General Manual

Automatic Greasing System
TriPlus

F212151R02

GROENEVELD

Your efficiency is our Challenge!

General information

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System	Automatic Greasing System TriPlus
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Preface

This general manual gives a description of the TriPlus automatic greasing system. It aims at giving insight in the system's operation and possibilities. Furthermore, in this manual you will find the technical data on several components of the TriPlus automatic greasing system.

In this manual the following icons are used to inform or warn the user:

ATTENTION

Draws the user's attention to important information meant to avoid problems.

WARNING
Warns the user for physical injuries or serious damage to the equipment caused by improper actions.

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1. General information

1.1 Introduction

With an automatic greasing system of *Groeneveld* all grease points of a vehicle or machine are lubricated automatically at the correct moment and with the correct amount of grease. Because greasing takes places while the vehicle or machine is in operation, the applied grease is spread optimally over the whole surface to be greased. The greasing system requires no user intervention to operate, apart from periodically replacing the grease in its reservoir.

Groeneveld's automatic greasing systems are designed with the utmost care and tested rigorously. This guarantees an extended operational life and error-free operation, even under the most extreme operating conditions.

Proper installation, using the correct type of grease, and periodic checks are prerequisites for the continual hassle-free operation of the system. The periodic checks, which take little time and effort, can be performed during the normal maintenance of the vehicle or machine (during oil-replacement, for instance). Careful selection of construction materials, makes the greasing system itself vitually maintenance-free.

ATTENTION
The automatic greasing system reduces the time and effort spent on manual greasing significantly. However, do not forget that there may be grease points that are not served by the greasing system and must still be greased by hand.

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1.2 The TriPlus automatic greasing system

A *Groeneveld* TriPlus automatic greasing system serves each grease point of the vehicle, machine or installation in sequence, i.e. grease is supplied to the connected grease points one at a time and one after the other (it is a progressive greasing system).

TriPlus systems are mainly applied on machines with a fixed number of grease points that require fixed amounts of grease at fixed intervals. This, because the amount of grease that will be supplied to the individual grease points is governed by the distribution ratios that results from the choice of doser segment types and the manner in which those segments are combined in distribution blocks.

A *Groeneveld* TriPlus automatic greasing system comprises the following parts (see Figure 1.1):

1. An electric grease pump (plunger pump) with integrated grease reservoir and a digital control unit with data storage facility.
2. One or more distribution blocks (assembled from multiple doser segments).
3. Primary grease lines between the pump unit and the distribution blocks and interconnecting the distribution blocks themselves.
4. Secondary grease lines between the distribution blocks (doser segments) and the individual grease points.

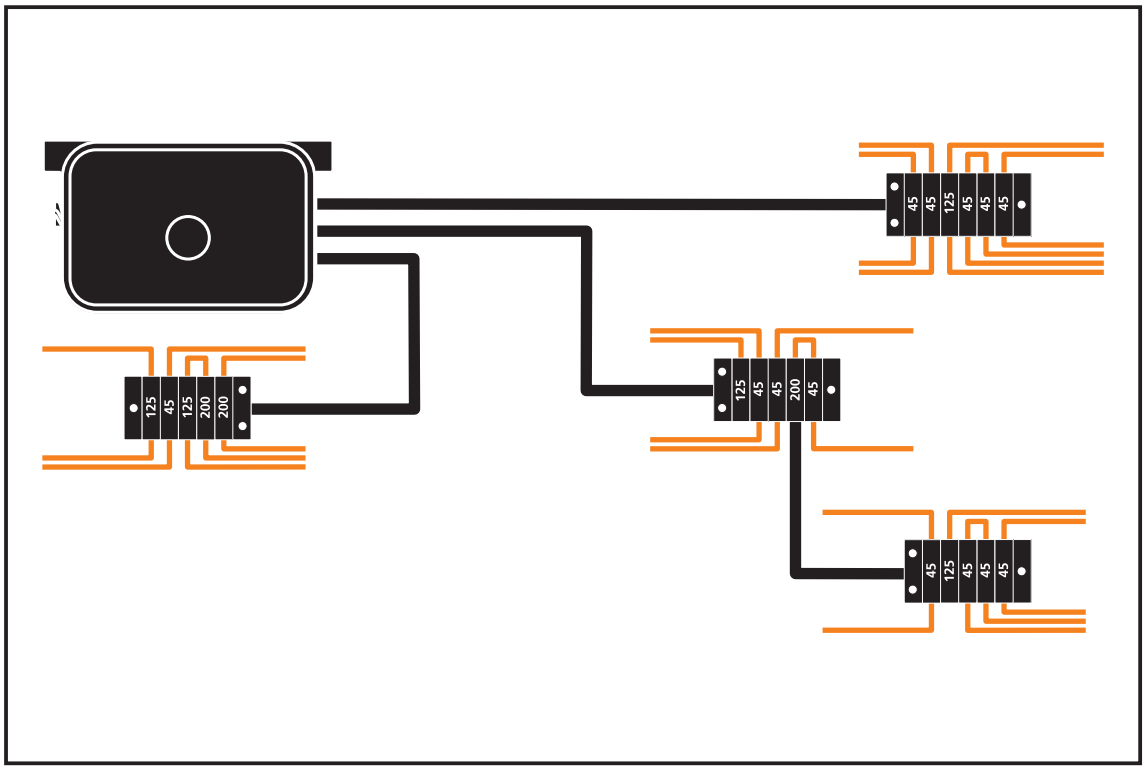

Figure 1.1 System overview

Two types of pump units are available:

- The TriPlus pump
- The TriPlus trailer pump

The TriPlus pump is applied when the supply voltage needed to power the greasing system is always available (while the vehicle or machine is in operation). The TriPlus trailer pump is used on pulled vehicles, where the supply voltage will not (always) be available.

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2. Description components

2.1 Properties

The pump unit is the heart of the TriPlus automatic greasing system. The *Groeneveld* TriPlus pump is designed specifically for vehicles or machines on which a supply voltage to power the greasing system is always available (at least while the machine or vehicle is in operation) (i.e. pulling vehicles). The TriPlus pump unit, with its integrated control unit, provides flexible solutions for all greasing requirements of vehicles or machines. The pump units can be supplied with a number of different grease reservoirs with different capacities.

The most significant properties of the TriPlus pump unit are:

- Up to 3 independent grease ports.
- By termination a different combination of grease output and greasing interval can be established, so that also grease points with very several needs and/or combine greasing intervals to be in one greasing system. A single *Groeneveld* TriPlus greasing system provides the same facilities and possibilities as three totally independent progressive greasing systems.
- The greasing interval is determined by the distance travelled or the elapsed time.
- Monitoring of the grease output of the pump.
- Monitoring the maximum acceptable grease pressure.
- Monitoring the grease level in the reservoir.
- Monitoring the electrical wiring and components.

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2.2 Composition of the TriPlus pump

The TriPlus pump comprises the following components:

1. Grease reservoir with follower piston.
2. Stirring device.
3. Plunger pump.
4. Electronic control and monitoring unit with a permanent memory.
5. Relief valve with return line to the grease reservoir and monitoring by the control unit.
6. Grease output port 1
7. Grease output port 2
8. Grease output port 3
9. Shuttle valve B (for grease output port 3)
10. Shuttle valve A (for grease output port 2)
11. Sensor (counts the number of revolutions of the drive shaft of the plunger pump).
12. Electric motor with reduction gear.
13. Test pushbutton.
14. Filler opening with grease filter.
15. De-aerating/grease overflow opening.
16. Electrical connector.
17. Minimum grease level switch.

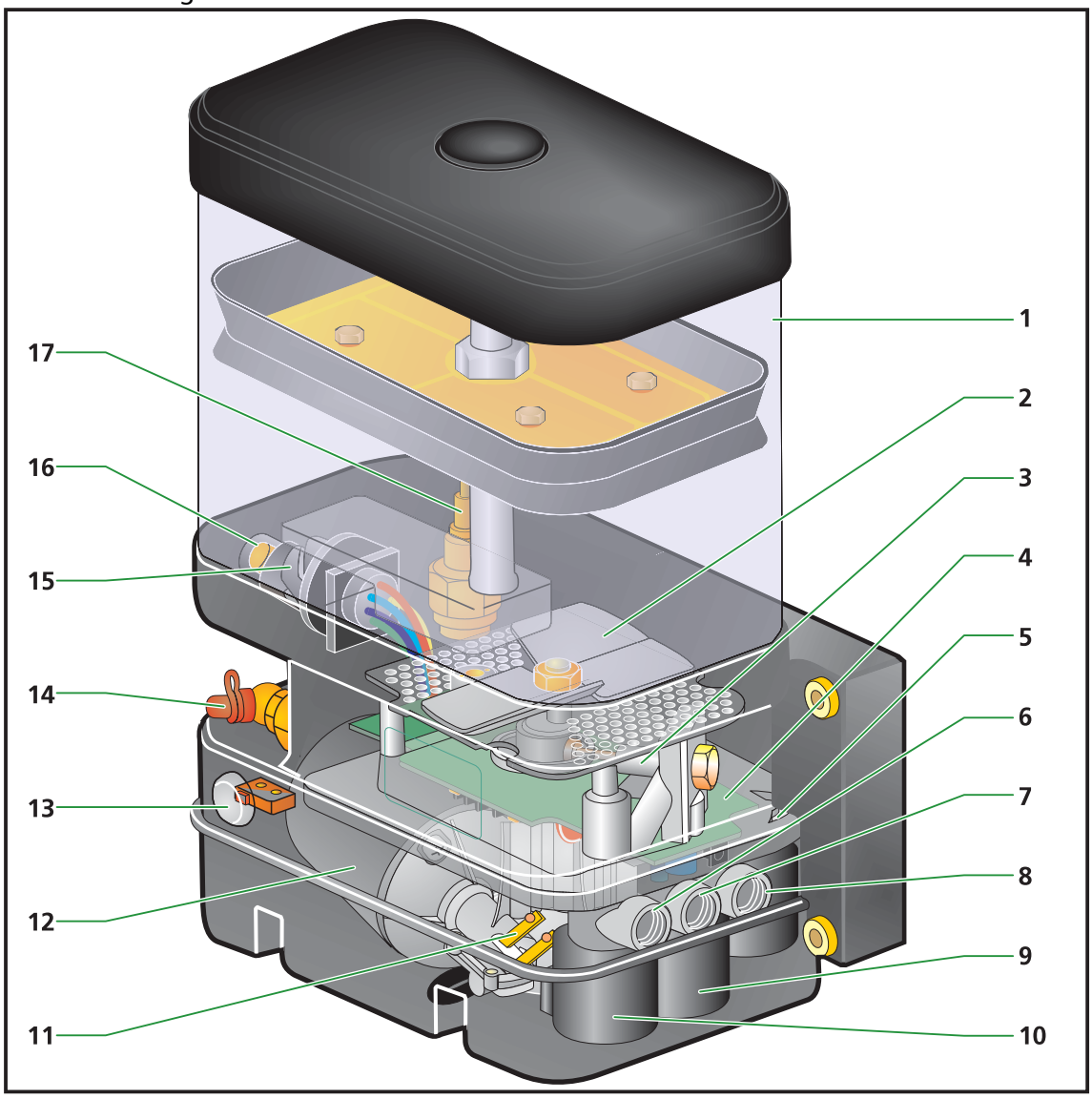

Figure 2.1 TriPlus pump

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2.3 The intigrated control and monitoring unit

The control and monitoring unit initiates and controls the greasing cycles of the greasing system. All required system and program parameters, such as at which intervals grease should be applied through which output ports and with what quantities, are laid down in the control unit. The control unit monitors the performance of various components of the greasing system, and processes, stores and reports the malfunctions it detects.

The control unit can be programmed or read with a GINA (**G**roeneveld tester for **IN**stallation and **A**nalysis) (see Figure 2.2)

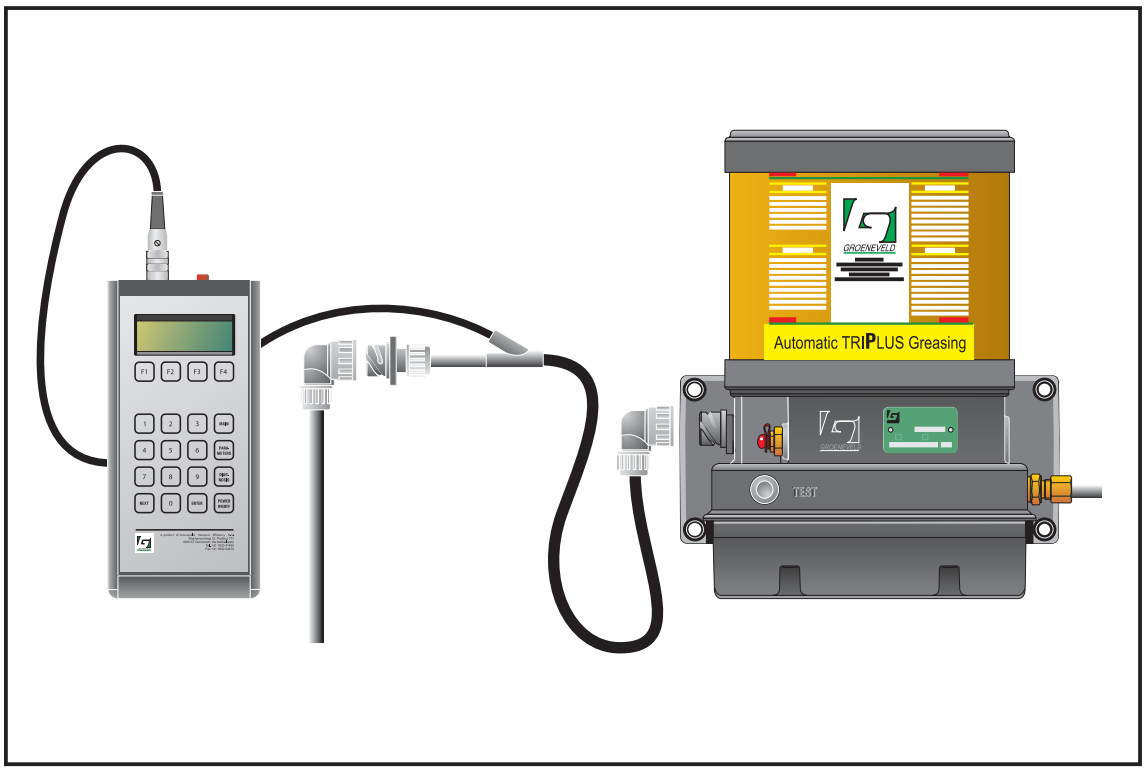

Figure 2.2 Connecting the GINA to the TriPlus pump

2.4 The plunger pump

The electric motor drives the plunger pump through a reduction gear. The plunger pump comprises a drive shaft with excentric, a cylinder with piston, and a non-return valve. The excentric moves the piston back and forth, once every revolution of the drive shaft. During the return stroke of the piston, grease is sucked from the reservoir into the cylinder (through an opening in the cylinder wall). During the forward stroke of the piston, the grease is pressed, via the non-return valve, towards the output port(s) of the pump unit. The amount of grease supplied during each stroke (revolutions of the drive shaft) depends on the (fixed) diameter of the cylinder and the stroke length of the piston.

