20/8/2016

TWIN DISC

MCD - Marine Control Drive

Catalogo MCD | TWIN DISC

TABLE OF CONTENTS

1. *INTRODUCTION*

TWIN DISC has accumulated three quarters of a century of experience in the design and the production of marine transmissions.

One of the latest developments is the **MARINE CONTROL DRIVE** or **MCD** which is a variable speed drive available in a range of sizes with power capacity from **160 to 3800 kW** (218 to 5200 HP) at 1500 rpm.

The **MCD** has proven its worth particularly in tug applications but also in purse seiners, ice breakers and dredgers.

The system provides distinct operational advantages for any vessel requiring accurate positioning or a high degree of slow speed maneuverability whilst the main engine powers another action.

The **MCD** has reached its present high level of development through continual research since the **MODULATED CLUTCH** concept was first launched by **TWIN DISC** over 30 years ago. It started life as the trolling valve, originally for the Pacific fishing industry. It has progressed through the **OMEGA CONTROL VALVE** to the Marine Control Valve itself. There are three sizes with five models maximum for each size to cover the range up to 4500 kW. The very latest developments include changes to the clutch on the very largest model enabling it to transmit 3000 kW with full modulation without any restriction.

2. *DESCRIPTION*

The **MCD** consists of a modulated clutch with slip control. To protect the unit from the wearing, a continuous oil flow is fed between the friction discs during the slipping phase; there is no contact between the friction elements.

The torque is transmitted by viscous friction using the shear strength of an oil film, varying its thickness. Full engagement can be achieved and the highest efficiency of the unit is then obtained due to the fact that input and output speeds are synchronized.

The control pressure is not directly applied on the piston acting on the friction discs, it is applied on a centrifugal regulator called the **OMEGA VALVE**. The omega valve turns with the output shaft of the **MCD.** The Omega Valve varies the applied clutch pressure to maintain a constant output speed irrespective of variations of load on the output shaft, and/or variations of input speed.

The control is based upon output speed levels, not output torque levels as in normal clutches.

The **MCD** is provided with integral sump, oil pumps for control and lubrication, oil filter and control valve.

2.1. ADVANTAGES & POSSIBILITIES

Improved vessel capabilities

Fishing Trawlers: Lower propeller speed allows faster haul-in of main nets. Higher engine speed provides faster gypsy operation and fish bag lift-out. Better try-net performance.

Purse Seiners: Excellent control of propeller thrust. Fast propeller response when needed. Drive fish loading pump from propulsion engine.

Lobster Boats and Crab Boats: Very low propeller speed, as needed, for "holding on-station" while raising or lowering pots.
Drive hydrostatic pump from propulsion engine.

Crew Boats, Tugs, Tow, Fishing Boats, Fire-Fighting Boats, Supply Vessels, Ocean Research Crafts, Ferries, etc.: Maneuver, "hold-on station" and dock with greater ease and safety at any engine speed.

Features

- Power dividing capability from main propulsion engine.
- Adjustment of propeller speed below low engine idling speed.
- Smooth and gradual propeller speed change resulting in greater maneuverability.
- Instant response when needed.
- Possibility of Dynamic Positioning.
- Overload protection for propeller and engine.
- Power Take Off available to drive auxiliary equipment.
- Emergency-come home devices.
- Lubrication of bearings, gears and of the clutch by 100% filtered oil under pressure.
- Oil cooled clutch.
- Bearings calculated for Cardan shaft angles up to 12 ° at maximum power.
- Step up or reduction gear on request.

2.2 TWO MARINE TRANSMISSIONS IN ONE

Fixed ratio - The **MCD** transmissions perform as a fixed ratio drive when continuously under way.

Variable ratio - For powering other vessel actions such as maneuvering, docking, hydraulic pumps, bilge pump, generator, etc., the **MCD** transmission will perform as a variable ratio unit.

The engine throttle lever controls auxiliary driven loads.
The MCD lever controls propeller speeds.
For example, an engine-driven fire-fighting pump could be operated at full capacity while the boat is readily maneuvered at any needed propeller speed.

3. *PRODUCT RANGE & MODEL SELECTION*

There are three basic models: MCD 400, 1000, and 3000. Each model has a maximum of five capacity ratings and a maximum input speed of 3000 rpm. As soon as the input does not exceed 2000 rpm, then the MCD model selection can be made by using the selection table here below.

LD UNITS	HD UNITS
MODULATION POSSIBLE ONLY UP TO ENGINE IDLE SPEED	**FULL MODULATION UP TO MAX ENGINE SPEED**
Selection is made by dividing the absorbed power in kW by the maximum engine speed	**Selection is made by checking the KW/RPM Ratio and the *heat dissipation in kW.***
	Heat Dissipation = Max Power x 0.15

MODEL	*KW/RPM*
400-1	0.13
400-2	0.16
400-3	0.19
400-4	0.23
400-5	0.27
1000-1	0.33
1000-2	0.41
1000-3	0.50
1000-4	0.59
1000-5	0.68
3000-1	0.84
3000-2	1.00
3000-3	1.33
3000-4	1.67
3000-5	2.00
3000-6	2.55
3000-7	2.55
3000-8	2.55
3000-9	2.55

MODEL	*kW dissipation*
400-1	60
400-2	60
400-3	60
400-4	60
400-5	60
1000-1	70
1000-2	90
1000-3	110
1000-4	130
1000-5	145
3000-1	150
3000-2	160
3000-3	170
3000-4	180
3000-5	200
3000-6	225
3000-7	300
3000-8	375
3000-9	450

