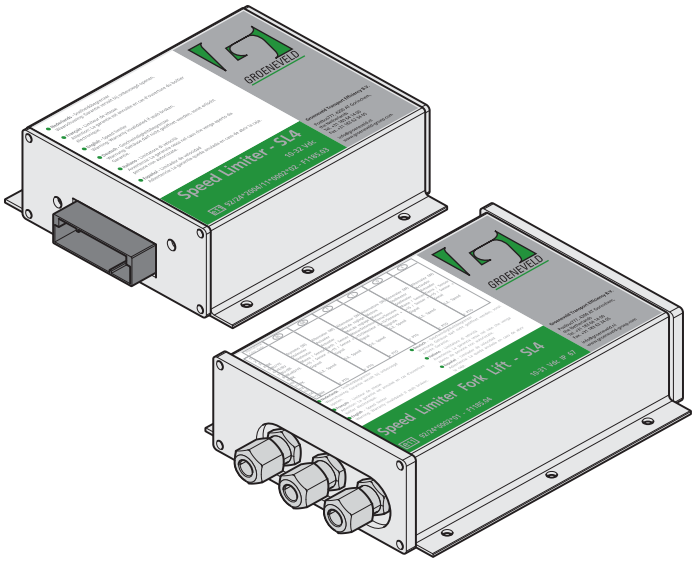
General Manual



Speed Limiter SL-4

EG0304R02

GROENEVELD

Your efficiency is our Challenge!

General information

Type of manual	General Manual
System	Speed Limiter SL-4
Document number	EG0304R02
Date of issue	November 2011
Revision	02

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Preface

This general manual gives a description of the speed limiter SL-4. 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 speed limiter SL-4.

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

ATTENTION

Draws the user's attention to important additional 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. Introduction

1.1 Speed limiter for trucks, busses, forklifts and off-road equipment

Excessive speeding costs a lot of money.
More speeding tickets, higher fuel consumption, increased insurance cost and increased maintenance. Rash driving behavior causes both your profits and your company's image to suffer.
Groeneveld supplies special speed limiters for trucks, busses, forklifts and off-road equipment.
The speed limiter has been designed as such that it will not affect the comfortable driving characteristics of the vehicle in any way.
The speed is limited but the full engine power and torque remains available.
Choosing a Groeneveld speed limiter means choosing proven functionality and cost reduction. It is a vital and essential safety device.

1.1.1 Operation

In case of a diesel engine, the existing mechanism on the fuel pump is extended or adapted in such a way that an actuator, irrespective of the position of the accelerator pedal, can control the 'lever' on the pump.
The electronics in the control unit receive speed signal pulses, and continuously compare this signal with the pre-set maximum. As the speed approaches the maximum, the control unit activates the actuator. The actuator in turn adjusts the position of the 'lever' on the fuel pump, in time to control the speed. As a result, the position of the accelerator pedal remains unaltered.
Conversely, the limiter also adapts the position of the 'lever' or throttle body, driving uphill or with a strong head wind. As a result, the driver is able to maintain an even speed, in all conditions.
In order to prevent unnecessary engine wear, it is also possible to keep the engine speed below a lower then maximum allowable engine speed. In this case, the alternator supplies the engine speed signal.

1.1.2 Speed Limiter functions

In its standard version, the Speed Limiter offers three functions - speed limiting, engine speed limiting and speed hold. Alternatively, the system can be supplied with the additional features of a cruise control in combination with power take off (PTO). If an error is identified during the self-test, a flashing lamp signal will be activated.
The standard version offers the following functions:

- Speed limiting
  Limiting the maximum speed, thus preventing driving at extremely high speeds. Speed limiting has no effect on acceleration.

- Engine speed limiting
  Limiting engine speed to a maximum, as requested by the customer. This prevents the driver accelerating up to maximum engine speed, thus reducing the risk of engine damage. The alternator supplies the control signal. Engine speed limiting - unlike vehicle speed limiting - could affect the vehicle's acceleration (this is a standard option, programmable).

- Speed hold
  By pushing a switch on the dashboard, the driver can temporarily have the system limited to a lower speed, for example for driving in a congested area, or where there is road construction, with a minimum of 40 km/h.
  The temporary maximum speed is the current driving speed at the moment the system is activated. This limit remains active until the driver once again operates the speed hold switch. Unlike with the optional cruise control, depressing the brake or clutch pedal will not switch off this function.

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1.1.3 Optional: Cruise Control / Power Take Off

Using cruise control, the driver can continue to drive at a preset speed (minimum 40 km/h) without keeping his foot on the accelerator pedal. It does of course remain possible to accelerate, for example when overtaking.
The cruise speed is the current speed at the moment the system is switched on.
Using the control lever, the driver can increase the cruise speed in steps of 1 km/hour. Cruise control automatically switches itself off, if the brake or clutch pedal is depressed. When he switches the system back on, the driver can opt for a new cruise speed or - by simply pressing the memory buttons - the previously selected cruise speed.
Speed hold and cruise control operation are integrated in a single control lever.
In the PTO (Power Take Off) application the engine is able to drive an external power unit at a constant engine speed, for example for a dump truck or chassis-mounted crane.

1.1.4 Optional: Second Maximum Speed

Through an externally controlled switch, a second pre-programmed lower maximum speed can be activated for driving on factory sites, garbage trucks or airfields for example.

1.1.5 Easy to install

Groeneveld has developed an easy-to-install kit, for the most common vehicle makes and models. The kits are supplied by certified product centres, which will adjust the limiter to your requirements.

The following chapters describe the different kind of Speed Limiters in a more extensive way.

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1.2 Legislation

European Legislation for speed limitation devices according to EU directives 92/24EU and 92/6 EU.

From 1 Jan 1994 - HGV's over 12 tonnes and buses over 10 tonnes newly registered in any EU state able to exceed 25 km/h must be limited so that the speeds of 85km/h for HGV's, and 100km/h for busses cannot be exceeded.
From 1 Jan 1995 - HGV's over 12 tonnes and buses over 10 tonnes able to exceed 25km/h, registered in an EU state and used for international transport and registered from 1 Jan 1988 must be limited so that the speeds of 85km/h for HGV's, and 100km/h for buses cannot exceeded.
From 1 Jan 1996 - HGV's over 12 tonnes and buses over 10 tonnes able to exceed 25km/h, registered in an EU state and used for national transport and registered from 1 Jan 1988 must be limited so that the speeds of 85km/h for HGV's, and 100km/h for buses cannot be exceeded.
Exemptions - official vehicles used for the Armed Forces as well as Fire, Police and Ambulance Services vehicles.
Member States may decide for themselves whether the following vehicles are to be exempted: vehicles used on the road for scientific tests and vehicles for public services in urban areas.
The speed limitation device must be installed and sealed by authorized installers (approved by the manufacturer of the speed limitation device). The government shall effect the authorization.

Extension of the legislation 92/24EU by the introduction of European Directive 2002/85/EC.

Buses and Coaches - The new requirements will apply to all buses and coaches whose maximum weight exceeds 3,500 tonnes but does not exceed 10,000 tonnes and which have more than eight seats in addition to the driver's seat. The implementation dates1 for which this extension to the legislation applies are:

- From 1st January 2005 for all vehicles registered on or after 1st January 2005
- From 1st January 2006 for all vehicles first registered on or after 1st October 2002 and before 1st January 2005, which comply with Euro III emissions legislation and are used on international operations.
- From 1st January 2007 for all vehicles first registered on or after 1st October 2002 and before 1st January 2005, which comply with Euro III emissions legislation and are used on UK domestic operations only.

A speed limiter, complying with the requirements of the annexes of Directive 92/24/EC must be fitted. The system must be calibrated in such a way that the speed cannot exceed 100 km/h.

Trucks - The new requirements will apply to all trucks whose maximum weight exceed 3,500 tonnes but does not exceed 7,500 tonnes. The implementation dates1 for which this extension to the legislation applies are:

- From 1st January 2005 for all vehicles registered on or after 1st January 2005
- From 1st January 2006 for all vehicles first registered on or after 1st October 2002 and before 1st January 2005, which comply with Euro III emissions legislation and are used on international operations.
- From 1st January 2007 for all vehicles first registered on or after 1st October 2002 and before 1st January 2005, which comply with Euro III emissions legislation and are used on UK domestic operations only.

A speed limiter, complying with the requirements of the annexes of Directive 92/24/EC must be fitted. The system must be calibrated in such a way that the speed cannot exceed 90 km/h.

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2. Trucks and busses

This chapter describes the way the Speed Limiter works on a Truck or Bus, also it describes the way it can be fitted in a proper way.

2.1 Main components

A speed-limiter system comprises, or involves, the following components (Figure 2.1):

1. Actuator
2. Digital control unit
3. Limiter cable
4. Throttle lever (original)
5. Accelerator rods or cable (original)
6. Clamping block (for Accelerator rod), or Coupling bracket (for accelerator cable)
7. Accelerator pedal (original)
8. End stop for accelerator pedal

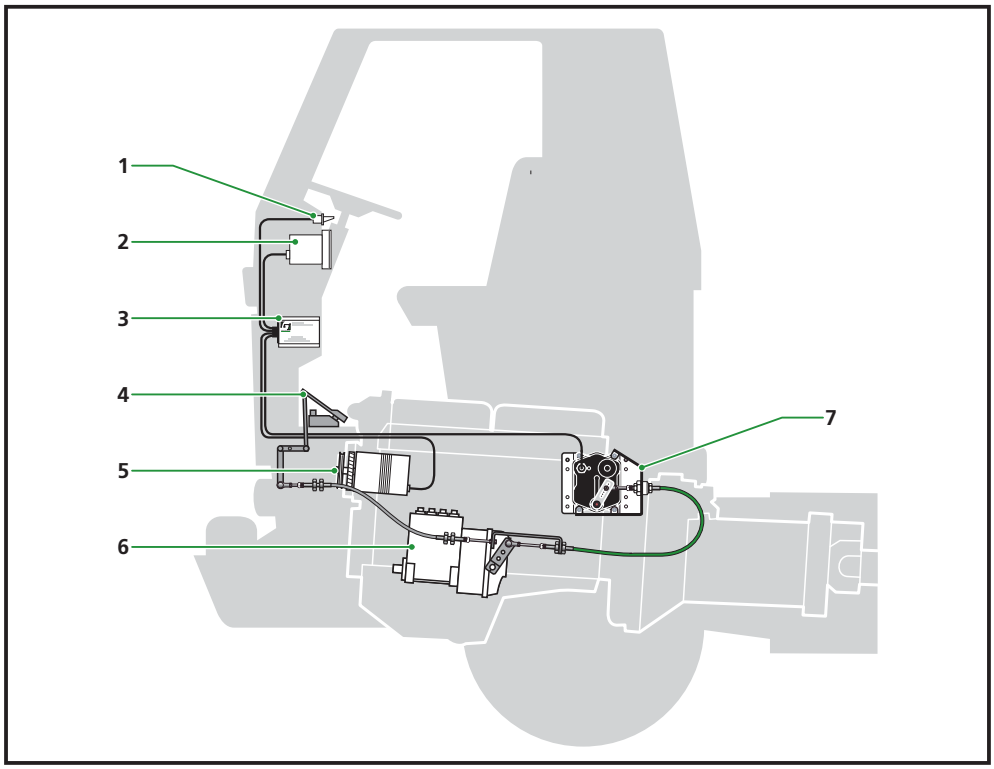

Figure 2.1 System overview

2.2 Electronic operation

The Groeneveld speed limiter is controlled by an electronic control unit, which must be mounted in the cab in such a way that it cannot be damaged by humidity or extreme heat sources (IP52).
The current digital model is suitable for 10-32Vdc.

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2.3 Mechanical operation

In order to limit the speed of the vehicle, the Groeneveld speed limiter controls the position of the lever on the fuel injection pump. The actuator, controlled by the electronic control unit continuously receives the command to supply more or less throttle in order to maintain a steady limited speed.
Actuators are available for vehicles with a voltage of 12Vdc and 24Vdc.
The arm of the actuator can move the fuel lever directly up to a maximum of 50mm.
The original throttle linkage to the fuel injection pump must be adapted to accommodate the speed limiter mechanism. A connection must be established from the limiter cable (from the actuator) to the original throttle mechanism, as otherwise it will not be possible to open the throttle normally.

This is achieved when a throttle rod is utilized by employing a clamping block (Figure 2.2) and in the case of a throttle cable a bridge piece is used as shown in Figure 2.3.

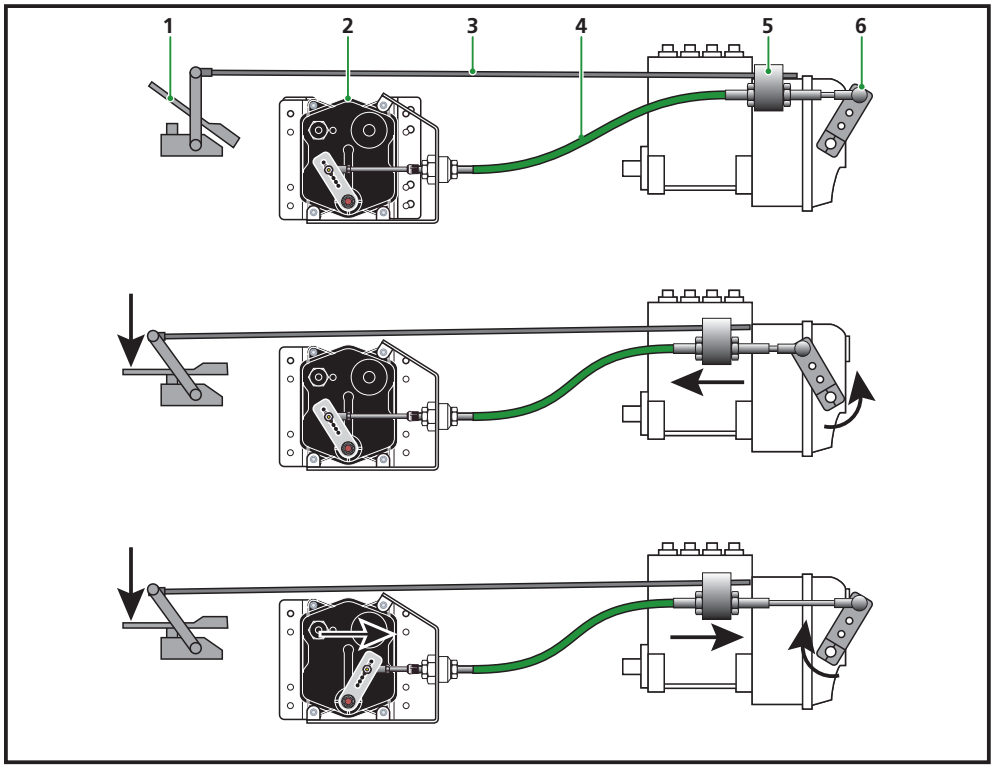

Figure 2.2 Throttle with rod and clamping block

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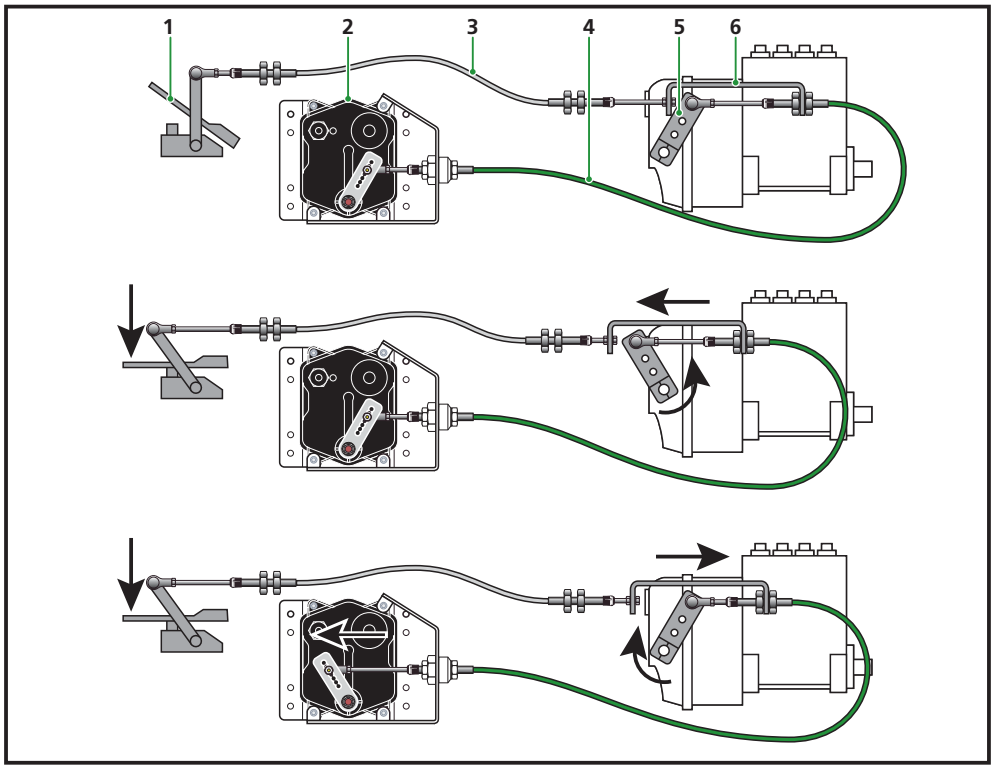

Figure 2.3 Throttle with cable and bridge

2.4 Speed signal

Normally a signal can be taken from the rear of the tachograph and processed by the control unit. However, if a mechanical tachograph or speedometer is used, there will be no ready to use signal so a pulse generator, that is available as an extra, must create the speed signal.

