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### HP690A Intensifier Panel including the following versions:

Model	Intensification Ratio	Part Number
HP690A28	2.8	980517
HP690A32	3.2	980511
HP690A40	4.0	980507
HP690A50	5.0	980518
HP690A66	6.6	980519
HP690A90	9.0	980513

### INSTRUCTIONS FOR INSTALLATION, OPERATION & MAINTENANCE

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**This document must not be modified in any way.**

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## 1 Introduction

The HP690 is a hydraulic intensifier panel and is designed to boost a high flow, low pressure hydraulic input to a lower flow, higher output pressure (up to 690 bar).

This is done using an integrated hydraulic circuit which contains a Minibooster™ intensifier.

The HP690 is designed to be compatible with the majority of the Webtool™ range of subsea cutting tools but is also compatible with other double acting hydraulic equipment that require up to a 690 bar feed.

Please check with the manufacturer of any third party equipment for compatibility before use.

### IMPORTANT

Please note this tool is designed for intermittent subsea use. Please refer to the manufacturer should you wish to use this tool subsea for any period over 14 days.

This machine is not intended for use in an explosive environment.

### 1.1 HP690 Versions

The HP690 is available in configurations with different intensification ratios as follows.

Model	Intensification Ratio	Part Number
HP690A28	2.8	980517
HP690A32	3.2	980511
HP690A40	4.0	980507
HP690A50	5.0	980518
HP690A66	6.6	980519
HP690A90	9.0	980513

Table 1 – Intensifier models

These versions are otherwise identical, and can be identified by the name plate as shown.

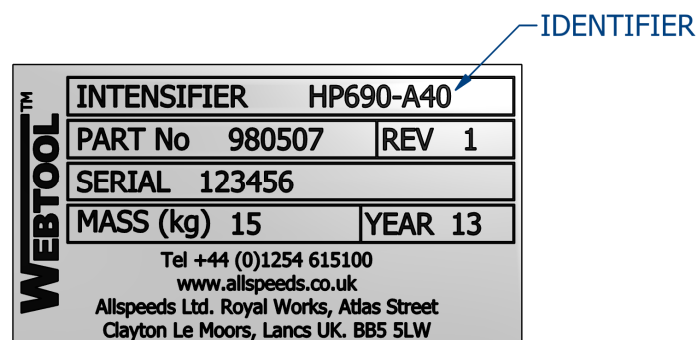


Figure 1 – Name Plate

## 2 Technical data

Weight of overall machine 10 kg

Machine dimensions See drawing below.

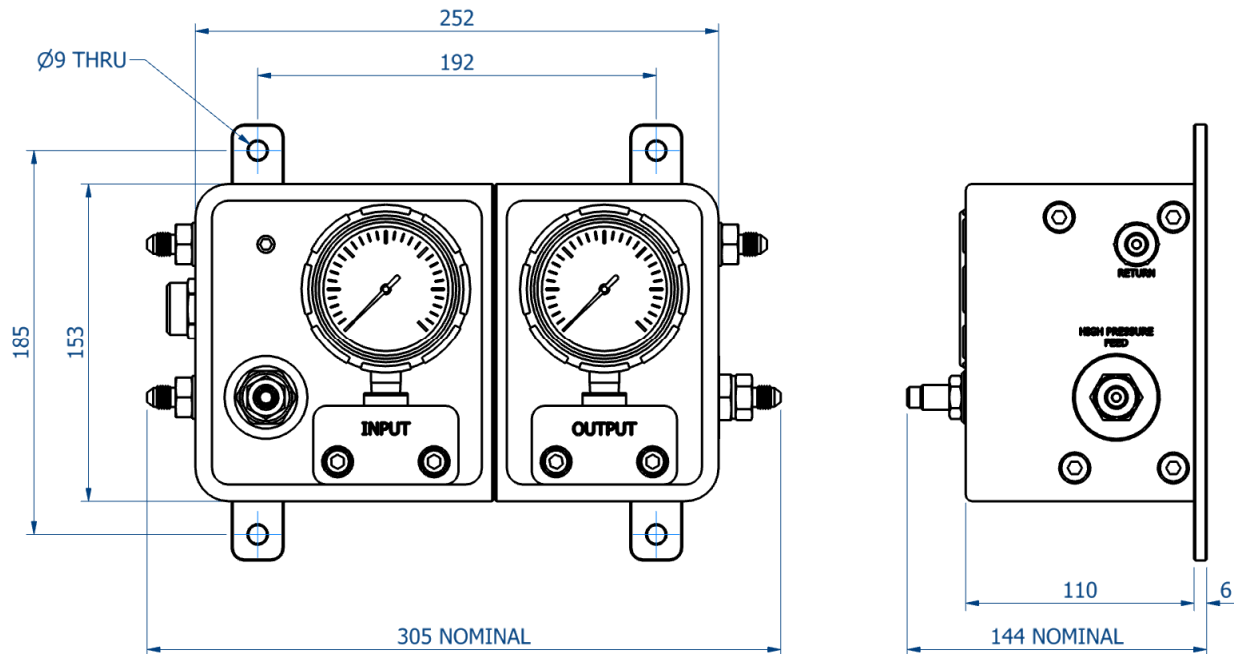


Figure 2 – Overall dimensions

### 2.1 Hydraulic Data

Intensifier Data - Hydraulic			Min Input Flow Rate (l/min)	Max Input Flow Rate (l/min)	Max Output Flow Rate (l/min)	Input Pressure to generate 690 bar
Model	Intensification Ratio	Part Number				
HP690A28	2.8	980517	4.0	13.0	2.2	246.4
HP690A32	3.2	980511	4.0	15.0	2.5	215.6
HP690A40	4.0	980507	4.0	14.0	2.0	172.5
HP690A50	5.0	980518	4.0	14.0	1.6	138.0
HP690A66	6.6	980519	4.0	13.0	1.3	104.5
HP690A90	9.0	980513	4.0	13.0	0.9	76.7

Table 2 – Hydraulic data

More information regarding the Minibooster hydraulic intensifier can be found in Appendix A.

### 3 Hydraulic Fluid Requirements

#### 3.1 Fluid Type

The HP690 is compatible with the following hydraulic fluids:

- ISO 32 mineral hydraulic oil (e.g. Shell Tellus 32)
- ISO 46 Water Glycol hydraulic fluid (e.g. Millmax FRG 46)

Please note that whilst compatible, the use of water glycol fluids may reduce system life.

Where possible it is recommended that the chosen fluid is ISO 32 hydraulic oil.

**IMPORTANT** - Please contact Allspeeds before using this product with any other hydraulic fluid to check compatibility.

#### 3.2 Fluid Cleanliness

**IMPORTANT** - It is critical that the correct grade and cleanliness of fluid is used with this panel as contaminated fluid may lead to system failure.

Whilst the HP690 does contain screens, these are designed to stop large particles from accidentally entering the critical components and will not prevent system damage caused by the use of contaminated fluid.

It is critical that filters are fitted to both the input and output stages to provide additional protection.

The minimum fluid cleanliness levels are as follows:

Fluid Type	ISO 4406:1999 Target Level	Filtration Rating ( $\mu\text{m}$ )
ISO 32 Hydraulic Oil	17/15/12	3
ISO 46 Water Glycol	16/14/11	3

Table 3 – Fluid cleanliness

**Performance and system life of this tool may be severely compromised or permanent damage may occur if contaminated fluid is used. If in doubt please contact Allspeeds.**

More information regarding the Minibooster hydraulic intensifier can be found in Appendix A.

## **4 General safety rules**

### **4.1.1 Warnings!**

These warnings are provided to improve safety and should be carefully read before installing, using or maintaining the machine.

### **4.1.2 Important Information**

It is vital that these instructions are available to machine users. It is also important to retain with the machine if the machine is sold or transferred to another user.

### **4.1.3 Safety for operation**

The HP690 should only be used by fully trained operators experience to prevent the risk of injury to themselves or other personnel.

