



AEROSPACE RECOMMENDED PRACTICE

ARP6175™

REV. A

Issued 2019-04
Revised 2022-06

Superseding ARP1084 and ARP6175

Definition, Recognition, Troubleshooting, and Repair of
Aircraft Hydraulic System External Leakage

RATIONALE

ARP6175 has been updated to Revision A for the following reasons:

- To incorporate aspects of ARP1084 into ARP6175 to allow ARP1084 to be cancelled.
- To include military aircraft and helicopters.
- To incorporate editorial changes, including changing the title and adding Section 7.

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Documents

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1. SCOPE

This SAE Aerospace Recommended Practice (ARP) provides a comprehensive and consistent set of guidelines for the definition, recognition, troubleshooting, and repair of hydraulic components and systems on in-service aircraft affected by external leakage.

1.1 Field of Application

Although the primary application of this document is for aircraft, it can also be used for commercial and military helicopters since they use similar hydraulic system components.

2. REFERENCES

2.1 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

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AIR1707	Patterns of O-Ring Failures
ARP994	Design of Tubing Installations for Aerospace Hydraulic Systems
ARP4386	Terminology and Definitions for Aerospace Fluid Power, Actuation and Control Technologies
ARP4752	Aerospace - Design and Installation of Commercial Transport Aircraft Hydraulic Systems
ARP5555	Recommendations for Installation of Seals in Standard Glands
AS1241	Fire Resistant Phosphate Ester Hydraulic Fluid for Aircraft

2.1.2 AIA Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, www.aia-aerospace.org.

NAS1611	Packing, Ethylene Propylene, Preformed O-Ring, Phosphate Ester Resistant (-65 °F to 250/300 °F)
NAS1612	Packing, Ethylene Propylene, O-Ring, Phosphate Ester Resistant, Straight Thread Tube Fitting Boss (-65 °F to 250/300 °F)
NAS1613	Packing, Preformed, Ethylene Propylene Rubber

2.1.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM F1790	Standard Test Method for Measuring Cut Resistance of Materials used in Protective Clothing with CPP Test Equipment
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2.1.4 EASA Publications

Available from European Aviation Safety Agency, Konrad-Adenauer-Ufer 3, D-50668 Cologne, Germany (for visitors and for mail over 1 kg) and Postfach 10 12 53, D-50452 Cologne, Germany (for mail 1 kg or less); Tel: +49 221 8999 000, www.easa.europa.eu.

CS-25 Certification Specification: Large Airplanes

2.1.5 European Committee for Standardization Publications

Available from European Committee for Standardization, CEN-CENELEC Management Centre, Avenue Marnix 17, B-1000 Brussels, Belgium, Tel: +32 2 550 08 11, www.cen.eu.

EN388 Protective Gloves Against Mechanical Risk

2.1.6 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

14 CFR Part 25 Airworthiness Standards: Transport Category Airplanes

FAA-H-8083-30 FAA Aviation Maintenance Technician Handbook - General

2.1.7 ISEA Publications

Available from International Safety Equipment Association, 1901 North More Street, Suite 808, Arlington, VA 22209-1762, Tel: 703-528-2148, www.safetysystem.org.

ISEA Z87.1 Occupational and Educational Personal Eye and Face Protection Devices

2.1.8 RTCA Publications

Available from RTCA, Inc., 1150 18th Street, NW, Suite 910, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

RTCA/DO-160 Environmental Conditions and Test Procedures for Airborne Equipment

2.1.9 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

MIL-PRF-5606 Hydraulic Fluid, Petroleum Base; Aircraft, Missile, and Ordnance (inactive for new design)

MIL-PRF-83282 Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Metric, NATO Code Number H-537

MIL-PRF-87257 Hydraulic Fluid, Fire Resistant, Low Temperature, Synthetic Hydrocarbon Base, Aircraft and Missile

2.2 Definitions

Refer to ARP4386 for general hydraulic system terms that are used in this Aerospace Recommended Practice.

DYNAMIC LEAKAGE: Dynamic leakage is leakage associated with operating or cycling the suspect LRU and is typically associated with leakage between moving elements (i.e., piston rods, rotary seals, etc.) observed while the LRU is operating, if access is available, or immediately after operation has concluded.

EXTERNAL LEAKAGE: Leakage from the interior of a device to the exterior, other than out of the fluid port.

LRU: A Line Replaceable Unit is the lowest level of a component that can be replaced per the AMM.

MINOR LEAK: Minor leakage is leakage sufficient to form fallen drops.

NOTES:

1. Minor leakage is typically measured in drops per cycle (i.e., dynamic leakage) or drops per minute (i.e., static leakage).
2. Minor leakage typically has no significant effect on LRU performance but is undesirable from an aesthetic or environmental standpoint.
3. For commercial aircraft, the Aircraft Maintenance Manual (AMM) will define the acceptance criteria for a minor leak for dispatch to ensure that the rate of leakage does not produce a system effect such as depleting the associated aircraft hydraulic system reservoir.