The electronic circuit compares the incoming speed signal to the set value, stored in the memory. As soon as the incoming signal approaches the value stored in the memory, the electronics will activate the actuator, which in its turn will change the position of the fuel pump.

The standard speed limiter kit includes a speed hold switch (Figure 2.4). This is normally a push-push switch and can be used to temporarily set a lower speed limit, from 40 km/h.

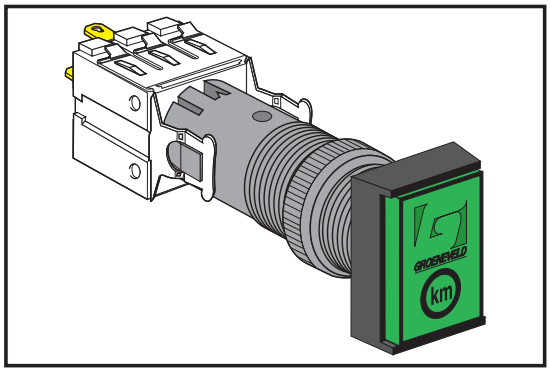

Figure 2.4 Speed hold switch

With the ignition on the push switch is dimly lit.
Depressing the switch during driving will switch on the speed hold function and the light will become brighter. Depressing the switch again will switch off the speed hold function when the switch will again be dimly lit.
Switching off the ignition will automatically switch off the speed hold function.

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2.5 Speed hold function

While the cruise function is switched off, pressing the lever to km will cause the present speed to be programmed as the maximum speed. The driver must still hold down the accelerator pedal.
Pressing the lever to STOP will cancel the speed hold function.
The wiring diagrams (Figure 2.9 untill Figure 2.13) shown apply to standard situations.

2.6 Electronic tachograph

There is a large variety of tachos and these instructions will refer to the most common types. There will be exceptions, and we would advise you to contact your tachograph supplier or Groeneveld for further information.
If the vehicle is equipped with an electronic tachograph supplying a standard signal this can be used for the speed limiter via a terminal on the back of the tachograph. The speed signal is often indicated by means of the symbol XX
Before establishing a connection to the speed signal output, check whether there is any other equipment connected to this output.

ATTENTION
Note that this may not necessarily be directly at the back of the tachograph.
(It is illegal to connect to the input speed signal).

Examples of equipment that use the speed signal:
Retarders, In-cab computers, Automatic height controls, Anti-locking systems etc.
Refer to Vehicle Manufacturer or Tachograph Centre if in doubt.

2.7 Measuring the speed signal

The presence and quality of the speed signal can be measured inside the vehicle by means of a digital voltmeter.
Whilst the vehicle is moving the pulse generator emits eight pulses per revolution.
The frequency of the signal will increase with speed. To check that the signal is present the vehicle can be driven slowly for a few meters and the voltmeter checked for a number of pulses. Measurement should be taken between signal output and earth.
The intensity of the signal can only be measured during a test run; in general, the voltage will increase from 0.5V to 3V at speeds between 30 and 80km/h.
The fact that the tachograph indicates speed does not necessarily mean that there is a signal at the output terminal. For some tachographs these are two different circuits. If in doubt ask your tachograph supplier.

2.8 Mechanical tachograph / speedometer

On vehicles without an electronic tachograph there is no speed limiter to use.
In these cases an impulse generator must be fitted between the gearbox speedodrive and the speedometer.
The standard impulse generator supplies 8 pulses per revolution.

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2.9 Installations

2.9.1 The basic equipment pack

Every registered installer of Groeneveld speed-limiters should have a basic equipment pack at his disposal. This pack allows him to install the speed-limiter in accordance with the guidelines.
This pack comprises:

- GINA (Groeneveld Tester for INstallation and Analysis)
- Connection cable for the GINA (part no. F122949 (086.33))
- General Manual: Speed-limiters
- Tube of sealing wax

2.9.2 Basic tools

- Open-end spanners 8 mm - 17 mm
- Ring spanners 8 mm - 17 mm
- Allen keys 3 - 4 - 5 - 6 mm
- Measuring tape or rule
- Drilling machine with drill bits Ø6, Ø8, Ø10, Ø10.5 mm and a cutter
- Digital voltage tester or voltmeter
- Wire stripping pliers or AMP-pliers
- Assorted screwdrivers
- Pair of side cutters
- Metal saw
- Sealing pliers
- Screw thread tap M12x1

With some vehicles, so-called torx-screwdrivers are required to remove the dashboard.

ATTENTION
Always consult the manufacturer of the truck or bus when you are in doubt whether it is allowed to drill new mounting holes in certain parts of the construction.
The control unit, the actuator and both ends of the limiter cable should be kept free of paint at all times. Cover them well before you start a paint job.
Never force the lever of the actuator.
Adhere to all safety regulations. Remove the ignition key before you start.
Do not hesitate to contact your dealer or Groeneveld if you have any questions regarding your speed-limiters.

WARNING
All safety regulations should be adhered to.
Always ensure that potentially dangerous situations are prevented from occurring. Always take adequate preventive measures before you start working on the vehicle.
The electrical system of the vehicle must be made dead, before you start working.
Only use tools that fit and are designed for the task you wish to perform with them.
Keep your workplace clean and tidy.
Take note of all (supplementary) regulations, specifications and recommendations that the manufacturer of the vehicle or engine might have specified.

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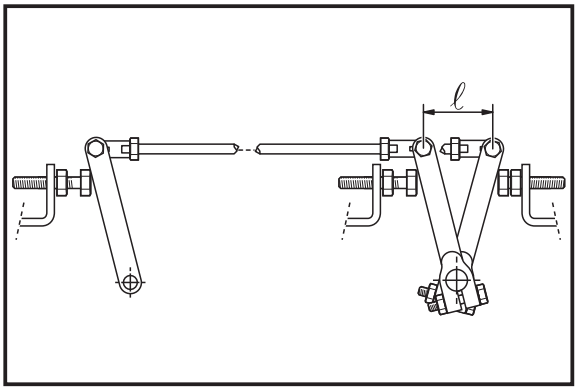
2.10 Mounting the components

2.10.1 Check the standard accelerator mechanism

With the accelerator pedal fully depressed make sure the pump lever reaches the full fuel position and returns fully to idle when released. The pedal stop should be set in such a position that with the pedal fully depressed the pump lever is at its maximum position.
If there is no restriction to the pedal movement an additional linkage stop must be fitted. Check the travel of the fuel pump lever or linkage point at which the limiter is to be connected.



Travel (ℓ)	*Position*
Not used	1
25-29 mm	2
30-34 mm	3
35-39 mm	4
40-44 mm	5
45-50 mm	6
>50 mm	7

Figure 2.5 Accelerator mechanism

Install a travel stop in the throttle mechanism at the first swivel from the fuel pump if there is not a suitable pedal stop. Operate the throttle rod/cable until the fuel is at maximum and adjust the stop accordingly.

2.10.2 Fitting the actuator bracket and brace

Connect the actuator according to the Figure 2.6. Mount the ball joint and the bracket with the cable swivel-clamping flange in one of the positions marked 1-4. This position should correspond to the position and value determined in the above procedure.

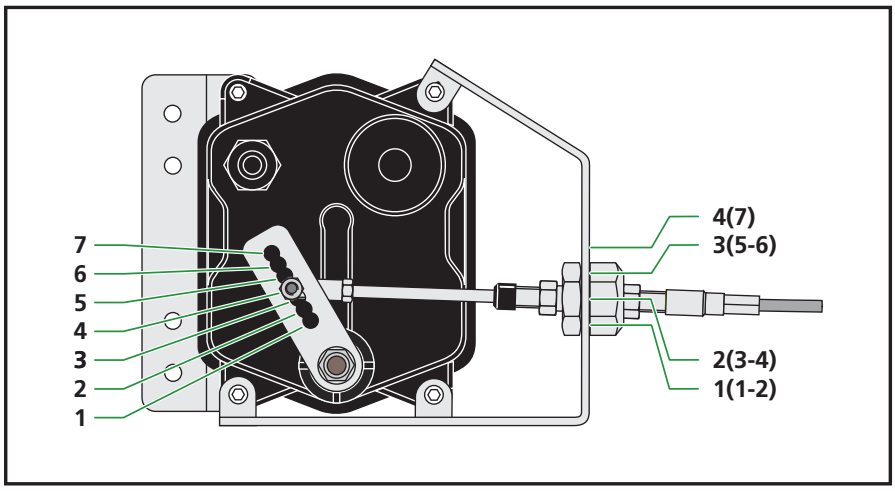


Figure 2.6 Actuator bracket and brace

ATTENTION

It is important to control the full stroke of the fuel pump lever in all cases.

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2.10.3 Assembling the bridge

Depending on the type of throttle linkage the actuator cable is connected by a clamping block (A) for rod operated throttles, or with a bridge version (B) for cable throttles. For version B assemble the bridge so that the ball joint on the actuator cable has sufficient space to execute a complete throttle lever travel. There are four settings the numbering of which corresponds to the length of travel required.

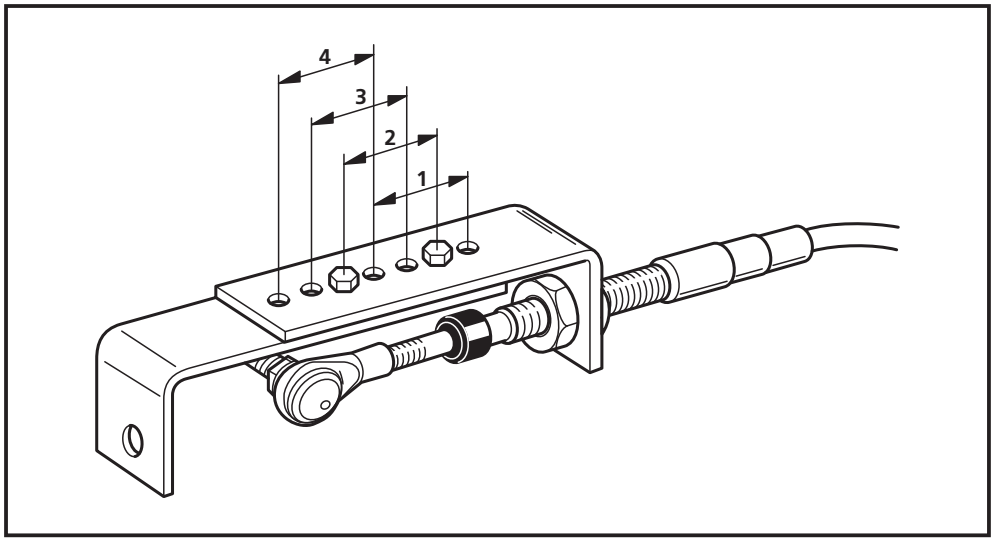

Figure 2.7 Assembling the bridge

2.10.4 Fitting the actuator cable

Remove the throttle linkage from the fuel pump lever and fix the actuator ball joint to the lever.

Version A: Fix the throttle rod in the clamping block (you may need to drill this out to fit).

Pulling throttle rod: Actuator IN (to left)	***Terminal***	***Pushing throttle rod: Actuator OUT (to right)***	***Terminal***
connect yellow wire to positive	5	connect yellow wire to earth	6
connect blue wire to earth	6	connect blue wire to positive	5

Version B: Fix the throttle cable to the bridge.
Fix the actuator in the correct position for adjusting the actuator cable.

Actuator OUT (to left)	***Terminal***
connect yellow wire to earth	6
connect blue wire to positive	5

ATTENTION
DO NOT change the overall length of the rod or cable otherwise pedal travel will be affected.

Adjust the actuator to the correct starting position by connecting the actuator wires to a supply voltage. Do NOT turn the actuator lever manually.

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2.10.5 Determing the best locations for the components

- Control unit: Mount the control unit underneath the dashboard, underneath the bonnet or at another dry, well protected location on the vehicle.
- Actuator: Mount the actuator, preferably, at a protected location on the inside of the chassis, or cross member, but never on the engine.

The locations of these components must be chosen to ensure that:

- The limiter cable, which runs between the throttle lever and the actuator can be routed so, that it will not be damaged by heat or sharp edges. The maximum temperature, which the limiter cable can endure, is 100 °C;
- The maximum total number of bends in the limiter cable will not exceed 270° and the bending radius will nowhere be smaller than 100 millimeters (Figure 2.8)
- The wiring between the control unit, actuator and speed sensor can be routed so, that all chances of immediate or subsequent damage to the wires are eliminated;
- As few as possible new mounting holes need to be drilled in the structure. If at all possible: use existing mounting holes.

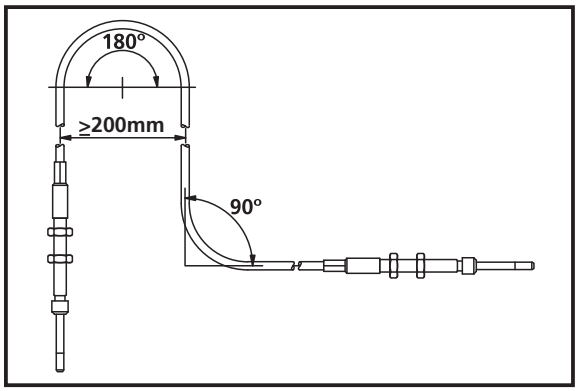

Figure 2.8 Limiter cable

2.10.6 Fitting the actuator bracket

Use existing holes where possible.
When removing the mounting bracket, it is important to replace the bracket with 5 mm flat washers and nuts, supplied in kits, to maintain warranty.

WARNING
NEVER drill the flange of a chassis rail. The centre distance of the holes must be at least 30 mm from the top or bottom flange. If in doubt consult the vehicle manufacturer guidelines.
Route the actuator electrical along existing wiring through the cable duct to the cab.

2.10.7 Setting the cable

Check that at idle the fuel pump lever touches the idle stop (don't forget the hand throttle).
Adjust the cable length using the two nuts at either the clamping block (or bridge), or the actuator swivel flange.

