



***DRAMIS***

# **User Manual**

**for  
Hydro pneumatic DTS suspension**

Released by	Date

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## Foreword:

This document is a guide for installing, commissioning and maintenance of a VSE DTS system for The Dramis D55T.

This manual is compiled based on the hydro-pneumatic suspension for the DTS deliverable functions (both standard and optional) and the technical specifications established by V.S.E. Vehicle Systems Engineering B.V.

The users of this manual are expected to have sufficient mechanic education and experience as well as knowledge of hydraulic systems.

If you are not familiar with the VSE DTS system then carefully read this entire manual before commencing any work on the system.

VSE recommends that all personnel who will be working with VSE supplied steering and/or suspension systems in any way receive training in this area. This guide may serve as a starting point.

VSE also offers the opportunity to provide courses related to the systems they provide care. Please contact with VSE.

If you are familiar with the VSE DTS system, this manual can be used as a reference.

For drivers of a DTS equipped truck is also a driver manual available; VSE #no. A10369

The following marking conventions are used in this manual to draw your attention to certain matters.



**Warning:** is used when not correctly following the process, procedure, etc. may result in personal injury.



**Attention:** is used when not correctly following the process, procedure, etc. can cause damaging or destruction of materials and/or equipment.



**Remark:** is used when a process, procedure, etc. should be emphasized.

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## Introduction

**V.S.E. Vehicle Systems Engineering B.V. develops, markets and manufactures advanced steering systems (ETS) and suspension systems (DTS) for trucks and trailers.**

**ETS (Electronic Truck and Trailer Steering) is the collective name for electronically controlled hydraulic steering system for knuckle steered pusher or tag axles and rigid axles (ETS-A) for trucks and trailers.**

**The infrastructure in cities makes manoeuvrable vehicles necessary. From the point of view of the environment, the use of large numbers of small distribution vehicles is not really a solution. ETS is a flexible solution for the steering of several axles of a vehicle. ETS saves fuel and reduces the wear and tear on tyres.**

**ETS is an autonomous system. With ETS, there is no mechanical or hydraulic connection to the steering system of the front axle on trucks or the kingpin on trailers. This means that the ETS-controlled axle has no influence on the front axle or tractor/trailer connection. Mechanical or hydraulic displacement steering systems cannot be influenced and takes up valuable space. ETS systems only steers if the circumstances require this and can be influenced by wireless remote or by automatically changing the steering behaviour e.g. in case of extendable trailers.**

**DTS (Dynamic Truck and Trailer Suspension System) is the collective name for electronically controlled hydro pneumatic suspension. This implies that the power transfer in the suspension takes place by means of hydraulic cylinders. The spring action is accomplished by nitrogen accumulators.**

**DTS is particularly suitable for applications with a high centre of gravity, fixed loading height(s), heavy duty transport and special requirements in the areas of suspension and comfort.**

**No shock absorbers are required for damping. Damping is an integral component of the DTS system. The damping can be regulated by controlling the oil flow in the system by applying (adjustable) restrictions when pressure is applied or reduced.**

**DTS offers an extremely good stability, both static and dynamic. The suspension offers the following options:**

## Safety instructions

The VSE DTS suspension is a hydraulic system in which high pressures occur. Through the application of gas pressure accumulator, the system after it has been put into operation, will always be pressurized.



**Warning:** During operation of the DTS system the vehicle can start to move up and down. Ensure the immediate vicinity of the vehicle is free of objects before the system is operated.



**Warning:** Always make sure that the VSE hydraulic suspension system is depressurized before starting any work on the hydraulic circuit. Follow the instructions below to depressurize the system.

**Perform the following actions to depressurize the hydraulic system**

1. Make sure the vehicle is not loaded.
2. Mount mechanical stops (e.g. wooden blocks) between the chassis and the axles of the vehicle. The height of the stops need to be made equal to the space between axle and chassis at ride height. When the chassis rests on the mechanical stops the vehicle height will be ride height.
3. Push the vehicle down button of the DTS suspension and lower the chassis until it is fix on the mechanical stops.
4. Keep pushing the chassis down button for at least 120sec after the chassis is fix on the mechanical stops. Thus the oil in the nitrogen filled accumulators will be drained and the DTS system will be depressurized.
5. Untighten the connecting nut of one of the hoses in the DTS system 2 full revolutions. Move the hose about to ensure no oil sprays out; the DTS system is now depressurized. When oil is still spraying out tighten the connecting nut and restart at point 4.
6. With the DTS system depressurized it is safe to start working on it.

## General description

A DTS suspension consists of a Pneumatic/Hydraulic part and a Control part.

The Pneumatic/Hydraulic part can be subdivided into:

- The oil supply incl. reservoir, pump and the flow control;
- The Suspension Manifold that includes (electro) hydraulic valves for the height control of the vehicle;
- The Suspension Cylinders for the height control of the vehicle;
- The Accumulators for the spring action of the vehicle.

The Control part consist two Angle Sensors measuring the vehicle height, three Pressure Sensors measuring various system pressures and an Electronic Control Unit (ECU). The ECU incorporates two microprocessors (= redundancy) for controlling and safeguarding the cylinder movements of the DTS system. The ECU is programmed to control the position of the DTS axles and to prevent dangerous situations using height-position sensors and the pressure sensors.

When a failure is detected in the DTS suspension system the driver will receive a warning by means of an in the cabin mounted buzzer and lamp. These indicators are also used to let the driver know a control mode is active (or has stopped) and that control mode requests have been accepted or not.

The suspension characteristic of the vehicle is determined by the accumulators and the hydraulic connection between the cylinders

With the DTS suspension system installed, the stability of the vehicle comes mainly from the rear. The suspension stiffness on the front axle(s) of the vehicle should therefore be relatively low.

