Owners Manual

Öhlins shock absorber, Snowmobile

Including:

ÖHLINS
ADVANCED SUSPENSION TECHNOLOGY

Safety signals

Important information concerning safety is distinguished in this manual by the following notations:

⚠

The Safety alert symbol means: Caution! Your safety is involved.

⚠ WARNING!

*Failure to follow warning instructions could result in **severe or fatal injury** to anyone working with, inspecting or using the suspension, or to bystanders.*

CAUTION!

Caution indicates that special precautions must be taken to avoid damage to the suspension.

NOTE!

This indicates information that is of importance with regard to procedures.

Introduction

All of Öhlins advanced suspension products are adapted to the brand and model. This means that length, travel spring action and damping characteristics are tested individually just for the snowmobile that you have chosen to fit with Öhlins suspension.

Before installation

Öhlins Racing AB can not be held responsible for any damage whatsoever to shock absorber or vehicle, or injury to persons, if the instructions for fitting and maintenance are not followed exactly.

Similarly, the warranty will become null and void if the instructions are not adhered to.

Contents

⚠ WARNING!

1. Installing a shock absorber, that is not approved by the vehicle manufacturer, may affect the stability of your vehicle. Öhlins Racing AB cannot be held responsible for any personal injury or damage whatsoever that may occur after fitting the shock absorber. Contact an Öhlins dealer or other qualified person for advice.

2. Please study and make certain that you fully understand all the installation instructions and the owners manuals before handling this shock absorber kit. If you have any questions regarding proper installation procedures, contact an Öhlins dealer or other qualified person.

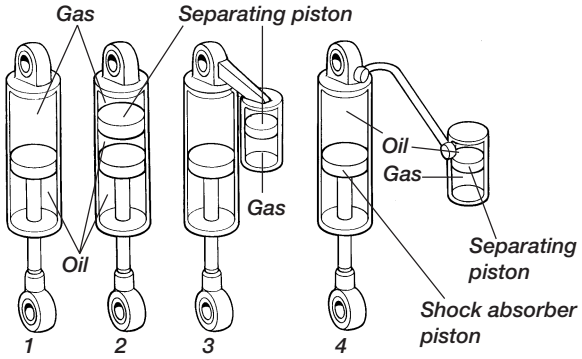
3. The vehicle service manual must be referred to when installing the Öhlins shock absorber.

NOTE

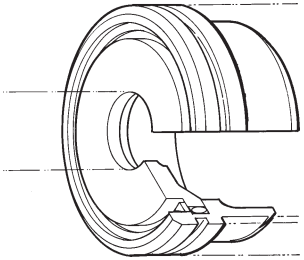
Öhlins products are subject to continual improvement and development. Consequently, although these instructions include the most up-to-date information available at the time of printing, there may be minor differences between your suspension and this manual. Please consult your Öhlins dealer if you have any questions with regard to the contents of the manual.

The installation instructions can be downloaded from: www.ohlins.com

1. Design principles



1. *Emulsion shock absorber*
2. *Internal gas reservoir*
3. *External piggyback reservoir*
4. *External reservoir with hose connection*



2. Patented ice scraper (US Pat. no. 5584 368)

Tuning your suspension

Snowmobile traction qualities

Most of the snowmobiles have a suspension with four shock absorbers (two front, one center, and one rear shock). Each shock absorber, with its spring, will cause pressure against the ground and can be seen as a “leg”. Since it is enough with three contact points or legs to keep the snowmobile (or anything) from falling, a fourth leg means the whole balance in the vehicle will change with very small adjustments.

Think about it as adding a fourth leg in the center of a three-legged stool. If this center leg is a just a little bit too long, one of the other legs will loose contact with the ground.

On a snowmobile this example could translate into too low ski pressure and lost steering ability if there is too much spring preload on the center shock for instance.

Changing to Öhlins suspension gives optimum performance only when both the front and the rear suspension interact properly.

Start from the rear

The suspension on your snowmobile can be divided in to three parts: front, center and the rear suspension. In most cases you should start from the rear if you do not want to change all shock absorbers at the same time. First change the rear shock absorber, then the center and, for the ultimate result, the ski shock absorbers at the front.

