Saritor
Self Propelled

Service Manual

Version 1.00
US - 02.2017

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Welcome Letter

Dear New HARDI® Owner,

Thank you for purchasing your new HARDI® product and welcome to the ever-increasing family of proud HARDI® owners.

HARDI® is the leading sprayer company in offering growers strong, reliable products made for the widest range of applications worldwide. Quality, reliability, and resale value make the HARDI® product line the preferred product line of customers both in North America as well as worldwide. Our guiding principle is to provide the highest level of customer satisfaction and long term value in the marketplace today. We have developed a very high level of customer loyalty in the marketplace which we are very proud of and strive every day to maintain and to continue to grow.

HARDI® is your specialist in spraying and we spend all of our time and keep all of our focus on spraying. We do not share our resources between other types of products or compromise on anything in providing the best quality sprayers to the market today. We can provide the latest in technology with our products if desired, or allow them to operate with the technology that you already use on other products in most cases. You get to decide that, and what best suits your needs. We feel that you, our customer, are the best suited to answer that question for your operation. Either way, you decide, and we will try and help make it happen for you.

Our broad spectrum of product offerings, from the ruggedly simple models we build to our highly sophisticated models, the built-in HARDI® strength and reliability ensures a low cost of ownership. HARDI® sprayers are all based on a functional design concept of being as simple to operate as possible and to meet our customers' requirements for all their application needs.

Please take the time to thoroughly read the Operator's Manual before using your equipment. You will find many helpful hints as well as important safety and operation information.

Some of the features on your HARDI® sprayer were suggested by growers. There is no substitute for "on farm" experience and we invite your comments and suggestions. If any portion of this instruction book remains unclear after reading it, contact your HARDI® dealer or service personnel for further explanation before using the equipment.

For Product, Service or Warranty Information please contact your local HARDI® dealer.

- Please use the HARDI® Customer Service number: 1-866-770-7063

- Or send your email to CUSTSERV@hardi-us.com

HARDI® NORTH AMERICA INC.

Visit us online at: www.hardi-us.com

1500 West 76th St.

Davenport, Iowa 52806

Phone: (563) 386-1730

Fax: (563) 386-1280

Sincerely,

Wayne Buchberger

President

Operator safety

Symbols

These symbols are used throughout this book to draw the reader's attention to certain points. This is the meaning of the four symbols.


This symbol means DANGER. Be very alert as your safety is at risk!


This symbol means WARNING. Be very aware as your safety may be at risk!


This symbol means ATTENTION. This guides you towards better, easier and safer use of your sprayer!


This symbol means NOTE.

Recommendations to users of treatment products

This sprayer has been designed and manufactured by HARDI to operate with treatment products that you select. For the proper functioning of the sprayer, we invite you to comply strictly to our recommendations, such as occasions in the Instructions of Use which is delivered to you at the time of the sale of the sprayer.

But, it is the sole responsibility of the user to you strictly comply with recommendations given by the manufacturers of the treatment products that you will use.

It is particularly strongly recommended that any user:

- Read the manufacturers labels of the treatment products uses carefully and to respect the instructions given therein (metering, personal protective equipment, etc…);
- Mix only the products, whose compatibility was expressly recognized by the manufacturer of phytosanitary products;
- Avoid incorporating air to fill the container for your sprayer to avoid the formation of foam and cause problems with overflow;
- Follow the precautions of use and the warnings indicated by the manufacturer of the plant protection product;
- In terms of storage of the processing products, keep them out of the reach of children and animals;
- Observe the precautions relating to the reprocessing of packaging in accordance with the recommendations of the manufacturers of phytosanitary products;
- Observe the areas not treated;
- Contact the manufacturer of the plant protection product (or his representative), in case of doubt or element not entered.

Before using the sprayer, read the following recommendations and the safety instructions:

- Read this instruction book carefully before using the equipment. It is equally important that other operators of this equipment also read this book.
- If any parts of this instruction book remain unclear after reading it, contact your retailer for further information before using the sprayer.
- Local legislation may require operators to have a certificate of competence in the use of the equipment. Respect the applicable local legislation.
- The driver's seat is the intended working place during operation.
- Wear protective clothing. Clothing may differ according to the plant protection chemicals used. Respect the applicable local legislation.
- After spraying, the operator should have a wash and change his clothes.
- Clean any equipment that may have become soiled.
- Do not eat, drink or smoke during the use and maintenance of your sprayer.
- In case of poisoning, immediately seek medical advice or call the emergency service (see instructions indicated on the packaging of the products used).

OPERATOR SAFETY

Filling and application

- No persons are allowed in the operational area of the sprayer.
- Take care not to harm people or surroundings when maneuvering the sprayer, especially when reversing.
- Slow down when driving on uneven terrain as the sprayer may become unbalanced and overturn.
- Keep children away from the sprayer.
- Do not attempt to enter the tank.
- Do not go under the machine unless it is secured. (The boom is secure when placed in the transport brackets).
- For further information, see the Spray Technique book.

Usage

This HARDI self-propelled sprayer is exclusively intended for use in farming work, (i.e. the application of plant protection chemicals and liquid fertilizers).
Any other use is considered contrary to normal usage and is therefore forbidden.

- Carry out a pressure test with clean water prior to filling with chemicals.


ATTENTION! Never dismantle a hose while the sprayer is in operation.


DANGER! Do not exceed the maximum recommended rotation speed of the pump.


ATTENTION! Rinse and wash the equipment after use and before servicing.


WARNING! Never service or repair the equipment while it is operating. Always replace all safety devices or shields immediately after servicing or repair.


ATTENTION! Disconnect the electrical power before servicing and de-pressurize the equipment after use and before servicing.


ATTENTION! If an arc welder is used and connected to any part of the sprayer, disconnect the power leads from the battery before welding. Remove all inflammable or explosive material from the welding area.


ATTENTION! The External Cleaning Device should not be used if important parts of the equipment have been damaged, including safety devices, high pressure hoses etc.


DANGER! Take all precautions to avoid the risks related to unintentional contact with overhead power lines. A sticker placed near the operator's seat warns of the risk of contact with overhead power lines.

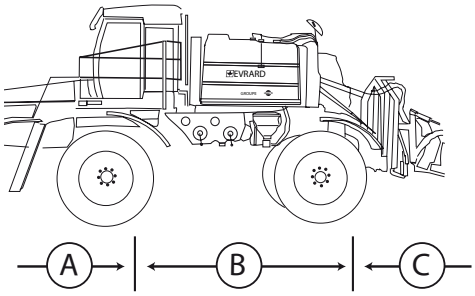
Operator's skill

The machine should be used and maintained by people who are aware of its special use and safety characteristics.
Before using your machine, familiarize yourself with all the commands. When working it will be too late to do so.
Ensure that you have the skills required for protecting crops and the environment, and for handling and spraying plant protection chemicals. For more information about personal and environmental protection, see the SPRAY TECHNIQUES book.

Definition of the working place

The following is considered as the working place:

A. Clean Zone	engine cabin access ladder and gangway operator's seat access to main tank
B. Work zone	liquid system valves filling with plant protection chemicals external connectors (filling - transfer)
C. Spraying zone	spraying boom and nozzles boom hydraulic controls



WARNING! Never leave the operator's seat when the machine is moving.

Responsibilities of the manufacturer and the user

- Comply with all recommendations for installation, carrying out adjustments, maintenance and repair contained in this instruction book.
- Use only original spare parts and accessories conforming to the manufacturer's recommendations.
- Do not modify or have your machine and its accessories modified by someone else (mechanical, electrical, hydraulic and pneumatic characteristics) and, more generally, the parts of the machine affecting user safety, without first requesting written agreement from the manufacturer.
- Failure to respect these rules may make your machine dangerous. In the event of damage or injury, HARDI shall not be held liable in any way.

Lights and working at night

If there is insufficient light for working at night, the spraying boom should be equipped with boom lights. For more information on this equipment, contact your HARDI retailer.

Driving on public roads

When driving on public roads where the highway code and any other regulations apply, these must be observed, particularly regarding mandatory equipment such as lights, indicators, hazard lights etc.

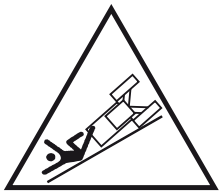
You should be aware of the vehicle's size and weight, particularly the overall width and height.

ATTENTION! In all circumstances, you should adapt to road driving, particularly by reducing your speed on curves, on meeting or being overtaking by another vehicle, and on the state of the road surface and how full the tank is.

OPERATOR SAFETY

Driving in fields

It is advisable to pay a lot of attention to the risks of overturning, especially in 4-wheel steering mode and when traveling at speeds of more than 9mph (15 km/hr).



ATTENTION! As a general rule:

- Adapt your speed and driving to suit the terrain you are driving on. Be aware and take care!
- In all circumstances and particularly on uneven and sloping terrain, drive the machine at a low speed, especially on curves, and avoid sudden changes of direction.
- Do not brake or start up suddenly when going up or down a slope, bearing in mind the variable volume of liquid in the sprayer tank.

WARNING! Boom maneuvers should be carried out with the machine stopped or in park and on flat ground. Ensure that there are no obstacles nearby (electricity lines, people, poles etc.).

Safety decals

When you purchased your sprayer the dealer would have informed you of safe operating procedures and areas of potential danger. The orange triangle decals on your sprayer will caution you in regards to hazards that may be encountered in their locality.

This manual contains explanations for the decals which are found on your sprayer.

Operator safety

Read and understand this source book in conjunction with your Operator's Manual before using the equipment. It is equally important that other operators of this equipment also read and understand this book. Local law may demand that the operator is certified to use spray equipment. Adhere to the law.

The following recommended precautions and safe operating practices, which should be adhered to regardless of the decals.

You must:

- Wear protective clothing.
- Rinse and wash equipment after use and before servicing.
- Never service or repair the equipment while it is operating.
- Replace all safety devices or shields immediately after servicing.
- Do not eat, drink or smoke while spraying or working with contaminated equipment.
- Wash and change clothes after spraying.
- Wash tools if they have become contaminated.
- In case of poisoning, immediately seek medical advice. Remember to identify chemicals used.
- Keep children away from the equipment.
- If any portion of this instruction book remains unclear after reading it, contact your HARDI dealer for further explanation before using the equipment.
- Be careful not to hit people or surroundings when using the sprayer, especially when reversing.

Personal safety equipment

Depending on which type of chemical is used, some or all of the following protective clothing and equipment will be required:

1. Ear muffs
2. Safety goggles or face shield
3. Respirator
4. Chemical resistant coveralls
5. Chemical resistant gloves
6. Chemical resistant boots

Contaminated clothing

Contaminated clothing should be removed and safely stored and laundered. Do not contaminate the inside of the tractor cab with soiled clothing.

Illustrations, technical information and data in this book are to the best of our belief correct at the time of printing.

As it is, HARDI always strives to improve our products. HARDI reserves the right to make changes in design, features, accessories, specifications and maintenance instructions at any time and without notice.

HARDI is without any obligation in relation to implements purchased before or after such changes.

HARDI can not undertake any responsibility for possible omissions or inaccuracies in this publication, although everything possible has been done to make it complete and correct

OPERATOR SAFETY

Explanation of symbols on safety decals

Mandatory

Read manual

- Consult Safety Manual, located inside the black manual canister or in manual slot in the cab.

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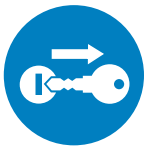
Remove key

- Used in conjunction with 'Read Manual' symbol to warn that manual must be read before operating the sprayer.



Personal protective equipment

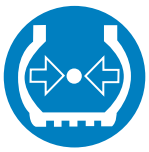
- Overalls, face screen, mask and gloves must be worn to operate in this area.

Maintenance

- A regular check and maintenance schedule is needed to keep this part operating safely.
- Consult Operator's Manual for maintenance schedule.

Tire pressure check

- A regular check and maintenance schedule is needed to keep tires operating safely.
- Consult Operator's Manual for recommended pressure levels



Prohibited

Speed limit

- Maximum speed limit while operating the sprayer.
- Extra care must be taken on hills and on cornering.

No passengers on sprayer

- Do not climb onto tank or into it.
- Danger of injury or death.

Do not drink

- Hand wash tank water is only for personal hygiene use.

Do not overfill tank

- Risk of contamination
- Risk of tank damage

Overhead wires

- Take care operating near wires to prevent entanglement or electrocution.

Fluids under pressure

- Wear glove and face screen

Chemical hazards

- Read manufacturers labels.
- Wear personal protective equipment:, including face screen and gloves when handling these.
- Provide adequate ventilation.

Danger overhead

- Do not enter paralift area or stand under booms
- Take care when opening lids - loose items may be present in them

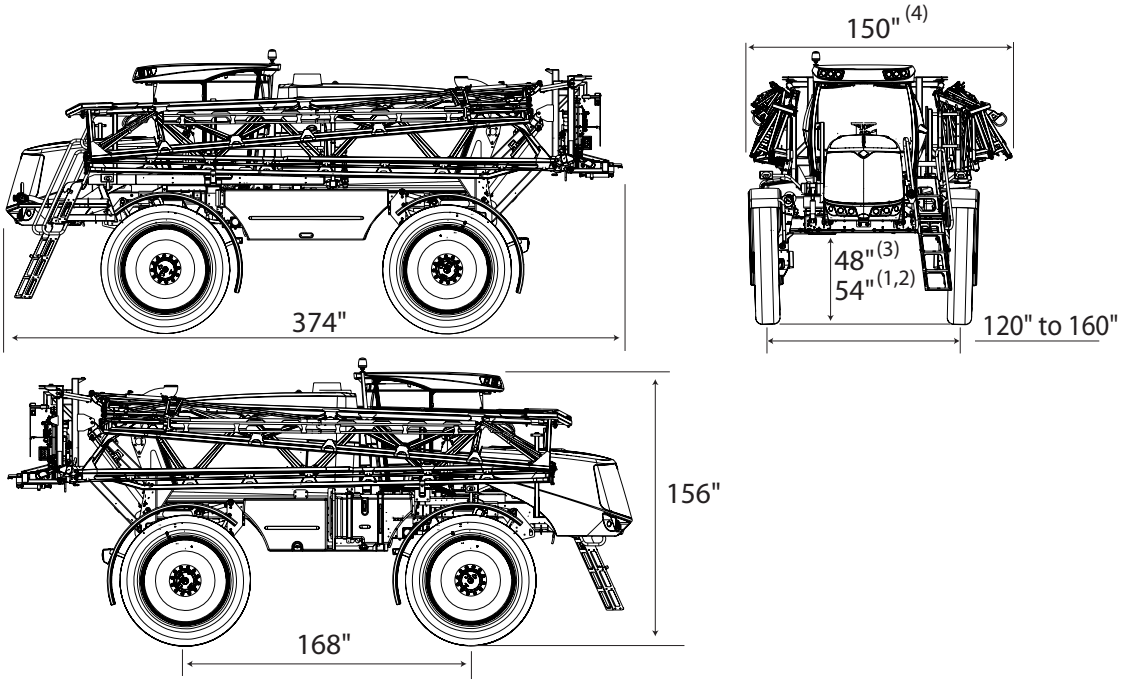
Danger toxic fumes may be present

- Take care when opening lids - fumes may be present
- Do not inhale tank fumes

Danger of toppling over on hillside or slope

- Drive with extreme caution
- Widen axle track width to minimize risk

OVERALL DIMENSIONS



(1) Wheels set 380/90 R50
(2) Wheels set 480/80 R50
(3) Wheels set 520/85 R46
(4) Transport 138 in.

The unit of measure Conversion

Units	US Units	Legal Units	Conversion legal units	Units Conversion US
Temperature	°F (Fahrenheit)	°C (degrees Celsius)	°F = 9/5 C + 32	°C = 5/9 (F-32)
Distance	Mid (mile)	Km (mile)	1 Mi = 1.60934 km	1 Km = 0,621 mid
Pressure	PSI	bar	1 psi = 0.06893 bar	1 Bar = 14.51 psi
Volume	Gal (US gallon)	L (liters)	1 Gal = 3,785 l	1L = 0,264 gal
Rotation speed (RPM)	rpm	RPM (revolutions per minute)	1 RPM = 1 rpm	1 RPM = 1 rpm
Flow	Gph (gallon per hour)	L/h (liter per hour)	1 Gph = 226.8 is shown from l/h	1 L/h = 0.0044 gph

Tire pressures

Sizes	Load index	Models	Inflation pressure PSI (bar)
380/90R50	169A8	Ultra Sprayer (Good Year)	70 (4.8)
480/80R50	169A8	?	58 (4.0)
520/85R46	169A8	?)	46 (3.2)

TECHNICAL SPECIFICATIONS

Lubrication

General information

Always store lubricants in a clean, dry and cool place - preferably at a constant temperature. Keep oil filling jugs, hoppers and grease guns clean, and clean the lubricating points thoroughly before lubricating. Avoid skin contact with oil products for longer periods. Always follow the recommendations concerning quantity. If no quantity is indicated, lubricate up to the required level, unless otherwise indicated.

Table of recommended lubricants

Components	Capacity		Recommended lubricants - TOTAL
	Housing (1)	With filter(1)	
Engine Cummins QSB 6.7	**19 quarts (18 liters)**	**19.5 quarts (18.5 liters)**	**CHEVRON DELO 400 LE SAE 15W-40** (For technical characteristics see section "Engine Lubrication Oil" page 21
Hydraulic Transmission and Hydraulic system	**26 gallons (100 liters)**		**CHEVRON RANDO HDZ ISO 46** (For technical characteristics see section "Transmission Hydraulic Oil" page 22
Motor-reducers of wheel	**3.2 quarts (3 liters)**		**CHEVRON DELO SYN-GEAR HD SAE 75W-90**
Coolant	**26.4 quarts (25 liters)**		**CHEVRON DELO EXTENDED LIFE (227811)** PREDILUTED 50/50 COOLANT/ANTIFREEZE (For technical characteristics see section "Engine Coolant" page 23
Anti-freeze oil for pneumatic circuit	**0,06**		**PNEUMA SY** (For technical characteristics see section "Antifreeze Oil for Pneumatic System" page 24
General lubrication	**--**		**UNIVERSAL LITHIUM GREASE** SHELL RETINAX EP2

The data values in the table above are indicative to titles. Only the level indicated by the gauge should be taken into consideration.

See Engine chapter for frequency of maintenance

Service intervals

	Daily	x1 10	150	250	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
				Interval +500 hours										
Hydraulic														
Hydraulic oil level	●													
Hydraulic oil			❑		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Check hydraulic filters clogged				●	●	●	●	●		●	●		●	●
Hydraulic filters			❑		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Drain the hydraulic tank			❑							❑				
Wheel Drive (gearbox)														
Oil level				● (Every 150 hours)										
Oil replacement				❑ (Every 500 hours)										
Tightening screws	●		●							●				
Cabin														
Combined filter (category 4)				❑ (Every 250 hours)										
Air conditioning gas				❑ (Every 5 years)										
Clean air conditioning condenser			●		●	●	●	●	●	●	●	●	●	●
Air conditioning compressor belt			●		●	●	●	●	●	●	●	●	●	●
Engine[1]														
Clean cooler	●													
Check oil level	●													
Check coolant level	●		●	●	●	●	●	●	●	●	●	●	●	●
Replace engine coolant				❑ (Every 2 years)										
Clean air filter	●													
Replace air filter						❑		❑		❑		❑		❑
Replace safety air filter						❑		❑		❑		❑		❑
Drain lubricating oil				❑ (Every 250 hours or 6 months) 2										
Empty water fuel prefilter														
Replace fuel prefilter					❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Replace fuel filter					❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Filling the fuel tank	●													
Clean fuel tank									❑					❑
Compressed air tank	●													
Compressed air filter and lubricator			●											
Compressed air pressure				●	●	●	●	●	●	●	●	●	●	●
Inspect V-belts roller				● (Every 2 years)										
Battery (maintenance + terminals)					●	●	●	●	●	●	●	●	●	●
Chassis and booms			●											
Tighten lug nuts		●		●										
Lubricate chassis and axles				●										
Check inflation pressure				●										
Inspect tires				●										
Dynamic brake accumulator				● (5 years)										
Spraying														
Check the boom		●		●										
Inspect spraying circuits			●	●	●	●	●	●	●	●	●	●	●	●
Lubricate 464 diaphragms pump				●										
Ace Centrifugal Pump	●			● (Weekly)						❑ (Season end)				
Inspect line filters	●													
Remove and inspect the pressure gauge				●	●	●	●	●	●	●	●	●	●	●
Check the compressed air pressure				●	●	●	●	●	●	●	●	●	●	●
	Daily	10	150	250	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
		x1		Interval +500 hours										

● Check ❑ Replacement (1) Refer to Operation manual (bulletin 4021531)

Engine Lubrication Oil

RUBIA WORKS 1000 15W-40

Very high performance specific multigrade lubricant dedicated to aspirated and turbocharged engines of Earth Moving or Construction machinery from worldwide origins.

USES

« Public works » segment

All engines conform to TIER 1, TIER 2 and TIER 3 standards

- Particularly dedicated to the lubrication, throughout the year of engines used in Earth Moving activities like quarries, constructions, minings, etc...
- More generally, is recommanded for engines working during long full load periods or under repetitive speeding up and idle phases, with dust and warm.
- Specially recommanded for recent technology engines meeting the last EURO Phase IIIa or US EPA TIER 3 pollution standards.
- Specially developped for Japanese but also for American and European engines.

PERFORMANCES

Classifications

D033TOL601 DH-1

JASO	:	DH-1 (Approved N° D033TOL601)
ACEA	:	E7 (E5)
API	:	CI-4 / CH-4 / CF / SL

OEMs approvals

MERCEDES-BENZ	:	MB-Approval 228.3
DEUTZ	:	DQC III-05
MAN	:	M 3275-1
MTU	:	Category 2
CUMMINS	:	CES 20078 / 20077 / 20076
VOLVO	:	VDS-3
RENAULT	:	RLD-2

Conform to the specifications

CATERPILLAR	:	ECF-2 / ECF-1a
KOMATSU	:	KES 07-851-1

Suitable in engines

HITACHI, ISUZU, MITSUBISHI, DEERE, PERKINS, CASE NEW-HOLLAND LIEBHERR, JCB, KUBOTA, etc…

CUSTOMER ADVANTAGES

Total security

Long drain interval

Simplification of the engines lubrication

- High thermal stability ensuring a very good lubrication of hot engine pieces, especially during severe and long working periods.
- Reinforced dispersivity, detergency and anti-wear powers for resisting against all attacks occurring to the engine during a long oil drain interval : dust, soots, water, gazole, combustion acid, etc…
- Suitable in all engine brands and types of old or recent technology

CHARACTERISTICS

RUBIA WORKS 1000	Unit	15W-40
Kinematic Viscosity at 40 °C	mm^2/s (cSt)	103
Kinematic Viscosity at 100 °C	mm^2/s (cSt)	14.0
Viscosity Index		141
TBN	mg KOH/g	11.0

The typical characteristics mentioned represent mean values

TOTAL LUBRIFIANTS
562 Avenue du Parc de l'Île
92029 NANTERRE
France

RUBIA WORKS 1000 15W-40
Sheet updated 01/2013

Transmission Hydraulic Oil

EQUIVIS ZS

Lubrication

High viscosity index anti-wear hydraulic oils.

APPLICATIONS

Hydraulic systems

- **EQUIVIS ZS** range is recommended for all kind of hydraulic systems operating under high pressure (limit as indicated by the pump manufacturer) and high temperature.
- Lubricants especially suitable for hydraulic systems working under extreme temperature variations and equipment operating outside : easy start up at low temperature and regular operating in all seasons : civil engineering, agriculture, marine, transport and other industrial applications.

SPECIFICATIONS

International specifications

- AFNOR NF E 48-603 HV
- ISO 6743/4 HV
- DIN 51524 P3 HVLP
- VICKERS M-2950S, -I-286

ADVANTAGES

Long equipment life time
High operating reliability

- Very high viscosity index
- Good shear stability.
- Superior thermal stability avoiding the formation of sludge even at high temperature.
- Very good oxidation stability ensuring a long service life of the fluid.
- High protection against wear insuring maximum equipment life.
- Excellent hydrolytic stability avoiding filter blocking.
- Remarkable filterability even in the presence of water.
- Excellent protection against rust and corrosion.
- Good anti-foam and air release properties by using **silicon free** components.
- Very low pour point.
- Good demulsibility ensuring rapid water separation.

TYPICAL CHARACTERISTICS	METHODS	UNITS	EQUIVIS ZS					
			15	22	32	46	68	100
Appearance	Internal	-	Clear liquid					
Density at 15°C	ISO 3675	kg/m^3	858	861	870	874	882	885
Viscosity at 40°C	ISO 3104	mm^2/s	15	22	32	46	68	100
Viscosity at 100°C	ISO 3104	mm^2/s	3.7	5.1	6.5	8.4	11.2	15.6
Viscosity index	ISO 2909	-	151	164	160	161	161	165
Cleveland flash point	ISO 2592	°C	174	202	208	215	220	230
Pour point	ISO 3016	°C	- 42	- 42	- 39	- 39	- 36	- 36
FZG (A/8, 3/90) - fail stage	DIN 51354	palier	-	-	10	11	11	-
Filterability index (IF)	NF E 48-690	-	1.05	1.02	1.09	1.02	1.09	1.05
Shear resistance 250 cycles Viscosity loss @ 40°C	DIN 51382	%	-	-	3	5	8	-

Above characteristics are mean values given as an information.

TOTAL LUBRIFIANTS
Industrie & Spécialités
25-07-2012 (supersedes 01-02-2012)
EQUIVIS ZS
1/1

Engine Coolant

COOLELF AUTO SUPRA -37°C

Ready-to-use coolant • O.A.T.

DESCRIPTION

COOLELF AUTO SUPRA -37°C is the premium product of our cooling liquid range.

COOLELF AUTO SUPRA -37°C is a «**very long life**» coolant based on monoethylene glycol and **organic inhibitors of corrosion**.

COOLELF AUTO SUPRA -37°C is a cooling liquid that can be used in all cooling systems of combustion engines in cars, vans, trucks, buses, constructing machines and agricultural tractors.

COOLELF AUTO SUPRA -37°C contains no silicates, phosphates, chromates, nitrites or boron.

SPECIFICATIONS

COOLELF AUTO SUPRA -37°C meets the ***international specifications*** for antifreezes:

- AFNOR NFR 15-601
- ASTM D3306
- ASTM D4656
- ASTM D4985
- ASTM D6210
- BS 6580
- JASO M325
- JIS K2234
- SAE J1034
- NATO S-759

COOLELF AUTO SUPRA -37°C is ***officially approved*** by the following manufacturers:

- VW SEAT AUDI SKODA PORSCHE : VW TL 774 D/F/G (G12/G12+/G12++)
- DAIMLER MB 326.3
- FORD WSS-M97B44
- MAZDA MEZ MN 121 D
- JAGUAR LAND-ROVER STJLR 651.5003
- MAN 324 Typ SNF
- DEUTZ DQC CB-14
- GM 6277M
- GMW 3420
- GE Jenbacher TA 1000-0201
- MWM 2091/11
- CAT 2091/11
- CUMMINS IS series u N14
- KOMATSU 07 892 (2009)
- LIEBHERR MD1-36-130
- MTU MTL 5048
- PACCAR DAF 74002
- YANMAR

COOLELF AUTO SUPRA -37°C ***meets the requirements*** of:

- RENAULT 41-01-001/ S Type D
- SAAB
- LEYLAND TRUCKS
- SCANIA
- WARTSILLA 32-9011

CHARACTERISTICS

COLOUR	-	PINK TO FLUORESCENT ORANGE
DENSITY AT 15 °C	ASTM D1122	1.068
PH	ASTM D1287	8.4
ALKALINITY RESERVE (PH 3.5)	ASTM D1287	2.8ML HCl 0.1N
TEMPERATURE AT WHICH THE FIRST ICE CRYSTALS OCCUR	ASTM D1177	-38°C
BOILING TEMPERATURE	ASTM D1120	108°C

The typical characteristics mentioned represent mean values

TOTAL LUBRIFIANTS
Immeuble Spazio
562, avenue du Parc de l'île
92029 Nanterre cedex
France

COOLELF AUTO SUPRA -37°C
Sheet updated: 11/15

afaq SO 9001 Qualité NOR CERTIFICATION

This coolant used in accordance with our recommendations and for the application for which it is intended does not represent a special hazard.
A safety data file conforming to the requirements of current EC legislation is available from your local trade consultant.

Antifreeze Oil for Pneumatic System

PNEUMA SY

Pneumatic tools

Anti-freeze oil for pneumatic tools.

APPLICATIONS

Pneumatic tools

- Percussion air tools, all sound proof pneumatic tools.
- Non miscible with conventionnal mineral oils.

ADVANTAGES

Long lasting equipment

- High impact strenght due to the extreme pressure additivation preventing the equipment wear.
- Water repellent.
- Antirust.

Allows the soft running of the equipment

- Prevents the ice build up at air tool exhaust.
- Low pour point.

TYPICAL CHARACTERISTICS	METHODS	UNITS	PNEUMA SY
Density at 15°C	ISO 3675	kg/m^3	1090
Viscosity at 40°C	ISO 3104	mm^2/s	17
Viscosity at 0°C	ISO 3104	mm^2/s	88
Pour point	ISO 3016	°C	< - 40
pH		-	8,2

Above characteristics are mean values given as an information.

TOTAL LUBRIFIANTS
Industrie & Spécialités
13 december 2002 (supersedes 4 october 2002)
PNEUMA SY
1/1

Wheel Drive Gearbox lubrication

The motor and the gearbox have separate lubrication. The gearbox is lubricated by oil splashing. The recommended oil type has to be

EP characteristics according to **MIL-L-2105 C & API GL5**

For heavy duty working conditions the recommended oil is **SAE 85W/140** or **SAE 75W/140**

During operation the oil temperature must not exceed 85-60 °C intermittent.

Use only synthetic oils with PAO base if not otherwise specified in the order. Do not mix together oils of different brands or characteristics. Recommended lubricant see "Wheel Drive Gearbox lubrication" page 25

RUBIA WORKS 1000 15W-40

TOTAL

Very high performance specific multigrade lubricant dedicated to aspirated and turbocharged engines of Earth Moving or Construction machinery from worldwide origins.

USES

« Public works » segment

All engines conform to TIER 1, TIER 2 and TIER 3 standards

- Particularily dedicated to the lubrication, throughout the year of engines used in Earth Moving activities like quarries, constructions, minings, etc...
- More generally, is recommanded for engines working during long full load periods or under repetitive speeding up and idle phases, with dust and warm.
- Specially recommanded for recent technology engines meeting the last EURO Phase IIIa or US EPA TIER 3 pollution standards.
- Specially developped for Japanese but also for American and European engines.

PERFORMANCES

Classifications

D033TOL601 DH-1

OEMs approvals

JASO	:	DH-1 (Approved N° D033TOL601)
ACEA	:	E7 (E5)
API	:	CI-4 / CH-4 / CF / SL
MERCEDES-BENZ	:	MB-Approval 228.3
DEUTZ	:	DQC III-05
MAN	:	M 3275-1
MTU	:	Category 2
CUMMINS	:	CES 20078 / 20077 / 20076
VOLVO	:	VDS-3
RENAULT	:	RLD-2

Conform to the specifications

CATERPILLAR	:	ECF-2 / ECF-1a
KOMATSU	:	KES 07-851-1

Suitable in engines

HITACHI, ISUZU, MITSUBISHI, DEERE, PERKINS, CASE NEW-HOLLAND LIEBHERR, JCB, KUBOTA, etc…

CUSTOMER ADVANTAGES

Total security

Long drain interval

Simplification of the engines lubrication

- High thermal stability ensuring a very good lubrication of hot engine pieces, especially during severe and long working periods.
- Reinforced dispersivity, detergency and anti-wear powers for resisting against all attacks occurring to the engine during a long oil drain interval : dust, soots, water, gazole, combustion acid, etc…
- Suitable in all engine brands and types of old or recent technology

CHARACTERISTICS

RUBIA WORKS 1000	Unit	15W-40
Kinematic Viscosity at 40 °C	mm^2/s (cSt)	103
Kinematic Viscosity at 100 °C	mm^2/s (cSt)	14.0
Viscosity Index		141
TBN	mg KOH/g	11.0

The typical characteristics mentioned represent mean values

TOTAL LUBRIFIANTS
562 Avenue du Parc de l'Île
92029 NANTERRE
France

RUBIA WORKS 1000 15W-40
Sheet updated 01/2013

AFAQ ISO 9001

Table of the other common brands of lubricant and the types recommended are shown

			Minerali/Minerals		Sintetici/Synthetics	
			-20°C / +30°C (SAE 80W/90)	+10°C / +45°C (SAE 85W/140)	-20°C / +30°C (SAE 75W90)	+10°C / +45°C (SAE 80W140)
	SHELL	SPIRAX S2 A 80W-90 (SPIRAX A 80W90)	●			
		SPIRAX S2 A 85W-140 (SPIRAX A 85W140)		●		
		SPIRAX S5 ATE 75W-90 (TRANSAXLE 75W90)			●	
		SPIRAX S6 AXME 75W-90 (SPIRAX ASX 75W90)			●	
		SPIRAX S 75W140				●
		SPIRAX S 80W140				●
	AGIP	ROTRA MP 80W90	●			
		ROTRA MP 85W140		●		
		GEAR SYNTH 75W90			●	
	API	EP SAE 80W90	●			
		EP SAE 85W140		●		
		EP SINT 75W90			●	
	ARAL	EP PLUS 80W90	●			
		HYP 85W140		●		
		HYP SYNTH 75W90			●	
	BP	ENERGEAR HYPO 80W/90	●			
		ENERGEAR HYPO 85W140		●		
		ENERGEAR SHX-M 75W90			●	
		ENERGEAR SHX-S 75W140				●
	CASTROL	EPX 80W/90	●			
		EPX 85W140		●		
		SAF-XO			●	
		MTX FULL SYNTHETIC				●
		SAF-X 75W140				●
	CEPSA	TRANSMISSIONES EP 80W90	●			
		TRANSMISSIONES EP 85W140		●		
		TRANSMISSIONES EP FE+LD 75W90			●	
		TRANSMISSIONES EP FE+LD 75W140				●
	CHEVRON TEXACO	DELO GEAR LUBRICANT EDI 80W90	●			
		DELO GEAR LUBRICANT EDI 85W140		●		
		TEGRA SYNTHETIC GEAR LUBRICANT 75W90			●	
		TEGRA SYNTHETIC GEAR LUBRICANT 80W140				●
	ELF	TRANSELF TYPE B 80W/90	●			
		TRANSELF TYPE B 85W/140		●		
		TRANSELF SYNTH ESE FE 75W90			●	
		TRANSELF SYNTH ESE FE 75W140				●
	ERG	GEAR EP 80W/90	●			
		GEAR EP 85W/140		●		
		GEAR EPS 75W90			●	
	ESSO	GEAR OIL GX 80W90	●			
		GEAR OIL GX 85W140		●		
		GEAR OIL TDL 75W90			●	
	FUCHS	TITAN SUPER GEAR 80W90	●			
		TITAN SUPER GEAR 85W140		●		
		TITAN GYTRAC HSY 75W90			●	
		TITAN SINTOPOID 80W140				●
	I.P.	PONTIAX HD 80W90	●			
		PONTIAX HD 85W140		●		
		PONTIAX HDS 75W90			●	
	MOBIL	MOBILUBE HD 80W90	●			
		MOBILUBE HD 85W140		●		
		MOBILUBE 1 SHC 75W90			●	
	PAKELO	GLOBAL GEAR SA 80W90	●			
		GEAR OIL EP GL-5 80W90	●			
		GLOBAL GEAR SA 85W140		●		
		GEAR OIL EP GL-5 85W140		●		
		GLOBAL MULTIGEAR TS 75W90			●	
		GLOBAL TRANSMISSION TS 80W140				●
	Q8	GEAR OIL XG 80W90	●			
		T 55 85W 90	●			
		T 55 85W140		●		
		T 65			●	
	TAMOIL	TAMGEAR MP LUBRICANT 80W90	●			
		TAMGEAR MP LUBRICANT 85W140		●		
		TAMGEAR PERFORMANCE 75W90			●	
	TEXACO	GEARTEX EP-C 80W90	●			
		MULTIGEAR 80W90	●			
		GEARTEX EP-C 85W140		●		
		GEARTEX S5 75W90			●	
		MULTIGEAR S 75W90			●	
	TOTAL	EP-B 80W90	●			
		TRANSMISSION TM 80W90	●			
		TRANSMISSION TM 85W140		●		
		TRANSMISSION SYN FE 75W90			●	
		TRANSMISSION SYN FE 75W140				●

Air conditioning

Gas: **R134a**

Pressure: **21.75** psi - (**1.5** bar).

Identification plate

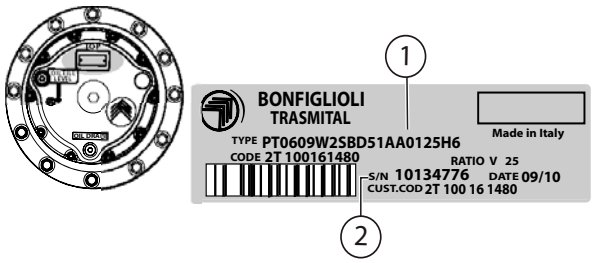
The identification data of the unit is shown on a name plate attached to it.

The plate must not be removed or damaged during the life of the product.

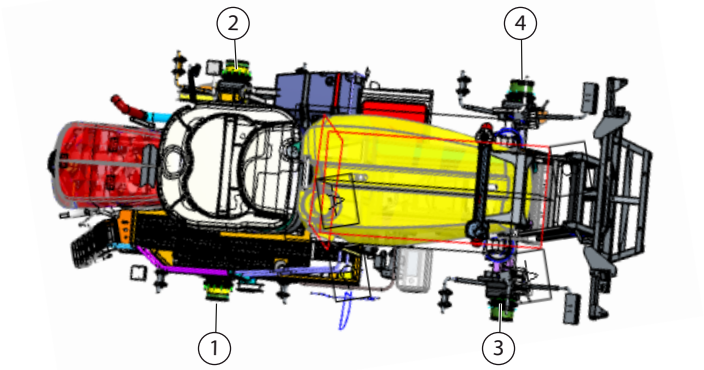
The following illustration shows how the data is set out:

1. Product Type
2. Serial Number

For all inquiries regarding general information on the product, spare parts, assistance etc, always give the identification data stamped on the ID plate.



Installation Diagram



Pos	Gear box P/N	Dynamic brake
1-2 - Front	28011101	**YES**

Pos	Gear box P/N	Dynamic brake	SARITOR S/N
3-4 - Rear	28008001	**NO**	Until 5**5944**
	28011101	**YES**	From **55951**

Service Intervals

Oil level	Every **150** hours
Oil replacement	Every **500** hours
Tightening screws	After **150** hours then every **3000** hours

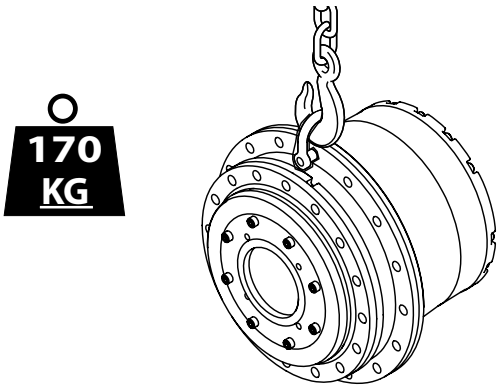
TRANSMISSION - GEARBOX

Lifting and handling

If the handling occurs when the product is still packaged, simply follow the instructions given on the packaging and/or use normal hoisting means.

Considering that the size and form of the product does not allow manual shifting, in particular handling, (e.g. installation) it is necessary to use accessories that guarantee human safety and which also avoid damages to the product.

Handling should be undertaken with maximum caution to avoid impacts.



Storage

In the storage process of the product follow the safety measures given below.

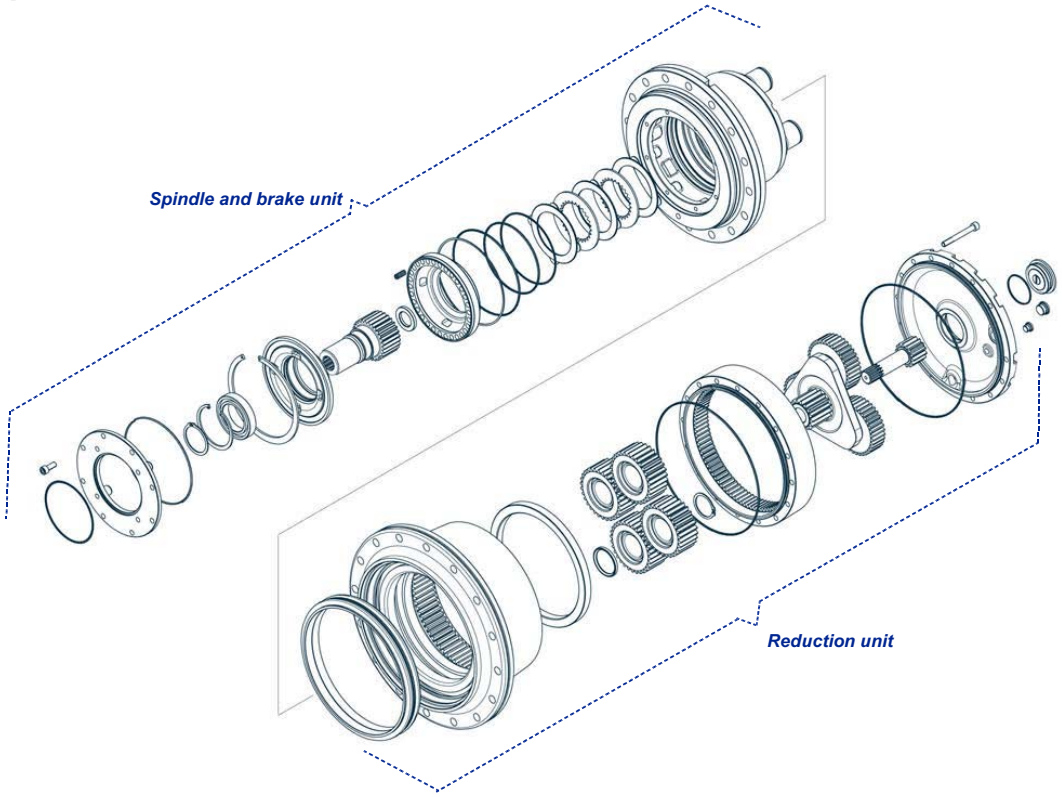
- Avoid environments with excessive humidity or exposure to changing weather conditions, and make sure that open areas are excluded.
- Make sure that the product does not lie directly on the ground.
- Make sure that the product is placed on a stable base thereby avoiding the product moving about unexpectedly.
- Stack the packaged product (if allowed) following the indications given on the packaging itself.
- For storage periods of over 60 days, all machined surfaces such as flanges, shafts and couplings must be protected with a suitable anti-oxidation product (SHELL ENSIS FLUID SDC or equivalent product).

For storing periods that go beyond 6 months, check and consult the following procedures.

- Cover outer machined parts and mating parts with grease to avoid oxidation.
- Fill the gearboxes completely with lubricating oil.

Before use, the gearboxes should be filled with the proper amount of lubricant of the recommended type.

Product description



The BONFIGLIOLI TRASMITAL gearboxes, of the series described in this manual, are designed and built for applications such as track drive for crawled machines equipped with an open loop hydraulic circuit.

The unit includes a planetary gearbox, 2 stages, rotating housing type.

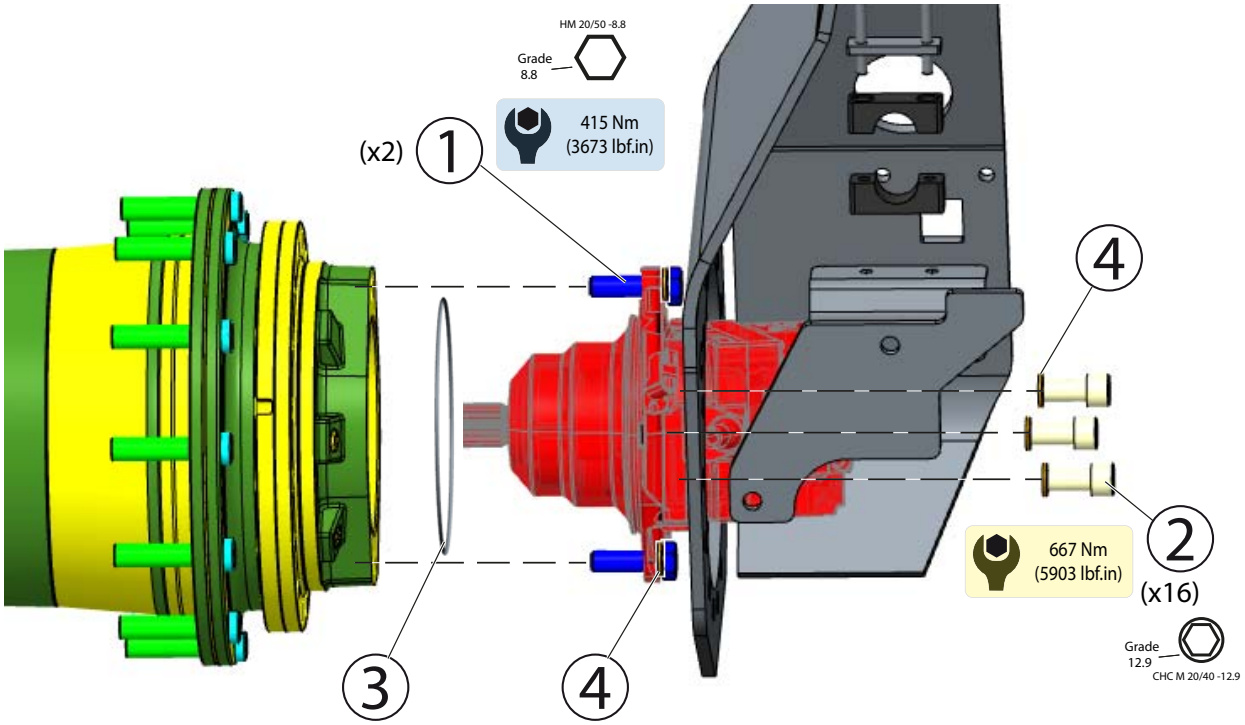
The illustrations show the parts and the main functions of the gearbox.

Installation of the track drive on the machine

ATTENTION! The person authorized to do the work must, if necessary, set out a safety plan to protect the health and safety of all persons directly involved and apply all applicable legislation.

- Check that the machine to which the gear unit is to be installed is switched off and cannot be accidentally switched on again.
- Make sure all mating surfaces are flat.
- Make sure the shaft(s) are perfectly aligned for coupling.
- Fit suitable guards to protect against the gear unit's external moving parts.
- We recommend applying a protective paste to all gear/motor mating surfaces and other parts such as Klüberpaste 46 MR 401 or Tecnolube WRL 115 or similar product, to ensure optimal coupling and protection against fretting corrosion.
- Move the track drive in the mounting area applying the lifting methods shown in "Lifting and handling" page 29.
- Clean the mating surfaces of oils or paint and fit the track drive on the machine frame (for the correct orientation refer to the installation drawing).

Wheel drive installation



ATTENTION! The person authorized to do the work must, if necessary, set out a safety plan to protect the health and safety of all persons directly involved and apply all applicable legislation

During installation of hydraulic motor, the following precaution must be observed:

- The mating areas, and the pilot diameter of the gearbox where the motor is to be mounted, must be clean and without burrs.
- Do not force the coupling and do not use inappropriate tools during assembly. Take care not to damage the flat/cylindrical coupling surfaces.
- Do not stress the rotary coupling mechanism with heavy, overhung, or thrust loads.
- To facilitate assembly and avoid rotary coupling mechanism wear, use a lubricating synthetic oil or similar product.

Hydraulic motor installation

- Fit the O-ring (3) seal in its seat in the hydraulic motor and assemble it to the gearbox being careful not to damage the seal already fitted.
- Assemble the hydraulic motor to the gearbox by tightening the bolts (1) (P/N 458125) with a torque wrench at the torque specified in the illustration.

Wheel Drive installation on the support

- Make sure all mating surfaces are flat.
- Make sure the shaft(s) are perfectly aligned for coupling.
- We recommend applying a protective paste, such assembly grease or similar product, to ensure optimal coupling and protection against fretting corrosion, to all gear/motor mating surfaces and other parts.
- Move the wheel drive in the mounting area applying lifting methods shown in section "Lifting and handling" page 29
- Clean the mating surfaces of oils or paint and fit the wheel drive on the machine frame.
- Apply thread locker (permanent) on the bolt threads (2). Fix the gear-motor to the machine frame tightening all the bolts with a torque wrench at the torque shown in the table above.
- Fix the wheel motor to the machine frame with bolts (2) and Nord-Lock Washers (4) provided, with a torque wrench to the torque indicated in the illustration above.

First start up and running in

In this first stage it is advised to follow the measures given below.

- Check for correct lubrication of the unit.
- Bleed air from every part of the hydraulic circuit and add oil in the tank if necessary.

The presence of residual air in the hydraulic circuit will manifest itself with the presence of foam in the tank and will lead to a jerking of the motor as well as excessive noise coming from the motor and the valves.

- Start the gear-motor at a low speed and gradually increase it after having verified that it is functioning correctly without any noises or vibrations.

Do not reach maximum pressure unless the entire system has been filtered to eliminate any particles of dirt that may be present.

During the running-in stage follow the steps given below:

- Check the correct revolution and direction of rotation.
- Make sure that it is functioning regularly and without any excessive noises and vibrations.
- Make sure that the oil temperature does not exceed 185-194°F (85-90°C).

After having completed this first running-in, follow the steps given below:

- Check that there are no oil leakages. (If present, proceed to remove them).
- Check the lubricating oil level in the gear-motor.
- It could happen that due to the presence of air, during the first start up, the opening action of the brake could be slowed down. It is advised to repeat the opening and closing function of the brake.
- Check that there are no other problems in general.

Maintenance Informations

Periodic Maintenance

The gear-motor only requires the scheduled maintenance procedures set out by the manufacturer (see table below).

Good maintenance will ensure an on going functionality as well as maximum reliability.

Should irregularities in function arise, it will be necessary to consult the troubleshooting checklist to find the most adequate solution.

If unsuccessful, it may be necessary to disassemble the motor gearbox partially or completely.

Inspection	Frequency	Action
Tightening bolts	**After the first 50 operating hours of the gearbox**	Re-torque bolts
Oil level	**Every 150 operating hours of the gearbox**	Refill oil if necessary
First oil change	**At 150 operating hours of the gearbox**	Oil replacement
Oil change	**Every 250 operating hours of the gearbox**	Oil replacement

Oil draining and replacement

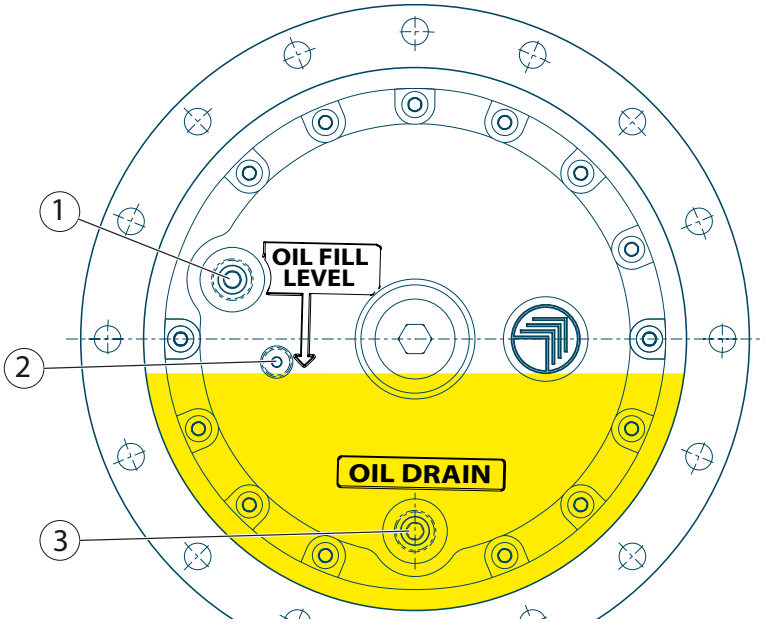
- Check that the gearbox axis is horizontal. Rotate the gearbox housing until the drain plug (3) is on the bottom of the vertical axis of the end cover.

Warning! Remove the oil plugs with extreme caution because an overpressure inside the unit could strongly expel them.

- Unscrew the plugs (1-2) and let the oil flow in a large enough container; in order to facilitate draining the oil must be still warm.
- Wait a few minutes until all the oil is drained and then proceed to screw on the plugs (1-2).
- Proceed with the oil fill-up following procedures.

ATTENTION! Never mix mineral oils with synthetic oils and vice versa.

ATTENTION! Do not dispose of the oil in the natural environment but be careful to eliminate it in compliance with the relative rules and regulations that govern locally.



Trouble shooting

The following table was created to help localize troubles in the gearbox.

External oil leakage

Anomalies	Causes	Remedies
From the lifetime seal	**Lifetime damaged**	Replace lifetime seal
From the end cover	**O-ring seal damaged**	Replace O-ring seals
From the plugs	**Plug seal damaged**	Replace plug seal
	Plugs or screws loose	Tighten the plugs/screws

Too much noise

Anomalies	Causes	Remedies
Hydraulic noise (during the slowing down of the motor speed)	**Hydraulic circuit malfunctioning**	Verify hydraulic circuit
Inside the gear-motor (reductions)	**Internal damage**	Check the gearbox

Other

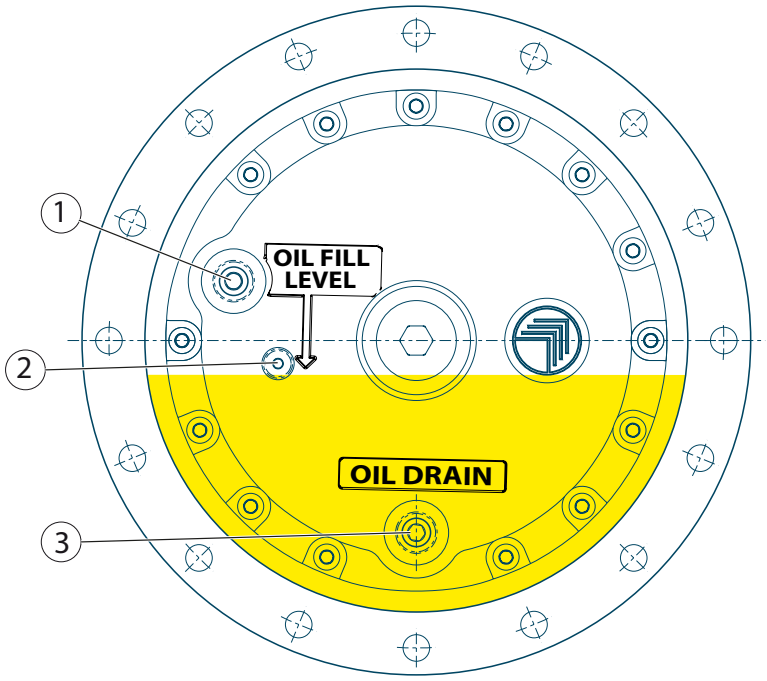
Anomalies	Causes	Remedies
Overheating	**Insufficient oil level**	Check oil level and refill if necessary
	Brake not fully released	Check the hydraulic circuit
	Insufficient oil level	Check oil level and refill if necessary
	Brake not fully released	Check brake release pressure
Insufficient braking torque	**Brake discs worm**	Replace brake disc pack
	Damaged parts	Check brake release
	Parking brake locked	Check the complete brake release
	Mechanical components damaged	Replace damaged parts

Oil filling

The gearbox is supplied without oil when replaced or rebuilt. It has filling, draining and oil level plugs. Before putting the gearbox into operation, it is necessary to fill it with oil. This procedure is undertaken following the instructions given below:

- Check that the gearbox axis is horizontal.
- Rotate the gearbox housing until the drain plug (3) is on the bottom, on the vertical axis of the end cover.
- Unscrew the fill and oil level plug (1-2).
- Fill from the hole (1) until the lubricant flows out from the level hole (2).
- Screw the filling and oil level plugs (1-2).
- Run the gearbox, after a few minutes, stop and check the oil level.
- If necessary, refill with lubricating oil (for plug orientation, size and dimension refer to the installation drawing).

1. Oil fill
2. Oil Level
3. Drain oil



Approximative oil capacity: **0.95 gallons ± 10% (3.6 liters** +/-10%)

AXLE AND HALF-AXLE

General info

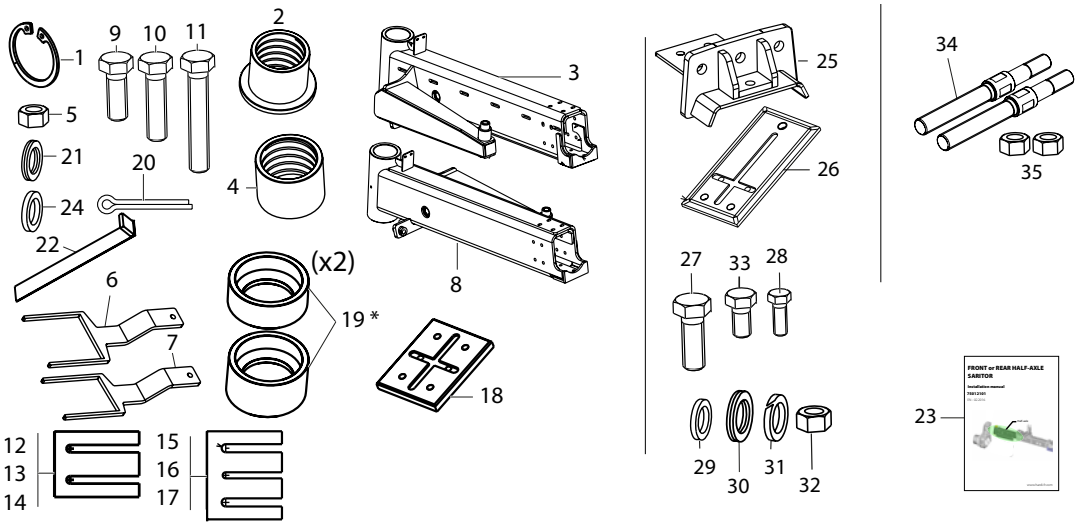
This section describes the disassembling and reassembling of the front or rear axle. For this 3 kits are available

75009701 Half-axle replacement. See below "Disassembling the half-axle" page 37
75011601 Mechanical stop rod replacement. See "SUSPENSION" page 50
75011701 Locking sliding plate

Machines affected

Concerns all SARITORS prior to serial number 55776. After the serial number 55776 apply the kit 75011601 and 75011701.

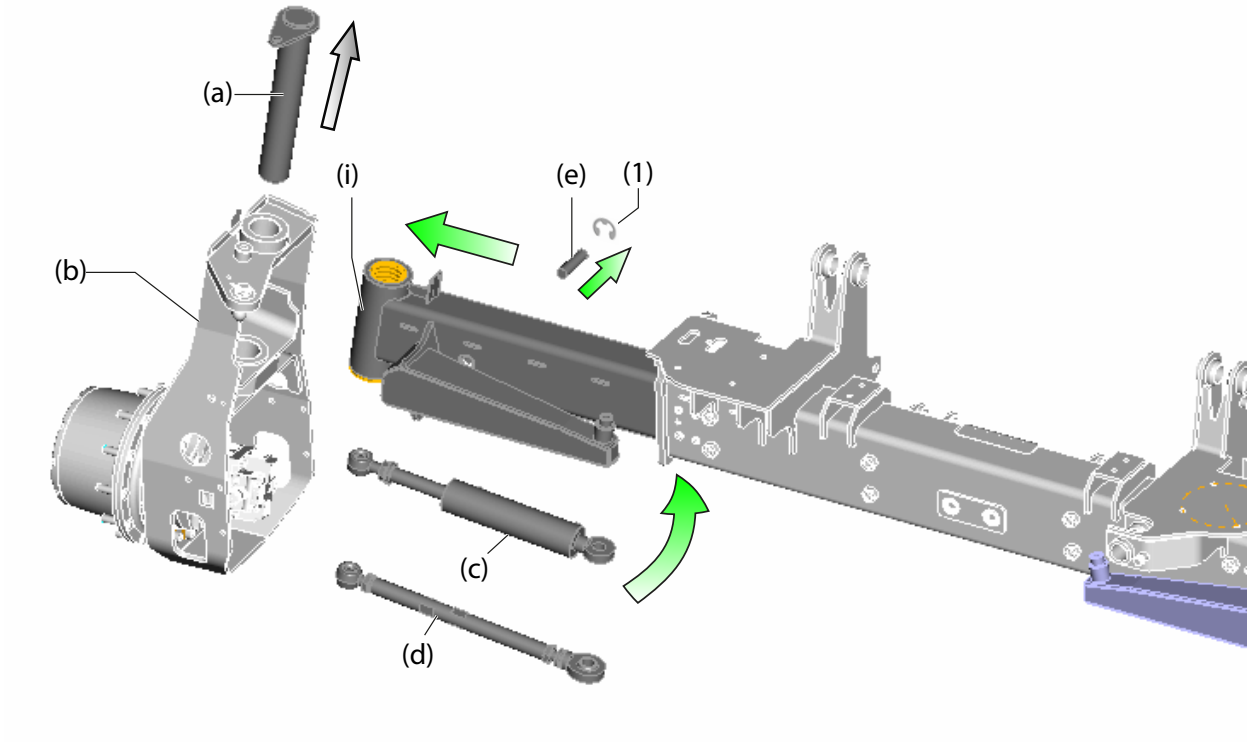
Description of kit contents



1	28012001	INTERNAL CIRCLIP	4	22	76010701	GUIDE FOR HOLDING THE TRACK CYLINDER	1
2	39000101	HEADED BUSH	2	24	47000301	WASHER NL20 21,4X30,7X3,4	1
3	63082901	LEFT REINFORCED HALF-AXLE	1		----------		
4	39000201	BUSH	2	25	63097301	UPPER SLIDING PLATE GUIDE	2
5	460806	LOCKNUT M20 A2 DIN985	2	26	14029701	SLIDING PLATE L205 SARITOR	2
6	16670901	MOUNTING TOOL FOR SIDE SLIDING PLATE	1	27	438036	SCREW HM 16-60/38 8.8 DAC DIN931	6
7	16671001	MOUNTING TOOL FOR UP/DW SLIDING PLATE	1	28	430286	SCREW HM 12-30	4
8	63082801	RIGHT REINFORCED HALF-AXLE	1	29	479039	NORD LOCK WASHER M12	4
9	43003001	SCREW HM 12-20/20 8.8 DEL DIN933	32	30	471168	NORD LOCK WASHER M16 17X25,4X3,4	12
10	430522	SCREW HM 12-25/25 8.8 DEL DIN933	20	31	478052	WASHER W14 A2 DIN127B	2
11	430286	SCREW HM 12-30/30 8.8 DAC DIN933	24	32	460585	LOCKNUT M16 A2 DIN985	6
12	16591201	SHIM 0,5 SIDE	12	33	43002701	SCREW 14x25	2
13	16591101	SHIM 0,8 SIDE	16		----------		
14	16591001	SHIM 1,5 SIDE	8	34	1401101	MECHANICAL STOP ROD	2
15	16590901	SHIM 0,5 LOWER-UPPER	12	35	468058	LOCKNUT M18	2
16	16590801	SHIM 0,8 LOWER-UPPER	16		----------		
17	16590701	SHIM 1,5 LOWER-UPPER	8	23	MANUAL	INSTALLATION MANUAL	1
18	14023801	SLIDING PLATE	14				
19*	14021501	HEADED SPACER (length 23 millimeter)	2				
	14025501	HEADED SPACER (length 50 millimeter)	4				
20	488010	SPLIT PIN 5X50	2				
21	479039	NORD LOCK WASHER M12	60				

Disassembling the half-axle

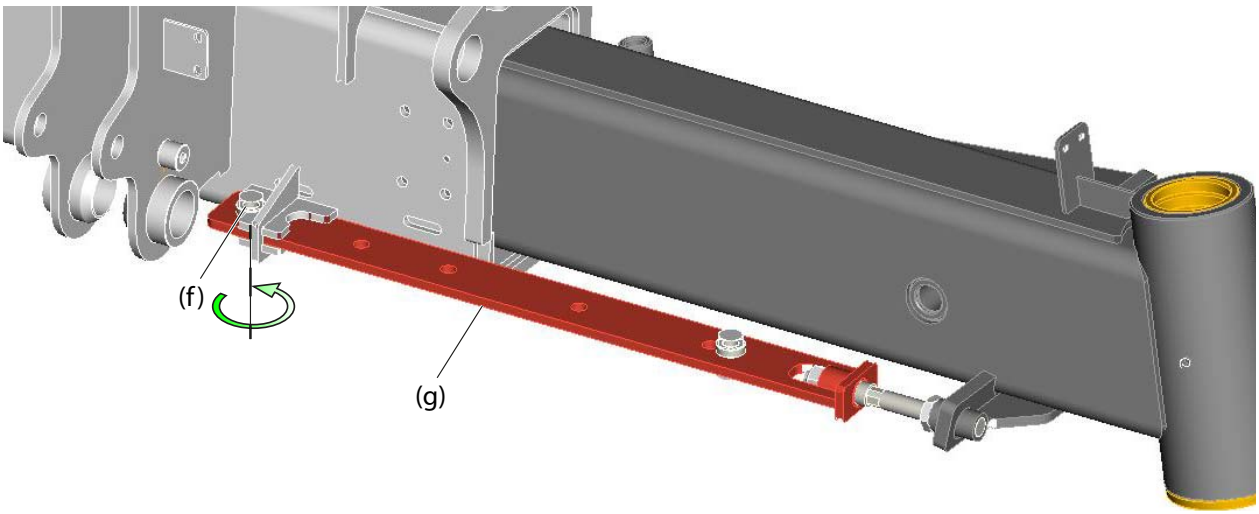
ATTENTION! You need to remove the motor support, the steering cylinder or steering lock bar, also disconnect the track cylinder and mechanical axle stop before pulling out the half-axle (**i**).



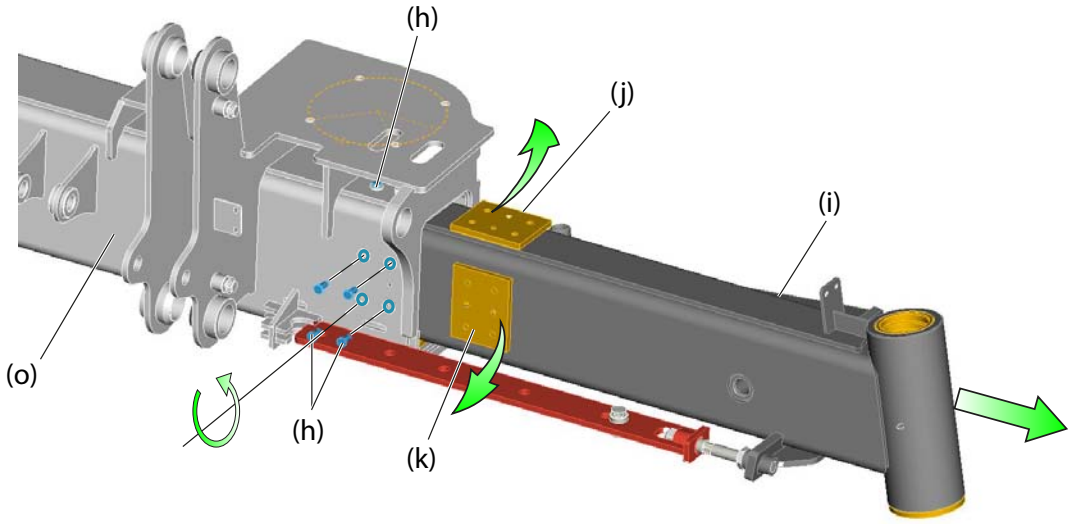
1. Extend the track width to the maximum position
2. Pull the axis (**a**) up and remove the motor support (**b**).

It is not necessary to disconnect hydraulic hoses.

3. Remove the steering cylinder (**c**) (front axle) or the locking steering bar (**d**) (rear axle)
4. Disconnect the track cylinder. For this remove the circlip (**1**) and the axis (**e**)
5. Retract the rod of the hydraulic cylinder to facilitate the reassembly

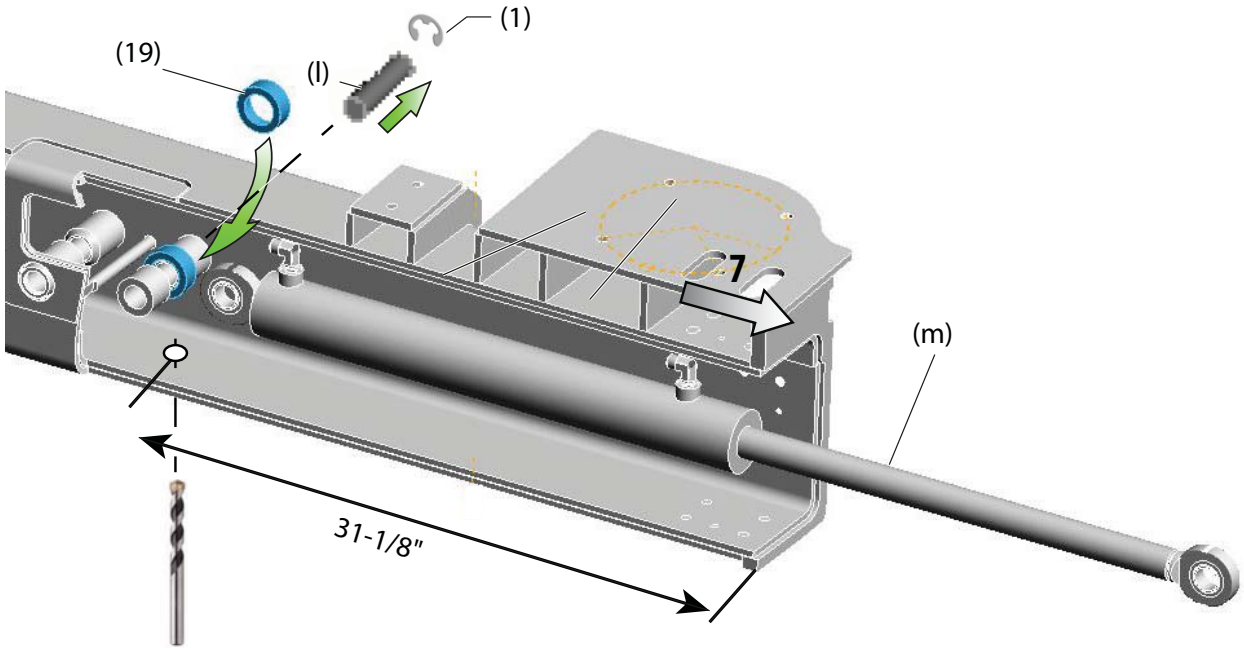


6. Remove the bolt (**f**) to allow the mechanical axle stop (**g**) disassembly



7. Dismantle 16 screws (**h**) located on each side of the axle (**o**)
8. Remove the sliding plates (**j**) and (**k**) of axle to allow removal the half-axle.

Mounting the heading spacer



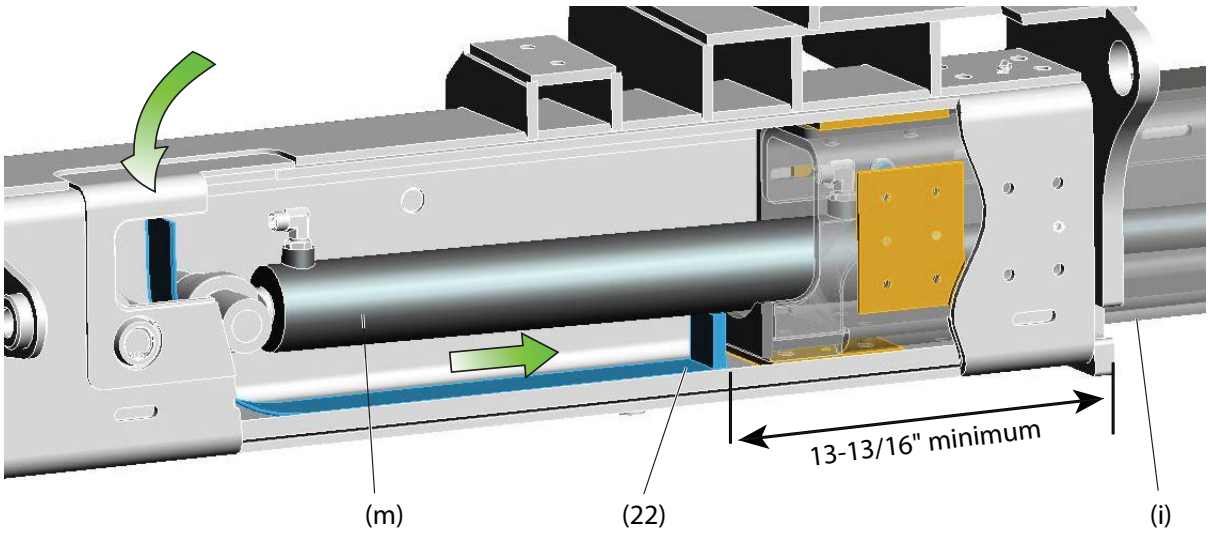
9. Remove the circlip (**1**) and the axis (**i**), and retract the rod of hydraulic cylinder
10. Mount the headed spacer (**19**) in order to prevent direct contact of hydraulic connectors during sliding of the half-axle, then reassemble the cylinder (**m**).

There are 2 different spacers:

- Part number 14025501 until Serial number 55268 (2 headed spacers per cylinder).
  Part number 14021501 from Serial number 55269 (1 headed spacer per cylinder).

11. Drill a hole and install a grease nipple (not supplied).

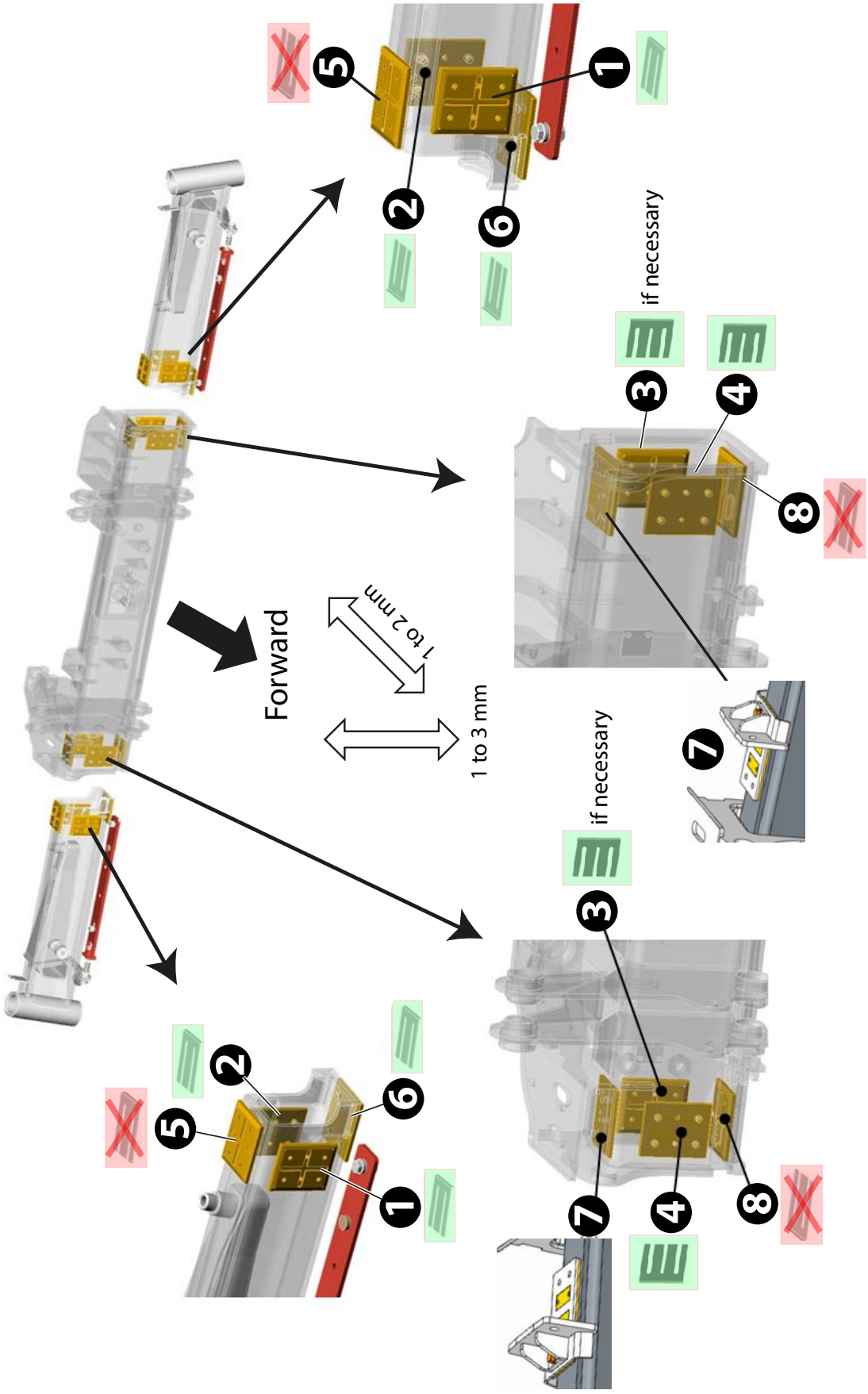
Hold the track cylinder



ATTENTION! To allow sliding of the half-axle (**i**) into the axle, it is necessary to raise the track cylinder (**m**) slightly and hold it horizontally, For this use thee guide for holding cylinder tool (**22**).

12. Put the tool as shown in the illustration, respecting a minimum distance of 13 13/16" (**350** mm) to support the track cylinder (**m**).

Where to place the shims?



