Aviation Investigation Final Report

Location:	Leesburg, Virginia	**Incident Number:**	ERA21LA065
Date & Time:	December 6, 2020, 19:10 UTC	**Registration:**	N282ST
Aircraft:	Piper PA46	**Aircraft Damage:**	Minor
Defining Event:	Loss of control on ground	**Injuries:**	1 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot reported that, after touchdown, while rolling straight down the runway, the airplane "went careening to the left." He stated that the right brake locked, and the right main landing gear (MLG) tire "blew" as the airplane skidded. The pilot applied rudder and brake inputs to correct the deviation and was able to straighten the airplane's path; however, the airplane exited the left side of the runway and came to rest in the grass. The calculated crosswind component at the time of landing was 7 kts with gusts to 12 kts.

Examination of the runway revealed distinct tire marks from the nose landing gear (NLG) and both MLG extending from the touchdown point on the runway to where the airplane exited the left side of the runway. The NLG tire mark was a dark, wide line with no evident tread pattern, consistent with the airplane skidding from the touchdown point to the runway departure point.

The left MLG tire marks displayed an evident tread pattern consistent with tires rolling under the application of brakes for the entire length. The right MLG tire marks had an evident tread pattern, consistent the tires rolling while braking was being applied, that then changed to a dark wide mark consistent with a skidding tire. The rubber transfer marks then changed to a light mark, likely as a result of the right MLG tire deflating due to wear through the tread.

Examination of the NLG revealed that the tire's right sidewall exhibited crosswise scuffing and the NLG fork was bent left about 10° left. A review of avionics data revealed that the airplane experienced an initial slight lateral acceleration to the right after the MLG touched down, followed by a more significant left lateral acceleration when the NLG touched down about 2 seconds later. The heading began to diverge left of the track when the NLG touched down. About 5 seconds after touchdown, the heading and lateral acceleration transitioned to the right, even though the airplane was still tracking to the left side of the runway. All of these factors are consistent with the NLG tire having been turned to the left at the time of touchdown and with the tire then skidding throughout the landing roll.

Examination of the steering horn revealed that some dimensions exceeded specified tolerances, but they were slight and would have a negligible effect on the function of the steering. Examination of the steering system did not reveal any anomalies or malfunctions that would have precluded normal operation. Following the incident, the NLG tire pressure was measured at 33 psi, significantly lower than manufacturer recommendations.

Given the significant crosswind component at the time of the landing, it is likely that the pilot was correcting for this crosswind component with left rudder input and did not neutralize the rudder pedals, and the NLG wheel, before NLG touchdown.

Other Incidents

N641WA

The airplane departed the left side of the runway shortly after touchdown and came to rest in the dirt and grass adjacent to the runway after the NLG collapsed. The wind at the time of the incident was variable at 3 kts. The pilot checked the NLG tire pressure and added air 2 days before the event. The NLG tire pressure was 78 psi when measured 3 days after the event and decreased to 64 psi 8 days after the event. It is likely that the NLG tire pressure was below recommended at the time of the incident. Data from the airplane showed two distinct oscillations in lateral acceleration after NLG touchdown before the excursion to the left. The heading and track diverged during the excursion, with the heading reaching a maximum of 60° left of the track. The skid marks show the airplane in a left skid with all three tires skidding. The airplane had the new configuration steering horn installed at the time of the incident which had some dimensions out of tolerance. Examination of the steering horn did not reveal any anomalies that would have precluded normal operation. The available information suggests that the pilot over-controlled the airplane in response to the initial lateral acceleration experienced upon NLG touchdown. The low tire pressure likely contributed to the event.

N831PS

The pilot experienced a veer to the left during landing on runway 33, but was able to control the airplane before it departed the runway surface. The wind at the time of the incident was from 120° at 3 kts. The pilot examined the airplane after the event and finding no damage, returned to his home airport. The NLG tire pressure after this flight was 72 psi. Examination of the steering horn did not reveal any anomalies that would have precluded normal operation. The data showed a deviation to the left with a response to the right as reported by the pilot. The available evidence suggests that the low tire pressure contributed to the left veer.

N115NX

The first of this airplane's three steering events occurred in December 2019 during a delivery flight performed by a manufacturer test pilot. The airplane departed the right side of runway 18 after touching down and came to rest on a taxiway. The wind at the time of the incident was from 190° at 9 kts. All tire pressures measured about 10 psi low and the steering horn pads-to-roller dimensions were significantly out of tolerance. The steering horn was replaced with a

new unit but of the older configuration. The available information suggests that the tire pressure and play in the steering system contributed to the excursion.

The second event occurred in June 2020 after the airplane had been purchased. During landing on runway 22, the airplane veered to the right upon NLG touchdown, but did not leave the runway surface. The wind at the time of the incident was from 210° at 11 kts. The pilot reported that he had very little time in the PA-46-600TP, but had previously owned a PA-46-350. The flight instructor onboard reported that the pilot corrected to the right, which developed into a left-right oscillation during which the pilot was applying rudder input to each of the stops. Avionics data corroborated the flight instructor's account of the event. The available information suggests that the pilot over-controlled the airplane following the initial left veer.

