



AEROSPACE RECOMMENDED PRACTICE

ARP5908™**REV. A**

Issued 2008-03
Revised 2018-07
Reaffirmed 2025-03

Superseding ARP5908

(R) Landing Gear Servicing

RATIONALE

This ARP has been revised as part of the Five-Year Review policy to include more detailed considerations for the servicing of dual chamber landing gear. The revision also ensures that the document reflects the latest industry practice and is representative of a wide a range of landing gear and airframe approaches.

ARP5908A has been reaffirmed to comply with the SAE Five-Year Review policy.

TABLE OF CONTENTS

1.	SCOPE.....	3
2.	REFERENCES.....	3
2.1	Applicable Documents	3
2.1.1	SAE Publications.....	3
2.1.2	U.S. Government Publications.....	3
2.2	Definitions	3
3.	WARNINGS, CAUTIONS AND ADVISORIES.....	5
4.	IMPORTANCE OF LANDING GEAR SERVICING.....	5
5.	LANDING GEAR SERVICING OPERATIONS	6
5.1	Servicing Verification.....	6
5.1.1	One-Point Check.....	6
5.1.2	Two-Point Check.....	8
5.2	Gas Servicing.....	10
5.2.1	Possible Gas Servicing Procedures – Single Chamber.....	10
5.2.2	Possible Gas Servicing Procedures - Dual Chamber (Aircraft on Ground or on Jacks)	10
5.3	Hydraulic Fluid Servicing.....	11
5.3.1	Possible Hydraulic Fluid Servicing Procedures – Single Chamber	11
5.3.2	Possible Hydraulic Fluid Servicing - Dual Chamber (Aircraft on Ground or on Jacks).....	14
5.3.3	Hydraulic Fluid Filling	14
6.	OTHER CONSIDERATIONS	14
6.1	Temperature Effects.....	14
6.1.1	Landing Gear Serviced at Normal Ambient Temperature Used in Extreme Temperatures	15
6.1.2	Landing Gear Serviced at Extreme Temperature Used in Normal Ambient Temperatures	15
6.2	Gas Absorption Effects	15
6.3	Useful Design Features.....	16
6.4	Hydraulic Fluid - Quality Monitoring or Replacing.....	16

SAE Executive Standards Committee Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2025 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, or used for text and data mining, AI training, or similar technologies, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

Full document details: SAE ARP5908A

For more information on this standard, visit
<https://www.sae.org/standards/content/ARP5908A/>

Documents

Standard, visit Sharing Hub

7.	GROUND EQUIPMENT/SPECIAL TOOLING AND ADAPTERS	16
7.1	Nitrogen Supply.....	16
7.2	Hydraulic Fluid Supply	16
7.3	Pressure Gages	18
7.4	Hydraulic Hoses and Adapters	18
8.	LANDING GEAR SERVICING AND MAINTENANCE SCHEDULE RECOMMENDATIONS.....	18
8.1	Servicing Verifications Operations	18
8.1.1	One-Point Servicing Check	18
8.1.2	Two-Point Servicing Check	18
8.2	Servicing Adjustment Operations.....	18
8.2.1	One-Point Servicing Check - Outside Tolerances	18
8.2.2	Two-Point Servicing Check - Outside Tolerances	19
8.3	Unscheduled Maintenance	19
8.3.1	Hydraulic Fluid Leakage.....	19
8.3.2	Gas Leakage.....	19
9.	SERVICING PLACARD RECOMMENDATIONS.....	19
9.1	Location.....	19
9.2	Content.....	20
10.	NOTES.....	21
10.1	Revision Indicator.....	21
APPENDIX A	SERVICING VERIFICATION FLOWCHARTS.....	29
APPENDIX B	SHOCK STRUT GAS SPRING - POSSIBLE MISSEVICING CONDITIONS.....	31
Figure 1	Pressure gage installed directly on the gas charging valve.....	7
Figure 2	Line pressurized to prevent pressure loss	7
Figure 3	Type I hydraulic fluid servicing	11
Figure 4	Type II hydraulic fluid servicing	12
Figure 5	Type III hydraulic fluid servicing	12
Figure 6	Type IV hydraulic fluid servicing	13
Figure 7	Fluid servicing cart	17
Figure 8	Servicing cart	17
Figure 9	Servicing plate example - chart format	22
Figure 10	Servicing Plate example - chart format	23
Figure 11	Servicing plate example - table format.....	24
Figure 12	Servicing plate example - chart and table format	25
Table 1	Lessons learned	27

