

# DENSO DIGEST



Special Marine Issue

**FOR THE PROTECTION OF STEEL, CONCRETE AND TIMBER MARINE PILING**

Denso products provide effective long-term solutions to a wide range of corrosion prevention and sealing problems backed by over 60 years experience. The protection of structures in the splash and inter-tidal zones presents many unique problems. We have worked closely with our companies based in six countries to develop SeaShield Systems which can be applied above and below water and meet the special demands of a variety of marine environments.

The Winn & Coales group of companies offer a consultancy service built on worldwide experience in the protection of marine piles. We will advise on the most suitable SeaShield System or combination of systems, based on environmental and economic considerations, to meet specific requirements.

**STEEL AND CONCRETE PILES**

The common and vital element of all the SeaShield systems for concrete and steel pile protection is the waterproof anti-corrosion layer placed over the substrate. This consists of a petrolatum based primer containing water displacing agents, corrosion inhibitors and wide spectrum biocides. Over the primer is wrapped a double layer of tape coated with a petrolatum based compound. The combination of the two components effectively isolates the steel or concrete from the surrounding environment.



The waterproof layer is protected from physical damage by an outer armouring layer. The choice of armouring depends on the environmental conditions at each particular site. The factors to be considered are: exposure to prevailing weather; tides; currents; wave height; marine growth; pollution; risk of impact, abrasion etc.

Pages 2-9 outline some of the armouring options used in SeaShield installations protecting concrete and steel piles.

**TIMBER PILES**

In many parts of the world timber piles become infested with borers of various types which destroy the integrity of the piles and can cause their eventual collapse. SeaShield Systems have been developed which prevent the initial infestation or destroy existing borers and stop reinfestation.

The systems operate by encapsulating the timber pile thereby preventing any water exchange between the surrounding sea and the infested timber. This destroys the resident borers and prevents further attack.



Pages 10-11 give details of SeaShield Systems specially developed for the protection of timber piles.

A division of Winn & Coales International Ltd, Archco-Rigidon Ltd specializes in the manufacture of high build, high performance reinforced coatings for use on concrete or steel. Archco-Rigidon has developed Rigspray specifically for use on oil production platforms and other coastal installations, see page 11 for further details.

## STEEL PILE PROTECTION

### SEASHIELD SERIES 80 SYSTEM

The waterproof anti-corrosion layer plus: A robust tape outer-wrap comprising a polymer modified bitumen compound laminated to a tough pvc backing film



## STEEL PILED JETTY IN THE THAMES ESTUARY

In 1985 a trial installation of SeaShield Series 80 was carried out on three 660mm diameter steel piles on a jetty in the Thames estuary.

Six years later the condition of the three protected piles was examined. The results so impressed the engineers that the remaining 103 piles were also protected with the SeaShield Series 80 System.

The piles were cleaned, primed and wrapped from the mud line to the underside of the jetty deck.

Completed installation at low tide.



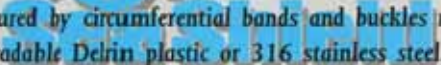
Prepared pile before installation of SeaShield Series 80 System.



### SEASHIELD SERIES 100 SYSTEM

The waterproof anti-corrosion layer plus: An ultraviolet resistant, high density polyethylene outer cover with excellent impact, abrasion and chemical resistance.

The covers are secured by circumferential bands and buckles made from non-degradable Delrin plastic or 316 stainless steel.



## LA GUARDIA AIRPORT, NEW YORK

La Guardia Airport in the State of New York has two runways spanning the East River.

The runways are supported by approximately 3,000, 16" and 18" diameter steel piles. After undergoing a stringent two year assessment programme, The

New York Port Authority selected SeaShield Series 100 System as one of the anti-corrosion systems for the project.



SeaShield protected piles supporting the runway.



## SEASHIELD SERIES 100 SYSTEM

### PROTECTION OF OFFSHORE CONDUCTOR PIPES

During an inspection in 1991, the conductor pipes on an offshore gas production platform in the Aegean Sea were found to be severely corroded. The pipes had been installed without the benefit of an anti-corrosion coating and consequently deep pitting corrosion had occurred above sea level in the splash zone. The engineers chose the SeaShield Series 100 System as the retro-fit system to prevent further corrosion damage.