General info

Shimming in horizontal plane

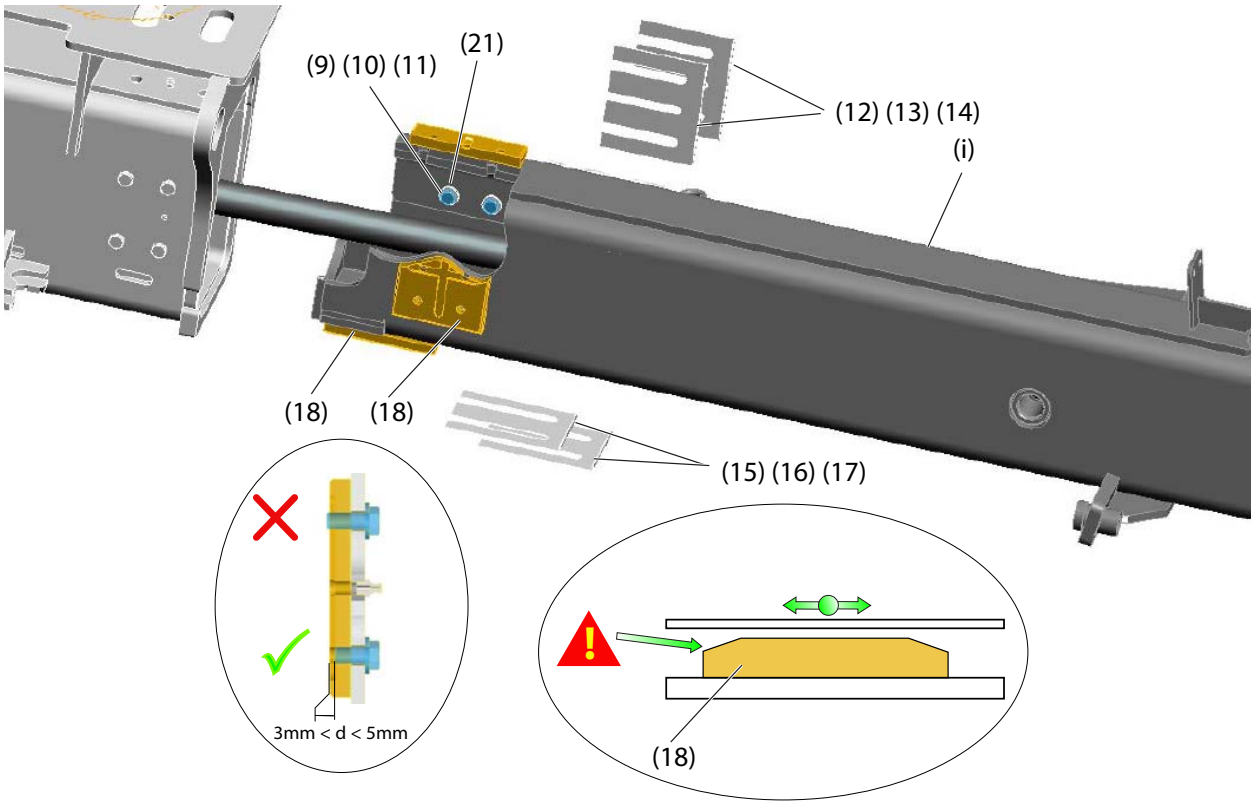
Shims are placed **primarily** in position **1 & 2** on the ha f-axle, and 4 on the axle, so that the half-axles point slightly forward.

If the clearance is out of range, put shims in position **3**

Shimming in vertical plane

Shims are placed **only** in position **6** on the half-axle, and **7** on the axle, so that the half-axles point slightly to downward.

Assembling the sliding plates on the half-axle



13. Assemble the sliding plates (**18**) on each side of the half-axle (**i**) using washers (**21**) and the appropriate screws (**9-11**).

The flat face of the sliding plate is against the half-axle

The length of screws may vary according to thickness and number of shims installed. In every instance, the end of the screw should not exceed the sliding plate. The recommended distance is 3mm approximately.

Different thickness of shims are available: 0.5mm, 0.8mm, 1.5mm

14. Insert a short length the half-axle (**i**) inside the axle.

Sliding plates on top and bottom of the half-axle (position 5-6)

Respect a minimum clearance at the top of **1.0 mm to 3.0 mm** to assist the sliding of the half-axle.

15. Put the appropriate shims (**15-17**) on the bottom, between the half-axle (**i**) and the sliding plate (**18**). Do not put shims on top of the half-axle

Different thicknesses of shims are available: 0.5mm, 0.8mm, 1.5mm

The half axle is inserted by hand without forcing!

Sliding plates on the side of the half-axle (position 1 & 2)

Respect a minimum clearance at the top of **1.0 mm to 2.0 mm** to assist the sliding of the half-axle.

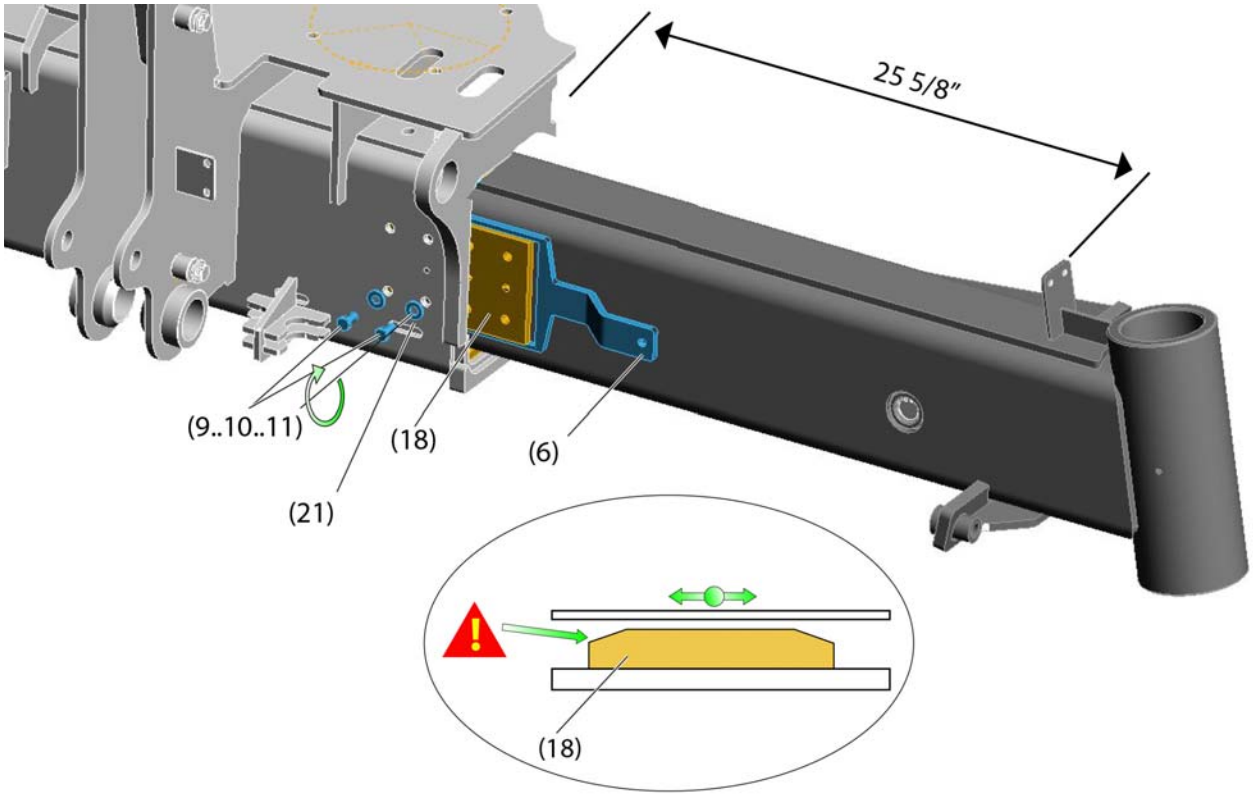
16. Insert the **same thickness of shims** (**14**) to obtain 50%-50% at position (**1**) and (**2**) between the sliding plates (**18**) and the half-axle (**i**) to ensure the minimum clearance required.
17. When the correct setting is reached, tighten all screws (**9-11**) completely.

Before installing the half-axle, check that the screws are the correct length.

Grease the sliding plates and inner axle.

Assemble sliding plates on the axle

Guiding the sliding plates



18. Place the half-axle at a distance of 25 5/8" (650mm)
19. Place the sliding plates (**18**) on each side by using the mounting tools (**6**) designed for this purpose.
20. Assemble sliding plates with washers (**21**) and appropriate screws (**9**) or (**10**) or (**11**).

The flat surface of the sliding plate is against the axle

The length of screws may vary according to thickness and number of shims installed. In every instance, the end of the screw should not exceed the sliding plate.

Sliding plates on the axle

Different thicknesses of shims are available: 0.5mm, 0.8mm, 1.5mm.

21. Insert the appropriate shims (**12-14**) between the sliding plates (**18**) and the axle (**o**) in order to ensure the correct clearance.
22. When the correct setting is reached, tighten the screws (**9-11**) completely.

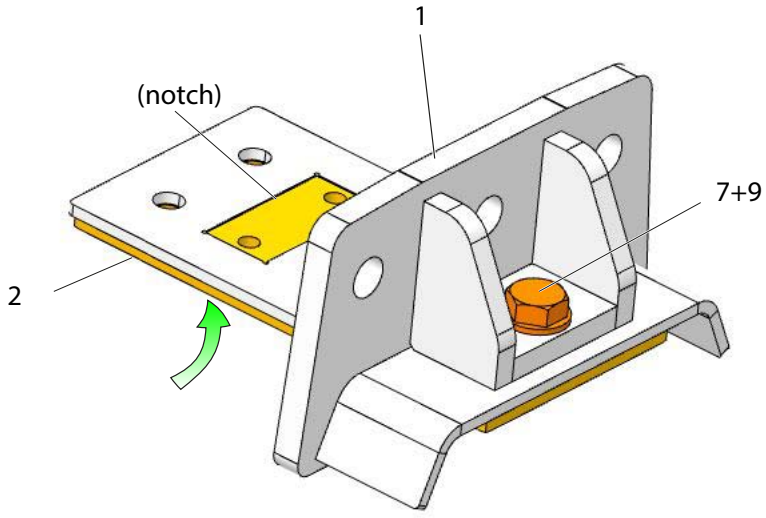
In practice, the optimal adjustment is achieved when the half-axle is slightly tight against the axle.

Before pushing the half-axle, check that the screws are the correct length.

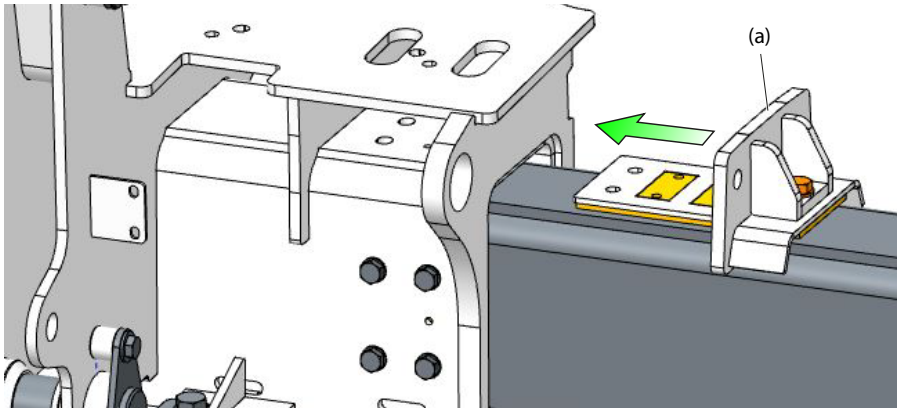
After setting, if the gap exceeds 3 mm in position 3, it is necessary to change the shim adjustment on the half-axle.
Respect the following rules. Position **2** =**75**% - Position **1** = **25**% (see chapter "Sliding plates on the side of the half-axle (position 1 & 2)" page 42).

23. Shim any gaps in position 3.

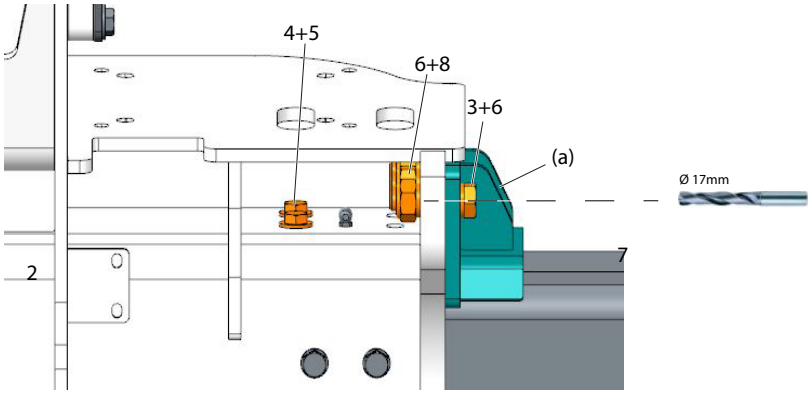
Upper sliding plate replacement



24. Assemble the sliding plate on the guide bracket (**1**) by using screw (**9**) and washer (**7**).



25. Grease the sliding plate before positioning the assembly as shown on the illustration (**a**)



26. Attach the guide bracket (**a**) to the axle by using screws (**4**) and washer (**5**).

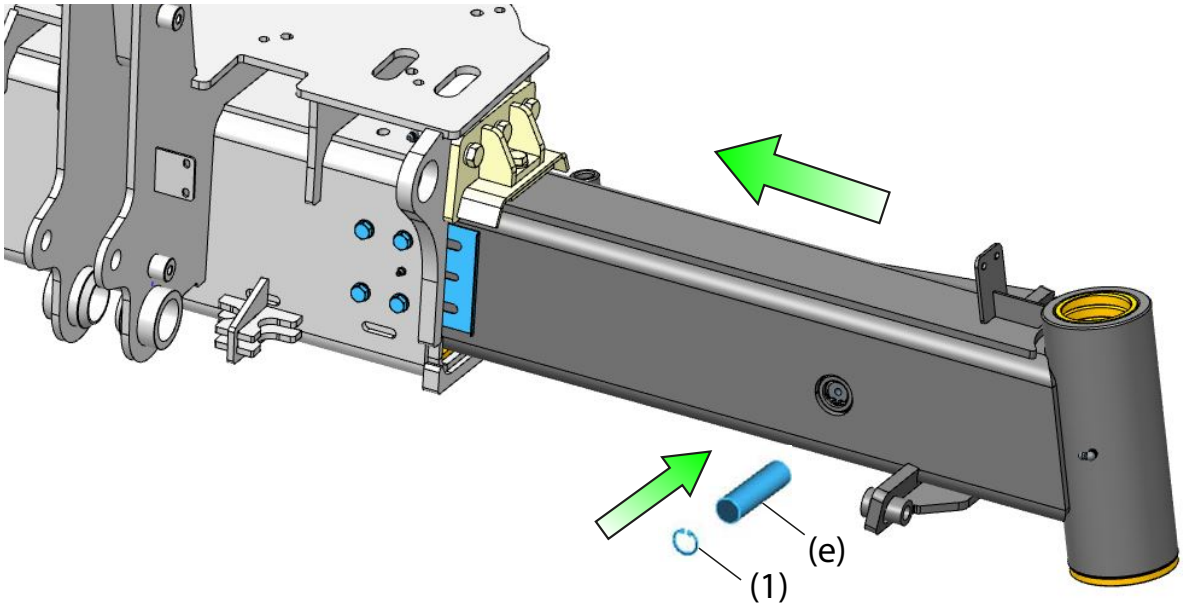
Before drilling make sure that the flat surface of the guide plate is against the axle face.

27. Drill 3 holes Ø 17mm.

28. Attach the assembly to the axle by using screws (**3**), washers (**6**) and lock-nut. (**8**)

ATTENTION! After 50 duty cycles of the track width, check the torque of the bolts, then again once a year. Tighten all bolts of the assembly if necessary.

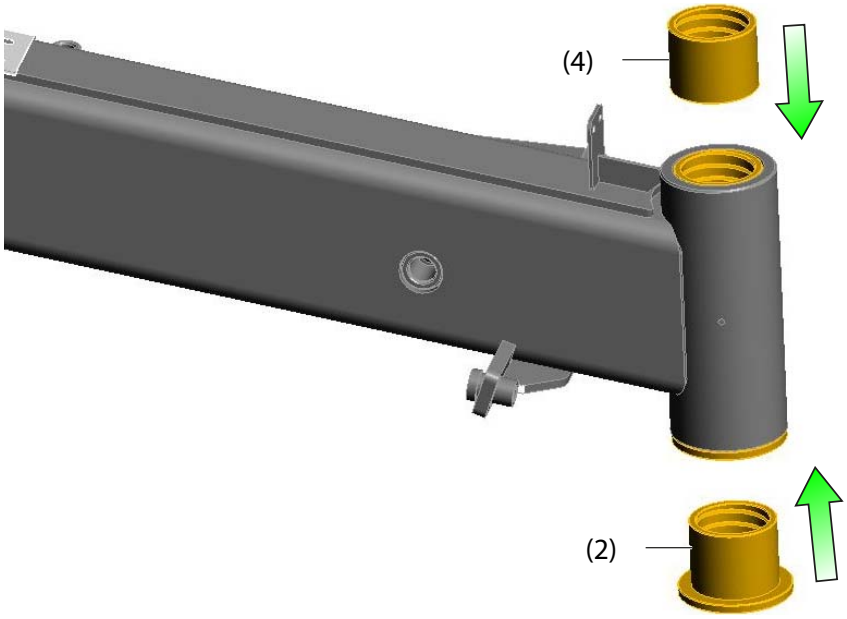
Reassemble the track cylinder on the half-axle



29. Push in the half-axle (**i**) until it is in the correct position. Use a clamp or other means to push the half-axle.
30. Reassemble the axis (**e**) and the internal circlip (**1**).

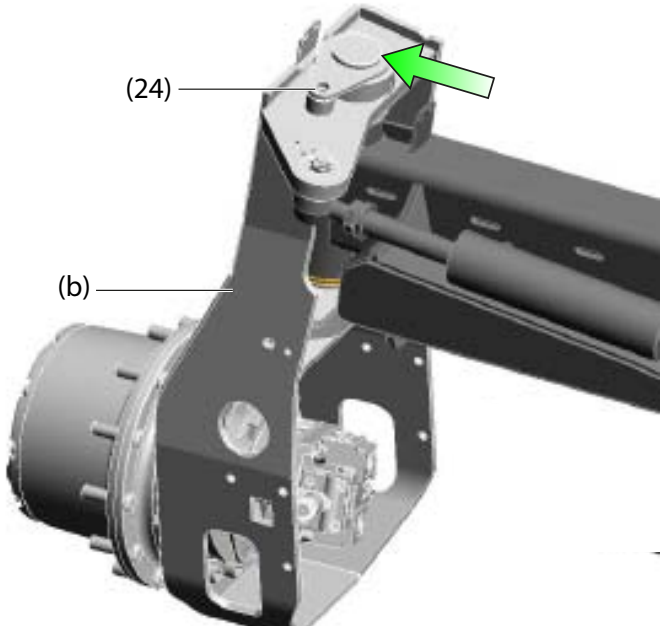
Grease the sliding plates before mounting.

Mounting bushings on the half-axle



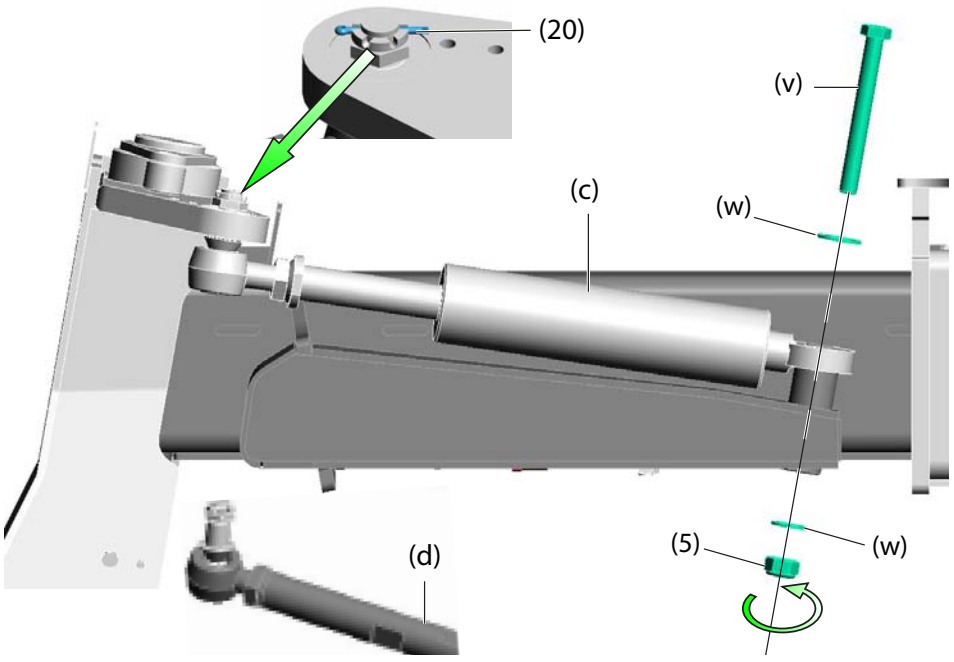
31. Replace the headed bushing (**2**) and the bushing (**4**).

Reassemble the motor support on the half-axle



32. Reassemble the motor support (**b**) by using a new washer (**24**)

Reassemble the steering cylinder

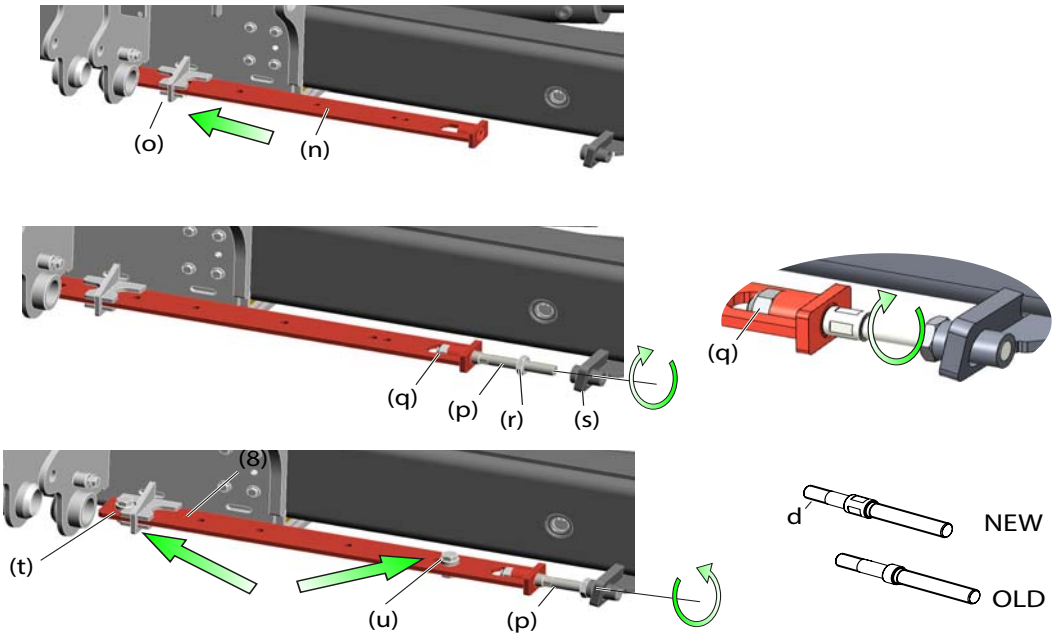


33. Reassemble the steering cylinder (**c)** (front axle) or the coupling rod (**d**) (rear axle). Insert a new split pin (**20**) and bend it outward in opposite directions.

34. Reuse the screw (**v**), washers (**w**) and screw a new locknut (**5**)

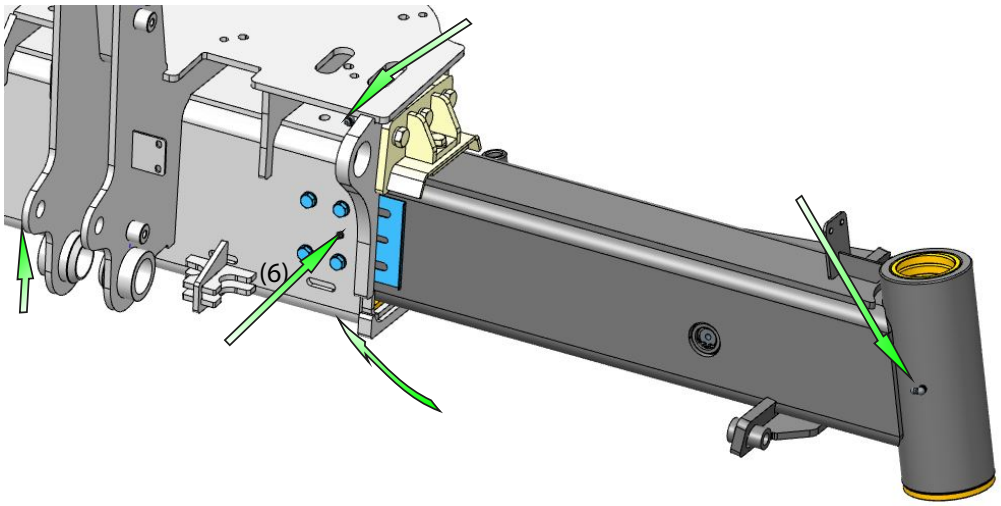
For safety reasons, it is imperative to use a new split pin and locknut

Reassemble the mechanical axle stop



35. Dismantle the adjustable rod (**p**) from the mechanical axle stop (**n**).
36. Place the **new** M18 lock-nut (**q**) into the bar
37. Reassemble the **new style** mechanical axle stop (**d**) on the axle (**o**)
38. Reassemble the adjustable rod (**p**) with the lock-nut (**q**) and nut (**r**). Do not fully tighten the screw (**q**) in order to allow the reassembling of the rod on the threaded bracket of the half-axle
39. Screw the threaded rod onto the threaded bracket (**s**), tighten the lock-nut (**q**). Finally, tighten the counter nut (**r**).
40. Reassemble the bolts (**u**) and (**t**)

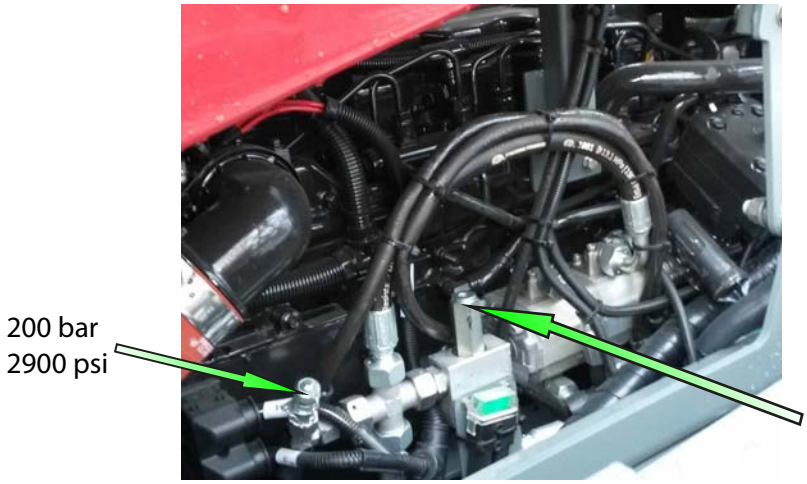
Lubricating the sliding plates



Before operating the track width, it is necessary to lubricate the sliding plates

41. Retract the half axle to minimum track width, and grease the sliding plates and half-axle pivot.

Set the hydraulic pressure



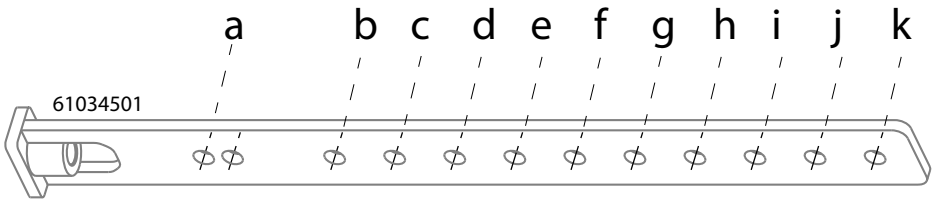
42. Set the pressure to control the variable track width (The oil must be hot and engine rpm at the maximum).

Mechanical stop bar

2 versions are available according the track width required

Mechanical stop bar for Australia

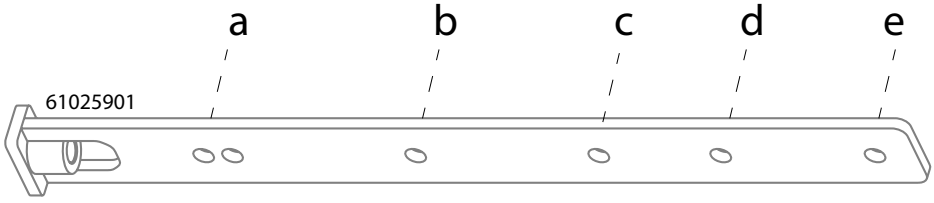
Designed for metric dimensions



	a	b	c	d	e	f	g	h	i	j	k
(m)	**3.00**	**3.10**	**3.20**	**3.30**	**3.40**	**3.50**	**3.60**	**3.70**	**3.80**	**3.90**	**4.0**
(inch)	118	122	126	130	134	138	142	145	150	153	257

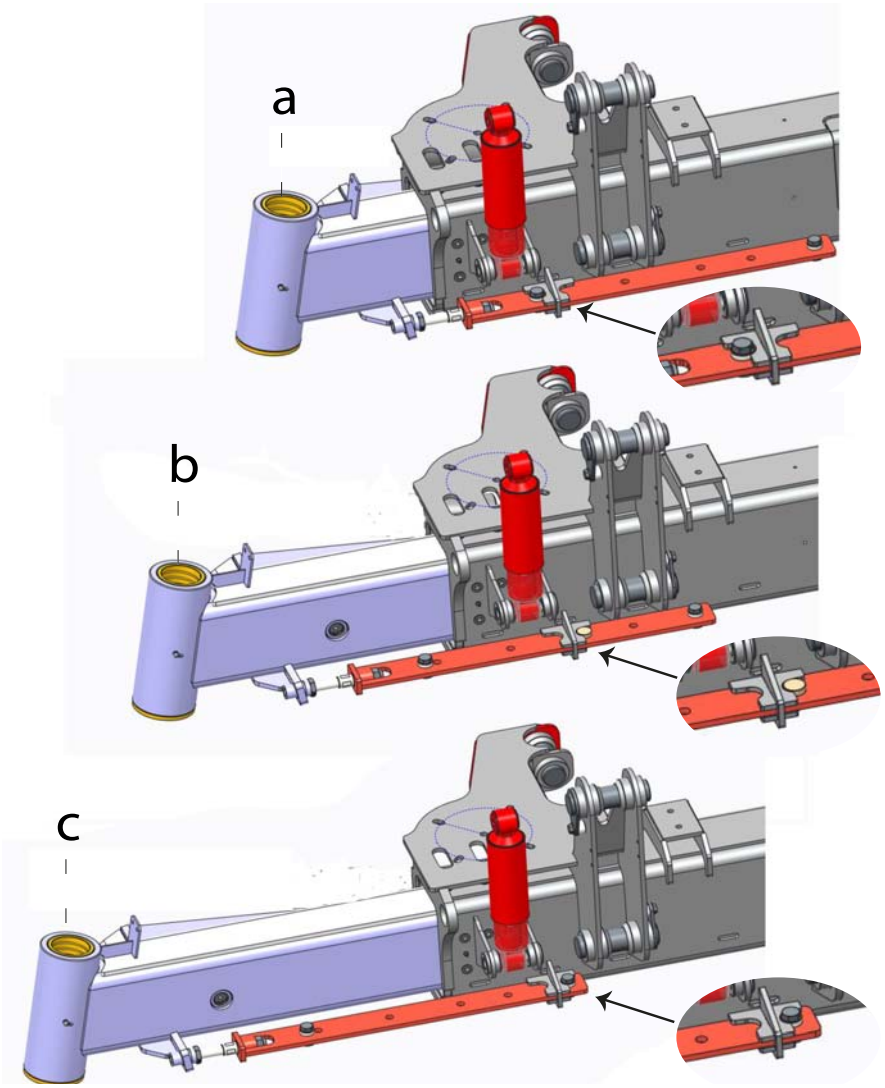
Mechanical stop bar for North America

Designed for inch dimensions



	a	b	c	d	e
(inch)	**120**	**132**	**144**	**152**	**160**
(m)	3.05	3.35	3.65	3.86	1.06

Mechanical stop bar settings



	(a)	(b)	(c)
Track width	**minimum**	**intermediate**	maximum

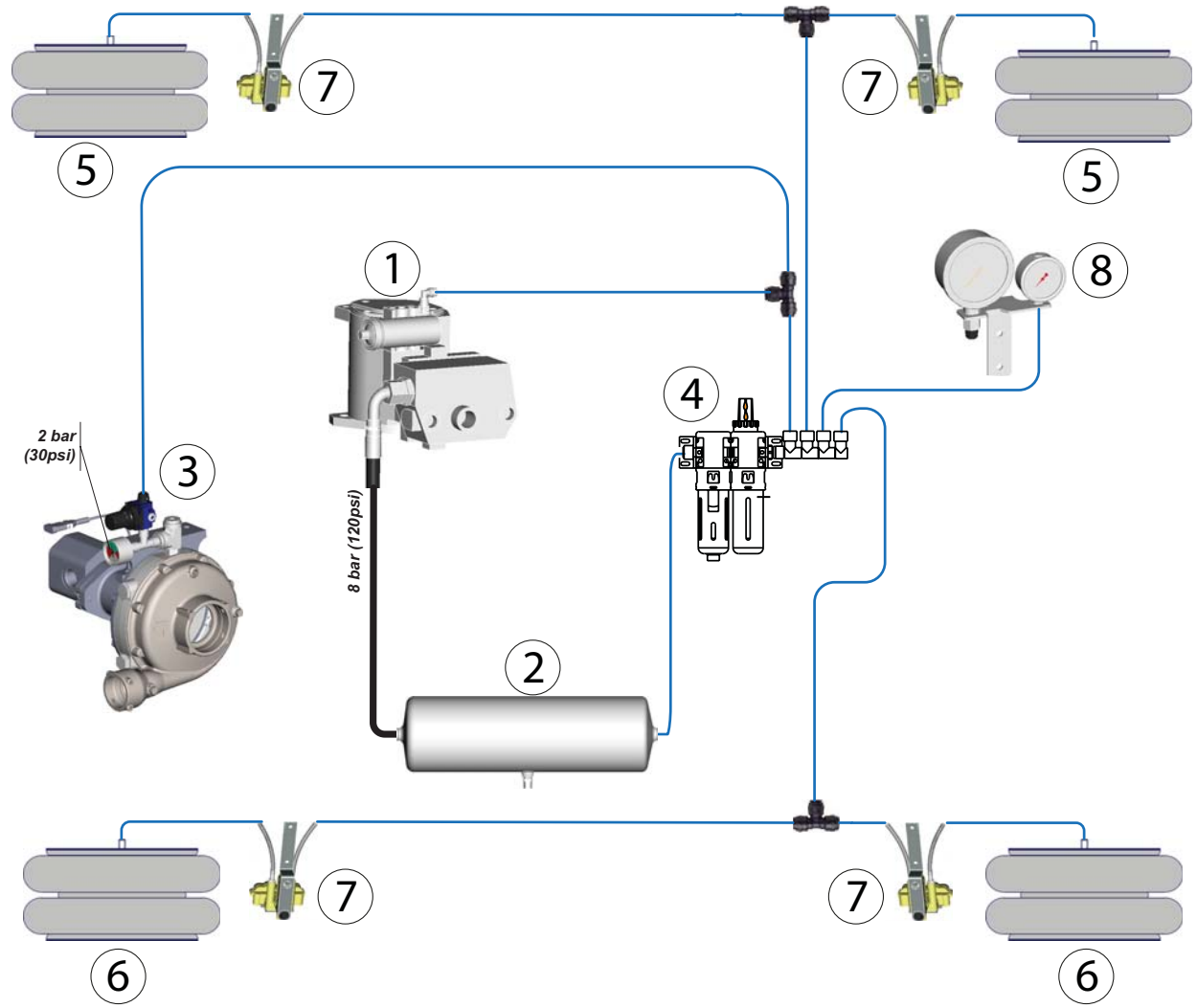
SUSPENSION

General info

The compressed air is used to control the following:

1. The suspension of the machine
2. Ace pump

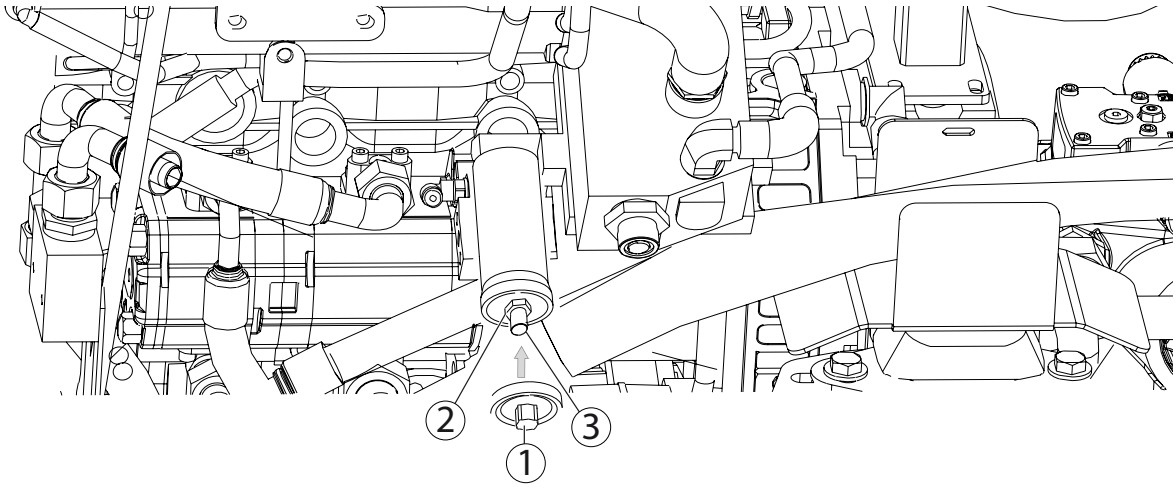
Air circuit diagram



1	Air pressure limiting valve	5	Front airbag suspension
2	Air tank	6	Rear airbag suspension
3	Air regulator	7	Air height control leveling valve
4	Air filter and lubricator	8	Air pressure gauge

Air pressure limiting valve setting

For proper functioning of the suspension, the air pressure should be set to **8** bar (**116** psi). The air pressure limiting valve is located on the left side of the engine.



For setting the air pressure:

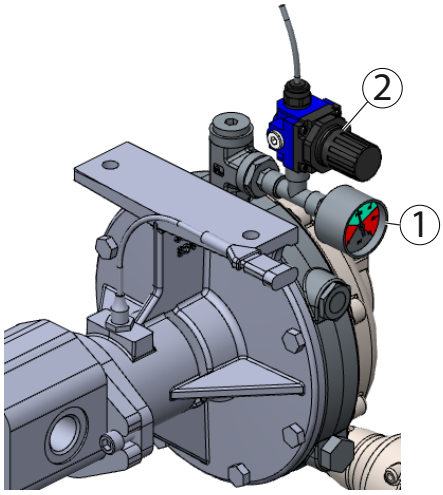
- Unscrew the protective cap (**1**).
- Loosen the locknut (**2**) and turn the screw (**3**) to adjust the normal operating pressure.

Air regulator for Ace pump

Air supply is regulated to **30 psi** (**2** bar). Adjust the pressure if necessary.

- Check the air pressure and adjust the air regulator (**2**)

The pressure gauge (**1**) indicates the supply pressure of the Ace pump



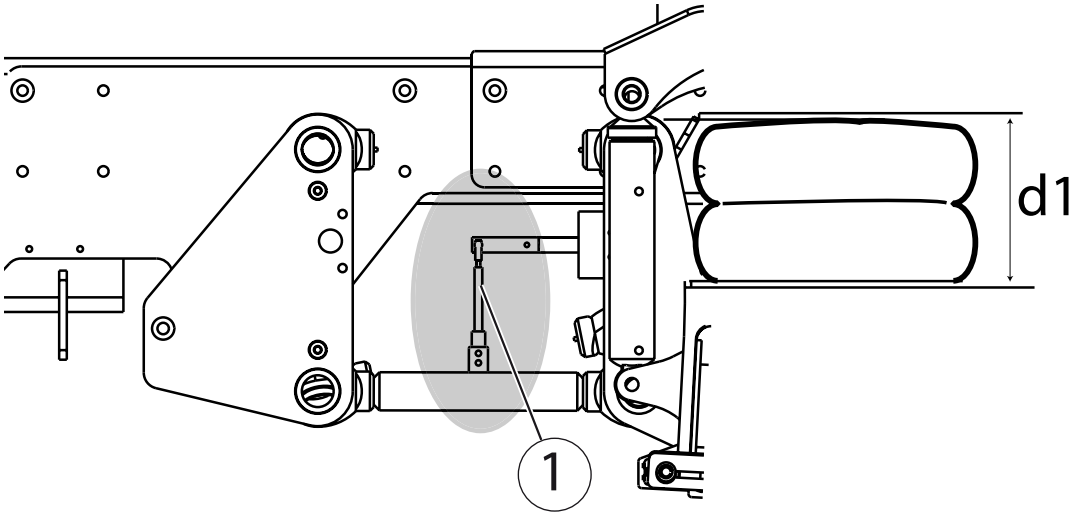
Air suspension adjustment

Check beforehand that the compressed air pressure is adjusted correctly. (see "Air pressure limiting valve setting" page 51).

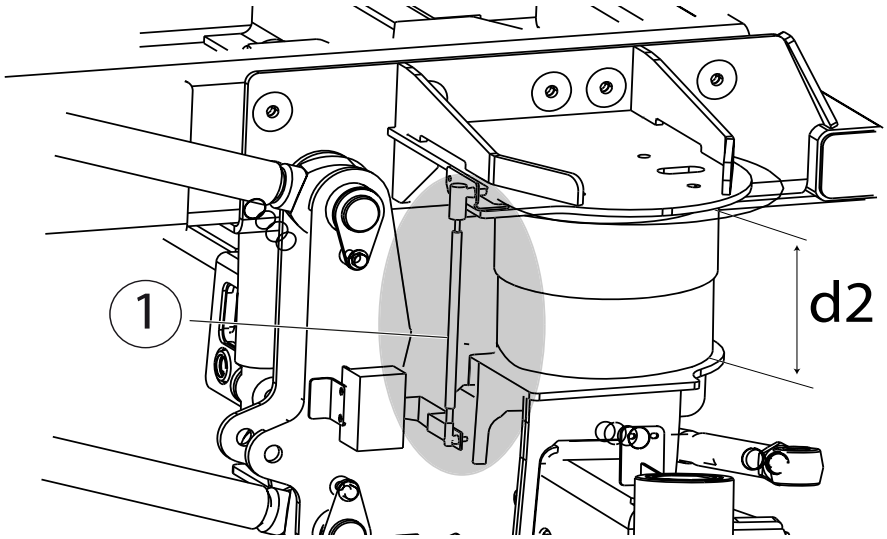
- Turn the adjustable linkage (**1**) to change the height of the front and/or rear airbag according the table below

The adjustment of the suspension is to achieve an empty tank.

Front height control leveling valve



Rear height control leveling valve



Axle	Ride height	in / mm
Front	d1	10/254
Rear	d2	9 / 228.6

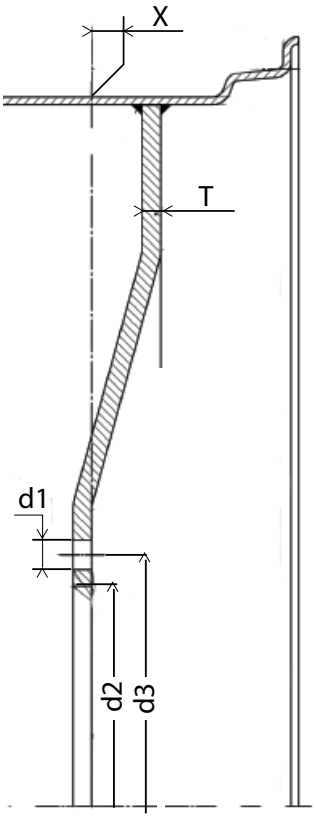
Spare parts - Pneumatic suspension

Refer to page **L045A** and **L045B** of the spare parts catalogue

Wheels - Tires - Rims

Rims description

P/N	Description	Offset (mm)	Thickness (mm)	Bolts	Bolts/ Diam.(mm)	Circle Diam. (mm)	Hub diam. (mm)
		X	T		d1	d3	d2
28011901	W12Ax50	0	15	12	24	400	350,1 +/- 0,1
28042501	W12-46						
28028901	W15Ax50						
28013101	W16A-46	-30					
28038501	W16A-46						



Tire characteristics

General info

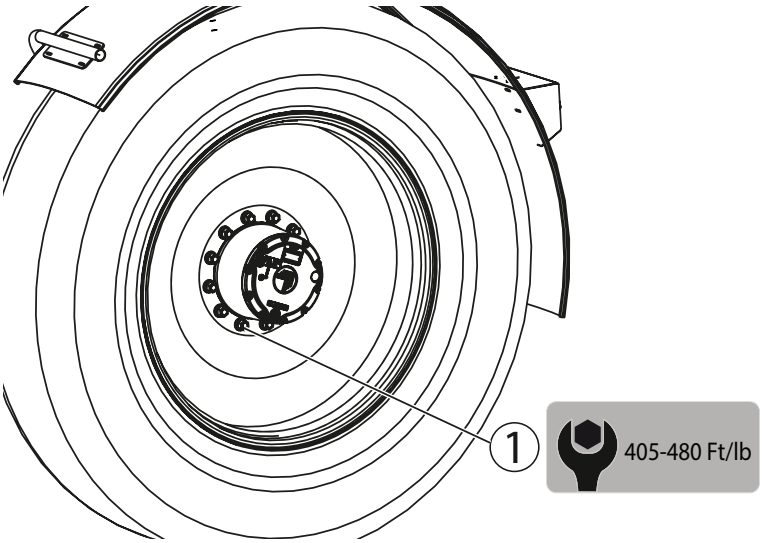
Overloading and under-inflating a tire both have the effect of over-deflecting it. Under these conditions the tread on the tire will wear rapidly and unevenly, particularly in the shoulder area. Radial cracking in the upper sidewall area will be a problem. With under inflated bias drive tires in high torque applications, sidewall buckles will develop leading to carcass breaks in the sidewall. While an under inflated drive tire may pull better in some soil conditions, this is generally not true and not worth the high risk of incurring tire damage.

Over inflation results in an under-deflected tire carcass. The tread is more rounded and wear is concentrated at the center. Traction is reduced in high torque applications because both length and width of the ground contact area are reduced. The harder carcass, with reduced flexing characteristics, does not work as efficiently. Moreover, the tightly stretched overinflated carcass is more subject to weather checking and impact breaks.

Tire technical data

Tire Size	Manufacturer	Load Index	Model	Inflation pressure PSI (bar)	Rim
380/90R50	GOODYEAR	166A8	DT800	67 (4,6)	W12Ax50
380/90R46	MICHELIN	173D	SPRAYBIB	55 (3,8)	W12x46
480/80R50	ALLIANCE	166D)	354	35 (2,4)	W15x50
520/85R46	ALLIANCE	173A8/169D	385	40 (2,8)	W16x46
520/85R46	GOOYEAR	169A8/169B	R1W AG49M	46 (3,2)	W16x46

Wheel nuts



- Tighten the nuts and apply a torque of **405-480lbf-ft (550** - **650Nm**).

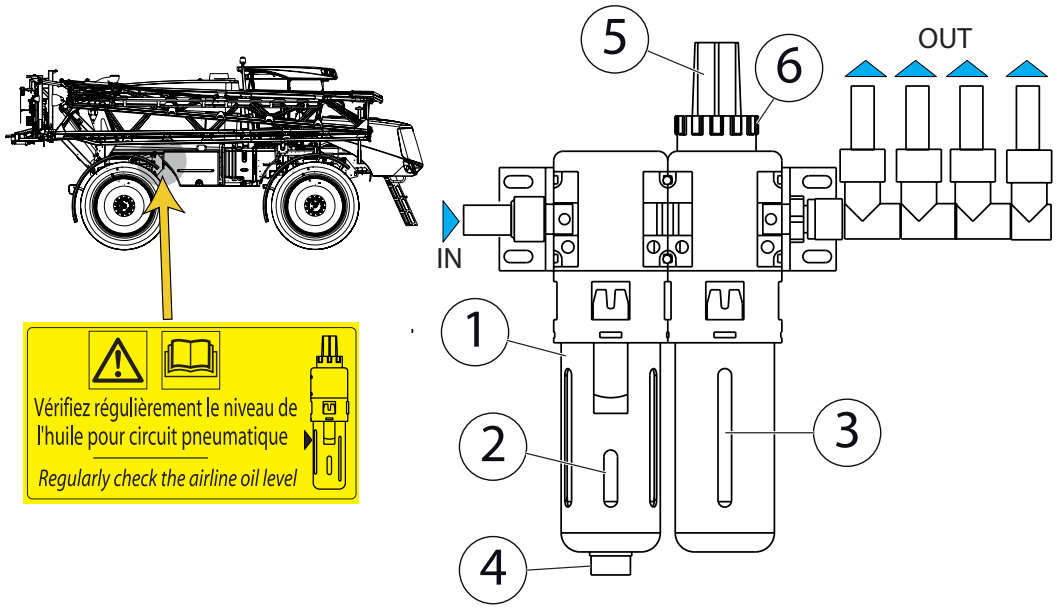
WARNING! Never oil or grease the wheel nut threads.
Observe the tightening torque.

Air treatment Filtration and lubrication of the compressed air

Excludes Sprayers prior serial# 55864

Sprayers fitted with a compressed air system have filter and lubricator mechanisms for the compressed air which is necessary for correct operation of the pneumatic components.

Air lubricator system location



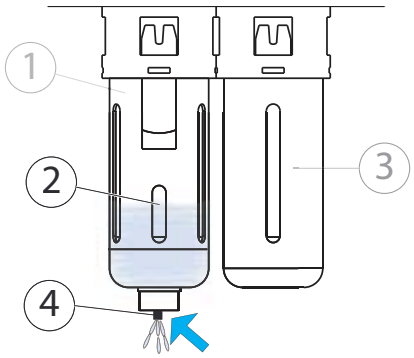
1	Metal bowl protector with transparent polycarbonate bowl	4	Semi-automatic drain
2	Condensate level window (short slot)	5	Adjustment sight glass
3	Oil min./max. level window (long slot)	6	Flow adjustment knob

Condensation during the compression of air and water vapor can cause particles of pipe scale and other contaminants in the pipes. These particles need to be removed before they reach the pneumatic equipment. Particles can damage and clog small orifices in the equipment unless they are filtered out. Filters separate the water droplets and particles from the air before they reach your pneumatic equipment.

All moving parts must be kept lubricated for a longer life. The lubricator stores droplets of oil in the bowl, releasing the oil into the high velocity air stream and spreading the oil throughout the piping system to the components

Condensate drain

- Push (**4**) to drain the bowl of the filter

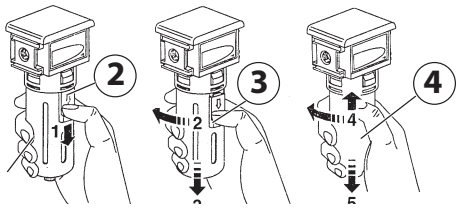


Semi-automatic drain operating pressure: min. 17.5psi (1.2 bar)

Oil refilling

WARNING! To avoid splatter, de-pressurize the compressed air system before dismantling the bowl.

- Press the clip (**2**) to unlock the protective bowl.
- Rotate 1/8 turn to remove the protective bowl.
- Rotate the tank (**4**) 1/4 turn to dismantle it.



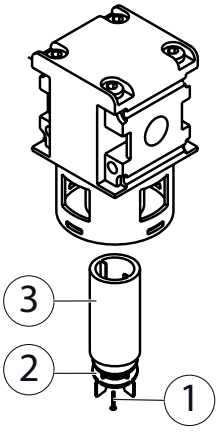
ATTENTION! Use only an alkaline solution (soapy water) and not a solvent for cleaning the polycarbonate bowls and sight glasses.

Recommended type of oil: Non-detergent and without aggressive additives. (see "Characteristics of antifreeze oil for pneumatic circuit" page 59).

Air filter

To replace the filter:

- Loosen the screw (**1**)
- Remove the cap (**2**)
- Pull the filter (**3**) down and replace the filter.



Oil flow rate adjustment

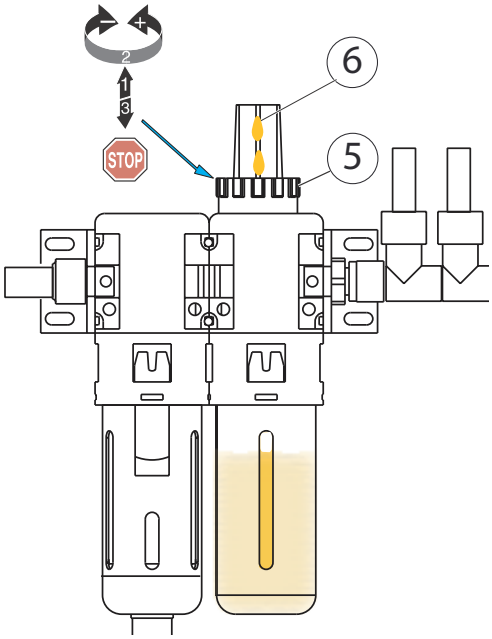
Adjustment by means of knob (**5**) with "pull-turn-push' type locking system, or by means of a 6 mm Allen key (**after the adjustment knob (5)has been unlocked**).

Flow direction indicated by arrow.

To ensure proper lubrication of the compressed air system, it is essential to adjust the lubricator as follows:

Set oil flow rate during the passage of air. For this:

- Slightly open the air reservoir valve
- Turn the sight glass adjustment (**6**) in a counterclockwise direction to increase the oil flow.



Oil flow rate: Approximately one drop of oil per minute.

Spare parts - Air lubricator system

Refer to page **L014A** of the spare parts catalogue

Pneumatic system - Technical data

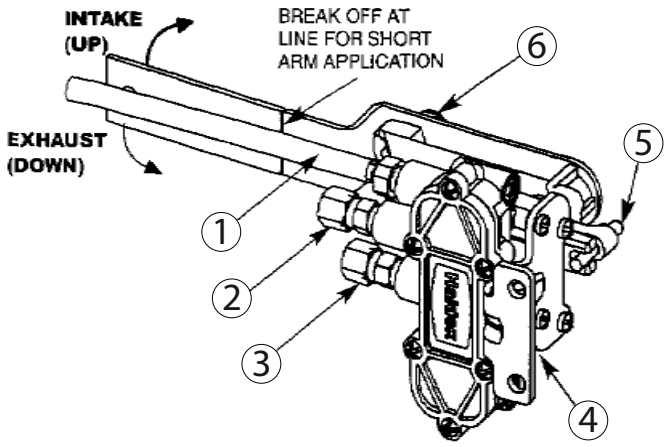
CR Control Leveling Valve

The Controlled Response (CR) Height Control Valve (HCV) automatically adds air to, or exhausts air from air suspension to maintain a constant static design height. The CR Height Control Valve does not respond to short duration dynamic changes in axle position.

Warning! Incorrect installation of valves and associated components can impair suspension and vehicle performance. It is extremely important that the original equipment manufacturer's specification of a one-or two-HCV system are followed when installing the air control system.

Attention! Do not use antifreeze or other solvents in air supply line. Use of solvents or antifreeze can damage seals and voids the valve warranty.

Type	CR	Controlled Response Height Control
Ports	1/8"NPT	
Dump Valve Includes	No	
Fitting Provided	No Fittings	

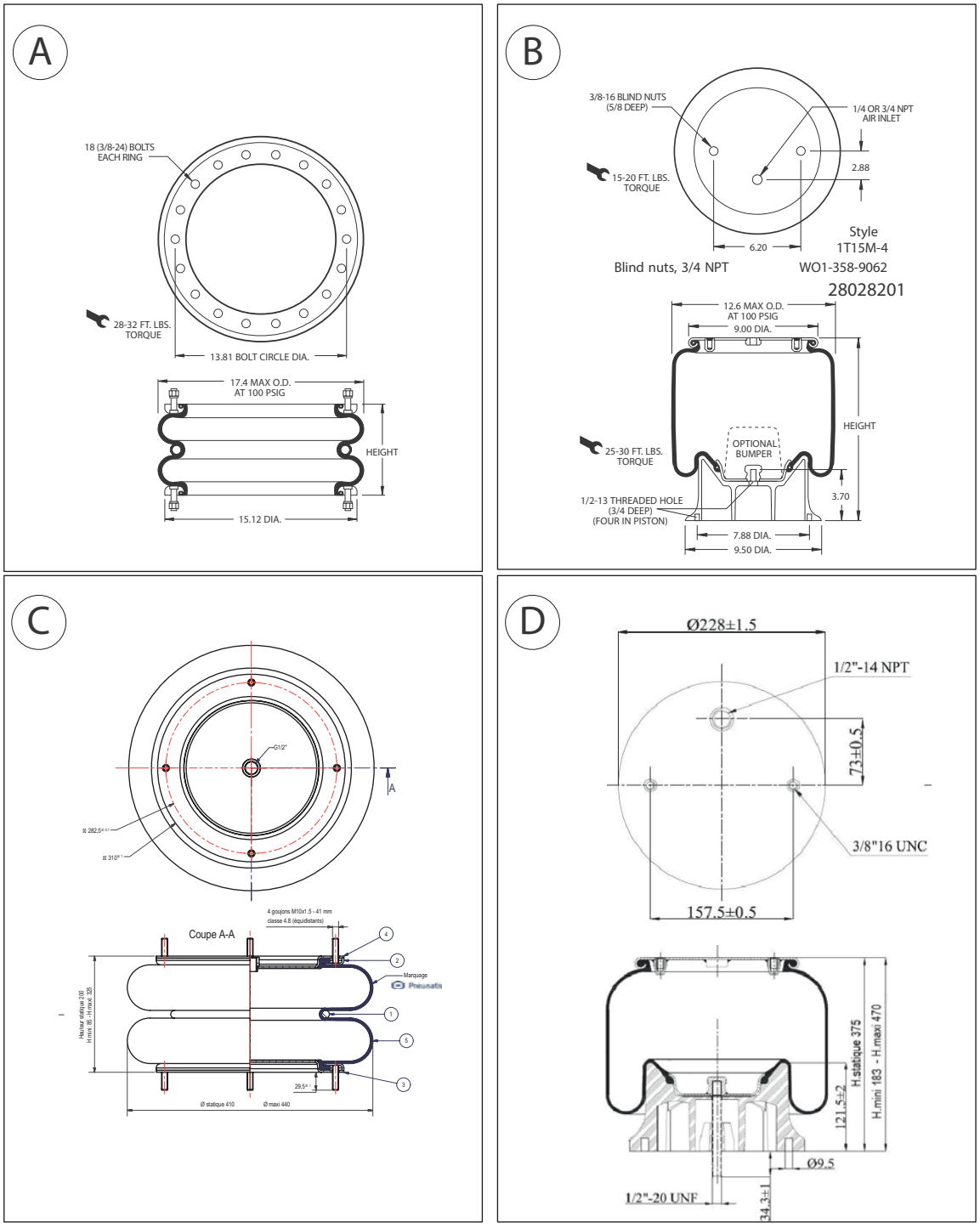


1 EXHAUST
2 OUT (To Airbag suspension)
3 IN (From Air Supply)
4 Manufactured Date Code
5 Locating Pin
6 1/4" Adjusting Lock Nut

Airbag Suspension

Airbag description

2 models of Airbag suspension are used on the front and rear axles



N°	Axle	Manufacturer	Hardi P/N	Serial number	Note
A	FRONT	FIRESTONE	28028101	From 54173 to 55951	
B	REAR	FIRESTONE	280282001	From 54173 to 55925	
C	FRONT	PNEUMATIS	28035301	From 55944 and beyond	Possible assembly P/N 28028101
D	REAR	PNEUMATIS	28035201	From 55952 and beyond	Possible assembly P/N 28028201

Characteristics of antifreeze oil for pneumatic circuit

PNEUMA SY

Pneumatic tools

Anti-freeze oil for pneumatic tools.

APPLICATIONS

Pneumatic tools

- Percussion air tools, all sound proof pneumatic tools.
- Non miscible with conventionnal mineral oils.

ADVANTAGES

Long lasting equipment

- High impact strenght due to the extreme pressure additivation preventing the equipment wear.
- Water repellent.
- Antirust.

Allows the soft running of the equipment

- Prevents the ice build up at air tool exhaust.
- Low pour point.

TYPICAL CHARACTERISTICS	METHODS	UNITS	PNEUMA SY
Density at 15°C	ISO 3675	kg/m^3	1090
Viscosity at 40°C	ISO 3104	mm^2/s	17
Viscosity at 0°C	ISO 3104	mm^2/s	88
Pour point	ISO 3016	°C	< - 40
pH		-	8,2

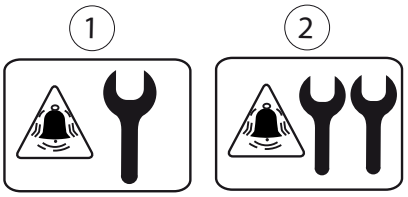
Above characteristics are mean values given as an information.

General Information

Display of the frequency of maintenance

The following alert symbols appear in the display after 150 hours and 500 hours to indicate that maintenance work needs to be performed on the sprayer:

1. Maintenance after 150 hours of use.
2. Servicing every 500 hours.



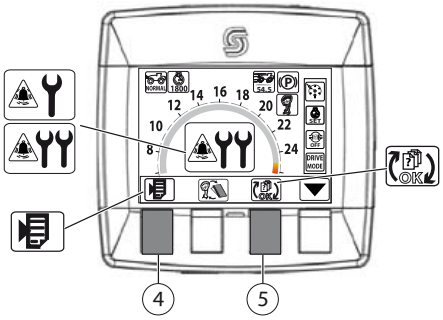
Message (1) appears only once after 150 hours to indicate that maintenance work is to be performed on the machine.

Message (2) appears periodically after 500 hours to indicate that maintenance work is to be performed on the machine.

Reset the time meter

- Simultaneously press buttons (4) and (5) for 5 seconds to reset the maintenance hour meter.

Note: Canceling the message is to be performed only after the maintenance work has been carried out.



Access to the engine

To access the engine, you must lift the hood. For more information on periodic maintenance of the engine, see page 270.

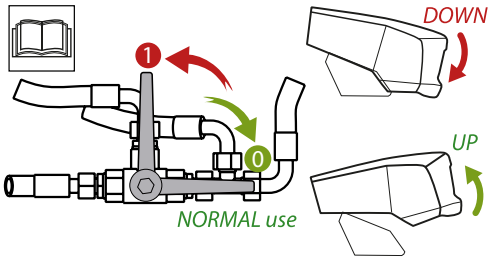
Opening the hood

- Turn valve handle to position (1).
- Use the manual pump to lift and hold the hood open to the desired height.

Closing the hood

- Gradually turn valve handle to position (0) to close the hood.

Note: The valve handle should remain in position (0) after the hood is lowered.



Engine

Check engine

The main elements must be verified before the first starting of the engine:

- Coolant Level and Engine Oil Level
- Correct tightness of the oil and fuel filters
- Tension on the belts

Daily

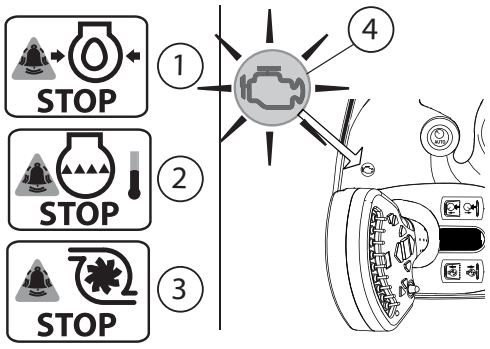
- Check sprayer filters.
- Check engine oil level.
- Fill the fuel tank.
- Check hydraulic oil level.
- Clean of the engine radiators.
- Check air filter is not clogged.

WARNING! After starting the engine, if the engine fault indicator (4) lights up and one of the 3 priority messages appears on the screen, you must stop the engine immediately to prevent damage to the engine.

Engine oil pressure is too low.

3. Engine overheating.
4. Pressure turbo-compressor too low.

Note: For more information on the error messages, see Electrical section.



Service and Maintenance intervals

	Daily	x1 10	150	250	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
				Interval +500 hours										
Hydraulic														
Hydraulic oil level	●													
Hydraulic oil			❑		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Check hydraulic filters clogged				●	●	●	●	●		●	●		●	●
Hydraulic filters			❑		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Drain the hydraulic tank			❑							❑				
Wheel Drive (gearbox)														
Oil level				● (Every 150 hours)										
Oil replacement				❑ (Every 500 hours)										
Tightening screws	●		●							●				
Cabin														
Combined filter (category 4)				❑ (Every 250 hours)										
Air conditioning gas				❑ (Every 5 years)										
Clean air conditioning condenser			●		●	●	●	●	●	●	●	●	●	●
Air conditioning compressor belt			●		●	●	●	●	●	●	●	●	●	●
Engine[1]														
Clean cooler	●													
Check oil level	●													
Check coolant level	●		●	●	●	●	●	●	●	●	●	●	●	●
Replace engine coolant				❑ (Every 2 years)										
Clean air filter	●													
Replace air filter						❑		❑		❑		❑		❑
Replace safety air filter						❑		❑		❑		❑		❑
Drain lubricating oil				❑ (Every 250 hours or 6 months) 2										
Empty water fuel prefilter														
Replace fuel prefilter					❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Replace fuel filter					❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Filling the fuel tank	●													
Clean fuel tank									❑					❑
Compressed air tank	●													
Compressed air filter and lubricator			●											
Compressed air pressure				●	●	●	●	●	●	●	●	●	●	●
Inspect V-belts roller				● (Every 2 years)										
Battery (maintenance + terminals)					●	●	●	●	●	●	●	●	●	●
Chassis and booms			●											
Tighten lug nuts		●		●										
Lubricate chassis and axles				●										
Check inflation pressure				●										
Inspect tires				●										
Dynamic brake accumulator				● (5 years)										
Spraying														
Check the boom		●		●										
Inspect spraying circuits			●	●	●	●	●	●	●	●	●	●	●	●
Lubricate 464 diaphragms pump				●										
Ace Centrifugal Pump	●			● (Weekly)						❑ (Season end)				
Inspect line filters	●													
Remove and inspect the pressure gauge				●	●	●	●	●	●	●	●	●	●	●
Check the compressed air pressure				●	●	●	●	●	●	●	●	●	●	●
	Daily	10	150	250	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
		x1		Interval +500 hours										

● Check ❑ Replacement (1) Refer to Operation manual (bulletin 4021531)

Maintenance of the Engine

Change engine oil and filter every 250 or 6 months

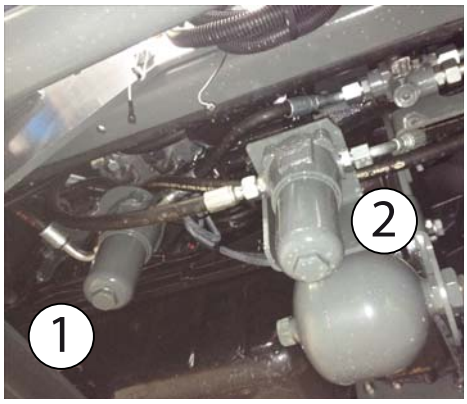
Drain Plug location

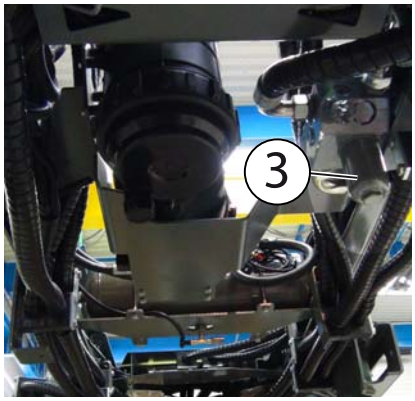
Fuel water separator filter location.

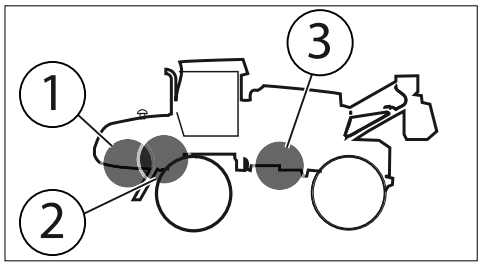
Maintenance

Auxiliary hydraulic filters

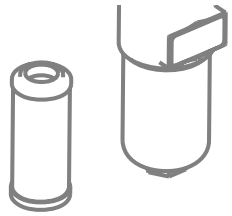
Use only original parts - P/N 782856







500



1. Steering valve, track width, sprayer hydraulics filter 2. Brake circuit filter	3. Regulating valve filter for hydraulic motor to ACE Pump.

To replace the filter cartridge:

- Unscrew the filter housing.
- Remove the filter cartridge and replace it with a new one.

WARNING! It is critical to use an original filter.

Tank hydraulic filters

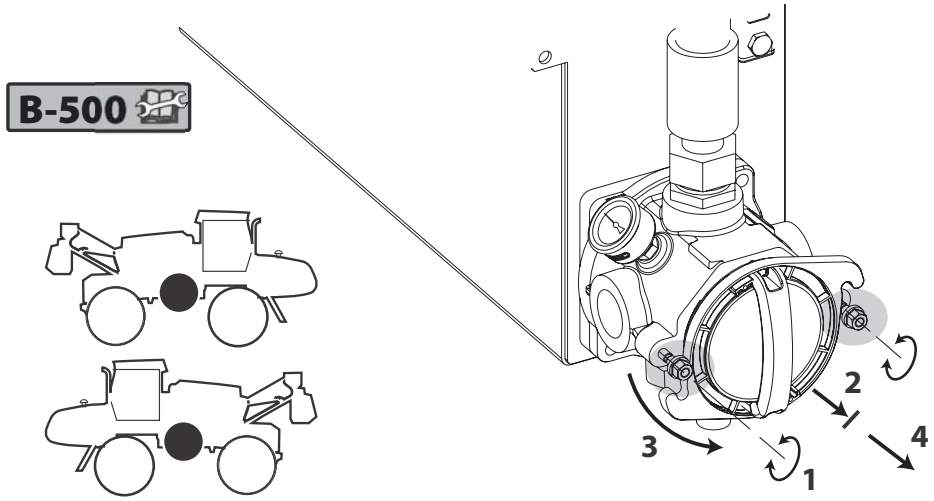
WARNING! When replacing the filters, wear protective gloves to avoid the oil making any contact with the skin.

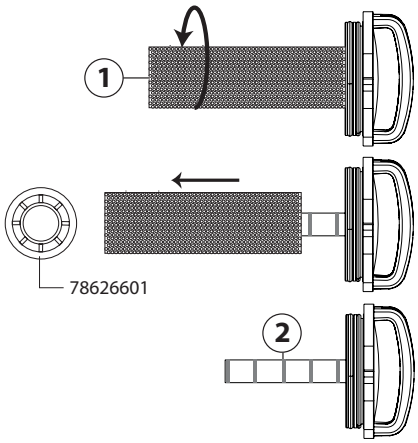
DANGER! Hot oil can cause serious burns.

WARNING! It is critical to use original filters.

ATTENTION! The filter elements should be fitted on either side of the tank. They should always be replaced at the same time.

ATTENTION! A drip pan should be put in place to collect the used oil contained in the filter housing. A valve at the end of the filter housing keeps the oil from the tank.





- Unscrew the 2 nuts, without disassembling.
- Pull the cover out to the limit stop of the nuts. A one-way valve at the end of the filter housing keeps the oil from the tank.
- Turn the cover and pull the assembly completely off.
- Unscrew the filter element.
- Carefully clean the magnetic core with a cloth
- Replace the filter element

500 hours service - Hydraulic filters in the tank

Prior to Serial 55864

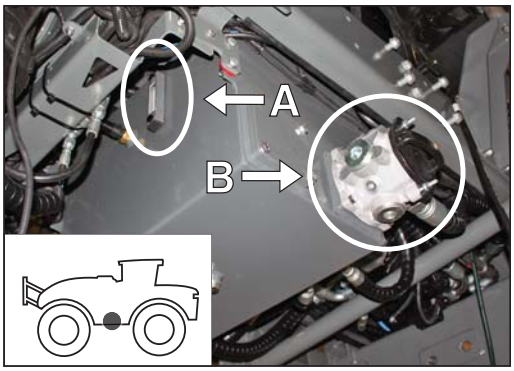
WARNING! Wear protective gloves while replacing filters to prevent the oil from making any contact with the skin.

DANGER! Hot oil can cause serious burns.

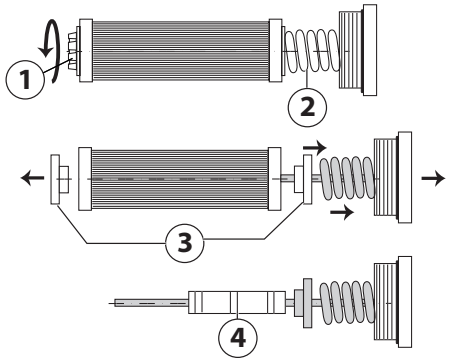
WARNING! It is essential to use an original filter.

A visual gauge (A) is located on the rear side of the hydraulic reservoir. The filter elements (B) are located on either side of the tank. They should always be replaced at the same time.

A drip pan should be put in place to collect the used oil contained in the filter housing. A valve at the end of the filter housing retains the oil in the tank.



- Completely unscrew the lid and remove the filter assembly.
- Unscrew the knob (1) to remove the filter. To facilitate this operation, gently press the spring (2).
- Remove the caps from the filter element (3).
- Carefully clean the magnetic core (4) with a cloth.

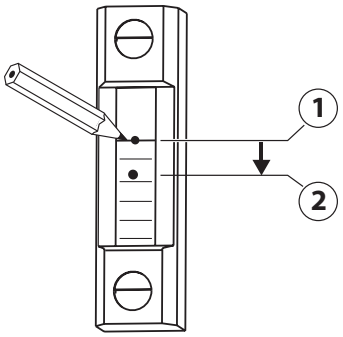


WARNING! It is essential to use original filter elements.

WARNING! Before replacing the filters, note the oil level in the tank (1).

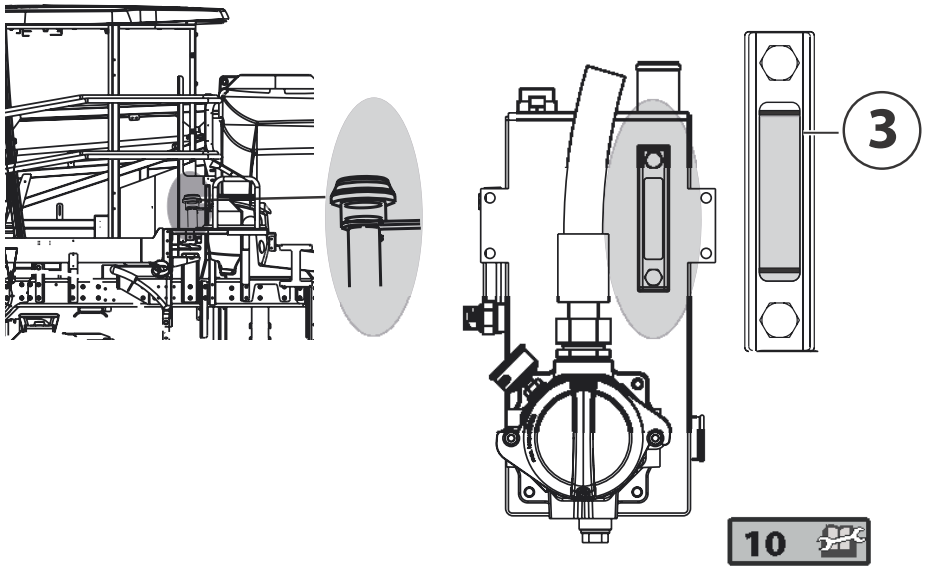
1. Initial level before replacing filters
2. Level after replacing the filters

- After installing the new filter, the oil level will drop by about 3/8" (10 mm), which means that the filters have been installed correctly.
- Top up with oil to the maximum level.
- Start the engine on idle then stop it after a few seconds. This evacuates the air contained in the hydraulic system.
- Start the engine again on idle and then gradually increase the engine speed.



Note: The oil drained from the filters must never be re-used as it may damage the hydraulic system components.

Hydraulic oil level



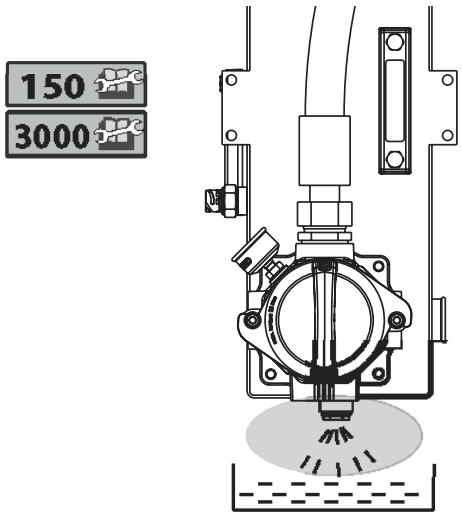
- Fill up to the maximum level
- Start the engine on idle then stop it after a few seconds. This evacuates the air contained in the hydraulic system.
- Start the engine again on idle and then gradually increase the engine speed.
- Top off the oil to the maximum level (3) again.

Use only original filter element - Part Number: 78626601.

Use the recommended hydraulic oil, refer to chapter "Table of recommended lubricants" page 20

ATTENTION! The oil running from the filters must never be re-used as it may damage the hydraulic system components.

Hydraulic oil change



- Remove the plug for emptying the tank

Towing the machine

General information

Before any towing of the machine, following a failure in the engine or the hydraulic transmission, it is essential to check the hydraulic motors and the transmission pump.

ATTENTION! To avoid any risk of damage to the transmission components (pump, motors etc.), the machine should be towed over a short distance and at low speed.

Before moving the machine, you should:

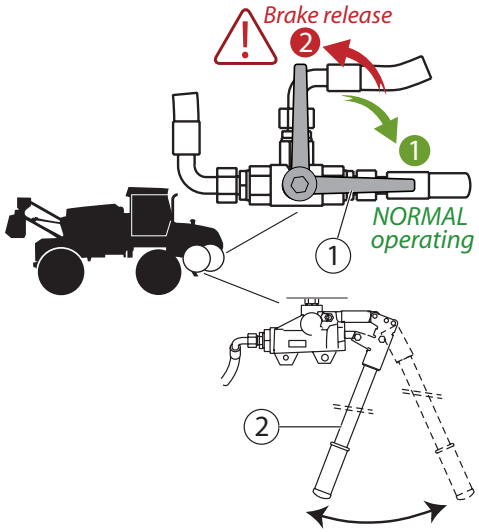
1. Release the hydraulic motor brakes.
2. Release the high pressure valves on the transmission pump.

Releasing the hydraulic motor brakes

1. Valve in NORMAL operating mode.
2. Valve in BRAKE RELEASE mode.

For releasing the brakes of the hydraulic motors, apply the following procedure:

- Turn the handle (1) of the release valve to the position 1
- Place the handle (2) to the hand pump.
- Operate the arm lever pump until the brakes on both motors are fully released.



NOTE! The arm lever pump (2) is placed into the storage box.

ATTENTION! Do not continue to work the hand pump after the brakes have been fully released. Excessive pressure could damage the motor braking mechanism.

ATTENTION: An excessive towing distance and too high of a speed could damage the motor braking mechanism.

