008	2009	Grand Total
F/A-18	8	7	11	3	7	36
H-60F/H/R/S	2	2	2	2		8
P-3C	2			2	2	6
EA-6B	1			1	1	3
S-3B		1				1
F-14	1					1
H-60B	1					1
T-34C					1	1
E-6A/B				1		1
EP-3					1	1
MH-53E			1			1
Grand Total	15	10	14	9	12	60

**Fig 4: Collisions By Aircraft Model  
(Excluding Aircraft To Aircraft Collisions)**

Logic tells us that embarked operations would have a higher collision rate than ashore operations. Figure 5 confirms this assumption.

Collisions by Location**						
FY	Ashore	Sorties	Rate	Embarked	Sorties	Rate
2005	12	197,959	6.06	8	55,114	14.52
2006	5	182,265	2.74	15	57,386	26.14
2007	8	180,308	4.44	8	59,008	13.56
2008	6	158,593	3.78	4	57,159	7.00
2009	11	156,581	7.03	6	57,088	10.51
Grand Total	42	875,706	4.80	41	285,755	14.35

\*\*FY07-FY09 are estimated sorties

**Fig 5: Embarked vs. Ashore Collisions**

Ground Support Equipment is the most common object that impacts an aircraft ashore followed by fixed man made components.

ASHORE COLLISIONS		
Object	Detailed Object	Grand Total
GSE	Tow Tractor	5
	B-2 Stand	3
	Electric Cart	2
	Man Lift	2
	Cart	1
	Fork Lift	1
Man Made Fixed Component	Aero-83A Transport Adapter	1
	Air Conditioning Unit	1
	Building	1
	Electrical Service Box	1
	Fire Bottle	1
	Fuel Tank Stand	1
	Light Pole	1
	Pole	1
	Rail	1
Vehicle	Car	2
	Crash Rescue Vehicle	1
	De-Ice Truck Boom	1
	Ordnance Truck	1
	Police Car	1
	Supply Vehicle	1
	Transportation Bus	1
Aircraft	Aircraft	7
Personnel	Personnel	2
Ship Component	Navigation Pole	1
Ground	Ground	1
Grand Total		42

**Fig 6: Collisions By Object (Ashore)**

When embarked, another aircraft is the most common impact object.

EMBARKED COLLISIONS		
Object	Detailed Object	Grand Total
Aircraft	Aircraft	16
GSE	Tow Tractor	4
	Fork Lift	2
	Hydraulic Generator	1
	Pallet Jack	1
	Spotting Dolly	1
	Tractor	1
	Transport Dolly	1
Ship Component	Navigation Pole	2
	Elevator Stanchion	1
	Fuel Tarp	1
	Fwd Deck Status Light	1
	Hatch	1
	Jet Blast Deflector	1
Man Made	Metal Framed Tent	1
Fixed Component	Support Shelf	1
	X-Ray Machine	1
Personnel	Personnel	3
Unknown	Unknown	1
Grand Total		41

**Fig 7: Collisions By Object (Embarked)**

Figure 8 details only collisions that were initiated by a moving aircraft. Events where a stationary aircraft was impacted by a non-aircraft object are excluded.

AIRCRAFT INITIATED ASHORE COLLISIONS		
Object	Detailed Object	Grand Total
Aircraft	Aircraft	7
Man Made Fixed Component	Air Conditioning Unit	1
	Building	1
	Electrical Service Box	1
	Fire Bottle	1
	Fuel Tank Stand	1
	Light Pole	1
	Pole	1
	Rail	1
Vehicle	Car	1
	Crash Rescue Vehicle	1
	Ordnance Truck	1
	Transportation Bus	1
Ship Component	Navigation Pole	1
GSE	Tow Tractor	2
	Electric Cart	1
Ground	Ground	1
Grand Total		24

**Fig 8: Aircraft Initiated Shore Collisions**

When an aircraft initiates the collision, the object of the collision is much less likely to be GSE than when all collisions are considered. Figure 9 shows a similar pattern with embarked collisions

