*General Manual*


# Automatic Greasing System
# TriPlus Truck-3 and Trailer-3

F211942R04

GROENEVELD

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# TABLE OF CONTENTS



Release date: March 2016

Release date: March 2016

# 1. PREFACE


Release date: March 2016

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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 attention of the user to important additional information with the aim of preventing problems.**

**WARNING**

**Warns the user if there is a risk of bodily injury or serious damage to the equipment as a result of incorrect actions.**

Release date: March 2016

# 2. GENERAL INFORMATION


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## 2.1 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 filling the grease 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 important conditions 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.**

Release date: March 2016

## 2.2 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 2.1):

1. An electric grease pump (plunger pump) with grease reservoir and integrated digital control unit with data storage facility.
2. One or more distribution blocks (composed of 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 and the individual grease points.

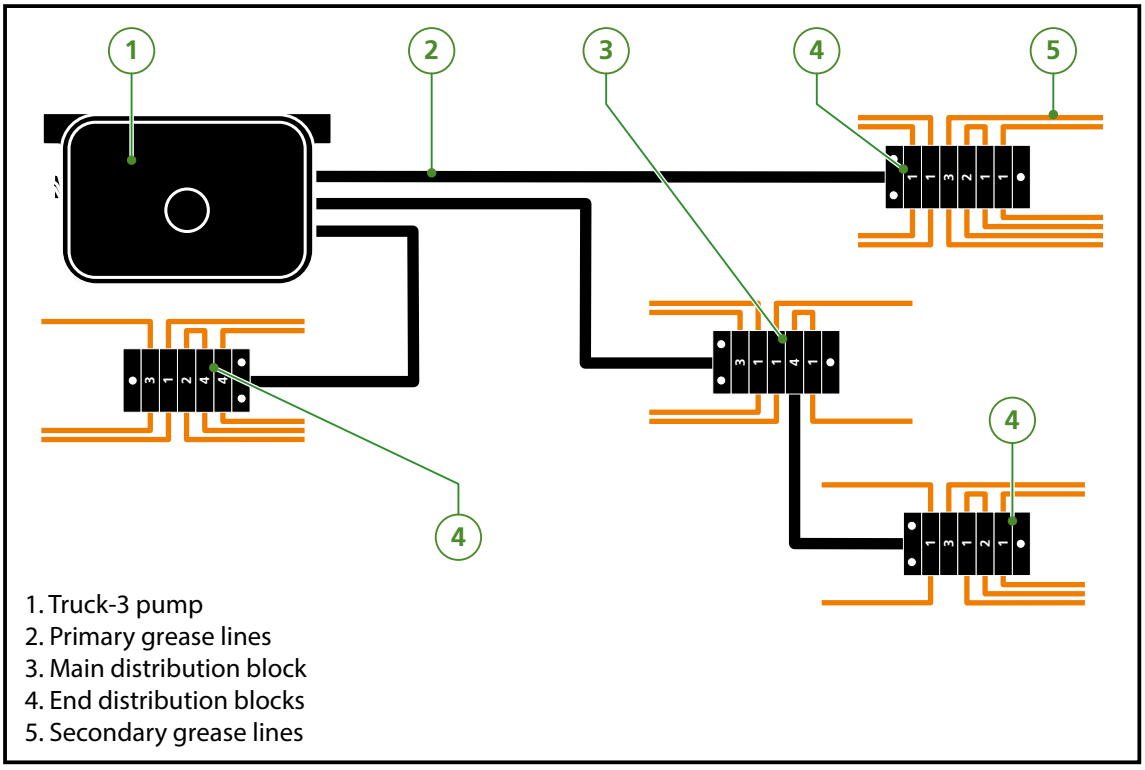


Figure 2.1 System overview.

Release date: March 2016

**Notes**

Release date: March 2016

# 3. COMPONENT DESCRIPTION


Release date: March 2016

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## 3.1 Properties

The Groeneveld TriPlus pump unit, with its integrated control unit, is the heart of the automatic greasing system. The pump unit can be supplied in two different versions to provide flexible solutions for all greasing requirements.

### TriPlus Truck-3 pump unit

The TriPlus Truck-3 pump unit is specifically designed for use on vehicles and machines with its own power supply for powering the greasing system when in operation.

Characteristics:
- Can be supplied with 1, 2 or 3 grease outlets. In this way the greasing system on complex vehicles or machines can be separated in maximal 3 independently operating system parts.
- An integrated digital control unit with 3 independent operating timers for controlling the three possible pump outlets.
- Integrated 275 bar safety valve in case of a blocked system, to prevent grease spill on the floor.
- Grease reservoir in different sizes, with follower plate and low level switch for standard.

### TriPlus Trailer-3 pump unit

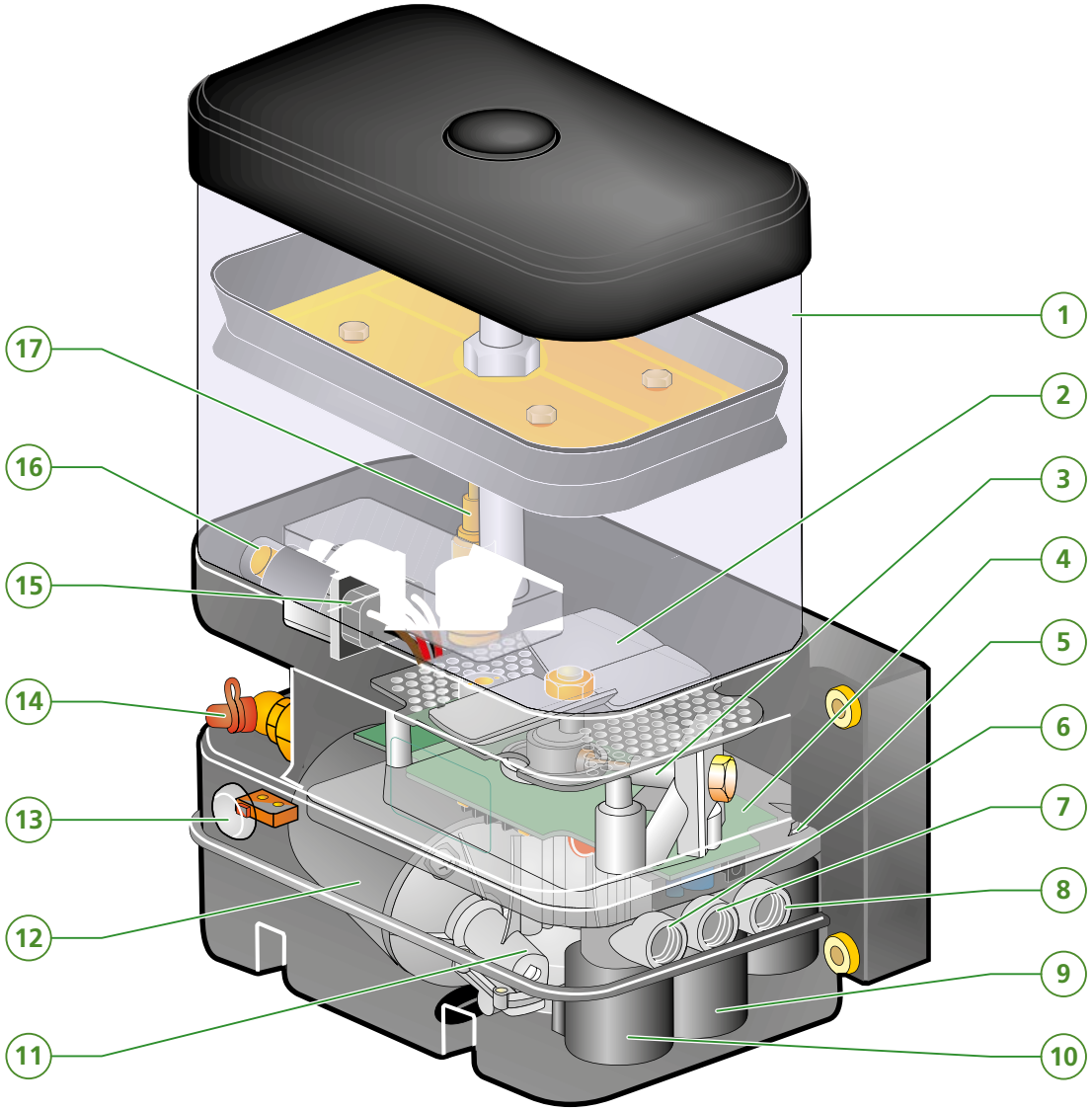
The TriPlus Trailer-3 pump unit is specifically designed for use on vehicles and machines without its own power supply.

Characteristics:
- Supplied with a single grease outlet.
- An integrated digital control unit, with counter and timer option for operating the single outlet.
- Integrated 275 bar safety valve in case of a blocked system, to prevent grease spill on the floor.
- Grease reservoir in different sizes, with follower plate and low level switch for standard.

Release date: March 2016

## 3.2 Composition of the TriPlus pump unit

The TriPlus pump unit consists of various parts. These parts are shown in figure 3.1.




