AOPA AIR SAFETY INSTITUTE

SAFETY HIGHLIGHTS

CESSNA 150/152

PREFACE

The Air Safety Institute's new *Safety Highlights* series updates similar reports published between 1999 and 2001. The *Highlights* are not intended to be complete guides to ownership and operation of the models reported on, but rather to provide summaries of their accident histories with attention to specific systems, characteristics, or procedures that have affected that record. Comparisons with other aircraft of similar design and capabilities are made to the extent the data support.

EXECUTIVE SUMMARY

- Although out of production for more than 30 years, more than 12,000 Cessna 150s and 152s remain in service. They are used almost entirely for personal and instructional flights rather than for business or in other working roles.
- Their dominance of their market niche means relatively few competing models are directly comparable.
- Over 20 years, the number of accidents in these aircraft has fallen twice as fast as overall flight activity in all piston singles.
- Two-thirds of Cessna 152 accidents took place during flight instruction. Two-thirds of all accidents in Cessna 150s and the most comparable competitors occurred on personal flights.
- Most training accidents occurred during takeoffs, landings, or go-arounds, a disproportionate number of them on student solos. Fatalities were rare.
- On personal flights, Cessna 150s and 152s suffered fewer mechanical failures and unexplained engine stoppages than comparable aircraft, but were more prone to fuel exhaustion.
- The leading causes of fatal accidents in the Cessnas were low-altitude maneuvering, losses of control during takeoff, and pilot impairment or incapacitation. In the comparable fleet, they were adverse weather and losses of engine power.
- The Cessna 150 and 152 showed greater vulnerability to errors in aircraft configuration, particularly flap settings and the appropriate use of carburetor heat.

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INTRODUCTION

The Cessna 150 and its successor the 152 rank among the most successful two-seat airplane designs in history. Only minor changes were made to the 150 over a production run of nearly 24,000 airplanes that spanned almost 20 years. In 1977 it was superseded by the 152, which featured a 10 percent increase in horsepower, a reduction in maximum flap extension from 40 degrees to 30, and a 70-pound increase in maximum gross weight. Almost 7,600 152s were built before Cessna halted all piston airplane production in 1985. As of December 2015, almost 10,000 150s and more than 2,200 152s were still registered in the United States.

Though not designed primarily as trainers – Cessna marketed the overwhelming majority of 150s under the model name "Commuter" – their simplicity, reliability, and handling qualities place them among the world's most popular training aircraft. They are also certified for limited aerobatics, allowing their use in spin training.

COMPARABLE **MODELS**

Their dominance of the two-seat instructional market makes it difficult to identify directly comparable models. The Piper Model PA-38 Tomahawk and the Beech Model 77 Skipper, both also introduced in 1977, were specifically designed to compete with the 150 and 152, but neither came close to matching their commercial success. Piper's PA-28-140 Cherokee was originally certified with two seats and now competes in many of the same market niches, but its specifications are less similar to the two Cessnas than the Tomahawk or Skipper: It offered 40 additional horsepower and a maximum gross weight 350 pounds higher, and many were delivered with a small back seat. While not certified for aerobatics, spins were permitted with the aircraft loaded in the utility category.

Comparisons for this report are based on a group of 11 different models with a combined registration of just over 10,000 airframes. Cherokee 140s make up the largest subset, accounting for 47 percent of the total. Details of the aircraft included may be found in the Appendix.

Aircraft included in analysis

Model	Years Produced	Registered in the U.S. as of 12/2015
Cessna 150	1958–1977	9,826
Cessna 152	1977–1985	2,241
Comparable fleet*	1940–present	10,368

* Includes 11 models whose current fleet sizes range from 26 to 5,030 airframes. The four most common account for 87 percent of the total. See the Appendix for a complete description.

ACCIDENTS AND **ACCIDENT RATES**

The most widely used benchmark of aircraft safety is the accident rate: the average number of accidents in some standard amount of flight time (usually 100,000 hours). However, this measure is not available for comparisons of specific models because the FAA does not estimate flight activity at the necessary level of detail. The best available alternative is to standardize accident counts by the numbers of aircraft registered, but this may prove misleading if there are substantial differences between models in the proportions being actively flown, average annual hours per airframe, or patterns of use (e.g., personal travel vs. flight instruction).

This report analyzes a total of 2,945 accidents between 1994 and 2013, 392 of which (13.3 percent) were fatal. Ninety-six percent occurred on either personal or instructional flights, with similar totals in both Cessna models and the comparable fleet (range 94.5 to 96.5 percent). Despite their physical similarities, however, the records of the Cessna 150 and 152 show startling divergences that likely reflect differences in amount and type of use. Nearly two-thirds of Cessna 152 accidents took place on training flights, while personal flights accounted for 60 percent of accidents in 150s and 70 percent of those in comparable models.