If the pump unit features more than one grease output port, one or two shuttle valves will be present between the non-return valve and the output ports (one shuttle valve for each output port).

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2.5 The shuttle valves

If the pump unit has two output ports, it contains one shuttle valve, and if it has three output ports, it has two shuttle valves. The control unit determines the port through which the grease by placing the shuttle valve(s) in a particular position:

Grease via port 1: no shuttle valve installed or valves A and B both disengaged.
Grease via port 2: shuttle valve A engaged, valve B not installed or disengaged.
Grease via port 3: shuttle valve A disengaged and valve B engaged.

2.6 Safety and control features

2.6.1 Maximum grease pressure

A relief valve (fitted with an electrical contact) is installed in the grease channel between the plunger pump and the shuttle valves. This relief valve will start to lead the grease back to the reservoir if the maximum grease pressure is exceeded during the pump phase of a greasing cycle. The grease pressure may become too high, for example, when one of the grease lines to the grease points has become blocked, or when the viscosity of the grease has become too high (at low temperature).

2.6.2 Minimum grease level in the reservoir

A minimum level switch is installed in the grease reservoir. If the grease reaches its minimum level, the control unit will process, store and report the occurrence of that condition.

2.6.3 Defective wiring and short-circuits

Open-loads (interruptions) in the wiring to the sensors, minimum level switch, relief valve, electric motor, shuttle valves and external signalling devices (e.g. buzzer or signal light) will be detected and processed by the control unit. Short-circuits in the wiring or components will also be noticed by the control unit.

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2.7 The test pushbutton

The test pushbutton on the pump unit has two functions:

- Performing a test cycle via one of the grease output ports of the pump unit.
- Retrieving error messages stored in the memory of the control unit.

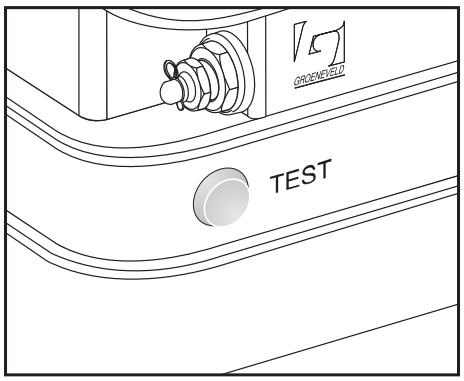

Figure 2.3 The test pushbutton

2.7.1 Performing a test cycle

A test cycle can be performed using the test pushbutton, as follow:

1. The supply voltage for the pump unit must be available (contact on).
2. Select the grease output port of the pump unit (1, 2 or 3) you want to test. Do this by pressing the test pushbutton momentarily (not longer than 1 second), once, twice or three times.
3. The test cycle starts two seconds after you pressed the test pushbutton for the last time.

During the test cycle the signal light will blink at a particular frequency. The blinking frequency indicates through which output port (1, 2 or 3) the test cycle is being performed.
Any errors that occur during the test cycle will not be indicated by the signal light and will not be stored in the memory of the control unit.

2.7.2 Retrieving fault messages

In the memory of the control unit information is stored about the operation of the greasing system. Two categories of fault messages can be distinguished:

1. ***Pending errors:*** errors that were detected since the control unit was switched on last (from the moment the supply voltage became available).
2. ***Stored errors:*** all errors that were detected by the control unit in the past.

All new errors that occur will be stored as pending errors. If the control unit is switched off all pending errors will be added to list of stored errors, and the list with the pending errors will be erased.

Retrieving fault messages:

The fault messages stored in the control unit's memory can be retrieved by keeping the test pushbutton on the pump unit depressed for at least five seconds. Seven seconds after you released the test pushbutton the signal light will start producing the blink codes to indicate the stored errors.

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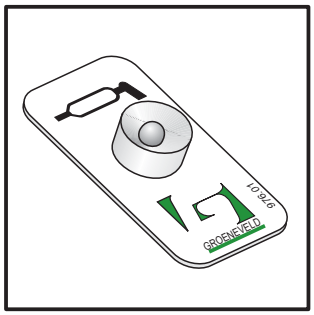
2.8 The signal light



The driver or operator will be informed about the operation of the greasing system through a signal light which is installed on the dashboard in the cabin. The physical form of the signal light may vary, but it is always installed so that is easily visible.

Figure 2.4 The signal light

The signal light produces the following signals:

Signal	*Moment*	*Significance*
1 x 3 seconds on.	5 seconds after switching on contact.	The supply voltage for the control unit is available and the signal light is OK.
1 x 2 minutes on.	After completion of a pump phase.	An error occurred during the pump phase. Precisely which error occurred can be determined by using the test push-button on the pump unit.
Repeatedly: 1 x 0,3 seconds on, followed by a pause of 2 seconds.	After momentarily pressing the test pushbutton once.	A test cycle is being performed via grease output port 1.
Repeatedly: 2 x 0,3 seconds on, followed by a pause of 2 seconds.	After momentarily pressing the test pushbutton twice.	A test cycle is being performed via grease output port 2.
Repeatedly: 3 x 0,3 seconds on, followed by a pause of 2 seconds.	After momentarily pressing the test pushbutton three times.	A test cycle is being performed via grease output port 3.

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The signal light indicates the fault codes by blinking:

The decades of the fault code: long pulses (0,5 seconds)
The units of the fault code: short pulses (0,15 seconds)

There is a two second pause between successive fault codes. For example, if the fault codes 13 and 22 are displayed, you will see the blink codes:

long, short, short, short fault code 13
two second pause

long, long, short, short fault code 22
two second pause

Each fault message has been assigned a two-digit fault code:

Fault code	***Meaning***
10	No error on this moment.
11	Distribution block monitoring switch has not switched.
12	Relief valve activated during a pumpphase in output port 1 (maximum grease pressure exceeded).
13	Relief valve activated during a pumpphase in output port 2 (maximum grease pressure exceeded).
14	Relief valve activated during a pumpphase in output port 3 (maximum grease pressure exceeded).
15	Grease reservoir is empty.
21	The pump did not complete the programmed number of revolutions within the set time.
22	Pump motor: open load.
23	Pump motor eliminated during pump phase concerning a too high flow usage.
24	Shuttle valve A: open load.
25	Shuttle valve A eliminated during pump phase concerning a too high flow usage.
31	Shuttle valve B: open load.
32	Shuttle valve B eliminated during pump phase concerning a too high flow usage.
33	Signal light: open load.
34	Signal light: short circuit in wiring (or lampfitting).
35	Short circuit components or wiring called in of above.

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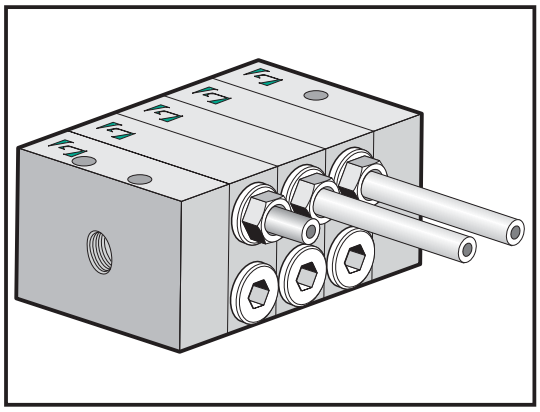
2.9 The distribution blocks

2.9.1 Properties

TriPlus distribution blocks distribute the grease to the various grease points and meter-out the amount of grease that goes to each individual grease point. They do so in a progressive, sequential way. The progressive distribution blocks in the greasing system distribute the grease to the grease points, one grease point at a time, and one grease point after another. Progressive distribution blocks can be placed in series, in which case an output of a block is used to feed the next block in line (through a primary grease line).

2.9.2 Composition



A progressive distribution block comprises the following components:

1. a start-segment
2. an end-segment
3. at least three doser segments

The doser segments to be deliverable in several versions with several amounts (quantity of grease which by cycle it is supplied). By several doser segments in a distribution block combine can a certain partitioning of the grease be obtained.

Figure 2.5 Distribution block

Each doser segment always has two grease output ports, with identical grease outputs per cycle. The grease channels between the segments are sealed by O-rings and the segments are pressed together with two compression bolts.

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2.9.3 Principle of operation

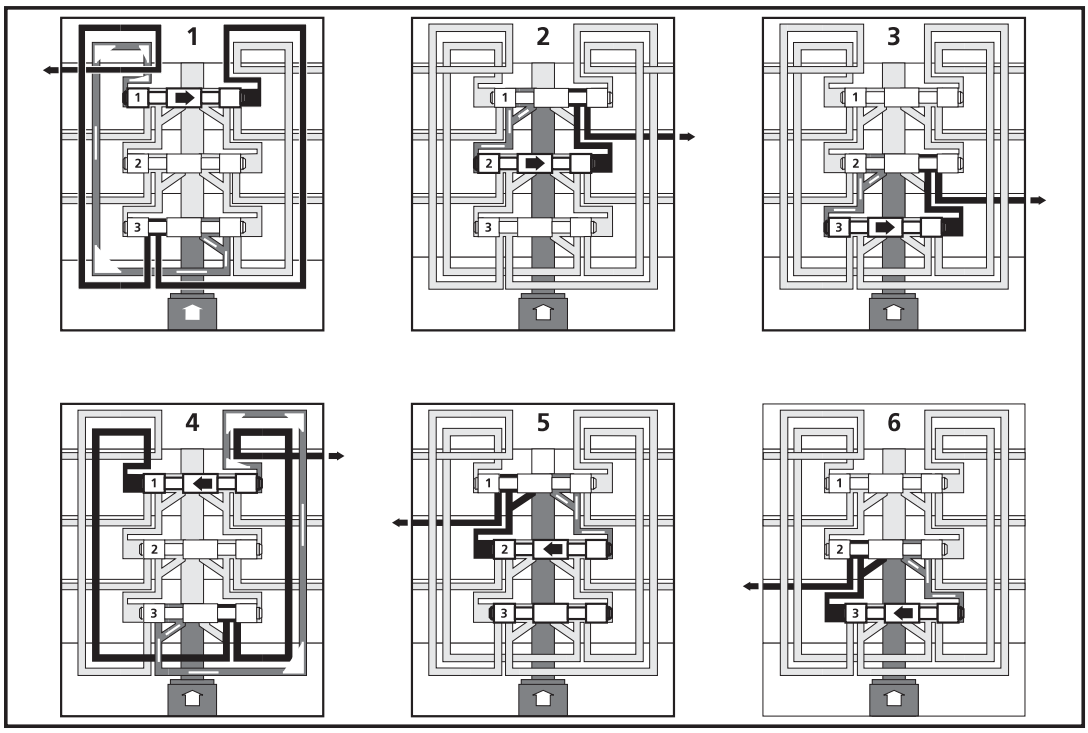

Figure 2.6 Principle of operation

To operate, progressive distribution blocks need no other energy source than the grease pressure supplied by the pump of the greasing system:

1. The lubricant flows from the input port, via piston 3, through all segments to the left-hand side of piston 1.
2. Piston 1 is pushed to the right by the grease pressure. The grease at the right-hand side of piston 1 is pressed to output port 1.
   Because piston 1 has now been pushed to the right, the lubricant now flows, via piston 1, from the central input channel to the left-hand side of piston 2.
3. Piston 2 is then moves and supplies grease to output 2.
   Because piston 2 has been pushed to the right, the lubricant now flows, via piston 2, to the left-hand side of piston 3. Piston 3 is pushed to the right and supplies lubricant to output port 3.
4. After piston 3 has been pushed to the right, the lubricant is pressed to the right-hand side of piston 1. Piston 1 will move to the left and supply lubricant to output port 4.
5. Afterwards piston 2 will also be pressed to the right and will supply lubricant to output port 5.
6. Afterwards piston 3 will also be pressed to the right and will supply lubricant to output port 6.
7. The distribution block then arrives back at its starting-off point, and the cycle will repeat as long as there is pressure in the primary grease line.

REMARK
The description and illustration above assume there is a fixed starting-off point for the doser segments in the distribution block. This is not so. The distribution block always continues from where it left-off during the previous pump phase of the grease cycle.