Basic set-up

The Öhlins shock absorbers are intended to be a bolt on accessory and have very carefully tested settings.

You can fine-tune the shock absorbers with the adjusters. You optimise them for your weight, your riding style and the riding conditions.

Design

Most of Öhlins suspensions are a high pressure monotube type. The fluid is put under gas pressure and the gas and the fluid are kept apart by a separating piston. The separating piston is often fitted in a separate fluid chamber, connected by hose (Fig.1:4), or fixed directly on top of the shock absorber (piggyback) (Fig.1:3).

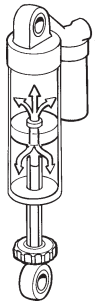
There are also cases where everything is fitted inside the main shock absorber (Fig.1:2).

A few shock absorber are of emulsion type, oil and gas mixed inside the shock absorber (Fig.1:1).

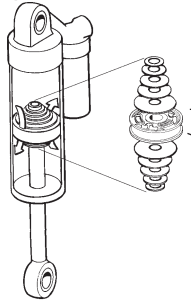
Pressurisation of the fluid is made with nitrogen. The pressurisation prevents cavitation of the fluid and the shock absorbing action is therefore more even. The external fluid chambers also contribute to better cooling of the fluid, giving longer service life for both the fluid and components.

All Öhlins snowmobile shock absorbers also have a patented bronze ice scraper (Fig.2) on the piston shaft, preventing ice from damaging the seals and moisture from entering the shock absorber.

3. Flow through needle valve

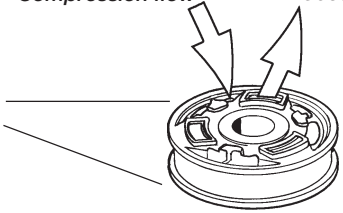


4. Flow through piston

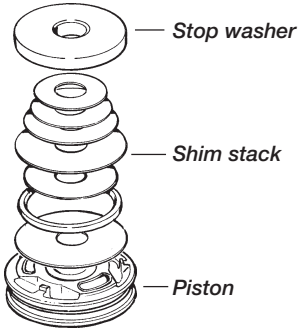


Piston with apertures

Compression flow *Rebound flow*



5. Shim stack



Function

Öhlins shock absorbers with external rebound adjustment have integrated temperature compensation. As the temperature increases and the fluid flows more easily the flow is controlled accordingly. The shock absorbing effect is therefore independent of the temperature.

The more advanced models permit individual adjustment of compression damping and rebound damping.

Öhlins shock absorbers provide the possibility for adjustment, making them adaptable to most snowmobiles, riders and ranges of use. All of the shock absorbers with springs have adjustable preloading of the spring action.

The function, in principle, is that fluid is forced through a needle valve at a low rate of flow (Fig.3) and through a number of apertures in the piston (Fig.4) at a high rate of flow. The flow through these apertures is regulated by shims (thin steel washers) that at high pressure are deflected to open for the fluid. On most models the needle valve can be adjusted from the outside.

By altering the size of the shim-stack (Fig.5) (i.e. number, thickness, diameter) the characteristics of the damping action can be changed (this should only be done by Öhlins authorized service workshops).

Compression damping

When movement of the snowmobile causes compression in the shock absorber, the fluid flows through the needle valve (combined compression and rebound valve) in the piston rod. If the velocity of the piston is high, i.e., in the case of rapid compression, this will not be sufficient and consequently the shims underneath the piston will open to allow a greater rate of flow.

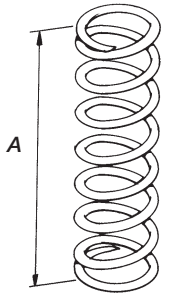
The fluid that is displaced by the volume of the piston rod is forced into the external fluid chamber via a separate compression valve. The separating piston is displaced, thus increasing the gas pressure.

