Product Information

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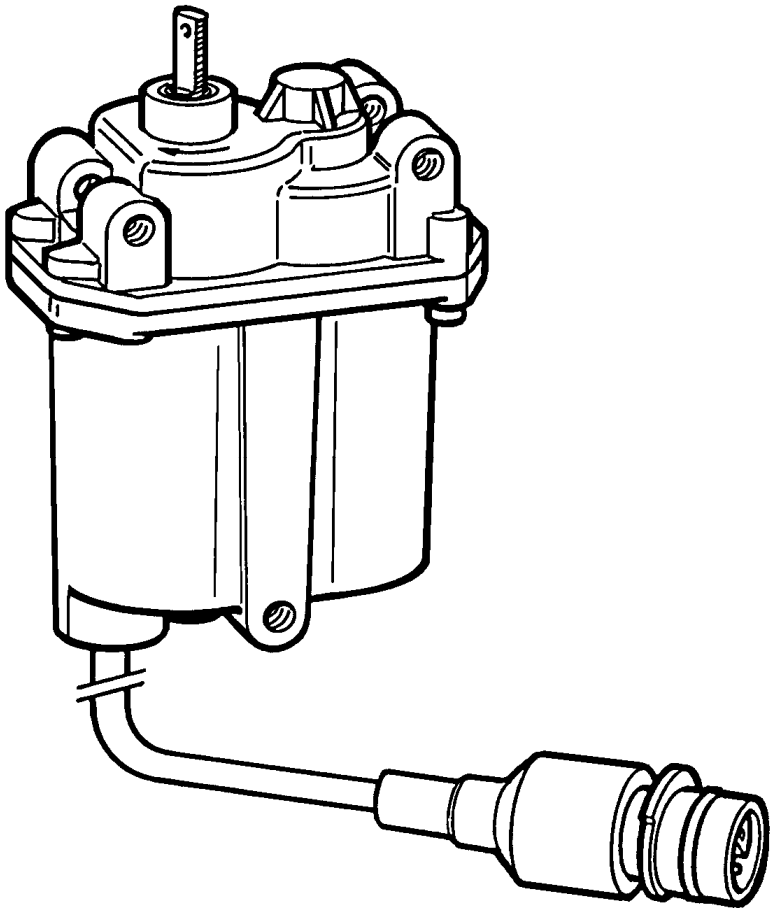
VDO Actuator

24 Volt, Part No. 408.411/005/013

12 Volt, Part No. 408.211/004/002



Contents

1. Introduction

The actuator is a component of the VDO E-Gas® II and E-Gas compact (electronic accelerator-position transmission) system. It has been specially designed, in keeping with the development specifications, for use in commercial vehicles and tailored to meet these requirements.

In principle it can be integrated into external controllers (electronic controllers such as hydrostatic drive controllers) to control the engine output, if the conditions set out below are observed, but it is not possible to give detailed information on the development of the electronic actuation system in this document as such data is dependent on the particular application. Therefore, integration into external controllers will have to be effected with the customer assuming full liability.

In particular the service life of the actuator depends to a large extent on the type of actuation by the electronics system (for example protection of the mechanical limit stops, etc.). Thus, in case of actuator failure the electronic actuation system may also have to be locked at when errors are being determined.

The warranty set out in this documentation consequently applies only to the use of the actuator in external controllers.
No data beyond the information given in the following is available; such data must be established by the client.

2. Interface Description

1. General data

1.1 Purpose

The actuator was developed for use as part of a VDO E-Gas®- system for adjusting the injection pump lever on diesel engines used in commercial vehicles. In terms of protection type, temperature and vibration load, it is designed for installation in the engine compartment near the injection pump. If it is secured directly on the engine, suitable damping elements must be used, depending on the vibration load.

1.2 Description of structure and function

The actuator adjusts the injection-pump lever in accordance with the specified set-point value by means of a mechanical linkage (lever rods). The angle of rotation (revolution) of the engine is reduced by a spur gear.