The third event occurred a week after the first event when the pilot was receiving training in the airplane with a flight instructor. The airplane experienced a veer to the right during landing on runway 4 and the pilot reported that the right MLG departed the paved surface. The wind at the time of the incident was from 020° at 4 kts. The pilot recalled touching down with a left drift, so he applied increasing right rudder until the airplane responded and darted right. The instructor had his feet on the rudder pedals and reported that the pilot was adding right ridder before the NLG touched down and the airplane darted right once the NLG touched down. The instructor took the flight controls and regained control of the airplane. According to the instructor, the tire pressures were normal before the flight. Avionics data corroborated the instructor's account of the incident, with an initial slight left acceleration followed by a hard veer to the right. The available information suggests that the pilot applied right rudder before NLG touchdown instead of centering the NLG wheel. The airplane's pilot operating handbook contains a caution that states, "In crosswind conditions, the nosewheel may not be aligned with the runway as the wheel touches down because of opposite rudder input. To prevent swerving in the direction the nosewheel is offset, the rudder must be promptly centered just as the nosewheel touches down." Straightening the nose wheel can be challenging, especially when landing in crosswind conditions, since any amount of rudder input will also rotate the NLG wheel. The manufacturer has maintained that NLG tire pressure is critical for NLG steering control on the airplane. As the pressure decreases in the NLG tire, the contact patch with the runway increases and therefore, the friction force generated at the tire runway interface increases. The manufacturer recommends checking the tire pressure before each flight and has modified the specified pressure through service letter (SL) 1285, 1285A, and 1285B.

The rake angle of the NLG was established with the first PA-46 airplane and has not changed as the airplane has changed. The NLG rake is essentially zero, with the NLG strut designed to be 90° from the airplane longitudinal axis with a very tight tolerance allowing 0.5° forward rake and zero aft rake. This zero rake angle is good for static stability and taxiing at slower speeds, but can be problematic for its dynamic stability at higher speeds. A zero or aft rake can tend to cause the NLG tire to turn sharper without any input by the pilot. Low tire pressure can exacerbate the problem. On NLG touchdown, the NLG strut will deflect aft due to spring-back, increasing the negative rake that could cause an instability.

Any amount of play in the NLG steering system can result in pilots tending to overcontrol the airplane and input more rudder pedal before there is a response. The manufacturer has

redesigned portions of the NLG steering system to tighten the tolerances and developed a new steering horn that attempts to minimize the play in the system by controlling the critical dimensions more closely. The new steering horn is being installed on all new airplanes after SN 4698135.

For the incidents investigated, there was not one single factor that could be identified as causal, but rather a combination of factors, such as tire pressure, rake angle, tolerance stack up, pilot technique, and crosswinds that combined to result in a directional excursion.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be:

The pilot's loss of directional control during landing in crosswind conditions. Contributing to the loss of control was the significantly underinflated nose landing gear tire.

Findings

Aircraft	Nose/tail landing gear - Incorrect service/maintenance
Environmental issues	Crosswind - Compliance w/ procedure
Personnel issues	Incorrect action performance - Pilot
Aircraft	Directional control - Not attained/maintained

Factual Information

History of Flight

Landing-landing roll	Loss of control on ground (Defining event)

On December 6, 2020, about 1420 eastern standard time, a Piper PA-46-600TP, N282ST, sustained minor damage when it was involved in an incident near Leesburg, Virginia. The pilot was not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The pilot reported that the wind was "straight down the runway" when he landed on runway 35 at the Leesburg Executive Airport (JYO), Leesburg, Virginia. While continuing straight during the landing roll, the airplane "went careening to the left." He stated that the right brake locked, and the right main landing gear (MLG) tire "blew" from the skidding. The pilot applied "significant" rudder and brake inputs to correct the deviation; however, he was unsuccessful, and the airplane departed the left side of the runway, coming to rest in the grass about 12 ft from the left edge of the runway and about 2,370 ft from the approach end of the runway.

Data downloaded from the airplane's Garmin G3000 Integrated Avionics System revealed a rightward lateral acceleration following touchdown immediately followed by a significant lateral acceleration to the left and a corresponding decrease in heading and track consistent with the airplane sliding.

Pilot Information

Certificate:	Airline transport; Commercial; Flight instructor; Military	**Age:**	55,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine	**Toxicology Performed:**	
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	March 26, 2019
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	August 3, 2020
Flight Time:	4003 hours (Total, all aircraft), 67 hours (Total, this make and model), 2618 hours (Pilot In Command, all aircraft)		

The pilot reported 4,003 total hours of flight experience, with 67 hours in the incident airplane make and model.

Aircraft and Owner/Operator Information

Aircraft Make:	Piper	**Registration:**	N282ST
Model/Series:	PA46 600TP	**Aircraft Category:**	Airplane
Year of Manufacture:	2019	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	4698111
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:		**Certified Max Gross Wt.:**	6000 lbs
Time Since Last Inspection:		**Engines:**	1 Turbo prop
Airframe Total Time:	91 Hrs at time of accident	**Engine Manufacturer:**	Pratt & Whitney
ELT:	Installed, not activated	**Engine Model/Series:**	PT6A-42A
Registered Owner:	On file	**Rated Power:**	600 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The Piper PA-46-600TP M600 is a single turbine engine, propeller-driven, low wing airplane that was certified in June 2016 (See figure 1). The incident airplane was serial number (SN) 4698111.