1. Grease reservoir with follower plate
2. Stirring gear
3. Plunger pump
4. Control unit
5. Relief valve with return line to the grease reservoir and monitoring by the control unit
6. Grease outlet 1
7. Grease outlet 2 (not in trailer pump)
8. Grease outlet 3 (not in trailer pump)
9. Shuttle valve B (for grease outlet 3, not in trailer pump)
10. Shuttle valve A (for grease outlet 2, not in trailer pump)
11. Sensor (counts the number of revolutions of the drive shaft of the plunger pump)
12. Elektro-motor with reduction gear
13. Test push button
14. Filler coupling with grease filter
15. Electric connector
16. De-aerating and grease overflow outlet
17. Minimum level switch

Figure 3.1 TriPlus Truck-3 pump unit.

Release date: March 2016

## 3.3 The control unit

The control and monitoring unit initiates and controls the greasing cycles of the greasing system. All required system and program parameters (e.g. interval type, grease delivery) can be set. The control unit monitors the performance of various components of the greasing system and processes, stores and reports the malfunctions it detects.

### 3.3.1 Behaviour during power off/on

When power to the system is switched off (power down), the software saves several variables to non-volatile memory. These are retrieved at power on, so the software can resume operation at the point when the power was switched off. This means that when, for example, the system is switched off during a pump cycle, the remaining pump revolution needed to finish the pump cycle are stored in the memory. When the system is powered again, the previously aborted pump cycle is resumed and the remaining pump revolutions finished.
Because it may take some time before the grease reaches the distribution blocks and thus the block switch, it may very well happen that an optional block switch changes state during power down. For the software to be able to detect this, the state of the block switches are also stored at power off. At power on, the system can then compare the current state with the state at power off.

### 3.3.2 Control unit in Truck-3 mode

The Truck-3 control unit program is specifically designed for use on vehicles and machines with its own power supply, for powering the greasing system when in operation. With its three independently operating grease outlets it is suitable for complex vehicles or machines with various system parts that require different intervals and grease doses (e.g. garbage trucks and concrete pump/mixer trucks).

Characteristics:
- Control unit features 3 independent operating timers for controlling the three possible pump outlets.
- The interval of each timer can be set in elapsed time (min.), number of movements (pulses) or travelled distance (km/miles).
- Multiple inputs for starting or stopping the 3 timers independently.
- Extensive memory bank for storing system events and errors with date and time.
- Active warning by signal lamp when system behind one of the three pump outlets blocked.
- Integrated 275 bar safety valve in case of a blocked system, to prevent grease spill on the floor.
- 3 block switch connections for monitoring the grease delivery to the distribution blocks in the system.

**NOTE**

**These block switches are optional.**

- Signal lamp in the cabin for standard that warns in case of a low level or serious system error.
- Test push-button at the pump for triggering a test cycle in one of the pump outlets or for resetting an error.
- Error code can be retrieved from the pump with the test push-button (flash code displayed by signal lamp).

Release date: March 2016

The TriPlus Truck-3 pump has up to three grease outlets in which grease can be pumped in cycles. The exact grease delivery per outlet is measured by the control unit by counting the number of cam shaft revolutions and can be set independently per outlet through the appropriate parameters.
A grease outlet can be disabled by setting the grease delivery parameter of that outlet on 0cc. Each outlet has its own interval timer/counter, which can be set in elapsed time (min), number of movements (pulses) or covered distance (km or miles).
The three interval timers/counters can be connected to one of the available run inputs by parameter setting.

When interval should be counted down in elapsed time it needs to be connected digitally to one of the following timer input options:

- ignition input by pump connector pin/wire 1: ign(P1),
- additional switch 1 input by pump connector pin/wire 3: S1(P3) or
- additional switch 2 input by pump connector pin/wire 7: S1(P7)

**NOTE**

**In case the interval timers of two outlets indicate a greasing cycle at exactly the same moment, the outlet that was served last will be put in wait till the other one is finished.**

When interval should be counted down in number of movements (pulses) or covered distance(km/ miles) it needs to be connected digitally to the pulse counter input by pump connector pin/wire 5: pulse(P5).
By means of W-factor parameter you can determine what to do with the pulses entered at pump conn. pin 5:

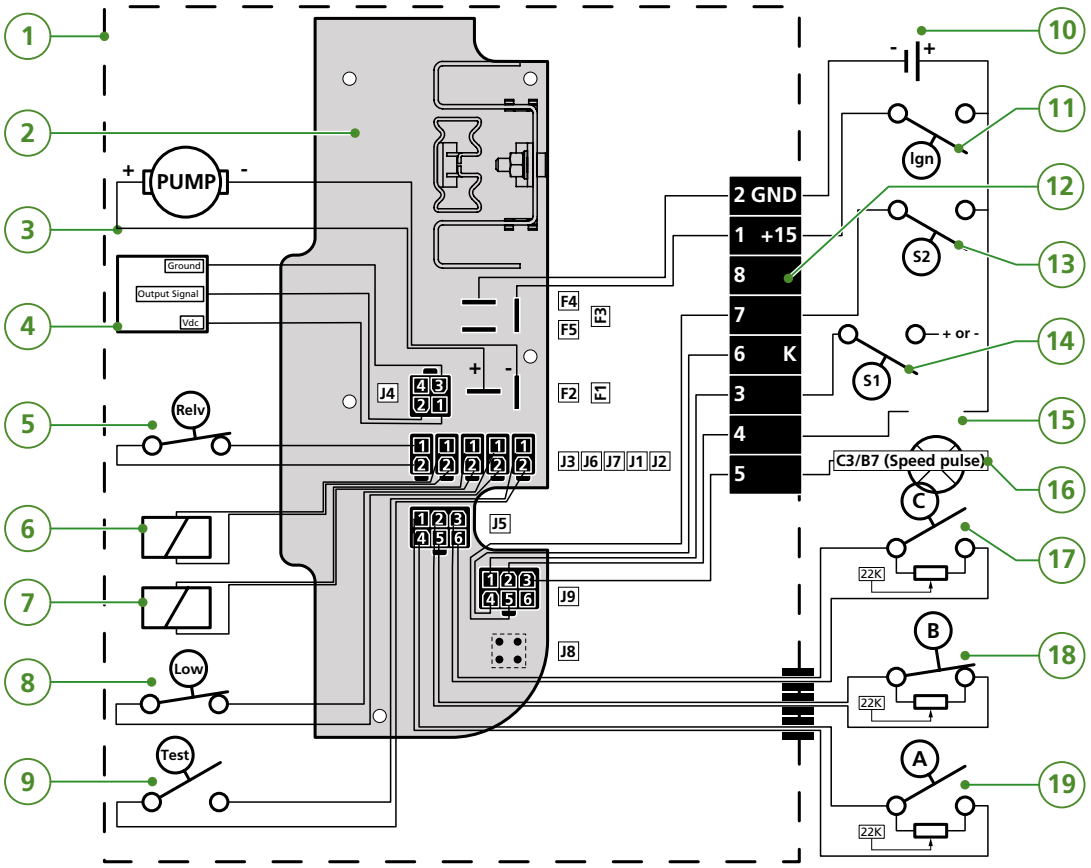
| | |
|---|---|
| Setting: 0 | Each pulse (movement) will be subtracted from set interval for the digital connected outlet(s). |
| Setting: 4000 | Each 4000 (speed) pulses a single unit (km or Mile) will be subtracted from set interval for the digital connected outlet(s). To find the correct number of pulses per unit (km or miles) please check the vehicle speedometer or contact the vehicle dealer or manufacturer. |

**NOTE**

**For the reason that there is only 1 counter input, it is not possible to choose an interval in distance (km/miles) and at the same time an interval in movements (pulses) for another outlet.**

The control unit also has extensive diagnostic features, as will be described in the paragraph "Error detection".
After a set number of greasing cycles in succession the signal lamp will be lit continuously. This error warning can be reset by pressing the test push-button at the pump unit.

Release date: March 2016




1. Pump unit
2. Control unit
3. Pump motor
4. Revolution sensor
5. Relief valve (NC)
6. Shuttle valve A
7. Shuttle valve B
8. Minimum grease level switch (NC)
9. Test push-button (NC)
10. Battery
11. Ignition
12. 8-Pole connector
13. Control input via extra switch 1
14. Control input via extra switch 2
15. Signal lamp
16. Speed signal
17. Block switch C (optional)
18. Block switch B (optional)
19. Block switch A (optional)

Figure 3.2 Wiring diagram TriPlus Truck-3.

Release date: March 2016

### 3.3.3 Control unit in Trailer-3 mode

The Trailer-3 control unit program is specifically designed for use on trailers without its own power supply, for powering the greasing system when in operation.

Characteristics:
- Control unit features a counter and timer for controlling the interval period of the single pump outlet.
- Inputs for brake lights and tail lights.
- Extensive memory bank for storing system events and errors with date and time.
- Integrated 275 bar safety valve in case of a blocked system, to prevent grease spill on the floor.
- 3 block switch connections for monitoring the grease delivery to the distribution blocks in the system.

