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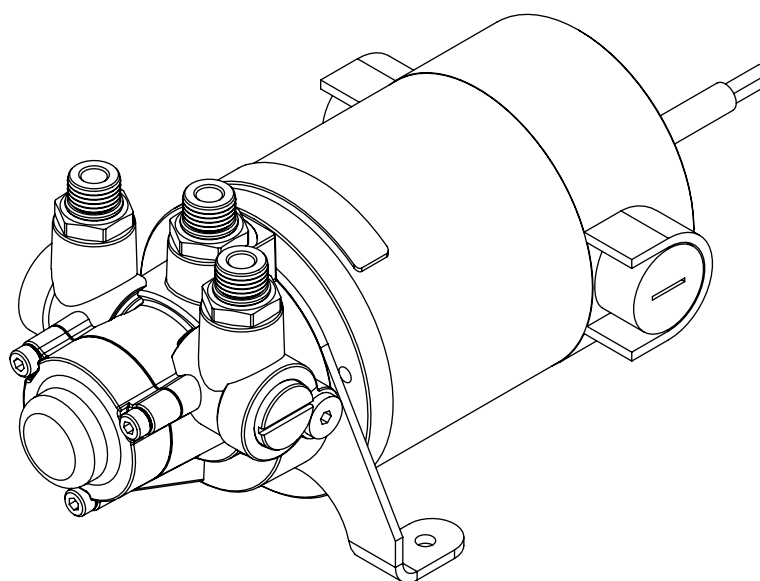
SIMRAD®

B&G®

Reversing Gear Pumps

Installation manual

English



Pump 1 | Pump 2
Pump 3 | Pump 4 | Pump 5

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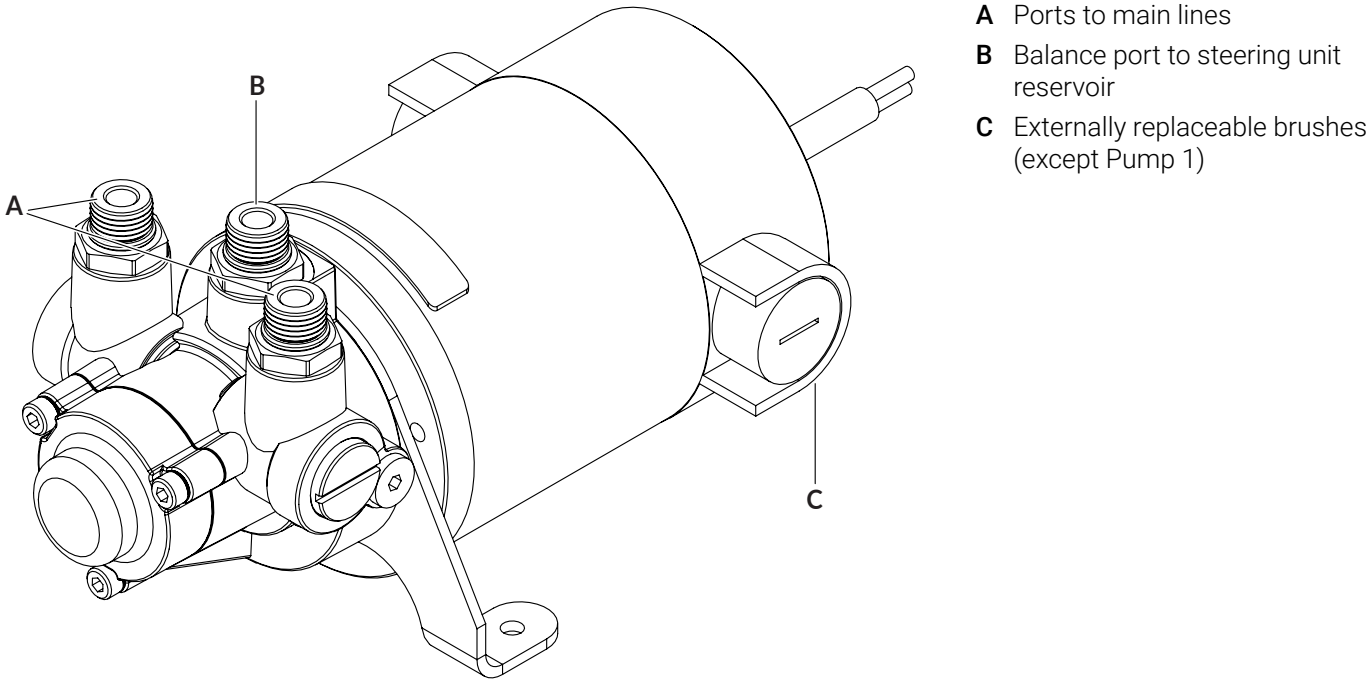
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PUMP FAMILY OVERVIEW