Before operating the HP690 there are several safety elements that have to be taken into account:

- Ensure sure that suitable PPE including safety glasses is worn when operating, adjusting or making connections to this equipment.
- Make sure that the HP690 is isolated from the hydraulic supply before any hydraulic connection is made or altered.
- Make sure that all hydraulic connections are rated to the correct working pressure (maximum 690 bar, 10,000 psi)
- Make sure that all hydraulic connections are tightened correctly.
- Make sure that the unit is connected to the correct type of 3 position control valve as described in section 7.2.
- When operating the HP690 ensure that the maximum input pressure is not exceeded, as described in table 2.

Recommended PPE is safety shoes, safety glasses and gloves.

## **4.2 Safety for maintenance**

Repairs carried out by untrained or unauthorised personnel may result in personal injury or serious malfunction of the HP690. If in doubt, return the unit to Allspeeds for servicing or maintenance.

## 5 Transportation and installation

### 5.1 Transportation

The weight of the HP690 is 10kg. It can be unpacked and moved by hand.

Components must be adequately secured to maintain stability during transportation.

### 5.2 Installation

The machine must be securely mounted onto a structural base (for example, ROV subframe or skid). Mounting points are provided as shown below.

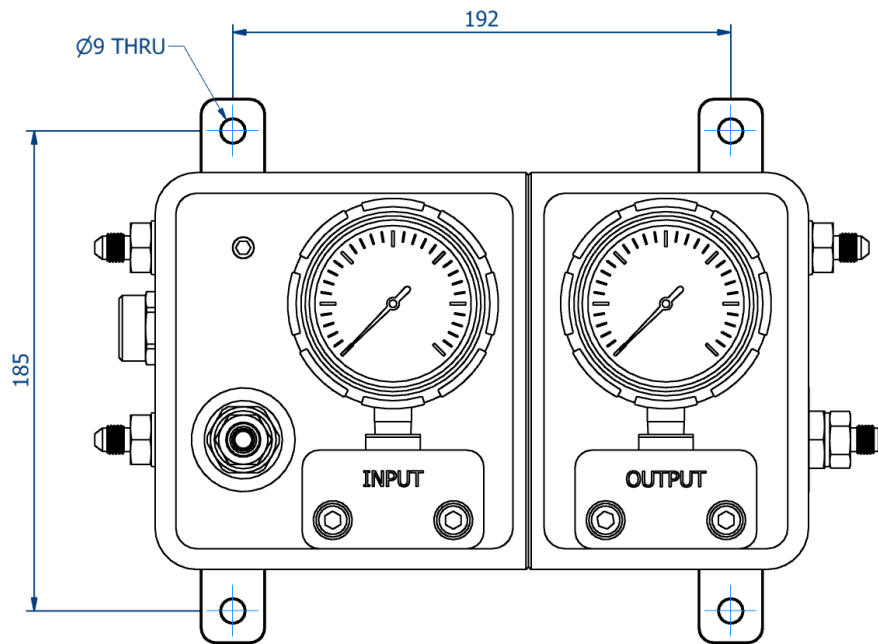


Figure 3 – Mounting strap hole positions



## 6 Operating instructions

### 6.1 Description of the HP690

The main components of the HP690 are shown on the image below.

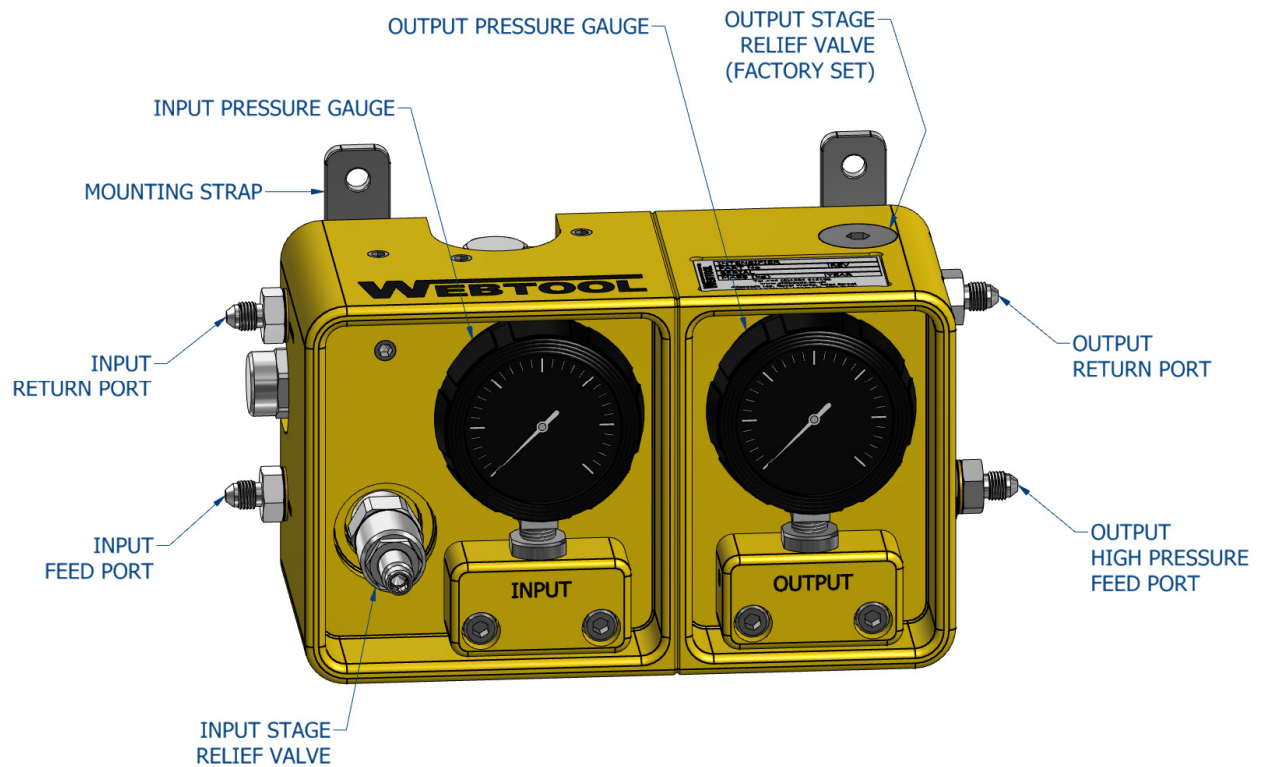


Figure 4 – HP690 main components

Please note that the output stage relief valve is factory set and should NOT be adjusted. This is described in more detail in section 7.3.

A full parts list for the tool can be found in section 11.

## 7 Operational procedures

### 7.1 Hydraulic Control System

For safe operation, it is **critical** that the HP690 is connected to a “centre float” or “centre open” style 4/3 control valve.

Do not connect the HP690 to a “centre closed” type control valve as it will not allow pressure within the system to be safely returned to tank and may lead to the unit being damaged. More information regarding this can be found in Appendix A.

The HP690 is designed to be connected to a double acting hydraulic device as shown below.

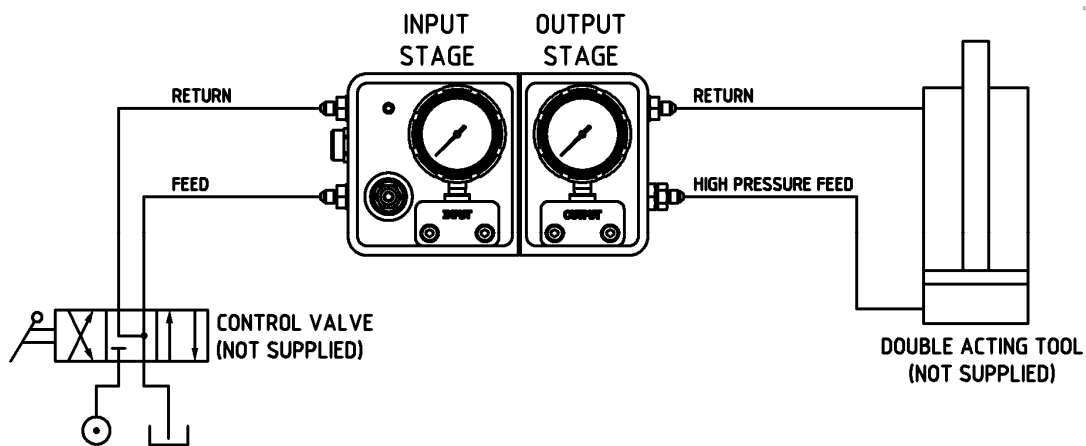


Figure 5 – HP690 connections

**IMPORTANT** - The maximum output pressure of this unit is 690 bar (10,000 psi) and all hoses and fittings must be rated accordingly.

