

**Test data:**

Customer: .....

Test Engineer: .....

Date: .....

Serial number: .....

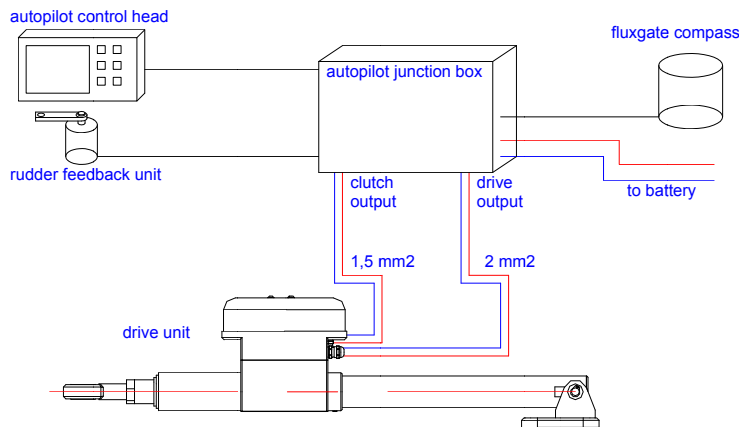
Output force 400 Kgs:

Motor Voltage: 12 Volts

Clutch voltage: 12 Volts

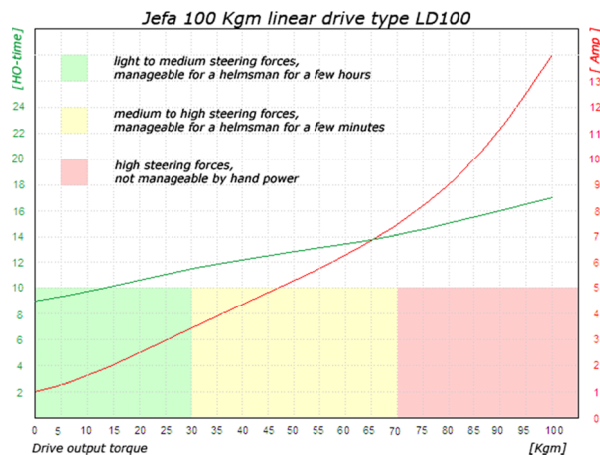
Insulation test:

**Electrical Connections:**



This illustration shows the minimal components for a working autopilot configuration. Jefa autopilot drives work together with all major autopilot electronics. The connection of the Jefa autopilot drive to the autopilot junction box is quite simple. The two 1,5 mm<sup>2</sup> red and black wires have to be connected to the plus and minus of the autopilot clutch line. This will make sure that when the autopilot user engages the autopilot on the control screen, the clutch will engage and allow the autopilot motor to drive the steering system. The two 2 mm<sup>2</sup> red and black wires have to be connected to the autopilot drive output connection.

**Performance table:**



This performance table shows the relation between the consumed power and the output power and how quick this is done (hard over time). The red line shows the output torque against the needed amperage. The green line shows the hard over time (time to travel 72° of rudder travel) of the drive relative to the output torque. Also visible is the strength of the drive unit related to man power. The unit is much stronger than a human being and can last much longer but one should note that when the unit is operated in the red zone, something is wrong with the trim of the boats and the sails should be adjusted to achieve lower rudder torques. The above table shows that the Jefa linear drive will steer the yacht even in the worst possible conditions. As the drive will mostly operate in the left green zone and will not continuously rotate, the average power consumption on 12 volts is 1 to 2 amps.