EXAMPLE: **Engine rating: 1450 kW @ 1000 RPM**

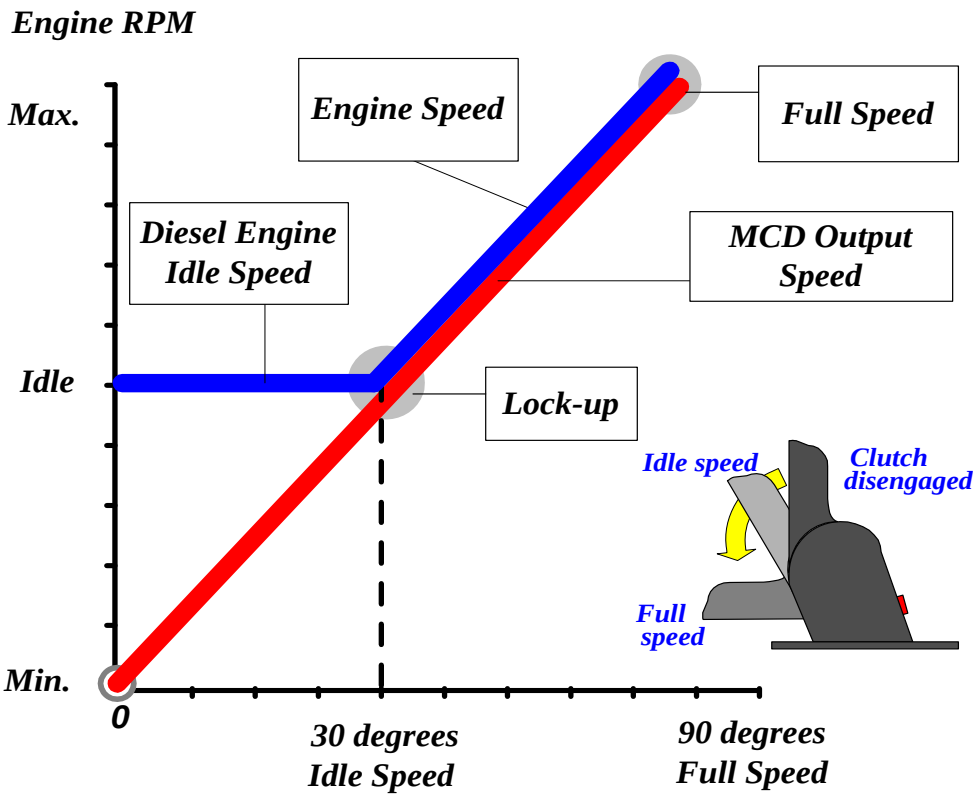
LD MCD SELECTION: **1450 / 1000 = 1.45** **MCD 3000 – 4 LD**

HD MCD SELECTION: **1450 x 0.15 = 217.5 kW** **MCD 3000 – 6 HD**

4. DUTY RATINGS

4.1. LIGHT DUTY

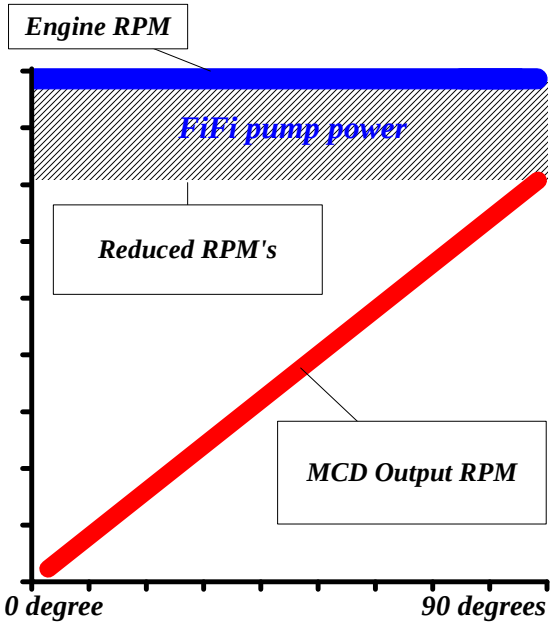
LD means that modulation is only required when the engine is at idle speed. A **LD** unit can dissipate (clutch heat rejection) **a maximum of 30 kW.** As the heat to be dissipated into the clutch is maximum of 15% of the transmitted power at lock-up condition, the power absorbed by the propeller at idling speed has to be below: 30/0.15 or 200 kW.