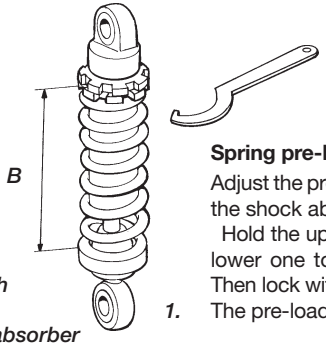
Rebound damping

When the spring forces the shock absorber to extend again, the fluid flows back through the needle valve into the piston rod. The fluid flowing into the chamber is forced by the pressure of the gas back into the shock absorber via a separate non-return valve.

If velocity of the piston is high, the shims on top of the piston will also open to allow the fluid to flow though.

6. Adjustment possibilities





A= Free spring length
B= Spring length of extended shock absorber

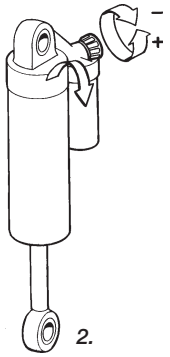
1.

Spring pre-load

Adjust the pre-load with the rings on the shock absorber.

Hold the upper ring and adjust the lower one to the desired position. Then lock with the upper ring.

The pre-load=A-B



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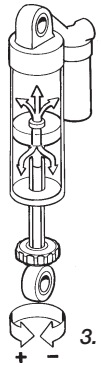


3.

Settings

Basic settings

Always ensure that the basic setting made by Öhlins is correct. It is adapted to the specific make and model (in its original state) and for a rider of average weight.

These adjustments are made to optimize the suspension: (Fig.6)

1. SPRING PRE-LOAD when adjusting the pre-load, you move the spring seat. This will raise or lower the ride height.

2. COMPRESSION DAMPING controls how easy the shock absorber compresses when you hit a bump.

3. REBOUND DAMPING controls how fast the shock absorber returns to its normal position after it has been compressed.

About spring pre-load

The spring pre-load is fundamental for the suspension function and vehicle road holding.

If the pre-load is incorrectly set, any other adjustments to the shock will not help to get the intended performance out of the suspension, or road holding of the vehicle. (see *Tuning your suspension*)

Öhlins shock absorbers comes with the spring pre-load carefully set for a good balance in the vehicle with a 70-90 kg or 155-200 lb rider.

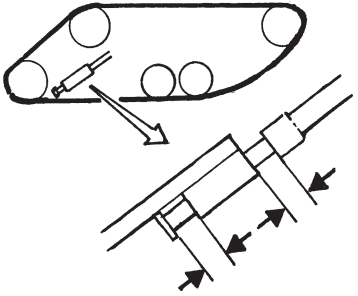
• The spring pre-load affects the ride height, which on a snowmobile is the same as the “share” of the total snowmobile weight for each shock to handle. This means it affects the balance and road holding in the snowmobile.

• The spring pre-load also affects the rebound force. Increasing the spring pre-load puts more force on the rebound stroke, which means the shock absorber will rebound quicker.

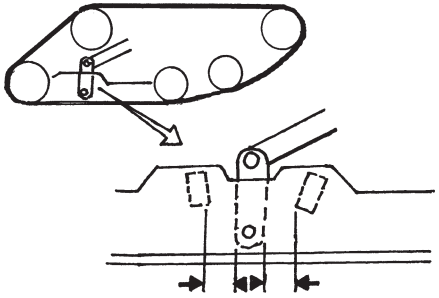
• Increasing the spring pre-load does not make the shock absorber stiffer, other than the initial force to compress the suspension from fully extended position. Since the suspension shall be compressed as soon as you sit on the snowmobile, the suspension will not be stiffer after increasing the pre-load, only higher.

• Within reasonable limits, the spring pre-load does not affect bottoming. The spring stiffness and the hydraulic damping are the keys to bottoming control.

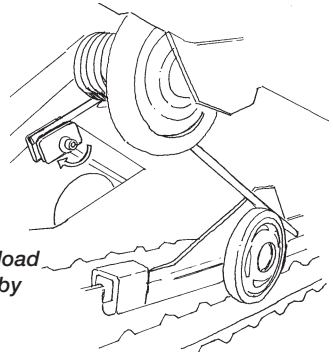
7. Pre-load adjustment



Equal distances



Equal distances



Spring pre-load is adjusted by turning the spring seat.

