S1 Tiller and Wheel Pilot

Service Manual

Document Number: 83187_1
Date: January 2007

Raymarine

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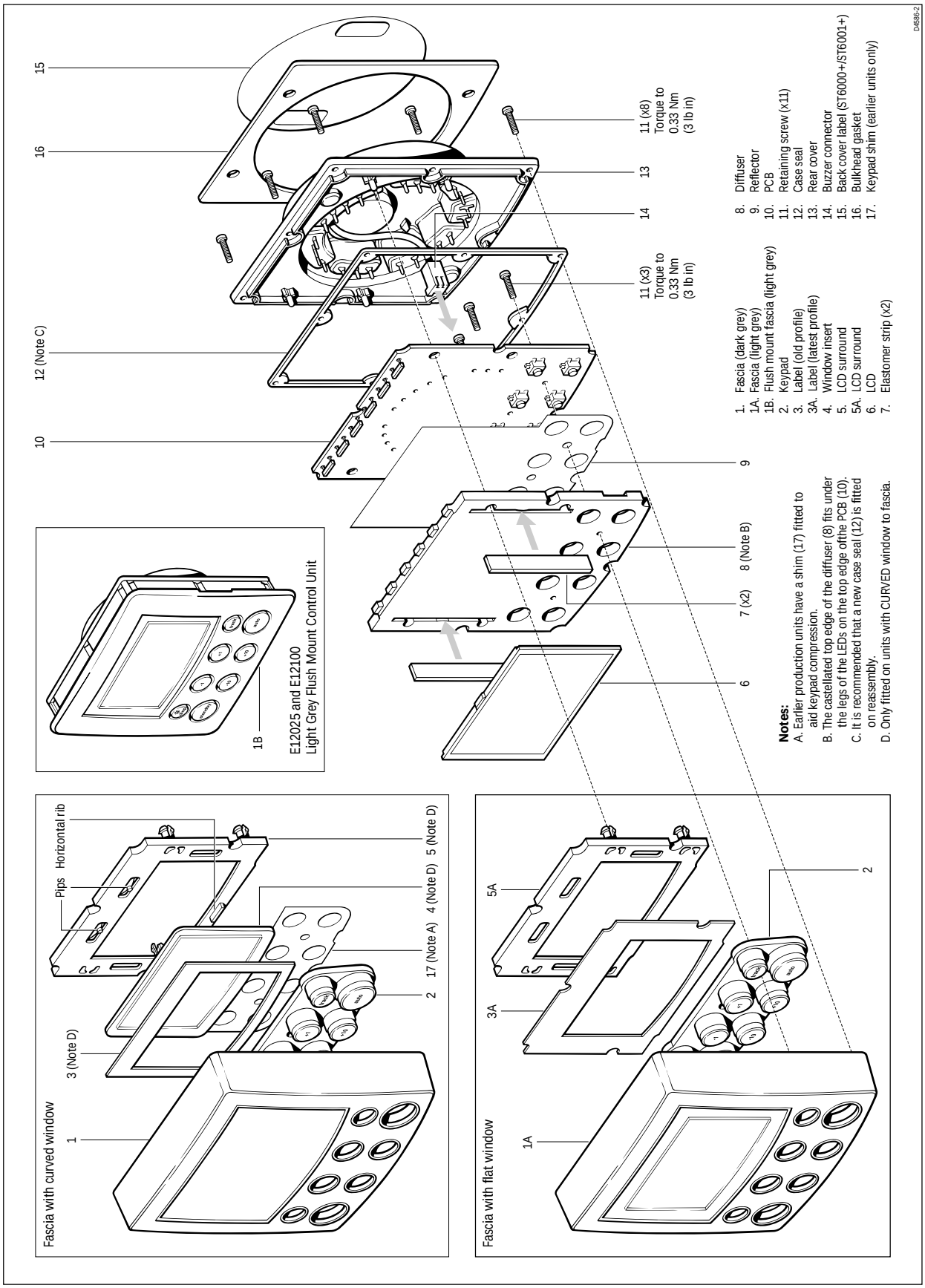
Chapter 1: ST6002 control head

1.2 Disassembly/Assembly



Note: *This drawing above is not an exact representation of the present plastics. Following this process will show you how to separate the plastics and seals to replace the PCB as there are no serviceable parts with this item. It is just a case of replacing the PCB if any problems are present*

1.2 ST6002 spare parts list

Below is a table populated with Spare parts for the ST6002 as there are no serviceable parts with this product it is just a case of dismantling the unit and replacing the internal PCB.

Spare Part Number	Description
A18012-P	Universal Pilot Display Kit
A18018-P	ST6002 Surface Mount Fascia Kit
A18090-P	ST6002 Spare PCB Assembly
A25004-P	ST60+ Surface Mount Sun Cover
Q219	ST4/5/6001 & 6002 Autopilot Keypad
W118	ST4/5/6001 & 6002 Case Seal
W119-P	ST6002 Back Cover Assembly

Chapter 2: Fluxgate Compass Transducer

2.2 Functional test

Disconnect the Fluxgate from the Autopilot and check continuity as follows:

Cable color connector pin number Resistance

Cable Color	Connector Pin Number	Resistance
Screen to blue	(2/4)	< 10 ohms
Red to green	(3/5)	< 5 ohms
Red to yellow	(3/6)	< 5 ohms
Red to screen	(3/2)	Open circuit

2.2 Magnetic deviation

The Fluxgate Compass requires careful siting if optimum Autopilot performance is to be achieved. The SeaTalk electronics is able to correct the compass for most deviating magnetic fields present when the linearization procedure is carried out. Any further deviation, introduced after linearization, will introduce an error between the Fluxgate and the ship's compass. This can be removed by carrying out the linearization again. If the displayed deviation is greater than +/– 15 degrees the Fluxgate should be re-sited.

Note: *The linearization procedure should always be carried out if the Fluxgate has been exchanged, removed or moved from its original mounting position.*

Disassembly/assembly

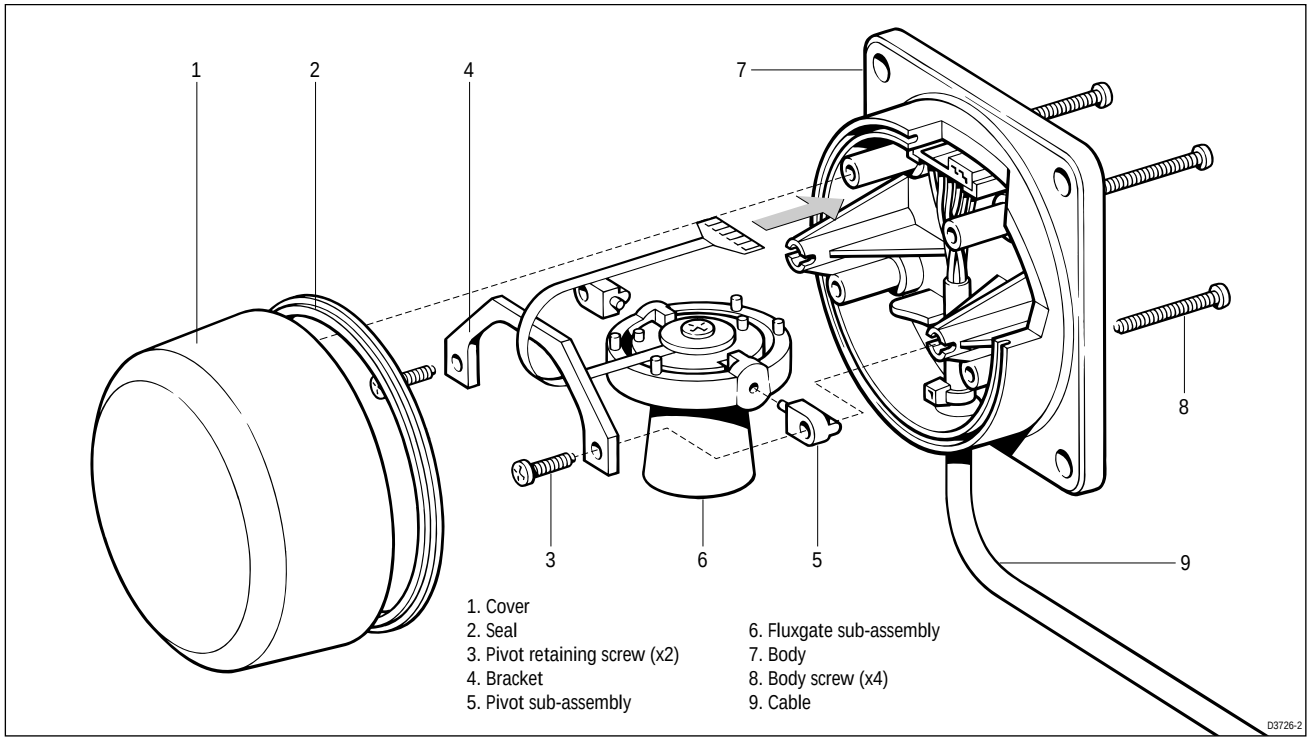


Figure 4. Fluxgate Compass exploded view

Fluxgate Compass spare parts list

The item numbers refer to Figure 4: Fluxgate Compass exploded view

Item	Spare Description	Part No.	Comments
	Compass base kit, including	M096	
3	Pivot retaining screw (x2)		
4	Bracket		
	Fluxgate sub-assembly, including	M022	
5	Pivot sub-assembly (x2)		
6	Fluxgate sub-assembly		