The motor is a permanently excited direct-current motor which is actuated by an external electronic controller with a pulse-width modulated signal.

The gear unit, which has a ratio of 26.5:1, has three levels. The gear unit has a spring-loaded gear wheel as a handling guard to prevent movement against the internal mechanical stops. The gear wheel on the drive shaft is designed in the form of a tooth segment. The internal mechanical stops are defined by the toothed segment.

The setting of the output axle is recorded by a potentiometer. The conductive plastic potentiometer is secured to the output shaft by means of a positive connection and is designed to return a signal indicating the position of the output shaft.

A safety contact has a fixed relation to a potentiometer value. The actuation cam is secured to the output shaft by means of a positive connection. When the output lever is moved from idling speed to full load, the safety contact is forced open.

Adaptation instructions for use as an E-Gas® actuator:
When the output lever is not under tension, it must be returned after the actuation process by an external spring.

2. Operating conditions

See client drawing.

3. Function data

3.1 Operating values

Maximum torque	600 [Ncm] (temporarily only, see 3.6 Control instructions)	
Continuous torque	180 [Ncm]	
Rated current	24 V	12 V
	1.2 A	2.4 A
Max. continuous current	1.3 A	2.7 A
Actuating time	≤ 250 ms for 90% electrical adjustment angle	

3.2 Adjustment angle

Mechanical	120°
Useful electrical adjustment angle	90° ± 3.7°
Electrical LL/VL [Us/Uo]	0.9 - 0.1
Operating range of potentiometer [Us/Uo]	0.915 - 0.08
Direction of rotation	Clockwise (cw) from a plan view of the output axle
Position of the pivot of the output axle at electrical zero (LL)	40° ± 5.5° relative to actuator longitudinal axis

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Us = Slider return-signal voltage
Uo = Potentiometer supply-voltage
LL = Idling (electrical zero)
VL = Full load (electrical maximum)

3.3 Potentiometer

Max. voltage	10 V
Max. slider current	10 µA
Slider contact resistance	≤ 10 kΩ
Slider protective resistance	1.5 kΩ
Series resistance	1 kΩ + 90%/-25%

3.4 Safety-contact switching point

The safety contact is closed in the idling position and opens towards full load.

Electrical (Us/Uo)	0.7897 - 0.7147
Mechanical (<)	12.5° - 21°
Minimum switching current	Ismin = 10 mA; non inductive
Maximum switching current	Ismax = 500 mA; non inductive

3.5 Terminal assignment

See client drawing.

3.6 Control instructions

The control frequency of the permanently excited direct-current motor is 300 Hz ± 30%.

The motor current must be limited by the electronic controller so that the average maximum continuous current of 30 s is not exceeded.

The approach of the external stops must be performed by the electronic controller, using position and speed controls.

Approaching the internal mechanical stops is not permissible.

To compensate for gear play, the output shaft must be subjected to an external torque during operation, for example by a reset spring.

3.7 Motor data

	24 V	12 V	
Armature resistance	4.1	1.0	[Ω]
Armature inductance	0.006	0.0012	[H]
Armature moment of inertia	2×10^{-5}		[kg m^2]
Motor constant	0.0764	0.0348	[V s Rad^{-1}]

All figures are “typical values”