**NOTE**

**These block switches are optional.**

- Test push-button at the pump for triggering a test cycle or for resetting an error.
- An optional "outdoor" signal lamp can warn in case of a low level or serious system error.
- Error code can be retrieved from the pump with the Test push-button (flash code displayed by signal lamp).

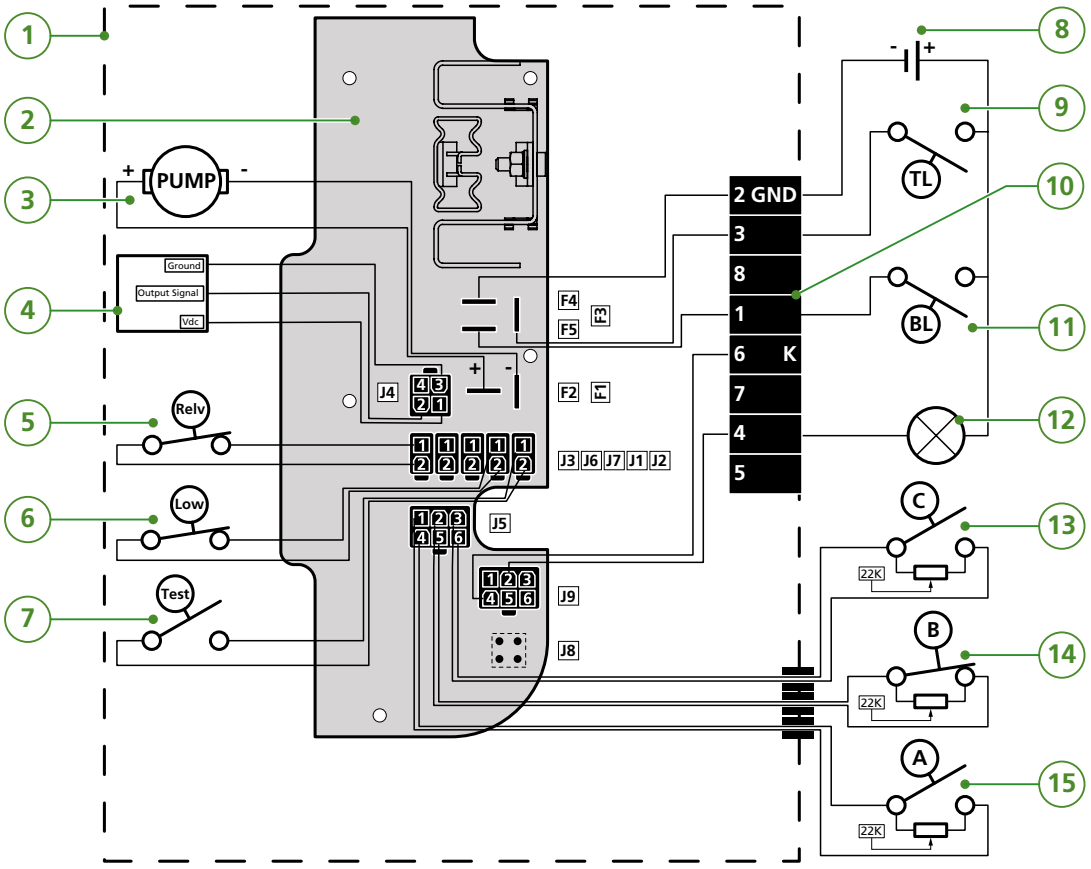
The TriPlus Trailer-3 pump has a single grease outlet in which grease can be pumped in cycles. The exact grease delivery is measured by the control unit by counting the number of cam shaft revolutions and can be set through the appropriate parameter.
The interval of the single pump outlet can be set in elapsed time (timer) and or number of brake pulses (counter).

When interval set in only brake pulses (pulse), the pump cycle is started after a number of brake pulses and only runs the moment the brake lights are activated. The drivers braking behaviour can trigger the start of a new cycle, while the current is still running (many short pulses per braking action). In this case the running cycle is aborted and remaining camshaft revolutions will be stored in the skipped revolutions counter. When also the tail light power is connected to the pump (brake pulse setting), the pump will start executing the stored remaining cam shaft rotations the moment the tail lights are switched-ON. To avoid grease spill on the floor during such a session, we hereby limited the number of cam shaft rotations to maximum twice the set grease quantity per tail light- ON period.

When interval set in brake pulses and elapsed time (pulse+min), the timer starts running simultaneously with the counter the moment the tail lights are switched-ON. The first one that finishes the interval period starts the pump cycle. Both the counter and timer will be reset for a fresh interval countdown start.

The control unit also has extensive diagnostic features, as will be described in the paragraph "Troubleshooting".
After a set number of greasing cycles in succession the optional signal lamp will be lit continuously.
This error warning can be reset by pressing the test push-button at the pump unit.

Release date: March 2016




1. Pump unit
2. Control unit
3. Pump motor
4. Revolution sensor
5. Relief valve (NC)
6. Minimum grease level switch (NC)
7. Test push-button (NC)
8. Battery
9. Tail light input (+)
10. 8-Pole connector
11. Brake light input (+)
12. Signal lamp output (-) (optional)
13. Block switch C (optional)
14. Block switch B (optional)
15. Block switch A (optional)

Figure 3.3 Wiring diagram TriPlus Trailer-3.

Release date: March 2016

## 3.4 The plunger pump

The electric motor drives the plunger pump through a reduction gear. The plunger pump comprises a drive shaft with excentric cam, a cylinder with piston and a non-return valve. The excentric moves the piston back and forth, once every revolution of the cam 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 outlet(s) of the pump unit. The amount of grease supplied during each stroke (revolutions of the cam 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 outlet, one (for 2 outlets) or two (for 3 outlets) shuttle valves will be present between the non-return valve and the outlets.

## 3.5 The shuttle valves

The TriPlus Truck-3 pump can be provided with maximal 2 shuttle valves (valve A and B).
- Valve A for connecting the pump internally to outlet 2
- Valve B for connecting the pump internally to outlet 3

**NOTES**

**When no valves activated or installed, the grease automatically shows at outlet 1.**

**NOTES**

**The valve ports in the pump body are marked with an A and B to prevent mistakes. Also the valve connections on the circuit board are marked with text to prevent mistakes: valve-1 (=A) and valve- 2 (=B).**

## 3.6 Safety and control features

### 3.6.1 Maximum grease pressure

A relief valve (fitted with an electrical contact) is installed in the grease channel between the plunger pump and the pump outlets. This relief valve leads 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 distribution blocks or grease lines to the grease points has become blocked or when the viscosity of the grease has become too high (at low temperature).

### 3.6.2 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.

### 3.6.3 Empty reservoir

Pump will be disabled automatically when the allowed quantity of grease is finished, after the minimum level switch became active.

### 3.6.4 Piston movement distribution block

An optional block switch monitors the movement of a block piston during the greasing cycle. When no movement detected over a number of cycles, the lamp will be switched on to indicate a problem.

Release date: March 2016

### 3.6.5 Revolutions of pump drive shaft

An integrated sensor monitors the drive shaft rotations. When it does not sense a rotation every 10 seconds of a pumping phase it will abort the greasing cycle.

### 3.6.6 Defective wiring and short-circuits

Open-loads (interruptions) in the wiring to the minimum-level switch, the relief valve, the electric motor, the shuttle valves and the external signalling devices (e.g. block switch or signal lamp) will be detected and processed and stored by the control unit. This is also applicable to short-circuits in the wiring.

## 3.7 The distribution blocks

### 3.7.1 Properties

TriPlus distribution blocks distribute and measure out the grease to the various grease points in a progressive way. That means that all grease points will be greased successively one after another.
The distribution blocks can be placed in sequence, in which case an output of a distribution block is used to feed the next block by a primary grease line.

### 3.7.2 Composition

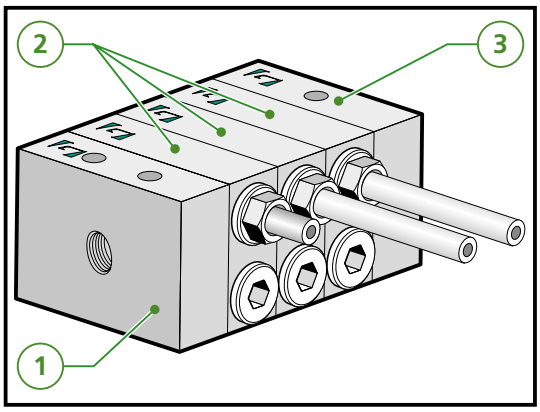



Figure 3.4 Distribution block.

A progressive distribution block comprises the following components:

1. A start-segment
2. Minimum 3 and maximum 12 doser segments
3. An end-segment

The doser segments are available in 5 sizes:
Size 1 (2x 0.045cc or 1x 0.090cc)
Size 2 (2x 0.075cc or 1x 0.150cc)
Size 3 (2x 0.125cc or 1x 0.250cc)
Size 4 (2x 0.200cc or 1x 0.400cc)
Size 6 (2x 0.300cc or 1x 0.600cc)

Each doser segment always has two grease outlets, with identical grease outputs per cycle. The connections of the grease channels between the doser segments are sealed with O-rings. The doser segments between the start- and end-segment are strung together by two bolts. For each additional doser segment, longer bolts are required.

