USFilter

ELECTROCATALYTIC PRODUCTS

CAPAC®

IMPRESSED CURRENT CATHODIC PROTECTION

When you choose Capac, you're backed by the expertise and service capabilities of USFilter's Electrocatalytic Products, a worldwide corporation that has manufactured Capac and other electrochemical equipment since 1950. The Capac system represents the best engineering and design standards available, and can be tailored to address the specific needs of every application.

Electrocatalytic means expertise. Our people offer a solid reputation for delivering technical excellence and customer satisfaction. The company has over 3000 shipboard CAPAC impressed current cathodic protection installations in use worldwide. System and system components such as anodes and reference electrodes are manufactured for the offshore oil, refining and power generating industries. These systems are renowned for their high quality of manufacture and reliability in use. In addition, Electrocatalytic offers customers single-source supply and manufacture of all major CAPAC system components.

CAPAC systems are backed by a network of strategically located service centers worldwide — one of the best and largest in the industry. Stocked with quality factory parts and staffed by factory-trained service technicians, they stand ready to provide prompt, expert assistance on CAPAC systems of all kinds.

CAPAC is a permanent, on-board, automatic corrosion protection system that prevents electrolysis and galvanic corrosion from attacking the submerged surfaces of vessels. This high-tech system is the ultimate state-of-the-art, long-term solution to corrosion problems on hulls, and is recognized as a superior alternative to sacrificial anode systems — which require more frequent replacement and increased fuel and maintenance costs.

CAPAC works by supplying a controlled amount of DC current to submerged surfaces utilizing highly reliable platinum- or mixed metal oxide (MMO)- surfaced anodes and silver/silver chloride reference electrodes. This electrical current, constantly monitored and regulated by the system itself, stops the electro-chemical action of galvanic corrosion.

Stopping corrosion on your ship's hull has numerous benefits. CAPAC not only keeps your ship's hull in top operating condition, but also eliminates the accompanying maintenance, down time, and fuel costs that are a direct result of premature corrosion. CAPAC is a maintenance tool used by the owner to keep the vessel in service for longer periods without drydocking. For these reasons alone, CAPAC is a tremendous benefit for all types of vessels.

CAPAC SYSTEMS...
FOR ALL VESSELS

CAPAC-equipped vessels of all kinds can be found sailing the seas under the 24-hour protection of our impressed current systems. From oil tankers to pleasure craft and workboats, CAPAC shields the underwater hull and components from the costly effects of electrolysis — for more than 20 years!

With CAPAC, you'll lengthen the life of rudders, shafts, struts, and wheels as well, plus any other underwater parts affected by electrolysis. CAPAC anodes, reference cells, and automatic control systems maintain just the right amount of protection to underwater hulls and fittings, unlike standard zinc anodes — which cannot adjust to changes in salinity or compensate for extreme paint loss.

The CAPAC system is at optimum effectiveness in any salt water (dockside or underway), regardless of water temperature. It operates automatically from the vessel's standard AC power source. Power draw is minimal, and is adjusted continuously by the most sensitive and reliable control components available for variations in hull paint coating, speed, salinity, and temperature of the water.

CAPAC offers ship owners a full range of standard components for corrosion protection tailored to the vessel, under all operating conditions. Our systems have been approved by all classification societies for all types of vessels.

The cost benefits and peace of mind that come with knowing you've utilized the best corrosion protection system available are reason enough to select CAPAC for your new vessels, as well as retrofits on your existing fleet.

POWER SUPPLY / RECTIFIERS

Highly reliable, state of the art "switch mode" type, like all CAPAC components, the system's DC supply is based on our 40 years of experience and refinement in design. These units are built to last the life of the ship.

FEATURES

- Class H (220 °C) insulation and Class B (80 °C) rise
- AC circuit breaker on the input
- Operating range is 0%-100% DC output
- Uses IGBTs to convert AC to DC

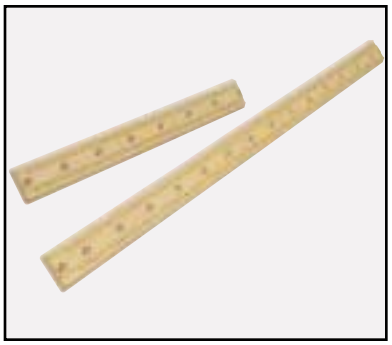
BENEFITS

- Assures a long, trouble-free life
- Coordinates thermal and over current protection
- Eliminates the possibility of over protection
- Allows for a 50% reduction in size and weight