When standardized as accidents per 100 registered aircraft, Cessna 152s had about 50 percent more accidents than 150s on personal flights but nearly six times as many during flight instruction. Comparable models had slightly fewer accidents than 150s in both activities.

ACCIDENT **CAUSES**

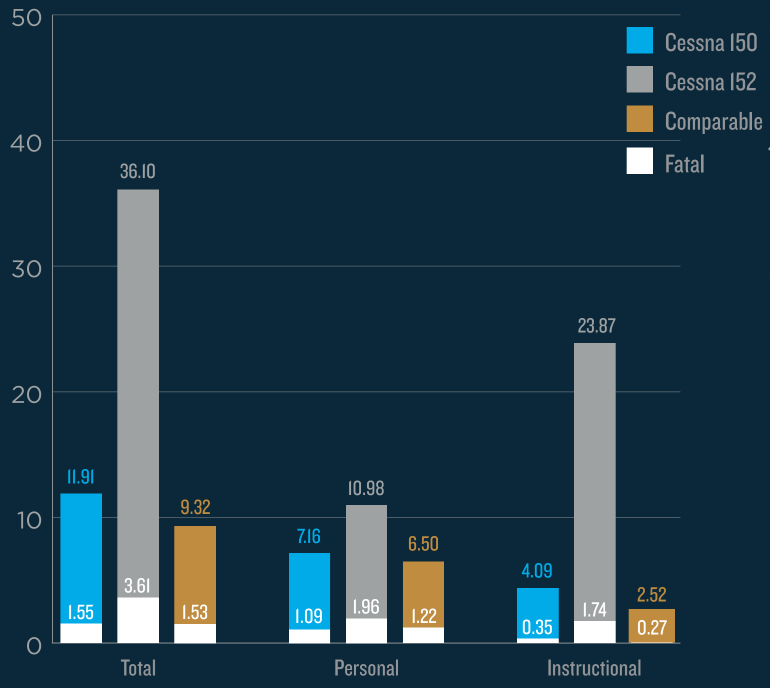
Among the possible explanations for the wide differences between the 150 and the 152, the most obvious would be that the newer model is both flown more actively and more widely used in flight instruction. This would follow if, for example, a large number of flight schools replaced 150s with 152s in their fleets, selling the older aircraft to private owners and perhaps also favoring 152s in leaseback arrangements.

While available data don't allow this conjecture to be evaluated directly, separate comparisons of the types of accidents on personal and instructional flights provide some insight. On personal flights, the causes of accidents in Cessna 150s and 152s are remarkably similar. Both were less susceptible to mechanical failures and unexplained engine stoppages than the comparable models, but

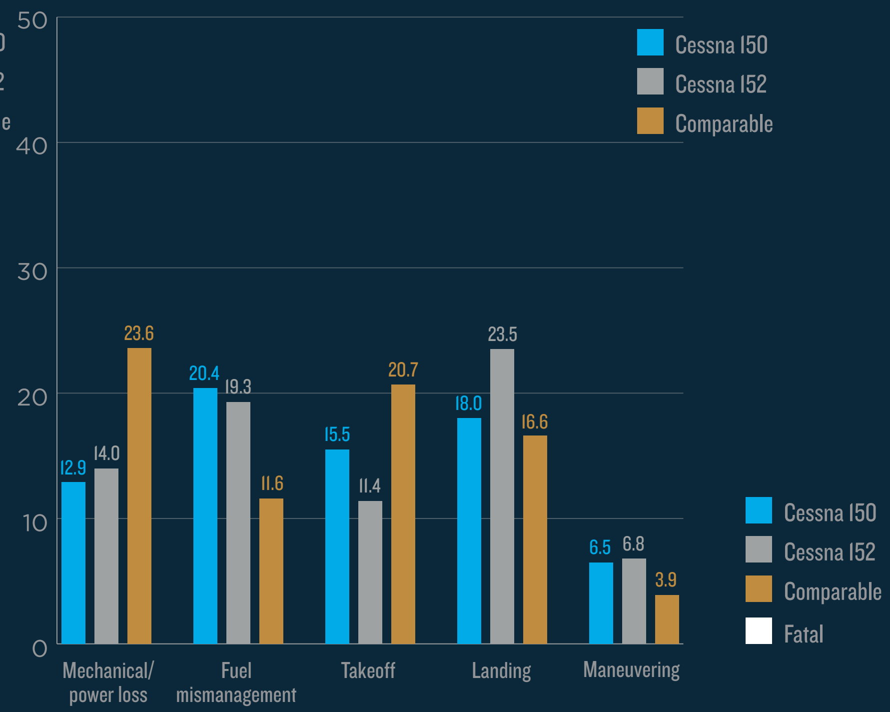
Accidents by purpose of flight

Model	All Flights		Personal		Instructional	
	Total	Fatal	Total	Fatal	Total	Fatal
Cessna 150	1,170	152	704	107	402	33
Cessna 152	809	81	246	44	535	30
Comparable fleet	966	159	674	127	261	28