This family of high-efficiency pilot drive gear pumps is available in five models covering nominal flow sizes of: 0.8, 1.6 and 3.0 lpm. The 0.8 and 1.6 lpm sizes come with 12 V motors, while the 3.0 lpm size is available in both 12 V and 24 V. Other than Pump 1, all motors in this family feature externally replaceable motor brushes.

Model	Nominal flow (lpm)	Voltage (V)	Model number
Pump 1	0.8	12	000-11770-002
Pump 2	0.8	12	000-15444-002
Pump 3	1.6	12	000-15445-002
Pump 4	3.0	12	000-15446-002
Pump 5	3.0	24	000-15447-002

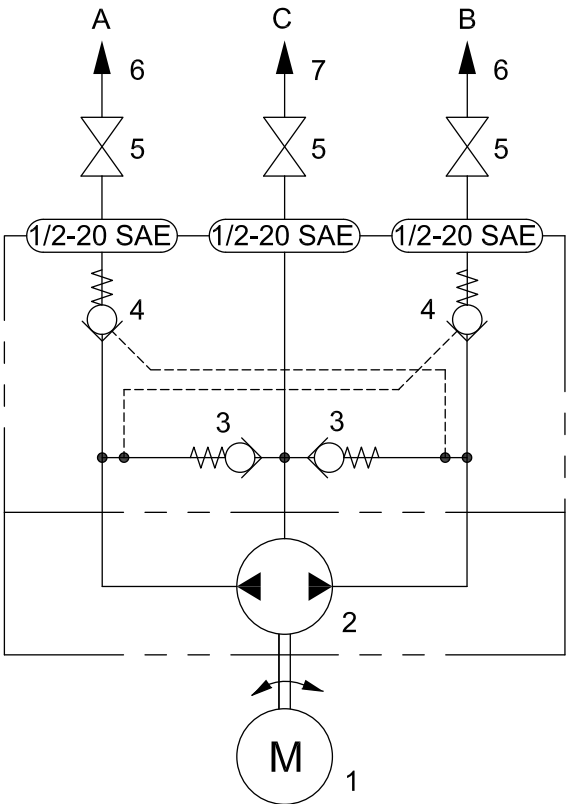


- A Ports to main lines
- B Balance port to steering unit reservoir
- C Externally replaceable brushes (except Pump 1)