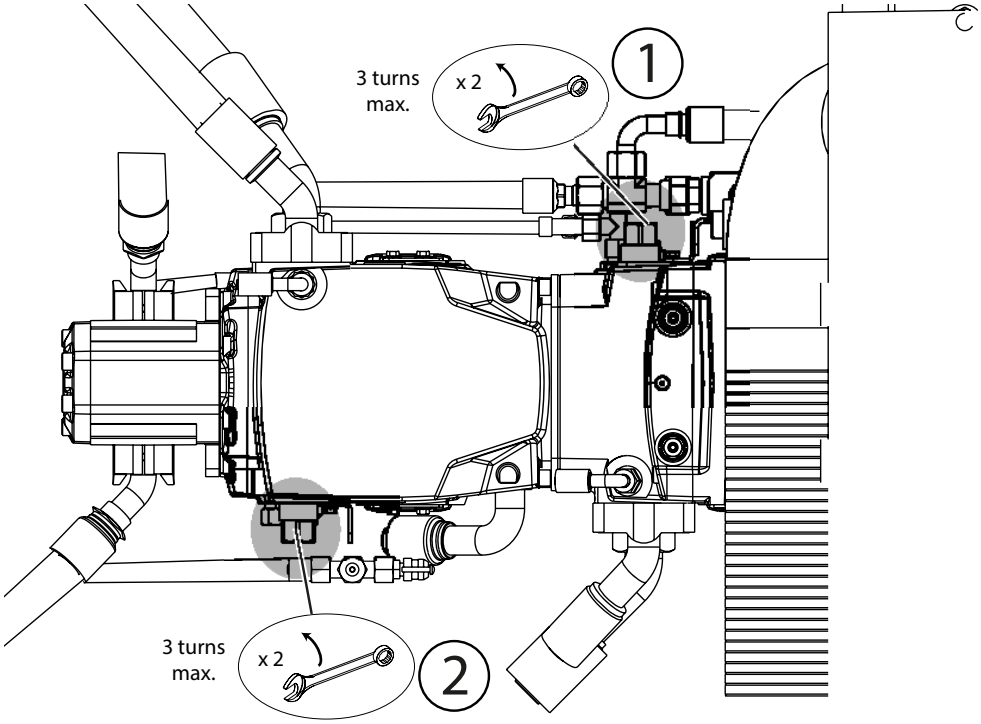
ATTENTION: After towing or before starting the machine again, always engage the parking brake by turning the valve handle to vertical position and remove the brake release handle.

Release the high pressure valves of the transmission pump

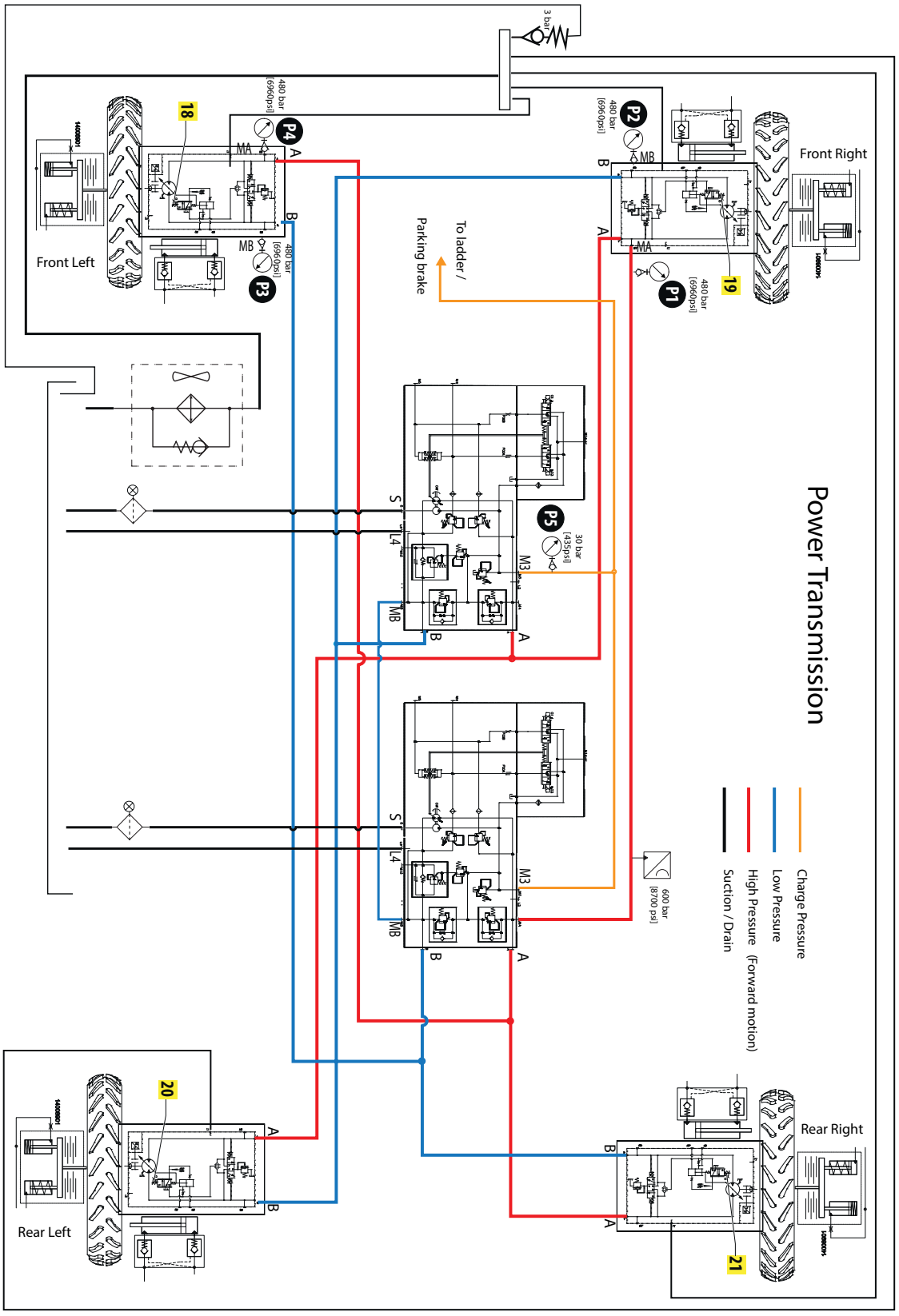
This operation consists of releasing the 2 high pressure valves located on the transmission pump to allow free circulation of oil in the system when towing the machine.

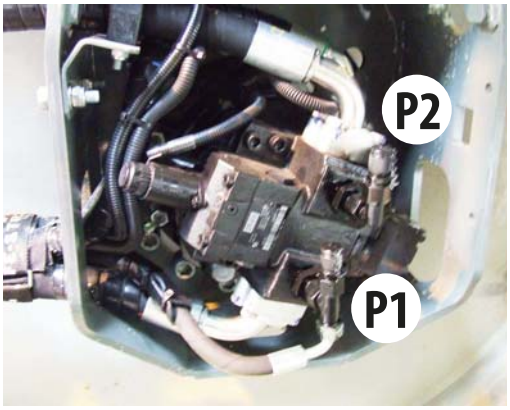
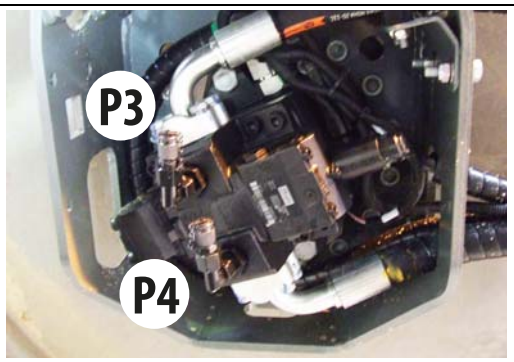
- Loosen the 2 valves (1) and (2) by a maximum of 3 turns to allow free circulation of the oil in the hydraulic transmission.

WARNING: The high pressure valves should be tightened before the machine is started up again.

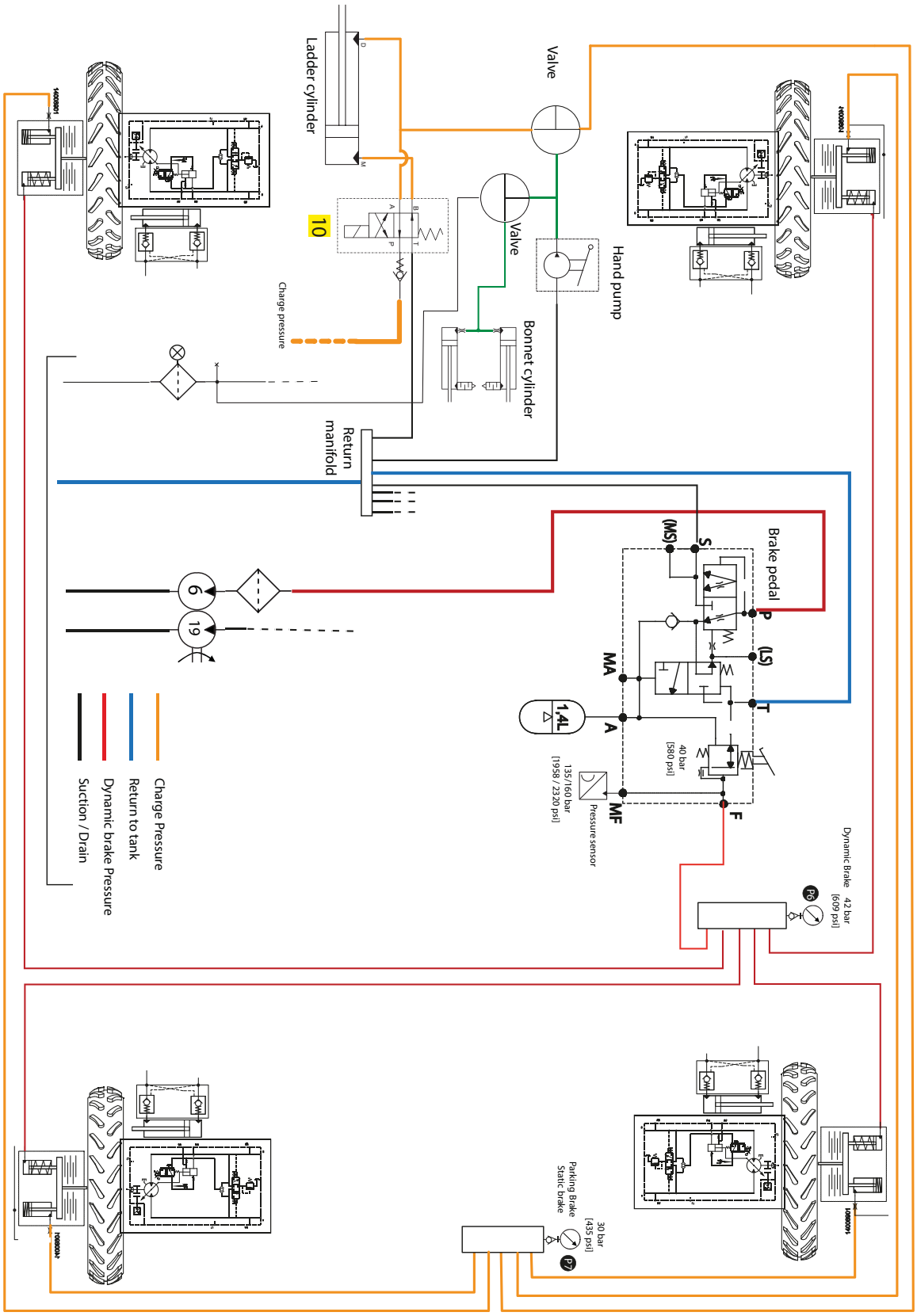


Power transmission circuit

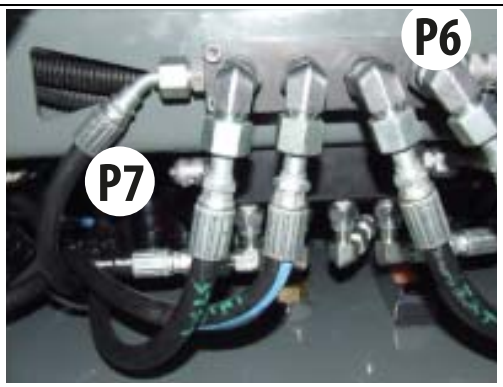
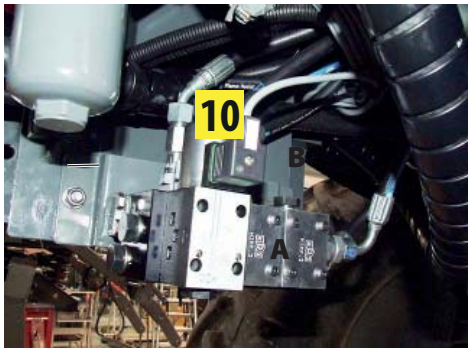


Power transmission Location: Front Right motor **P1:** Port A - 6961 psi [480 bar] max. **P2:** Port B - 6961 psi [480 bar] max.	
Power transmission Location: Front Left motor **P3:** Port B - 6961 psi [480 ± 10 bar] max. **P4:** Port A - 6961 psi [480 ± 10 bar] max.	
Charge Pressure Location: Left hand Side of the hydrostatic pump **P5:** Nominal pressure 435 psi [30 bar] at 1500 rpm	

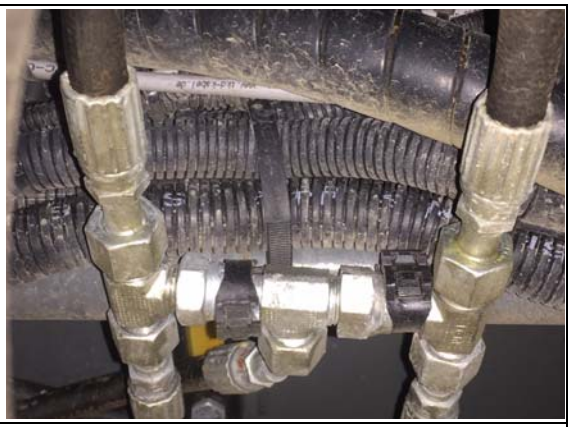
Parking and Dynamic brake



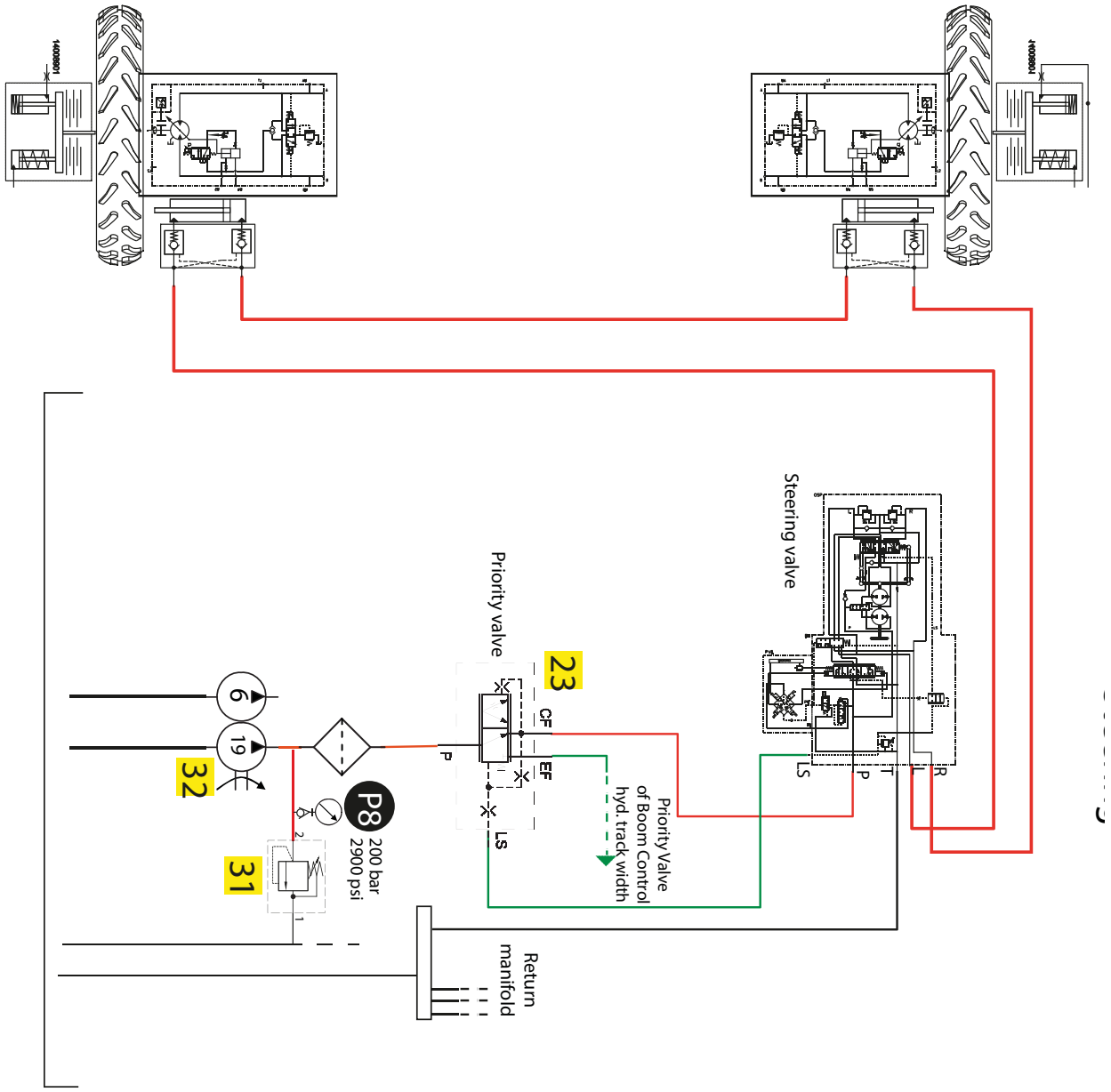
New Style Brakes

Dynamic and static brakes Location: Under the machine and behind the hydraulic tank **P6:** Static brake (parking brake) - 435 psi[30 ± 2 bar] max. Minimum pressure to release the brake - 218 psi [15 bar] **P7:** Dynamic brake - 580 psi [40 ± 1 bar] max.	
Static brake solenoid Location: At the left hand side and inner chassis 10. Parking brake solenoid.	

Old Style Brakes

Dynamic and static brakes Location: Under the machine and behind the hydraulic tank **P6:** Static brake (parking brake) - 435 psi[30 ± 2 bar] max. Minimum pressure to release the brake - 218 psi [15 bar]	
Static brake brakes Location: Under the cab center of hydraulic tank **P7:** Dynamic brake - 580 psi [40 ± 1 bar] max.	
Static brake solenoid Location: At the left hand side inner chassis Parking brake solenoid.	

Steering hydraulic diagram

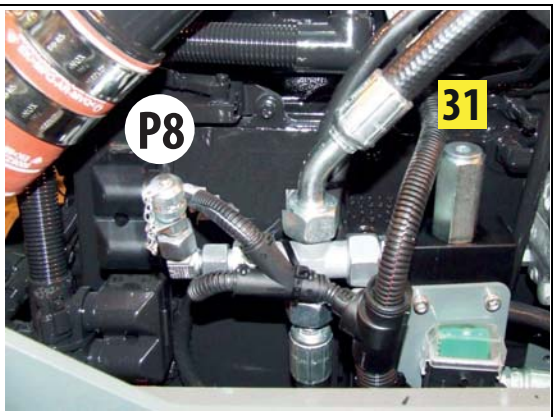


Steering - Boom Control - Track Width Adjustment

Location: At the left hand side of he engine

P8: 2900 psi [200bar] max.

- Adjust the relief valve (31) to achieve the required pressure (P8)



Priority Valve for Steering

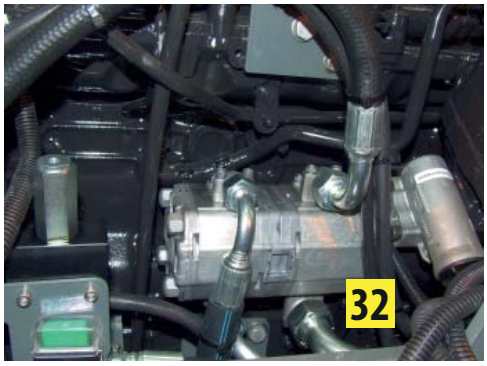
Location: At the left hand side of he engine

No adjustment is required for the priority valve

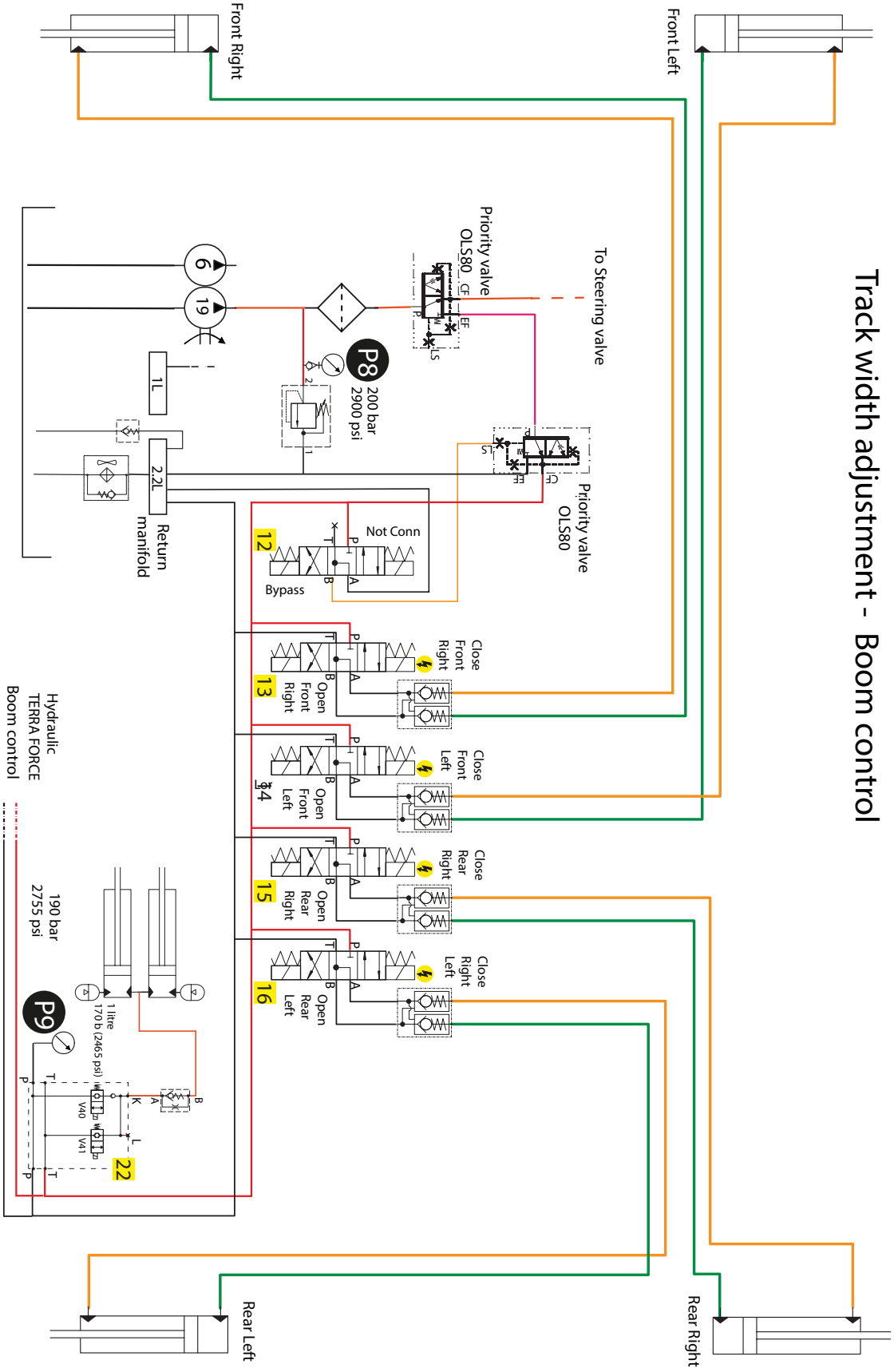
Steering and Boom Controls pump (19 cc)

Location: Mounting on the left hand side of engine

The 10 cc hydraulic pump (32) is flanged to the engine



Track width adjustment, Banjo pump, Boom controls

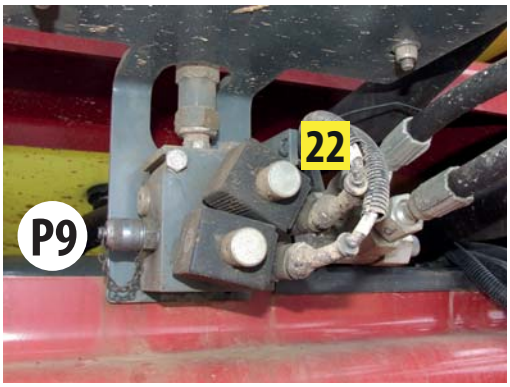


Boom Control

Location: at the rear of the machine

P9: 2755 psi [190 bar].

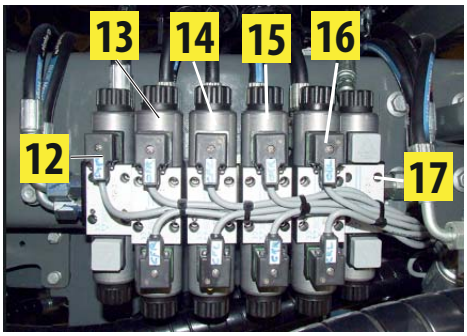
- Adjust the relief valve (31) if necessary, located at the left hand side of the engine, to achieve the pressure (P9).



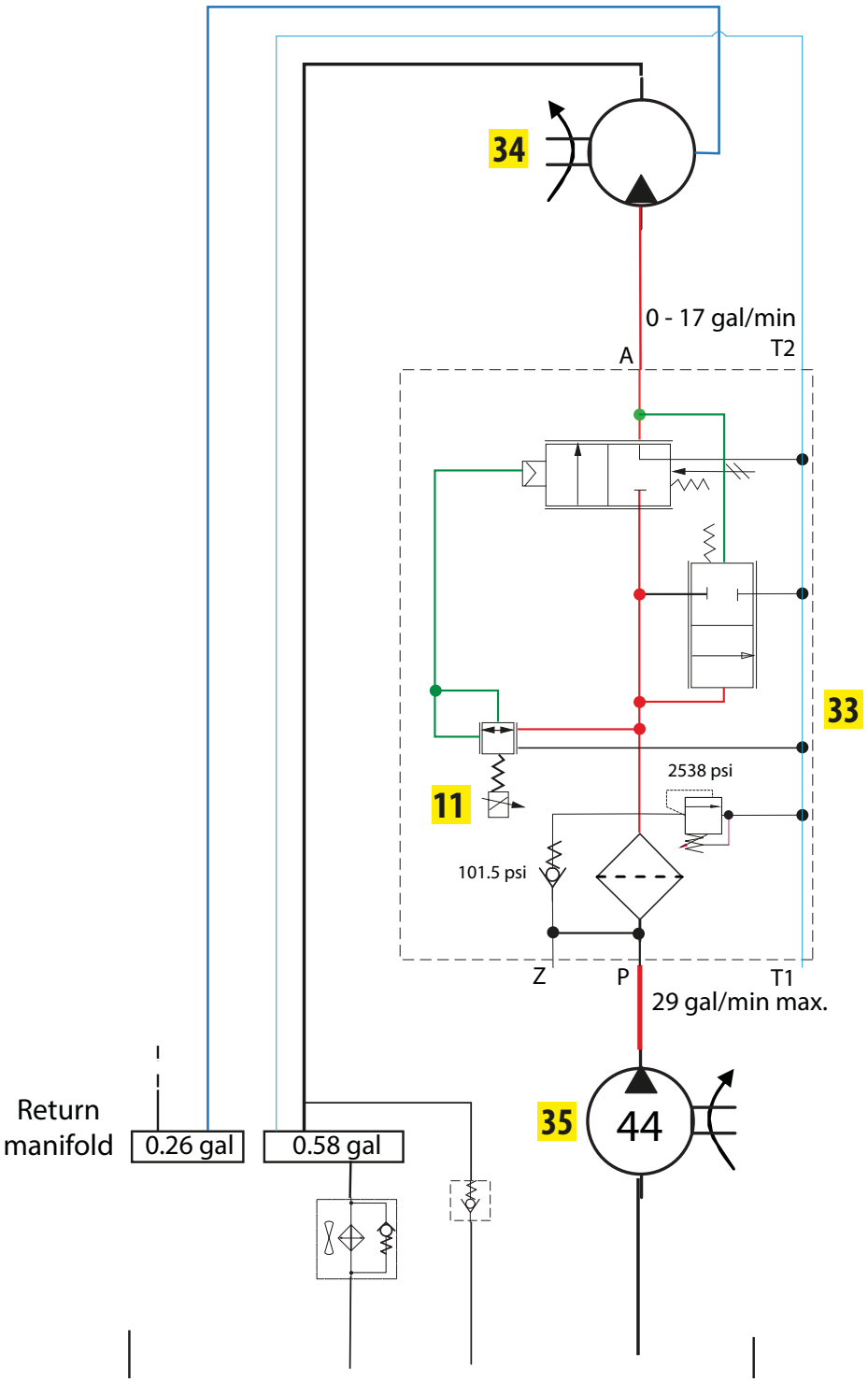
Track Adjustment control

Location: at the left hand side of the machine

12. By-pass solenoid
13. Front Right solenoid
14. Front Left solenoid
15. Rear Right solenoid
16. Rear Left solenoid
17. Banjo pump solenoid



ACE Pump control



Ace pump control

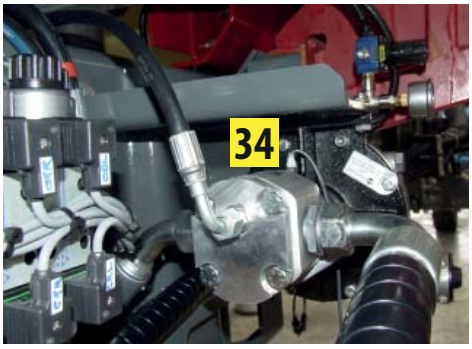
Location: at the left hand side of the machine
Oil flow regulator with integrated filter (33)

The pressure is preset. It is not necessary to change the pressure of the circuit.

Hydraulic motor for spraying pump (Ace pump)

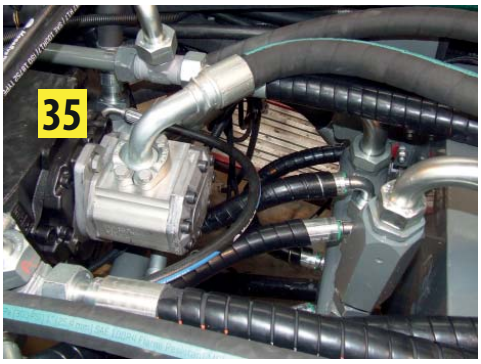
Location: Flanged to the spraying pump

The drain port is located at the top of the hydraulic motor.

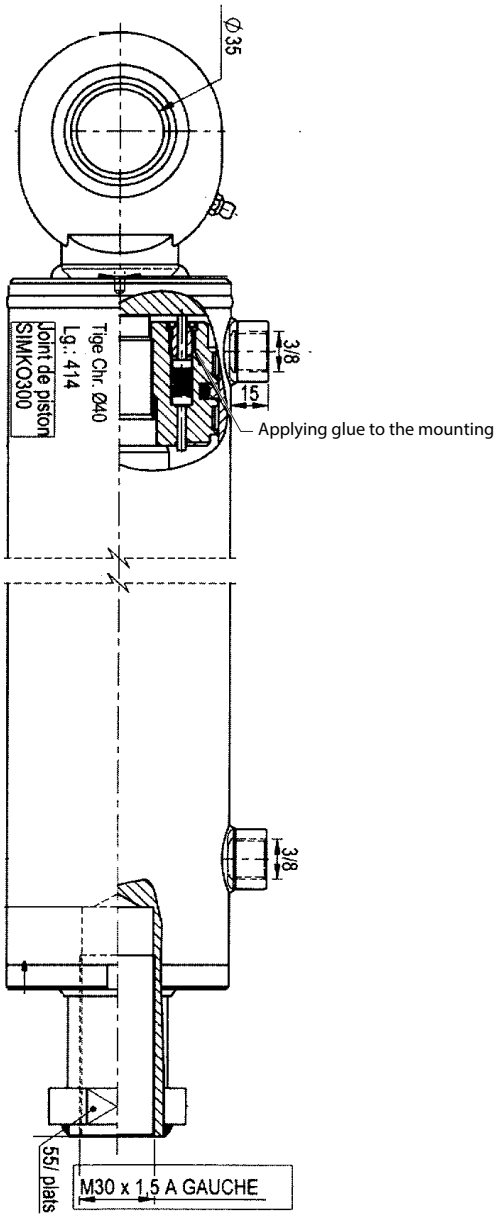


Hydraulic pump for spraying pump (Ace pump)

Location: Flanged to the hydrostatic pump



Steering cylinder characteristics



Description	Dimension	
Double acting cylinder / self-bleeding cylinder		
Total length	490 mm	19,29 inch
Stroke	245 mm	9,645 inch
Cylinder bore	80 mm	3,149 inch
Diameter of rod	40 mm	1,574 inch
Diameter of left-hand-thread (metric)	M30 x1,5 mm	
Cap and rod ports	3 / 8"	
Seal kit reparation	26003301	

AXIAL PISTON PUMP

H1-P-115-R-A-A4-C2-N-E2-G-G2-H4-L-45-L-45-L-L-30-PN-NNN-G21

HYDRAULIC - SAUER H1 PUMP

Introduction

Overview

This manual includes information on the installation, maintenance, and minor repair of H1 pumps. It includes a description of the unit and its individual components, troubleshooting information, and minor repair procedures.

Warranty

Performing adjustments and minor repairs according to the procedures in this manual will not affect your warranty. Major repairs requiring the removal of a unit's center section, servo sleeves, or front flange voids the warranty unless a Sauer-Danfoss Authorized Service Center performs them.

General instructions

Follow these general procedures when repairing H1 variable displacement closed circuit pumps.

Remove the Unit

Prior to performing repairs, remove the unit from the vehicle/machine. Chock the wheels on the vehicle or lock the mechanism to inhibit movement. Be aware that hydraulic fluid may be under high pressure and/or hot. Inspect the outside of the pump and fittings for damage. Cap hoses after removal to prevent contamination.

Keep it Clean

Cleanliness is a primary means of assuring satisfactory pump life on either new or repaired units. Clean the outside of the pump thoroughly before disassembly. Take care to avoid contamination of the system ports. Cleaning parts by using a clean solvent wash and air drying is usually adequate.

As with any precision equipment, you must keep all parts free of foreign material and chemicals. Protect all exposed sealing surfaces and open cavities from damage and foreign material. If left unattended, cover the pump with a protective layer of plastic.

Replace all O-rings and Gaskets

We recommend you replace all O-rings and seals during service. Lightly lubricate O-rings with clean petroleum jelly prior to assembly.

Secure the Unit

For repair, place the unit in a stable position with the shaft pointing downward. It will be necessary to secure the pump while removing and torquing fasteners and components.

Safety Precautions

Always consider safety precautions before beginning a service procedure. Protect yourself and others from injury. Take the following general precautions whenever servicing a hydraulic system.

WARNING! Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

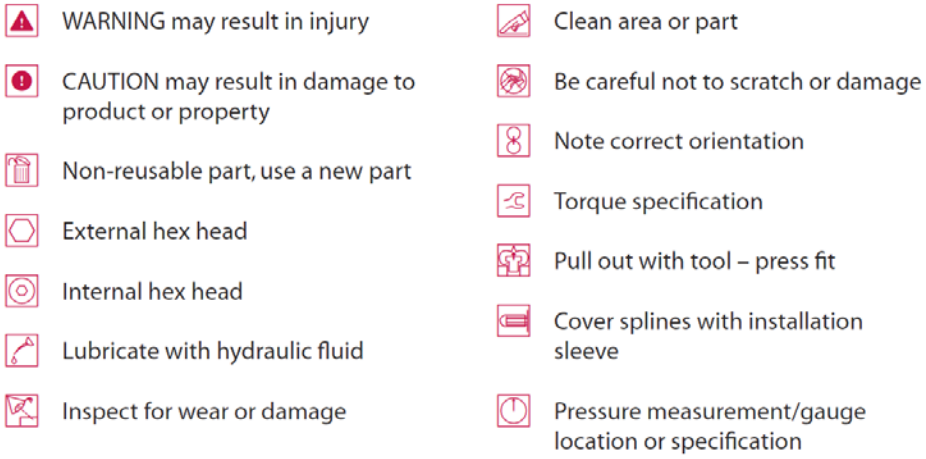
WARNING! Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

WARNING! Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. This fluid may also be hot enough to cause burns. Use caution when dealing with hydraulic fluid under pressure. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Never use your hand or any other body part to check for leaks in a pressurized line. Seek medical attention immediately if you are cut by hydraulic fluid.

WARNING! Protect yourself from injury. Use proper safety equipment, including safety glasses, at all times.

WARNING! hydraulic fluid contains hazardous material. Avoid prolonged contact with hydraulic fluid. Always dispose of used hydraulic fluid according to state, and federal environmental regulations.

Symbols Used in Sauer-Danfoss Literature

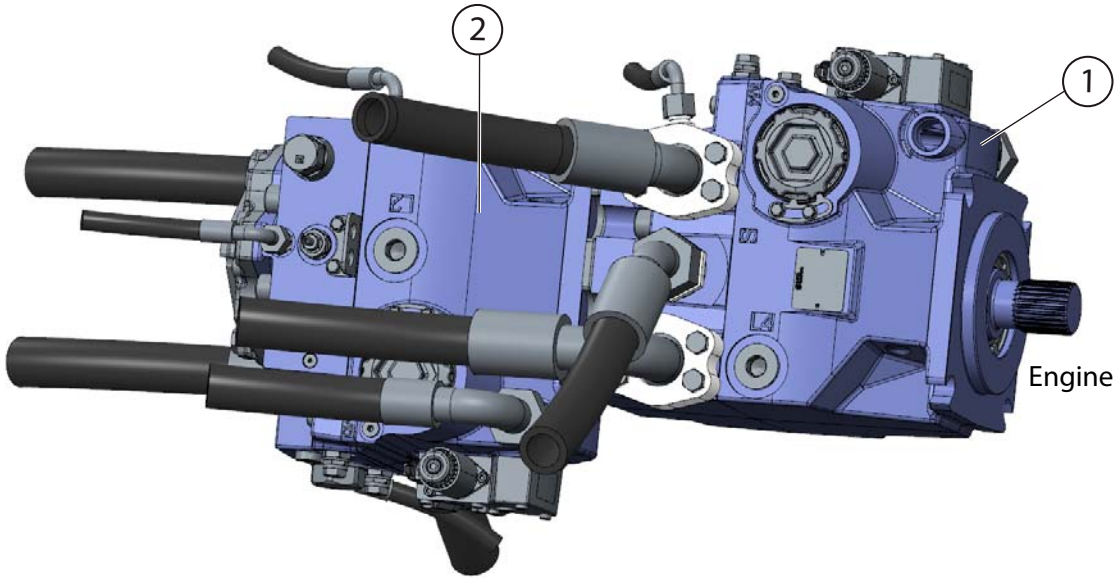


The symbols above appear in the illustrations and text of this manual. They are intended to communicate helpful information at the point where it is most useful to the reader. In most instances, the appearance of the symbol itself denotes its meaning. The legend above defines each symbol and explains its purpose.

HYDRAULIC - SAUER H1 PUMP

Identification

H1 Axial Piston Pumps
Technical Information
Frame 115/130 cm³ Single Pump



Pos.	HARDI P/N	SAUER DANFOSS Code	SAUER DANFOSS see details "Description Code Details" page 87	Comment	Machines Concerned
1	78307201	83030520	H1-P-115-R-A-A4-C2-N-E2-G-G2-H4-L-45-L-45-L-L-30-PN-NNN-G21	(Current version) Charge pressure = 435psi (30bar)	From S/N 55809 (and only 55789)
	78303801	83015464	H1-P-115-R-A-A4-C2-N-E2-G-G2-H4-L-45-L-45-L-L-24-PN-NNN-G21	(No longer available) Charge pressure = 348psi (24 bar)	Until S/N 55808
2	78307101	83030419	H1-P-115-R-A-A4-C2-N-E8-G-G3-H3-L-45-L-45-L-L-30-PN-NNN-G21	(Current version) Charge pressure = 435psi (30bar)	From S/N 55809 (and only 55775)
	78303601	830154463	H1-P-115-R-A-A4-C2-N-E8-G-G3-H3-L-45-L-45-L-L-24-PN-NNN-G21	(No longer available) Charge pressure = 348psi (24 bar)	Until S/N 55808

Replacing the H1 pump

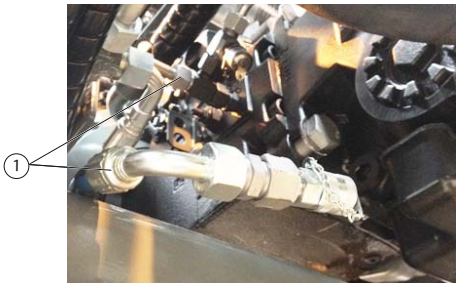
The pumps H1 (P/N 78303601and 78303801) are no longer available. In this case, if a new H1 pump is installed (P/N 78307101or 78307201), the charge pressure has to be set at the same value of the original pump that is 348psi **24 bar** at **1500** engine rpm.

To set the charge pressure on the pump, refer to "Charge Pressure Valve" page 91

Procedure

Initially the charge pressures are connected together. The circuit must be independent to set the charge pressure of the original pump

1. Disconnect the hydraulic. hose to separate the charge circuit


1

Description Code Details

Displacement

115	**115.2** cm^3 [7.03 in^3]
130	**130.0** cm^3 [7.93 in^3]

A Rotation

L	**L**eft hand (counter clockwise)
R	**R**ight hand (clockwise)

B Product Version

B	Revision code

D Control

A2	Electric Displacement Control (EDC) 12V, Deutsch connector
A3	Electric Displacement Control (EDC) 24V, Deutsch connector
A4	Electric Displacement Control (EDC) 12V, Deutsch connector, Manual override
A5	Electric Displacement Control (EDC) 24V, Deutsch connector, Manual override
A9	Forward-Neutral-Reverse (FNR) 12V, Deutsch connector, Manual override
B1	Forward-Neutral-Reverse (FNR) 24V, Deutsch connector, Manual override
A8	Non Feedback Proportional Electric (NFPE) 12V, Deutsch connector, Manual override *(align with option E: Displacement Limiters & option W: Special Hardware)*
B8	Non Feedback Proportional Electric (NFPE) 24V, Deutsch connector, Manual override *(align with option E: Displacement Limiters & option W: Special Hardware)*

F Orifices

C1	Orifices, 0.8 mm in Servo supply 1 and 2, recommended for propel applications
C2	Orifices, 1.3 mm in Servo supply 1 and 2 (Standard), recommended for propel applications
C3	No orifice, recommended for non-propel applications

E Displacement Limiters

N	None
C	No limiters, with nested springs (required for NFPE)
B	Adjustable externally *(see option Y: Settings for adjustment, if applicable)*
D	Adjustable externally with nested springs, required for NFPE *(see option Y: Settings for adjustment, if applicable)*

G Endcap Options

	Twin Port, 4-Bolt Split Flange (Code 62)					
Match with below Options (K)	Auxiliary Mounting Pad None, SAE-A, B, B-B, C			Auxiliary Mounting Pad SAE-D		
Match with below Options (T)	Suction Filtration	Integral Full Charge Flow Filtration	Remote Full Charge Flow Filtration	Suction Filtration	Integral Full Charge Flow Filtration	Remote Full Charge Flow Filtration
D3		X				
D5					X	
D6	X					
D7						X
D8			X			
D9				X		

H Mounting

G	SAE D 4-bolt

J Input Shaft

G3	13 teeth splined shaft 8/16 pitch
G2	27 teeth splined shaft 16/32 pitch

K Auxiliary Mounting Pad (align with option G: Endcap Selection)

NN	None
H2	SAE A pad, 9 teeth 16/32 coupling, shipping cover
H1	SAE A pad, 11 teeth 16/32 coupling, shipping cover
H3	SAE B pad, 13 teeth 16/32 coupling, shipping cover
H5	SAE B-B pad, 15 teeth 16/32 coupling, shipping cover
H6	SAE C pad, 14 teeth 12/24 coupling, shipping cover
H4	SAE D pad, 13 teeth 8/16 coupling, shipping cover

M Overpressure Protection Type and Setting Side "A" **

N Overpressure Protection Type and Setting Side "B" **

*** Pressure Protection Type must be the same for Side "A" and "B"*

L		High pressure relief valve + pressure limiters with bypass
	K	High pressure relief valve with bypass (no pressure limiters)
L15	—	150 bar [2180 psi]
L20	**K20**	200 bar [2900 psi]
L23	**K23**	230 bar [3336 psi]
L25	**K25**	250 bar [3630 psi]
L28	**K28**	280 bar [4061 psi]
L30	**K30**	300 bar [4350 psi]
L33	**K33**	330 bar [4786 psi]
L35	**K35**	350 bar [5080 psi]
L38	**K38**	380 bar [5510 psi]
L40	**K40**	400 bar [5800 psi]
L42	**K42**	420 bar [6090 psi]
L43	—	430 bar [6237 psi] (115 cm^3 only)
L44	—	440 bar [6382 psi] (115 cm^3 only)
L45	**K45**	450 bar [6960 psi] (115 cm^3 only)

Use to selection for ports "A" and "B"

S Charge Pump

A	26 cm^3/rev [1.59 in^3/rev]
L	34 cm^3/rev [2.07 in^3/rev]

T Filtration Options (align with option G: Endcap Selection)

L	Suction filtration *(see basic drawings)*
M	Integral full charge flow filtration with bypass sensor and bypass
P	Remote full charge flow filtration *(see endcap drawings, order remote filter separately)*

V Charge Pressure Relief Setting

20	20 bar [290 psi]
24	24 bar [348 psi]
30	30 bar [435 psi]

W Special Hardware Features

NN	None
M1	NFPE valve plate *(align with option D: Control Selection and option E: Displacement Limiters)*

X Paint and Nametag

NNN	Black paint and Sauer-Danfoss nametag

Y Special Settings

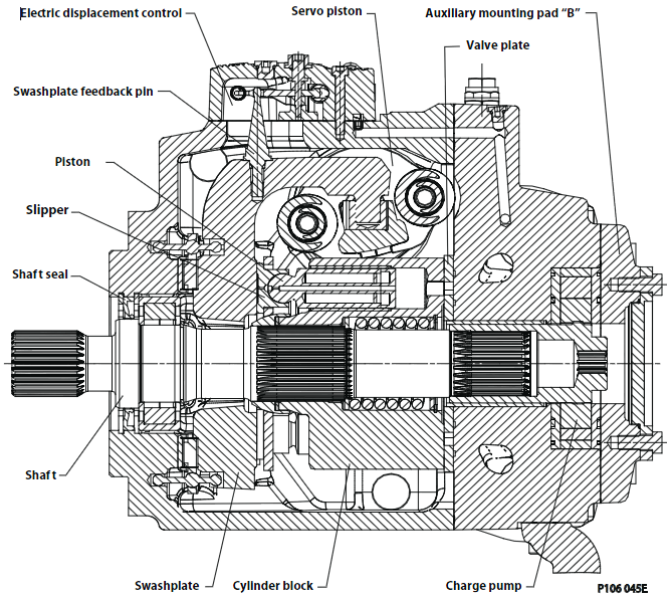
NNN	None

Design

Sauer-Danfoss H1 closed circuit piston pumps convert input torque into hydraulic power. The input shaft transmits rotational force to the cylinder block. Bearings at the front and rear of the pump support the shaft. Splines connect the shaft to the cylinder block. A lip-seal at the front end of the pump prevents leakage where the shaft exits the pump housing. The spinning cylinder block contains nine reciprocating pistons. Each piston has a brass slipper connected at one end by a ball joint. The block spring, ball guide, and slipper retainer hold the slippers to the swash-plate. The reciprocating movement of the pistons occurs as the slippers slide against the inclined swash-plate during rotation. Via the valve plate, one half of the cylinder block is connected to low pressure and the other half to high pressure. As each piston cycles in and out of its bore, fluid is replenished by charge flow and displaced to the outlet thereby imparting hydraulic power into the system. A small amount of fluid is allowed to flow from the cylinder block/valve plate and slipper/swash-plate interfaces for lubrication and cooling. Case drain ports return this fluid to the reservoir.

The angle of the swash-plate controls the volume and direction of fluid displaced into the system. The servo piston controls the angle of the swash-plate. The pump control, by varying the pressure at the servo piston, controls the piston's position. An electric signal to the control coils transmits the command from the operator to the pump. Mechanical feedback of the swash-plate position to the control through the feedback pins allows for very precise displacement control and increases overall system stability. Non-feedback control options do not use the mechanical feedback link.

Cross section view



The System Circuit

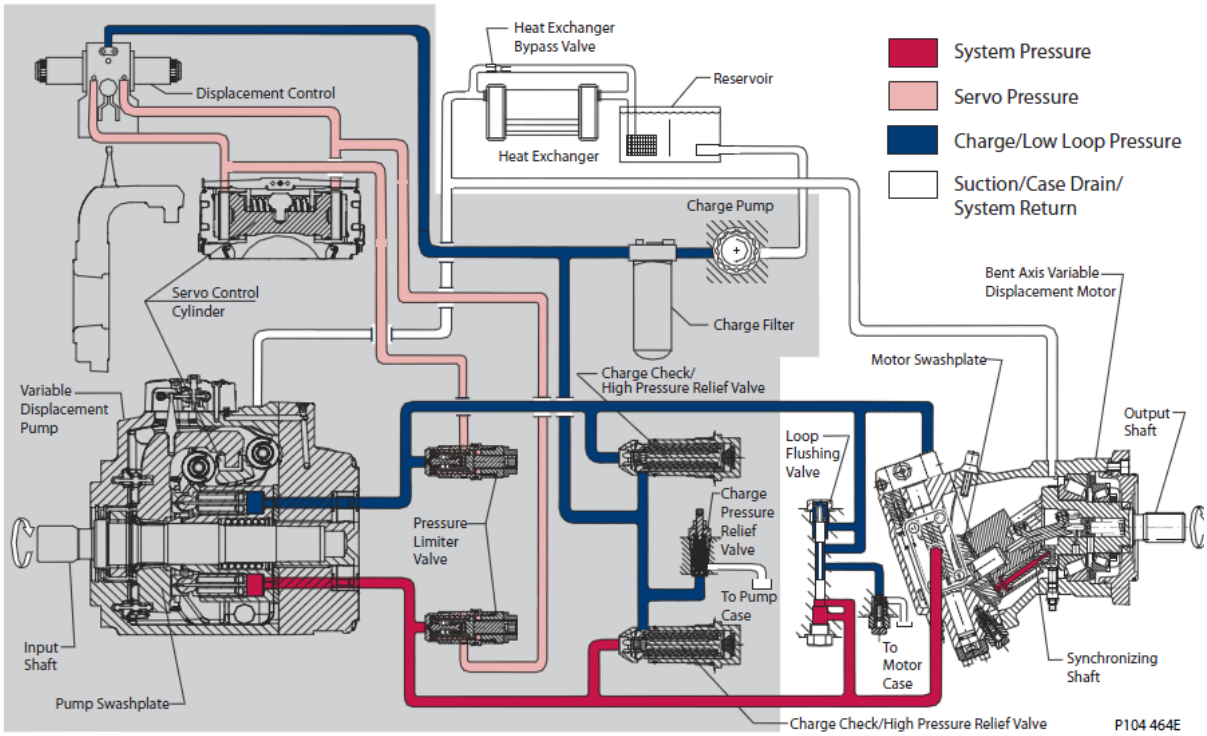
The Basic Closed Circuit

Hydraulic lines connect the main ports of the pump to the main ports of the motor. Fluid flows in either direction from the pump to the motor and back. Either of the hydraulic lines can be under high pressure. In pumping mode the position of the pump swash-plate determines which line is high pressure as well as the direction of fluid flow.

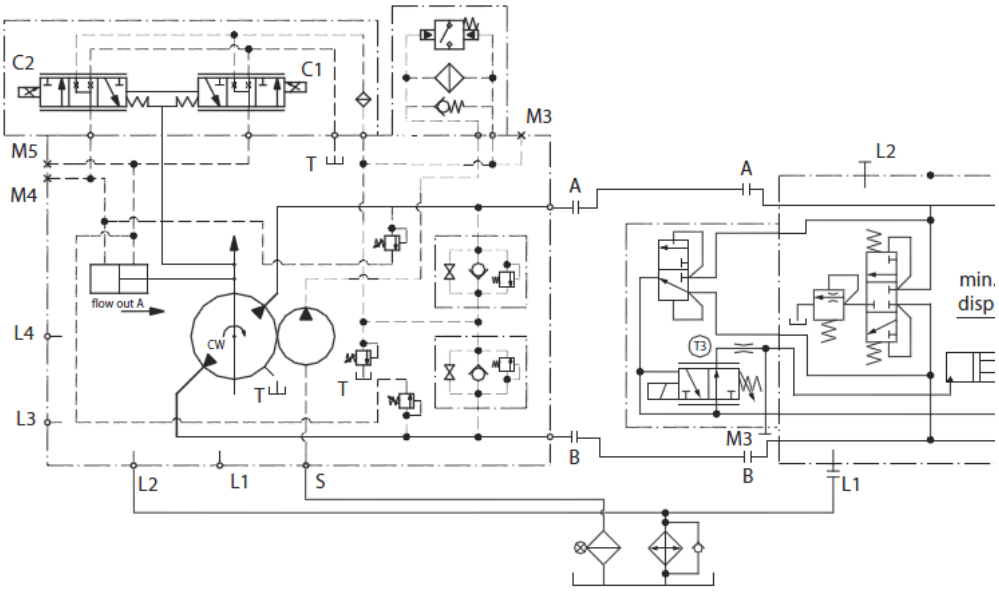
Case drain and Heat Exchanger

The pump and motor require case drain lines to remove hot fluid from the system. The pump and motor drain from the topmost port to ensure the cases remain full of fluid. The motor case drain can connect to the lower drain port on the pump housing or it can tee into the case drain line upstream of the heat exchanger. A heat exchanger with bypass valve cools the case drain fluid before it returns to the reservoir.

System Circuit Diagram



System Schematic



Above schematic shows the function of a hydrostatic transmission using an H1 axial piston variable displacement pump with electric displacement control (EDC) and a series 51-1 bent axis variable displacement motor with two-position control (T1).

Pressure Limiter Valve

Pressure limiter valves provide system pressure protection by compensating the pump swash-plate position when the set pressure of the valve is reached. A pressure limiter is a non-dissipative (non heat generating) pressure regulating system.

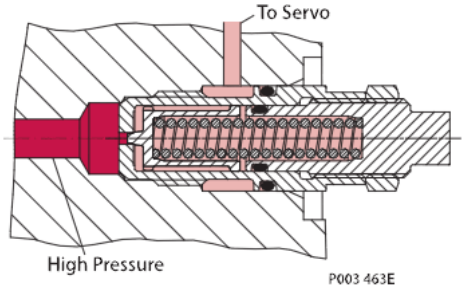
Each side of the transmission loop (and each section of the tandem pump) has a dedicated pressure limiter valve that is set independently. Each system port may have a different pressure limiter setting.

The pressure limiter setting is the maximum differential pressure between the high and low loops. When the pressure limiter setting is reached, the valve ports oil to the low-pressure side of the servo piston. The change in pressure across the servo rapidly reduces pump displacement. Fluid flow from the valve continues until the resulting drop in pump displacement causes system pressure to fall below the pressure limiter setting.

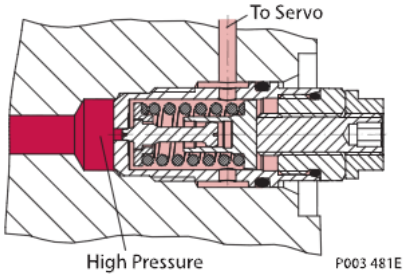
An active pressure limiter de-strokes the pump to near neutral when the load is in a stalled condition. The pump swash-plate moves in either direction necessary to regulate the system pressure, including increasing stroke when over-running or over-center.

The pressure limiter is optional on H1 pumps.

078/089/100 Single Pumps



115/130/147/165 Single Pumps



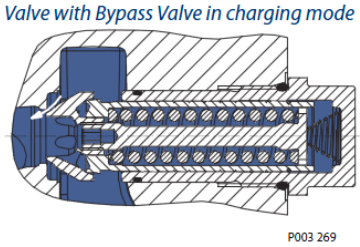
High Pressure Relief Valve

All H1 pumps have a combination high pressure relief and charge check valve. The high-pressure relief function is a dissipative (heat generating) pressure control valve for the purpose of limiting excessive system pressures. The charge check function replenishes the low-pressure side of the working loop with charge oil. Each side of the transmission loop has a dedicated non-adjustable, factory-set HPRV valve. When system pressure exceeds the factory setting of the valve, it passes oil from the high pressure system loop into the charge gallery and the low pressure system loop via the charge check.

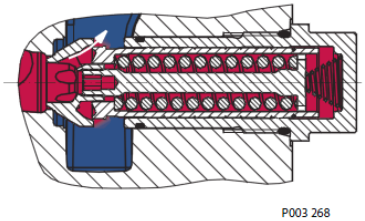
The pump may have different pressure settings at each system port. When an HPRV valve is used in conjunction with a pressure limiter, the HPRV valve is always factory set above the setting of the pressure limiter. The system pressure, shown in the order code for pumps with only HPRV, is the HPRV setting. The system pressure, shown in the order code for pumps with both pressure limiter and HPRV, is the pressure limiter setting.

HPRVs are set at low flow conditions. Any application or operating condition which leads to elevated HPRV flow will cause a pressure rise with flow above the valve setting. Consult factory for application.

High Pressure Relief and Charge Check Valve with Bypass Valve in charging mode



High Pressure Relief and Charge Check Valve with Bypass Valve in relief mode



Pressures marked on HPRV valve

Mark	Pressure bar [psi]
20	200 [2900]
25	250 [3626]
30	300 [4351]
35	350 [5076]
37	370 [5366]
40	400 [5801]
42	420 [6092]
45	450 [6527]
48	480 [6962]
51	510 [7397]

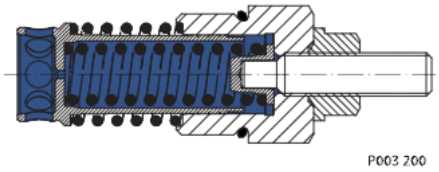
By Pass function

The HPRV valve also provides a loop bypass function when each of the two HPRV hex plugs are mechanically backed out 3 full turns. Engaging the bypass function hydraulically connects both A & B sides of the working loop to the common charge gallery. The bypass function allows you to move a machine or load without rotating the pump shaft or prime mover.

WARNING! The HPRV valves are not tow valves. Damage to the pump and motor can occur when operating without charge flow. Limit vehicle/machine movement to no more than 20% of maximum speed and no longer that three minutes. Re-seat the HPRV valves after vehicle/machine movement.

Charge Pressure Valve

Charge Pressure Relief Valve



Electrical displacement Control (EDC)

EDC principle

The Electrical Displacement Control (EDC) consists of proportional solenoids on each side of a three-position, four-way porting spool. The proportional solenoid applies a force to the spool, which ports hydraulic fluid to either side of the servo piston. Differential pressure across the servo piston rotates the swash-plate, changing the pump's displacement from full displacement in one direction to full displacement in the opposite direction.

EDC Operation

H1 EDC is a current driven control requiring a Pulse Width Modulated (PWM) signal. Pulse width modulation allows more precise control of current to the solenoids. The PWM signal causes the solenoid pin to push against the porting spool, which pressurizes one end of the servo piston, while draining the other. Differential pressure across the servo piston moves the swash-plate. A swash-plate feedback link, opposing control links, and a linear spring provide swash-plate position force feedback to the solenoid. The control system reaches equilibrium when the position of the swash-plate spring feedback force exactly balances the input command solenoid force from the operator. As hydraulic pressures in the operating loop change with load, the control assembly and servo/swash-plate system work constantly to maintain the commanded position of the swash-plate.

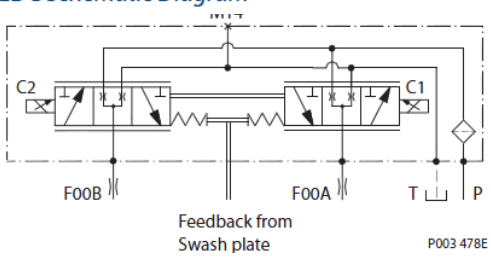
The EDC incorporates a positive neutral dead-band as a result of the controlled spool porting, spring pre-load from the servo piston assembly, and the linear control spring. Once the neutral threshold current is reached, the swash-plate position becomes directly proportional to the control current. To minimize the effect of the control neutral dead band, we recommended the transmission controller, or operator input device, incorporate a jump up current.

The neutral position of the control spool does provide a positive pre-load pressure to each end of the servo piston assembly.

When the control input signal is either lost or removed, or if there is a loss of charge pressure, the spring-loaded servo piston automatically returns the pump to neutral position.

The EDC is a displacement (flow) control. Pump swash-plate position is proportional to the input command and therefore vehicle or load speed (excluding influence of efficiency), is dependent only on the prime mover speed or motor displacement.

EDC Schematic Diagram



Manual Override (MOR)

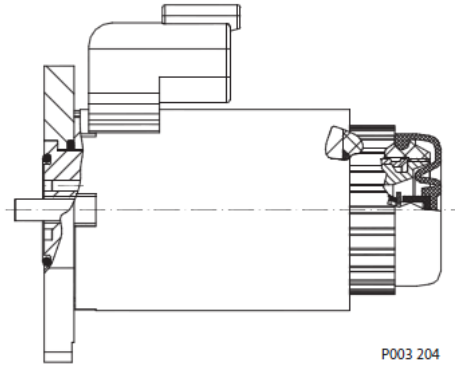
All controls are available with a Manual Override (MOR) for temporary actuation of the control to aid in diagnosis. FNR controls always include MOR functionality.

⚠ DANGER! Depressing the plunger causes the pump to go into stroke which will move the machine or mechanism. Ensure the vehicle or machine is in a safe condition (wheels off the ground or mechanism disconnected) before attempting to use the MOR feature.

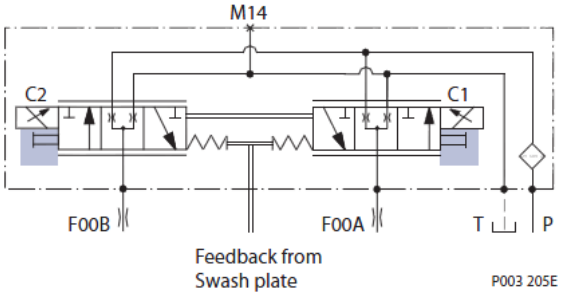
An O-ring seals the MOR plunger. Initial actuation of the function requires additional force to overcome the O-ring resistance. A threshold force of 10lbf (45 N) is typically required at first actuation. Additional actuations typically require a threshold force of 2.7lbf (12 N) to move the MOR plunger. Force required to keep the pump at full stroke is typically 11.5lbf (51 N). Do not expect proportional control of the pump using the MOR.

Refer to control flow table for the relationship of solenoid to direction of flow.

Control Solenoid



EDC Schematic Diagram Showing Manual OverRide



Operating parameters

Overview

This section defines the operating parameters and limitations for H1 pumps with regard to input speeds and pressures. For actual parameters, refer to the operating parameters for each displacement.

Input Speed

Minimum speed is the lowest input speed recommended during engine idle condition. Operating below minimum speed limits the pumps ability to maintain adequate flow for lubrication and power transmission.

Rated speed is the highest input speed recommended at full power condition. Operating at or below this speed generally yields satisfactory product life.

Maximum speed is the highest operating speed permitted. Exceeding maximum speed reduces product life and can cause loss of hydrostatic power and braking capacity. Never exceed the maximum speed limit under any operating conditions.

Pressure and speed limits.

When determining speed limits for a particular application see Sauer-Danfoss publication BLN-9884.

WARNING! Exceeding maximum speed may cause a loss of hydrostatic drive line power and braking capacity. You must provide a braking system, redundant to the hydrostatic transmission, sufficient to stop and hold the vehicle or machine in the event of hydrostatic drive power loss.

System Pressure

System pressure is the differential pressure between system ports A & B. It is the dominant operating variable affecting hydraulic unit life. High system pressure, which results from high load, reduces expected life. Hydraulic unit life depends on speed and normal operating (or weighted average) pressure that you can only determine from a duty cycle analysis.

Applied pressure is the chosen application pressure in the order code for the pump. This is the pressure at which the drive line generates maximum pull or torque in the application.

Rated pressure is the design pressure for the pump. Applications with applied pressures at or below this pressure should yield satisfactory unit life given proper component selection.

Maximum pressure (peak) is the highest intermittent pressure allowed under any circumstances. Applications with applied pressures between rated and maximum require factory approval with complete application, duty cycle, and life expectancy analysis.

All pressure limits are differential pressures referenced to low loop (charge) pressure. Subtract low loop pressure from gauge readings to compute the differential.

Charge Pressure

An internal charge relief valve regulates charge pressure. The internal charge pump supplies the control with pressure to operate the swash-plate and to maintain a minimum pressure in the low side of the transmission loop.

Minimum charge pressure is the lowest pressure safe working conditions allow in the system loop. Minimum control pressure requirements are a function of speed, pressure, and swash-plate angle, and may be higher than the minimum charge pressure shown in the technical specifications.

Maximum charge pressure is the highest charge pressure the charge relief adjustment allows, and which provides normal component life. You can use elevated charge pressure as a secondary means to reduce the swash-plate response time.

The charge pressure setting listed in the order code is the set pressure of the charge relief valve with the pump in neutral, operating at 1800 min^{-1} (rpm), and with a fluid viscosity of 32 mm^2/sec [150 SUS]. The charge pressure setting is referenced to case pressure (the differential pressure above case pressure).

Charge Inlet Pressure

At normal operating temperature charge inlet pressure must not fall below the rated charge inlet pressure.

Minimum charge inlet pressure is only allowed at cold start conditions. In some applications, you may need to warm up the fluid (start the prime mover without using the vehicle/machine functions) before moving the vehicle or operating the machine.

Case Pressure

Do not exceed rated case pressure under normal operating conditions. During cold start, keep case pressure below maximum intermittent case pressure. Size drain plumbing accordingly

WARNING! Operation with case pressure in excess of stated limits may damage seals, gaskets, and/or housings, causing external leakage. This condition may also affect performance since charge and system pressure are referenced to case pressure.

Temperature and viscosity

Temperature

High temperature limits apply at the hottest point in the transmission loop, which is normally the motor case drain. Ensure the system generally runs at or below the rated temperature. The maximum intermittent temperature is based on material properties: Never exceed it.
Cold oil will generally not affect the durability of the transmission components, but it may affect the ability of oil to flow and transmit power: therefore ensure temperatures remain 60 °F [16 °C] above the pour point of the hydraulic fluid. Minimum temperature relates to the physical properties of component materials.
Size heat exchangers to keep the fluid within these limits. Sauer-Danfoss recommends testing to verify that these temperature limits are not exceeded.

Viscosity

For maximum efficiency and bearing life, ensure the fluid viscosity remains in the recommended range. Minimum viscosity should be encountered only during brief occasions of maximum ambient temperature and severe duty cycle operation. Maximum viscosity should be encountered only at cold start.

HYDRAULIC - SAUER H1 PUMP

Technical specifications

Overview

Specifications and operating parameters for pumps are given here for reference.

General Specifications

Design	Axial piston pump of cradle swashplate design with variable displacement
Direction of rotation	Clockwise, counterclockwise
Pipe connections	Main pressure ports: SAE straight thread O-ring boss
	Remaining ports: SAE straight thread O-ring boss
Recommended installation position	Pump installation recommended with control position on the top or side. Consult Sauer-Danfoss for non conformance to these guidelines. The housing must always be filled with hydraulic fluid. Rear case drain recommended
Auxiliary cavity pressure	Will be equal to pump case pressure of rear housing. Please verify mating pump shaft seal capability.

Physical Properties

Feature	Unit	Frame size						
		078	089	100	115	130	147	165
Displacement	cm^3 [in^3]	78 [4.76]	89 [4.76]	100 [4.76]	115.2 [7.03]	130.0 [7.93]	147 [8.97]	165 [10.07]
Oil volume	liter [US gal]	2.0 [0.5]*			3.0 [0.8]			
Mounting flange		SAE flange, size C (SAE J 744) mounting pad			SAE flange, size D (SAE J 744) mounting pad			
Auxiliary mounting		SAE A, SAE B, SAE B-B, SAE C			SAE A, SAE B, SAE B-B, SAE C, SAE D			
Shafts		Splined: 21-teeth 16/32, 23-teeth 16/32, 14-teeth 12/24			Splined: 27-teeth 16/32, 13-teeth 8/16			
Suction port		1.625-12UN-2B [1 5/8-12UN-2B]						
Main port configuration		Ø25.4 - 450 bar split flange boss per ISO 6162 M12x1.75			Ø31.5 - 450 bar split flange boss per ISO 6162 M12x1.75			
Case drain ports L1, L3 (SAE O-ring boss). Case drain ports L2, L4 (SAE O-ring boss) prefered usage		0.875-12UNF-2B [7/8-12UNF-2B] 1.0625-12UNF-2B [1 1/16-12UNF-2B]			1.0625-12UNF-2B [1 1/16-12UNF-2B] 1.3175-12UNF-2B [1 5/16-12UNF-2B]			
Other ports		SAE O-ring boss. *See installation drawings.*						
Customer interface threads		Metric fastener						

Operating Parameters

Feature		Unit	Frame size						
			078	089	100	115	130	147	165
Input speed	Minimum	min^{-1} (rpm)	500						
	Minimum for full performance		1200						
	Rated		3500			3200		3000	
	Maximum		4000			3400		3100	
System pressure	Rated	bar [psi]	400 [5800]			450 [6525]	420 [6090]	450 [6525]	400 [5800]
	Maximum		450 [6525]			480 [6960]	450 [6525]	480 [7000]	450 [6525]
	Minimum low loop		10 [150]						
Charge Pressure	Minimum	bar [psi]	10 [150]					16 [232]	
	Maximum		35 [508]						
Control Pressure	Minimum (at corner for EDC and FNR)	bar [psi]	17 [247]						
	Minimum (at corner for NFPE)		20 [290]					17 [247]	
	Maximum		40 [580]						
Charge pump inlet pressure	Rated	bar (absolute) [in Hg vacuum]	0.7 [9]						
	Minimum (cold start)		0.2 [24]						
	Maximum	bar [psi]	4.0 [58]						
Case pressure	Rated	bar [psi]	3.0 [40]						
	Maximum		5.0 [75]						

Fluid Specifications

Ratings and data are based on operation with premium petroleum-based hydraulic fluids containing oxidation, rust, and foam inhibitors.

Feature		Unit	Value
Viscosity	Minimum	mm^2/sec [SUS]	7 [49]
	Recommended Range		12-80 [66-370]
	Maximum		1600 [7500]
Temperature Range	Minimum	°C [°F]	-40 [-40]
	Rated		104 [220]
	Maximum intermittent		115 [240]
Filtration (recommended minimum)	Cleanliness per ISO 4460		22/18/13
	Efficiency (charge pressure filtration)	β–ratio	$\beta_{15-20} = 75$ ($\beta_{10} \geq 10$)
	Efficiency (suction and return line filtration)		$\beta_{35-45} = 75$ ($\beta_{10} \geq 2$)
	Recommended inlet screen mesh size	µm	100 - 125

Fluid and Filter Recommendations

To ensure optimum life, perform regular maintenance of the fluid and filter. Contaminated fluid is the main cause of unit failure. Take care to maintain fluid cleanliness when servicing.

Check the reservoir daily for proper fluid level, the presence of water, and rancid fluid odor. Fluid contaminated by water may appear cloudy or milky or free water may settle in the bottom of the reservoir. Rancid odor indicates the fluid has been exposed to excessive heat. Change the fluid and correct the problem immediately if these conditions occur.

Inspect vehicle for leaks daily. Change the fluid and filter per the vehicle/machine manufacturer's recommendations or at intervals shown in the table. We recommend first fluid change at 500 hours.

Fluid and Filter Change Interval

Reservoir type	Max oil change interval
Sealed	2000 hours
Breather	500 hours

High temperatures and pressures will result in accelerated fluid aging. More frequent fluid changes may be required

HYDRAULIC - SAUER H1 PUMP

Change the fluid more frequently if it becomes contaminated with foreign matter (dirt, water, grease, etc.) or if the fluid is subjected to temperature levels greater than the recommended maximum. Dispose of used hydraulic fluid properly. Never reuse hydraulic fluid.

Change filters with the fluid or when the filter indicator shows it's necessary. Replace all fluid lost during filter change

WARNINIG! Hydraulic fluid contains hazardous material. Avoid contact with hydraulic fluid. Always dispose of used hydraulic fluid according to state and federal environmental regulations.

Pressure measurements

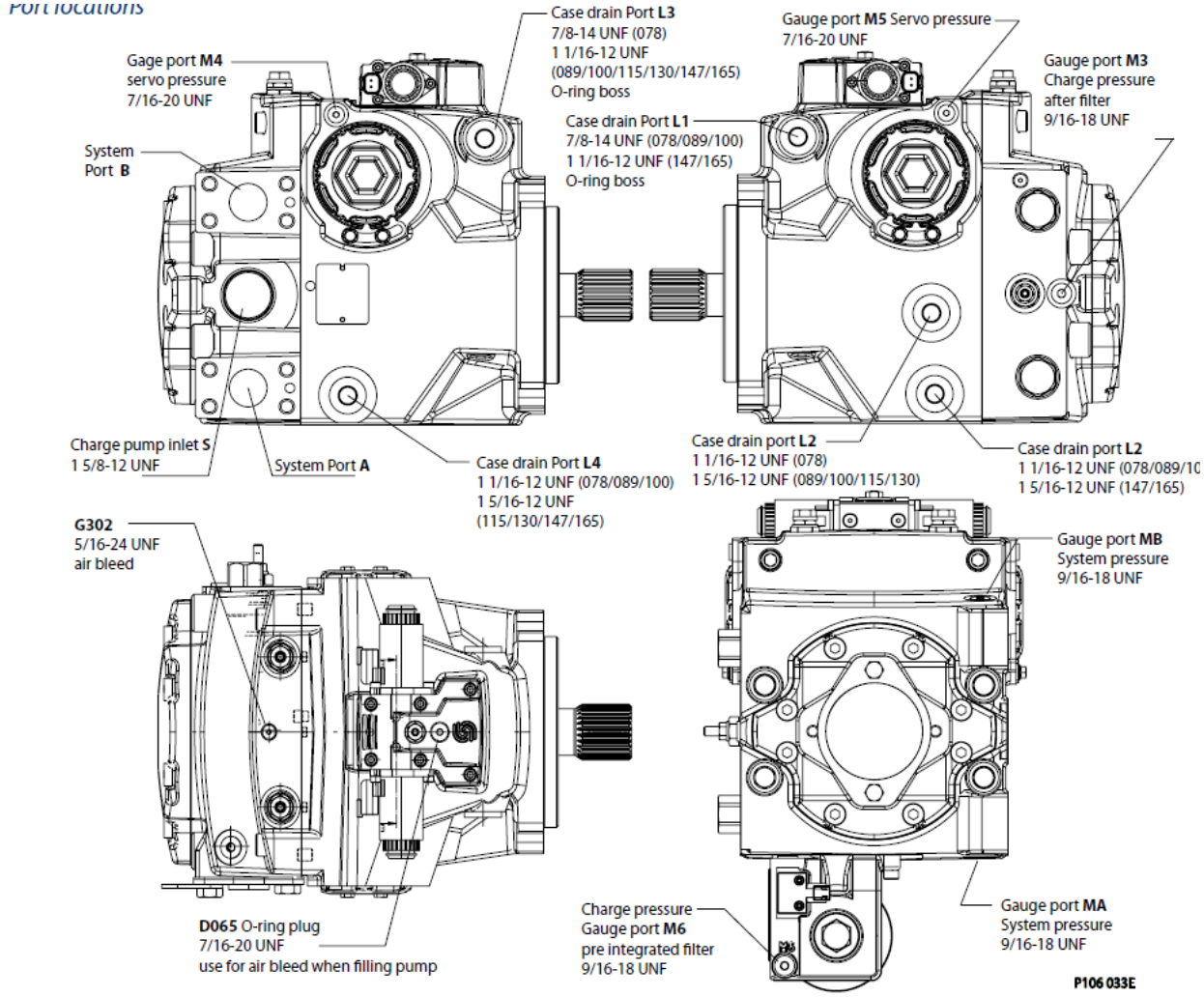
Port Location and Gauge Installation

The following table and drawings show the port locations and gauge sizes needed. When testing system pressures, calibrate pressure gauges frequently to ensure accuracy. Use a snubber to protect gauges.

Port information

Port identifier	Port size	Wrench size	Reading	Gauge size, bar [psi]	Displacement
L1, L3	7/8-14 UNF 2B	3/8 internal hex	Case drain	10 [100]	078
L2, L4	1 1/16-12 UNF 2B	9/16 internal hex	Case drain	10 [100]	078/089/100
L1, L3	1 1/16-12 UNF 2B	9/16 internal hex	Case drain	10 [100]	089/100/115/ 130/147/165
L2, L4	1 5/16-12 UNF 2B	5/8 internal hex	Case drain	10 [100]	115/130/147/165
MA, MB	9/16-18 UNF	1/4 internal hex	System pressure	600 [10,000]	115/130/147/165
M3	9/16-18 UNF 2B	1/4 internal hex	Charge pressure- after filter	50 [1000]	115/130/147/165
M4, M5	7/16-20 UNF 2B	3/16 internal hex	Servo pressure	50 [1000]	115/130/147/165
M6	9/16-18 UNF 2B	1/4 internal hex	Charge pressure - pre integrated filter	50 [1000]	115/130/147/165

Port locations



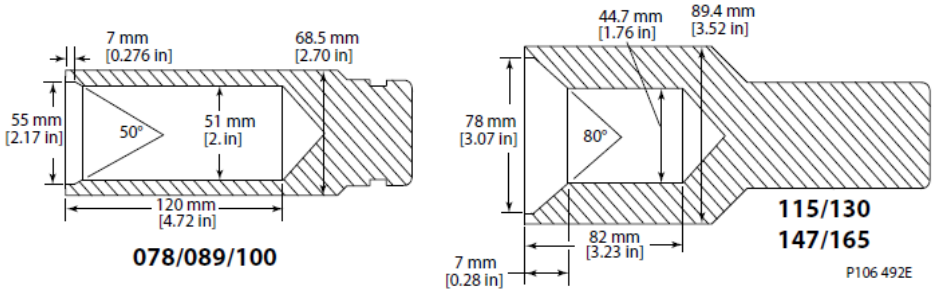
Specialized tools

Overview

You can perform the service procedures described in this manual using common mechanic's hand tools. This section details any specialized tools helpful to service H1 pumps.