4. Qualification / Service-life test

4.1 Combined temperature, climate and endurance test

4.1.1 Actuation cycles

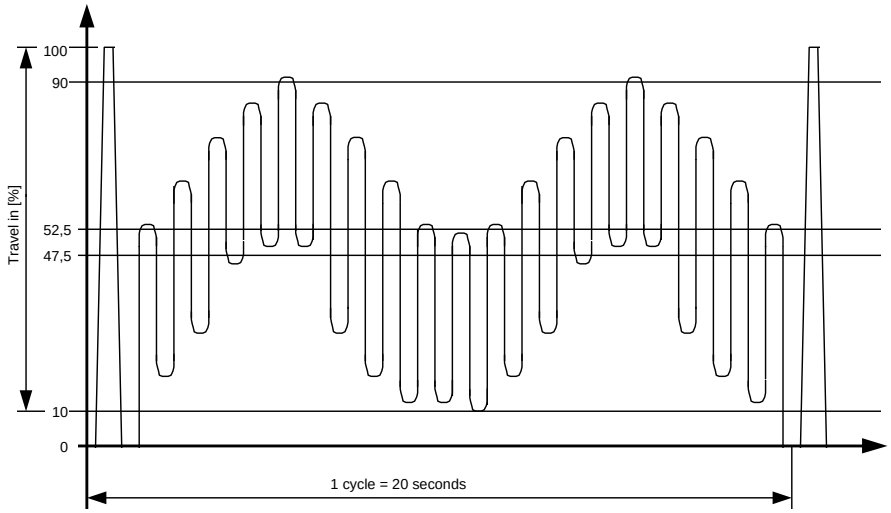

Figure 1: Actuation cycles of the actuator

$5 \bullet 10^5$ Cycles at full-load point at 100% angle of rotation
10^6 Cycles at idling point at 0% angle of rotation
10^7 Superimposed load cycle over 42.5% angle of rotation within a range of 10% to 90% angle of rotation

The load torque over the travel distance should be 100 Ncm at the idling point, rising to 180 Ncm at the full-load position.

4.1.2 Temperature cycle during service-life test

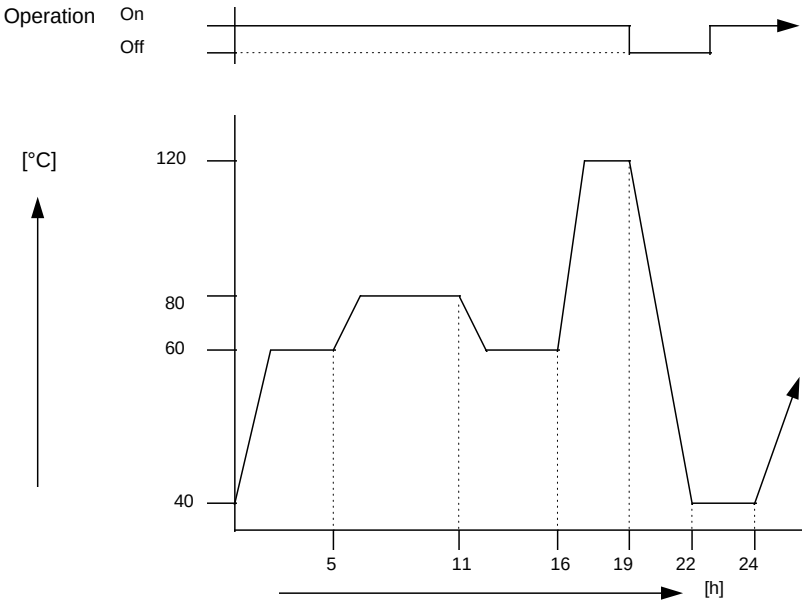

Figure 2: Temperature cycle

4.1.3 Endurance test at relative humidity

As part of the service-life test, 25,000 cycles at +55°C and 90% relative humidity are to be completed.

4.2 Storage-temperature test

24 hours: Store at a temperature of -40°C.
6 hours: Store at room temperature, then conduct function test.

24 hours: Store at a temperature of +120°C.
6 hours: Store at room temperature, then conduct function test.

4.3 Vibration test

See client drawing.

4.4 Protection-type test

See client drawing.

4.5 Corrosion test

4.5.1 Salt-spray test

In accordance with DIN 50021-SS over a period of 144 hours.

4.5.2 Industrial atmosphere

In accordance with DIN EN ISO 6988 s over 6 cycles

4.5.3 Damp-heat alternating atmosphere

In accordance with DIN 50017-KWF over 18 cycles.

