Havforskningsinstituttet – Rederiavdelingen

Fartøy: **Dr. Fridtjof Nansen**

VERKSTEDSJOBBER/ DOKKING

Jobb : 08 **Dato utført :** **Sign :**
Konto nr : **Lokalitet/plassering : Maskin rom/sjøkister**
Komponent: : Cathelco anti groe system

JOBB INFORMASJON/ DETALJER		INKLUDERT I ARBEID
Installere Cathelco antigroe system Anodene monteres i SB & BB sjøkiste Installasjon i henhold til produsentens instruksjons manual, vedlagt. Plassering av anoder bestemme på plass i lag med representanter fra rederi og verksted. Installasjon og sveiser skal kontrolleres/godkjennes av DNV **Vedlegg:** CA105399 FRIDTJOF NANSEN MGPS MANUAL		
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		Ventilasjon
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		Transport til verksted
		Transport ombord
		Sandblåsing
		Priming/Grunning
		Maling
		Trykk/Vacuum testing
		X-ray
		Ultrasonic testing
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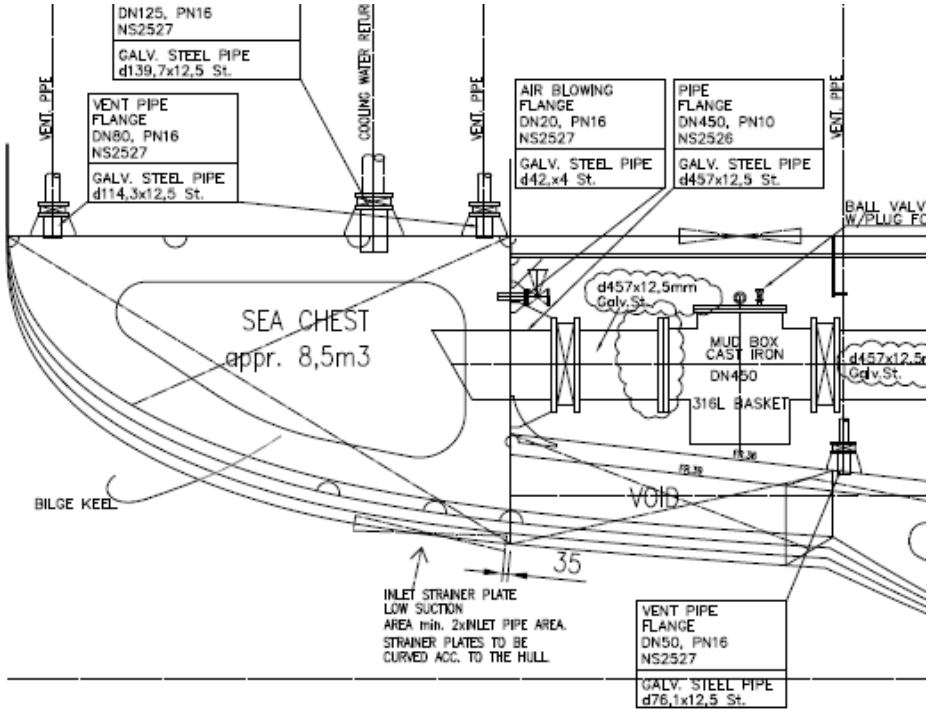

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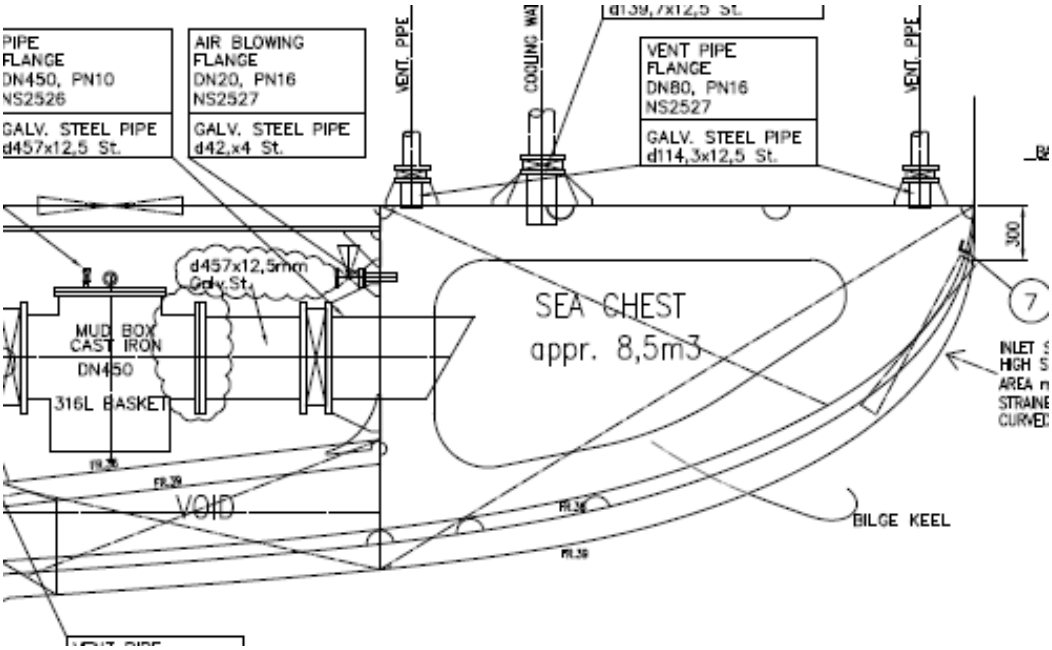

Marine Growth Prevention System Installation & Operational Manual

Vessel Name	**DR. FRIDTJOF NANSEN**
Customer Name	**HAVFORSKININGSINSTITUTTET**
Cathelco Reference Number	**CA105399**

Revision	Date	Description	Signature
0	3-Mar-20	FIRST ISSUE	JPH

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Issue 15.1
(29/01/18)

IMPORTANT NOTICE

From September 1st 2015, a biocidal product cannot be made available on the EU market if the substance or product supplier is not included in the Article 95 list for the product type to which the product belongs.

All customers must check their MGPS/AF system supplier is on the Article 95 list, under the correct Active Substance and Product Type. The Article 95 list can be accessed here http://echa.europa.eu/web/guest/information-on-chemicals/active-substance-suppliers

Cathelco have gone the extra mile becoming one of the very few approved active substance suppliers included in the Article 95 list for copper MGPS (Product Type 11).

Enforcement authorities, such as the HSE in the UK, ANSES in France and BAUA in Germany, are checking all MGPS/AF systems; evidence that the Active Substance supplier is on Article 95 must be made available.

Cathelco Evac

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SECTION 1 Definitions

Anode	The electrode through which direct current enters an electrolyte.
MGPS, C/S	Marine Growth Prevention System, Corrosion Suppression. An MGPS system can also have C/S components.
Cable tail	A double insulated cable connecting an anode to a junction box.
Cathode	The electrode through which direct current leaves an electrolyte.
Client	The purchaser of the equipment or service.
Contractor	The shipyard or other party responsible for installing the equipment.
Earth	In metal ships, the ship's structure is the earth, also known as 'ground'.
Earth Return	The return path for an electrical circuit made by connections to earth at each end.
Earth Fault	An unintentional connection between a live conductor and earth.
Electrolyte	A liquid in which electric current flows by the movement of ions i.e. salt water.
FSR	Field service representative. An engineer or technician authorized by Cathelco to commission a new system, and to carry out tests and repairs on Cathelco equipment
Inspection Authority	A classification society and/or other organization having responsibility for compliance with the applicable ship safety regulations.
Peripheral	A sensor such as a flow switch, valve, on-off proximity switch, pump on-off contact, which activates a relay in the control panel.
Sleeve	A permanent watertight fitting in which anodes are mounted.
Stud	A solid or hollow threaded steel bar forming part of an anode, by which the anode is fastened into its sleeve.
Electrolysis	Chemical decomposition produced by passing an electric current through an electrolyte with subsequent migration of charged ions to the negative and positive electrodes
Impingement Corrosion	A physical/chemical form of degradation of a metallic or non-metallic surface caused by the sustained impact of fluid or solid particles in a high velocity flow against a surface.
Stray Current Corrosion	Corrosion damage resulting from current flow other than in the intended circuit(s).
Galvanic Corrosion	An electrochemical process in which one metal corrodes potentially to another when both metals are in electrical contact, in the presence of an electrolyte.
Calcareous Deposit	Calcareous deposits are a mixture of calcium carbonate ($CaCO_3$) and magnesium hydroxide ($Mg(OH)_2$) which are accumulated on cathodic surfaces as a result of electrolysis.

SECTION 2 Information and General System Notes

DO NOT ATTEMPT TO SERVICE OR RE-ADJUST THE SYSTEM OPERATING LEVELS WITHOUT FIRST READING AND UNDERSTANDING THIS MANUAL. SHOULD ANY INFORMATION BE REQUIRED WHICH IS NOT COVERED BY THIS MANUAL, PLEASE CONTACT CATHELCO IMMEDIATELY (ADDRESS ON COVER)

ALL EQUIPMENT MUST BE STORED INSIDE A CLEAN, DRY AND DUST FREE BUILDING WITH AN AMBIENT TEMPERATURE OF 15 TO 25 ℃. FOR ANY SPECIFIC STORAGE INSTRUCTIONS REFER TO INDIVIDUAL MANUAL SECTION

THE SYSTEM OPERATES AT LOW D.C. VOLTAGE LEVELS AND MAY BE SEVERELY DAMAGED BY HIGH VOLTAGE TEST EQUIPMENT SUCH AS 500V MEGGER. READ THE RELEVANT SECTION IN THIS MANUAL BEFORE CARRYING OUT ANY TESTS.

ALWAYS ISOLATE THE AC POWER SUPPLY AT THE SWTCHBOARD PRIOR TO OPENING THE TRANSFORMER RECTIFIER CABINETS.

Symbols

Caution or Note

Electrical Hazard - Potential Risk of Electric Shock.

SECTION 3 System Specification

3.1 System Size Calculation

Sea Water to be Treated 2 x Sea Chests; flow rate = 700 m^3/hr (max)

Anode Location 1 x MG & 1 x TC to be fitted in each of 2 Strainers

Pipe work material Steel

Anode Life/Renewal every 5 years

When re-ordering please quote drawing No. 106251M/105399
And the anode part number from table 2.3

3.2 Current Settings

The current settings that appear below should be used in most circumstances. If, however, there continue to be signs of fouling, refer to SECTION 9 for guidance on current settings.

Strainer	Anode Ref	80% In Operation Current Settings ± 0.02	20% Not In Operation Current Settings ± 0.02
Strainer 1 – 700 m^3/hr (max)			
MG 1	CA105399MGA	0.60 amps	0.20 amps
TC 1	CA105399TCA	0.60 amps	0.20 amps
MG2	CA105399MGA	0.60 amps	0.20 amps
Strainer 2 – 700 m^3/hr (max)			
MG 3	CA105399MGA	0.60 amps	0.20 amps
TC 2	CA105399TCA	0.60 amps	0.20 amps
MG4	CA105399MGA	0.60 amps	0.20 amps

Please note the anode settings should be set to the in operation current setting for a maximum 80% of the systems life.

On vessels where the anodes are mounted in strainers that are self-draining when not in use, the current will automatically reduce when the anode is dry and the panel will show a reading of 0 amps. Switch off the control panel when removing the anodes from the strainers.

The actual life of the anode depends on the actual operation of the system; the above stated values assume continuous current setting and should be used as a guide. The higher the current setting the shorter the anode life. The lower the current setting the greater the anode life.

3.3 Scope of Supply and Weights per Hull Supplied by Cathelco

Cathelco Reference number: **CA105399**

Qty	Description	Cathelco Part No	Weight. Each/kg	Total Weight/kg
4	**Anodes Ref: CA105399MGA C/W 5m Cable**	**CA105399MGA**	**41.0 kg**	**164.0 kg**
2	**Anodes Ref: CA105399TCA C/W 5m Cable**	**CA105399TCA**	**13.6 kg**	**27.2 kg**
6	**Anode Mounting (Flanged Sleeve)**	**PAF106245**	**14.3 kg**	**85.8 kg**
1	**Installation & Removal tool ref: TIM-9**	**PAY020**	**0.3 kg**	**0.3 kg**
1	**Control Panel: RS/2Q/6W/SM 100-240v AC Painted: RAL 7035**	**PAPRS2Q06WSM**	**12.0 kg**	**12.0 kg**
			Total Nett weight of system	**289.3 kg**

Supplied by Client/Contractor

Cables from control panel to junction box and vessel alarm system.
Vessel's alarm system
Power supply cable
Earth return cables
Junction Boxes
All Cable Glands as Required

Power source required 100-240V AC 50/60Hz 1Phase

SECTION 4 Information

4.1 Project Identification

This manual refers to a Cathelco Marine Growth Prevention System (MGPS) and Corrosion Suppression (C/S) installation.

4.2 Cathelco Contact Data

For technical matters,

Tel: +44 (0)1246 457900
Fax: +44 (0)1246 457901
Email: technical@cathelco.com

For parts or component replacement quotations and purchases,

Tel: +44 (0)1246 457900
Fax: +44 (0)1246 457901
Email: sales@cathelco.com

Please refer to the Cathelco website, www.cathelco.com for any additional contact information and for the locations of our agents worldwide.

4.3 Application

The generic parts of this manual apply to all commercial steel-hulled vessels including military vessels where commercial standards are specified and semi-submersible Mobile Offshore Drilling Units (MODU's). They may not apply to combat military vessels where shock test or other special requirements are specified, stationary offshore/onshore installations or jack-up MODU's.

4.4 Safety

Cathelco equipment is sold on the assumption that personnel handling, installing, operating or repairing obey the safety rules of their workplace. In addition, this manual highlights specific safety warnings in the appropriate sections. It is VERY IMPORTANT that these warnings be heeded.

4.5 Approvals (and Certification)

Cathelco operates under ISO 9001:2015 Quality Assurance standards and the Lloyd's Register of Shipping approved manufacturer scheme. Not being essential to the ship's continued operation or survival, the components of a Cathelco system are not normally individually approved or certified. Component certification by a Class or other authority surveyor can be arranged at extra cost and with reasonable notice.

4.6 Liability

Cathelco's liability in warranty claims is limited to the value of the goods supplied.
Please refer to our Standard Terms and Conditions as shown at the back of this manual.

4.7 Warranties

Standard warranty is for 12 months from the date of commissioning, if the system is fully commissioned by a Cathelco Authorised Service Engineer and a signed copy of the Commissioning Check List sent to Cathelco. In order to meet the warranty requirements it is essential that monthly log sheets are recorded and returned to Cathelco. Failure to follow the instructions in the manual can void the warranty.

4.8 Intellectual Property

Copyright and intellectual property law protects the contents of this manual and all drawings associated with it. They should only be reproduced for purposes in connection with installing or operating Cathelco equipment.

The word “Cathelco”, whether capitalized or not, is registered by Cathelco Ltd. as a trade mark or brand name in many but not all maritime jurisdictions. In this manual, it is simply used as a convenient abbreviation for the company name, Cathelco Ltd.

SECTION 5 The Principles of the Cathelco System

5.1 The Problem

The settlement and growth of marine life forms in salt water piping systems, in ships and on other marine installations can be very costly. The flow velocity and temperature in these systems are ideal habitats for sessile marine animals to settle on the available surfaces of pipes, heat exchangers, valves, etc. The most common fouling organisms are mussels, barnacles and Tunicates all of which can cause a build-up or blockage in the pipework resulting in overheating and possible shut-down of machinery, accelerated corrosion, and reduced firefighting capability.

It is not practical to filter out the larvae of these creatures due to their small size, thus filtration has to be supplemented with water treatment.

5.2 The Cathelco Solution

5.2.1 Basic principle – Marine Growth Prevention

Cathelco MGPS systems are designed on the fact that the main fouling organisms can be inhibited from settling by the introduction of very small quantities of copper into the water. The required dosage per litre is usually only a few parts per billion. Copper is introduced into the water flow by electrolysis, in the form of positive ions. Thus, the principle is known as copper ion generation, or CIG. Seawater is a good electrolyte, and a low DC voltage is sufficient to provide the necessary current. Figure 1 shows the electrolysis circuit in its simplest form.