Accidents per 100 aircraft by purpose of flight



Major accident causes: personal flights



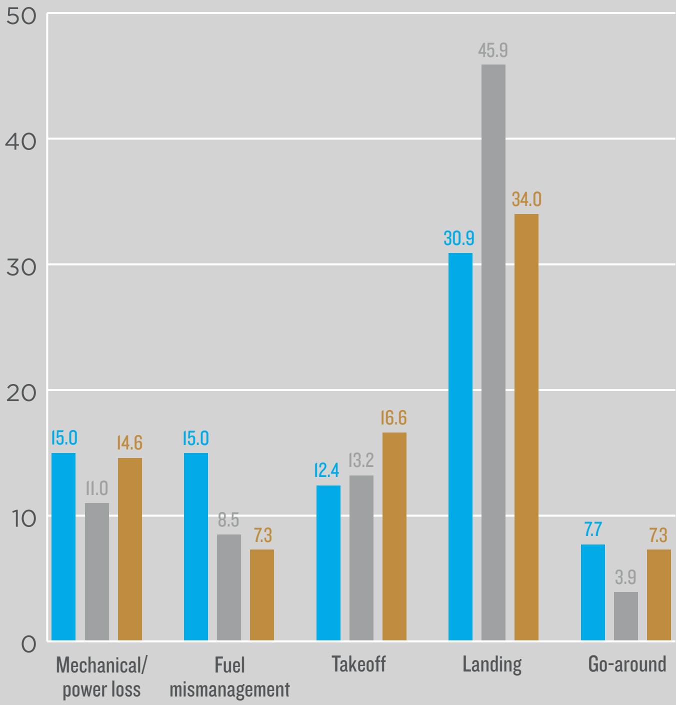
Type of accident by level of instruction

Type of accident	C150	C152	Comparables
Takeoff, landing, go-around	206	322	153
Student solo	145 (70.4%)	266 (82.6%)	99 (64.7%)
Primary dual	47 (22.8%)	45 (14.0%)	46 (30.1%)
Advanced	14 (6.8%)	11 (3.4%)	8 (5.2%)
All other types	196	213	108
Student solo	79 (40.3%)	90 (42.3%)	39 (36.1%)
Primary dual	98 (50.0%)	93 (43.7%)	45 (41.7%)
Advanced	19 (9.7%)	30 (14.1%)	24 (22.2%)
TOTAL	402	535	261
Student solo	**224 (55.7%)**	**356 (66.5%)**	**138 (52.9%)**
Primary dual	**145 (36.1%)**	**138 (25.8%)**	**91 (34.9%)**
Advanced	**33 (8.2%)**	**41 (7.7%)**	**32 (12.3%)**