The DTS suspension system is able to be in several modes, in order to put the suspension in an optimal condition for the planned usage. A number of these modes have to be ordered separately as they are optional. If they are available, the driver can choose the suitable mode but only if the safety is not concerned. In this manual we will restrict to the functions available on The Dramis D55T:

**Standard modes:**

- Automatic height control
- Blocking of all height control functions
- Vehicle up / down (both sides)
- Vehicle to normal ride height at speeds exceeding 3km/h

**Optional modes:**

- Vehicle leveling (perpendicular to vehicle axis)
- PTO release after vehicle leveling

## Automatic Height Control ( $\geq 3\text{km/h}$ )

The automatic ride height control is active with speeds  $\geq 3\text{km/h}$ . If height differs too much from the target value, the height control valves will automatically regulate the suspension cylinder length to get the vehicle at the target height again. If both sides need to be adjusted but the difference between actual and target value differs too much between both sides synchronization will become active; the side which differs the most will be adjusted first.



**Remark:** When the speed is lower than 3 km/h, no regulation is done, even if the ride height is not ok.

Automatic ride height control is the default function. This function can only be overruled by functions with higher priority:

- manual activation of stabilization
- Blocking of all height functions (while driving this function is normally not active but e.g. in case of malfunctioning tipper sensor it might happen. In that case, automatic height control during driving will function again with speeds over 10km/h for more than 10 s).
- the speed at which actual regulation is possible can be set by software parameters.

## Blocking of all Height Control functions

Because change of suspension cylinder length can seriously influence the vehicle stability, it can be necessary to block all regulations under certain conditions. This is normally needed during e.g. tipping operation.

In order to have this function working, normally on tippers a proximity switch is used which signals if the tipper is down or not. When up, all functions are blocked.

When the tipper comes down again or in case of a malfunctioning switch, a signal change will be detected by the ECU but for safety reasons, the blocking will remain active. The blocking will become inactive when, a "tipper-down" signal is present AND a height function is activated. Also when the speed will be over 3 km/h the function will be deactivated.

A warning lamp will alert the driver that the blocking is (in)active.

In case of a malfunctioning switch, automatic height control during driving will function only if the speed exceeds 10 km/h for more than 10 s. An alarm will be set as well to indicate to the driver that the tipper signaling is malfunctioning.



**Remark:** This function has the highest priority in all control functions as it maintains the high security level of the DTS system.



## Vehicle up (both sides)

**This function can be used to raise the vehicles' ride height temporarily to a custom value. During this function, no synchronization of height between left and right hand side is active. This function can also be used to get the vehicle fully up and have maximum system pressure on the suspension e.g. for de-aerating.**

**This function cannot be activated while driving (speed exceeding 3 km/h). If a ride height other than the regulated height is set with this function, the automatic height control will change this height automatically back to the preset height when the speed exceeds 3 km/h.**

## Vehicle down (both sides)

**This function can be used to lower the vehicles' ride height temporarily to a custom value. During this function, no synchronization of height between left and right hand side is active. This function can also be used to get the vehicle fully down e.g. for de-aerating.**

**This function cannot be activated while driving (speed exceeding 3 km/h). If a ride height other than the regulated height is set with this function, the automatic height control will change this height automatically back to the preset height when the speed exceeds 3 km/h.**

## Vehicle to preset ride height below 3km/h(both sides)

**This function is in fact an activation of the automatic ride height control with speeds below 3 km/h. If the actual height differs too much from the preset value, the height control valves will automatically regulate the suspension cylinder length to get the vehicle at the preset height again. If both sides need to be adjusted but the difference between actual and preset value differs too much between both sides synchronization will become active; the side which differs the most will be adjusted first.**

**This function cannot be activated while driving (speed exceeding 3 km/h). But as it is an activation of the automatic ride height control, this is not needed as this function automatically will regulate the ride height during driving already.**

## Vehicle leveling (perpendicular to vehicle axis)

**This function will level the chassis of the vehicle in perpendicular direction to vehicle axis when the vehicle chassis at the rear (where the DTS suspended axles are mounted) is not level. The regulation will try to achieve the average ride height by lowering one side first and then raising the other.**

This function cannot be activated while driving (speed exceeding 3 km/h). If the actual ride height differs too much from the preset height (this is normally the case after leveling), the automatic height control will change this height automatically back to the preset height when the speed exceeds 3 km/h, so the leveling adjustments are discarded. On significant slopes it is better to activate *'vehicle to preset ride height below 3 km/h* first before driving.



**Warning:** This function should not be used when the whole vehicle is on a slope as it can damage the chassis and make tipping less stable. For this reason the system is fitted with the next function.

## PTO release after vehicle leveling

This function will release the PTO function automatically after the vehicle is leveled in perpendicular direction to vehicle axis. This is done to add extra safety when the vehicle is tipping.

When the vehicle leveling function has ended the ECU will check certain parameters in order to be sure the vehicle is in a safe position for tipping. When these parameters are correct the ECU will release the PTO function and the tipping procedure will start automatically.

When the vehicle is not in a safe position the PTO function will not be released and there for tipping will not be possible. The driver will then have to reposition the vehicle in a better position and start the leveling function again.

## Main operation and failure modes

The DTS modes can be selected using switches. The acceptance and (if applicable) the start and finish of each mode is indicated by a buzzer and different lamps.

When a failure is detected in one of the components or circuits of a DTS system (e.g. broken wire), all outputs of the ECU are switched off, deactivating all valves. In this mode the suspension cylinders maintain their current position and the operator receives a warning via an alarm lamp and buzzer.



**Remark:** For specific information regarding the different buzzer and lamp signals please refer to the DTS driver manual (VSE document# A10369).

## Hydraulic system

### Hydraulic system in general

The oil supply for the DTS suspension installation comes from an additional engine driven variable piston pump. The flow and pressure is controlled by the DTS system via the LS regulation on this pump. In case an ETS-A steering system is also connected, the flow and pressure is controlled by the ETS-A system and the DTS system request oil supply from the ETS-A system via messages on the CAN bus.

The pump requirement for DTS are 250bar with a flow of 5 to 10L/min. The flow is determined by the requested vehicle-raise speed (i.e. higher flows results in faster cylinder movements). If the oil supply also supplies an ETS-A steering system, a total flow of 30-35L/min is required.

The cleanliness of the total system is the most important issue in a hydraulic circuit. When dirt enters or is present in the system, the correct operation of the different valves could be seriously affected.

Filters are mounted on the input and output of the Height Control Manifold for avoiding blocking problems of the hydraulic valves due to contamination particles in the system.