The length of the cable must be such that the maximum position of the throttle lever on the fuel pump corresponds to the maximum travel stop.
During full throttle the actuator must be able to control the pump lever almost down to idle. In the case of Cummins engines or when the PTO is used, the actuator should be set to fully close the fuel pump to idle position.

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2.10.8 Fitting the control unit

Connect up as shown in the wiring diagram (Figure 2.9 untill Figure 2.13). Fit the control unit inside the cab in a dry and protected area.

Fitting options:

- Speed hold switch: This push switch is included in all standard kits. When used it allows a lower maximum speed to be set during driving. The switch will be dimly lit whilst the ignition is on. Depressing the switch during driving will activate the speed hold function and the light will become brighter.
- RPM limiting: Engine speed can be limited for safety or economy. The only additional physical requirement is a connection to the alternator W terminal, though the speed will need to be set up by the GINA.
- PTO: The engine speed can be limited whilst using a PTO. This is achieved by connecting the alternator W terminal and the PTO switch to the unit.
  When the vehicle is equipped with a hand throttle, please see the diagram.
  When the vehicle is equipped with a automatic throttle, please contact your local Groeneveld dealer for the optional kit.
- 2nd end speed: This gives the opportunity to set a second speed. When using a SL2 speed limiter, please contact you local Groeneveld dealer. When using the SL4, it is programmable.

2.10.9 Cruise control (optional)

A cruise control allows the driver to drive at a constant speed without having to keep his foot on the throttle pedal.
An air cylinder is added to the speed limiter installation, keeping the throttle pedal at "full throttle" while the cruise control is switched on. The speed limiter limits the speed to the relevant speed chosen by the driver, while the electronic control takes into account continually changing conditions such as descending or climbing hills and head wind.
Actuating the brakes, exhaust brake or clutch will automatically switch off the cruise control but all limiter functions will remain active at all times.
For this purpose a special cruise control installation kit is available, made to correspond to the relevant vehicle types and, depending on make and type of the vehicle, comprises the following parts:

- Air cylinder
- Solenoid valve with mounting bracket
- Operating lever
- Safety components for automatically switching off the cruise control, such as:
- Micro switch(es) with mounting bracket(s)
- Switch for 'full air' exhaust brake
- Fitting kits

The cruise control is operated as follows by means of a lever on the dashboard:

- Press the lever once to SET; the present speed will be programmed. Then release the throttle pedal.
- Holding the lever for longer will increase the speed. The newly programmed speed will be the speed at the moment the lever is released.
- Press the lever once to MEMO after the cruise control had been switched off; the speed that had been programmed last will be retrieved. Then release the throttle pedal.
- Holding the lever for longer will decrease the speed. The newly programmed speed will be the speed at the moment the lever is released.
- Pressing the lever to STOP will cancel the cruise function.
- Actuating the clutch, brakes or exhaust brake (retarder) will also cancel the cruise function.
- While the cruise function is switched off, pressing the lever to KM will cause the present speed to be programmed as the maximum speed. The throttle pedal must still be hold down by the driver.
- Pressing the lever to STOP will cancel the speed hold function.

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2.10.10 Fitting the air cylinder

The air cylinder moves the throttle pedal to the lowest position ("full throttle") and keeps it there for as long as the cruise control function remains switched on. Limiting more or less speed will then control the speed.
Mount the cylinder in the throttle linkage between the throttle pedal and the actuator.
Make sure the cylinder can definitely move the system to the full throttle position up to the maximum travel stop.
The cylinder is of the double acting type, which means that the pressure and return lines are interchangeable, depending on the mounting circumstances.

ATTENTION

The air cylinder must achieve full throttle when activated.

2.10.11 Fitting and connecting the solenoid valve

The solenoid valve actuates the air cylinder. Screw the throttle valve in connection P of the solenoid valve.
Fasten the solenoid valve including the bracket to a suitable place in the chassis, preferably in the engine compartment. Include a tee in the existing accessory airline. Connect an airline between the tee and the throttle valve (connection P).
Connect an airline between the solenoid valve (conn. A) and the air cylinder. Connect a vent line (approx. 1m long) to the air cylinder and fasten with tie wraps.

Establish the electrical connection of the solenoid valve and route the wire alongside existing wires through the cable duct into the cab.
Adjust the throttle valve in such a way that the throttle pedal is pulled completely down (to the full throttle position) within 2 seconds. For this adjustment the complete pressure in the air system of the vehicle must be available.

Fitting the switch to the clutch pedal:
Fit the micro switch supplied next to the clutch pedal. This switch will cancel the cruise control function as soon as the clutch pedal is operated.
The switch is of the normally open type (NO), but is mounted against the pedal in the closed, i.e. depressed, position. This makes the switch function as normally closed contact (NC).

Fitting the joystick:
Mount the joystick on the dashboard or on the steering column, within direct reach of the driver. The lever can possibly be bent or shortened in order to ease the operation as much as possible. Connect the cable to the outer socket at the rear of the control unit.

Connecting the engine brake:
For a pneumatically operating engine brake include a normally closed (NC) air activated switch in the system. Connect the exhaust brake (electrically or pneumatically activated version) according to the diagram.

Connecting the Retarder:
If the vehicle has a Retarder, it must always be connected. The retarder is connected in practically the same way as the engine brake, the only difference being that a relay is included in the circuit.

Connecting the stop lights / brakes:
Connect the existing stop light switch to the system according to the diagram.
As soon as the brake pedal is depressed, the cruise control function will automatically be switched off.
If connection to the stop light switch is impossible, a micro switch must be added to the brake pedal. Connect this micro switch in the same way as the switch on the clutch pedal.

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ATTENTION
All the above safety features must have an earth in order for the cruise control to work.
For safety reasons the cruise control can only be used above 40 km/h.

2.11 Wiring diagrams

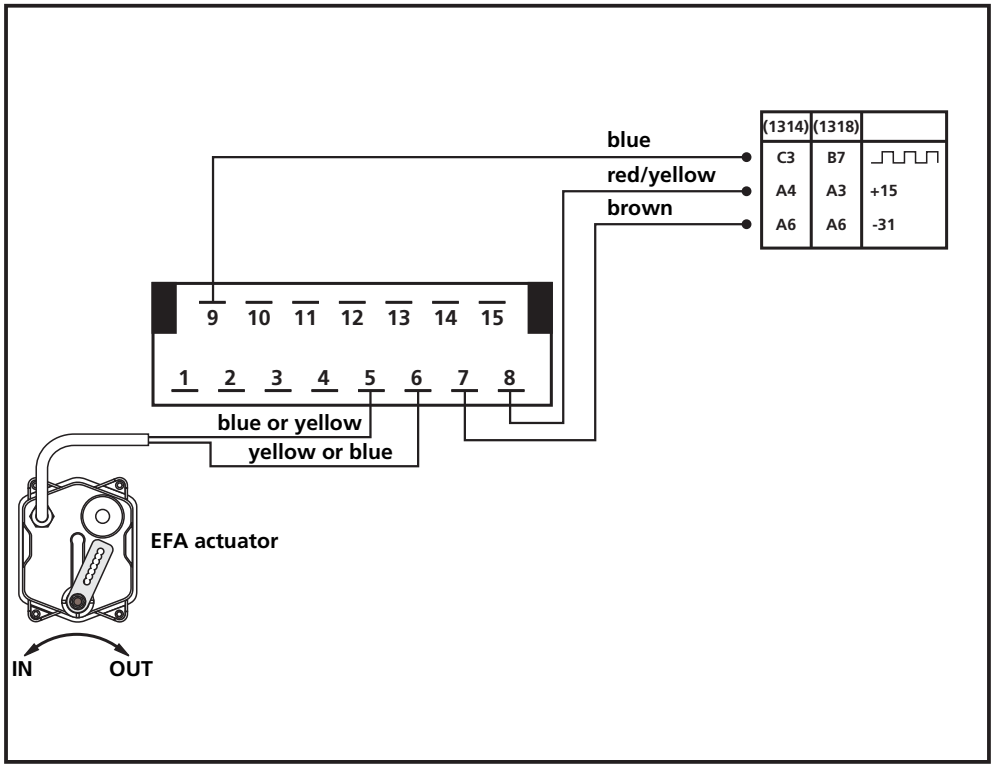

Figure 2.9 Wiring diagram with electronic tachograph

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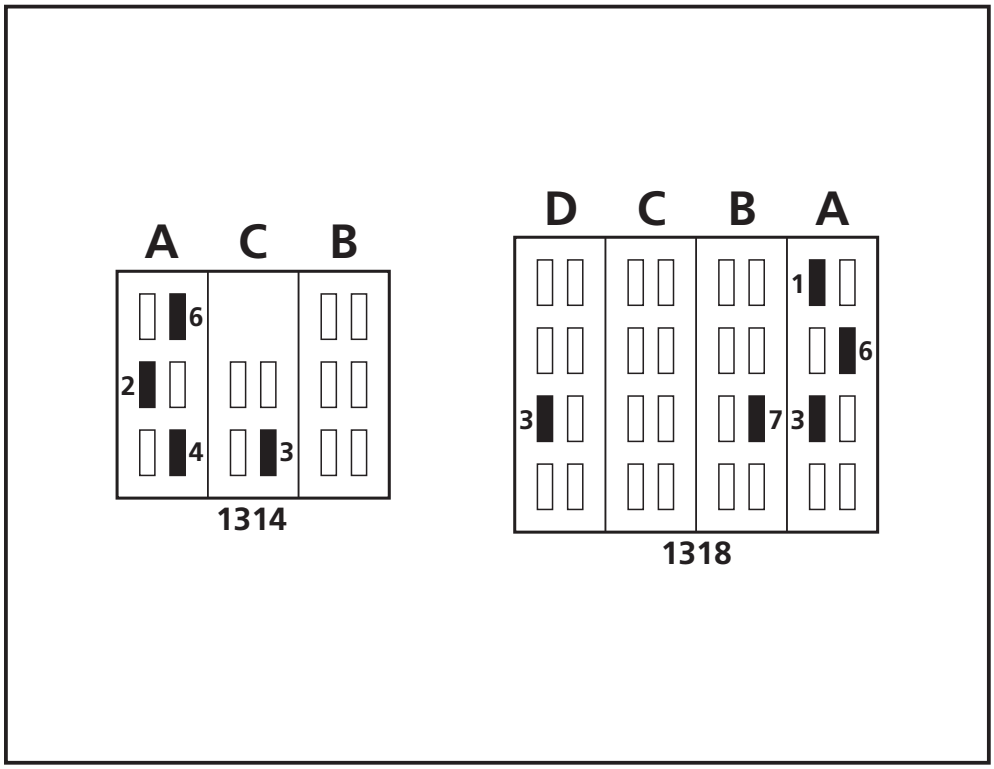

Figure 2.10 Tachograph connections

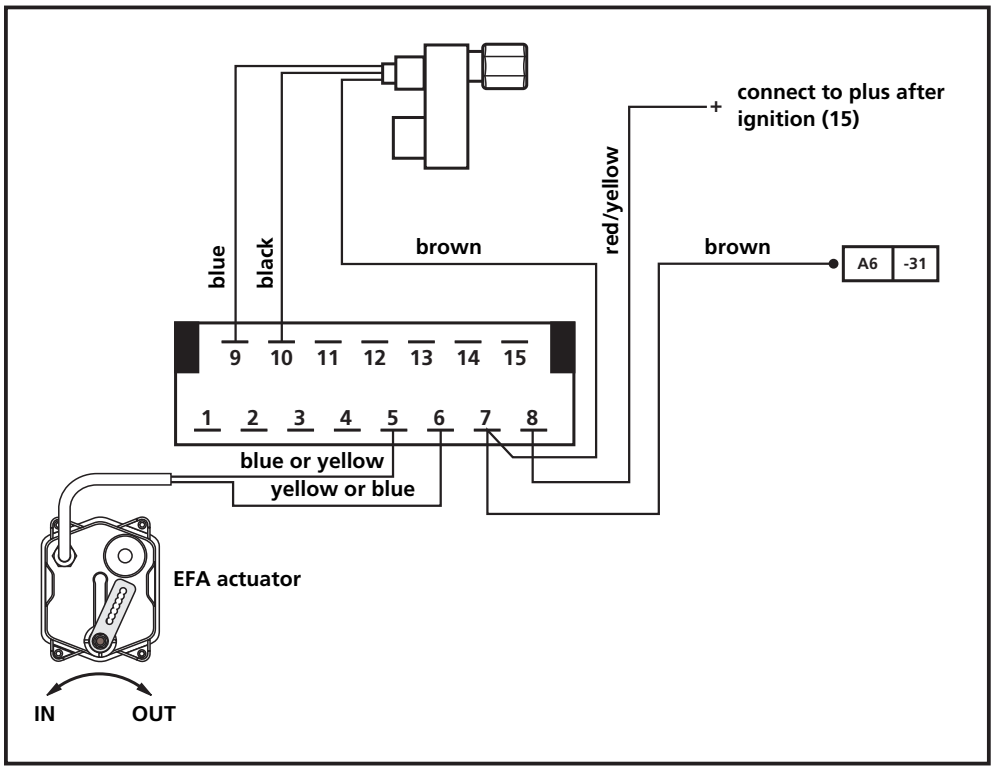

Figure 2.11 Wiring diagram with mechanically driven pulse sender

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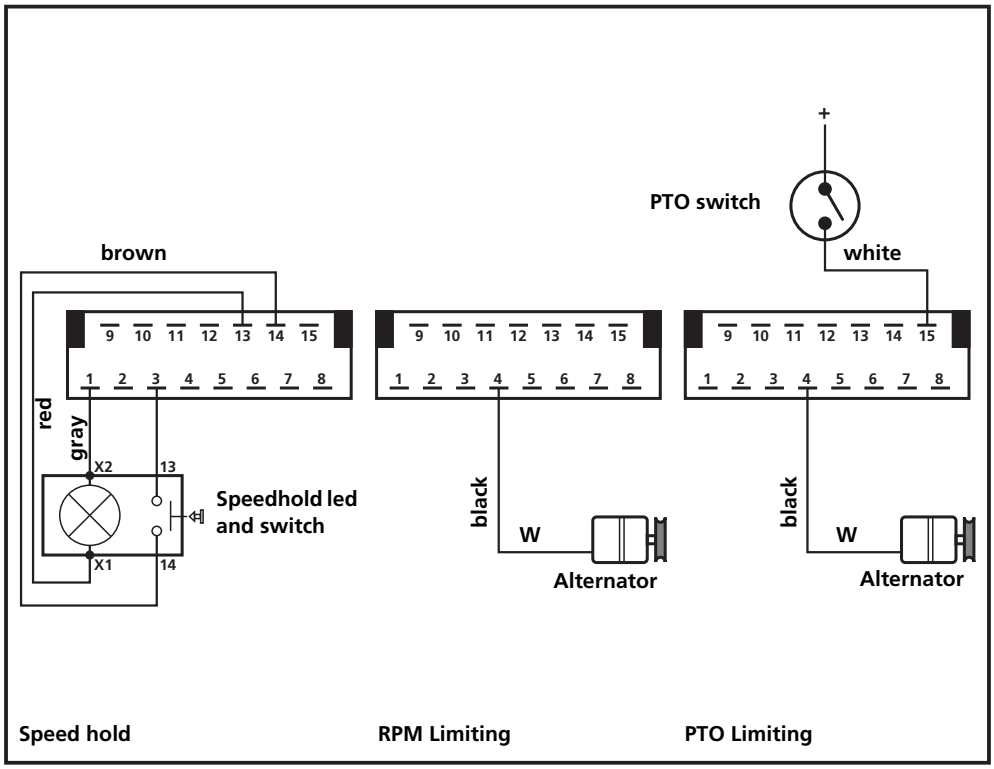