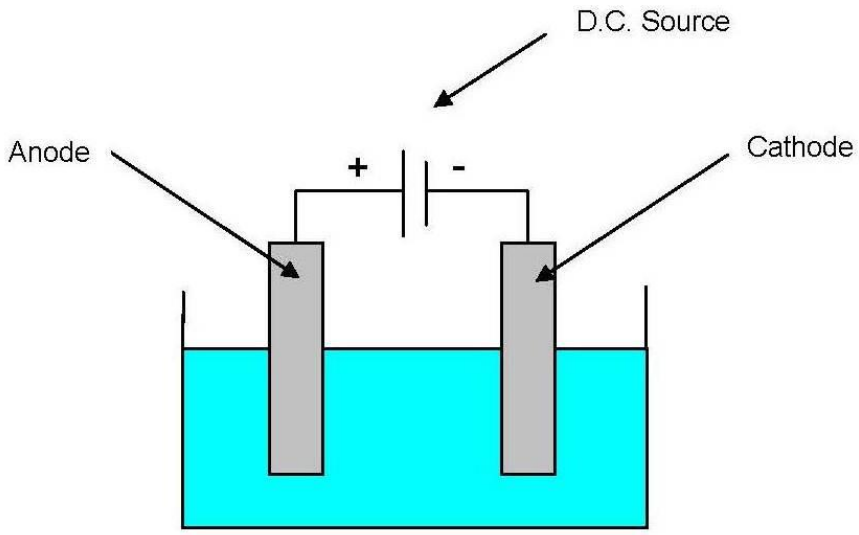


Figure 1 – Basic Circuit

In the simplified circuit with a copper anode, the cathode would in time become copper plated. This effect can indeed be observed with Cathelco systems when there has been zero flow for a significant period.

In a typical sea chest arrangement, the negative conductor from the power source is connected (earthed) to the ship's structure, which is in effect the cathode. The ions are carried by the water flow through the piping system. The copper ion concentration can still be high enough to inhibit the targeted marine growth one hundred meters or more from the anode.

5.2.2 Corrosion suppression

With Cathelco systems, it is relatively simple and economic to supplement the marine growth prevention function by adding corrosion suppression (C/S) anodes. They are energized by the same control panel as the MGPS anodes, as shown in **Error! Reference source not found.**.

Comprehensive studies and experience has shown that by consuming the C/S and MGPS anodes at the same rate by volume (with the convenience that all anodes are ready to change at the same time), substantial corrosion suppression is gained.

In the case of ferrous piping, the C/S anodes are aluminium, and with cuprous piping, they are cast iron. The Al anodes emit aluminium hydroxide ions, which form a protective coating on the inside of the pipes. Cuprous pipes (CuNi, CuNiFe, AlBro) are much more resistant to sea water corrosion than steel, but are nevertheless susceptible to what is known as impingement corrosion. (This form of erosion/corrosion is generally associated with the impingement of a high velocity flowing liquid containing air bubbles against a solid surface.) The cast iron anodes emit ferrous ions, which give significant protection from this form of corrosion. Marine engineers are familiar with the use of iron or steel “sacrificial” anodes fitted in the headbox of a shell and tube condenser having cuprous tubes and tube sheets. The Cathelco anodes perform the same function, the only difference being that they are “live”, with a controlled rate of ion emission.

Although it is extremely unusual, some vessels have aluminium sea water piping (AlBro is acceptable, see above). Cathelco MGPS and C/S systems should not be installed in such cases (see appendix).

5.2.3 The control panel

Depending on their design, Cathelco control panels require a range of supply voltages: -

- 110 volt single phase AC
- 220 volt single phase AC
- 12-24 volt DC

(See drawings for required input voltage)

AC power is transformed and rectified to a 0 – 12 volt DC output.

The output voltage is automatically adjusted to maintain a constant current to each anode as each anode is controlled individually. The great majority of systems work with a current range of 0 – 2 amps per anode which is manually adjustable in 0.02 amp steps.

MGPS panels are dust and spray tight to from IP44-IP65, and are thus suitable for mounting in machinery spaces not too far from the anodes that they control.

SECTION 6 System Installation Variations

6.1 Strainer Mounted

Strainers are housings inboard of a vessels' main sea valve where a filter is used to remove solid material from the seawater. Anodes installed here protect the strainer and the following pipework against fouling or corrosion.

As the strainers are inboard of the main valve, flow to the strainers can be isolated so the anodes can be removed, replaced or monitored while the vessel is alongside and therefore anode replacements are not dictated by the vessel's dry docking intervals.

When an MGPS system is strainer mounted, the strainer basket must be bonded to the strainer housing and earthed back to the control panel via the junction box for the system to function effectively, as shown in Figure 2. If the system is not correctly earthed, this may cause stray current corrosion upon the strainer basket or housing. Strainers that are heavily coated or rubber lined may require a cathode to act as the earth return source.

In the case where strainers are coated or use mixed metals, please contact Cathelco for further information.

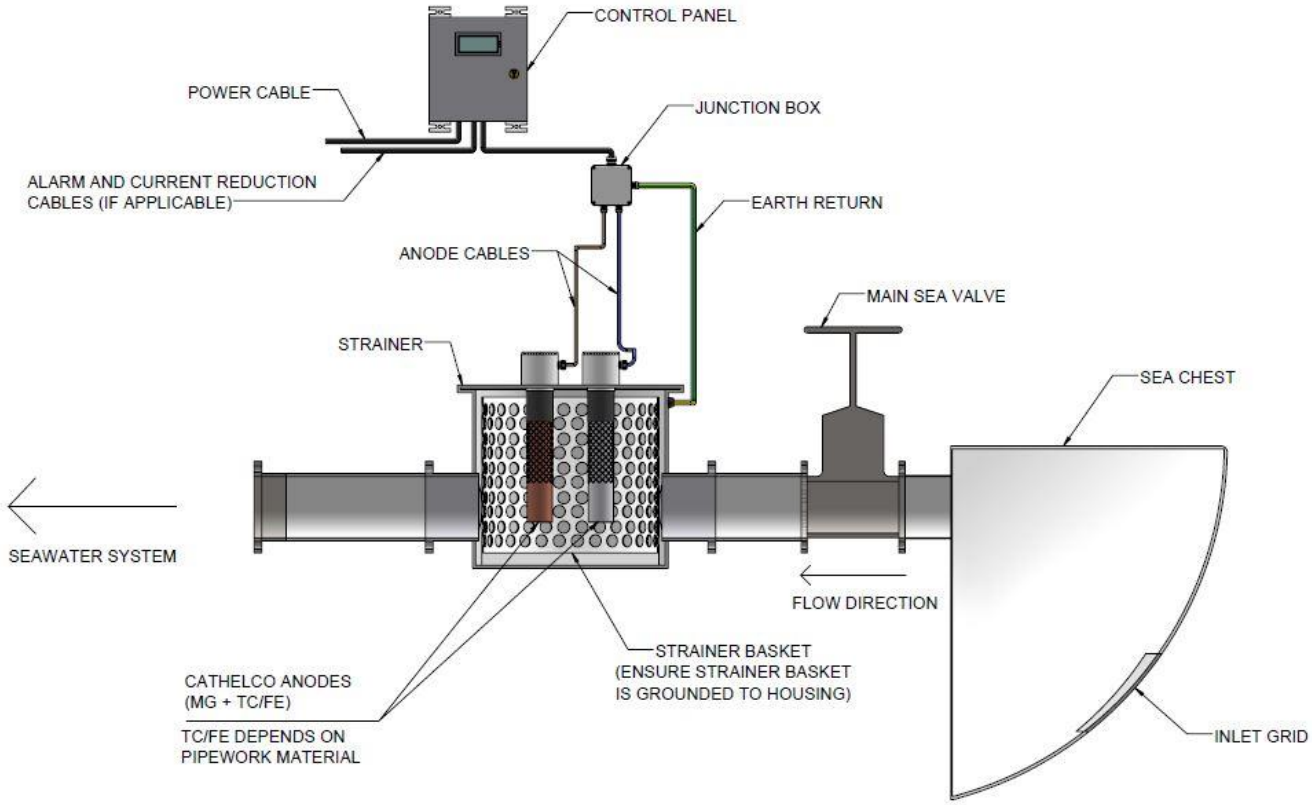


Figure 2 – Typical Strainer Installation

SECTION 7 Installing Flanged Sleeves

7.1 Handling and Storage

Cathelco components are shipped in substantial wooden boxes and their contents should be stored indoors until needed at site.

On receipt, the boxes should be opened and the contents checked against the packing list.

Normal care should be exercised in handling anodes and panels. On no account must anodes be lifted by their cables.

Flange type sleeves are supplied unpainted, but with a rust prevention coating. This coating must be removed using white spirits or turpentine before installation.

If anodes are installed in a space where blast cleaning or painting is not finished, they must be suitably protected. Before flooding the spaces, check to ensure that the protection has been removed, and remove any paint, tape adhesive residue or grease from the anode surfaces.

Please note:
If the anodes supplied come with mesh sleeving, please do not remove this as it is designed to prevent premature wearing at the top of the anode.

7.2 General Anode Positioning Instructions

It is important that anodes be mounted in the **vertical position** unless otherwise stated on the Cathelco drawings for specific vessels. **Do not coil or apply any mechanical load to anode cable.**

Anodes that are mounted in the sea chest should be positioned in or as close to the direct flow of seawater from the inlet grids to the main seawater suction pipe as possible, with the copper anode to be positioned closest as a priority.

The mechanical and electrical installation work must meet the standards of the inspection authorities. The contractor is responsible for arranging on site drawing approvals and inspections at their cost. Cathelco will supply equipment approval certificates at extra cost if covered in the customer's purchase order, to the extent that authorities are willing to issue certificates. See also SECTION **4.5** of this manual.

7.3 Mechanical Installation

The housings in which the anodes are mounted are known as sleeves. Each sleeve, irrespective of type, is fitted with a mounting sleeve lid/safety cap which is pressure tested to 100 psi. The cap is supplied with a watertight cable gland. If the anodes have been installed using metal sleeves, they should be painted to the same specification as the strainer/sea-chest/tank.

Flanged sleeves are designed with a flange welded to the sleeve barrel. Cathelco can supply flanged sleeves to a variety of standards that include ANSI, DN and JIS. The contractor must supply and fit pipe up-stands (or studded pads) to accommodate the sleeves and anodes. Alternatively, these can be ordered from Cathelco as an additional item. The material and wall thickness, flange type and welding specifications of the pipe up-stands must meet the approval of the on-site inspection authorities.

The white sealing gaskets on the wet side of the anode assembly are for one time use only and must be replaced once the assembly has been fitted. For this reason, it is best not to disassemble flanged anode assemblies that are delivered from the factory correctly torqued, before installation, as reassembly with the original washers can lead to leakage.

Upon completion of installation, the sleeve with exception of any sealing surfaces should be painted to the same specification as the surrounding area e.g. sea chest. The underside of the sea chest/strainer as well as the inside of the pipe upstand should also be painted with a Di-electric paint.

Flanged Sleeve Type	O/D of Flange mm	No Of Bolts required	Bolt Hole PCD mm	Hole to be cut in sea-chest mm
3" ANSI/BS	190	4	152.4	100
4" ANSI/BS	229	8	190.5	130
DN 100 PN10/16	220	8	180	130
JIS 100 5K	200	8	165	130
DN 125 PN16	250	8	210	140
6" ANSI/BS	280	8	241	190
DN 150 PN16	285	8	240	190
JIS 150 10K	280	8	240	190
JIS 150 5K	265	8	230	190
DN 200 PN16	340	8	295	240
JIS 200 10K	330	8	290	230

Figure 3 - Flange Sleeve Installation Requirements

7.4 Installation of Flanged Mounted Sleeves Fitted to a Mating Flange

1)
   a) If Cathelco have supplied drawings for your particular system, burn a hole in the lid of the strainer or top plate of the sea chest in the positions stated.
   b) If Cathelco have not supplied drawings, please determine the position of the anode mounting flange and burn hole in top plate of sea chest or strainer lid to suit. If the anodes are fitted in the sea chest, they must be positioned between the inlet grid and main suction outlet.
2) For recommended maximum distances between the centres of the anodes and the centres of the anodes to the nearest steelwork, see Anodes – Installation and Positioning. The diameter of the hole should correspond to the diameter of the flange shown in Figure 3 - Flange Sleeve Installation Requirements.
3) Weld the mating flange in position above the top plate of the sea chest (weld on both sides) and fit studs to the mating flange.
4) Coat the flanged mounting sleeve and the mating flange to the same specification as the sea-chest/strainer lid, ensuring the sealing surfaces remain uncoated.
5) Bolt the mounting flange complete with anodes to mating flange. Remember to fit a gasket between flanges. Remove lid from top of mounting flange and check nut and lock nut are tight to a torque of 100Nm (70lbs.ft)

6) Fill space with an electrical isolating grease (silicon or similar). Ensure ‘O’ ring is fitted to top of sleeve, replace lid and tighten gland.

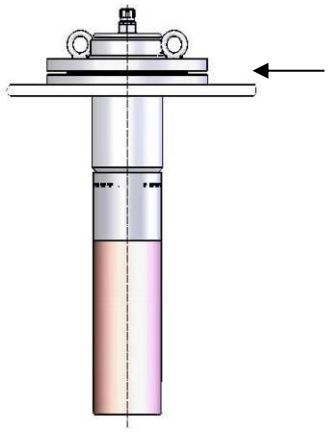


Figure 4 – Mating Flange Mounting

7.5 Installation of Flange Mounted Sleeves Fitted to a Pipe Up-Stand

These can be used where either the sea chest top plate is sloping, the anode is pipe mounted or when installing in shallow sea chests.

1) If Cathelco have supplied drawings for a specific system, burn a hole in the sea-chest top plate/pipe to suit the outside diameter of the pipe in the position stated on the drawing.
2) Weld pipe up-stand in position ensuring pipe is welded to sea chest/pipe using full penetration welds.
3) Flange top surfaces must be horizontal unless otherwise stated.
4) Coat the flanged mounting sleeve to the same specification as the sea-chest/strainer lid, ensuring the sealing surfaces remain uncoated. The internal surface of pipe upstand tube to be coated to same specification as the sleeve.
5) Bolt flange mounting complete with anode to mating flange on pipe up-stand. Remember to fit a gasket between flanges. Remove lid from top of mounting flange and check nut and lock tight to a torque of 100Nm (70lbs.ft)
6) Fill space with insulating (non-conductive) grease.
7) Ensure that 'O' ring is fitted to top of sleeve. Replace lid and tighten cable gland.
8) If an isolation kit has been fitted, check the resistance between the sleeve and the up-stand after installation. This should give a Multi-meter reading of infinity.

It is important that Cathelco be notified when flanged sleeves are to be mounted in a non-ferrous pipe up-stand. In such cases, isolation kits will be supplied with the flanges to prevent electrical contact between the dissimilar metals.

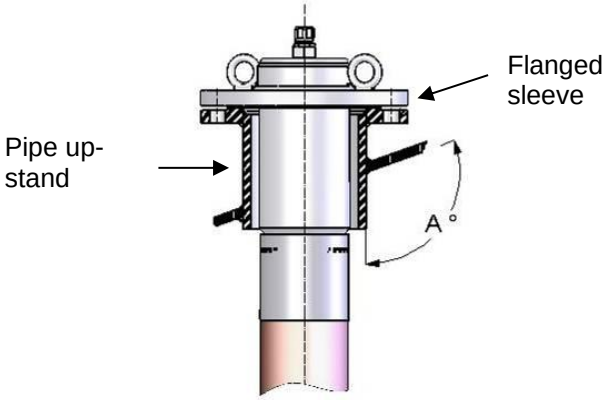


Figure 5 – Pipe Up-Stand Mounting

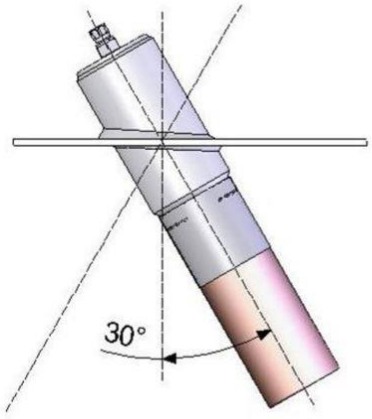
SECTION 8 Anodes – Installation and Positioning

Generally, a given installation will have anodes of more than one size and material. The system information in SECTION 3 indicates the type and size of anode at each location.

The Cathelco system diagram does not show structural details or the precise location and orientation of each anode. Sometimes the contractor will make working drawings showing such details, but even in some cases, careful measurements should be made to ensure that the anodes and sleeves could be installed as shown.

In locating anodes, the following points must be taken into consideration:

- For orientation more than 30 º from the vertical, Cathelco should be consulted.



Most anodes can be mounted up to 30 degrees from the vertical as shown on the right. Shorter anodes may be mounted horizontally after prior agreement with Cathelco.

Consult Cathelco if angle is greater than 30 degrees.

Figure 6 – Anode Orientation

- With flanged sleeves, the clearance must be more than the distance from the end of the anode to 30 mm above the top of the cable gland.

The installation of flanged sleeve anodes usually requires clear access from above to allow for the use of lifting equipment.