1. SCOPE

The present document addresses gas and hydraulic fluid servicing required on commercial and military aircraft landing gears, for both single and dual chamber (also known as dual stage and two stage) shock struts. This document should be considered as landing gear industry recommended practice but in no way is meant to supersede the shock strut OEM's published procedures.

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.

AIR5358A	Landing Gear Shock Strut Hydraulic Fluid
AIR5829	Air in Aircraft Hydraulic Systems
ARP1311	Landing Gear Structures and Mechanisms
ARP6408	External Hydraulic Fluid Leakage Definition for Landing Gear Shock Absorbers
AS4059	Aerospace Fluid Power - Contamination Classification for Hydraulic Fluids
AS5166	Fitting, Tee, Gas Pressure Gage
AS5167	Fitting, Adapter, Flared, Gas Pressure Gage

2.1.2 U.S. Government Publications

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

MIL-L-8552	Landing Gear, Aircraft Shock Absorber (Air-Hydraulic fluid Type)
A-A-59503	Technical Nitrogen - Commercial Item Description

2.2 Definitions

ADDITIVE: Additives mixed with the shock strut hydraulic fluid to improve lubricity and corrosion resistance. Refer to AIR5358A for types of additives and recommendations for percent by volume mixture.

DUAL CHAMBER SHOCK STRUT (also known as Dual Stage or Two Stage Shock Strut): A shock strut which has two gas chambers – a high pressure chamber and a low-pressure chamber.

FLUID DRAIN PORT: The port used for draining the hydraulic fluid from the shock strut, usually placed at the bottom of the shock strut. Fluid drain ports are not always required, especially for smaller shock struts.

FLUID FILLING PORT: The port used for refilling the shock strut with hydraulic fluid, placed at the top of the shock strut. The fluid filling port is sometimes combined with the gas servicing port or sometimes at the bottom of the cylinder in the rebound chamber of the strut.

GAS ABSORPTION: A phenomenon that occurs in mixed gas-fluid shock absorbers when pressure is applied to the shock strut and the gas dissolves into the hydraulic fluid. After hydraulic fluid servicing, gas will be absorbed by the fluid as the strut is pressurized. This is not to be confused with gas bubbles in the fluid (entrained gas), AIR5829 provides a definition of dissolved gas and entrained gas. In a closed system the pressure will reduce as gas dissolves in the fluid whereas the pressure does not change if the gas remains as bubbles in the fluid (entrained gas).

GAS CHARGING VALVE: A valve installed on the shock strut to allow the gas servicing to the prescribed pressure.

GAS SERVICING PORT: The port used for gas servicing, typically placed at the top of the shock strut, where the gas charging valve is installed and for dual chamber struts, wherever the high and low-pressure chambers are located.

GAS SERVICING: A procedure to adjust the amount of gas only, assuming the shock strut fluid volume is correct.

HIGH PRESSURE CHAMBER: The gas chamber in a dual chamber shock strut filled with the higher pressure when the shock strut is fully extended. The high-pressure chamber is often referred to as the secondary chamber and frequently has a very minimal amount of hydraulic oil used for seal lubrication.

HYDRAULIC FLUID SERVICING: A procedure to adjust the volume of shock strut hydraulic fluid to the correct level. This procedure is followed by a gas servicing procedure to provide a functioning strut.

LEAKAGE, HYDRAULIC (see 8.3.1)

LOW PRESSURE CHAMBER: The gas chamber in a dual chamber shock strut with the lower pressure when the shock strut is fully extended. The low-pressure chamber is often referred to as the primary chamber.

MIXED GAS-FLUID: A shock strut without mechanical means to separate the gas and the hydraulic fluid.