WARNING

To be able to operate at all, a distribution block needs to have at least three doser segments.

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2.9.4 Non-return valves

Non-return valves are installed in the outputs of the distribution block to prevent lubricant from flowing back into the distribution block. All output ports to which primary lines are connected or which are used to interconnect distribution blocks **must** be fitted with non-return valves. Output ports which secondary grease lines are connected, must be fitted with non-return valves if significantly different return pressures are expected at different output ports.

2.9.5 Failure of one of the doser segments

If one of the doser segments fails to operate properly (due to internal or external damage), the whole greasing system will fail to operate.

2.9.6 Closing outputs

An output may only be closed-off after removal of the little plug that seperates the two outputs of a doser segment. Removing the plug allows the grease meant for the close-off to exit through the output that remains open (it doubles the output of the one that remains open). The distribution block will become inoperable if the little plug is not removed.

2.9.7 Combining outputs

The outputs of a distribution block can be combined by installing an external interconnection line. The total grease output in that case is the sum of all outputs thus interconnected.
The two outputs of a doser segment can be combined by removing the little internal plug that seperates the two outputs and closing-off one of the ports. This doubles the output of the port that remains open.

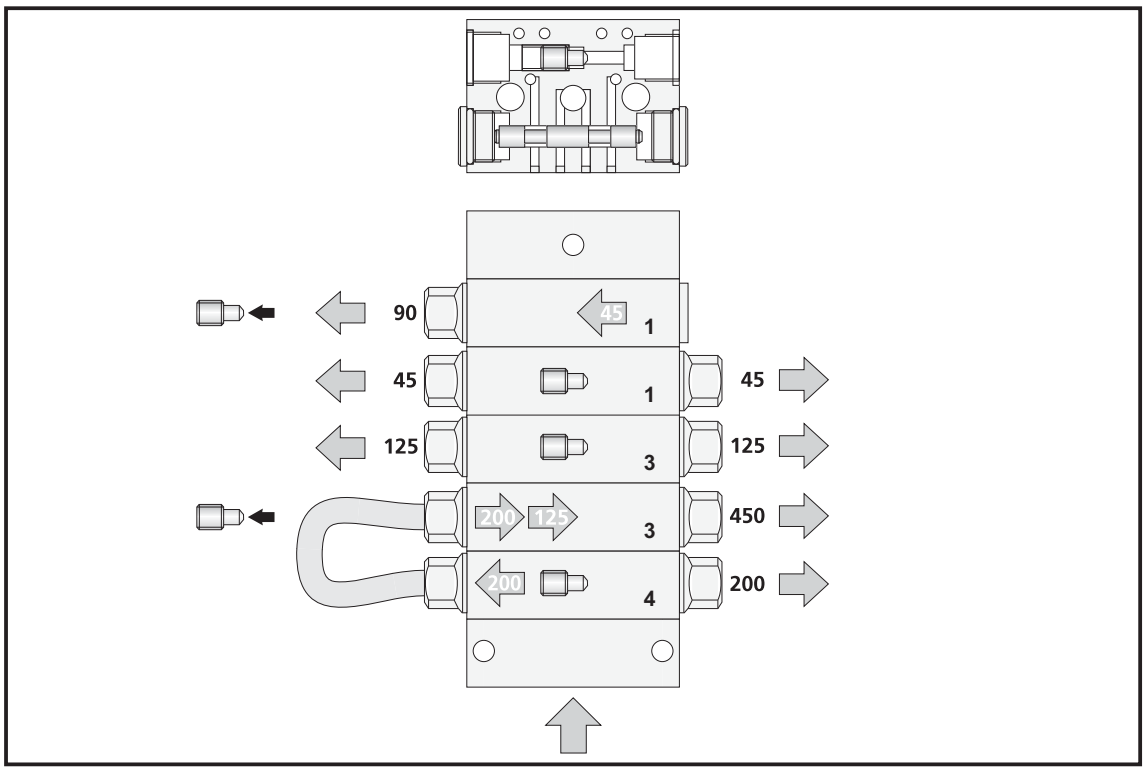

Figure 2.7 Combining outputs

The values in the illustration represent the outputs of the ports in mm³ (0,001 cc) per complete cycle of the distribution block. The amount supplied is determined by the diameter of the piston.

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3. The GINA

3.1 Introduction

The GINA (**G**roeneveld tester for **In**stallation and **A**nalysis) is a programming and read-out device for the digital control unit of the TriPlus automatic greasing system.

Figure 3.1 The GINA

In the description that follows all screens of the GINA are dealt with in the order in which they have been placed in its menu system. To get acquainted with the menu system and the features the GINA offers, we advise you to follow the sequence as presented, if only once. In practise there is, of course, no reason whatsever for such a rigid and time consuming approach.

The read-outs and setting have been grouped in three menus: main menu, parameters timer and diagnosis menu. You can access each of these menus by pressing <MAIN>, <PARAMETERS> or <DIAGNOSIS> on the keypad of the GINA.
You can do so at any time, regardless of the screen currently shown on the display.

Some screens just show information. You cannot change anything in those screens. Other screens allow you to change parameters or the status of a particular input or output. You can recognise those screens by the blinking cursor that appears on them (with the exception of the system configuration and error-logging-reset screens).
A number of screens show the current time in their top-right corner. In the screens, as reproduced in this manual, this is indicated by **hh:mm:ss**.
Values are usually denoted to by a number of **x**-signs, with one '**x**' for every possible digit in the number.

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3.2 Connecting the GINA

The supply voltage of the control unit to be read or programmed must be available (from the vehicle or an external power supply, if need be).
Connect the GINA with the control unit, using the supplied interconnection cable.

3.3 Control pad

Key	*Function*
<POWER ON/OFF>	to turn the GINA on or off (toggle)
<F1> .. <F4>	('soft keys') to make a particular choice in a menu
<0> .. <9>	to enter numerical data
<MAIN>	to call the main menu to view miscellaneous information
<PARAMETERS>	to call the parameter menu to view and enter parameter data
<DIAGNOSIS>	to call the diagnosis menu to view various system data
<NEXT>	to go to the next screen in the menu system
<ENTER>	to confirm a setting you have changed or entered

3.4 Switching on the GINA

The GINA can be switched-on after:

- the GINA has been connected with the control unit, and
- the power supply has been available to the control unit for at least 8 seconds.

Press <POWER ON/OFF>.

You can access the main menu, parameters timer and diagnosis menu by pressing, respectively <MAIN>, <PARAMETERS> or <DIAGNOSIS>.

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This message appears when the GINA is unable to communicate with the control unit:

Communication error

This can be cause by:
- bad connection (wire in cable broken or bad connector).
- GINA switched-on too quickly.

Always try to alleviate the problem first by turning the GINA off and then on again, or by pressing one of the softkeys (<F1>, <F2>, <F3> or <F4>).

This message appears if the control unit is not supported by this GINA:

DEVICE NOT SUPPORTED

You need another GINA to access this control unit.

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3.5 Main menu

Press <**main**>

MAIN MENU

info time contr

The main menu contains various data about the GINA and the control unit that is connected. You can change only some of the data.

Press <F1> (**info**).

INFO
User ID
last access: xxxxxx
u-ac d-ac u-ch d-ch

The screen shows the indification number of the person who most recently connected a GINA to this control unit.

ATTENTION: This number is overwritten when the GINA is switched off, with your own indification number.

Press <F2> (**d-ac**).

INFO
Time&date , last access
xx-xx-xx xx:xx
u-ac d-ac u-ch d-ch

The screen shows the date and time at which a GINA has, most recently, been connected with this control unit.

ATTENTION: This date and time will be updated when you switched-off the GINA.

Press <F3> (**u-ch**).

INFO
User ID
last change: xxxxxx
u-ac d-ac u-ch d-ch

The screen shows the identification number of the person who, most recently, changed any settings of this control unit.

ATTENTION: This number will be overwritten with your own identification number when you switch-off the GINA, provided you have changed at least one setting.

Press <F4> (**d-ch**).

INFO
Time&date , last change
xx-xx-xx xx:xx
u-ac d-ac u-ch d-ch

The screen shows the date and time at which the settings of this control unit were most recently changed.

ATTENTION: This time and date will be updated when you switch-off the GINA, provided you have changed at least one setting.

Press <NEXT>.

INFO
Software-version
Prog unit: xxxx
p-s p-ui acces

The screen shows the version number of the software in this GINA.

Press <F2> (**p-ui**).

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INFO
User ID
Prog unit: xxxx
p-s p-ui acces

The screen shows the identification number of the registered user of this GINA.

Press <F3> (**acces**).

INFO
Authorisation level
xxx [Device 7]
ald7 ald8

The screen shows the access level of the control unit (GINA) in the TriPlus program (truck version / device 7). You cannot change this setting.

Press <F2> (**ald8**).

INFO
Authorisation level
xxx [Device 8]
ald7 ald8

The screen shows the access level of the control unit (GINA) in the TriPlus program (trailer version / device 8). You cannot change this setting.

Press <NEXT>.

INFO
Software-version
Prog unit: xxxx
p-s p-ui acces

The screen shows the version number of the software in this GINA.

Press <NEXT>.

text vers. xxxx78002
September 1997

The screen shows the version number of the display texts in the software of the GINA.

Press <MAIN>.

MAIN MENU

info time contr

The main menu contains various data about the GINA and the control unit that is connected. You can change only some of the data.

Press <F2> (**time**).

TIME
Enter hours
xx
hrs min

The screen shows the hours of the current date and time. You can change this setting with the numeric keys. Confirm the new setting with <ENTER>.

Press <F2> (**min**).

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TIME
Enter minutes
xx
hrs min

The screen shows the minutes of the current date and time. You can change this setting with the numeric keys. Confirm the new setting with <ENTER>. As soon as you press <ENTER>, the seconds will start running at zero.

Press <NEXT>.

DATE
Enter day
xx
day mnth year

The screen shows the day of the month of the current date and time. You cannot change this setting.

Press <F2> (**mnth**).

DATE
Enter month
xx
day mnth year

The screen shows the month of the current date and time. You cannot change this setting.

Press <F3> (**year**).

DATE
Enter year
xx
day mnth year

The screen shows the year of the current date and time. You cannot change this setting.

Press <MAIN>.

MAIN MENU

info time contr

The main menu contains various data about the GINA and the control unit that is connected. You can change only some of the data.

Press <F3> (**contr**).

MAIN MENU
Adjust contrast

- +

The contrast of the display may be increased or decreased in this screen.
Press <F1> (-) to lower the contrast or <F4> (+) to raise it.

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3.6 Parameters timer

The parameters timer menu contains the parameter settings for the grease cycle. You can view and/ or change these parameters, provided you have the correct 'access level'.

Press <**parameters**>

```
PARAMETERS TIMER


io-1   io-2   io-3   ipmp
```

The screen shows the parameters timer menu with the settings for grease output ports 1, 2, 3 and other pump settings.

Press <F1> (**io-1**).

```
Info outlet 1
Interval Period
 xxxxx
ip-1   do-1   inp-1  end-1
```

The screen shows the duration (either in minutes or kilometers, depending on another parameter setting) of the grease output port 1.

Range: 0 ... 65535
Set the interval with the numeric keys <0> to <9>.

The location of the cursor (the flashing square) indicates the digit will be changed; after you entered a digit, the cursor will automatically move forward to the next digit. Press <ENTER> when you are satisfied with the setting. The cursor will then disappear from the screen.

Press <F2> (**do-1**).

```
Info outlet 1
Delivery outlet 1
 xxx.x [cc]
ip-1   do-1   inp-1  end-1
```

The screen shows the grease output (in cc) of output port 1. The grease output set must match the grease demand per greasing cycle of the branch of the greasing system connected to this output port.

Range: 0,0 ... 999,9 cc
If necessary, change this setting with the numeric keys and confirm with <ENTER>.

Press <F3> (**inp-1**).

```
Info outlet 1
Interval period
 x 0=+15  1=S1  2=S2  3=C3/B7
ip-1   do-1   inp-1  end-1
```

The screen shows the several control signals with what the interval can be counted for this output port (minutes or kilometers).

Interval in time (minutes)
0= +15 (via wire/pin nr.1, connected to the contact)
1= S1 (via wire/pin nr.3, connected to an extra control voltage)
2= S2 (via wire/pin nr.7, connected to an extra control voltage)
Interval in KM
3= C3/B7 (via wire/pin nr. 5, connected to a tacho, pin C3 or B7)
If necessary, change this setting and confirm with <ENTER>.

Press <F4> (**end-1**).

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Info outlet 1
End-switch outlet 1
x [cycles]
ip-1 do-1 inp-1 end-1

The screen shows the number of grease cycles within at least 1 pulse of the end- (block) switch (optional) must been received, to prevent an error.
If necessary, change this setting and confirm with <ENTER>.

Press <NEXT>.

PARAMETERS TIMER

io-1 io-2 io-3 ipmp

You are back in the parameters timer menu.

Press <F2> (**io-2**) to set the settings for output port 2 (see parameter settings of output port 1 with exception of **end-1**).

Press <F3> (**io-3**) to set the settings for output port 3 (see parameter settings of output port 1 with exception of **end-1**).

Press <F4> (**ipmp**).

Info pump (1)
Revolution delivery
x.x [cc.r]
rdlv vpct ldf

The screen shows the output (in cc) of the plunger pump per revolution of its drive shaft (determined by the stroke length and diameter of the plunger). With this parameter the program will be able to calculate the number of revolutions needed to achieve a certain grease output during each greasing cycle.
The default value is 0,10 (cc/r) and may not be changed.