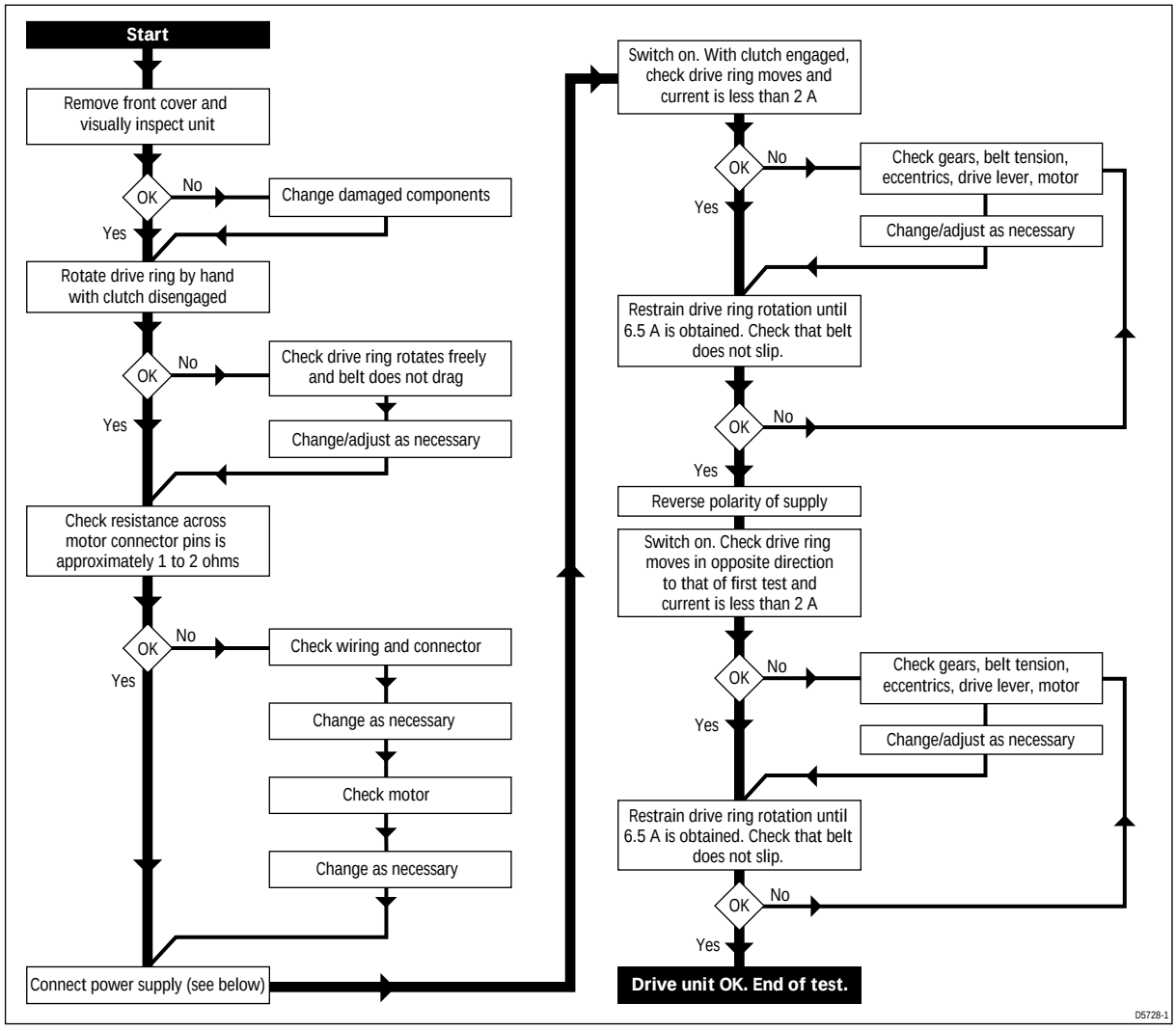
Chapter 3: 4000 MK2 wheel drive

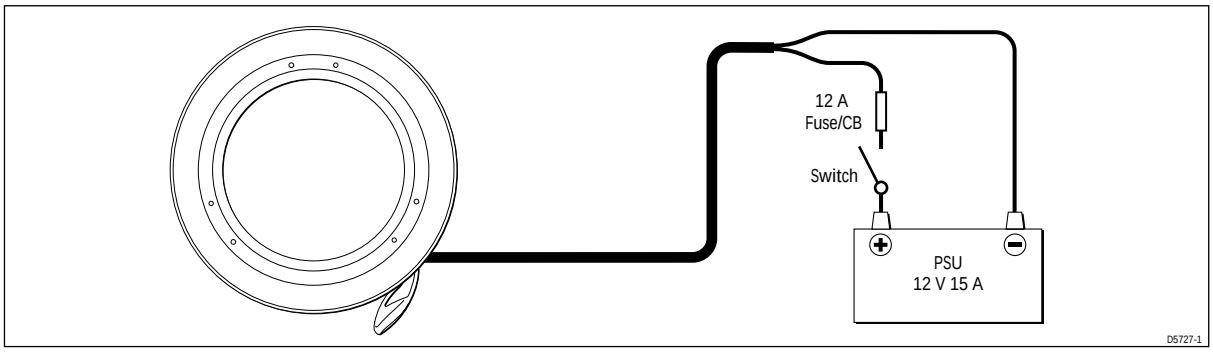
Introduction

This manual explains the service and maintenance procedures for the Raymarine 4000 Mk2 wheel drive unit.

3.1 4000 MK2 wheel drive test

Note: For information about servicing the ST4000+ control unit and fluxgate compass, refer to the ST4000 Plus Autopilots Service Manual (83115-3)