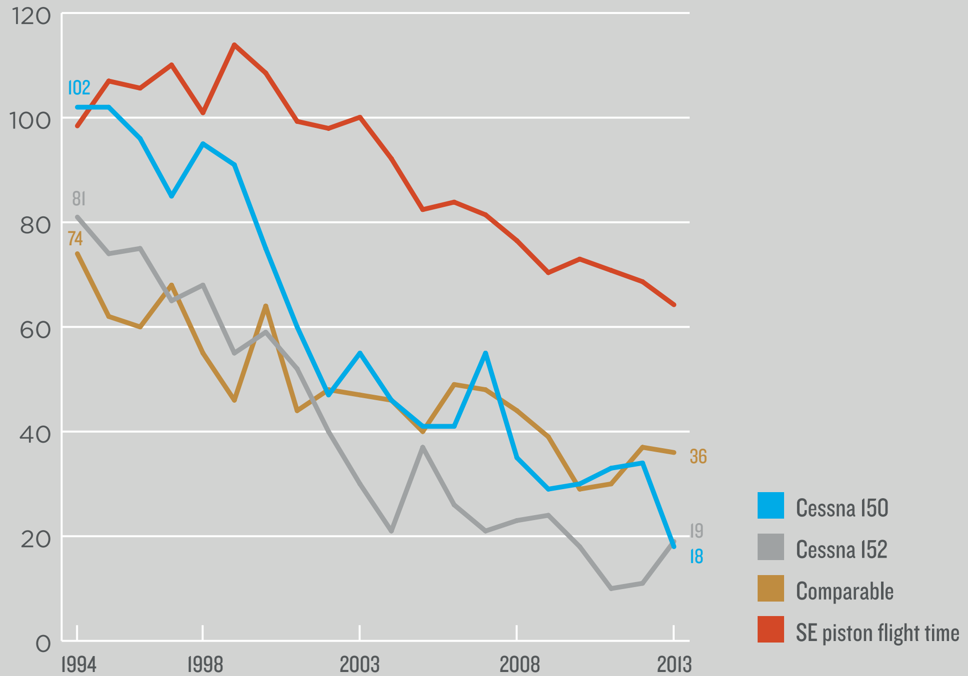
were more prone to fuel mismanagement (a bit surprising given the simplicity of their fuel systems, which feature a single on/off selector valve). C152s experienced relatively fewer takeoff accidents but more landing accidents, perhaps reflecting their increased horsepower and reduced flap travel, respectively. In all three groups, less than 10 percent of accidents on personal flights took place during low-altitude maneuvering, and less than six percent were caused by adverse weather.

The causes of instructional accidents were likewise similar in all three groups aside from the higher proportion due to fuel mismanagement in the 150, which is difficult to explain. Cessna 152s also experienced a higher proportion of accidents during landing attempts but fewer during go-arounds, also consistent with their combination of higher power, greater weight, and reduced flap extension.

Major accident causes: instructional flights



Accidents vs single-engine piston flight activity, 1994-2013



In all three groups, low-altitude maneuvering accidents were rare on instructional flights. They made up less than five percent of the total, and weather accidents were almost non-existent, accounting for just one percent.

More than 90 percent of training accidents in the two Cessna models and 88 percent of those in the comparable fleet occurred during primary instruction. More than half were on student solos, including two-thirds of those in 152s. Student solos were the setting for 65 percent of all takeoff, landing, and go-around accidents on instructional flights in the comparable fleet, 70 percent of those in Cessna 150s, and more than 80 percent in 152s.

Over this 20-year period, the annual number of accidents in these aircraft fell by over 70 percent, more than double the 35 percent decrease in hours flown by all single-engine piston airplanes. Some of that decline no doubt reflects both diminishing numbers of aircraft in the fleet – 150s and 152s that were lost to accidents, retired, or exported have not been replaced, and only two of the comparable models are currently in production – and declining activity per aircraft among the survivors.

MECHANICAL **FAILURES**

Losses of thrust precipitated the overwhelming majority of these accidents, with few differences between personal and instructional flights. In all three groups, documented powerplant breakdowns, fuel system malfunctions, and unexplained engine stoppages jointly caused about 90 percent of all accidents attributed to physical problems with the aircraft. The largest share of these – 35 percent in the 152s and more than 40 percent in the 150s and comparable group – were power losses for reasons that could not be determined. About 30 percent of accidents in the comparable group and 40 percent of those in the Cessnas were caused by failures of "hard" engine parts – cylinders, pistons, camshafts, crankshafts, etc. Magneto and carburetor malfunctions caused 13 percent of mechanical accidents in 152s, about double the share in the other models. Fuel-system problems were primarily blockages of lines or vents.