ONE-POINT CHECK: A check to ensure the shock strut is properly serviced, performed by verifying one point on the static gas spring curve and assuming the shock strut contains the appropriate amount of hydraulic fluid.

OUTGASSING: A phenomenon that occurs in mixed gas-fluid shock absorbers when the dissolved gas comes out of solution as strut pressure is reduced.

SEPARATED GAS-FLUID: shock strut with mechanical means to separate the gas and the hydraulic fluid (such as a floating piston).

SERVICING: A procedure to ensure the correct amount of hydraulic fluid and gas under pressure is present in a shock strut – sometimes known as FULL or INITIAL SERVICING.

SERVICING PLACARD: Pressure versus X-Dimension servicing specification, usually found on or near the shock strut.

STATIC GAS SPRING CURVE: The curve relating the pressure in the shock strut to the stroke, in static conditions, at standard temperature.

STICTION: The stick-slip characteristic of the shock strut due to bearing and seal friction.

TRANSITION PRESSURE: The range of pressures at which both the low-pressure chamber and the high-pressure chamber are both changing with stroke.

TWO-POINT CHECK (SERVICING VERIFICATION): A check to verify the shock strut is properly serviced (with both gas and hydraulic fluid), performed by verifying two points on the static gas spring curve (usually at the static stroke and at some other extended position). The two-point check confirms that both the fluid level and the gas charge are correct.

WETTING: A visible film of hydraulic fluid evident following dynamic usage of the shock strut (refer to ARP6408 for further definition).

X-DIMENSION (sometimes referred to as the H-DIMENSION or A-DIMENSION): A reference dimension between two defined points on the shock strut representative of shock strut stroke.

3. WARNINGS, CAUTIONS, AND ADVISORIES

- Safety precautions: Deflating a shock strut can be a dangerous operation unless servicing personnel are thoroughly familiar with high pressure gas valves. Always deflate slowly; proper deflating techniques should always be referenced
- Proper equipment: It is important to avoid the use of improvised servicing equipment. The use of improvised servicing equipment under an aircraft could cause injuries to personnel and damage to the aircraft. It can also result in improper servicing. The use of properly calibrated equipment having the proper range is essential when servicing a strut.
- Hydraulic fluid: Only hydraulic fluid as specified on the servicing placard should be used. Mixing of hydraulic fluid could have a detrimental effect on static and dynamic seals, as well as on shock strut performance. Shock strut fluid additives are used throughout the industry as a supplement to the base fluid to improve lubrication, anti-wear properties and corrosion protection. The use of additives has been shown to reduce the occurrence of frictional heat induced ladder cracks in shock strut components. These additives may be incorporated into the base fluid during regular shock strut fluid servicing, however to ensure proper mixing of the additives in the correct proportions, it is strongly recommended that a "pre-mixed" shock strut fluid is used. Pre-mixed fluids can be distinguished from base fluids by color to prevent introducing additives to excessive quantity. Refer to AIR5358A for types of additives and recommendation percent by volume mixture.
- Dry nitrogen: Gas servicing usually means nitrogen (99.5% pure) servicing. The use of compressed air or oxygen instead of nitrogen could be a cause of corrosion inside the shock strut and for a few struts with a very high compression ratio, auto-ignition inside the gas chamber (dieseling).
- Aircraft on ground servicing: caution should be used during pressure release to prevent injuries to personnel or aircraft damages from unbalancing the aircraft due to sudden shock strut movements or unintended fuel migration, or due to insufficient clearances for aircraft movement.
- Aircraft on jacks servicing: If a landing gear jack is used for shock strut stroking, appropriate measures should be provided to prevent lifting the aircraft from the aircraft jacks during stroking or down-jacking following servicing.

4. IMPORTANCE OF LANDING GEAR SERVICING

Proper servicing of the landing gear represents a necessary condition for proper functioning and adequate performance of the landing gears.