Release date: March 2016

### 3.7.3 Principle of operation

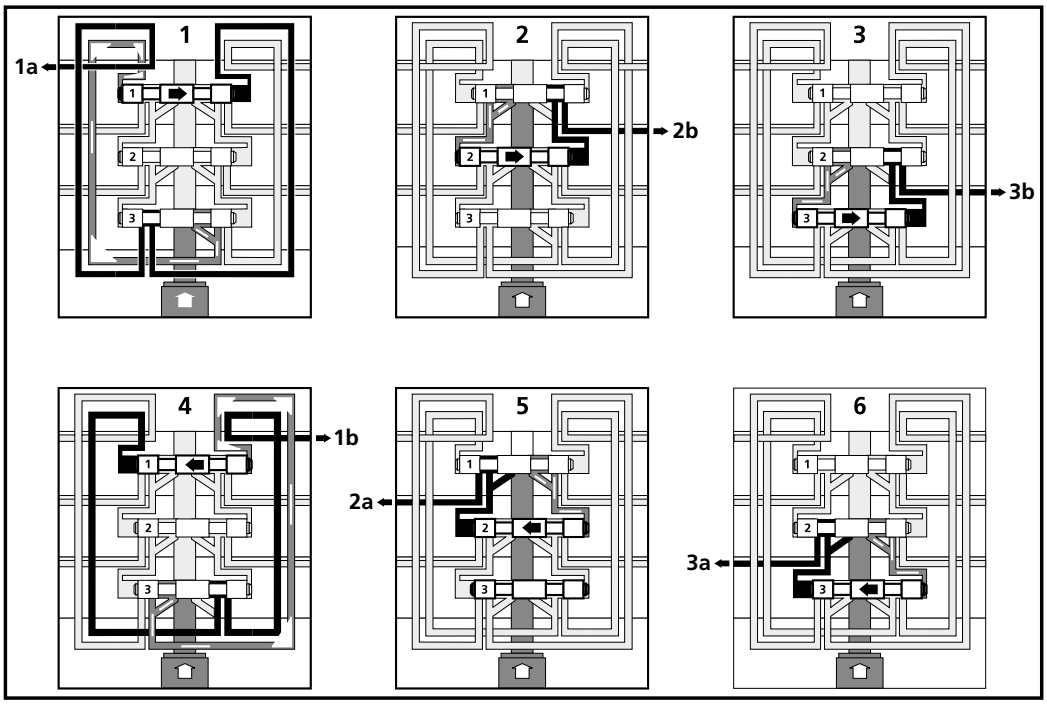



Figure 3.5 Principle of operation.

To operate, progressive distribution blocks need grease pressure supplied by the pump:

1. The lubricant flows from the entrance of the block, 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 outlet 1a.
   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 2b.
   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 outlet 3b.
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 outlet 1b.
5. Afterwards piston 2 will also be pressed to the right and will supply lubricant to outlet 2a.
6. Afterwards piston 3 will also be pressed to the right and will supply lubricant to outlet 3a.
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**

Release date: March 2016

### 3.7.4 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 outlets to which primary lines are connected or which are used to interconnect distribution blocks ãìëí be fitted with non-return valves. Outlets which secondary grease lines are connected on, must be fitted with non-return valves if significantly different return pressures are expected at different outlets.

### 3.7.5 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.

### 3.7.6 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.

### 3.7.7 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 outlets. This doubles the output of the outlet that remains open.

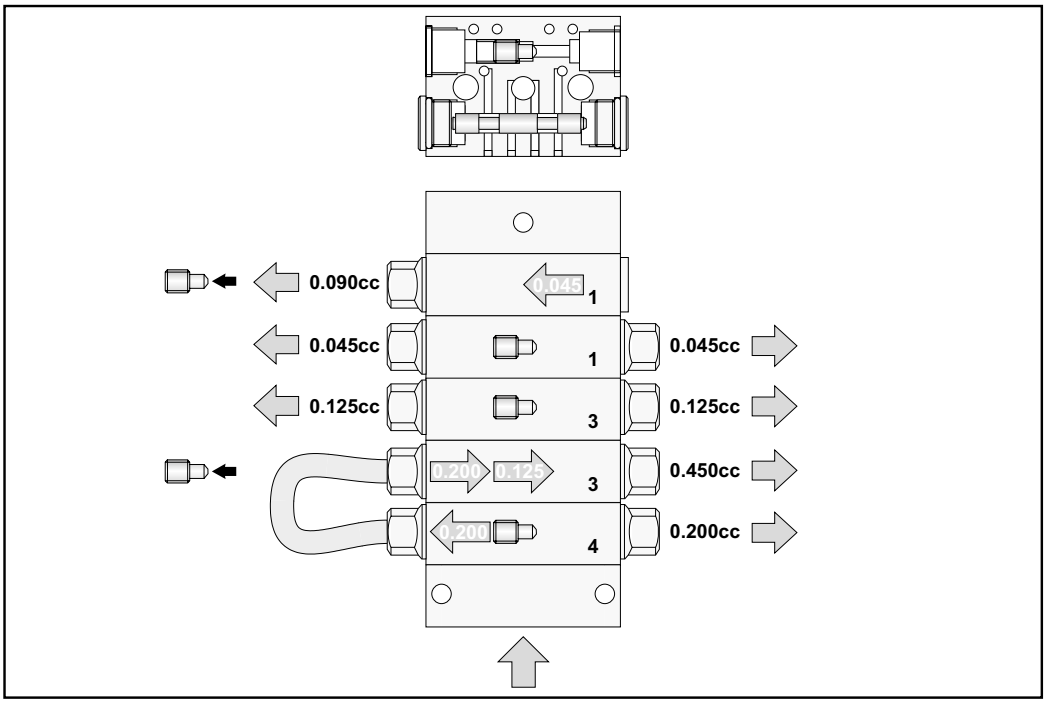



Figure 3.6 Combining outputs.

The values in the illustration represent the grease outputs of the ports in $mm^3$ (0.001cc) per complete cycle of the distribution block. The amount supplied is determined by the diameter of the piston.

Release date: March 2016

## 3.8 The signal lamp

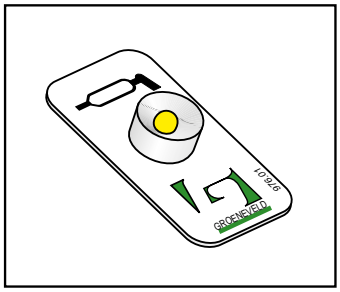


Figure 3.7 Signal lamp.

The signal lamp is mounted in the field of vision of the driver and out of direct sunlight, because of the visibility of the signals.
The lamp shows the status of the greasing system and malfunction reports by means of flashing codes. In the table below, an overview of normal signals is given. For malfunction signals refer to paragraph 6.4 Troubleshooting.

### The signal lamp flash codes

| *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 lamp is OK. |
| | After the additional timer input switch S1 (P3) or S2 (P7) becomes active. | Only happens when the parameter lamp display function has been set correctly. |
| Repeatedly: 1 x 0.3 seconds on, followed by a pause of 2 seconds | After momentarily pressing the test push-button once. | A cycle test is being performed via grease outlet 1. |
| Repeatedly: 2 x 0.3 seconds on, followed by a pause of 2 seconds | After momentarily pressing the test push-button twice. | A cycle test is being performed via grease outlet 2. |
| Repeatedly: 3 x 0.3 seconds on, followed by a pause of 2 seconds | After momentarily pressing the test push-button three times. | A cycle test is being performed via grease outlet 3. |
| Continuously | When allowed quantity of grease is finished after reaching low-level. | Grease reservoir theoretical empty. |
| | When maximum allowed number of errors in succession is reached. | Serious system errors. |
| 1 second on, second off continuously | When a low grease level is detected. | Provided the parameter settings have been set to act this way. |
| 0.5 second on, 0.5 second off continuously | When pump cycle is executed. | Provided the parameter settings have been set to act this way. |

Release date: March 2016

### 3.8.1 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: the number of errors stored since last successful cycle.
2. Total errors: the total number of errors stored since installation.

#### Retrieving error codes

The pending errors stored in the control unit's memory can be retrieved by keeping the test pushbutton on the pump unit depressed for at least 5 seconds. 7 seconds after you released the test push-button the signal lamp will start producing the flash code to indicate the pending error(s) (see paragraph 6.4.3).

#### System error

Lamp lights continuously after an error has shown to be persistent (default: 10 errors in succession). Press the test push-button once to reset the lamp. The error however remains pending and when not solved the lamp will be triggered again the next greasing cycle.

## 3.9 The test push-button

The test push-button on the pump unit has three functions:

- Performing a cycle test via one of the grease outlet(s) of the pump unit.
- Retrieving error messages stored in the memory of the control unit.
- Lamp reset after solving the error.