LOW PROFILE ANODES

In ICCP systems, anodes are insulated from the hull and appendages. The anodes are powered by a DC source, usually a rectifier. The anodes are constructed of relatively insoluble metal/metal oxide. Platinum- or MMO-surfaced anodes on tantalum and niobium and titanium substrates are used exclusively in the CAPAC system. The platinum and MMO forms an oxide when electrically energized. CAPAC anodes are manufactured in strip, oval, and circular shaped insulating holders. They are available in a single unit capacity up to 225 amperes, as may be needed for various installations.

MIL-SPEC ANODES



FEATURES

- Platinum and MMO has long life in all services
- Platinum and MMO operates in all natural waters
- Substrates have high voltage capability
- Compression molded GRP anode holder
- Center-fed “H”-shaped anode insert
- Diver-serviceable designs are available
- Lightweight, bolt-on design with all capacities
- Anode assembly incorporates the secondary cofferdam

BENEFITS

- Proven 20-year installations; eliminates replacement costs
- Does not fail in brackish or fresh water like lead alloy anodes
- Reduces the number required
- Pressure molding eliminates failure of hand layup
- High reliability even when struck by underwater objects
- Damaged anodes are replaced with the hull afloat
- Lowers installed cost; minimum handling, welding, scaffolds
- Reduced installation time and cost

LOW PROFILE REFERENCE ELECTRODES

ICCP systems are controlled to assure optimum protection. This control is obtained by inserting a third electrode between the anode and the cathode. The third electrode is insulated and does not receive any anode current. This electrode is freely corroding and it becomes the starting point — or reference — in eliminating corrosion. Electrodes constructed of silver with a silver chloride coating (Ag/AgCl) are used exclusively with the CAPAC system.

MIL-SPEC REFERENCE ELECTRODES

FEATURES

- Ag/AgCl electrodes have long life in all services
- Ag/AgCl operates in all natural waters
- Ag/AgCl has proven high stability
- CAPAC incorporates a shielded electrode
- CAPAC uses a large-area electrode
- CAPAC offers an optional cartridge electrode design
- Electrode assembly incorporates the secondary cofferdam

BENEFITS

- Proven 20-year installations; eliminates replacement costs
- Does not fail in brackish or fresh water like zinc electrodes
- Stability is shown to be better than 10 mV (zinc is 135 mV)
- Potential does not change with speed, as do exposed designs
- Potential does not change with contaminants, as do others
- Cartridge electrodes can be changed while afloat
- Reduced installation time and cost

ECL-2000 COMPUTER CONTROLLER

Each standard CAPAC system utilizes a solid-state controller which monitors and controls the protection as measured by the silver/silver chloride electrode. Anode current automatically increases when the electrode potential falls below the designated control value. An over- and under-potential alarm is provided with the system package.

We also offer optional digital control, state-of-the-art technology with every CAPAC system. The ECL-2000 computer controller (shown at left) is more accurate and provides central control, monitoring, data storage and hard printout.

MIL-SPEC-QUALIFIED

ECL-2000 MIL-SPEC

FEATURES	BENEFITS
• Central control of foreward, midship, and aft sub-systems	• Provides fully uniform level of protection

• Continuous monitoring and display of:
  • Ship name, date, and time
  • System status
  • Control set point
  • Port and starboard electrode(s)
  • Output current of each supply
  • Shaft ground millivolts
	• Eliminates possibility of overprotection
	• Eliminates oscillation
	
	• User-friendly

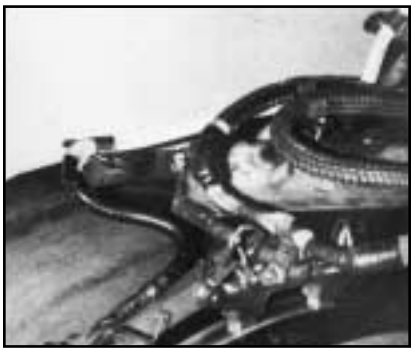
• Automatic data logging and printing on demand • Storage of data for up to six months • Self-diagnostics of vital system components	• Reduces long-term manpower expense • Eliminates numerous manual operations • Extends drydock interval • Performance-based warranty
• Automatic selection of control electrode • Visual display of trouble items • Integrated with ship's mainframe (ICAS)	• Provides optimum cathodic protection • Ease of maintenance

SHAFT GROUND

CAPAC systems feature a silver alloy slip band and silver graphite brushes to ensure that the propeller and shaft are electrically bonded to the hull. Silver utilized on the contact surfaces provides a low-resistance electrical connection.