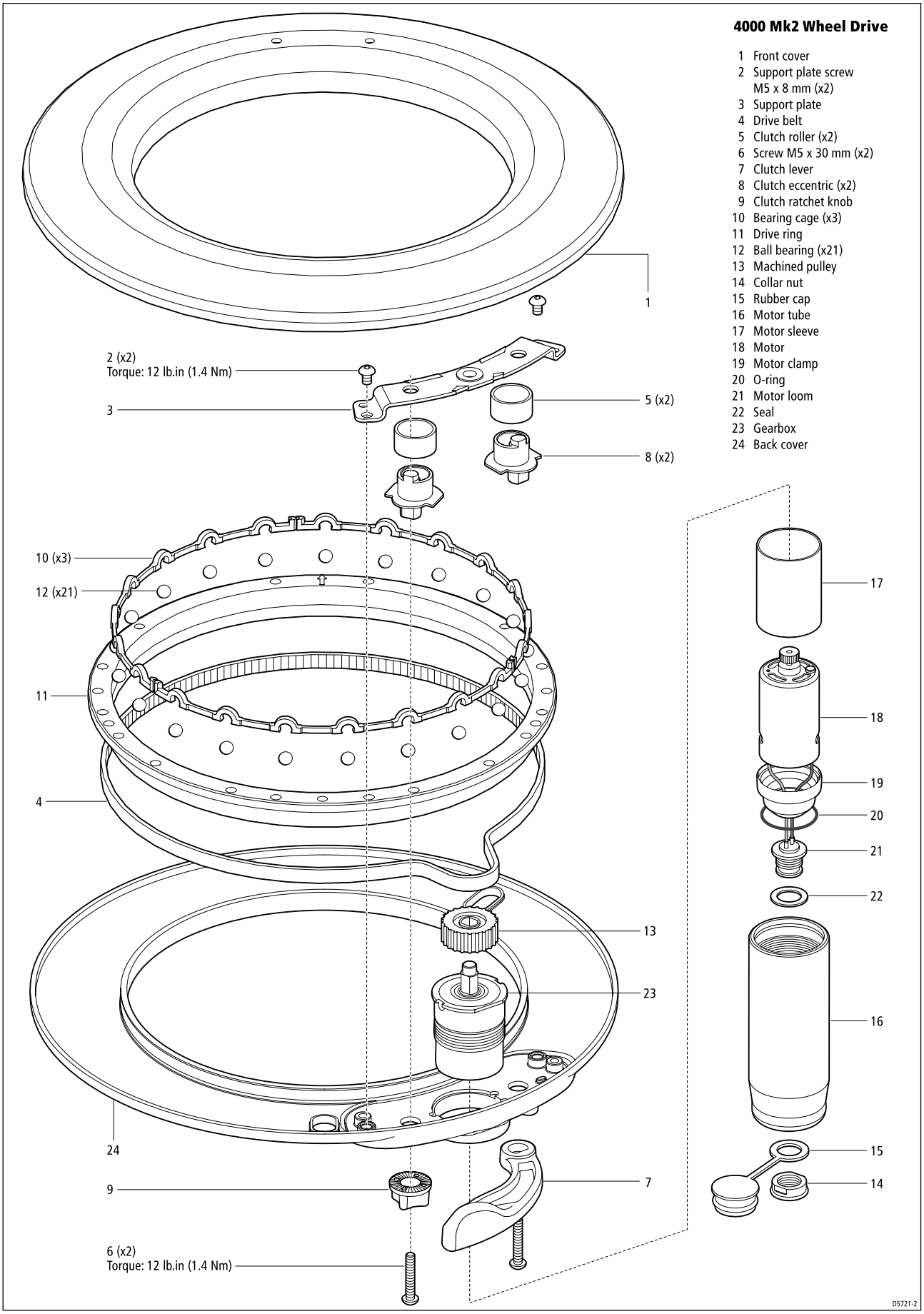




3.2 Spares for 4000 Mk2 wheel drive

Item	Spare/Accessory	Part No.	Comments
	Front cover	A18074	
1	Front cover		
–	6 mm drill bit		Not illustrated on exploded view
24	Back cover	A18075	
11	Drive ring	A18076	
	Clutch lever	A18077	
7	Clutch lever		
6	M5 x 30 mm screw		
	Clutch ratchet knob	A18078	
9	Ratchet knob		
6	M5 x 30 mm screw		
	Support plate	A18079	
3	Support plate		
2	M5 x 8 mm screw (x2)		
	Torque restraint (pedestal bracket)	A18080	
–	Torque restraint		Not illustrated on exploded view
–	No 10 x ¾ inch screw (x4)		Not illustrated on exploded view
–	4 mm drill bit		Not illustrated on exploded view
–	Wheel drive unit	A18081	Entire wheel drive assembly
4	Drive belt	A18083	
	Clutch kit	A18084	
8	Clutch eccentric		
5	Clutch roller		
6	M5 x 30 mm screw		
	Bearing kit	A18085	
12	Ball bearings (x21)		
10	Bearing cage (x3)		
18	Motor	A18086	
13	Machined pulley	A18087	
23	Gearbox	A18088	
	Single spoke clamp	A18089	
–	Spoke clamp		Not illustrated with exploded unit
–	16 mm spoke clamp insert		Not illustrated with exploded unit
–	12 mm spoke clamp insert		Not illustrated with exploded unit
–	M5 x 16 mm screw		Not illustrated with exploded unit
–	3 mm allen key		Not illustrated with exploded unit
	Motor loom and seal kit	A18092	
14	Collar nut		
15	Rubber cap		
19	Motor clamp		
20	O-ring		
21	Loom plug assembly		
22	Gasket		
	Power cable	A18061	Not illustrated with exploded unit
	4.5 m (15 ft) cable with plug at one end and connector spades at the other		

3.3 4000 MK2 wheel drive exploded view



Disassembly and Reassembly

Note: *The numbered parts in the following instructions refer to the annotations on the exploded views.*

3.4 Tools required

To assemble/disassemble the 4000 Mk2 wheel drive unit you will need a 3 mm allen key.

3.5 Disassembly

Remove the wheel drive from the wheel and release the clutch, then complete these steps:

Support plate and drive belt

1. Remove the front cover (1) by pulling it away from the back cover.
2. Remove the support plate:
   - unscrew and remove the 2 support plate screws (2)
   - lever the support plate (3) away from the back cover
3. Remove the drive belt:
   - lever the drive belt (4) up and over the machined pulley (13)
   - remove the drive belt from the drive ring (11)

Clutch eccentrics, knob and lever

4. Remove the 2 clutch rollers (5) from the clutch eccentrics.

Note*: the clutch rollers are identical.*

5. Remove the clutch lever:
   - unscrew and remove the clutch lever screw (6)
   - pull the clutch lever (7) off the back cover
6. Remove the clutch lever eccentric (8).
7. Remove the clutch ratchet knob:
   - unscrew and remove the ratchet knob screw (6)
   - pull the ratchet knob (9) off the back cover
8. Remove the clutch knob eccentric (8).

Note*: the clutch lever eccentric and clutch knob eccentric are identical.*

Bearing cage and drive ring

9. Remove the 3 parts of the bearing cage (10):
   - insert one end of the allen key into the joint between 2 parts of bearing cage (10), then lever one part of the cage up so you can pull it out
10. Push all of the ball bearings together. The drive ring (11) will then be free to move.
11. Hold the drive unit horizontal, then lift off the drive ring (11).
12. Remove the 21 ball bearings (12), taking care to retain them for reassembly (e.g. in the inside of upturned front cover).
13. Lift off the machined pulley (13).

Motor and gearbox

14. Unscrew the plastic collar nut (14) by turning it anti-clockwise, then remove the rubber cap (15).
15. Unscrew the motor tube (16) by hand (turning it anti-clockwise) and then remove it.
16. Lift off the motor assembly, consisting of: motor sleeve (17), motor (18), motor clamp (19), O-ring (20), motor loom (21) and gasket (22).
17. Remove the gearbox (23) by pushing it out from the rear of the back cover (24).

3.6 Reassembly

CAUTION: Do NOT use mineral-based solvents (e.g. WD40) to lubricate or clean the wheel drive as they will damage the material. The wheel drive is designed to run without lubrication.

Gearbox

1. Fit the gearbox (23) by inserting it from the inside of the back cover (24). Ensure that the locating slots on the gearbox are aligned with the lugs in the back cover.
2. Place the machined pulley (13) onto the gearbox shaft, with the recessed face on top.

Clutch eccentrics

3. Fit the 2 clutch eccentrics (8) with their flanges downwards, so that they are clear of the foul pins on the back cover. Note: the 2 clutch eccentrics are identical.
4. Fit the 2 clutch rollers (5) over the clutch eccentrics. Note: the 2 clutch rollers are identical.

Drive ring and bearing cage

5. Place the drive ring (11) onto the back cover, with its lipped edge uppermost.
6. Place the 21 ball bearings (12) back into the ball groove.
7. Roughly distribute the ball bearings around the ball groove – this should secure the drive ring.
8. Fit the 3 parts of the bearing cage (10):
    - clip the first part of the bearing cage into the ball groove, capturing 7 ball bearings in the cage
    - repeat for the other 2 parts of the bearing cage
    - when you have fitted the 3 parts of the bearing cage, check that the drive ring is free to rotate

Drive belt and support plate

9. Fit the drive belt (4):
    - Fit the belt around the drive ring
    - rotate the clutch eccentrics to make the maximum amount of space between the machined pulley and the clutch eccentrics
    - then fit the belt around the machined pulley
10. Fit the support plate (3):
    - fit the support plate over the clutch eccentrics and gearbox shaft, making sure the plate is pressed down fully
    - insert and tighten the 2 screws (2): torque to 12 lb.in (1.4 Nm)

Clutch lever and ratchet knob

11. Fit the clutch lever (7):
    - place the clutch lever onto the eccentric spindle (it should be positioned between the two pips on the rear of the back cover)
    - insert and tighten the clutch lever screw (6): torque to 12 lb.in (1.4 Nm)
    - check that the lever engages and disengages the clutch
12. Fit the clutch ratchet knob (9):
    - place the clutch ratchet knob over the eccentric spindle
    - insert and tighten the clutch ratchet knob screw (6): torque to 12 lb.in (1.4 Nm)
    - you will need to adjust the clutch after reassembling the wheel drive (Section 3.4)

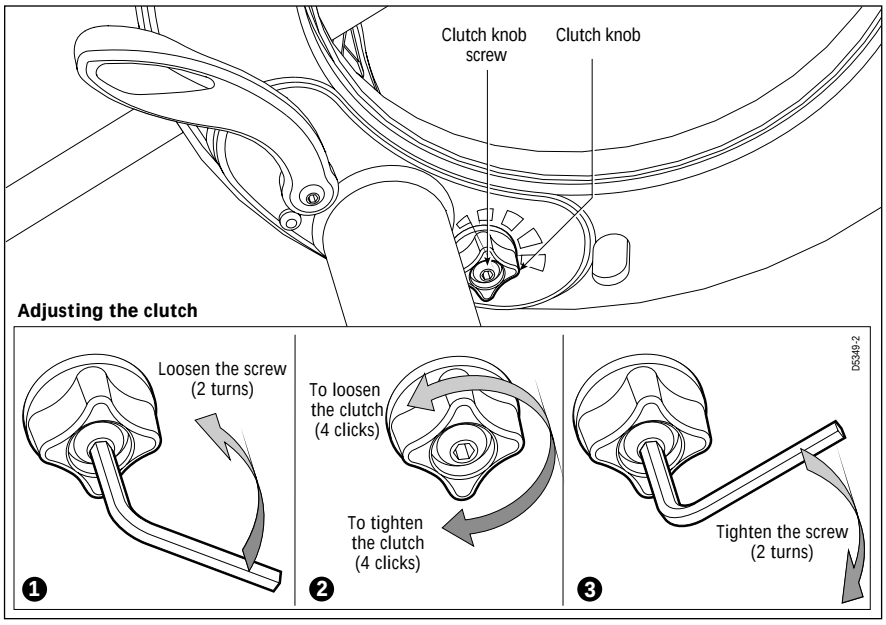
Motor assembly

13. Fit the motor assembly:
    - carefully insert the gear at the end of the motor (18) into the hole on the gearbox (23), making sure the teeth engage properly
    - also make sure that the pin on the motor engages into one of the 2 holes on the top of the gearbox
    - check that the O-ring seal (20) is still sitting on the motor clamp
14. Fit the motor tube (16):
    - place it over the motor and hand-tighten it onto the back cover
15. Fit the rubber cap (15) and secure it with the plastic collar nut (14), making sure the lip on the collar nut is uppermost.