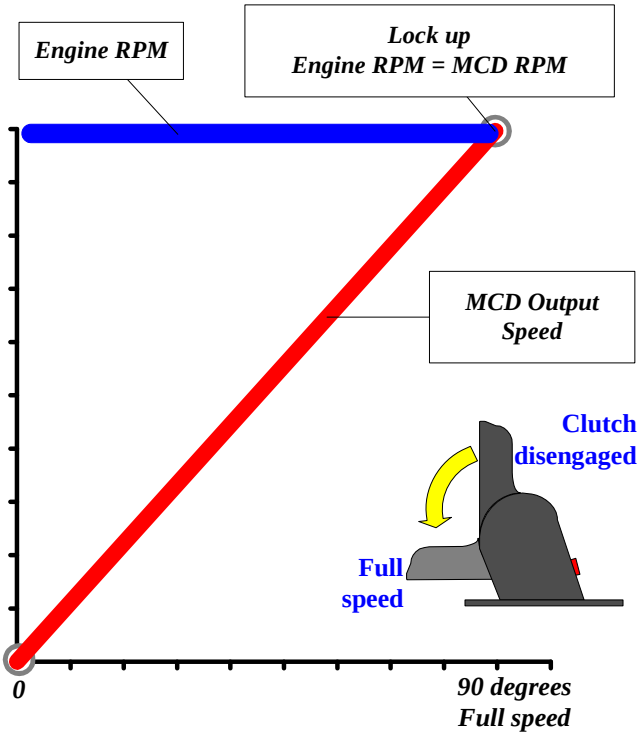


Engine Speed RPM	MCD Output RPM	Joystick Angle Degrees
450	0	0
450	90	10
450	180	15
450	270	20
450	360	25
450	450	30
500	500	40
600	600	50
700	700	60
800	800	70
900	900	80
1000	1000	90

4.2. HEAVY DUTY

HD means that modulation is requested when engine speed is at full speed or if the prime mover is an electric motor. Then the heat to be dissipated into the clutch of the MCD is maximum of 15 % of the propeller absorbed power when driven at prime mover speed.





Engine Speed RPM	*MCD Output RPM*	*Joystick Angle Degrees*
1000	0	0
1000	100	10
1000	200	20
1000	300	30
1000	400	40
1000	500	50
1000	600	60
1000	700	70
1000	800	80
1000	1000	90

5. MCD INSTALLATION

5.1. MOUNTING PADS

Nowadays, metal chockes are less and less used and the use of synthetic cast resin is more and more adopted for the installation of the **MCD's** on their foundation. Furthermore, this kind of arrangement reduces the noise and the vibrations whilst in operation. **TWIN DISC** is not responsible for the workman of the execution of the cast resin bedding.

Nevertheless, the alignment of the **MCD** in relation with the shafting has to be realized in the same way as when bedding the **MCD** on steel chockes and should be done in accordance with our installation prescriptions and in accordance to the flexible coupling manufacturer recommendations.

Commonly used cast resin: **CHOCKFAST ORANGE PR610 TFC MANUFACTURED BY PHILADELPHIA – RESINS.**

Mounting screws are not provided by **TWIN DISC** and we recommend therefore the use of the following material:

- Steel grade requested is : **8.8**
- Min. length is : **According to the bedding thickness**
- Size : **M 24**
- Quantity of screws : **6**
- Mounting torque : **644 Nm**

5.2. ALIGNMENT

The **MCD** is basically designed for horizontal mounting. Inclinations of ± 15 % are acceptable to accommodate sea conditions.
As a guide it can be mentioned that a final alignment check should not produce greater **parallel** misalignment than **0.005 – 0.1 mm** or an **angular** misalignment exceeding **0.005 – 0.1 mm** per 100 mm measured length.

5.3. VIBRATION LEVEL

Vibrations (Horizontal & Vertical) must be limited to a maximum of 12 mm/Sec. Vibration sensors are optional and can be provided with the unit upon request.

5.4. CARDAN SHAFT INCLINATION

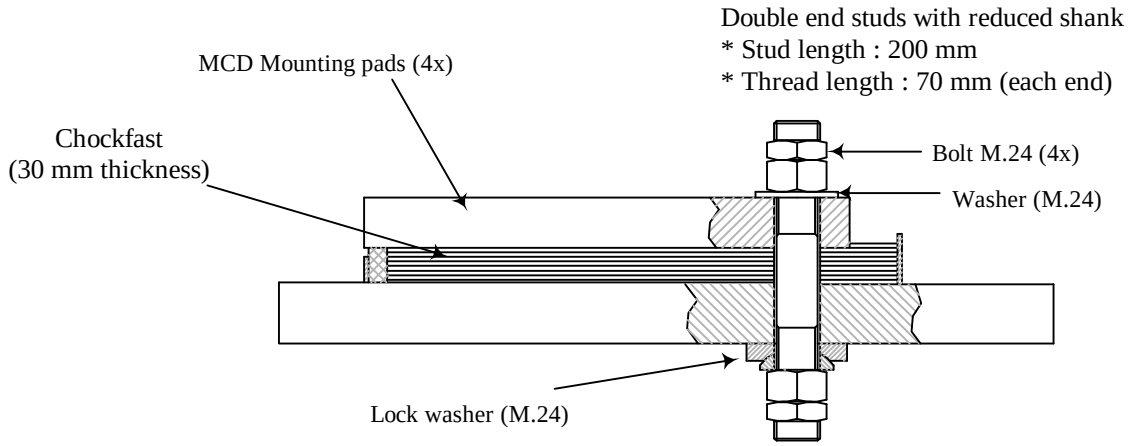
The **MCD** input and output shafts are provided with high quality conical bearings. They are mounted on "tête bêche" by two. Such bearings are foreseen to sustain both directions stresses from a Cardan shaft angle up to 12° under nominal speed of 1500 rpm and maximum transmissible power of each model (MCD1000 & MCD 3000). For each model, bearing life are minimum of 20 000 hours.