Press <F2> (**vpct**).

Info pump (1)
Valve position change time
xxx [Sec]
rdlv vpct ldf

The screen shows the time allotted to the shuttle valve of the pump unit to complete a switching action to another grease output port.
The default value is 1 second and may not be changed.

Press <F3> (**ldf**).

Info pump (1)
Lamp display function
x 0=+15 1=S1 2=S2 3=C3/B7
rdlv vpct ldf

The screen shows the several possibilities to generate a lamp signal during a special occassion:

0= Signal light lights up for 3 seconds after switching on contact via wire/pin 1 (+15).
1= Signal light lights up for 3 seconds after switching on contact via wire/pin 1 and/or 3 (+15 and S1).
2= Signal light lights up for 3 seconds after switching on contact via wire/pin 1, 3 and/or 7 (+15, S1 and S2).
3= Signal light lights up for 3 seconds after switching on contact via wire/pin 1 and/or 5 (+15 and C3/B7).

Press <NEXT>.

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Info pump (2)
W-factor
xxxx [pulses/km]
wfct ddv masd misd

A screen with four parameter follows. Those parameters are of importance if the greasing interval is expressed in a distance (number of kilometres) travelled.
The screen shows the set value of the W-factor for the impulse sender on the vehicle, which generates a certain number of pulses per kilometre travelled.
This parameter setting must be set if, for at least one of the output ports, you have chosen to express the length of the greasing interval as a certain distance travelled or a number of machine handlings (number of single pulses). When this "wfct" value is set on 1, the timer will subtract each pulse from the remaining value until the next pumping phase.

Press <F2> (**ddv**).

Info pump (2)
Distance decrement value
xxx [km]
wfct ddv masd misd

If the length of the greasing interval had a really fixed value, the grease points would received too much grease during long trips and too little during short ones. Therefore, there are three parameters available with which, under certain circumstances, fictitious kilometres can be added to the real distance travelled. If fictitious kilometres are added, the next greasing cyle will be initiated sooner. Effectively, the three parameter settings will cause the greasing interval to shorten each time the vehicle stops or brakes.
The screen show the number of fictitious kilometres with which the current greasing interval will be shortened (see next two parameters masd and misd).
If necessary, change this setting and confirm with <ENTER>.

Press <F3> (**masd**).

Info pump (2)
Max. speed
xxx [km/h]
wfct ddv masd misd

The screen shows the speed that must be reached before a brake action or stop (see next parameter misd) may regarded as a reason to shorten the greasing interval.
If necessary, change this setting and confirm with <ENTER>.

Press <F4> (**misd**).

Info pump (2)
Min. speed
xxx [km/h]
wfct ddv masd misd

The screen shows the minimum speed to which the vehicle must have slowed, after reaching a certain speed (see previous parameter), before the greasing interval will be shortened.
If necessary, change this setting and confirm with <ENTER>.

Press <NEXT>.

Info pump (3)
Max release errors allowed
xxx [%]
mre poct voct loct

The screen shows a filter period, in % of the total pumping phase, in which a possible opening of the over-pressure relieve valve will be ignored by the program. The maximum setting is 50% calculated from the end of the pumping phase, which means that during the second half of the pumping phase valve openings will be ignored.
The standard settins is 25%, ignoring possible valve openings during the last 1/4 of the pumping phase. Openings during the first 3/4 will cause an "release during grease" (rdg) error and trigger the lamp for the rest of the pumping phase.
If necessary, change this setting and confirm with <ENTER>.

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Press <F2> (**poct**).

Info pump (3)
Pump over-current time
xxx [msec]
mre poct voct loct

The screen shows the amount of time (in milliseconds) the control unit tolerates an overcurrent or short-circuit in the electric motor of the pump, before it disconnect the electric motor. The default is 50 ms and value should not be changed.

Press <F3> (**voct**).

Info pump (3)
Valve over-current time
10 [msec]
mre poct voct loct

The screen shows the amount of time (in milliseconds) the control unit tolerates an overcurrent or short-circuit in the shuttle valve circuit(s), before it disconnect the shuttle valve(s). The default is 10 ms and value should not be changed.

Press <F4> (**loct**).

Info pump (3)
Lamp over-current time
10 [msec]
mre poct voct loct

The screen shows the amount of time (in milliseconds) the control unit tolerates an overcurrent or short-circuit in the signal light circuit, before it disconnect the signal light. The default is 10 ms and value should not be changed.

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3.7 Diagnosis menu

Press <**diagnosis**>

```
DIAGNOSIS MENU


err    I/O    var    tinfo
```

The diagnosis menu shows various pieces of information concerning the current status of the greasing system, such as error messages and the status of its input and output signals.

Press <F1> (**err**).

```
DIAGNOSIS
Total errors
  xxxxx
terr
```

The screen shows the total number of errors that have been occurred.

Press <NEXT>.

```
DIAGNOSIS
Pending errors (1)
  0      0      0      0
end1   rdg1   rdg2   rdg3
```

The screen shows four "pending errors" (=most recent errors). (0= did not occur / 1= occurred).

end1 the end switch in the greasing system, connected to the output port 1, did not send any or not enough pulses to the control unit.

rdg1 relief valve activated during pump phase in output port 1.

rdg2 relief valve activated during pump phase in output port 2.

rdg3 relief valve activated during pump phase in output port 3.

A "pending errors" is automatically cleared and moved to the “stored errors” when that error is no longer occurs during the next cycle or when the contact is switched off.

Press <NEXT>.

```
DIAGNOSIS
Pending errors (2)
  0      0      0      0
 lwl    rto    pol    poc
```

The screen shows four "pending errors" (=most recent errors). (0= did not occur / 1= occurred).

lwl minimum grease level reached in the reservoir.

rto the drive shaft of pump turns too slowly or not at all. The pump phase has been cut short.

pol open load in circuit of electric pump motor.

poc short-circuit in circuit of the electric pump motor. The pump phase has been cut short.

Press <NEXT>.

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DIAGNOSIS
Pending errors (3)

0	0	0	0
volA	vocA	volB	vocB

The screen shows four "pending errors" (=most recent errors). (0= did not occur / 1= occurred).

volA open load in circuit of solonoid of shuttle valve A.
vocA short-circuit in circuit of solonoid of shuttle valve A.
volB open load in circuit of solonoid of shuttle valve B.
vocB short-circuit in circuit of solonoid of shuttle valve B.

Press <NEXT>.

DIAGNOSIS
Pending errors (4)

0	0	0	0
lol	loc	sc	spr

The screen shows four "pending errors" (=most recent errors). (0= did not occur / 1= occurred).

lol open load in the signal light circuit.
loc short-circuit in the signal light circuit.
sc short-circuit in one of the components of the pump unit.
spr spare

Press <NEXT>.

DIAGNOSIS
Stored errors (1)

0	0	0	0
end1	rdg1	rdg2	rdg3

The screen shows four "stored errors".
(0= did not occur / 1= occurred).
For explanation see "pending errors".

Press <NEXT>.

DIAGNOSIS
Stored errors (2)

0	0	0	0
lwl	rto	pol	poc

The screen shows four "stored errors".
(0= did not occur / 1= occurred).
For explanation see "pending errors".

Press <NEXT>.

DIAGNOSIS
Stored errors (3)

0	0	0	0
volA	vocA	volB	vocB

The screen shows four "stored errors".
(0= did not occur / 1= occurred).
For explanation see "pending errors".

Press <NEXT>.

DIAGNOSIS
Stored errors (4)

0	0	0	0
lol	loc	sc	spr

The screen shows four "stored errors".
(0= did not occur / 1= occurred).
For explanation see "pending errors".

Press <NEXT>.

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```
DIAGNOSIS MENU


err    I/O    var    tinfo
```

The screen shows the diagnosis menu.

Press <F2> (**I/O**).

```
INP/OUTP
Mode:   0=auto  1=man
 X : 2=out1  3=out2  4=out3
Mode
```

The screen shows the current operating mode of the greasing system:

0	**auto**	the system operates on automatic and is executing the program stored in the control unit.
1	**man**	the functions of the greasing system are operated by hand (by means of the GINA).
2	**out1**	the system is performing a test cycle through output port 1 (amount dependent on parameter setting)
3	**out2**	the system is performing a test cycle through output port 2 (amount dependent on parameter setting)
4	**out3**	the system is performing a test cycle through output port 3 (amount dependent on parameter setting)

You can change the current operating mode by pressing one of the numeric keys <0> to <4> and confirm that with <ENTER>.
If the current greasing cycle (in "auto" mode) is interrupted, that greasing cycle will not be completed when the system is put back on "auto". The "auto" mode will automatically be restored when the contact is switched on.

Press <NEXT>.

```
INP/OUTP          hh:mm:ss
I/O (1)
  0      0      0      0
vlvA   vlvB   lamp   pump
```

This is the first I/O-screen. It shows the status of various output signals:

vlvA	solonoid of shuttle valve A is powered.
vlvB	solonoid of shuttle valve B is powered.
lamp	signal light lit.
pump	electric pump motor is running.

To test the system, these outputs may toggled manually by pressing function key <F1>, <F2>, <F3> or <F4>, to (de)activate, respectively, shuttle valve A, shuttle valve B, the signal light or the pump motor. You can only do this after the system's operating mode has been set to "1" **(manual)**.

Press <NEXT>.

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INP/OUTP			hh:mm:ss
I/O (2)			
0	0	0	0
lwl	test	rvlv	revol

This is the second I/O-screen. It shows the status of various output signals (only if the output is currently not "high"):

lwl minimum grease level reached in the reservoir.
test test pushbutton actuated.
rvlv relief valve activated (maximum grease pressure exceeded).
revol sensor impulse sent at every revolution of the drive shaft of the pump.

Press <NEXT>.

INP/OUTP			hh:mm:ss
I/O (3)			
0	0	0	0
end1	spr	spr	spr

This is the third I/O-screen. It shows the status of various input signals:

end1 sensor signal at each distribution block cycle in output port 1.
spr spare.

Press <NEXT>.

INP/OUTP			hh:mm:ss
I/O (4)			
0	0	0	0
S1	S2	C3/B7	pol

This is the fourth I/O-screen. It shows the status of various input signals:

S1 control voltage via extra switch switched-on.
S2 control voltage via extra switch switched-on.
C3B7 impulse sender on the vehicle (X impulses per kilometre).
pol open load in circuit of electric pump motor.

Press <NEXT>.

INP/OUTP			hh:mm:ss
I/O (5)			
0	0	0	0
volA	volB	lol	pol

This is the fifth I/O-screen. It shows the status of various input signal:

volA openload in circuit of shuttle valve A.
volB openload in circuit of shuttle valve B.
lol open load in signal light circuit.
pol open load in circuit of the electric pump motor.

Press <diagnosis>.

DIAGNOSIS MENU			
err	I/O	var	tinfo

The screen shows the diagnosis menu.

Press <F3> (**var**).

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```
VARIABLES        hh:mm:ss
Remainder period 1
 xxxxx
rp-1   rp-2   rp-3   rrev
```

The screen shows the remaining part (in minutes or kilometres) of the greasing interval of the greasing cycle currently running for output port 1 of the pump.

Press <F2> (**rp-2**).

```
VARIABLES        hh:mm:ss
Remainder period 2
 xxxxx
rp-1   rp-2   rp-3   rrev
```

The screen shows the remaining part (in minutes or kilometres) of the greasing interval of the greasing cycle currently running for output port 2 of the pump.

Press <F3> (**rp-3**).

```
VARIABLES        hh:mm:ss
Remainder period 3
 xxxxx
rp-1   rp-2   rp-3   rrev
```

The screen shows the remaining part (in minutes or kilometres) of the greasing interval of the greasing cycle currently running for output port 3 of the pump.

Press <F4> (**rrev**).

```
VARIABLES        hh:mm:ss
Remainder revolution
 xxxxx
rp-1   rp-2   rp-3   rrev
```

The screen shows the remaining part of the number of revolutions of the drive shaft of the pump that consitute the pump phase that is currently being executed (through one of the output ports of the pump).

Press <NEXT>.

```
VARIABLES        hh:mm:ss
Speed
 xxx.x  [km/h]
spd    rerr
```

The screen shows the current speed of the vehicle.
The speed is only shown if the control unit is connected with the impulse sender (C3 or B7 of the tacho) on the vehicle and the correct W-factor has been set in the parameters menu.

Press <F2> (**rerr**).

```
VARIABLES        hh:mm:ss
Release errors
 xxx
spd    rerr
```

The screen shows the moment the “mre” filter gets active. From start of the pumping phase this counter counts down till 0, which is the moment the filter gets active and possible over-pressure relieve valve openings will be ignored by the program.

Press <NEXT>.

```
DIAGNOSIS MENU


err    I/O    var    tinfo
```

The screen shows the diagnosis menu.

Press <F4> (**tinfo**).

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TIMER INFO MENU

pdif hist

The screen shows the timer info menu.

Press <F1> (**pdif**).

PRODUCTION INFO
Part number
xxxxx
prno srno tive

The screen shows the part number of the control unit PCB.

Press <F2> (**srno**).

PRODUCTION INFO
Serial number
xxxxxxxxxx
prno srno tive

The screen shows the serial number of the control unit PCB.

Press <F3> (**tive**).

PRODUCTION INFO
Timer version
xxx
prno srno tive

The screen shows a version number which denotes both the software version and the type of hardware present.

Press <NEXT>.

TIMER INFO MENU

pdif hist

The screen shows the timer info menu.

Press <F2> (**hist**).

HISTORY
Total cycles outlet 1
xxxxxxxx
tcy1 tcy2 tcy3 teewr

The screen shows the total number of greasing cycles that the system has, thus far, performed in output port 1.