Front cover

16. Fit the font cover (1):
    - line up the arrow on the front cover with the arrow on the drive ring, then press the cover into place

3.7 Adjusting the clutch



You need to adjust the clutch if you have removed the clutch eccentrics, replaced the ratchet knob, or replaced the drive belt. When the clutch is correctly adjusted:

- the drive ring can rotate freely when the clutch is disengaged
- the drive belt does not slip when the clutch is engaged and the motor is driving

To adjust the clutch, make sure the clutch is disengaged. Then:

1. Use a 3 mm allen key to loosen the clutch knob screw about 2 turns anti-clockwise.
2. Turn the clutch knob either 4 clicks clockwise to tighten the clutch, or 4 clicks anti-clockwise to loosen the clutch.
3. Use the allen key to re-tighten the clutch knob screw.
4. Check that the wheel still moves freely with the clutch off.

Note: *If the wheel does not move freely, reduce the clutch tension by turning the clutch knob 2 clicks anti-clockwise and check again*

5. Check the drive's operation with the clutch engaged.

This procedure is usually sufficient to correct a slipping or dragging drive belt. In some cases, however, you may need to repeat the steps to adjust the clutch further.

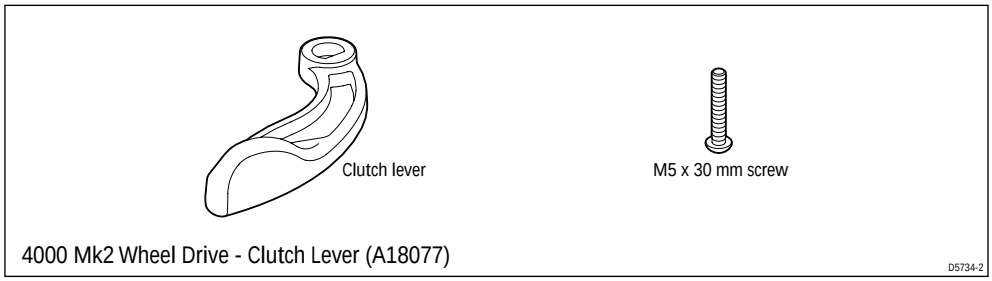
3.8 Cleaning the wheel drive

CAUTION: Do NOT use mineral-based solvents (e.g. WD40) to lubricate or clean the wheel drive as they will damage the material. The wheel drive is designed to run without lubrication.

- To clean the wheel drive front/rear cover: use a mild detergent if necessary, then flush thoroughly with fresh water.
- To clean inside the wheel drive: if there is a build-up of salt on the wheel drive bearings and drive belt, thoroughly flush the wheel drive interior with fresh water.

3.9 Fitting spares and accessories

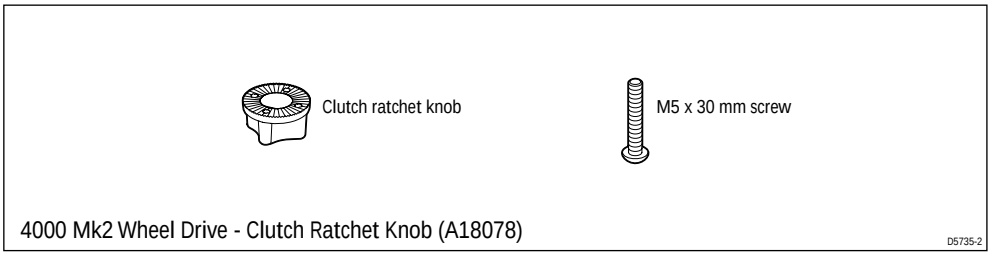
Clutch lever A18077



To replace the clutch lever:

- follow step 5 of ‘Disassembly’ to remove the lever
- follow step 11 of ‘Reassembly’ to fit the new lever

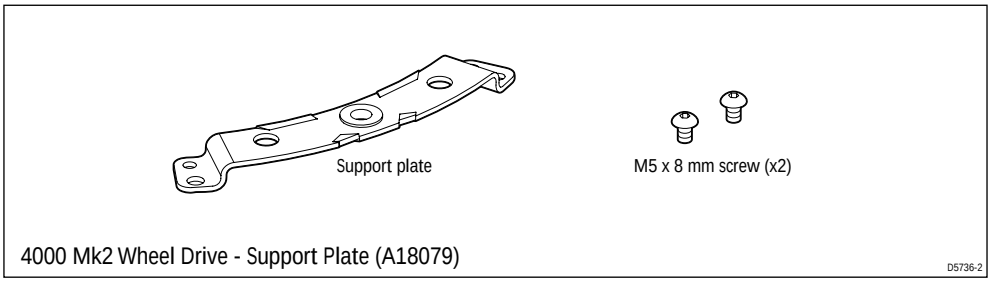
Clutch ratchet knob A18078



To replace the clutch ratchet knob:

- Follow step 7 of ‘Disassembly’ to remove the knob
- follow step 12 of ‘Reassembly’ to fit the new knob
- adjust the clutch (as described above)

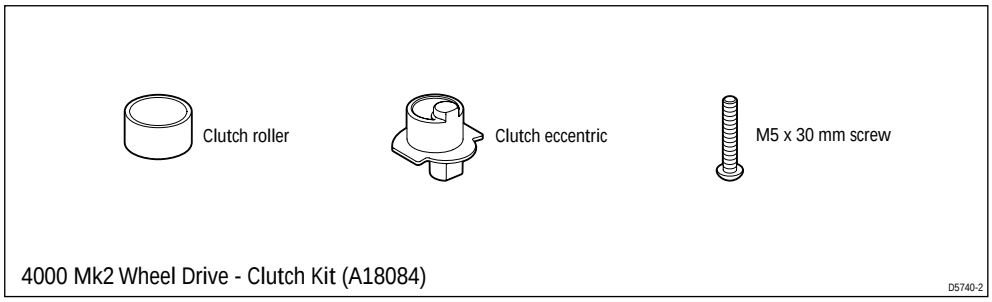
Support plate A18079



To replace the support plate:

- Follow steps 1-2 of ‘Disassembly’ to remove the support plate
- follow step 10 of ‘Reassembly’ to fit the new support plate
- fit the front cover

Clutch kit A18084



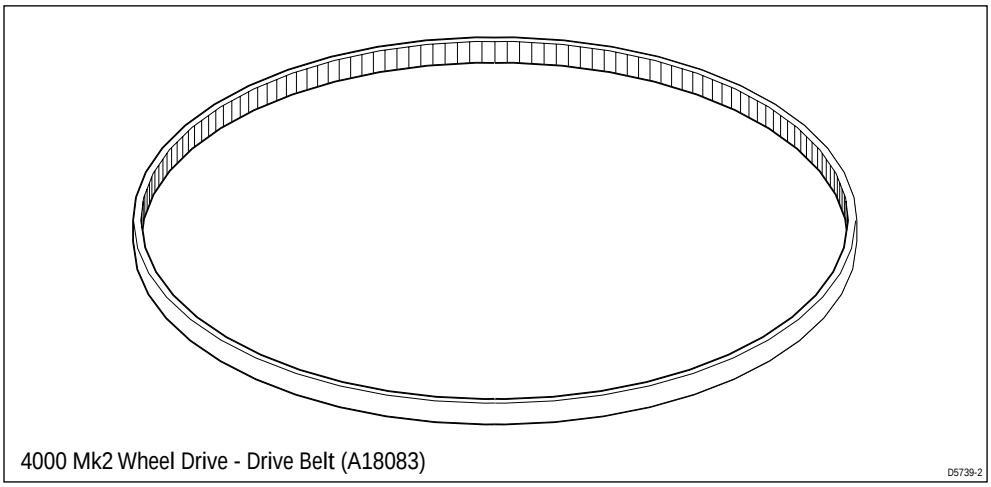
To replace either of the clutch eccentrics:

- follow steps 1-8 of ‘Disassembly’ to remove the eccentric:

***Note**: you do not need to remove the drive belt*

- follow steps 3-4 of ‘Reassembly’ to fit the new eccentric and then follow steps 9-12 of ‘Reassembly’ to reassemble the drive unit
- adjust the clutch (as described above)

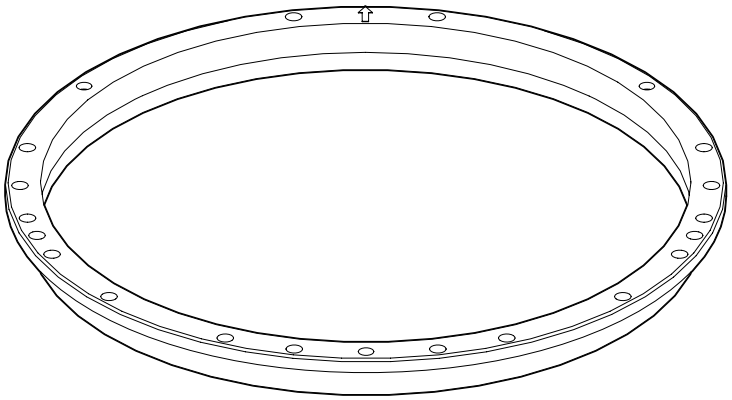
Drive belt kit A18083



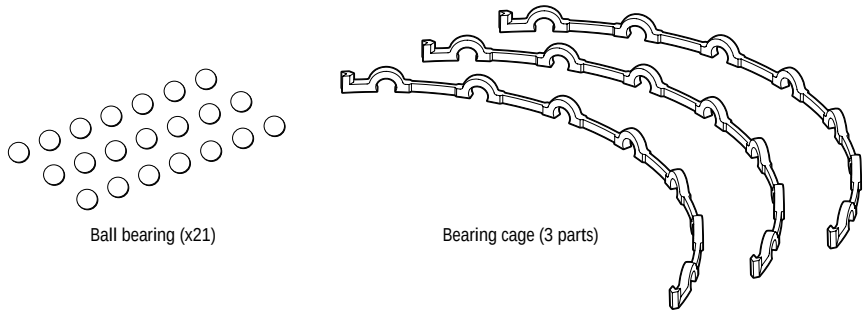
To replace the drive belt:

- follow steps 1-3 of ‘Disassembly’ to remove the old drive belt
- follow steps 9-10 of ‘Reassembly’ to fit the replacement drive belt and then the support plate
- fit the front cover
- adjust the clutch (as described above)

Drive ring A18076 and Bearing kit A18085



4000 Mk2 Wheel Drive - Drive Ring (A18075) D5733-2

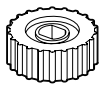


4000 Mk2 Wheel Drive - Bearing Kit (A18081) D5741-2

To replace the drive ring and/or ball bearings and/or bearing cage:

- follow steps 1-12 of ‘Disassembly’ to remove the ball bearings, bearing cage and drive ring
- follow steps 5-16 of ‘Reassembly’ to fit the new drive ring and/or bearing cage and/or ball bearings, and reassemble the wheel drive
- adjust the clutch (as described above)

Machined pulley A18087

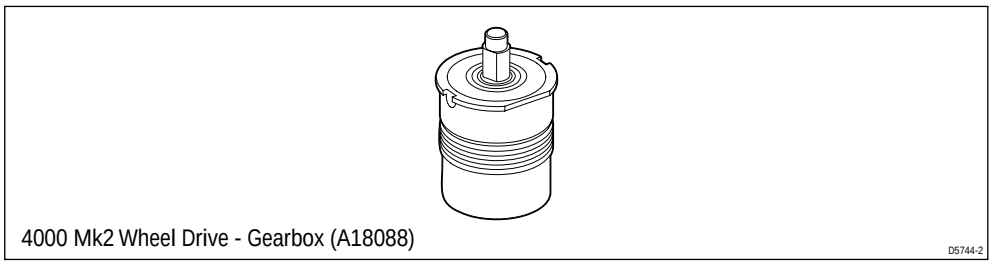


4000 Mk2 Wheel Drive - Machined Pulley (A18087) D5743-2

To replace the machined pulley:

- follow steps 1-13 of ‘Disassembly’ to remove the machined pulley
- follow steps 2-16 of ‘Reassembly’ to fit the new machined pulley and reassemble the wheel drive
- adjust the clutch (as described above)

Gearbox A18088

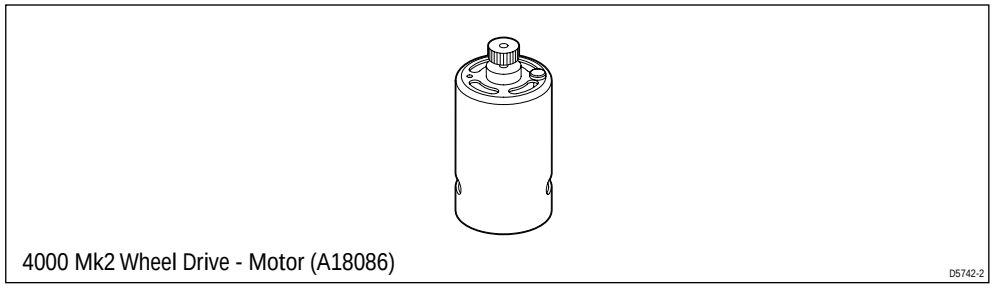


4000 Mk2 Wheel Drive - Gearbox (A18088) D5744-2

To replace the gearbox:

- follow all of the ‘Disassembly’ steps to remove the gearbox
- follow all of the ‘Reassembly’ steps to fit the new gearbox and reassemble the wheel drive
- adjust the clutch (as described above)

Motor A18086

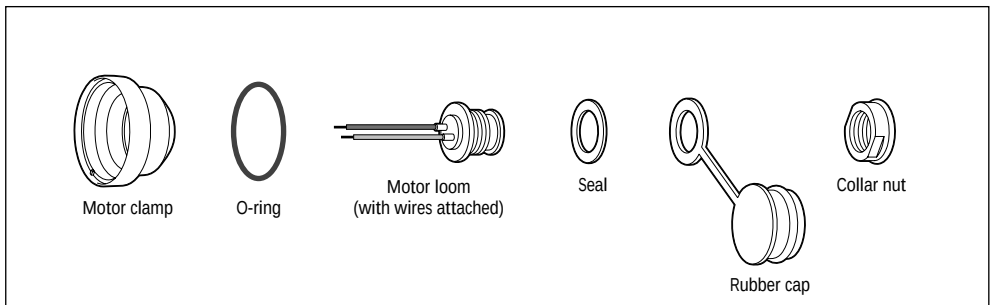


4000 Mk2 Wheel Drive - Motor (A18086) D5742-2

To replace the motor:

- follow steps 14-16 of ‘Disassembly’ to remove the motor assembly
- lift up the motor clamp so you can de-solder the motor loom wires from the contacts on the motor
- solder the motor loom wires to the new motor
- follow steps 13-15 of ‘Reassembly’ to fit the new motor assembly

Motor loom and seal kit A18092

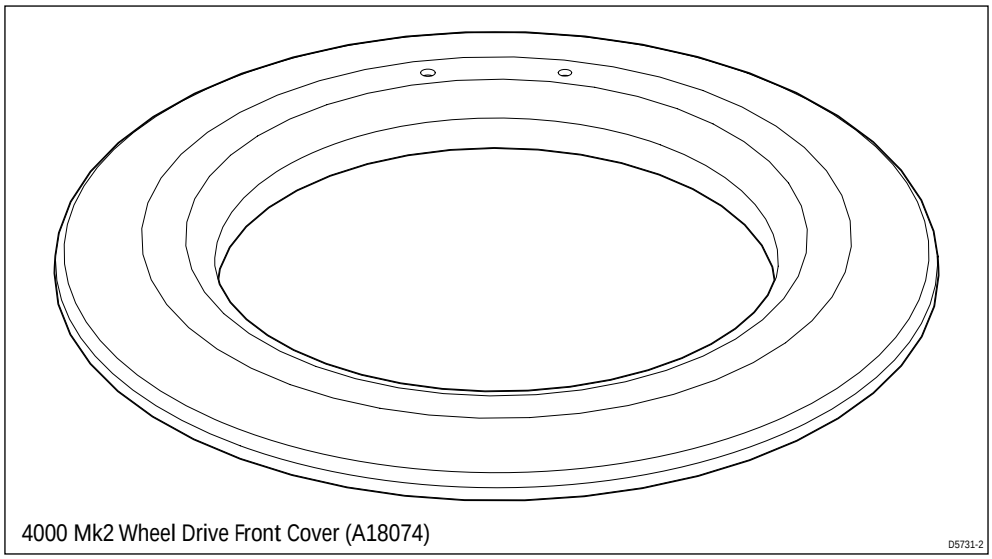


4000 Mk2 Wheel Drive - Motor Loom and Seal Kit (A18092) D5746-2

To replace the motor loom:

- follow steps 14-16 of ‘Disassembly’ to remove the motor assembly
- lift up the motor clamp so you can de-solder the motor loom wires from the contacts on the motor
- solder the new loom wires to the motor terminals
- follow steps 13-15 of ‘Reassembly’ to fit the motor assembly

Front cover A18074



4000 Mk2 Wheel Drive Front Cover (A18074)

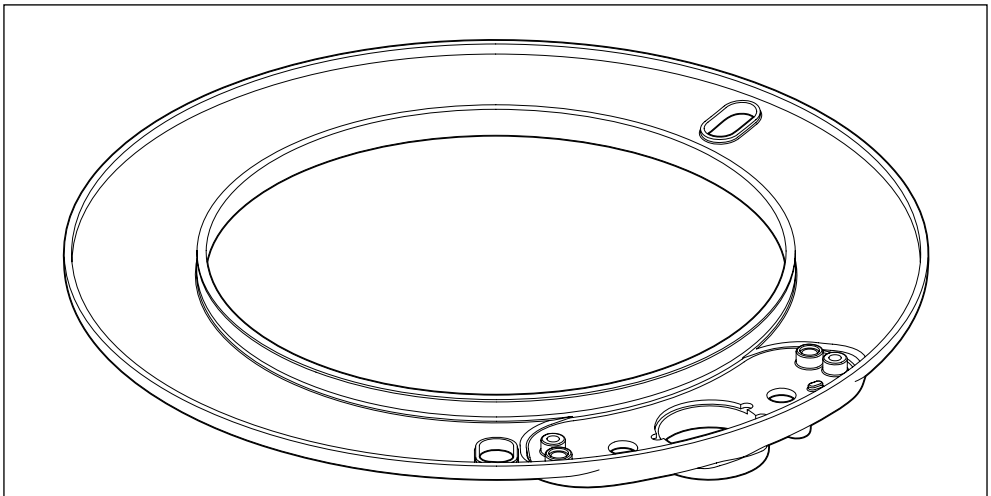
D5731-2

To replace front cover:

- pull off the old front cover
- drill the relevant spoke clamp holes in the new front cover
- fit the front cover back onto the drive unit

For more details, refer to the instructions supplied with the cover.