Mis-serviced landing gears, depending on the severity of the condition, can generate:

- Discomfort for the passengers and the crew.
- Possible instability and difficulty to control the aircraft on ground.
- Possibility to exceed the design loads envelope with effects on the structural integrity of the landing gear and of the aircraft.
- Possibility to increase the normal operating (fatigue) loads with potential effects on the life of the landing gear and of the aircraft structure.
- Potential damage to shock strut components due to differential pressures resulting from underservicing.
- Malfunction of the weight-on-wheel sensing, affecting flight, brake or steering control systems.
- Insufficient piston extension load or overload of the gland nut.
- Shock strut bottoming.
- Insufficient fluid within the shock strut can result in loss of recoil damping which may result in shock strut damage.

- Nose gear may not fully extend and center on landing.
- The shock strut may partially compress in the retracted position resulting in potential nuisance messages and rotation from center for NLG where tire contact with structure can occur during extension.

5. LANDING GEAR SERVICING OPERATIONS

5.1 Servicing Verification

5.1.1 One-Point Check

5.1.1.1 Description and Rationale

The one-point check is a servicing inspection where the amount of gas in the shock strut is verified. This check assumes the shock strut hydraulic fluid level is correct.

The main purpose of this check is to provide an expeditious method of determining whether the shock absorber is properly serviced before the flight.

The one-point check is performed by measuring the stroke (X-Dimension), the surface temperature of the shock strut (if required) and the pressure of the shock strut and verifying it is within acceptable tolerances of the static gas spring curve of the servicing instructions.

Note of Caution: Although the strut level indication (X-Dimension) may fall within the acceptable tolerances of the static gas spring curve, it does not provide any indication of the proper nitrogen/hydraulic fluid volume distribution that should be maintained for optimal performance. As a reference, if a low strut condition was previously serviced by correcting X-Dimension positioning with nitrogen and the X-Dimension again needs to be adjusted the fluid level is suspect. If there is a concern about the amount of fluid loss, the two-point method described below is recommended.

NOTE: After stroking to extend or compress a shock absorber, some time should be allowed before measuring the pressure in order to allow gas temperature to return to the ambient temperature. Depending on the landing gear size and configuration this may take a few minutes, or it could take an hour or more.

5.1.1.2 Possible Methods for One-Point Check

The X-Dimension is typically measured using a tape, a ruler or a caliper. The shock absorber surface temperature (if required) is typically measured using a standard thermometer or temperature probe. The pressure can be measured in one of four ways. In the case of a dual chamber shock strut, both chamber pressures are measured. Below are listed four possible methods for measuring the pressure for the One-Point check, highlighting the pros and cons of each (designated by “+” and “-”).

1. Use of ground support tooling consisting in a special line for servicing check with a very small volume (a capillary line is preferred) for attaching the pressure gage directly to the gas charging valve (see Figure 1). This is the method used typically.

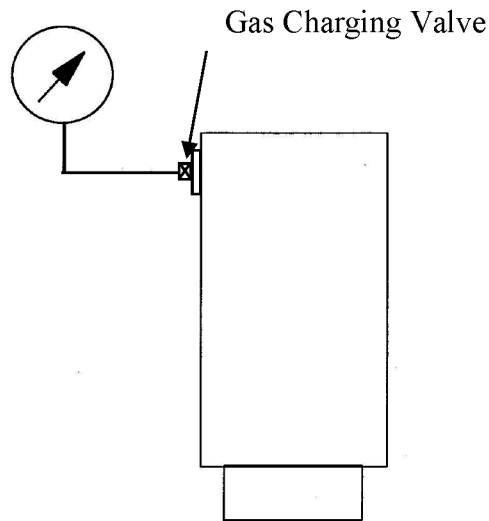


Figure 1 - Pressure Gage installed directly on the Gas Charging Valve

+Quick and practical

-Only usable for large gears. For landing gears with a small gas volume, the volume of gas lost over several servicing checks makes up an important volume percentage-wise; therefore, the gear would become mis-serviced.

2. Same as above except a nitrogen source is used to pressurize the line volume to the expected pressure, according to the servicing curve. The volume is then isolated from the nitrogen source by closing the valve (see Figure 2) before opening the gas charging valve to read the shock strut pressure.