3. Installation Instructions

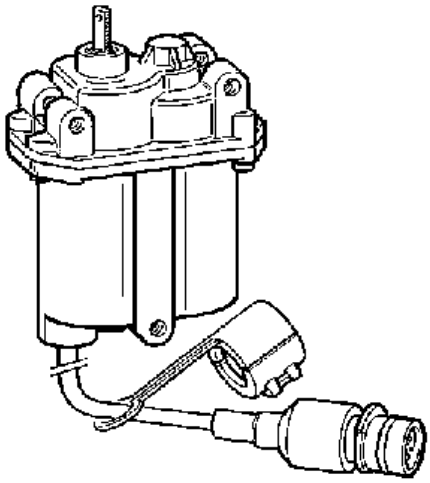

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Figure 8: Electrical actuator

Operating data (extract)

Temperature	
Operating temperature:	-40°C to +120°C (+140°C max. 1 hour)
Storage temperature:	-40°C to +120°C
Rated torque	180 Ncm at room temperature and rated voltage
Electrical adjustment angle:	90° ± 3.5°
Electrical zero position:	40° ± 5.5° relative to longitudinal axis of the casing

Excitation and de-excitation time at rated voltage and 100 - 180 Ncm actuating torque < 0.25 seconds.

Vibration resistance:	
Continuous load:	(See VDO client drawing, section 8.)
Protection class:	IP 56 in accordance with DIN 40050
Securing screws:	Strength class 8.8
Max. tightening torque:	8 Nm + 4 Nm (9 mm screw-in depth)
Max. tightening torque on the drive axle:	10 Nm

INSTALLATION NOTES

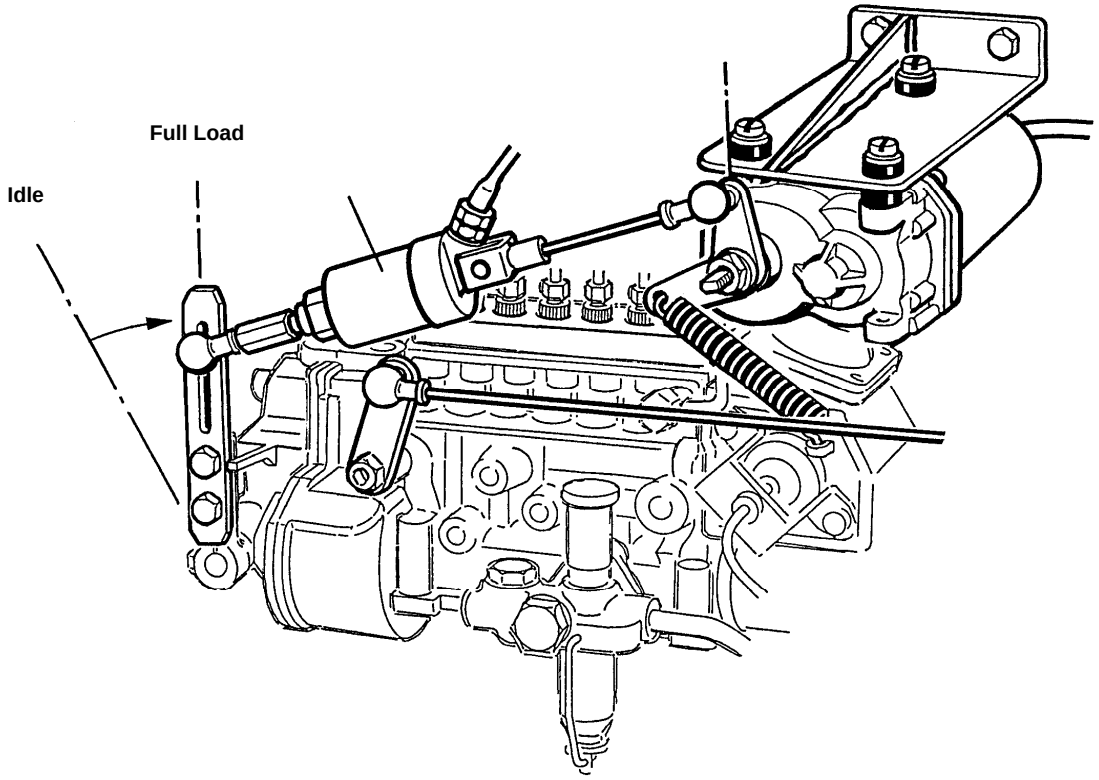
The actuator should be mounted on a mounting bracket in accordance with local requirements, insulated from engine vibrations.