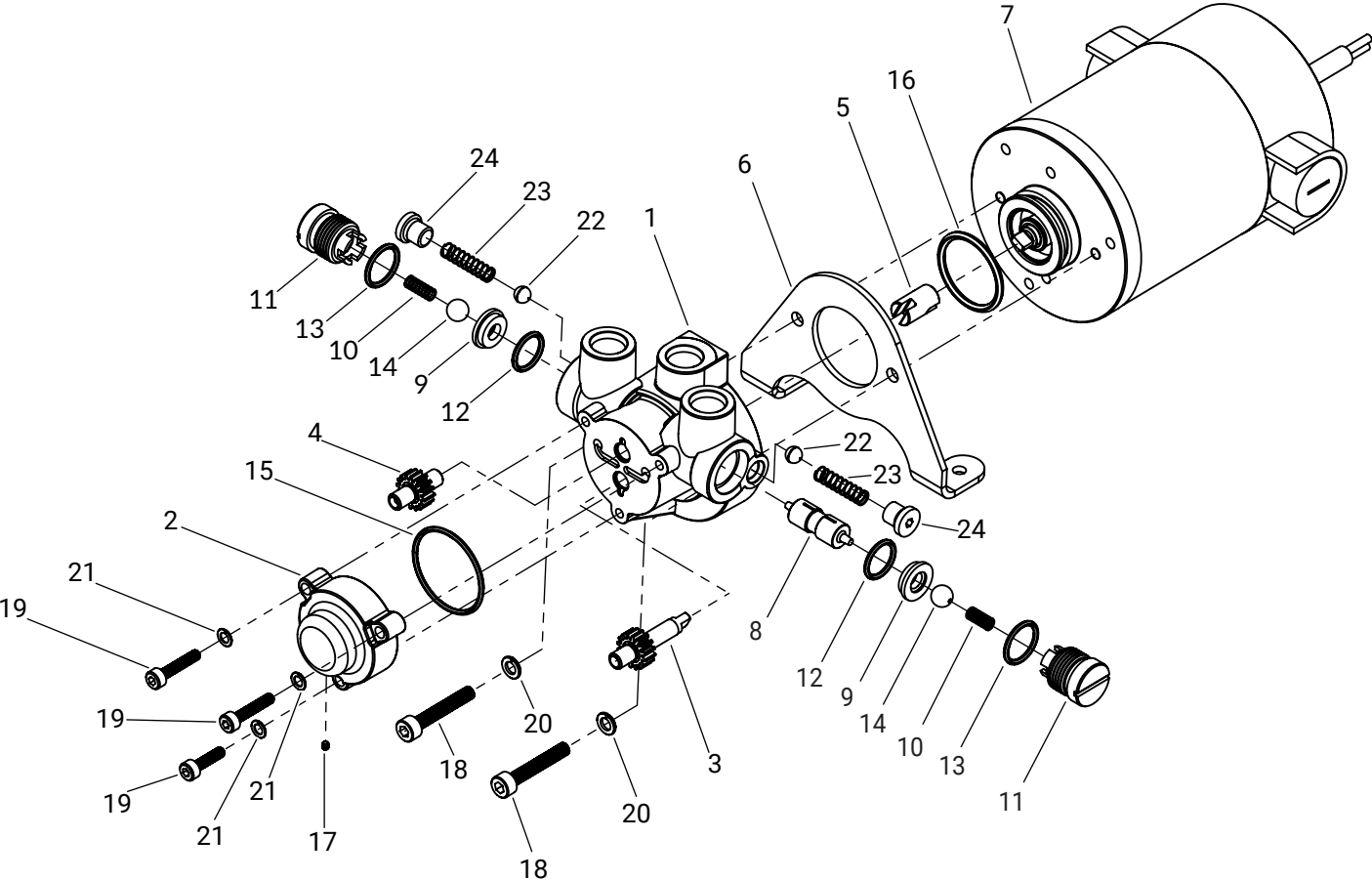
The pumps are reversible and therefore don't need an external direction control valve to change flow direction. All models include integral lock valves to ensure positive load holding. The pumps can only be used with balanced cylinders.

Pump schematic

- 1 DC motor (permanent magnet type)
- 2 Reversible gear pump
- 3 Inlet check valves
- 4 Dual lock valves (non-return valves)
- 5 Stop cocks (not supplied)
- 6 A and B main lines
- 7 Balance line C to steering unit/expansion tank



Gear pump components



Item	Quantity	Description
1	1	Gear pump body
2	1	Gear cap
3	1	Drive gear
4	1	Idler gear
5	1	Drive coupling
6	1	Motor mount
7	1	DC motor
8	1	Pilot piston
9	2	Lock valve seat
10	2	Lock valve spring
11	2	Lock valve body
12	2	O-ring 2-014 nitrile, 70 durometer
13	2	O-ring 2-015 nitrile, 70 durometer
14	2	Check ball
15	1	O-ring 2-026 nitrile, 70 durometer
16	1	O-ring 2-121 nitrile, 70 durometer
17	1	Expander plug
18	2	Cap screw M5-0.8 x 30 (SS)
19	3	Cap screw M4-0.7 x 16 (SS)
20	2	Lock washer #10 (SS)
21	3	Lock washer #8 (SS)
22	2	Inlet check ball
23	2	Inlet spring
24	2	Plug

PUMP SELECTION

When sizing a pump for an autopilot application, consider the following:

- This pump family works only with balanced cylinders.
- Match the motor voltage to the supply voltage from the autopilot course computer.
- Size pump considering both the steering cylinder size and vessel/autopilot manufacturer’s recommended rudder Hard Over to Hard Over (HO to HO) time. See chart below.
- Rudder HO to HO speed usually falls within 9-15 seconds.