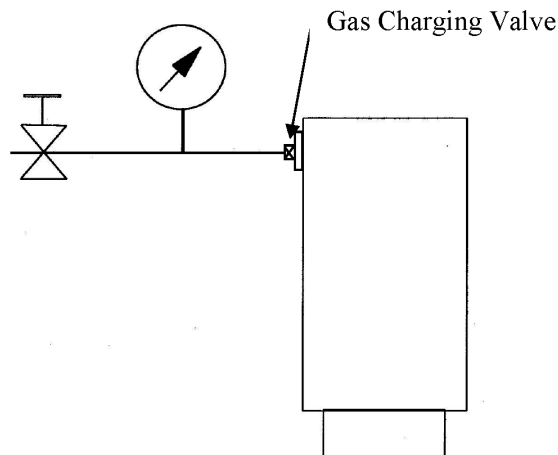


Figure 2 - Line pressurized to prevent pressure loss

+This method fully corrects the deficiency of the method shown at paragraph 1 above - i.e., there is no pressure loss during servicing verification.

+Having the nitrogen supply already connected makes it easy to gas service the strut if needed.

-Having the nitrogen supply already connected may lead to abuse of gas servicing. A very clear distinction should be made between servicing check (verification) and gas servicing (adding nitrogen). When gas servicing is performed, this should be properly noted in the aircraft maintenance log.

-Requires nitrogen cart.

3. Use of an external pressure gage (or pressure gages) permanently installed on the shock strut.

+Very practical.

+Fairly simple to replace when necessary.

-The accuracy of existing devices is typically not sufficient. This may be increased by limiting the range of pressures to be read to the pressures corresponding to the range of aircraft weights from min to max.

-A calibration schedule should be observed. This is an additional maintenance effort.

-In most cases this requires an additional hole in a structural component (the cylinder). This may be overcome by a special design that combines the functionality of the gas charging valve with the pressure gage function or by addition of a fitting similar to AS5166 or AS5167.

-Creates an additional leak path.

4. Use of a pressure transducer (or transducers) permanently installed on the shock strut.

+Can be installed in a non-structural component (as the metering pin base).

+Appropriate accuracy.

+Can incorporate a hydraulic fluid temperature probe for correction of temperature effects.

+Can be either read by the maintenance crew or fed into an aircraft computer where combined with a stroke reading can yield the servicing status.

-May require special processing of signals or special processor.

-May require additional instrumentation.

-Increased use of on board systems may reduce reliability and increase maintenance (requires development of appropriate routines to avoid maintenance penalty).

-Difficult to replace when faulty.

5.1.2 Two-Point Check

5.1.2.1 Description and Rationale

This is an accurate servicing inspection where both the hydraulic fluid level and the amount of gas are verified to be correct.

This procedure is performed by measuring the stroke (X-Dimension), the surface temperature of the shock strut (if required) and the pressure of the shock strut for two points on the gas spring curve and verifying if they are on the placarded static gas spring curve within acceptable tolerances. In the case of a dual chamber shock strut, both chamber pressures are measured.

NOTE: After stroking to extend or to compress a shock absorber, some time should be allowed before measuring the pressure in order to allow gas temperature to stabilize. Depending on the landing gear size and configuration this may take a few minutes, or it could take an hour or more.

Typically the two points are:

- One in the fully extended shock strut position (aircraft on jacks)
- One with the aircraft weight on wheels, close to the static stroke position (aircraft on ground)

Under specific circumstances established by the landing gear manufacturer the two points can be:

- Lightly loaded aircraft
- Heavily loaded aircraft

NOTE: The accuracy of the two-point check is improved as the difference in stroke between the two measurements increases.

5.1.2.2 Possible Methods for Two-Point Check

The pressure and stroke (X-Dimension) can be measured in one of three ways as described below, highlighting the pros and cons of each (designated by “+” and “-”).

1. With a pressure gage, a thermometer (if required) and a measuring tape, measure the pressure, the surface temperature (if required) and the X-Dimension at the two specified conditions, preferably static and fully extended stroke conditions. This is the method typically used. A two-point servicing check can be scheduled together with other maintenance activities that require aircraft jacking. In this situation, one-point servicing check will be performed before jacking the aircraft and the second one-point check will be performed on the fully extended gear after jacking. Verify the measured X-Dimension and pressures are in line with the servicing instructions (placard or service manual).