L= Required clearance for installation with flanged sleeves

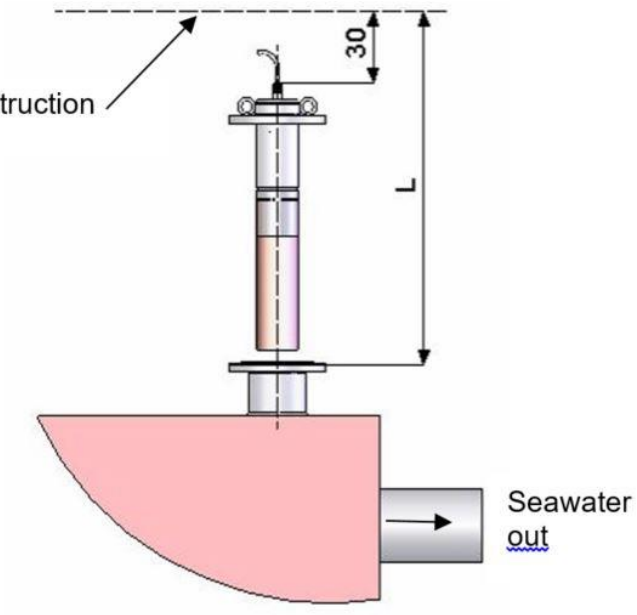
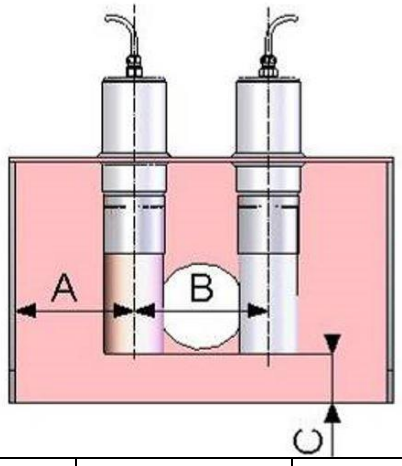


Figure 7 – Clearance for Flanged Sleeves

- Anodes must not be located in “dead” spaces where the anodes would be above the waterline or in the top of large sea chests where the inlet point is well below. They must be mounted as close as possible to the direct flow path of the water from the inlet grids to the seawater suction pipes.

- In order to prevent uneven wear to the anode or stray current corrosion, structural members must not be nearer to the anode surface than shown in Figure 8. Where this amount of clearance is a problem, Cathelco should be consulted.



See table below for minimum acceptable distance from structure.

Anode Dia./Mounting	**'A'**	**'B'**	**'C'**	**'L'**
DN/JIS150/6"flange	250	450	50 min	400 + anode length

The above table applies to all anode installations i.e. sea chest, strainer etc.

'A' = Distance from centre of anode to nearest steelwork.
'B' = Distance across centres of anodes.
'C' = Clearance from bottom of anode to sea chest bottom Min.
'L' = Clearance top of anode mounting to nearest obstruction.
The above are recommended minimum distances. In some circumstances, they may be reduced, but it is essential to consult Cathelco before installation.

Figure 8 – Clearance from Structural Members

8.1 Mounting Anodes in Direct Flow

The anodes should be mounted as close to either the inlet suction or the direct flow as possible (if sea chest mounted). This is to ensure the majority of the ions released from the anodes travel through the inlet to offer the downstream pipework and components as much protection as possible. If you are unsure if the proposed anode mounting location(s) are suitable, please contact Cathelco with dimensional drawings of the proposed mounting location to technical_af@cathelco.com.

8.2 Painting

Cathelco recommend painting all mounting sleeves, mating flanges and pipe up stands to the same specification as the sea chest or strainer lid to which they are fitted. The only surfaces that should not be painted are those that are in contact with sealing gaskets such as the flange gaskets and top sides of the anodes and the anode/cathode bodies. All weld-in and flanged mounting sleeves are supplied painted with a weldable primer.

SECTION 9 Operating & Maintaining a Cathelco MGPS System

9.1 Current Settings, Dosage Rates and Anode Life

SECTION 3 of this manual gives the recommended current setting for each anode.

The effective working of the system can only be determined by inspection and it is suggested that examinations of the strainer(s) should be taken at regular intervals or whenever possible to check that the MGPS system is functioning correctly. If fouling does seem to be occurring then increasing the current settings slightly maybe an option, however this will reduce the design life of the anodes so contacting **technical_af@cathelco.com** is advised before doing so.

The seagoing current settings are adjusted manually. If there is evidence of marine growth beginning to appear in strainers or heat exchangers, adjust this setting for the copper (MG) anodes upwards in increments of 0.02 amps until new growth ceases to appear. Each increment should be left set for 30 days before further adjustment up or down.

For installations in which current reduction is not automatically controlled by peripherals, adjustment to the 'not in use' settings given in SECTION 3 must be made manually. Cathelco recommends doing this whenever a port stay, with the main seawater circulating pumps shut down, lasts more than 24 hours or whenever a sea chest is not in use.

Some vessels such as shuttle tankers may have large ballast pumps running during unloading operations. If the ballast pumps draw from the same sea chests as the main circulating pumps, the current should be left at the 'in use' setting even if the latter are not running.

Cathelco engineers will recommend the number, size and disposition of anodes in a new MGPS system based on the seawater piping schematic, pump capacities, and the vessel's trading pattern (including port time, fresh water sailing time, and dry docking interval). The current settings, which in turn determine the rate of depletion of the anodes, will be specified to give reasonable assurance of fouling control, but because many varied environmental factors can have an effect on these calculations, anodes will generally be sized with a margin to allow the user to increase current if some fouling is still experienced.

When a vessel's main engines are not running there is a significant reduction in sea water cooling requirement, and in the case of port stays lasting over 24 hours, the current settings can be reduced. This reduction can be accomplished manually, by adjusting current to each anode or by a master switch controlling all affected anodes through relays; alternatively, it can be controlled automatically through relay(s) activated by contacts in the relevant pump starters if the control panel in use has automatic current reduction capability.

9.2 Anode Life

Since Cathelco has no control over anode current settings after a system has been commissioned, anode lifetime cannot be guaranteed. In the case of new builds at shipyards located in fouling prone areas, it may be desirable to operate the system during the outfitting afloat stage. Owners must take this period into account when estimating the time to re-order anodes.

9.3 Brackish & Fresh Water

9.3.1 Brackish water operation.

The standard control panel maximum output voltage is usually sufficient to operate the anodes at full current in water with up to two or three times the resistivity of standard ocean water, or about 75 ohm-cm, which includes many estuarial and coastal waters. However, if the salinity of the water becomes too low the system will go to maximum voltage with little or no current output. In brackish or very dirty water, there may be an

automatic drop in output current shown at the control panel, which will rectify itself once the vessel is back in seawater that is more saline.

9.3.2 Fresh water operation.

When navigating rivers and lakes (fresh water) for more than a few days, the fresh water will cause the system settings to drop to zero. Cathelco recommends keeping the system switched on and check panel condition again on return to salt water.

9.4 Seawater Supply Management

The assumption in determining anode current values is generally that all sea valves, except for high suctions for use in shallow muddy or sandy water, are normally open, and only closed during strainer cleaning. Any departure from this mode of operation may lead to insufficient dosing in some seawater systems.

9.5 Anode Change/Replacement

Only genuine Cathelco anodes/parts should be fitted. Using anodes/parts supplied by other manufacturers will invalidate the Cathelco warranty.

Most anodes are available from stock. Nevertheless, it is recommended that Cathelco be given 4-6 weeks' notice for supply of replacement anodes. The Cathelco reference (CA number), vessel name and the anode reference code should be quoted when ordering replacements.

The system must be switched off before any work is carried out on the anodes.

All anodes are sacrificial and will be consumed after a period.

Sea-chest mounted anodes must be replaced at every dry docking.

Anodes mounted in-board of a sea valve (i.e. in strainers) can be replaced when required at sea.

9.6 Submersible Anodes

Cables should be disconnected from the junction box/anode top as appropriate.
The securing nuts should be undone as required and the anodes removed.

After installation, perform the same dry and afloat tests as for a new system installation.

9.7 Effect on Hull Cathodic Protection (ICCP Systems)

In a typical Cathelco system, the effect of using the hull structure as part of the return (negative) path for the anode current is to reduce the hull potential with respect to a standard reference cell. In other words, it is reinforcing the function of the hull cathodic protection system, be it by impressed current (ICCP) or sacrificial anodes. Usually, the effect is insignificant, but in very large MGPS installations, the reduction can amount to a few tens of millivolts, and where owners prefer not to have the systems interact, Cathelco can supply dedicated cathodes that are isolated from the hull as shown in Figure 9 – Dedicated Cathode Arrangement.

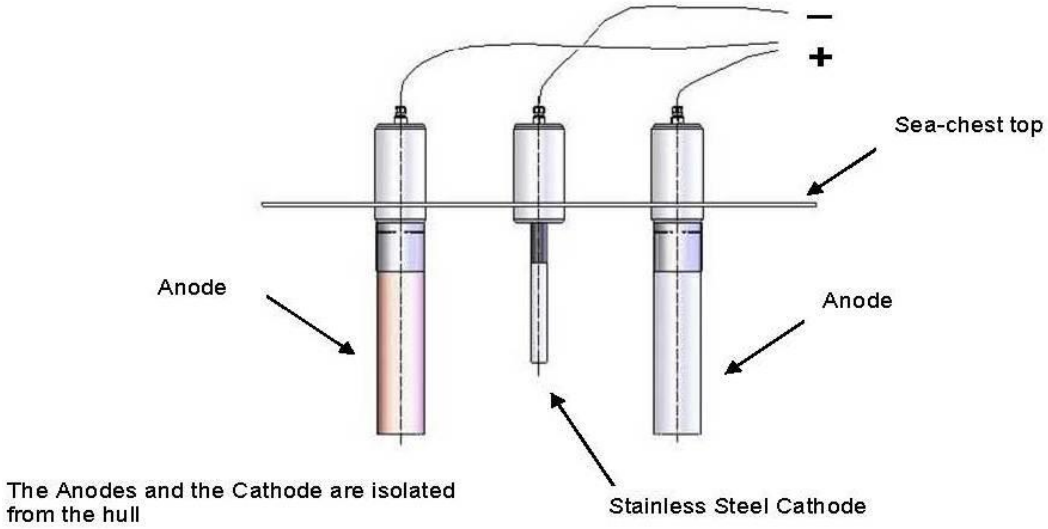


Figure 9 – Dedicated Cathode Arrangement

9.8 System Flushing Procedure

During long periods of the Cathelco system being set as not in use we recommend that you use the system flushing procedure.
When the pumps are turned off the control panel is set to the not in use setting.
During this period, there is no flow in the sea chests and copper ions will build up in the isolated area over time.
Please ensure that the pumps are regularly turned on for a minimum of one hour per week during down time and the control panel settings set to the in use settings. (See setting page)
When the system is in flushing mode a greater concentration of ion rich water will purge the system for a short period.
This will ensure that the entire system will work efficiently during the whole period.

9.9 Routine Operating Procedure

Cathelco MGPS systems are rugged, relatively simple, and very reliable if installed correctly.

Everyday

Cathelco recommends recording the current readings for each anode daily on the log sheet located in SECTION 15. This will ensure that anomalies can be dealt with promptly, and reduce the chance that crew will forget to adjust from the 'in use' to the 'not in use' settings. A standard copy of the log sheet can be downloaded from the Cathelco website.

All log sheets can be sent to Cathelco for analysis free of charge. They should be emailed to aflogsheets@cathelco.com this is important because the record of the current settings will help in determining the cause of any problems that might arise.

If one of the current settings is showing zero and cannot be adjusted, or if there are any other problems with system, please see SECTION 11 of the manual. If the cause of the problem cannot be found, please contact Cathelco for further assistance by emailing technical_af@cathelco.com.

As part of the daily supervision, check that all the digital display ammeters are working. When an anode has nearly wasted, the corresponding display will start to fall. When this happens, reduce the current to zero and leave it until the anode renewal. Reset once again at sea after renewal to the previously given current settings.

Every week

Weekly checks and maintenance should be made to the strainer basket as well as the MGPS anode/s if strainer mounted, to check for signs of marine growth settlement and to remove any debris or calcareous deposits that may build up which could potentially have a detrimental effect on the function of the vessel if left unregulated. These calcareous build ups on the anode/cathode do not have a detrimental effect on the MGPS system if they are removed using a wire brush regularly to keep the anode in good working order.

Every Month

Monthly checks upon the wiring, junction boxes and the control panel/anode connections should be made to check that the MGPS system is in good working order and that no water ingress has developed. Each log sheet has the capacity for a complete month, after which the copies should be sent to aflogsheets@cathelco.com.

Every 3 Months

Every 3 months switch off and isolate the power externally to the control panel, inspect the power supply unit internally for signs of loose wires or other visual defects. Check that the ventilation grills in the sides are not obstructed in anyway and clean any dust or dirt from the unit paying particular attention to the cooling vents.

Pre Drydock

One month before the vessel enters drydock, ensure that the daily log sheets have been maintained and forwarded to aflogsheets@cathelco.com for assessment along with information that drydocking is expected. This will ensure that any necessary spares can be despatched in good time. Continue to log the system readings up to the time the vessel enters drydock. It is advised that an engineer from Cathelco be in attendance during drydocking to check and service the MGPS system. If a Cathelco representative is not present to supervise the anode change, a responsible technician should inspect the panel(s) as well as performing commissioning checks/installation tests.

Semi-Modular (Touch Screen) Control Panels

Every month the current settings recorded in the History section on the control panel should be downloaded from the control panel and sent to aflogsheets@cathelco.com for assessment.

If there is an issue with the Semi-Modular control panel that requires technical assistance from Cathelco then the log of the current settings should be downloaded and sent to technical_af@cathelco.com for analysis.

SECTION 10 Control Panels

10.1 The Cathelco Control Panel

10.1.1 Semi Modular Quantum Blade – RS/*Q

Quantum Semi-Modular (Blade) 2Q/4Q/6Q control panels come in many different variations, ranging from 2 way to 16 way. Below shows an example of a 2Q/4 way configuration.

- Cathelco Semi Modular Quantum Blade panels are dust and spray proof to a rating of IP44, and can be located in machinery spaces. The IP rating must be preserved by using spray tight strain relief glands for cable entry.

- The contractor must make a robust structural frame to which the panel will be bolted. Bolt size and spacing are shown on the panel drawing in SECTION 13 of this manual. The panel should be located at about eye level, with convenient and safe access for adjusting currents and servicing. The door on Semi Modular Quantum Blade panels must be clear to swing out at least 90 degrees.

- It is highly recommended that Semi Modular Quantum Blade panels are mounted on horizontal brackets supplied and fitted by the client to give additional support. Cathelco also recommends gluing a 5 mm thick strip of rubber to the top of the bracket to give greater protection to the panel and to reduce the effect of vibration.

- The contractor must use the pre-punched holes in the control panel and supply & fit glands to the required standard.

- Control panels must be earthed to the ship's hull. Generally, the mounting bolts will perform this function satisfactorily. This can be checked by carrying out a continuity test between the panel casing and the ship's structure.

- RS485 connection allows the control panel to be connected to the vessels alarm management system where the systems readings and alarms can be read and controlled.

10.1.2 Operating the Quantum touch screen control panel

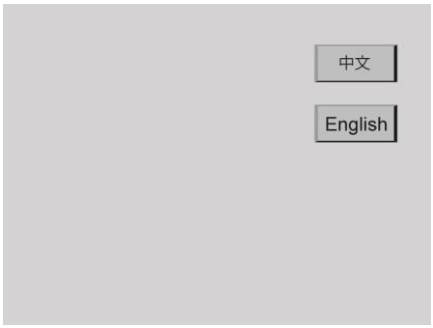
The Marine Growth Prevention System touch screen Quantum panel is compact in design and has data logging capabilities along with many other features. These include Adjustment of alarm set points, system run time, current reduction, history, trend graph, alarm information and the option to have English or Chinese language.

After the control panel has been installed as per the above and the supplied drawings the panel is ready to be switched on. The on/off switch can be found on the side of the panel.
Cathelco Quantum touch screen control panels come pre-set and the user specific settings should not be changed without contacting Cathelco for advice.

Note: All values stated below are for illustration purposes only and may vary from the panel supplied. For project specific current settings please refer Section 3.2 of this manual. If in any doubt, please contact Cathelco at technical_af@cathelco.com.

10.1.3 Start Up

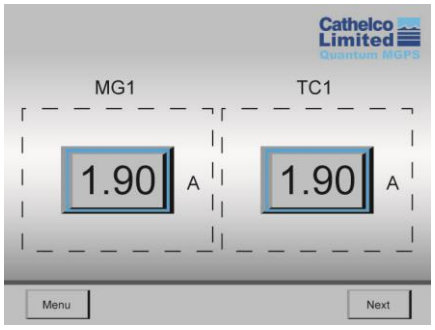
After switching on the control panel the Cathelco start up screen will appear followed by the option to choose English or Chinese language. Select the required language by pressing the required icon.



10.1.4 Setting the Anode Output

After the language has been selected the anode current setting screen is shown. Pressing the next and back icons scrolls through the anode settings. To set or change the anode current setting press the icon and enter the value required. Press enter to confirm or escape to cancel. Repeat as required.