Pump selection chart for optimum performance

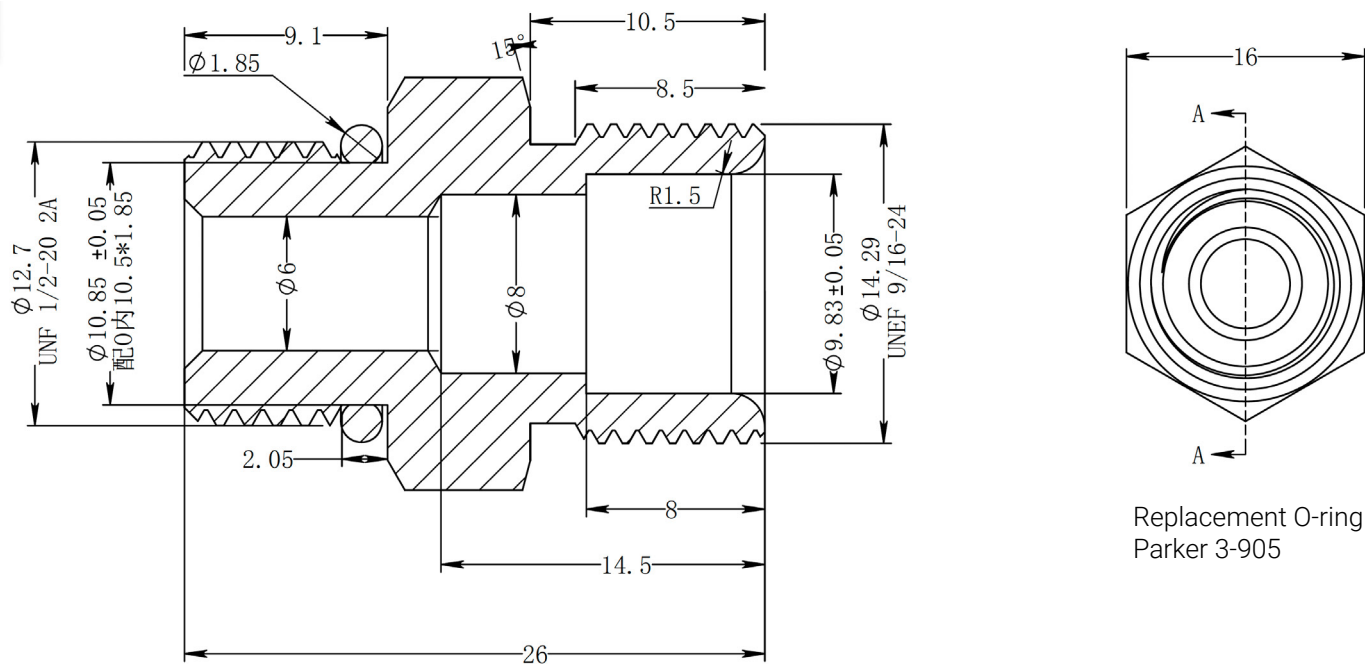
➔ *Note: Pumps will work with cylinders outside these ranges, but HO-to-HO time will fall outside optimum ranges.*

Model	Flow (lpm)	Voltage	Steering RAM displacement cm³ (cu. in)																	
			98	131	164	197	230	262	295	328	361	394	426	459	492	525	558	590	623	656
			(6)	(8)	(10)	(12)	(14)	(16)	(18)	(20)	(22)	(24)	(26)	(28)	(30)	(32)	(34)	(36)	(38)	(40)
Pump 1	0.8	12		9-15 seconds HO to HO																
Pump 2	0.8	12		9-15 seconds HO to HO																
Pump 3	1.6	12						9-15 seconds HO to HO												
Pump 4	3.0	12												10-15 seconds HO to HO						
Pump 5	3.0	24												9-14 seconds HO to HO						

PUMP PREPARATION

Port connections

The three female ports on the pump body are ½-20 SAE (-05 ORB). Each pump kit also includes 3x adapter straight: ½-20 male SAE (-05 ORB) x 9/16-24 male (3/8” tube style).