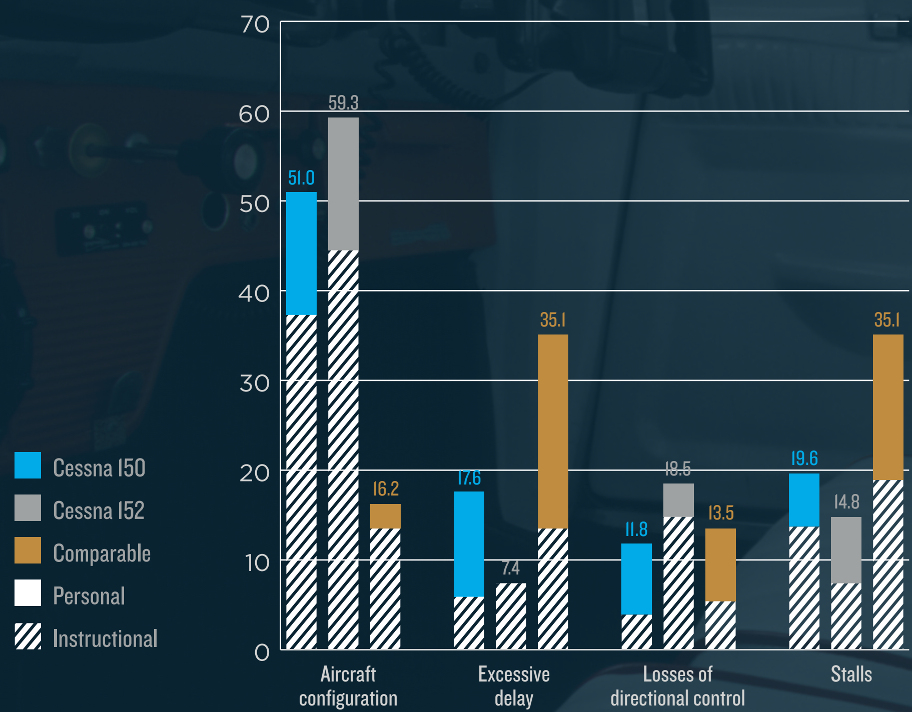
Electrical-system malfunctions accounted for a relatively small portion of mechanical failures. However, three in C150s deserve mention. In each, a blown fuse in the flap system prevented flap retraction before takeoff, resulting in a stall. All three were attributed to maintenance personnel installing incorrect replacement fuses during inspections. The Cessna Operators Manual requires use of "... a special 'SLO-BLO' fuse" rated for 15 amps.

TAKEOFFS, LANDINGS, **AND GO-AROUNDS (TLGS)**

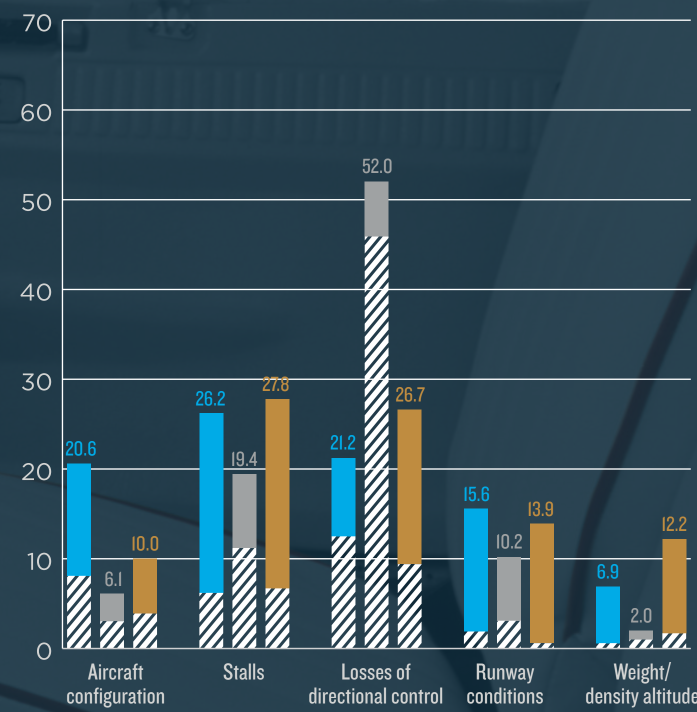
More than half of all instructional accidents in all three groups were caused by poor airmanship during takeoffs, landings, and go-arounds. This is consistent with the overall record of fixed-wing training (see ASI's *Accidents During Flight Instruction: A Review*) and the predominant use of light two-seaters for primary instruction. In Cessna 150s, these accounted for 51 percent; their shares in 152s and the comparable fleet were indistinguishable at 60 and 58 percent, respectively. TLGs also caused a little more than one-third of all accidents on personal flights, with little difference between models (range 34 to 39 percent).

Cessna 150s have proven especially susceptible to errors in aircraft configuration. Nearly half of all go-around accidents (24 of 51) were attributable to erroneous flap settings; attempts to go around with the full 40 degrees outnumbered premature retraction by about two to one. Fourteen takeoff accidents were also caused by attempts to take off with full flaps, and another 15 by the failure to use carburetor heat in conditions conducive to carb ice. Together these represented 18 percent of all takeoff accidents, about double the proportion in 152s and the comparable fleet. Flap position was also implicated in half of all 152 go-around accidents (14 of 27) and misuse of carburetor heat in another five. In the comparable fleet (many of which use manually actuated flaps), they accounted for less than 15 percent.