Setting the spring pre-load

Procedure
Set the spring pre-load to the basic settings on the front and center shock absorbers. Also, put the limiter straps for the center shock absorber to the basic setting. Now you can start adjusting the rear shock absorber according to below. Then continue with the center and front shock absorbers if needed.

Rear ride height and suspension comfort
It is very important that the rear ride height is adjusted correctly. Due to the coupling device in the rear suspension, the rear ride height and comfort are linked together. If the ride height is not within the right range, the center and rear shock absorbers may start working parallel in unwanted situations, thus creating a too stiff suspension and a harsh ride.

NOTE!

It is of importance that this adjustment is carried out on a flat surface and the most correct setting is made indoors when the snowmobile is thawed out/ warmed

Recommended rear ride height
When you sit on the snowmobile in riding position, wearing all your riding gear, we recommend the coupling adjuster free play to be equal in both directions, assuming that the coupling adjuster is in its standard setting.

Increase or decrease the spring pre-load until you have reached the middle position of the coupling adjuster. (Fig.7)

If you carry heavy luggage, or a passenger on a 2-seater, you will need to perform the adjustments with these in place.

Front and center
Take the snowmobile for a test ride. Choose a short run of varying character, i.e. both long and sharp bends, with varying bumps. Stick to the same run and make only one adjustment at a time.

Do you experience that any of the following behaviors are exaggerated?

- The snowmobile feels heavy on the skis.
- Difficult to hold a straight line.

⚠ WARNING!

Too much ski pressure and/or no toe out will cause the sled to dart to each side, you'll feel unsafe on straights.

Check that the skis are toe out according to the snowmobile's manual.

One of the causes for these behaviors could be that the front and rear shock absorbers take too much of the vehicle weight, which is the same as the center shock absorber taking too little of the vehicle weight.

Since the rear ride height is already decided by the coupling mechanism, only the front and center shock absorber springs pre-load remain to adjust.

Try either of these changes
Increase the spring pre-load on the center shock in 2mm or 1/12" steps or decrease the spring pre-load on the front shocks in 3mm or 1/8" steps.

Fig.8

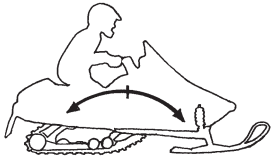


Fig.9

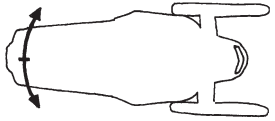
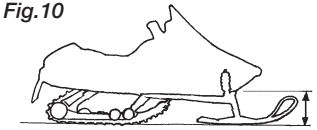


Fig.10



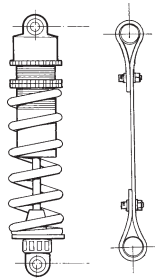


Fig.11 The limiter strap must limit the suspension travel before the shock absorber is fully extended.

Limiter straps

If your snowmobile has limiter straps or a similar adjuster for the center shock absorber, you can adjust the extended length of the center shock absorber.

If you feel you need more weight transfer during acceleration, you can adjust to longer limiter straps. This will allow the center shock absorber to extend further during acceleration, putting more weight on the track and less weight on the skis.

Do you experience that any of the following behaviors are exaggerated?

- The snowmobile understeers (low ski grip)
- The snowmobile rolls from front to rear
- The inner ski lifts in turns
- The snowmobile is "wagging its tail" when letting off the throttle (coming into corners for example)

Check that the limiter straps have the basic length. If they do, we recommend adjusting the spring pre-load (see page 6) instead of taking away suspension travel by shortening the limiter straps.

NOTE!

The limiter straps protect the center shock absorber from being torn apart. Very high tearing forces can occur, for instance if you jump with the snowmobile and land on the rear part of the rear suspension.
Therefore the limiter straps must always be shorter than the shock, in the fully extended position. (Fig.11)

Do you experience that any of the following behaviors are exaggerated?