Rear cover A18075



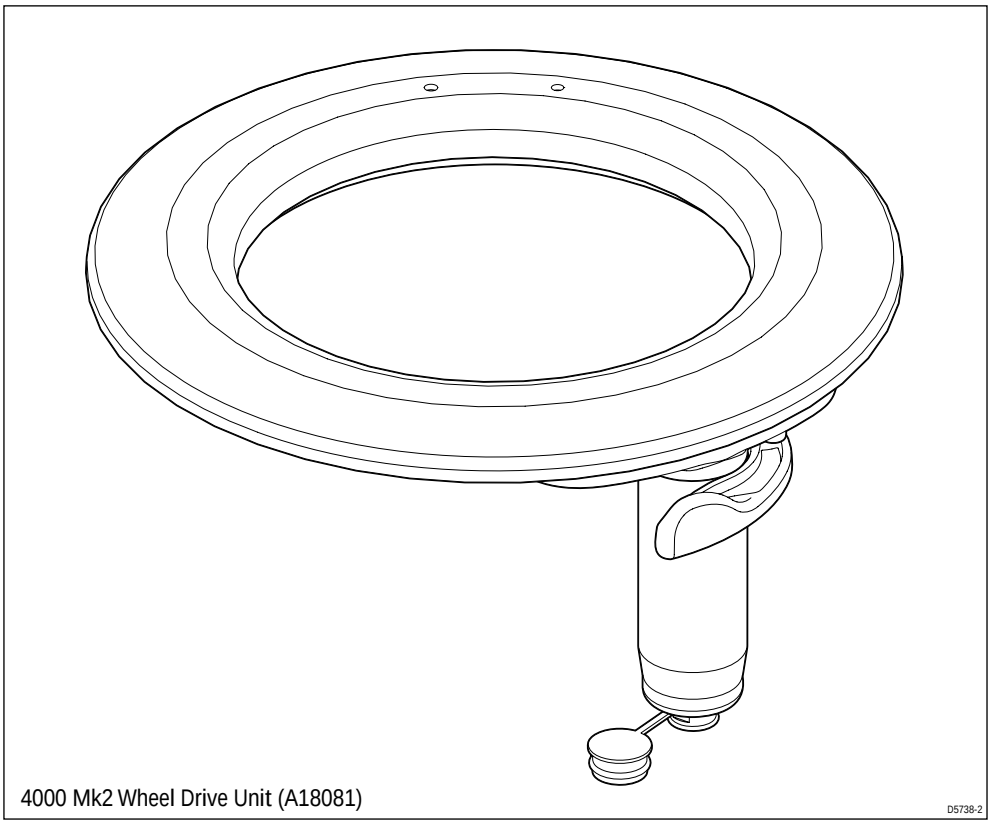
4000 Mk2 Wheel Drive - Back Cover (A18075)

D5732-2

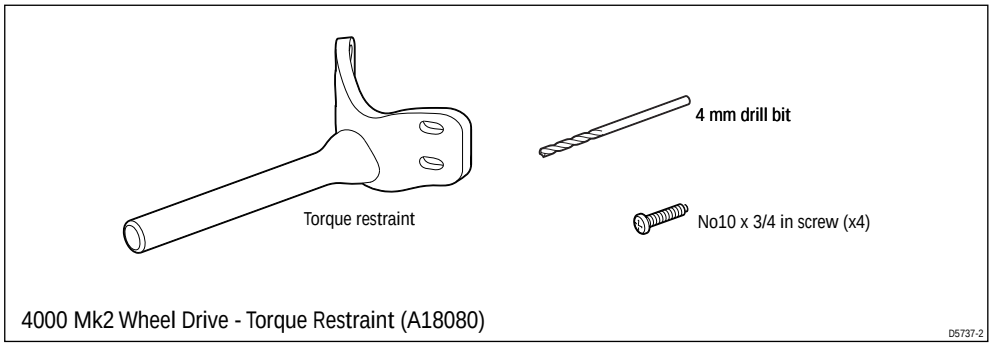
To replace the rear cover:

- follow all of the disassembly steps
- follow all of the reassembly steps

Wheel drive unit A18081

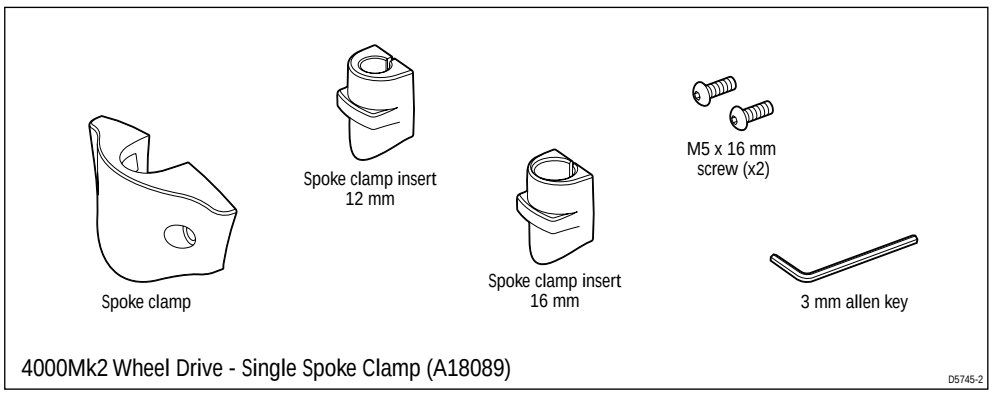


Torque restraint A18080



Fit according to instructions supplied with the torque restraint.

Single spoke clamp A18089



Fit according to instructions in ST4000+ Wheel and Tiller Autopilots Owner's Handbook.

Chapter 4: Tiller Drive Actuator

4.1 Tiller Drive Actuator test

Carry out the passive and active tests detailed in Figure 11. Tiller Drive Actuator test flowchart.