Press <F2> (**tcy2**).

HISTORY
Total cycles outlet 2
xxxxxxxx
tcy1 tcy2 tcy3 teewr

The screen shows the total number of greasing cycles that the system has, thus far, performed in output port 2.

Press <F3> (**tcy3**).

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HISTORY
Total cycles outlet 3
xxxxxxxx
tcy1 tcy2 tcy3 teewr

The screen shows the total number of greasing cycles that the system has, thus far, performed in output port 3.

Press <F4> (**teewr**).

HISTORY
Total EEPROM writes
xxxxxxxx
tcy1 tcy2 tcy3 teewr

The screen shows the total number of times the contents of EEPROM have been overwritten.

Press <NEXT>.

HISTORY
Total distance
xxxxxxxx [km/pls]
tdis

The screen shows the total number of kilometres travelled.

All screens have now been visited. If you have completed reading or programming the control unit, you can switch-off the GINA.
Press <POWER ON/OFF> and disconnect the interconnection cable and remove the GINA.

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3.8 Layout of the menu system

3.8.1 Used abbreviations

Abbreviation	*Meaning*
-	minus (decreasing contrast)
+	plus (increasing contrast)
access	authorisation level
ald (7)	authorisation level device (7) (TriPlus truck-version)
auto	automatic
C3B7	speed-impulse tachograph (conn. C, pin 3 or conn. B, pin7)
contr	screen contrast
d-ac	time & date, last access
d-ch	time &date, last change
day	day
ddv	distance decrease value
do1	delivery output (1)
end1	end-switch in the system, connected to output port (1)
err	errors
hist	history
hrs	hours
I/O	inputs/outputs
info	information GINA
inp/outp	inputs/outputs
lamp	lamp
loc	lamp over-current
loct	lamp over-current time
lol	lamp open load
lwl	low level switch
man	manual
masd	maximum speed difference
misd	minimum speed difference
min	minutes
mode	mode
month	month
mre	filter period in which a possible opening of the over-pressure relieve valve will be ignored by the program
p-s	software-version GINA
p-ui	user id GINA
pdif	production info
po1	pump output (1)
poc	pump over-current

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Abbreviation	*Meaning*
poct	pump over-current time
pol	pump open load
prno	part number
pump	pump
rdgr	relief valve activated during pump phase
rdlv	grease output per revolution of the pump drive shaft
rvlv	relief valve
rerr	relief valve errors
rrev	remaining number of revolutions for the current pump phase
revol	revolution sensor
rp-1	remaining part of pause phase of greasing cycle through output port (1)
rto	revolution time out
S1	control voltage via extra switch (1)
S2	control voltage via extra switch (2)
sel1	select (km/hours) for pause phase for output port (1)
spd	speed
spr	spare
srno	serial number
tcy	total cycles
tdis	totaal distance
teewr	total EEPROM writes
terr	total errors
test	test pushbutton
text vers.	text version, software GINA
time	time
tinfo	timer information
tive	timer version
tot	total operating time
tpt	total pumping time
u-ac	user id, last access
u-ch	user id, last change
var	variables
vlvA	shuttle valve (A)
vocA	over-current shuttle valve (A)
voct	over-current time shuttle valve
volA	open-load shuttle valve (A)
wfct	W-factor
year	year

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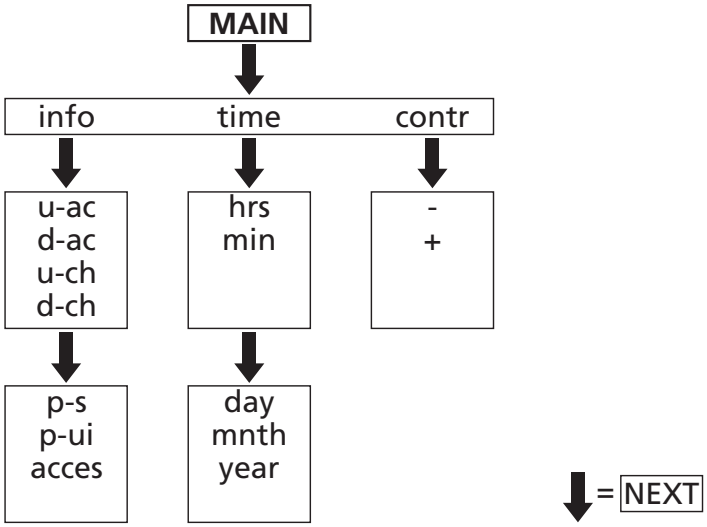
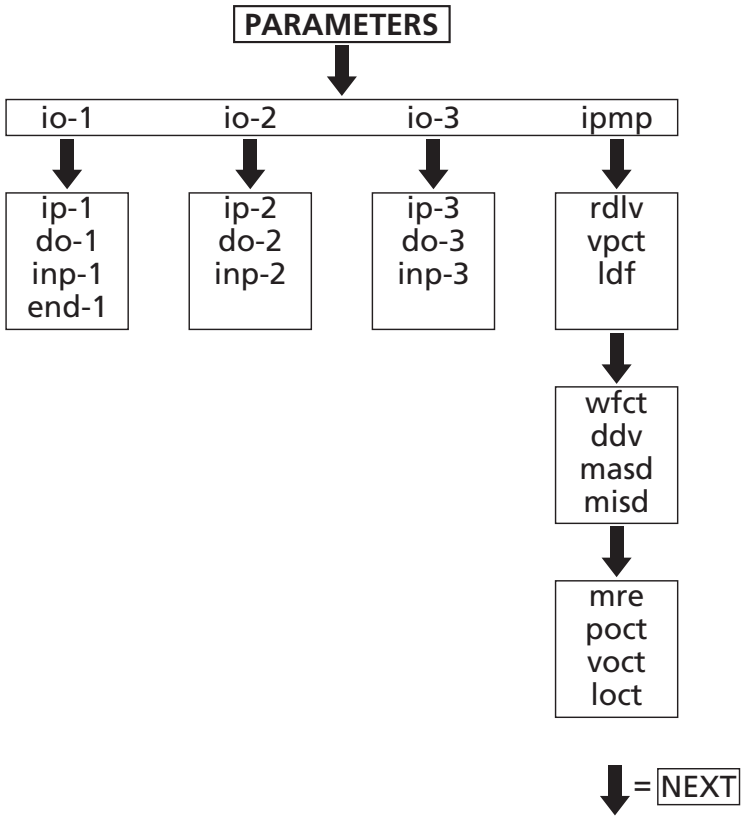
3.8.2 Main menu



3.8.3 Parameters menu



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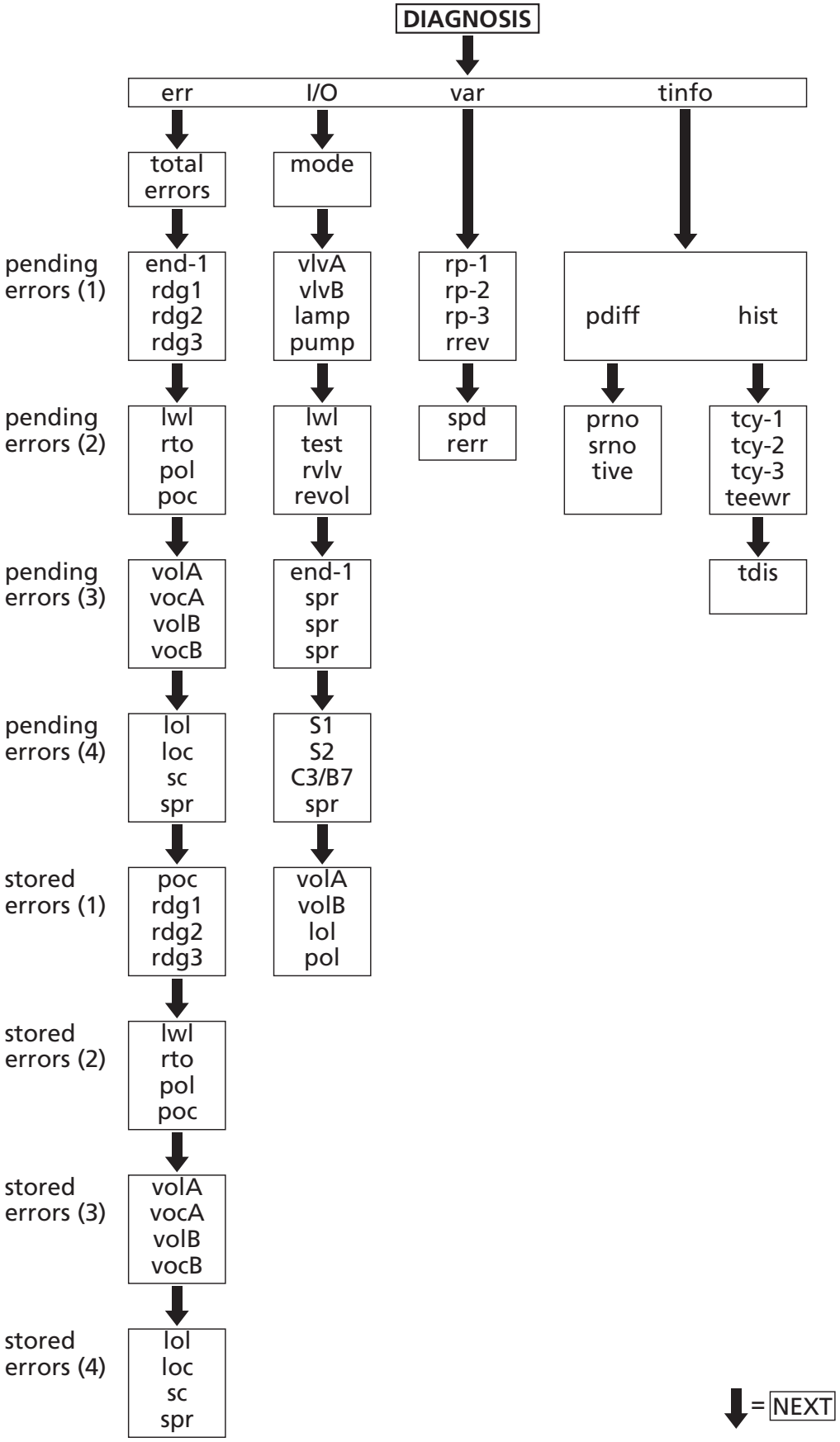
3.8.4 Diagnosis menu



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4. Designing a system

4.1 Introduction

The following aspects influence the design of a TriPlus greasing system:

1. The number of grease points to be connected and:

- The position of the grease points on the vehicle or machine.
- The grease demand of the grease points.
- The greasing interval required by the grease points.

2. The space available on the vehicle or machine for the pump unit and the distribution blocks.

3. The NLGI class of the grease to be used and the lowest ambient temperature under which the greasing system is expected to function.

4.2 Points of departure

Pump	
Maximum working pressure	275 bar
Number of grease output ports	up to 3
Distribution blocks	
Maximum number of distribution blocks in series	2
Available segment types	table 1
Minimum number of doser segments in a distribution block	3
Maximum number of doser segments in a distribution block	12
Pressure drops in a distribution block, related to:	table 2
• The number of segments in the distribution block	
• The NLGI class of the grease used	
• The ambient operating temperatures	
Primary and secondary grease lines	
Pressure drops in the grease lines, connected with:	table 3
• The diameter of the lines	
• The length of the lines	
• The NLGI class of the grease used	
• The ambient operating temperatures	
Resistance at the grease point	
Ball or roller bearing	5 bar
Slide bearing	15 bar

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Table 1: Outputs of doser segments

Segment type	*Output per segment (2 outputs) [cc]*	*Output with combined outputs [cc]*
45	2 x 0,045cc	0,090cc
125	2 x 0,125cc	0,250cc
200	2 x 0,200cc	0,400cc

Table 2: Internal resistance in a distribution block (bar)

Grease class	*T [°C]*	*3 doser segments*	*8 doser segments*	*12 doser segments*
NLGI 2	+20	14 bar	16 bar	22 bar
	+10	28 bar	24 bar	26 bar
	0	34 bar	44 bar	55 bar
	-10	52 bar	58 bar	72 bar
	-15	73 bar	77 bar	100 bar
	-20	80 bar	85 bar	170 bar

Table 3: Grease line resistance (bar per metre)

Grease class	*T [°C]*	*PA ø3/16 ø2,4 mm i.d.*	*PA ø6 ø3 mm i.d.*	*High-pressure hose DN4 ø4mm i.d.*	*High-pressure hose DN6 ø6mm i.d.*
NLGI 2	+20	6 bar	6 bar	6 bar	3 bar
	+10	14 bar	8 bar	6 bar	4 bar
	0	17 bar	12 bar	10 bar	6 bar
	-10	25 bar	18 bar	16 bar	9 bar
	-15	34 bar	25 bar	20 bar	14 bar
	-20	55 bar	36 bar	30 bar	22 bar

REMARK
The values in these tables were collected during laboratory and field tests and will be supplemented as new data becomes avialable.

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4.3 Method

1. Determine the conditions under which the system must be able to operate.
2. Make a so-called greasing plan.
3. Indicate, in the greasing plan, the grease demand and greasing interval required by each grease point.
4. Compile the greasing points in groups.
5. Determine the required layout of the greasing system.
6. Check, by calculation, whether the system will be able to operate under the conditions determined during step 1.

4.3.1 Determine the operating conditions

Determine with which type and NLGI class of grease the system must be able to operate at the lowest ambient temperature expected.

4.3.2 Produce a greasing plan

Make a simplified layout drawing of the vehicle and/or the machine. Indicate the positions of the grease points on that drawing and number them.