When designing the linkage in connection with a single lever pump, the following possible problem needs to be allowed for:
In the event of failure of the supply voltage, the actuator is returned to the idle or stop position by return spring.

The bracket must be made of sheet metal of 4 mm thickness. The diameter of the 3 bores used to accommodate the damping elements (VDO No. 240.110/001/001 P) is 20. The bracket should be designed in such a way that the rigid structure is obtained (reinforcement ribs).

In order to minimise the actuating forces and load and path hysteresis, the installation should be mounted as close as possible to the injection pump.

Because of the adjustment to the actuating distance, only spherical sockets made from metal should be used between actuating unit and injection pump lever.

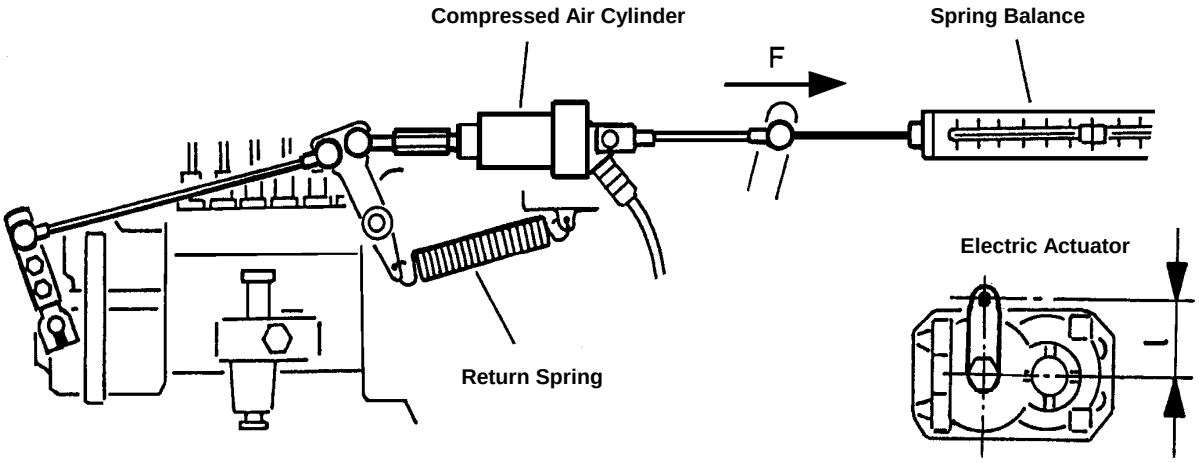


When designing the linkage, allowance should be made for the maximum permitted actuating torque of 180 Ncm at the actuating member.
(Important, remember the return spring!)

To prevent consequential damage to the actuating motor, the actuating torque should be determined at the injection pump lever, for every installation of a VDO E-GAS® installation.

The following dimensions and forces must be recorded:

1. Maximum force necessary to move the accelerator regulator form the idling position to the full load position (with engaged return spring).
2. Length of the lever at the actuating motor from the fulcrum to the centre of the spherical head.



Determination of the injection pump forces.