- The snowmobile understeers (low ski grip)
- The snowmobile pitches from front to rear (Fig.8)
- The inner ski lifts in turns
- The snowmobile is "wagging its tail" when letting off the throttle (coming into corners for example) (Fig.9)

One of the causes for these behaviors could be that the center shock absorber takes too much of the vehicle weight, which is the same as the front and rear shock absorbers taking too little of the vehicle weight.

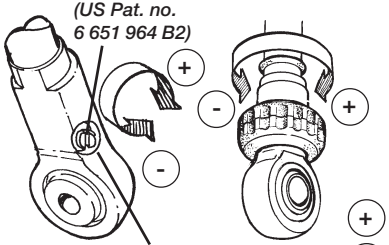
Since the rear ride height is already decided by the coupling mechanism, only the front and center shock absorber springs pre-load remain to adjust.

Try either of these changes

Increase the pre-load on the front shocks in 3mm or 1/8" steps or decrease the pre-load on the center shock in 2mm or 1/12" steps.

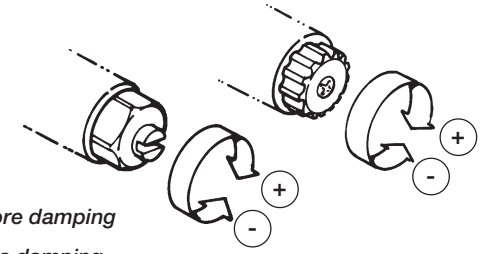
As a rule of thumb, the front ride height with rider should normally be around 1/4-1/3 of the total travel. (Fig.10)

12. Adjustment of rebound damping



Tip: Use a coin as tool

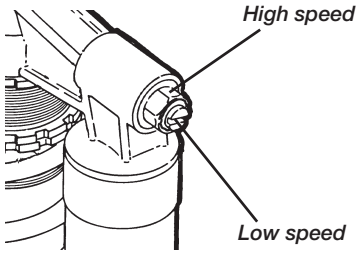
13. Adjustment of compression damping



+ *= more damping*

- *= less damping*

14. High and low speed compression damping adjusters



The clicks or turns are counted from the closed position. The basic settings are specified in the mounting instruction for each shock absorber.

Adjustable damping

The adjusting possibilities of Öhlins shock absorbers facilitate fine setting. You can optimize adjustments to suit your own riding style, equipment and riding condition. To be able to improve the road holding qualities it is of the utmost importance that you fully understand the functioning of the shock absorbers. Then you can learn by trial and error how they affect the sled.

Depending on the model there can be adjustments for rebound damping and compression damping. Damping is set with knobs and screws with a normal right-hand thread. By turning them clockwise the damping action increases and by turning them counter clockwise it'll be reduced. Most of the adjusters have definite positions with a noticeable "click", so it is easy to count to the right setting.

Some models (PRX) have separate adjusters for high speed compression and low speed compression (Fig.14). The low speed compression is adjusted in 25 steps. The high speed adjuster has a wide range without steps.

NOTE!

If no "clicks" are felt on the rebound knob, the shock absorber must be inspected by an authorized service workshop. It could be due to low gas pressure or lack of oil.

The compression damping affects the force needed to compress the suspension. More compression damping will make the suspension firmer and make the vehicle run a little bit higher.

On PRX shocks, the X stands for the high and low speed compression adjuster.

A simplified description

Low speed circuit: More damping will make the ride firmer and higher.

High speed circuit: More damping gives a firmer ride and more resistance against bottoming.

The rebound damping affects the force needed to extend the shock. More rebound damping will make the extension slower, and vice versa.

The external rebound adjustment actually also affects the compression damping by the ratio off approximately 90% rebound damping and 10% compression damping. (See *Function*)

NOTE!

The damping forces are related to the speed between the shock absorber piston and the shock absorber body. The damping forces do not vary with the position of the piston inside the shock absorber.

EC – Electronic Control Settings

Setting the damping

The electronically controlled compression damping is set with the control panel of the electronic unit.

You can instantly optimize adjustments to suit your individual way of riding and the condition of the trail.