4.3.3 Determine the grease demand of the grease points

Note the grease demand (per particular period) of each grease point in a particular period on the greasing plan. The grease demand can be determined by combining the recommended amount and the recommended greasing frequency. This information can be extracted from:

- The maintenance instructions concerning the vehicle or machine.
- Existing greasing plans for class 0 or 2 grease systems.
- Information provided by the manufacturer, importer, dealer, owner or maintenance personnel.
- The information in the table below.

Description	*Segment type*	*Description*	*Segment type*
Upper stub axle	3	Stub axle, single grease point	2 x 3
Lower stub axle	3	Automatic brake adjuster	1
Suspension bearing, brake axle (drum side)	1	Suspension bearing (brake adjuster side)	1
Upper stabiliser	1	Lower stabiliser	1
Spring shackle	3	Rotation point of spring	3
Cabin bearing	1	Coupling disc pin	1
Coupling disc	2 x 4	Tail board hinge	1
Coupling disc, rotation point	1	Suspension bearing drive shaft	1
Tail board cyclinder	1		

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4.3.4 Group the grease points

Compile groups of grease points, taking account of the following:

- A main distribution block or multiple grease output ports on the TriPlus pump may be utilised.
- The maximum and minimum number of doser segments that can be combined in a single distribution block.
- The lengths of the primary and secondary lines in relation with the NLGI class of grease that must be used and the projected operating temperatures.
- Any special demands that might be placed on the grease output and the greasing interval.

4.3.5 Determine the layout of the system

Note the positions of the pump unit and the distribution blocks on the greasing plan. Determine the required composition of the distribution blocks, based on the group of grease points to be connected with that block. Indicate the routing of the grease lines on the greasing plan. Take account of:

- The routing of the lines and the type of secondary grease lines that will be used (single or composite lines with 2 to 3 seperate lines).
- The possibility to combine outputs of doser segments.
- The minimum (3) and maximum (12) number of doser segments that can be combined in a single distribution block.

Calculate the grease demand of the whole distribution block per whole cycle of the distribution block (the sum of all rated grease outputs of all doser segments in the block).

System featuring a main distribution block

Determine the composition of the main distribution block by:

- Determining the ratios of the grease demands of the distribution blocks to be connected to the main distribution block.
- Selecting segment types for the main distribution block with which those ratios are most precisely matched.
- Determining the required grease output (per particular output port) of the pump unit. This is the sum of the grease demands of all distribution blocks connected with that output port (**excluding the main distribution block!**).

This value can be used in a later stage to determine the grease output of that output port of the pump unit.

System without a main distribution block

- The determined values may be used to calculate the required grease output of each output port of the pump unit.

Determine the lengths of the primary grease lines between the pump unit and the distribution blocks (between the distribution blocks) and the lengths of the secondary grease lines between the distribution blocks and the grease points. Note those lengths on the greasing plan. Determine the number of non-return valves that must be incorporated into the greasing system.

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4.3.6 Check the design

Before the components of the system are assembled and installed, the projected system should be checked, by calculation, against the operating conditions it was designed for. Will it work under the giving operating conditions?
The loss of pressure in the system may not exceed P*p* (P*p* equals 90% of the maximum operating pressure supplied by the pump unit).

1. Calculate the pressure loss P*v* over the distribution blocks, under the set operating conditions, using table 2.
2. Determine, using the greasing plan, which grease point is furthest from the pump unit. Calculate, using table 3, the total pressure loss "P*l*" over that grease line.
3. Determine which type of grease point is connected to this grease line. Determine the resistance "P*s*" induced by that type of grease point (see 5.2 Points of departure).
4. Calculate the largest, total loss of pressure "Pt" for each output port of the pump unit by adding together the values of the pressure losses in the grease lines, distribution blocks and at the grease point (P*t* = P*v* + P*l* + P*s*).
5. Check: that P*t* ≤ P*p*.

If the loss of pressure in the system exceeds P*p* investigate the following:

1. Is it possible to use a grease of a lower NLGI class?
2. Is it possible to raise the minimum operating temperature requirement?
3. It might be necessary to redesign the system and reconsider whether:
   - Its not better to omit the main distribution block by utilising a pump unit with more grease output ports.
   - The layout of the system can be modified to shorten the grease lines or to reconfigure the distribution blocks.
   - Using a grease line of larger diameter to reduce pressure loss will solve the problem.

After you have redesigned the system you should always recalculate its suitability.

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5. Installation

5.1 Overview

To install a *Groeneveld* TriPlus greasing system the following tasks must be performed:

1. Mounting the pump (including the control unit).
2. Mounting the progressive distribution blocks.
3. Mounting the primary grease lines (between the pump and the distribution blocks and between the distribution blocks themselves).
4. Mounting the secondary grease lines and couplings.
5. Mounting the electrical wiring.
6. Testing the system.

There are a few different types of pump unit available (all with integrated control unit). The type of pump unit most suitable for a particular greasing system can be determined on the basis of:

- The type and model of the vehicle or machine on which the TriPlus system is to be installed. An important discriminator is, for instance, whether the vehicle or machine is capable of supplying the greasing system with an uninterrupted power supply voltage (+15 or +30).
- The number of greasing points to be served and the layout of the greasing system.
- The specific wishes the user may have concerning the greasing system.

5.2 Safety precautions

1. Take the necessary precautions to prevent potentially dangerous situations from occuring during installation, checking and maintenance.
2. Always apply or use adequate safety measures to prevent bodily harm and damage, before you start working on the vehicle.
3. Ensure the vehicle is immobilised before you start work. Remove the ignition key and store it in a safe place. Block parts that may move on their own accord. Engage the parking brake.
4. Pay special attention to tailbords, loading flaps, drop flaps, etc. Take care that you can work safely unter these parts, without these parts can drop down.
5. Never work underneath a vehicle which is raised by a jack only. Always use a trestle and check that the ground is firm and flat enough.
6. Keep in mind that a vehicle with air-suspension may drop of its own accord.
7. Only work underneath the cabin if it is fully tilted (and latched). Otherwise a support must be placed underneath the cabin to ensure the cabin cannot drop back.
8. Disconnect the earth-clamp from the vehicle's battery. This prevents electrical equipment from being inadvertently activated.
9. Avoid working on the cooling system without allowing it to cool down first. The system is pressurised and may cause burns. Direct contact with the (poisonous) cooling fluid must be avoided.
10. Adhere to all regulations, specifications and limitations as specified by the manufacturer of the machine, vehicle or engine.
11. Only use tools that fit and are designed for the specific task you want to perform with them.
12. A vehicle or machine may only be operated by those who are competent to do so and aware of all possible dangers. If necessary, an expert should be consulted.
13. Keep the environment in which you work clean and tidy. This enhances safety.

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5.3 General installation directives

1. Check the contents of the parts kit (using the parts list including in the kit).
2. Before you start installing the greasing system: Check that all grease points are open and furnished with a sufficient amount of grease. If that is not the case, grease the grease points by hand. This prevents insufficient greasing of the grease points during the period following the first few greasing cycles of the greasing system.
3. Apply Teflon tape, or another type of sealant (e.g. Loctite), to the couplings and plugs on the distribution blocks and pump unit, if not already fitted with O-rings, gaskets or sealing rings. While mounting the couplings and plugs, make sure that the tape does not cause internal contamination of the system.
4. Prevent contamination of the system during the installation. Work with clean tools and clean the areas on the vehicle or machine where the distribution blocks and pump unit are to be mounted, before you start installing them. **Even small contaminations can cause the greasing system to malfunction!**
   Flush the primary grease lines after installation or maintenance, if contaminations or moisture could not be prevented from entering the system. The de-aerating procedure may be used to flush the system.
5. During installation of the grease lines and electrical wiring, ensure that:
   - the lines are not mounted onto parts that may become hot, such as the exhaust, retarder, compressor, turbo charger and air conditioning;
   - the lines are routed straight and neatly, and are properly fixed in place with small or large tie-wraps or clamps;
   - the lines that are mounted along moving parts have enough slack and are mounted in such a manner that , even in the long run, they will not be damaged, through abrasion or otherwise;
   - the lines to moving parts are sufficiently long to follow the movements. Check this by moving the parts to all positions possible;
   - feed-through rubbers are applied at all locations where the lines may otherwise get damaged.

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5.4 TriPlus pump unit

5.4.1 Pump types

There are a few different types of pump unit available (all with integrated control unit).

The type of pump unit most suitable for a particular greasing system is determined by:

- The type and model of the vehicle or machine on which the TriPlus system is to be installed. An important discriminator is, for instance, whether the vehicle or machine is capable of supplying the greasing system with an uninterrupted power supply voltage (+15 or +30).
- The number of greasing points to be served and the layout of the greasing system.
- The specific wishes the user may have concerning the greasing system.

The following pump unit types are available:

- The TriPlus pump units with 1, 2 or 3 independent grease output ports.
- The TriPlus trailer pump unit with 1 grease output port.

The TriPlus pump units are usually applied on pulling vehicles (trucks). The TriPlus trailer pump units are primarily meant for use on pulled vehicles (trailers).

5.4.2 Mounting the pump

1. If the projected location for the pump unit is not indicated on a vehicle-specific greasing plan, determine, in consultation with the client, the most suitable location of the pump unit on the vehicle. Take account of:
   - The pump unit must be easily accessible (for filling its grease reservoir).
   - The grease level in the reservoir must be easy to inspect visually.
   - The pump unit must be protected against possible damage.
2. First investigate whether existing mounting holes in the chassis of the vehicle can be used to mount the mounting plate of the pump unit. Always follow the directions of the vehicle's manufacturer when you need to drill new holes. Do not let the mounting plate rest on the profile flange of the chassis and do not drill additional mounting holes in the flange in an effort to fix the mounting plate even more securely. Be sure not to damage anything (e.g. lines or air- tanks) that may be present behind the part in which you drill a hole. After drilling a hole, always remove the chips (with compressed air or brush).
3. If the mounting plate is to be welded onto the vehicle, the directions of the vehicle's manufacturer should be strictly adhered to.
4. Mount the mounting plate with the pump unit onto the chassis.
5. Remove the yellow/red transport plugs from the grease output port(s) and the de-aerating opening of the pump unit.
6. Mount the coupling(s) for the primary grease line(s) onto the output port(s) of the pump unit.

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5.5 TriPlus distribution blocks

5.5.1 General

The composition of a progressive distribution block is always vehicle/machine-specific.

If the distribution blocks are part of an installation kit, the secondary grease lines and the couplings for the primary grease lines (to the pump unit or main distribution block) will, usually, have already been mounted onto the distribution blocks.
If the blocks are not part of an installation kit and have not been pre-assembled, you should mount the grease lines and couplings before you mount the distribution block onto the vehicle or machine.

5.5.2 Assembling distribution blocks

The distribution block must be assembled before it can be installed on the vehicle. To ensure the reliability of the greasing system, the distribution blocks should be assembled in a clean, dust-free environment.

The criteria that govern the composition (number and type of doser segments) of a distribution block are discussed in the Designing a system section of this manual.

1. First study the drawing of the distribution block to be assembled.
2. Check whether all required components are at hand and whether the right couplings for the right kinds of secondary grease line are available.
3. Begin by placing the start-segment (to which the primary grease line will be connected) onto the work bench with the port for the primary grease line facing downward.
4. Place, in the order as indicated on the drawing, the various doser segments on top of the start-segment. Place the end-segment on top of the stack. Ensure that all the openings in the segments are line-up and check that the required O-rings have been correctly placed between all the segments.
5. Place, using two toothed spring washers, the compression bolts through their respective holes. Tighten the two bolts alternately and in phases (allen key: 5mm). Tightening moment: 12 Nm.
6. If two output ports of a doser segment need to be combined, remove (allen key: 2,5mm) the little internal plug that seperates the two output ports. The grease output of the port that remains open will then be double its normal output.
7. Mount the couplings, non-return valves and plugs into the output ports of the distribution blocks, as indicated on the drawing.
8. Mount the secondary grease lines.
9. Connect a grease pump or manual grease gun to the port of the primary grease line to test the operation of the distribution block and to check for leakage.

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5.5.3 Mounting the distribution blocks

Determine the location of the distribution block on the vehicle or machine. Consult the specific installation instruction card and/or take account of:

- No stresses may be present in the mounted distribution block. It is best to use mounting brackets to install the distribution blocks!
- The distribution blocks should not be installed too near moving parts.
- The distribution blocks should not be installed near parts that become hot (e.g. turbo charger, exhaust).
- Existing mounting holes in the chassis should be utilised, whenever possible.

The distribution blocks can be mounted with the mounting brackets in two ways:

1. First mount the brackets. Then mount the distribution block onto the brackets (this method is compulsory if the brackets are welded onto the vehicle or machine).
2. First mount the distribution block onto the bracket. Then mount this assembly on the vehicle.

Which method is to be preferred depends on the manoevring space you have available.

ATTENTION
Always apply toothed spring washers to the M5 mounting nuts and bolts of the distribution blocks. Tighten the bolts alternately and evently. Maximum tightening moment: 5 Nm.

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5.6 Primary grease lines and couplings

5.6.1 Grease line types

The primary grease lines are those between the pump unit and the distribution blocks, and between the distribution blocks themselves. The primary grease lines are available in a number of different sizes and materials.

- Flexible high-pressure line DN4 (inside diameter 4,0 mm - outside diameter 9,7 mm).
- Flexible high-pressure line DN6 with steel-wire armour (inside diameter 6,0 mm - outside diameter 12,0 mm).
- Metal lines with sizes ø6 x 1 mm or ø8 x 1 mm.