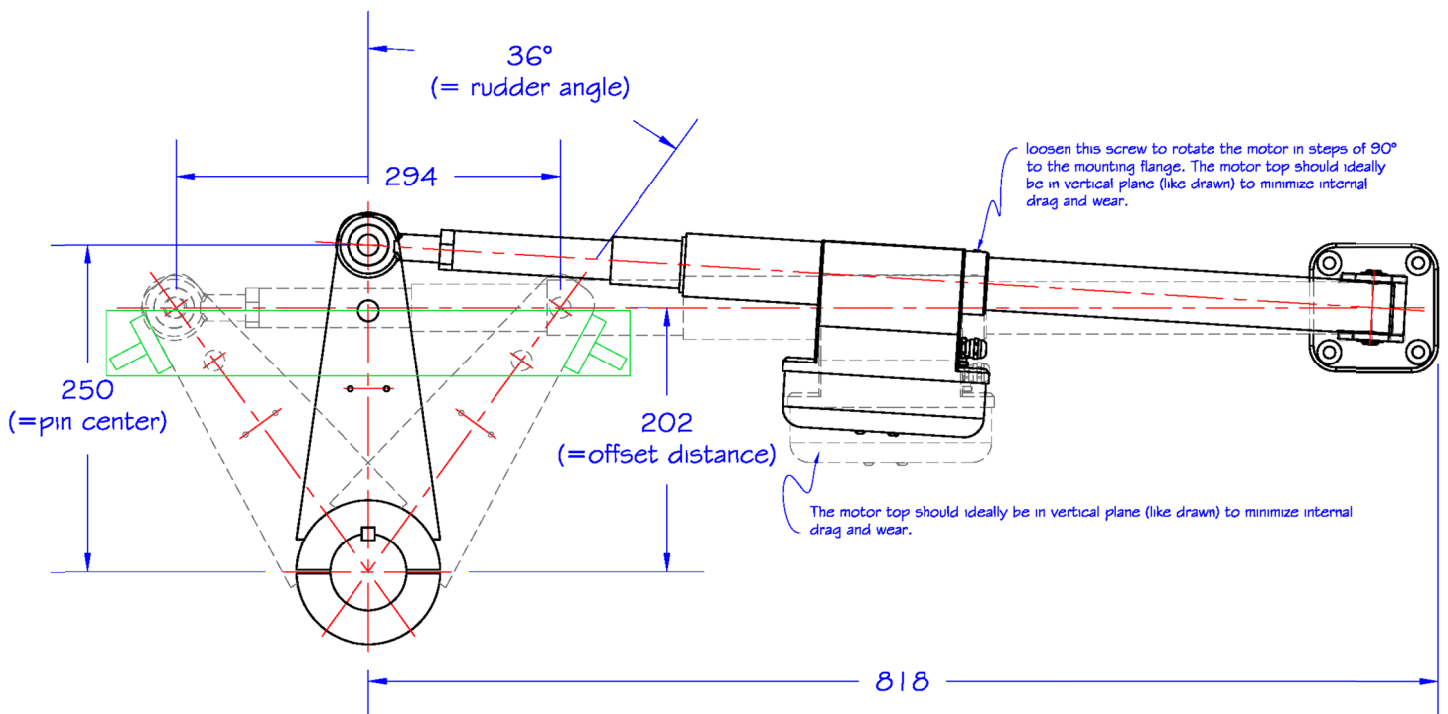
## Compatibility in 12 Volts:

Following table shows the maximum rudder torques at midships and full rudder that can be generated by the Jefa 150 KgM direct drive type 1 in combination with various autopilot junction boxes. The hard over time (HO-time) states the time it takes the drive to travel the full 72 degrees of rudder travel when the speed control of the pilot is set to maximum speed.

| Autopilot junction box 12 Volt version. | Max. output (Amp.) | Rudder torque (KgM) |
|---|--------------------|---------------------|
| Garmin GHP12/GHC10 sailboat APS         | 40                 | 100                 |
| Simrad AC12                             | 12                 | 100                 |
| Simrad AC40                             | 40                 | 100                 |
| Raymarine X-10 (*1)                     | 10                 | 100                 |
| Raymarine X-30                          | 30                 | 100                 |
| Nexus-Silva A-1510 (*2)                 | 15                 | 100                 |
| NKE gyropilot 2 RVP (*2)                | 25                 | 100                 |
| Navman G-Pilot (*2)                     | 20                 | 100                 |
| Northstar MCU600 (*2)                   | 20                 | 100                 |
| Furuno Navpilot 500/511/520             | 25                 | 100                 |

\*1: We strongly advise to not use the standard X10 autopilot as it delivered without rudder feedback unit. Without rudder feedback unit the autopilot is not aware of actual rudder angle. In very slow speed conditions or in conditions of a stalling rudder blade, the autopilot doesn't stop with powering the drive unit, running it against the rudder stops and still continuing to power the drive. In time the drive fuse will blow, but mechanical damage can occur in the drive unit which will not be covered under our warranty terms as we can identify this specific damage. We strongly advise only to use the X10 unit in combination with the optional rudder feedback unit or use the X30 unit.  
 \*2: Special arrangement needed for clutch operation. See separate manual on our FTP server ftp.jefa.com or visit the linear drive product page on www.jefa.com

## Mechanical installation:



The above illustration shows the correct installation geometry of the linear drive. It's very important to check if correct rudder stops are fitted (shown in green) limiting the rudder travel to 2 x 36° (normal for wheel steered systems). The lack of correct rudder stops will cause the direct drive to act as travel limiter, resulting in damage to the internal gears. The linear drive has a maximum travel of 303 mm, so there is 4 mm of spare travel each side assuring a free run. It's advisable to mount the drive with the motor pointing sideways and not up or downwards (like in above illustration) as this position generates less friction and also less wear in time.

