



AEROSPACE RECOMMENDED PRACTICE

ARP6408™

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External Hydraulic Fluid Leakage Definition for Landing Gear Shock Absorbers

RATIONALE

A clear understanding of leakage definition will result in minimizing what is often the unnecessary removal of landing gear shock absorbers from an aircraft. The leakage definitions are intended to assess and control the quality, assembly and proper functioning of landing gear shock absorbers/struts in service.

ARP6408 has been reaffirmed to comply with the SAE Five-Year Review policy.

FOREWORD

The acceptable external leakage parameters for landing gear shock absorbers/struts have not been documented to date. The intent of this ARP is to establish leakage definitions that will be applicable only to oleo landing gear shock absorbers/struts. It is intended that this will result in minimizing what is often the unnecessary removal of landing gear shock absorbers/struts from an aircraft. The recommendation(s) in this document do not override any requirements from the aircraft manufacturer and/or the landing gear original equipment manufacturer (OEM).

Leakage as hereafter referred to in this document shall mean external hydraulic fluid leakage of oleo (gas-hydraulic fluid) landing gear shock absorbers/struts. Hydraulic fluid in this document and in this context, refers to the working fluid specified by the Original Equipment Manufacturer (OEM) specifically for the internal use of the landing gear shock absorbers/struts for the intended air vehicle application.

1. SCOPE

The purpose of this SAE Aerospace Recommended Practice (ARP) is to provide a practical definition of external hydraulic fluid leakage exhibited by landing gear shock absorbers/struts. The definition will outline normal (acceptable weepage) and excessive leakage (unacceptable leakage) of shock absorbers/struts that is measurable. The definition of leakage is applicable to new gear assemblies, refurbished/remanufactured (overhauled) shock absorbers/struts, leakage of shock absorbers/struts encountered during acceptance flights, newly delivered and in-service aircraft. This ARP is intended to provide guidelines for acceptable leakage of landing gear shock absorbers/struts between the ambient temperatures of -65 °F (-54 °C) and 130 °F (54 °C) and to outline the procedure for measuring such leakage. The specific limits that are applied to any particular aircraft shall be adjusted by the aircraft manufacturer before inclusion in the applicable maintenance manual.

1.1 Application

This ARP is applicable to all model aircraft and to all in-service aircraft utilizing oleo landing gear shock absorbers.

Guidance for acceptable leakage for in-service of aircraft hydraulic components, excluding shock absorbers/struts, is governed by ARP1084.

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2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

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ARP1084 External Hydraulic Leakage for In-Service Components

ARP5908 Landing Gear Servicing

3. HYDRAULIC FLUID LEAKAGE – GENERAL

External hydraulic fluid leakage of landing gear shock absorber/strut is difficult to describe in a quantitative manner such that it is obvious whether a component is acceptable or unacceptable for service. Since static or dynamic seals are not functionally perfect, some hydraulic fluid wetting is normally present. This document will distinguish between excessive leakage which is unacceptable for continued service, minor leakage which allows operation with continued monitoring and normal wetting (weepage/seepage) which is deemed acceptable. See Figure 1 for a generic landing gear shock absorber/strut image of normal wetting.