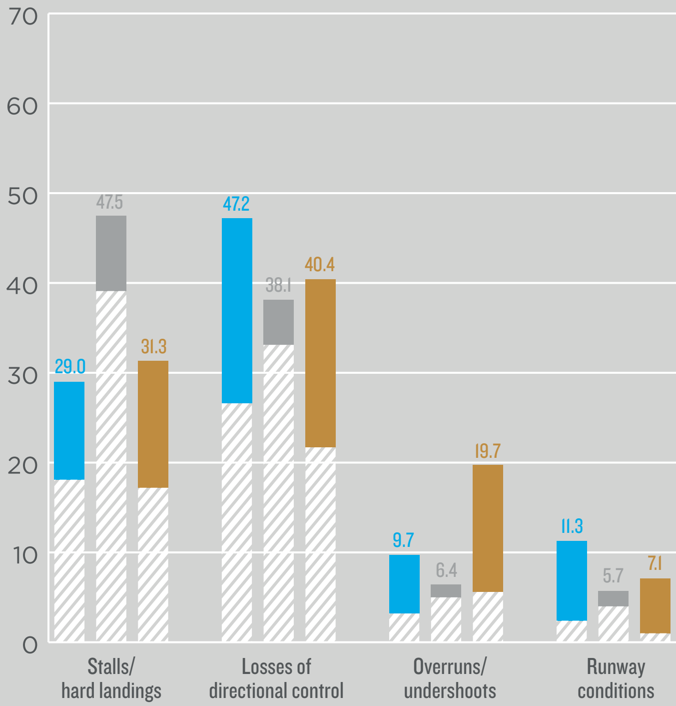
Leading causes of go-around accidents



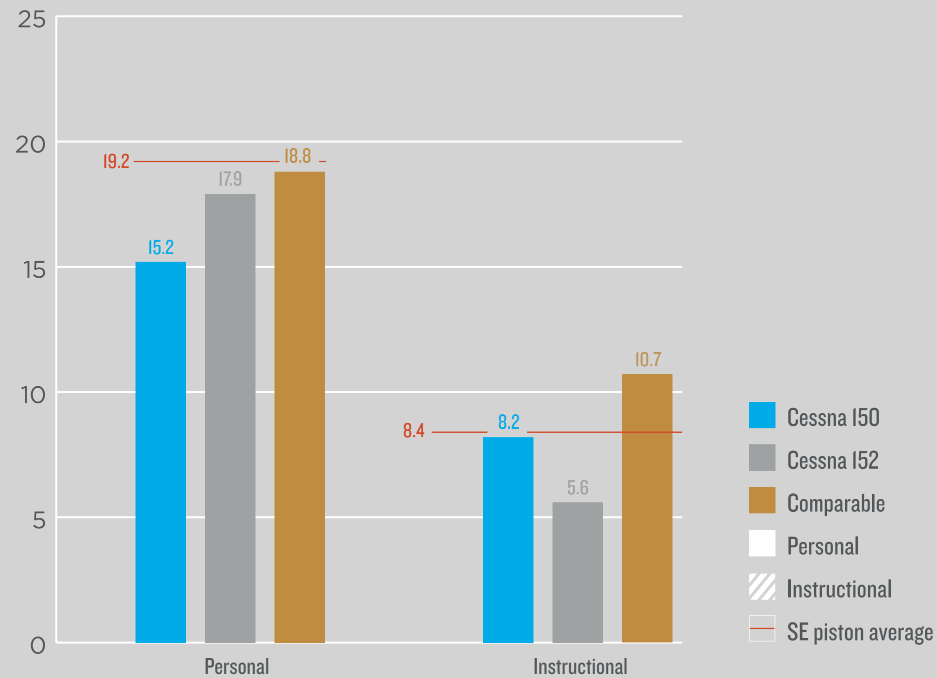
Leading causes of takeoff accidents



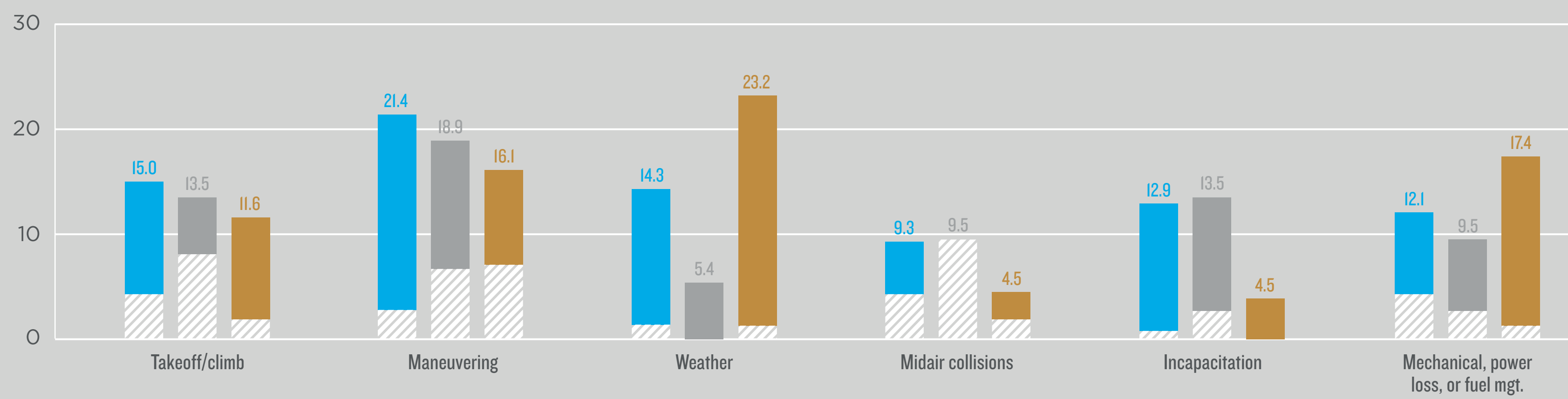
Leading causes of landing accidents



Accident lethality by purpose of flight



Leading causes of fatal accidents



Inadvertent stalls and losses of directional control were the predominant causes of takeoff accidents, accounting for 45 percent of those in C150s, 53 percent among the comparable aircraft, and 71 percent in C152s. They occurred in roughly even proportions on personal flights, but on instructional flights losses of directional control dominated, causing more than three times as many accidents as stalls in the two Cessna models and one and a half times as many in the comparable fleet. Most accidents of both types shared the common factor of trying to force the airplane to fly before it was ready: premature rotation, excessive nose-up pitch, and attempts to make low-altitude turns without sufficient airspeed.

Three-quarters of landing accidents on instructional flights also involved either stalls or losses of directional control. On personal flights, they accounted for 55 percent. In each case the combined proportions were similar in all three groups of aircraft, but stalls figured more prominently in the record of the 152 than those of the other models. In the Cessna 150, losses of control outnumbered stalls by four to one on personal flights and more than two to one in instructional accidents. Among the comparable aircraft, the margins were on the order of 2.3 and 1.7, respectively. In the 152, there were only 15 percent more, with little difference by purpose of flight. Hard landings without reported stalls, mostly attributable to difficulty timing the flare and the accompanying bounces and balloons, accounted for 10 to 13 percent of all landing accidents – except in Cessna 152s used for personal travel, where they made up some 27 percent.