Shaft seal Installation Tool

Shaft Seal Installation Tool Drawing



Initial Startup Procedure

General

Follow this procedure when starting-up a new pump installation or when restarting an installation in which the pump has been removed and re-installed on a machine. Ensure pump has been thoroughly tested on a test stand before installing on a machine

WARNING! Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Prior to installing the pump, inspect for damage that may have occurred during shipping

Start-up Procedure

1. Ensure that the machine hydraulic oil and system components (reservoir, hoses, valves, fittings, and heat exchanger) are clean and free of any foreign material.
2. Install new system filter element(s) if necessary. Check that inlet line fittings are properly tightened and there are no air leaks.
3. Install the pump. Install a 1000 psi [50 bar] gauge in the charge pressure gauge port M3.
4. Fill the housing by adding filtered oil in the upper case drain port. If the control is installed on top, open the construction plug in the top of the control to assist in air bleed.
5. Fill the reservoir with hydraulic fluid of the recommended type and viscosity. Use a 10-micron filler filter. Fill inlet line from reservoir to pump.
6. Disconnect the pump from all control input signals.
7. Close construction plug removed in Step 4.

CAUTION! After start-up the fluid level in the reservoir may drop due to system component filling. Damage to hydraulic components may occur if the fluid supply runs out. Ensure reservoir remains full of fluid during start-up.

Air entrapment in oil under high pressure may damage hydraulic components.

Check carefully for inlet line leaks. Do not run at maximum pressure until system is free of air and fluid has been thoroughly filtered.

8. Use a common method to disable the engine to prevent it from starting. Crank the starter for several seconds. Do not exceed the engine manufacturer's recommendation. Wait 30 seconds and then crank the engine a second time as stated above. This operation helps remove air from the system lines. Refill the reservoir to recommended full oil level.
9. When the gauge begins to register charge pressure, enable and start engine. Let the engine run for a minimum of 30 seconds at low idle to allow the air to work itself out of the system. Check for leaks at all line connections and listen for cavitation. Check for proper fluid level in reservoir.
10. When adequate charge pressure is established (as shown in model code), increase engine speed to normal operating rpm to further purge residual air from the system.
11. Shut off engine. Connect pump control signal. Start engine, checking to be certain pump remains in neutral. Run engine at normal operating speed and carefully check for forward and reverse control operation.
12. Continue to cycle between forward and reverse for at least five minutes to bleed all air and flush any system contaminants out of loop.

Normal charge pressure fluctuation may occur during forward and reverse operation.

13. Check that the reservoir is full. Remove charge pressure gauge. The pump is now ready for operation.

Troubleshooting

Overview

This section provides general steps to follow if you observe undesirable system conditions. Follow the steps listed until you solve the problem. Some of the items are system specific. We reference the section in this manual if more information is available. Always observe the safety precautions listed in the "Introduction" section and precautions related to your specific equipment.

Safety precautions

WARNING! High inlet vacuum causes cavitation which can damage internal pump components.

DANGER! Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. Relieve pressure in the system before removing hoses, fittings, gauges, or components.

DANGER! Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

WARNING! Contamination can damage internal components and void the manufacturer's warranty. Take precautions to ensure system cleanliness when removing and reinstalling system lines

DANGER! Hydraulic fluid contains hazardous material. Avoid contact with hydraulic fluid. Always dispose of used hydraulic fluid according to state, and federal environmental regulations.

Electrical Troubleshooting

Item	Description	Action
Control operates pump in one direction only.	Control coil failure	Measure resistance at coil pins. Resistance should be 14.20 ohms (24V) or 3.66 ohms (12V) at 20°C [70°F]. Replace coil
No pump function	No power to controller	Restore power to controller.
Erratic pump function	Electrical connection to pump is bad.	Disconnect connection, check wires, reconnect wires.
Filter bypass indicator switch	Filter bypass indicator switch may be bad.	Check/replace filter switch. Add gauge to filter bypass port to verify proper fluid flow and verify switch operation by measuring resistance: open resistance>=510 ohms, closed resistance<=122 ohms

If available, use manual override to check proper pump operation and verify electrical problem

System operating hot

	cooling demands of system.	
Heat exchanger.	Heat exchanger is not sufficiently cooling the system.	Check air flow and input air temperature for heat exchanger. Clean, repair or replace heat exchanger.
Charge pressure.	Low charge pressure will overwork system.	Measure charge pressure. Inspect and adjust or replace charge relief valve. Inspect charge pump. Repair or replace charge pump.
Charge pump inlet vacuum.	High inlet vacuum will overwork system. A dirty filter will increase the inlet vacuum. Inadequate line size will restrict flow.	Check charge inlet vacuum. If high, inspect inlet filter and replace as necessary. Check for adequate line size, length or other restrictions.
System relief pressure settings	If the system relief valves are worn, contaminated, or valve settings are too low, the relief valves will be overworked.	Verify settings of pressure limiters and high pressure relief valves and adjust or replace valves as necessary.
System pressure.	Frequent or long term operation over system relief setting will create heat in system.	Measure system pressure. If pressure is too high, reduce loads.

Integral Filter Bypass

Item	Description	Action
Filter bypass activated	Filter is plugged causing fluid to bypass filter.	Replace filter. Check that bypass switch indicates proper operation after filter is replaced.
Filter bypass indicator switch	Filter bypass indicator switch is indicating wrong bypass situation.	Check/replace switch. open>=510 ohms closed<=122 ohms

Neutral Difficult or Impossible to Find

Item	Description	Action
Input to pump control	Input to control module is operating improperly.	Disconnect input and check to see if pump comes back to neutral. If Yes, input fault, replace/repair external controller. If No, go to next step.
Neutral	Neutral set improperly	Shunt servo gauge ports (M4 and M5) together with external hose and see if pump comes back to neutral. If Yes: Control neutral improperly set (see page 36) If neutral still impossible to set, balance swashplate (see Mechanical neutral adjustment, page 37). If you still cannot set neutral, replace control.

System Will Not Operate in Either Direction

Item	Description	Action
Oil level in reservoir.	Insufficient hydraulic fluid to supply system loop.	Fill reservoir to proper level.
Pump control orifices	Control orifices are blocked.	Clean control orifices.
Pump control screens	Control screens are blocked.	Replace control screens. Refer to **520L0874** H1 078/147/165 Repair instructions for screen locations. Only a Sauer-Danfoss Authorized Service Center may remove the unit's endcap without voiding the warranty.
Bypass function open	If bypass function is open, the system loop will be depressurized.	Close bypass valves. Replace high pressure relief valve if defective.
Low charge pressure with pump in neutral	Low charge pressure insufficient to recharge system loop.	Measure charge pressure with the pump in neutral. If pressure is low, go to *Pump charge relief valve.*
Low charge pressure with pump in stroke	Low charge pressure resulting from elevated loop leakage. Insufficient control pressure to hold pump in stroke.	Deadhead the pump to isolate it from the motor. With pump in partial stroke and engaged for only a few seconds, check pump charge pressure. Low charge pressure indicates a malfunctioning pump. Continue to next step. Good charge pressure indicates a malfunctioning motor or other system component. Check motor charge relief operation (if present).
Pump charge relief valve	A pump charge relief valve that is leaky, contaminated, or set too low will depressurize the system.	Adjust or replace pump charge relief valve as necessary.
Charge pump inlet filter	A clogged filter will under supply system loop.	Inspect filter and replace if necessary.
Charge pump	A malfunctioning charge pump will provide insufficient charge flow.	Repair or replace the charge pump.
System pressure	Low system pressure does not provide enough power to move load.	Measure system pressure. Continue to next step.
High pressure relief or pressure limiter valves	Defective high pressure relief or pressure limiter valves cause system pressure to be low.	Repair or replace high pressure relief or pressure limiter valves.
Input to control	Input operating improperly	Repair/replace control.

System Noise or Vibration

Item	Description	Action
Reservoir oil level	Low oil level leads to cavitation.	Fill reservoir.
Aeration of the oil/pump inlet vacuum	Air in system decreases efficiency of units and controls. Excessive noise, foaming oil, and hot oil all indicate air in system.	Find location where air is entering into the system and repair. Check that inlet line is not restricted and is proper size.
Cold oil	If oil is cold, it may be too viscous for proper function and pump cavitates.	Allow the oil to warm up to its normal operating temperature with engine at idle speed.
Pump inlet vacuum	High inlet vacuum causes noise/cavitation.	Check that inlet line is not restricted and is of proper size. Check filter and bypass switch.
Shaft couplings	A loose shaft coupling will cause excessive noise.	Replace loose shaft coupling..
Shaft alignment	Misaligned shafts create noise.	Align shafts.
Charge/system relief valves	Unusual noise may indicate sticking valves and possible contamination.	Clean/replace valves and test pump.

Sluggish System Response

Item	Description	Action
Oil level in reservoir	Low oil level causes sluggish response.	Fill reservoir.
High pressure relief valves/ pressure limiter settings	Incorrect pressure settings affects system reaction time.	Adjust or replace high pressure relief valves.
Low prime mover speed	Low engine speed reduces system performance.	Adjust engine speed.
Charge pressure	Incorrect pressure affects system performance.	Measure and adjust charge pressure relief or replace charge pump.
Air in system	Air in system produces sluggish system response.	Fill tank to proper level. Cycle system slowly for several minutes to remove air from system.
Contaminated control orifices	Control orifices are plugged.	Clean control orifices.
Contaminated control screens	EDC supply screen is plugged.	Replace control screens. Refer to **520L0874** H1 078/147/165 Repair instructions for screen locations. Only a Sauer-Danfoss Authorized Service Center may remove the unit's endcap without voiding the warranty.
Pump inlet vacuum	Inlet vacuum is too high resulting in reduced system pressure.	Measure charge inlet vacuum. Inspect line for proper sizing. Replace filter. Confirm proper bypass operation.

Transmission Operates Normally in One Direction Only

Item	Description	Action
Input to pump control.	Input to control module is operating improperly.	Check control input and repair or replace as necessary.
Control orifices	Control orifice(s) are blocked.	Clean control orifices.
Control screens	Control screen(s) are blocked.	Replace control screens. Refer to **520L0874** H1 078/147/165 Repair instructions for screen locations. Only a Sauer-Danfoss Authorized Service Center may remove the unit's endcap without voiding the warranty.
Exchange system pressure limiters	Exchanging the pressure limiter valves will show if the problem is related to the valve function.	If the problem changes direction, replace the valve that does not operate correctly.
Exchange high pressure relief valves	Exchanging the high pressure relief valves will show if the problem is related to the valve function.	If the problem changes direction, replace the valve that does not operate correctly.
Servo pressure low or decaying	Damaged servo seals may prevent servo piston from stroking the pump.	Check for torn/missing servo seals. Replace and retest. Refer to **520L0874** H1 078/147/165 Repair instructions for seal locations. Only a Sauer-Danfoss Authorized Service Center may remove the servo piston without voiding the warranty.
Bypass function open	Open bypass will cause one or both directions to be inoperative.	Close bypass function.

Adjustments

Pump Adjustment

This section offers instruction on inspection and adjustment of pump components. Read through the entire topic before beginning a service activity.

Standard procedures

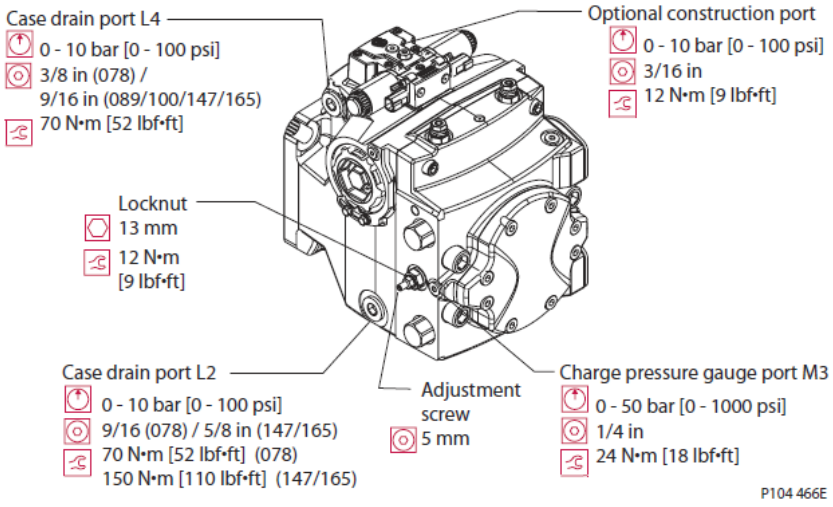
WARNING! Contamination can damage internal components and void your warranty. Take precautions to ensure system cleanliness when removing and reinstalling system lines

1. With the prime mover off, thoroughly clean the outside of the pump.
2. If removing the pump, tag each hydraulic line. When you disconnect hydraulic lines, cap them and plug each open port to prevent contamination.
3. Ensure the surrounding area is clean and free of contaminants like dirt and grime.
4. Inspect the system for contamination.
5. Check the hydraulic fluid for signs of contamination: oil discoloration, foam in the oil, sludge, or metal particles.
6. If there are signs of contamination in the hydraulic fluid, replace all filters and drain the hydraulic system. Flush the lines and refill the reservoir with the correct filtered hydraulic fluid.
7. Before re-installing the pump, test for leaks.

Charge Pressure Relief Valve Adjustment

This procedure explains how to check and adjust the charge pressure relief valve.

1. Install a 1000 psi [50 bar] pressure gauge in charge pressure gauge port M3. Install a 145 psi [10 bar] gauge at case drain port L1, L2, L3, or L4. Operate the system with the pump in neutral (zero displacement) when measuring charge pressure.
2. The table shows the acceptable pump charge pressure range for some nominal charge relief valve settings (refer to model code located on serial number plate). These pressures assume 1800 min-1 (rpm) pump speed and a reservoir temperature of 120°F [50°C], and are referenced to case pressure.



Listed pressures assume a pump speed of 1800 min^{-1} (rpm). At higher pump speeds (with higher charge flows) the charge pressure will rise over the rated setting.

Model code	Actual charge pressure*
20	20 bar [290 psi] ± 1.5 bar [21.8 psi]
24	24 bar [348 psi] ± 1.5 bar [21.8 psi]
26	26 bar [377 psi] ± 1.5 bar [21.8 psi]
30	30 bar [435 psi] ± 1.5 bar [21.8 psi]

* This is the actual charge pressure port gauge reading minus the case pressure port gauge reading. Factory set at 1800 min^{-1} (rpm) with a reservoir temperature of 50° C [120° F].

3. Loosen the locknut and turn the adjusting screw clockwise to increase the setting; counterclockwise to decrease it. The table gives approximate adjustment per turn.

Depending on the pressure rating, the charge pressure relief valve may have one or two springs

Number of springs	Change per turn
1 Spring	consult factory
2 Springs	3.9 bar [56.6 psi]

4. While holding the adjusting screw, torque locknut to 9lbf-ft [12 Nm].
5. When you achieve the desired charge pressure setting, remove the gauges and plug the ports.

Pressure Limiter Adjustment

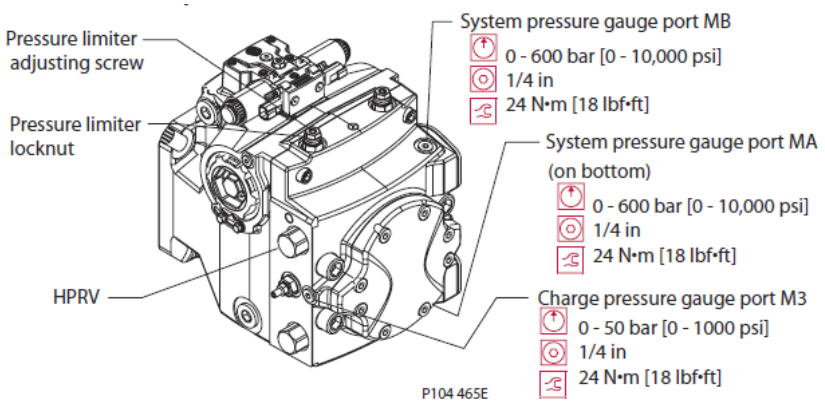
Lock the motor output shaft to adjust the pressure limiter setting. Lock the vehicle's brakes or rigidly fix the work function so it cannot rotate.

1. Install 10,000 psi [600 bar] pressure gauges in the high pressure gauge ports (MA and MB). Install a1000 psi [50 bar] pressure gauge in the charge pressure gauge port (M3).

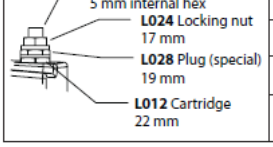
Ensure charge pressure is properly set before checking pressure limiter

Subtract charge pressure from system pressure to get correct system pressure.

Pressure Limiter Adjustment

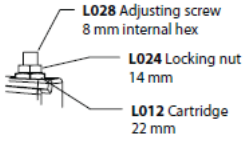


115/130/147/165



Fastener	Torque N•m [lbf•ft]
L010	N/A
L024	20 [15]
L028	68 [50]
L012	70 [52]

078 Pressure limiter



Fastener	Torque N•m [lbf•ft]
L028	N/A
L024	20 [15]
L012	30 [22]

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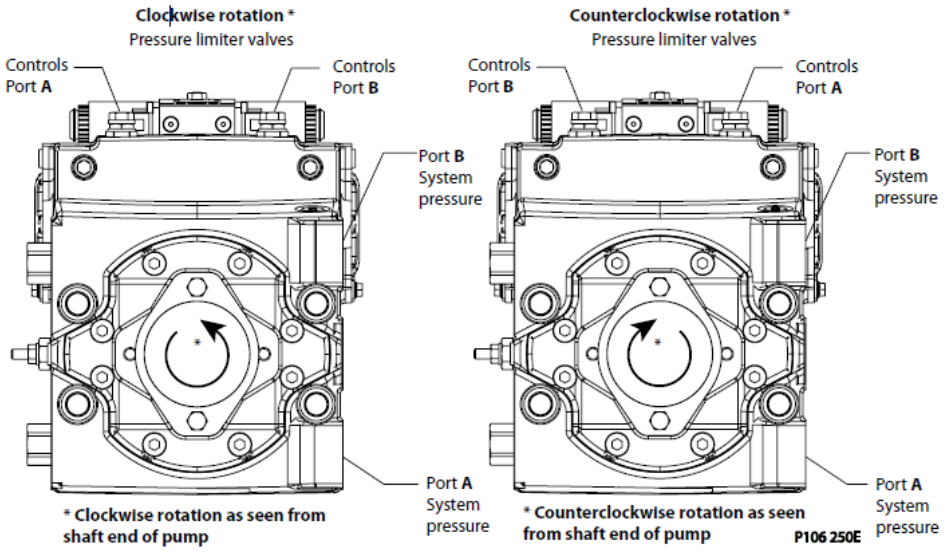
Pressure Limiter Valve Adjustment



End caps are different for clockwise and counterclockwise rotation.

The model code on the serial plate gives the factory setting of the PL (Pressure Limiter). The PL setting is referenced to charge pressure. Subtract charge pressure from system pressure gauge readings to compute the effective PL setting.

2. Start the prime mover and operate at normal speed.
3. Use a 17mm wrench to loosen the locking nut (L024).
4. Activate the control input until pressure in the high side of the system loop stops rising. This pressure is the PL setting.
5. Return the pump to neutral and adjust the PL setting using an internal hex wrench. Wrench size is in the diagram on the previous page. Turn the adjusting screw clockwise to increase the PL setting, counterclockwise to decrease it. The adjustment is very sensitive.

Change per turn is 2176 psi/rev [150 bar/rev].

6. Repeat steps four and five until you reach the desired PL setting. After adjustment, torque the locknut (L024) to 15lbf-ft [20 Nm]. Do not over torque.
7. Shut down the prime mover. Remove gauges and replace plugs.

Pressure Limiter Settings

Pressure limiter setting	HPRV setting
150	200
180	230
200	250
230	280
250	300
280	330
300	350
330	380
350	400

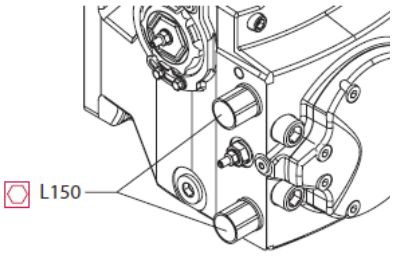
Pressure limiter setting	HPRV setting
400	450
410	
420	
430	480
440	
450	
460	510
470	
480	

Engaging the Bypass Function

Use this procedure to bypass the pump to allow moving the vehicle/machine short distances when you cannot start the prime mover.

WARNING! It is possible to damage the drive motor(s) by operating in bypass mode without charge pressure. Move the vehicle/machine at a speed not more than 20% of maximum for a duration not exceeding 3 minutes.

1. To open the HPRVs (L150), rotate three revolutions counterclockwise. Do not rotate more than 3 revolutions, as leakage will result.
2. To close the HPRVs, rotate them clockwise until seated. See table for torque values.
3. If machine is tow-able with HPRVs opened three turns and if wheels are locked (not tow-able) with HPRV valves closed, bypass function is working correctly.



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HPRV Wrench Size and Torque Values

Displacement	Wrench size and torque
078	22 mm - 70 N•m [52 lbf-ft]
115/130/147/165	30 mm - 110 N•m [81 lbf-ft]

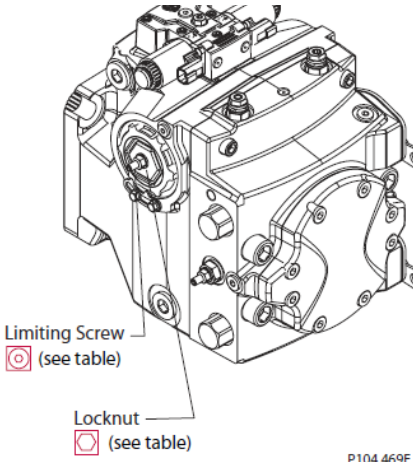
Displacement Limiter Adjustment

If your pump has displacement limiters, you will find them on either servo cover. You can limit forward and reverse displacement independently.

Displacement limiters are not preset by the factory. We install them as far as possible without contacting the servo piston. Limiting displacement requires clockwise adjustment of the limiting screw.

WARNING! Before adjusting the displacement limiter, mark the position of the servo cylinder. Be sure the servo cylinder does not turn when setting the displacement limiter locknut.

1. Loosen the lock-nut.
2. Rotate the adjusting screw to achieve the desired maximum displacement. Set the adjusting screw against the servo piston by feel before counting turns. Refer to the table below for change per turn. Clockwise rotation decreases displacement, counterclockwise rotation increases it. Adjustment is possible from zero to maximum.
3. After establishing the desired maximum displacement setting, hold the adjusting screw while torquing the locknut to the value in the table below.
4. Test operation of the vehicle/machine to verify proper maximum speed of vehicle/work function.



P104 469E

Displacement Limiter Adjustment (continued)

Displacement Limiter Adjustment Data

Displacement	Locknut wrench size and torque	Adjusting screw wrench size	Approximate displacement change per revolution of adjusting screw
078	13 mm - 24 N•m [18 lbf-ft]	4 mm	7.4 cm³/turn [0.452 in³/turn]
089	17 mm - 48 N•m [35 lbf-ft]	5 mm	9.3 cm³/turn [0.57 in³/turn]
100	17 mm - 48 N•m [35 lbf-ft]	5 mm	10.7 cm³/turn [0.65 in³/turn]
115	22 mm - 80 N•m [59 lbf-ft]	6 mm	10.8 cm³/turn [0.66 in³/turn]
130	22 mm - 80 N•m [59 lbf-ft]	6 mm	12.2 cm³/turn [0.745 in³/turn]
147	22 mm - 80 N•m [59 lbf-ft]	6 mm	12.4 cm³/turn [0.757 in³/turn]
165	22 mm - 80 N•m [59 lbf-ft]	6 mm	13.9 cm³/turn [0.848 in³/turn]

Control Neutral Adjustment

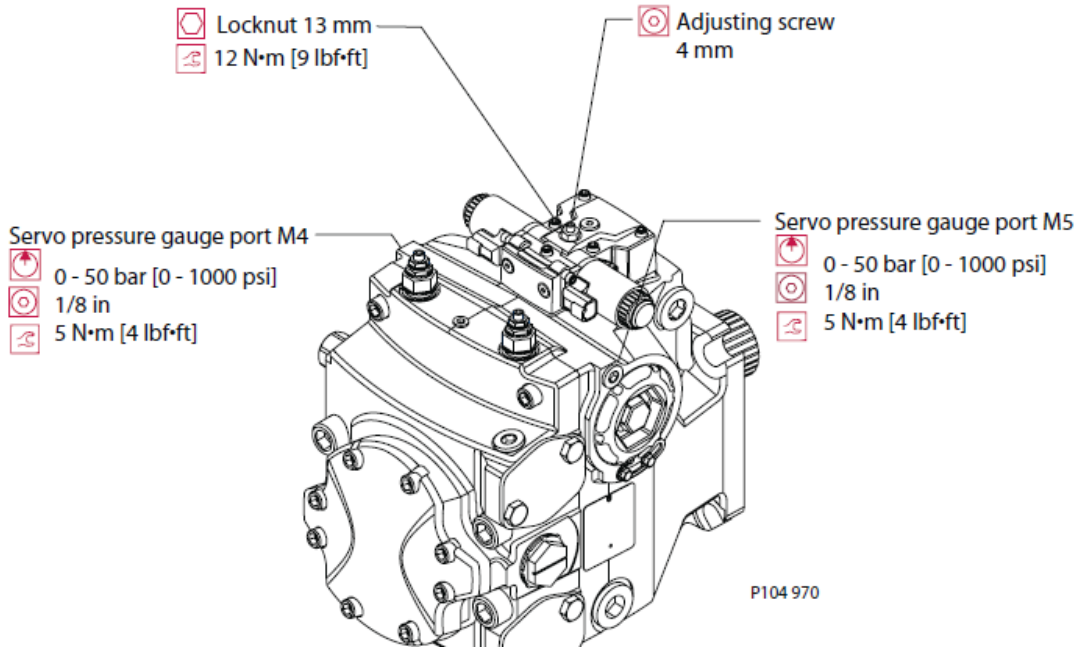
All functions of the Electric Displacement Control (EDC), are preset at the factory. If necessary, adjust the pump to neutral with the pump running on a test stand or on the vehicle/machine with the prime mover operating. If adjustment fails to give satisfactory results, you may need to replace the control or coils. See "Automotive Control" page 116 for details.

WARNING! Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

1. Install a 1000 psi [50 bar] gauge in each of the two servo gauge ports (M4 and M5). Disconnect the external control input (electrical connections) from the control. Start the prime mover and operate at normal speed.
2. Use a 4mm internal hex wrench to hold the neutral adjusting screw (D015) stationary while loosening the locknut (D060) with a 13mm wrench.
3. Observe pressure gauges. If necessary, turn adjusting screw (D015) to reduce pressure differential.

ATTENTION! Adjustment of the EDC is very sensitive. Be sure to hold the hex wrench steady while loosening the locknut. Total adjustment is less than 120 degrees.

Control Adjustment



Control Neutral Adjustment (continued)

Neutral adjustment (EDC) (bottom view)

4. Rotate the neutral adjusting screw (D015) clockwise until the pressure increases on the gauge. Note the angular position of the wrench. Then rotate the neutral adjusting screw counterclockwise until the pressure increases by an equal amount on the other gauge. Again note the angular position of the wrench.
5. Rotate the neutral adjusting screw clockwise half the distance between the wrench positions noted above. The gauges should read the same pressure, indicating that the control is in its neutral position.
6. Hold the neutral adjusting screw stationary and tighten the locknut (D060). Torque to 9lbf-ft [12 Nm]. Do not over torque the nut.
7. When the neutral position is set, stop the prime mover, remove the gauges, and install the gauge port plugs. Reconnect the external control input.

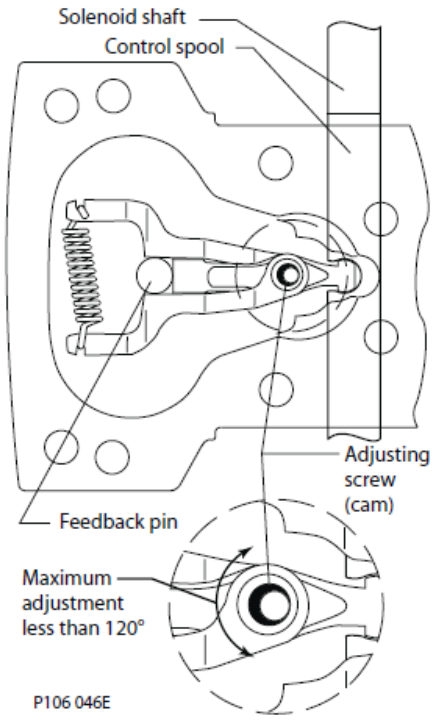


Illustration shows how cam on adjusting pin rotates to adjust for neutral position after pump is re-installed.

A small pressure differential of 22 psi [1.5 bar] or less is acceptable. Zero differential is usually not possible.

Mechanical Neutral Adjustment

Mechanical neutral is set with the pump running at 1800 min^{-1} (rpm). To set neutral, you must stroke the pump in each direction. You can do this with a small movement of the eccentric screw on EDC controls, however non-feedback controls (NFPE/FNR) lack this mechanism. To stroke a pump with non-feedback control, you must provide a 100 Hz PWM signal to the control solenoids. Refer to the H1 Pumps Technical Information manual 11009999 for signal specifications. If you perform this adjustment with the pump installed in a vehicle or machine, safely elevate the wheels or disconnect the mechanism to allow safe operation during adjustment.

This procedure details setting neutral for the pump. Alternate M4/M5 and MA/MB to zero out forward and reverse directions of the unit. Refer to the drawing on the next page to identify all ports. The control solenoids C1 and C2 are marked on the control.

While performing this adjustment, you will monitor the following pressures.

- Servo pressure at M4 and M5
- System pressure at MA and MB
- Pressure differential between M4 and M5 (optional)
- Pressure differential between A and B (optional)

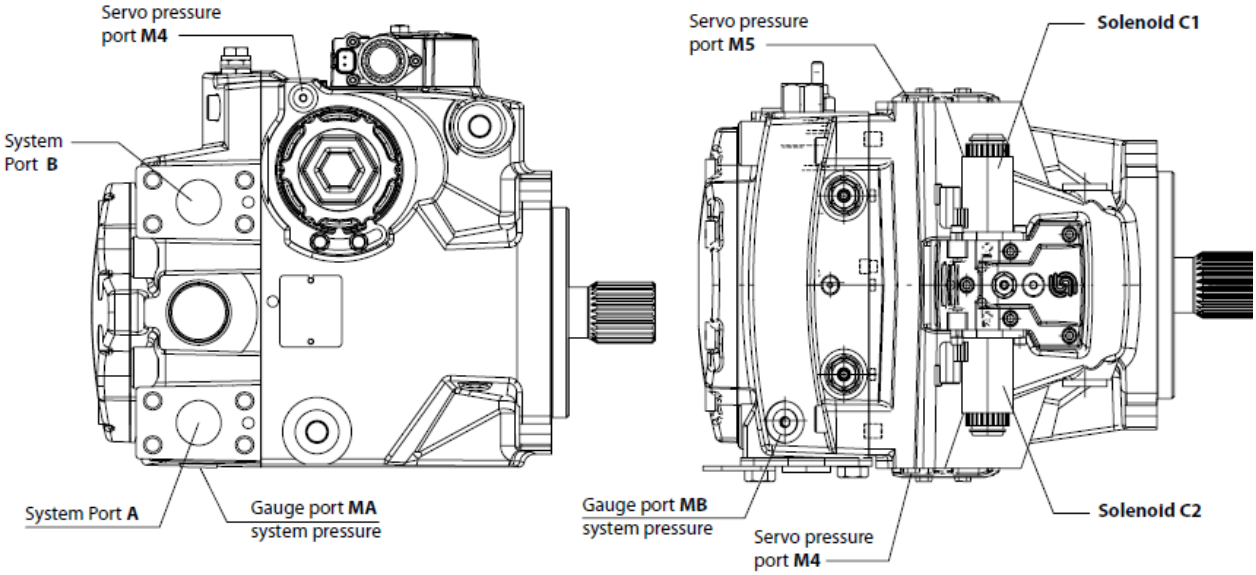
Refer to ***"Pressure measurements" page 98***, and the illustration on the next page for gauge port locations and information.

Pump setup

1. Attach a 1000 psi [50 bar] gauge to each servo pressure port M4 and M5
2. Attach a 10 000 psi [600 bar] gauge to each system pressure port (MA and MB).
3. Remove the servo cylinder locking screws (E350) and plates (E300) from both sides of the pump.
4. Disconnect the control solenoids from the vehicle wiring harness.
5. If using a PWM signal to set mechanical neutral, connect the control solenoids C1 and C2 to the signal source. Ensure the source supplies no current to the solenoids until required in the following procedure.

The figure below shows the locations of system and gauge ports you use when adjusting the servo neutral position.

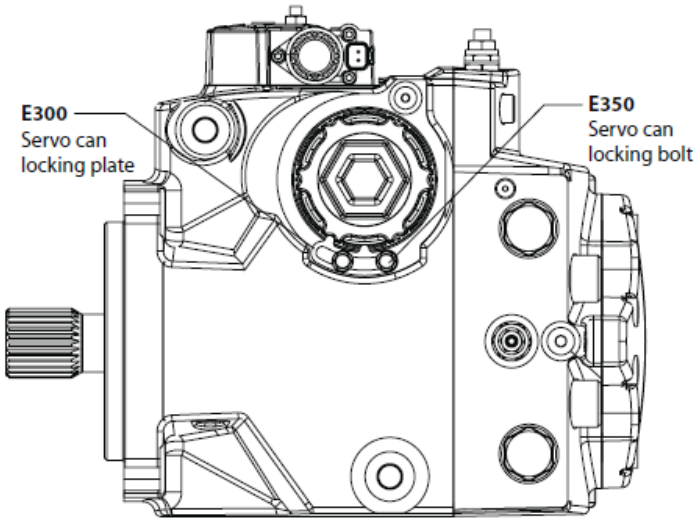
System Pressure Gauge Port Locations



Mechanical Neutral Adjustment (continued)

Servo Adjustment

1. Run the prime mover at 1800 min^{-1} (rpm).
2. If using a PWM signal, ensure the signal is off. Check the servo pressure gauges. Ensure the differential between M4 and M5 is less than 22 psi [1.5 bar].
3. Using a 3/4" hex deep socket, un-thread both servo cylinders 2-3 turns. This step ensures the servo cylinders have no contact with the servo piston.
4. Stroke the pump by turning the control eccentric screw (or supplying current to solenoid C1) until the servo pressure at port M4 is 14– 29 psi [1 to 2 bar] greater than at port M5 and the system pressure gauges indicate displacement. Pressure should be greater at port MA for clockwise rotation, or MB for counterclockwise rotation. This also indicates the servo piston is in contact with the servo cylinder on side M5.
5. Slowly thread the servo cylinder on the M5 side in until the system pressure differential starts to decrease. Maintain servo pressure differential between 14-29 psi [1-2 bar] during this step. Continue turning the servo cylinder in until the system pressure differential (between ports MA/MB) is less than 22 psi [1.5 bar]. This procedure sets the servo and swash-plate to mechanical neutral on the M5 side.
6. To complete setting neutral, repeat steps 1-5 but stroke the pump in the opposite direction by turning the eccentric screw in the opposite direction, or by supplying current to solenoid C2. Reverse gauge locations (M4 for M5, MB for MA) from those stated above since the pump is now stroking the other direction.
7. Remove all gauges and replace gauge port plugs. You can find wrench sizes and plug torques in the "Plug Size and Torques" page 126.



HYDRAULIC - SAUER H1 PUMP

Minor Repair

Standard Procedures, Removing the Pump

Before working on the pump, thoroughly clean the outside. If the pump has an auxiliary pump attached, remove both pumps as a single unit. Tag and cap all hydraulic lines as they are disconnected, and plug all open ports to ensure that dirt and contamination do not get into the system.

WARNING! Contamination can damage internal components and void the manufacturer's warranty. Take precautions to ensure system cleanliness when removing and installing system lines.

Disassembly

1. With the prime mover off, thoroughly clean all dirt and grime from the outside of the pump.
2. Tag, disconnect, and cap each hydraulic line connected to the pump. As hydraulic lines are disconnected, plug each open port to ensure that dirt and contamination do not get into the pump.
3. Remove the pump and its auxiliary pump (if applicable) as a single unit.

WARNING! Do not damage solenoids and electrical connections when using straps or chains to support the pump.

Inspection

4. Ensure the work surface and surrounding area are clean and free of contaminants such as dirt and grime.
5. Inspect the system for contamination.
6. Look at the hydraulic fluid for signs of system contamination, oil discoloration, foam in the oil, sludge, or metal particles.

Reassembly

7. Before replacing the pump, replace all filters and drain the hydraulic system. Flush the system lines and fill the reservoir with the correct, filtered hydraulic fluid.
8. Fill the pump with clean, filtered hydraulic fluid.
9. Attach the pump to the prime mover. Torque mounting screws according to the manufacturer's recommendation.
10. Replace all hydraulic lines. Ensure the charge inlet line is filled with fluid.

EDC Control

Removal

Refer to exploded diagram, next page.

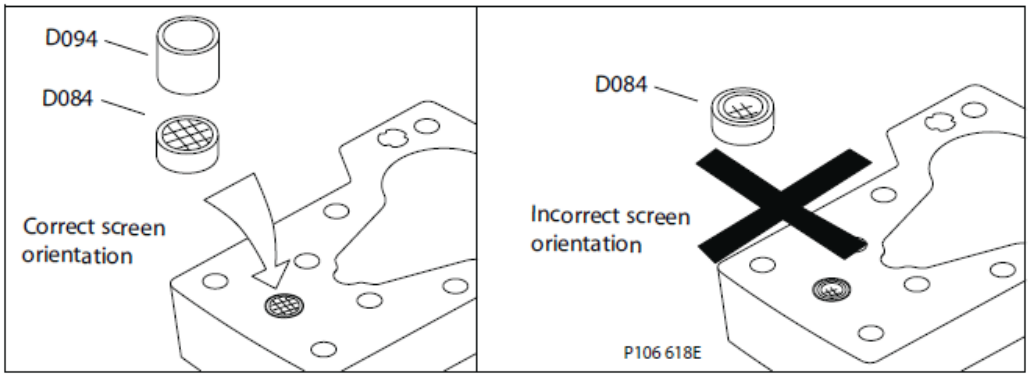
1. Using a 5 mm internal hex wrench, remove the six cap screws (D250).
2. Remove the control module and gasket (D150). Discard the gasket.
3. If necessary, remove orifices (F100) using a 3 mm internal hex wrench. Tag and number them for re installation.
4. If screen (D084) is clogged, use a hook to remove retaining ring (D098) and screen. Discard screen and replace with new screen.
5. Inspect the machined surfaces on the control and top of the pump. If you find any nicks or scratches, replace the component

Reassembly

ATTENTION: Ensure you install dowel pins (D300) in housing before installing control.

Remove plug on top of control to ensure the swash-plate feedback pin is properly positioned in the center of the control module when installing control.

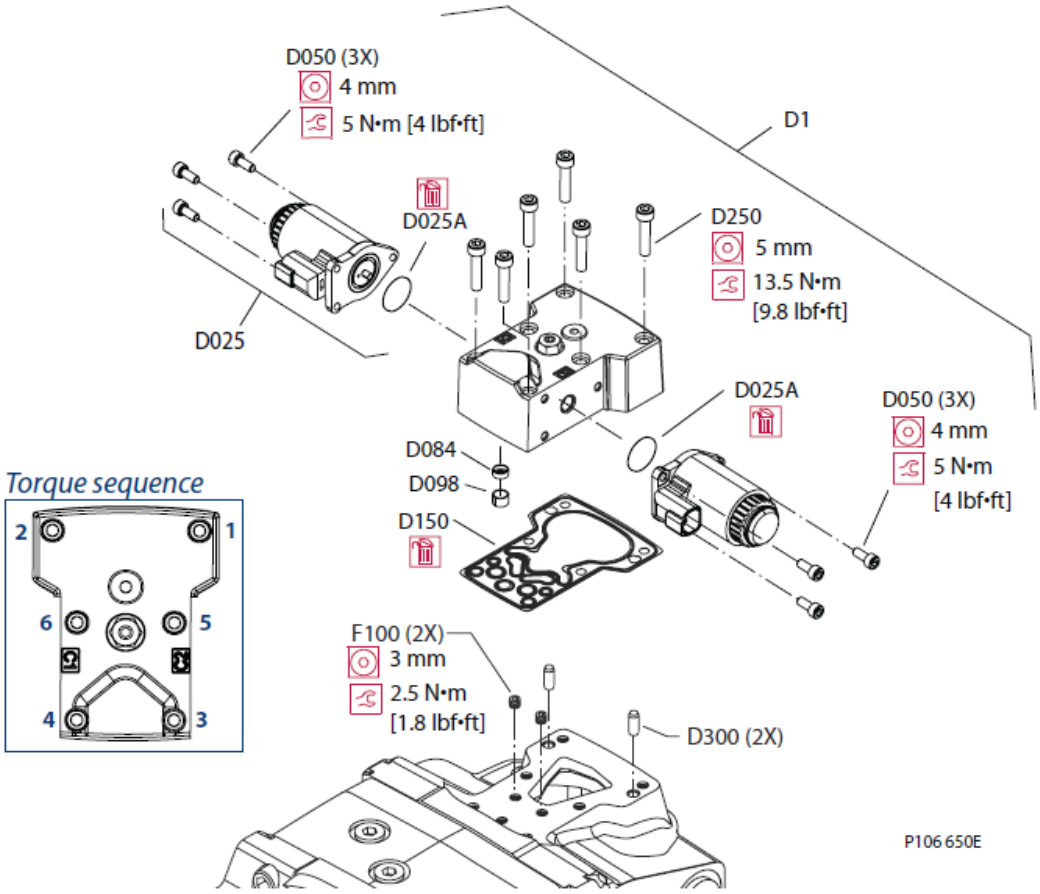
6. Install a new gasket (D150).



7. If you removed screen (D084), install a new one. Install with the mesh facing outward (see drawing). Install retaining ring (D098).
8. If previously removed, install orifices (F100) using a 3 mm internal hex wrench. Torque to 1.8lbf-ft [2.5 Nm].
9. Install the control module and six cap screws (D250).
10. Using a 5 mm internal hex wrench, torque the cap screws (D250) to 9.8lbf•ft [13.3 Nm].

EDC Control (continued)

Control Module and Solenoid Removal/Installation



Control Solenoids

Removal

1. Disconnect electrical connection and remove the three cap screws (D050) using a 4 mm internal hex wrench.
2. Remove the solenoid (D025) and O-ring (D025A). Discard the O-ring.
3. If necessary, remove the coil using a 12 point 26 mm socket.
4. Inspect the machined surface on the control. If you find any nicks or scratches, replace the component.

Reassembly

5. Lubricate A new O-ring (D025A) using petroleum jelly and install.
6. Install solenoid with three cap screws (D050) using a 4 mm internal hex wrench. Torque screws to 4lbf-ft [5 Nm].
7. Install coil using a 12 point 26 mm socket. Torque coil nut to 3.7lbf-ft [5 Nm].
8. Reconnect electrical connections and test the pump for proper operation.

Automotive Control

Removal

1. Drain pump completely before removing control. Disconnect and remove wiring (D640).
2. Fabricate a special tool to remove two plastic plugs (D610). See drawing below for tool dimensions. Push down on plug and turn 45 degrees counterclockwise. Discard plugs.

ATTENTION! Wax seals will be destroyed when the plugs are removed. Do not damage the housing in the plug sealing area.

3. Use a 5 mm internal hex to remove six screws (D250). Remove control from pump.
4. Remove and discard gasket (D150).

ATTENTION! Alignment pins are pressed into control. Do not remove them.

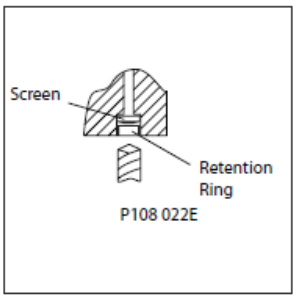
5. If necessary, use a 3 mm internal hex to remove orifices (F00A, F00B) from housing. Tag each orifice for re installation.

Each orifice may be a different size.

6. If it is necessary to remove the screens, drill out screen retention ring (D098) and remove and discard screen (D084). Note screen orientation for reassembly.

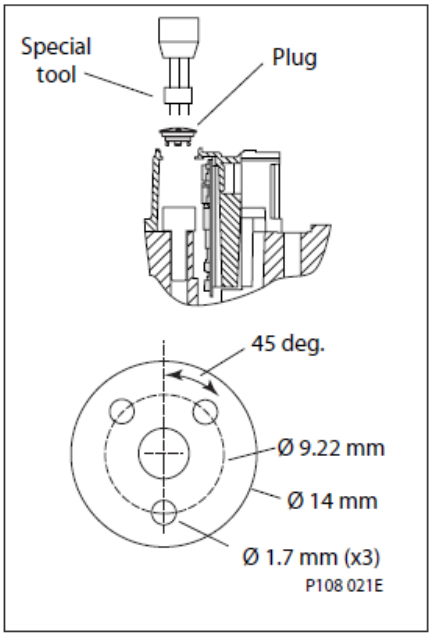
WARNING! Do not allow metal fragments to fall into control housing. This may cause erratic pump operation.

Drill Out Retention Ring

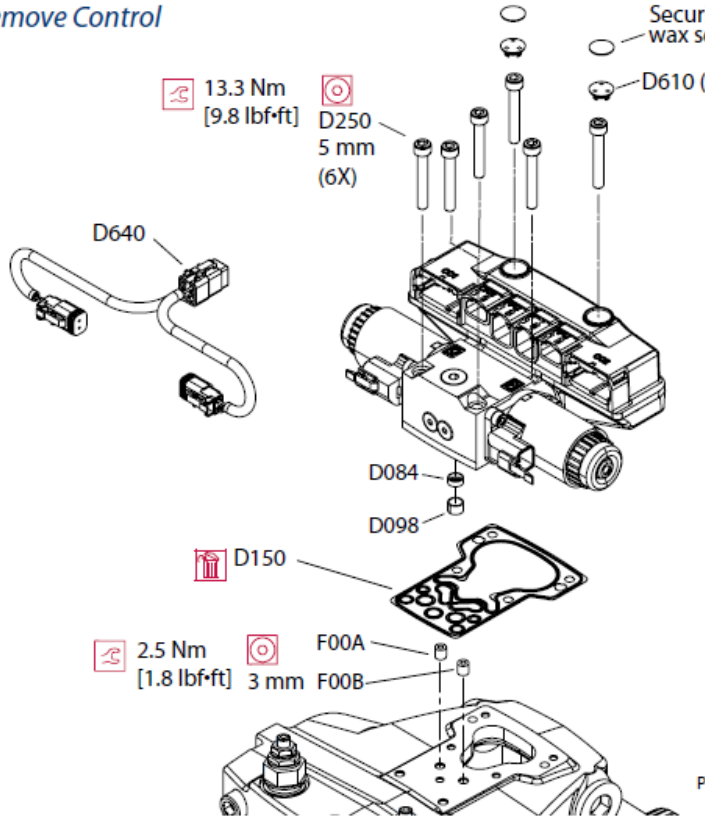


Automotive Control (continued)

Special Tool



Remove Control



Inspection

Inspect machined surfaces on control and pump housing. Inspect plastic PC board housing and its sealing areas. If any damage is found, replace damaged components. Controls are available as a complete unit. Do not disassemble the control

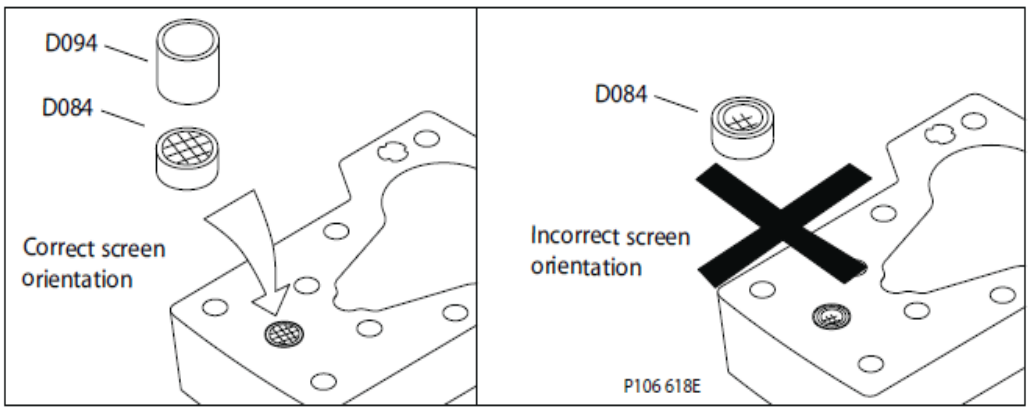
Assembly

1. If previously removed, install new screen (D084) in original orientation. Press in new retention ring (D098).

Be sure screen will not move axially in bore after retention ring is installed.

ATTENTION! Failure to install screen will result in erratic pump operation.

Proper Screen Orientation



Automotive Control (continued)

If pump has been rebuilt or a new control is being installed, control software must be re-calibrated. Refer to H1- "Automotive Control User Manual" 70012797 for recalibration instructions.

2. If previously removed, use a 3 mm internal hex to install orifices (F00A, F00B) in original orientation. Torque to 1.8lbf-ft [2.5 Nm].
3. Install a new gasket (D150) to the bottom of the control.
4. Install the control on pump. Use a 5 mm internal hex to install six screws (D250). Torque to 9.8lbf-ft [13.3 Nm]. Follow torque sequence shown on page 152.

ATTENTION! Do not damage the plastic housing in the plug sealing area when installing the screws.

5. Connect wiring (D640).
6. Use the special tool to install new plastic plugs with O-rings (D610). Press plugs in and turn 45 degrees clockwise.

If control will continue to be under warranty, install new sealing wax of a different color (original wax is blue). Pumps without sealing wax installed will not be warrantied.

Replacing Solenoids

Refer to the solenoid replacement procedure in "Control Solenoids" page 116.

Bearing and shaft Replacement

The input shaft, seal, and front bearing are serviceable without disassembling the entire pump. Orient the pump on the work surface so the shaft is pointing up.

ATTENTION! Do not damage the housing bore, shaft, or bearing when removing the seal.

Removal

1. Using snap-ring pliers, remove the outer snap-ring (J200).
2. Puncture the seal (J250) and use a slide-hammer type puller to remove the seal. Discard the seal.
3. Use a press or gear puller to press down on the shaft. Using snap-ring pliers, remove the inner snap-ring (J200).
4. Remove the shaft (J100) and bearing (J150) from the pump. It may be necessary to tap the shaft to dislodge it from the internal pump components. After you remove the shaft, take care not to move or jar the pump. Reassembly can be difficult if the internal components move while the shaft is out.
5. Remove snap-ring (J300). Press bearing (J150) from shaft.

Bearing and shaft Replacement (continued)

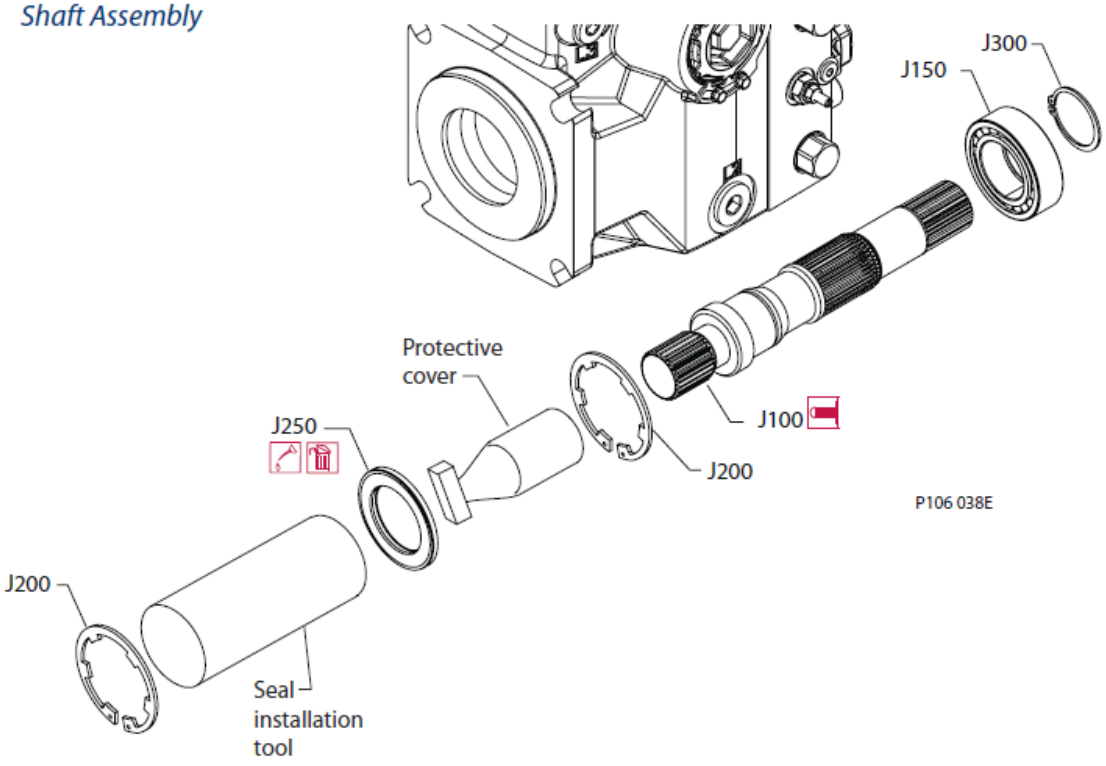
Inspection

6. Inspect the shaft and bearing for wear, scratching, and pits. Rotate the bearing and feel for roughness. Replace damaged components

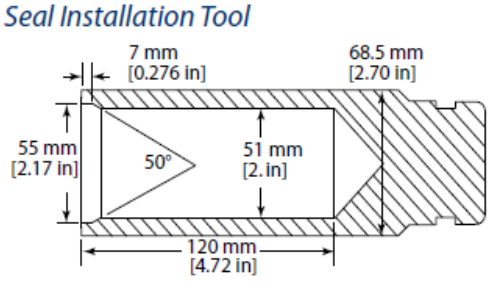
Reassembly

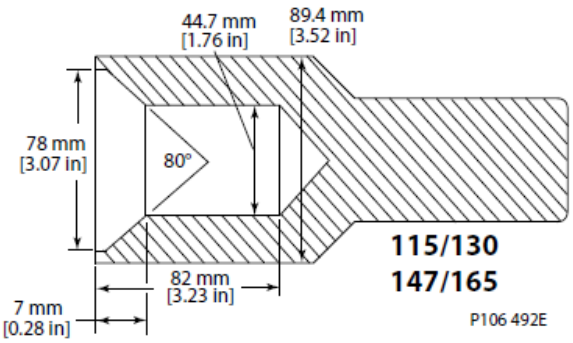
7. Press bearing (J150) on shaft. Install snap-ring (J300).
8. Install the shaft/bearing assembly into the pump. Rotate the shaft to align it with the block and charge pump splines. Press down on the shaft and install the inner snap-ring (J200).
9. Cover end of the shaft with an installation sleeve to protect the seal during installation. Lubricate the seal. Tap on the seal replacing tool or an appropriate deep-socket to press in the seal. Remove the protective cover. Refer to "Specialized tools" page 99, for installation sleeve and seal installation tool part numbers and dimensions.
10. Install the remaining snap-ring.

Shaft Assembly



Seal Installation Tool





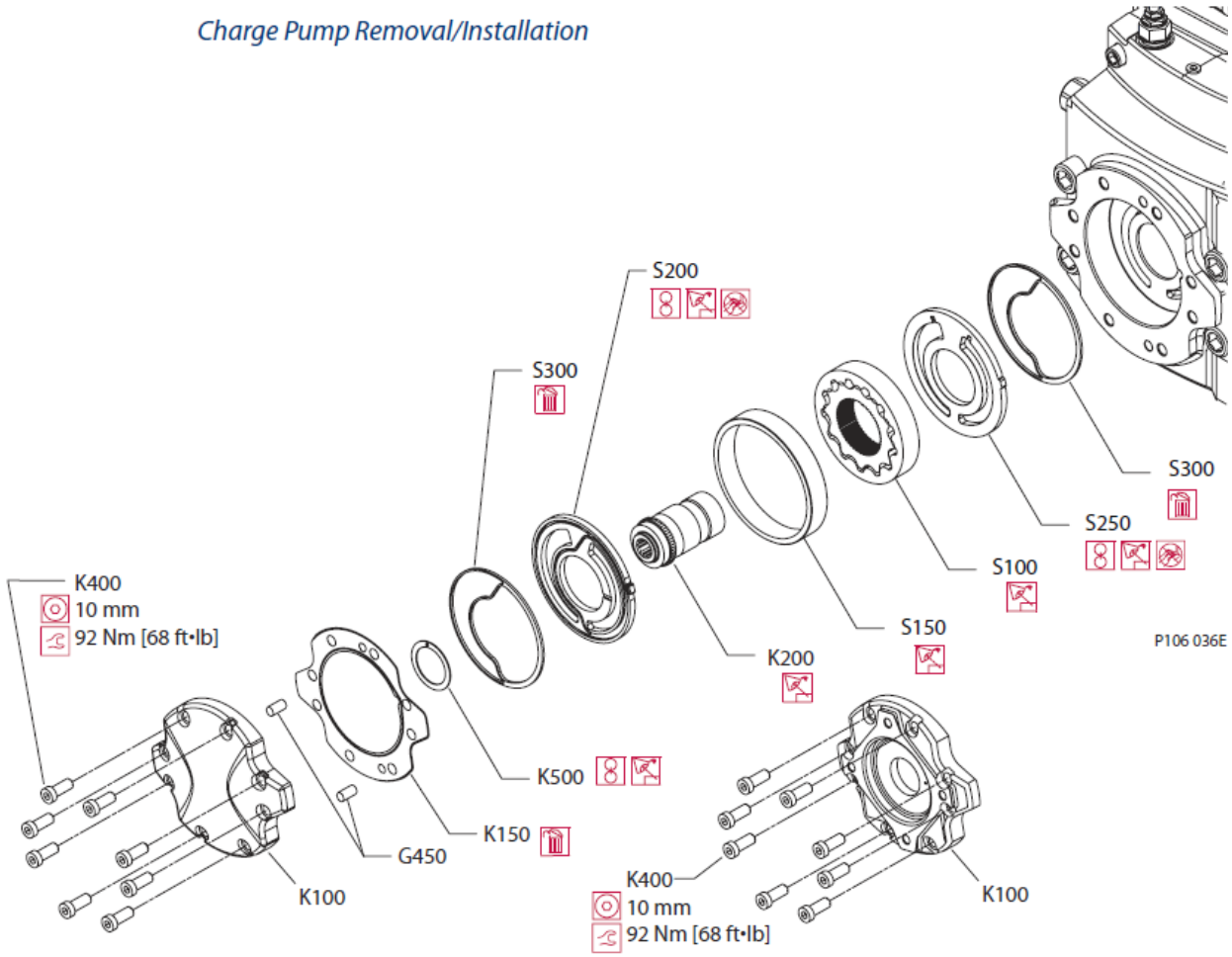
Charge pump

If the pump has an auxiliary pump attached, remove the auxiliary pump and coupling before removing the auxiliary pad.

Charge Pump removal (removable auxiliary pad/cover)

1. Using a 10 mm internal hex wrench, remove cap screws (K400).
2. Remove charge pump cover or auxiliary pad (K100) and gasket (K150). Discard the gasket. Alignment pins (G450) may remain in the cover or the end-cap.
3. Remove thrust washer (K500). Note its orientation. Coated side is towards charge pump coupling (K200).
4. Remove the pressure-balance plate (S200) with seal (S300). Note orientation of plate and seal. Discard seal.
5. Remove charge pump coupling (K200).
6. Remove charge pump gear set (S100) and outer ring (S150).
7. Remove valve plate (S250) with seal (S300). Note orientation of valve plate and seal. Discard seal (S300).

Charge Pump Removal/Installation

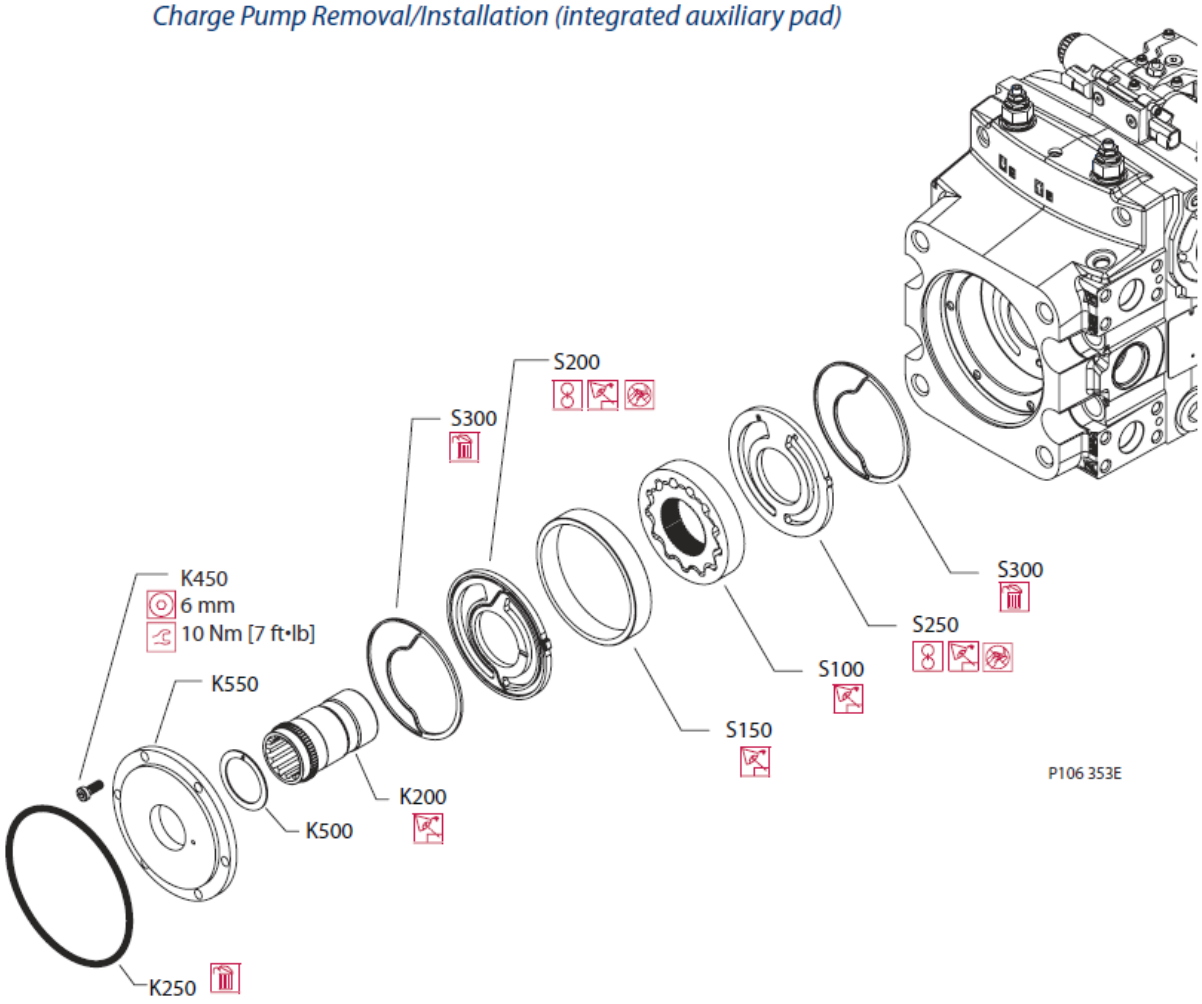


Charge pump (continued)

Charge Pump Removal (integrated auxiliary pad)

1. Remove auxiliary pump and O-ring (K250). Discard O-ring.
2. Remove charge pump cover screws (K450) and charge pump cover (K550).
3. Remove thrust washer (K500). Note its orientation. Coated side is towards charge pump coupling (K200).
4. Remove pressure-balance plate (S200) with seal (S300). Note orientation of valve plate and seal. Discard seal (S300).
5. Remove charge pump coupling (K200).
6. Remove charge pump gear set (S100) and outer ring (S150).
7. Remove valve plate (S250) with seal (S300). Note orientation of valve plate and seal. Discard seal (S300).

Charge Pump Removal/Installation (integrated auxiliary pad)



Inspection

Inspect the components for wear, scratches or pitting. Carefully inspect the valve and pressure-balance plates. Scratches on these components will cause a loss of charge pressure. If any component shows signs of wear, scratching, or pitting, replace it.

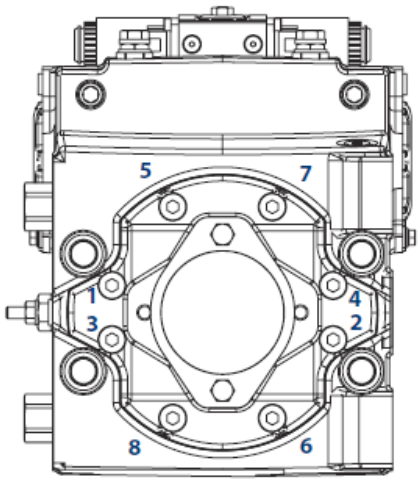
Charge Pump Removal (integrated auxiliary pad) (continued)

1. Install new seals (S300) in the valve (S250) and pressure-balance plates(S200).
2. Install valve plate (S250) in the same orientation as it was removed.
3. Lubricate and install the charge pump gear set (S100) and outer ring (S150).
4. Install the charge pump coupling (K200).
5. Install the pressure-balance plate (S200) in the same orientation as it was removed.
6. Install the thrust washer (K500). the coated side goes towards the charge pump coupling (K200).
7. Install a new cover gasket (K150). If removed, install guide pins (K450).
8. Install the auxiliary pad or the charge pump cover and cap screws. Using a 10mm internal hex wrench, torque the cap screws (K400) to 68ft-lb [92 Nm], or using a 6mm internal hex wrench (K450), torque to 7lbf-ft [10 Nm]. Torque in the sequence below.

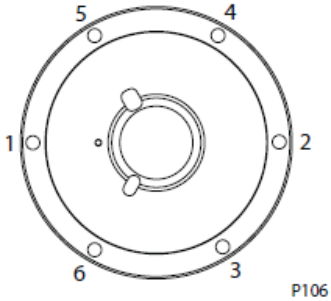
Ensure proper torque on aux pad screws (K400).If necessary, replace screws.

If charge pump replacement is necessary, replace complete charge pump kit.

Cover (K100) Torque Sequence



Cover (K550) Torque Sequence



High Pressure Relief Valve (HPRV)

Removal

1. Using a hex wrench shown in the table below, remove the HPRVs (L150). Remove and discard the O-rings (L060) and backup rings (L068)

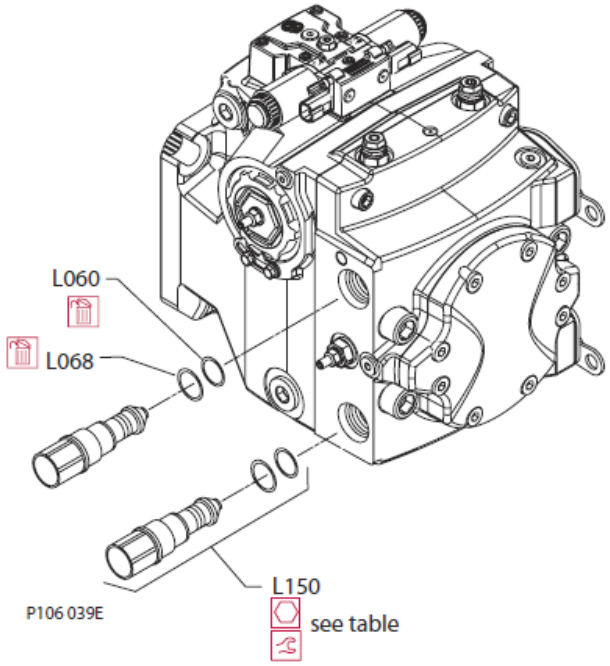
Inspection

2. Inspect the sealing surfaces in the pump for nicks or scratches. Check the valves for damage. Replace any damaged components

Reassembly

3. Lubricate and install new backup rings (L068) and O-rings (L060).
4. Install HPRVs. Torque to the value in the table below.
5. Operate the vehicle/machine through full range of controls to ensure proper operation. Check for leaks.

HPRVs



HPRV Wrench Size and Torque Values

Displacement	Wrench size and torque
078/089/100	22 mm - 70 N•m [52 lbf-ft]
115/130/147/165	30 mm - 110 N•m [81 lbf-ft]

Charge Pressure Relief Valve

Replace the charge pressure relief valve (V010) as a complete unit. Do not attempt to repair the internal components of the valve. Torque to 38lbf-ft [52 Nm]. See "Charge Pressure Relief Valve Adjustment" page 105, for adjustment instructions.

Removal

1. Using a 22 mm wrench, remove the charge pressure relief valve (V010). Discard seal (V024).

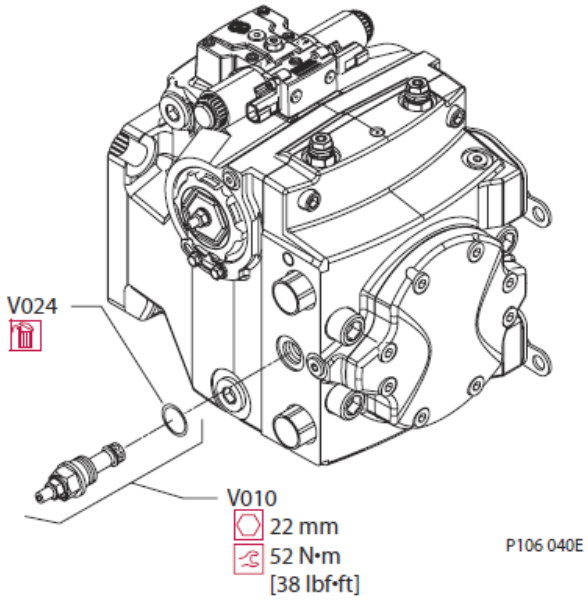
Inspection

2. Inspect the sealing surfaces of the pump for nicks or scratches

Reassembly

3. Lubricate and install new seal (V024).
4. Install the charge pressure relief valve. Torque to 38lbf-ft [52 Nm].
5. Operate vehicle/machine through full range of controls to ensure proper operation.

Charge Pressure Relief Valve



Pressure Limiter Pressure Valve Replacement

Replace the pressure limiter valve as a complete unit. Do not attempt to repair individual components. See"Pressure Limiter Adjustment" page 106, for adjustment instructions.

Removal

1. Using a 22 mm wrench, remove the pressure limiter valve (L100). Discard O-ring.

Inspection

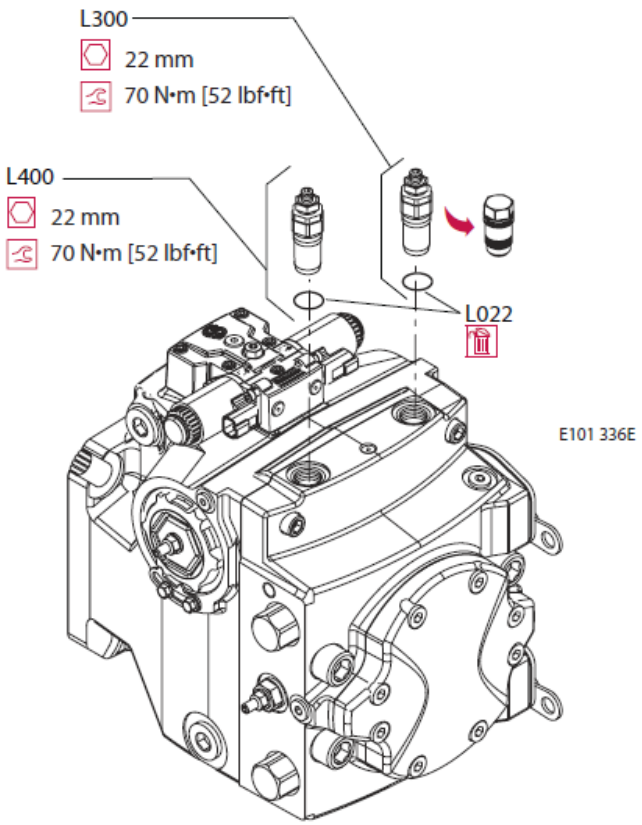
2. Inspect the sealing surfaces of the pump for nicks or scratches.

Reassembly

3. Install new O-ring. Lubricate 0-ring with petroleum jelly.
4. Replace pressure limiter valve. Torque to 52lbf-ft [70 Nm].
5. Operate pump at full range of controls to ensure proper machine operation.

Pressure limiter is available as complete unit only. O-ring is available separately.

Pressure Limiter



Fastener Size and Torques

078/115/130/147/165

Item	Fastener	Wrench size	Torque
D015	Neutral adjust screw	4 mm internal hex	NA
D050	Coil mounting bolt	4 mm internal hex	8 N•m [6 lbf•ft]
D060	Neutral adjust locking nut	13 mm	10 N•m [7 lbf•ft]
D200	Swash plate feedback pin (not shown)	13 mm deep well socket	25 N•m [18 lbf•ft]
D250	Electric control mounting bolt	5 mm internal hex	13.3 N•m [9.8 lbf•ft]
E350	Servo can locking bolt	10 mm	14 N•m [10 lbf•ft]
T015	Filter mounting bolt	17 mm	NA
T025	Filter adapter gage plug	6 mm internal hex	18 N•m [13 lbf•ft]
V010	Charge pressure cartridge	22 mm	52 N•m [38 lbf•ft]
V020	Charge pressure adjusting screw	4 mm internal hex	NA
V022	Charge pressure locking nut	13 mm	12 N•m [9 lbf•ft]

078/089/100

Item	Fastener	Wrench size	Torque
K400	Rear cover/Aux pad mounting bolt	10 mm internal hex	100 N•m [74 lbf•ft]
K450	Charge Pump Cover Screw	5 mm internal hex	10 N•m [7 lbf•ft]
L010	Pressure limiter adjust screw	8 mm	NA
L012	Pressure limiter cartridge	14 mm	30 N•m [22 lbf•ft]
L024	Pressure limiter locking nut	14 mm	20 N•m [15 lbf•ft]
L150	High pressure relief valve	22 mm	70 N•m [52 lbf•ft]

115/130/147/165

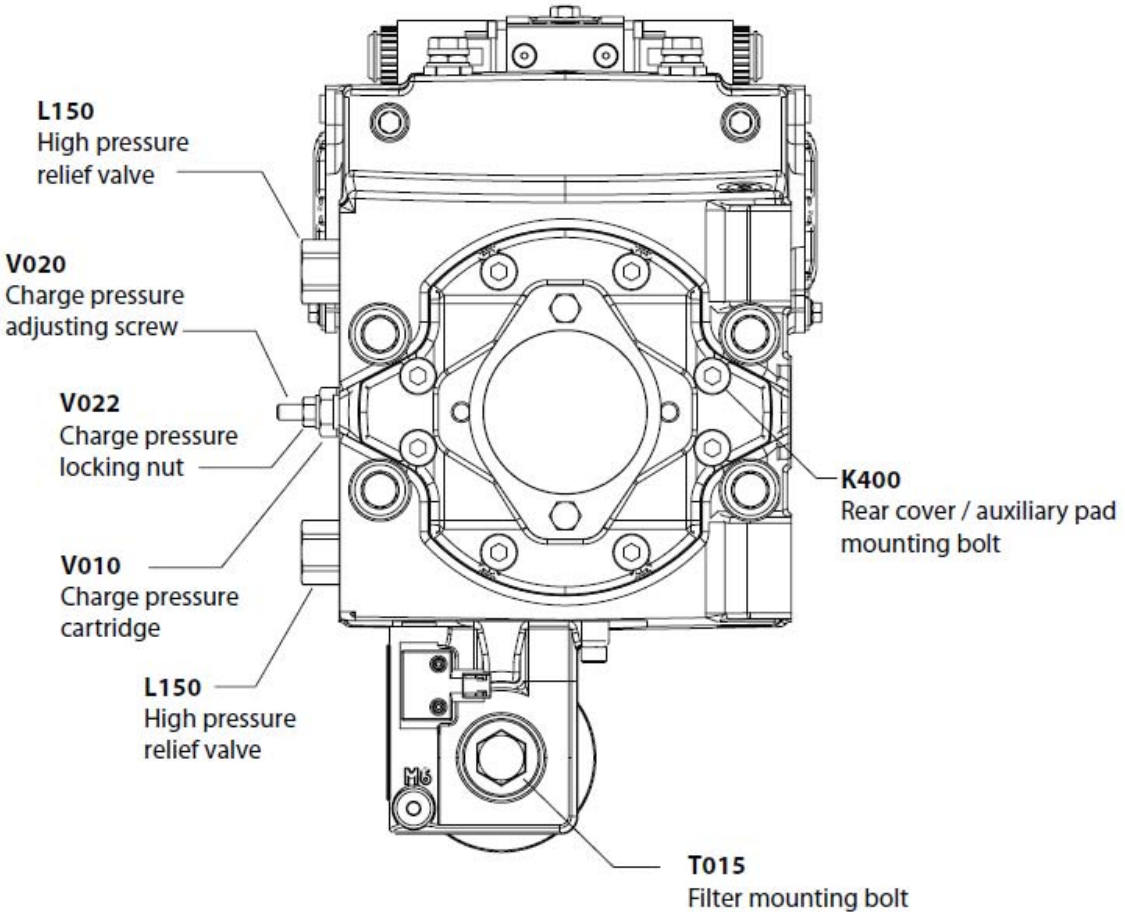
Item	Fastener	Wrench size	Torque
K400	Rear cover/Aux pad mounting bolt	10 mm internal hex	100 N•m [74 lbf•ft]
K450	Charge Pump Cover Screw	5 mm internal hex	10 N•m [7 lbf•ft]
L010	Pressure limiter adjust screw	5 mm internal hex	NA
L012	Pressure limiter cartridge	22 mm	70 N•m [52 lbf•ft]
L024	Pressure limiter locking nut	17 mm	20 N•m [15 lbf•ft]
L028	Pressure limiter plug (special)	19 mm	68 N•m [50 lbf•ft]
L150	High pressure relief valve	30 mm	110 N•m [81 lbf•ft]

Plug Size and Torques

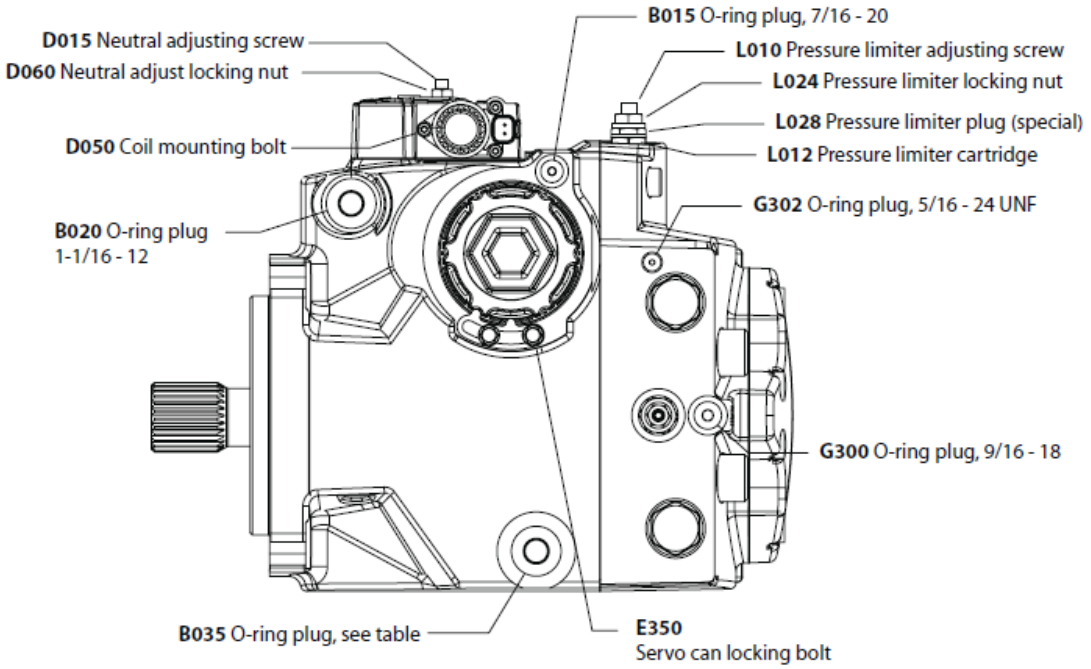
078/115/130/147/165

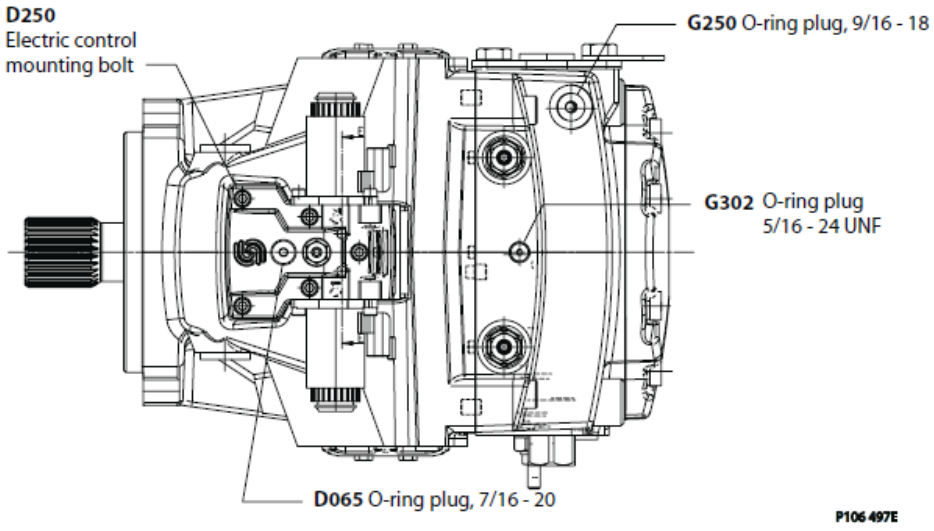
Item	O-ring plug	Wrench size	Torque
B015	7/16 - 20	3/16 mm internal hex	12 N•m [9 lbf•ft]
B020 (078)	7/8 - 14	3/8 internal hex	70 N•m [52 lbf•ft]
B020 (147/165)	1-1/16 - 12	9/16 internal hex	70 N•m [52 lbf•ft]
B035 (078)	1 1/16 - 12	9/16 internal hex	70 N•m [52 lbf•ft]
B035 (147/165)	1 5/16 - 12	5/8 internal hex	150 N•m [110 lbf•ft]
D065	7/16 - 20	3/16 internal hex	12 N•m [9 lbf•ft]
G250	9/16 - 18	1/4 internal hex	24 N•m [18 lbf•ft]
G300	9/16 - 18	3/16 internal hex	24 N•m [18 lbf•ft]
G302	5/16 - 24 UNF	1/8 internal hex	5 N•m [4 lbf•ft]

Fasteners and plugs



Fasteners and plugs (continued)





Integrated Speed Limitation

General Description

The H1 axial piston variable displacement pumps are of cradle swash-plate design and are intended for closed circuit applications.