Figure 2.12 Wiring diagram for options

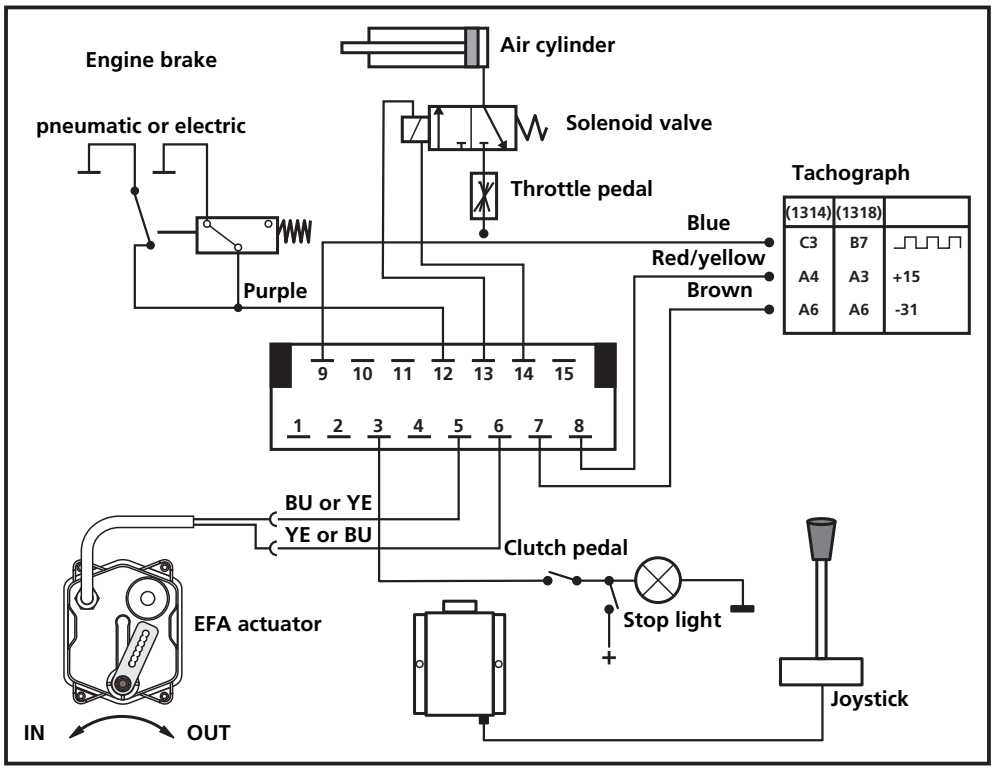

Figure 2.13 Wiring diagram for cruise control

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2.12 Checking the speed limiter system after installation

- Check the fuel pump lever reaches full fuel position with pedal fully depressed.
- Check pump lever returns fully to idle position when pedal released.
- Check maximum travel stop settings.
- Fully depress pedal and change connections to make actuator run to fully limited position making sure the pump lever is at least at 70% of full stroke.
- Use switch Systeemtest +/- on the GINA to change polarity.
- Check electrical connections are as per diagram.
- Check all seals fitted.
- Check speed limiter operation during a test drive.
- Check speed hold operation during a test drive.
- Complete registration label and stick it where it can be seen easily.

2.13 Sealing

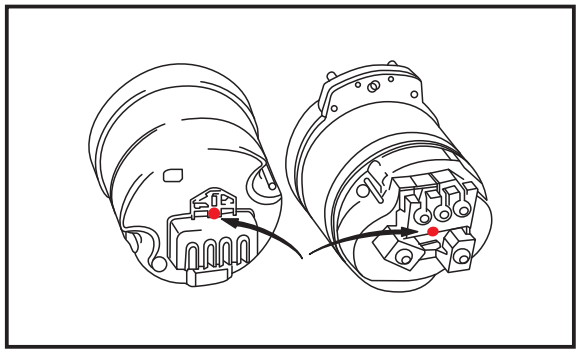

Figure 2.14 Sealing of the tachograph

Before carrying out the installation of a speed limiter, ensure that the tachograph system has been correctly sealed and that the seal markings have been applied correctly.

After the installation of the speed limiter and checking the system for correct operation, the system must now be sealed against un-authorised interfence.

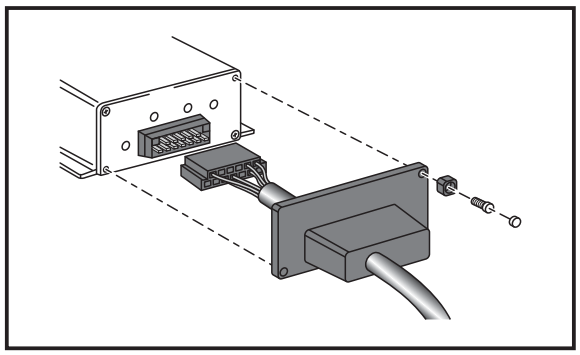

Figure 2.15 Sealing of the control unit

The wire harness provided has a plastic sealing cap. This cap must be fastened by means of the two screws and then sealed as showned in the illustration.

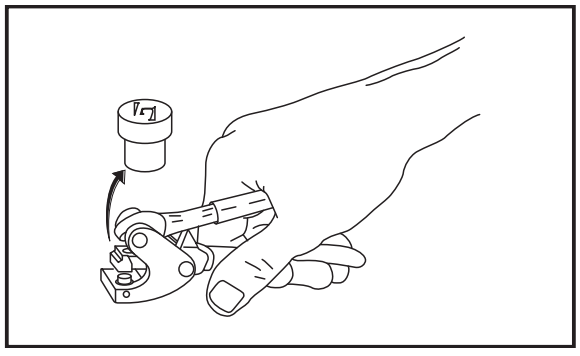

Figure 2.16 Sealing pliers

Replace the seal at the back of the tachograph using the sealing pliers and designated seal number.
This seal must be replaced only by an **approved** tachograph agent.

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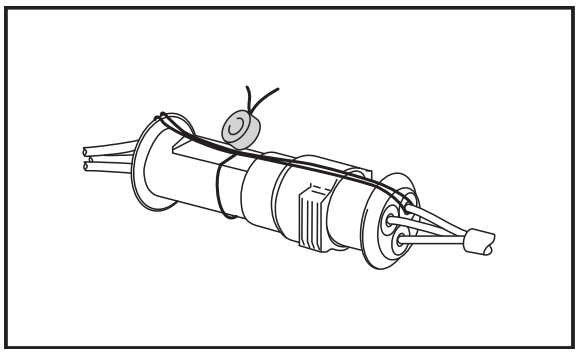
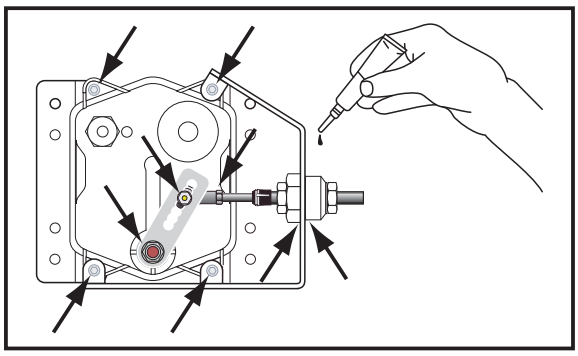


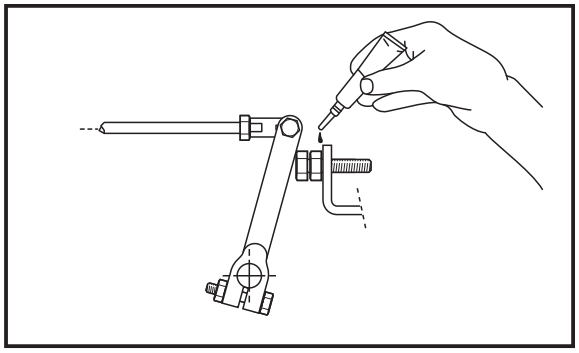
Plug connection between the actuator and control unit. Firmly wind the sealing wire around the two connectors and then apply the lead seal using the sealing pliers and designated seal number.

Figure 2.17 Plug connection between actuator and control unit



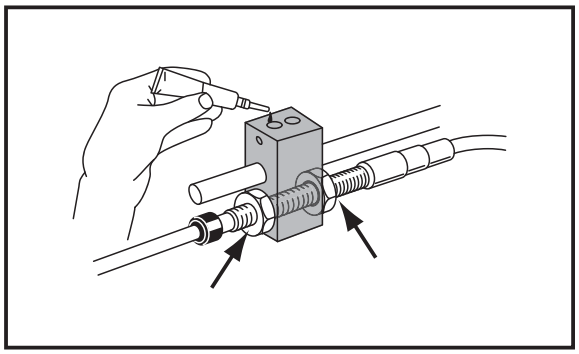
All connections of the actuator which can influence the functioning of the speed limiter must be sealed by means of the sealing paint.

Figure 2.18 Sealing of the actuator



All connections of the end stop which can influence the functioning of the speed limiter must be sealed by means of the sealing paint.

Figure 2.19 Sealing of the end stop



All connections of the connection block which can influence the functioning of the speed limiter must be sealed by means of the sealing paint.

Figure 2.20 sealing of the connection block

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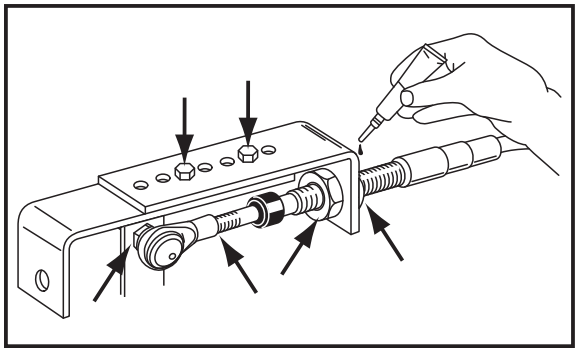
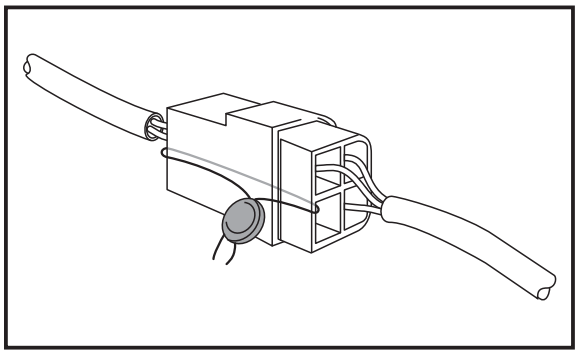


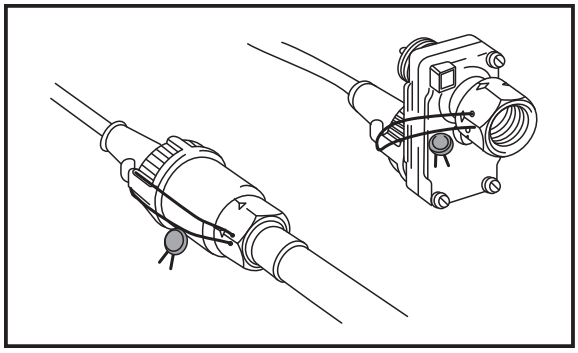
All connections of the bridge can influence the functioning of the speed limiter must be sealed by means of the sealing paint.

Figure 2.21 Sealing of the bridge



PAmp and PCon. If the speed limiter is fitted with a pulse con-diotioner or pulse amplifier, the electrical connections of these units must be sealed as shown in the illustration.

Figure 2.22 Sealing connections PAmp and PCon



Where an impuls sender unit is fitted to the vehicle gearbox the electrical connections to the impulse sender must also be sealed.
This sealing must be done by an approved tachograph centre.

Figure 2.23 Sealing connections of the impulse sender

2.14 Calibration record

Every authorized installer must adhere to the following regulations on sealing and registration of speed limiters with respect to any installation or repair.

For each installation of a speed limiter a registration form must be completed in the form of:
- Original (white) for the vehicle owner
- Duplicate (green) for your own records

ATTENTION
As an installer you are legally responsible and liable for the installation. If the form is incomplete or incorrectly filled in you risk losing your rights as an installer. You must keep the completed green copies for at least two years after the installation.

If any changes are made to the speed limiter installation, follow the same procedure as you would for a new installation.

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2.15 Test equipment

2.15.1 Setting and checking procedure

Setting the control unit requires special equipment. This equipment (GINA) is described in a special manual.

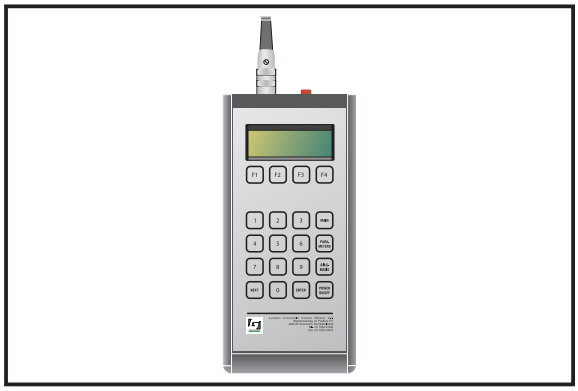

Figure 2.24 GINA

2.15.2 Digital unit

Maximum road speed.
Groeneveld units (F119358 only) are supplied with a standard speed setting of 85 km/h.
This setting can be changed if legally permitted.

Maximum engine speed (rpm).
Never limit the maximum speed at a value lower than 150 rpm below the factory set maximum engine speed.

A lower maximum speed decreases the available engine power.

Maximum PTO speed (rpm).
First set the maximum engine speed because this is a reference for the PTO speed.

Setting range: -The following setting ranges apply to all control units:
Road speed 30-125 km/h
Engine speed 1500-2500 rev/min
PTO speed 800-1800 rev/min

The setting range for the numbers of revolutions depends, among other things, on the alternator (W-frequency) and therefore, in exceptional cases can deviate from the above-mentioned ranges. Groeneveld cannot take responsibility for settings outside the above ranges.