Ensure that all hydraulic connections are secure before proceeding.

### 7.2 Control Valve

Ensure that the intensifier is isolated from the hydraulic power source with the control valve in centre position as shown below before proceeding.

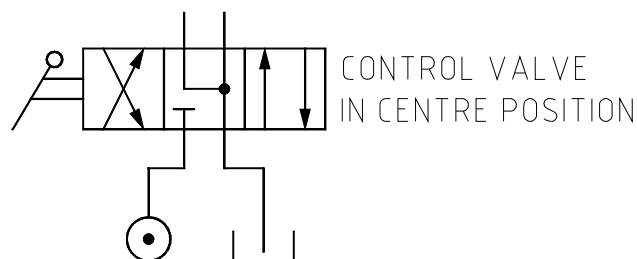


Figure 6 – HP690 isolated. Control valve in centre position.

### 7.3 Relief Valve – IMPORTANT NOTE

The HP690 contains a factory set relief valve on the output stage that limits the generated pressure to approximately 760 bar (11,000 psi).

Setting the input pressure too high will cause the output pressure to be above this pre-set value, causing the relief valve to operate.

**IMPORTANT** - This relief valve is intended for use in an emergency situation only, and should not be operated for prolonged periods as it may lead to excessive amounts of heat being transferred into the oil. Prolonged use may also lead to a reduced relief valve life.

Setting the input pressure correctly is essential to ensure optimal performance.

### 7.4 Input Pressure

#### 7.4.1 Input Pressure Set At The HPU

If the input pressure is to be set at the HPU, the input relief valve can be bypassed by fully opening it.

Fully open the input relief valve by loosening the locknut and turning the adjuster clockwise/anticlockwise until it stops. Re-tighten the locknut after adjusting.

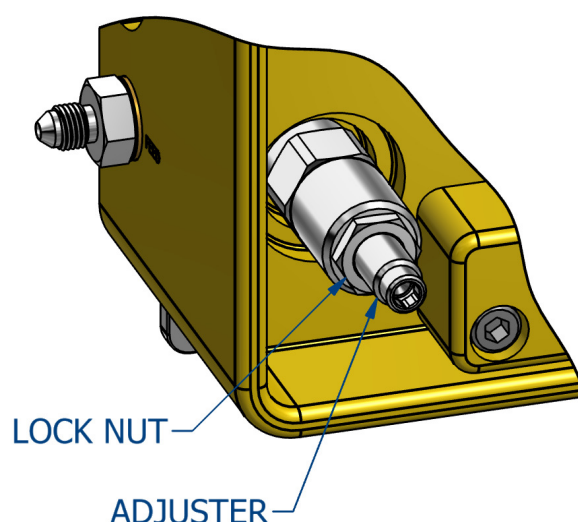


Figure 7 – Input relief valve

To generate an output pressure of 690 bar (10,000 psi), ensure that the input pressure from the power source is set as shown in the table below:

Model	HP690A28	HP690A32	HP690A40	HP690A50	HP690A66	HP690A90
Ratio	2.8	3.2	4.0	5.0	6.6	9.0
Max Input Pressure (bar)	246.4	215.6	172.5	138.0	104.5	76.7

Table 4 – Maximum input pressure

#### 7.4.2 Input Pressure Set Via HP690 Relief Valve

If the input pressure cannot be adjusted at source then it can be set via the input relief valve.

**IMPORTANT** – The input relief valve is rated for a maximum input pressure of 250 bar (3625 psi). Pressures higher than this may lead to tool damage or serious injury.

The following procedure assumes that the HP690 is connected to a double acting cylinder as shown in figure 9.

Fully open the relief valve by loosening the locknut and turning the adjuster clockwise/anticlockwise until it stops.

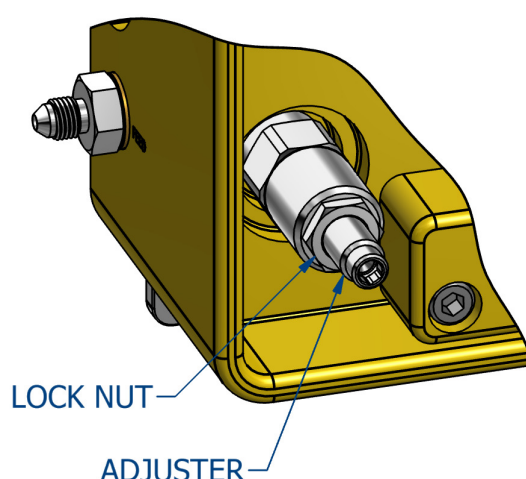


Figure 8 – Input relief valve

Turn on the hydraulic supply to the tool, pressuring the input feed port and leaving the input return port open to tank. The double acting cylinder should begin to extend.

The input pressure gauge should now show that there is pressure within the system. Once the cylinder is fully extended, the pressure will rise dramatically.

Adjust the input relief valve until the desired input pressure is achieved. The input pressure to achieve an output of 690 bar (10,000 psi) is as shown below:

Model	HP690A28	HP690A32	HP690A40	HP690A50	HP690A66	HP690A90
Ratio	2.8	3.2	4.0	5.0	6.6	9.0
Max Input Pressure (bar)	246.4	215.6	172.5	138.0	104.5	76.7

Table 5 – Input pressure

Check that the output pressure is also correct (for example the HP690A40 with an input of 100 bar should show an output of 400 bar). Once the correct pressure is set, tighten the lock nut.

Isolate the HP690 from the hydraulic supply when finished and check that both pressure gauges show zero.

## 8 Operating Procedure

Ensure that the input and output pressures have been correctly set as described in section 7 before proceeding.

The following example shows the HP690 connected to a Webtool™ RCO40 wire rope cutter. This is a double acting cutting tool that requires 690 bar (10,000 psi) to operate.

### 8.1 Connections

Ensure that the HP690 is connected to the hydraulic supply as described in section 7 before proceeding.

### 8.2 Extending the Cylinder

Move the control valve into the position shown so that the input feed port of the HP690 is pressurised and that the input return port is free to flow back to tank.

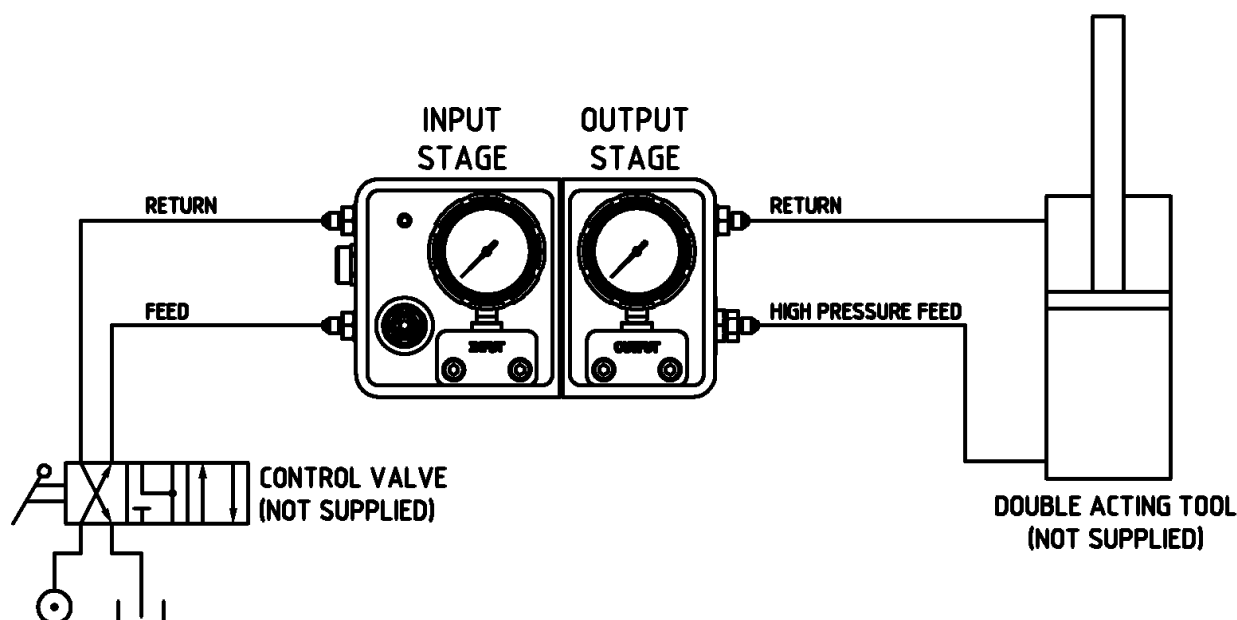


Figure 9 – Cylinder extended

The cylinder will extend, and as the tool begins to cut the pressure within the system will rise and the intensifier will boost the output pressure. This can be seen by checking the two pressure gauges on the front of the HP690.