Pressing the icon above the current settings box will allow the text to be changed. For example, pressing the ‘MG1’ icon on the below image will enable the text to be changed if a different text is preferred.

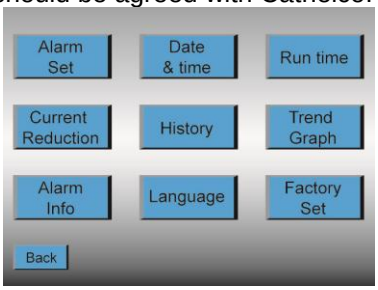


Pressing the menu icon on the current setting screen enters the menu mode. Upon entering the Menu mode, the following options will be available.

10.1.5 Menu

To enter the menu, press the menu icon of the anode output screen. From this menu the following options are available. Alarm set points, set date and time, run time of control panel, current reduction settings, system history, trend graphs of anode settings, alarm information, language selection and factor settings. Please note factory settings are password protected and the password is for Cathelco engineers only.

Control panels are delivered pre-set and should not require any adjustment. Amendments to factory settings should be agreed with Cathelco.



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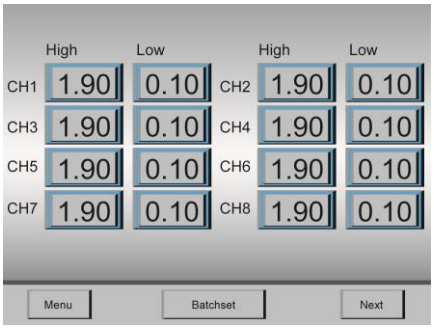
10.1.6 Alarm Set Point

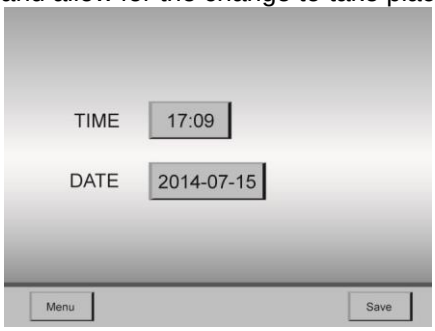
Press the Alarm Set icon to enter the alarm set point screen. In this screen the high current output and low current output can be set. To enter the high current alarm for an individual anode, press the high alarm icon next to the anode. Enter the desired value and press enter or escape to cancel. To enter the low current alarm, press the low alarm icon next to the anode. Enter the desired value and press enter to confirm or escape to cancel.

If all alarm set points are the same the batch option can be used. Press the batch set icon and enter the high and low current alarm set point following the steps above.



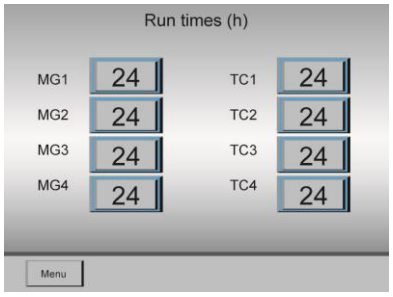
10.1.7 Set Date and Time

Press the Set Date and Time icon to set the date and time. Pressing either box will enter the relevant option and allow for the change to take place.



10.1.8 Run Time

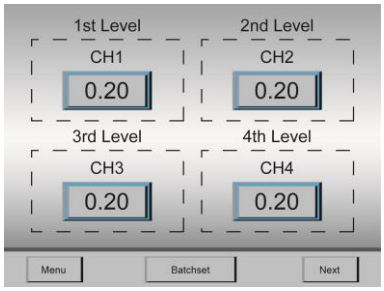
Pressing the Run Time icon indicates the running time of the control panel in hours.



10.1.9 Current Reduction

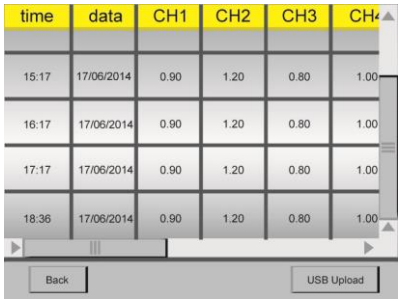
The Quantum touch screen panel is fitted with the option to have automatic current adjustment, which can be connected to volt free pump relay contacts or similar. This allows the current to be automatically switched between in operation and not in operation current settings to prolong the anode life.
Once the settings are set within the control panel they need a volt free switch hard wired into the control panel that will operate the normally open contact and alter the current output automatically.
The current reduction feature allows one current reduction per channel. Should a pump be required to operate more than one channel this can be linked by hard wiring the relevant pump terminals together. Refer to the relevant wiring diagram for full connection details.

Press the Current Reduction icon to enter the current reduction screen. To enter the current reduction value for the first pump, press the CH1 icon and enter the setting required and press enter to confirm or escape to cancel. Repeat this for the other channels as required.



10.1.10 History

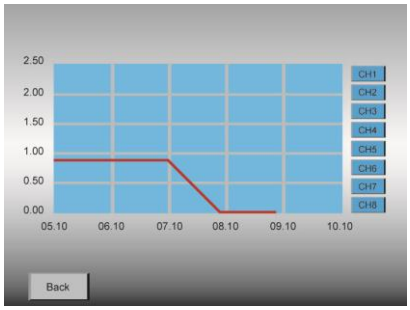
Pressing the History icons enters the history mode which logs the current setting of each anode every hour. Under this option there is an option to upload the system readings to a USB. This should be done at the end of each month and the system readings sent to aflogsheets@cathelco.com for analysis. To upload the readings to a USB, insert the USB to the control screen located on the back of the door. Press the USB upload icon and the readings will be uploaded after a short period of time. Press menu to exit and remove the USB.



10.1.11 Trend Graph

Press the trend graph icon to enter the trend graph. The anodes are indicated on the right hand side of the screen. By pressing the anode icon required a trend graph is shown indicating the current setting

which is logged every hour. Previous current settings can be viewed by swiping left and right on the screen.



10.1.12 Alarm information

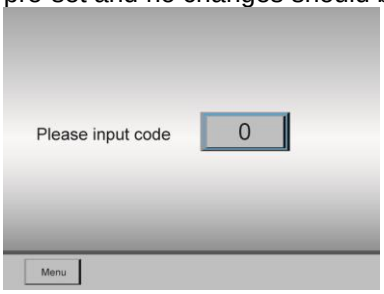
Press the Alarm Info icon to enter the alarm information screen. This screen indicates when an anode is or has been in alarm along with the date and time the alarm occurred. When anodes are in alarm the alarm status also scrolls across the home screen until it's cleared.

10.1.13 Language

Press the language icon to enter the language selection screen. English and Chinese options are available. Press the required icon to choose the language.

10.1.14 Factory Set

Factory set is for Cathelco engineers only and is protected by a password. Cathelco control panels come pre-set and no changes should be made under this setting.



10.1.15 Semi-Modular control panel details

Type	Input Voltage	Max no. Modules	Max Anodes	Max Output Per Anode	Fuse (Power)	Fuse (Anode)	I.P Rating
RS/2Q 2W-8W SM	100-240 AC	N/A	8	2 A	N/A	3.15 A CXFU019	I.P 44
RS/2Q 10W-16W SM	100-240 AC	N/A	16	2 A	N/A	3.15 A CXFU019	I.P 44
RS/4Q 1W-4W SM	100-240 AC	N/A	4	4 A	N/A	3.15 A CXFU019	I.P 44
RS/4Q 5W-8W SM	100-240 AC	N/A	8	4 A	N/A	3.15 A CXFU019	I.P 44

10.2 Electrical Installation

10.2.1 Cable sizes and types

Cathelco supplies each anode with a minimum of 1 metre of double insulated single conductor cable (longer if ordered by the client). For ease of identification, cables supplied as part of anode assemblies are coloured as follows: -

Anode Type	Cable Colour Coding
MG (Copper)	Red Outer/Red Inner PVC covering **OR** Grey Outer/Brown Inner PVC covering
TC (Aluminium)	Black Outer/Black Inner PVC covering **OR** Grey Outer/Blue Inner PVC covering
FE (Cast Iron)	Black Outer/Black Inner PVC covering **OR** Grey Outer/Blue Inner PVC covering
Note: For Dual Purpose Anodes, smaller Nano Type and Submerged Anodes refer to drawing for cable specification.	

Figure 10 – Cable Colour Coding

All other cables in the MGPS system are to be supplied by the contractor.
Cables and their insulation must be of a type approved by the inspection authorities for their location, voltage and temperature. In order to achieve acceptable voltage drop, and based on not more than four anodes per earth return conductor, Cathelco recommends the following conductor sizes for the anode circuits:

Length of cable run/m	Metric	AWG
0 - 25	2.5 sq.mm	14
25 - 50	4.0 sq.mm	12
50 - 100	6.0 sq.mm	10

Figure 11 – Cable Supply Sizes

Cable for the power supply should not exceed 2.5 sq.mm^2 with a minimum of 1.0mm^2 core.
Oversize cables should be avoided, as they are likely to cause mechanical overload on the terminal blocks.
For signal circuits from peripherals to relays, 1.5 sq.mm or AWG 16 will generally suffice, regardless of length.

10.3 Cable Installation

Proximity to other cables, cable clip spacing, and mechanical protection in vulnerable areas, shall all meet with the approval of the inspection authorities.

The Cathelco supplied anode cables shall be connected to the system wiring in watertight junction boxes, located as far above the bilges as practicable. In the case of solid stud anodes, make sure the anode cable is tightly secured to the top of the stud using the 6 mm cap screw. To avoid malfunctioning of the system due to leaky glands or condensation, Cathelco recommends packing the sleeve cavities and junction boxes with petroleum jelly or non-conducting silicone grease.

After packing the sleeve cavity and screwing on the safety cap, tighten the gland, making sure there is no mechanical tension on the cable. Cathelco recommends that all cables be tagged. Future troubleshooting

can be simplified if a marked up copy of the Cathelco wiring diagram or a contractor's working drawing with the tag numbers identified, is placed in the back of the control panel. This drawing should also show the supply distribution panel number and circuit number.

Do not coil or apply any mechanical load to anode/cathode cables.

10.4 Power Supply

Each AC panel should have a properly identified dedicated single phase supply circuit, protected by a fuse or circuit breaker. The supply cable shall have three conductors, phase, phase or neutral, and earth. The fuse/circuit breaker rating must not be less than the maximum input of the wattage divided by the voltage. In most cases, a 10 amp rating will suffice, although 15 amps is commonly the smallest available. In any case, the ampacity of the supply cable must exceed the fuse/breaker rating. DC panel supply cables should be two conductors with an ampacity of 10 amps.

	Panel Type						
	2 Amp Module	**4 Amp Module**	**6 Amp Module**	**8 Amp Module**	**10 Amp Module**	**EB/CC**	**EB/NS**
Power Consumption/ Per Channel (No of anodes)	30 VA Per Channel (60 VA Total)	60 VA	90 VA	120 VA	150 VA	30 VA	12 Watts Per Channel

Figure 12 – Power Consumption

10.5 Peripheral Circuits

In most cases a two conductor 1.5 sq.mm cables will suffice for connecting a peripheral to the corresponding relay in the panel. If Cathelco are not supplying or specifying the peripheral, they should be informed of its specifications.

10.6 Testing

Final testing of the system is described in SECTION 12, Commissioning. Before installing hollow stud anodes, the resistance between the anode and the stud should be checked using a multi-meter. It should be infinity for a dry anode before it has been fitted in situ. Cable run integrity should be checked before the system is flooded, with the anode supply and return cables disconnected at the panel. Once the anodes are connected, their circuit resistance to earth must be checked using a multi-meter only, a megger tester voltage is too high.

10.7 Retrofit Installations

When retrofitting a CIG system caution should be taken as there may be a large amount of growth already in the pipework. Any existing fouling inside the sea chests, strainers and pipework must be removed before the replacement Cathelco MGPS system is fitted.

10.8 Systems Fitted with Current Reduction Relays

As an optional extra, the current setting can be adjusted automatically using peripheral devices such as flow switches, pump starter contacts, and valve open/close contacts. The peripherals are wired to current reduction or on/off relays in the panel, which modify the current to the relevant anodes.

Automatic current adjustment can be achieved on the Cathelco control panel when connected to a normally open (N/O) zero voltage relay/switch on the pump, strainer/sea chest valve or similar.
A pair of wires can be connected from the pump terminal on the control panel to the N/O zero voltage switch and back to the pump return on the control panel.
When the switch e.g. pump/valve is operated this completes the circuit to automatically adjust the current on the control panel.

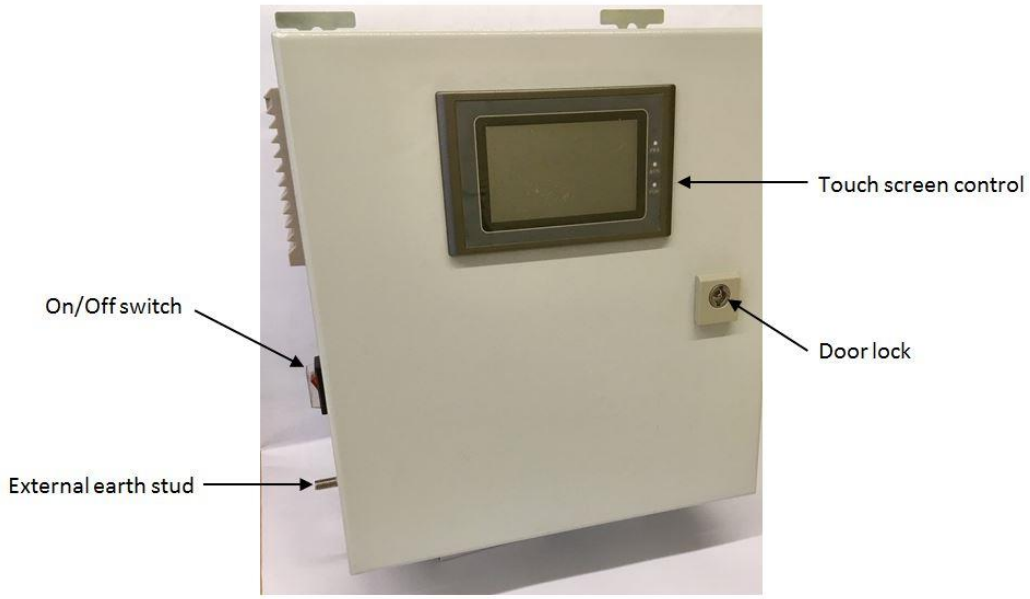
SECTION 11 Troubleshooting a Cathelco MGPS System

11.1 Semi-Modular Quantum Blade Control Panel

The troubleshooting instructions below should be carried out by a suitably trained person following all the necessary on board safety procedures.

Quantum Semi-Modular (Blade) 2Q/4Q/6Q control panels come in many different variations, ranging from 1 way to 16 way. Below shows an example of a 2Q/4 way configuration.

Please note: If the current reduction feature is in use, please disconnect the current reduction relays to the control panel prior to troubleshooting.



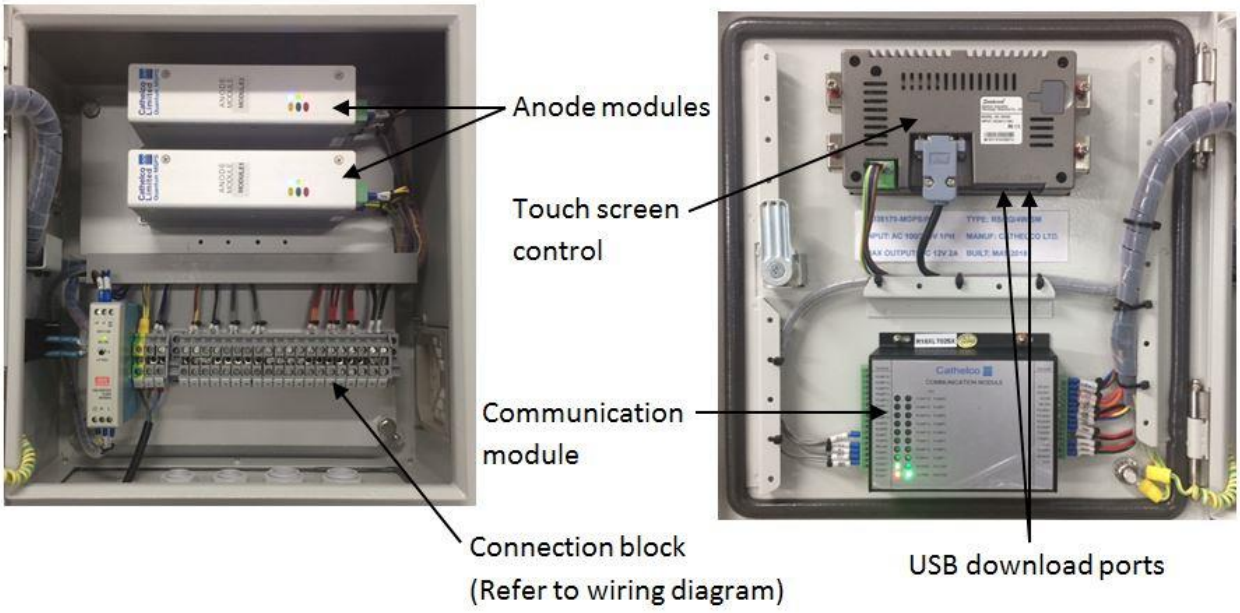
Control panel start up screen does not load when switching on.