The flow rate is proportional to the pump input speed and displacement. The latter is infinitely adjustable between zero and maximum displacement.

Flow direction is reversed by tilting the swash-plate to the opposite side of the neutral (zero displacement) position.

4 different displacements with ISL: 7.07 in^3 [115.8 cm^3], 7.98 in^3 [130.8 cm^3], 8.97 in^3 [147 cm^3], and 10.07 in^3 [165 cm^3]

General Description of H1 family of Hydrostatic Pumps

The H1 family of closed circuit variable displacement axial piston pumps is designed for use with all existing Sauer-Danfoss hydraulic motors for the control and transfer of hydraulic power. H1 pumps are compact and high power density where all units utilize an integral electro-hydraulic servo piston assembly that controls the rate (speed) and direction of the hydraulic flow. H1 pumps are specifically compatible with the Sauer-Danfoss family of PLUS+1 micro controllers for easy Plug-and-Perform installation.

H1 pumps can be used together in combination with other Sauer-Danfoss pumps and motors in the overall hydraulic system. Sauer-Danfoss hydrostatic products are designed with many different displacements, pressures, and load-life capabilities. A quick overview of the total Sauer-Danfoss hydrostatic pump and motor product lines are shown below. Go to the Sauer-Danfoss website or applicable product catalog to choose the components that are right for your complete closed circuit hydraulic system.

A word about the organization of this manual

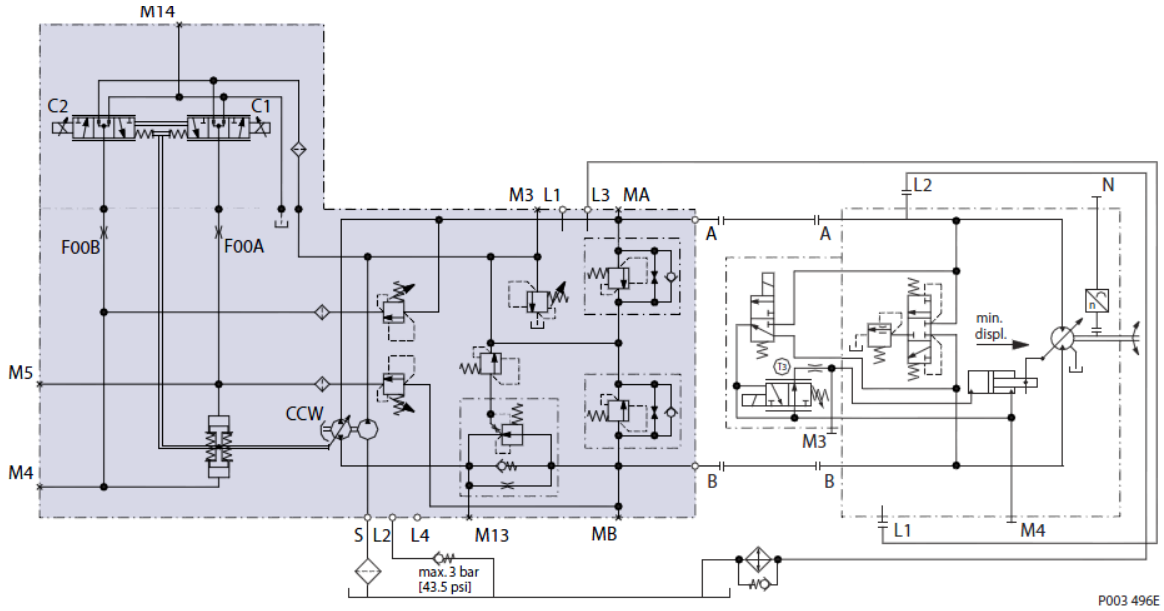
General information covering all displacements of the H1 range is given in the beginning of this section. This includes definitions of operating parameters and system design considerations. Sections later in this book detail the specific operating limitations for each frame and give a full breakdown of available displacements, features and options, and basic installation drawings.

The table below shows the available range of H1 pumps as of this printing, with their respective speed, pressure, theoretical flow ratings, and mounting flange.

Pump	Displacement			Speed		Pressure				Theoretical flow *(at rated speed)*		Mounting flange
			Min.	Rated	Max.	Application pressure*		Maximum working pressure				
	cm^3	$[in^3]$		min^{-1} (rpm)		bar	[psi]	bar	[psi]	l/min	[US gal/min]	SAE
Frame 115/130 Single pumps												*see page 10*
H1P115	115.8	[7.07]	500	3200	3400	450	[6525]	480	[6960]	371	[98]	D
H1P130	130.8	[7.98]				400	[5800]	450	[6525]	419	[111]	
Frame 147/165 Single pumps												*see page 26*
H1P147	147.0	[8.97]	500	3000	3100	450	[6525]	480	[6960]	441	[117]	D
H1P165	165.0	[10.07]				400	[5800]	450	[6525]	495	[131]	

* Operation above application pressure is permissible with Sauer-Danfoss application approval

System Schematic



Above schematic shows the function of a hydrostatic transmission using a H1 axial piston variable displacement pump with electric displacement control (EDC) and a bent axis variable displacement motor with two-position control.

Operation

For machines which are equipped with hydrostatic propel drive systems. Over-speeding of the diesel engine appears when the machine works in downhill- or in braking mode. As a result, the diesel engine as well as the attached components exceed the maximum speed so that defects could occur. For this, the reasons are both the limited braking torque of the today used turbo charged diesel engines and the machine's high weight.

To avoid this we have developed a system which prevents over-speeding by means of integrated valves in the pump. This feature is called Integrated Speed Limiting (ISL) and is offered for H1 pumps.

The performance of ISL and advantages for system

- Sufficient deceleration of the vehicle when braking.
- Protect the diesel engine and the hydraulic pump against over-speeding.
- Ensures an optimal use of the diesel engines braking capability.
- Provides high comfort of driving because it acts independently from the operator.
- It saves the mechanical brakes.
- No additional hydrostatic components or others (like retarders) are required for this function.

When is the ISL - function required

- Turbocharged diesel engine with low braking power is used
- Braking power of the diesel engine is not adequate for the machine mass and speed (mass up to 29 t; speed up to 18.64 mile/hour [30 km/h])
- High pressure in the pump has to be limited when braking, brake pressure acting on the hydraulic motor should be high
- Mechanical brakes will have less load.

Function of the Integrated Speed Limitation

Example of the dynamic braking: the machine is driving on flat ground at a high speed and should be stopped hydrostatically. This is usually done by pulling back the control handle. As a result, the displacement of the pump will be decreased by the servo control and consequently, the machine will slow down. Here, the hydraulic motor works like a pump which is driven by the machine's mass. Due to this fact, the high pressure sides in the closed hydraulic loop, change although the flow direction is constant: now the machine is in braking mode.

Now the hydraulic pump has a pressure increase at the low pressure side so that the pump tries to increase the speed and/or to built up a torque respectively. This torque is transferred to the diesel engine by the pump shaft which would normally lead to an over-speeding situation.

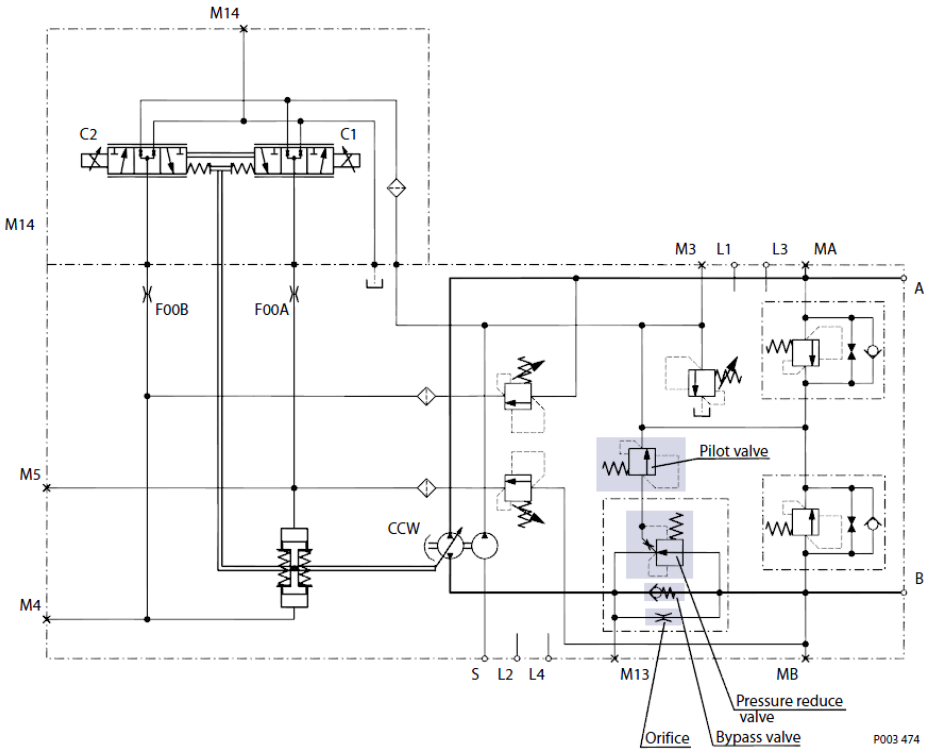
The special feature of the system is a pilot operated pressure reducing valve and orifice which are installed in the pump's end-cap. The components are located between the motor and pump to reduce the maximum pressure of the pump while braking.

The pressure reducing valve closes at a certain pressure controlled by the pilot valve (e.g. 2900 psi [200 bar]) which is equivalent to the diesel motor's braking capability. At the same time, the system signals the control the effective braking pressure of 6500 psi [450 bar] to stroke the pump to maximum displacement to ensure taking off the oil which is delivered by the motor.

Additionally, there is an orifice which is installed in parallel to the pressure reducing valve to continue controlling the pump at the maximum pressure while the machine is slowing down - although the amount of oil decreases. Now, the diesel engine can take up the maximum braking capability which it is able to manage. By this, a high temperature increase in the hydraulic circuit will be avoided. In reverse driving direction the bypass valve opens and allows normal driving.

Advantages

- Avoiding over-speeding of the diesel motor and their flanged components
- The hydrostatic braking power of the machine is not to be influenced – the motor always records the maximum braking pressure of 6500 psi [450 bar]
- No influences regarding driving comfort
- Easy to retrofit
- Nearly the same installation dimensions as standard pumps
- No electronic sensors are necessary



Technical Specifications

Definitions of the following specifications, see below Operating parameters.

General specifications

Design	Axial piston pump of cradle swashplate design with variable displacement
Direction of rotation	Clockwise, counterclockwise
Pipe connections	Main pressure ports: ISO Split Flange Boss
	Remaining ports: SAE straight thread O-ring boss
Recommended installation position	Pump installation position is discretionary, however the recommended control position is on the top or at the side. If the pump is installed with the control at the bottom, it is recommended to flush the case through port M14 located at the EDC and NFPE control. Vertical input shaft installation is acceptable. Consult Sauer-Danfoss for non conformance to these guidelines. The housing must always be filled with hydraulic fluid.
Auxiliary cavity pressure	Will see inlet pressure with internal charge pump. Will be case pressure with external charge supply. Please verify mating pump shaft seal capability.

General specifications

Design	Axial piston pump of cradle swashplate design with variable displacement
Direction of rotation	Clockwise, counterclockwise
Pipe connections	Main pressure ports: ISO Split Flange Boss
	Remaining ports: SAE straight thread O-ring boss
Recommended installation position	Pump installation position is discretionary, however the recommended control position is on the top or at the side. If the pump is installed with the control at the bottom, it is recommended to flush the case through port M14 located at the EDC and NFPE control. Vertical input shaft installation is acceptable. Consult Sauer-Danfoss for non conformance to these guidelines. The housing must always be filled with hydraulic fluid.
Auxiliary cavity pressure	Will see inlet pressure with internal charge pump. Will be case pressure with external charge supply. Please verify mating pump shaft seal capability.

Operating parameters

Feature		Unit	Frame size	
			115	130
Input speed	Minimum for internal charge supply	min^{-1} (rpm)	500	
	Minimum for external charge supply		500	
	Minimum for full performance		1200	
	Rated		3200	
	Maximum		3400	
System pressure	Application pressure	bar [psi]	450 [6525]	400 [5800]
	Maximum working pressure		480 [6960]	450 [6525]
	Minimum pressure		10 [150]	
Charge pressure	Minimum	bar [psi]	16 [232]	
	Maximum		34 [493]	
Control pressure	Minimum (at corner power for EDC and FNR)	bar [psi]	17 [247]	
	Minimum (at corner power for NFPE)		20 [290]	
	Maximum		40 [580]	
Charge pump inlet pressure	Rated	bar (absolute) [in Hg vacuum]	0.7 [9]	
	Minimum (cold start)		0.2 [24]	
	Maximum	bar [psi]	4.0 [58]	
Case pressure	Rated	bar [psi]	3.0 [44]	
	Maximum		5.0 [73]	

Fluid specifications

Feature		Unit	Frame size	
			115	130
Viscosity	Minimum	mm²/s [SUS]	7 [49]	
	Recommended range		12-80 [66-370]	
	Maximum		1600 [7500]	
Temperature range [1]	Minimum	°C [°F]	-40 [-40]	
	Rated		104 [220]	
	Maximum intermittent		115 [240]	
Filtration (recommended minimum)	Cleanliness per ISO 4406		22/18/13	
	Efficiency (charge pressure filtration)	β-ratio	$\beta_{15-20} = 75$ ($\beta_{10} \geq 10$)	
	Efficiency (suction and return line filtration)		$\beta_{35-45} = 75$ ($\beta_{10} \geq 2$)	
	Recommended inlet screen mesh size	µm	100 – 125	

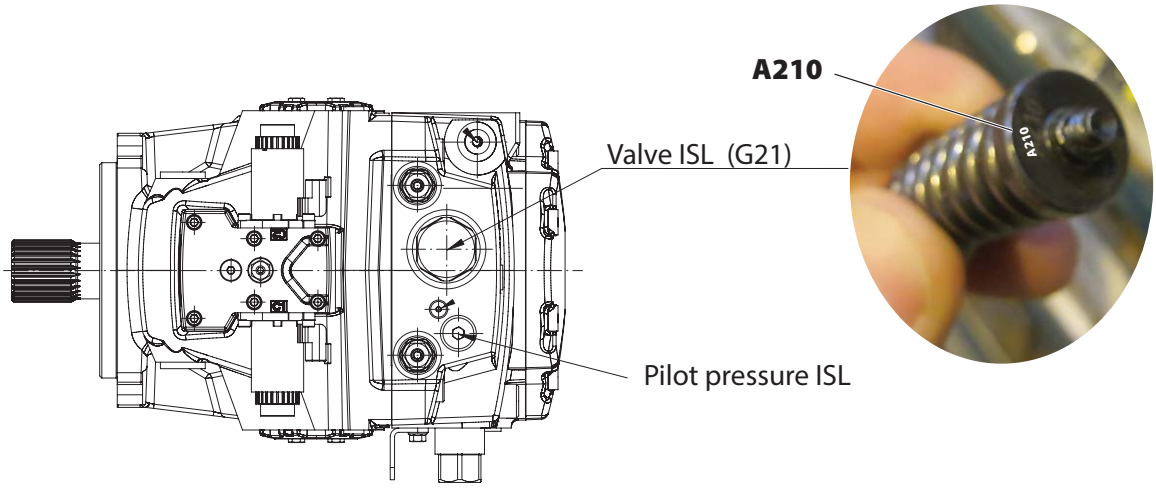
[1] At the hottest point, normally case drain port.

ISL - Model Code

	A	B	D	F	E	G	H	J	K	M	N	S	T	V	W	X	Y
H1P	115	R	A	A4	C2	N	E2	G	G2	H4	L45	L45	L	L	30	PN	NNN	G21
H1P	115	R	A	A4	C2	N	E8	G	G3	H3	L45	L45	L	L	30	PN	NNN	G21

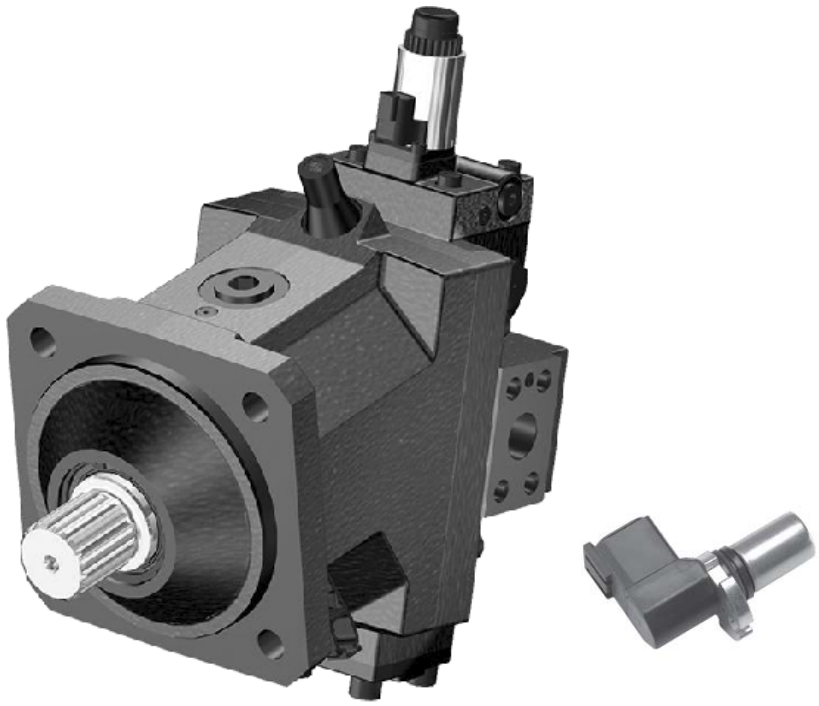
G21 = ISL Pressure setting 210 bar [3046 psi]

Location of ISL Components



BENT AXIS MOTOR

H1 B 110 A L1 BA N A PB CS JS S A 15 NN 000 N NNN



HYDRAULIC - SAUER BENT-AXIS MOTOR

Introduction

Overview

This section includes information for the installation, maintenance, and minor repair of the H1 bent-axis motor. It includes a description of the unit and its individual components, troubleshooting information, and minor repair procedures.

Performing minor repairs may require removal from the vehicle/machine. Thoroughly clean the unit before beginning maintenance or repair activities. Since dirt and contamination are the greatest enemies of any type of hydraulic equipment, follow cleanliness requirements strictly. This is especially important when changing the system filter and when removing hoses or plumbing.

A worldwide network of Danfoss Global Service Partners is available for major repair. Danfoss trains and certifies Global Service Partners on a regular basis. You can locate your nearest Global Service Partner using the distributor locater at www.powersolutions.danfoss.com. Click on the Sales and Service link.

Warranty

Performing installation, maintenance, and minor repairs according to the procedures in this manual will not affect your warranty. Major repairs requiring the removal of a unit's rear cover voids the warranty unless done by a Danfoss Global Service Partner.

General instructions

Follow these general procedures when repairing H1 variable displacement closed circuit motors.

Remove the unit

Chock the wheels on the vehicle or lock the mechanism to inhibit movement. Prior to performing repairs, remove the unit from the vehicle/machine. Be aware that hydraulic fluid may be under high pressure and/or hot. Inspect the outside of the motor and fittings for damage. Cap hoses after removal to prevent contamination.

Keep it clean

Cleanliness is a primary means of assuring satisfactory motor life, on either new or repaired units. Clean the outside of the motor thoroughly before disassembly. Take care to avoid contamination of the system ports. Cleaning parts with a clean solvent wash and air drying is usually adequate.

Keep all parts free of foreign materials and chemicals. Protect all exposed sealing surfaces and open cavities from damage and foreign material. If left unattended, cover the motor with a protective layer of plastic.

Replace all O-rings and gaskets

Danfoss recommends you replace all O-rings and gaskets during repair. Lightly lubricate O-rings with clean petroleum jelly prior to assembly.

Secure the unit

For repair, place the unit in a stable position with the shaft pointing downward. Secure the motor while removing and torquing components and fasteners.

Safety precautions

Always consider safety precautions before beginning a service procedure. Protect yourself and others from injury. Take the following general precautions whenever servicing a hydraulic system.

DANGER! Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

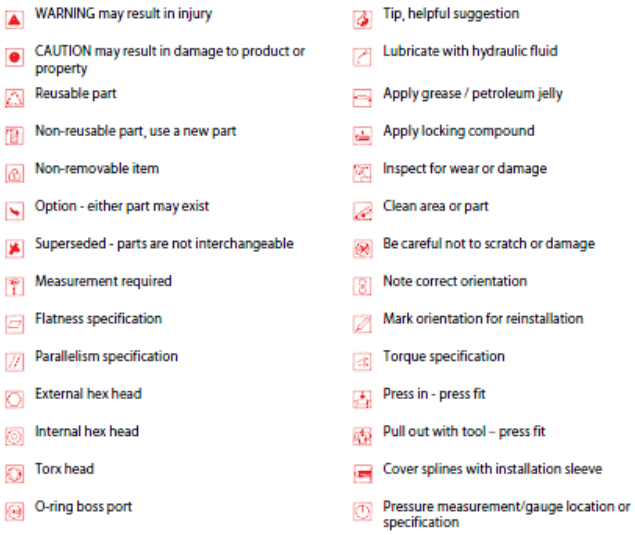
DANGER! Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

DANGER! Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. This fluid may also be hot enough to cause burns. Use caution when dealing with hydraulic fluid under pressure. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Never use your hand or any other body part to check for leaks in a pressurized line. Seek medical attention immediately if you are cut by hydraulic fluid.

DANGER! Avoid prolonged contact with hydraulic fluid. Always dispose of used hydraulic fluid according to environmental regulations

Protect yourself from injury. Use proper safety equipment, including safety glasses, at all times.

Symbols used in Danfoss literature



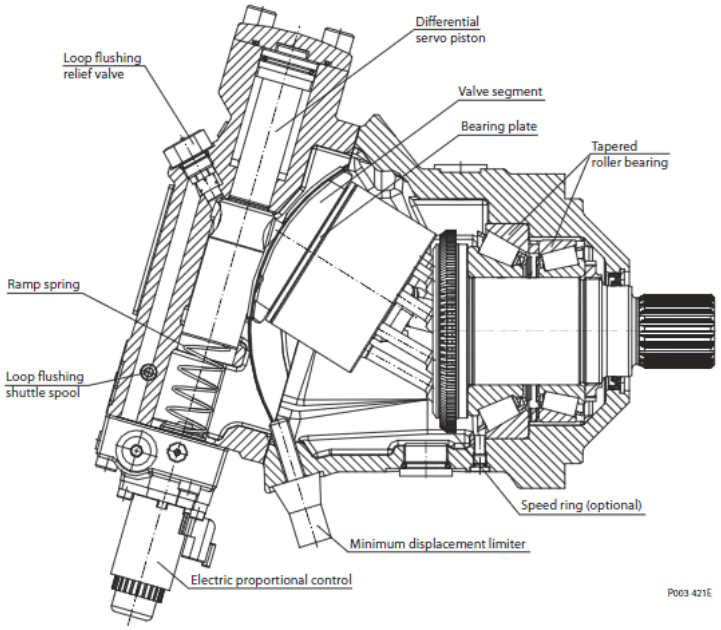
The symbols above appear in the illustrations and text of this manual. They are intended to communicate helpful information at the point where it is most useful to the reader. In most instances, the appearance of the symbol itself denotes its meaning. The legend above defines each symbol and explains its purpose.

Model Code Description

2010 - juin - 15		
Customer		
Application		
Model Code	H1-B-110-A-L1-BA-N-A-PB-CS-JS-S-A-15-NN-000-N-00-NNN	
Material Number	83008678	
List Price	unknown	
Series	H1	Product Family H1
Product Type	B	Motor, Variable, Bi-directional
Frame Size	110	Displacement 110 cc/rev at maximum angle
Product Version	A	Product Version
Control	L1	Electric Proportional 12V, DEUTSCH DT 04-2P connector, de-energized = maximum displacement, no PCOR
PCOR, BPD	BA	without PCOR & without BPD, Use with "L*" controls
Default	N	Not applicable
Orifices	A	1.2mm diameter orifices M4 and M5
Endcap Type & Ports	PB	Endcap for proportional controls, Side ports ISO 6162 Type 1 (metric), Use with L* controls
Flange & Housing	CS	Cartridge-Flange motor housing, With Speed sensor port
Shaft & Speed Ring	JS	W40x2x30x18x9g DIN 5480 with speed ring, Use with DIN ("DS") or Cartridge ("CS") flange only
Sensor	S	Speed sensor, DEUTSCH DTM 04-6P connector
Loop Flushing Shuttle System	A	Standard 6.5 bar shift pressure
Loop Flushing Relief Valve	15	15 l/min, non adjustable, 16 bar cracking pressure
Special Hardware Feature	NN	Standard hardware
Minimum Displacement	000	000 cc/rev minimum displacement setting
Maximum Displacement	N	100% maximum displacement for all L*, M* and K* control options, non adjustable
PCOR Setting	00	For all controls without PCOR function (L*-, M*- and E* control options)
Paint & Nametag	NNN	Black paint and S-D Nametag
Comments		

Design

Cross section of an H1 Electric proportional control



Series H1 variable displacement motors are of a bent axis design, incorporating spherical pistons. These motors are designed primarily to be combined with other products in closed circuit systems to transfer and control hydraulic power. Series H1 motors have a large maximum/minimum displacement ratio of 5:1 and high output speed capabilities. The expanded function of zero degree capability, coupled with a high performance 32 degree maximum angle, creates opportunities to easily improve the machine performance for:

- wheel assist on the steering axle of high inertia machines (i.e. combines) and could include Anti Slip Control
- off highway machines requiring Anti Slip (i.e. Ag sprayer)
- multi-motor applications requiring optimized work and transport modes (i.e. wheel loader, Ag sprayer) utilizing the zero degree position for maximum transport speed
- improved machine (i.e. Single Drum Roller) grade-ability through precise Anti Slip Control.

The Anti Slip Control reduces ground damage, increases traction control, and improves machine controllability for the operator. SAE, Cartridge, and DIN flange with radial or axial high pressure port configurations, are available including the loop flushing device. A complete family of controls and regulators are available to fulfill the requirements of a wide range of applications. Motors normally start at maximum displacement. This provides maximum starting torque for high acceleration.

All controls utilize an internally supplied servo pressure. This may be overridden by a pressure compensator which functions when the motor is operating in motor and pump modes. A defeat option is available to disable the pressure compensator override when the motor is running in pump mode during deceleration/braking.

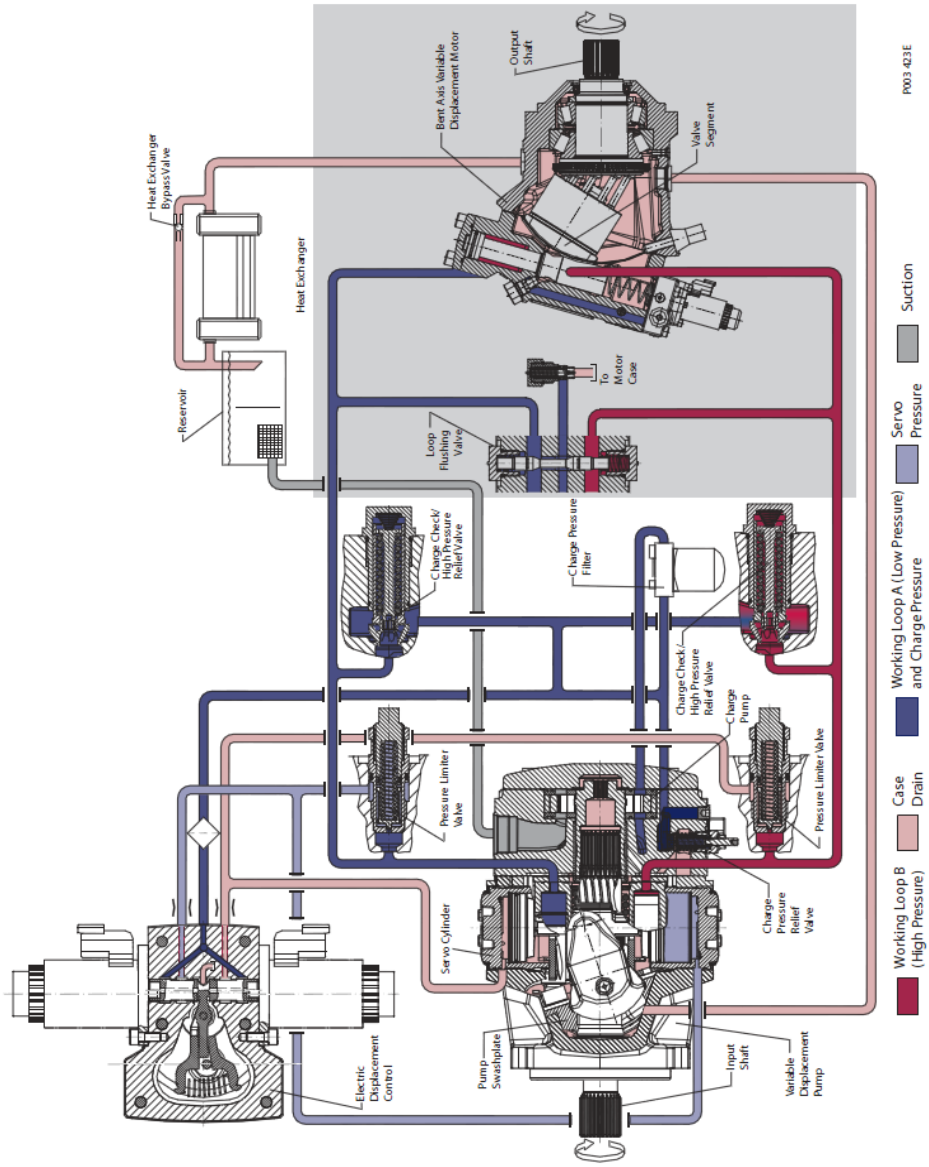
The pressure compensator option features a low pressure rise to ensure optimal power utilization throughout the entire displacement range of the motor.

Speed sensor options are available to cover all frame sizes and flange styles. They are capable of sensing the following, all in one package:

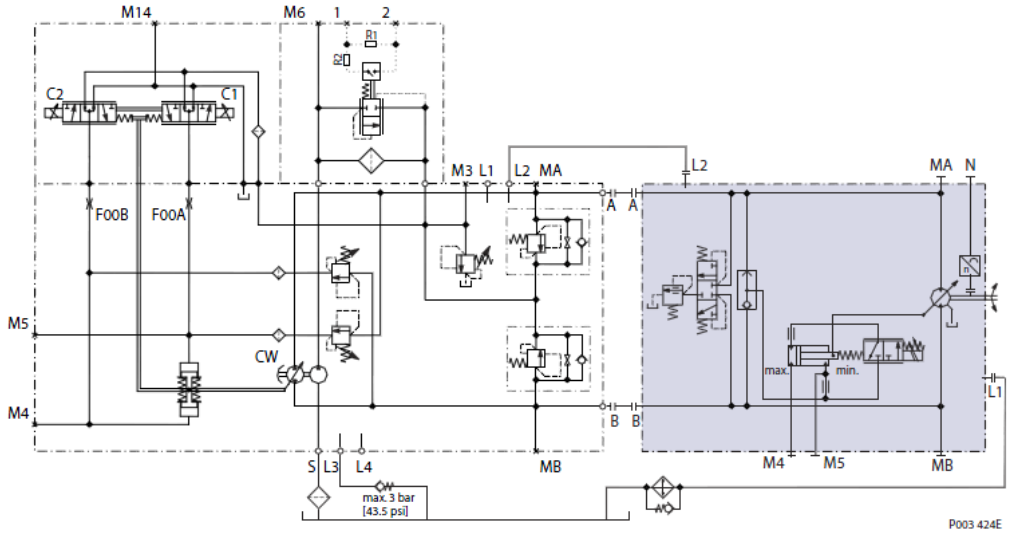
- Speed
- Direction
- Temperature

The electric controls are specifically designed for the Sauer-Danfoss family of Plus+1™ micro controllers for easy Plug-and Perform™ installation.

System diagram



System schematic



The schematic above shows the function of a hydrostatic transmission using an H1 Axial variable displacement pump with electric proportional displacement control (EDC) and an H1 Bent axis variable displacement motor with electric proportional control (L*) and integrated loop flushing device.

Technical Specifications

General Specifications

Design	Piston motor with variable displacement bent axis design
Direction of rotation	bi-directional
Pipe connections	Main pressure ports: ISO split flange boss
	Remaining ports: SAE straight thread O-ring boss
Recommended installation position	Discretionary, the housing must always be filled with hydraulic fluid

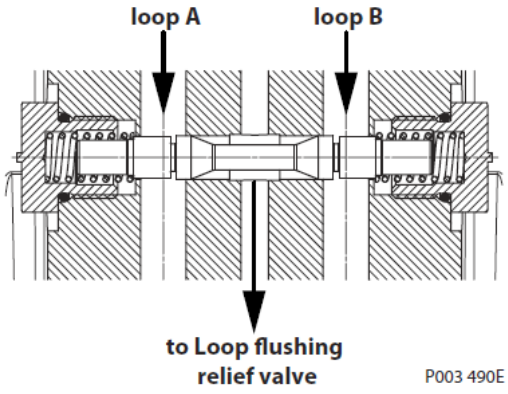
Operating Specifications

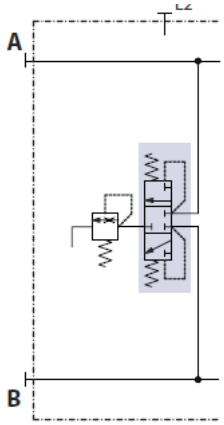
Features			Unit	Frame size 080	110
Output speed	Rated	maximum displacement 32°	min-1 (rpm)	3200	2900
		minimum displacement 6°		5100	4800
		zero displacement 0°		5500	5350
	Maximum	maximum displacement 32°		4100	3700
		minimum displacement 6°		6350	5950
		zero displacement 0°		6750	6500
System pressure	Max. working pressure		bar [psi]	450 [6527]	
	Maximum pressure			480 [6960]	
	Minimum pressure			7.5 [109]	
Case pressure	Rated		bar [psi]	3 [44]	
	Maximum			5 [73]	
	Minimum			0.3 [4]	

Operating

An integral loop flushing shuttle spool is used to separate system A and system B pressures. System delta pressure will cause the shuttle spool to shift, allowing the low side system pressure to flow to the loop flushing relief valve.

Loop Flushing Shuttle Spool



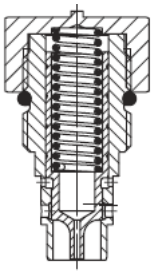


ATTENTION! Unintended vehicle or machine movement hazard. Excessive motor loop flushing flow may result in the inability to build required system pressure in some conditions. Maintain correct charge pressure under all conditions of operation to maintain pump control performance in hydrostatic systems.

Loop Flushing Relief Valve

The loop flushing relief valve is incorporated into all H1 motors. Use the loop flushing option, in installations that require fluid to be removed from the low pressure side of the system circuit due to cooling requirements, and also used to facilitate the removal of contaminants from the loop.

The loop flushing valve is equipped with an orificed charge pressure relief valve designed with a cracking pressure of 232 psi [16 bar]. Valves are available with several orifice sizes to meet the flushing flow requirements of all system operating conditions.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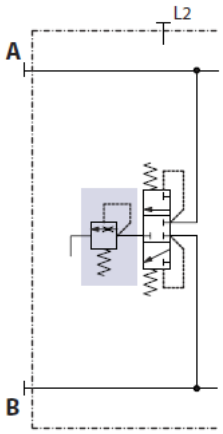
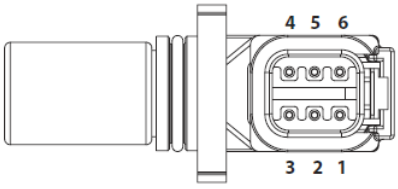


Speed and Temperature Sensor data

An optional, non-adjustable speed sensor is available. It is capable of measuring speed, direction of rotation, and case oil temperature. The temperature sensor can not be used for dynamic measurement. The temperature sensor can be used for diagnostic purposes and other uses not requiring instantaneous temperature updates.

Speed sensor technical data

	Min.	Nom.	Max.	Units	
Supply	4.75	5	5.25	Vdc	
Supply protection	–	–	30	Vdc	
Max. required supply current			25	mA	
Output mode	NPN & PNP				
Connector	DEUTSCH DTM-Series 6-Pin DTM 04 – 6P				
Connector terminals					Sensor Pinout: 1 Signal 2; 2 Direction; 3 Signal 1; 4 Supply; 5 Ground; 6 Temperature
Protection code IP-class	IP 67 and IP 69k according to IEC 60529 & DIN 40050				

Speed Sensor Connector

Description	Quantity	Ordering number
Mating connector Deutsch® DTM06-6P	1	11033865

Speed and Temperature Sensor Position

Refer to the section "Speed and Temperature Sensor" page 161

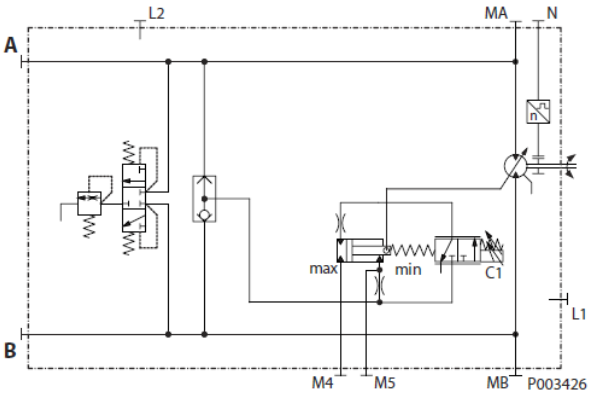
Minimum Displacement Limiter

All Series H1 Motors incorporate mechanical displacement limiters. The minimum displacement of the motor is preset at the factory with a set screw in the motor housing. A tamper-proof cap is provided.

Control Circuit Diagram - Nomenclature- Description

L1 (Electric Proportional 12 V/de-energized = max. displacement)

BA (without Pressure Compensator Over Ride/without Brake Pressure Defeat)



Ports:

A, B	=	Main pressure lines
L1, L2	=	Drain lines
M4, M5	=	Gage port servo pressure
N	=	Speed sensor (optional)
MA, MB	=	Gage port system pressure

Initial Startup Procedures

DANGER! This service procedure may require disabling the vehicle/machine (raising the wheels off the ground, disconnecting work function) while performing; to prevent injury to the technician and bystanders. Take the necessary safety precautions.

Always follow this procedure when starting-up a new H1 installation or when the motor has been removed.

1. Before installing the motor, inspect the units for possible damage incurred during shipping and handling.
2. Make certain all system components (reservoir, hoses, valves, fittings, heat exchanger, and so forth) are clean before filling with fluid.
3. Fill the reservoir with the recommended hydraulic fluid. Pass this fluid through a 10 micron (nominal, no bypass) filter before it enters the reservoir.
4. Fill the inlet line leading from the reservoir to the pump.
5. Check inlet line for properly tightened fittings. Make sure the inlet line is free of restrictions and air leaks.
6. Fill the motor and pump housings with clean hydraulic fluid before start up. Fill by pouring filtered oil into the upper case drain port.

WARNING! Never start the prime mover unless the motor and pump housings are completely filled with clean hydraulic fluid.

7. For closed loop systems, install a 0-1000 psi [0-60 bar] pressure gauge, in the charge pressure gauge port of the pump, to monitor the charge pressure during start-up. For open circuit systems, use gauges in system ports.
8. Disconnect any external control input signal from the pump control until after initial start-up. This ensures that the pump remains in its neutral position.
9. Jog (slowly rotate) prime mover until charge pressure starts to rise.
10. Start the prime mover and run at the lowest possible speed until charge pressure builds.

WARNING! Do not start the prime mover unless the pump is in neutral position (swash plate at 0° angle). Take necessary precautions to prevent machine movement in case pump is actuated (in stroke) during initial start-up. If necessary, bleed excess air from the high pressure lines through the high pressure system gauge ports.

11. Once charge pressure is established, increase to normal operating speed. Charge pressure should be as indicated in the pump model code. If charge pressure is low, shut down and determine cause.

Low charge pressure may affect the ability to control the machine.

12. Shut down the prime mover.
13. Connect the external control input signal.
14. Reconnect the machine function if disconnected earlier.
15. Start the prime mover, checking to ensure the pump remains in neutral.
16. Check for forward and reverse machine operation, with the prime mover at normal operating speed. Charge pressure may decrease slightly during forward or reverse operation.
17. Continue to cycle slowly between forward and reverse for at least five minutes.
18. Shut down prime mover.
19. Remove gauges. Replace plugs at the gauge ports.
20. Check reservoir level. Add filtered fluid if needed. The motor/transmission is now ready for operation.

Troubleshooting

Overview

This section provides general steps to follow if you observe undesirable system conditions. Follow the steps until you solve the problem. Some of the items are system specific. Always observe the safety precautions in the section "Introduction" page 135.

WARNING! Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Electrical troubleshooting

Item	Description	Action
Motor operates at one displacement only.	Control coil failure	Measure resistance at coil pins. Proportional controls: Resistance should be 14.20 Ohms (24V) or 3.66 Ohms (12V) at 20°C [70°F]. Two-position controls: Resistance should be 8.4 Ohms (24V) or 34.5 Ohms (12V) at 20°C [70°F]. Replace coil if necessary.
Erratic motor function	Electrical connection to motor is intermittent.	Disconnect connector, check wires and terminals, reconnect wires. Check terminals for corrosion and correct position.

Sluggish operation

Check		Cause	Corrective action
1.	Control orifices	Blocked or restricted orifice may cause sluggish response. Orifices installed in the wrong locations may cause PCOR control to be sluggish.	Remove, inspect and clean all orifices. Ensure the appropriate orifices are installed and in the correct location.
2.	Threshold setting (proportional controls)	Inappropriately high or low threshold setting may shift the motor at the wrong time.	Check threshold setting. Adjust if necessary.
3.	Control spool	A sticky control may cause sluggish response or no response.	Clean and inspect the control spool. Replace if necessary.
4.	Pressure compensator setting	Low pressure compensator setting may shift motor to maximum displacement at lower pressure.	Check pressure compensator setting. Adjust if necessary.
5.	Control input signal	An improper or erratic input signal to the control may cause sluggish response.	Check input signal and correct if necessary.
6.	Internal leakage	Excessive leakage will cause lower charge pressure and affect performance.	Install loop flushing defeat option and measure case flow. If case flow is excessive, motor may require major repair. Contact your Danfoss authorized service center.

System Operating Hot

Check		Cause	Corrective action
1.	Oil level	Insufficient hydraulic fluid may cause overheating.	Fill reservoir to proper level.
2.	Heat exchanger	Blocked heat exchanger or low air flow may cause system overheating.	Check temperature upstream and downstream of heat exchanger. Clean, repair, or replace heat exchanger if necessary.
3.	Loop flushing flow	Restricted orifice in loop flushing cartridge reduces flow.	Measure case drain flow. Clean or replace orifice cartridge.
4.	Loop flushing shuttle	Loop flushing shuttle may be sticking in one direction.	Ensure shuttle moves freely in its bore.
5.	Air in system	Entrained air generates heat under pressure	Look for foam or bubbles in reservoir. Check for leaks on inlet side of charge pump.
6.	Internal leakage	Excessive internal leakage may overheat the system.	Install loop flushing defeat option and monitor case flow. If case flow is excessive, motor may require major repair. Contact your Danfoss authorized service center.

Excessive noise and vibrations

Check		Cause	Corrective action
1.	Oil level in reservoir	Insufficient hydraulic fluid may cause cavitation.	Fill reservoir to proper level.
2.	Air in system	Air bubbles may lead to cavitation.	Look for foam or bubbles in reservoir. Check for leaks on inlet side of charge pump.
3.	Shaft coupling	Loose shaft coupling may create excess noise.	Replace loose shaft coupling. Replace or repair motor if shaft splines show excessive wear.
4.	Shaft alignment	Misaligned shafts may create excessive noise and vibration and can damage motor.	Correct shaft misalignment.

Motor operates normally in one direction only

Check		Cause	Corrective action
1.	Charge pressure	If charge pressure is low in one direction, the loop flushing shuttle spool may be sticking to one side.	Measure charge pressure in forward and reverse. If pressure drops significantly lower in one direction, inspect and repair loop flushing shuttle spool.
2.	Pressure compensator control	If pressure compensator operates in one direction only, the motor may stay at minimum displacement in the opposite direction.	Check brake pressure defeat spool. It may be sticking or receiving an improper signal. Repair spool or correct input signal.

Improper Output Speed

Check		Cause	Corrective action
1.	Oil level in reservoir	Insufficient hydraulic fluid may reduce system efficiency.	Fill reservoir to proper level.
2.	Threshold setting	Improper threshold setting may cause motor to have wrong displacement for given signal.	Check threshold setting. Refer to Control Service Manual for adjustment procedure.
3.	Pressure compensator setting	Improper pressure compensator setting may shift motor displacement at wrong pressure.	Check pressure compensator setting. Adjust if necessary. Refer to Control Service Manual for adjustment procedure.
4.	PC spool	Pressure compensator spool sticking may shift motor to improper displacement.	Check pressure compensator spool. Repair or replace if needed. Refer to Control Service Manual for adjustment procedure.
5.	Control orifices	Blocked or restricted orifice may cause motor to shift improperly.	Remove, inspect and clean all orifices.
6.	Control spool	Sticky proportional control spool may cause motor to shift improperly.	Check control spool for proper operation. Repair if necessary. Refer to control adjustment procedure.
7.	Control input signal	Improper input signal may cause motor to shift improperly.	Correct control input signal.
8.	Internal leakage	Excess internal leakage may cause lower charge pressure and affect motor performance including output speed.	Install loop flushing defeat option and measure case flow. If case flow is excessive, motor may require major repair. Contact your Danfoss authorized service center.

Low Output Torque

Check		Cause	Corrective action
1.	Pressure compensator setting	High pressure compensator setting may cause improper motor displacement for torque required.	Check and adjust pressure compensator setting.
2.	Control orifices	Blocked or restricted orifice may cause motor to shift improperly.	Remove, inspect and clean all orifices.
3.	Pressure compensator spool	Sticking pressure compensator spool may cause control to hold motor at minimum displacement.	Remove and inspect pressure compensating spool. Repair or replace control if necessary.
4.	Control spool	Sticking control spool may cause motor to shift improperly.	Remove and inspect control spool. Repair or replace control if necessary.
5.	Two position solenoid	Two position control not shifting motor to maximum displacement.	Inspect solenoid valve for bent stem or damaged coil. Repair or replace if necessary.
6.	Control input signal	Improper control input signal may cause motor to stay at minimum displacement.	Correct control input signal.
7.	Threshold setting (proportional control)	Improper threshold setting may cause improper motor displacement for torque required.	Check and adjust threshold setting.
8.	Internal leakage	Excess internal leakage may cause charge pressure to decay, reducing output torque.	Install loop flushing defeat option and monitor case flow. If case flow is excessive, motor may require major repair. Contact your Danfoss authorized service center.

HYDRAULIC - SAUER BENT-AXIS MOTOR

Required tools and standard procedure

Required tools

The service procedures described in this manual can be performed using common mechanic's hand tools. Special tools, if required, are shown. When testing system pressures, calibrate pressure gauges frequently to ensure accuracy. Use a snubber to protect gauges.

Standard procedures

ATTENTION! Contamination can damage internal components and void the manufacturer's warranty. Take precautions to ensure system cleanliness when removing and reinstalling system lines

1. With the prime mover off, thoroughly clean all dirt and grime from the outside of the motor. Ensure the surrounding areas are clean and free of contaminants such as dirt and grime.
2. If removing the motor, tag each hydraulic line connected to the motor. If you disconnect hydraulic lines, plug each open port to keep dirt and contamination out of the motor.
3. Inspect the system for contamination. Look at the hydraulic fluid for signs of system contamination, such as oil discolouration, foam in the oil, sludge, or small metal particles.
4. Remove the motor as a single unit.

ATTENTION! Be careful not to damage solenoids and electrical connections when using straps or chains to remove motor from machine.

5. Perform motor function test.
6. Before re-installing the motor on the machine, drain the system, flush all lines, replace all filters, and fill with new hydraulic fluid.

Adjustments

Minimum displacement limiter

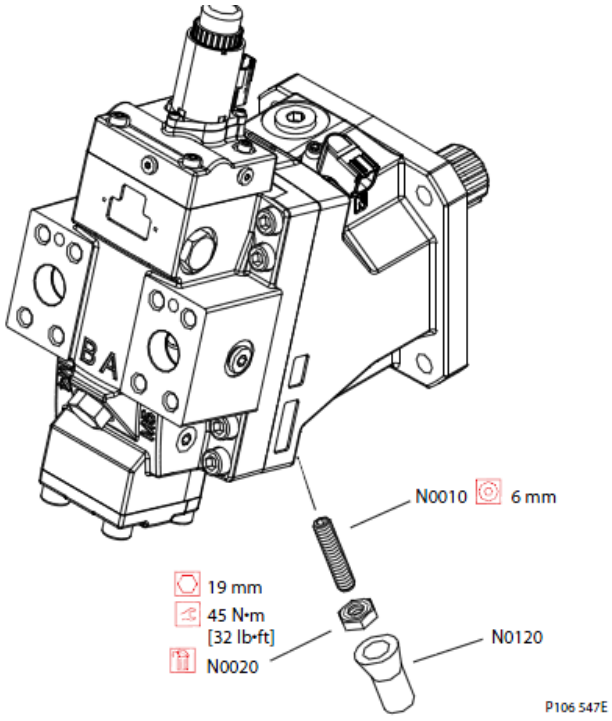
Adjusting the minimum displacement limiter

1. Remove cap (N0120).

Removing the cap destroys the caps locking mechanism. Replace with a new cap

.

2. Using a 6 mm internal hex wrench, hold adjusting screw (N0010) in place.
3. Using a 19 mm hex wrench, loosen seal locknut (N0020).
4. Turn adjusting screw clockwise to increase minimum displacement or counter-clockwise to decrease minimum displacement. Minimum displacement is inversely related to the maximum shaft speed. To increase maximum speed, decrease minimum displacement. Adjusting displacement limits also affects output torque. Refer to table for displacement change per turn.
5. When properly adjusted, hold adjusting screw in place and torque locknut seal to 32lbf-ft [45 Nm].
6. With the motor on the machine or test stand, verify correct motor function.
7. Install new cap (N0120).



Displacement change per turn

Model	Displacement change
250	5.5 cm^3 [0.34 in^3]
210	5.1 cm^3 [0.31 in^3]
160	4.1cm^3 [0.25 in^3]
110	3.2 cm^3 [0.20 in^3]

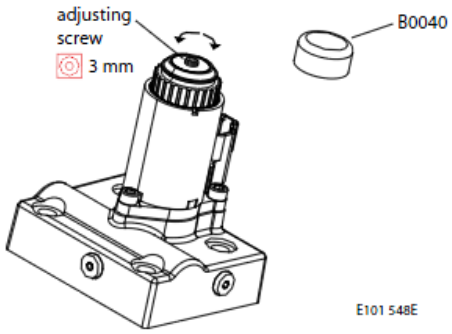
Optional threshold adjustment - electric proportional controls

1. Connect flow meter to A or B system port.
2. Connect solenoid to PWM signal generator at 100 Hz.

Threshold is the electric signal when the motor starts to change from maximum to minimum displacement.

3. Run prime mover at operating speed.

Threshold adjustment



4. Adjust PWM signal to current listed in model code. Note the flow reading.
5. If adjustment is necessary, remove cap (B0040). Using a 3mm internal hex wrench, turn adjusting screw clockwise or counter-clockwise until flow starts to change from maximum. Test your adjustment by lowering the current, then increasing the current until the displacement starts to change. Readjust the setting if necessary.
6. When the threshold is adjusted correctly, stop prime mover, install cap (B0040), and install the motor on vehicle. Run the vehicle and test for proper motor operation.

Adjusting threshold on a machine or test stand without flow meter

1. Install 10,000 psi [600 bar] gauges to ports M5 and M4. Connect the solenoid to PWM signal.
2. Raise wheels off ground, or disconnect the work function.

DANGER! Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

3. Run the prime mover at operating speed. Stroke the pump to get some rotation of the motor shaft.
4. Increase the signal current until M4 pressure becomes 1/2 of the M5 pressure. Check the signal current at this point.
5. If adjustment is necessary, remove cap (B0040). Turn the adjusting screw until the signal current matches the model code setting.
6. When threshold is adjusted correctly, stop the prime mover, and install the cap. Run the vehicle and test for proper motor operation.
7. Remove from test stand

Optional threshold adjustment - hydraulic proportional controls

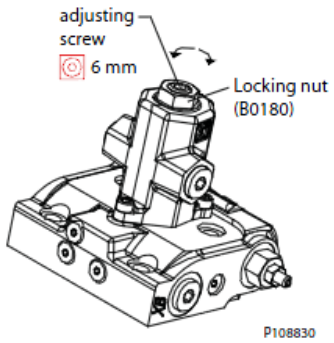
Adjusting threshold on test stand

1. Connect flow meter to A or B system port.
2. Connect a variable pressure supply to X1 port (0-725)(0-50 bar).

Threshold is the pressure at which the motor starts to change from maximum to minimum displacement.

3. Run prime mover at operating speed.

Threshold adjustment



4. Adjust the control pressure to the pressure listed in the model code. Note the flow reading.
5. If adjustment is necessary, remove nut (B0180). Using a 6mm internal hex wrench, turn the adjusting screw clockwise or counter-clockwise until the flow starts to change from maximum. Test your adjustment by lowering the pressure, then increasing the pressure until the displacement starts to change. Readjust the setting if necessary.
6. When the threshold is adjusted correctly, stop the prime mover, install nut (B0180), and install the motor on the vehicle. Run the vehicle and test for proper motor operation.

⚠ DANGER! Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

7. Run the prime mover at operating speed. Stroke the pump to get rotation of motor shaft.
8. Increase X1 pressure until M4 pressure becomes 1/2 of the M5 pressure. Check the X1 pressure at this point.
9. If adjustment is necessary, remove nut (B0180). Turn the adjusting screw until the X1 pressure matches the model code setting.
10. When the threshold is adjusted correctly, stop the prime mover, and install nut (B0180). Run the vehicle and test for proper motor operation.
11. Remove from test stand.

Minor Repair

Shaft seal

Removal

1. Using snap ring pliers, remove retaining ring (G0030).
2. Use a slide-hammer style puller to remove seal (G0020). Be careful not to damage the shaft or seal bore when removing. Discard seal.

Inspection

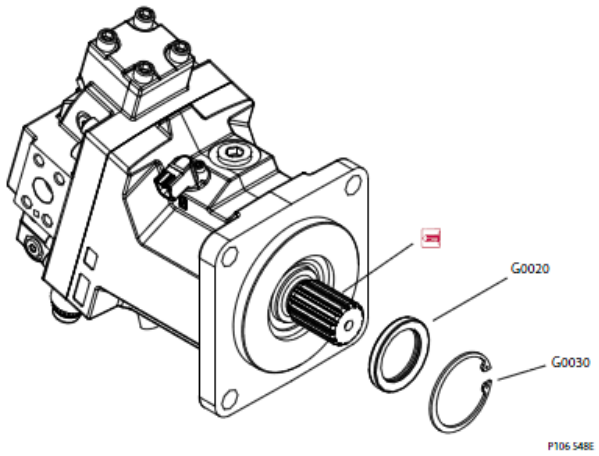
1. Inspect the retaining ring for wear or damage. Replace if necessary. Inspect the shaft for wear or grooves at seal area.

Assembly

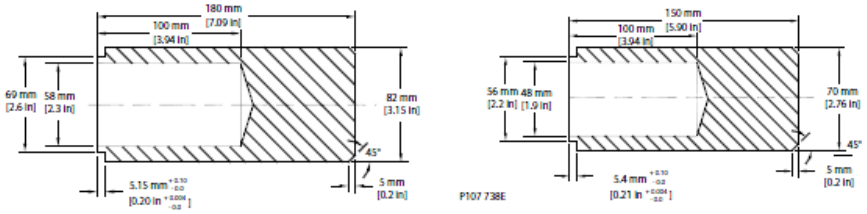
1. Lubricate the inside diameter of the new seal. Cover the shaft splines with shaft cover or packing tape to avoid damaging the seal during installation.
2. Using seal installation tool, press seal into housing bore.
3. Using snap ring pliers, install retaining ring (G0030).
4. Use the seal installation tool to press the seal and retaining ring into the housing until the retaining ring snaps into its groove.

If not using seal installation tool: Do not press seal beyond snap-ring groove. Stop pressing just when you have room to install the retaining ring into the bore. Pressing the seal and snap-ring together ensures proper installation depth. Using the seal installation tool prevents pressing the seal too deeply.

Shaft seal



110/160/210/250 - Seal installation tool dimensions, 060/080 - Seal installation tool dimensions



Electric proportional solenoid replacement

Removal

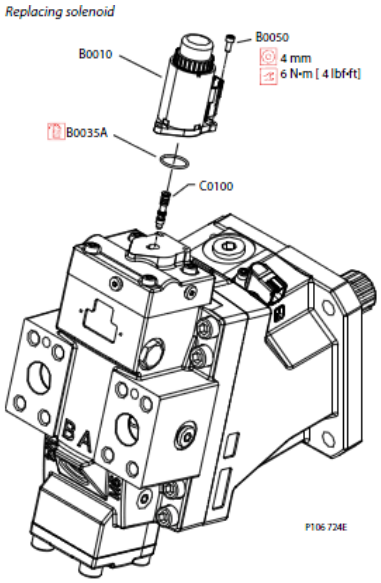
1. Disconnect the electrical connection and remove the three cap screws (B0050) using a 4 mm internal hex wrench.
2. Remove the solenoid (B0010) and O-ring (B0035A). Discard the O-ring.
3. Remove the valve spool (C0100).

Inspection

1. Clean and inspect the valve spool and all machined surfaces for damage or wear. Replace parts if necessary.

Assembly

1. Lubricate and install the valve spool (C0100).
2. Using petroleum jelly, lubricate and install new O-ring (B0035A).
3. Install cap screws (B0050) using a 4 mm internal hex wrench. Torque screws to 4lbf-ft [6 Nm].
4. Reconnect electrical connections and test the motor for proper operation.



Hydraulic proportional actuator replacement

Removal

1. Remove the three cap screws (B0050) using a 4 mm internal hex wrench.
2. Remove the actuator (B0010).

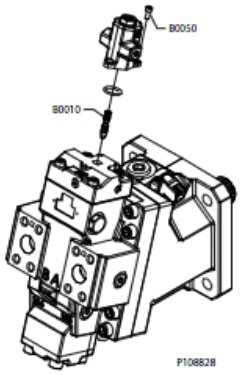
Inspection

1. Clean and inspect all machined surfaces for damage or wear. Replace parts if necessary.

Assembly

1. Install the cap screws (B0050) using a 4 mm internal hex wrench. Torque screws to 4lbf-ft [6 Nm].
2. Test the motor for proper operation.

Replacing actuator



Control module replacement

Removal

1. Remove the four cap screws (C0110 and/or C0120). Refer to table for wrench sizes.
2. Remove control (C0010) from motor. Remove and discard gasket (C0130).
3. Proportional control only - using a magnet, remove spring seat (F0030) and spring (F0040).

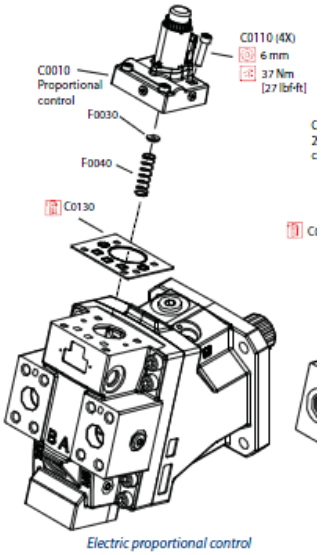
Inspection

1. Clean and inspect the machined surfaces on the control and the end-cap. If you find any nicks or scratches, replace the control or end-cap. Inspect valve spool, washer, and spring. Replace if necessary.

Assembly

1. Lubricate and install spring (F0040) and spring seat (F0030) into the servo.
2. Install a new gasket (C0130). Position the control on motor.
3. Install the four cap screws (C0110 and/or C0120). Torque (C0110) to 27lbf-ft [37 Nm] for proportional control. Torque (C0110) and (C0120) to 85lbf-ft [115 Nm] for 2 position control.

Control module removal/installation



Electric proportional control

Electric proportional control module

Coil O-rings are not included in the overhaul seal kit. They may be purchased as a separate kit.

Disassembly

1. Remove plastic cap (B0040) and O-ring (B0029). Discard the O-ring.
2. Remove solenoid nut (B0027) using a 26mm 12-point socket. Remove and discard the O-ring (B0028).
3. Remove coil (B0020A). Remove and discard the O-ring (B0025).
4. Use a 4 mm internal hex wrench to remove screws (B0050). Remove solenoid (B0010).
5. Remove and discard O-ring (B0035A).
6. Remove spool (C0100).
7. Using a 1/4" internal hex wrench remove plug (C0050) and discard O-ring (C0050A).
8. Use a 5 mm internal hex to remove shuttle valve (C0025).
9. Using a 1/8" internal hex wrench, remove the 3 plugs (C0060) and discard the O-rings (C0060A).
10. Using a 3 mm internal hex wrench, remove the 2 orifices (E00T3 and E00T2).

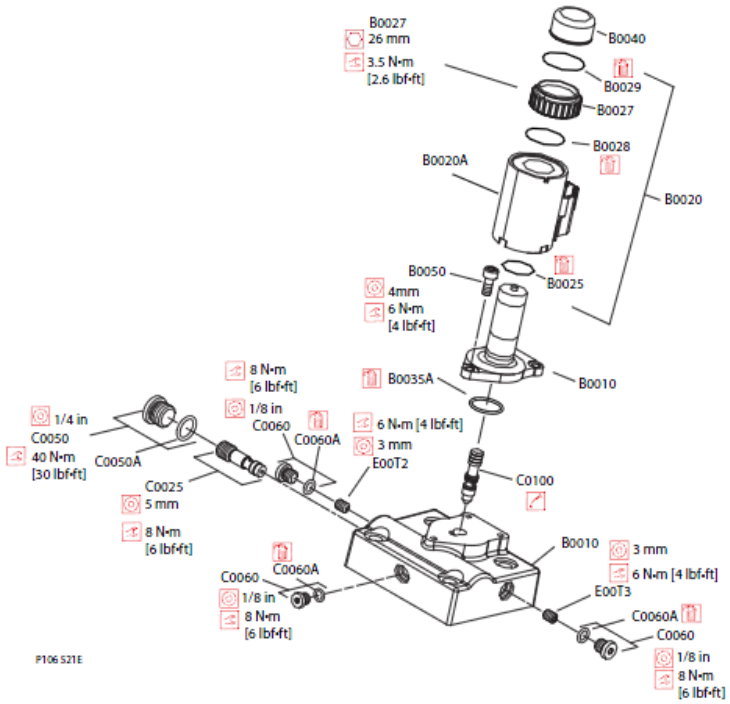
Inspection

1. Inspect the machined surfaces on the control and the end-cap. If you find any nicks or scratches, replace the control or end-cap assembly. Check that shuttle ball moves freely in housing (C0025).

Assembly

1. Install orifices (E00T3 and E00T2). Torque to 4lbf-ft [6 Nm].
2. Lubricate and install new O-rings (C0060A). Using a 1/8" internal hex wrench, install and torque plugs (C0060) to 6lbf-ft [8 Nm].
3. Lubricate and install spool (C0025) into the control block. Using a 5 mm internal hex wrench, torque to 11lbf-ft [14 Nm]
4. Install a new O-ring (C0050A). Using a 1/4" internal hex wrench, install and torque plug (C0050) to 30lbf-ft [40 Nm].
5. Lubricate and install spool (C0100).
6. Lubricate and install a new O-ring (B035A).
7. Install solenoid (B0010). Using a 4 mm internal hex wrench, install the screws (B0050). Torque to 4lbf-ft [6 Nm].
8. Lubricate and install a new O-ring (B0025) onto the solenoid. Install coil (B0020A). Lubricate and install a new O-ring (B0028) onto solenoid.
9. Install coil nut (B0027) and torque to 2.6lbf-ft [3.5 Nm] using a 26mm 12-point socket. Do not over-torque.
10. Install a new O-ring (B0029) and plastic cap (B0040) to the solenoid

Proportional control block assembly

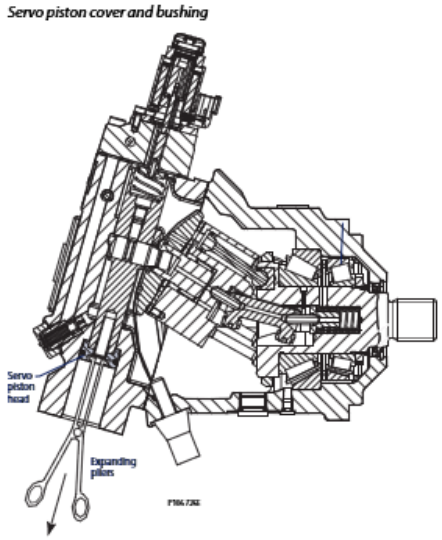


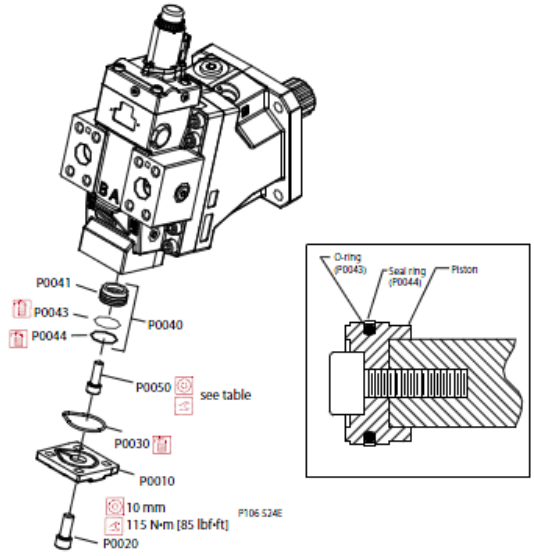
Servo piston cover – proportional control

Removal

1. Using a 10 mm internal hex wrench, remove the four screws (P0020).
2. Remove servo piston cover (P0010).
3. Remove and discard O-ring (P0030).
4. Remove screw (P0050). See table for wrench size.
5. Using expanding pliers, remove piston head (P0040). Remove and discard seal ring (P0044) and O-ring (P0043).

Servo piston cover and bushing





P0050 wrench size and torque

Model	Wrench size	Torque
060/080	8 mm	66 N•m [49 lbf-ft]
110	10 mm	115 N•m [85 lbf-ft]
160/210/250	12 mm	213 Nm [157 lbf-ft]

Inspection

1. Clean and inspect bushings and machined surfaces for wear or damage. If wear or damage are found, replace the component in question.

Assembly

1. Lubricate and install a new O-ring (P0043) and seal ring (P0044) on piston (P0041).

Allow seals time to relax before installing piston.

2. Install the piston and screw (P0050). Torque screw (P0050) per table.
3. Lubricate and install a new O-ring (P0030) and install servo piston cover (P0010).
4. Using a 8 mm or 10 mm internal hex wrench install screws (P0020). Torque to 85 bf-ft [115 Nm].

Replace speed sensor

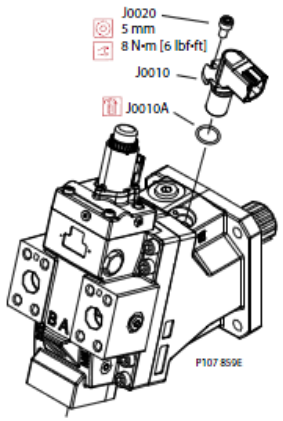
Removal

1. Using a 5 mm internal hex wrench, remove screw (J0020).
2. Remove speed sensor (J0010).
3. Discard O-ring (J0010A).

Assembly

1. Lubricate and install new O-ring (J0010A).
2. Install speed sensor (J0010).
3. Using a 5 mm internal hex wrench, install screw (J0020). Torque to 6lbf-ft [8 Nm].

Speed sensor



Loop flushing spool

Removal

1. Remove plugs (K0030) using a 24 mm hex wrench.
2. Remove and discard O-rings (K0030A).
3. Use a magnet to remove springs (K0020) and spool (K0010).

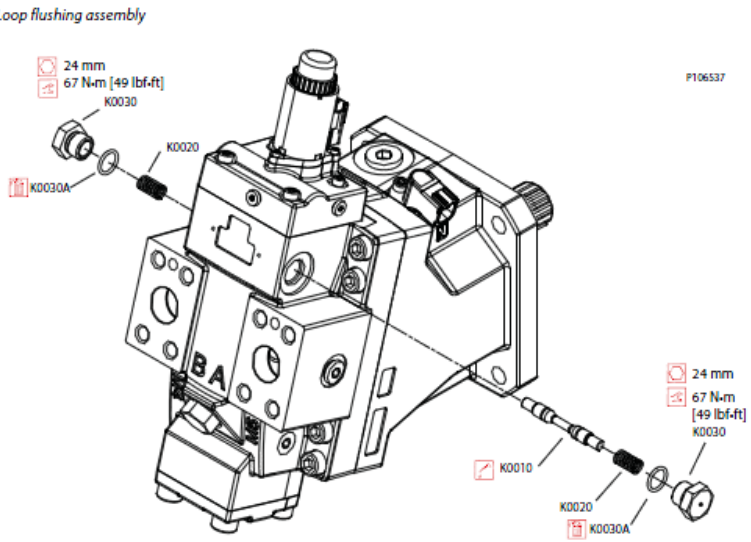
Inspection

1. Clean and inspect spool (K0010). If the spool is damaged or worn replace it. Replace the springs if they are cracked or bent.

Reassembly

1. Lubricate and install spool (K0010).
2. Lubricate and install springs (K0020).
3. Lubricate and install new O-rings (K0030A).
4. Using a 24 mm hex wrench, install plugs (K0030). Torque to 49lbf-ft [67 Nm]

Loop flushing assembly



Loop flushing charge relief valve

Removal

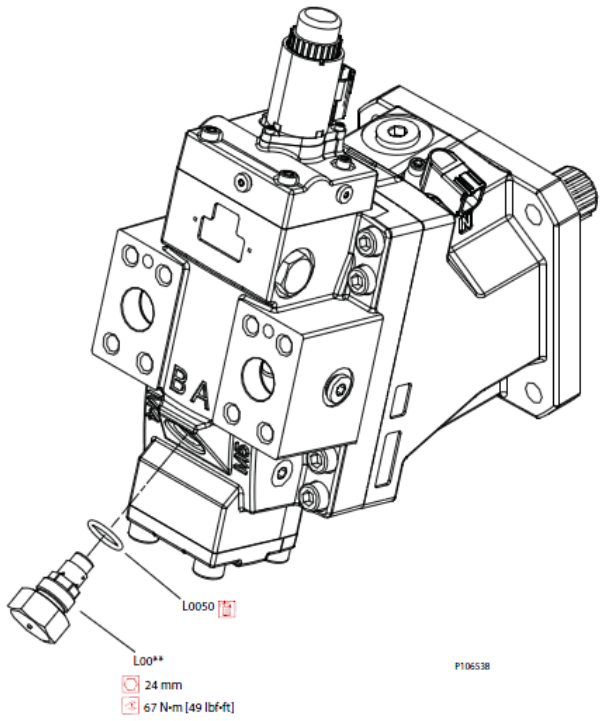
1. Using a 24 mm hex wrench remove valve (L00**)
2. Remove and discard O-ring (L0050).

Do not disassemble the valve. If you suspect a malfunction, replace the valve.

Assembly

1. Install a new O-ring (L0050).
2. Using a 24 mm hex wrench, install valve (L00**). Torque to 49lbf-ft [67 Nm].

Loop flushing charge relief valve replacement



Minimum Displacement limiter

Removal

1. Remove cap (N0120).

ATTENTION! Removing the cap destroys the caps locking mechanism. Replace with a new cap.

2. While holding the position of the adjustment screw, remove the locknut seal (N0020) using a 19mm hex wrench. Discard the locknut. After removing the locknut, mark the position of the limiter screw for reassembly.
3. Using a 6 mm internal hex, remove displacement limiter screw (N0010).

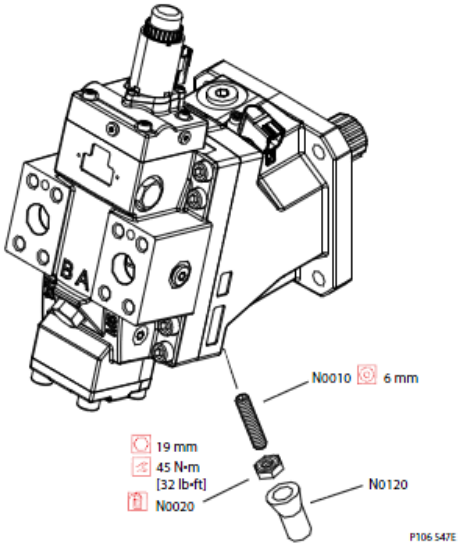
Inspection

1. Inspect the set screw for wear or damage. Replace the set screw if necessary.

Assembly

1. Using a 6 mm internal hex wrench, install adjustment screw (N0010) to the original position.
2. 2. Using a 6 mm internal hex wrench to hold the position of the adjustment screw, install a new locknut seal (N0020) using a 19mm hex wrench. Torque to 32lbf-ft [45 Nm].
3. Install a new cap (N0120).

