

Log 2425



National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

Date: October 4, 1993

In reply refer to : A-93-118 through -122

Honorable David R. Hinson
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On May 7, 1993, the left main landing gear strut of a Fokker F-28-MK-0100, operating as USAir flight 200, collapsed during landing at the Greater Pittsburgh International Airport, Pittsburgh, Pennsylvania, causing secondary damage to the underside of the left wing and the lower left side of the aft fuselage. One passenger received a minor injury during the emergency evacuation. On the flight before the incident, the flightcrew reported vibrations in the right main landing gear during the landing roll. The gear was inspected, and no defects were noted.

The Fokker F-28-MK-0100 main landing gears are configured with shimmy dampers, which provide torsional/lateral vibrational stability to the landing gears during the landing roll. The upper torque link, connected to the main stationary strut, is assembled with a 41.9 millimeter-long spacer. The lower torque link, connected to the compressible strut, is assembled with a 33.3 millimeter-long spacer. Both the upper and lower torque links are connected to a shimmy damper with a single apex bolt. The upper torque link remains stationary and the lower torque link moves laterally along with the apex bolt and shimmy damper, to provide a total lateral damping movement of approximately 10.85 millimeters.

Postincident examination of the left main landing gear revealed that the two spacers were improperly installed in the torque link shimmy damper assembly. Examination of the fractured left main landing gear strut revealed that a portion of the outer strut cylinder broke in the area of the upper torque link attach point. Examination of the fracture revealed features typical of overload. The fractured strut piece was about 15 inches long and 7 inches wide and surrounded the area of the upper torque link attach lug. Fokker reported that the fracture was similar in shape and size to two previous F-28-MK-0100 landing gear fractures.

According to Fokker, if the two spacers are interchanged during installation, the total lateral damping capability of the lower torque link is reduced to about 2.25 millimeters. This provides inadequate damping. Also, with the damping stroke limited

to 2.25 millimeters, it is possible to excite main landing gear vibrations, which cause abnormally high load amplitudes. At landing and takeoff speeds, the load may cause severe damage to the main landing gear, resulting in gear failure and collapse.

Fokker Safety Assessment Report No: L.G.-100-057, dated February 15, 1990, describes the initial damping in the torsional/lateral direction as an important parameter. If this damping capability decreases enough, an unstable situation can occur. Therefore, a shimmy damper is installed to achieve sufficient main landing gear damping of torsional/lateral movement. The Fokker Safety Assessment Report was based on flight test data and three previous main landing gear failures where the landing gears were not equipped with shimmy dampers. The three main landing gears failed because of torsional/lateral bending, as a result of high frequency vibrations. Subsequently, a shimmy damper was installed on the production airplanes and retrofitted on the existing fleet of F-28-MK-0100 airplanes in accordance with Airworthiness Directive (AD) 91-07-10. The May 7, 1993, USAir F-28-MK-0100 main landing gear failure was the first such incident for the airplane since AD 91-07-10 was implemented and the main landing gear shimmy dampers were installed.

The main landing gear torque link removal/installation portion of the USAir Fokker F-28-MK-0100 Aircraft Maintenance Manual (AMM), provided by Fokker for line maintenance, contains steps describing the installation of the spacers on the apex bolt of the shimmy damper. The AMM also contains an illustration that shows the sequence of installation. The AMM is not specific in terms of the dimensions of the two spacers, except that in the illustration, one appears to be slightly longer than the other. The illustration does not specify or identify the difference in the length of the spacers, although correct spacer positioning is essential for proper operation of the damper. The Safety Board believes that a more accurate and complete description of the spacer installation should be included in the AMM. USAir and Fokker have indicated their intent to revise the F-28-MK-0100 AMM accordingly.

A review of the Dowty Aerospace (manufacturer of the landing gear assembly) Component Maintenance Manual, utilized by USAir's maintenance facility in Winston-Salem, North Carolina, for landing gear overhaul, revealed that the main landing gear torque link apex bolt assembly is also not described adequately in dimensions or verbiage.