**Attention:** The oil to be used in this system is specified in VSE specification No.137.  
Use of unspecified oils can cause damage to the hydraulic system



**Attention:** some hydraulic components in the DTS system are very precise. This means that even the smallest contamination in the hydraulic circuit can cause faults and / or damage.

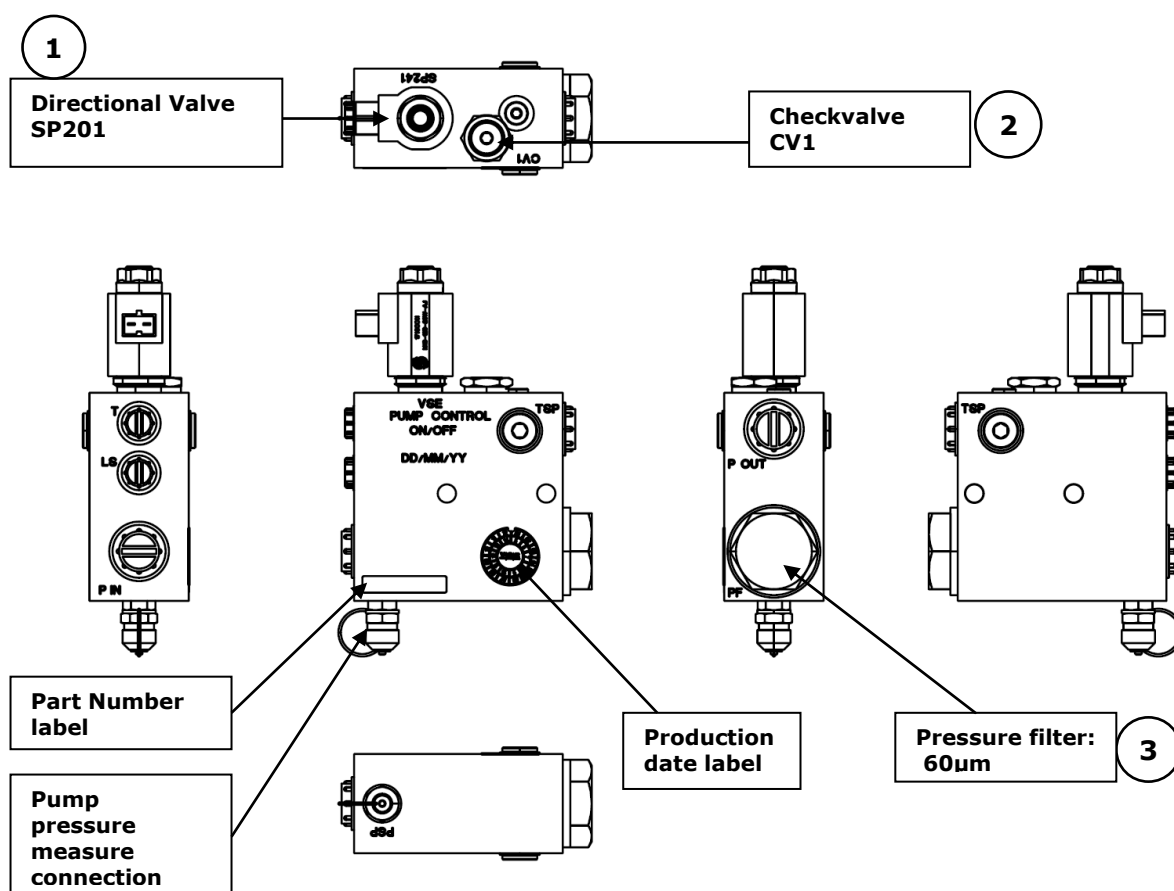
**Consult** VSE specification 573: instructions for clean work;  
to minimize the risk for malfunctions and optimize the lifecycle of the DTS system



**Attention:** The specifications of the piping, hoses and fittings used to build up the DTS system may differ. For the correct specifications see the Hydraulic Scheme made by VSE for the application.  
See also VSE specification 45.

## Hydraulic components

### Flow control manifold A10618



Flow control manifold A10618

The oil supply from the external engine pump is controlled by the ECU via the Flow Control Manifold. When no oil is required by the DTS system the oil flow from the pump is lead straight back to the oil reservoir. When no oil is required by the DTS system (i.e. request for Height Control) the valve SP201 is actuated and closes the return line to the oil reservoir. The oil flow will be sent to the DTS system.