Formula:
M = I x F
M = Actuation torque, 180 Ncm max.
I = Length of lever at the actuating member (cm)
F = Force required to effect adjustment (N)

The actuating member is returned to the idle position by means of a mechanical return spring. The return torque of the spring must increase form 30 Ncm to 60 Ncm.

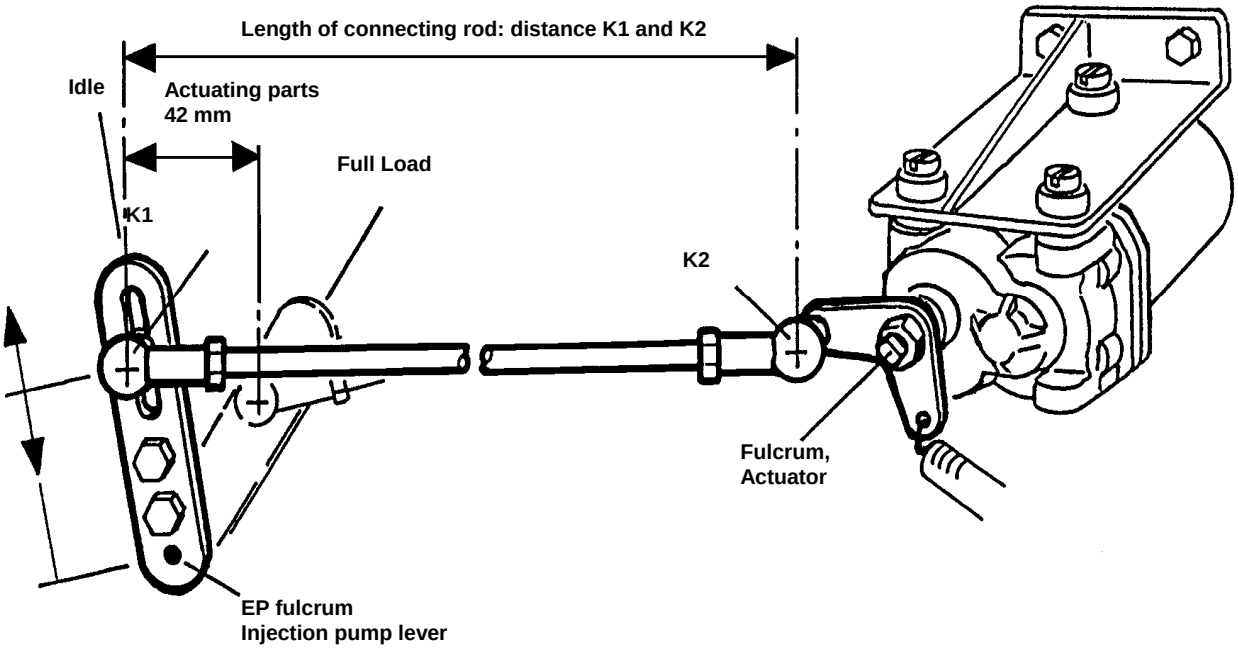
In order to prevent damage of the gears in the actuating unit, the internal abutment must be approached slowly before tightening the fixing nut of the drive lever **(tightening torque 10 Nm max.).**

The adjusting ranges of the injection pump adjusting lever in the actuator should be adjusted to suit one another and should then be set in accordance with the adjusting instructions. Where there is free running clutch to protect the injection pump regulator from over speed, this function must remain enabled.

Adjusting instructions (precondition: single lever pump: engine in warm condition)

a) Basic setting

- If fitted, switch of engine speed transducer („change parameter“).
- Switch on ignition. The actuator moves into its electrical idle position.
- Injection pump lever in idle position.
- Determined distance between K1 and K2.