Overruns, undershoots, and attempts to land on unsuitable runways were all rare on instructional flights, again consistent with the overall record of accidents during flight training. By contrast, 10 percent of landing accidents on personal flights in C152s, 11 percent of those in the comparable models, and 19 percent of those in C150s were attributed to runway conditions. The two Cessna models showed a distinct advantage in getting down and stopped; the proportion of overruns was more than three times higher in the comparable fleet, where they accounted for 19 percent compared to just five to six percent in the Cessnas. C152 pilots also did particularly well at avoiding undershoots, with just one on a personal flight. They made up eight percent of the landing accidents in both the 150 and the comparison group.

FATAL **ACCIDENTS**

Survivability was higher in Cessna 150 and 152 accidents than in the comparable fleet and as good as or better than the average for all fixed-gear single-engine piston aircraft engaged in similar operations. Instructional accidents typically have lower lethality due to their greater proportion of low-energy landing and taxi mishaps and the rarity of encounters with hazardous weather, a pattern maintained here.

Fatal training accidents were quite rare in all three groups, with a combined 91 in the span of 20 years. The single most prevalent cause in both the 150 and the 152 models was midair collisions, a clear reflection of their popularity as trainers. Sloppy airmanship during takeoff and climb ranked just behind. Together these accounted for 40 percent of the total. No other single cause arose more than three times during that 20-year period. In particular, fatalities due to mechanical problems, fuel mismanagement, or unexplained engine stoppages were extremely rare on instructional flights.

By contrast, 40 percent of fatal training accidents in the comparison group resulted from low-altitude maneuvering, which was also the number-one killer on personal flights in the C150 and C152. The most common maneuvering accidents were stalls during "low and slow" steep turns and in-flight upsets at high density altitudes or during heavy or overweight operations. Fatal maneuvering accidents on personal flights were only half as common in the comparable fleet, which instead suffered far more due to adverse weather (70 percent more relative to the number of registered aircraft). More than 80 percent of those were attempts to continue flight by visual references in instrument meteorological conditions (VFR into IMC).