## Specifications flow control manifold A10618

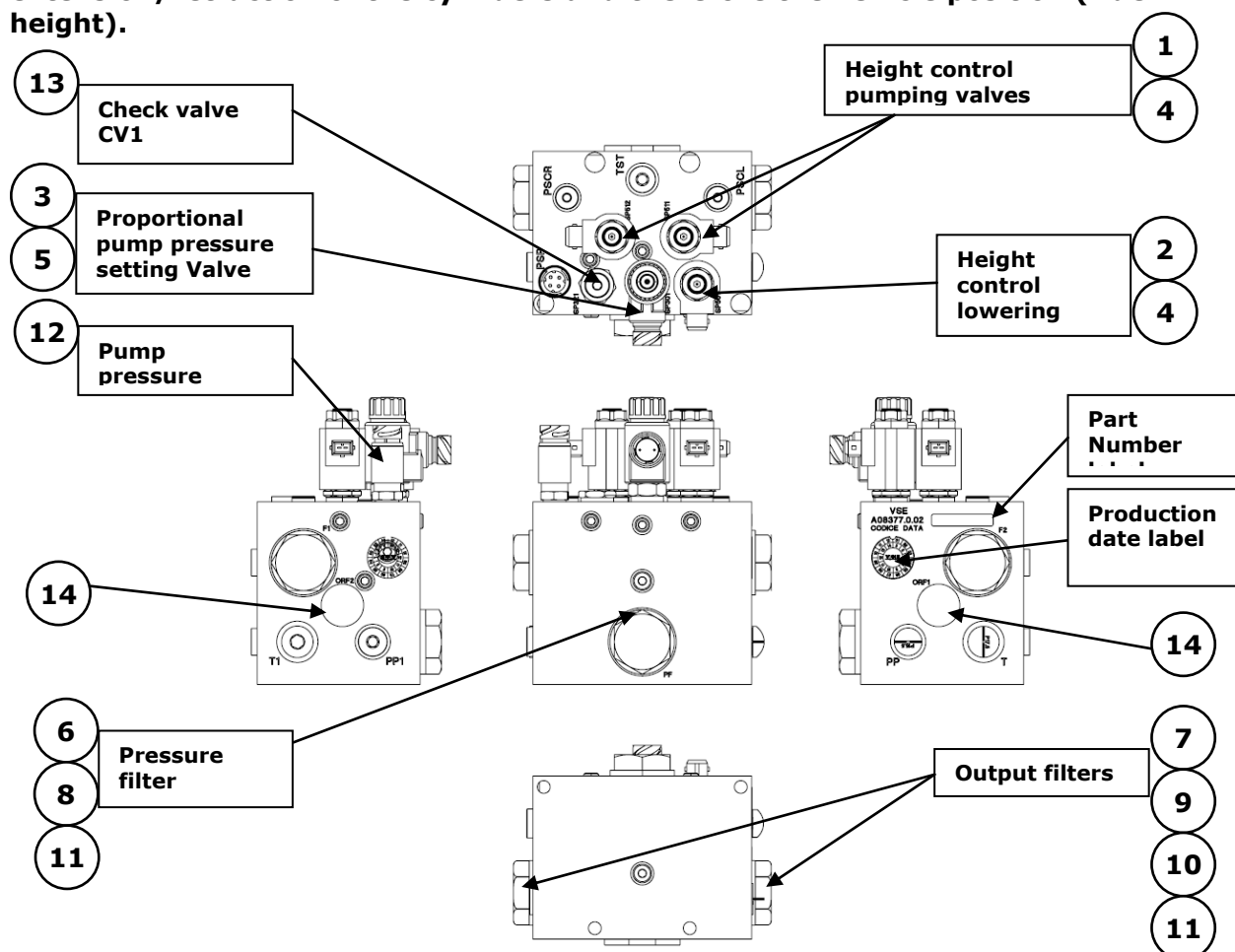
Description	Specification	Remark
Block outside dimensions	130x60x130mm (LxWxH)	LxWxH
Dim. incl. valves	157x60x224mm (LxWxH)	LxWxH
Mounting holes	Ø11 (2 times) all through	
Port Pin and Pout	M27x2 x16.3 min. thread length	
Port LS and T	M16x1.5 x13 min. thread length	
Measurement Port PSP	G ¼ Minimes	
Cleanliness level	18/16/13 according to ISO 4406	
Max design flow rate	40 L/min	
Max system pressure	250 bar	
Ambient temperature range	-40° ÷ + 45° C	
Oil temperature range	-40° ÷ + 100° C	
Storage temperature range	-40° ÷ + 85° C	
Dry weight	6.4 kg	
Mounting positions	No restrictions regarding angles but is preferred to have the valves facing down to assure that no dirt will fall in when valves are removed. The accessibility of the valves has to be assured.	

## Spare parts flow control manifold A10618

Pos.	Description	VSE part#	Tightening torque
1	Directional valve	A10811	45 - 50 Nm
2	Check valve	A05962	68 - 75 Nm
3	Pressure filter	A09167	500 Nm

## Height control manifold A12533

The DTS Height Control manifold houses (electro) hydraulic valves, filters and pressure sensors that are connected to the ECU to control the extension/retraction of the cylinders and therefore the vehicle position (ride height).



Height control manifold A12533

When the ride height is lower than the preset value (i.e. after loading or small internal leakage) the valves in the Flow Control Manifold are set to enable the desired oil supply pressure and flow. Provided the oil supply pressure is sufficient (measured via sensor PSP), Proportional Valve SP301 is set to the desired pressure to enable the cylinders to extend causing the vehicle to rise.

The oil flow from the pump enters the Height Control Manifold via port PP. On entering the manifold the oil passes through the Pressure filter cartridge. Normally this filter needs no maintenance. Only in case of a high contamination in the system, e.g. due to a pump damage, it becomes necessary to replace the filter cartridge.

Depending on the need to raise the vehicle on the left or right side or simultaneously, respectively valves SP511, SP512 or both are opened allowing oil to flow to the piston side of the cylinders. The oil now flows to the piston

side of the cylinders and to the accumulators. Due to the cross-wise connection of the piston en rod side between the left- and right side cylinders, oil that is pushed out of the rod side of a cylinder is added to the piston side of the cylinder(s) on the other side of the vehicle. Pressure sensors PSCR and PSCL guard the pressure on the cylinders and thus the axle load. When the preset ride height is achieved, valves SP511 and/or SP512 and SP301 are closed.

If the Height Sensors detect a too high ride height (i.e. after unloading) valves SP511 and/or SP512 (depending on which side of the vehicle is too high), SP301 is opened.

Oil will now flow from the accumulators and the rod side of the cylinders to the tank via filters F1 and F2 in the manifold to prevent valve damage and a Return Filter near the tank. Orifices in the manifold prevent the vehicle from lowering too fast in case valve SP301 cannot be controlled.



**Remark:** All hydraulic components are designed and tested to withstand a nominal pressure of 350-400 bars.

## Specifications height control manifold A12533

Description	Specification	Remark
Block outside dimensions	180x134x150mm	LxWxH
Dim. incl. valves	215x152x264mm	LxWxH
Mounting holes	4x Ø10,4mm (all through) Separation left 2 holes 162mm, Separation right 2 holes 78mm, Separation left/right 116mm	
Port TST, T, CR, CL	M16x1.5 x12 min. thread length	T-output
Port P, P1	M18x1.5 x12 min. thread length	
Port T, T1	M22x1.5 x14 min. thread length	T-input
Port PSCL, PSCR, PSP	G1/4" x12 min. thread length	
Electrical connection SP301, PSCL, PSCR, PSP	AMP DIN 72585 (IP 69K)	
Electrical connection SP501, SP502, SP501	AMP Junior Power Timer (IP 67)	
Cleanliness level	18/16/13 according to ISO 4406	
Max design flow rate PX	40 L/min	
Max system pressure	350 bar	
Ambient temperature range	-40° ÷ + 45° C	
Oil temperature range	-40° ÷ + 100° C	
Storage temperature range	-40° ÷ + 85° C	
Dry weight	24.6 kg	