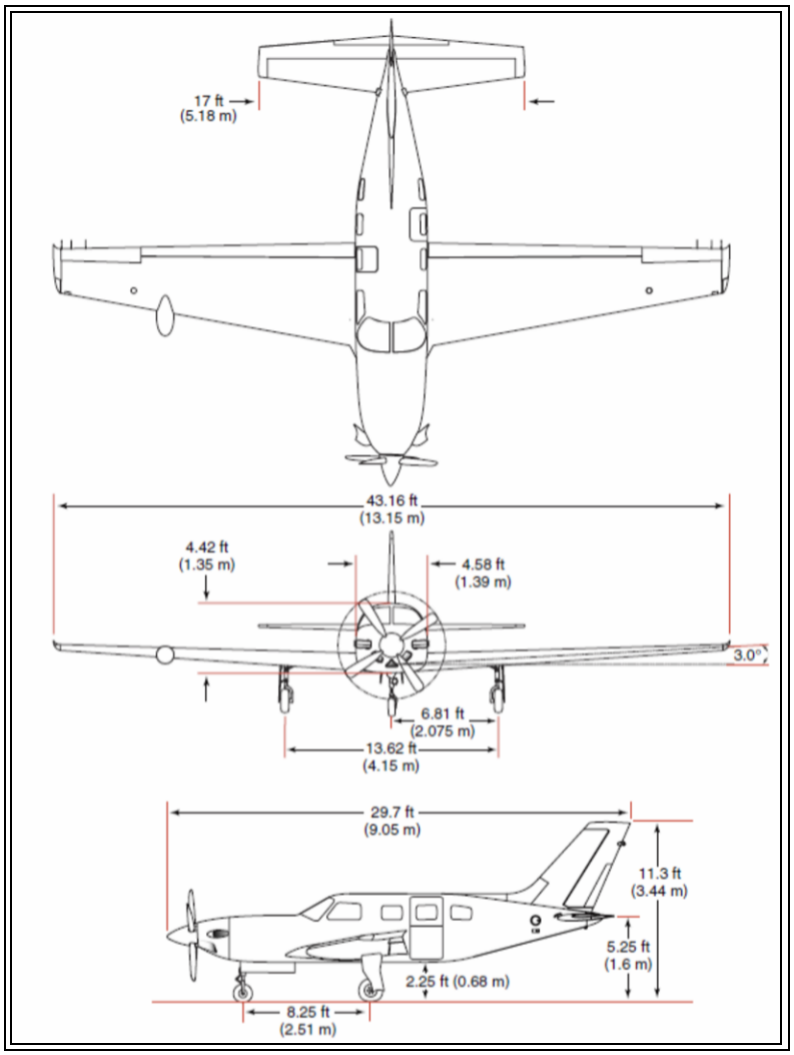


Figure 1. Piper PA-46-600TP M600 airplane 3-view drawing.

Nose Landing Gear Steering

The nose landing gear (NLG) is attached to the engine mount at the upper end of the trunnion assembly by two trunnion bolts. The NLG strut assembly is installed in the trunnion assembly, where it rotates for nosewheel steering. The retract actuator is attached to the NLG trunnion assembly and engine mount to allow the NLG to retract aft into the wheel well. During retraction, the NLG strut and tire rotate 90° left through a mechanism that stows the NLG tire in a horizontal position.

The NLG is steerable through a 50° arc, 20° left and 30° right of center, using the rudder pedals. Primary rudder mechanical stops are installed adjacent to the rudder sector in the empennage to limit the deflection of the rudder and thus the motion of the rudder pedals. Secondary rudder pedal mechanical stops are installed in a machined aluminum fitting aft of the steering bellcrank. The secondary stops allow for a small amount of additional rudder pedal

movement, as the rudder cables stretch before the stops engage the steering bellcrank. The NLG steering horn is attached to the top of the NLG strut with three bolts.

When the landing gear are extended, the right and left forward faces of the steering arm engage the right and left pads and rollers on the steering horn to transmit the linear motion of the rudder pedals to a rotational motion of the NLG strut.

Steering Horn Assembly

During manufacture, a steering horn assembly (part number 85154-012) was installed on M600 airplanes with SN 4698001 to 4698135. The assembly was the same as used on the M500 airplane and is attached to the NLG strut with three bolts through the base. A rub block is attached to the forward leg of the top plate, a large roller is attached to the top plate's left leg, and a small roller is attached to the top plate's right leg. The two steering pads and two steering rollers interface with the steering arm to provide nosewheel steering when the NLG is in the down position. The left roller should be up to 0.020 inch forward of the steering pad. The manufacturer discovered alignment issues with certain steering horn assemblies installed on airplanes with SN 4698102 and above, where the location of the steering pads and rollers were not consistent due to variances in the tolerance stack up. The alignment could be adjusted by machining the faces of the steering pads to achieve the necessary dimensional relationship between the pads and rollers. Starting at SN 4698136, the nose wheel steering horn and roller assembly was changed. The overall design of the new steering horn assembly, part number 46N32A009-001, did not change; however, the tolerances on certain critical dimensions were reduced.