Midair collisions also caused 10 percent of fatal personal accidents in Cessna 150s but none in 152s; there were four (seven percent of the total) in the comparison group. Poor technique during takeoff and climb was also a problem on personal flights, causing nine percent of all fatalities in the 152, 13 percent in the 150, and

12 percent in comparable aircraft. Twenty percent of those in the comparable fleet arose from fuel mismanagement, mechanical failures, or unexplained power losses, double the share in either of the Cessna models. Unlike instructional flights, the impairment or physical incapacitation of the pilot in command emerged as a significant fatal accident cause. Less than a third involved outright incapacitation, and three-quarters of impairment cases were alcohol intoxication.

NOTEWORTHY

Botched landings were among the most common accidents on personal flights and the number one cause of instructional accidents. This is consistent with the record of fixed-gear piston singles in general. Losses of directional control from crosswinds, excessive speed, and hard landings due to improper flares and ballooning were common culprits here, offering an obvious payoff for more strenuous efforts to improve pilot proficiency.

Improper flap usage or problems preventing flap retraction caused numerous takeoff accidents in Cessna 150s, chiefly during touch-and-goes, and half of all go-around accidents in both models. Fourteen, three of which were fatal, resulted from flaps being extended beyond 10 degrees on takeoff; all were in 150s. Pilots should note that most 150 and all 152 Pilot Operating Handbooks state that *flap deflections greater than 10 degrees are not approved for takeoff.* Some older model 150 POHs merely state that *flap deflections of 30 and 40 degrees are not recommended at any time for take-off.* Rather than a position lever with detents, older models typically had a flaps-up or -down switch with a separate position indicator. To extend or retract the flaps, the pilot had to hold the switch down or up until the desired setting was achieved before releasing the handle. This requires specific attention paid to the flap position indicator and can be a formidable distraction while rolling down the runway during a touch-and-go, or retracting the flaps during a go-around.

These models' susceptibility to carburetor ice should also be noted. Known or suspected carburetor ice caused 20 of the takeoff accidents due to incorrect aircraft configuration, 15 of them in C150s and five in C152s. These accidents, caused by power loss, occurred at takeoff power settings during serious carburetor icing conditions. Takeoffs with carburetor heat on are normally discouraged due to the loss of available power and longer takeoff run, but might have prevented some of these accidents. Instead, FAA Advisory Circular AC 20-113, released in 1981, recommends a "brief" application of carburetor heat prior to takeoff (but not during taxi due to the risk of foreign object ingestion). The takeoff itself should be made with the carb heat off "unless extreme intake icing conditions are present." This raises the question of whether flight should even be attempted in conditions conducive to serious carburetor icing. AC 20-113 states that the potential for icing conditions exists any time the temperature-dewpoint spread falls below 20 degrees F (11 degrees C in a METAR).

Stall and stall/spin accidents in the "maneuvering" category accounted for 28 accidents in C150s, of which seven were fatal. These involved high density altitudes and overweight aircraft. Interestingly, maneuvering stalls only caused 16 accidents in C152s, six of which were fatal. None appear to have involved either density altitude or gross weight as factors.

IN CONCLUSION

Being lightweight and nimble aircraft, the C150 and C152 are fun to fly and offer an affordable alternative with a proven track record of reliability. Overall, their accident record compares favorably to those of other similarly light aircraft. However, like all airplanes, certain aspects of their operation require particular care and caution. Attention to weight and balance, flap position during takeoff, use of carburetor heat, and airspeed control during takeoffs, landings, and go-arounds all come to mind. Take the time to practice slow flight at a safe altitude and get to know the characteristics of the airplane in these regimes. Practice stall recognition and recovery – straight and turning, power-on and -off – with an instructor familiar with the make and model, and put in the practice necessary to refine crosswind control and improve the precision of takeoffs and landings. Remember, their low power and light weight give these durable little aircraft their own unique control feel. Safe flying!

Appendix: List of "Comparable" Models

Model	Registered in the U.S.*
Piper PA-28-140 Cherokee	5,030
Piper PA-22 Tri-Pacer *(engines rated for 135 hp or less)*	1,712
Ercoupe *(all models, various manufacturers)*	1,394
American/Grumman AA-1A Trainer	865
Piper PA-38 Tomahawk	575
Diamond DA20	361
Beechcraft 77 Skipper	140
Varga Kachina	101
Zenair / Alarus CH-2000 *(excluding amateur-built)*	95
Liberty XL-2	69
OMF Symphony	26
TOTAL	**10,368**

*as of 12/2015

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