<b>Mounting positions</b>	<b>No restrictions regarding angles but is preferred to have the valves facing down. The accessibility of the valves has to be assured.</b>
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*Spare parts height control manifold A12533*

<b>Pos.</b>	<b>Discription</b>	<b>VSE part#</b>	<b>Tightening torque</b>
<b>1</b>	<b>2/2 cartridge valve; SP511 +SP512</b>	<b>A09692</b>	<b>45 - 50 Nm</b>
<b>2</b>	<b>2/2 cartridge valve; SP501</b>	<b>A09693</b>	<b>45 - 50 Nm</b>
<b>3</b>	<b>Proportional valve; SP301</b>	<b>A10810</b>	<b>45 - 50 Nm</b>
<b>4</b>	<b>Coil set for pos. 1 + 2</b>	<b>A06341</b>	<b>9 -11 Nm</b>
<b>5</b>	<b>Coil set for pos. 3</b>	<b>A06340</b>	<b>3 - 5 Nm</b>
<b>6</b>	<b>Pressure filter 60μ</b>	<b>A05277</b>	
<b>7</b>	<b>Pressure filter 10μ</b>	<b>A05671</b>	
<b>8</b>	<b>Plug M42 for pos.6</b>	<b>A06337</b>	<b>480 - 520 Nm</b>
<b>9</b>	<b>Plug M42 adapted for pos.7</b>	<b>A08490</b>	<b>480 - 520 Nm</b>
<b>10</b>	<b>Shim for pos.9</b>	<b>A08491</b>	
<b>11</b>	<b>O-ring,038.50x 3.00 for pos 8 and 9</b>	<b>A05984</b>	
<b>12</b>	<b>Pressure sensor 0 - 250Bar</b>	<b>A06302</b>	<b>25 Nm</b>
<b>13</b>	<b>Check valve</b>	<b>A05962</b>	<b>45 - 50 Nm</b>
<b>14</b>	<b>Orifice 3.0 mm</b>	<b>A10817</b>	<b>45 - 50 Nm</b>



## Heavy duty suspension cylinder A09929

For DTS several suspension cylinders are available. The Heavy duty cylinder used on The Dramis D55T is shown below. Two of these cylinders are used per wheel.



**DTS Suspension cylinder A09929**

### *Specifications heavy duty DTS Cylinder*

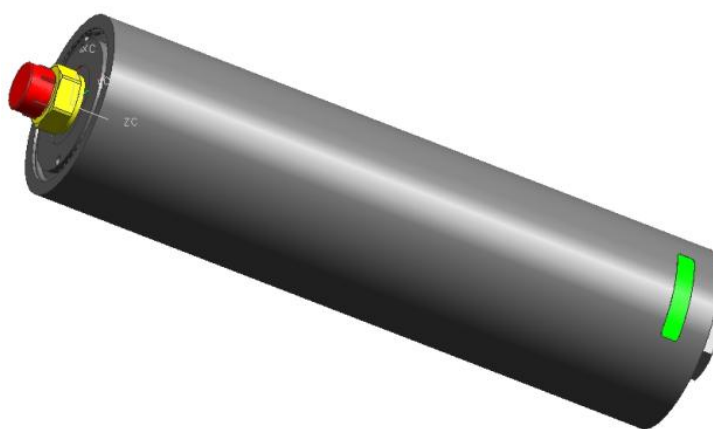
DESCRIPTION	SPECIFICATION
<b>VSE # no</b>	<b>A09929</b>
<b>Installation manual</b>	<b>A10336</b>
<b>Length in mid position</b>	<b>573 mm (+ 5 / -5 mm)</b>
<b>Stroke</b>	<b>127.5 mm in and 130.5mm out</b>
<b>Cylinder outside diameter</b>	<b>110 mm</b>
<b>Cylinder piston diameter</b>	<b>85 mm</b>
<b>Cylinder rod diameter</b>	<b>70 mm</b>
<b>Max. rated pressure</b>	<b>250 bar static pressure</b>
<b>Connection P and R</b>	<b>16S G1/2</b>
<b>Joint axle side</b>	<b>Custom VSE sliding bearing, holes Ø 14 mm (separation 134x94 mm) M12 bolts, quality 10.9</b>
<b>Ball Joint chassis side</b>	<b>Rubber Ø 80 mm, holes Ø 21 mm (separation 152 mm) M20 bolts, quality 10.9</b>
<b>Cleanliness level</b>	<b>18/16/13 according to ISO 4406</b>
<b>Salt spray specification</b>	<b>Class 9 / 96 hours Cylinders need to be painted for optimal corrosion protection</b>
<b>Ambient temperature range</b>	<b>-40° ÷ + 45° C</b>
<b>Oil temperature range</b>	<b>-40° ÷ + 100° C</b>
<b>Storage temperature range</b>	<b>-40° ÷ + 85° C</b>
<b>Mounting position</b>	<b>Hydraulic connections on top side</b>

<b>Dry weight total incl. ball joints</b>	<b>30 kg</b>
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## Accumulator A09644

The piston type accumulator fulfils the suspension function by storing- or releasing the energy due to axle movement when driving over an uneven surface. The accumulator is pre-charged with nitrogen at 5 and 15 bar (at 20°C).

The gas pre-charge pressure should be checked every two years.



**Accumulator**

### Specification Accumulator

Description	Specification
<b>VSE # no</b>	<b>A09644</b>
<b>Type</b>	<b>Piston</b>
<b>Nominal volume</b>	<b>1L</b>
<b>Dimensions (LxW)</b>	<b>355 x ø100 mm (±3mm)</b>
<b>Dimensions incl. Connections (LxW)</b>	<b>399 x ø100 mm (±4mm)</b>
<b>Hydraulic connection</b>	<b>16S G3/4</b>
<b>Permissible operating pressure</b>	<b>350 bar</b>
<b>Gas</b>	<b>Nitrogen</b>
<b>Gas pressure</b>	<b>5 &amp; 15 bar</b>
<b>Oil pressure (after starting-up)</b>	<b>Depending on load</b>
<b>Ambient temperature range</b>	<b>-20° ÷ + 80° C</b>
<b>Dry weight</b>	<b>12,25 kg</b>

## Electrical system

The complete DTS installation of course, has an E-marking indicating it fulfills the EMC requirements.