The two outer ports on the pump body connect to the main steering lines through an appropriate T-connection. The middle port connects to the rear reservoir port of the primary helm or to an external expansion tank if fitted.

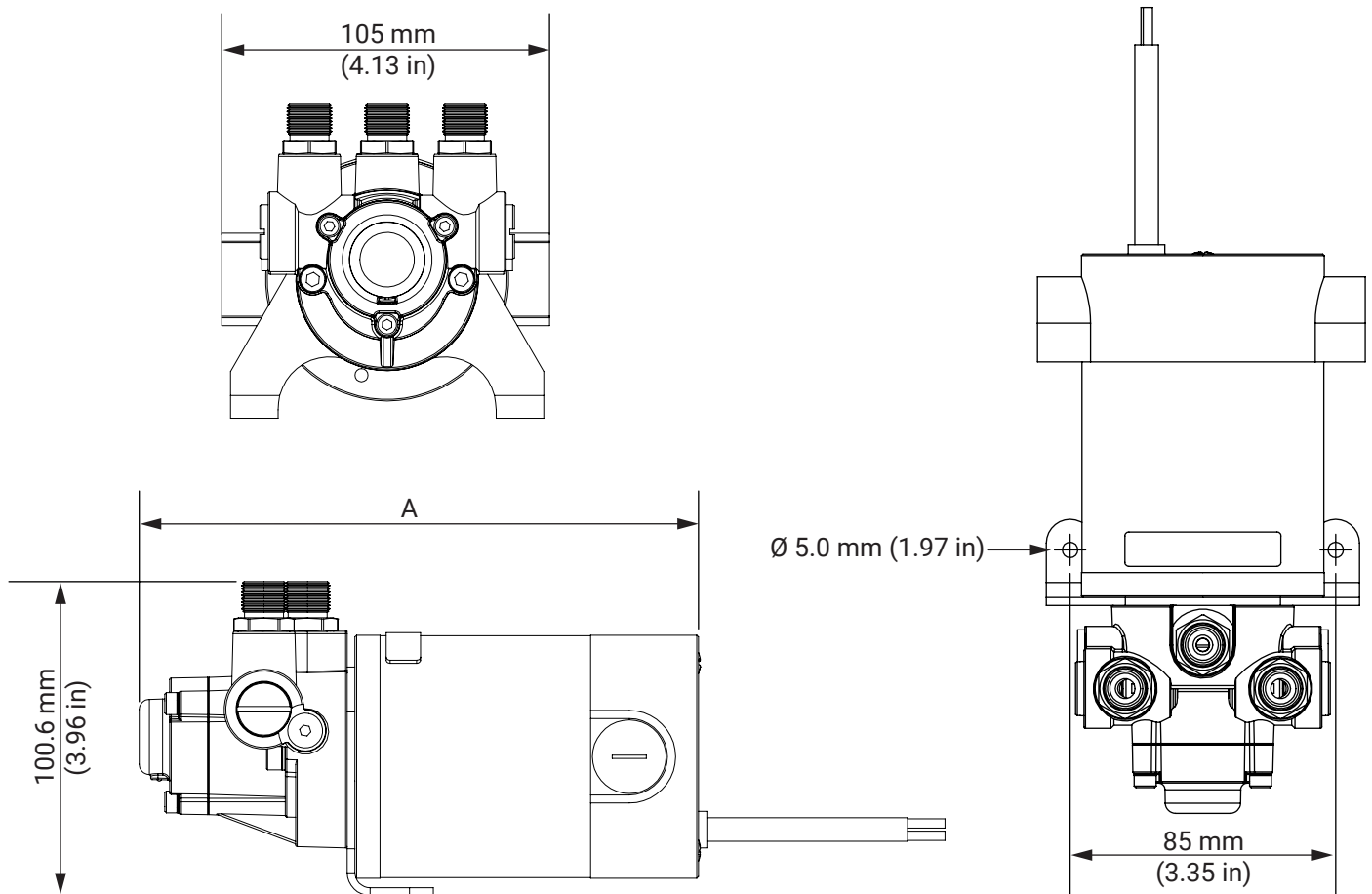
To assemble the SAE ORB fittings into pump ports:

- 1 Inspect the port and connector threads to ensure they are free of dirt, burrs etc.
- 2 Lubricate the fitting O-ring with oil and install the fitting into the pump. Tighten to torque 17 Nm (12.5 ft-lb).