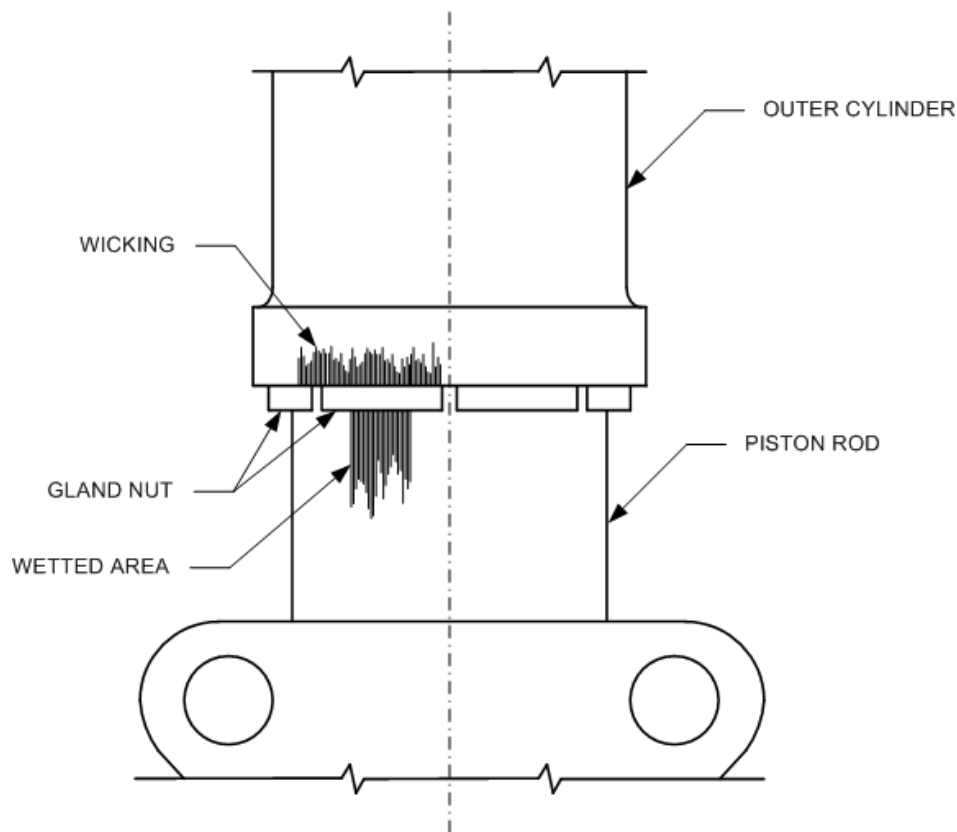


Figure 1 - Generic shock strut/absorber normal wetting

Although the intent of this ARP is to establish the acceptable leakage for in-service components, some judgment will need to be exercised when these criteria are applied to individual aircraft. Subjective considerations may range from undesirable wetting for aesthetic reasons on a business jet to a higher level of normal leakage based on the operational needs of a military aircraft. In addition, increased normal leakage is encountered as a result of operating in extremely cold ambient temperatures near or below -25 °F (-33 °C) and or if an aircraft is moved from a warmer location, above freezing (hangar, below ship deck or cargo aircraft) and then rapidly exposed to significantly colder, below freezing, location.

These conditions may be manageable and acceptable based on the operational needs of the aircraft and/or the operator. Additionally, it should be apparent that under certain circumstances it may be possible to have multiple normal hydraulic fluid wetting with acceptable leakages however their combined leakage may be classified as excessive since hydraulic fluid loss may sufficiently reduce the shock absorber fluid volume to a level below the normal service level of the shock absorber/strut.

Hydraulic fluid leakage has been reduced in shock absorbers/struts as a result of advances in sealing/scrapper technology. This is due to the fact that the newer technology capped type seals are designed to operate on a wetter surface in comparison to previous use of elastomeric contact seals such as T-seals. Because of the design nature of capped type seals, the piston surface will contain more surface wetness. Additionally, experience has shown that capped type seals can take up to 50 in-service/operational landing cycles to conform to the mating surface and “break-in”. During the initial “break-in” period before leakage is normalized, normal operation of cap type seals can result in an increased quantity of hydraulic fluid escaping beyond the seal and could potentially be confused as leakage.

It is recommended that the maintainer be cognizant of trends regarding frequency of gas servicing and when wiping/cleaning the piston surfaces is accomplished. Frequent gas servicing of a shock absorber/strut needs to be recorded in the aircraft maintenance log and chronic servicing of a shock absorber/strut, requiring progressive gas servicing over time needs to be addressed as a maintenance item requiring gas chamber seal evaluation and hydraulic fluid servicing at a minimum. The maintainer also needs to pay attention to weepage/seepage and recognize trends in which frequent wiping prevents the discernible accumulation of leaking hydraulic fluid in the absence of a strut fluid monitoring system that will detect a strut low on hydraulic fluid.

Acceptable leakage can exist on new or overhauled units, this may appear as hydraulic fluid wetting (seepage, stain, wicking or wet area). However, it is possible for seepage or an acceptable leakage to collect in a cavity of a unit or depression in an adjacent structure over a period of time and falsely indicate excessive leakage. This same leakage when allowed to accumulate on a flat area or on a white or gray painted surface often has the appearance of being excessive.

3.1 Classification of Leakages

When subject to the conditions of 3.2 below, shock absorbers/struts external hydraulic fluid leakage is classified as one of three criticality levels: (1) wetting, (2) minor leakage, and (3) major leakage.

Wetting: This classification is considered normal and always acceptable for continued service. Wetting is a visible film, wicking or drop of hydraulic fluid evident during dynamic usage. It is expected that some acceptable level of wetting on the exposed surface of the piston will occur, most prominently on initial operations following installation of a new seal. Wicking may be evident on the surface of the cylinder above the gland nut. Wicking may be more apparent if there is finish system applied to the cylinder. Also, it is normal to see a hydraulic fluid ring at the end of the shock strut stroke. This ring is formed by the scraper wiping action, leaving a visible accumulation of fluid on the piston surface.

Minor Leakage: This classification is considered acceptable under certain conditions for continued service. Minor leakage is defined as recurring shock absorbers/struts hydraulic fluid leakage following operation of the shock absorbers/struts with an equal or increased quantity of hydraulic fluid visible on the exposed surface of the piston, when compared to documented leakage from previous flights. Over multiple operations this level of hydraulic fluid leakage must not result in an unacceptable reduction in hydraulic fluid volume and adversely affect the performance of the shock absorbers/struts.

Major Leakage: This classification level of leakage is unacceptable for continued service. This is a continuous self-sustaining leak where hydraulic fluid from a static shock absorbers/struts will reform on the exposed surface of the piston immediately or shortly after being wiped clean of fluid.