AIRCRAFT INITIATED EMBARKED COLLISIONS		
Object	Detailed Object	Grand Total
Aircraft	Aircraft	16
Ship Component	Navigation Pole	2
	Elevator Stanchion	1
	Fwd Deck Status Light	1
	Hatch	1
	Jet Blast Deflector	1
GSE	Tow Tractor	2
	Hydraulic Generator	1
	Transport Dolly	1
Man Made Fixed Component	Support Shelf	1
Grand Total		27

**Fig 9: Aircraft Initiated Embarked Collisions**

When the aircraft initiates the contact 55% of the events involve a pilot in the cockpit. 41% involve maintenance personnel. Pilots generally impact other aircraft, while maintenance generally impact GSE or fixed objects.

AIRCRAFT INITIATED (PILOT/MAINTENANCE)				
Object	Pilot	Maintenance	Neither	Grand Total
Aircraft	20	2	1	23
Man Made Fixed Component	3	6		9
Ship Component	1	6		7
GSE		7		7
Vehicle	3		1	4
Ground	1			1
Grand Total	28	21	2	51

**Fig 10: Pilot vs Maintenance Collisions**

#### GROUND COLLISION INVOLVED FACTORS

This section will detail the "what" and "why" involved factors in ground collisions. Involved factors are given in three levels with each level providing more detail. Figure 11 displays the level 1 "what" factor. There were 83 ground collision mishaps. The number in the chart shows how many of the 83 mishaps contained factors related to facilities, maintenance, supervisory or aircrew.

Facilities personnel were listed as a factor in 60% of the mishaps. Aircrew were only listed in 17 mishaps (20%).

WHAT FACTORS (LEVEL 1)	
FACILITIES	50
MAINTENANCE	24
SUPERVISORY	20
AIRCREW	17

**Fig 11: Level 1 "What" Factors**

Figure 12 lists the top ten level three involved factors. Seven of the ten were facilities personnel, particularly improper procedures and loss of situational awareness. None were aircrew.

TOP "WHAT" FACTORS			
FACILITIES	FAILED TO ADHERE TO PROCEDURES/DIRECTIONS/INSTRUCTIONS	SAFETY PRECAUTIONS/PROCEDURES	11
FACILITIES	LOSS OF SITUATIONAL AWARENESS/FAILED TO IDENTIFY/RECOGNIZE	IMPROPER POSITION/DISTANCE	10
FACILITIES	FAILED TO ADHERE TO PROCEDURES/DIRECTIONS/INSTRUCTIONS	NATOPS PROCEDURES	9
FACILITIES	FAILED TO CALCULATE/CHECK/VERIFY	PROPER CLEARANCE	9
MAINTENANCE	SUPERVISORY	FAILED TO MANAGE/SUPERVISE PERSONNEL/ASSETS	8
FACILITIES	FAILED TO ADEQUATELY SUPERVISE	AIRCREWS/AIRCRAFT MOVEMENT	7
FACILITIES	FAILED TO ADHERE TO PROCEDURES/DIRECTIONS/INSTRUCTIONS	STANDARD OPERATING PROCEDURES	6
FACILITIES	LOSS OF SITUATIONAL AWARENESS/FAILED TO IDENTIFY/RECOGNIZE	UNSAFE SITUATION NOT OTHERWISE DESCRIBED	6
FACILITIES	LOSS OF SITUATIONAL AWARENESS/FAILED TO IDENTIFY/RECOGNIZE	HAZARDOUS/UNSAFE DECK CONDITION	5
FACILITIES	FAILED TO ADHERE TO PROCEDURES/DIRECTIONS/INSTRUCTIONS	SHIP/STATION/LOCAL DIRECTIVES/INSTRUCTIONS	5
MAINTENANCE	PRODUCTION	FAILED TO FOLLOW SAFETY PROCEDURES	5
SUPERVISORY	FAILURE TO PROVIDE/PROVIDED INADEQUATE/IMPROPER	TRAINING	5

**Fig 12: Level 3 "What" Factors**

Level 1 "why" factors are listed in figure 13. Performance issues are the overwhelming factor in ground collisions.