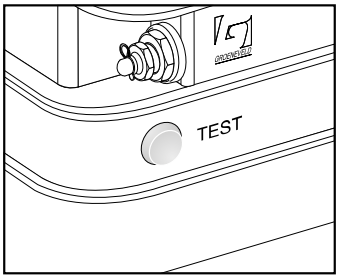



Figure 3.8 The test push-button.

### 3.9.1 Performing a cycle test

A cycle test can be performed using the test push-button, as follows:

1. The supply voltage for the pump unit must be available (ignition, brake lights or tail lights on).
2. Push the test push-button (less than 1 second) 1, 2 or 3 times to perform a cycle test at outlet 1, 2 or 3 respectively. Provided that the preset delivery amount per outlet is more than 0cc.
3. After 2 seconds the cycle test starts.

During the cycle test the signal lamp will flash at a particular frequency (see paragraph 3.8). The flashing frequency indicates at which outlet the cycle test is being performed.
To end the cycle test immediately press the test push-button once.
Any errors that occur during the cycle test will not be indicated by the signal lamp and will not be stored in the memory of the control unit.

Release date: March 2016

# 4. DESIGNING A SYSTEM


Release date: March 2016

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## 4.1 Introduction

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

- The number of grease points to be connected.
- 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.
- The space available on the vehicle or machine for the pump unit and the distribution blocks.
- 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 outlets | 1, 2 or 3 |
| ***Distribution blocks*** | |
| Maximum number of distribution blocks in serie | 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 |

Release date: March 2016

**Table 1: Outputs of doser segments**

| *Segment type* | *Output per segment (2 outputs) [cc]* | *Output with combined outputs [cc]* |
|---|---|---|
| 1 | 2 x 0.045cc | 0.090cc |
| 2 | 2 x 0.075cc | 0.150cc |
| 3 | 2 x 0.125cc | 0.250cc |
| 4 | 2 x 0.200cc | 0.400cc |
| 6 | 2 x 0.300cc | 0.600cc |

**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 | 22 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" ø2.4mm i.d.* | *PA ø6mm ø3mm 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.**

Release date: March 2016

## 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 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

The grease demand of a grease point over a period of time is determined by grease output per greasing cycle and greasing frequency. This information can be extracted from:

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

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

Release date: March 2016

### 4.3.4 Group the grease points

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

- A main distribution block or multiple grease outlets 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 distribution block per whole cycle. The sum of all rated grease outputs of the distribution 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 outlet) of the pump unit. This is the sum of the grease demands of all distribution blocks connected with that outlet **(excluding the main distribution block!)**.

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

#### System without a main distribution block

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

Release date: March 2016

### 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.
The loss of pressure in the system may not exceed Pp (Pp equals 90% of the maximum operating pressure supplied by the pump unit).

1. Calculate the pressure loss Pv 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 "Pl" over that grease line.
3. Determine which type of grease point is connected to this grease line. Determine the resistance "Ps" induced by that type of grease point (see 3.2 Points of departure).
4. Calculate the largest, total loss of pressure "Pt" for each outlet of the pump unit by adding together the values of the pressure losses in the grease lines, distribution blocks and at the grease point (Pt = Pv + Pl + Ps).
5. Check: that Pt < Pp.

If the loss of pressure in the system exceeds Pp 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 outlets.
   - 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.

Release date: March 2016

# 5. INSTALLATION


Release date: March 2016

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## 5.1 Overview

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

1. Mounting the pump with integrated 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.

## 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. Therefore remove the ignition key (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 under 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.

Release date: March 2016

## 5.3 General installation directives

1. Check the contents of the parts kit using the parts list included 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 cable ties 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.

## 5.4 TriPlus pump unit

### 5.4.1 Pump types

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

- The type and model of the vehicle or machine has its own power supply (+15).
- The number of grease 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 Truck-3 pump units with 1, 2 or 3 independent grease outlets.
- The TriPlus Trailer-3 pump units with only 1 grease outlet.

The TriPlus Truck-3 pump units are usually applied on trucks or machines with their own power supply (+15). The TriPlus Trailer-3 pump units are primarily meant for use on trailers without their own power supply.

Release date: March 2016

### 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 outlet(s) and the de-aerating opening of the pump unit.
6. Mount the coupling(s) for the primary grease line(s) onto the outlet(s) of the pump unit.

## 5.5 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 distribution block usually will be pre-assembled including the secondary lines.

### 5.5.2 Assembly

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). Torgue: 12 Nm.
6. If two outlets of a doser segment need to be combined, remove (allen key: 2,5mm) the little internal plug that seperates the two outlets. 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 outlets 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.

Release date: March 2016

### 5.5.3 Mounting

Determine the location of the distribution block on the vehicle or machine. Consult the specific installation instruction card and 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 torque: 5 Nm.**

## 5.6 Primary grease lines

The primary grease lines are situated between the pump unit and the distribution blocks or between the distribution blocks.
The most common line used in TriPlus is the DN4. This high-quality hose combines compactness with high strength and flexibility.

### 5.6.1 Line types

- Flexible high-pressure hose DN4: F123414, inside diameter 4.0mm, outside diameter 9.7mm;
- Flexible high-pressure hose DN6: F113422, inside diameter 6.0mm, outside diameter 12.0mm;
- Metal tube with sizes ø6x1mm or ø8x1mm.

### 5.6.2 Crimp diameter

- Ferrule DN4: F115311, crimp diameter 9.95 - 10.1mm;
- Ferrule DN6: F113941, crimp diameter 14.8 - 15.0mm;

### 5.6.3 High pressure hose assembly

1. Cut the length of the hose to the required length;
2. Remove any burrs and other remnants produced by cutting the hose and clean the grease hose by blowing it through.
3. Assemble the removable fittings or crimp fittings;
4. Fill the hose with grease. Either use a pneumatic or hand-operated grease gun;
5. Install the grease hose and fix it in place with cable ties or clamps. Do not yet connect the primary grease hose(s) to the outlet(s) of the pump unit, if you want to use the pneumatic or hand-operated grease gun to de-aerate the system.

Release date: March 2016

### Removable fittings

1. Clamp the ferrule in a bench vice;
2. Turn the hose counter-clockwise into the ferrule til the end;
3. Turn the hose clockwise ¼ to ½ turn;
4. Apply oil or grease to the insert, the ferrule and the inside of the hose;
5. Turn the hose insert clockwise in the ferrule untill it is in position without tension;
6. Mount the coupling at the other end of the hose in a similar way.

### Crimp fittings

1. Check if the press block with the required ferrule diameter is used onto the press;
2. Slide the ferrule over hose until the end;
3. If necessary use some oil and slide the insert into the end of the grease hose until the insert is completely in the grease hose;
4. Pull the ferrule back slightly until it touches the outside edge of the coupling pin. While doing this, ensure that the insert remains in place and is not pressed out of the grease hose;
5. Place the assembly into the press and press the ferrule to the required diameter;
6. Check the resulting outside diameter by measuring between the ridges that may have formed by the crimping or the internal diameter of the insert with a caliper (only applicable with straight inserts);
7. Mount the crimp fitting at the other end of the grease hose in a similar way.

## 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 grease point.
- The position of the grease 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 hoses 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 also 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

Release date: March 2016

### 5.7.2 Mounting the secondary lines

Pay 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 cable ties 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 points.
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.
4. Strip and remove the outer jacket over this length. Make absolutely sure that you do not damage the individual grease lines!
5. Fix the line in place with cable ties 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.

Release date: March 2016

## 5.8 Electrical wiring

Detailed wiring diagrams are available as aids to install the electrical wiring. Where possible, pre-assembled wiring 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). This does not apply to systems with a TriPLus Trailer-3 pump, because those systems make use of the already adequately fused brake and tail light circuits 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 lamp, 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 brake-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 cable gland onto the junction box.

### 5.8.1 Fuse ratings

#### Truck-3 pump

| *Voltage* | *Supply circuit (P1)* | *Control options (P3 + P5 + P7)* |
|---|---|---|
| 12 Vdc | 20 A | 5 A |
| 24 Vdc | 10 A | 5 A |

#### Trailer-3 pump

| *Voltage* | *Brake light supply circuit (P1)* | *Tail light supply circuit (P3)* |
|---|---|---|
| 12 Vdc | 20 A | 20 A |
| 24 Vdc | 10 A | 10 A |

Release date: March 2016

### 5.8.2 Pin layout of the connector on the pump unit

| *Pin no.* | *Description TriPlus Truck-3* | *Description TriPlus Trailer-3* |
|---|---|---|
| 1 | Power (+15) | Brake light input (+) |
| 2 | Ground (-31) | Ground (-31) |
| 3 | Additional control input S1 | Tail light input (+) |
| 4 | Lamp output (-) | Lamp output (-) |
| 5 | Additional counter / speed pulse | n.a. |
| 6 | K-line (communication UniGina) | K-line (communication UniGina) |
| 7 | Additional control input S2 | n.a. |

## 5.9 De-aerating of the greasing system

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

### Method 1

This method can be used when a pneumatic workshop greasing system is available in the workshop. With such a system the greasing system can be de-aerated quickly by disconnecting the primary grease line(s) from the TriPlus pump unit and connect them one by one to the workshop system instead. After the entire system has been de-aerated, the primary line(s) must be reconnected to the right outlets 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 outlet, its shuttle valves must be placed in certain positions with the UniGINA to select one of the outlets. The pump unit must then be started and be allowed to run until the branch of the system connected to the selected outlet is properly de-aerated. This procedure must be repeated for each outlet of the pump unit.