On most cable steered boats the rudder travel is 2 x 40° and on some tiller steered boats the rudder angle is even bigger. Please revert to the table at the right for the correct pin centres and offset distance in these cases. Please note that the maximum achievable rudder torque will be lower when shorter centres are used. For example: The maximum rudder torque for the 50° setup will be  $192/250 \times 100 = 77$  KgM instead of the 100 KgM with the 36° setup.

| Operating centres for non standard rudder angles |                 |               |
|--|-----------------|---------------|
| Output centre                                    | Offset distance | Tiller centre |
| 36°  | 250             | 202           |
| 38°  | 239             | 188           |
| 40°  | 229             | 175           |
| 42°  | 220             | 163           |
| 44°  | 212             | 152           |
| 46°  | 204             | 142           |
| 48°  | 198             | 132           |
| 50°  | 192             | 125           |

## Test the system:

Before you can test the system, make sure following things are correct:

- Solid rudder stops should be fitted limiting the rudder travel to an equal travel of 36 degrees from midships to port and starboard. (PS. In the case of a larger rudder angle than 36°, the tiller centres of the linear drive should be adjusted accordingly to prevent the linear drive from acting as rudder stop)
- Make sure all bolted parts (tiller pins, rosejoints, mounting plate bolts, tillerarm, etc) are firmly tightened and will not come loose even when exposed to heavy vibrations. Use loctite when necessary.
- No part of the drive unit should contact the vessel, the quadrant, or the tiller arm throughout the full range of movement.
- The drive unit should be mounted with the motor pointing sideways if possible. Mounting the drive unit with the motor pointing up or down may generate more friction, and therefore cause more wear over time.
- Make sure no (drip) water can reach the drive unit as it is NOT waterproof. When the drive is submerged or heavily splashed with water, immediately remove the drive unit, dry it and return it to our factory for overhaul. Continuing using the wet drive will jeopardise the functioning and it will be not repairable any more. The IP rating code of the LD100 drive unit is 43. Please read more at this web link: [http://en.wikipedia.org/wiki/IP\\_Code](http://en.wikipedia.org/wiki/IP_Code)

Connect the electronics. Make absolutely sure the autopilot is set to “reversible drive” or equivalent. Don’t use settings like “solenoid” or “hydraulic drive” as these settings will disable the speed control of the autopilot leaving the drive running at 100% speed or 0%, but nothing in between. Make sure the clutch voltage is set to 12 volts. Some autopilots pulse the clutch and slowly drop to 6 Volts instead of a steady 12 volts. A contactor (relais) with a capacitor should be used. See the separate manual on our FTP server <ftp.jefa.com> or visit the linear drive product page on [www.jefa.com](http://www.jefa.com) for info on your specific autopilot electronics.

When the drive doesn’t react to the electronics, test the drive by bypassing the electronics: Connect a plus and minus wire to the battery or fuse box and first connect the clutch, one should hear a click when connecting and disconnecting. With the clutch under power, connect power for a short time to the motor cables. The system should get in motion now. Don’t connect the cables too long as the drive will try to continue, even when the rudder stops are reached, with potential damage to the structure and drive unit. If motion is detected, one can rule out the drive causing the malfunction.

## Maintenance:

The direct drive is “greased for life”, so should no be opened. No maintenance is required except for periodic checks of all bolted connections. As the rudder system, the steering system and the autopilot drive is exposed to heavy vibrations (mainly by cruising on motor), all bolted connections should be yearly checked. The only parts that could wear in time are the balls of the draglink. These balls are easy exchangeable and available for around 10 € each from any Jefa distributor.

## Declaration of conformity:

I, Stig Jensen of Jefa Marine Steering ApS, Nimbusvej 2, 2670 Greve, Denmark, confirm that the Jefa direct drive type I, when fitted in accordance with these installation instructions, will meet the requirements of the Electro Magnetic Compatibility Directive Standard contained within Standard No. 60945/A1.

Signed:.....

Stig Jensen

Date: 08-05-2008

*For more information please visit our website [www.jefa.com](http://www.jefa.com)*