The conductor pipes were cleaned to remove marine growth and loosely adhering rust and scale and the full system of paste, tape and outer jackets applied during the summer of 1992.

Twenty-four pipes of 610mm diameter were protected from one metre below mean water level to three metres above.



Application of petroleum tape.



Underwater application of paste to prepared pipe. (Note epoxy coated locating band already positioned).

### TEES PORT CARGO WHARF

The Tees and Hartlepool Port Authority, as part of the upgrading of the Cargo Fleet Wharf, planned to cast a new concrete deck over the existing one. The hexagonal section steel piles of the structure were tested and it was found that they would safely support the extra weight. However, the engineers decided to install a corrosion prevention system on the piles at the high water level, that being the most vulnerable area for corrosion attack and subsequent weakening.

Completed Series 100 cover.



As the wharf is situated some miles up the river estuary, a mixture of systems was considered appropriate. Firstly the areas one metre above and two metres below high water level were cleaned using high pressure water and a twin jetted rotary head.

The cleaned piles were coated with underwater paste and wrapped with Denso Tape.

The area below high water level, on the inner rows of piles,

H.P. water jet cleaning using a Neolith SP2 rotating head at 12,000 psi.



was protected by the SeaShield Series 80 System. On the outer row, as the risk from impact damage was greater, the Series 100 System was used. This consisted of pre-formed HDPE jackets secured with coated stainless steel bands and buckles.

## STEEL PILE PROTECTION



### SEASHIELD SERIES 150 SYSTEM

The waterproof anti-corrosion layer plus: An ultraviolet resistant, high density polyethylene outer jacket with excellent impact, abrasion and chemical resistance. The covers have electrofusion wires embedded in the edges and are secured by tensioning around the wrapped pile and fusing the edges together.

Pile in foreground is in its original state. The pile behind it has been clamped and connected to a power supply ready to be electrofused.

## FREEMANTLE PORT AUTHORITY BULK CARGO JETTY, KWINANA, WESTERN AUSTRALIA

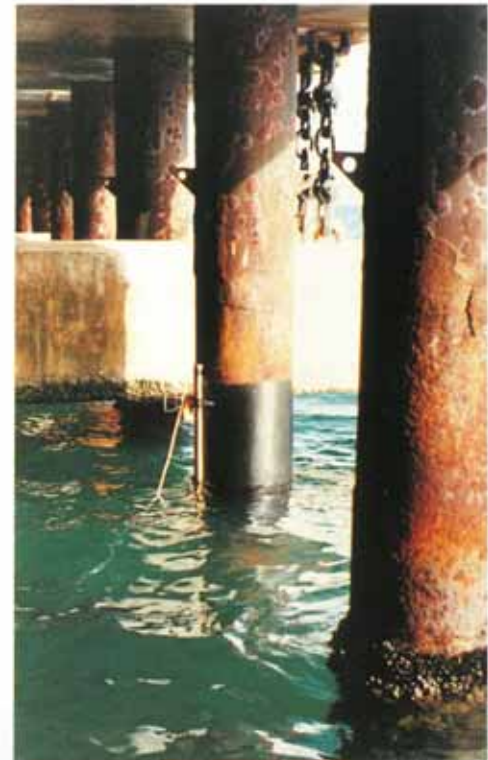
The bulk cargo jetty was originally designed and constructed for a 60 year life utilising a 100% corrosion allowance factor on the cylindrical steel piles.

After 30 years in operation the extra steel incorporated to provide the required corrosion allowance has corroded away.

Approximately 120 piles are being refurbished using the SeaShield Series 150 System with all piles scheduled for complete protection over a five year period.

The piles are water blasted until clean then primed and taped. Polyethylene jackets two metres in length are then clamped tightly around the pile and electrofused into place.

Connection of power supply prior to electrofusion.



## STEEL PILE PROTECTION

### SEASHIELD SERIES 200 SYSTEM

The waterproof anti-corrosion layer plus: An ultraviolet resistant outer jacket fabricated from either high density polyethylene or polypropylene, with excellent impact, abrasion and chemical resistance.