The type of primary grease line most commonly used in the transport industry is the flexible high-pressure line DN4. This high-quality line combines compactness with high strength and flexibility.

5.6.2 Mounting the primary grease lines

To limit the loss of pressure in the system, particularly at low temperatures, the length of the system of grease lines should be as short as possible. Please take account of this, especially when you decide to re-route a grease line.

1. Determine the required length of the grease line to be installed, and cut it to that length.
2. Mount the couplings onto the line (with high-pressure lines).

Removable couplings:

a. Clamp the sleeve in a bench vice.
b. Turn the line into the sleeve, to end of the sleeve (counter-clockwise!).
c. Turn the line backward 1/4 to 1/2 turn.
d. Apply oil or grease to the pillar, the sleeve and the inside of the line.
e. Turn (clockwise) the grease line pillar in the sleeve, untill it is in position without tension.
f. Mount the coupling at the other end of the grease line in a similar way.

Press couplings (applied with a simple hand-operated press) for high-pressure line DN4 (F115307):

a. Slide the press sleeve completely over the end of the grease line, so that the line fills the sleeve completely.
b. Slide, use some oil if necessary, the pillar or the required coupling pin into the end of the grease line untill the pillar is completely in the grease line.
c. Place the assembly in the press in such a manner that a little piece of the sleeve remains visible at both sides. Apply pressure until the lever of the hand-operated press reaches its end-stop.
d. Mount the coupling at the other end of the grease line in a similar way.

ATTENTION
A simple hand-operated press that can be placed in a bench vice is used with DN4 high-pressure lines. The thin-walled sleeve of the couplings for this type of grease line must be pressed exactly in the middle, so that small pieces of unpressed sleeve remain on both sides. This note of attention does not apply to sleeves meant for use with a hydraulic press. Those types of sleeves must be pressed over their whole length.

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Press couplings (applied with a hydraulic press) for high-pressure grease line DN6 (F113422):

a. Check that the press is fitted with the correct type of press blocks, and the set press diameter. The correct press diameter for this type of grease line is 14,6 mm.
b. Slide the sleeve over the end of the grease line, until it covers the line completely.
c. Slide, use some oil if necessary, the pillar or the required coupling pin into the end of the grease line until the pillar is completely in the grease line.
d. Pull the sleeve back slightly until it touches the outside edge of the coupling pin. While doing this, ensure that the pillar remains in place and is not pressed out of the grease line.
e. Place the assembly into the press and press the sleeve to the required diameter (14,6 mm).
f. Check the resulting diameter by measuring it (between ridges that may have formed).
g. Mount the coupling at the other end of the grease line in a similar way.

3. Remove any burrs and other remnants produced by cutting the line, and clean the grease line by blowing it through. Check that the line is free of obstructions and check it for internal damage behind the couplings (the inner lining may have been upset).
4. Fill the line with grease. Either use a pneumatic or hand-operated grease gun.
5. Install the grease line and fix it in place with tie-wraps or clamps. Do not yet connect the primary grease line(s) to the output port(s) of the pump unit, if you want to use the pneumatic or hand-operated grease gun to de-aerate the system.

ATTENTION

Always use steel cutting rings when using metal grease lines and couplings.

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5.7 Secondary grease lines and couplings

5.7.1 Grease line types

The secondary grease lines are the ones between the distribution blocks and the grease points. These grease lines are connected to the grease points with the aid of special couplings. A wide variety of couplings is available.

Which types of couplings should be applied depends, among more things, on:
- The screw thread at the greasing point.
- The position of the greasing point.
- The direction from which the grease line approaches the grease point.
- The type of grease line employed (polyamide lines with brass or steel couplings; metal lines or high-pressure lines with steel couplings).
- The operation conditions.

The secondary grease lines can be supplied in a number of different sizes and materials:
- Polyamide lines with outside diameters of 3/16" or 6 mm (standard).
- Stainless steel lines with the outside diameters of 3/16" or 6 mm (standard).
- Kunifer (copper/nickel) lines with outside diameters of 3/16" or 6 mm (standard).
- Flexible high-pressure lines with inside diameters of 4 mm or 6 mm (1/4").

The type of secondary grease line most commonly used in the transport industry is the polyamide line with an outside diameter of 3/16” or 6 mm. These grease lines are supplied as composite lines. In a composite line 2 or 3 polyamide lines are held together by a single plastic jacket. Each grease line in such a composite line has its own colour (red, blue or black), so that they can be easily distinguished at the ends of the composite line (necessary for easy installation and maintenance).

If a composite line is connected to doser segments with different grease outputs, the individual grease lines should be connected as follows:
- Doser segment with the lowest output — Red line
- Doser segment with the highest output — Black line
- Doser segment with intermediate output — Blue line

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5.7.2 Mounting the secondary lines

Take attention at the following points during mounting the secondary grease lines and couplings:

- Always make sure the screw threads of the coupling(s) and the grease point are identical.
- To identify them, elbow couplings with metric screw thread are marked with a "M". Straight couplings with metric screw thread have a groove on their hexagons.
- Always apply brake booster rubbers when routing grease lines along the vehicle's booster lines (this to prevent the booster lines from becoming pinched-off (over time) by the tie-wraps that are usually used to fix grease lines).
- Never add extra grease points on your own accord. The integrity of certain structures may be adversely affected by drilling holes. Always adhere to the relevant directives issued by the vehicle's manufacturer.

If a vehicle-specific greasing plan is available, the types (or combination) of couplings to be used at grease point will have been noted on that plan.

First remove the existing grease nipple at the grease point, and replace it by the required coupling(s).
If the grease point to be connected is a so-called "added" grease point, a hole must be drilled and the right thread tapped. Do not forget to clean the new hole of any debris. Mount the required coupling(s) onto the grease point (see the greasing plan). Make sure that elbow couplings point in the direction of the grease line (avoid unnecessary (sharp) corners in the grease line).

ATTENTION
Always check that the newly drilled grease point is open by applying a hand-operated grease gun to it.

1. Determine the most suitable route for the (composite) grease line to the grease line(s).
2. Cut the grease line at roughly the required length.
3. Determine approximately, the required length of the individual grease lines in a composite (polyamide) line. Make absolutely sure that you do not damage the individual grease lines!
4. Strip and remove the outer jacket.
5. Fix the line in place with tie-wraps or clamps up to the coupling at the grease point.
6. Cut the (individual) grease line to its required length and connect it with the coupling to the grease point.

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5.8 Electrical wiring

5.8.1 General

Detailed wiring diagrams are available as aids to install the electrical wiring. Where possible, pre-assembled wire harnesses are employed.

ATTENTION
To prevent damage to the electrical system of the vehicle or machine, the correct fuses must be installed in power supply circuit (+15 and +30). This does not apply to systems with a TriPlus trailer pump, because those systems make use of the already adequately fused brake light circuit of the vehicle. Consult the wiring diagrams or the tables below for the correct fuse values.

On VLG vehicles special demands are placed on:

- the components (e.g. pump, wiring and switches).
- the location of the components on the vehicle.
- the manner in which the greasing system is to be connected to the vehicle's electrical system.

Always verify whether the system you are installing and the methods you plan to use meet those demands.

- Install the wiring only after the main components of the greasing system have been mounted (e.g. pump unit, signal light, monitoring switches on the distribution blocks).
- Try, as far as possible, to route the electrical wiring along the grease lines, and fix the wiring in place together with the grease lines.
- Connect the trailer pump to the braking-lights supply wire and ground potential (do not exchange these connections). Make the connection in a waterproof junction box on the trailer, and ensure the cable is fed into the junction box properly (watertight). If required, mount an extra swivel onto the junction box.

5.8.2 Fuse ratings

Voltage	*Supply circuit fuse*	*Control circuit fuse*
12 Vdc	15 A	5 A
24 Vdc	7,5 A	5 A

5.8.3 Pin-layout of the connector on the pump unit

Pin number connector	*Description connection*
1	Supply voltage (+15)
2	Ground (-31)
3	Additional control voltage 1
4	Signal light (-)
5	Speed signal (C3/B7)
6	K-line (communication with the GINA)
7	Additional control voltage 2
8	End-switch for output port 1

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5.8.4 Wiring diagram

1. Pump unit
2. Revolution sensor
3. Relief valve
4. Test pushbutton
5. Minimum grease level switch
6. Controle unit
7. Pump motor
8. Shuttle valve (A)
9. Shuttle valve (B)
10. End (distribution block)-switch
11. Control voltage via an extra switch1
12. Control voltage via an extra switch 2
13. Speed signal
14. Signal light
15. Ignition
16. 8-Pole connector
17. Battery

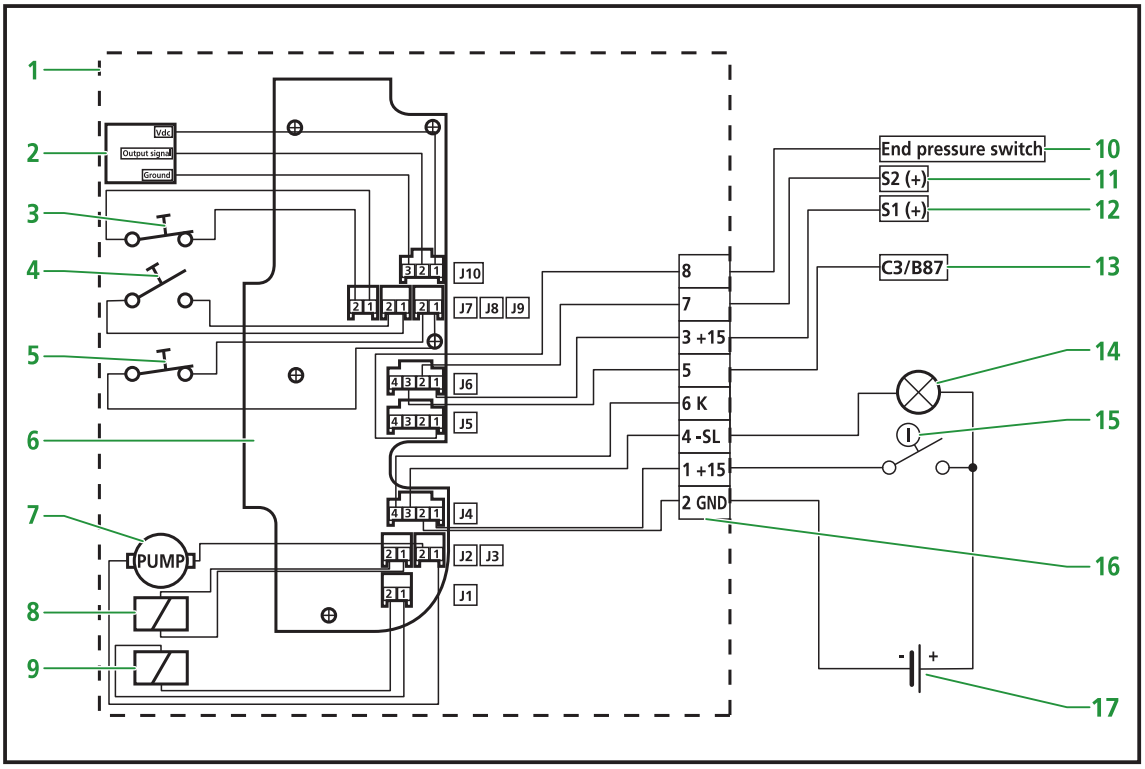

Figure 5.1 Wiring diagram

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5.9 De-aerating of the greasing system

The greasing system can be de-aereted in three different ways:

Method 1

This method can be used when a pneumatic greasing system is available in the workshop. With such a system the greasing system can be de-aereted quickly by connecting the primary grease line of the TriPlus system (at the pump unit) with that system. If the pump unit has more than one grease output port, the procedure must be repeated through the other primary grease line(s). After the system has been de-aereted, the primary line(s) must be reconnected to the right output port of the pump unit.

Method 2

This method may be used when only a hand-operated grease gun is available. The procedure is the same as described for method 1.

Method 3

This method will have to be used when neither a pneumatic system or a hand-operated grease gun is available. There is no need to disconnect the primary grease line(s) from the pump unit. If the pump unit has more than one grease output port, its shuttle valves must be placed in certain positions with the GINA to select one of the output ports. The pump unit must then be started and be allowed to run until the branch of the system connected to the selected output port is properly de-aereted. This procedure must be repeated for each output port of the pump unit.

The system has been de-aereted properly when a closed collar of fresh grease is present at all grease points.

5.10 Commissioning of the greasing system

During commissioning, the system parameters (greasing interval, grease supply per phase, etc.) must be set or checked using the GINA. Detailed information about the system parameters and the operation of the GINA can be found in the chapter
"GINA" of this manual.
After you have set or checked the system parameters with the GINA, you should initiate a test cycle with the GINA or the test pushbutton on the pump unit. A test cycle should be performed for every grease output port of the pump unit. After conclusion of the test cycle you can check with the GINA whether the system functioned properly.
Check, again with the GINA, whether the various input signals of the control system (e.g. the extra control voltages S1 and S2, sensors and switches) are received properly. To do this, check the read-outs in the DIAGNOSIS/IO screens 4 and 5, while switching the relevant input signals.

ATTENTION
If the system has a TriPlus trailer pump it is required that the brake lights of the vehicle are lit during the test cycle(s), otherwise the pump unit would be without a power supply.

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6. Maintenance

6.1 General

The maintenance of *Groeneveld's* TriPlus systems can be combined with the normal maintenance of the vehicle or machine.

WARNING
If a high-pressure steam/water jet is used to clean the vehicle or machine, the pump unit of the greasing system should not be directly exposed to the jet. This to prevent water from entering the pump unit through its de-aerating opening. During normal operation, however, water will never be able to enter the pump unit.