In addition, CAPAC'S shaft-hull monitor provides the system operator with quick answers when determining the status of the electrical bond. It guarantees that voltage drops between the shaft and hull never exceed 40 millivolts. When this voltage is higher than 40 millivolts, it may be necessary to clean the shaft ground device or replace the brushes.

The shaft-hull monitor is not required when a CAPAC computer controller is installed.



FEATURES

- Silver alloy slip ring band is installed
- Silver-graphite brushes are installed
- Shaft currents can be very high — even over 50 amperes
- Potential between shaft and hull is low — under 40 mV

BENEFITS

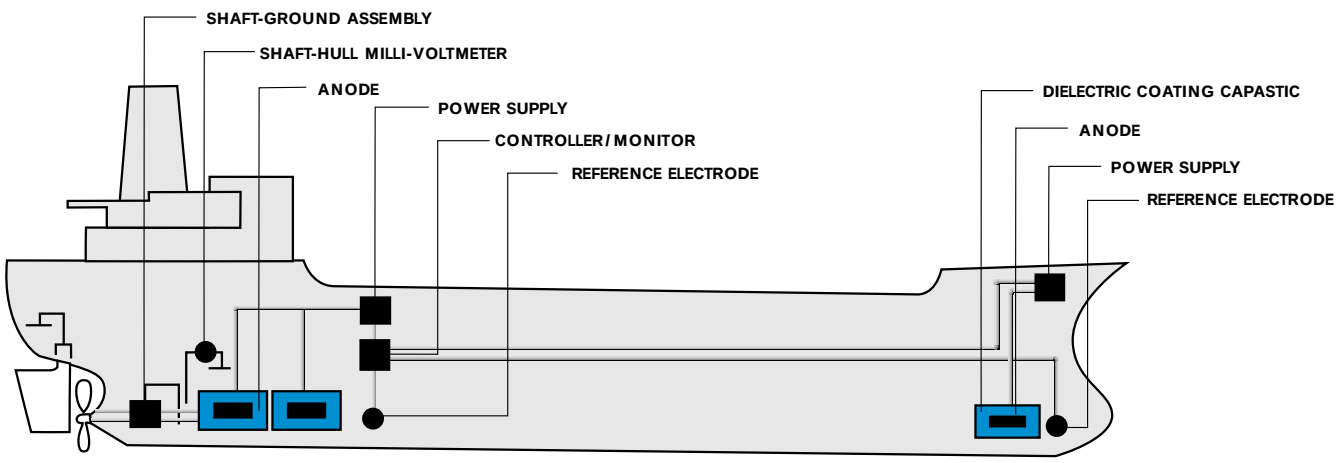
- Silver oxide is a conductor and resistance stays low
- Operating resistance is very low — less than one milliohm
- Protection of propellers from corrosion is achieved
- Pitting of shaft, shaft liner, and gear can be eliminated