5.5. MCD THERMAL EXPANSION

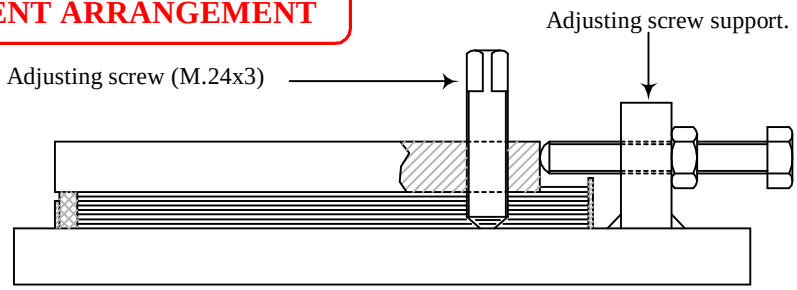
From 20°C up to 80°C (Δt = 180°F)

Length: 0.7 mm max
Height: 0.4 mm max

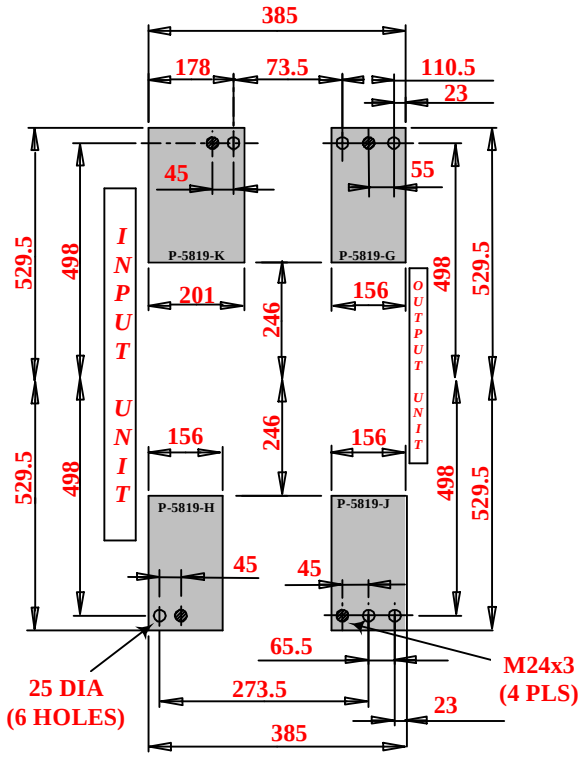
PADS MOUNTING ARRANGEMENT



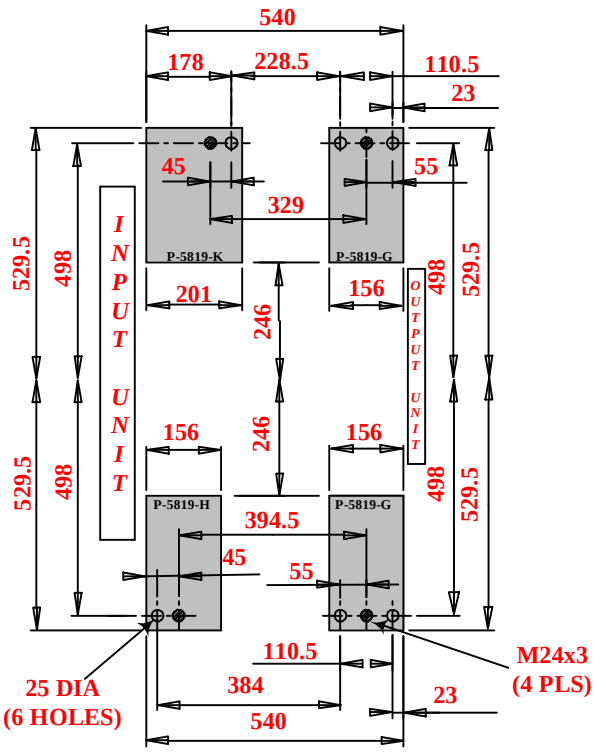
UNIT ALIGNMENT ARRANGEMENT



TOP VIEW OF MOUNTING PADS



MCD - 1000



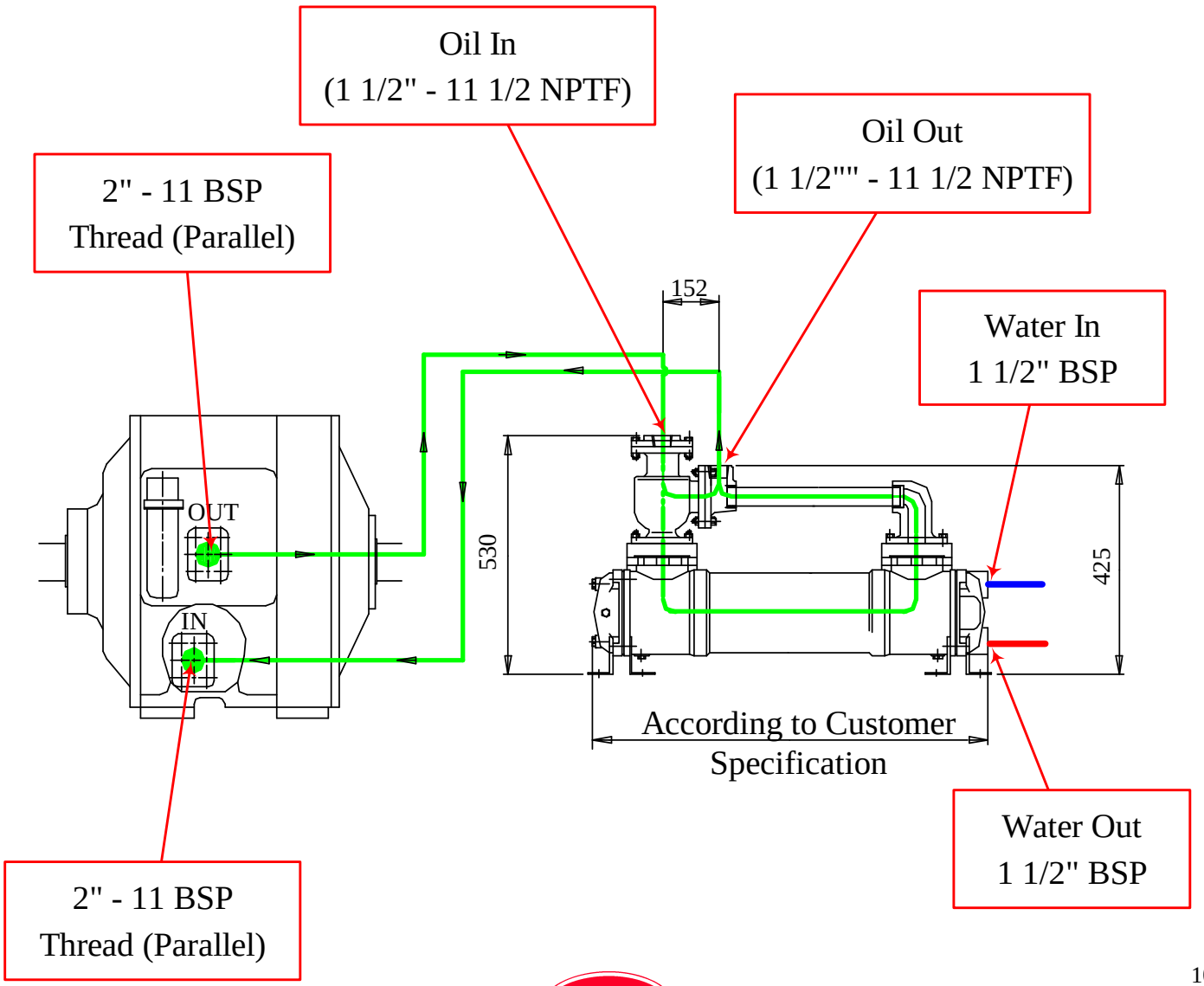
MCD - 3000/1=>/6

6. COOLER INSTALLATION

Drawings: PX 9195 Series Heat Exchanger Requirements
PX 9185 Series Heat Exchanger Installation & Cooler assembly

Cooler Recommendations:

- Cooler is provided on request either for sea water or for fresh water
- Cooler is equipped with thermostatic valve assuring a constant **MCD** operating oil temperature between 71°C and 85°C (160°F and 185°F)
- Water pressure inside the cooler must be limited to a maximum of 5 Bar
- Piping between the cooler and the unit is not provided by **TWIN DISC**
- Cooler installation dimensions are according to customer specification
- **TWIN DISC does not** recommend to mount the cooler in a vertical position
- **TWIN DISC does not** recommend to install the cooler more than 1 meter higher than the top cover of the **MCD**
- Water pressure drop should be limited at 0,05 Bar
- Max. allowable pressure drop : 0,07 Bar across Heat Exchanger & Hoses