Is there full voltage at the panel power terminals?

If no, close the switch or breaker at the ship's distribution panel. Check that voltage supply is set within the control panel's operating input voltage range between 100-240V and re-start the control panel.

If the above checks have been carried out and have not rectified the problem or there are any other screen issues, please contact Cathelco at technical_af@cathelco.com.

Anodes fail to respond to the full range of their current controls.



The maximum output of a 2Q control panel is 2.0A.
The maximum output of a 4Q control panel is 4.0A.
The maximum output of a 6Q control panel is 6.0A.

Is the vessel in fresh, brackish or out of water?

If yes, the resistance of the water will be too high to maintain the desired current setting. Keep the system switched on and check panel condition again on return to salt water.

If no, check all the cables from the control panel to the anode, including inside the junction boxes, for signs of damage or loose connection. Check that the fuses located at the side of each anode module are still intact. The anode alarm can be triggered when the anode(s) are not fully submerged. If the anode(s) are strainer mounted, an air pocket can build up inside preventing the anode from being fully submerged. Use bleed valves to remove an air pocket inside the strainer to raise the water level.

If the current reduction feature is being used, check that the current reduction set points are not influencing the desired current setting and that they are set to the recommended in operation/not in operation settings in SECTION 3.

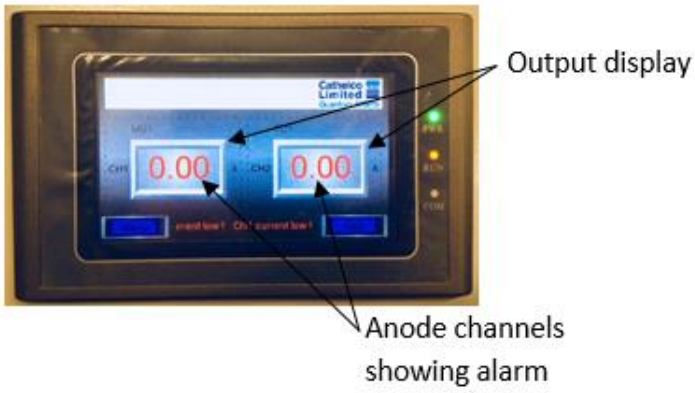
Are all earth returns fitted?

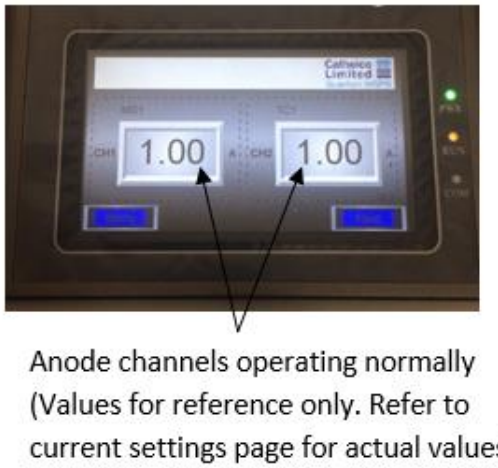
If yes, then check all connections.

If no, install earth returns (at least one per sea-chest/strainer/pipe section) and connect back to the earth return terminals inside the control panel via the junction boxes.

If the problem persists, please contact Cathelco at technical_af@cathelco.com.

Anode channel(s) show alarm reading





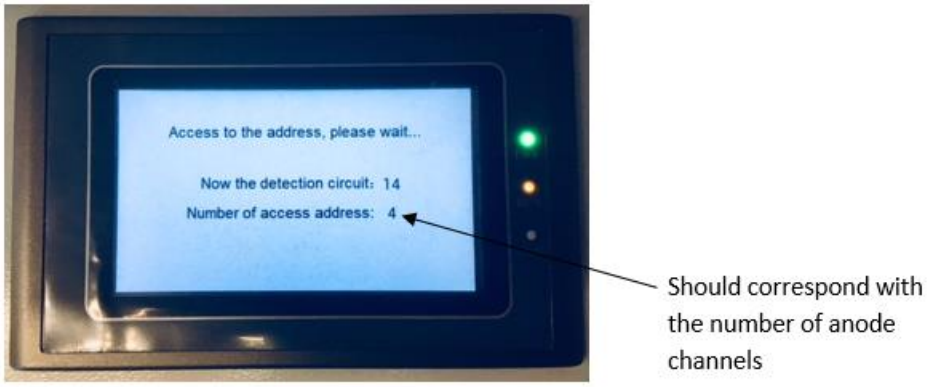
Check the alarm set points are set correctly. Are the high alarm set points set below the in operation settings shown in SECTION 3? Are the low alarm set points set above the not in operation settings shown in SECTION 3?

If the high alarm set points are set below the in operation current settings, increase the high alarm set points to a value above the in operation current settings.

If the low alarm set points are set above the not in operation current settings, decrease the low alarm set points to a value below the not in operation current settings.

If the alarm set points are set correctly, proceed to the below checks for further troubleshooting.

Upon start-up, check that the number of access address corresponds with the total number of anode channels arranged inside the panel. For example, a 4 way panel should have 4 access addresses connected during the start-up procedure as shown below.



Does the number of access address correspond with the number of anode channels?

If yes, proceed to the below checks for further troubleshooting.

If no, turn off the control panel, check for any loose cable connections at the connection block, anode modules, communication module and touch screen control, and turn the panel back on.

If the problem persists, please contact Cathelco at technical_af@cathelco.com.

Can the current be set to the desired setting by typing the current into the selected channel?

If yes, adjust the current settings to align with the recommended settings in SECTION 3.

If no, proceed to the below checks for further troubleshooting.

Switch off the control panel, open panel, and exchange positive lead for the circuit showing alarm with one functioning correctly, and switch on again. Is the alarm now showing on the other anode channel position? Alternatively, has the alarm stayed at the original channel location? Note: this test is only applicable if the control panel has at least one working channel.

If the alarm has moved to the new channel location, the issue will not be caused by the control panel. Please proceed below for further troubleshooting.

If the alarm has stayed at the original channel location, please contact Cathelco at technical_af@cathelco.com.

A multi-meter should also be used to test if the control panel is in working condition. Remove the anode and earth return cables connected to the suspect anode(s) and measure the Amps from the anode channel to earth. Repeat the test for each suspect anode. Does the meter show a current transmitted from the control panel that corresponds with the setting shown on the panel output display?

If yes, proceed to the below checks for further troubleshooting.

If not, please contact Cathelco at technical_af@cathelco.com.

The anode alarm can be triggered when the anode(s) are not fully submerged below the waterline. If the anode(s) are strainer mounted, an air pocket can build up inside preventing the anode from being fully submerged. Use bleed valves to remove an air pocket inside the strainer to raise the water level.

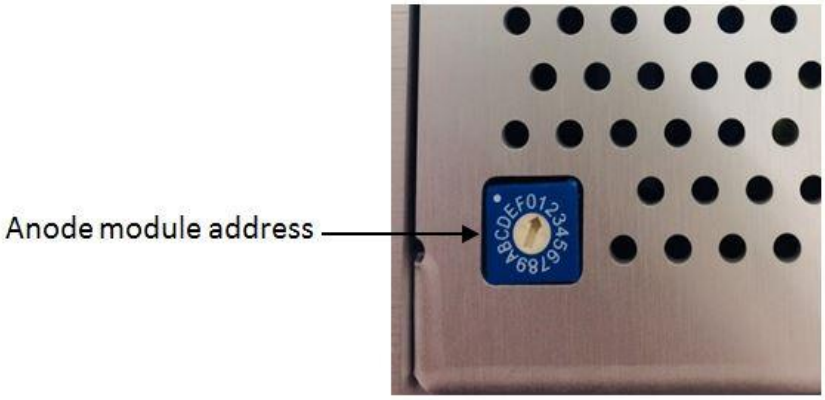
Turn off the control panel, open up the anode sleeve safety cap (if applicable) and any junction boxes in the circuit, and clean and repair any obvious deficiencies such as loose connections, missing or incorrectly located earth return, or water ingress. If the anodes are mounted inboard of the main valve, then close the valve and remove the anode from the mounting to check the anode still has consumable material left or for signs of damage.

If the anode(s) are mounted downstream of the main valve they can be removed for inspection, check the continuity between the anode cable and the anode body. The anode cable should show between 0Ω and a maximum reading of 0.4Ω to the anode body. For Omni type anodes, the anode cable for this test is marked as “1” and the cathode cable is marked as “2”. Ensure both the anode cable to anode body reading and the cathode cable to the cathode body reading shows between 0Ω and a maximum of 0.4Ω. For dual-purpose type anodes, the cable is connected to the MG anode body and the stud is connected to the corrosion suppression anode body. Ensure both the anode cable to the MG anode body reading and the stud to the corrosion suppression body reading shows between 0Ω and a maximum of 0.4Ω.

Channels may display an alarm if the anode module address, shown below, is set to the incorrect position. The anode module address should correspond with every anode module. For example, an anode module address should be set to 1 for the first anode module inside the panel. The anode module address should be set to 3 for the second anode module inside the panel and so on. Is the alarm still showing after the position of the anode module addresses are set to the correct position?

If not, set the current settings to align with the recommended settings in SECTION 3 and operate as normal.

If yes, proceed to the below checks for further troubleshooting.



No. Of Modules	Module Address Setting
1	1
2	1, 3
3	1, 3, 5
4	1, 3, 5, 7
5	1, 3 , 5, 7, 9
6	1, 3, 5, 7, 9, B
7	1, 3, 5, 7, 9, B, D
8	1, 3, 5, 7, 9, B, D, F

Carry out flooded resistance and potential check as specified in SECTION 12 of this manual. If test readings are good, reconnect in the original location and switch on system. Anode control should now respond correctly.

If test readings are bad or dubious, or anode control still shows reduced or no current, the anode may be fully consumed and may need to be replaced. If the anode is located in the sea chest, please contact Cathelco at technical_af@cathelco.com.

Water leaks slowly in the sleeve.

It is sometimes possible to stop a leak by tightening the anode stud nuts. For a sea chest mounted anodes, this might not work if the anode rotates. If the leak cannot be stopped, remove the tail cable, replace the safety cap, and plug the gland.

Warning! If when slacking off the gland nut on an anode sleeve, water squirts out under pressure, tighten up immediately, cut the tail cable short and tape it off. This will prevent water tracking up the cable.

For strainer mounted anodes, check that all the seals and gaskets for signs of damage or defects that may cause water ingress.

Marine growth is found in the strainers, heat exchangers or pipework.

Remove all existing fouling from the strainers, heat exchangers and pipework as the Cathelco system is designed to prevent the settlement of marine growth and will not remove any existing fouling.

Ensure the current settings are in line with SECTION 3 in the manual.

If the current settings are already set to the correct reading, increase the copper dosage slightly by adjusting the current to the appropriate anode(s) upwards by 10%. If new marine growth continues to settle, then keep increasing the current slightly whilst monitoring the situation daily until new marine growth ceases to settle. Once the sufficient level of current required has been found, gradually start to reduce the current back to the recommended current settings in the manual over a number of days and continue to monitor the situation for any more signs of marine growth settlement.

Warning! When increasing the current beyond the recommended settings shown in SECTION 3 of this manual, the lifespan of the anode(s) will be reduced. If you would like to receive further information regarding the effects of increasing the current settings on the system's design life, please contact Cathelco at technical_af@cathelco.com.

If any attempts to increase the current settings fail to halt the settlement of marine growth, check that the anode is isolated from the hull/strainer lid/pipe section. If there is continuity between the anode and the hull/strainer lid/pipe section, then there will be reduced current flow to the anode body. This will result in the control panel showing the correct level of current transmitted to the anode but in reality the majority of the current will be passed straight to ground.

If the above checks have been carried out and found to be unsuccessful, please contact Cathelco at technical_af@cathelco.com.

SECTION 12 Testing and Commissioning a Cathelco MGPS System

12.1 Application

These test procedures apply to new installations (new build or retrofit) and when replacing anodes.

12.2 Dry Tests

The majority of Cathelco systems are based on sea chest location of the anodes, which involves installation before launch for new systems and during dry docking for retrofit systems. Before the vessel is launched or re-floated, check the isolation of each anode from the hull, as well as continuity of the positive feed circuit to the anode.

Multi meters should not be used except on cable runs that are disconnected both from the control panel and from the anodes.

With a hand-held multi-meter, the resistance between anode cable and hull should be in the mega-ohm range. The actual reading will depend on the make of meter, the polarity, and the presence of any moisture or dirt in the chest. If there is a poor reading, but the cable from the panel to the junction box appears to be intact, disconnect the anode tail cable at the junction box and repeat the check.

Check that the anode is isolated from the hull/strainer lid/pipe section. If there is continuity between the anode and the hull/strainer lid/pipe section, then there will be reduced current flow to the anode body when the vessel is afloat and the system is turned on. This will result in the control panel showing the correct level of current transmitted to the anode but in reality the majority of the current will be passed straight to ground.

12.3 Flooded Tests

With the vessel afloat and system flooded with seawater, the integrity of each anode's circuit should be checked. With the anode (positive) cable disconnected from the terminal block in the controller, the following readings should be taken; using a good multi-meter, (a Megger tester will not give a valid reading).

Before starting this test, make sure that sea chests and strainers are properly vented. It is not unusual for crew or shipyard personnel to miss some vent valves when preparing to flood.

12.3.1 Open circuit potential check

The following table shows the expected range in millivolts of the potential between anode and ground. If there are sacrificial anodes in the sea chest, or even near it on the shell, the last two columns will apply; otherwise, the first will show the upper range of expected values. In the absence of sacrificial anodes in the sea chest, the better the paint job and cathodic protection of the outer hull, the nearer the value will be to the right hand figure in the first column of the table. Very low potential difference is likely to indicate loss of continuity or breakdown of insulation of the circuit, except in the cases where anode and hull or sacrificial materials are the same, or very close in the galvanic series. Potential readings are also useful for verifying that MGPS and corrosion suppression cables have not been crossed over, which is important where different currents are specified.

MGPS or C/S Anode	No sacrificial anodes	Sacrificial anodes in sea-chests	
	MS	Zn	Al
Cu	250-400 (+)	650-900 (+)	600-850 (+)
Al	100-250 (-)	100-200 (+)	0
Fe	0-150 (+)	300-400 (+)	200-400 (+)

Figure 13 - Galvanic Potential Ranges in Salt Water

These figures are guidelines only. Actual potentials depend on many variables.

12.3.2 Resistance check

A multi-meter can be used to check the resistance between the circuit wiring and the hull. The reading will not be true, as among other factors, it will vary according to whether the meter is opposing or reinforcing the galvanic potential, but it will give a good comparative indication if the same meter is used all the time. With a Fluke series 80 meter, for example, the higher of the two readings should be at least in the kilo-ohm range. Low readings will not necessarily affect the functioning of the system, but are indicative of possible breakdown of circuit integrity and an inspection should be made of the anode mounting sleeves, junction boxes and cable runs. An infinity reading is equally suspicious, indicating lack of continuity. See SECTION 11 Trouble-shooting.

12.3.3 Leak check

Slacken the glands, screw back the safety caps from the sleeves, and check for leaks. If there is a very small seepage, the wet side spacer may swell and stop the leak in a few hours; otherwise, the anode nuts must be tightened. When satisfied there are no leaks, make sure the safety caps and gland nuts are fully tightened. For Nano anodes ensure there are no leaks around the fixing nuts.

12.3.4 Function check

Check the power supply voltage and make sure the correct voltage is selected in the panel.

After reconnecting the wires to the terminal block, switch on the power and make sure each anode control is responding throughout its range (normally zero to 2 amps). Measure the output voltage for each anode with current set at a given value, say 1.0 amp. Finally, adjust current to the "in port" values.

Check that any peripheral sensors/switches and the corresponding current reduction relays in the panel are operating properly when fitted.

12.3.5 Wiring verification

First verify that the wires connected to the earth return terminals are all showing zero resistance to the hull (except in the case of dedicated cathodes, when it should be infinity). Then check that the positive wires are connected to the terminal block in the proper sequence. A simple way to do this is to switch on the system and set the current for each anode in ascending steps of say 0.02 amps. Then by reading the current at each anode using a DC clamp meter on the tail cable, any crossed wires can be quickly located and correctly reconnected at the panel, and any incorrect tags changed.