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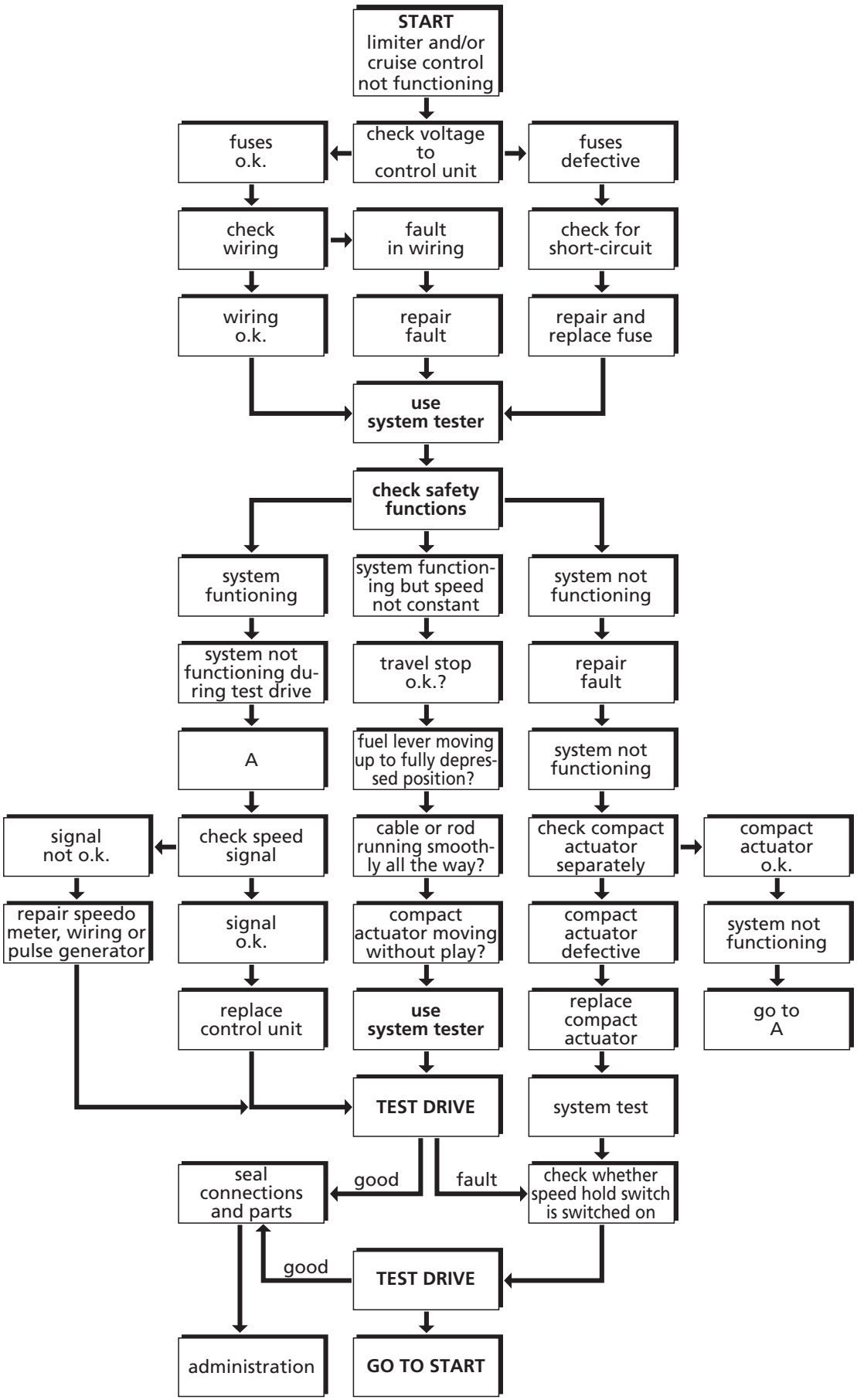
2.16 Trouble shooting



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2.17 Standard kits

These are the standard Truck kits Groeneveld has:

1. 24 V unit with 0.75 m push-pull cable
2. 24 V unit with 1.00 m push-pull cable
3. 24 V unit with 1.50 m push-pull cable

4. 12 V unit with 0.75 m push-pull cable
5. 12 V unit with 1.00 m push-pull cable
6. 12 V unit with 1.50 m push-pull cable

For more detailed information about the different kind of article numbers, please check the website **www.groeneveldonline.com**, or your local Groeneveld Dealer.

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3. Fork lifts

This chapter describes the way the Speed Limiter works on a fork lift, also it describes the way it can be fitted in a proper way.

3.1 Main components

A speed-limiter system comprises, or involves, the following components (Figure 3.1):
1. (Electric) accelerator actuator
2. Digital control unit (electronic)
3. Limiter cable
4. Throttle lever (original)
5. Accelerator rods or cable (original)
6. Clamping block (for Accelerator rod), or Coupling bracket (for accelerator cable)
7. Accelerator pedal (original)
8. End stop for accelerator pedal
9. Speed sensor (proximity switch)

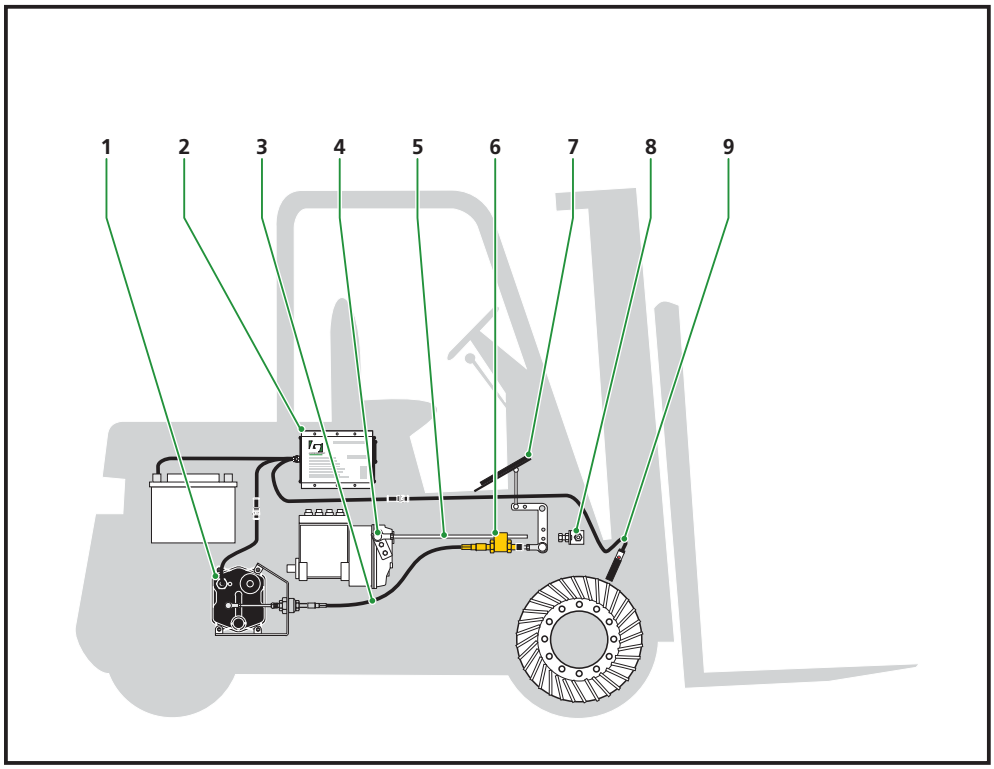

Figure 3.1 System overview

3.2 Principle of operation

The maximum allowable speed is laid down in the control unit. The control unit measures the current speed continuously by means of the speed sensor. The speed sensor measures the peripheral velocity of the crown wheel in the differential.

When the accelerator pedal is depressed so far that the maximum speed threatens to be exceeded, the control unit starts influencing the position of the throttle lever on the engine. It does this by means of the accelerator actuator and the limiter cable that connects the actuator with the throttle lever.
The position in which the control unit puts the lever on the actuator, determines -via the limiter cable and the clamping block or coupling bracket -how a particular position of the accelerator pedal is translated into a position of the throttle lever.

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The accelerator pedal retains its normal function and its full stroke: it can still be used to accelerate normally and be depressed fully. The driver, therefore, does not notice a thing, other than that his mount has apparently reached its maximum speed.
Because of the quick reactions by the electronic control system and the direct character of the control mechanism, the speed-limiter will only enhance the driving behavior and comfort of the forklift truck. Even if the driver accelerates quickly, the speed of the forklift will never exceed the set maximum speed by more than 2 kilometers per hour.

3.2.1 Mechanical principles

No doubt, the mechanical principle of the speed-limiter will become clear to you if you view the schematic diagrams below.
Depending on the make and type of forklift truck at hand, the standard accelerator mechanism utilizes either a rod or a cable. This, however, makes no difference to the operating principle of the speed-limiter, other than that either a clamping block (with accelerator rod) or a coupling bracket (with accelerator cable) is used to incorporate the speed-limiter into the accelerator mechanism. Each of these configurations is shown in Figure 2.2 and Figure 2.3.

3.2.2 Limiting engine rpm (optional feature)

If the speed-limiter system is also used to limit the speed of the engine, the control unit requires an input signal from the dynamo. The control unit will use a voltage generated by the dynamo - the frequency of which is proportional to the engine rpm - to measure the speed of the engine. The dynamo may have to be modified to provide this input signal.

3.3 Installations

3.3.1 The basic equipment pack

Every registered installer of Groeneveld speed-limiters should have a basic equipment pack at his disposal. This pack allows him to install the speed-limiter in accordance with the guidelines.
This pack comprises:
- GINA (Groeneveld Tester for INstallation and Analysis)
- Connection cable for the GINA (part no. F122949 (086.33))
- General Manual: Speed-limiters
- Tube of sealing wax

3.3.2 Basic tools

- Open-end spanners 8 mm - 17 mm
- Ring spanners 8 mm - 17 mm
- Allen keys 3 - 4 - 5 - 6 mm
- Measuring tape or rule
- Drilling machine with drill bits Ø6, Ø8, Ø10, Ø10.5 mm and a cutter
- Digital voltage tester or voltmeter
- Wire stripping pliers or AMP-pliers
- Assorted screwdrivers
- Pair of side cutters
- Metal saw
- Sealing pliers
- Screw thread tap M12x1

With some vehicles, so-called torx-screwdrivers are required to remove the dashboard.

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ATTENTION
Always consult the manufacturer of the fork lift when you are in doubt whether it is allowed to drill new mounting holes in certain parts of the construction.
The control unit, the actuator and both ends of the limiter cable should be kept free of paint at all times. Cover them well before you start a paint job.
Never force the lever of the actuator.
Adhere to all safety regulations. Remove the ignition key before you start.
Do not hesitate to contact your dealer or Groeneveld if you have any questions regarding your speed-limiters.

WARNING
All safety regulations should be adhered to.
Always ensure that potentially dangerous situations are prevented from occurring. Always take adequate preventive measures before you start working on the vehicle.
The electrical system of the vehicle must be made dead, before you start working.
Only use tools that fit and are designed for the task you wish to perform with them.
Keep your workplace clean and tidy.
Take note of all (supplementary) regulations, specifications and recommendations that the manufacturer of the vehicle or engine might have specified.

3.4 Mounting the components

3.4.1 Check the standard accelerator mechanism

- The accelerator mechanism must act smoothly.
- The throttle lever on the engine must be able to reach its maximum deflection (full power).
- If the accelerator pedal is released, the throttle lever must return to its idling position.
- If the accelerator pedal is fully depressed, it must hit its end-stop and the throttle lever should touch its full-power end-stop.

If the accelerator pedal does not already have an end-stop, one must be installed (Figure 3.2). Mount the end-stop near the first point of rotation of the accelerator pedal.
Then pull the accelerator rod (or cable) to its full-power position and adjust the end-stop.

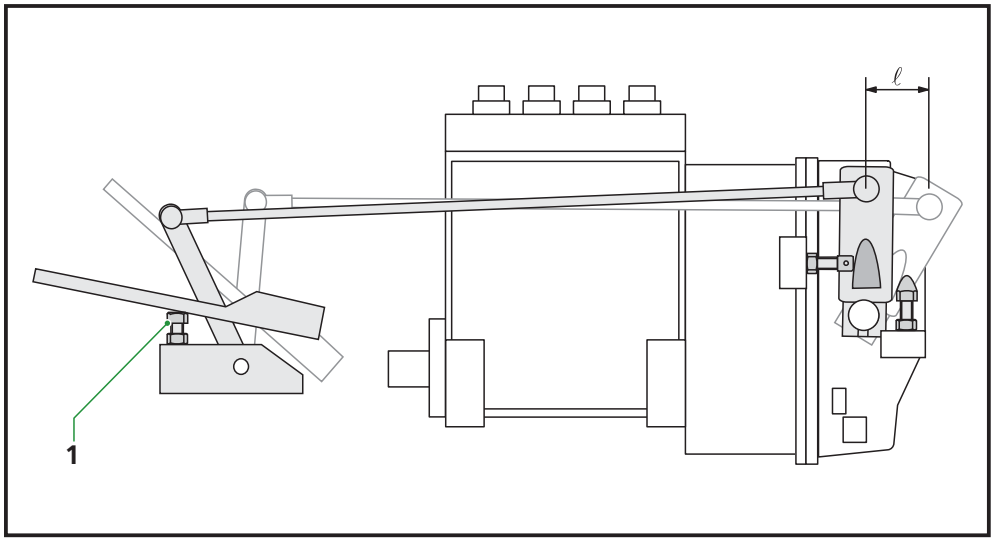

Figure 3.2 Accelerator mechanism

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3.4.2 Determine the stroke lenght of the throttle lever

Measure the length of a full stroke (ℓ) of the throttle lever on the engine (Figure 3.3).
Determine - using the table below - at which position the limiter cable should be mounted in the lever of the actuator (see chapter 2), to allow the actuator to influence the throttle lever over the full stroke of that lever.

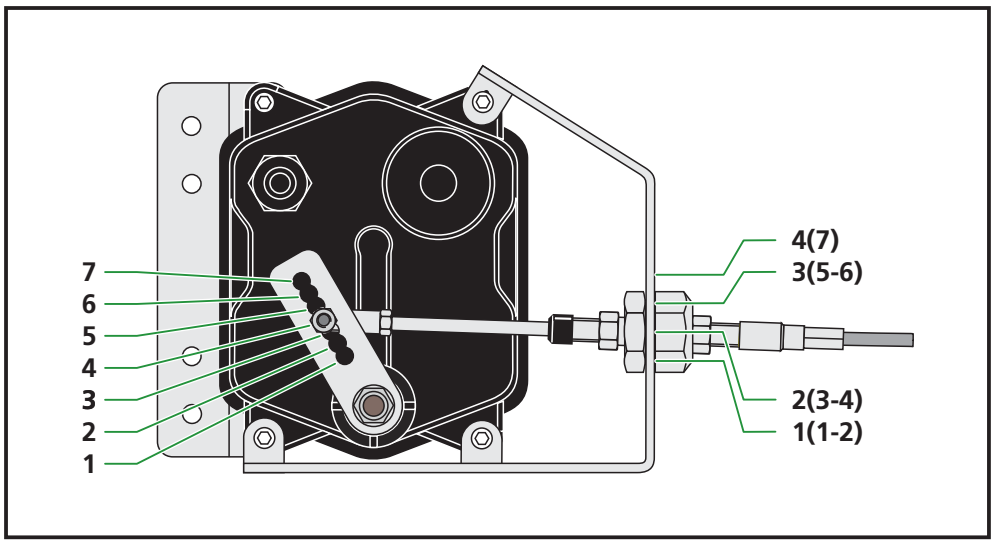

Figure 3.3 Position of the limiter cable in the lever of the actuator

Stroke (ℓ)	*Position in lever*
Not used	1
25-29 mm	2
30-34 mm	3
35-39 mm	4
40-44 mm	5
45-50 mm	6
>50 mm	7

3.4.3 Determine the best locations for the components

- Control unit: Mount the control unit where it is possible, but as far away as possible from any ignition source, when routing wiring, run away from any ignition source.
- Actuator: Mount the actuator, preferably, at a protected location on the inside of the chassis, not on the engine.
- Speed sensor: The speed sensor must be mounted at the crown wheel in the differential.

The locations of these components must be chosen to ensure that:

- The limiter cable, which runs between the throttle lever and the actuator can be routed so, that it will not be damaged by heat or sharp edges. The maximum temperature, which the limiter cable can endure, is 100 °C;
- The maximum total number of bends in the limiter cable will not exceed 270° and the bending radius will nowhere be smaller than 100 millimeters (see paragraph 2.10.5);
- The wiring between the control unit, actuator and speed sensor can be routed so, that all chances of immediate or subsequent damage to the wires are eliminated;
- As few as possible new mounting holes need to be drilled in the structure. If at all possible: use existing mounting holes.

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3.4.4 Accelerator actuator

The actuator (see chapter 2) is supplied preassembled, with two mounting brackets (Figure 3.4-1) and a brace (Figure 3.4-2) for the limiter cable.
To mount the actuator you can use the mounting holes in both the mounting bracket(s) and/or the brace.

ATTENTION
If you remove one or both of the mounting brackets (1) - because you cannot or will not use them - you must re-apply the nuts with which those brackets were fixed to the actuator. To prevent damage to the housing of the actuator and to seal it properly, you must place washers underneath those nuts.