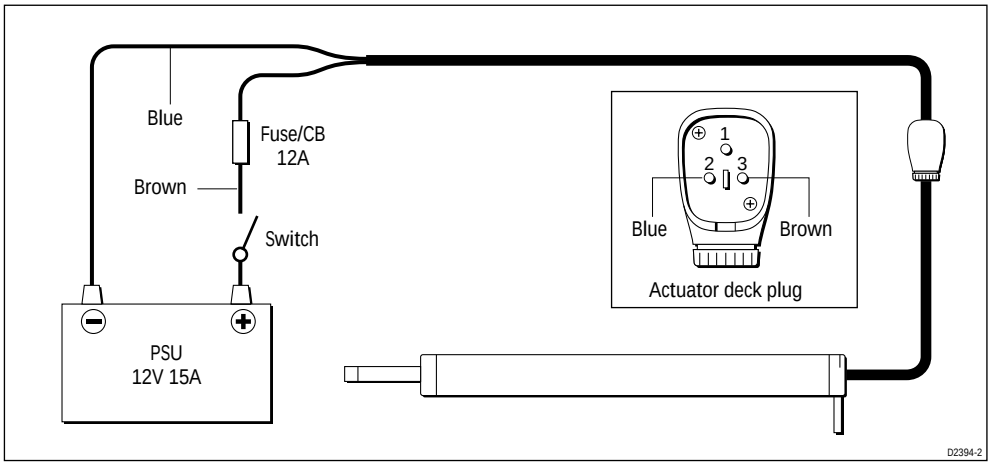


Figure 10. Tiller Drive Actuator test connections

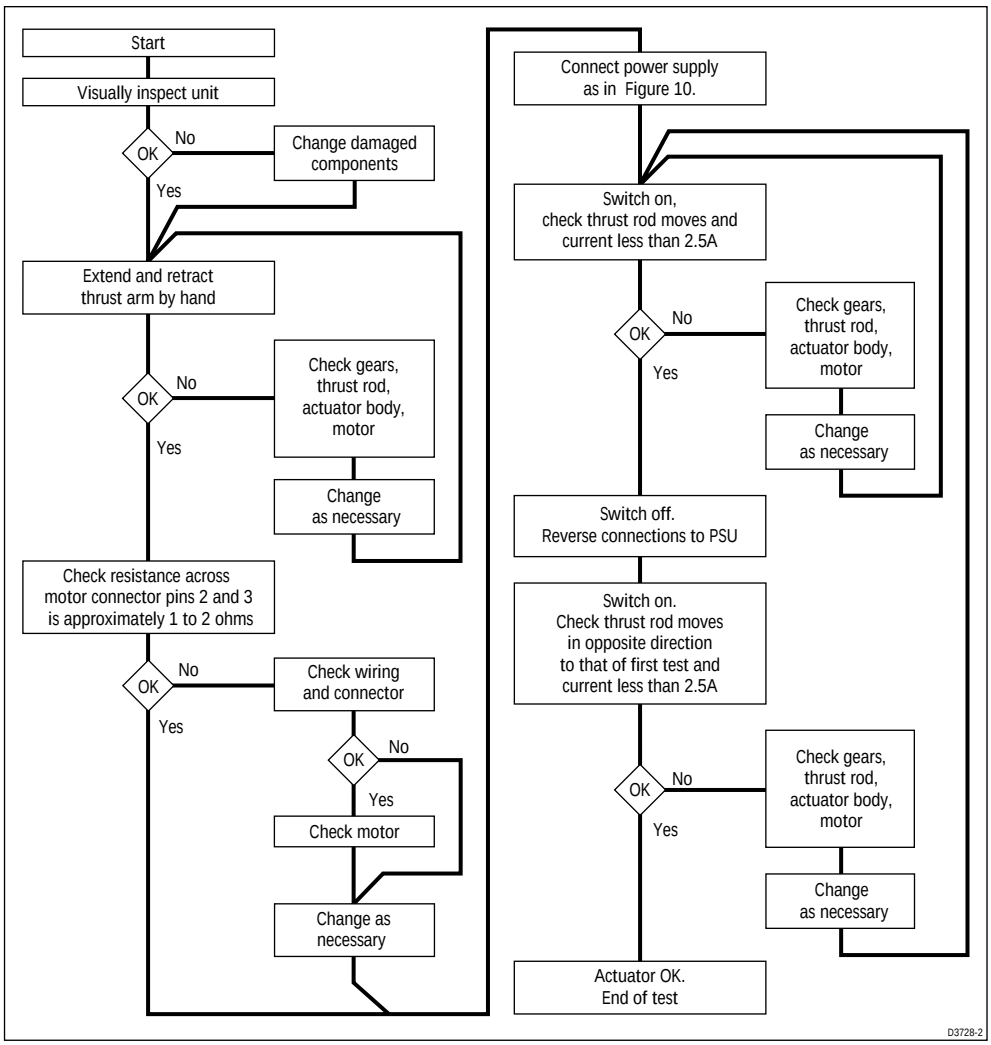


Figure 11. Tiller Drive Actuator test flowchart

4.2 Disassembly/assembly

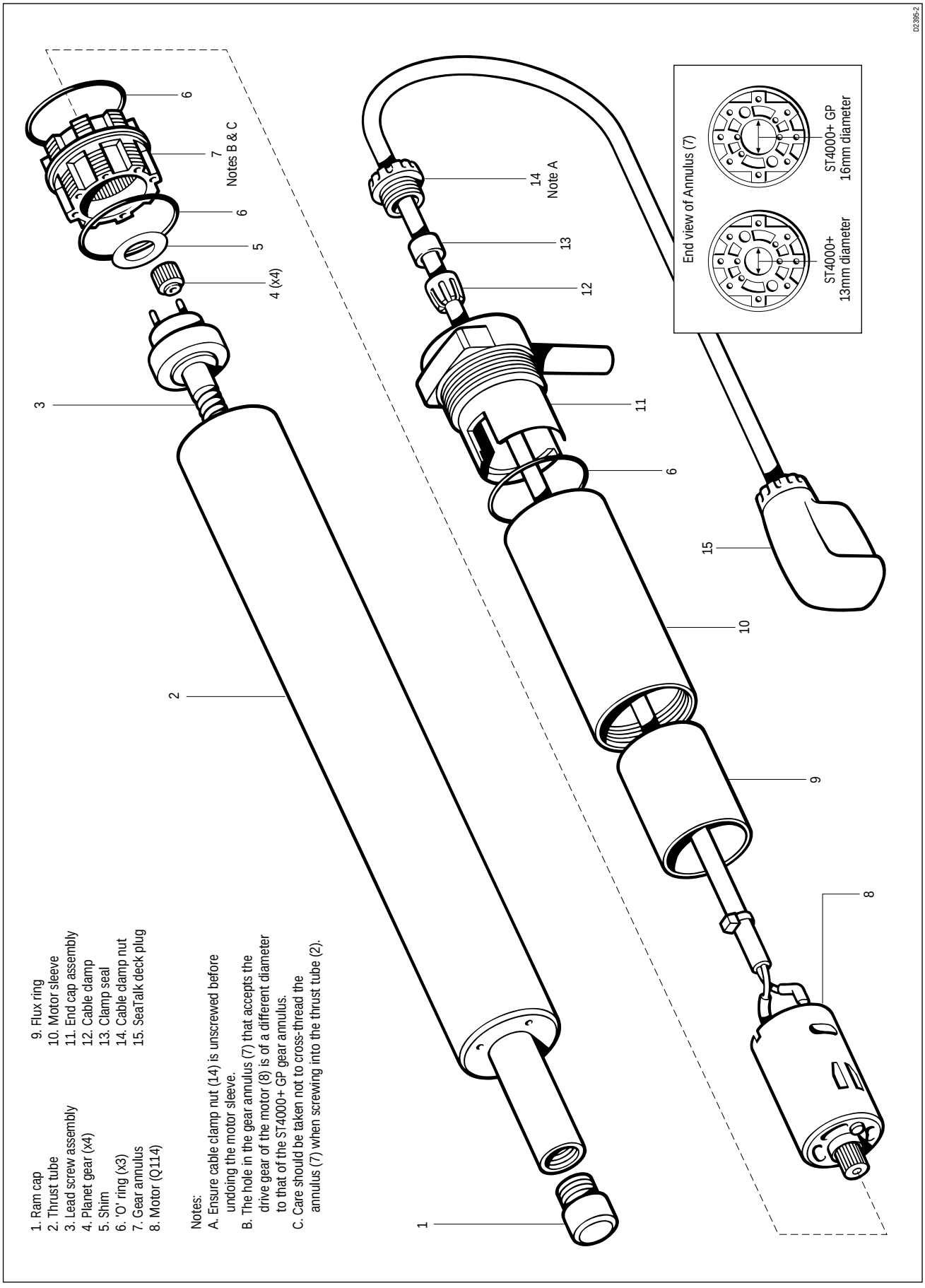


Figure 12. Tiller Drive Actuator exploded view

Tiller Drive Actuator spare parts list

The item numbers refer to Figure 12: Tiller Drive Actuator exploded view

Item	Spare Description	Part No.	Comments
	Drive module	Q047	Complete drive unit
8	Motor	Q114	
11	End cap assembly	W014	

Tiller Drive Actuator GP conversion kit (W003)

This GP conversion kit (W003) gives the option of converting the ST4000+ which has the power to helm boats of up to 6,500 kg (14,300 lbs) displacement, to the ST4000+ GP which would push the limit up to 9,000 kg (20,000 lbs) displacement.

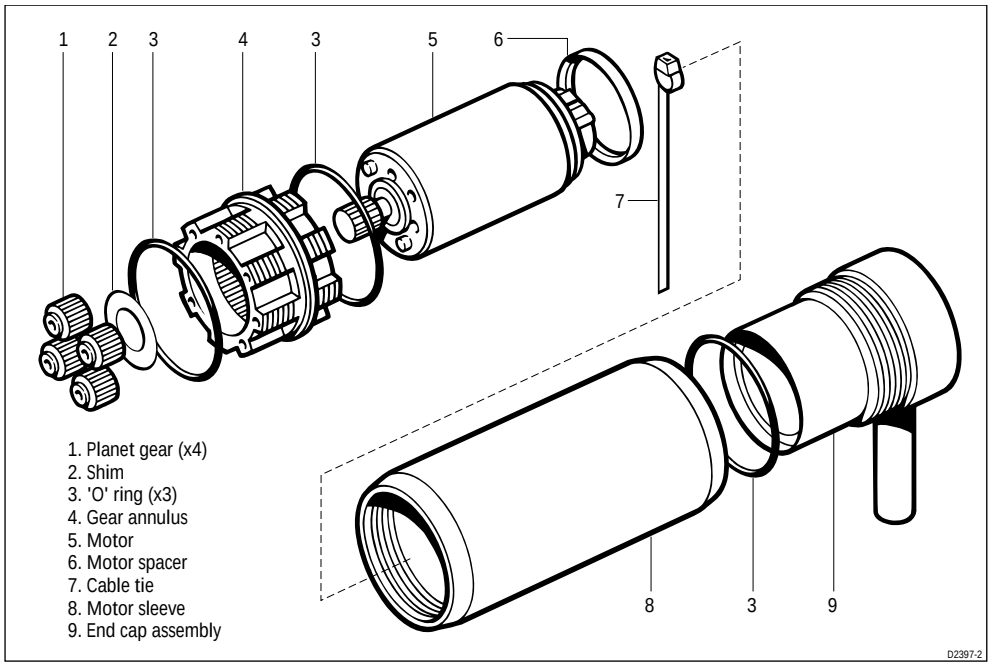


Figure 13. Tiller Drive Actuator GP conversion kit (W003)

Chapter 5: Tiller Drive Actuator GP

5.1 Tiller Drive Actuator GP test

Carry out the passive and active tests detailed in Figure 15. Tiller Drive Actuator GP test flowchart.