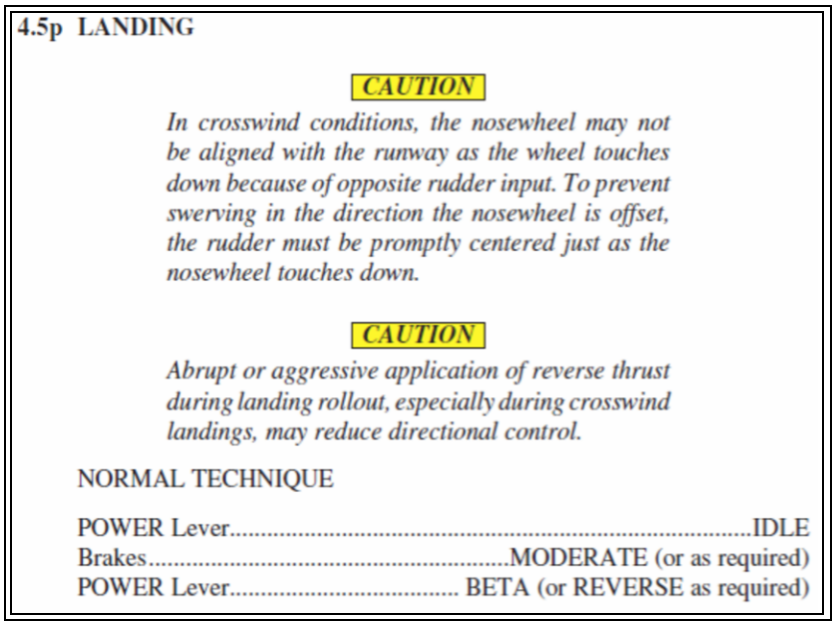
Maintenance History

At the time of the incident, the airplane had accrued a total of 91 flight hours. The airplane received its airworthiness certificate on December 7, 2019. On January 17, 2020, the steering horn was removed from the NLG so that the steering pads could be resurfaced in accordance with the manufacturing drawing. The steering horn was reinstalled while the airplane was still at the Piper factory service center after it had accrued 5 hours total time.

The airplane manufacturer's Warrantable 1st 50-hour inspection was completed on May 20, 2020, at which time the NLG and MLG oleo struts were serviced. The airplane had accrued 25.0 hours total time at the time of the maintenance. The most recent maintenance on the airplane was work on the avionics performed on August 7, 2020, at an airplane total time of 52.1 hours.

Landing Procedures

According to the normal procedures section of the Pilot's Operating Handbook (POH), pilots are cautioned to promptly center the rudder just as the nosewheel touches down in crosswind conditions to prevent swerving during landing.



4.5p LANDING

CAUTION

In crosswind conditions, the nosewheel may not be aligned with the runway as the wheel touches down because of opposite rudder input. To prevent swerving in the direction the nosewheel is offset, the rudder must be promptly centered just as the nosewheel touches down.

CAUTION

Abrupt or aggressive application of reverse thrust during landing rollout, especially during crosswind landings, may reduce directional control.

NORMAL TECHNIQUE

POWER Lever.....IDLE
Brakes.....MODERATE (or as required)
POWER Lever..... BETA (or REVERSE as required)

Figure 2. POH Normal landing procedures.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	JYO,389 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	13:55 Local	**Direction from Accident Site:**	274°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	11 knots / 19 knots	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	300°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.94 inches Hg	**Temperature/Dew Point:**	6°C / -2°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Stuart, FL (KSUA)	**Type of Flight Plan Filed:**	IFR
Destination:	Leesburg, VA	**Type of Clearance:**	IFR
Departure Time:	11:01 Local	**Type of Airspace:**	Class D

At 1355, the recorded weather at JYO included wind from 300° at 11 knots gusting to 19 knots. The calculated (left) crosswind component was 7.1 kts gusting to 12.2 kts.

Airport Information

Airport:	Leesburg Executive Airport JYO	**Runway Surface Type:**	Asphalt
Airport Elevation:	389 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	35	**IFR Approach:**	None
Runway Length/Width:	5500 ft / 100 ft	**VFR Approach/Landing:**	Full stop;Traffic pattern

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Minor
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	39.077972,-77.5575(est)

Airplane Examination

Examination of the airplane revealed impact damage to the left wingtip just aft of the navigation light and slight buckling of the upper wing skin just inboard of the wingtip and forward of the main wing spar.

The right MLG tire was deflated and exhibited two flat spots, one that was worn through the tire. Examination of the preload bearings and brakes revealed no anomalies. The left MLG tire exhibited two flat spots; however, the tire was not worn through. The left MLG tire pressure measured 44.0 psi. At the time of the incident, the manufacturer specified a MLG tire pressure of 99-104 psi. The left main gear hub cap's schrader valve access door was not oriented to access the schrader valve. The NLG tire remained inflated, and the fork was deformed to the left about 10°. The right side tire wall markings were significantly abraded. The NLG tire pressure measured 33.3 psi. At the time of the incident, the manufacturer specified a NLG tire pressure of 92-97 psi.

The steering horn remained attached to the top of the NLG strut and exhibited areas of chipped and cracked paint, but no mechanical damage. There was a small impact mark noted on the aft face of the left side of the steering arm that serves as the left turn mechanical stop. No anomalies to rake angle or roller gap settings were noted during the examination in reference to service letter (SL) 1286, dated August 18, 2020.