Compression damping adjustments are made by setting the electronic adjustment device. By setting high figures the damping action will increase and low figures reduces the damping.

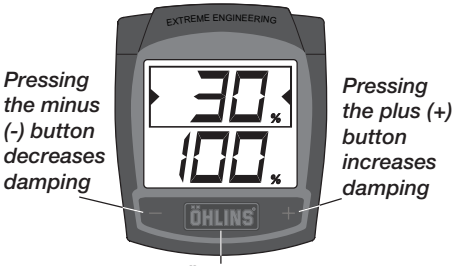
New settings will affect the damping within ten [10] milliseconds. High figures are recommended when riding with greater load (eg. passenger and packing) and when riding on a race track.

To be able to improve the traction qualities it is of the utmost importance that you fully understand the functioning of the shock absorbers. Please refer to the Mounting Instructions, as well as page five (5) of this manual for basic setup (spring pre-load). Then you will learn by trial and error how they affect the vehicle.

The control unit

The control unit display has a window with two sections, showing how much damping power the shock absorbers have. The upper section shows the front damping and the lower section shows the rear damping. If the electronic control unit operates one shock absorber only, the damping force is read in the upper display and the lower display shows the electrical voltage of the snowmobile.

By pressing the ÖHLINS logotype you choose front or rear setting and by pushing the + or – buttons you increase or decrease the damping forces. The higher the figures, the stronger the damping forces.



Pressing the minus (-) button decreases damping

Pressing the plus (+) button increases damping

Pressing the ÖHLINS button switches between front and rear settings

NOTE!

The control unit will automatically switch to the correct mode: single suspension *or* front and rear suspension.

Functions for front and rear suspension:

A Press for front suspension
B Press for rear suspension
C Press for front and rear
After C the function returns to A.

NOTE!

If the button is pressed for at least one second the display will show the voltage for five seconds.

Functions for single suspension only:

A Press for voltage readings
B Press to turn the voltage readings off
After B the function returns to A

⚠ WARNING!

Do not alter the damping when riding. The snowmobile must come to a stop before the damping is set. To avoid dangerous situations, do not take your eyes and attention off the surroundings.

When the snowmobile is restarted the adjusters will return to the earlier chosen positions. If the power supply should fail the shock absorber will retain its last applied damping force settings, to ensure safe riding.

Troubleshooting

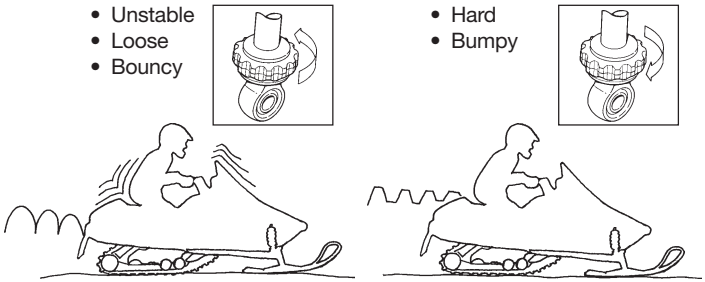
Er1 **No power to the front damper**
Measures: Make sure the damper is connected. Check cables and connections for damages.

Er2 **No power to the rear damper**
Measures: Make sure the damper is connected. Check cables and connections for damages.

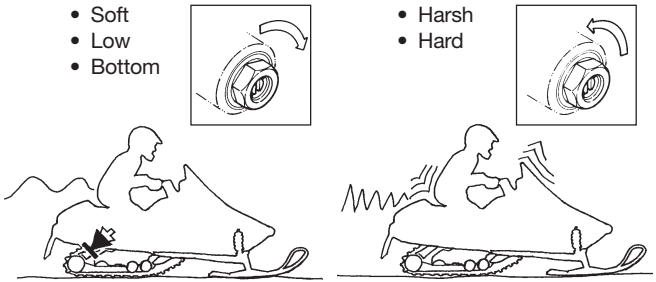
Er3 **No power to front and rear dampers**
Measures: Make sure the dampers are connected. Check cables and connections for damages.