Displacement limiter assembly

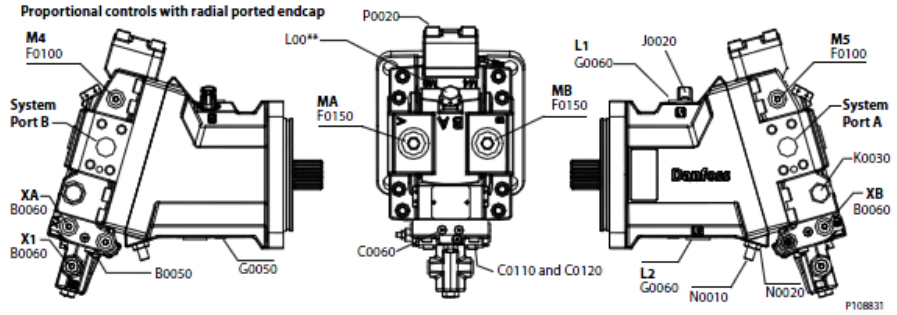


Torque charts

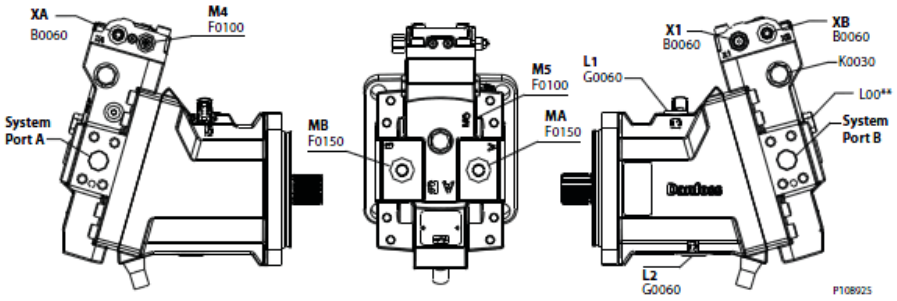
Fasteners and plugs

Port, plug and fastener locations

Proportional controls with radial ported endcap



Two position controls with radial ported endcap



Fastener size and torque chart

Item	Fastener	Wrench size	Torque
B0050	Solenoid screws	4 mm internal hex	6 N•m [4 lbf•ft]
C0110 (proportional)	Control assembly screws	6 mm internal hex	37 N•m [28 lbf•ft]
C0110 & C0120 (two-position)	Control assembly screws	10 mm internal hex	115 N•m [85 lbf•ft]
J0020	Speed sensor screw	5 mm internal hex	8 N•m [6 lbf•ft]
N0010	Displacement limiter screw	6 mm internal hex	N/A
N0020	Displacement limiter locknut	19 mm	45 N•m [32 lbf•ft]
P0020	Servo piston cover screws	10 mm internal hex	115 N•m [85 lbf•ft]

Item	O-ring plug	Wrench size	Torque
B0060	9/16 - 18UNF	1/4 internal hex	40 N•m [30 lbf•ft]
C0050 (not shown)	9/16-18 UNF	1/4 internal hex	40 N•m [30 lbf•ft]
C0060	5/16 - 24UNF	3/8 internal hex	8 N•m [5 lbf•ft]
F0100	9/16 - 18UNF	1/4 internal hex	40 N•m [30 lbf•ft]
F0150 (060) Radial endcap	1-1/16 - 12 UN	9/16 internal hex	95 N•m [70 lbf•ft]
F0150 (080, 110, 160, 250) Radial endcap	1-1/16 - 12 UN	9/16 internal hex	115 N•m [85 lbf•ft]
G0050	5/16 - 24UNF (SAE and DIN flange)	1/8 internal hex	8 N•m [5 lbf•ft]
G0055 (cartridge model only) (not shown)	7/16 - 20UNF (Cartridge)	3/16 internal hex	8 N•m [5 lbf•ft]
G0060 (060, 080)	7/8 - 14UN	3/8 internal hex	70 N•m [52 lbf•lb]
G0060 (110, 160)	1-1/16 - 12UN	9/16 internal hex	70 N•m [52 lbf•lb]
G0060 (250)	1-5/16 - 12UN	5/8 internal hex	70 N•m [52 lbf•lb]
K0030	M18 - 1.5	24 mm hex	67 N•m [49 lbf•ft]
L00**	M18 - 1.5	24 mm hex	67 N•m [49 lbf•ft]
F0160 Axial endcap (not shown)	9/16-18 UNF	1/4 internal hex	40 N•m [30 lbf•ft]

Speed and Temperature Sensor

Theory of operation

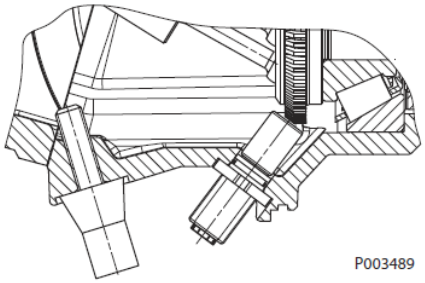
The speed sensor is externally powered, and in response to the speed of the target ring, outputs a digital pulse signal. A magnet inside the sensor provides the magnetic field that changes with the position of the target teeth. The target ring is attached to the cylinder block or the shaft. Hall sensors change from high/low state as the target teeth pass by the sensor's face. The digital (on-off-on-off) pulse train is fed to a controller, which interprets its rate of change as a speed. The speed sensor uses two Hall sensors with specific distance and orientation resulting in a pulse train output shift of 90° between the two sensors. A logic circuit decodes the two signals to provide an additional direction indication (high or low depending on direction).

Due to the design of the sensor, the duty cycle (ratio between on and off time at constant speed) of both speed signals at any working condition is close to 50% and can be used for better resolution at low speeds.

Sensor installation

The sensor is positioned in the housing and fastened by one screw. The gap between the sensor and the target does not need to be adjusted. Nor does it need to be rotated for direction sensing.

Cartridge housing

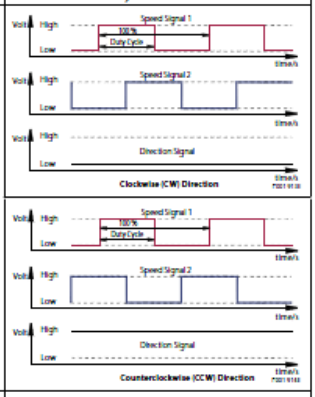
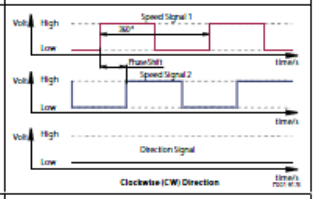


Target ring

Motor size	H1B110
Number of teeth	86

Speed and temperature sensor technical data

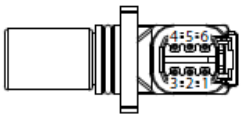
Technical Data

		Min.	Nom.	Max.	Units	
Supply		4.5	5	8	Vdc	Regulated supply voltage, Reverse Polarity protected
Supply protection		–	–	30	Vdc	30 V over voltage protection. Shuts off above 9 V.
Max. required supply current				25	mA	Max. required supply current at supply voltage
Operating mode		NPN & PNP				Sensor works in NPN & PNP mode (push-pull amplifier)
Output signal range speed signal 1 square wave	Low	5 %	8.5 %	12 %	V	Ratiometric[1] output voltage. Low state > 0 V to provide wire fault detection. See page 10 for wire fault detection circuitry.
	High	88 %	91.5 %	95 %		
Output signal range speed signal 2 square wave	Low	5 %	8.5 %	12 %	V	Ratiometric[1] output voltage. Low state > 0 V to provide wire fault detection. See page 10 for wire fault detection circuitry.
	High	88 %	91.5 %	95 %		
Duty cycle		42.5	50	57.5	%	
Phase shift		70	97.5	125	°	
Square wave direction signal	Low = CW	5 %	8.5 %	12 %	V	Ratiometric output voltage. Low state > 0 V to provide wire fault detection. See page 10 for wire fault detection circuitry. Clockwise (CW) rotation is defined on page 11
	High = CCW	88 %	91.5 %	95 %	V	
Rise time and fall time		–	–	7	µs	For all square wave signals. To be measured from 10 % to 90 % with 2.2nF + 470pF load.
Wire fault detection		Short to supply		> 95 % ratio-metric	V	> 4.85 V at 5 Vdc. See page 10 for wire fault detection circuitry.

1) Ratiometric means that the output signal is proportional to the supply voltage.
E.g.
5 % of 5 000 mV sensor supply = 250 mV sensor signal accepted as low
5 % of 4 900 mV sensor supply = 245 mV sensor signal accepted as low

Speed and temperature sensor technical data (continued)

Technical Data (continued)

	Min.	Nom.	Max.	Units	
Wire fault detection	Short to ground		< 5 % ratio-metric	V	< 0.15 V at 5 Vdc. See page 10 for wire fault detection circuitry.
Detectable frequency range	1		10 000	Hz	
Speed and Temperature Sensor	Order number 149055				
Connector terminals					Sensor pinout 1 Speed signal 2 2 Direction signal 3 Speed signal 1 4 Supply 5 Ground 6 Temperature
Operating temperature range	-40	80	125	°C	
Protection code IP-Class	IP 67 and IP 69k according IEC 60529 & DIN 40050				IP67 w/o connector installed IP69k with connector installed
EMC-Emission	EN 61000-6-3				
EMC-Immunity (EMI):	100 V/m incl. 1 kHz AM 80 %, ISO 11452-5 and ISO 11452-2				
ESD : Air discharge Contact discharge	EN 61000-4-2: 15 kV 8 kV				
Automotive electrical transients	ISO 7637/3				
Vibration	30 G (294 m/s²)				
Shock	50 G (490 m/s²)				
Temperature range	-40		+104	°C	115°C Intermittent = Short term t < 1min per incident and not exceeding 2 % of duty cycle based load-life
Case pressure			5 Maxi-mum	bar	
Sealing	O-ring (FPM), dimensions see outline drawings on page 4				

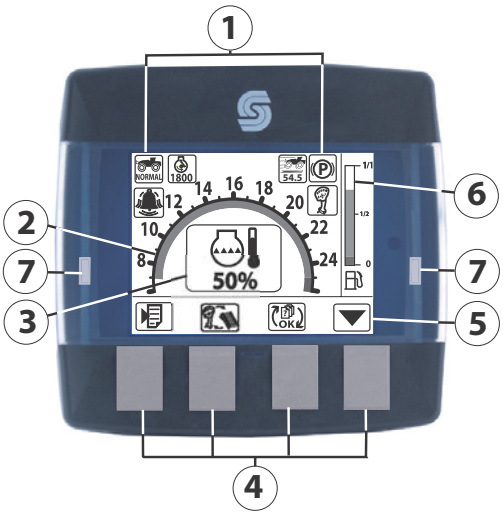
Temperature sensor

Temperature measurement range	Minimum		-40 °C	[-40 °F]
	Maximum		+125 °C	[257 °F]
Output signal at *see formula below for temperature range	-40 °C	[-40 °F]	2.203 V	
	125 °C	[257 °F]	0.520 V	
Tolerance			± 5 °C	[51 °F]
Temp. measurement response time in oil	T_{90} = 360 s			

PLUS +1 OPERATING

Multifunction screen description

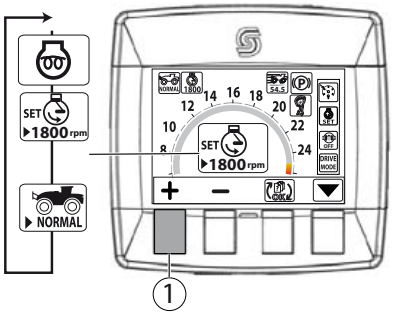
The multifunction screen displays the information relating to the operation of the engine (tachometer, temperature, etc.) and the various modes of lines (hare, tortoise, etc.). The display also shows the errors that may occur during the use of the machine (temperature and pressure of the engine oil, transmission errors, etc...).



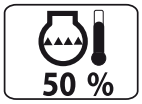
1. Status	5. Vertical menus (cruise control, transmission, fuel gauge)
2. Engine speed tachometer	6. Horizontal menus (controls in relation with buttons)
3. Engine and transmission status	7. Alarm lights
4. Controls and settings buttons	

Functions of the Display

- Press push button (1) to scroll through the various functions.



Messages in normal operating mode



Engine temperature

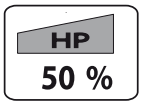
0-100%.

Engine oil pressure

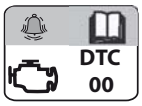
Turbocharger pressure

Hydraulic pressure of the transmission

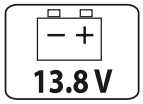
Instant fuel consumption



Power supplied by the engine



Displays if engine operation errors occur (level 1)

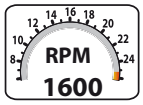


Battery charge voltage

Limitation of the motor speed mode [field]

Restriction of the speed in movement mode [road]

Restriction of the speed in movement mode [Field]



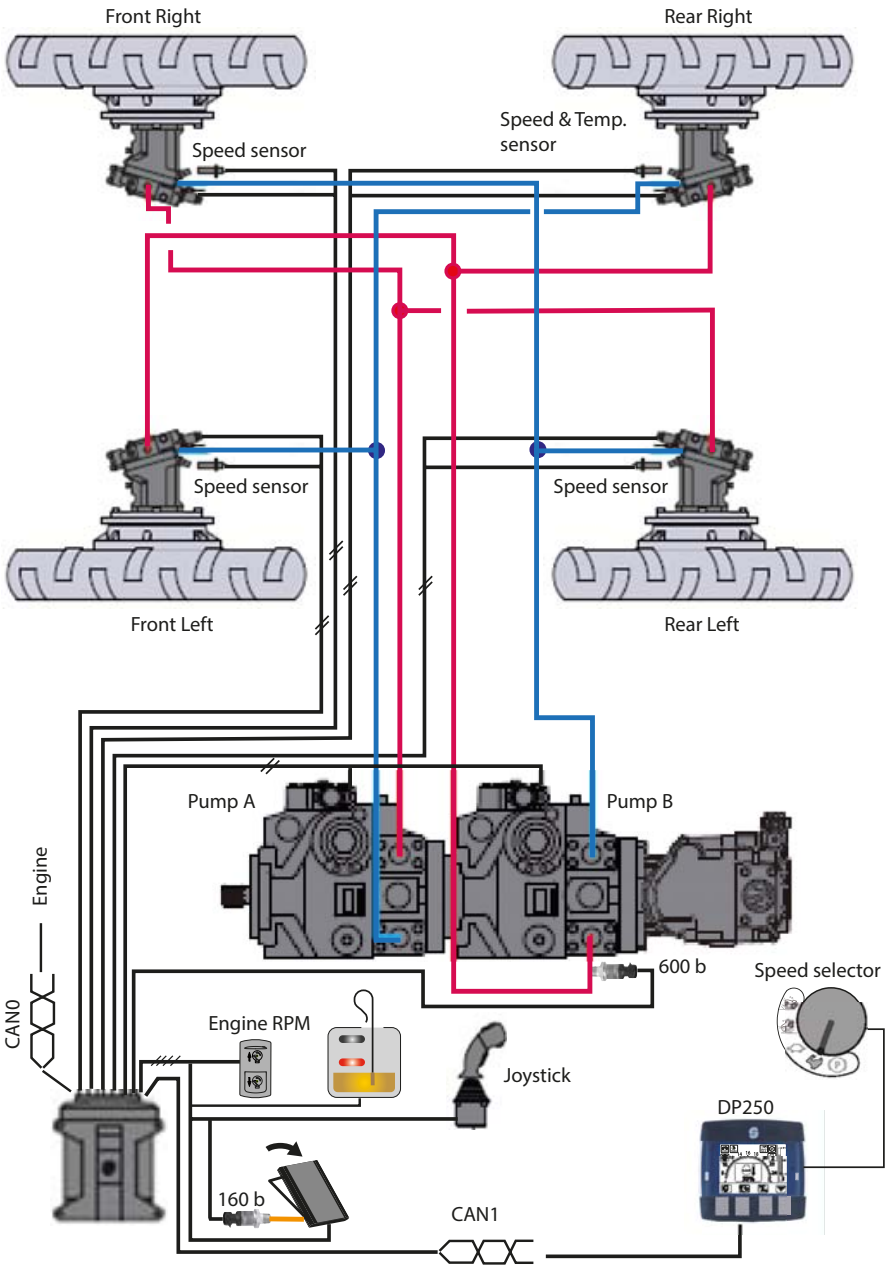
Displays the speed of the engine

Drive-shaft functioning errors

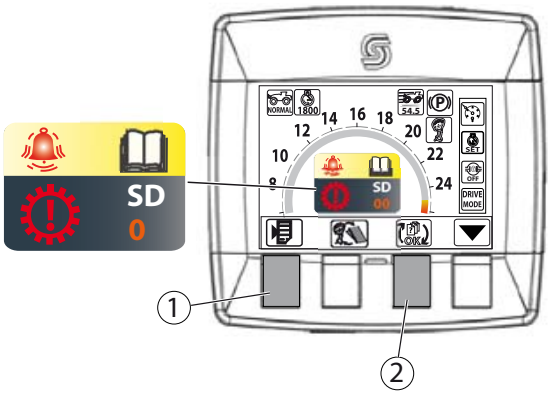
"Transmission Error Codes" page 167

Engine Preheating

Electronic diagram of the transmission



Transmission Error Codes

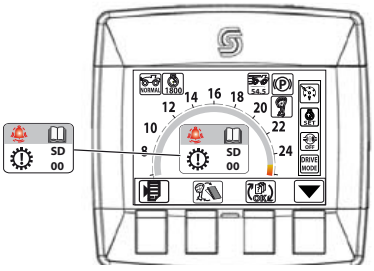


- Press button (1) to scroll to the SD function display.
- Press button (2) to display the error menu. A red bar means a malfunction of the hydraulic system.

Messages	Description
CAN 0	ECU MC050 and engine communication
CAN 1	MC050 ECU and DP250 display communication
Power sensor	5VDC power sensor
Joystick	Joystick control input
Pedal	Brake pedal input
Back Angle	Not used
Front Angle	Not used
Temperature Sensor	Hydraulic oil temperature
Speed Sensor MARD	Right rear speed sensor
Speed Sensor MARG	Left rear speed sensor
Speed Sensor MAVD	Right front speed sensor
Speed Sensor MAVG	Left front speed sensor
Mode selector	Selector mode and parking
Coil Motor ARD	Right rear coil motor
Coil Motor ARG	Left rear coil motor
Coil Motor AVD	Right front coil motor
Coil Motor AVG	Left front coil motor
Coil A Pump AVDARG	Right front/Left rear coil for pump A (engine side)
Coil A Pump AVGARD	Left front/Right rear coil for pump A
Coil B Pump AVDARG	Right front/Left rear coil for pump B
Coil B Pump AVGARD	Left front/Right rear coil for pump B
Oil level	Hydraulic oil level

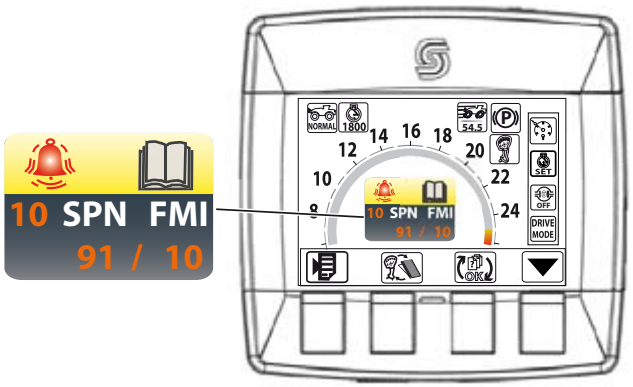
Engine Code Error

Transmission error codes



Error codes	Description	Error codes	Description
001	Low battery voltage	070	Loop error
002	Low battery voltage	071	PWM2 current loop error
003	12V sensor low supply voltage	074	Loop error pump 1
004	12V sensor high supply voltage	080	Brake pressure sensor signal out of range
005	5V sensor low supply voltage	083	CAN bus communication error: signal not received
006	5V sensor high supply voltage	084	High pressure sensor signal out of range
007	Stack overflow	092	Joystick sensor error
008	E2prom memory error	097	Analog mode selector sensor error
009	FLASH memory error	100	Joystick limitation control error
010	RS232 memory error	200	Offroad SD: high battery voltage
011	CAN bus connection error	201	Offroad SD: low battery voltage
012	Current return protection	202	Offroad SD: 12V supply voltage sensor out of range
020 to 045	Internal system error		
051	MAF loading error		
052	Inconsistent key		
053	Inconsistent MAF		
054	Inconsistent input/output		
055	Error in sensitive parameter		
056	SDPHASE code error		
057	Checksum error		
058	Min/Max error in parameter		

CUMMINS engine error codes



SPN	Component / Location	Description (Error location)	FMI
29	Hand throttle	Cable break or short circuit, signal implausible compared to signal or idle sensor	2,3, 4, 11
84	Vehicle speed signal	Speed above target range, signal missing or implausible	0, 8, 12, 14
91	Accelerator pedal	Cable break or short circuit, signal implausible compared to signal of idle sensor (analog pedal)	2, 3, 4, 11
91	Accelerator pedal	Cable break or short circuit, bad PWM signal range or frequency (digital pedal)	2, 8
91	Accelerator pedal	Bad PWM pulse-width repetition rate (digital pedal)	8, 11
94	Fuel low pressure sensor	Cable break or short circuit	3, 4, 11
94	Fuel low pressure	Below target range with system reaction	2, 11
97	Fuel filter water level sensor	Cable break or short circuit	3, 4, 11
97	Water level in fuel filter	Above target range	11, 12
100	Oil pressure sensor	Cable break or short circuit	0, 2, 3, 4
100	Oil pressure sensor	Pressure value implausibly low	1, 11
100	Oil pressure	Above target range	0, 11
100	Oil pressure	Below target range	1, 11
102	Charge air pressure sensor	Cable break or short circuit	2, 3, 4
102	Charge air pressure	Outside target range with system reaction	2, 11
105	Charge air temperature sensor	Cable break or short circuit	2, 3, 4, 11
105	Charge air temperature	Outside target range with system reaction	0, 11
107	Air filter condition	Pressure loss above target range with system reaction	0, 11
108	ECU internal error	Ambient pressure sensor defective	2, 3, 4, 11
110	Coolant temperature sensor	Cable break or short circuit	2, 3, 4
110	Coolant temperature	Outside target range with system reaction	0, 11
111	Coolant Level	Outside target range with system reaction	1, 11
157	Rail pressure sensor	Cable break or short circuit	3, 4, 11
157	Rail pressure sensor	Deviation of signal during start or after-run above target range	0, 1, 11
158	Terminal 15	Ignition ON not detected	11, 12
168	Battery	Voltage below target range	0, 1, 11
168	Battery voltage	Above target range with system reaction	2, 11
174	Fuel temperature sensor	Cable break or short circuit	3, 4, 11
174	Fuel temperature	Above target range with system reaction	0, 11

175	Oil temperature sensor	Cable break or short circuit	2, 3, 4
175	Oil temperature	Below target range with system reaction	0, 11
190	Engine speed sensor	Engine running with cam-shaft speed signal only	11, 12
190	Engine speed sensor	Speed signal from cam-shaft bad or missing	8, 11, 12
190	Engine speed sensor	Speed signals from crank-shaft bad or missing	8, 11, 12
190	Engine speed sensor	Speed signals of crank-shaft and cam-shaft are phase-shifted	2, 11
190	Over-speed	Engine over-speed with system reaction	0, 11
190	Overrun conditions	Overrun conditions with system reaction	11, 14
520	CAN message	Missing (message "TSC1-TR")	11, 12
563	Main relay	Short circuit to ground or emergency shut-off (relay 3)	7, 11, 12
624	Diagnostic lamp	Cable break or short circuit, disabled by ECU	2, 3, 4, 5
630	ECU internal error	EEPROM memory access	11, 12
639	CAN bus off-state	Cable break or short circuit, off-state (CAN bus A)	11, 14

SPN	Component / Location	Description (Error location)	FMI
651	Single injector	Short circuit (injector 1)	3, 4, 11, 13
651	Single injector	Cable break (injector 1)	5, 13
652	Single injector	Short circuit (injector 2)	3, 4, 11, 13
652	Single injector	Cable break (injector 2)	5, 13
653	Single injector	Short circuit (injector 3)	3, 4, 11, 13
653	Single injector	Cable break (injector 3)	5, 13
654	Single injector	Short circuit (injector 4)	3, 4, 11, 13
654	Single injector	Cable break (injector 4)	5, 13
655	Single injector	Short circuit (injector 5)	3, 4, 11, 13
655	Single injector	Cable break (injector 5)	5, 13
656	Single injector	Short circuit (injector 6)	3, 4, 11, 13
656	Single injector	Cable break (injector 6)	5, 13
657	Single injector	Short circuit (injector 7)	3, 4, 11, 13
657	Single injector	Cable break (injector 7)	5, 13
658	Single injector	Short circuit (injector 8)	3, 4, 11, 13
658	Single injector	Cable break (injector 8)	5, 13
676	Air heater relay	Cable break or wrong connection	4, 11
676	Air heater relay	Inoperable during shut-off	2, 5, 11
677	Start relay	Start relay (high side): Short circuit	3, 4, 11
677	Start relay	Start relay (low side): Cable break or short circuit, disabled by ECU	3, 4, 5, 11
701	Reserve output	Short circuit to Ubatt (output 1)	11
701	Reserve output	Short circuit to ground (output 1)	11
701	Reserve output	Cable break or ECU internal error (output 1)	11
702	Reserve output	Short circuit to Ubatt (output 2)	11
702	Reserve output	Short circuit to ground (output 2)	11
702	Reserve output	Cable break or ECU internal error (output 2)	11
703	Engine operating signal lamp	Cable break or ECU internal error	2, 3, 4, 5
704	Coolant temperature warning lamp	Cable break or short circuit	11
705	Oil pressure warning lamp	Cable break or short circuit	2, 3, 4, 5
729	Air heater relay	Cable break or short circuit	3, 4, 5, 11
730	Air heater magnetic valve	Cable break or short circuit	3, 4, 5, 11
898	CAN message	Missing (message "TSC1-TE")	11, 12
923	Engine power output	Engine power output: Cable break or short circuit	2, 3, 4, 5
975	Fan actuator	Fan actuator: Cable break or short circuit	2, 3, 4, 5
1072	Engine break (internal)	Internal engine brake: Cable break or short circuit	3, 4, 5, 11
1074	Engine break flap actuator	Engine brake flap actuator: Cable break or short circuit	3, 4, 5, 11
1079	ECU internal error	Wrong voltage of internal 5V reference source 1	3, 4, 11
1080	ECU internal error	Wrong voltage of internal 5V reference source 2	3, 4, 11
1081	Preheating signal lamp	Cable break or short circuit	2, 3, 4, 5
1109	Shut-off request	Shut-off request ignored by operator	2, 11

1231	CAN bus off-state	Cable break or short circuit, off-state (CAN bus B)	11, 14
1235	CAN bus off-state	Cable break or short circuit, off-state (CAN bus C)	11, 14
1237	Override switch	Switch hangs	2, 11

SPN	Component / Location	Description (Error location)	FMI
523451	Multi state switch	Cable break or short circuit, input voltage outside target range (switch 2)	2, 3, 4, 11
523452	Multi state switch	Cable break or short circuit, input voltage outside target range (switch 3)	2, 3, 4, 11
523470	Rail pressure limiting valve	Opening failure	2, 11, 12, 14
523470	Rail pressure limiting valve	Opening failure with system reaction	11, 12
523490	ECU internal error	Redundant shut-off conditions detected	3, 4, 11, 12
523500	CAN message	Time-out of at least one sent message	11, 12
1322	Multiple cylinders	Misfire detected	11.12
1323	Single cylinder	Misfire detected (cylinder 1)	11, 12
1324	Single cylinder	Misfire detected (cylinder 2)	11, 12
1325	Single cylinder	Misfire detected (cylinder 3)	11, 12
1326	Single cylinder	Misfire detected (cylinder 4)	11, 12
1327	Single cylinder	Misfire detected (cylinder 5)	11, 12
1328	Single cylinder	Misfire detected (cylinder 6)	11, 12
1346	Misfire	Misfire detected with system reaction	0, 11
1450	Single cylinder	Misfire detected (cylinder 7)	11, 12
1451	Single cylinder	Misfire detected (cylinder 8)	11, 12
1638	Customer-specific sensor	Cable break or short circuit (sensor 2)	3, 4, 11, 12
1638	Customer-specific temperature	Outside target range with system reaction (temperature 2)	2, 11
2634	Main relay	Short circuit to Ubatt (relay 1)	3, 11
2634	Main relay	Short circuit to ground (relay 1)	4, 11
2634	Main relay	Short circuit to ground or emergency shut-off (relay 2)	7, 11, 12
2634	Main relay	Short circuit to ground or emergency shut-off (relay 3)	7, 11, 12
2791	EGR actuator (external)	Short circuit to Ubatt	3, 11
2791	EGR actuator (external)	Short circuit to ground	4, 11
2791	EGR actuator (external)	Cable break or ECU internal error	2, 5, 11
2791	EGR actuator (external)	Cable break or short circuit	2, 3, 4, 5
523212	CAN message	Missing (message "EngPrt" = engine protection)	11, 12
523216	CAN message	Missing (message "PrHtEnCmd" = Preheat and engine command	11, 12
523218	CAN message	Missing (message "RxCCVS" = cruise control)	11, 12
523222	CAN message	Missing (message "TCO1" = speed signal)	11, 12
523238	CAN message	Missing (message "SwtOut" = switch outputs)	11, 12
523239	CAN message	Missing or value above target range (message "DecV1" = pseudo pedal)	2, 12
523240	CAN message	Missing (message "FunModCtl" = function mode control)	11, 12
523350	Multiple injectors	Short circuit (cylinder bank 1)	3, 4, 11, 13
523351	Multiple injectors	Cable break (cylinder bank 1)	5, 13
523352	Multiple injectors	Short circuit (cylinder bank 2)	3, 4, 11, 13
523353	Multiple injectors	Cable break (cylinder bank 2)	5, 13
523354	ECU internal error	Injector power stage A	2, 3, 12, 14
523355	ECU internal error	Injector power stage B	12
523370	Rail pressure	Compression test active: Rail-pressure monitoring is going to be disabled	11, 14
523420	ECU internal error	Watchdog counter exceeds maximum	11, 14
523450	Multi state switch	Cable break or short circuit, input voltage outside target range (switch 1)	2, 3, 4, 11
523550	Terminal 50	Engine start switch hangs	11, 12
523550	ECU internal error	Time processing unit (TPU) defective	2, 11
523561	Begin of injection period	Outside target range or missing (cylinder 1)	2
523562	Begin of injection period	Outside target range or missing (cylinder 2)	2
523563	Begin of injection period	Outside target range or missing (cylinder 3)	2
523564	Begin of injection period	Outside target range or missing (cylinder 4)	2
523565	Begin of injection period	Outside target range or missing (cylinder 5)	2
523566	Begin of injection period	Outside target range or missing (cylinder 6)	2
523567	Begin of injection period	Outside target range or missing (cylinder 7)	2

523568	Begin of injection period	Outside target range or missing (cylinder 8)	2
523600	ECU internal error	Serial communication interface defective	11, 12
523601	ECU internal error	Wrong voltage of internal 5V reference source 3	3, 4, 11
523602	Fan speed	Above target range with system reaction	2, 11
523604	CAN message	Missing (message "RxEngTemp" = engine temperature)	11, 12
523605	CAN message	Missing (message "TSC1-AE")	11, 12
523606	CAN message	Missing (message "TSC1-AR")	11, 12
523607	CAN message	Missing (message "TSC1-DE")	11, 12
523608	CAN message	Missing (message "TSC1-DR")	11, 12
523609	CAN message	Missing (message "TSC1-PE")	11, 12
523610	CAN message	Missing (message "TSC1-VE")	11, 12
523611	CAN message	Missing (message "TSC1-VR")	11, 12
523612	ECU internal hardware monitoring	A recovery occurred which is stored as protected	11, 14
523612	ECU internal hardware monitoring	A recovery occurred which is not stored	11, 14
523612	ECU internal hardware monitoring	A recovery occurred which is visible in the error memory	11, 14
523612	ECU internal hardware monitoring	Over-voltage	3, 11
523612	ECU internal hardware monitoring	Under-voltage	4, 11
523613	Rail pressure	Positive deviation (speed dependent) outside target range	0, 11
523613	Rail pressure	Positive deviation (flow dependent) outside target range (=> Leakage!)	0, 11
523613	Rail pressure	Negative deviation (flow dependent) outside target range	0, 11
523613	Rail pressure	Negative deviation (speed dependent) outside target range	1, 11
523613	Rail pressure	Pressure above target range	0, 11
523613	Rail pressure	Implausible (leakage, injector needle blocked in open position)	2, 11
523615	Metering unit valve	Flow rate outside target range	3, 4, 11
523615	Metering unit valve	Not connected or output disabled	5, 11, 12
523615	Metering unit valve	Short circuit to Ubatt	11, 12
523615	Metering unit valve	Short circuit to ground	11, 12
523617	ECU internal error	Communication with chip CJ940 disturbed	11, 12
-	Customer-specific sensor	Cable break or short circuit (sensor 1)	2, 3, 4, 11
-	Customer specific temperature	Outside target range with system reaction (temperature 1)	2, 11

PLUS +1 SERVICE TOOL

General Info

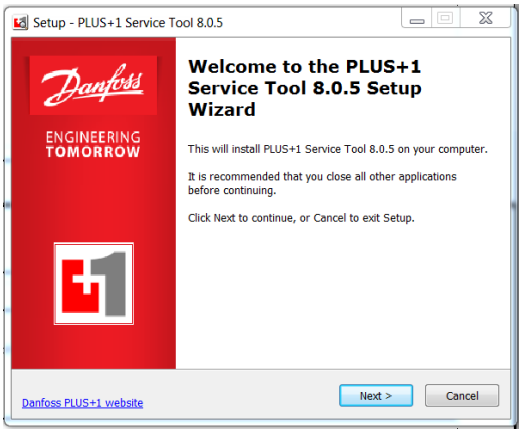
This chapter describes how to install the software on the computer and use the service tool.

Service Tool Installation on the computer

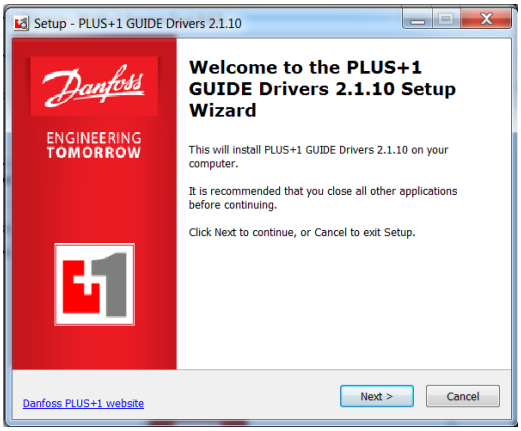
1. Download the service tools software from the address:

http://powersolutions.danfoss.com/products/plus-1-software/plus-1-service-tool-software-and-license/

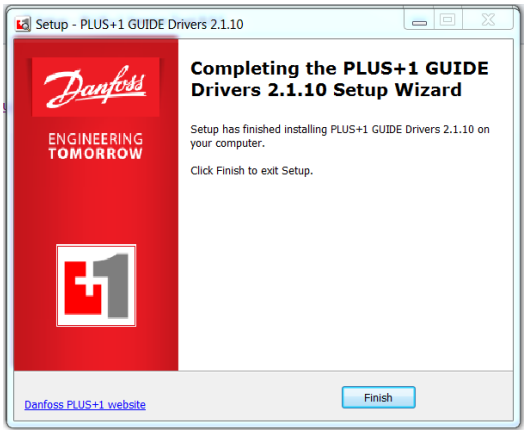
2. Click on PLUS 1 Service Tool 8.0.5 setup.exe to install the PLUS+1 Service Tool on the computer.



3. Click on Next to Install the drivers, follow the instructions.



4. Click on Finish to finalize the installation.

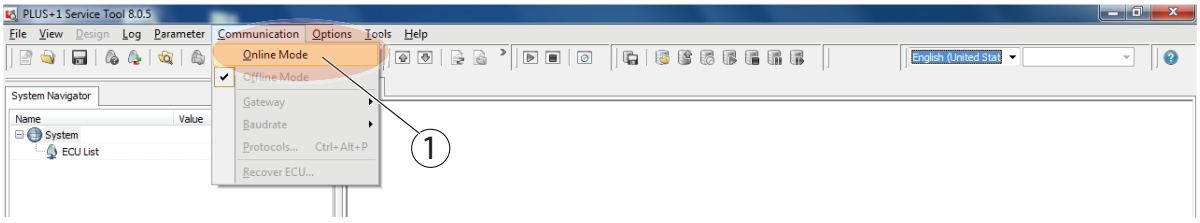


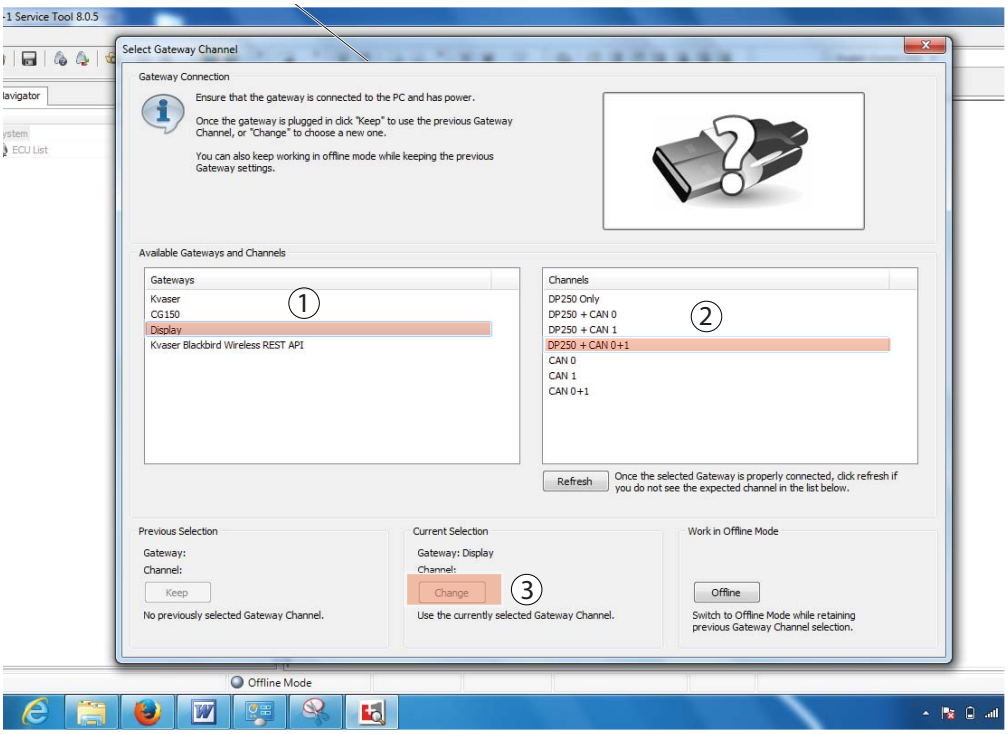
Read the release notes, "Service Tool ReadMe.pdf".

5. Connect the DP250 display to the computer, by using the Mini USB/USB cable.

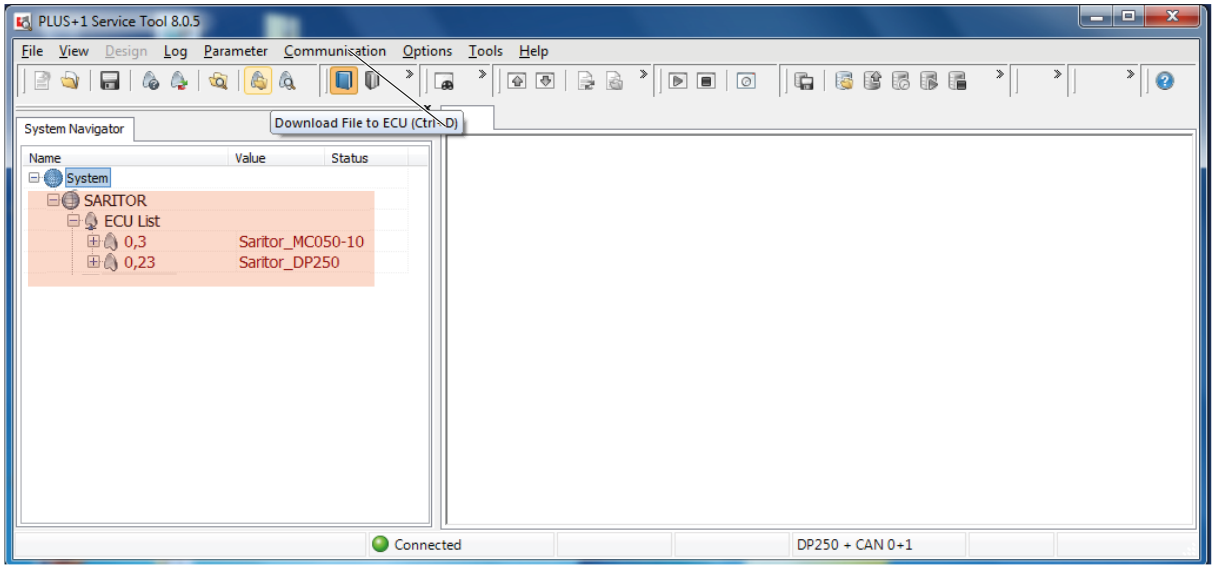
6. Launch the Plus+1 Service Tool.exe.

7. Power ON the DP250 and MC050 Electronic Controller Unit.
8. Click on the menu Communication>Online Mode to start the communication.



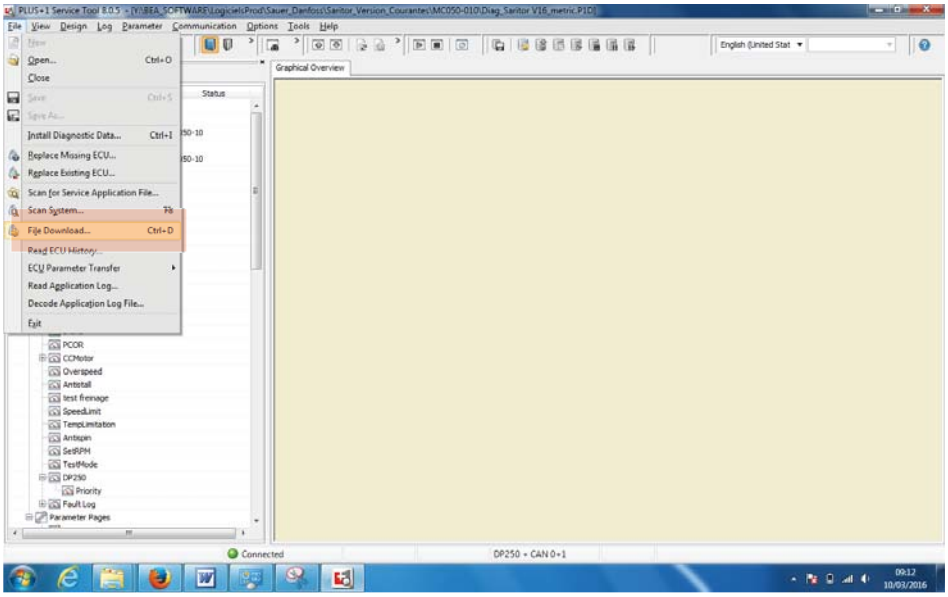


9. Click on Display to select the channel, then DP250 + CAN0+1.
10. Click on Change to accept.



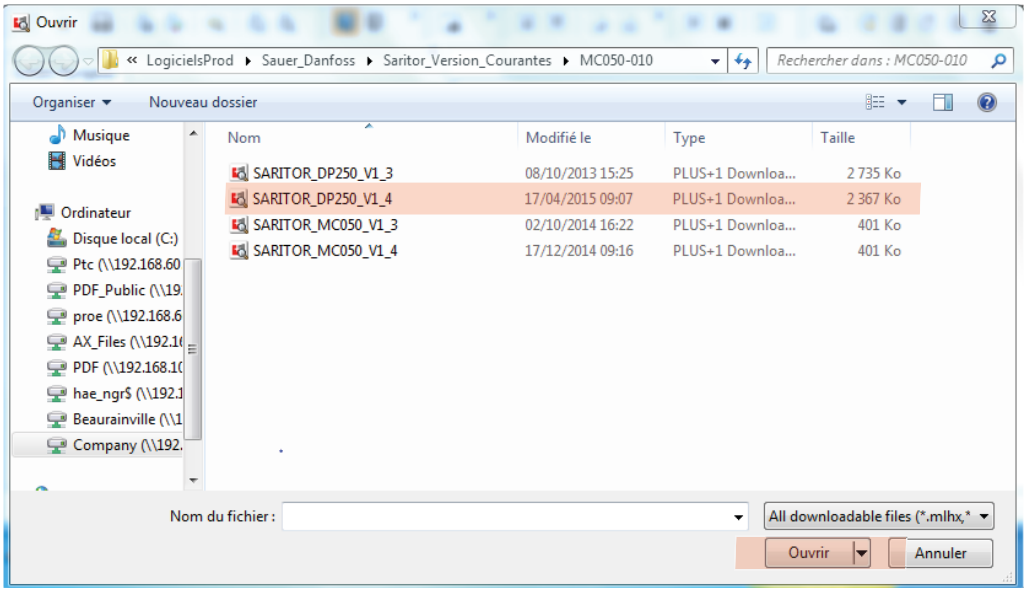
The list of ECUs is displayed on the screen.

Download the firmware



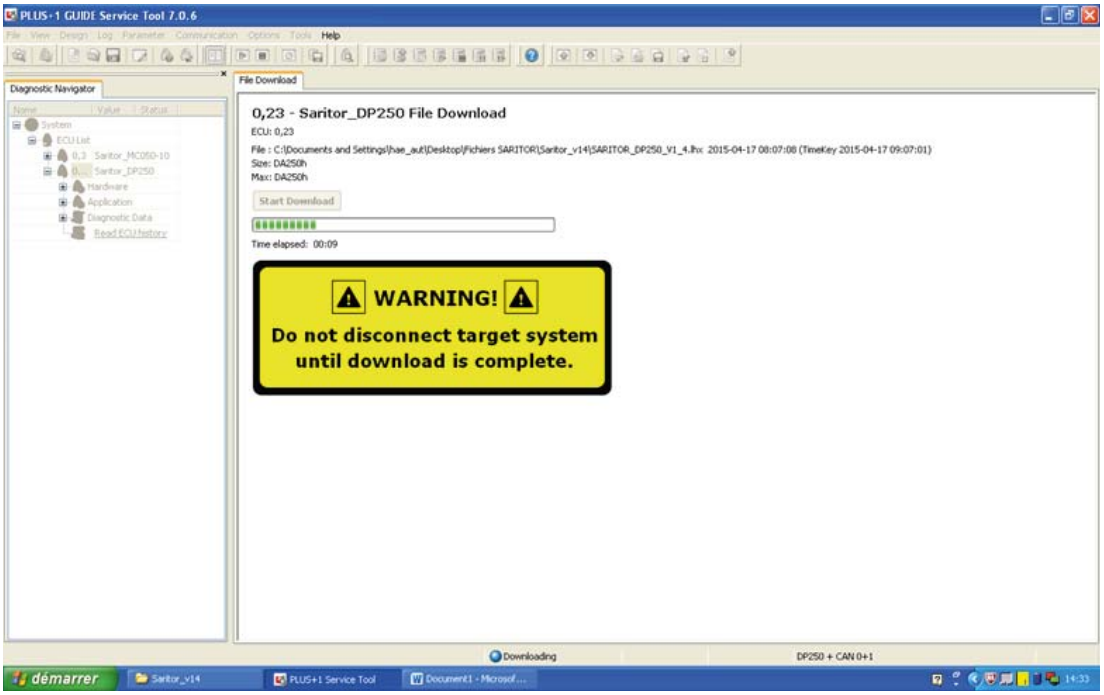
Click on File>File Download.

11. Click on the current version to download the firmware to PLUS+1 ECU.

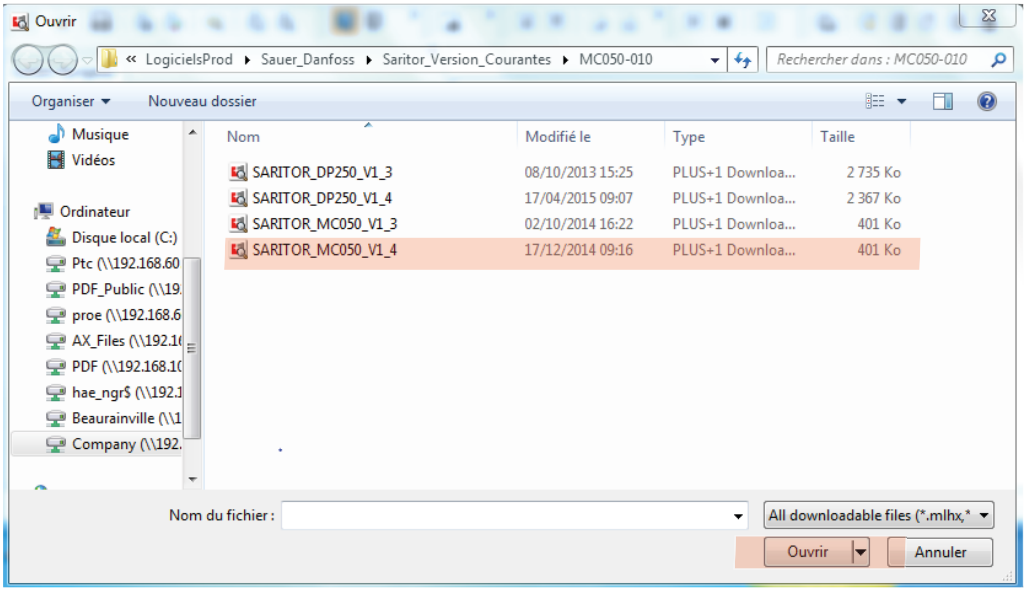


The DP250 ECU is ready to download the software.

12. Click on Start Download to transfer the firmware to the ECU.

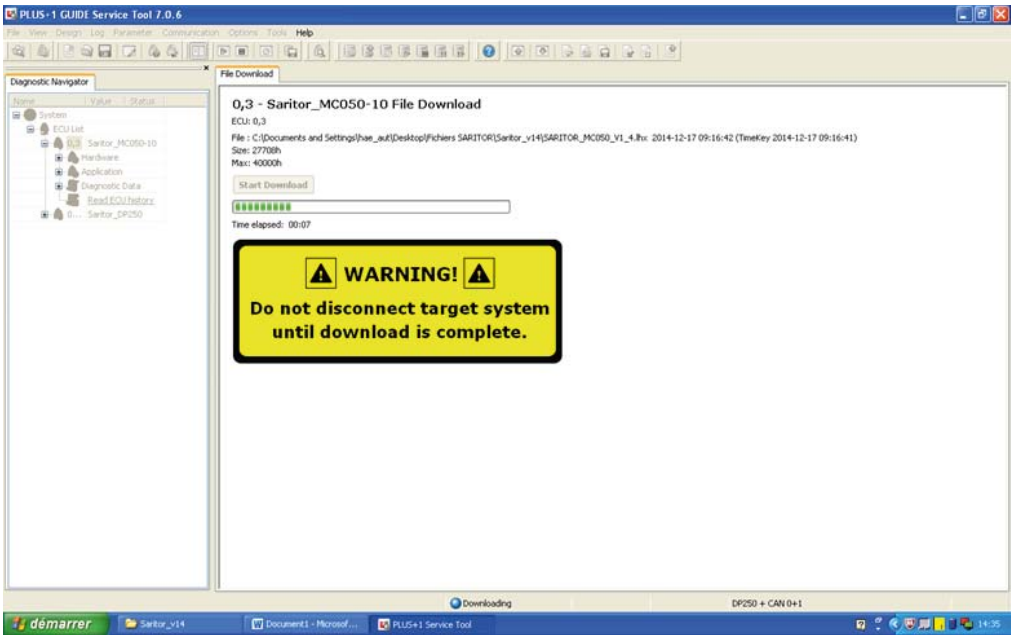


13. Click on the current version to download the firmware to MC050 ECU.

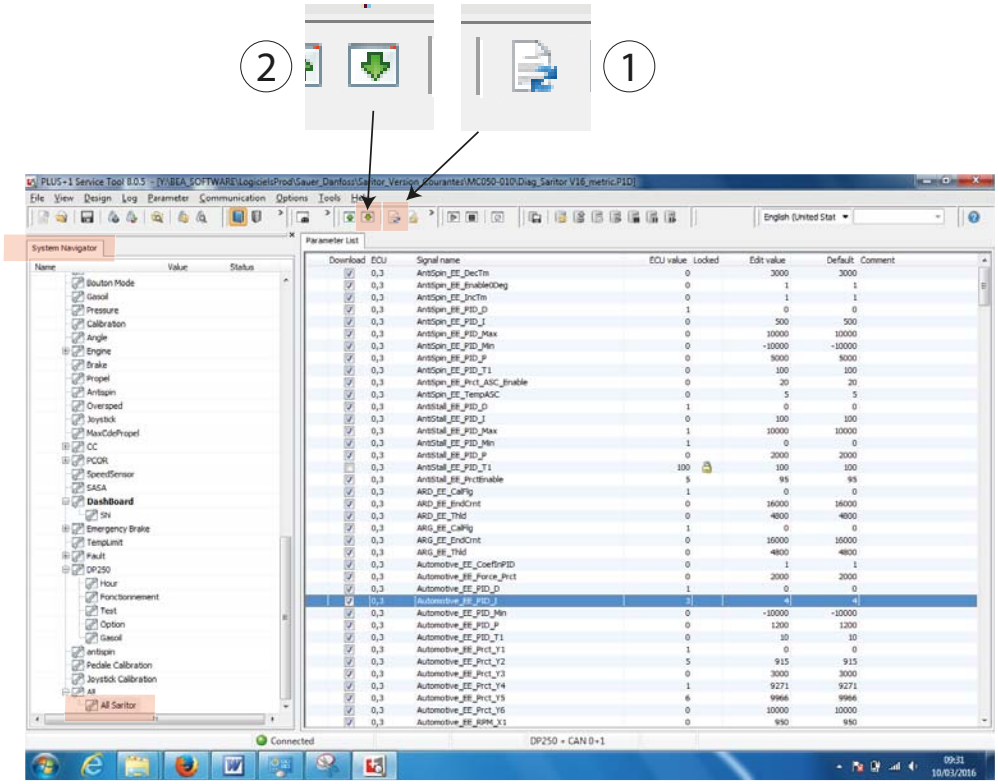


The MC050 ECU is ready to download the firmware.

14. Click on Start Download to transfer the firmware to the ECU.



Download the parameters to ECU



15. Click on System Navigator and All Saritor.
16. Click on the tab (1) to set all values to the default value, then click on the tab (2) to download the parameters to the ECU.

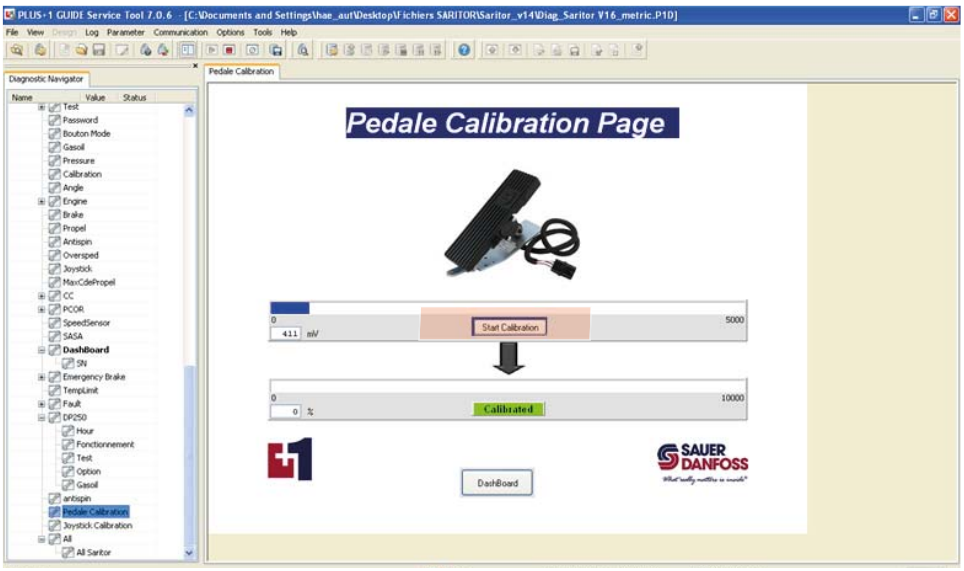
Calibrating the pedal and joystick

Before operating the system, it is necessary to calibrate the throttle pedal and the joystick (grip). This calibration can be performed with either the service tool or by the PLUS+1 ECU.

1. Pedal Calibration	2. Joystick Calibration

Throttle pedal via the service tool

1. Click on tab Pedal Calibration to display the Pedal Calibration Page.



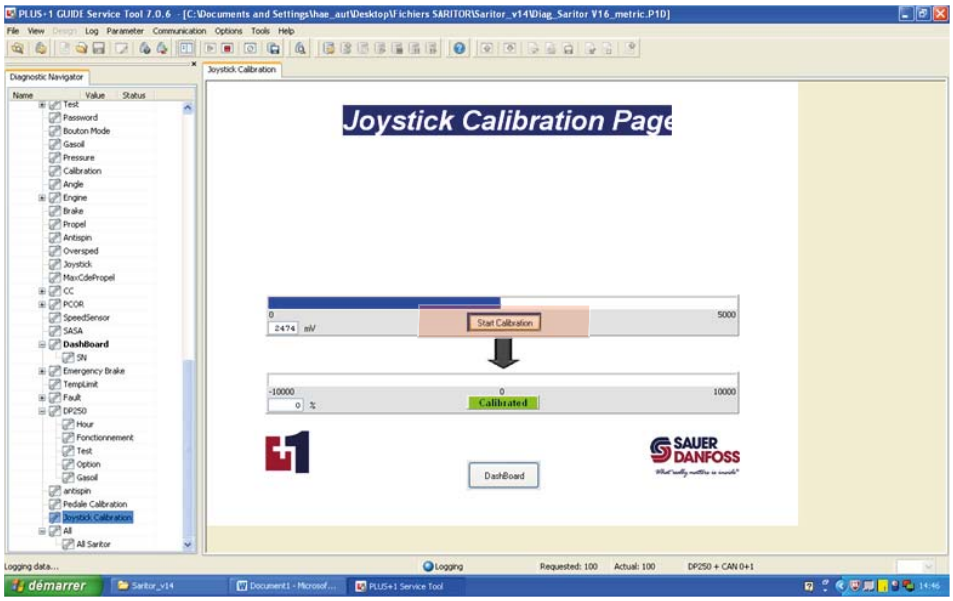
2. Press Start Calibration to start the procedure.
3. Press the throttle pedal fully for 3 seconds. The calibration is automatically saved.
4. Click on the tab Dashboard to exit the page.

Throttle pedal Calibration via PLUS+1 Screen

Refer to the chapter “MC050 and PLUS+1 Calibration” page 182.

Joystick calibration via the service tool

1. Click on tab “Joystick Calibration” to display the Joystick Calibration Page.



2. Press Start Calibration to start the procedure.
3. Push the joystick fully forward for 3 seconds. The calibration is then saved.
4. Pull the joystick fully back for 3 seconds. The calibration is then saved.
5. Set the joystick to the neutral position. After 3 seconds the neutral position is automatically saved.
6. Click on the tab “Dashboard” to exit the calibration page.

Joystick Calibration via PLUS+1 Screen

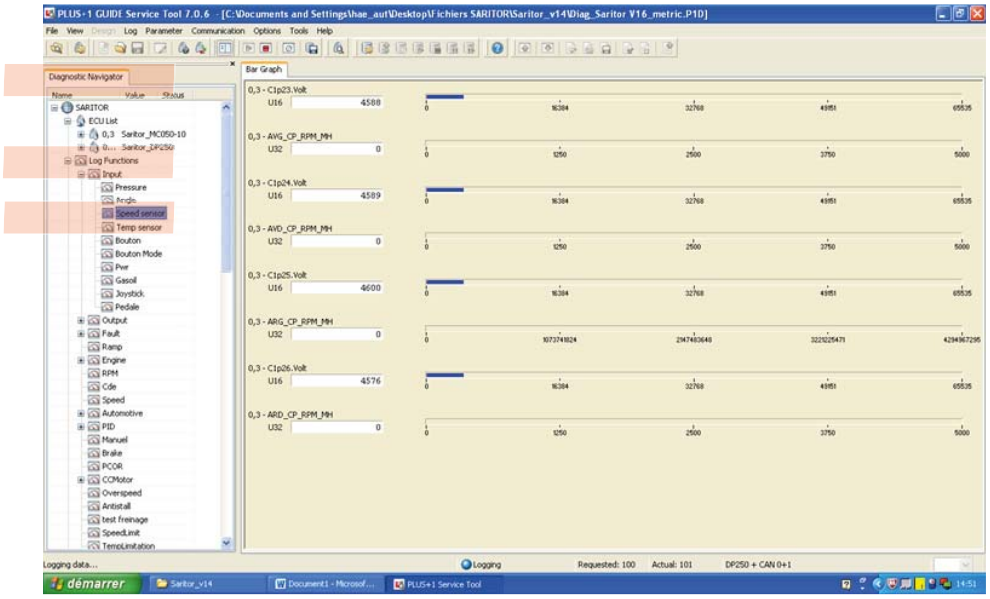
Refer to the chapter See “MC050 and PLUS+1 Calibration” page 182.

Check the Log via the Service Tool

This section below describes the main functions of the transmission system.

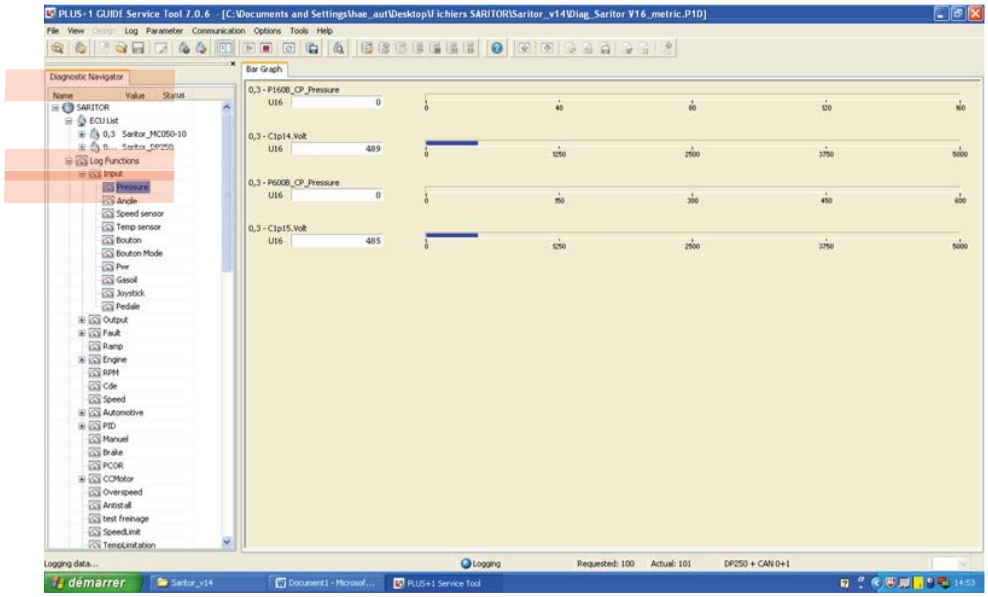
Check the speed sensor input

1. Click on the tabs Diagnosis Navigator>Input>Speed Sensor.



Check the hydraulic pressure

1. Click on the tabs Diagnosis Navigator>Input>Pressure to check the at 2320 and 8702 PSI (160 and 600 bar).



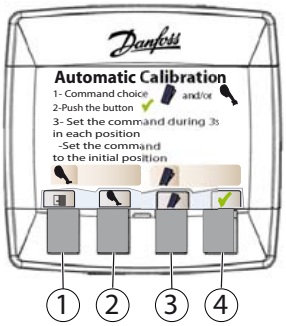
MC050 and PLUS+1 Calibration

To access to the calibration menu:

1. Press buttons **(1)** and **(2)** simultaneously for **3 sec.**
2. Enter the password by pressing buttons **(1)** and/or **(4):**

Password: **0 0 10**

This page allows the calibration of the throttle pedal and /or joystick.



Calibrating the throttle pedal

1. Press button (3), the message "Calibration" is displayed.

2. Press button (4), the message "Calibration In progress" is displayed.

3. Press the pedal fully for 5 seconds, then release it. After a few seconds, the message "Calibration Ok" indicates that the procedure is completed.

How to calibrate the joystick

1. Press button (2)

2. Press button (4), the message "Calibration In progress" is displayed.

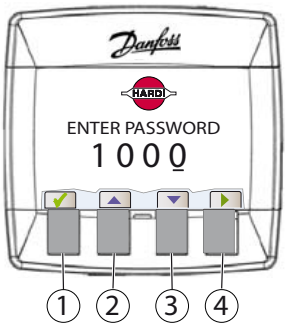
3. Push the joystick fully forward for 5 seconds. The calibration is then saved.
4. Pull the joystick fully back for 5 seconds. The calibration is then saved.
5. Set the joystick to the neutral position. After 5 seconds the neutral position is automatically saved and "Calibration Ok" indicates that the procedure is completed.

Check Log via PLUS+1 screen

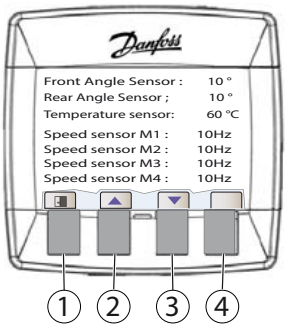
To access to the diagnosis pages:

1. Press buttons (1) and (2) simultaneously for 3 sec.
2. Enter the password by pressing buttons (1) and/or (4):

Password: **1 0 0 0**



Press button (2) or (3) to display the next or previous page



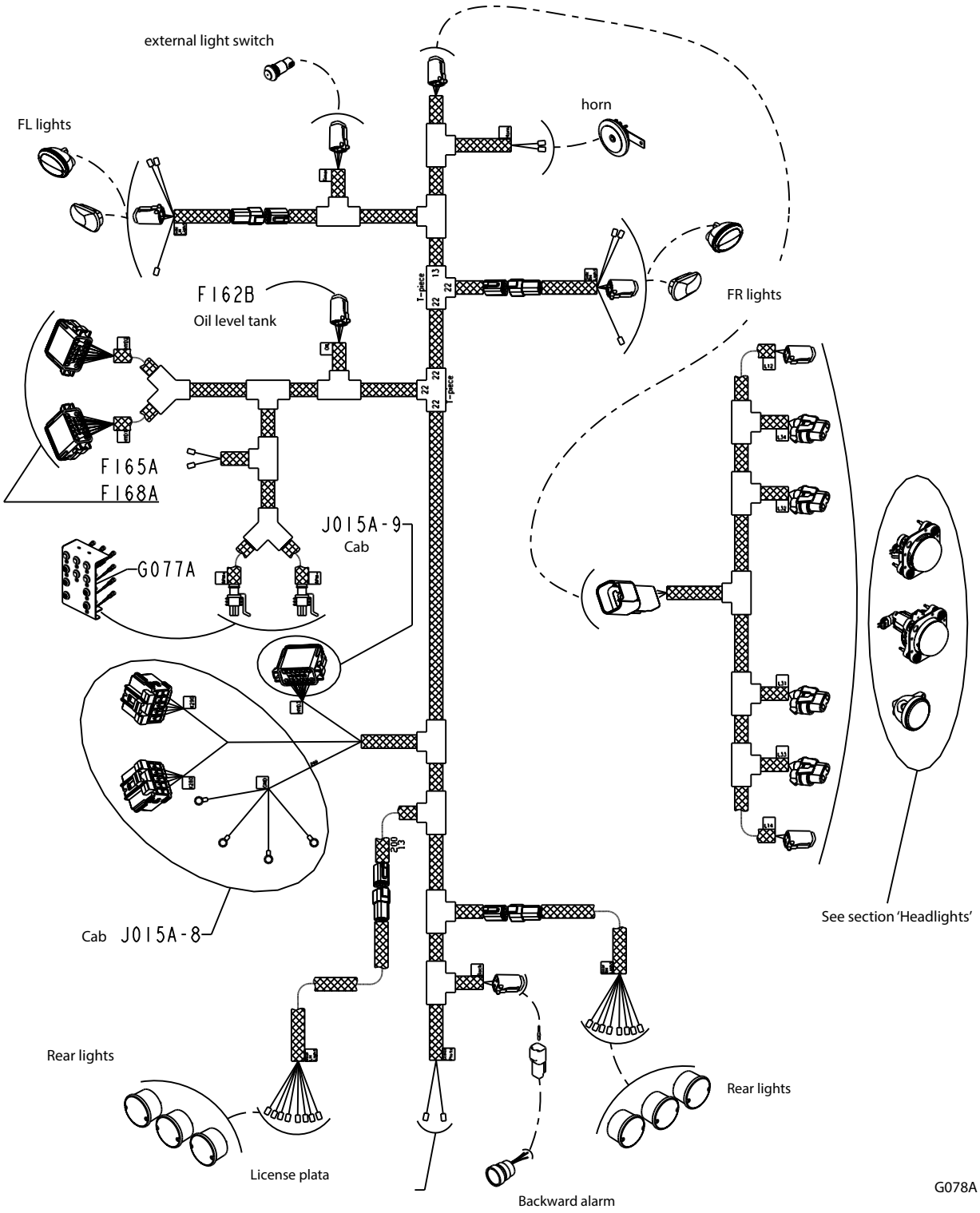
function	Typical signal (V)	Range (V)
Short-circuit5 V	**0.7**	**0.25 -1.15**
Parking	**0.7**	**0.25 -1.15**
Downhill	**1.6**	**1.15 - 2.00**
Uphill	**2.50**	**2.00 - 2.95**
Field	**3.40**	**2.95 - 3.85**
Automotive	**4.30**	**3.85 - 4.75**
Short-circuit 0V		**0.00 - 0.25**

Resistance GO: Fuel gauge resistance

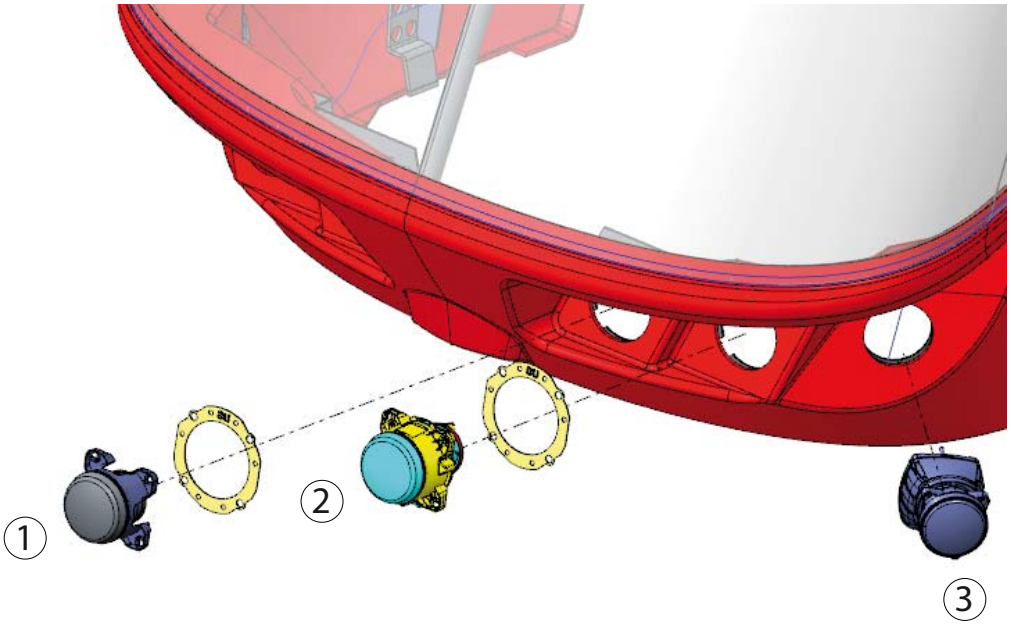
0 short-circuit
1 - 200 operating range
65535 cable break

Harness overview

Main Harness



Headlights



1. High beam headlamp
2. Dipped/low beam headlamp
3. Working headlamp

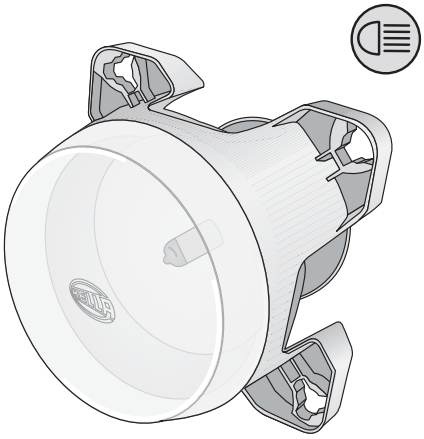
High Beam for US

Type: SAE - for USA high beam

Hella Part Number: 1K0 008.191-051

Hardi Part Number: 26045001

Bulb Type: Halogen - H9



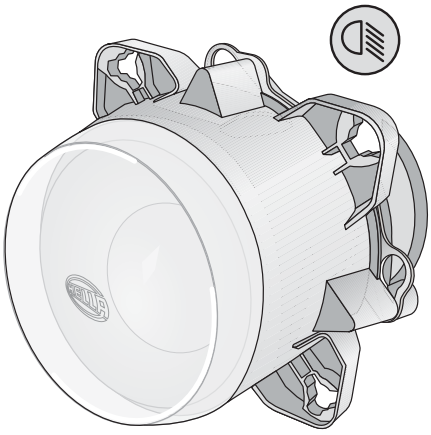
Dipped/low Beam for US

Type: SAE - for USA low beam

Hella Part Number: 1BL 008.193-021

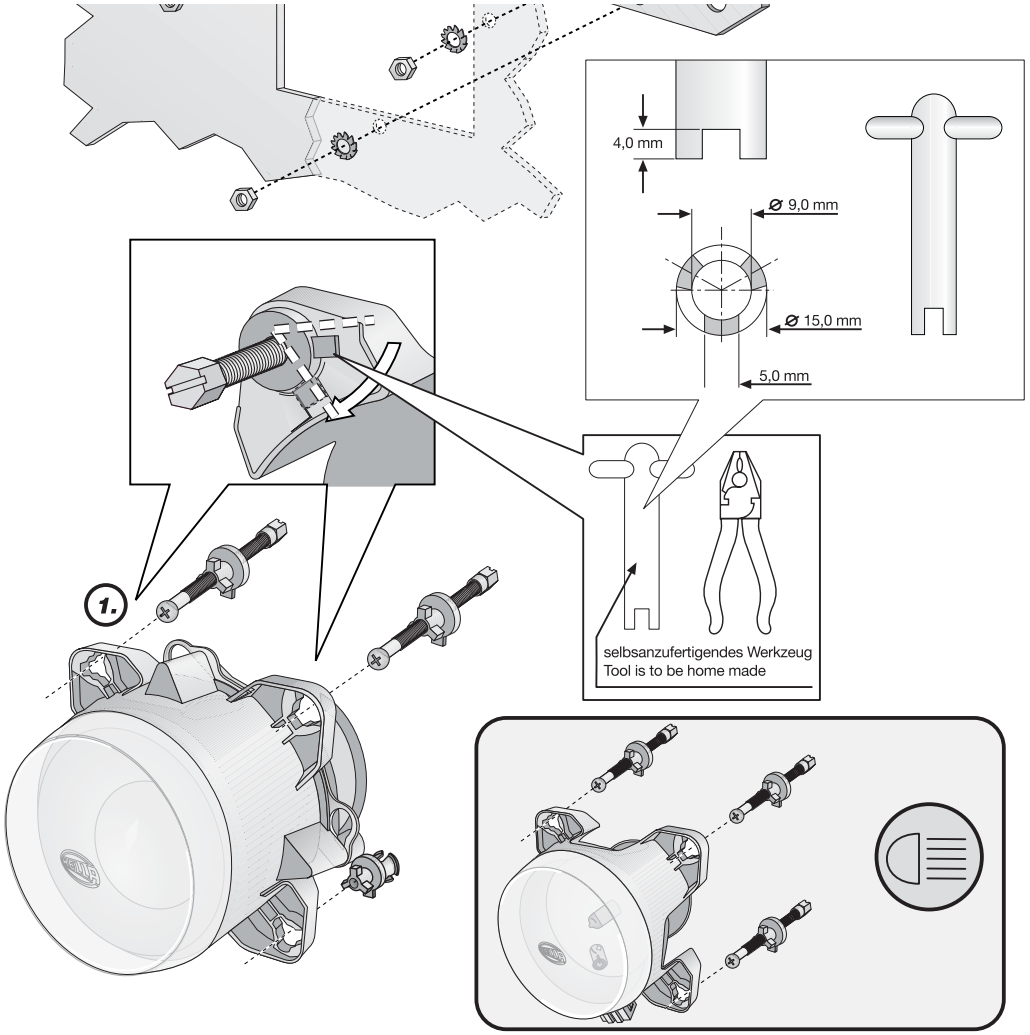
Hardi Part Number: 26044901

Bulb Type: Halogen - H9

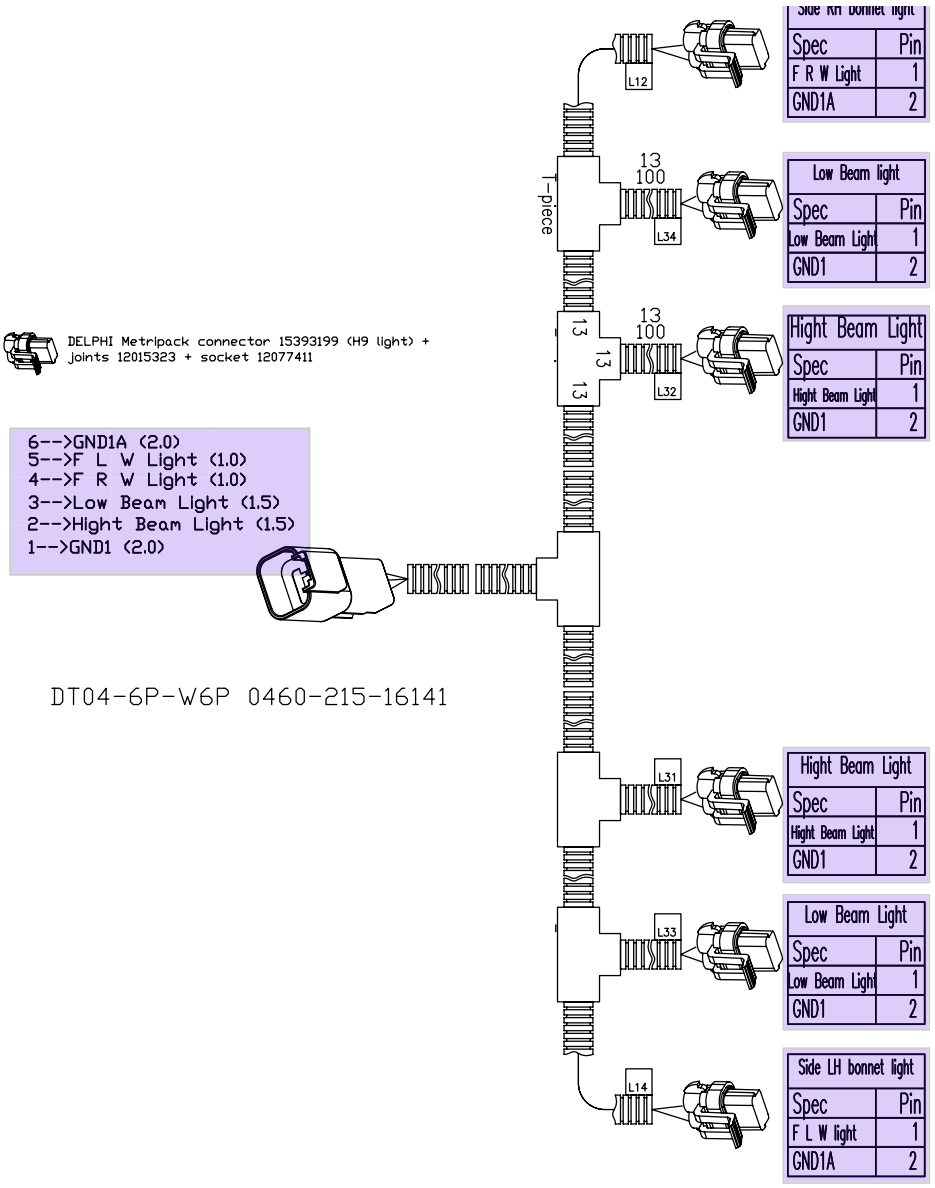


Only vertical adjustment of headlamp is permitted. Horizontal adjustment is not allowed!