Examination of the steering horn assembly at the manufacturer revealed that the left roller hole location measured 0.001-inch aft of its maximum tolerance. The right roller hole location measured 0.001-inch closer laterally to the center of the base than its maximum tolerance. The left steering pad measured 0.030-inch closer laterally to the center of the base than its

maximum tolerance and the right steering pad measured 0.020-inch closer laterally to the center of the base than its maximum tolerance. All other dimensions were within the tolerances specified on the relevant manufacturing drawing(s).

Runway and Ground Scars Examination

Examination of the incident site revealed three distinct ground scars in the grass at the edge of the runway. At the runway departure point, the NLG ground scar was 4 ft from the right MLG ground scar and 8.8 ft from the left MLG ground scar measured perpendicular to the scars. There were distinct rubber transfer marks on the paved surface of runway 35 that matched the locations of the ground scars. The rubber transfer marks were traced back to their beginning points on the runway surface. The left MLG rubber transfer mark showed four parallel lines with spaces between, consistent with the tire tread pattern and the tires rolling with brakes applied. The marks were lighter in appearance for the first 85 ft then became much darker, consistent with heavier braking action. The right MLG rubber transfer mark showed four parallel lines with spaces between for the first 7 ft, then transitioned to a darker and wider line with no tread pattern consistent with a skidding tire. The dark, wide right MLG skid mark continued until about 60 feet from the departure point, where it transitioned to a very light mark. The NLG rubber transfer mark was a wider line of varying intensity with no tread pattern, consistent with a skidding tire.

Recorded Flight Data

The Garmin G3000 Integrated Avionics System on the airplane recorded certain flight parameters. Data downloaded and plotted by the manufacturer revealed the altitude, groundspeed, heading, track, pitch, and lateral acceleration data for the incident landing, shown in Figure 3. The airplane experienced an initial slight lateral acceleration to the right after the MLG touched down, followed by a more significant left lateral acceleration when the NLG touched down about 2 seconds later. The heading began to diverge left of the track when the NLG touched down. About 5 seconds after touchdown, the heading and lateral acceleration transition to the right, even though the airplane was still tracking toward the left side of the runway.