The pressure should increase as the cylinder reaches end of stroke, whereby the output gauge will indicate the pressure as set previously in section 7.4.2.

### 8.3 Remove Pressure from the System

Moving the control valve into the centre position as shown below will cause all pressure within the system on either side of the HP690 to be released back to tank. This can be seen via the two pressure gauges on the front of the HP690.

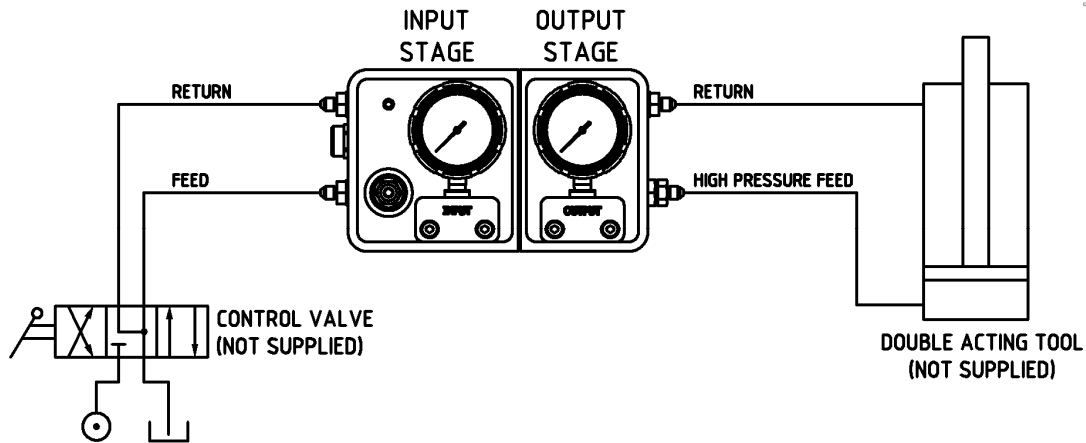


Figure 10 – Remove pressure from the system

### 8.4 Retracting the Cylinder

Move the control valve into the position shown so that the input return line of the HP690 is pressurised and the input feed line is free to flow back to tank.

The hydraulic fluid will flow into the return side of the cylinder, retracting it. Please note that this fluid will be at the pressure generated at source, and is not boosted by the intensifier circuit.

This pressure is NOT indicated on the gauges on the front of the HP690.

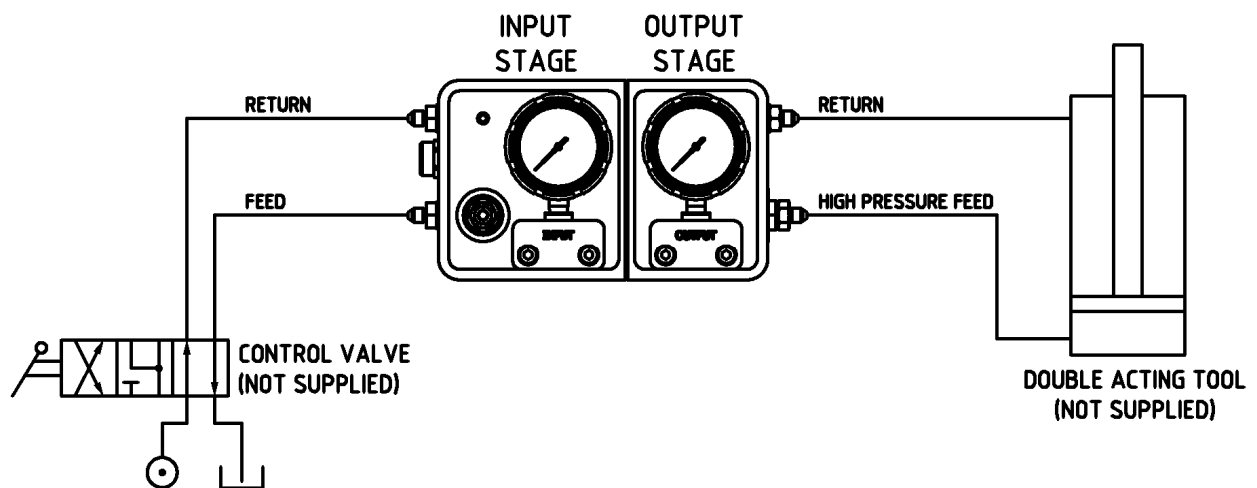


Figure 11 – Retract the cylinder

## 8.5 Remove Pressure from the System

Again, moving the control valve into the centre position will cause all pressure within the system on either side of the HP690 to be released back to tank.

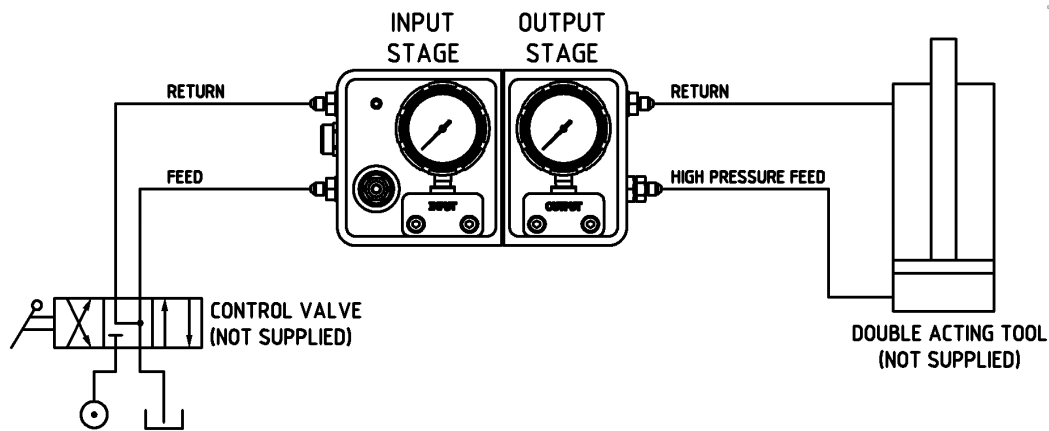


Figure 12 – Remove pressure from the system

## 8.6 IMPORTANT

Ensure that the control valve is always placed in the centre position after use. This ensures that both the feed and return lines are open to tank and removes the risk of pressure build up within the tool due to surfacing or temperature rise.

## 9 Safety Devices

### IMPORTANT - Guards

No guards are fitted to the HP690. It is the responsibility of the end user to ensure that suitable PPE is worn when working with this equipment.

The HP690 contains the following safety features:

### 9.1 Input Relief Valve

This pressure relief valve should only be used in instances where the input pressure cannot be adjusted at source. Use of this valve is as described in section 7.4.2.

### 9.2 Output Relief Valve

This pre-set relief valve is designed to operate at approximately 760 bar (11,000 psi) and avoids excessive output pressure caused by the input pressure being set too high. It is not designed for prolonged use. This valve is factory set and should not be adjusted by the end user.

### 9.3 G-Type Minibooster™

The Minibooster™ intensifier unit contained within the HP690 contains proportional valve technology. The HP690 contains an integrated circuit to ensure that when the input pressure drops to zero, the pressure within the circuit also drops to zero. Please note that this is dependent upon the user following the operating instructions and connecting to a suitable control valve as described in section 7.1.