Er4-Er7 **Insufficient voltage to the control unit**
Measures: Check battery and alternator. Check all connections.

15. Rebound damping



16. Compression damping



Setting your snowmobile

NOTE!

Always begin with the basic settings recommended by Öhlins. Always make notes, adjust in small steps and make only one adjustment at a time. Adjustments should be made with two steps (clicks)/ 1/2 turn (two-way compression damping) at a time.

By utilizing the adjustment possibilities you can test by trial and error, and learn how they affect your snowmobile.

Always begin by test riding the snowmobile with all adjustments at their basic setting. Choose a short run of varying character, i.e., long and sharp bends, hard and soft bumps. Keep to the same run and adjust only one setting at a time.

Start with the rebound damping (Fig.15)

If the snowmobile feels unstable, loose and rather bouncy then the rebound damping should be increased. Begin by turning the adjusting knob 2 steps (clicks). Test run again and adjust one step back if it felt too hard and bumpy.

If the snowmobile is hard and bumpy, especially over a series of bumps, then the rebound damping should be reduced. Turn 2 steps, test run and make any necessary correction. For original rebound setting, see installation instructions.

Compression damping (Fig.16)

If the snowmobile feels soft, has low riding position and a tendency to bottom easily in long dips then the low-speed compression damping should be increased. Turn clockwise 4 clicks/ 1 turn and test run again. If this was too much, then turn back two steps (clicks)/1/2 turn.

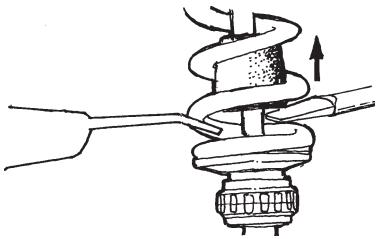
If the snowmobile feels harsh and has hard resilience, e.g., over changes in the ground surface, then the high-speed compression damping must be reduced. Turn the adjuster 1/2 turn at a time. Test run and make any necessary corrections.

When you have sufficient feel of the snowmobile then you can make further fine adjustments. It is feeling and experience that counts.

NOTE!

Ensure that the springs are properly pre-loaded before attempting to make any damping adjustments. A simple rule is that increased pre-load of the spring should be followed by an increase of rebound damping by two steps/1/2 turn.

When you feel that you have achieved an improvement, go back to where you started and check once more. Be observant of other relevant factors such as snow conditions, temperature, etc. Test run to make sure whether further fine adjustment should be made.



17. Lift the bump rubber and clean the area below

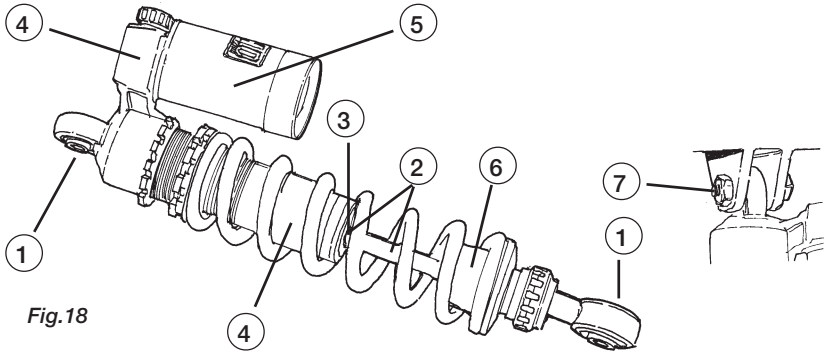


Fig.18

Inspection and maintenance

Clean the shock absorbers externally with a soft detergent . Use compressed air . Be careful that all ice water, dirt and debris is removed.

Lift the bump rubber and clean the area below from ice and dirt (Fig.17).

Keep the shock absorbers clean and always spray them with oil (QS 14, WD40 or CRC 5-56) after washing.

Preventive maintenance and regular inspection reduces the risk of functional disturbance. If there is any need for additional service, please get in touch with an authorized Öhlins service workshop. They have the necessary tools and know-how for whatever you need.

NOTE!