12.4 Validation

In the case of new installations, the warranty comes into effect after a Cathelco technician or authorized technical representative has completed and signed the attached Commissioning Check List. One copy should be left in the manual. Another copy should be faxed or e-mailed to Cathelco. (See page 1 for contact information.

12.5 Forms of Fouling Not Controlled by Cathelco Systems

MGPS systems are not effective against seaweed and grasses, and have to be cleared from the intake strainers when they proliferate. Certain algae and “green slimes” are not affected, but these do not build up and block pipes in the way mussels do, as they require light for growth.

12.6 Treatment of Processed Water from Water Makers

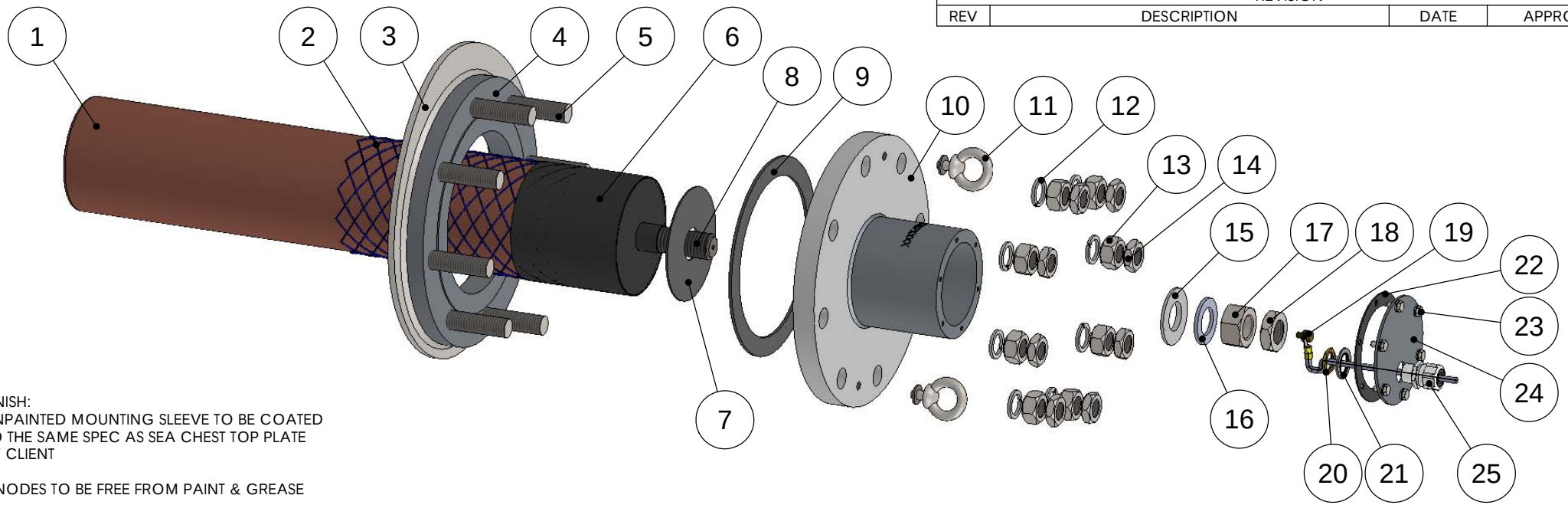
The copper (and aluminium or ferrous) ions generated by the electrolysis process do not carry over with the condensate in evaporative type fresh water generators, or pass through all the membranes in reverse osmosis units. The CIG process is approved by the UK Ministry of Health for feed water in potable water makers.

While the addition of copper in the same order of magnitude as that already in the seawater is enough to prevent transition of shellfish and molluscs from larvae to adults, it will not affect adult animals. CIG treated water is used in holding tanks for adult shrimp, clams and lobster with no noticeable ill effects.

SECTION 13 Project Specific Drawings

Drawing Title	Drawing No
Arrangement of Anode C/W Flanged Sleeve	106251M/105399
Wiring connection for 6W Marine Growth Prevention System	W1962
Arrangement of RS/2Q/6W/SM control panel	G1721

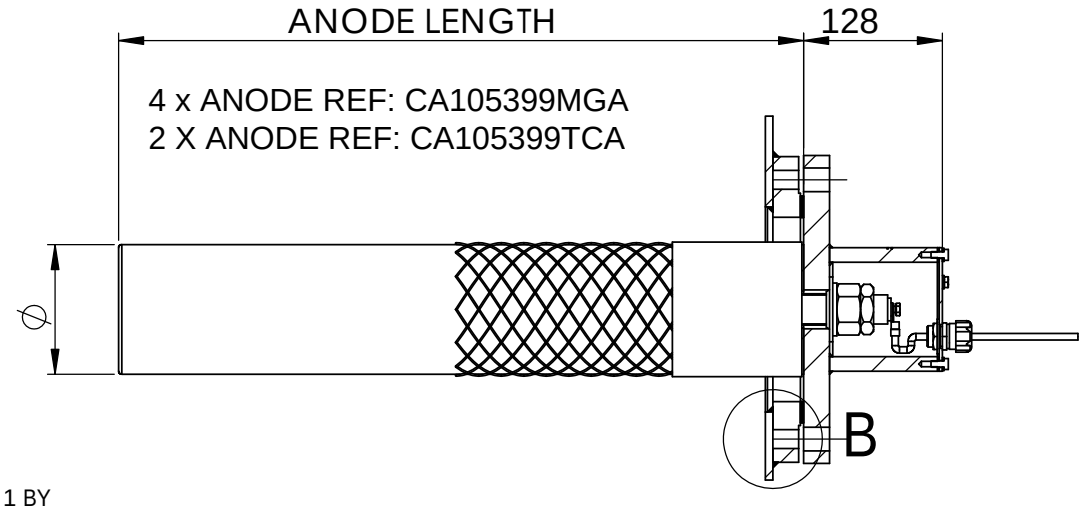
REVISION			
REV	DESCRIPTION	DATE	APPROVED

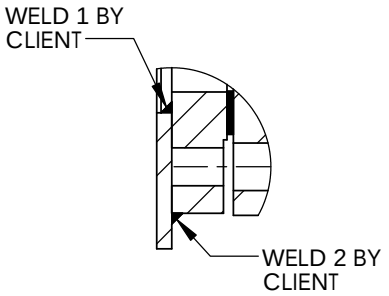


FINISH:
UNPAINTED MOUNTING SLEEVE TO BE COATED TO THE SAME SPEC AS SEA CHEST TOP PLATE BY CLIENT

ANODES TO BE FREE FROM PAINT & GREASE

ITEM No	COMPONENT DESCRIPTION
1	ANODE BODY- ENSURE MINIMUM CLEARENCE OF 50mm FROM BOTTOM OF SEA CHEST
2	ANODE MESH IS FITTED TO LARGER ANODES WHEN REQUIRED- IF FITTED **DO NOT REMOVE** THIS ITEM
3	SEA CHEST TOP PLATE OR STRAINER LID- CLIENT TO CUT HOLE IN TOP PLATE 190mm DIAMETER
4	DN150 PN16 MATING FLANGE (C/W ITEMS 5, 12, 13 & 14) SUPPLIED BY CLIENT OR CAN BE SUPPLIED BY CATHELCO AT AN EXTRA COST - CLIENT TO WELD TO TOP PLATE AS SHOWN IN WELD DETAIL VIEW B (AT LOCATIONS 1 & 2 AROUND PERIPHERY)
5	THREADED STUDS X 8 TO BE SCREWED INTO MATING FLANGE
6	HEAT SHRINK SLEEVE
7	NEOPRENE WASHER
8	ANODE STUD
9	NEOPRENE GASKET FITTED BETWEEN ITEMS 4 & 10
10	DN150 PN16 COMPACT FLANGE SLEEVE
11	SCREW IN LIFTING LUGS C/W WASHER
12	8 X SPRING WASHER FITTED TO ITEM 5
13	8 X FULL NUT FITTED TO ITEM 5
14	8 X HALF NUT FITTED TO ITEM 5
15	TOP HAT WASHER
16	WASHER
17	FULL NUT
18	HALF NUT
19	5M LENGTH 6mm SQ DOUBLE INSULATED CABLE BY CATHELCO
20	CABLE GLAND LOCKNUT
21	DOWTY WASHER
22	GASKET FITTED BETWEEN ITEMS 10 & 24
23	COMPACT SLEEVE LID FIXING BOLTS C/W WASHERS
24	COMPACT SLEEVE LID
25	CABLE GLAND





WELD DETAIL VIEW "B"

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Cathelco
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EMAIL: technical@cathelco.com

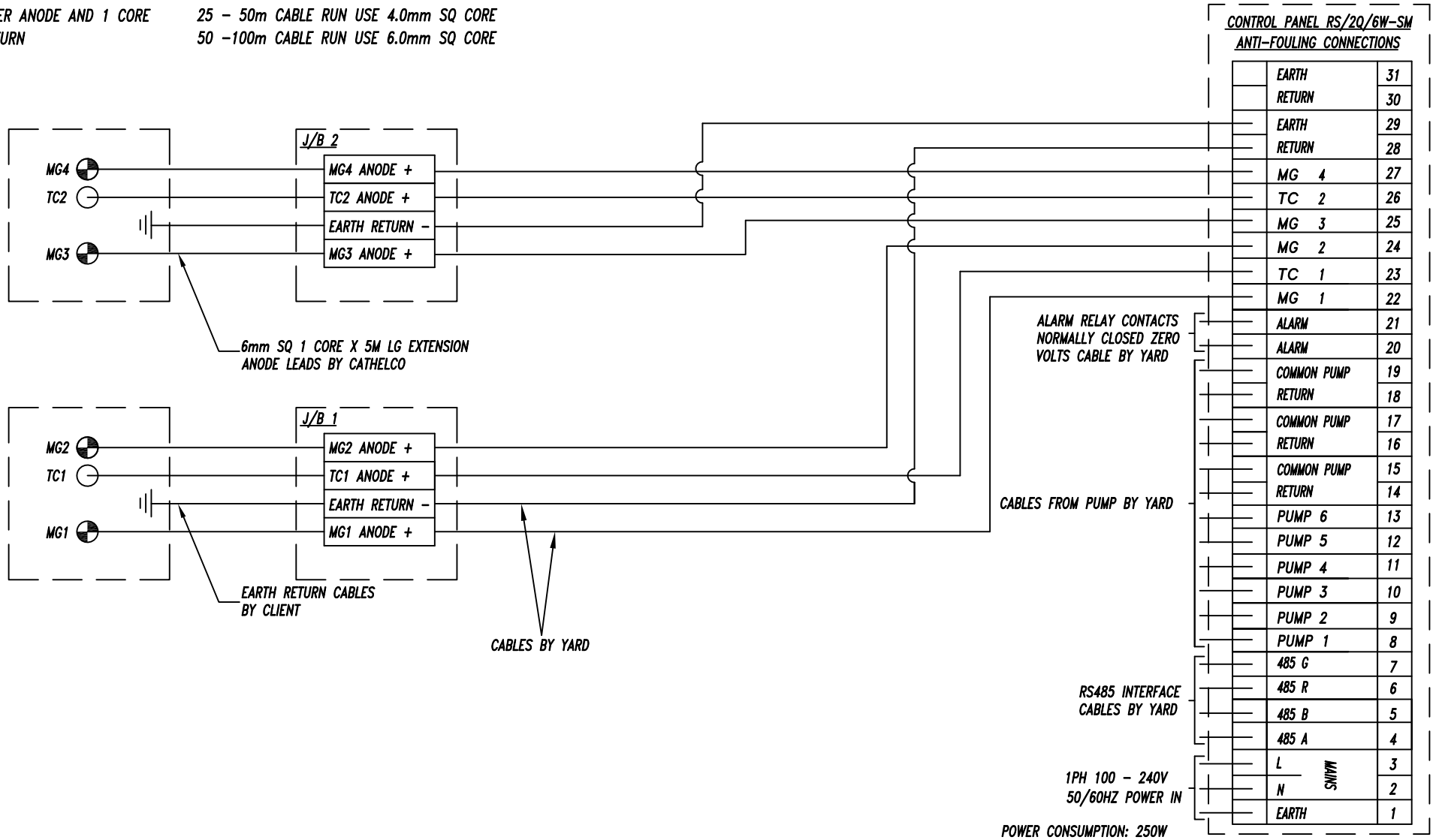
SCALE: NTS	DO NOT SCALE.	TITLE: DETAIL OF TYPE 2 ANODE ARRANGMENT C/W DN150 PN16 COMPACT FLANGE MOUNTING	
SHEET SIZE: A4	SHEET: 1 OF 1		
DRN BY: N.B	DATE: 03.04.2014		
APP' BY: C.H	DATE: 03.04.2014		
DRG TYPE:	MANUAL	DRG NO: 106251M/105399	REV:

MINIMUM CABLE SPECIFICATION:

MARINE RUBBER DOUBLE INSULATED
USE 1 CORE PER ANODE AND 1 CORE
PER EARTH RETURN

MINIMUM CORE SIZES.....ALL CABLES:

00 – 25m CABLE RUN USE 2.5mm SQ CORE
25 – 50m CABLE RUN USE 4.0mm SQ CORE
50 –100m CABLE RUN USE 6.0mm SQ CORE



CATHELCO LIMITED
MARINE HOUSE, DUNSTON ROAD
CHESTERFIELD, DERBYSHIRE, S41 8NY, UK.

REV:	DATE:	SIG:	MODIFICATION:
1	06.09.17	COH	TERMINAL LAYOUT UPDATED

TITLE: WIRING CONNECTION TERMINAL DIAGRAM SHOWING A 6 ANODE CONFIGURATION

DATE: 14/07/2014

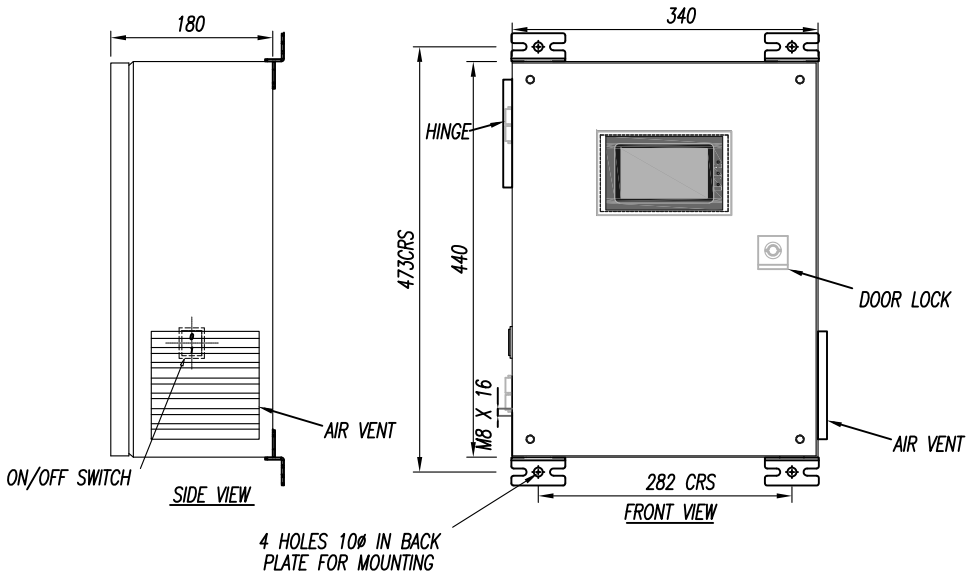
SCALE: NTS

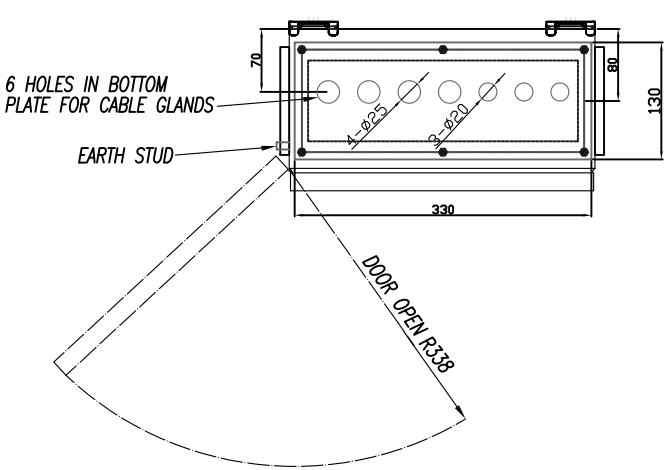
DRAWN: CH

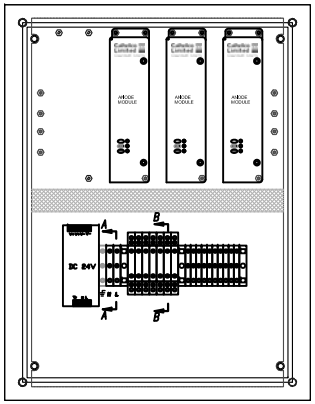
CH'KED BY: NRB

DRG No. W1962

REV : 1

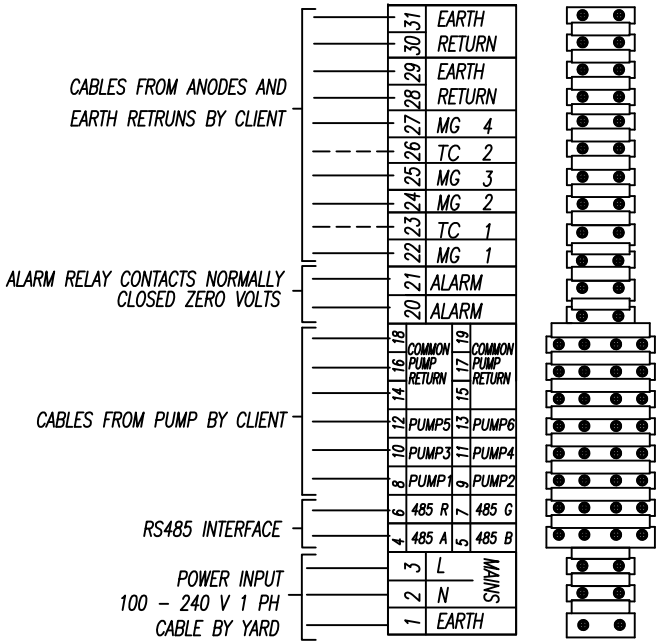






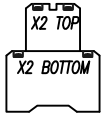
6W ARRANGEMENT

INTERNAL WIRING CONNECTION BLOCKS



SECTION A–A

SECTION B–B



NOTES:

1. CABLES FROM ANODES SHOWN THUS:
   MG (COPPER) ANODE LEAD DENOTED ——————
   TC (ALUMINIUM) ANODE LEAD DENOTED - - - - - - -
2. ENSURE EARTH RETURN LEADS ARE CONNECTED TO CORRECT BLOCK
3. DRAWING TO BE READ IN CONJUNCTION WITH THE RELEVANT WIRING DIAGRAM.
4. IP GRADE 44
5. POWER CONSUMPTION:250W

CATHELCO LIMITED
MARINE HOUSE, DUNSTON ROAD
CHESTERFIELD, DERBYSHIRE, S41 8NY, UK.