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

Release date: March 2016

## 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 UniGINA (**Uni**versal **G**roeneveld tester for **IN**stallation and **A**nalysis).
Detailed information about the system parameters and the operation of the UniGINA can be found in user manual:

- UniGINA TriPlus Truck-3 (F211417)
- UniGINA TriPlus Trailer-3 (F211418)

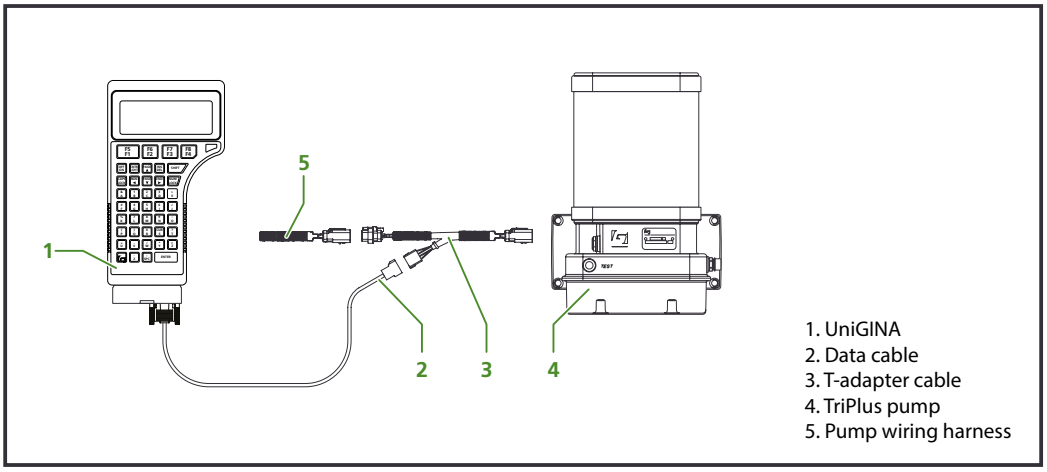


Figure 5.1 UniGINA cable connections.

After you have set or checked the system parameters with the UniGINA, you should initiate a cycle test with the UniGINA or the test push-button on the pump unit. A cycle test should be performed for each grease outlet of the pump unit. After conclusion of the cycle test you can check with the UniGINA whether the system functioned properly.
Check, again with the UniGINA, whether the various input signals of the control system (e.g. the extra control inputs S1 and S2, sensors and switches) are received properly. To do this, check the read-outs in the diagnosis screens, while switching the relevant input signals.

**ATTENTION**

**If the system has a TriPlus Trailer-3 pump unit it is required that the brake lights of the vehicle are lit during the cycle test(s), otherwise the pump unit would be without a power supply.**

Release date: March 2016

# 6. MAINTENANCE


Release date: March 2016

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## 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 cycle test for every grease outlet of the pump unit. Retrieve the fault codes stored in the control unit, either by using the test push-button on the pump unit or by connecting a UniGINA to the pump unit.
4. The primary and secondary grease lines for damage and leakage.
5. A collar of fresh grease should be present at all grease points.

## 6.3 Filling the reservoir

When the grease in the reservoir reaches its minimum level, it needs to be refilled. To facilitate this, the pump unit is fitted with a grease nipple onto which a workshop 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 filling pumps (hand- or air-operated).

Release date: March 2016

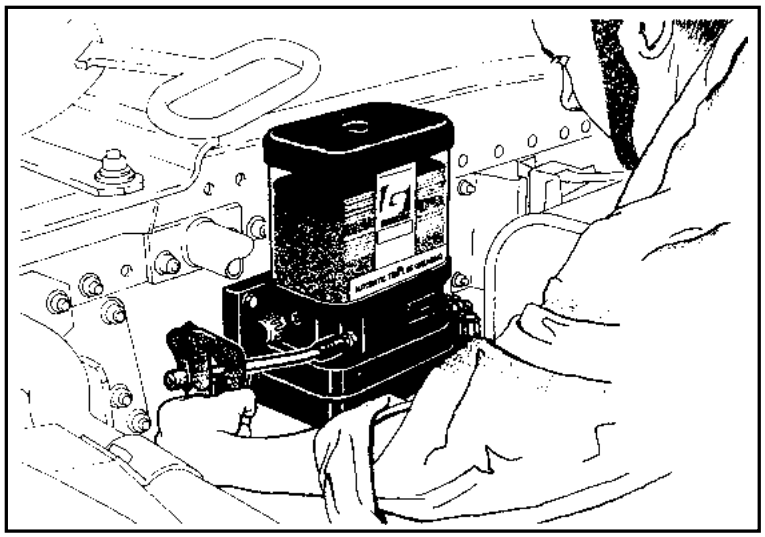

Figure 6.1 Filling the reservoir with a garage grease pump.

## 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 plate may become damaged.
5. Remove the filling hose.
6. Clean the dust cap and 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 filling coupling on the pump unit. Clean the filter and the filler coupling. Also check the filling hose for obstructions and clean it. Any air that may be introduced beneath the follower plate will escape through an opening at the top of the guide rod of the follower plate. These air inclusions, together with any excess grease, will exit via the de-aerating opening at the side on the pump unit.**

Release date: March 2016

## 6.4 Troubleshooting

### 6.4.1 General

The TriPlus greasing system is equipped as standard with an electronic control unit with a database. All relevant data concerning the functioning of the greasing system are stored in that database. This data can be read out with the use of an UniGINA.

### 6.4.2 Recognizing malfunctions

Malfunctions are recognizable or discovered as follows:

- The signal lamp no longer lights up when ignition is switched ON.
- The signal lamp shows a malfunction.
- Retrieving a fault code on the signal lamp.
- Reading the malfunction reports saved in the database of the control unit.
- The grease level in the pump no longer decreases.
- When visually checking the bearings, it appears that no fresh grease collar is present.

**NOTE**

**When lamp is lit due to an error, first reset the lamp with a short push on the test push-button before holding it for minimal 5 seconds to retrieve the error code.**

**General malfunction reports**

| *Problem* | *Cause* | *Solution* |
|---|---|---|
| Signal lamp does not light-up after contact was switched on. | 1. No supply voltage (+15) on pin no.1 or at signal lamp. | Check the fuse and, if required, replace the fuse. |
| | 2. No ground potential on pin no.2. | Check the ground connection and if required repair it. |
| | 3. Signal lamp defective. | Replace the bulb. |
| | 4. Wiring to pump or signal lamp defective. | Check the wiring and, if required, repair it. |
| Signal lamp ON continuously. | 1. Empty reservoir. | Fill the reservoir. |
| | 2. Persistent system error. | Retrieve fault code with the test push-button or the UniGINA and repair the system. |
| All grease points connected to one of the grease outlets of the pump unit are too dry, but no malfunction is indicated | The interval (pause phase) or pump phase for this grease outlet is not set correctly for the current application. | Set a shorter interval or lengthen the pump phase for this outlet of the pump unit. |
| Too much grease has been applied to all grease points. | The interval (pause phase) or pump phase for this grease outlet is not set correctly for the current application. | Lengthen the interval or set a shorter pump phase for this outlet 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. |

Release date: March 2016

| *Problem* | *Cause* | *Solution* |
|---|---|---|
| All grease points are too dry and a malfunction is indicated. | Defective pump unit or blockage in the system. | Retrieve the fault code. If outlet blocked (relief valve opened during a pump phase):<br><br>1. System contains grease that is not suitable for the current operating conditions.<br>Solution:<br>Replace the grease in the pump and flush the system.<br><br>2. Distribution block, grease line or grease point blocked.<br>Solution:<br>Remove the grease lines behind the main distribution block one by one and each time perform a cycle test.<br>If the "maximum pressure" error does not occur during a test, the problem is located in the branch you disconnected. Repeat the procedure with the end distribution block behind this line until you find the blockage.<br>Removing the blockage:<br>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 renew or clean it internally.<br><br>Other fault codes:<br>Remedy the indicated malfuntion. |

**REMARK**

**For setting and reading out the parameters of the control unit a UniGINA is used. The UniGINA 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 lamp in the cabin the stored fault codes can also be viewed with the aid of this signal lamp and the test push-button on the pump unit.**

Release date: March 2016

### 6.4.3 Fault codes by signal lamp

The signal lamp indicates the fault codes by flashing:

- Dozens are shown by long pulses (0,5 seconds)
- Units are shown by short pulses (0,15 seconds)

**NOTE**

**Reset, after solving the problem, the signal lamp with the test push-button at the pump.**

**Examples**

| *Pulse* | *Fault code* |
|---|---|
| long, short, short, short, short | 14 |
| long, long, short | 21 |