SEEPAGE: Seepage is slight wetting insufficient to form a fallen drop.

NOTES:

1. Seepage does not affect performance.
2. Seepage is often associated with leakage from dynamic seals and cold weather conditions. However, seepage can be observed at any joint enclosing hydraulic fluid.
3. Seepage is often observed many hours or days after operation or entry into operation depending on external environmental conditions.

SEVERE LEAK: Severe leakage is leakage above the AMM criteria for a minor leak.

NOTES:

1. Severe leakage typically forms a continuous stream of leaked fluid and is customarily measured in cc per minute or gallons per hour (1 cc = 20 drops).
2. Severe leakage may cause the loss of function of the LRU and in the absence of a means of isolating the leak, often results in the loss of the associated aircraft hydraulic system.
3. Depending upon the fluid type, severe leakage can create a fire hazard.

STATIC LEAKAGE: Static leakage is leakage not associated with operating the suspect LRU.

NOTES:

1. Static leakage can be observed with system pressure applied or after system pressure has bled down to residual system (i.e., head) pressure.
2. Static leakage is often observed many hours after the associated hydraulic system has been depressurized.
3. Dynamic seals can experience static leakage when the LRU is not in motion or receiving a mechanical input.

2.3 Abbreviations

AMB	Ambient
AMM	Aircraft Maintenance Manual
ANSI	American National Standard Institute
ASTM	American Society for Testing and Material
ATP	Acceptance Test Procedure
CAS	Crew Alert System
CFR	Code of Federal Regulation
CHK	Check
CMM	Component Maintenance Manual
CPP	Cut Protection Performance
CS	Certification Specification
EASA	European Aviation Safety Agency
EHA	Electrohydrostatic Actuator
EHSV	Electrohydraulic Servovalve
EN	European Standard
FAA	Federal Aviation Administration
FHA	Functional Hazard Assessment
FIM	Fault Isolation Manual
FOD	Foreign Object Damage
HVOF	High Velocity Oxygenated Fuel
ISEA	International Safety Equipment Association
LRU	Line Replaceable Unit
MSDS	Material Safety Datasheet
PPE	Personal Protective Equipment
PTFE	Polytetrafluoroethylene
RECMD	Recommend
SOV	Solenoid Operated Valve

TAT Total Air Temperature

TEMP Temperature

TSM Troubleshooting Manual

TYP Typical

3. IDENTIFICATION OF CONTRIBUTORS

3.1 Environmental Aspects

3.1.1 Fluid and Ambient Temperatures

As shown in Figure 1, there is a close relationship between hydraulic fluid temperature and external leakage. Dynamic (absolute) viscosity, coefficient of thermal expansion, and the elasticity of the materials used in system elements are the primary contributors. Pumps, valves, and actuators generate a significant amount of heat during operation that is absorbed by the fluid and transferred through conduction, convection, and radiated into the environment. During periods of limited activity, such as extended operations at altitude, where cold soak is encountered, LRUs will chill down to within 9 to 18 °F (5 to 10 °C) of the installation bay temperature. If there is significant airflow around the LRU, the bay temperature could be just above the TAT for the flight condition.

Envelope(s)	-67°F to +158°F (-54°C to +70°C) DO-160 Amb Temp Range (Typ Qual)																													
	-10°F to +165°F (-23°C to +74°C) Typical Normal Fluid Operating Range																													
	Typ Cold Soak												Recmd Leak Chk																	
Leakage	-Seals materials contract ~10 times more than steel parts. -Seal materials stiffer, less flexible -Increased clearances.																								ATP values corrected to 100°F (38°C) by some supplier				-Lower fluid viscosity -Seal materials soften	
Increases																														
-Significant contributor																														
-Minor contributor																														
Reduces	-Higher fluid viscosity																												-Reduced clearances	
-Minor contributor																														
-Significant contributor																														
°F	-67	-58	-49	-40	-31	-22	-13	-4	5	14	23	32	41	50	59	68	77	86	95	104	113	122	131	140	149	158	167	176	185	
°C	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	

Figure 1 - Factors affecting fluid leakage

Transport category aircraft hydraulic systems are typically designed to ARP4752 with seals installed per ARP5555 and qualified over a wide range of ambient temperatures, such as down to -67 °F and up to +158 °F (-55 to +70 °C) (e.g., RTCA/DO-160). The applicable LRU specification defines the acceptable external leakage limits, often with allowances at the low temperature extreme to support qualification. During such testing, the LRU under test is typically supplied with chilled fluid at the same temperature as the ambient environment.