REV:	DATE:	SIG:	MODIFICATION:
2	21/12/17	NRB	REVISED GLAND PLATE & EARTH STUD
1	12/01/17	MB	PUMP CONNECTIONS UPDATED

TITLE:
ARRANGEMENT AND TERMINAL LAYOUT FOR PANEL REF:
QUANTUM TOUCH SCREEN 6W UNIT MG/TC

DATE: 23/09/14
SCALE: NTS
DRAWN: CH
CH'KED BY: NRB
DRG No. G1721
REV : 2

SECTION 14 Commissioning Check List

Vessel: _____

Shipyard: _____

Newbuilding No.: _____

Panel Type: _____

Owner: _____

Task	Signature
Make a physical check of the commodities for any possible transit damage.	
Locate shipyard mains input voltage supply point.	
Confirm power supply matches the required supply for the control panel.	
Check panel-holding bolts & frame. Make sure panel is secure.	
Check all fuses are intact.	
Check shipyard cable connections to panel terminals.	
Check the continuity of shipyard cables to anodes.	
Check that the anodes are isolated, testing from the anode cables to the sea chest top plate/strainer lid etc.	
Anodes installed & torqued as per manual.	
Cathodes installed as per manual (if applicable).	
Confirm polarity of connections. Anode +, cathode ship hull -.	

Earth return connections secure and free from corrosion.	
Check shipyard mains input cables are connected.	
Check any auxiliary circuit input cables if applicable.	

Remarks and Recommendations

After the commissioning is complete, the system should be set as per the current settings table indicated in the manual. The readings are to be taken on a daily basis and logged on the log sheet. Log sheets are to be returned monthly to aflogsheets@cathelco.com.

If there are any problems relating to these instructions or the control panel does not function as expected, then please contact Cathelco immediately for further instructions.

Engineer		*Print*		*Date*	
Client		*Print*		*Rank*	

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SECTION 15 Log Sheet for Anti-Fouling System

Vessel **Owner** **Month:** **Year:**
Cathelco Ref No: CA105399 **Anode change over period 5 Years**

Day	MG1	TC1	MG2	MG3	TC2	MG4										
In Use																
Not Use																
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
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26																
27																
28																
29																
30																
31																
Initial Setting																

OBSERVATIONS	**Strainer inspected on**			
(x) as observed	**Nil**	**Light**	**Medium**	**Heavy**
Fouling in strainer				
Fouling in pipeline				
Fouling in heat exch.				
Corrosion in strainer				
Corrosion in pipeline				
Corrosion in heat exch.				

Remarks……
……
Submitted by…… **Chief Engineer**……

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SECTION 16 Appendix

16.1 Recommended Welding Procedures

Weld-in sleeves in steel to BS970/73 070M20 to mild steel plate

1) Use low hydrogen electrodes specification AWS E7018 or BS 639 1986 E5154B26H (Eutectic EUTECTRODE 6666). Ensure all welding consumables (electrodes) are dried according to manufacturer's instruction prior to use.

2) Burn a hole in sea chest top plate or strainer lid. Then grind the face and surrounding top and bottom edges of hole to remove dross, scale, rust and any other contamination that may be present.

3) When welding large diameter sleeves to thick strainer lids or plates preheat is advisable at min 100 C. Electrodes should be baked before use.

4) Tack weld in position using a 3.2 diameter electrode at 130-140 amps.

5) Deposit the top fillet weld using a 5mm diameter electrode at 220-240 amps. 3 passes for a 10mm fillet. 6 passes for a 12mm fillet. Suggested fillet sizes: -

10mm thick plate, use 10mm fillet
25mm thick plate, use 12mm fillet

6) If welding to strainer lid turn the assembly over and repeat the procedure.

7) If welding has to be carried out in the overhead position. Then weld using 3.2mm diameter electrodes at 125/130 amps using a multi-run stringer bead technique: -

6 passes for a 10mm fillet.
10 passes for a 12 mm fillet.

16.2 Fitting Cathelco Anti-Fouling Systems to Vessels with Aluminium Hulls

Important Note

Copper-based systems are **not recommended in aluminium pipe work.** This is because aluminium will react as an anode in the presence of copper, causing severe corrosion of the aluminium.

However, copper-based anti-fouling systems **can be used on aluminium hulled** vessels provided the following steps a strictly followed. Failure to do so can result in damage.

1) The anode(s) must not be fitted in the sea chests.

2) Where the anodes are fitted in-board, inlet and the overboard pipe connection should be electrically insulated from the hull and any aluminium stub pipe coated internally with a dielectric paint.

3) A separate earth return cable/core should be fitted from each anode location (On small systems using 2 only MG anodes, the panel is modified to give two separate earth returns)

4) If the flow goes via an aluminium stern tube the internal surface on the stern tube must be coated and painted with a Di-Electric material

5) All Di-Electric coated areas must be regularly inspected for damage. Any areas of repair must be immediately repaired at the first available docking.

6) On vessels fitted with aluminium strainers, the anodes should be located in board of the strainers. If this is not possible due to pipe work space restriction, then the anode may be fitted as follows: -

7) The aluminium strainer, filter and lid to be fully protected with a dielectric coating and a separate cathode to be fitted in the strainer lid.

8) Any exposed aluminium preceding the strainers should be coated / painted with a dielectric material.

9) Full drawings of the inlets and strainers should be provided to Cathelco for anode position approval.

10) If the strainers are directly over the seawater intakes, then the seawater isolation valve **must** be closed during periods of inactivity. i.e. when there is no water flow. This will prevent any Copper ions from being drawn back towards the inlet grids and aluminium strainers.

Vessels fitted with Aluminium pipe work

A Cathelco system must not be fitted to systems where aluminium pipe work is used downstream of the anodes due to the potential corrosion effects it may have.

16.3 Classification, Packaging and Labelling of Biocidal Products

Cathelco Marine Growth Prevention System (MGPS)

1. **Hazard and Precautionary Statements:** Non-applicable.

   Directive 1999/45/EC – Dangerous Preparations: Not relevant or classified as a 'dangerous' substance or preparation under the definitions of this Directive.

   Regulation (EC) No 1272/2008 - on Classification, Labelling and Packaging of substances and mixtures: According to Article 23 of CLP, metals in massive form benefit from a derogation from labelling requirements.

2.

   a) **Identity of every active substance:**

   Substance (common name): Copper.
   Purity: 99.9%.
   CAS No.: 7440-50-8.
   EC No.: 231-159-6.
   Concentration used (max): 25 parts per billion (µg/L).
   Copper (Cupric – Cu^{2+}) ions generated from elemental copper (99.9% w/w) at concentrations of up to 0.024mg/L (0.00000234% w/w).

   b) **Nano-materials:** Not applicable.

   c) **Authorisation number for EU Member States allocated to the biocidal product:**

EU MEMBER STATES	AUTHORISATION NUMBER
BULGARIA	NO ESSENTIAL USE REQUIRED
CROATIA	534-07-1-1-4/4-16-3
CYPRUS	B1438
DENMARK	PR-No. 2507463
ESTONIA	CERT No: 1478/16
FINLAND	NO ESSENTIAL USE REQUIRED
FRANCE	No: 15-02092-DI
GERMANY	REG. No: DE-2015-WV-11-0001
ICELAND	NO ESSENTIAL USE REQUIRED
IRELAND	PCS 97814
ITALY	NO ESSENTIAL USE REQUIRED
LATVIA	INVENTORY No: LV30062016/5197
LITHUANIA	NO ESSENTIAL USE REQUIRED
LUXEMBOURG	REF: 139/14/L
MALTA	REF No: 2014-09-11-BO1
MONTENEGRO	NO ESSENTIAL USE REQUIRED
NORWAY	P-325524
PORTUGAL	CIAV No: 1741/2016
SLOVENIA	NO ESSENTIAL USE REQUIRED

SPAIN	CIF: GB 125275971
SWEDEN	NO ESSENTIAL USE REQUIRED
UNITED KINGDOM	AUTHORISATION No: UK-2014-O862

d) Name and address of the authorisation holder:

Cathelco Ltd., Marine House, Dunston Road, Chesterfield, Derbyshire, S41 8NY, UK.

e) Type of formulation: Substance, 99.9% purity, massive copper, solid.

f) Uses for which the Biocidal product is authorised:

- For the prevention of bio fouling of the water inlet/pumps and throughout the entire pipework and waterway system of a ship.
- For the prevention of bio fouling of the water inlet/pumps and throughout the entire pipework and waterway system of offshore oil and gas platforms, and other marine and costal installations.

g) Directions for use, frequency of application and dose rate: Continuous low dosage of 2-25 parts per billion (µg/L).

h) Indirect adverse side effects and directions for first aid:

Inhalation: Move victim to fresh air. If not breathing, give artificial respiration or oxygen. Call a physician.
Contact with skin: In case of irritation of the skin, immediately wash skin with copious amounts of water. Wash contaminated clothing before reuse. Wash hands before eating or smoking.
Contact with eyes: Flush thoroughly with copious amounts of water for 15 minutes. Call a physician.
Ingestion: Wash out mouth with water. Induce vomiting if conscious. Call a physician.

i) Accompaniment by a leaflet: Not applicable.

j) Directions for safe disposal of the product and packaging:

Copper containing waste is normally collected to recycle copper. Should waste disposal be deemed necessary, follow applicable local regulations.
Wooden crate packaging should be reused or recycled.
Plastic packaging used should be safely disposed of into general landfill waste.

k) Formulation batch number and expiry date: Not applicable.

l) Period needed for the Biocidal effect: Immediate.
Interval between applications: Constant.
Ventilation of treated areas: None required.
Precautionary measures during use and transport: Wash hands thoroughly after handling. Good manual handling principles and procedures should be followed where copper material is large and heavy. Copper products must be protected against humidity during transportation.

m) Categories of users to which the biocidal product is restricted: Not applicable.

n) Danger to the environment: Not applicable.

o) **Products containing microorganisms:** Not applicable.

p) **Application method:** Ionisation - Metallic electrodes are placed into water and subjected to electrical current releasing free metal ions into the water.

SECTION 17 CATHELCO LIMITED STANDARD TERMS AND CONDITIONS

1. INTERPRETATION

1.1 The following definitions and rules of interpretation apply in these terms and conditions ("the Conditions"):-

Authorised Person: any director of Cathelco.

Buyer: the person, firm or company who purchases the Goods from Cathelco.

Cathelco: Cathelco Limited, a company registered in England and Wales under registered company number 562740 and whose registered address is Marine House, Dunston Road, Chesterfield S41 8NY United Kingdom.

Commercial Arbitration: an arbitration process conducted by (and in accordance with the rules of) the London Court of International Arbitration: -

i) consisting of one arbitrator;
ii) taking place in London;
iii) conducted in the English language; and
iv) seated in England

Contract: any contract between Cathelco and the Buyer for the sale and purchase of the Goods incorporating the Conditions.

Date of Commissioning: the date that the vessel to which the Goods have been fitted is completed and the commissioning report has been signed. In the case of retrospective fittings on vessels that are already operating, the Date of Commissioning will be the date upon which either the fitting is completed or (in the event that the vessel is in dry dock during fitting) the vessel is returned to the water.

Delivery Documents: means the delivery receipt, bill of lading, airway bill or such other document as specified in the Contract as to be passed to the Buyer on delivery as receipt of delivery.

Delivery Point: such location as is specified in the order confirmation issued by Cathelco or as advised by the Buyer.

Goods: any goods agreed in the Contract to be supplied to the Buyer by Cathelco (including any part or parts of them).

Incoterms: Incoterms 2000 as published by the International Chamber of Commerce.

Intellectual Property Rights: all copyright, database rights, topography rights, design rights, trade marks, patents, domain names and any other intellectual property rights of a similar nature (whether or not registered) subsisting anywhere in the world in or associated with the Goods.

1.2 A reference to a particular law is a reference to it as it is in force for the time being taking account of any amendment, extension, application or re-enactment and includes any subordinate legislation for the time being in force made under it.

1.3 Words in the singular include the plural and in the plural include the singular.

2. APPLICATION OF TERMS

2.1 Subject to any variation under Condition 2.*2*, the Contract shall be on these Conditions to the exclusion of all other terms and conditions (including any terms or conditions which the Buyer purports to apply under any purchase order, confirmation of order, specification or other document) other than those specified by Cathelco in their quotation.

2.2 These Conditions apply to all Cathelco's sales and any variation to these Conditions and any representations about the Goods shall have no effect unless expressly agreed in writing and signed by an Authorised Person. The Buyer acknowledges that it has not relied on any statement, promise or representation made or given by or on behalf of Cathelco which is not set out in the Contract. Nothing in this Condition shall exclude or limit Cathelco's liability for fraudulent misrepresentation.

2.3 Each order or acceptance of a quotation for Goods by the Buyer from Cathelco shall be deemed to be an offer by the Buyer to buy Goods subject to these Conditions. No order placed by the Buyer shall be deemed to be accepted by Cathelco until a written acknowledgement of order is issued by Cathelco or (if earlier) Cathelco delivers the Goods to the Buyer.

2.4 Any quotation is given on the basis that no Contract shall come into existence until Cathelco despatches an acknowledgement of order to the Buyer.

3. DESCRIPTION/PRICE

3.1 Subject to Condition 3.4 below, the quantity, description and price of the Goods shall be as set out in Cathelco's quotation or acknowledgement of order subject to availability.

3.2 The Buyer shall ensure that the terms of its order and any specifications are complete and accurate. The specification shall include the waters that the vessel will operate in as well as a full specification of the vessel to which the Goods will be fitted along with any such other details or information requested by Cathelco.

3.3 Unless the quotation specifies otherwise, all quoted prices for Goods are inclusive of packing, but exclusive of carriage, insurance, VAT and all other duties, fees and taxes.

3.4 All samples, drawings, descriptive matter, specifications and advertising issued by Cathelco (other than those provided in the written quotation provided by Cathelco) and any descriptions or illustrations contained in Cathelco's catalogues, brochures or website are issued or published for the sole purpose of giving an approximate idea of the Goods described in them. They shall not form part of the Contract.

4. DELIVERY

4.1 Delivery of the Products shall take place at the Delivery Point. Acceptance of any change to the Delivery Point requested by the Buyer shall be at Cathelco's sole discretion and the Buyer shall be liable for any additional expenses incurred by Cathelco as a result of such change. Cathelco shall arrange for suitable transport to the Delivery Point.

4.2 On delivery Cathelco (or its appointed carrier) shall where necessary provide the Buyer with any UK licence required for the export of the Goods along with Delivery Documents.