Mounting


4,0 mm
Ø 9,0 mm
Ø 15,0 mm
5,0 mm
selbsanzufertigendes Werkzeug
Tool is to be home made
1.

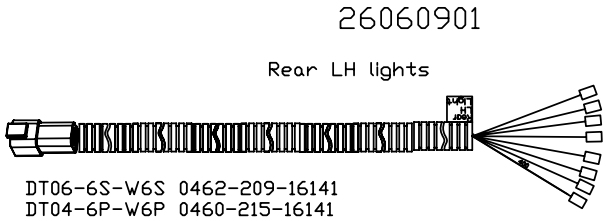
Harness Headlight diagram (USA version)



Harness Part Number: 26056301

Rear left lights harness

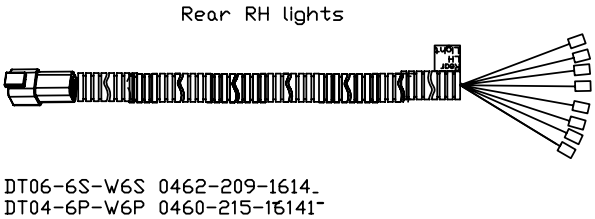
Left Rear Lights	
Spec	Pin
Rear LH flashing light	1
Stop Light	2
Marker Light	3
Left Amber flashing lights	4
GND	5
NU	6



GND
Rear LH flashing light
GND
Stop Light
Marker Light
GND
Stop Light
Marker Light
Left Amber flashing lights

Rear right lights harness

Right Rear Lights	
Spec	Pin
Rear RH flashing light	1
Stop Light	2
Marker Light	3
Right Amber flashing lights	4
GND	5
NU	6



Right Amber flashing lights
Marker Light
Stop Light
GND
Marker Light
Stop Light
GND
Rear RH flashing light
GND

Hydraulic oil level switch (Old version)

This model is a capacitive oil level switch which is designed to give an alarm signal if the fluid falls below a preset level. It will only signal an alarm after a few seconds of low level to eliminate false alarms due to turbulence.

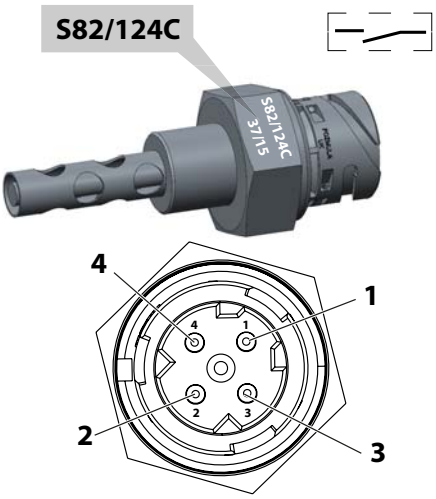
Manufacturer Part Number: CLS3285A - S82/124C

Hardi Part Number: 26050301

Power Voltage: 7.35 VDC

Output 1: Transistor switched to GND (Sink)

Signal: Normally Open (Close in fluid)



Torque setting on installation should not exceed 16lbf-ft (22Nm).
Unit should be tightened using a 31mm ring spanner.

Hydraulic oil level switch (New version)

This new model is a capacitive oil level switch which is designed to give an alarm signal if the fluid falls below a preset level. It will only signal an alarm after a few seconds of low level to eliminate false alarms due to turbulence.

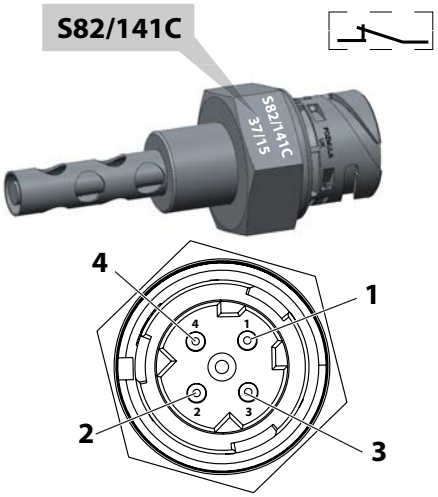
Manufacturer Part Number: CLS3285A - S82/141C

Hardi Part Number: 26065901

Power Voltage: 7.35 VDC

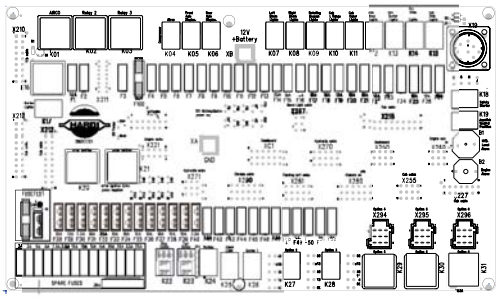
Output 1: Transistor switched to GND (Sink)

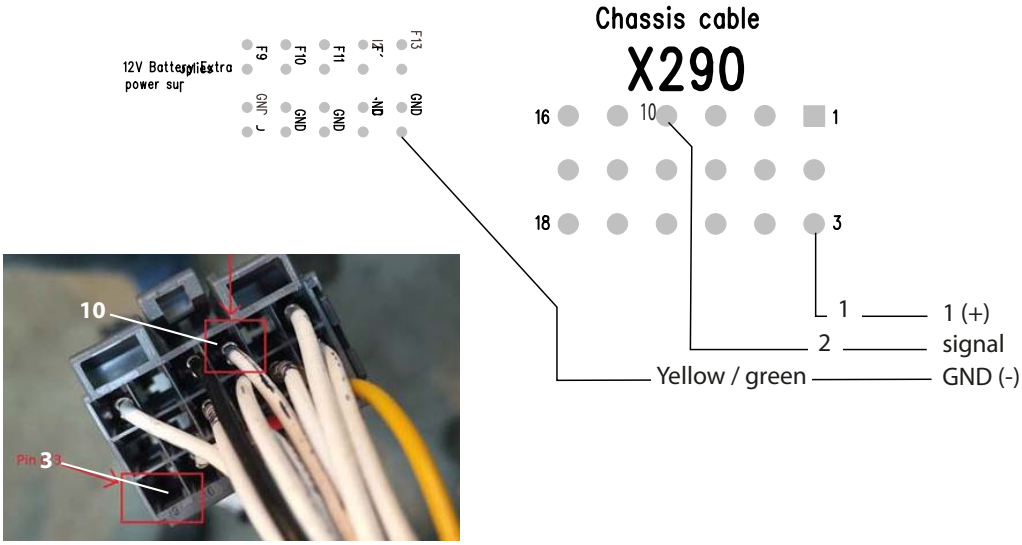
Signal: Normally Closed (Open in fluid)



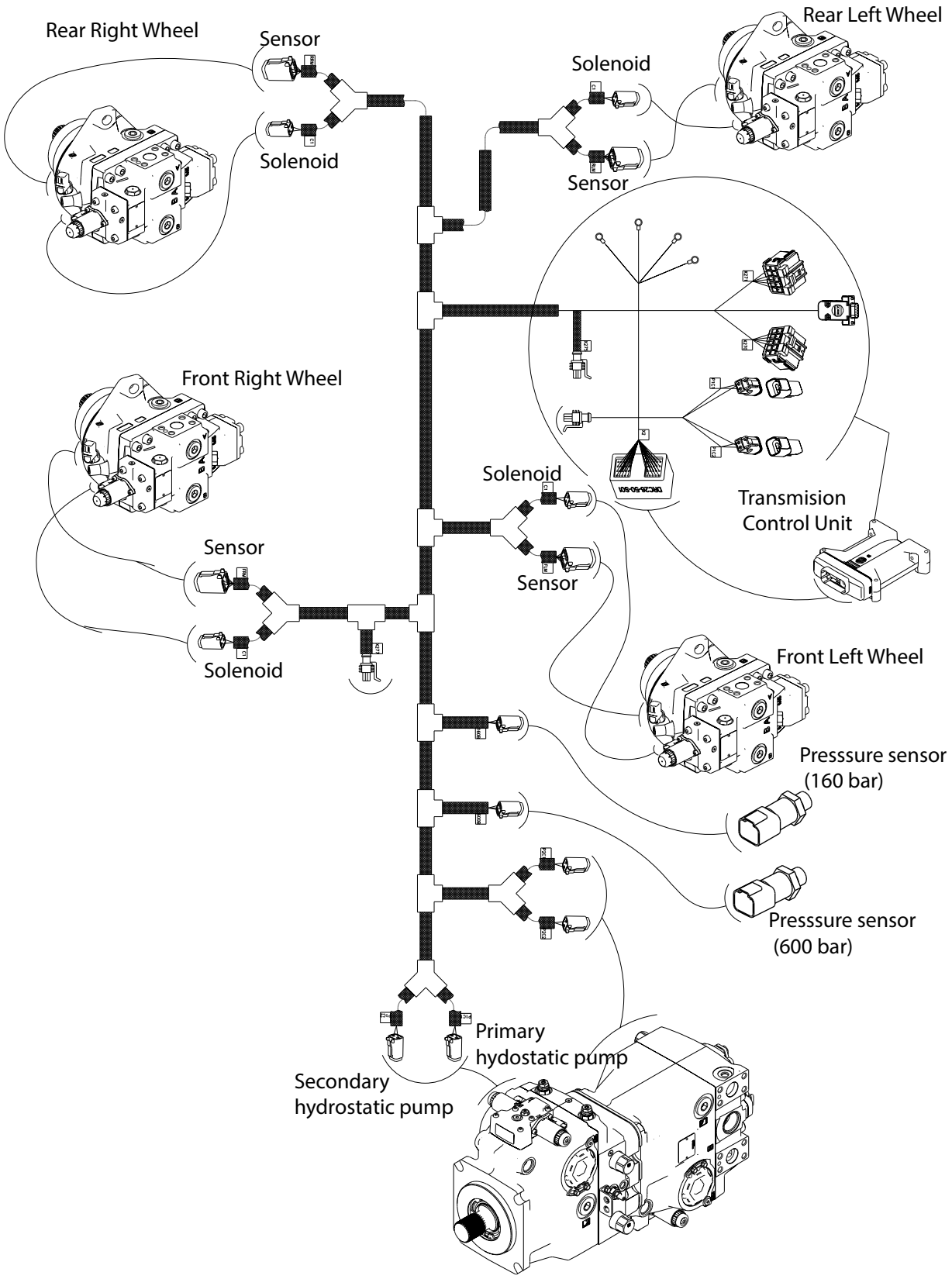
Torque setting on installation should not exceed 16lbf-ft (22Nm).
Unit should be tightened using a 31mm ring spanner.

Electrical connection



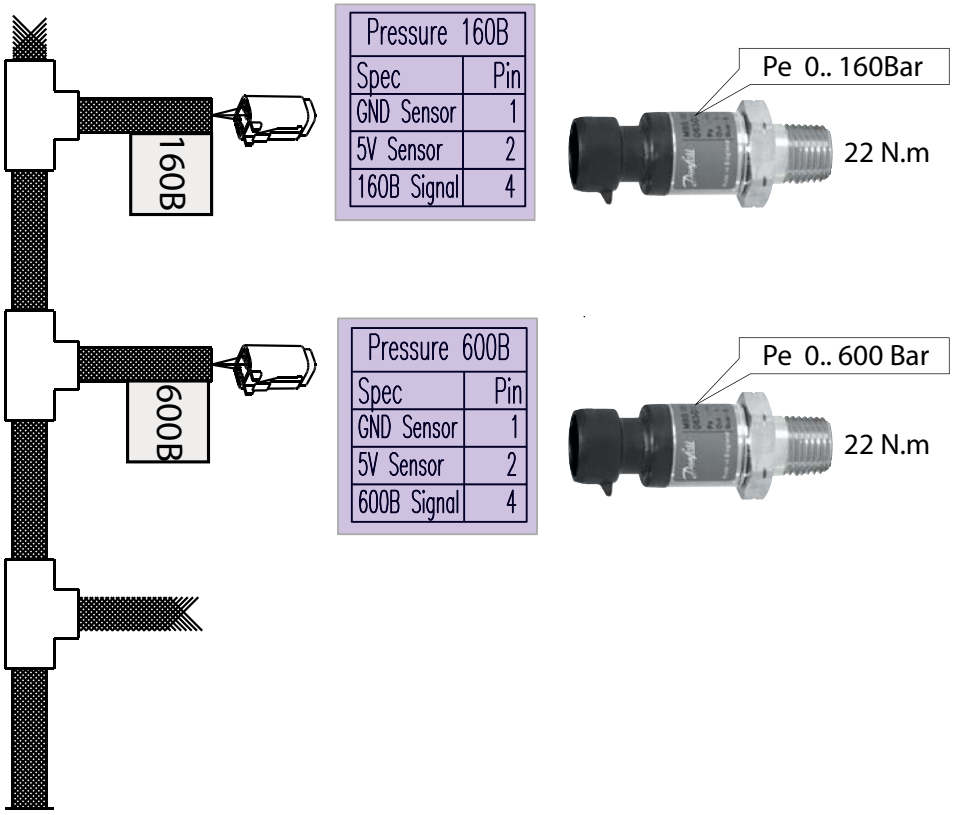


Overview of Main Power Transmission Harness

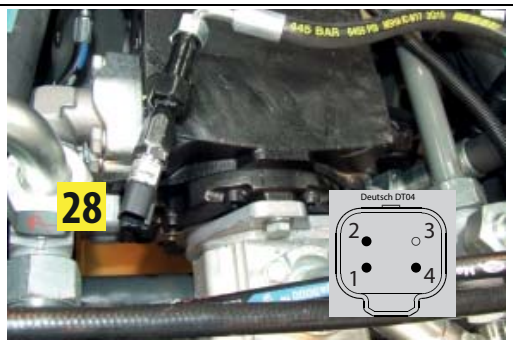


Pressure Transmitter (600 bar - 8702psi)

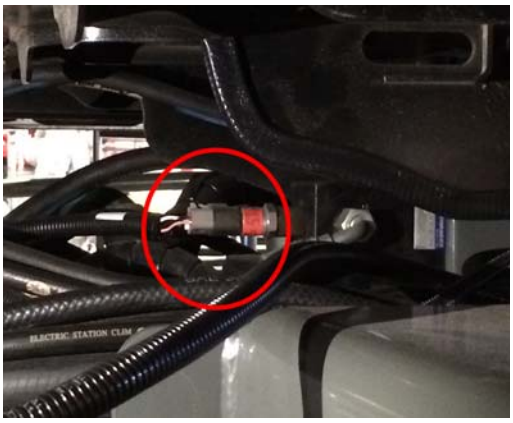
Cabling



Pressure transmitters Location (New Cab)

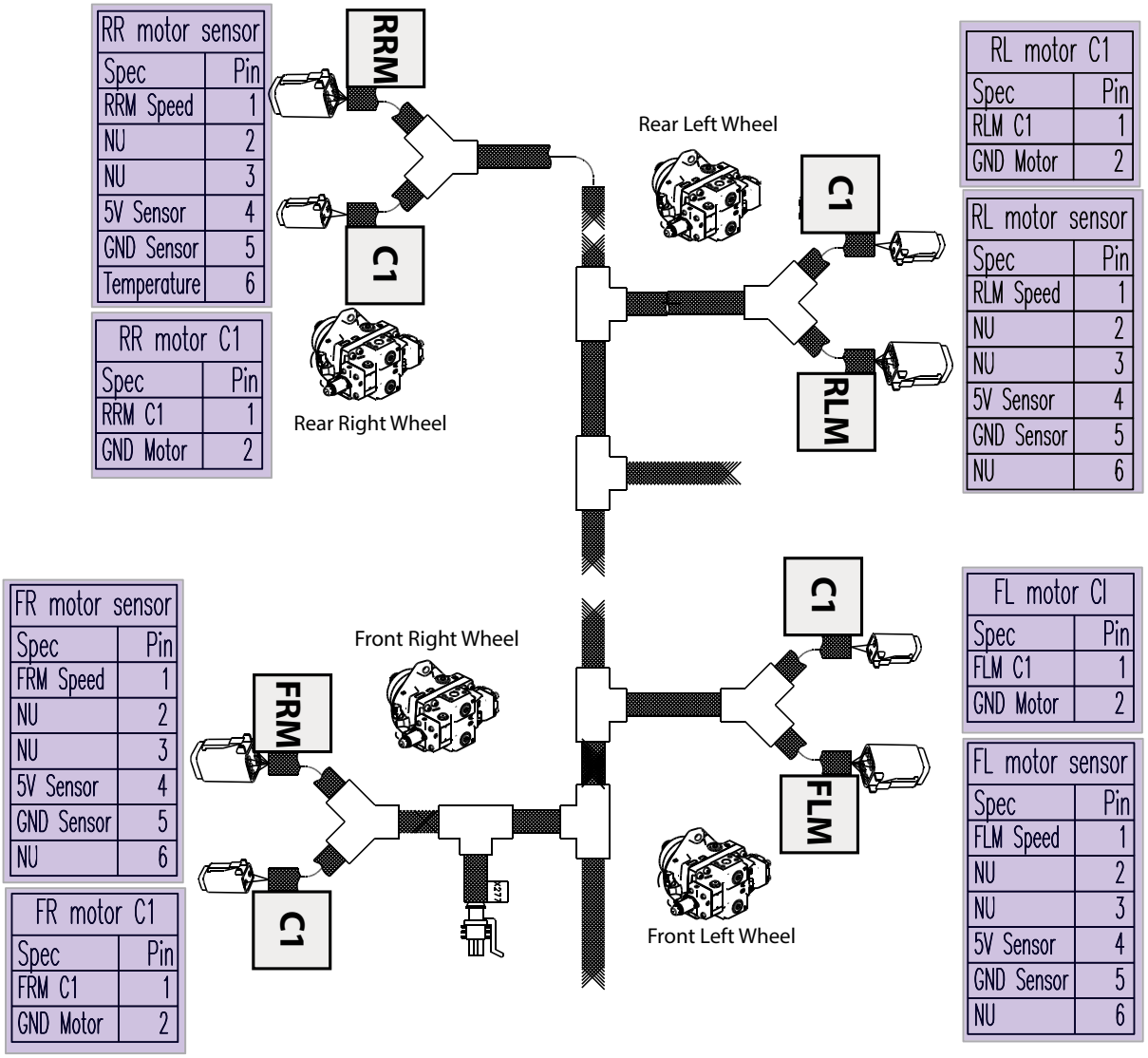
2320 PSI (160 Bar) Pressure transmitter The Pressure transmitter (27) is fitted on the brake pedal pin 1. GND sensor pin 2. 5VDC power pin 3 No connected pin 4 Output 0.5.-4.5 V	
8702 PSI (600 Bar) Pressure transmitter The Pressure transmitter (28) is fitted on the top of the hydrostatic pump. pin 1. GND sensor pin 2. 5VDC power pin 3 No connected pin 4 Output 0.5.-4.5 V	

Pressure Transmitters Location (Old Cab)

2320 PSI (160 Bar) Pressure transmitter The Pressure transmitter (27) is fitted on the brake pedal pin 1. GND sensor pin 2. 5VDC power pin 3 No connected pin 4 Output 0.5.-4.5 V	
8702 PSI (600 Bar) Pressure transmitter The Pressure transmitter (28) is fitted on the top of the hydrostatic pump. pin 1. GND sensor pin 2. 5VDC power pin 3 No connected pin 4 Output 0.5.-4.5 V	

Speed Sensor/Temperature Probe

Cabling



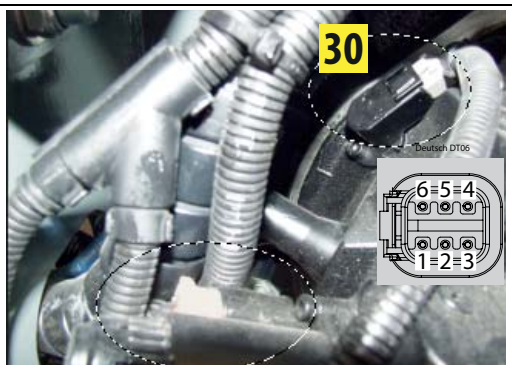
Speed sensor/temperature probe location

Speed sensor and temperature probe

Speed sensor (30) is fitted on hydraulic motor casing

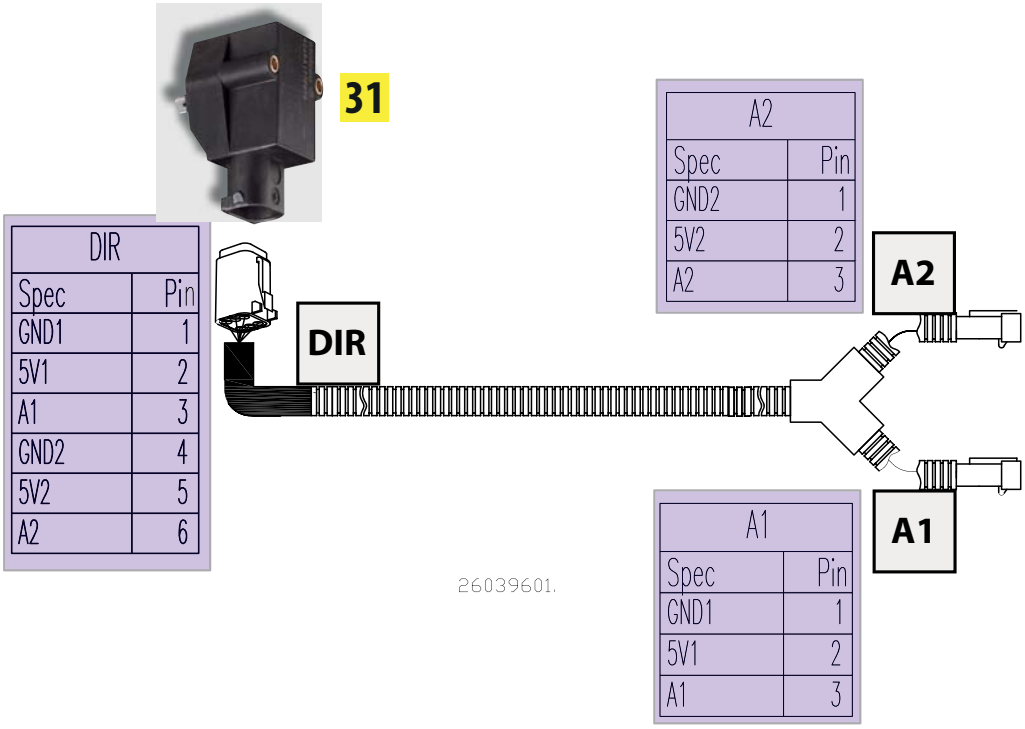
pin 1. Speed signal
pin 2. Not used
pin 3 Not used
pin 4 5 VDC power supply
pin 5 GND sensor
pin 6 Temperature signal (located on the rear right wheel

For technical data, refer to “Speed Sensor Connector” page 141



Angular Sensor

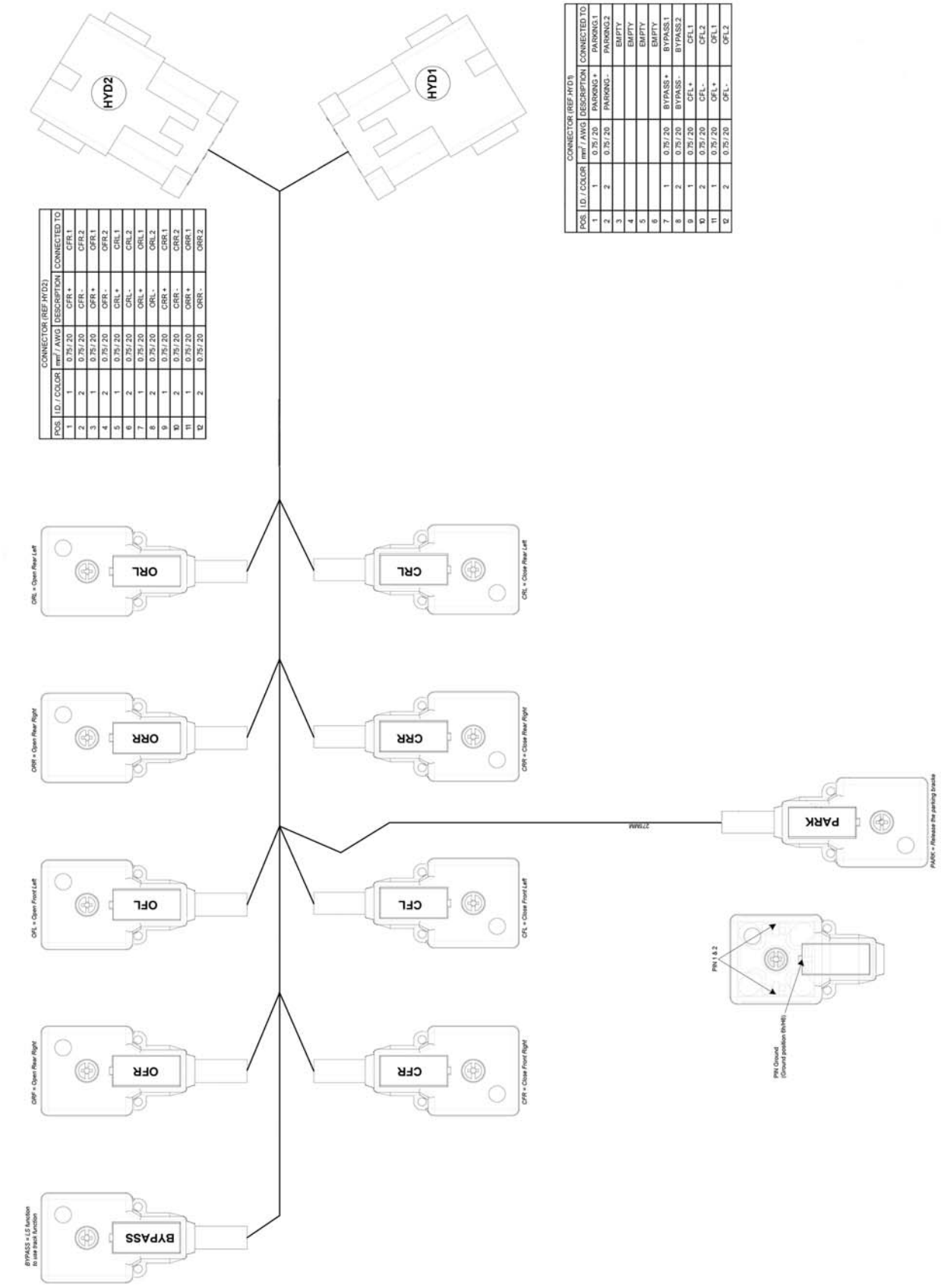
Cabling



Angular Sensor

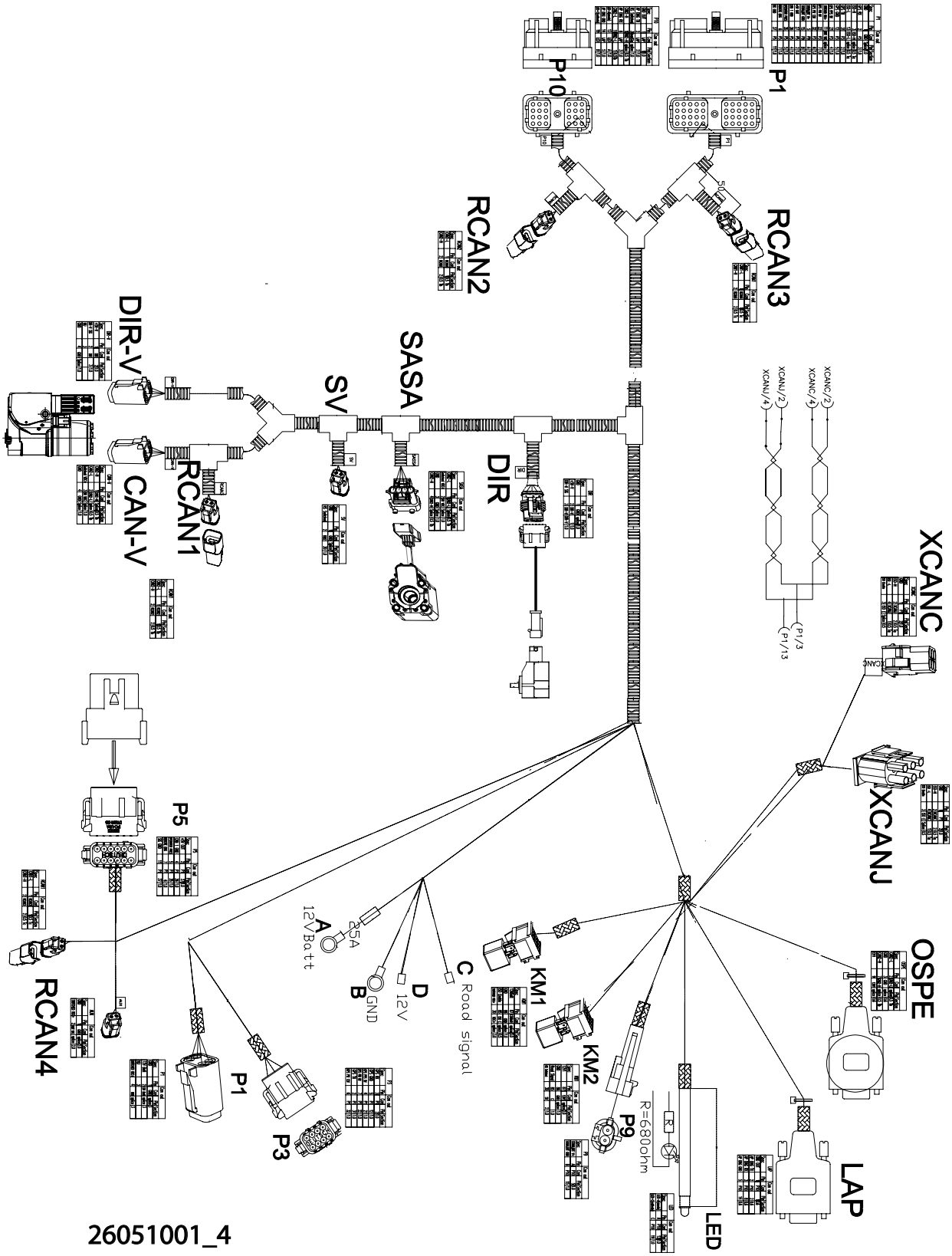
Angular sensor, 2 output (redundant) with Deutsch connector The sensor is fitted on the front right steering pivot pin 1. GND sensor pin 2. 5VDC power pin 3 Output 1 (A1) pin 4. GND sensor pin 5 5VDC power pin 6 Output 2 (A2)	 **424RD166P070** **070** = **Angular measuring angle** (70degree) **P**= **ouput signal** parallel **6**= **Output signal 2** 0,5-4.5V (ratiometric) **6**= **Output signal 1** 0,5-4.5V (ratiometric) **1**= **Bearing** Ball bearing **D** = **Connector** Deutsch connector

Track, Park, and Bypass Harness



TRIMBLE Auto Steering

Main Harness



SASA Sensor - General Description

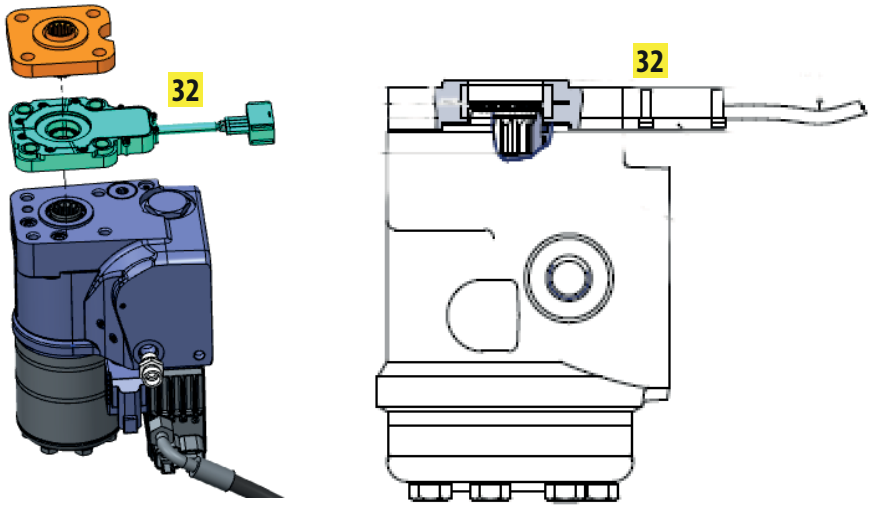
The SASA sensor detects the absolute position and speed of the steering wheel. The sensor can be used in electro-hydraulic steering systems using Sauer-Danfoss EH or EHPS steering valves with programmable controller.

The SASA sensor is used for variable steering ratio and closed loop set-ups where steering wheel position and steering have to match.

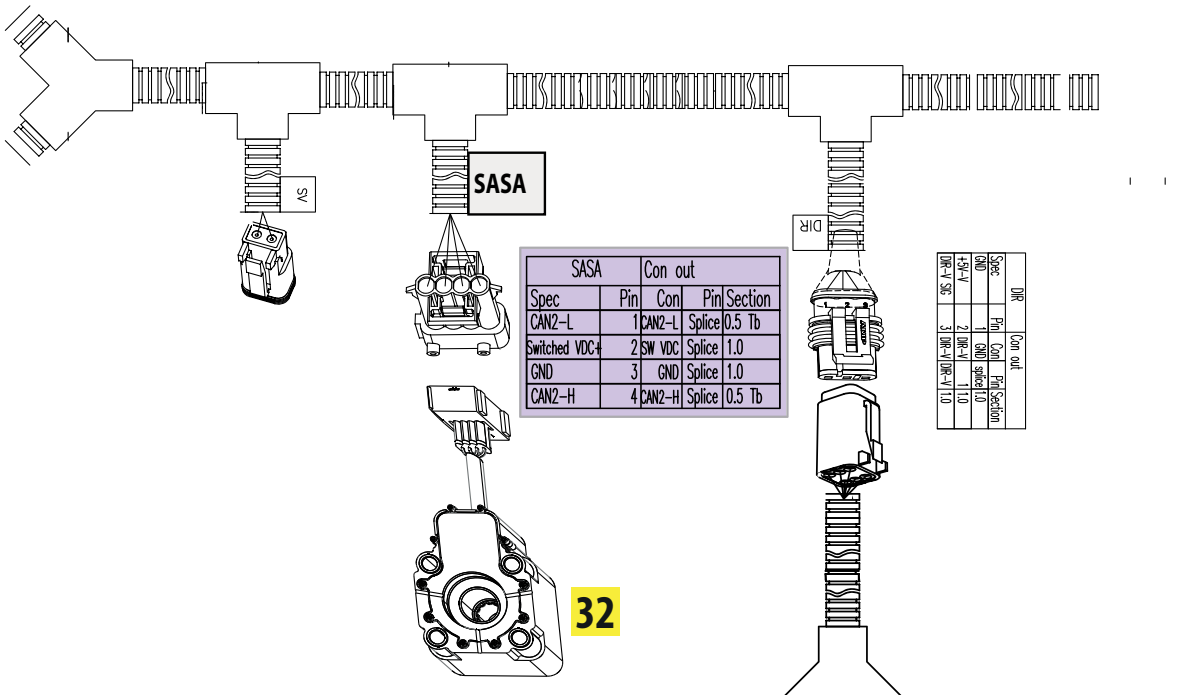
The SASA is based on a non-contact inductive principle giving a very high resolution. The sensor features a robust design and resists e.g. electro-magnetic radiation. The output is a CAN signal, which makes it easy to interface to advanced vehicle controllers. The steering wheel shaft turns the rotor of the SASA sensor, and the sensor is simply mounted between the steering unit and steering column. The shaft of the steering column must be 15 mm longer when using SASA sensor.

Installation

The SASA has to be mounted between the steering column and steering unit with 4 bolts torqued to 22lbf-ft [30 N-m.] The shaft in the column must be 15 mm (0.59 in) longer when using the SASA.



SASA Sensor Cabling



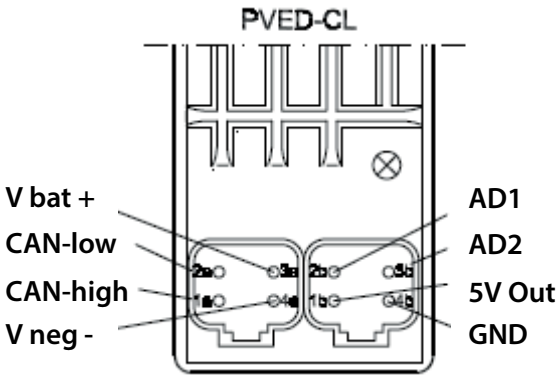
OSPE Steering Valve

General

On self-propelled sprayers, there is often a need for electrically actuated steering to make automatic GPS controlled steering possible. Also, manual steering with a variable ratio is an often wanted feature to improve productivity and driver comfort.

For this purpose Sauer-Danfoss has developed a combined steering unit and electro hydraulic steering valve named OSPE: **OSP** for normal manual steering wheel activated steering and **E** for electro hydraulic steering activated by electrical input signal, either for GPS or vehicle controller, or from steering wheel sensor (Sauer-Danfoss type SASA), or variable steering ratio. In variable steering mode, the electro hydraulic valve part adds flow to the metered out flow from the steering unit part of the OSPE.

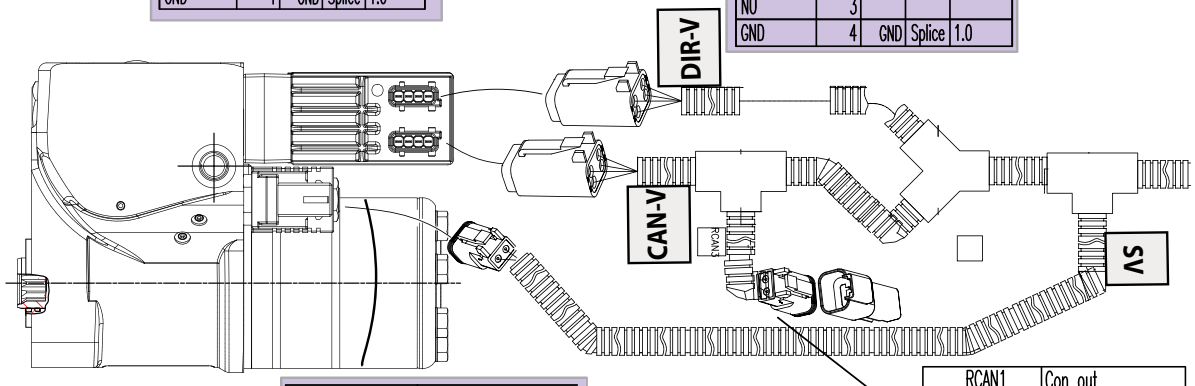
OSPE has built in safety function in the form of a cut off valve, which makes unintended steering from Electro hydraulic valve parts impossible. So OSPE is the right steering element, first of all to build up a steering system with a very high safety level, and so it will be able to fulfill legislation demands



The CAN-wiring is done according to J1939-15.

CAN–V		Con out		
Spec	Pin	Con	Pin	Section
CAN2–H	1	CAN2–H	Splice	0.5 Tb
CAN2–L	2	CAN2–L	Splice	0.5 Tb
Switched VDC+	3	SW VDC	Splice	1.0
GND	4	GND	Splice	1.0

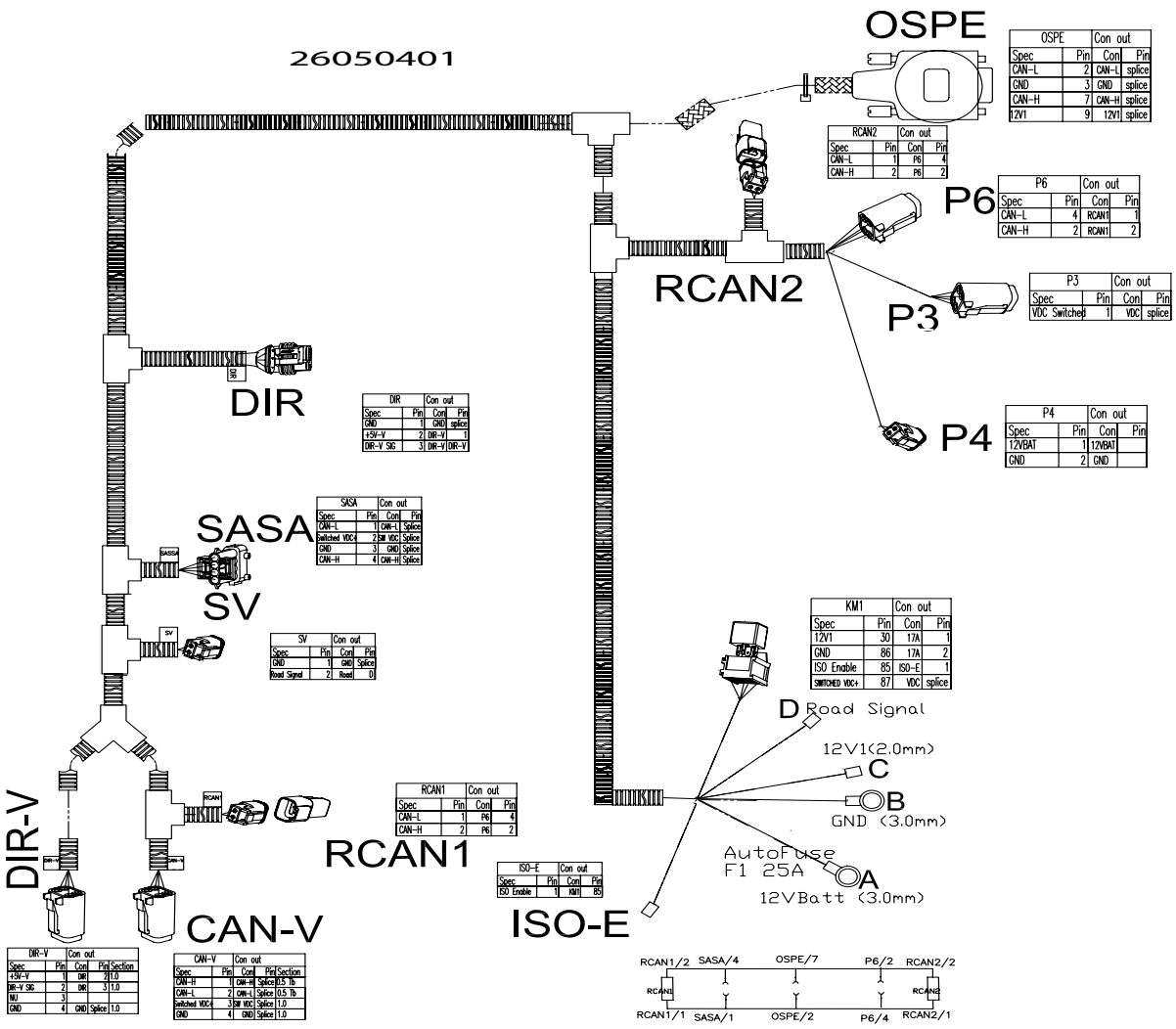
DIR–V		Con out		
Spec	Pin	Con	Pin	Section
+5V–V	1	DIR	2	1.0
DIR–V SIG	2	DIR	3	1.0
NU	3			
GND	4	GND	Splice	1.0



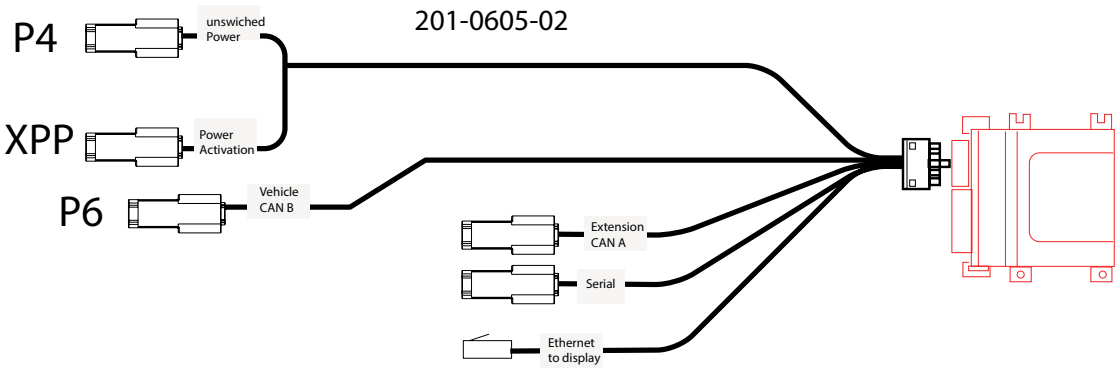
SV		Con out		
Spec	Pin	Con	Pin	Section
GND	1	GND	Splice	1.0
RS Switched	2	KM2	30	1.0

RCAN1		Con out		
Spec	Pin	Con	Pin	Section
CAN2–L	1	RCAN2	1	0.5 Tb
CAN2–H	2	RCAN2	2	0.5 Tb

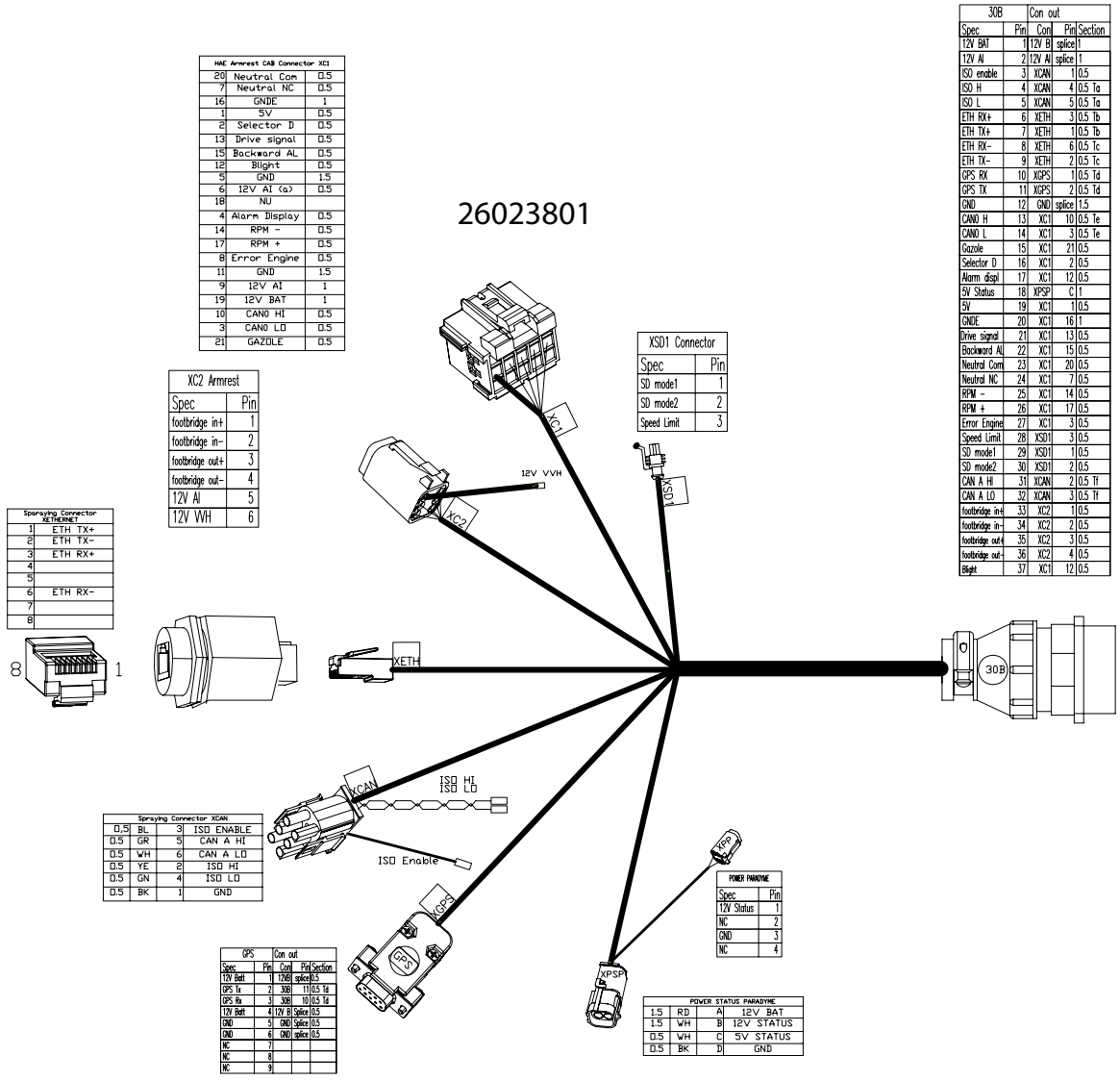
GeoSteer System



Steer Command cable



Armrest harness (Pre s/n 56307)



HAC Armrest CAB Connector XC1		
20	Neutral Com	0.5
7	Neutral NC	0.5
16	GNDE	1
1	5V	0.5
2	Selector D	0.5
13	Drive signal	0.5
15	Backward AL	0.5
12	Blight	0.5
5	GND	1.5
6	12V AI (a)	0.5
18	NU	
4	Alarm Display	0.5
14	RPM -	0.5
17	RPM +	0.5
8	Error Engine	0.5
11	GND	1.5
9	12V AI	1
19	12V BAT	1
10	CAN0 HI	0.5
3	CAN0 LO	0.5
21	GAZOLE	0.5

XC2 Armrest	
Spec	Pin
footbridge in+	1
footbridge in-	2
footbridge out+	3
footbridge out-	4
12V AI	5
12V WH	6

XSD1 Connector	
Spec	Pin
SD mode1	1
SD mode2	2
Speed Limit	3

30B		Con out		
Spec	Pin	Con	Pin	Section
12V BAT	1	12V BI	splice	1
12V AI	2	12V AI	splice	1
ISO enable	3	XCAN	1	0.5
ISO H	4	XCAN	4	0.5 Ta
ISO L	5	XCAN	5	0.5 Ta
ETH RX+	6	XETH	3	0.5 Tb
ETH TX+	7	XETH	1	0.5 Tb
ETH RX-	8	XETH	6	0.5 Tc
ETH TX-	9	XETH	2	0.5 Tc
GPS RX	10	XGPS	1	0.5 Td
GPS TX	11	XGPS	2	0.5 Td
GND	12	GND	splice	1.5
CAN0 H	13	XC1	10	0.5 Te
CAN0 L	14	XC1	3	0.5 Te
Gazole	15	XC1	21	0.5
Selector D	16	XC1	2	0.5
Alarm displ	17	XC1	12	0.5
5V Status	18	XPSP	C	1
5V	19	XC1	1	0.5
GNDE	20	XC1	16	1
Drive signal	21	XC1	13	0.5
Backward AL	22	XC1	15	0.5
Neutral Com	23	XC1	20	0.5
Neutral NC	24	XC1	7	0.5
RPM -	25	XC1	14	0.5
RPM +	26	XC1	17	0.5
Error Engine	27	XC1	3	0.5
Speed Limit	28	XSD1	3	0.5
SD mode1	29	XSD1	1	0.5
SD mode2	30	XSD1	2	0.5
CAN A HI	31	XCAN	2	0.5 Tf
CAN A LO	32	XCAN	3	0.5 Tf
footbridge in+	33	XC2	1	0.5
footbridge in-	34	XC2	2	0.5
footbridge out+	35	XC2	3	0.5
footbridge out-	36	XC2	4	0.5
Blight	37	XC1	12	0.5

Spraying Connector ETHERNET	
1	ETH TX+
2	ETH TX-
3	ETH RX+
4	
5	
6	ETH RX-
7	
8	

Spraying Connector XCAN			
0.5	BL	3	ISO ENABLE
0.5	GR	5	CAN A HI
0.5	WH	6	CAN A LO
0.5	YE	2	ISO HI
0.5	GN	4	ISO LO
0.5	BK	1	GND

GPS		Con out		
Spec	Pin	Con	Pin	Section
12V Batt	1	12VBI	splice	0.5
GPS Tx	2	30B	11	0.5 Td
GPS Rx	3	30B	10	0.5 Td
12V Batt	4	12V BI	Splice	0.5
GND	5	GND	Splice	0.5
GND	6	GND	splice	0.5
NC	7			
NC	8			
NC	9			

POWER PARADYNE	
Spec	Pin
12V Status	1
NC	2
GND	3
NC	4

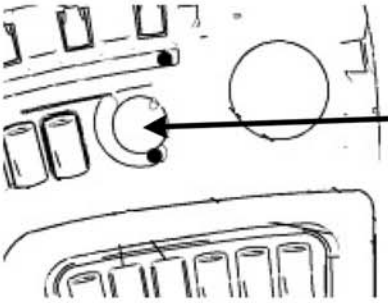
POWER STATUS PARADYNE			
1.5	RD	A	12V BAT
1.5	WH	B	12V STATUS
0.5	WH	C	5V STATUS
0.5	BK	D	GND

Post s/n 56307 is 26051601.

Mode Selector Change from 5v to 12v

Modifications apply from S/N 56307. Change in supply voltage from 5v to 12v

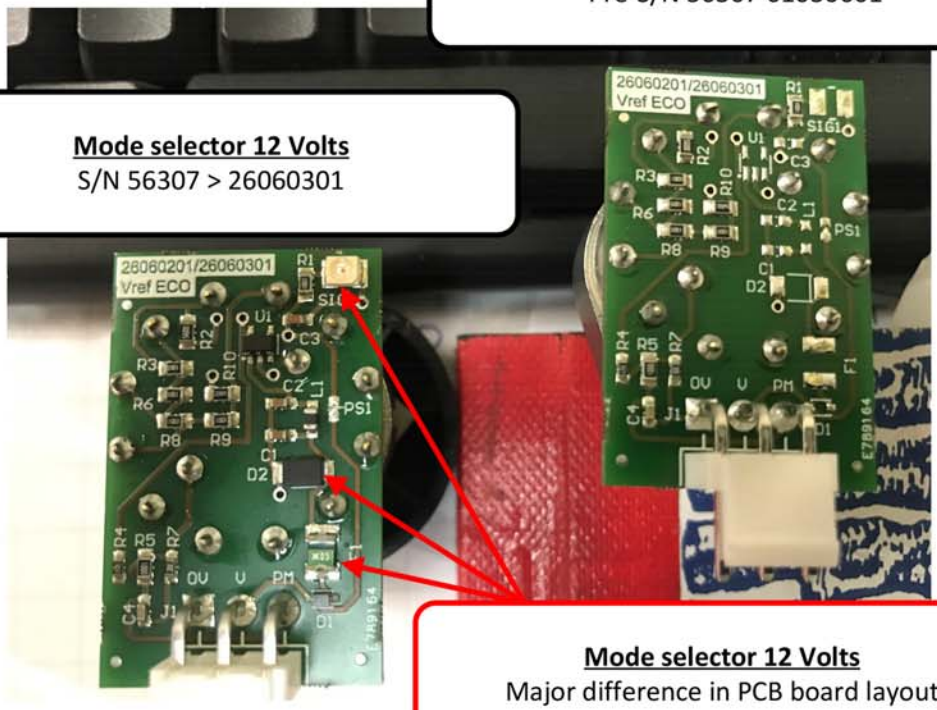
Transmission controller
Pre-S/N 56307 MC 050-010 26007201
S/N 56307 > MC 050-110 26057101



Mode selector
Pre-S/N 56307 61030601
S/N 56307 > 26060301 and 16713301

Mode selector 5 volts
Pre-S/N 56307 61030601

Mode selector 12 Volts
S/N 56307 > 26060301

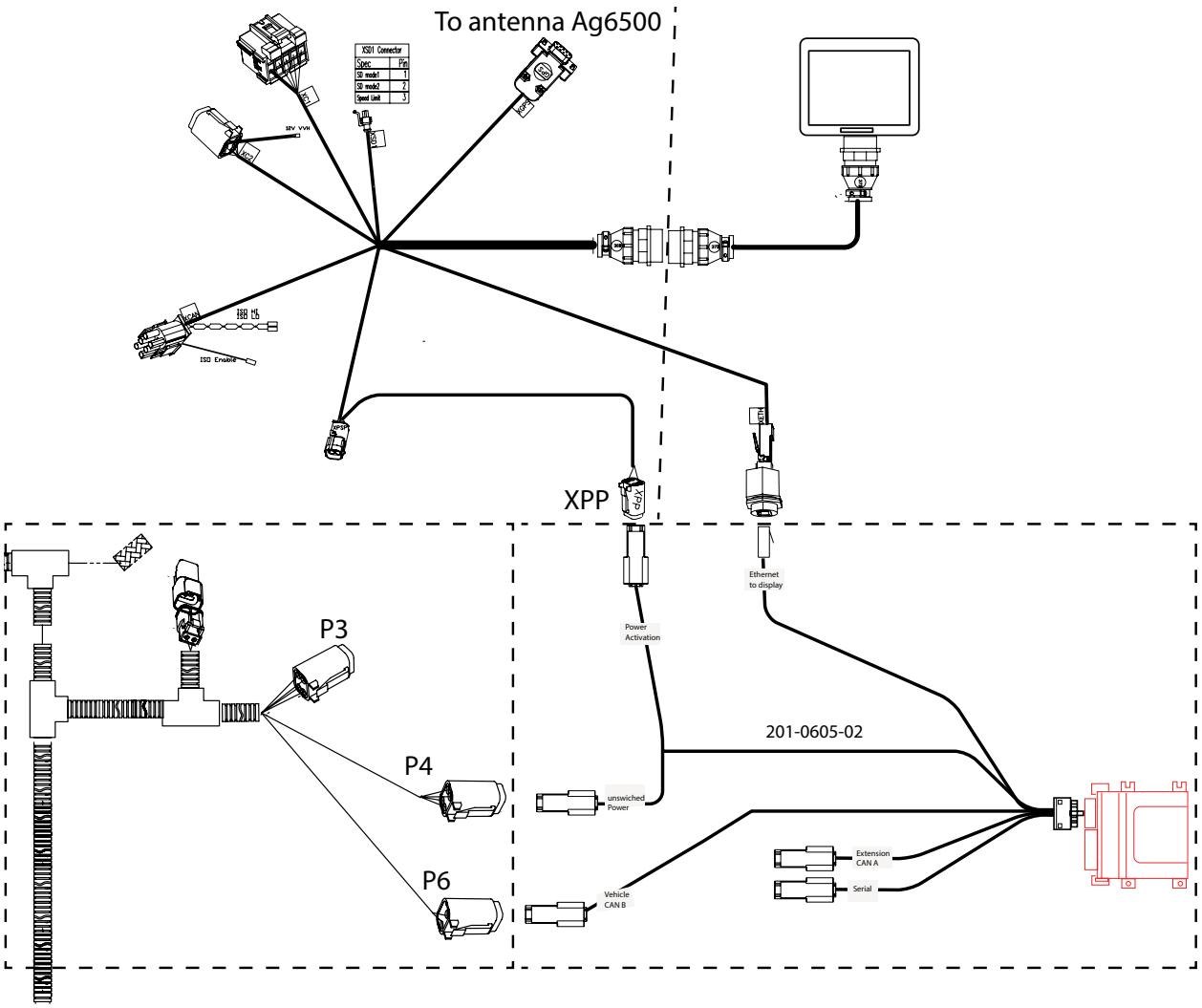


Mode selector 12 Volts
Major difference in PCB board layout

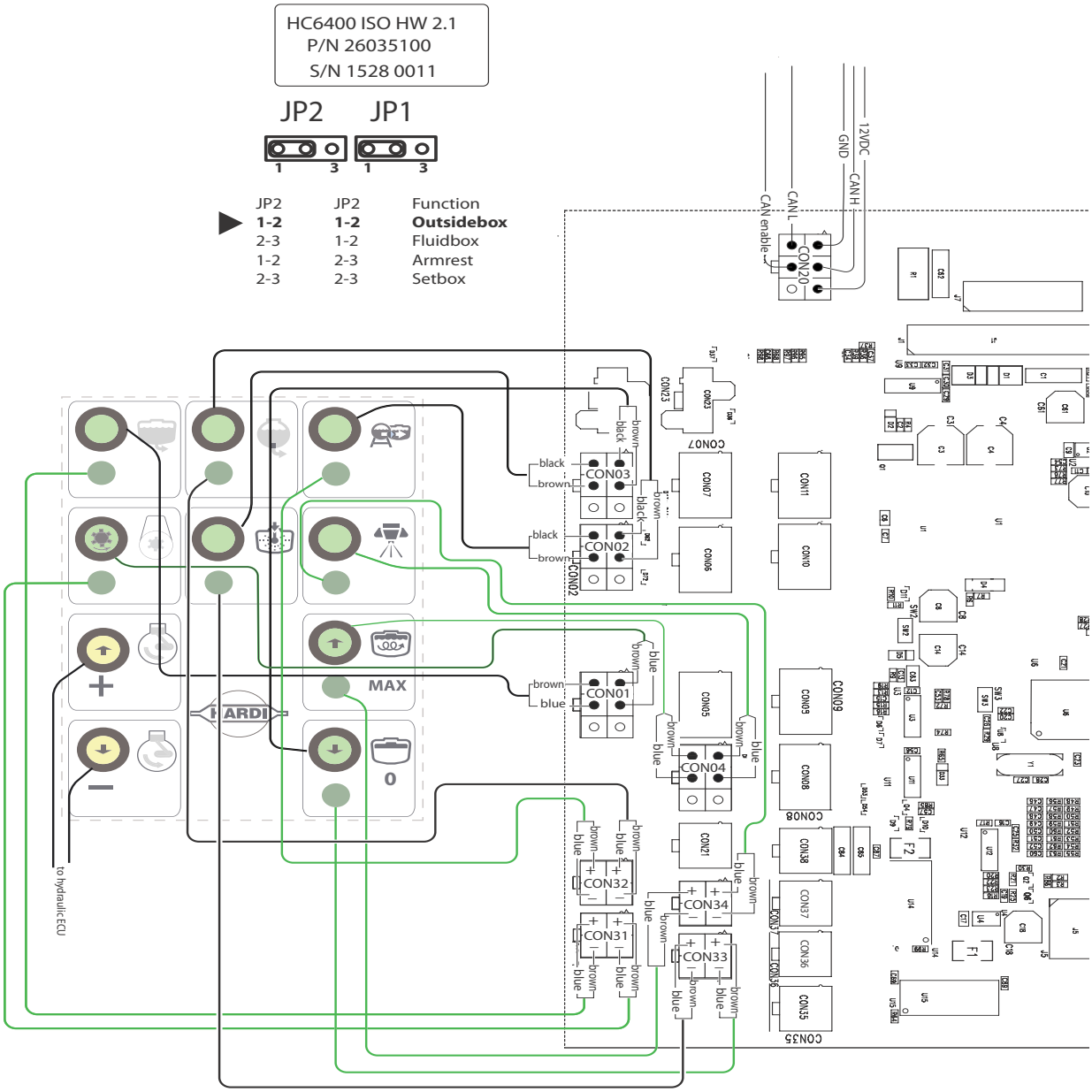
Harness updates due to Mode Selector change

	Pre s/n 56307	Post s/n 56307
Hydraulic Harness		**26018401**
Spray-center Harness	**26023401**	**26068701**
Armrest Harness	**26023801**	**26051601**
DP250 Harness	**26023901**	**26072301**
Firmware Change		**MC050-110: Saritor_MC050_110V_V1_0.ihx** **DP250: Saritor_DP250_V1_5.lhx**

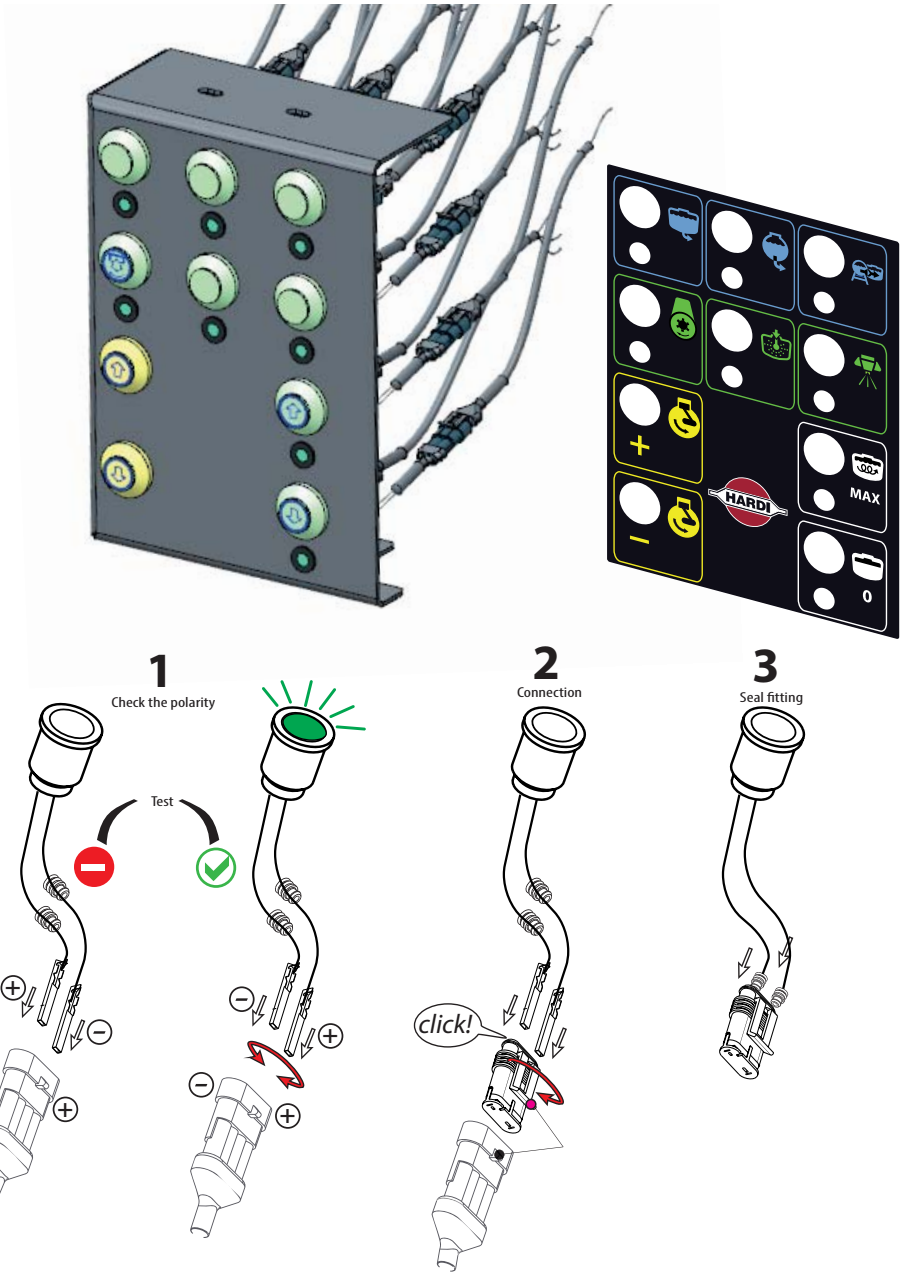
Connections of the Steer Command cable



External Control diagram



External Controls panel



Sticker replacement

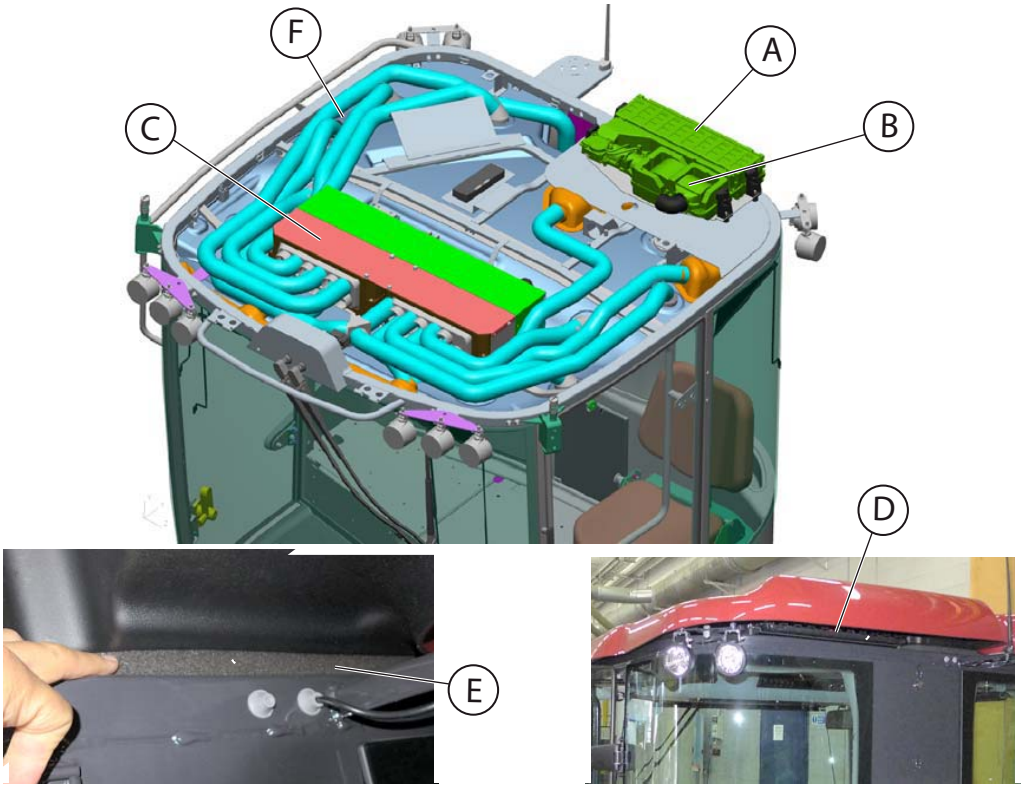
1. Remove all switches and lights from the front panel
2. Place the new sticker on the panel

Light replacement

1. Before connecting, check the polarity of the light (LED), then clip the pins into the connector

Do not connect the pins into the connector

Air filtration and conditioning system



A. Class 4 filter
B. Pressurization unit
C. Air conditioning unit
D. Air inlet to filter
E. Sealing liner
F. Cab aeration ducting

External air is sucked in through the Class 4 filter and a second anti-dust filter positioned upstream from the former (see (A) in "Air filtration and conditioning system" page 208.). The air inlet (D) is positioned under the roof in the rear part of the cab. The pressurization unit (B), composed of 2 fans and a pressure switch that measures the difference in pressure between the inside and the outside of the cab, is positioned after the filters.

This pressure difference is adapted for the adjustment of the speed of the fans and therefore the flow of external air into the cab.

The air is conditioned in the air conditioning unit (C). All the cab's openings to the outside (doors, opening roof, etc.) are equipped with sealing liners (E). The controls for the aeration system are positioned in the cab's ceiling above the driver's seat in front of the operator.

Ventilation is adjusted using the dial (F); temperature is adjusted using the dial (H).

The alarm light (I) signals:

- no overpressure: the difference in pressure between the inside of the cab and the outside is lower than 20 Pa (the value specified by Standard EN 15695).

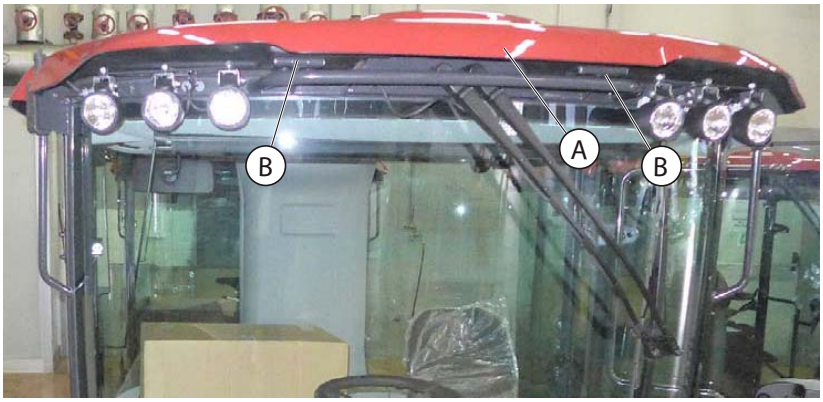
The alarm light (J) signals:

- change safety filter: the Class 4 filter has reached the end of its working life (maximum 200 hours) and must be changed.

Opening th Roof

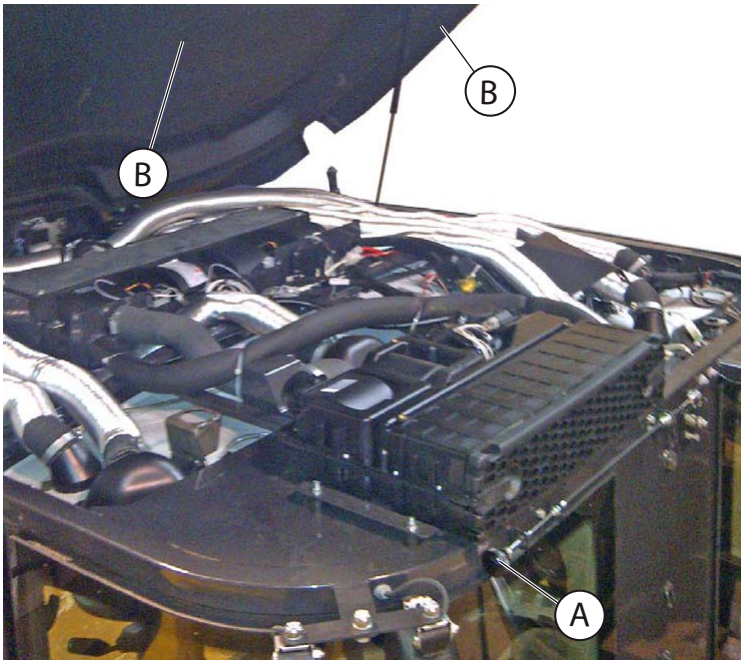
The cab's roof contains the aeration, air filtration, and air conditioning system, and the motor for the front windshield wiper. In order to access the storage compartment beneath the roof, the roof can be opened by rotating it around the two hinges positioned at the front (B in "Opening th roof" page 209.) under the thrust of the gas piston. The movement of the roof is locked by two screw knobs (C) that are released from inside the cab and by a safety locking system positioned outside the rear part of the cab.

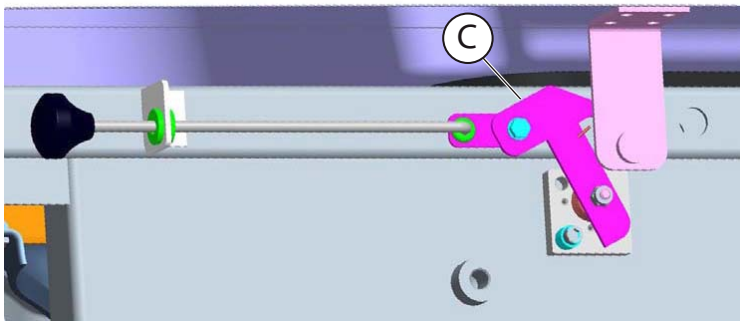
Opening th roof



A. Opening roof
B. Opening hinges
C. Roof unlocking screw knobs

Opening the roof





A. Opening knob

B. Roof

C. Roof locking clip

MAINTENANCE

General safety checks

- Make sure that the maintenance operations assigned to the operator have effectively been performed.
- Keep the driver's seat clean.
- Make sure that the doors always close correctly.
- Make sure that the sealing liners on the doors and roof are always integral, in good condition, and free from leaks.
- Always respect local regulations and the instructions provided by the manufacturer.

Cleaning of the cab

Although the cab is designed for operation in dusty surroundings, the user is urged to scrupulously respect the following general rules:

•After work has been completed, wash the windshield, the doors, and the lateral and rear windows. During such cleaning operations, the operator must use the corresponding external handles and the walkway.

- Regularly clean the entire cab, especially the driver's seat and the pedal board (removing the carpet if necessary).
- Regularly replace the aeration system's anti-dust filter, the Class 4 filter, and the internal circulation filters.

According to the provisions and specifications to be respected in compliance with the guidelines above, the following must be kept in mind:

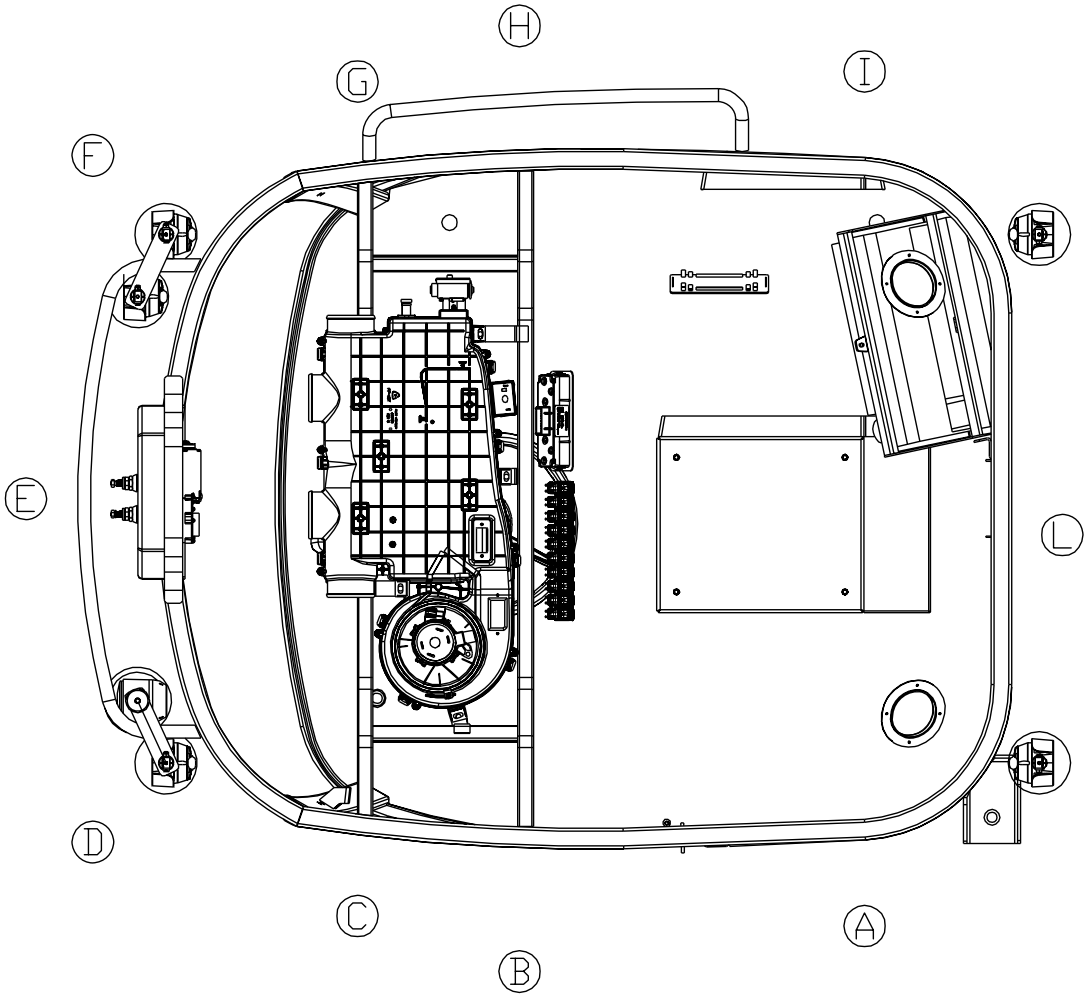
- Prior to proceeding with any type of internal and/or external cleaning operation on the cab, make sure that the engine of the agricultural vehicle has been switched off and that it cannot be accidentally re-started. Also make sure that the windshield wiper's motor has been switched off in order to avoid risk of impact with the arms and brushes.
- The Class 4 filter and the anti-dust used in the cab must be treated in accordance with the regulations in force for contaminant wastes.
- In any case, when cleaning the cab and its components, scrupulously and strictly respect all the provisions regarding safety and those that regard the use of potentially toxic/flammable/contaminating substances and the use of both safety PPE and the appropriate hoisting equipment in compliance with the regulations in force.