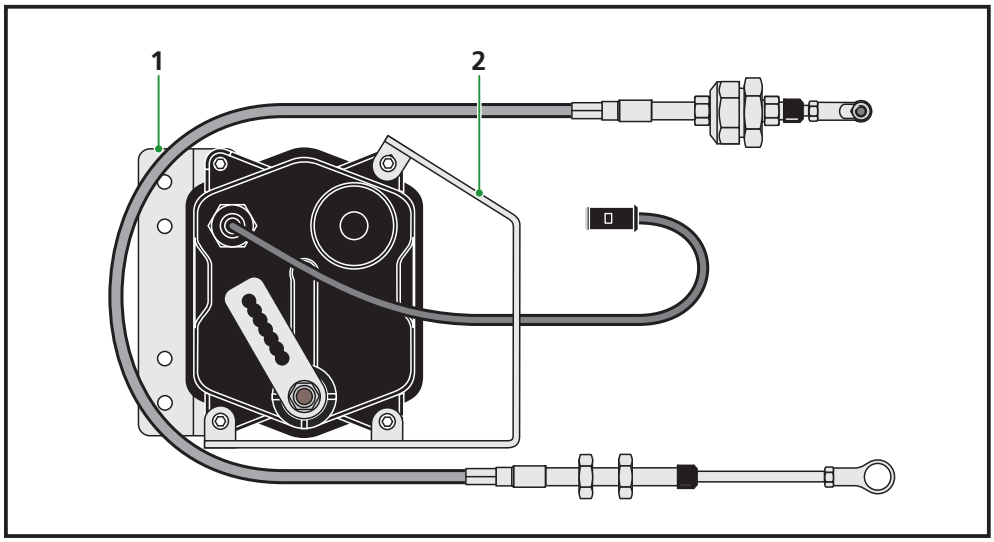

Figure 3.4 Accelerator actuator

3.4.5 Control unit

The control unit must be oriented so, that the connector for the GINA remains easily accessible at all times. Mount the control unit with four plate screws or bolts.

3.4.6 Speed sensor

You must mount the speed sensor according the following criteria:
1. The extended, imaginary centre line of the proximity switch (Figure 3.5) must intersect the centre of the crown wheel (Figure 3.6).
2. The distance between the circumference of the crown wheel and the proximity switch must be adjusted to 1 to 2 millimeters.
3. The teeth (Figure 3.6) of the crown wheel must pass underneath the proximity switch. The proximity switch must be able to detect each individual tooth.

Tighten the speed sensor firmly and lock the adjustment with seal wax.

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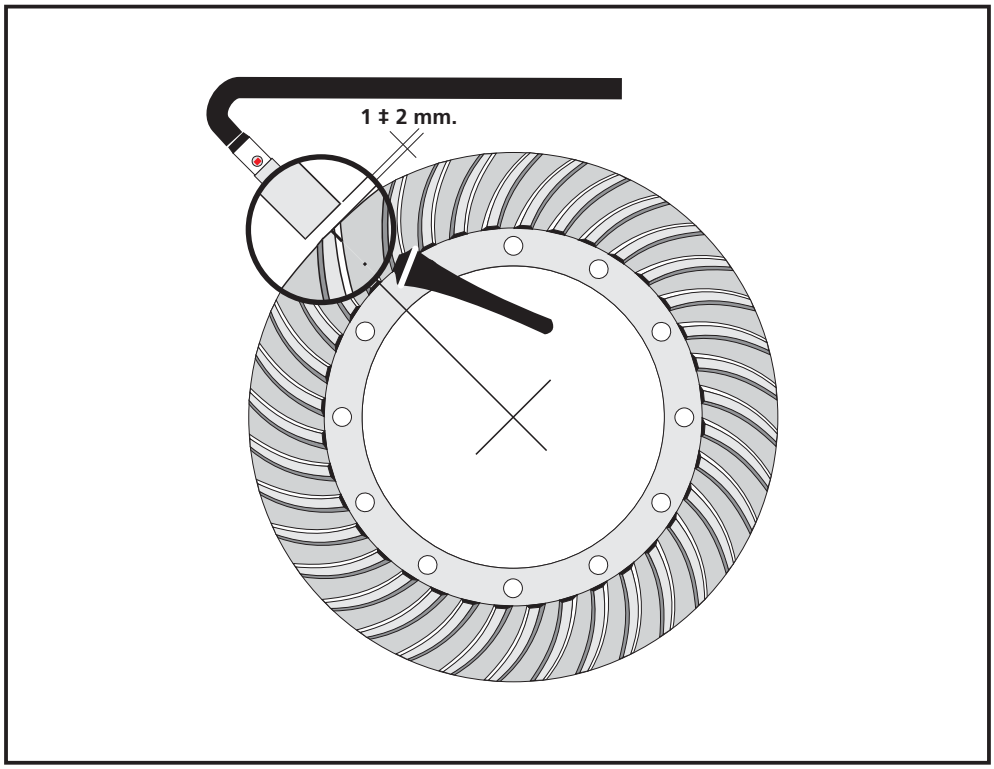

Figure 3.5 Crown wheel

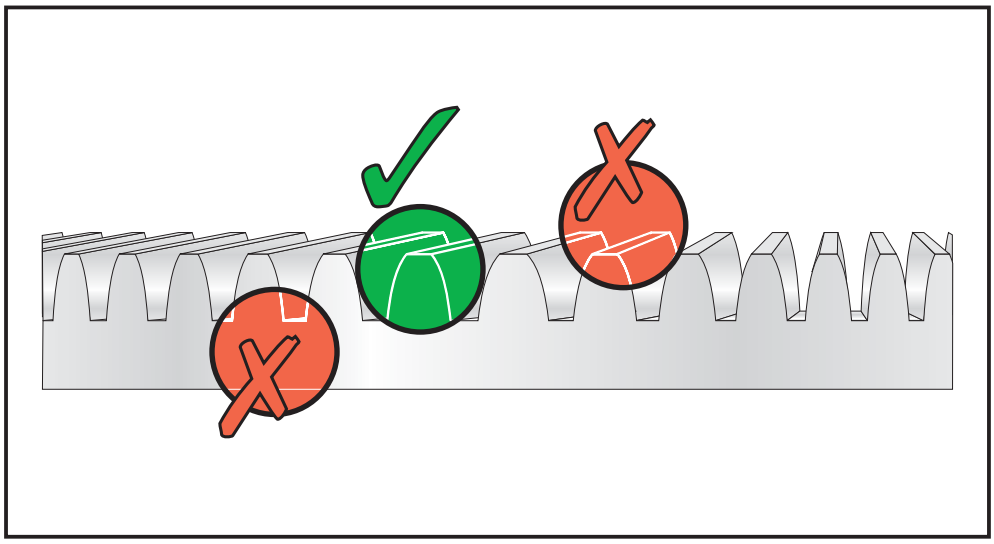

Figure 3.6 The teeth of the crown wheel

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3.4.7 Limiter cable on the actuator

The limiter cable is supplied pre-assembled (Figure 3.7).

1. Remove the lock nut (2) from the swivel head (3).
   Insert the end of the limiter cable through the brace (1). Apply the lock nut (2) again.
2. Fix the rod end (6) of the limiter cable into the required position in the lever (5) of the actuator. You have determined the required position earlier see paragraph 3.4.4.
3. If the limiter cable is too long or too short to be able to mount it easily, you can use the two set nuts (4) to lengthen or shorten it.
4. Adjust the position of the swivel head (3) in the brace (1) to the position of the rod-end (6) in the lever (5). The optimum position lies exactly in between the highest and lowest positions that the rod-end will reach during a full stroke of the lever.
   Fasten the lock nut (2) of the swivel head (tightening moment: 20 Nm)

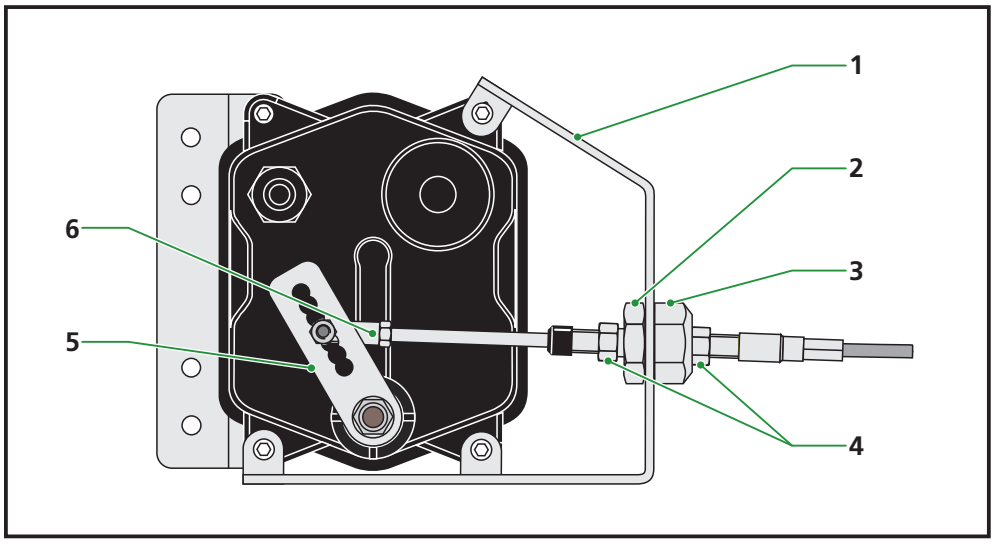

Figure 3.7 Limiter cable on the actuator

3.4.8 Limiter cable on the throttle lever

1. Remove original accelerator rod (or cable) from the throttle lever.
2. Mount the rod-end (Figure 3.8-1) of the limiter cable (3) onto the throttle lever (2).
3. Onto the clamping block or mounting bracket.

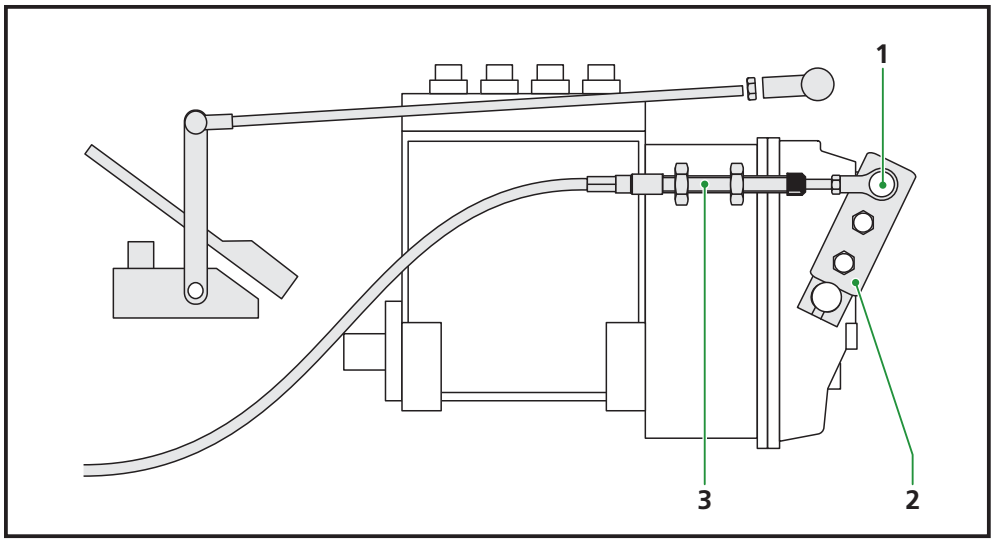

Figure 3.8 Limiter cable on the throttle lever

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3.4.9 Accelerator cable and clamping block

1. Slide the clamping block (Figure 3.9-3) over the accelerator rod.
2. Place the clamping block (3) between the two set nuts (2) on the limiter cable.
3. Tighten the set nuts (2) against the clamping block (3) to fix it onto the limiter cable (1).
4. Fasten the clamping block with its two lock screws (4) onto the original accelerator rod.

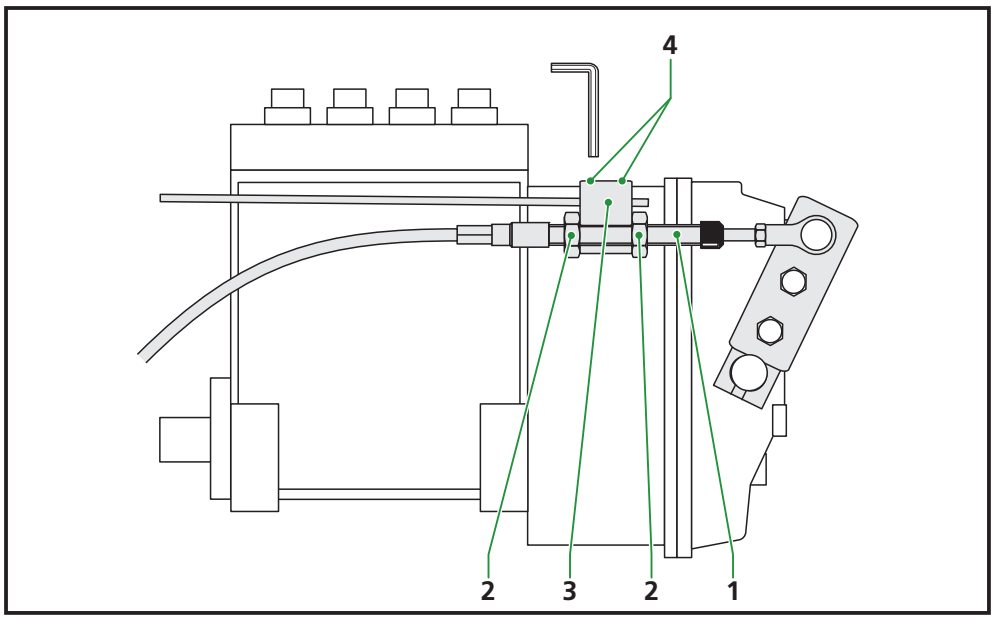

Figure 3.9 Accelerator rod and clamping block

3.4.10 Accelerator cable and mounting bracket

1. Compose the mounting bracket in such a manner that sufficient room is created for a full stroke of the rod-end of the limiter cable (i.e. the throttle lever).
2. Connect the limiter cable (Figure 3.10-2)(from the actuator) to one end of the bracket and the original accelerator cable (3) (from the accelerator pedal) to the other.
3. Then fasten the rod-end (1) of the limiter cable onto the throttle lever.

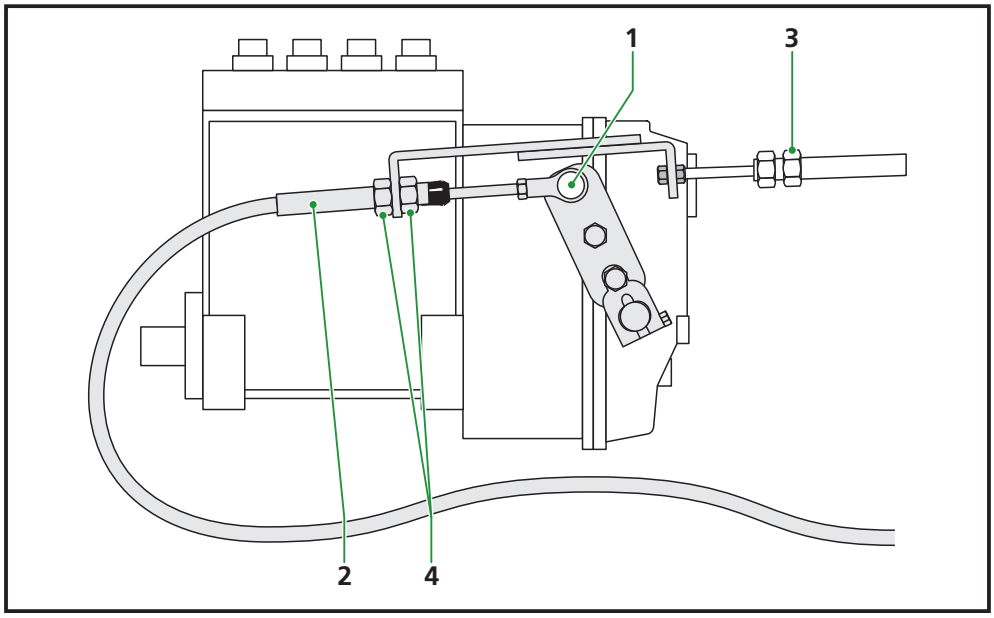

Figure 3.10 Accelerator cable and mounting bracket

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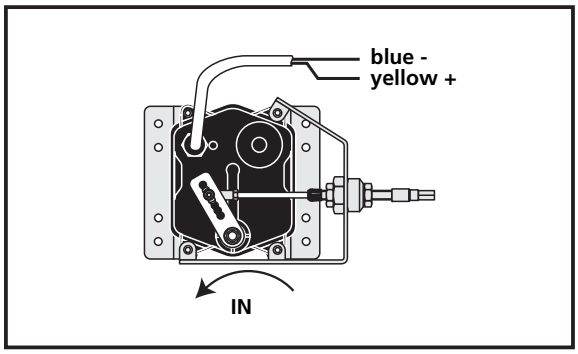
3.4.11 Adjust the limiter cable

The length of the limiter cable must be adjusted so, that the throttle lever reaches its end-stop at maximum throttle.
The maximum stroke of the lever on the actuator must be sufficient to regulate the throttle lever (almost) entirely back to idle when the accelerator pedal is fully depressed. This you can check by placing the lever on actuator temporarily in the required position. ('In' or 'out').