COMPONENTS

Equipment	Part No.	Specification*	Weight**
SHIPBOARD ANODE ASSEMBLIES			
Anode, Circular, 50A	82824-050	355 mm Dia. x 6 mm (14 in x 1 in)	1 Kg (2 lbs)
Anode, Elliptical,100A	82825-100	229 mm x 457 mm x 6 mm (9 in x 18 in x 0.250 in)	1 Kg (2 lbs)
Anode, Elliptical, Diver Serviceable, Pt/Niobium, 50A	74200-001	240 mm x 470 mm x 31 mm (9.5 in x 18.5 in x 1.2 in)	15 Kg (33 lbs) (with cable)
Anode, Rectangular, 100A	82824-100	1.2 m x 110 mm x 6 mm (48 in x 4 in x 0.250 in)	1.5 Kg (3.3 lbs)
Anode, Rectangular, Diver Serviceable, Pt/Niobium, 120A	73400-001	1.8 m x 110 mm x 25 mm (72 in x 4 in x 1 in)	25 Kg (55 lbs) (with cable)
Anode, Rectangular, 150A	82824-150	2.4 m x 470 mm x 6 mm (76 in x 4 in x 0.250 in)	2.0 Kg (4.4 lbs)
Anode, Rectangular, 225A	82824-225	2.4 m x 470 mm x 6 mm (76 in x 4 in x 0.250 in)	27 Kg (60 lbs)
Dielectric Shield, "Capastic"	35524	Included With All Anode Assemblies	6.0 Kg/KIT (13lbs/KIT)
Other custom anode shapes are available for protection of those special areas such as thruster tunnels and sea chests.			
REFERENCE ELECTRODE			
Cartridge Type	32622	Silver/Silver Chloride	5 Kg (11 lbs)
SWITCH MODE POWER CONVERSION UNIT 58600 - SERIES			
150 AMP D.C.	58614-SW	380/440V, 3PH, 50/60Hz 813 mm x 736 mm x 365 mm (32 in x 29 in x 14 in)	114 Kg (250 lbs)
200 AMP D.C.	58613-SW	" "	114 Kg (250 lbs)
300 AMP D.C.	58612-SW	" "	105 Kg (230 lbs)
450 AMP D.C.	58611-SW	" "	105 Kg (230 lbs)
600 AMP D.C.	58615	" "	359 Kg (790 lbs)
REMOTE CONTROLLERS / MONITORS			
Computer Controller (Optional)	79681	120/220V Input	9 Kg (20 lbs)
Monitor (Optional)	81943	120/220V Input	5Kg (11 lbs)
SHAFT GROUND ASSEMBLY			
Silver Alloy Band Type	37000	Silver Alloy Band with Silver Graphite Brushes	5 Kg (11 lbs)
SHAFT HULL MILLIVOLT METER			
Shaft Ground Monitor (Optional)	36828	292 mm x 229 mm x 127 mm Note: Not required when computer controller 79681 is installed	5 Kg (11 lbs)

*Dimensions and weights shown are approximate

**Weight does not include Cofferdam or Capastic



WHY IMPRESSED CURRENT CATHODIC PROTECTION (ICCP)?

BECAUSE OF THE BENEFITS

It is proven that cathodic protection eliminates corrosion. The protection is provided by anode amperes. This protection, however, must be provided at optimum ampere levels — too little and corrosion occurs, too much and coatings may be damaged. With ships, the optimum amount of amperes is always changing.

Ampere requirements increase proportionately to ship speed, coating age, and oxygen content. Current provided by ICCP is automatically and continuously adjusted to meet conditions. Voltage provided by sacrificial zinc or aluminum anodes is too high when new and too low when old. Compare the results below.