Scheduled maintenance

1. Changing the Class 4 safety filter - Refer to chapter "Maintenance of the combined air filter" page 226.
2. Anti-dust circulation filter cleaning
   - Remove the gratings
   - Remove the anti-dust circulation filters and clean it with a spray of compressed air. Replace the filters when necessary. (At least every two months, and under particularly dusty conditions or whenever the vehicle has traveled widely with its doors partially closed).

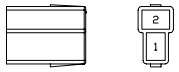
ELECTRIC CIRCUITS OF THE CABIN

Top view of the cabin

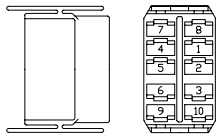


Cabin harness - list of connectors

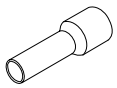
180907 RIF.01
Tyco Electronics Amp Italia S.r.l.



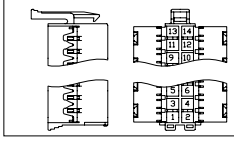
507277 RIF.02
RS Componenti S.p.A.



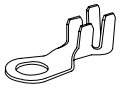
2809370 RIF-15
Cembre S.p.A.



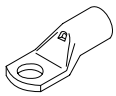
929504/5 RIF.16
Tyco Electronics Amp Italia S.r.l.



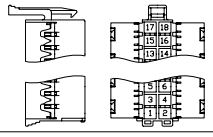
17.06710 RIF.03
MTA S.p.A.



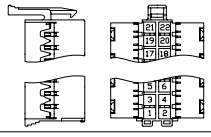
2180190 RIF.04
Cembre S.p.A.



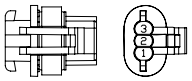
929504/6 RIF.17
Tyco Electronics Amp Italia S.r.l.



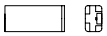
929504/7 RIF.18
Tyco Electronics Amp Italia S.r.l.



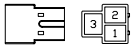
15336029 RIF.05
Power and Signal Group



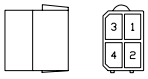
854022700 RIF.06
Inarca S.p.A.



Mikropla S.r.l.

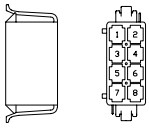


Mikropla S.r.l.

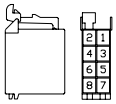


854023700 RIF.07
Inarca S.p.A.

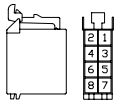
14864.562645 RIF.08
Klingel Italiana S.r.l.



962189/1 RIF.19
Tyco Electronics Amp Italia S.r.l.



962191/1 RIF.20
Tyco Electronics Amp Italia S.r.l.



1/962352/1 RIF.09
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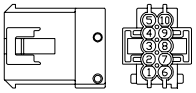
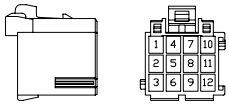
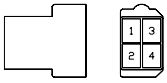


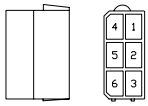
1/967622/1 RIF.10
Tyco Electronics Amp Italia S.r.l.



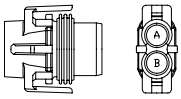
CT-1041 RIF.25
Mikropla S.r.l.



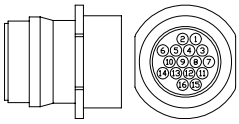
CT-1060 RIF.26
Mikropla S.r.l.



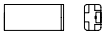
15393199 RIF.11
Power and Signal Group



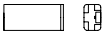
183077/1 RIF.12
Tyco Electronics Amp Italia S.r.l.



CT-1004/C RIF.21
Mikropla S.r.l.



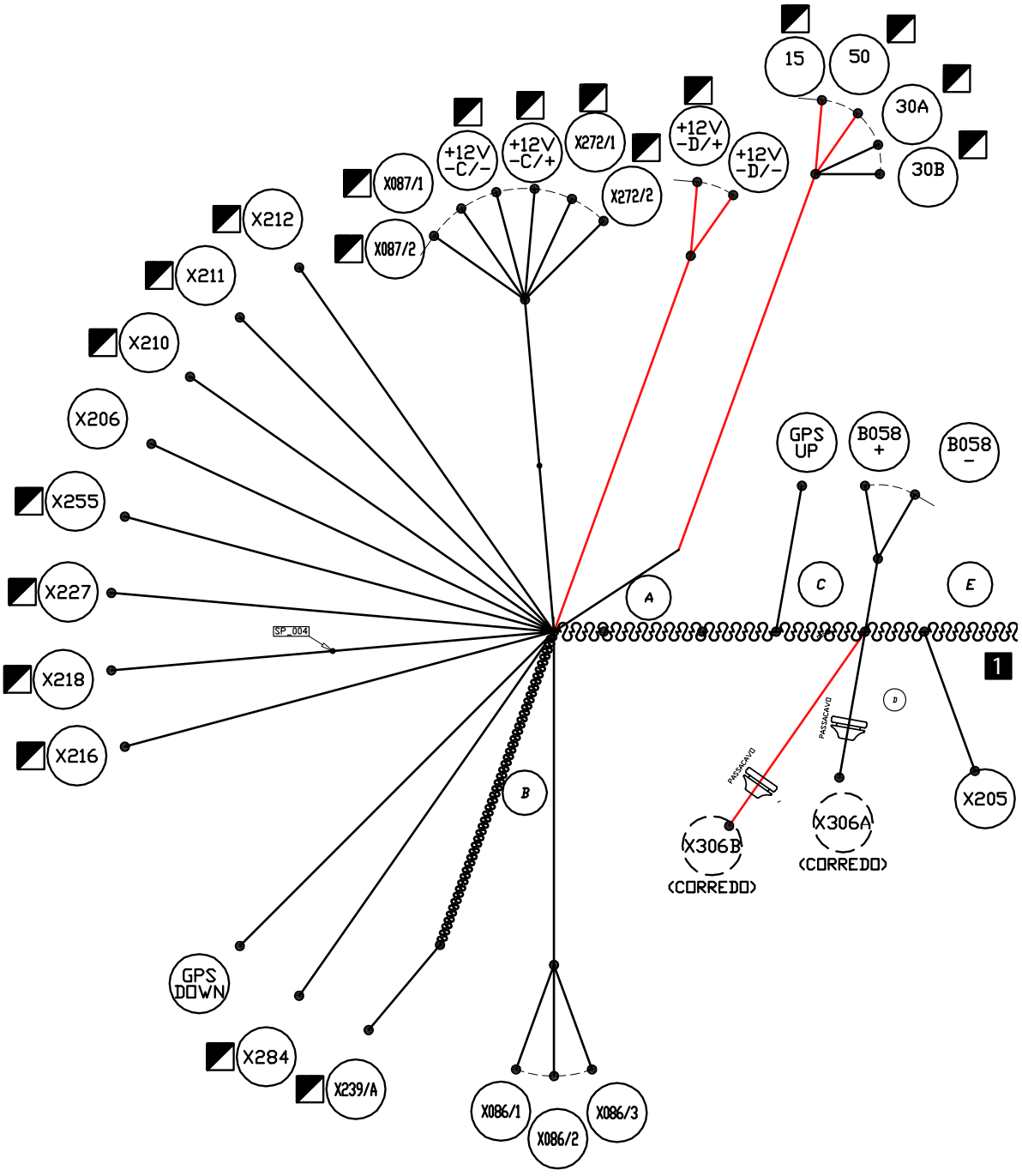
CT-1012 RIF.22
Mikropla S.r.l.



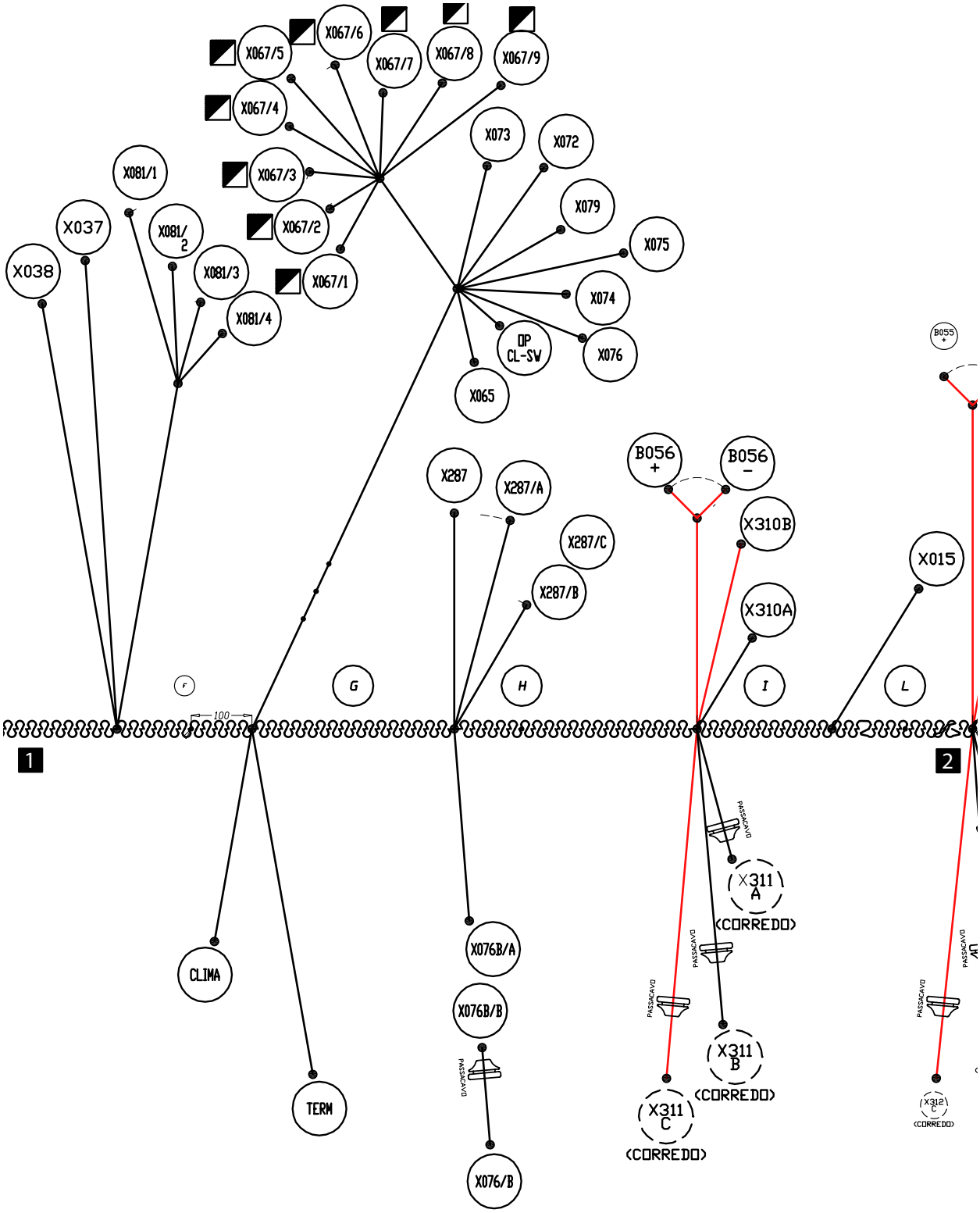
280311/0 RIF.27
Tyco Electronics Amp Italia S.r.l.

280232/0 RIF.14
Tyco Electronics Amp Italia S.r.l.

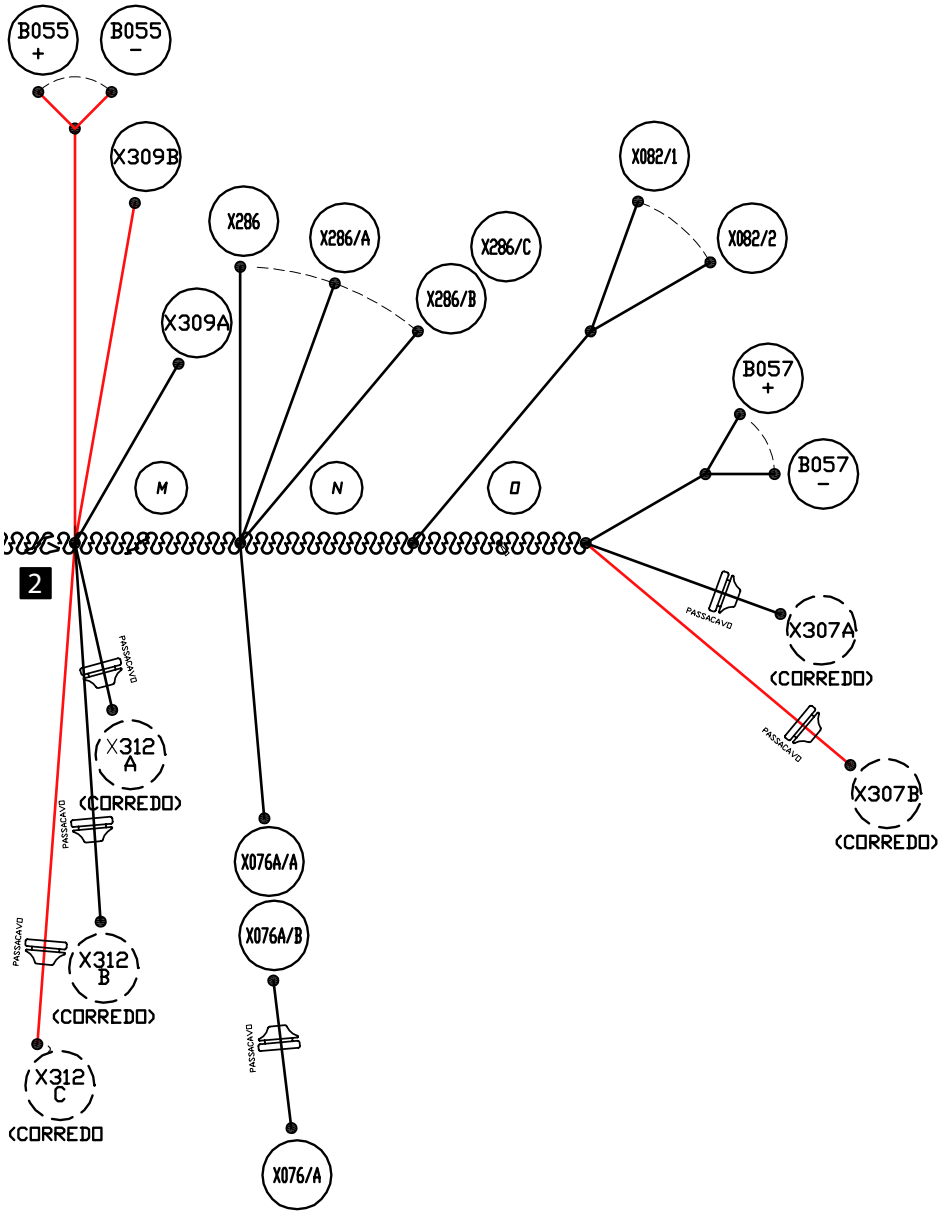
Cabin harness (1/3)



Cabin harness (2/3)



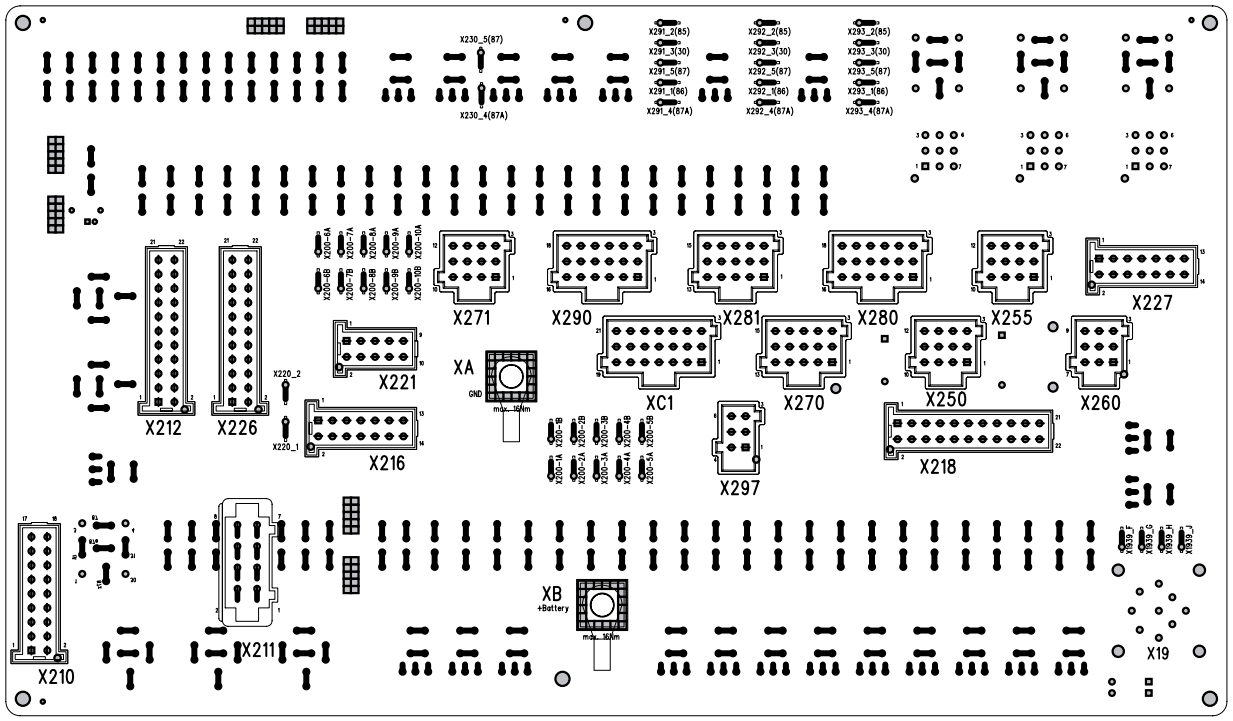
Cabin Harness (3/3)



Fuses box location

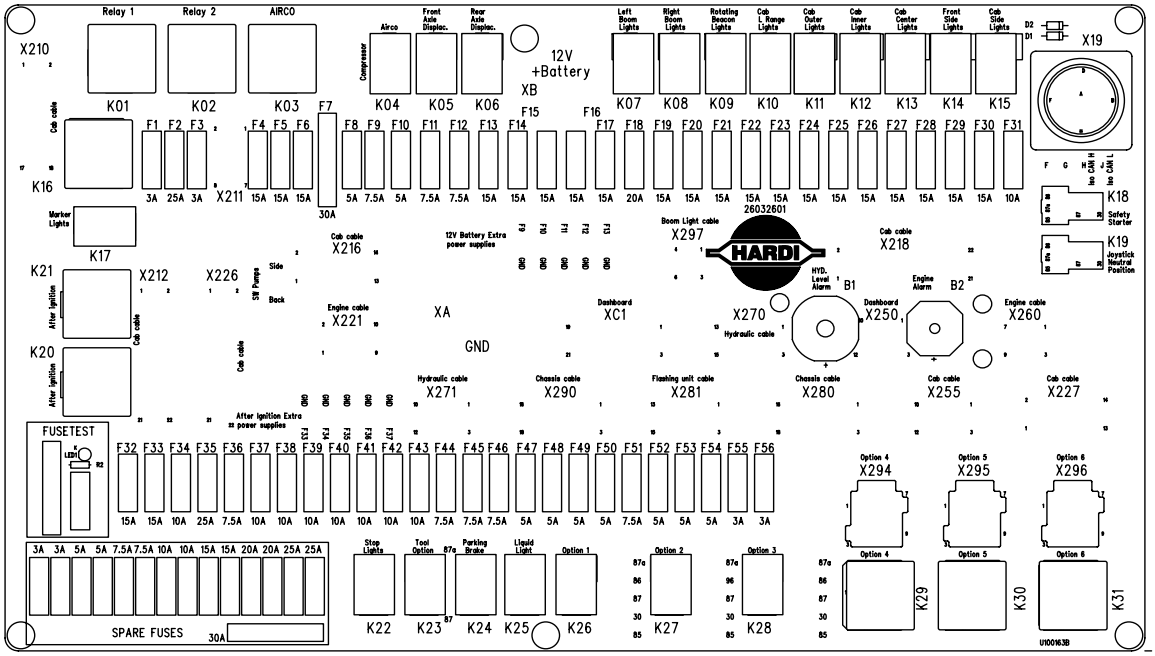
Remove the knobs (A) to access to the compartment for inspection

Main PCB power cab



X212	Cabin cable	**X280**	Chassis cable
X226	After ignition extra power supply	**X294**	Option 4
X216	Cabin cable	**X295**	Option 5
X221	Engine cable	**X255**	Cabin cable
X271	Hydraulic cable	**X227**	Cabin cable
X290	Chassis cable	**X296**	Option 6
XC1	Dashboard		
X281	Flashing unit cable		

Main circuit fuses and relays (U100163B)



F

Code		Description	Code	Amp. (A)	Description	Code	Amp. (A)	Description
F1	3.0	Outdoor cab light timer	F21	15 A	hazard lights	F41	10 A	12 V after ignition -
F2	10 A	side lights/back-lighting	F22	15 A	cigarette lighter - 12V sockets	F42	10 A	road- parking
F3	3 A	12 V BAT - ceiling	F23	15 A	seat compressor unit	F43	10 A	stop lights
F4	15 A	flasher unit - control	F24	15 A 20 A	Cab front outer halogen lights Cab front outer xenon lights	F44	7.5 A	12 V after ignition hydraulic ECU
F5	15 A	not used	F25	15.0 A	Right front cab lights	F45	7.5 A	permanent 12 V battery - console
F6	15 A	not used	F26	15 A	Cab front centre halogen lights	F46	7.5 A	12 V after ignition -hydraulic ECU
F7	30 A	12V BAT - air conditioning	F27	15 A	not used	F47	5 A	hydraulic ECU
F8	5 A	12V BAT - car radio	F28	15 A	Hood working halogen lights	F48	5 A	not used
F9	7.5 A	timer control	F29	15A 20 A	Cab front inner halogen lights Cab front inner XENON lights	F49	5 A	brake pressure - display alarms
F10	5 A	air conditioning compressor	F30	15 A	starter contact	F50	5 A	hydraulic oil level alarm
F11	7.5 A	hydraulic ECU	F31	10 A	starter solenoid	F51	7.5 A	12 V after ignition - engine error
F12	7.5 A	hydraulic ECU	F32	15 A	dipped beam	F52	5 A	12 V after ignition -HC9500 console
F13	15 A	12V BATT optional	F33	15 A	main beam headlights	F53	5 A	12 V after ignition - right and left direction indicator
F14	15 A	12V BATT - optional	F34	10 A	work area lighting (optional)	F54	5 A	12 V after ignition - cab switches
F15	15 A	12V BATT - optional	F35	15 A	windshield washer pump -Wipers	F55	3 A	12 V after ignition - air conditioning and car radio
F16	15 A	12V BATT - optional	F36	7.5 A	horn	F56	3 A	12 V after ignition - J1939 diagnostic socket
F17	15 A	12V BATT - optional	F37	10 A	12 V after ignition			
F18	20 A	flasher unit	F38	10 A	12 V after ignition - optional			
F19	15 A	boom lights 1 and 2 (HC9500 only)	F39	10 A	12 V after ignition - optional			
F20	15 A	boom lights 3 and 4 (HC9500 only)	F40	10 A	12 V after ignition - optional			

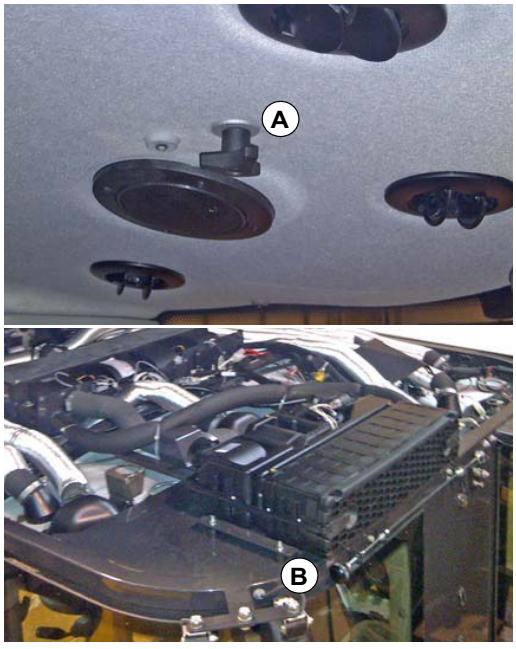
Always use the appropriate fuse listed in the table located in the fuses box.

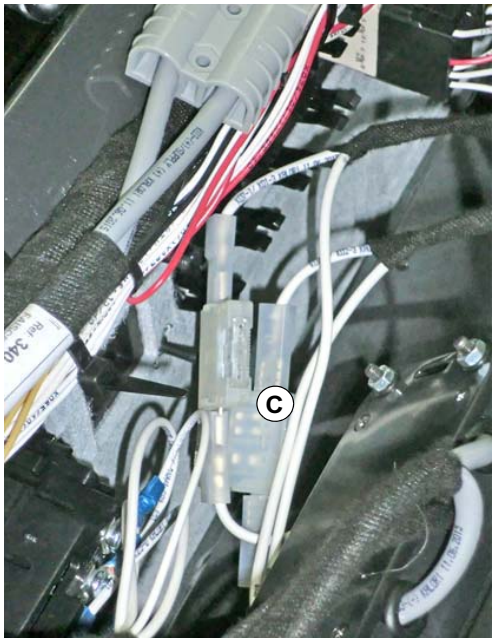
Relays	Description	Relays	Description
K01	not used	K16	not used
K02	not used	K17	back-lighting - side lights
K03	air conditioning power	K18	engine starter control
K04	air conditioning compressor	K19	forward handle neutral position
K05	Not used	K20	circuit control after contact
K06	Not used	K21	circuit control after contact
K07	HC9500 only (boom lights 3 and 4)	K22	BRAKE lights
K08	HC9500 only (boom lights 1 and 2)	K23	ROAD mode
K09	hazard lights	K24	parking brake
K10	not used	K25	work area lighting (optional)
K11	right rear cabin lights	K26	not used
K12	left rear cabin lights	K27	not used
K13	not used	K28	not used
K14	front cabin lights		
K15	Front side of the cab lights		

HVAC - Air conditioning unit fuses

Refer to the chapter "HVAC - Air conditioning unit fuses" page 235.

Fuse in the area under the roof



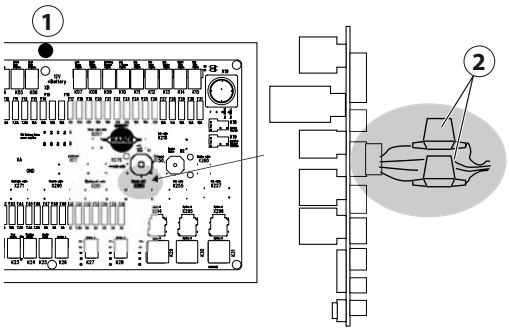


- Remove the roof unlocking knobs (A) and pull the opening knob (B) to open the roof.
- Change the fuse (25A) which is located near the A/C control unit.

Position lights fuses

2 fuses are placed at the rear of the main printed circuit to protect the lighting circuit (position lights).

- Remove the screw (1) and rock the main printed circuit to access the fuses.
- Check and replace the defective fuse (7.5 A).



Spare fuses are available on the main printed circuit.

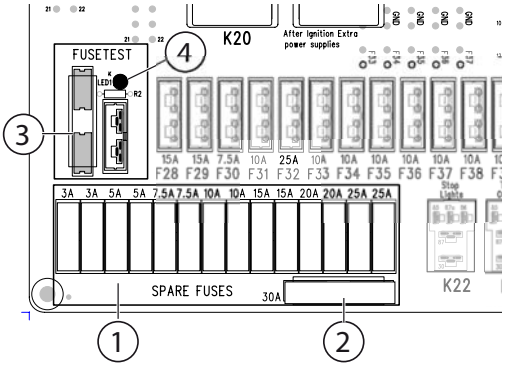
ATTENTION! Ensure that the replacement fuse has the same capacity as the original fuse.

Fuse test

The main circuit has **"**Automotive**"** type spare fuses (1)and a "Maxi-fuse" (2).

To test a fuse.

- Remove the fuse to be checked and place it in the fuse holder (3) according to the model.
  If the indicator (4) lights up, this means that the fuse is in good working order. If not, use an "Automotive" (1) or "Maxi-fuse" (2) replacement fuse.



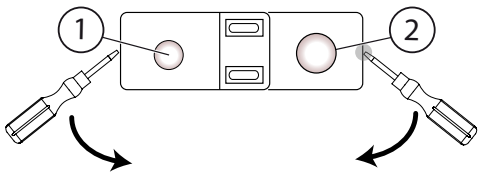
ATTENTION! Ensure that the replacement fuse has the same capacity as the original fuse.

Cabin lighting

Interior cab lighting

To replace a bulb:

- Use a screwdriver and remove the cover.
- Replace the bulb.



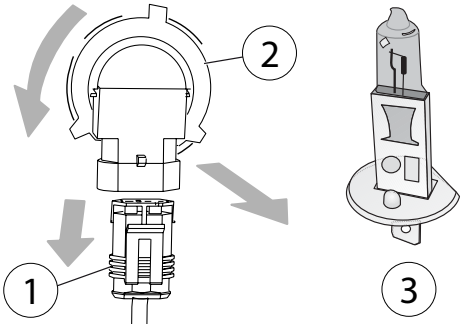
bulb 12 V - 10Watt

bulb 12 V - 21Watt

Working lights

ATTENTION! Before changing the bulb, ensure that the component is disconnected and wait for the bulb to fully cool down in order not to burn yourself.

- Disconnect the connector (**1**).
- Turn the base (**2**) counter-clockwise.
- Replace the bulb.

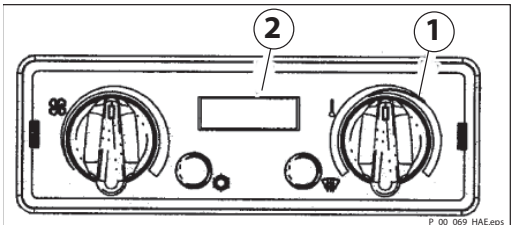


Halogen bulb (**3**): H1 - 12 V - 55W.

ATTENTION! Never touch the halogen bulb directly with the fingers but hold it with a soft cloth.

Cabin ceiling controls

Control Module of the ATC air conditioning



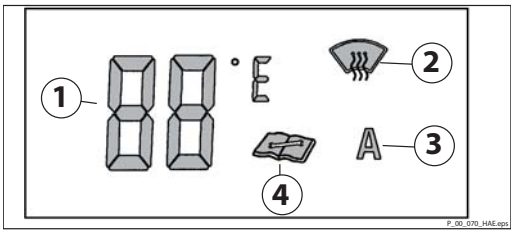
Automatic Temperature Control (ATC)

A. Temperature control in the cab

- Turn the temperature control dial (1) clockwise to increase the temperature, or counter-clockwise to lower the temperature in the cab.

B. ATC Display (2)

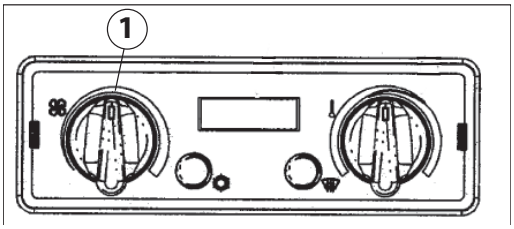
The ATC display allows you to view the following information:



- The desired cab temperature (1) in degrees Fahrenheit or Celsius. To change between F. and C., see "Selection of temperature unit" on page 4.3.
- Symbol (2) is displayed when window de-fogging is in operation.
- The mode of operation. Symbol 'A' (3) indicates that the system is in automatic mode. In this mode, fan speed and heating/cooling are controlled automatically to maintain the desired temperature. When the letter 'A' is not displayed on the screen, the fan speed is controlled manually.
- Symbol (4) is displayed when there is a fault in the operation of the ATC system. A diagnostic code linked to the fault will be shown in the display.
- The ATC operates in the temperature range between 60° F. (16 °C.) and 90° F. (30 °C.).

Note: Symbol (3) is not displayed when the programmed temperature is minimum or maximum.

Fan Speed Control



You can increase or reduce the air flow by turning the fan speed dial (1).

- Turn the fan speed dial (1) clockwise to increase the air flow from the vents placed at the top of the cab.
- Turn the fan speed dial (1) counter-clockwise to decrease the air flow from the vents placed at the top of the cab.

Note: If necessary, the automatic control of the air conditioning (ATC) will vary the speed of the air flow to maintain the required temperature in the cab.

If you turn the fan speed dial (1) while the ATC mode is engaged, the ATC mode will disengage. The symbol 'A' disappears and the fan speed is manually controlled by the fan speed dial (1).

To reengage the ATC mode, you need to toggle the ATC switch OFF and then back ON to reset the automatic mode. The automatic temperature control works whether the symbol 'A' is displayed or not.

When the automatic air conditioning function or defogging is in operation, the ventilation increases to obtain a temperature difference of 2 °F between the set temperature and that measured in the cab.

When the evaporator sensor reads a temperature below 80°F (26 °C) and the system requests heat, the fan speed does not increase as long as the temperature of the sensor doesn't increase.

Cabin error codes

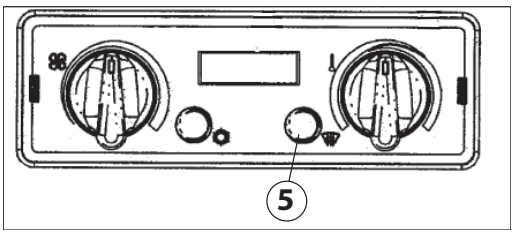
ERROR #	Description	Fault operation
01	High pressure switch - Wiring or cycling 2 in 1 minute	Heat mode - compressor clutch disabled
02	Low pressure switch - Wiring or open for 1 minute	Heat mode - compressor clutch disabled only while low pressure switch is open
03	Blower speed select pot open/shorted to power	Auto blower speed
04	Temperature select pot open/shorted to power	72°F Set point
05	Recirc. pot open/shorted to power	Not used on combine
06	Mode select pot open/shorted to power	Not used on combine
07	Cab temp sensor wiring - open, short, ground, power	Manual mode - compressor clutch disabled
08	Evap. temp sensor wiring - open, short, ground, power	Heat mode - compressor clutch disabled
09	Outlet temp sensor wiring - open, short, ground, power	Doesn't limit blower speed on startup
10	Outside temp sensor wiring - open, short, ground, power	Not used on combine
12	Cab pressure sensor wiring	Not currently implemented
14	Clutch output fault (overcurrent, short to ground)	Not currently implemented
15	Defog light output fault (overcurrent, short to ground)	Not currently implemented
15	Defog light output fault (overcurrent, short to ground)	Not currently implemented

The messages below will be displayed when a fault appears on the system of the cab's air conditioning.

List of error codes

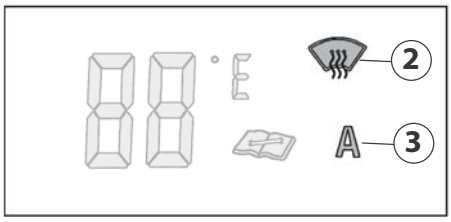
Selecting ATC mode

Once you have activated the ATC mode, you can press switch (5) to switch between the AUTO mode and the defog mode.



In defog mode, the air conditioning compressor operates full-time, and the air is warmed up to promote the defogging of the windows. In this mode, the display indicates symbol (2).

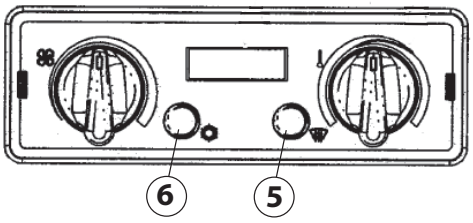
In AUTO mode, the system heats or cools the air to maintain the desired temperature in the cab. In this mode, the display shows the symbol 'A' (3).



Window defogging

The window defogging mode uses the air conditioning to reduce the moisture in the air for the purpose of drying the windows of the cab.

- Press switch (6) to activate the AUTO mode.
- Toggle switch (5) to display the defog symbol (2).



The temperature control dial can be adjusted to the desired value. If the temperature of the air in the cabin is too cold, the temperature control dial can be rotated in a clockwise direction to increase the temperature. The temperature in the cab is controlled by a probe measuring the recycled air, while maintaining the temperature requested by means of a heater valve. During the operation of defogging the windows, the a/c compressor is running continuously, unless the evaporator probe detects that it is too cold, which may result in the formation of ice.

The computer of the ATC automatically regulates the speed of the fan to maintain the required temperature in the cab. It is normal that the temperature of the air at startup is colder, caused by the engine being cold. If you reduce the fan speed, during the heating of the engine, the computer of the ATC will disable the automatic mode of the fan speed. To re-engage the automatic mode of the fan speed, the switch of the ATC (6) must be toggled off, then back on to reset the automatic mode.

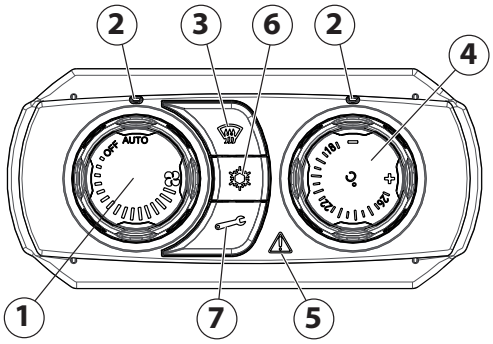
Operational problems

An error code is displayed if a malfunction is shown on the air conditioning system. For more information on the errors, see "Cabin error codes" on page 7.1.

Air conditioning controls

Description of Controls

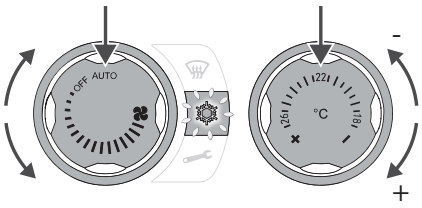
1. Fan control
2. Indicator light (index). Always on
3. Defrost
4. Temperature setting
5. Warning light
6. Air Conditioning
7. Pressurization maintenance



CABIN - Air Conditioning

AUTOMATIC Mode

- Turn the control knob (**1**) to **AUTO**. The air conditioning light (**6**) will come on
- Turn the control knob (**4**) to the desired temperature The fan speed will adjust depending on the selected temperature.



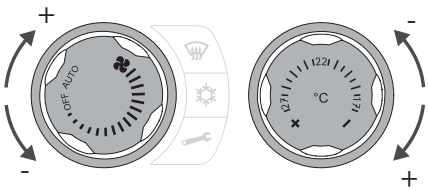
DEFROST Mode

- Push the defrost button (**3**) and light (**6**) will come on.

The air conditioning, heating and maximum fan will come on.

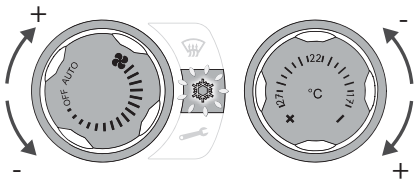
HEATING Mode

- Turn the temperature control knob (**4**) to set the temperature
- Select the fan speed (**1**)



AIR CONDITIONING (AIRCON) Mode

- Use knob (**4**) to set the minimum target temperature
- Press the air conditioning button (**6**). The light will come on.
- Control the fan speed by turning knob (**1**)



K PROTECT Pressurization

The control panel comes with firmware that controls the cabin pressure. The firmware verifies and maintains.

- a minimum pressure air flow of 39 yard^3/hour (30 m^3/hour)
- a cabin pressure higher than 23 Pa

If the warning light ⚠ comes on, it means that the cabin pressure in the cabin is too low. To fix the problem, see chapter "Maintenance of the combined air filter" page 226

Combined air filter usage

The warning light will light after 250 hours of use to indicate that it is necessary to replace the combined air filter.

Non Category 4 Usage

If you use a configuration with a non category 4 filter, the warning light will remain on.

Storing the combined air filter

For long lasting performance, only use the filter during the spraying period. Store it carefully after use into hermetic packaging.

Maintenance of the combined air filter

WARNING! Replacing the safety filter when necessary is essential in protecting the operator's health

WARNING! Never exceed the duration of the filter's specified working life. The frequency of replacement is given for information purposes. However, if bad odors would appear in the cab, that would mean that the filter is no longer completely effective, it must be replaced in the shortest time possible, to avoid any risk of contamination.

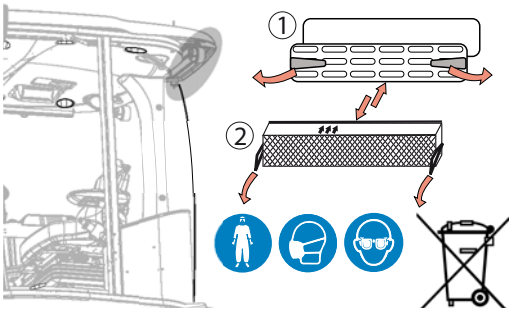
The indicator warning light will come on after 250 hours of operation with a category 4 combined air filter.

Strictly follow instructions: do not blow, do not wash, and do not open the filter. For a long lasting performance, only use the filter during the spraying period.

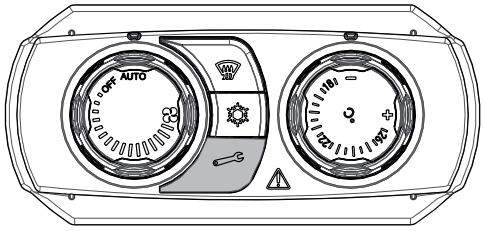
Store it carefully after operation into hermetic packaging.

Use only an genuine category 4 combined air filter

- Unlock the 2 latches and pull and remove the filter cover (**1**) from the K-Protect pressurizer.
- Simultaneously pull the two strips of the filter and extract it.
- Install the filter (**2**) following the arrow directions.



ATTENTION! If you use a non combined air filter (category 4) the warning light will remain on.



- Once the combined air filter has been changed, press and hold the button for 3 seconds to reset the indicator light.

FUNCTIONALITY TEST - TESTING THE SPECIFIED STATUS OF THE FUNCTIONS

Pressurizer maintenance instructions

The control panel features a warning light (**5**) that indicates a problem with cabin pressure.

Follow the instructions below to troubleshoot.

If a problem persists, contact your dealer.

Symptom	Cause	Solution
The pressurizer fan doesn't work	Power supply	Connect the pressurizer directly to a power supply If the problem persists, replace the pressurizer
The pressurizer fan works but the ⚠ light is on	Category 4 filter is missing	Make sure a category 4 filter is installed in the pressurizer Install a filter if necessary
	Cabin door is open or not properly close	Close the cabin door
	Air diffuser is closed or blocked	Check and open the diffusers.
	Cabin is not sealed	Check that the roof panel is firmly closed Check the seals on the cabin door Replace if necessary
	Door adjustment	Check the adjustment of the cabin openings
	Cabin pressure sensor	Check and replace the pressure sensor if necessary
	Air flow sensor	Check and replace the air flow sensor if necessary

Air conditioning maintenance

The ⚠ light can indicate a problem with the control panel or electrical system.

Light Status ⚠	Cause
Steady light	Problem with cabin pressurization
Blinking 1 time / 2 seconds	Overheating of the control panel or electrical short circuit. Check the electrical circuit (cable harness, fuses and relays). Measure the electricity consumption of the K Protect air conditioner and pressurizer).
Blinking 1 time / 4 seconds	Temperature sensor default Check the connection of the probes.

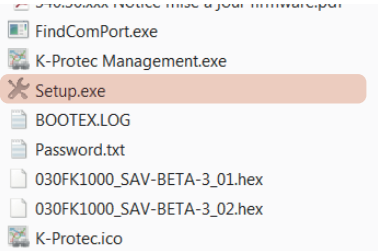
PC -K MANAGEMENT SOFTWARE

Software installation

The PC-K can be connected to a computer using the USB port located behind the front cover.

The PCK Management software allows you to diagnose problems and configure settings

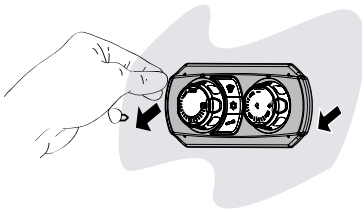
- Click on **Setup.exe** and follow the instructions to install K Protect Management software on the computer.



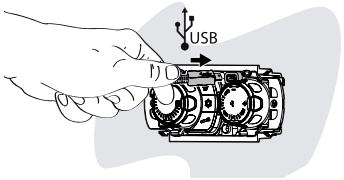
Use only the original USB bar supplied by the manufacturer Kalori

Connect the USB to the Panel Control

- Remove the cap with a paper clip



- Connect the USB cable to the panel control and your computer



"Calibration of the ventilation and temperature buttons" page 231

Operating the K-protect Management

Use the K-Protect software

To use the K-protect management you need:

- The USB key Manager p/n 340.30.249 (provided from the manufacturer).
- Enter the administrator password: COMPACT

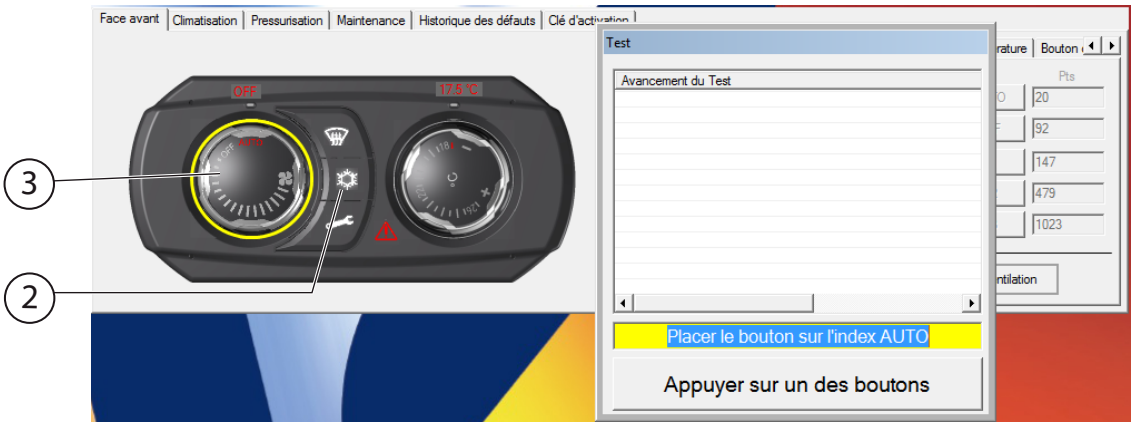
Main menu description

1. Software version
2. Firmware version
3. USB connection
4. Choose your language: French or English
5. Firmware model

Calibration of the ventilation and temperature buttons

Calibrate the ventilation button

- Click on tab (1) **Front Panel**
- Click on tab (2) **Calibrate ventilation button**



- Turn knob (3) to **AUTO**
- Press any button (e.g. button (2)) to continue

- Turn knob (3) to **OFF**
- Press any button (e.g. button (2)) to continue

- Turn knob (3) to **V1**
- Press any button (e.g. button (2)) to continue

- Turn knob (3) to **V2**
- Press any button (e.g. button (2)) to continue

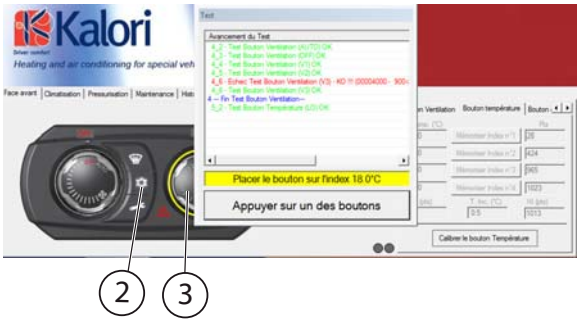
- Turn knob (3) to **V3**
- Press any button (e.g. button (2)) to escape

Calibrate the temperature button

- Click on tab (1) **Front Panel**
- Click on tab (2) **Calibrate temperature button**

- Turn knob (3) to **LOW (59°f) (15°c)**
- Press any button (e.g. button (2)) to continue

- Turn knob (3) on position **64°f (18°c)**
- Press any button (e.g. button (2)) to continue



- Turn knob (3) on position **71°f (22°c)**
- Press any button (e.g. button (2)) to continue

- Turn knob (3) on position **79°f (26°c)**

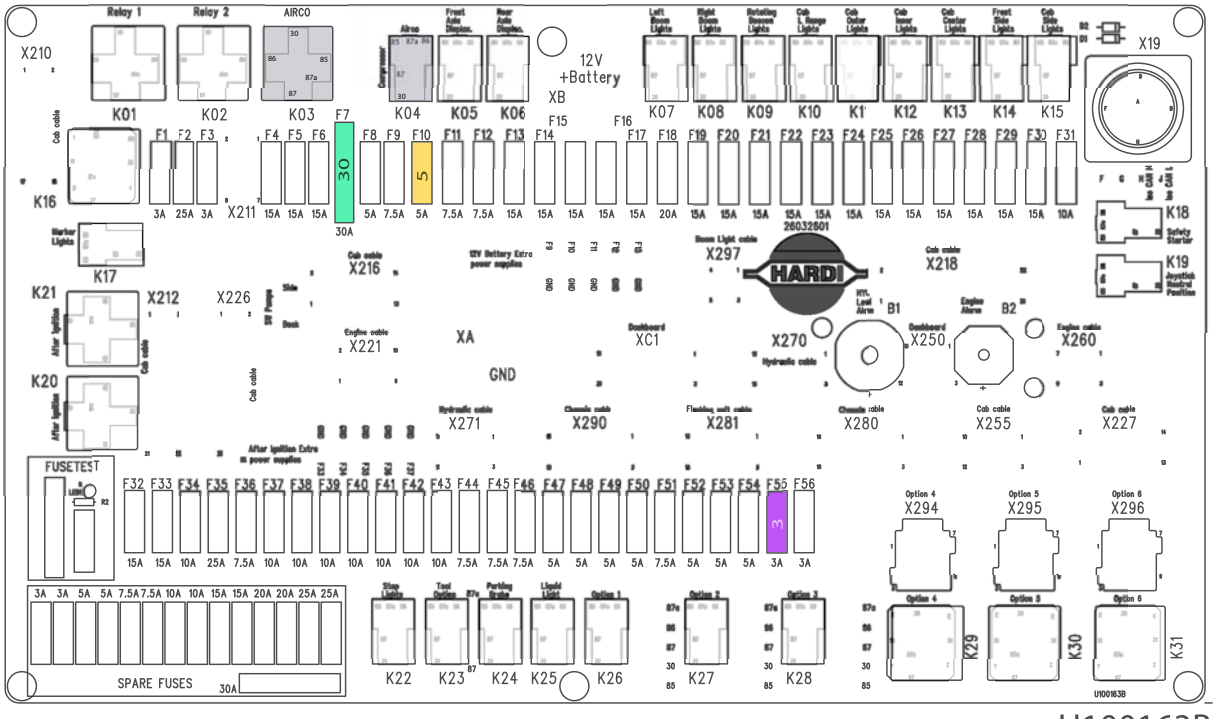
Press any button (e.g. button (2)) to continue

- Turn knob (3) on position **84°f (29°c)**
- Press any button (e.g. button (2)) to escape.

CABIN - Air Conditioning

A/C ELECTRIC CIRCUITS

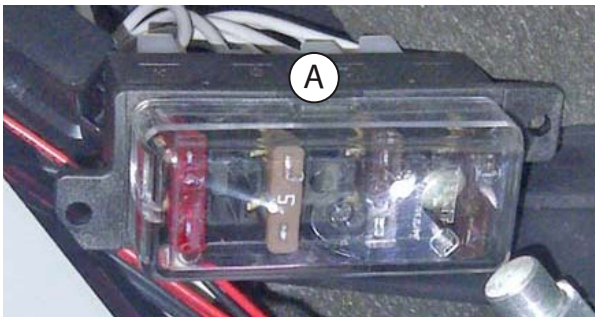
Air conditioning - Fuses table

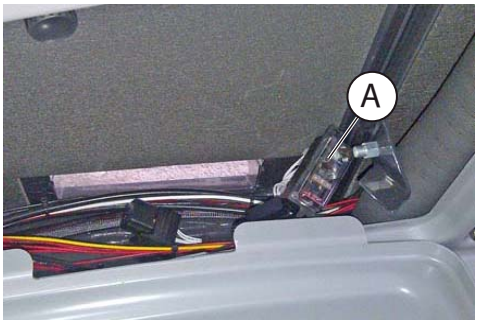


No	Amp (A)	Fuse description	No	Relay description
F7	30 A	12V BAT - A/C	K03	A/c Power supply
F10	5A	A/C compressor	K04	A/C compressor
F55	3A	12V BAT - ignition		

HVAC - Air conditioning unit fuses

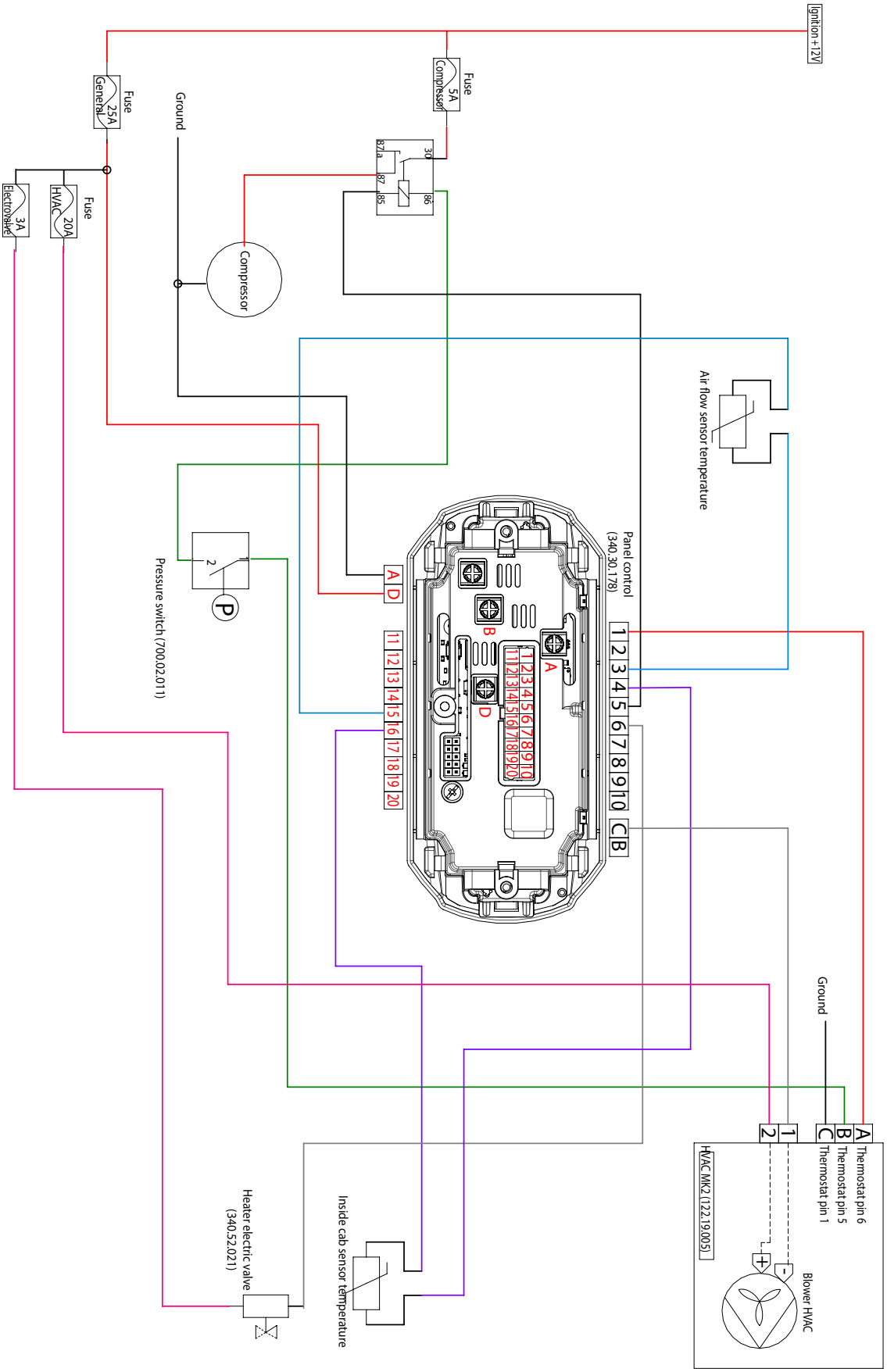
The Heating, Ventilation Air conditioning (HVAC) fuses are located at the rear of main box fuses



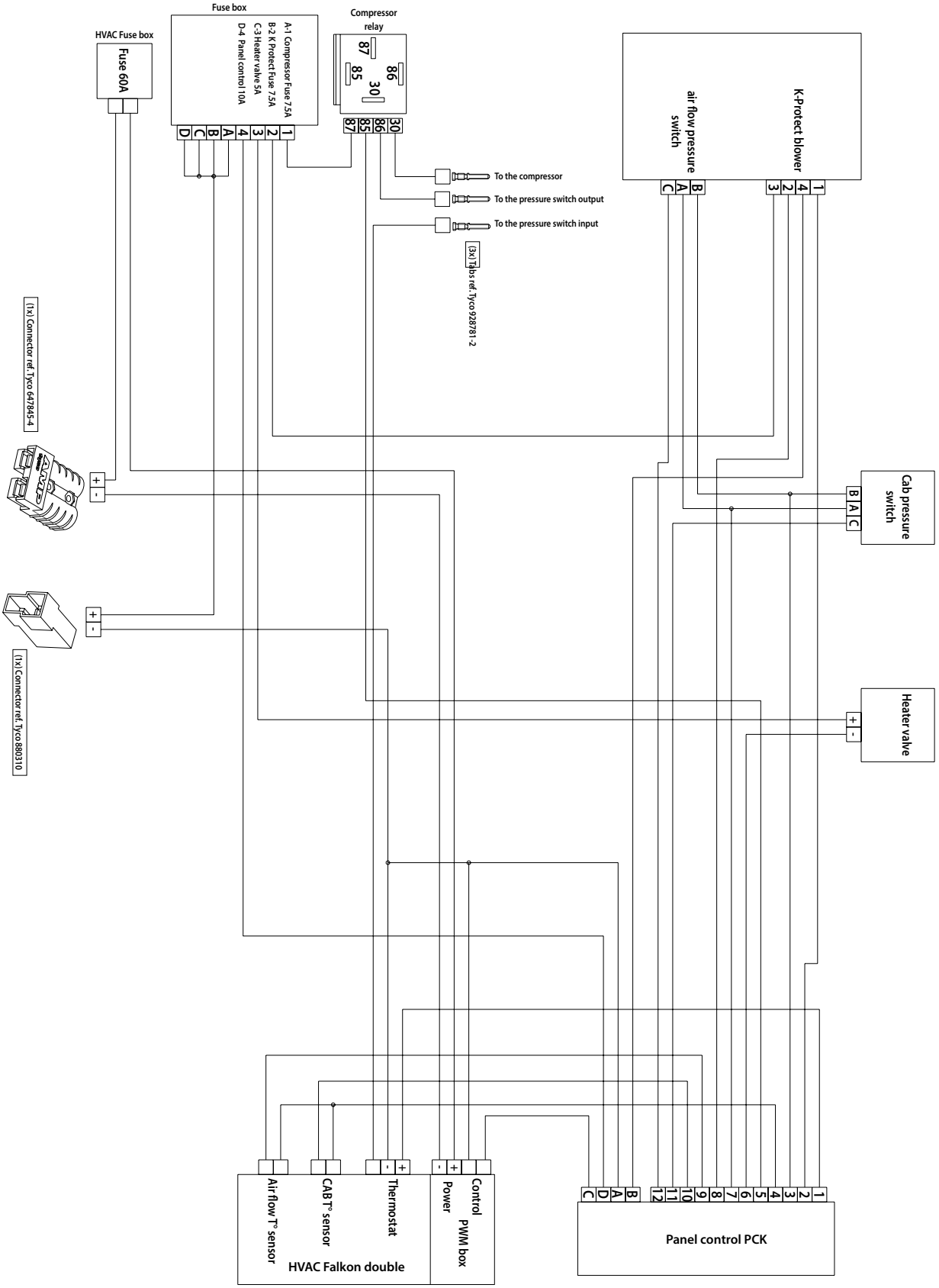


Protected device	Fuse value	Inlet connection	Outlet connection
Compressor	7,5 A	K27-1	K21-A
K Protec pressurization unit	7,5 A	K22-2	K24-B
Heating solenoid valve	5 A	K23-2	K28-C
PCK	10 A	K26-4	K25-D

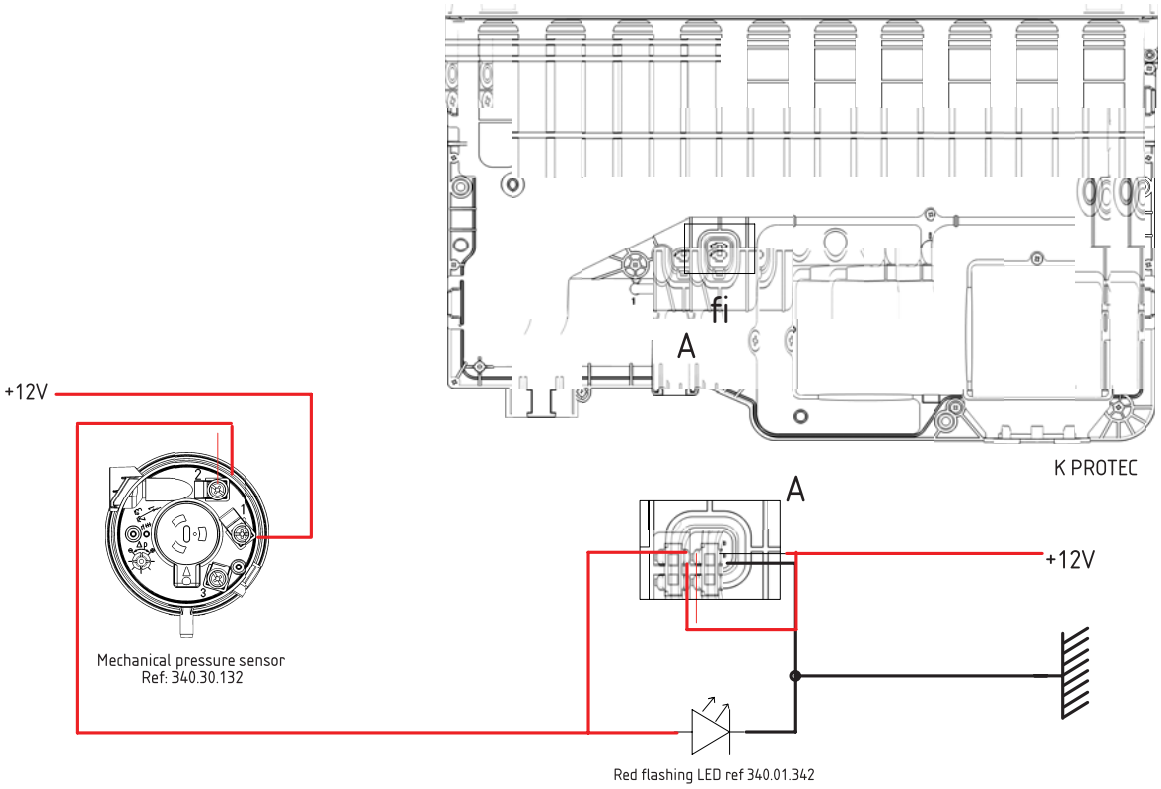
Air conditioning - Electrical diagram



Electrical diagram - harness



K-Protect Electrical diagram

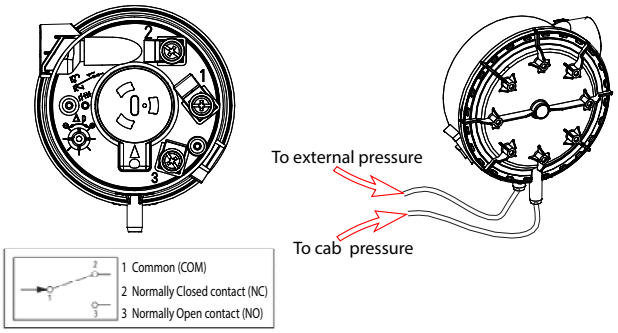


COMPONENTS AND PROBES SPECIFICATIONS

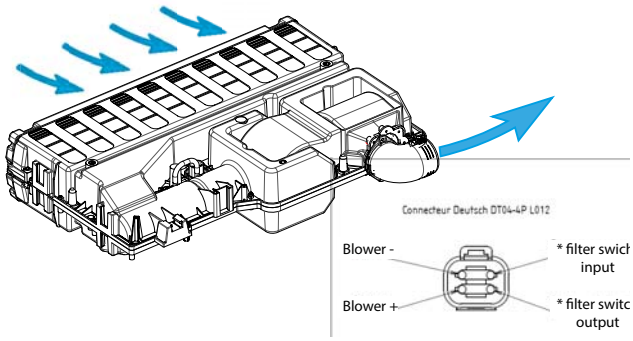
This section describes the main components of the HVAC system

Differential pressure switch

This sensor is connected to the K-Protect system and measures the differential pressure between the exterior and the interior of the cab



K-Protect module for category 4 filter



(*) The switch is connected with a category 4 filter

Binary Pressure Switch

The binary switch is fitted on the dehydrator filter

(see chapter "Dehydrator filter" page 241

Female thread = 7/16"-20UNF (1/4" SAE)

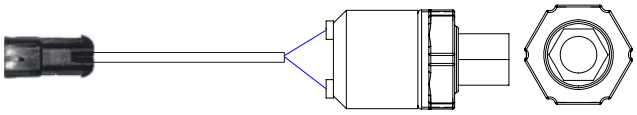
Connector = METRIPACK 280

Low Pressure Closes = 33 - 39.16 PSI

Low Pressure Opens = 14.5 - 20.3 PSI

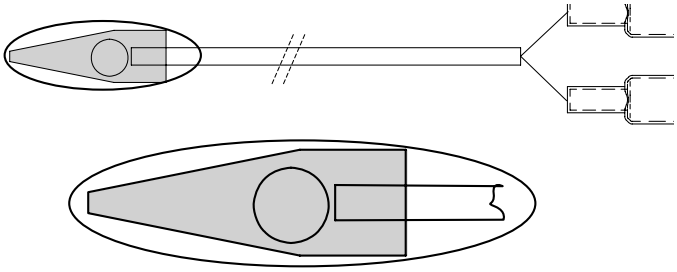
High Pressure Closes = 232 - 261 PSI

High Pressure Opens = 319 - 377 PSI



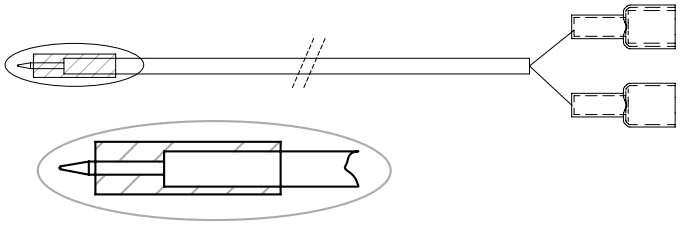
Interior cab temperature probe

Resistance (77°f) (25°Celsius): 10k ohm +/- 1%



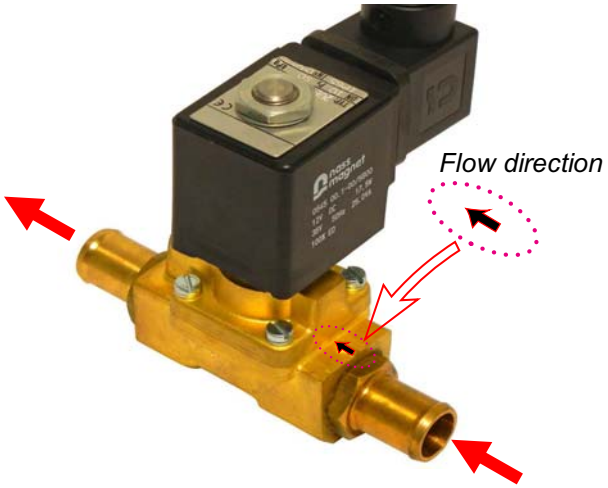
Air mixing probe

Resistance (77°f) (25°Celsius): 10k ohm +/- 1%



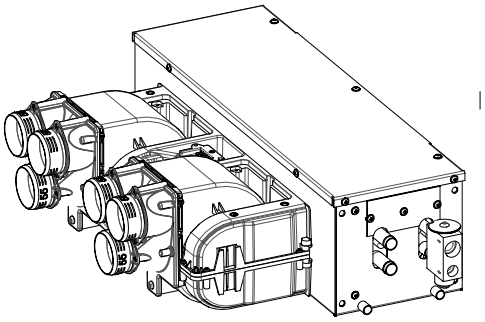
Heating solenoid valve

When the heating solenoid valve is replaced, respect the flow direction



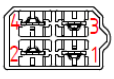
Heating Ventilation Air Conditioning - HVAC

	Amp (A)
Cooling power	8kW
Heating power	840m^3/h
Air flow	Ø16
Water connect	10
Speed ventilation	3 or PWM
Electric consumption	360W
Input voltage connect	12V



Connecteur / Connection

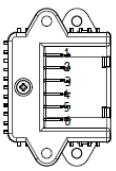
Blower connection Connector AMP 180 901-0



With resistor
1/ Ground
2/ Low speed
3/ High speed
4/ Medium speed

With PWM
1/ - PWM
2/ Not used
3/ + PWM
4/ Not used

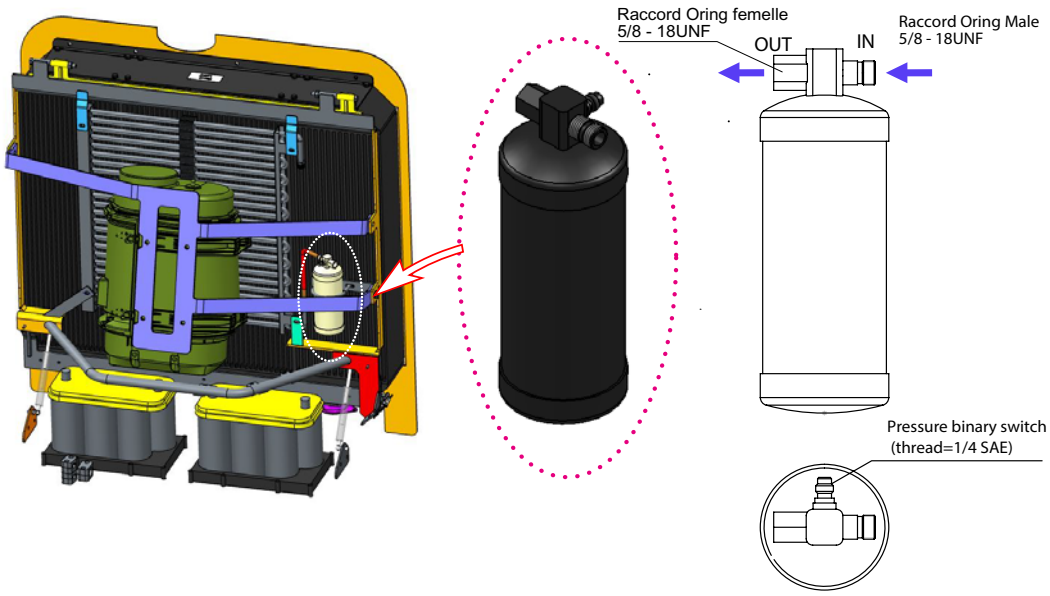
Thermostat Plug with faston clip 4.8



1/ Ground
2/ Icing sensor
3/ Icing sensor
4/
5/ AC output
6/ + 24V

Dehydrator filter

(New Cab)



(Old Cab)

TECHNICALS SPECIFICATIONS

Refrigerant	R134a
Oil for compressor	PAG (polyalkylene glycol)
Vacuum delay	90 min
Vacuum delay	90 min
Gas pressure	30.45 PSI (2.1 bar)

Warranty policy and conditions

HARDI® NORTH AMERICA INC. , 1500 West 76th Street, Davenport, Iowa, USA hereinafter called "HARDI®", offers the following limited warranty in accordance with the provisions below to each original retail purchaser of its own manufacturer, from an authorized HARDI® dealer that such equipment is at the time of delivery to such purchaser, free from defects in material and workmanship and that such equipment will be warranted for a period of one year from the time of delivery to the end user, providing the machine is used and serviced in accordance with the recommendations in the Operator's Manual and is operated under normal farm conditions.

HARDI®'s extended standard 3 year warranty and optional 5 year warranty is underwritten by Ag Guard, 21295 Hollingsworth Road, Tonganoxie, KS 66086, AgGuard.com. All warranty decisions after the first year are at the sole discretion of Ag Guard.

Standard 3 year and optional 5 year self-propelled warranty.

POWER TRAIN covers components that produce, transmit or control engine horsepower for propelling the machine (e.g. engine, engine electronic controls/sensors, turbo, water pump, fuel injection, drive-line couplers/shafts, U-joints, transfer gears, differential, transmission, final drives, axles, hydro, creeper, PTO, etc.).

POWER TRAIN + HYDRAULIC SYSTEMS includes Power train coverage plus hydraulic systems, parts and components associated with steering and implement control (e.g. tanks, pumps, coolers, motors, controls, sensors, valves, cylinders, accumulators, hoses/lines, couplers, swivels, filter bases, etc.).

POWER TRAIN + HYDRAULIC SYSTEMS + PLATFORM includes Power train + Hydraulic Systems coverage plus additional mechanical, electrical and structural components..

Model	Coverage	Terms	Hours	Deductible
Alpha	PT & Hydraulics	3 Years	1,000	$500.00
Alpha	PT & Hydraulics	5 years	2,000	$500.00
SARITOR	PT & Hydraulics	3 years	1,000	$500.00
SARITOR	PT & Hydraulics	5 Years	2,000	$500.00
PRESIDIO	PT & Hydraulics	3 Years	1,000	$500.00
PRESIDIO	PT & Hydraulics	5 Years	2,000	$500.00

1. This limited warranty is subject to the following exceptions:

   a)Parts of the machine not manufactured by HARDI®, (i.e. engines, tires, tubes, electronic controls and other components or trade accessories, etc.) are not covered by this warranty but are subject to the warranty of the original manufacturer. Any claim falling into this category will be taken up with the manufacturer concerned.

   b)This warranty will be withdrawn if any equipment has been used for purposes other than for which it was intended or if it has been misused, neglected, or damaged by accident, let out on hire or furnished by a rental agency. Nor can claims be accepted if parts other than those manufactured by HARDI® have been incorporated in any of our equipment. Further, HARDI® shall not be responsible for damage in transit or handling by any common carrier and under no circumstances within or without the warranty period will HARDI® be liable for damages of loss of use, or damages resulting from delay or any consequential damage.

2. We cannot be held responsible for loss of livestock, loss of crops, loss because of delays in harvesting or any other expense or loss incurred for labor, supplies, substitute machinery, rental for any other reason, or for injuries either to the owner or to a third party, nor can we be called upon to be responsible for labor charges, other than originally agreed, incurred in the removal or replacement of components.

3. The customer will be responsible for and bear the costs of:

   a)Normal maintenance such as greasing, maintenance of oil levels, minor adjustments including the boom.

   b)Transportation of any HARDI® product to and from where the warranty work is to be performed.

   c)Dealer travel time to and from the machine or to deliver and return the machine from the service workshop for repair unless otherwise dictated by state law.

   d)Dealer traveling costs.

4. Parts defined as normal wearing items, (i.e. Tires, Valves and O-rings) are not in any way covered under this warranty.

5. This warranty will not apply to any product which is altered or modified without the express written permission of the HARDI® Service and Engineering Departments and/or repaired by anyone other than an Authorized HARDI® Dealer.

6. Warranty is dependent upon the strict observance by the purchaser of the following provisions:

   a)That this warranty may not be assigned or transferred to anyone.

   b)That the Warranty Registration Certificate has been correctly completed by dealer and purchaser with their names and addresses, dated, signed and returned to the appropriate address as given on the Warranty Registration Certificate within 30 days of delivery to the purchaser.

   c)That all safety instructions in the operator's manual shall be followed and all safety guards regularly inspected and replaced where necessary.

7. This warranty is non-transferable.

8. Subject to the following terms, conditions and contributions, HARDI® extends the warranty on polyethylene tanks (excluding fittings, lids and gaskets) to FIVE YEARS. To qualify for this extended warranty, the tank must be drained and flushed with fresh water after each day's use. HARDI®'s liability is limited to replacement of defective parts FOB our plant in Davenport, IA at no cost to the purchaser for the first twelve months after date of purchase; at 20% of the then current retail price during the second year; at 40% during the third year; at 60% during the fourth year; and at 80% during the fifth year. This extended warranty is subject, in each instance, to the tank being inspected and approved for replacement or repair by HARDI® personnel before HARDI® will accept any liability hereunder.

9. HARDI® reserves the right to incorporate any change in design in its products without obligation to make such changes on units previously manufactured.

10. The judgement of the HARDI® Service Department in all cases of claims under this warranty shall be final and conclusive and the purchaser agrees to accept its decisions on all questions as to defect and the repair or exchange of any part or parts.

11. No employee or representative is authorized to change this warranty in any way or grant any other warranty unless such change is made in writing and signed by the CEO of HARDI® NORTH AMERICA INC. Approval of warranty is the responsibility of the HARDI® Service Department.

12. Any warranty work performed which will exceed $1000.00 MUST be approved IN ADVANCE by the Service Department. Warranty claims filed without prior approval will be returned.

13. ANY pump replacement MUST be approved by the HARDI® Service Department.

14. Claims under this policy MUST be filed with the HARDI® Service Department within thirty (30) days of when the work is performed or warranty shall be void unless prior arrangements are made.

15. Parts which are requested for return by the HARDI® Service Department must be returned prepaid within thirty (30) days for warranty settlement.

16. Warranty claims must be COMPLETELY filled out including part numbers and quantities or claims will be returned to the submitting dealer.

DISCLAIMER OF FURTHER WARRANTY

THERE ARE NO WARRANTIES, EXPRESSED OR IMPLIED, EXCEPT AS SET FORTH ABOVE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION OF THE PRODUCT CONTAINED HEREIN. IN NO EVENT SHALL THE COMPANY BE LIABLE FOR INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES (SUCH AS LOSS OF ANTICIPATED PROFITS) IN CONNECTION WITH THE RETAIL PURCHASER'S USE OF THE PRODUCT.