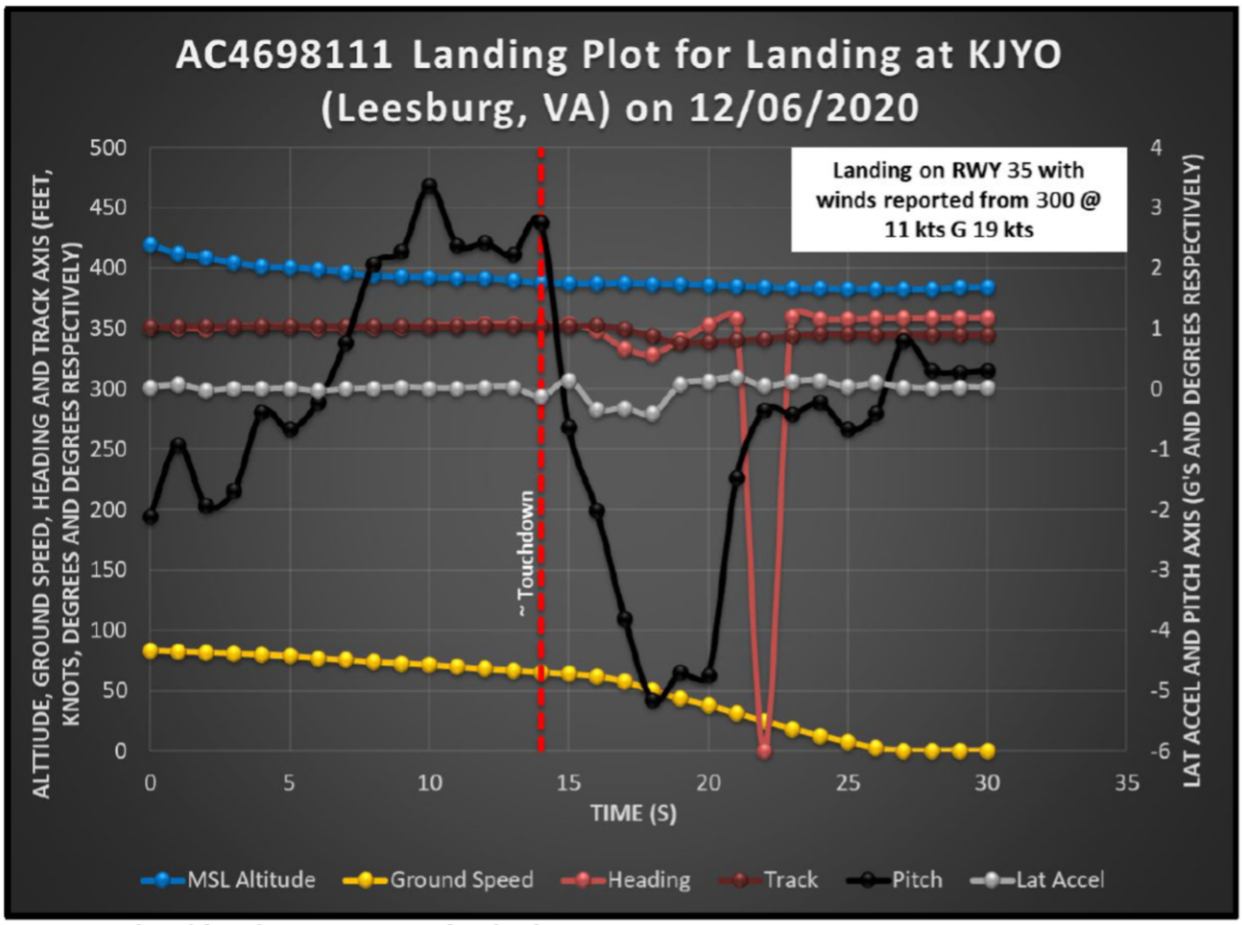


Figure 3. Plot of data from N282ST incident landing.

Tests and Research

Published Service Information

On July 24, 2020, the airplane manufacturer issued SL 1285 Proper Tire Pressure Maintenance. The NLG tire pressures increased from 88 psi to 92-97 psi. SL 1285A was issued on January 12, 2021, to supersede SL 1285 and added information on replacement placards and a revision to the Pilot's Operating Handbook (POH). SL 1285B was issued on June 15, 2021, to supersede SL 1285A and the NLG tire pressure changed to 88-92 psi. The SL also added information about temperature effects and changed the PN for the replacement placards.

On August 18, 2020, the manufacturer issued SL 1286 Nose Landing Gear Steering Components Inspection and Adjustment. The SL highlighted existing Airplane Maintenance Manual (AMM)

procedures for NLG alignment, NLG rake angle adjustment, and rudder cable tension and updated the procedures for measuring and adjusting the clearance between the NLG steering arm and steering horn rollers. It recommended compliance within 50 hours and recurring inspection every 100 hours. SL 1286A was issued on January 21, 2021, to supersede SL 1286 for all PA-46 airplanes and contained updated nose landing gear alignment procedures for the M600 airplanes. The recommended compliance remained the same as the original, but it recommended compliance at the next scheduled maintenance visit for M600 airplanes. SL 1286B was issued on January 28, 2021, for all PA-46 airplanes to supersede SL 1286A and added new information on rigging of the rudder-aileron interconnect for M600 airplanes. The recommended compliance remained the same as the original, but it recommended compliance at the next scheduled maintenance visit for M600 airplanes that were compliant with SL 1286 and prior to further flight for M600 airplanes that were compliant with SL 1286A. SL 1286C was issued on March 24, 2021, to supersede SL 1286B and contained clarification of the procedures to check and adjust the clearance between the NLG steering arm and steering horn rollers and the NLG alignment. The recommended compliance time remained the same as the original, but it recommended no further action until the next recurring action for M600 airplanes that already complied with SL 1286B, compliance before further flight for M600 airplanes that already complied with SL 1286A, and compliance at the next maintenance visit for M600 airplanes that already complied with SL 1286. SL 1286D was issued on October 15, 2021, to supersede SL 1286C and updated the clearance between the steering arm and rollers to 0.010-inch minimum when pushing the right and left rudder pedals to the stops. The recommended compliance remained the same as the original, but it recommended no further action until the next recurring action for M600 airplanes that already complied with SL 1286B or SL 1286C, compliance before further flight for M600 airplanes that already complied with SL 1286A, and compliance at the next maintenance visit for M600 airplanes that already complied with SL 1286.

On December 17, 2020, the manufacturer issued Service Bulletin (SB) 1350 Nose Landing Gear Steering Horn and Arm Assemblies Inspection, applicable to M600 airplanes with SN 4698100 through SN 4698135. Piper considered compliance with the SB mandatory at the next maintenance visit but not to exceed 50 hours. The SB called for inspection of the steering horn and steering arm and replacement, if necessary. The aim of the SB was to make the affected airplanes compliant with the updated alignment requirements between the steering horn pads and rollers in accordance with the updated steering horn design discussed above. SB 1350A was issued on February 10, 2021, to supersede SB 1350 for the same affected airplanes and updated the torque of the bolts that attach the steering horn to the NLG strut from 25-30 in-lb to 60-75 in-lb.

Additional Information

Other Incidents

During this investigation, the NTSB was notified of similar events involving Piper PA-46-600TP airplanes. Although these events did not meet the criteria for classification as an accident, the NTSB gathered information and performed some investigative work for comparison.

N641WA Incident

On January 19, 2021, about 1615 eastern standard time, a Piper PA-46-600TP, N641WA, sustained minor damage when it departed the runway during landing at Manchester Airport (MHT), Manchester, New Hampshire. The pilot and passenger were not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The pilot reported that the airplane underwent its 50-hour inspection in late December 2020, after which he flew to Arizona, where he completed 20 hours of flight training in the airplane. The day before the event, the pilot checked the tire pressures and found them to be low. A mechanic recalled that the NLG tire pressure was about 80 psi and he added air to the tire to bring it to 92 psi. Upon landing on runway 35 at MHT, the airplane experienced a loss of directional control and a subsequent runway excursion during which the NLG collapsed. MHT airport operations examined the runway immediately following the incident and reported a dry runway and no snow or ice contamination. The wind at the time of the incident was variable at 3 kts.