+Minimal temperature effects.

2. With a shock strut equipped with a pressure transducer permanently installed on the shock strut and being read by an aircraft computer, for the first point the maintenance crew on ground can input the stroke and the aircraft computer will provide the pressure reading. For the second point, the evaluation will be made by the aircraft computer at a given delay after take-off based on the pressure reading and the shock strut stroke (known: fully extended). The pressure reading should be compensated for temperature effects as applicable.

+The second point reading is available every flight

-Requires special processing of signals

-Increased use of on board systems may reduce reliability. If not properly used can increase the maintenance work for performing the servicing (nuisance faults).

3. Same as above but with the addition of a transducer for gear stroke. This system will be able to perform servicing check with the aircraft resting on ground or during flight but not in dynamic conditions.

+Performs Two-Point Check every flight.

+Reduces maintenance work for servicing verification.

-Adds complexity and upfront cost to the landing gear and aircraft.

-Requires special processing of signals.

-Increased use of on board systems may reduce reliability. If not properly used can increase the maintenance work for performing the servicing (nuisance faults).

5.2 Gas Servicing

Gas servicing is the procedure employed to correct a situation where the stroke of the shock strut in static position is not that required by the pressure due to an incorrect amount of gas in the shock strut.

Gas servicing is performed by introducing or releasing an amount of gas in/from the shock strut in order to bring the point defined by the pressure and the stroke within the acceptable tolerances. If the underlying assumption that the appropriate amount of hydraulic fluid exists in the shock strut is correct, this procedure results in a correctly serviced gear. However, if the underlying assumption that the appropriate amount of hydraulic fluid exists in the shock strut is incorrect, then this procedure will result in a mis-serviced shock strut.

The indiscriminate and abusive use of gas servicing to restore the X-Dimension can significantly change the hydraulic fluid/gas ratio, resulting in a malfunctioning shock strut.

5.2.1 Possible Gas Servicing Procedures – Single Chamber

5.2.1.1 Aircraft on Ground

This is the method typically used for adjusting the content of nitrogen in the shock strut.

This can be done with a set-up as described in 5.1.1.2., item 2.

Measure the pressure in the shock strut. Determine the range of the X-Dimension appropriate for this pressure. Measure the actual X-Dimension and add or release nitrogen as required to fall within the range. Re-check the pressure as it may have changed due to the stiction of the shock strut. Assure that the final pressure and X-Dimension falls within the range specified on the servicing placard.

5.2.1.2 Aircraft on Jacks

While on jacks with shock strut fully extended add or release nitrogen to obtain correct extend pressure.

NOTE: The shock struts of separated gas-fluid design are not sensitive to problems related to gas dissolution.

5.2.2 Possible Gas Servicing Procedures - Dual Chamber (Aircraft on Ground or on Jacks)

There are several arrangements of dual chamber shock absorbers that can be used to give different spring curve characteristics. Depending on the shock absorber arrangement the gas servicing procedure for the shock absorber will be different. Therefore, rather than providing a specific procedure for gas servicing of dual chamber shock absorbers below are general principles that should be considered when servicing dual chamber shock absorbers.

- All dual chamber shock absorbers have two isolated gas chambers. The aim of the gas servicing is to achieve the correct amount of gas in each chamber (i.e., the correct volume and pressure of gas in both chambers).
- Each gas chamber will have a specific charging valve that is used to add or remove nitrogen from the chamber. It is important to ensure that it is clear which charging valve corresponds to which chamber as the charge pressures may be different, particularly when servicing the shock absorber with the aircraft on jacks.
- There will be at least one floating piston within the shock absorber, some arrangements use two floating pistons.
- When gas servicing the shock absorber it is important to service the two chambers in the correct order as this will ensure that the floating piston(s) are in the correct positions (giving the correct chamber volumes) for servicing.
- Dual chamber shock absorbers will have a high pressure and a low-pressure chamber. When servicing the shock absorber with the aircraft on jacks the final pressure required in the two chambers following servicing will be different with the pressure in the high-pressure chamber greater than the pressure in the low-pressure chamber.