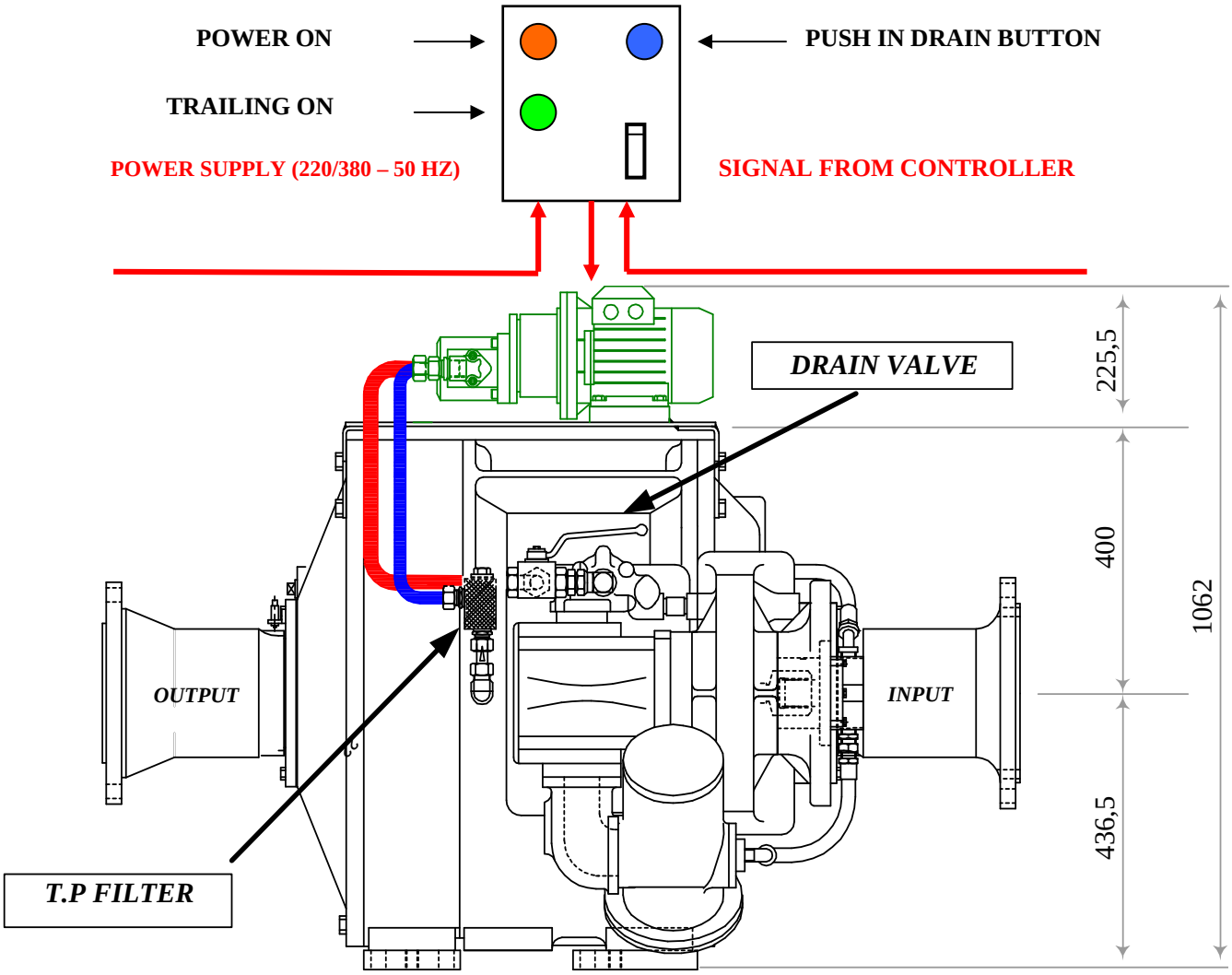
7. TRAILING PUMP GROUP INSTALLATION

Role of the Built-in Trailing Pump:

Lubricate the clutch plates and the bearings whilst the main engine is stopped and the **MCD** output shaft is back-driven for speeds over 50 rpm. The sequence for the start-up and the shut down of the trailing pump is totally directed by the electronic controller.

Features:

- The T.P is also used now to drain the oil from the unit. During this mode, the main engine must be stopped, the drain valve lever must be in the **DRAIN** position (refer to drawing PX 11050 A), and the blue push button located on the trailing pump starting box must be in the pushed in position during this operation.
- Direction of rotation of the trailing pump must be checked and corrected if necessary during the MCD commissioning.
- The power supply of the electric motor varies with customer's specification. Please refer to the name plate located on the front door of the trailing pump starting box (0,75 HP, IP 54, 220-380 VAC-50 Hz). Other voltages are available upon request.
- T.P Starting box dimensions: 250 x 150 x 300 mm



8. OIL RECOMMENDATIONS

The fluid must be an ATF and SAE 10 W type and certified to be a Caterpillar TO-2 or Allison C-3 transmission fluid specification.

8.1. OIL SUMP CAPACITIES

Oil sump capacity is dependent on the necessary oil flow for heat dissipation of each duty (LD / HD). Nevertheless, standard capacities are:

- MCD 400 55 Liters
- MCD 1000 75 Liters
- MCD 3000 / 1 till 6 90 Liters
- MCD 3000 / 7 till 9 310 Liters

(They have to be raised by piping and cooling capacity).

8.2. COMMONLY USED OILS

PRODUCER	OIL REFERENCE
SHELL	DONAX TA
SHELL	DONAX TM
SHELL	**DONAX TD**
SHELL	ROTELA
CASTROL	CASTROL TQ DEXRON II
CASTROL	CASTROL TFC 310
CASTROL	CASTROL TQ D
MOBIL	ATF 220
ESSO	ATF DEXRON II (GM TYPE)
ESSO	**ESSO TORQUE FLUID 56**
BP	AUTRAN MBX
TEXACO	TEXAMATIC 4261
TEXACO	AUTOMATIC TRANSMISSION FLUID DEXRON II
TEXACO	**TEXTRAN TDH PREMIUM**
CPC	LB55176 LO
Q8	AUTO 14
ELF	ELFMATIC G2
UNIL	UNIL MATIC DEXRON II D

8.3. OIL CHANGE INTERVALS

Every 3000 hours for any **MCD** model or once a year whatever come first. At the same time, filter element must be changed; strainer and air breather must be cleaned. Oil filter elements cannot be cleaned and have to be replaced when draining oil or when clogging indicator is showing.

9. SAFETY DEVICES

Standard control is electrical. The servo-valve can be controlled manually in the event of electrical failure and if there is hydraulic failure, the **MCD** is provided with an **Emergency "COME HOME" device.** This consists of a set of three screws which can be engaged whilst the unit is stationary to mechanically lock the clutch. Bearing temperatures require constant monitoring whilst operating the "Come home" feature. Engine must be limited to half of the nominal speed during this operation.

10. CLASSIFICATIONS

11. THE ELECTRONIC CONTROLLER

By controlling the hydraulic pressure in the clutch, the **MCD** provides a closed-loop speed control, which reduces the propeller shaft speed range from engine idle to zero rotary speed. During the slip mode, the engine remains at idle while the clutch is slipped to deliver the reduced propeller speed. When a propeller speed above engine idle is needed, the joystick is moved over an angle of 30° degrees and the control system fully engage the clutch and the engine accelerates.