WARNING

Never force the lever of the actuator.

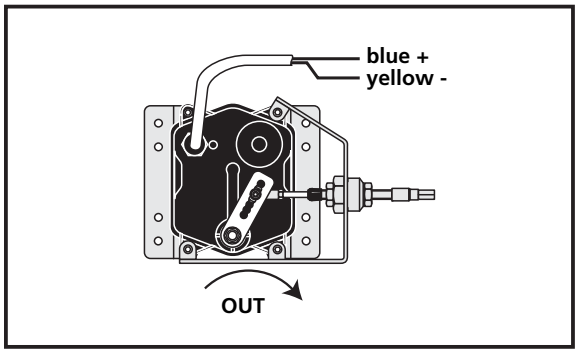
1. Connect the actuator to a suitable power supply (Figure 3.11 and Figure 3.12).



To move the lever 'in':

Connect the yellow wire with the plus.
Connect the blue wire to earth (minus).

Figure 3.11 Actuator IN



To move the lever 'out':

Connect the yellow wire with the plus.
Connect the blue wire to earth (minus).

Figure 3.12 Actuator OUT

2. Check that in one of these situations the throttle lever lies against its full-power stop and in the other situation against its idling stop.
3. If necessary, adjust the length of the limiter cable by means of the set nuts of the clamping block (or mounting bracket) and/or the set nuts near the actuator until the requirement as noted in step 2 is fulfilled.

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3.5 Wiring diagram

If possible, route the wiring adjacent existing wire harnesses. Make sure to fixate the wiring properly with tie-wraps.

Refer to Figure 3.13 on how to connect the actuator, the speed sensor and the power supply to the control unit.

Note that the actuator must be able to counteract the actions of the accelerator pedal. The initial position ('in' or 'out') of the lever of the actuator, therefore, depends on the way in which the mechanism has been put together (i.e. whether it must push or pull to counteract the accelerator pedal).

Wiring the actuator in a specific must set the initial position of the lever way (see Figure 3.11 and Figure 3.12).

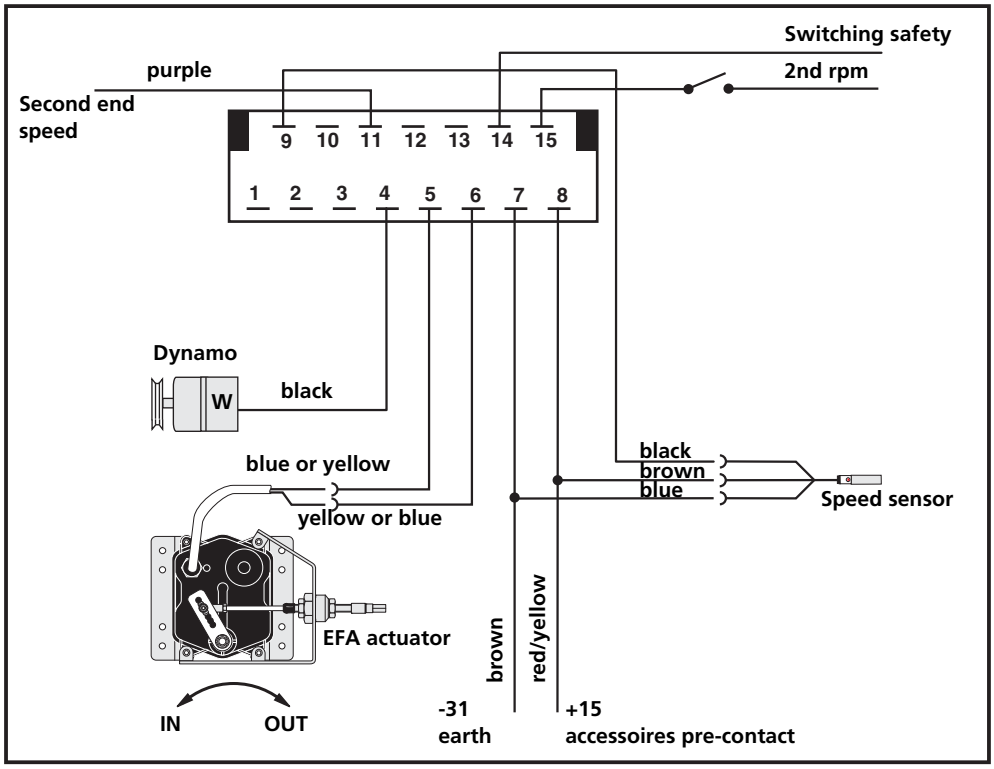

Figure 3.13 Wiring diagram

3.6 The speed signal

The control unit uses the signal (impulses) it receives from the speed sensor - the proximity switch which 'senses' the passing of the teeth of the crown wheel - to determine when and by how much it should influence the throttle setting. The frequency of the impulses that are generated by the speed sensor is proportional to the current speed of the forklift truck.

Different crown wheels, however, may have different sizes and numbers of teeth.
Therefore the control unit must be programmed with a conversion factor (the number of actual pulses it receives for every kilometer traversed). You need a GINA to do that.

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3.6.1 Measure the true maximum speed of the forklift truck.

To be able to program the correct conversion factor, you need to know the true maximum speed at full throttle of the forklift on which you installed the speed limiter.

Mark off a 100-meter stretch of road and measure the time the forklift takes to traverse that distance at full throttle. You need, of course, to maintain the maximum speed over that whole distance, so you will need some extra space to accelerate and decelerate.

Once you know how long it takes drive 100 meters at full throttle you can calculate the maximum speed of the forklift thus:

Speed (km/h) = 360 / time (seconds per 100 meters)

or you may consult this table:

time/100m seconds	*speed (km/h)*	*time/100m seconds*	*speed (km/h)*	*time/100m seconds*	*speed (km/h)*
36,00	10	21,18	17	15,00	24
32,73	11	20,00	18	14,40	25
30,00	12	18,95	19	13,85	26
27,69	13	18,00	20	13,33	27
25,71	14	17,14	21	12,86	28
24,00	15	16,36	22	12,41	29
22,50	16	15,65	23	12,00	30

In the SL4 a counter is included, which can be accessed through the GINA unit.

3.6.2 Set the speed conversion factor with the GINA

1. Connect the GINA to the control unit of the speed-limiter with the special interface cable.
2. With the GINA, set an initial speed conversion factor of 15000 (impulses per kilometer)
3. If you now start driving the forklift at full power, the GINA will report a certain speed. If the reported speed is too low - lower than the top speed you measured (see the previous paragraph) - you should increase the conversion factor. If the reported speed is too high, you must lower the conversion factor with the GINA.
   In other words: If the reported speed is 25% too high, decrease the conversion factor by 25%. If the reported speed is 10% too low, increase the conversion factor by 10%.
   Repeat this procedure until the top speed as reported by the GINA equals the top speed as determined and calculated by you.

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3.7 Speed control behaviour

If the control unit has been programmed correctly and all components have been installed properly, the actual speed of the fork-lift truck will never exceed the programmed (reduced) maximum speed (V_{lim}) by more than 1.5 km/h, and even that only once and for a very short time.
The speed limiter will stabilize the speed to within 1 km/h (V_{stab}) of the programmed maximum speed (V_{lim}) within 10 seconds.
The decelerations generated to correct the initial excess of speed will never be greater than a moderate 1,8 km/h per second (0,5 m.s $^{-2}$). The accelerations and decelerations that occur after the speed had been stabilized are truly small: smaller than 0,72 km/h per second. (0,2 m.s $^{-2}$).

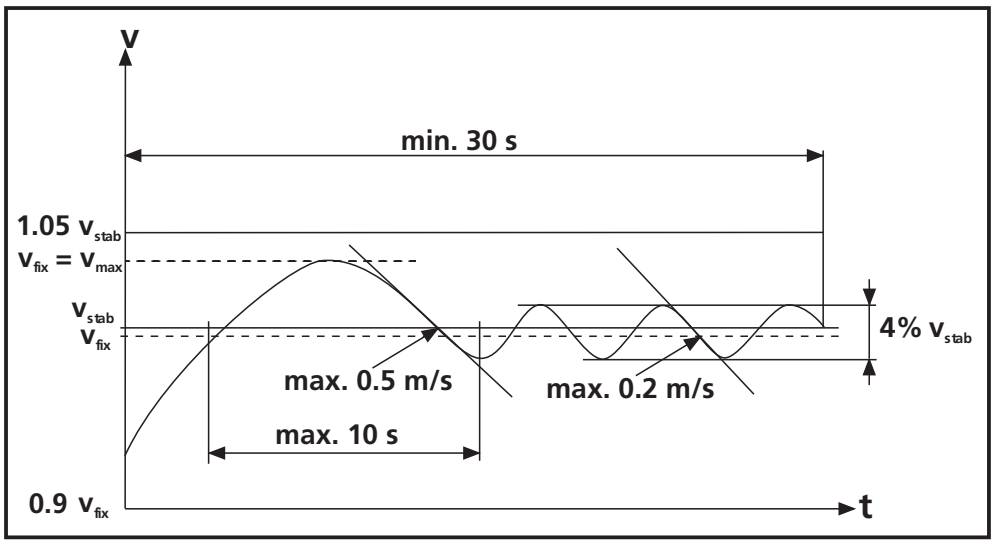

Figure 3.14 Control curve

3.8 Checking the speed-limiter system after installation

- Check that the throttle lever touches its full-power end-stop when the accelerator pedal is fully depressed.
- Check that the throttle lever touches its idling end-stop when the accelerator pedal is at rest.
- Check the electrical wiring again.
- Check that when you put the actuator in its fully-limiting position - which you can do by swapping its electrical wires around - and you depress the accelerator pedal fully, the throttle lever is corrected back to its idling position for 100% of the way (almost to idling).
- Check the various speed-limiter functions during a test drive.

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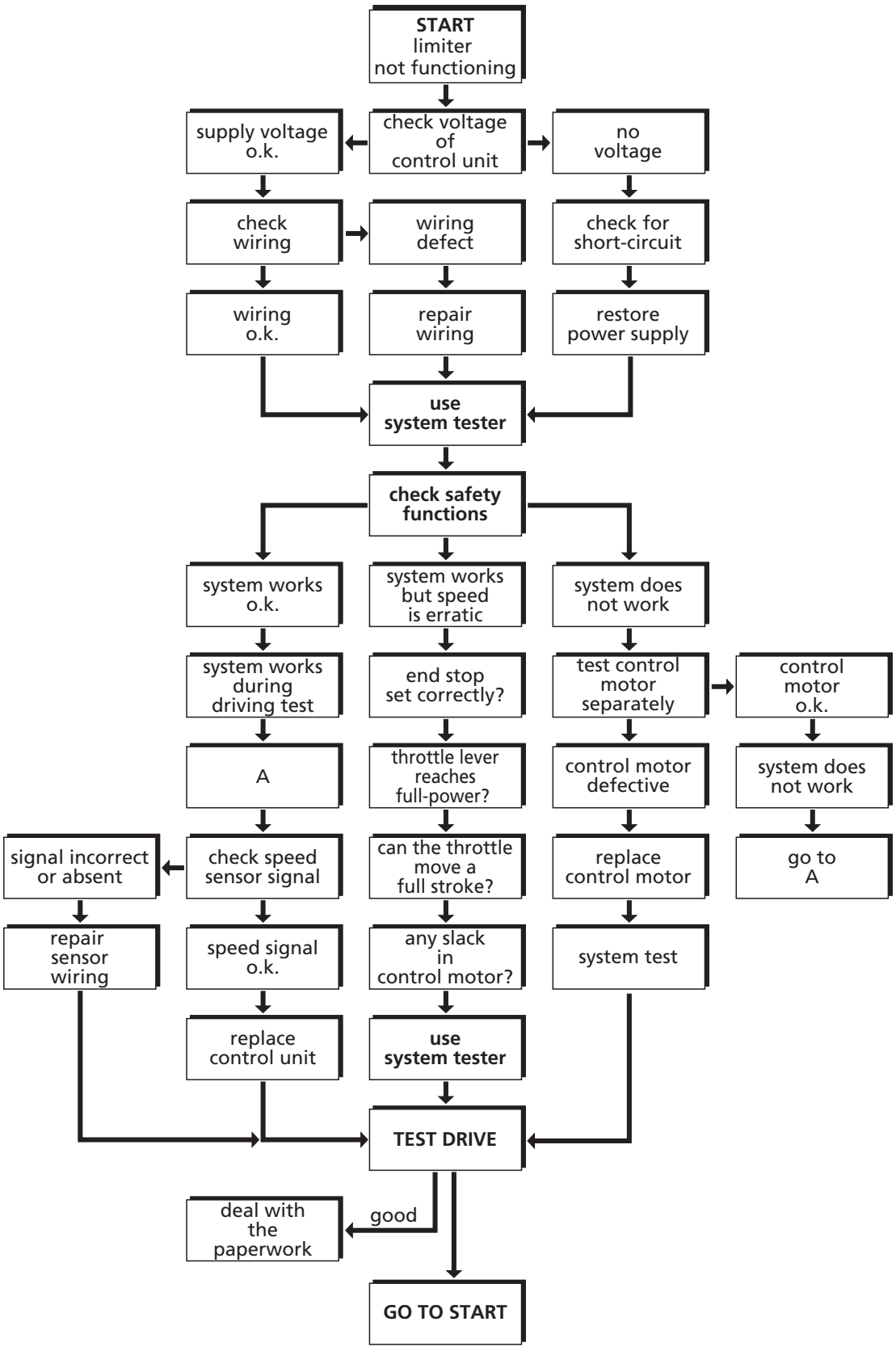
3.9 Troubleshooting



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3.10 Standard kits

These are the standard Truck kits Groeneveld has:

1. 24 V Fork Lift kit
2. 12 V Fork Lift kit

For more detailed information about the different kind of article numbers, please check the website **www.groeneveldonline.com**, or contact your local Groeneveld dealer.