WHY FACTORS (LEVEL1)	
PERFORMANCE	74
COMMUNICATION/COORDINATION	22
PSYCHOSOCIAL	19
MEDICAL/PHYSIOLOGICAL	7
HUMAN ENGINEERING	4
ENVIRONMENT	2

**Fig 13: Level 1 "Why" Factors**

Judgment, decision and attention errors are the main level three factors.

TOP "WHY" FACTORS			
PERFORMANCE	JUDGEMENT ERROR	POOR JUDGEMENT	35
PERFORMANCE	FAILURE OF ATTENTION	COMPLACENCY, OTHER	19
PERFORMANCE	DECISION ERROR	FAILURE TO CONSIDER OR EMPLOY AVAILABLE/ADEQUATE RISK CONTROLS	17
PERFORMANCE	DECISION ERROR	POOR DECISION	16
PERFORMANCE	FAILURE OF ATTENTION	FAILED TO ANTICIPATE NEED	15
PERFORMANCE	JUDGEMENT ERROR	FAILURE TO CONSIDER OR EMPLOY AVAILABLE/ADEQUATE RISK CONTROLS.	14
PERFORMANCE	FAILURE OF ATTENTION	CHANNELIZED ATTENTION; FIXATION	14
PERFORMANCE	FAILURE OF ATTENTION	GENERAL INATTENTION	11
PERFORMANCE	DECISION ERROR	NECESSARY INFORMATION HAD NOT BEEN PROVIDED	7
PERFORMANCE	FAILURE OF ATTENTION	HABIT PATTERN ERROR	7
COMMUNICATION/COORDINATION	MISINTERPRETATION - WRITTEN	AMBIGUITY OR INADEQUACY OF INSTRUCTION	6

**Fig 14: Level 3 "Why" Factors**

The remaining four charts detail the "what" factors separately when the pilot is in control of an aircraft and when maintenance personnel are in control of the aircraft. Figure 15 shows level 1 pilot events (28 mishaps).

PILOT CONTROL LEVEL 1	
AIRCREW	16
FACILITIES	13
MAINTENANCE	5
SUPERVISORY	3

**Fig 15: Pilot Collision Mishaps**

Aircrew were the leading level 1 factor; however facilities personnel are close behind. Figure 16 displays the level three factors that were involved in more than one mishap.

**Fig 16: Pilot Level 3 Factors**

PILOT CONTROL WHAT FACTORS			
AIRCREW	MISJUDGE DISTANCE/ALTITUDE/POSITION	MISJUDGED DISTANCE BETWEEN AIRCRAFT	4
AIRCREW	FAILURE OF AIRCREW COORDINATION	FAILURE TO BACKUP PLT/COPLT/ACCDR/ETC	4
FACILITIES	FAILED TO ADHERE TO PROCEDURES/DIRECTIONS/INSTRUCTIONS	NATOPS PROCEDURES	3
FACILITIES	FAILED TO CALCULATE/CHECK/VERIFY	PROPER CLEARANCE	3
AIRCREW	FAILURE OF AIRCREW COORDINATION	FAILED TO COMMUNICATE	2
SUPERVISORY	FAILURE TO PROVIDE/PROVIDED INADEQUATE/IMPROPER	OPERATIONAL DOCTRINE	2
FACILITIES	FAILED TO PROVIDE	ADEQUATE AIRFIELD VISUAL AIDS/LIGHTING	2
FACILITIES	LOSS OF SITUATIONAL AWARENESS/FAILED TO IDENTIFY/RECOGNIZE	PROPER AIRCRAFT/AIRCRAFT HANDLING SIGNALS	2
FACILITIES	LOSS OF SITUATIONAL AWARENESS/FAILED TO IDENTIFY/RECOGNIZE	HAZARDOUS/UNSAFE DECK CONDITION	2

The top two involve aircrew misjudged distance and aircrew coordination, but it can be seen that facilities factors are also a major issue.