The jackets are secured in position with bolts, washers and nuts made from

## PLYMOUTH PORT RECONSTRUCTION, MONTserrat, WEST INDIES

The jetty at the port of Plymouth, on the small West Indian island of Montserrat, was destroyed in a devastating hurricane. As part of the rebuilding programme a new steel piled jetty was designed, large enough to accommodate the cruise ships that ply between the Caribbean islands.

Construction and fabrication of all the elements of the new jetty took place on the island, utilising local labour as much as possible.

As a long service life free from major maintenance was required, a two-fold system was incorporated in the design to protect the steel piles from corrosion. Firstly, the fabricated piles were given an epoxy

Partially completed jetty showing protection system in place.

Final tightening of the locating bands.



coating. They were driven, cut to length and the concrete crossheads cast in-situ. Secondly, the SeaShield Series 200 System was applied over the epoxy coating.

A total number of 178 piles, each of 762mm diameter, were fitted with the SeaShield Series 200 System for a length of three metres from the underside of the crossheads

Fitting HDPE jacket with temporary holding straps in position.



## CONCRETE PILE PROTECTION

### SEASHIELD SERIES 200 SYSTEM

Pre-formed grey polypropylene jackets in place.



View of bridge during jacket installation.

## BLYTHBURGH ROAD BRIDGE

The construction of a new road bridge over a small river estuary involved the driving of reinforced concrete piles with an hexagonal cross-section.

Concrete piles wrapped with petrolatum tape.



There was concern that the brackish estuary water would create problems in the future from penetration of chlorides and subsequent re-bar corrosion. The additional risk of impact from floating debris influenced the final selection of the SeaShield Series 200 System. This would give good abrasion and impact resistance whilst providing a waterproof barrier for the concrete.

The outer jackets were fabricated from grey coloured polypropylene which were pre-formed to conform to the hexagonal profile of the piles.

## SEASHIELD SERIES 200 SYSTEM

## RAYNES QUARRY AGGREGATE LOADING JETTY, NORTH WALES

The original loading jetty had to be demolished during the up-grading of the A55 trunk road along the North Wales coast to the ferry port of Holyhead on the Isle of Anglesea. When a replacement was built, the severe winter weather conditions necessitated a high standard of corrosion protection for the steel piles.

The piles were factory coated with aluminium and the SeaShield Series 200 System was chosen as the primary defence against the sea water and the inevitable abrasion that would occur on the exposed sandy beach.

In 1984, the SeaShield Series 200 System was a new development and had only been trialled for severe impact and abrasion resistance. However, the consulting engineers approved its use and the system was installed in two stages during the summers of 1984 and 1985.



Partly completed installation, winter 1984.





## STEEL PILE PROTECTION



View of system 3-4 years after installation.

The nine 600mm piles were protected from 0.5m below the existing beach level to the concrete crossheads. The two 850mm piles were also protected from 0.5m below the existing beach level up to the deck level, above this SeaShield Series 80 was considered adequate.

Inspection of the installation took place in 1988, 1993 and in 1995. No maintenance work was carried out during this 10 year period. The 1995 inspection was part of a general maintenance survey by the original consulting engineers. The SeaShield system was found to be in excellent condition with only minor

Inspection May 1995 - marine growth on SeaShield jackets after 10 years.



damage to low level jackets and some missing joint bands.

However, over the years the beach level had varied and in 1995 exposed the base of the piles. The engineer decided that, in view of the excellent 10 years maintenance free performance of the system, it would be opportune during the planned maintenance contract to replace the lower jackets and extend the protection down to 0.5 metres below the 1995 beach level.

The SeaShield Series 80 protection of the upper part of the two 850mm piles was, apart from a film of salt and quarry



Close-up of 850mm diameter pile illustrating raised beach level and marine growth in 1995.

dust, as good as the day it was applied.

Due to the success of the SeaShield System at Raynes Quarry the consulting engineers, Symonds Travers Morgan, have specified the Series 200 System for another new jetty in North Wales.

## STEEL PILE PROTECTION

### SEASHIELD SERIES 300 SYSTEM

The waterproof anti-corrosion layer plus: Pre-moulded fibre reinforced plastic (f.r.p.) jackets in two matching halves. Extremely tough and can be moulded to fit non-symmetrical profiles.