**Fault codes**

| *Error code / failure* | *Cause* | *Solution* |
|---|---|---|
| 10: Currently no pending errors | - | - |
| 11: Block switch A fault | Block switch A did not change state at least once (either from opened to closed or vice-versa) during a number of pump cycles in succession, making it uncertain whether grease still reached this distribution block, possibly caused by: | |
| | a. Grease leakage in the primary grease line to this distribution block. | a. Check primary grease line on leakages. |
| | b. Pump does not deliver grease. | b. Check grease delivery pump. |
| | c. Valve stuck, allowing the grease to be delivered at another outlet. | c. Check grease delivery pump at specific outlet. |
| | d. Defective distribution block switch. | Check block switch functionality. |

Release date: March 2016

| *Error code / failure* | *Cause* | *Solution* |
|---|---|---|
| 12. Outlet 1 blocked | Maximum pressure exceeded during a pump cycle in outlet (relief valve opened), possibly caused by: | |
| | a. Blocked primary grease line to this distribution block. | a. When pressure at the inlet of the distribution block is low, check the primary grease line and or the pump outlet coupling on blockage.<br>If low pressure at the inlet is not the case, reconnect primary grease line and start the pump. |
| | b. Blocked bearing | b. Disconnect the secondary grease lines one by one until the distribution block starts giving grease. Last disconnected line/ bearing causes the blockage. Ask the customer to fix the bearing blockage. Connect the secondary grease line to the bearing only when the blockage is fixed. |
| | c. Blocked non-return valve(s) | c. Disconnect the non-return valves one by one until the distribution block starts giving grease. Replace the non-return valve that caused the blockage. |
| | d. Blocked distribution block | d. Replace the distribution block when no blockage is caused by the bearing, secondary grease line or non-return valve(s). |
| 13. Outlet 2 blocked | See 12. Outlet 1 blocked | See 12. Outlet 1 blocked |
| 14. Outlet 3 blocked | See 12. Outlet 1 blocked | See 12. Outlet 1 blocked |
| 15. Empty reservoir | Pump disabled and theoretically declared empty because the maximum allowed grease quantity with an active low level switch was finished. | Refill the reservoir<br>Lamp will be reset automatically when filling the reservoir. |
| 16. Low level | Grease in the reservoir reached the level where it activates the low level switch. | Refill the reservoir.<br>Lamp will be reset automatically when filling the reservoir. |

Release date: March 2016

| *Error code / failure* | *Cause* | *Solution* |
|---|---|---|
| 21: Revolution fault | Control unit detected a not or too slow rotating pump drive shaft and aborted the attempted cycle (max. allowed revolution time exceeded), possibly caused by: | Start a test cycle and check whether pump is running and keeps running for longer than 10 seconds. When: |
| | a. Pump drive shaft blocked or rotating heavily: | a1. not running: check pump cam shaft or pistons on blockages and solve. |
| | | a2. running heavily for 10 seconds: check pump cam shaft or pistons on damage and repair or renew pump section. |
| | b. Defective revolution sensor | b. running smooth for 10 seconds: check revolution sensor and magnet in the motor reduction gear and repair or renew pump section. |
| 22: OL pump motor | Control unit detected an unusual resistance in the pump motor circuit and aborted the attempted pump cycle, possibly caused by: | |
| | a. Interrupted wiring | a. Check wiring harness between pump motor and circuit board and restore when necessary. |
| | b. Defective motor | b. Check the resistance of the motor. Replace when necessary. |
| | c. Corroded contacts | c. Check wiring harness contacts on corrosion. Replace when necessary. |
| | d. Defective control unit | d. Replace control unit when error persists. |
| 23: OC pump motor | Control unit detected a too high current draw to pump motor and aborted the attempted cycle, caused by: | |
| | a. Drive shaft blocked | a. Check pump cam shaft or pistons on damage or blockage and repair or renew pump section. |
| | b. Extreme low working temperatures in combination with a grease not suitable for these conditions. | b. Replace the grease in the reservoir and bleed the system with a suitable grease for the obtained working conditions. |
| | c. The "pump motor current limit" setting not suitable for the extreme low working temperatures. | c. Increase the "pump motor current limit" parameter setting but only after checking whether the vehicle wiring and fuse can handle a higher setting |

Release date: March 2016

| *Error code / failure* | *Cause* | *Solution* |
|---|---|---|
| 24: OL valve A | Control unit detected an unusual resistance in the valve A circuit and aborted the attempted pump cycle for outlet 2, possibly caused by: | |
| | a. Interrupted wiring valve A | a. Check wiring harness between valve A and circuit board and restore when necessary. |
| | b. Defective coil valve A | b. Check the resistance of the valve coil. Replace when necessary. |
| | c. Corroded contacts | c. Check wiring harness contacts on corrosion. Replace when necessary. |
| | d. Defective control unit | d. Replace control unit when error persists. |
| 25: OC valve A | Control unit detected a too high current draw to valve A and aborted the attempted pump cycle for outlet 2, possibly caused by: | |
| | a. Short circuit in wiring valve A | a. Check wiring harness between valve A and circuit board and restore when necessary. |
| | b. Short circuit in coil valve A | b. Check the resistance of the valve coil. Replace when necessary |
| | c Short circuit in control unit | c. Replace control unit when error persists. |
| 31: OL valve B | Control unit detected an unusual resistance in the valve A circuit and aborted the attempted pump cycle for outlet 3, possibly caused by: | |
| | a. Interrupted wiring valve B | a. Check wiring harness between valve B and circuit board and restore when necessary. |
| | b. Defective coil valve B | b. Check the resistance of the valve coil. Replace when necessary. |
| | c. Corroded contacts | c. Check wiring harness contacts on corrosion. Replace when necessary. |
| | d. Defective control unit | d. Replace control unit when error persists. |

Release date: March 2016

| *Error code / failure* | *Cause* | *Solution* |
|---|---|---|
| 32: OC valve B | Control unit detected a too high current draw to valve B and aborted the attempted pump cycle for outlet 3, possibly caused by: | |
| | a. Short circuit in wiring valve B | a. Check wiring harness between valve B and circuit board and restore when necessary. |
| | b. Short circuit in coil valve B | b. Check the resistance of the valve coil. Replace when necessary |
| | c Short circuit in control unit | c. Replace control unit when error persists. |
| 35: SC pump motor | Control unit detected a too high current draw to pump motor and aborted the attempted pump cycle, possibly caused by: | |
| | a. Short circuit in wiring pump motor | a. Check wiring harness between pump motor and circuit board and restore when necessary. |
| | b. Short circuit in motor | b. Check the resistance of the motor. Replace when necessary. |
| | c. Short circuit in control unit | c. Replace control unit when error persists. |
| 41: Voltage drop | Control unit encountered a successive power dip during pump start and aborted the attempted pump cycle, possibly caused by: | |
| | a. Faulty battery (vehicle) | a. Charge or replace battery. |
| | b. Faulty wiring (ground) | b. Check wiring. Replace or repair when necessary. |
| | c. Corroded pin-contacts in pumpcable connector(s). | c. Check connections at pump and in cabin. Replace or repair when necessary. |
| 42: Clock fault | Control unit encountered a corrupted real time clock, causing the events and errors to be stored with inaccurate time & date, possibly caused by: | |
| | a. Empty clock battery | a. Replace the control unit. |
| | b. Faulty clock | b. Replace the control unit. |
| 43: Clock battery low | Control unit detected a low real time clock battery mounted on its circuit board. | Replace the control unit. |

Release date: March 2016

| *Error code / failure* | *Cause* | *Solution* |
|---|---|---|
| 44: Parameter fault | Control unit encountered corrupted parameters during power up and restored the default production settings which can be totally unsuitable for this application. | Replace the control unit. |
| 45: Power relay fault | Control unit encountered a power relay that does not want to switch over and aborted the attempted pump cycle, caused by a defective power relay. | Replace the control unit. |
| 51: Block switch B fault | Block switch B did not change state at least once (either from opened to closed or vice-versa) during a number of pump cycles in succession, making it uncertain whether grease still reached this distribution block, possibly caused by: | |
| | a. Grease leakage in the primary grease line to this distribution block. | a. Check primary grease line on leakages. |
| | b. Pump does not deliver grease. | b. Check grease delivery pump. |
| | c. Valve stuck, allowing the grease to be delivered at another outlet. | c. Check grease delivery pump at specific outlet. |
| | d. Defective distribution block switch | d. Check block switch functionality. |
| 52: Block switch C fault | Block switch C did not change state at least once (either from opened to closed or vice-versa) during a number of pump cycles in succession, making it uncertain whether grease still reached this distribution block, possibly caused by: | |
| | a. Grease leakage in the primary grease line to this distribution block. | a. Check primary grease line on leakages. |
| | b. Pump does not deliver grease. | b. Check grease delivery pump. |
| | c. Valve stuck, allowing the grease to be delivered at another outlet. | c. Check grease delivery pump at specific outlet. |
| | d. Defective distribution block switch | d. Check block switch functionality. |