Figure 17 displays the level 1 factors when maintenance personnel are in control of the aircraft (21 events).

MAINTENANCE CONTROL LEVEL1	
FACILITIES	15
MAINTENANCE	7
SUPERVISORY	6
AIRCREW	0

**Fig 17: Maintenance Collision Mishaps**

It is interesting to note that facilities personnel (72%) are involved more often than maintenance personnel (33%). A look at the level three factors shows the details. Figure 18 displays all of the level three factors that were involved in more than one mishap.

MAINTENANCE CONTROL WHAT FACTORS			
FACILITIES	FAILED TO ADEQUATELY SUPERVISE	AIRCREWS/AIRCRAFT MOVEMENT	6
FACILITIES	FAILED TO ADHERE TO PROCEDURES/DIRECTIONS/INSTRUCTIONS	NATOPS PROCEDURES	4
FACILITIES	FAILED TO ADHERE TO PROCEDURES/DIRECTIONS/INSTRUCTIONS	SAFETY PRECAUTIONS/PROCEDURES	3
FACILITIES	FAILED TO CALCULATE/CHECK/VERIFY	PROPER CLEARANCE	3
SUPERVISORY	FAILURE TO PROVIDE/PROVIDED INADEQUATE/IMPROPER	TRAINING	2
SUPERVISORY	FAILURE TO PROVIDE/PROVIDED INADEQUATE/IMPROPER	TECHNICAL DATA/PROCEDURE	2
FACILITIES	FAILED TO ADHERE TO PROCEDURES/DIRECTIONS/INSTRUCTIONS	STANDARD OPERATING PROCEDURES	2
FACILITIES	FAILED TO ADHERE TO PROCEDURES/DIRECTIONS/INSTRUCTIONS	SHIP/STATION/LOCAL DIRECTIVES/INSTRUCTIONS	2
FACILITIES	FAILED TO ADHERE TO PROCEDURES/DIRECTIONS/INSTRUCTIONS	STANDARD COMMUNICATIONS PROCEDURES	2
FACILITIES	FAILED TO PROVIDE	PROPER CLEARANCE	2
FACILITIES	LOSS OF SITUATIONAL AWARENESS/FAILED TO IDENTIFY/RECOGNIZE	IMPROPER POSITION/DISTANCE	2
FACILITIES	LOSS OF SITUATIONAL AWARENESS/FAILED TO IDENTIFY/RECOGNIZE	UNSAFE SITUATION NOT OTHERWISE DESCRIBED	2
FACILITIES	LOSS OF SITUATIONAL AWARENESS/FAILED TO IDENTIFY/RECOGNIZE	OTHER	2
FACILITIES	FAILED TO RESPOND	TO AIRCRAFT/AIRCRAFT HANDLING SIGNALS	2
FACILITIES	FAILED TO RESPOND	IN THE REQUIRED TIME	2

**Fig 18: Maintenance Level 3 Factors**

### CONCLUSIONS

- AIRFOR ground collisions decreased in 2008 as a result of fewer F/A-18 mishaps. 2009 mishaps returned to levels consistent with the FY2005-FY2007 average.
- No aircraft is statistically more likely to be involved in a ground collision when collisions per sortie are considered.
- Embarked ground collisions occur at a higher rate than ashore ground collisions.
- The most frequently impacted objects ashore were GSE and man-made fixed objects. The most frequently impacted objects embarked were aircraft and GSE.
- Facilities personnel were the most frequently involved factor in ground collisions followed by maintenance personnel.

### RECOMMENDATIONS

- Review facilities personnel training particularly in the areas of NATOPS, safety and SOP.
- Review aircrew coordination procedures in the areas of aircrew back-up and communication.
- Review maintenance supervision of personnel and training/qualifications during aircraft movement operations.