This integrated circuit ensures that both the feed and return lines are open to tank after use, which removes the risk from dangerous build-up of pressure due to surfacing, temperature rise or operator error.

#### 9.4 Dual Pressure Gauges

The dual pressure gauges show the pressure within the feed line on both the input and output stages of the circuit. DO NOT make or break disconnections or perform any servicing if these do not read zero.

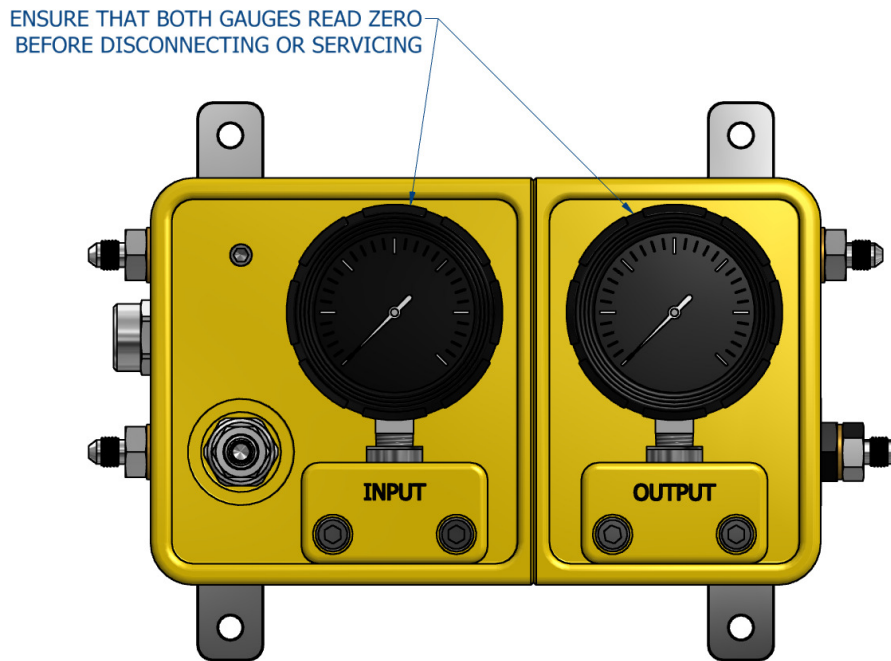


Figure 13 – Pressure gauges

Please note that the return line is NOT connected to a pressure gauge. Ensure that the system is isolated from the hydraulic supply before performing any servicing.



## 10 Maintenance

### 10.1 Hydraulic Schematic

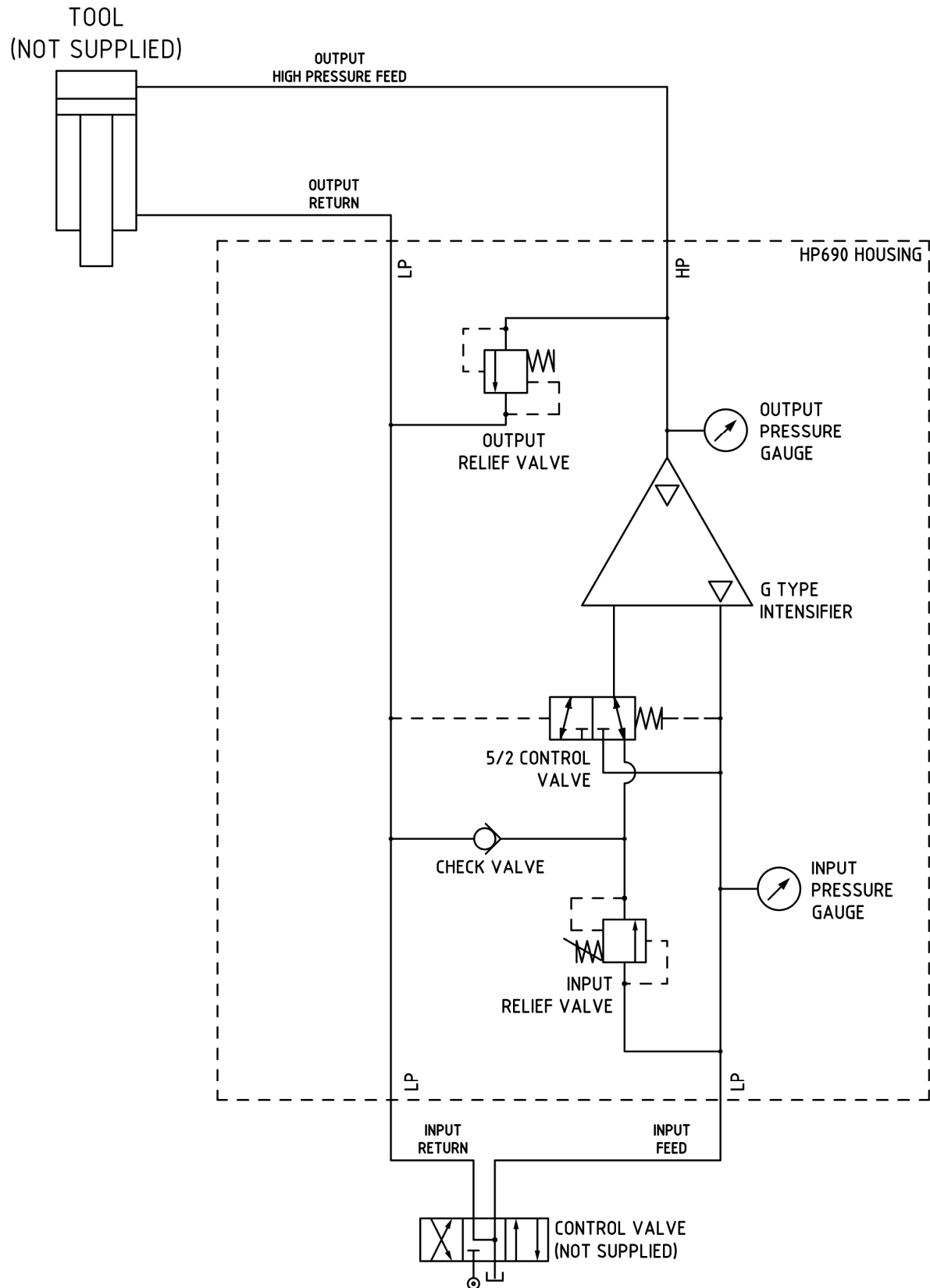


Figure 14 – Hydraulic schematic

## 10.2 IMPORTANT – Oil Cleanliness

The most important maintenance task that should be carried out is to ensure that the hydraulic fluid supply to the HP690 is kept clean as described and conforms to the minimum cleanliness levels as described in section 3.

**The use of contaminated fluid will reduce the life of this equipment or stop it from working altogether.**

## 10.3 Maintenance schedule

Most maintenance tasks can be carried out with standard tools.

Before carrying out any maintenance tasks ensure that the machine is isolated from the hydraulic supply. Remove all hoses before any maintenance is carried out.

The table below shows checks that should be carried out before use.

Item	Procedure
Check the correct function of the HP690, including pressure gauges.	As described in section 7.
Check all connections	Check that all connections are tight and that all fittings and hoses are rated to the correct working pressure.
Check oil condition	Check that the oil cleanliness meets the minimum requirements as stated in section 3.

Table 6 – Maintenance items

## 10.4 Recommended Spares

It is recommended that the customer keeps stock of the following components:

Part Number	Description	Qty
995163	Seal kit	1
791164	Input Pressure Gauge	1
791163	Output Pressure gauge	1
766086	Hydraulic fluid screen	2

Table 7 – Recommended spares

## 10.5 Replacing Parts

See drawings / parts list for details of the component parts.

Replacement parts must always be sourced from Allspeeds. The use of third party components will invalidate the warranty and may lead to system damage or injury.

### 10.5.1 Replace Pressure Gauge

If the pressure gauges are damaged during use, they must be replaced before the HP690 is used.

This procedure applies to both pressure gauges on the HP690.

**IMPORTANT** - Isolate the HP690 from the hydraulic supply and ensure that there is no pressure within the system before proceeding.

Remove the two off screws 31-75-0830

Slide the pressure gauge and mounting block assembly away from the body of the HP690

Remove the seal spigot assembly (701211) and retain.