### Interfaces between DTS and vehicle

**For a correct installation and functioning of the DTS systems the following electrical interfaces are required:**

Code in the scheme	Description
<b>GND</b>	<b>KL 31 Ground connections on pin A2, B3 and B18 of ECU</b>
<b>Z4</b>	<b>KL 15 Switched Power Supply, 24V, fuse Z4 (10 A) connected to pin A1 of ECU</b>
<b>Z5</b>	<b>KL 30 Constant Power Supply 24V for output valves, fuse Z5 (15A) connected to pins B1 and B2 of ECU</b>
<b>Z6</b>	<b>KL 15 Switched Power Supply, 24V, fuse Z6 (5A) for function lamp, buzzer, centring switch, oil level switch and display (diagnosing)</b>
<b>GATE1</b>	<b>CAN to CAN gateway between ECU pins D10 (CAN HIGH) and D11 (CAN LOW) and the vehicle CAN bus. Vehicle speed (two independent sources) , engine speed, oil level, ambient temperature information are taken from the CAN bus.</b>
<b>S3</b>	<b>Master switch (e.g. proximity switch to detect that the container is up)</b>
<b>R3</b>	<b>Operator relais to initiate leveling connected to tipper switch</b>
<b>S1</b>	<b>Operator switch to maintain constant ride-height</b>
<b>S2/1</b>	<b>Operator switch to raise the ride-height</b>
<b>S2/1</b>	<b>Operator switch to lower the ride-height</b>
<b>L2</b>	<b>Indicator light DTS disabled</b>
<b>L3</b>	<b>Indicator light lift axle activated</b>
<b>B1</b>	<b>Buzzer</b>
<b>R2</b>	<b>Release PTO</b>

## Electronic components

### Angle sensors A05791

The DTS system uses angle sensors of the contactless, magneto resistive type. The sensors are mounted on both sides of the chassis and are attached to the DTS axles using levers. The lever transfers the up- and down motion of the DTS cylinder to a rotation motion. The rotation angle has therefore a fixed relation with the height of the vehicle (both left and right).



Angle sensor (vehicle height)

The sensors are redundant which is obtained by having the electronics for two sensors combined in one housing. This method assures a quick failure detection.

Since the cylinders are hydraulically put in series, only one sensor per vehicle side is necessary to detect the vehicle height.

#### Specification Heavy Duty Angle Sensor

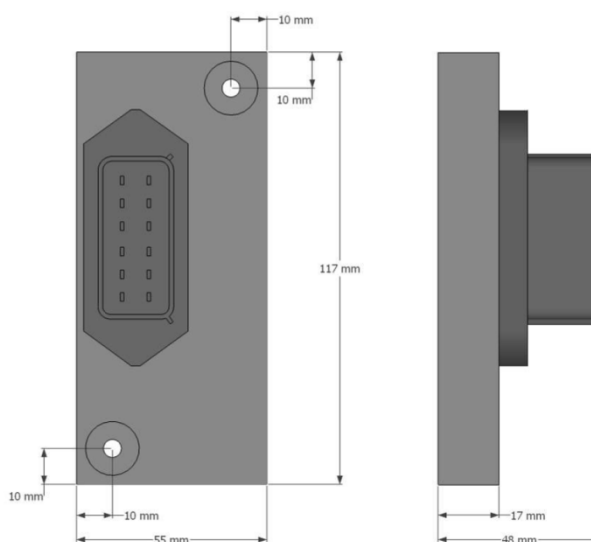
DESCRIPTION	SPECIFICATION
Type	Magneto resistive contact less sensor
Housing version	Heavy duty
Housing material	Aluminium
Weight	1kg
Mounting positions	Lever parallel to the chassis in ride height. A connecting rod between lever and axle body which is perpendicular to the lever and the axle in ride height. Ensure this linkage cannot over stretch in extreme positions (cylinders stroke max in and/or max out).

## CAN to CAN gateway A09416

The DTS system uses a CAN-to-CAN gateway to allow a safe connection to the vehicle CAN bus. It is placed between the CAN1 bus connector on the ECU and the CAN bus on the truck. The gateway will only pass messages from the truck to the ECU and not vice versa.

### Pinning

1	KL15 (Ignition)
2	KL30 (Battery)
3	KL31 (GND)
4	CAN1-L
5	CAN1-H
6	CAN1-GND
7	CAN2-L
8	CAN2-H
9	CAN2-GND
10	ISP-RxD
11	ISP-TxD
12	ISP-Prog

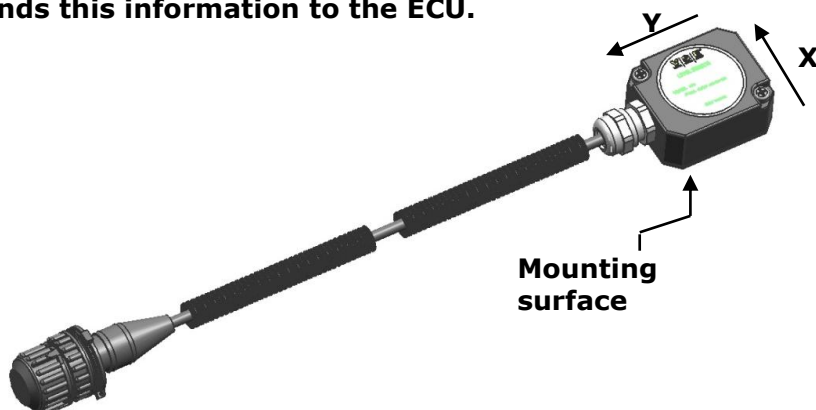


**CAN to CAN gateway**

Description	Specification
<b>Dimensions (LxWxH)</b>	<b>117x55x48 mm</b>
<b>Operating temperature range</b>	<b>-30°C to +70°C</b>
<b>Storage temperature range</b>	<b>-40°C to +90°C</b>
<b>Protection level</b>	<b>IP67</b>
<b>Weight</b>	<b>0,14 kg</b>

## Inclination sensor A09297

The inclination sensor measures the longitudinal and transversal angle of the vehicle and sends this information to the ECU.