MOUNTING

The pump must be located at a level lower than the helm pump. It can be mounted in any orientation. Care should be taken to ensure the reservoir hose runs in an upwards path towards the helm pump reservoir connection with no loops or dips. The main steering lines should run as directly and neatly as possible.

Pump dimensions



- A** Length of pump
- Pump 1: 168 mm (6.61 in)
 - Pump 2: 179 mm (7.04 in)
 - Pump 3: 194 mm (7.63 in)
 - Pump 4: 214 mm (8.42 in)
 - Pump 5: 214 mm (8.42 in)

Hydraulic connections

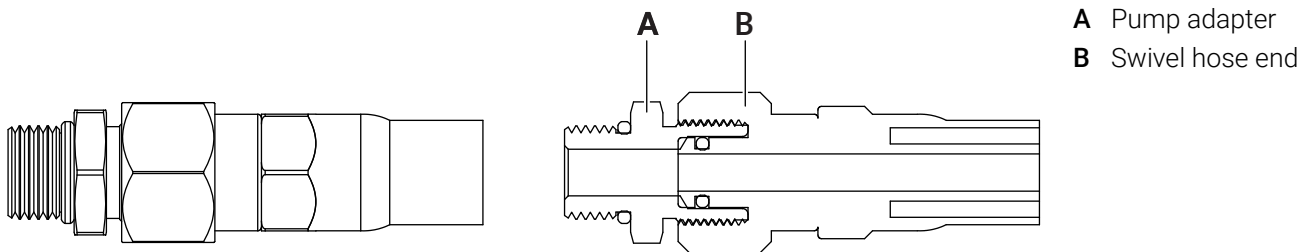
- 1 The two outer ports on the pump unit must be connected using T-connectors to the main steering lines that run from the steering unit to the steering cylinder. Use flexible hoses from the rigid tubing to the steering cylinder to accommodate cylinder motion.
- 2 The middle port on the pump is the balance line which must be connected to the reservoir associated with the steering unit. This is either a separate pressurized reservoir or the steering unit itself. There is usually a port on the bottom of the steering unit. If there are two steering units, use the most convenient.
- 3 To reduce noise transfer from the pump to the vessel structure and tubing fatigue, it is recommended to use hose connections from the pump to the rigid piping.

Recommended tube material:

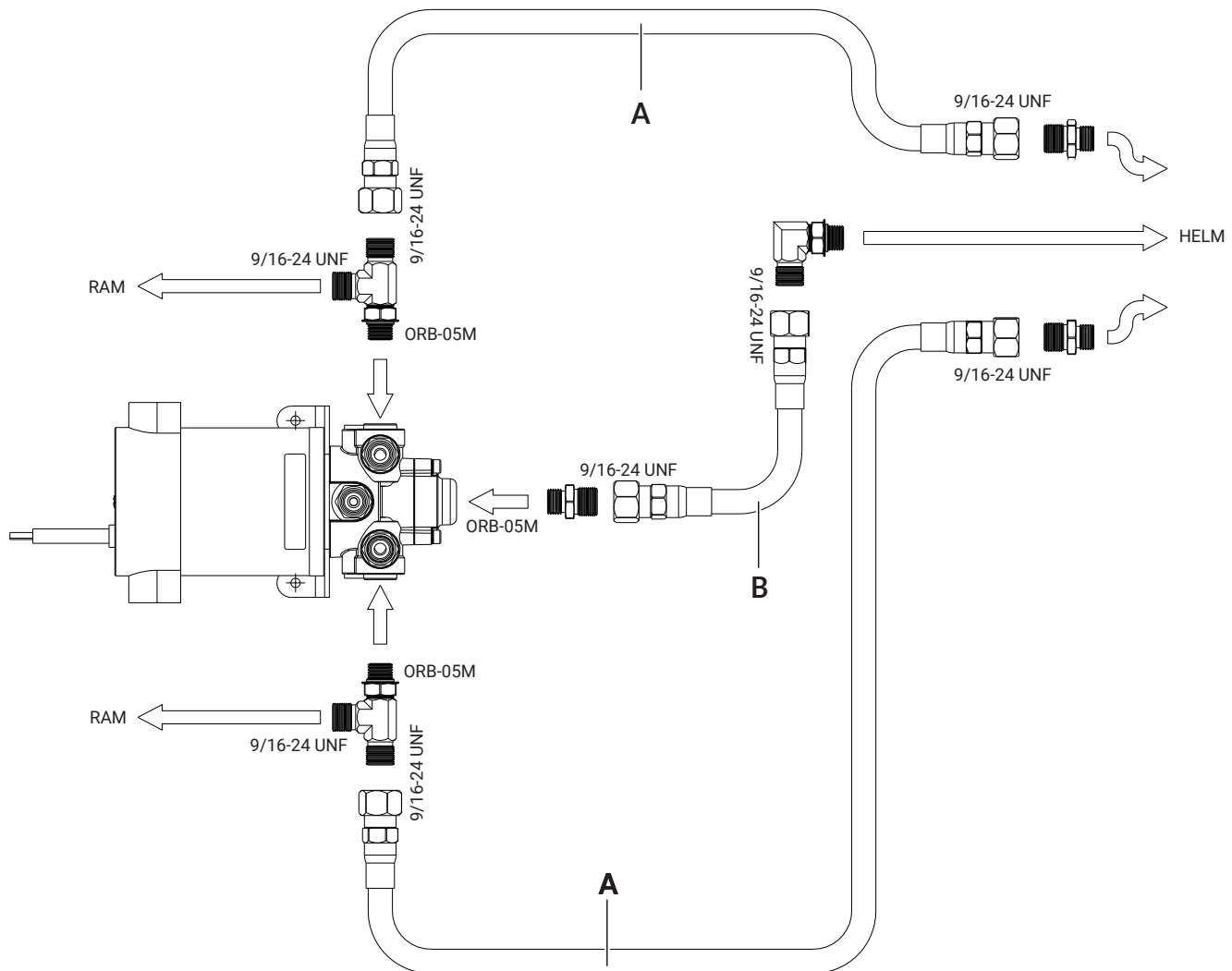
- North American: Ø 3/8" OD Annealed Copper – Type L ASTM B88, 0.030" min wall.
- European: Ø 10 mm OD Annealed Copper – BS EN 12735-1:2001, 0.8 mm min wall.

- 4 If making tubes, it is important to prepare the tube ends correctly to ensure a leak-free installation. Consider the following recommendations:
- Cut tube squarely within $\pm 1^\circ$.
 - Do not use an abrasive cutting wheel as this can introduce contamination into the tube.
 - De-burr both the ID and OD of the tube end.
 - Clean each tube with compressed air.
- 5 A swivel hose end is needed to connect to supplied fittings. Common name is "3/8 female tube connection". The female hose swivel thread callout is 9/16"-24 UNEF-2B.

Pump fitting to hose connection



Typical hydraulic installation



A 750 mm black hose 5/16"

B 750 mm clear hose 5/16"

⚠ WARNING: Ensure the existing hydraulic system has non-return/lock valves (check with the steering system manufacturer). If it doesn't, then suitable valves must be fitted. Most modern steering systems include non-return valves.

Electrical connections

Correct sizing of cable is important for optimal pump performance. See the chart below for suggested wire sizing. Do not compromise pump performance by using undersized cables. Ensure all electrical connections are properly made.

Model	Flow (lpm)	Voltage	Typical current (A)	Peak current @ 50 bar	Suggested min. wire size
Pump 1	0.8	12	4-7	11	AWG 12 (4.0 mm ²)
Pump 2	0.8	12	4 -7	11	AWG 12 (4.0 mm ²)
Pump 3	1.6	12	8 -14	22	AWG 10 (6.0 mm ²)
Pump 4	3.0	12	10-20	30	AWG 8 (10 mm ²)
Pump 5	3.0	24	6-10	15	AWG 12 (4.0 mm ²)

Bleeding the system

It is important to bleed the hydraulic lines system once the pump is installed and plumbing connections are complete. If there is any air left in the system, the steering will feel unresponsive. Excessive air will also reduce pump performance and increase pump noise.