Release date: March 2016

| *Error code / failure* | *Cause* | *Solution* |
|---|---|---|
| 53: OL block sw A | Control unit detected an unusual resistance in the block switch A circuit, possibly caused by: | |
| | a. Interrupted wiring block switch A | a. Check wiring harness between block switch A and circuit board and restore when necessary. |
| | b. Defective switch | b. Check the resistance of the switch and wiring (should be 22 kiloohm when switch open). Replace when necessary. |
| | c. Corroded contacts | c. Check contacts on corrosion and restore or replace. |
| | d. Defective control unit | d. Replace control unit when error persists. |
| 54: OL block sw B | Control unit detected an unusual resistance in the block switch B circuit, possibly caused by: | |
| | a. Interrupted wiring block switch B | a. Check wiring harness between block switch B and circuit board and restore when necessary. |
| | b. Defective switch | b. Check the resistance of the switch and wiring (should be 22 kiloohm when switch open). Replace when necessary. |
| | c. Corroded contacts | c. Check contacts on corrosion and restore or replace. |
| | d. Defective control unit | d. Replace control unit when error persists. |
| 55: OL block sw C | Control unit detected an unusual resistance in the block switch C circuit, possibly caused by: | |
| | a. Interrupted wiring block switch C | a. Check wiring harness between block switch C and circuit board and restore when necessary. |
| | b. Defective switch | b. Check the resistance of the switch and wiring (should be 22 kiloohm when switch open). Replace when necessary. |
| | c. Corroded contacts | c. Check contacts on corrosion and restore or replace. |
| | d. Defective control unit | d. Replace control unit when error persists. |

Release date: March 2016

| *Error code / failure* | *Cause* | *Solution* |
|---|---|---|
| 61: T-high exceeded | The control unit temperature exceeded the set high threshold. This period will be stored in the memory to be able to declare possible damage or malfunction. | |
| 62: T-low exceeded | The control unit temperature exceeded the set low threshold. This period will be stored in the memory to be able to declare possible damage or malfunction. | |

Release date: March 2016

**Notes**

Release date: March 2016

# 7. TECHNICAL DATA


Release date: March 2016

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## 7.1 TriPlus pum unit

| | |
|---|---|
| Maximum operating pressure : | 275bar |
| Operating temperature : | -25 ... +70 °C |
| Supply voltage range : | 10 ... 32Vdc |
| 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 |
| Maximum pressure relief valve : | standard |
| Number of outlets : | 1, 2 or 3 |
| Pump material : | hard anodised aluminium - nylon reinforced |
| Delivery : | 2,5cc/min |
| Protection class : | IP67 (for lower part of pump unit) |
| Grease types : | NLGI 2 |

* Other grease reservoir sizes are available on request.

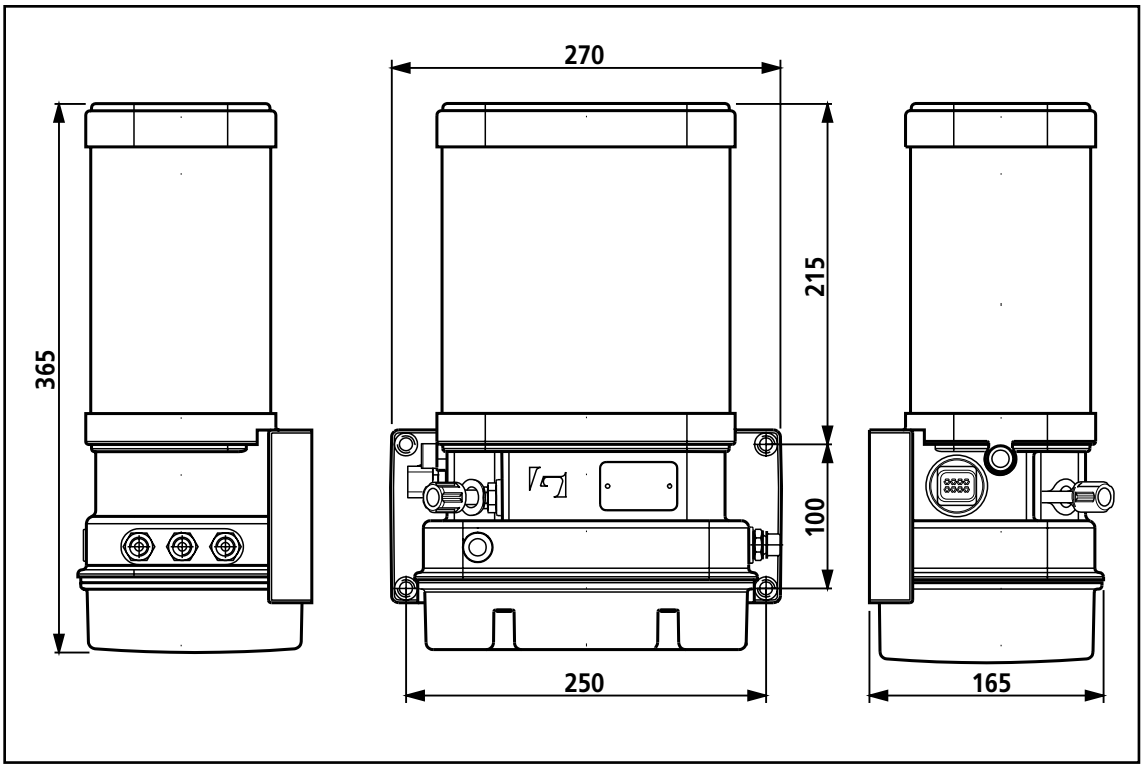


Figure 7.1 Dimensions of the TriPlus pump with a 3 litre reservoir.

Release date: March 2016

## 7.2 Distribution blocks

| | |
|---|---|
| Maximum operating pressure : | 275bar |
| Operating temperature : | -25 ... +70 °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 segment type 1 : | 2x 0.045cc or 1x 0.090cc |
| Delivery per segment type 2 : | 2x 0.075cc or 1x 0.150cc |
| Delivery per segment type 3 : | 2x 0.125cc or 1x 0.250cc |
| Delivery per segment type 4 : | 2x 0.200cc or 1x 0.400cc |
| Delivery per segment type 6 : | 2x 0.300cc or 1x 0.600cc |

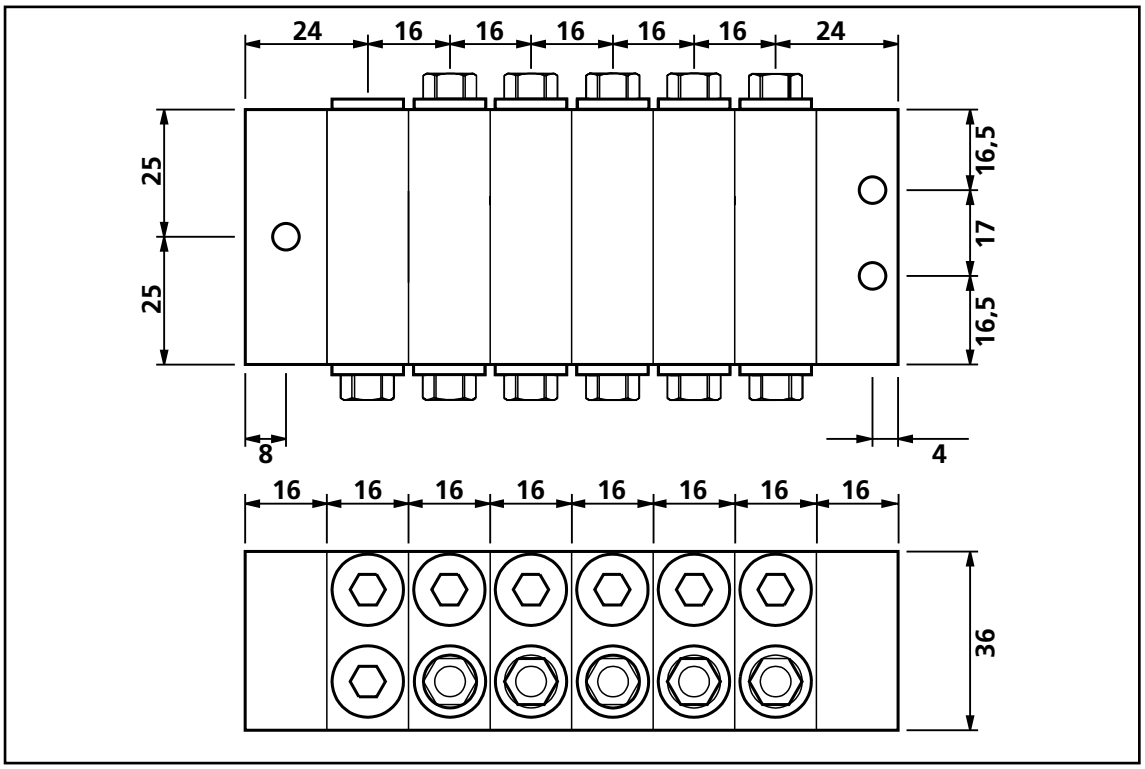


Figure 7.2 Dimensions of the distribution block.

Release date: March 2016

## Notes

Release date: March 2016


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