Data downloaded from the airplane's Garmin G3000 Integrated Avionics System indicated that, following NLG touchdown, there were two distinct oscillations in lateral acceleration before the excursion to the left. The G3000 wheel speed sensors were not recording at the time of the incident.

Examination of the runway revealed three distinct rubber transfer marks that led to two ground scars and the right MLG. All three transfer marks were dark, wide lines with no visible tread pattern, consistent with the tire's track angle while skidding. The three marks arced to the left throughout their length. The NLG mark was initially to the right of the left MLG mark and crossed over the left MLG mark about halfway along the length of the marks.

The NLG tire pressure was 78 psi when measured 3 days after the incident.

The airplane was equipped with the new configuration steering horn at the time of the incident. Examination of the steering horn by the manufacturer revealed that the left roller hole location measured 0.001-inch aft of its maximum tolerance, the right roller hole location measured 0.005-inch aft of its maximum tolerance, the left steering pad measured 0.020-inch closer laterally to the center of the base than its maximum tolerance, and the right steering pad measured 0.020-inch closer laterally to the center of the base than its maximum tolerance.

N831PS Incident

On December 19, 2020, about 1436 eastern standard time, a Piper PA-46-600TP, N831PS, experienced a veer to the left during landing on runway 33 at Martin State Airport (MTN),

Middle River, Maryland. The pilot was not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The pilot reported that the visual approach was normal, and he crossed the runway threshold at 85 kts. The touchdown was normal and on the runway centerline; however, when the NLG touched down, the airplane veered "hard" to the left. The pilot was able to correct the deviation and the airplane remained on the runway surface. After shutdown and a visual inspection, he returned to his home airport, where upon landing, the NLG tire pressure was 72 psi.

Data downloaded from the airplane's Garmin G3000 Integrated Avionics System indicated that, following NLG touchdown on the incident flight, there was a left lateral acceleration about -0.12 g followed by a right lateral acceleration about 0.20 g. The lateral acceleration oscillated slightly for the next 3 seconds before becoming stable and during this time, the heading deviated from the track. The remainder of the landing roll appeared normal.

After the incident, the airplane underwent an annual inspection, during which the NLG steering horn was replaced. Examination of the steering horn assembly from the incident airplane by the manufacturer revealed that the left steering pad measured 0.020-inch closer laterally to the center of the base than its maximum tolerance and the right steering pad measured 0.040-inch closer laterally to the center of the base than its maximum tolerance.

N115NX Incidents

This Piper PA-46-600TP, N115NX, SN 4698115, experienced three separate steering events. On December 23, 2019, about 1013 central standard time, during landing on runway 18 at Johnson County Executive Airport (OJC), Olathe, Kansas, the airplane departed the right side of the runway, crossed a grassy area, and came to rest on a taxiway. The airplane was being operated by a manufacturer engineering flight test pilot as a delivery flight from the factory. The wind at the time of the incident was from 190° at 9 kts.

Examination of the airplane revealed that all tire pressures were about 10 psi low and the NLG steering pads protruded aft of the roller tangent lines about 0.074-inch. The steering horn assembly, part number 85154-012, was replaced with a new assembly, also part number 85154-012.

On June 3, 2020, the airplane veered to the right during landing on runway 22 at Driggs-Reed Memorial Airport (DIJ), Driggs, Idaho. The airplane did not leave the paved surface and was not damaged. The airplane was being operated by the owner with a flight instructor present. The wind at the time of the incident was from 210° at 11 kts. He stated that the airplane touched down and darted to the right on the incident landing. The flight instructor stated that the initial dart was to the left before the pilot corrected to the right and that the "wandering" got worse and the pilot was applying left and ruight rudder from "stop to stop." The pilot reported that he had previously owned a PA-46-350 airplane and had recently purchased the M600.

On June 10, 2020, about 1000 mountain standard time, the airplane again veered to the right during landing on runway 4 at Winslow-Lindberg Regional Airport (INW), Winslow, Arizona.

The airplane was being operated by the owner with a flight instructor present and was not damaged. The wind at the time of the incident was from 020° at 4 kts.

The pilot reported that the airplane touched down left of the runway centerline and the airplane was drifting left. He applied right rudder, but the airplane was not responsive. The airplane finally responded and darted right. The flight instructor reported that, during the incident landing, he had his feet on the rudder pedals to feel the pilot's inputs. He stated that there was a left deviation during the landing, and he felt the pilot apply right rudder before NLG touchdown. When the NLG touched down, the airplane veered sharply to the right. The instructor took the airplane controls, lifted the nose, and regained directional control; however, the right MLG departed the paved runway surface. The instructor stated that the tire pressures were in the normal range before the flight and there was no evident damage or handling issues after the incident. They returned to Phoenix, where the pilot informed the flight instructor that he wished to discontinue training. The pilot reported that he parked the airplane on July 16, 2020, and had not flown it since.

Examination of the airplane in April 2021 revealed a NLG tire pressure of 62 psi. The right MLG tire exhibited a flat spot. Data was downloaded from the airplane's Garmin G3000 Integrated Avionics System pertaining to the DIJ and INW incidents.