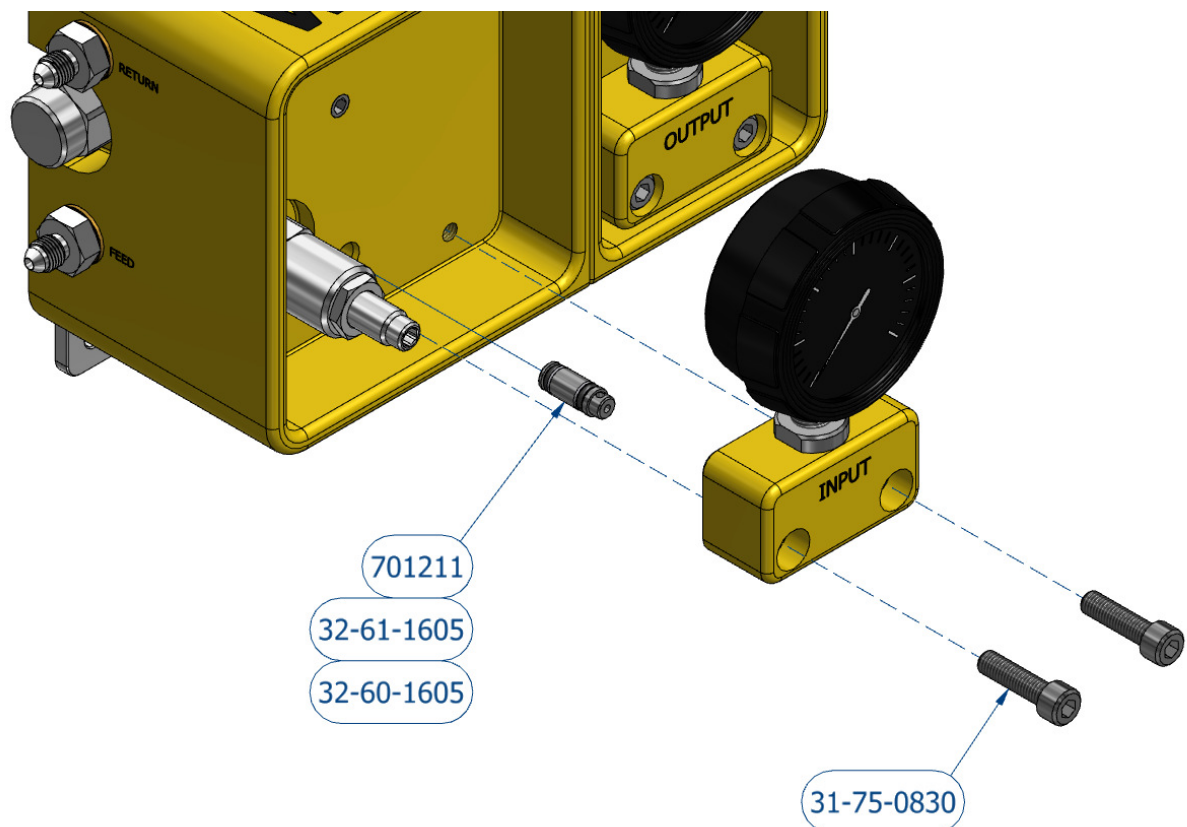


Figure 15 – Pressure gauge assembly removal

To remove the pressure gauge from the housing:

Whilst holding part 701210 with a spanner, unscrew the pressure gauge (791164 for the input stage, 791163 for the output stage)

Replacement is the reverse of disassembly. Ensure that a suitable thread sealing compound such as Loctite 567 is used on the thread of the pressure gauge and allowed to fully cure before use.

**Do not use PTFE tape.**

Check the condition of seals and backup rings as part numbers 32-61-1605 and 32-60-1605 before reassembly. Replace if required.

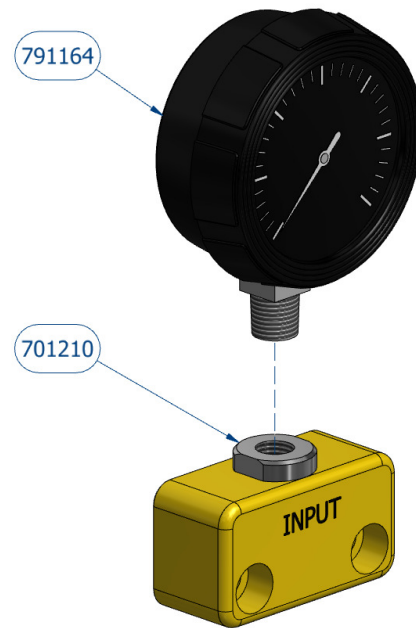


Figure 16 – Pressure gauge removal

### 10.5.2 Replace Minibooster™ and screens

**IMPORTANT** - Isolate the HP690 from the hydraulic supply and ensure that there is no pressure within the system before proceeding.

Before splitting the housing, loosen retaining cap (749057) by one turn.

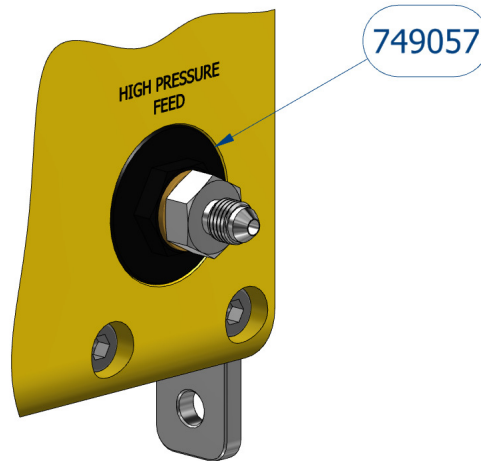


Figure 17 – Retaining cap

Remove the four screws 041860.

Separate the two halves of the HP690.

Retain dowels 027616, spigot 701212 and seals for reassembly.

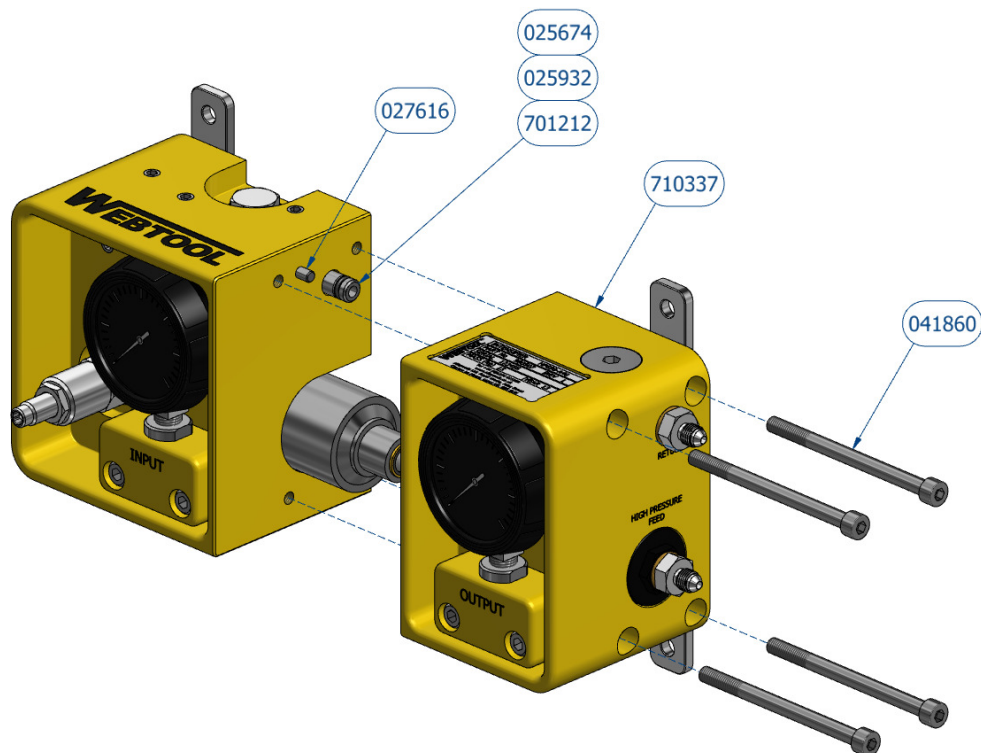


Figure 18 – Split the housing of the HP690

The exploded view of the Minibooster™ seal assembly is as shown below.