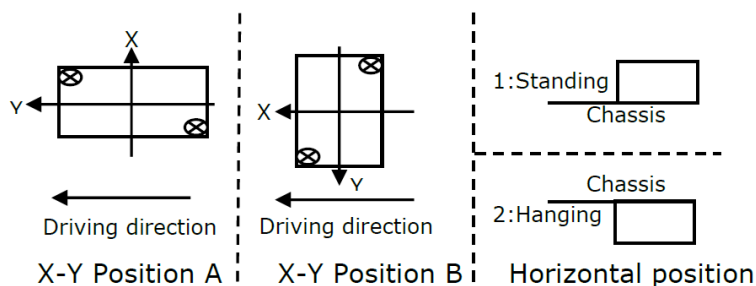


## Inclination sensor

The transversal angle is used by DTS to detect the angle of the vehicle in relation to the horizontal plane. It is the primary input for the leveling function of DTS that is used to increase stability during i.e. tipping.

### Specifications Inclination Sensor

Description	Specification
Overall dimensions housing	60x50x26 mm (LxWxH)
Mounting pattern	Two holes Ø 4,5mm diagonally located. Separation 46mm x 36mm
Cable length	1700 ±50mm
Protection class	IP 67
Ambient temperature range	-25° ÷ + 85° C
Storage temperature range	-25° ÷ + 85° C
Weight	0,38 kg
Mounting positions	The mounting surface (bottom, opposite side of identification sticker) has to be mounted on the chassis with use of the rubber plate included in the set. The X-Y plane of the sensor has to be parallel to the horizontal plane of the vehicle with the X or Y direction pointing in driving direction. Inform VSE of the exact mounting position because this has to be implemented in the software. See below; tick the box of the actual position



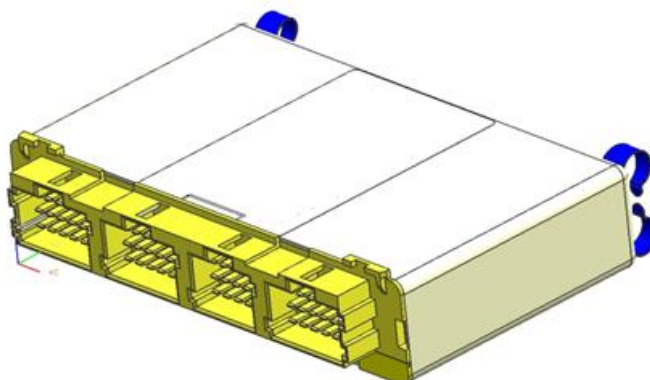
### Actual Mounting position

Position	1	2
A		
B		
Cable exit side out of sensor at ... vehicleside	Right	Left

## Electronic Control Unit (ECU) A10222

The ECU is a state of the art controller with two micro processors for redundancy reasons.

The unit is equipped with an AMP Multi port connector with 69 pins and 4 slots (3X 18 pins and 1X 15 pins). The connectors have different shapes and therefore they can't be interchanged.



**DTS ECU**

### Specifications ECU

Description	Specification
Overall dimensions housing	178x104x45 mm (LxWxH)
Mounting pattern	4-points
Centre distance mounting pattern	182.5 x 163 mm
Pins surface protection	Ag
Protection class	IP 30
Ambient temperature range	-40° ÷ + 45° C
Thermal range of application	-40° ÷ + 85° C
Storage temperature range	-40° ÷ + 90° C
Weight	0,6 kg
Mounting	The ECU has to be mounted inside the cabin. It needs to be placed in a well protected environment because of the low level of protection against water and dirt ingress (IP30). Other than that no restrictions regarding angles.

## Commissioning

### Filling the system with oil

**When the DTS system is completely electrically and hydraulically installed and before you can start calibrating the system and putting it into operations the system first has to be filled with oil.**



**Attention:** The oil to be used in this system is specified in VSE specification No.137.  
Use of unspecified oils can cause damage to the hydraulic system



**Attention:** Running without oil can cause substantial damage to the pump. Fill the pump with oil before start-up when necessary and make sure the pump always is provided with an adequate supply of oil.

**To fill the DTS system with oil the following tasks have to be performed:**

- fill the oil reservoir with oil.
- Fill the oil pump with oil when necessary, some pump types need to be filled with oil before start-up, check to the pump documentation for details.
- Make sure that during the filling process the oil reservoir remains filled with oil.
- Start the pump, the system will be filled.
- Manually move the hydraulic suspension up and down several times to remove all air from the system. Wait app. 3 minutes before initiating the next up or down movement.
- The DTS system is now ready for calibration.



## System calibration and diagnostics

When the DTS system is fully installed on the vehicle and filled with oil you will have to perform the final step: **System calibration**. Without performing a full calibration run the DTS system will not perform properly and some operating modes cannot be selected.

The purpose of the calibration is to check the system for a correct installation; hydraulically and electrically. Also the Pressure and the Angle sensors are checked and calibrated.

Every time when work is executed on the system it will be necessary to re-calibrate the system partly or completely depending on the work which has been done.

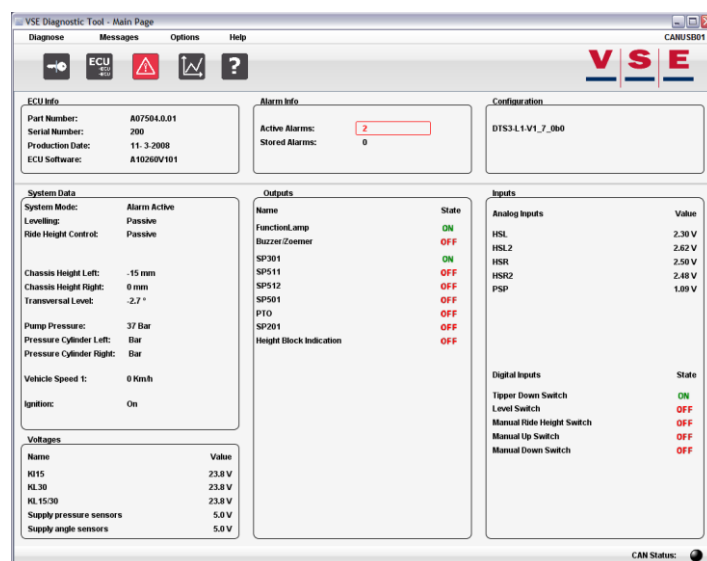
In the electrical installation of DTS two DIN- connectors are present (inside the cab close to the ECU) for the diagnosis and the calibration of the system. One is used for VSE testing purposes (data logging) and the second connector is used for connecting the PC via an intermediate wiring loom and USB-CAN interface for diagnosis and calibration of the DTS system.