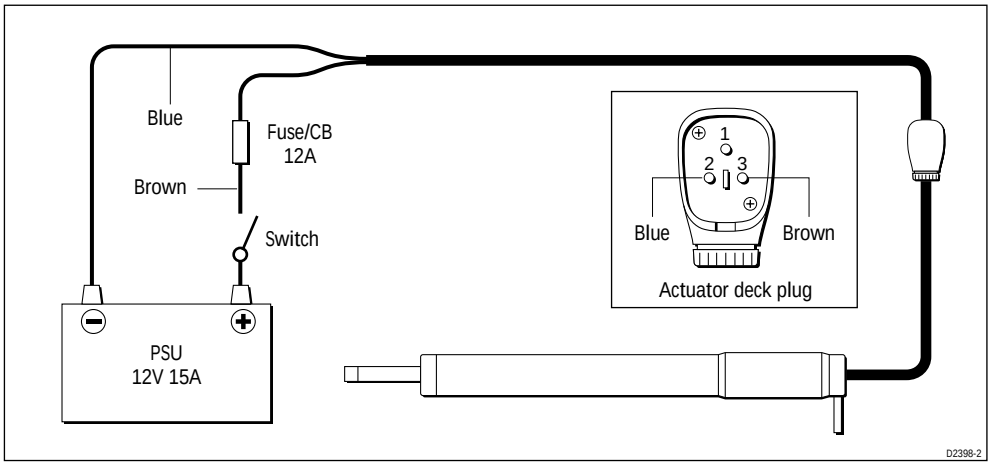


Figure 14. Tiller Drive Actuator GP test connections

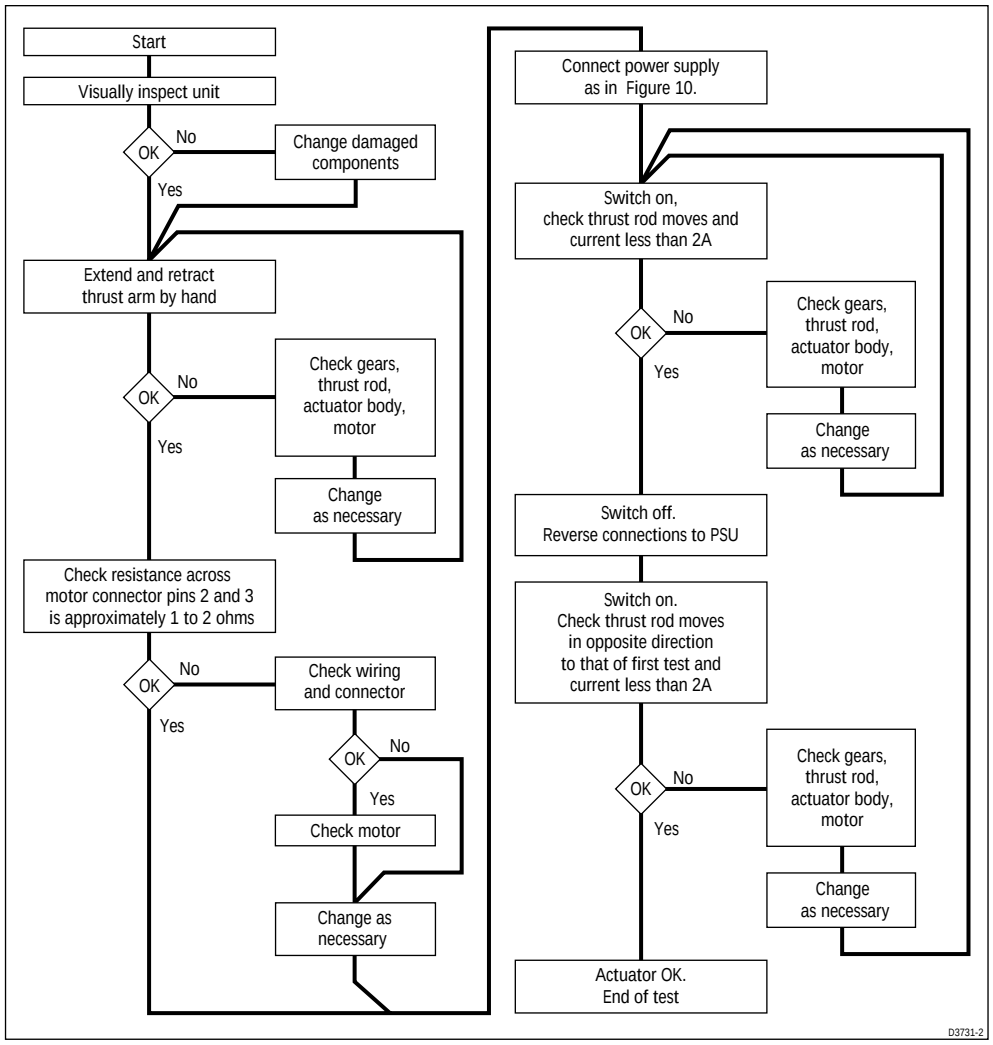


Figure 15. Tiller Drive Actuator GP test flowchart

5.2 Disassembly/assembly

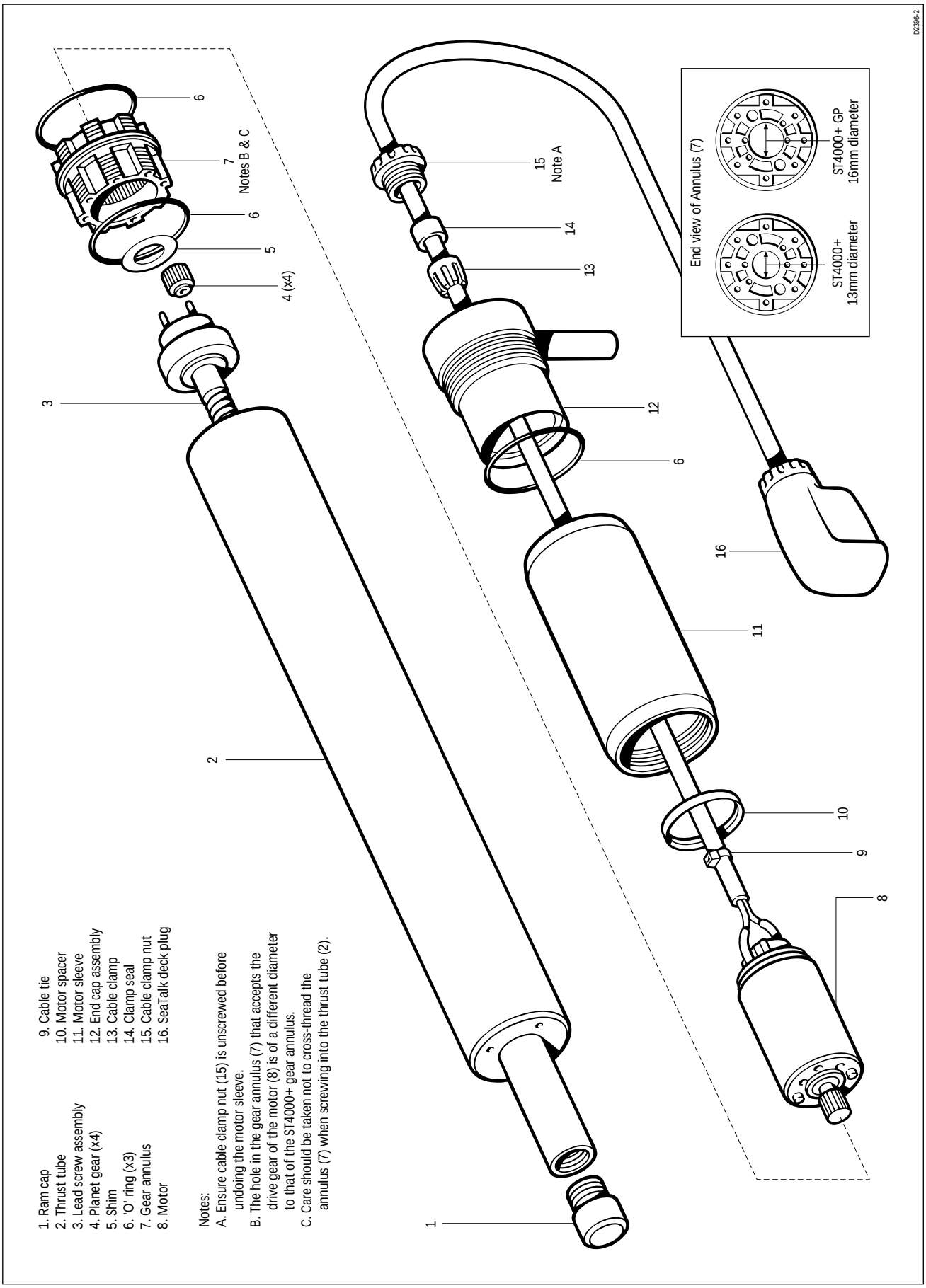


Figure 16. Tiller Drive Actuator GP exploded view

Tiller Drive Actuator GP spare parts list

The item numbers refer to Figure 16: Tiller drive actuator GP exploded view

Item	Spare Description	Part No.	Comments
	Drive module	Q086	Complete drive unit
	ST4000+ GP kit, including	W003	Serves as an upgrade
4	Planet gear (x4)		conversion kit for the
5	Shim		ST4000+ tiller drive
6	‘O’ ring (x3)		actuator.
7	Annulus		
8	Motor		
9	Cable tie		
10	Motor spacer		
11	Motor sleeve		
12	End cap assembly		