Please note that thread sealing compound should NOT be used on the threads of the 769012 and 769014 adaptors. These are sealed using bonded face seals (32-67-1201) and o-rings (025674) with anti-extrusion rings (025932).

Discard the existing screens (766086) and replace on reassembly.

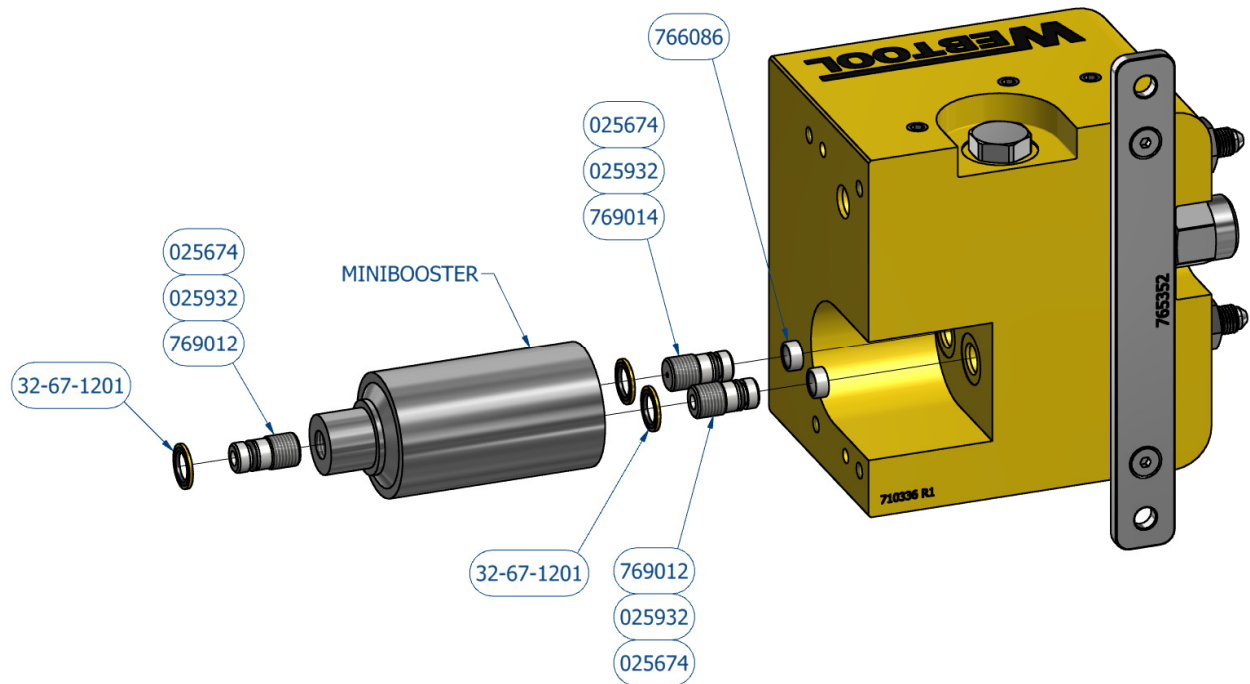


Figure 19 – Minibooster™ assembly

Check all seals before reassembly, and replace if necessary

Tighten the four screws (041860) before tightening the retaining cap 749057

## 11 Parts List

PART NUMBER	DESCRIPTION	QTY
020212	M12 LOCK NUT	1
027616	Ø6 X 16 DOWEL PIN	2
035075	M8 X 10 SKT SET SCREW - CUP POINT	2
035130	CSK SKT HEAD SCREW - M6 X 15	4
035153	M10 X 10 SKT SET SCREW - FLAT POINT	8
041413	HEX SKT HD CAP SCREW M6 X 12	2
041860	ISO 4762 - M8 x 110	4
701210	PRESSURE GAUGE ADAPTOR	2
701211	GAUGE BLOCK ADAPTOR	2
701212	BODY CONNECTOR	1
704013	1/4" BALL	2
709099	GAUGE BLOCK - INPUT	1
709100	GAUGE BLOCK - OUTPUT	1
710336	INTENSIFIER BODY - INPUT SIDE	1
710337	INTENSIFIER BODY - OUTPUT SIDE	1
749057	MINIBOOSTER RETAINING CAP	1
749060	CONTROL VALVE HOUSING	1
749061	CHECK VALVE HOUSING	1
749062	RELIEF VALVE BODY	1
749063	SPRING ADJUSTER	1
749064	RELIEF VALVE SPRING HOUSING	1
752579	NAME PLATE	1
765352	MOUNTING STRAP	2
766086	MICRO FILTER	2
766099	RELIEF VALVE PLUG	1
769012	INTENSIFIER CONNECTOR	2
769014	INTENSIFIER RESTRICTOR	1
791157	1/4" BSPP TO JIC 4 STRAIGHT ADAPTOR	4
791161	7/16" JIC BLANKING CAP	3
791163	PRESSURE GAUGE 15,000 PSI	1
791164	PRESSURE GAUGE 5,000 PSI	1
793085	SPOOL VALVE	1
793086	RELIEF VALVE	1
793087	NON RETURN VALVE	1
995163	SEAL KIT	1
1155008	RELIEF VALVE ASSEMBLY	1
31-47-0310	5/16" BALL	8
31-75-0830	M8 X 30 SKT HEAD CAP SCREW	4
VARIES	MINIBOOSTER INTENSIFIER	1

## **12 Trouble shooting**

### **12.1 Intensifier is not boosting pressure**

This can be caused by the following:

Input flow rate too low. Check that the input flow rate is within the parameters stated in section 2.1.

Minibooster™ has been affected by contaminated oil. Contact Allspeeds for replacement parts or repair.

### **12.2 Unit is getting hot**

Excessive operation of the input or output relief valves can cause the temperature of the oil to rise, leading to the HP690 feeling hot.

This can be caused by an input pressure that is too high, leading to the output pressure generated being over the recommended 690 bar (10,000 psi).

To solve this problem, either reduce the input pressure at source to ensure that the output pressure relief valve is not operated or run the unit for short periods of time with sufficient time allowed for cooling.

## **13 Decommissioning**

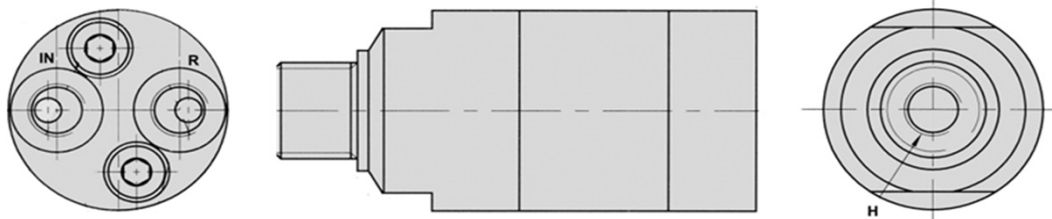
This unit can be disassembled for disposal. The majority of the components in the unit can be recycled (e.g. stainless steel and aluminium). Remaining components such as pressure gauges should be disposed of in accordance with local regulations.

Any oil that is drained from the system should be disposed of in accordance with local regulations.