Make certain that your shock absorbers are always filled with Öhlins High Performance Shock Absorber Oil.

Inspection points (Fig.18)**:**

1. Check ball joints for possible excessive play or stiction.
2. Check the piston shaft for leakage and damage.
3. Check the ice scraper for excessive wear.
4. Check the shock absorber body for external damages.
5. Check the external reservoir for damages that can restrict the floating piston from moving freely.
6. Check for excessive wear of rubber components.
7. Check the fastening to the vehicle.
8. Check the hose equipped models for leaks in hose and inlet plugs.
9. Check that the hose is properly attached and will not interfere with anything.

NOTE!

Regular maintenance and inspection contribute to the prevention of functional disturbances.

Recommended service intervals:

Normal use:	Once a year
Racing:	Every 20 hours of operation

⚠ WARNING!

Never alter the gas pressure. Special-purpose charging equipment and access to nitrogen is required. The gas pressure should normally never be altered.

NOTE!

Discarded Öhlins products should be handed over to an authorized work shop or distributor for proper disposal.

Rear suspension coupling system

Most modern rear suspension systems have a coupling arrangement between the front and rear swing arm, making both shock absorbers of the rear suspension interact during certain situations.

The coupling system is often adjustable for coupling from the center shock absorber to the rear shock absorber and vice versa.

Adjusting refers to:

- Progressiveness in overall spring and damping force in the rear suspension.
- Rear suspension weight transfer (possibility of traction).
- Balance between comfort of the rear suspen sion and the two above mentioned.

Coupling from center shock absorber to rear shock absorber

Uncoupled rear suspension system

When running over a bump with the front part of the rear suspension the center shock absorber is compressed and the front part of the rear suspension moves upwards. (Fig.19) When the rear part of the rear suspension reaches the same bump, the rear shock absorber is compressed and the rear part of the rear suspension moves upwards.

Coupled rear suspension system

When running over a bump with the front part of the rear suspension the front part moves upwards. After a certain portion of the movement, the rear shock absorber is also coupled in, so both rear suspension shock absorbers are compressed. The entire rear suspension moves upwards although the bump is under the front part of the rear suspension, the rear suspension acts like a parallelogram.

Early coupling makes the rear suspension feel hard but also reduce the secondary kick because the entire rear suspension moves upwards and meets bumps at a smaller angle of incidence (floating on top of the bump)(Fig.20).

Late coupling in from the center shock absorber makes the rear suspension feel soft, but gives more of a secondary kick because the entire rear suspension does not move upwards so the bump is met at a steeper angle of incidence (must climb up onto the bump).

Fig.19 Hitting a bump, uncoupled rear suspension system

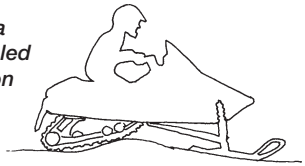
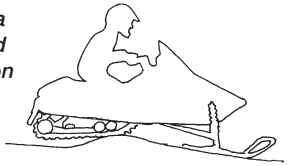


Fig.20 Hitting a bump, coupled rear suspension system



Coupling from rear shock absorber to center shock absorber

Uncoupled rear suspension system

When meeting a bump with the rear part of the rear suspension, or applying all weight on the rear part of the rear suspension (acceleration, jump landing), the rear shock absorber is of course compressed and the rear part of the rear suspension moves upwards.

Coupled rear suspension system

When meeting a bump with the rear part of the rear suspension, or applying all weight on the rear part of the rear suspension (acceleration, jump landing), the rear part of the rear suspension moves upwards. After a certain amount of movement, the center shock absorber is also coupled in. Both rear suspension shock absorbers are thus compressed, although the bump is underneath the rear part of the rear suspension.

Early coupling makes the suspension feel hard because the progressive action achieved by an extra shock absorber occurs early during the stroke. The traction can be experienced as poor because early coupling from rear shock absorber to center shock absorber counteracts weight transfer.

Late coupling from rear shock absorber to center shock absorber implies that spring action of the rear shock absorber feels soft, but the traction better, because late coupling from rear shock absorber to center shock absorber facilitates weight transler.

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