The presence of the VSE diagnostic tool VIDI is imperative for putting the DTS system into service.

Also for maintenance and repair purposes the presence of this tool is required. Please contact VSE for details.



## VSE Intelligent Diagnostic Interface



**Screenshot VSE VIDI**

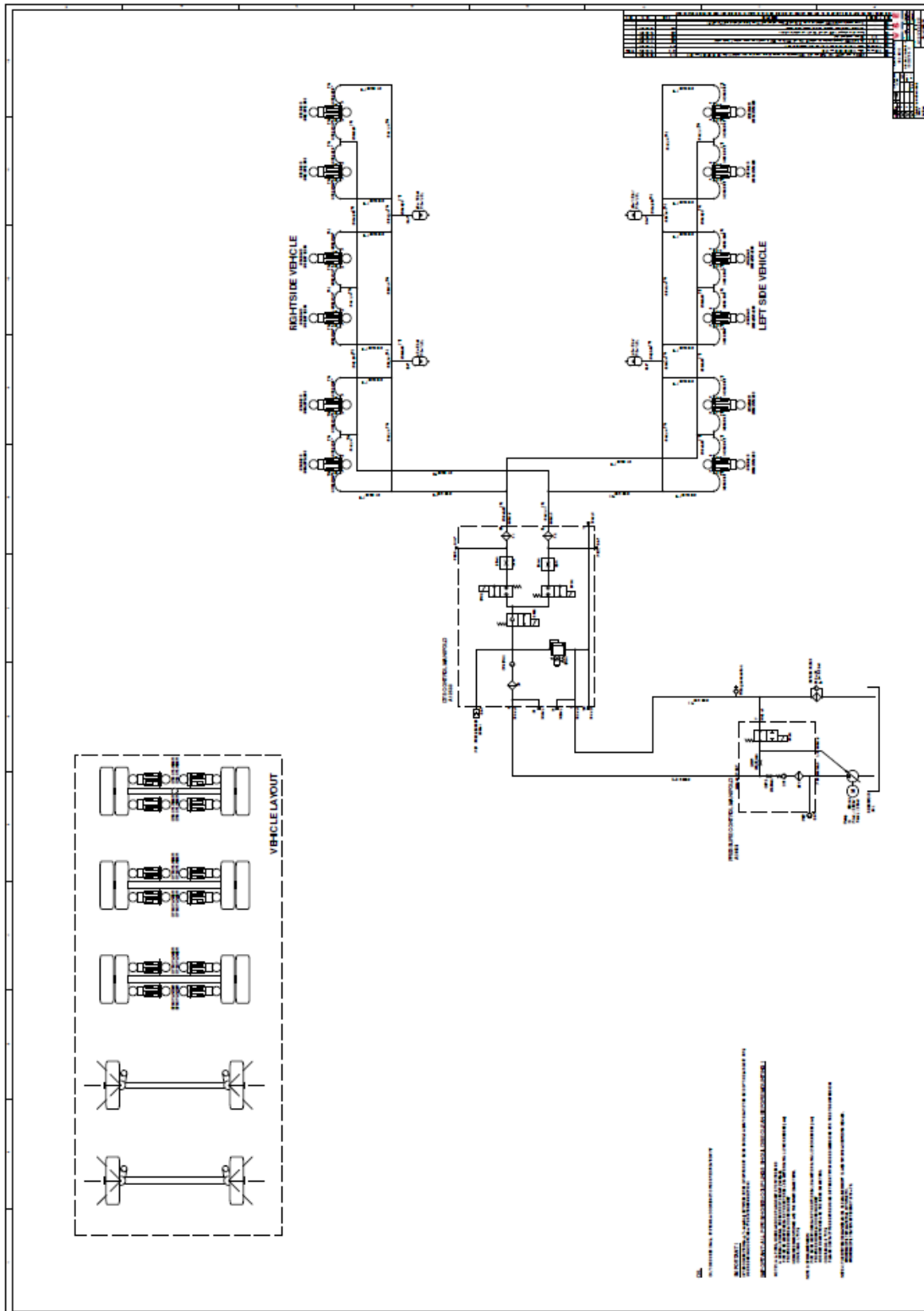
## Maintenance

The VSE DTS suspension is a low maintenance system. To prevent failures as much as possible and extend the DTS system life cycle some maintenance has to be carried out. This recommended and necessary maintenance is listed below.

- General:  
**Regularly checking of the system for damages is advised.**
- Suction filter:  
**No maintenance necessary.**
- Pressure filter:  
**In general no maintenance necessary. The only reason for maintenance is when a lot of dirt, for example by a pump/hose/breather/etc. damage or sand in the reservoir, is introduced in the system.**
- Return filter:  
**VSE recommends to change the return filter every two years.**
- Filler/breather filter:  
**No maintenance necessary.**
- Oil:  
**No maintenance necessary.**
- Oil level:  
**The minimum level is detected by a level switch. The level can be checked with a dipstick and should be between the minimum and maximum indication.**
- Manifold:  
**No maintenance necessary.**
- Accumulator:  
**The gas pre-charge pressure should be checked every two years.**
- Cylinder:  
**Consult Installation manual A10336.**
- Couplings:  
**Check for leakage all couplings weekly.**
- Pipes/hoses:  
**Check for leakage/damage and corrosion all pipes and hoses regularly.**

## Attachments

### Hydraulic schematic A10178



## Electrical schematic A09914