## Appendix A – Minibooster Datasheet

## Instructions for Hydraulic Booster HC2W



### IN

<b>DK</b> Forskruning, Pumpetilslutning	1/4" BSPP	7/16-20 UNF
<b>UK</b> Screwed connection, Pump connection		
<b>DE</b> Verschraubung, Pumpenanschluss		
<b>FR</b> Raccordement, Raccordement de pompe		

### R

<b>DK</b> Forskruning, Pumpetilslutning	1/4" BSPP	7/16-20 UNF
<b>UK</b> Screwed connection, Pump connection		
<b>DE</b> Verschraubung, Pumpenanschluss		
<b>FR</b> Raccordement, Raccordement de pompe		

### H

<b>DK</b> Forskruning, Pumpetilslutning	1/4" BSPP	7/16-20 UNF
<b>UK</b> Screwed connection, Pump connection		
<b>DE</b> Verschraubung, Pumpenanschluss		
<b>FR</b> Raccordement, Raccordement de pompe		

Max. Tilspændingsmoment Max Anzugmoment	Max. Tightening torque Couple de serrage max	1/4" BSPP	7/16-20 UNF
<b>DK</b> Med stålskive		40 Nm	40 Nm
<b>UK</b> With steel washer			
<b>DE</b> Mit Stahlscheibe		29.5 ft-lbs	29.5 ft-lbs
<b>FR</b> Avec rondelle en acier			

<b>DK</b> Med aluminiumskive	30 Nm	30 Nm
<b>UK</b> With aluminium washer		
<b>DE</b> Mit Aluminiumscheibe		
<b>FR</b> Avec rondelle en aluminium		
	22.1 ft-lbs	22.1 ft-lbs

<b>DK</b> Med skærekant	40 Nm	40 Nm
<b>UK</b> With cutting edge		
<b>DE</b> Mit Dichtkante		
<b>FR</b> Avec rondelle en acier		
	29.5 ft-lbs	29.5 ft-lbs

<b>DK</b> Med o-ring	20 Nm	35 Nm
<b>UK</b> With o-ring		
<b>DE</b> Mit o-ring		
<b>FR</b> Avec Avec joint torique		
	14.8 ft-lbs	25.8 ft-lbs

i	Max. flow IN		Max. flow H		Max. pressure IN		Max. pressure H	
	l/min	gal/min	l/min	gal/min	bar	psi	bar	psi
1.2	8,0	2,1	1,2	0,3	200	2,900	240	3,480
1.5	8,0	2,1	1,0	0,3	200	2,900	300	4,350
2.0	8,0	2,1	0,8	0,2	200	2,900	400	5,800
2.8	8,0	2,1	0,6	0,2	200	2,900	560	8,120
3.2	15,0	4,0	2,5	0,7	200	2,900	640	9,280
4.0	14,0	3,7	2,0	0,5	200	2,900	800	11,600
5.0	14,0	3,7	1,6	0,4	160	2,300	800	11,600
6.6	13,0	3,4	1,3	0,3	120	1,740	800	11,600
9.0	13,0	3,4	0,9	0,2	90	1,305	800	11,600
13.0	12,0	3,2	0,6	0,2	62	900	800	11,600
20.0	12,0	3,2	0,3	0,1	40	580	800	11,600

### DK

HC2W kræver et pumpetryk på minimum 20 bar / 300 psi. Filtrering: Se side to. Komponenten må ikke tages i brug, før maskinen, hvori den monteres, overholder alle relevante bestemmelser i EU og EFTA.

### UK

The minimum inlet pressure required to operate the HC2W is 20 bar / 300 psi. Filtration: See page two. Do not put the component to work till the machine in which it is to be mounted complies with all relevant regulations and directives by the EU and EFTA.

### DE

Der HC2W funktioniert ab einem Eingangsdruck von 20 bar / 300 psi. Filtrierung: Siehe Seite zwei. Die Komponente nicht in Betrieb nehmen, bis die Maschine, in die sie eingebaut werden muss, alle relevanten Regulativen und Direktiven von der EU und EFTA erfüllt.

### FR

Le HC2W Fonctionne avec une pression minimale de 20 bar / 300 psi. Filtration: Voir la page deux. Avant de mettre en service le composant monté, la machine doit être conforme à toutes les réglementations et directives en vigueur dans l'UE et l'AELE.

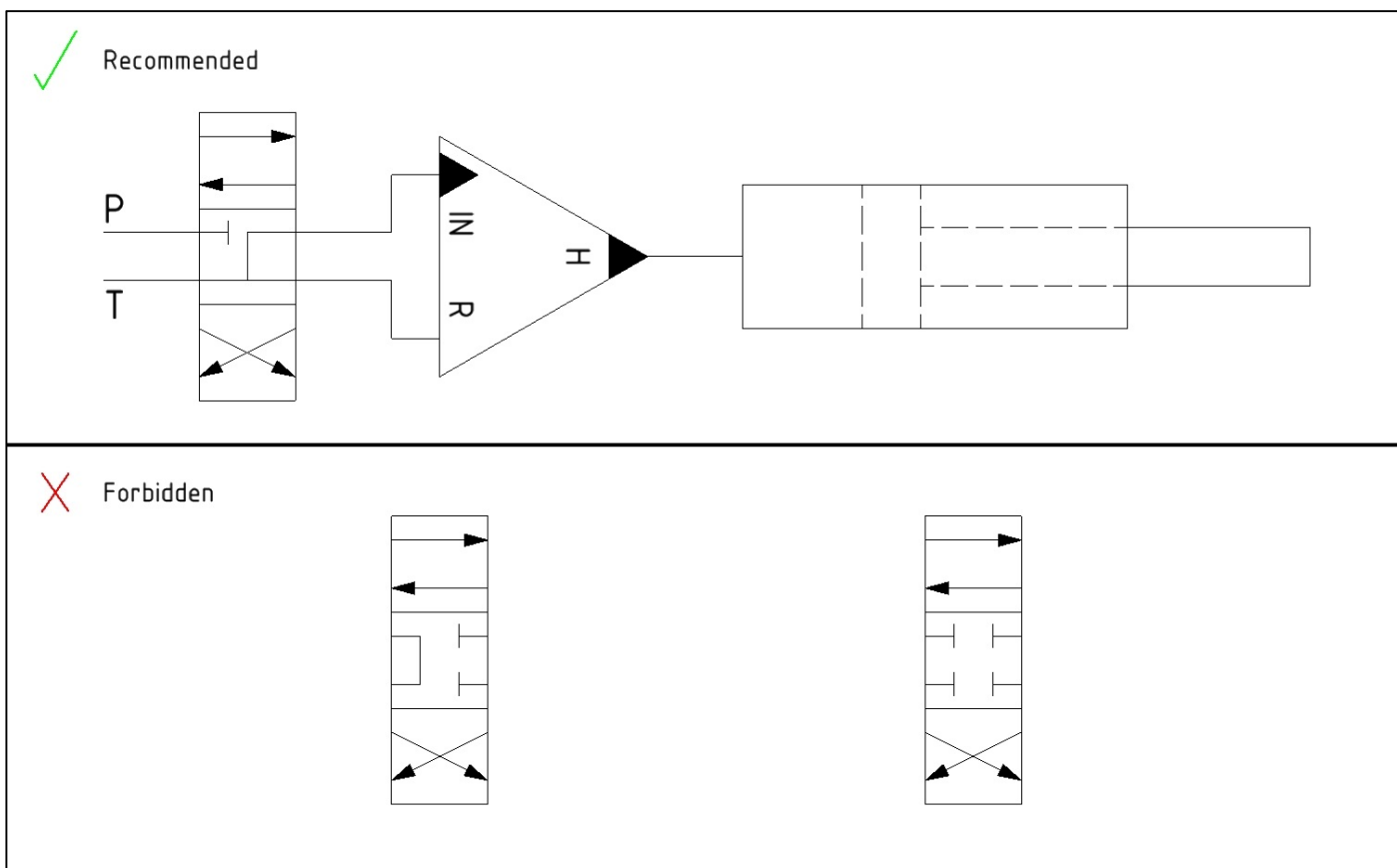
Info:

<http://www.miniBOOSTER.com>

## IMPORTANT: Closed Center Valves

It is strongly forbidden to install a closed center directional valve in line with the IN & R connections of the booster.

miniBOOSTER<sup>®</sup> uses check valves that are leakage proof down to a few drops per minute. Even with a small amount of leakage through the check valves, high pressure can build up over time on the IN and R connection (when in closed position) and cause failure of the booster.



## Filtration: According to ISO 4406

		0 to 140 bar 0 to 2000 psi		141 to 200 bar 2000 to 3000 psi		> 200 bar > 3000 psi	
Media		ISO Target Levels	Micron Ratings	ISO Target Levels	Micron Ratings	ISO Target Levels	Micron Ratings
Oil	> 5 cSt	19/17/14	10	18/16/13	5	17/15/12	3
Water	< 5 cSt	18/16/13	5	17/15/12	3	16/14/11	3
Water Glycol	< 5 cSt	18/16/13	5	17/15/12	3	16/14/11	3