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4. Technical specifications

4.1 Control unit trucks and busses

Supply voltage:	10...32 Vdc
Rated current:	1 A
Dimensions (l x w x h):	136 x 130 x 48 mm

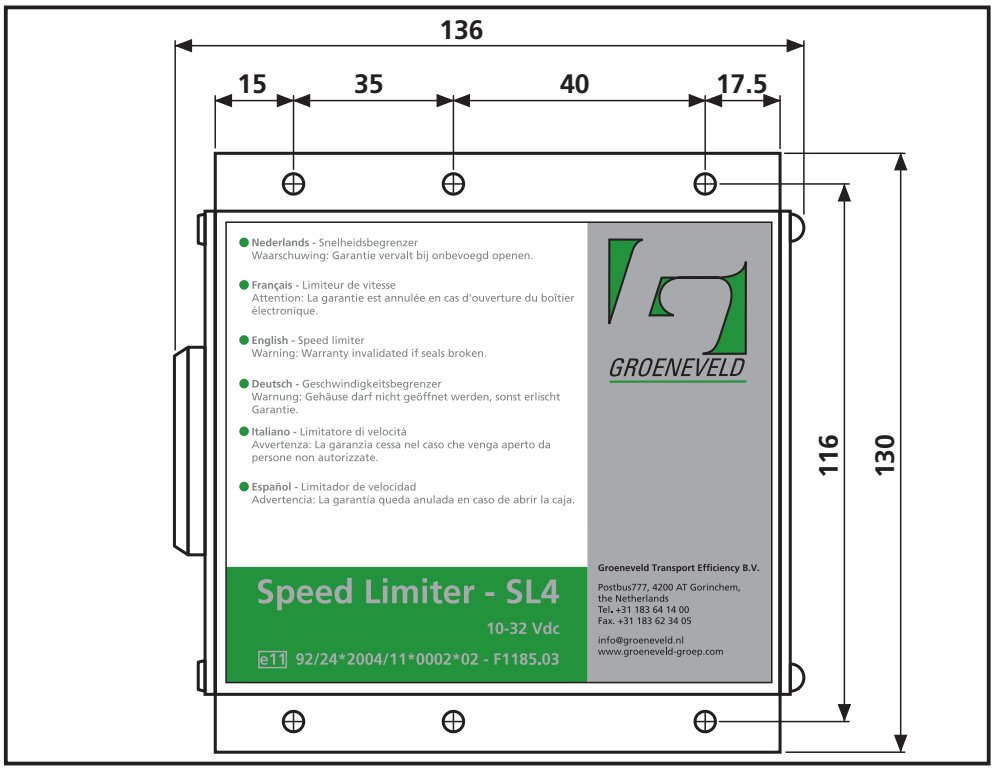

Figure 4.1 Control unit trucks and busses

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4.2 Control unit fork lifts

Supply voltage:	10...32 Vdc
Rated current:	1 A
Dimensions (l x w x h):	207 x 130 x 48 mm

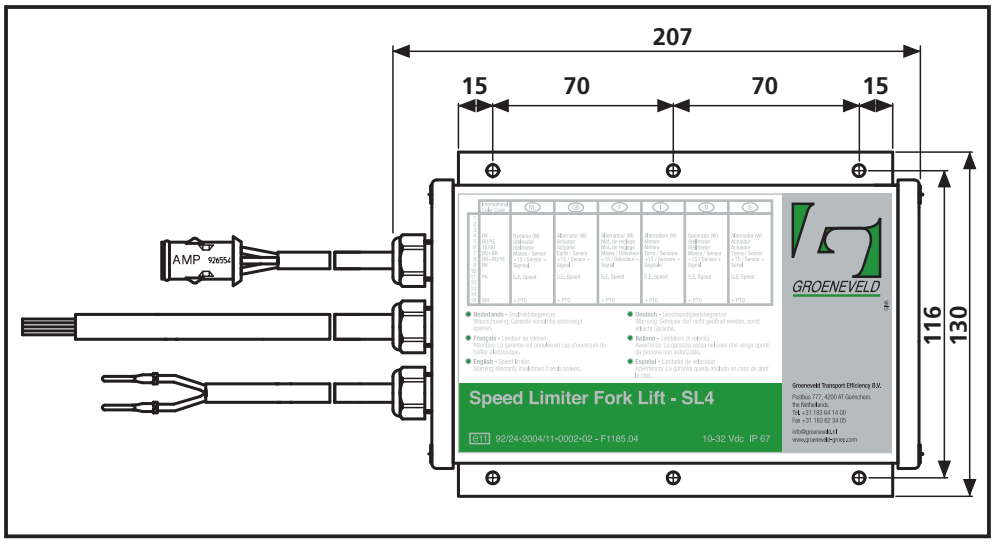

Figure 4.2 Control unit fork lifts

4.3 Speed sensor (proximity switch)

Operating temperature:	-40°C ... +95°C
Dimensions:	M12x1, l=60mm
LED:	function indication

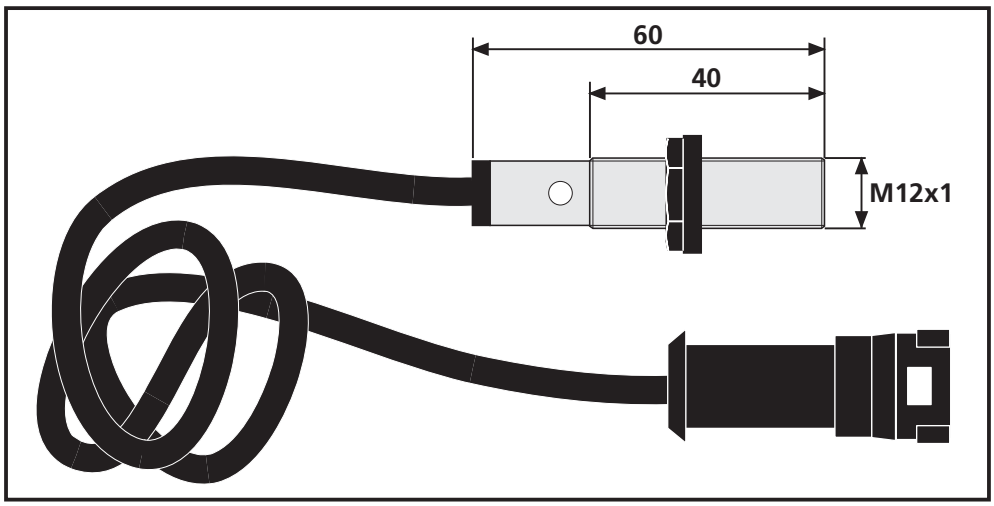

Figure 4.3 Speed sensor

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4.4 Actuator

Supply voltage:	12 / 24 Vdc
Rated current:	0,7 A
Dimensions (l x w x h):	173 x 140 x 120 mm

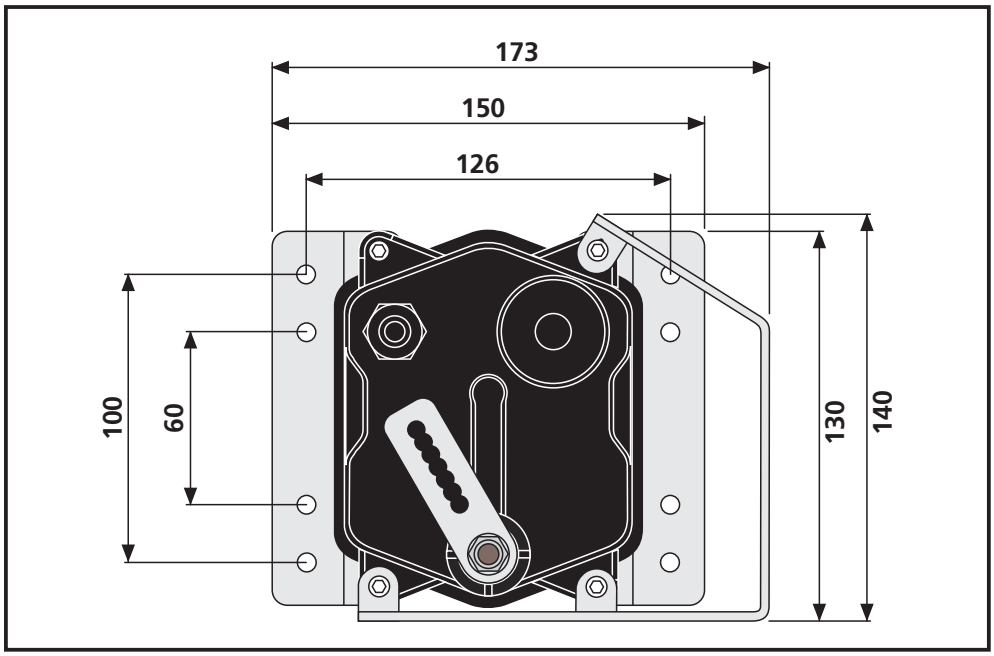

Figure 4.4 Actuator

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Appendix A

Coupling bracket configurations

Depending on the make andtype of fork-lift trucks at hand, the coupling bracket can be (or has to be) installed in different ways. The most common configurations are illustrated below.

Note that the actuator motor must be able to counteract the actions of the accelerator pedal. Therefore, the initial position ('IN' or 'OUT') of the lever of the actuator motor depends on the way in which the mechanism has been put together (i.e. whether it must push or pull to counteract the accelerator pedal). The initial position of the lever must be set by wiring the actuator motor in a specific way (see paragraph 3.4.11).

In all illustrations below, both the throttle lever of the engine and the actuator motor are presumed to be at rest (the engine is idling and the position of the throttle lever is not influenced by the actuator motor). The arrows in the illustrations show the direction in which the accelerator cable moves when the accelerator pedal is depressed.

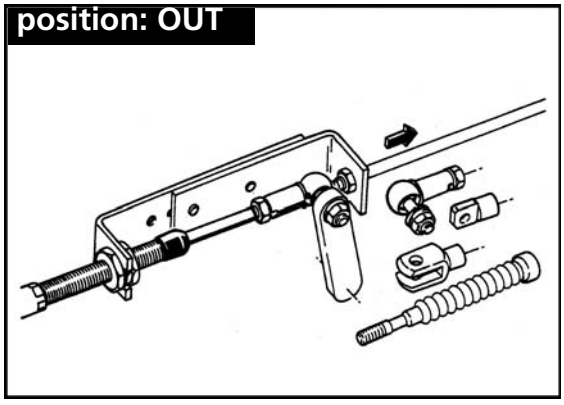

figure A.1 Pulling accelerator cable, initial actuator motor position 'OUT'

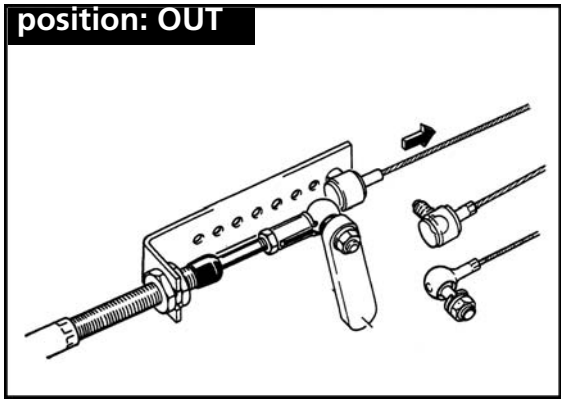

figure A.2 Pulling accelerator cable, initial actuator motor position 'OUT'

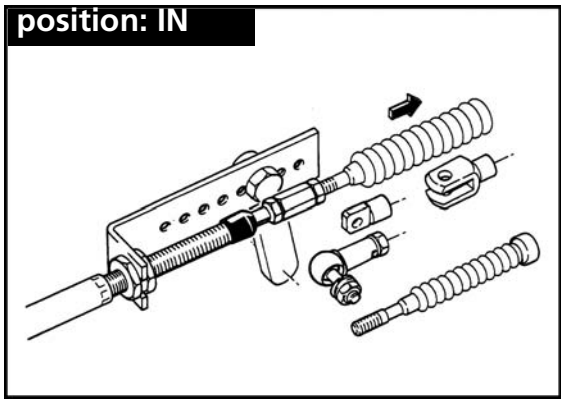

figure A.3 Pulling accelerator cable, initial actuator motor position 'IN'

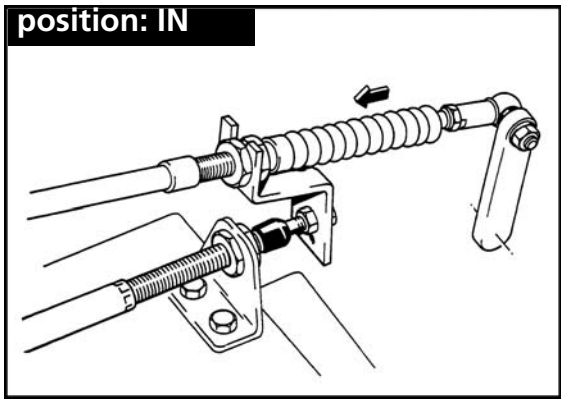

figure A.4 Pulling accelerator cable, initial actuator motor position 'IN'

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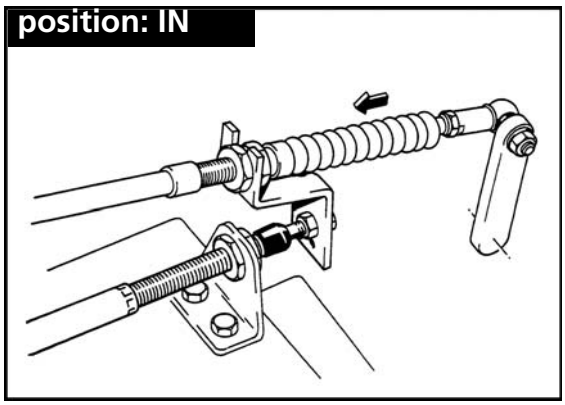

figure A.5 Pulling accelerator cable, initial actuator motor position 'IN'

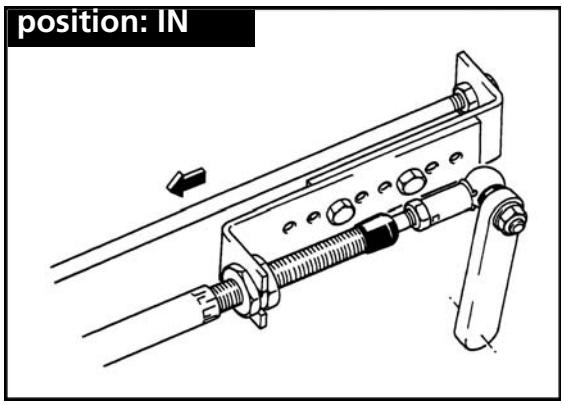

figure A.6 Pulling accelerator cable, initial actuator motor position 'IN'

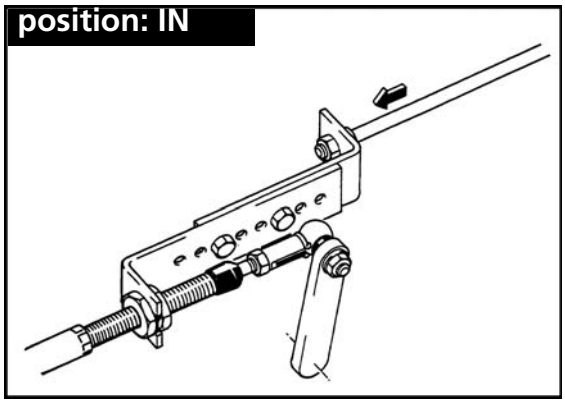

figure A.7 Pushing accelerator cable, initial actuator motor position 'IN'

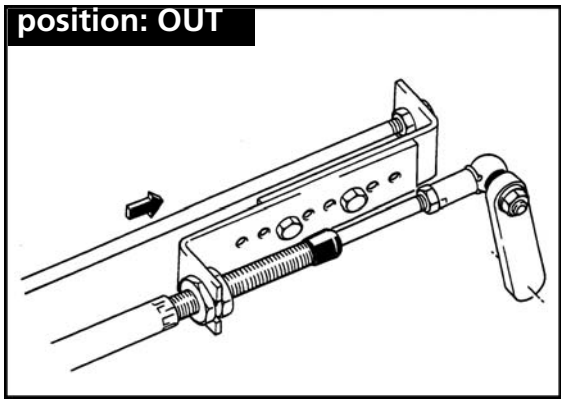

figure A.8 Pushing accelerator cable, initial actuator motor position 'OUT'

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