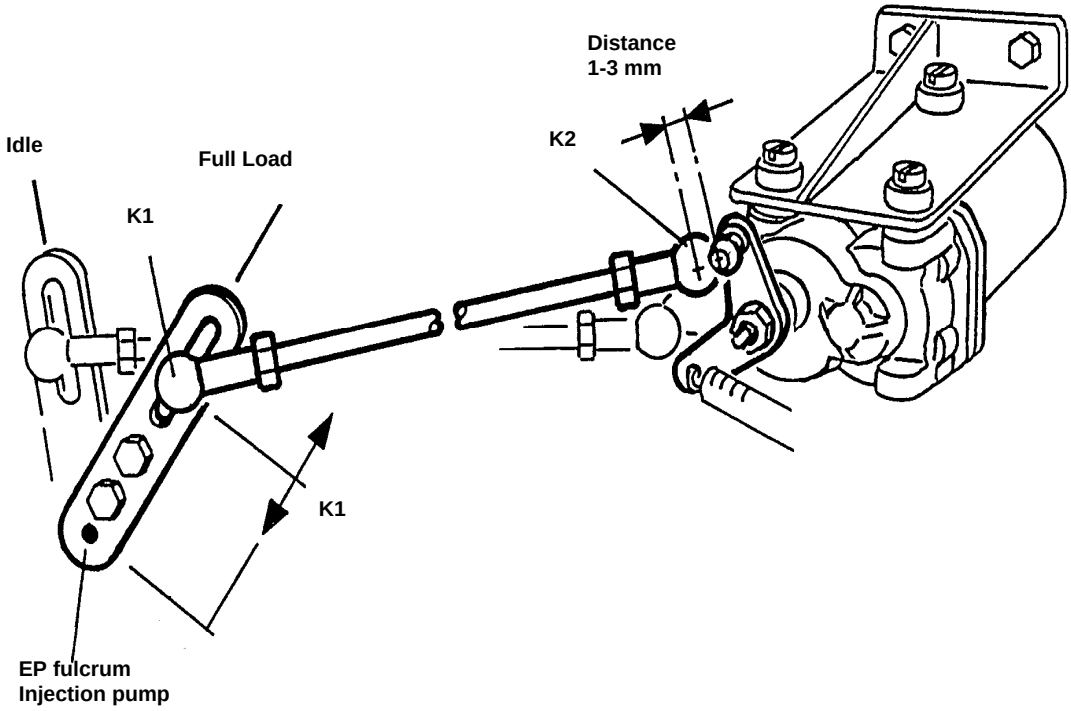


Basic setting

- Determine the fulcrum point for spoil head K1 at the lever of the injection pump. The distance between the fulcrum EP of the injection pump lever and the ball head K1 should be chosen in such a way the unit moves through an actuating path of x mm* between idle and full load
(*Lever 993 620 079 = 35 mm, lever 993 620 082 = 42 mm).
- The length of the connecting rod should be determined by measuring the distance between ball heads K1 and K2.
- Fit the connecting linkage and adjust length in such a way that the required engine idle speed achieved.

b) Adjustment of actuating parts

- Operate engine stop (engine off).
- Disengage connecting rod from ball head K2.
- Depress accelerator pedal (actuator moves to full load position).
- Keep adjusting pump lever in full load position.



Adjustment of actuating parts

- Adjust actuating parts (distance: change the distance between EP and K1) so that in full load position of the injection pump and actuator lever there is a distance of 1-3 mm between the ball socket K2 and the ball head of the actuator lever.
- Engage the connecting road into ball head K2.
- Check engine idle, if necessary repeat adjustment process.
- If adjustment control required: switch on motor engine speed transducer.
- The ball head should be greased and protected from disengagement.
- After insertion, the safety cap should be fitted to the pump coupling.

4. Warranty Terms

Attention is drawn to the fact that the integration of the actuator into external controllers is being effected at the customer's own risk.

If the actuators described in the document are not actuated by a VDO electronic controller with the Part No.: 412.413/.../... Continental Trading GmbH reserves the right to reject any warranty claims made by the customer pending a thorough investigation of the circumstances. The limited liability stated in the General Terms and Conditions of Business will have to be taken into account. (see point 7d of the same)