The electrical components (course computer/control head) must be installed and the pump connected in order to use the pump during the bleeding procedure.

The system reservoir must be full of hydraulic fluid before starting this procedure and this level must be maintained during the procedure. See the steering system manufacturer's guide for the exact procedure for your steering system. (Note: this can vary depending upon the type of steering cylinder that is fitted).

Stage 1 –Purge the lines using the pilot pump

- 1 Using the autopilot control head, run the pump in one direction to fully extend the steering cylinder.
- 2 Using the autopilot control head, run the pump in the opposite direction to fully retract the steering cylinder.
- 3 Repeat the above steps 2-3 times. If the pump does not pick up, re-check the fluid level in the steering unit and confirm the balance line has no dips that could trap air. It may also help to turn the wheel on the steering unit clockwise and counterclockwise to help fill the lines.

Stage 2 – Purge the steering unit through to the steering cylinder

The type of steering cylinder will dictate the specific procedure for this operation. See the steering system manufacturer's purging guide. What follows is a generic guide to the steering cylinder bleeding process.

- 1 With steering unit full of oil, turn the steering wheel clockwise until the cylinder rod is fully extended. Open the air bleeder on the side of the cylinder that is extended.
 - 2 Hold the cylinder rod to prevent it from retracting while simultaneously turning the steering wheel slowly in the counterclockwise direction. Observe the stream of oil exiting the bleeder fitting. Note: It is easier to do the procedure with an appropriately sized clear vinyl bleeder tube attached to the bleeder fitting. Continue turning the steering wheel until the steam of oil is steady and free of air. It is important to keep the reservoir topped up with oil while doing this step.
 - 3 Close the bleeder and turn the steering wheel counterclockwise until the cylinder rod is fully retracted. Open the air bleeder on the side of the cylinder that is now fully retracted.
 - 4 Hold the cylinder rod to prevent it from extending while simultaneously turning the steering wheel slowly in the clockwise direction. Observe the stream of oil exiting the bleeder fitting. Note: It is easier to do this procedure with an appropriately sided clear vinyl bleeder tube attached to the bleeder fitting. Continue turning steering wheel until the stream of oil is steady and free of air.
- **Note:** The clockwise rotation of the steering wheel may result in the cylinder retracting rather than extending. In this case, use opposite bleed screw on the cylinder. The goal of the procedure is to bleed from the side of the cylinder that has its oil volume at minimum thus ensuring there is no trapped air left in the cylinder.

Stage 3 – Oil level and system check

At this time, the steering system must be checked for proper connections of all hoses and fittings and for air removal. To do so, turn the steering wheel and pressurize very hard to port. Apply enough force to the wheel to exceed the pressure relief valve setting. You will not harm the system.

While pressure is maintained on the steering wheel, check all port fittings and line connections for leaks. If no leaks are obvious, your steering system is ready for use. If leaks are found, they must be corrected.

Repeat this procedure for the starboard lines. Watch the oil level in the helm pump when the steering reached both hard over positions. If there is no obvious drop in the oil level, the air has been removed. If there is an obvious drop in oil level, you are compressing air and further purging is required. Repeat **Stage 2 – Purge the steering unit through to the steering cylinder**.

TROUBLESHOOTING

If the unit fails to operate after installation is complete, check for the following common causes:

Motor does not run

- No voltage applied to motor – Action: Check voltage with voltmeter.
- Autopilot not switched on correct setting – Action: Check autopilot manual.

Motor runs but pump does not move the rudder

- System not filled with oil – Action: Top up with oil and purge system.
- Hydraulic connections incorrect – Action: Check that both steering ports and balance line are connected as per diagram on page 5.
- Balance line to helm has air pocket – Action: Ensure there are no dips in line that can trap air.
- Steering Unit is non-vented – Action: Ensure that upper most steering unit on vessel has vented cap.

Hard over to hard over time is excessive

- Low voltage to motor – Action: Confirm wire size to motor is correct.
- Pump undersized for steering cylinder – Action: Select larger pump.