During fire-fighting mode, the joystick will only control the **MCD** slippage from 0 degree up to 90° degrees.

Closed-loop slip control is by means of a Proportional – Integral – Derivate (P.I.D.) controller, to assure that selected propeller speed is maintained regardless of wave, wake or current conditions. The controller compares the error between operator – selected speed and true propeller speed, and adjusts clutch hydraulic pressure as required through a proportional servo valve.

To facilitate troubleshooting, the controller has a monitoring and feedback system. A LCD screen displays useful information such as **MCD** input and output speeds, control pressure in the clutch and oil temperature. Should a major problem arise, the controller terminates the slip mode, returns the servo-valve current to zero, and displays a fault signal. The LCD screen displays then indicates the exact reason for terminating the slip mode.

11.1. INSTALLATION

The electronic controller must be installed in the wheelhouse and not in the engine room. Also it may not be mounted close to high voltage sources.
Refer to the installation drawingPX 10 325

11.2. WIRING INSTALLATION

The wiring between the **MCD** and the controller must be realized following our wiring schematics PX10310 (with AUT-UMS alarms) or PX10320 (without AUT-UMS alarms). The wire specification must be respected.

11.3. POWER SUPPLY

Different power supplies can power the electronic controller.

- 24 VDC (+/- 20%) – 3A min. from rectifier (Master) Terminals 59 (+) & 60 (-) or
- 24 VDC (+/- 20%) – 3A min. from batteries (Back up) Terminals 57 (+) & 60 (-) or
- 18 VAC –3A (transformer) Terminals 57 & 58

NOTE: *If during blackouts, the commutation time from the mains of the vessel to the emergency power supply source (batteries) is superior to 200 milliseconds, then two power supplies are requested to insure a continuous operation of the electronic controller.*

WHAT MUST BE PREPARED BY THE SHIPYARD?

- Install in the wheelhouse the electronic controller according drawing PX10325
- Connect the module PX10001 to LCD module PX10002 by means of two computer cables (125 m long – grey color)
- Connect module PX10001 to Intermediate Terminal (green color – 60 terminals) by means of six grey cables (flat connector controller side, square connectors – I.T. side)
- Connect joystick potentiometer to our I.T. (Terminals 24, 25, 26). Follow our PX10310 or PX10320 electric wiring for continuing.

WHAT KIND OF SIGNAL IS ACCEPTED BY TWIN DISC AS SET POINT?

- ***If a potentiometer is used***
  A 2 kΩ or a 5kΩ linear potentiometer (a minimum mechanical angle of 290° is necessary)

- ***If others signals are used (D.P. for example)***
  - 4 □ 20 mA (min 4.1 mA & max 20.2 mA)
  - 0 □ 5 VDC (min 0.2 Volts & max 5.06 Volts)

WHAT KIND OF SIGNAL IS USED BY TWIN DISC AS FEEDBACK?

Two electromagnetic speed pick-ups located on **MCD** input and output shafts (provided with the unit).

11.4. TWIN DISC FURNITURE

- 1 x 9.5” Rack PX 10001
- 1 x display module (LCD) PX 10002
- 1 x data cable PM 10333 (1.5m length, computer type)
- 1 x power cable PM 10334 (1.5m length, computer type)
- 6 x cables and terminal strip PX 9348 A (1.5m length with 10 terminals each)

12. SPECIFICATION MCD 1000 / 1 TO / 5 LD & HD TYPES

POWER RANGE	**1000 kW (HD) @ 1500 RPM** **1300 kW (LD) @ 1500 RPM**
Max. Input and Output Torque	6365 Nm (4695 Lbf. ft)
Max. Input and Output Speed	2000 RPM
Max. Input and Output Thrust Load	1225 Kg (2700 Lbs)

Housing	Free-standing
Input	GWB 390-55 with O.D of 250 mm
Output	GWB 390-55 with O.D of 250 mm
Control	Manual Electronic
Rotation	Clockwise or anti-clockwise. Oil pumps need to be adapted accordingly.
PTO Available Ratios PTO SAE PTO Splines PTO max. Power PTO max. Torque	1 or 1,5 or 2 C (2 bolts or 4 bolts) Flat root, 14 teeth's, pitch 12/24, Angle press: 30° 110 kW @ 1500 RPM 710 Nm (524 Lbf.ft)
Unit Weight Packing dimensions (crate) Packing weight (complete)	950 kg 188 x 200 x 122 cm 1470 kg
Oil Capacity	75 L (not including the cooler neither the piping between the cooler and the MCD)
Cooler	Tube type for remote mounting equipped with thermostatic valve Max. water temp @ inlet 35° C Max. water pressure @ inlet 5 BAR
Oil Pumps	Flanged on unit, driven by MCD input shaft
Oil Filter Oil Strainer	Flanged on unit: (10 µ nominal and 25 µ absolute) 160 µ
Alarms	Overheating, Lubrication pressure, Clogged filter
Sensors	Control oil pressure Lubrication oil temperature Input & output speeds

Drawings	Installation	PX 8870 Series
	Cooler	PX 9195 Series
	Controller	PX 10325
	Wiring	PX 10310 (with A.U.T.)
		PX 10320 (without A.U.T.)