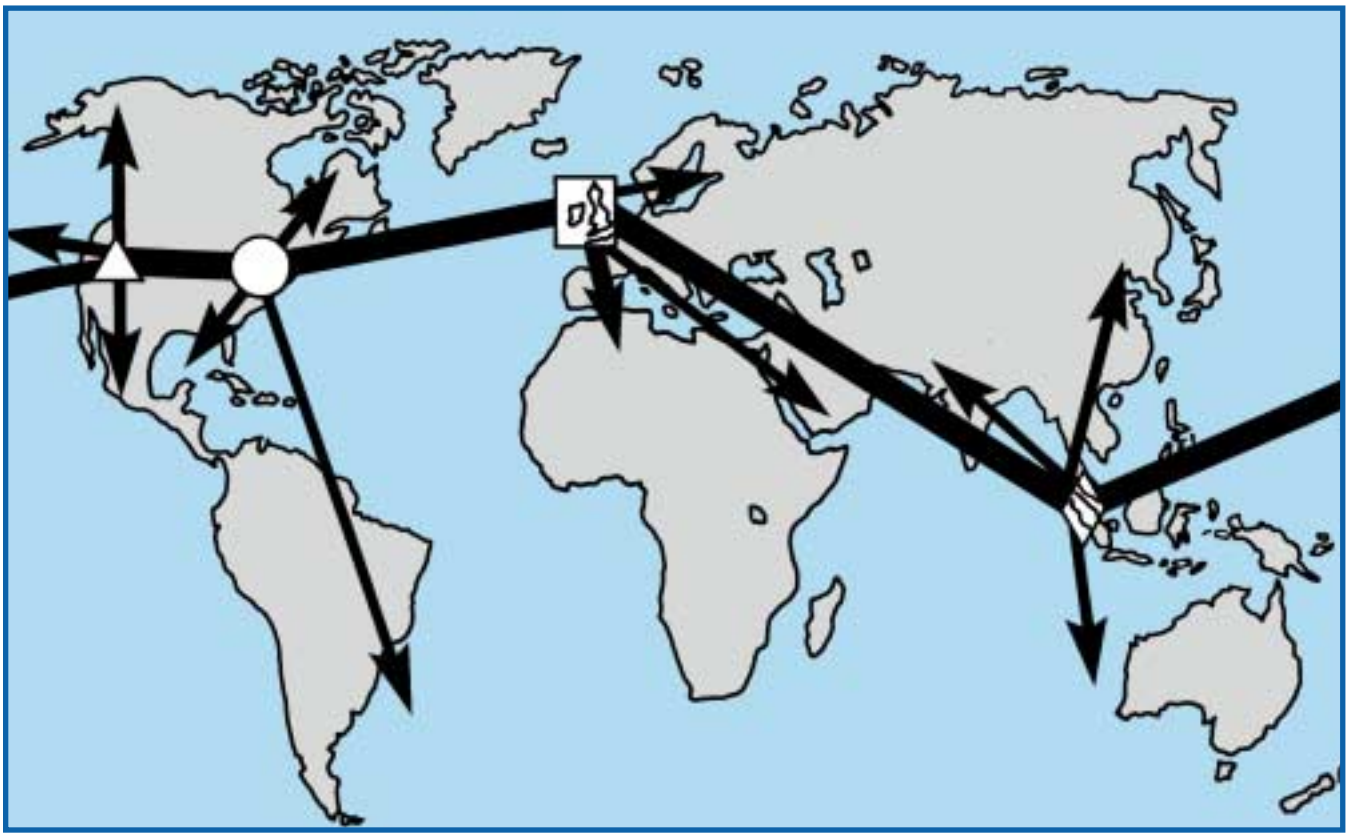
ICCP SYSTEM	SACRIFICIAL ANODES
Long life	Limited life
Extended drydocking interval (5 years or more)	Two-year drydocking interval
Optimum protection	High stress on new coatings
Optimum protection	Corrosion on hull as coating deteriorates
Contribute to meeting speed specifications	Slower speed on rough hulls
Help reduce fuel consumption by maintaining a smooth hull	High drag and fuel use
One-time installation	High reinstallation cost
Documented protection	Unknown protection level
Documented distribution	Unknown protection location
Documented amperes	Unknown protection amperes

...WITH SACRIFICIAL ANODES, YOU WILL NOT KNOW THE RESULTS UNLESS YOU PERFORM A SURVEY – EITHER IN DRYDOCK OR UNDERWATER BY A DIVER. WITH ICCP, THE RESULTS ARE RECORDED EVERY DAY.

SACRIFICIAL ANODE SYSTEMS

Require replacement up to

- 10 times in a similar period
- 10 sets of labor
- 10 repair bills
- 10 periods of downtime



DEPEND ON USFILTER'S ELECTROCATALYTIC PRODUCTS WORLDWIDE TECHNICAL SERVICE CAPABILITIES

- Installation supervision
- Commissioning
- Operator training
- Technical "hotline" support
- Planned maintenance on contract
- On-site routine service
- Around-the-clock emergency service

...and rely on our strategically located technical service centers – with parts inventory – to ensure your system is performing at its best at all times.

ALSO AVAILABLE FROM USFILTER'S ELECTROCATALYTIC PRODUCTS:

THE CHLOROPAC® ELECTROCHLORINATION SYSTEM FOR MARINE GROWTH PREVENTION

CHLOROPAC provides proven, warranted protection from marine organisms on offshore platforms and other installations. It provides an effective method of treating cooling water in these installations without the safety hazards associated with liquid chlorine. CHLOROPAC offers a low life cycle cost, and is backed by the same excellent service as our CAPAC system.

USFILTER'S ELECTROCATALYTIC PRODUCTS

USFilter is the leading global provider of commercial, industrial, municipal and residential water / waste-water treatment systems, maintaining operations in more than 100 countries. USFilter's Electrocatalytic Products are a leading provider of hypochlorination and electrochemical equipment designed to control biological fouling and corrosion at power plants, petro-chemical facilities as well as ships and offshore facilities. Founded in 1950, USFilter's Electrocatalytic Products offer sales and support services worldwide.

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