Data pertaining to the landing at DIJ revealed that, immediately after NLG touchdown, there was a left lateral acceleration followed by lateral acceleration oscillations right and left for the next 5 seconds. About 5 seconds after NLG touchdown, the heading and track reached their maximum difference, with the heading about 9° right of the track. About 6 seconds after NLG touchdown, there was a noticeable increase in pitch followed by a decrease in the lateral acceleration oscillation. The remainder of the landing then appeared nominal with the heading and track aligned.

Data pertaining to the landing at INW revealed that, before NLG touchdown, there was a slight left lateral acceleration that continued as the NLG touched down. About 1 second after NLG touchdown, there was a significant veer to the right with the right lateral acceleration reaching a maximum of about 0.73 g about 3 seconds after NLG touchdown. At that time, the deviation between heading and track was at its maximum, with the heading about 20° right of the track. About 5 seconds after NLG touchdown, the pitch began to increase and the heading and track became aligned again. The remainder of the landing appeared nominal with the heading and track mostly aligned.

Examination by the manufacturer of the steering horn assembly removed from the incident airplane after the first incident revealed that the right (small) roller hole measured 0.002-inch further aft that the maximum tolerance. The left (large) roller hole measured 0.004-inch further aft than the maximum tolerance. The left steering pad measured 0.020-inch closer laterally to the center of the base than its maximum tolerance and the right steering pad measured 0.010-inch closer laterally to the center of the base than its maximum tolerance.

Examination by the manufacturer of the steering horn assembly removed from the incident airplane after the third incident revealed that one steering pad measured 0.016-inch closer

laterally to the center of the base than its maximum tolerance and the other steering pad measured 0.010-inch closer laterally to the center of the base than its maximum tolerance.

Published Service Information

On July 24, 2020, the airplane manufacturer issued SL 1285, Proper Tire Pressure Maintenance. The NLG tire pressures increased from 88 psi to 92-97 psi. SL 1285A was issued on January 12, 2021, to supersede SL 1285 and added information on replacement placards and a revision to the POH. SL 1285B was issued on June 15, 2021, to supersede SL 1285A and the NLG tire pressure changed to 88-92 psi. The SL also added information about temperature effects and changed the PN for the replacement placards.

On August 18, 2020, the manufacturer issued SL 1286, Nose Landing Gear Steering Components Inspection and Adjustment. The SL highlighted existing Airplane Maintenance Manual (AMM) procedures for NLG alignment, NLG rake angle adjustment, and rudder cable tension, and updated the procedures for measuring and adjusting the clearance between the NLG steering arm and steering horn rollers. It recommended compliance within 50 hours and recurring inspection every 100 hours.

SL 1286A was issued on January 21, 2021, to supersede SL 1286 for all PA-46 airplanes and contained updated nose landing gear alignment procedures for the M600 airplanes. The recommended compliance remained the same as the original, but it recommended compliance at the next scheduled maintenance visit for M600 airplanes.

SL 1286B was issued on January 28, 2021, for all PA-46 airplanes to supersede SL 1286A and added new information on rigging of the rudder-aileron interconnect for M600 airplanes. The recommended compliance remained the same as the original, but it recommended compliance at the next scheduled maintenance visit for M600 airplanes that were compliant with SL 1286 and prior to further flight for M600 airplanes that were compliant with SL 1286A.

SL 1286C was issued on March 24, 2021, to supersede SL 1286B and contained clarification of the procedures to check and adjust the clearance between the NLG steering arm and steering horn rollers and the NLG alignment. The recommended compliance time remained the same as the original, but it recommended no further action until the next recurring action for M600 airplanes that already complied with SL 1286B, compliance before further flight for M600 airplanes that already complied with SL 1286A, and compliance at the next maintenance visit for M600 airplanes that already complied with SL 1286.

SL 1286D was issued on October 15, 2021, to supersede SL 1286C and updated the clearance between the steering arm and rollers to 0.010-inch minimum when pushing the right and left rudder pedals to the stops. The recommended compliance remained the same as the original, but it recommended no further action until the next recurring action for M600 airplanes that already complied with SL 1286B or SL 1286C, compliance before further flight for M600 airplanes that already complied with SL 1286A, and compliance at the next maintenance visit for M600 airplanes that already complied with SL 1286.

On December 17, 2020, the manufacturer issued Service Bulletin (SB) 1350, Nose Landing Gear Steering Horn and Arm Assemblies Inspection, applicable to M600 airplanes with SN 4698100 through SN 4698135. Piper considered compliance with the SB mandatory at the next maintenance visit, but not to exceed 50 hours. The SB called for inspection of the steering horn and steering arm and replacement, if necessary. The aim of the SB was to make the affected airplanes compliant with the updated alignment requirements between the steering horn pads and rollers in accordance with the updated steering horn design discussed above. SB 1350A was issued on February 10, 2021, to supersede SB 1350 for the same affected airplanes and updated the torque of the bolts that attach the steering horn to the NLG strut from 25-30 in-lb to 60-75 in-lb.

Administrative Information

Investigator In Charge (IIC):	Spencer, Lynn
Additional Participating Persons:	Eric West; FAA/AVP-100; Washington, DC Robert Martellotti ; Piper Aircraft; Vero Beach, FL
Original Publish Date:	May 3, 2022
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this incident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=102391