4.3 Any dates specified by Cathelco for delivery of the Goods are intended to be an estimate and time for delivery shall not be made of the essence by notice unless otherwise agreed in writing by Cathelco. If no dates are so specified, delivery shall be within a reasonable time taking into account all relevant factors (including without limitation the distance and chosen method of delivery). The Buyer shall take delivery of the Goods on receipt of adequate notice from Cathelco (being not less than 4 days) that the Goods are ready for delivery.

4.4 Cathelco may deliver the Goods by separate instalments unless otherwise stipulated on the Purchase Order. Each separate instalment shall be invoiced and paid for in accordance with the provisions of the Contract. Each instalment shall be a separate Contract

and no cancellation or termination of any one Contract relating to an instalment shall entitle the Buyer to repudiate or cancel any other Contract or instalment.
4.5 If for any reason the Buyer fails to accept delivery of any of the Goods when they are ready for delivery, or Cathelco is unable to deliver the Goods on time because the Buyer has not provided appropriate instructions, documents, licences or authorisations:
(a) risk in the Goods shall pass to the Buyer (including for loss or damage caused by Cathelco's negligence);
(b) the Goods shall be deemed to have been delivered; and
(c) Cathelco may store the Goods until the Buyer takes possession of the Goods, whereupon the Buyer shall be liable for all related costs and expenses (including, without limitation, storage and insurance).
4.6 Unless agreed otherwise in the quotation (including by way of reference to a relevant Incoterm) the Buyer shall provide at the Delivery Point and at its expense adequate and appropriate equipment and manual labour for unloading the Goods.
4.7 The Buyer shall examine the Goods as soon as reasonably practicable after delivery and shall immediately notify Cathelco of any incomplete or failed delivery or any loss or damage during carriage. Unless the Buyer so notifies Cathelco within 30 days after the date at which the Buyer became or ought reasonably to have become aware of the incomplete or failed delivery or loss or damage to the Goods during carriage, the Buyer will be treated as having waived all claims connected with the matter.
4.8 Where the Buyer has entered into more than one Contract with Cathelco failure to deliver the Goods under this Contract will not affect the Buyer's obligation to comply with the terms of any other contracts***.***

5. IMPORT AND EXPORT LICENCES

If appropriate, Cathelco undertakes to obtain any UK licence required for the export of the Goods from the UK by Cathelco. The Buyer shall comply with any such licence and shall obtain and comply with all other necessary licences, permits and consents. If required by Cathelco, the Buyer shall make any such licences or consents available to Cathelco prior to delivery.

6. RISK/TITLE

6.1 The Goods are at the risk of the Buyer from the time of delivery. The condition and security of the Goods from the date of delivery to the Date of Commissioning is the sole responsibility of the Buyer.
6.2 Ownership of the Goods shall not pass to the Buyer until Cathelco has received in full (in cash or cleared funds) all sums due to it in respect of the Goods and all other sums which are or which become due to Cathelco from the Buyer on any account. Cathelco shall be entitled to recover payment for the Goods notwithstanding that ownership of any of the Goods has not passed from Cathelco.
6.3 Until ownership of the Goods has passed to the Buyer, the Buyer shall:
(a) hold the Goods on a fiduciary basis as Cathelco's bailee;
(b) store the Goods (at no cost to Cathelco) separately from all other goods of the Buyer or any third party in such a way that they remain readily identifiable as Cathelco's property;
(c) not destroy, deface or obscure any identifying mark or packaging on or relating to the Goods; and
(d) maintain the Goods in satisfactory condition and keep them in a safe and secure manner.
6.4 The Contract and the Buyer's right to possession of the Goods shall terminate immediately if:
(a) the Buyer commits a breach of any term of any Contract and (if the breach is capable of remedy) fails to remedy it within 30 days after receipt of notice in writing requiring it to do so; or
(b) the Buyer makes any voluntary arrangement with its creditors or (being an individual or firm) becomes bankrupt or (being a company) becomes subject to an administration order or goes into liquidation (otherwise than for the purpose of amalgamation or reconstruction) or an encumbrancer takes possession or a receiver is appointed of any of the property or assets of the Buyer, or the Buyer ceases, or threatens to cease, to carry on business; or
(c) any event analogous to those described in condition 6.4(b) which occurs in relation to the Buyer in any jurisdiction in which the Buyer is incorporated, resident or carries on business.
6.5 The Buyer grants Cathelco, its agents and employees an irrevocable licence to enter any of its premises or vessels where the Goods are or may be stored in order to recover Goods when the Buyer's right to possession of the Goods has terminated.
6.6 On termination of the Contract, howsoever caused, Cathelco's rights contained in this Condition 6 shall remain in effect.

7. PAYMENT

7.1 Subject to Conditions 7.2 and 7.5 and unless otherwise agreed in writing in accordance with Condition 2.2, invoices shall be settled within 30 days of the date of the invoice and time for payment shall be of the essence.
7.2 Should Cathelco stipulate a requirement for security for payment before dispatch of the Goods, Cathelco shall have the right to withhold delivery of the Goods until such security has been received.
7.3 No payment shall be deemed to have been received until Cathelco has received cleared funds in the currency stated on the invoice. In the event of any failure to pay Cathelco any sum due pursuant to the Contract and without prejudice to any other remedies available to Cathelco under the Conditions, the Buyer shall be liable to pay interest to Cathelco at 6% above HSBC Bank Plc base rate for the time being per annum accruing on a daily basis until payment is made, whether before or after judgement.
7.4 All payments payable to Cathelco under the Contract shall become due immediately on its termination despite any other provision.
7.5 All payments under the Contract are due in full without deduction by way of set-off, counterclaim, discount, or otherwise unless the Buyer has a valid court order requiring an amount equal to such deduction to be paid by Cathelco to the Buyer.
7.6 Where the Buyer has entered into more than one contract with Cathelco, failure to pay Cathelco any sum due pursuant to the Contract will entitle Cathelco to terminate all other contracts with and/or suspend any deliveries to the same Buyer and seek payment of all outstanding sums.
7.7 The Buyer shall indemnify Cathelco against all costs, charges and expenses (including legal costs) incurred by Cathelco in recovering sums owing by the Buyer (including but not limited to seizure of vessels).

8. QUALITY

8.1 Cathelco warrants that (subject to the other provisions of the Conditions) the Goods will conform in all material respects to the specification provided by the Buyer in accordance with Condition 3.2. Cathelco further provides a one year warranty applying to all Cathelco systems but excluding all consumable items. The warranty period starts from the delivery date. Consumable items are not included in the warranty unless they fail before their recommended operating period. The condition and security of the equipment from the date of receipt to the date of commissioning is the sole responsibility of the purchaser. All other warranties or conditions (whether express or implied) as to quality, condition, description, compliance with sample or fitness for purpose (whether statutory or otherwise) other than those expressly set out in this agreement are excluded from this agreement to the fullest extent permitted by law.
8.2 Cathelco shall not be liable for a breach of the warranty in Condition 8.1 unless the Buyer gives written notice of the defect to Cathelco within 30 days of the date of which the Buyer became or ought reasonably to have become aware of the breach and Cathelco

is given a reasonable opportunity after receiving the notice to examine such Goods. The Buyer shall as far as possible preserve the Goods for inspection by Cathelco.

8.3 Cathelco shall not be liable for a breach of the warranty in Condition 8.1 if:

(a) the Buyer makes any further use of such Goods after giving such notice; or

(b) the Buyer alters or repairs such Goods without the written consent of Cathelco; or

(c) the defect was caused in any way by the Buyer's failure to provide a full and accurate specification of the vessel that the Goods would be applied to and/or the waters that the Goods would be used in (as required by Condition 3.2); or

(d) the defect was caused in any way by the Buyer's failure to follow good trade practice or the Cathelco's oral or written instructions as to storage, installation, use or maintenance of the Goods.

8.4 Subject to Conditions 8.2 and 8.3, if any of the Goods do not conform with the warranty in Condition 8.1, Cathelco shall at its option repair or replace such Goods (or the defective part) or refund the price of such Goods at the pro rata Contract rate provided that, if requested, the Buyer shall return the Goods to Cathelco.

8.5 If Cathelco complies with Condition 8.4 (or if Cathelco's reasonable attempts to comply with its preferred remedy under Condition 8.4 are obstructed by the Buyer), Cathelco shall have no further liability for a breach of the warranty in Condition 8.1 in respect of such Goods.

8.6 Where Goods are returned to Cathelco, Cathelco will accept no responsibility for the condition of the Goods received from the Buyer. It is the responsibility of the Buyer to ensure that the packing is sufficient to protect the Goods during transit. The Buyer will be required to pay for the replacement of Goods received which are damaged beyond economical repair or for repairs where such damage is caused by transit.

9. INSTALLATION AND TESTING

9.1 It is the sole responsibility of the Buyer to ensure that the Goods are installed correctly and in compliance with Cathelco's instructions. Cathelco can accept no responsibility for any damage or loss to Goods or otherwise arising as a result of incorrect installation. The conditions of warranty may be extended if the installation is supervised by a Cathelco approved engineer but any such extensions of warranty must be agreed in writing and signed by an Authorised Person. The supervision will not apply to the structural applications involving preparation, cutting or welding of the vessel for the purposes of mounting and securing the installed equipment.

9.2 Cathelco accepts no responsibility for testing and commissioning unless it is carried out by a Cathelco-approved engineer. In such cases, Cathelco warrants that the engineer will exercise reasonable care and skill within the meaning of the Supply of Goods and Services Act 1982. This warranty will run for one year from the Date of Commissioning where the Cathelco-approved engineer has signed the commissioning report and it has also been countersigned by a recognised representative of the shipyard.

10. LIMITATION OF LIABILITY – <u>THE BUYER'S ATTENTION IS PARTICULARLY DRAWN TO THE CONTENTS OF THIS CONDITION</u>

10.1 All warranties, conditions and other terms implied by statute or common law (save for the conditions implied by section 12 of the Sale of Goods Act 1979) are, to the fullest extent permitted by law, excluded from the Contract.

10.2 Nothing in the Conditions excludes or limits the liability of Cathelco:

(a) for death or personal injury caused by Cathelco's negligence; or

(b) under section 2(3) or any other applicable section under the Consumer Protection Act 1987; or

(c) for any matter which it would be illegal for Cathelco to exclude or attempt to exclude its liability; or

(d) for fraud or fraudulent misrepresentation.

10.3 The Buyer will not be entitled to claim any damages in contract, tort (including negligence or breach of statutory duty), misrepresentation, restitution or otherwise, arising from the performance or contemplated performance of the Contract unless they have first given notice of the claim to Cathelco in compliance with Condition 8.2.

10.4 Subject to Conditions 10.1 and 10.2: -

(a) Cathelco's total liability in contract, tort (including negligence or breach of statutory duty), misrepresentation, restitution or otherwise, arising in connection with the performance or contemplated performance of the Contract shall be limited to the total cost of the Goods; and

(b) Cathelco shall not be liable to the Buyer for: -

i) any indirect, special or consequential loss or damage; or

ii) loss of data or other equipment or property; or

iii) economic loss or damage; or

iv) incurring of liability for loss or damage of any nature whatsoever suffered by third parties (including in each case incidental and punitive damages); or

v) any loss of actual or anticipated profit, interest, revenue, anticipated savings or business or damage to goodwill even if Cathelco is advised in advance of the possibility of any such losses or damages.

The Buyer acknowledges and agrees that the price of the Goods reflects the limitations of liability contained in the Contract.

11. INTELLECTUAL PROPERTY

11.1 The Buyer acknowledges that:

(a) the Intellectual Property Rights are Cathelco's (or its licensor's) property;

(b) nothing in this Contract shall be construed as conferring any licence or granting any rights in favour of the Buyer in relation to the Intellectual Property Rights; and

(c) any reputation in any trade marks affixed or applied to the Goods shall accrue to the sole benefit of Cathelco or any other owner of the trade marks from time to time.

11.2 The Buyer shall not remove any copyright notices, confidential or proprietary legends or identification from the Goods save for any removal which is a necessary result of an installation process.

11.3 The Buyer shall not use or seek to register any trade mark or trade name (including any company name) which is identical to, confusingly similar to or incorporates any trade mark or trade name which Cathelco or any of its associated companies own or claim rights to anywhere in the world.

11.4 The Buyer shall promptly and fully notify Cathelco of:

(a) any actual, threatened or suspected infringement of any Intellectual Property Rights which comes to the Buyer's notice; and

(b) any claim by any third party that comes to the Buyer's notice that the sale or advertisement of the Goods infringes the rights of any person.

11.5 The Buyer agrees (at Cathelco's request and expense) to do all such things as may be reasonably required to assist Cathelco in taking or resisting any proceedings in relation to any infringement or claim referred to in Condition 11.4.
11.6 On termination of the Contract howsoever caused Cathelco's rights contained in this Condition 11 shall remain in effect.

12. FORCE MAJEURE

Cathelco shall not be liable for any delay in performing or failure to perform any of its obligations under this Contract if such delay or failure results from events or circumstances outside its reasonable control which shall include (without limitation): natural disasters; war; terrorism; accidents; explosions; incidents; breakdown of equipment or machinery; sabotage; strikes or other labour disturbances (regardless of the reasonableness of the demands of labour); acts or omissions of government; port congestions; and shortage of supplies or labour. Such delay or failure shall not constitute a breach of this Contract and the time for performance shall be extended by a period equivalent to that during which performance is so prevented or a period of 21 days, whichever is the shorter, after the expiry of which the Buyer shall be entitled to give notice in writing to Cathelco to terminate the Contract with respect to any Goods undelivered at that time.

13. SEVERANCE

13.1 If any Condition (or part of a Condition) of the Contract is found by any court or administrative body of competent jurisdiction to be invalid, unenforceable or illegal, the other Conditions will remain in force.
13.2 If any invalid, unenforceable or illegal Condition would be valid, enforceable or legal if some part of it were deleted, that Condition will apply with whatever modification is necessary to make it valid, enforceable and legal.
17.1.1.1 13.3 The parties agree, in the circumstances referred to in Condition 13.1 to substitute for any invalid, unenforceable or illegal Condition a valid, enforceable and legal Condition which achieves to the greatest extent possible the same effect as would have been achieved by the invalid or unenforceable Condition.

17.1.1.2 14. WAIVER

Failure or delay by Cathelco in enforcing or partially enforcing any term of the Contract shall not be construed as a waiver of any of its rights under the Contract. Any waiver by Cathelco of any breach of, or any default under, any term of the Contract by the Buyer shall not be deemed a waiver of any subsequent breach or default and shall in no way affect the other terms of the Contract.

15. THIRD PARTIES

15.1 The parties to the Contract do not intend that any term of the Contract shall be enforceable by virtue of the Contracts (Rights of Third Parties) Act 1999 by any person that is not a party to it. This Condition 15.1 does not affect any right or remedy of any person that exists or is available otherwise than pursuant to that Act.
15.2 Each party shall promptly notify the other of any claims brought or contemplated by third parties in relation to the Contract or the particular Goods sold hereunder and shall comply with the other's reasonable requirements to minimise and/or avoid any further liability and shall allow the other conduct of any action and/or settlement on reasonable terms.

16. ASSIGNMENT

Cathelco may assign the Contract or any part of it without the prior written consent of the Buyer. The Buyer shall not assign this Contract or any rights hereunder in whole or in part to any third party without the prior written consent of an Authorised Person.

17. LAW, JURISDICTION AND DISPUTES

17.1 The formation, existence, construction, performance, validity and all aspects of the Contract shall be governed by English law. The parties submit to a final resolution of any dispute by Commercial Arbitration rather than through the English Courts. For the avoidance of doubt, the United Nations Convention on the International Sale of Goods shall not apply to this Agreement.
17.2 Nothing in this Condition 17 shall limit the right of Cathelco to take proceedings against the Buyer in any other court of competent jurisdiction, nor shall the taking of proceedings in any one or more jurisdiction preclude the taking of proceedings in any other jurisdiction, whether concurrently or not, to the extent permitted by the law of such other jurisdiction
17.3 Incoterms shall apply to the Contract but where they conflict with the Contract, the Contract shall prevail.
17.4 Subject to Condition 17.1, any disputes that cannot be resolved between the parties must be referred to Commercial Arbitration within one year of either (i) the date of this Contract, or (ii) the end of the warranty period as defined in Condition 8.3, whichever is the later.

18. COMMUNICATIONS

18.1 All communications between the parties about the Contract shall be in writing and delivered by hand or sent by pre-paid first class post (or airmail if sent from outside the UK) or sent by fax or e-mail:
(a) (in case of communications to Cathelco) to the Sales Team at Cathelco's registered office; or
(b) (in the case of the communications to the Buyer) to any address of the Buyer as shall be notified to Cathelco by the Buyer.
18.2 Communications shall be deemed to have been received: -
(a) if delivered by hand, at the time of delivery;
(b) if posted first-class within the United Kingdom, 48 hours after posting;
(c) if posted by airmail, five days after the date of posting; and
(d) if sent by fax or e-mail on a working day prior to 4.00 pm, at the time of transmission and otherwise on the next working day.