The jackets are secured with studs, washers and nuts made from a marine resistant alloy.

## ABBOT POINT, AUSTRALIA

When Mt Isa Mines determined that a coal loading facility would be required for their coal mine in Newman, Queensland, the choice was between building a railroad to the nearest major port facility, which was 174 miles away, or building a railroad 50 miles to Abbot Point and constructing a two mile wharf out to deep water.

The railroad/wharf combination was chosen, but after only three years in service, the splash zone coating system on the wharf had failed and the piles were showing signs of severe corrosion. Winn & Coales' SeaShield Series 300 System was

chosen by the Harbours Corporation of Queensland for the repair project over a myriad of competitors' protective coatings due to the long-life protection afforded by the system, and its in-situ installation capabilities.

The project involved the



SeaShield 300 System installed on berthing dolphin at Abbot Point.

protection of 550 x 48 inch diameter piles, with a total coverage length on each pile of 20 feet.

## TIMBER PILE PROTECTION

### SEASHIELD SERIES 30 AND 40 SYSTEMS

A flexible, ultraviolet resistant polyethylene jacket tensioned around the pile and secured with non-corrodible nails driven through the jacket and into the timber.

Compressible seals on the top, bottom and longitudinal overlap of the jacket prevent the exchange of water between the encapsulated timber and the surrounding sea.

## MANHATTAN PIERS

Piers 13 and 14 in Manhattan, New York were built in the 1940s and currently contain tennis courts for the New York Health and Racquet Club. Over the years the timber piles were subjected to marine borer damage which threatened the structural integrity of the piers. The consultant, Han-Pandron Associates and New York City Economic Development Corporation approved the installation of SeaShield Series 40 System to protect the piles.

The piles were protected with a 30 mil outer-jacket from two foot below the mud line to low tide line. The low tide line and above was protected with 60 mil outer-jacket to provide additional protection against the aggressive marine environment and accidental impact. A stagnant

film of water is created between the pile and outer-jacket. This action kills the marine borer activity within the piling and those outside cannot penetrate the SeaShield barrier.

The outer-jackets were custom fabricated to accommodate the various length and diameter piles

and the bracing and support members.

This major rehabilitation project required more than 25,000 lft to be protected and SeaShield Series 40 System provided an effective and economic solution to the marine borer infestation.

Installation of system in progress.





In-situ application of Rigspray.

## LONG TERM CORROSION PREVENTION

Rigspray is a one-coat glass flake reinforced polyester coating designed for the long term protection of steel structures exposed to corrosive marine environments. It is ideally suited for use in the oil industry on offshore structures in areas such as splash zones, underdeck areas, riser pipes etc.

The principal advantages of Rigspray are that it will cure rapidly and can be applied in a single coat up to 1mm dft. It can be fully submerged in sea water once the material has hardened without any adverse effects.

Rigspray has excellent resistance to abrasion and erosion and, if required, can be

combined with a non-slip element for use on helidecks and main deck surfaces



## TIMBER PILE PROTECTION

### SEASHIELD SERIES 60 SYSTEM

A highly conformable self-adhesive tape wrap of a polymer modified bitumen compound laminated to a p.v.c. backing film.

A tough high density polythene outer mesh is fitted over the tape wrap when there is a risk of impact damage.

## ROAD BRIDGES, BUSSELTON, WESTERN AUSTRALIA

Two timber piled road bridges in Busselton were exposed to sea water and were being severely attacked by toredo worms after the failure of fibreglass sleeve protection.

After conducting extensive investigations into the available marine pile protection systems, Main Roads Department, Western Australia selected the SeaShield Series 60 System of protection with Pilemesh.

The Denso SeaShield Series 60 System was found to be the only product able to offer a full 20 years proven history of service.

Road bridge no.3447A, twelve 500mm diameter timber pile protected



Road bridge no.3438, completed installation of SeaShield Series 60 System with Pilemesh.

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Front cover: SeaShield Series 200 System at Raynes Quarry, 1995. (See pages 8-9). Back cover: Completed installation of SeaShield Series 80 protecting steel piles in a river estuary. (See page 3).