ATTENTION
The automatic greasing system reduces the time and effort spent on manual greasing significantly. However, do not forget that there may be grease points that are not served by the greasing system and must still be greased by hand.

6.2 Regularly checks of the greasing system

Check the following points of the TriPlus greasing system:

1. The grease level in the reservoir of the pump unit (refill on time).
2. The pump unit for damage and leakage.
3. The operation of the whole greasing system. Perform a test cycle for every grease output port of the pump unit. Retrieve the fault codes stored in the control unit, either by using the test pushbutton on the pump unit or by connecting a GINA to the control unit.
4. The primary and secondary grease lines for damage and leakage.
5. The grease points, collar of fresh grease should be present at all grease points.

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6.3 Filling the grease reservoir

When the grease in the reservoir reaches its minimum level, the reservoir needs to be refilled. To facilitate this, the pump unit is fitted with a grease nipple onto which a garage grease pump can be placed.
To be able to fill the reservoir using a special filling pump, a special filler coupling can be installed. *Groeneveld* can supply you with both mobile or stationary, hand-operated or pneumatic filling pumps.

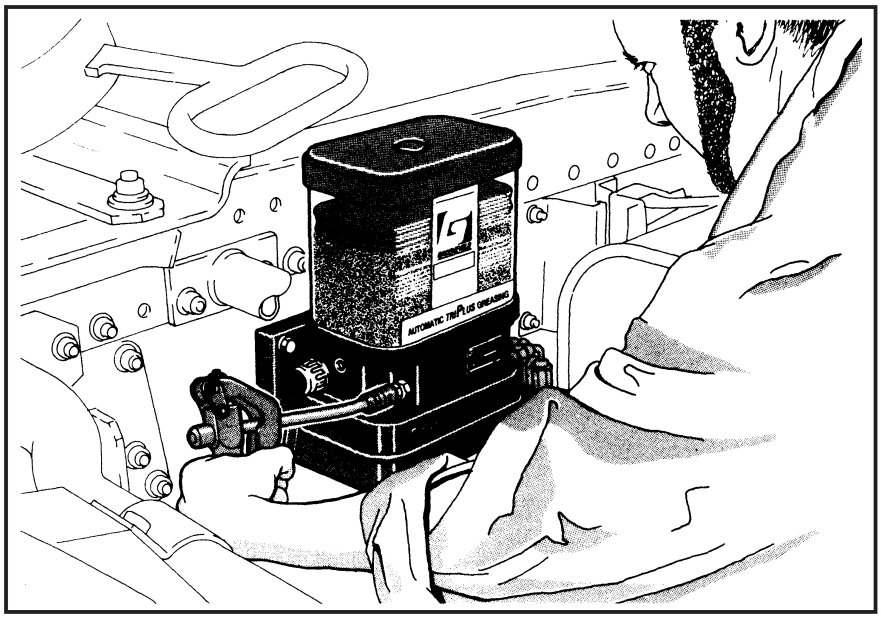

Figure 6.1 Filling the reservoir with a garage grease pump

Filling procedure

The grease pump must be suitable for class 2 grease.
First fill the filling hose with grease (if the filling pump or grease barrel is new). This prevents air being introduced in the grease reservoir.

1. Remove the dust cap of the filler coupling.
2. Clean the filler coupling and the coupling on the hose thoroughly.
3. Lock the hose onto the filler coupling or position the grease gun onto the filler coupling.
4. Fill the reservoir up to its maximum level, as indicated on the reservoir. Never fill the reservoir any higher than the maximum level indicated, otherwise the follower piston may become damaged.
5. Remove the filling hose or grease gun.
6. Clean the dust cap and the grease nipple or filling coupling with a clean rag. Place the dust cap back onto the filler coupling.

NOTES
If the pumping action seems to go heavy, check the filter behind the grease nipple or filling coupling on the pump unit. Clean the filter and the grease nipple or filler coupling. Also check the filling hose for obstructions and clean it.
Any air that may be introduced beneath the follower piston will escape through an opening at the top of the guide rod of the follower piston. These air inclusions, together with any excess grease, will exit via the de-aerating opening at the side on the pump unit.

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6.4 Fault finding

Problem	*Cause*	*Solution*
Signal light does not light-up after contact was switched on.	1. No supply voltage (+15) on pin 1 or at signal light.	Check the fuse and, if required, replace the fuse.
	2. No ground potential on pin 2.	Check the ground connection and, if required repair it.
	3. Signal light defective.	Replace the bulb.
	4. Wiring to pump unit or to signal light defective.	Check the wiring and, if required, repair it.
Signal light lights during 2 minutes after a pump phase has been concluded.	1. Minimum level in grease reservoir reached.	Fill the reservoir.
	2. System is malfunctioning.	Retrieve the fault codes with the test pushbutton or the GINA and repair the system.
All grease points connected to one of the grease output ports of the pump unit are too dry, but no malfunction is indicated.	The interval (pause phase) or pump phase for this grease output port is not set correctly for the current application.	Set a shorter interval or lengthen the pump phase for this output port of the pump unit.
Too much grease has been applied to all grease points	The interval (pause phase) or pump phase for this grease output port is not set correctly for the current application.	Lengthen the interval or set a shorter pump phase for this output port of the pump unit.
One or more grease points are to dry while others received the correct amount of grease.	Improper composition of the distribution blocks.	Change the composition of the distribution blocks.

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Problem	*Cause*	*Solution*
All grease points connected (with one) grease output port are too dry, and a malfunction is indicated.	Defective pump unit or blockage in the system behind this output port.	Retrieve the fault code. If "Maximum pressure exceeded" (relief valve opened during a pump phase): 1. System contains grease that is not suitable for the current operating conditions. Solution: Replace the grease in the pump and flush the system. 2. Distribution block, grease line or grease point blocked. Solution: Remove the grease lines behind the main block one by one , and each time perform a test cycle. If the "maximum pressure"error does not occur during a test, the problem is located in the branch you disconnected. If the line with the problem leads to a block, you should repeat this procedure for the lines connected to that block, until you find the blockage. Removing the blockage: If the "maximum pressure" error persists, even after disconnecting every grease line in turn, the blockage resides in the block itself. Disassemble the block and clean it internally. Other fault codes: Remedy the indicated malfuntion.

REMARK
A programming and read-out unit (GINA) is used to program and read-out the control unit. The GINA can also be used to consult a list of faults that have occurred and were stored in the memory of the control unit. If the system features a signal light in the cabin the stored fault codes can also be viewed with the aid of this signal light and the test pushbutton on the pump unit.

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7. Technical data

7.1 TriPlus pump unit

Maximum operating pressure	: 250bar
Operating temperature	: -20 ... +85 °C
Supply voltage	: either 12 or 24 Vdc
Rating pump motor (nominal at 20 °C)	: 36 W
Rating shuttle valve (nominal at 20 °C)	: 36 W
Rest current	: 10 mA
Capacity grease reservoir (standard)	: 3 litres *
Minimum level switch	: standard
Number of output ports	: 1, 2 or 3
Pump material	: hard anodised aluminium - nylon reinforced
Delivery per pump output	: 0,1 cc per stroke
Protection class	: IP67 (for lower part of pump unit)
Grease types	: NLGI 2 **

* Other grease reservoirs are available on request.
** Depending on the ambient temperature (consult your grease supplier).

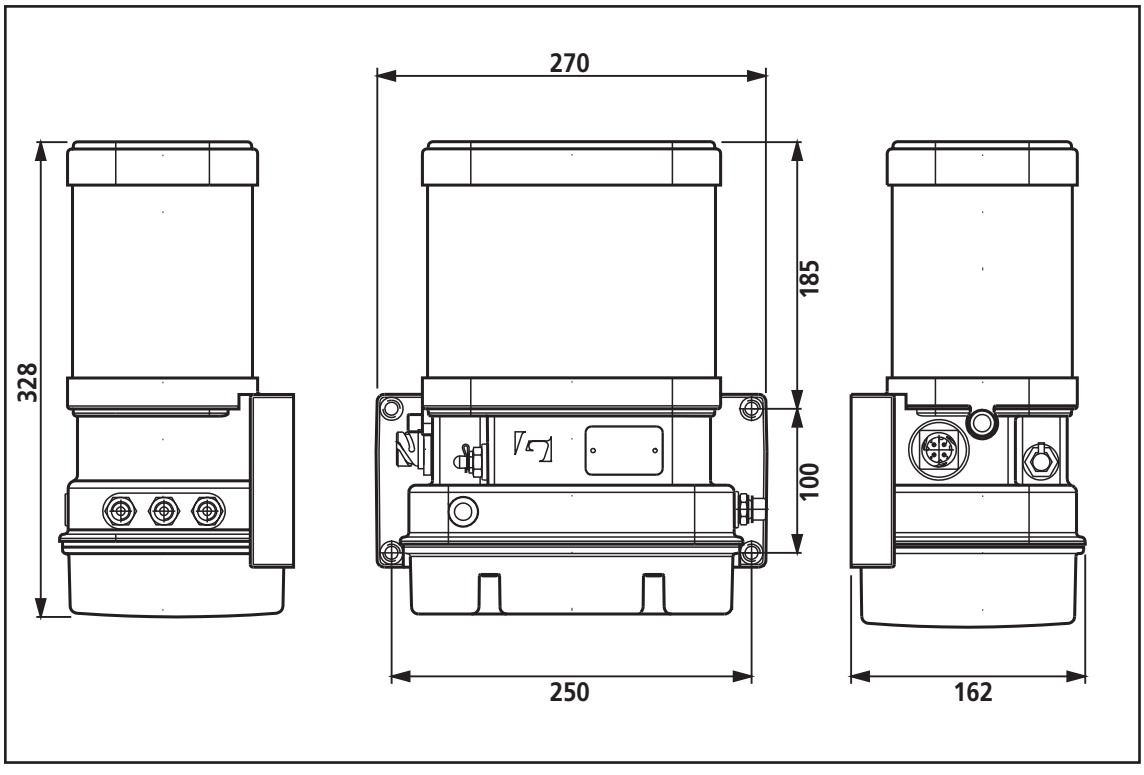

Figure 7.1 Dimensions of the TriPlus pump unit with a 3 litre reservoir.

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7.2 Distribution blocks

Maximum operating pressure	: 250bar
Operating temperature	: -20 ... +85 °C
Minimum number of doser segments	: 3 (excluding start and end segments)
Maximum number of doser segments	: 12 (excluding start and end segments)
Material	: galvanised steel
Material O-rings	: NBR
Grease inlet port thread	: M10 x 1 mm
Delivery per outlet type 45 (two per segment)	: 0,045 cc
Delivery per outlet type 125 (two per segment)	: 0,125 cc
Delivery per outlet type 200 (two per segment)	: 0,200 cc

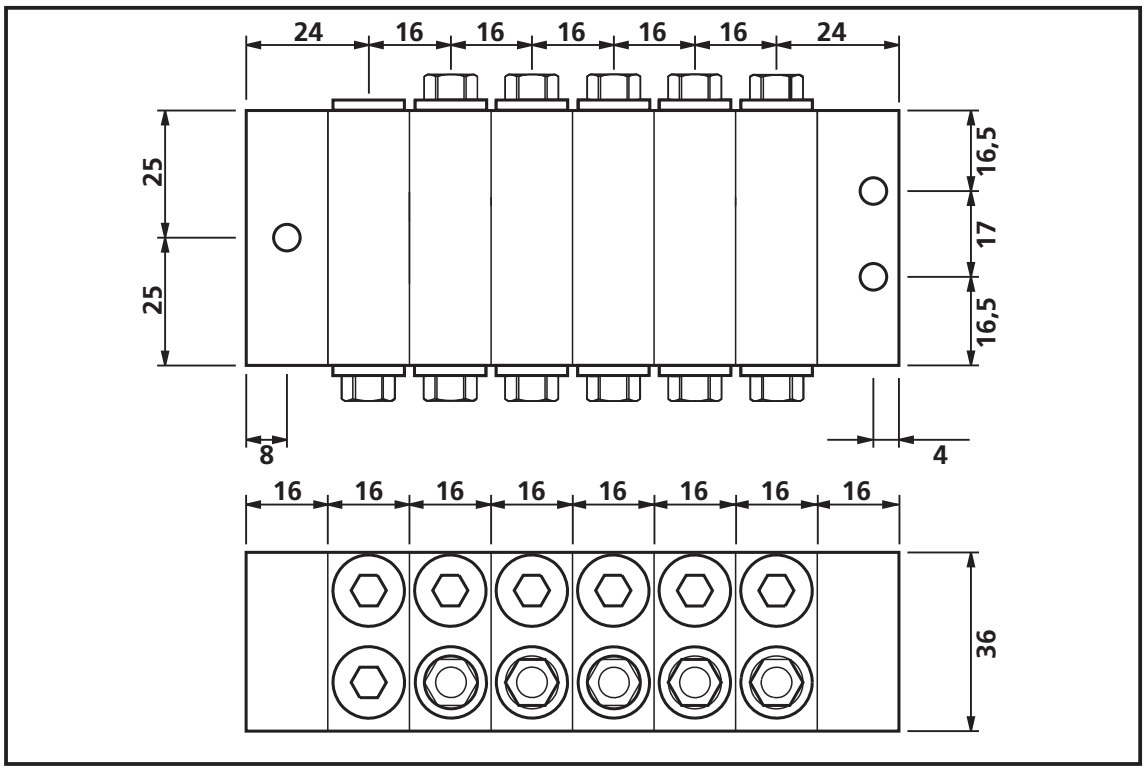

Figure 7.2 Dimensions of the distribution block

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Notes

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