The Safety Board's interview with the USAir line maintenance mechanic who last installed the torque links and shimmy damper assembly in the incident airplane revealed some confusion concerning the assembly. The mechanic found the parts of the damper assembly disassembled and unmarked as he began the assembly process. He recalled referring to the illustration in the AMM depicting the two spacers with the apex bolt in an assembly sequence. He noted that the two spacers he had were of different lengths, although the spacers shown in the AMM illustration appeared to be the same length. This confusion prompted the mechanic to refer to the F-28-MK-0100

Illustrated Parts Catalog to obtain the part numbers for the spacers and to order new spacers for the assembly. Since the new spacers were not in stock, the old spacers, which were not marked with identifying part numbers, had to be used. Unable to determine the sequence of the spacer installation using the reference manuals, the mechanic said he consciously installed the longer spacer with the wider flanged torque link, which happened to be the lower torque link, convinced that this was the correct assembly. However, this was the incorrect sequence of assembly.

The Safety Board found that there was no specific procedure written in the AMM to mark the damper assembly parts during disassembly for overhaul. Therefore, overhauled damper assembly parts could similarly be installed improperly following overhaul because of the lack of any markings on the parts. The Safety Board believes that a specific procedure for marking/identifying damper assembly parts should be written in the AMM, where it would be available to all maintenance personnel.

Discussions with the USAir inspector assigned to inspect the torque links and main landing gear shimmy damper assembly on the F-28-MK-0100 revealed that only a visual inspection of the work was required. A dimensional inspection of the clearance between the upper and lower links for lateral damping movement of the lower torque link was not required. The Safety Board believes that a dimensional inspection of the gap between the links would have identified the problem on the incident airplane and should be required. Because access to the area is difficult, a specific procedure may be required to ensure that technicians will inspect and measure the gap accurately.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue a Maintenance Alert Bulletin to advise U.S. operators of the importance of correct installation of the spacers on the main landing gear torque link and shimmy damper assembly on the Fokker F-28-MK-0100 airplane and the implications of improper installation. (Class II, Priority Action) (A-93-118)

Require Fokker, Dowty Aerospace, and U.S. operators of Fokker F-28-MK-0100 airplanes to revise their Aircraft Maintenance Manual (or equivalent document) to include an improved description and illustration of the main landing gear torque link and shimmy damper assembly installation. Require the inclusion of nomenclature or dimensions that will clearly differentiate between the spacers used in the installation. (Class II, Priority Action) (A-93-119)

Require all U.S. operators of the Fokker F-28-MK-0100 airplane to revise their Aircraft Maintenance Manual (or equivalent document) to include

specific procedures for marking/identifying torque link and shimmy damper assembly parts when being disassembled so they can easily be identified during installation. Also, require the operators to establish a specific inspection procedure that will verify the correct installation and dimensional measurement of the torsional/lateral damping movement of main landing gear lower torque link assemblies. (Class II, Priority Action) (A-93-120)

Advise foreign airworthiness authorities of the possibility and the consequences of improper installation of spacers in the F-28-MK-0100 main landing gear torque link and shimmy damper assembly and recommend that Maintenance Manuals, or equivalent documents pertinent to the Fokker F-28-MK-0100, be amended to include an improved description and illustration of the assembly installation and to include nomenclature or dimensions that will clearly differentiate between the spacers used in the installation. (Class II, Priority Action) (A-93-121)

Encourage Fokker to redesign the F-28-MK-0100 main landing gear shimmy damper spacer assembly to prevent the required spacers from being interchanged and assembled incorrectly. (Class II, Priority Action) (A-93-122)

Chairman VOGT, Vice Chairman COUGHLIN, and Members LAUBER, HART, and HAMMERSCHMIDT concurred in these recommendations.



By: Carl W. Vogt
Chairman