13. SPECIFICATION MCD 3000 / 1 TO / 6 LD & HD TYPES

POWER RANGE	**1500 kW (HD) @ 1500 RPM** **3800 kW (LD) @ 1500 RPM**
Max. Input and Output Torque	24 444 Nm (18031 Lbf.ft)
Max. Input and Output Speed	2000 RPM (3000 possible)
Max. Input and Output Thrust Load	2545 Kg (5600 Lbs)

Housing	Free-standing
Input	GWB 390-55 with OD of 285 mm
Output	GWB 390-55 with OD of 285 mm
Control	Manual Electronic
Rotation	Clockwise or anti-clockwise. Oil pumps need to be adapted accordingly.
PTO Available Ratios	1:1 or 1,1:1 or 1,5:1 or 2:1
PTO	C (2 or 4 bolts), D, E or DIN 5480
PTO Splines	Flat root, 14 teeth's, pitch 12/24, Angle press: 30°
PTO max. Power	110 kW @ 1500 RPM
PTO max. Torque	710 Nm (524 Lbf. ft)
Unit Weight	1600 kg
Packing dimensions (crate)	188 x 200 x 122 cm
Packing weight (complete)	1958 kg
Oil Capacity	90 L (not including the cooler neither the piping between the cooler and the MCD)
Cooler	Tube type for remote mounting equipped with thermostatic valve Max. water temp @ inlet 35° C Max. water pressure @ inlet 5 BAR
Oil Pumps	Flanged on unit, driven by MCD input shaft
Oil Filter	Flanged on unit: (10 µ nominal and 25 µ absolute)
Oil Strainer	160 µ
Alarms	Overheating, Lubrication pressure, Clogged filter
Sensors	Control oil pressure Lubrication oil temperature Input & output speeds

Drawings	Installation	PX 8890 Series
	Cooler	PX 9195 Series
	Controller	PX 10325
	Wiring	PX 10310 (with A.U.T.)
		PX 10320 (without A.U.T.)

14. SPECIFICATION MCD 3000 / 7 TO / 9 LD & HD TYPES

POWER RANGE	**3000 kW (HD) @ 1500 RPM** **3800 kW (LD) @ 1500 RPM**
Max. Input and Output Torque	24 683 Nm (18 207 Lbf.ft)
Max. Input and Output Speed	2200 RPM
Max. Input and Output Thrust Load	2545 Kg (5600 Lbs)

Housing	Free-standing
Input	GWB 390-65 with O.D of 315 mm
Output	GWB 390-65 with O.D of 315 mm GWB 390-70 with O.D of 350 mm
Control	Manual Electronic
Rotation	Clockwise or anti-clockwise. Oil pumps need to be adapted accordingly.
PTO Available Ratios PTO SAE PTO Splines PTO max. Power PTO max. Torque	1:1 or 1,1:1 or 1,5:1 or 2:1 C (2 or 4 bolts), D, E or DIN 5480 Flat root, 14 teeth's, pitch 12/24, Angle press: 30° 110 kW @ 1500 RPM 710 Nm (524 Lbf.ft)
Unit Weight Packing dimensions (crate) Packing weight (complete)	2300 kg 188 x 203 x 157 cm 2446 kg
Oil Capacity	310 L (not including the cooler neither the piping between the cooler and the MCD)
Cooler	Tube type for remote mounting equipped with thermostatic valve Max. water temp @ inlet 35° C Max. water pressure @ inlet 5 BAR
Oil Pumps	Flanged on unit, driven by MCD input shaft
Oil Filter Oil Strainer	Flanged on unit: (10 µ nominal and 25 µ absolute) 160 µ
Alarms	Overheating, Lubrication pressure, Clogged filter
Sensors	Control oil pressure Lubrication oil temperature Input & output speeds

Drawings	Installation	PX 8850 Series
	Cooler	PX 9195 Series
	Controller	PX 10325
	Wiring	PX 10310 (with A.U.T.)
		PX 10320 (without A.U.T.)

15. SCOPE OF SUPPLY

FOR TWIN DISC MCD MODELS 1000 & 3000 complete units with:

- Input and output flanges, machined to customer needs, GWB type
- Monitoring of Input and output bearings temperature
- Monitoring of clutch lubrication pressure and lubrication oil temperature
- Clutch safety devices for immediate engaging and disengaging (Emergency)

Lubrication Oil System:

- Main pressure and lubrication pumps flanged on the **MCD** and driven by the **MCD** input shaft
- PTO to drive the propeller steering pump
- Built in trailing pump, electric driven in standard on all units
- Remote cooler equipped with thermostatic by-pass valve for fresh or sea water
- Filtration and alarm switches for oil pressure and oil temperature

Electronic Controller:

- 1 x 9,5" Rack
- 1 x display module (LCD)
- Data and power cables linking both modules (1,5 meters each)
- Interface to Engine and Propeller Control

Other TWIN DISC Supply:

- Complete **MCD** and accessories installation drawings
- Operation, Service, and Spare Parts manuals (3 sets in English language)
- Service Engineer to attend commissioning (5 consecutive days max)

Excluded From TWIN DISC Supply:

- The installation of the **MCD** and of the accessories (Cooler, T.P, Controller)
- Flexible coupling, Cardan shaft (s)
- Interconnecting piping between the **MCD** and the cooler
- Wiring between the **MCD** junction box and the electronic controller
- Wiring of the trailing pump group (starting box and electric motor)
- Seawater pumps
- Power supplies, voltage converters or transformers/rectifiers for control systems
- Special inspection charges (if any)
- Items not listed above